

REQUEST FOR PROPOSAL (RFP)

For

Rate contract

Of

**PCB wiring, Assembly and Testing of
Payload Electronics**

RFP No.: SAC-SEDA-RFP-PLE-10-2023

(PART A)

February – 2024



**SPACE APPLICATIONS CENTRE
INDIAN SPACE RESEARCH ORGANISATION
DEPARTMENT OF SPACE
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Index

Introduction.....	1
1. Scope of Work for Vendor:	2
2. Responsibilities.....	7
3. Documentation.....	9
4. Payload Electronics Overview.....	9
5. Tentative Work Load Details.....	10
6. Operational Procedure For Rate Contract.....	15
7. Work Scheduling and Progress Review	15
8. Deliverables	15
9. Delivery Schedule	16
10. Requirements Along-with proposal.....	18
11. Warranty.....	18
12. Bank guarantee	18
13. Terms and Conditions	19
14. Payment Terms.....	20
15. Contract Duration And Renewal.....	20
16. Contract Award Criteria	20
17. Typical Sequence of Events & Guidelines to Vendors for Submitting the Offer	20
18. Billing For The Services.....	21
Annexure A: R&QA Requirements for Fabrication, Assembly and Testing of Payload Electronics	23
Annexure B: Confidentiality & Non-Disclosure Agreement.....	43
Annexure C: Compliance table.....	44
Annexure D: Checklists for T&E	45
Annexure E: DC POWER SUPPLY TESTING REQUIREMENTS	51

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PCB wiring, Assembly and Testing

Introduction

Space Applications Centre (SAC) ISRO is engaged in the development of a number of electro-optical remote sensing payloads for earth resources monitoring. SAC/ISRO, Govt. of India, proposes to involve reputed Indian industries for the development of Payload Electronics. Quotations are invited from Indian vendors for PCB wiring, assembly and testing of QM/FM payload electronics cards and packages. This Request for Proposal (RFP) document provides the details of the work involved, mode of operation, responsibility, delivery schedule, tendering procedures etc.

This RFP is divided into two parts: Part A and Part B. Part A provides the overall scope of RFP along with quality requirements for pre bid discussions, while part B provides the package specific information for vendors to have details of actual work. Actual details (Part B) of the package development will be provided at the time of individual work order placement against rate contract after signing non-disclosure agreement by vendor.

Part A consists of:

1. Scope of Work for Vendor
2. Responsibilities
3. Documentation
4. Payload Electronics Overview
5. Tentative Work Load Details
6. Operational Procedure For Rate Contract
7. Work scheduling and progress review
8. Deliverables
9. Delivery Schedule and payment milestone
10. Requirements Along-with proposal
11. Warranty
12. Bank Guarantee
13. Terms and Conditions
14. Payment terms
15. Contract duration and renewal
16. Contract award criteria
17. Typical Sequence of Events & Guidelines to Vendors for Submitting the Offer
18. Billing For The Services

Part B consists of:

1. Card development details (Component mounting, LP/CC etc.)
2. Mechanical details of card and package
3. Tray development details
4. Package development details
5. Card level testing details
6. Tray testing details
7. Package testing details

8. Package T&E details
9. Test setup details
10. FIM list
11. Documents (Relevant Documents by SAC and vendor)

Note:

- (1) Details submitted in the document are as per current requirement. The subsequent requirements shall be similar in nature with minor changes.
- (2) Scope of work is divided in multiple sections based on stages of development.
- (3) The Vendor shall submit proposal in two parts
 - Part-1: Technical Proposal (Capability, Schedule, scope of work, etc. ,**without pricing**)
 - Part-2: Commercial Proposal (with price breakup, milestones, etc.)
- (4) The proposal submitted in response to RFP shall be in conformity with requirements / specifications laid down in subsequent sections. Point by point compliance to all requirements including annexure C shall be given. **(Only Marking such as “C”/ “V” / “-” etc. are not acceptable).**

1. Scope of Work for Vendor:

Scope of work includes following:

1. FIM (PCB/ EEE)/ procured parts incoming inspection and acceptance by vendor
2. Mechanical Hardware / Package incoming inspection and acceptance by vendor
3. EEE parts wiring and assembly
4. Integration / packaging of wired cards
5. Test setup development
6. Card level testing
7. Package level testing; and Test and Evaluation (T&E)
8. Delivery

Each of these steps are elaborated below:

1. Printed Circuit Boards (PCBs)
 - Accepted PCBs will be provided as FIM from SAC
 - Incoming inspection and acceptance by vendor QC/QA
 - Vendor shall provide incoming inspection report to SAC
2. Mechanical hardware / package
 - Mechanical hardware / packages with surface treatment will be provided by SAC as FIM.
 - Approved assembly drawings will be provided by SAC as FIM
 - Carry out assembly as per assembly drawing with torqueing in presence of QC as per approved torque table given by SAC.
 - Fabrication and assembly of test jigs by vendor as agreed upon with SAC
3. EEE parts wiring and assembly

- All EEE parts will be provided as FIM from SAC
- Vendor to Collect all FIM as per sequence
- Incoming inspection and acceptance by vendor QC/QA
- Vendor shall provide incoming inspection report to SAC
- Understand the fabrication details, and generation of fabrication flow/sequence by the vendor and approval by SAC-QA.
- Assembly and wiring of PCBs as per approved fabrication sequence by certified manpower as per ISRO-PAX-300.
 - In case vendor does not have SAC / ISRO approved facility for soldering of BGAs and CCGAs, it can be outsourced to ISRO approved third party after consultation with SAC. Option of getting it done at SAC also exists with discretion of SAC
 - This is allowed only for soldering of BGA & CCGA type components. For all other component types and activities, vendor must have certified fabricators and approved line/facility in-house.
- SAC approved test jigs are to be used at the time of fabrication
- Online QC by vendor.
- Rework if required, as per SAC Material Review Board (MRB) disposition.
- SAC-QA audits and stage wise clearance by SAC as per approved fabrication sequence.
- Vendor shall have JTAG programmer for programming PROMS, Flash based FPGAs, etc. at vendor premises.
- SAC reserves the right to carry out Quality check inspection at any stage of hardware realisation and SAC QC has precedence over vendor QC
- Clearance of wired cards/packages for packaging after approval from SAC.
- Carry out Local Potting/ dam filling /Conformal Coating etc. as per fabrication detail and sequence.
- All the cards require conformal coating. Type of conformal coating may be parylene (with machine) or poly urethane (Manual with brush) as per fabrication document.
- Araldite and local potting are required as per fabrication document for heavy, multi-pin components and components with height > 5 mm. This includes flat packages > 80 pins, inductor coils, heavy leaded capacitors, 3D packaged memories etc.

4. Integration / packaging

- Integration of packages as per approved assembly drawings as agreed with SAC
- Thermal implementation as per SAC requirement. Thermal implementation may require fixing of cold fingers, heat pipes, copper straps etc. as per SAC design

5. Test setup development

A typical test set-up block diagram is shown below:

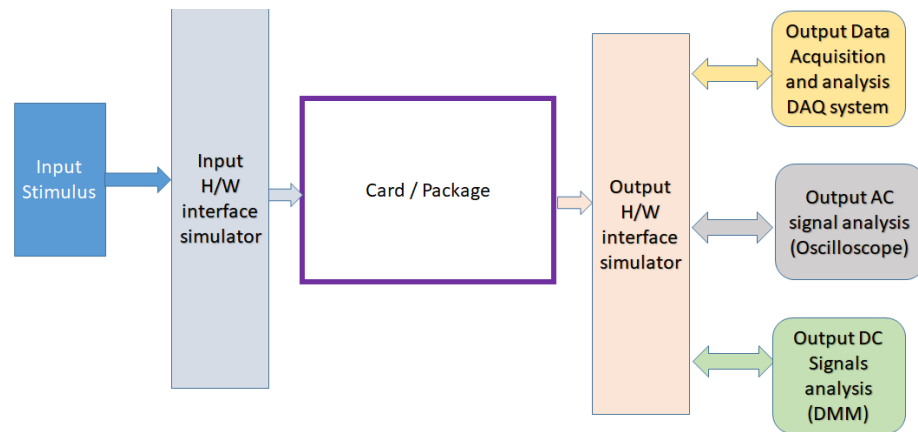


Figure 1: Typical card / package level test set-up

- Customized test hardware (Electronics cards), test and measurement instruments and software; for card level & package level testing and T&E will be provided by SAC on loan basis as FIM (Free Issue Material) as agreed upon. These will be subject to Bank Guarantee as per section 12.
- List of standard instruments mostly used for testing is as given below:

Table 1: Tentative list of Instruments Required for Hardware Testing

SN	Instrument Type	Description	Cost
1.	NI PXI 1095	18-Slot 3U PXI Express Chassis	40 Lac
2.	NI PXIE – 8881	PXI Express Controller	
3.	NI PXIe –6548	400 Mbits/s Data generation and acquisition card	
4.	NI PXIe - 7975R	NI FlexRIO FPGA Module	
5.	NI MIL 1553 card	MIL 1553B interface card	
6.	NI HDD – 8261	Hard disk	
7.	NI PXIE – 6375	Analog and Digital I/O card	
8.	NI PXIE – 2536	Switch matrix	
9.	PXI DMM	6½-Digit DMM with voltage, current, resistance, true RMS	
10.	MSO56 C015300: 2-6.25 GS/s	Oscilloscope	20 Lac
11.	Custom Power Supply	Low noise Multi-output power supplies	10 Lac
12.	Miscellaneous	Harnesses , custom cards etc.	15 Lac

- Test jigs if required to be developed as per agreement with SAC
- Use of uninterrupted power supply (UPS) is mandatory while working with FM hardware. This shall be provided by the vendor. Details of the capacity will be mutually worked out.
- Test setups will be verified by SAC team before starting of first FM testing of each type of card.
- Regarding Test set-ups developed by Vendor, should have at least 2 sets to avoid single point failure and for parallel testing.

5.1 Harness for testing:

Following is the tentative details of harness that vendor is expected to fabricate:

Table 2: Tentative details of harness Required for hardware testing

SN	Harness Connectors	Type of wires	No of wires	Gauge (AWG)	Length	Quantity
1	D sub, HD connectors	Twisted Pair(TP), 100Ohm, 78 Ohm, 60 Ohm	TP – 15 to 20 LVDS – 20 to 25 78 Ohm – 4 60 Ohm – 4	22 to 28	1.5 to 2m	2 to 4
2	D Sub, HD connector	TP, Shielded Twisted Pair (STP)	TP – 30 to 40 STP – 5 to 10	22 to 28	1.5 to 2 m	2 to 4
3	D Sub, HD connectors	TP, LVDS, Coaxial	TP – 3 to 5 LVDS – 30 to 35 Coaxial – 5 to 10	22 to 28	1.5 to 2 m	2 to 4
4	D sub, HD, Micro D connectors	TP, LVDS	TP – 3 to 5 LVDS – 3 to 5	22 to 28	1.5 to 2 m	2 to 4

*Connectors and wires/cables will be provided as FIM to maintain compatibility with FM hardware. Harnesses used for card level testing may be re-used at package level testing.

6. Card level testing

- Test Procedure documents for card level testing will be provided by SAC.
- Card level testing will be required at multiple stages of card development like after various phases of component soldering, after carrying LP, CC, DAM or any other such implementation, after tray fixing, etc.
- Card testing should be carried out with SAC approved test jigs as agreed upon with SAC
- Visual inspection is required prior to power-on of card and observations shall be recorded in log book.
- DVM / QM provided by SAC will be connected every time, to verify setup, before connecting FM
 - Each card should be tested as per the test procedure document provided by SAC at vendor premises and results should be tabulated in logbook.
 - Each card should have individual test logbook where card power ON/OFF date and time details, test conditions and all the test results are to be logged.
- After the completion of the test on each card, all test results are to be recorded in a systematic way against specifications in the form of test report and to be submitted for review & approval by SAC.
- Card to be cleared for further packaging purpose only after successful approval from SAC.

7. Package level testing and Test and Evaluation (T&E)
 - Vendor has to carry out the package testing at vendor premises as per the test procedure document provided by SAC.
 - Each package should have individual test logbook where all the test results & test conditions are to be logged.
 - After the completion of the test on each package, all test results are to be recorded in a systematic way as test reports and to be approved by SAC.
 - Test setup Burn-in shall be carried out by vendor as per SAC requirement, as part of approval by SAC. Only approved Test setups shall be used for FM testing. Any modifications after approval will need re-approval.
 - Qualification of packages as per test plan provided by SAC.
 - Test results review and approval by SAC before dispatch of packages.

Note: SAC reserves the right to participate in card/package level testing. Hence, vendor is requested to send test schedule in advance.

Different types of cards will have different test parameters. Depending on complexity, time taken for card level testing will also vary.

Similar requirement will be there for package level testing, which may vary depending on type of package and type of cards in the package.

8. Delivery
 - Delivery of qualified hardware in SAC approved container and all necessary measures for transportation including and ESD precaution, with necessary documentation after pre-shipment clearance by SAC.

Following figure shows the preliminary activity Flow diagram for end-to-end work order. Actual work order may or may not require execution of all stages mentioned in flow diagram. Also, FIMs may be delivered all at a time or stage wise.

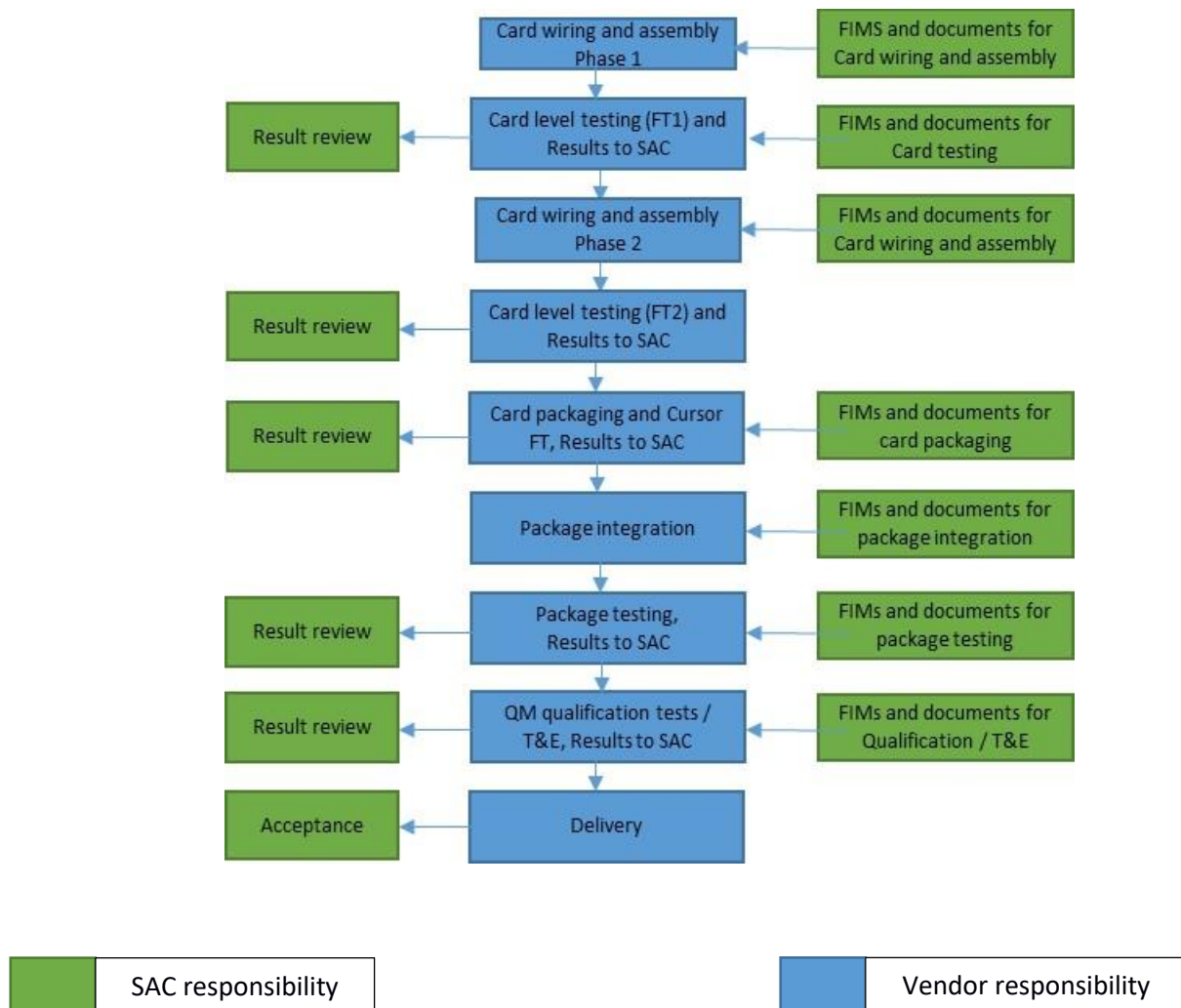


Figure 2: Typical card / package level work flow

2. Responsibilities

SAC:

SAC will provide:

- Card Fabrication detail and fabrication sequence
- Free Issue materials (Components, PCB, Mechanical Packages test setups etc.)
- Stage wise QA audit
- Mechanical hardware
- Tray fixing, packaging details
- Test setup components as agreed upon
- Test setup details
- Electrical Test procedure for card and package level testing
- Test result review
- Approval of test jigs, test set-ups, software and documents for fabrication and testing of FM hardware

- k. Any other module (hardware/software) as agreed upon
- l. Will identify focal point persons for logistics

VENDOR:

- a. The vendor shall respect the Secrecy and Non-disclosure agreement with SAC/ISRO related to confidentiality of all the circuits, electronics configuration and other information provided by SAC as proprietary elements of work order.
- b. Vendor shall collect FIM. Vendor is required to submit suitable bank guarantee /security deposit as per government norms for the FIM supplied by the SAC.
- c. The vendor shall study the data, information and details provided by SAC and ensure conformance to specifications.
- d. The vendor will execute the work order as per the content, acceptance standards and delivery schedule mentioned in the work order.
- e. The vendor will be responsible for safe custody of the materials supplied by SAC or procured by vendor including their storage in proper environment (As defined in Annexure A).
- f. Any subcontracting or work order issued by the vendor towards carrying out this contract will be in consultation with SAC and only with SAC approved facilities. SAC will not provide any test facilities.
- g. Inspection for all the activities will be carried out by the vendor and inspection report to be supplied to SAC.
- h. The vendor should nominate a team with a focal point for work, scheduling and progress review. The vendor identified focal persons will ensure submission of periodic reports, schedule of activities and at least 48 hrs in advance intimation for SAC audits.
- i. Arrangement of all the facilities (e.g. wiring facility, testing facility), test setups, instruments, software etc. required to execute the contract is the responsibility of the vendor apart from those provided by SAC as FIM. SAC will review and approve them.
- j. The vendor shall follow Hi-Rel guidelines including that provided by SAC to protect all the circuits. List of activities and their responsibilities are tabulated below. The table is overall list of activities. Actual will be defined in work order.
- k. Vendor shall inspect all fabrication materials, components and submit logged reports to SAC for every card/ package.
- l. Vendor will qualify hardware, software developed by them and get the same approved by SAC.
- m. Vendor to workout spare components for yield if any

Table 3: List of Activities

Sr. No.	List of Activities	Responsibility	
		SAC	Vendor
1.	Fabrication document (containing circuit details, components list, assembly details and fabrication sequence with SAC approved drawings including mechanical drawings)	√	-
2.	Team, Scheduling & Progress Review	√	√
3.	Supply of FIM	√	-
4.	Procurement of (a) Fabrication materials	-	√

Sr. No.	List of Activities	Responsibility	
		SAC	Vendor
	(b)Tools required as per scope of work		
5.	Electrical & Mechanical Interfaces Details	√	√
6.	Incoming PCB and Components (Electrical & Mechanical) Inspection	-	√
7.	PCB Wiring and QC	-	√
8.	QA audit	√	-
9.	Tray fixing of Card	-	√
10.	Test Specifications Generation @ Card and Package Level	√	-
11.	Test jig & Test set-up development including design (Electrical & Mechanical) as per option mentioned in “Scope of work”	√	√
12.	Test Software Development as per option mentioned in “Scope of work”	√	-
13.	Functional Testing, tuning and optimization at card level	-	√
14.	Packaging & package level test	-	√
15.	R & QA audit (stage wise) including periodic facility audit	√	√
16.	Test and Evaluation as per R&QA plan with SAC participation	-	√
17.	Documentation (As mentioned in “Scope of work”)	√	√
18.	Tests results review	√	√
19.	H/W Delivery	-	√
20.	T & E clearance certificate	√	√

Any delay on SAC part with respect to above points will not lead to LD clause.

3. Documentation

- Vendor shall maintain the report/documents like Non-Conformance Reports (NCRs) and Rework Data Cards (RDCs), Log books for test procedure, test plans and procedures, maintaining PCB/ component Inspection and wiring reports and recording results. Logbooks should be deliverable.
- All the cards and packages are to be tested and all the test results are to be logged as per the test procedure document provided by SAC during contract. Separate documents/log books to be maintained for each card and package.
- Vendor will prepare test procedure documents with guidance from SAC for all the cards and packages based on the feedback obtained during the trial/testing phase. This revised and approved test procedure shall be followed for further testing.
- Vendor shall compile test results in a format acceptable to SAC during various phases, which will be reviewed by SAC and generate End Item Data Package (EIDP) at the end of testing. This data package, soft copy shall be sent to SAC along with QM / FM units.

4. Payload Electronics Overview

Typical block diagram of payload electronics and interfaces is shown in figure-1. The Payload Electronics consists of mainly four building blocks:

Detector Interface Board (DIB):

This card houses the sensor and all its proximity electronics.

Front End Camera Electronics (FECE):

It is typically a precision analog/Mixed signal electronics systems which interfaces with sensor, Power systems and provides digital output data. The major building blocks of CE are Detector Interface Board (DIB), Video processor (VP), Bias and clock driver (BCD), Logic and control electronics (LCE) and Cooler Drive Electronics (CDE).

Digital Control and Processing Electronics (DCPE):

It will process the digital data into the required format for transmission to ground.

Payload Controller (PLC):

It has spacecraft interfaces having Tele-command and Telemetry interfaces with controls for heater and temperature.

Payload Power Supply (PPS):

It is a power supply distribution system having Tele-command and Telemetry interfaces.

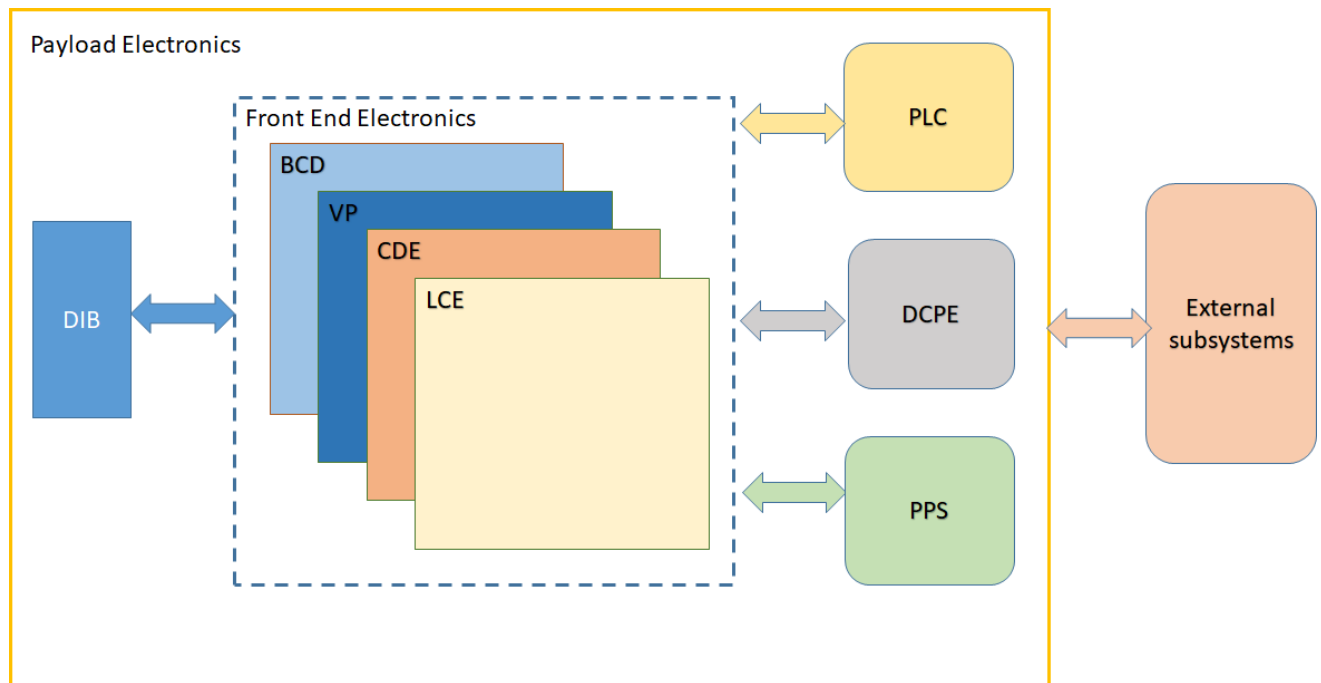


Figure 3: Typical Payload Electronics

5. Tentative Work Load Details

Following tables (Table 4 to Table 10) gives the idea about typical workload and type of work envisaged. These details are only indicative. Actual details will be specified in individual work order.

Table 4: Card Design Types

SN	PCB Type	No of wired components	PCB size mm X mm	PCB material & finish	No of layers	Component types & quantity
1	TD1	Up to 100	Up to 80 X 80	FR4 / ENIG	4 to 8	Passives(≤ 60), Diodes(≤ 10), Transistors(≤ 10), CFPs / SOICs – 16 to 48 pins (≤ 20), Leaded (≤ 5), connectors (≤ 2)
2	TD2	101 to 250	> TD1 and up to 100 X 100	FR4 / ENIG	4 to 10	Passives(≤ 250), Diodes(≤ 10), Transistors(≤ 10), CFPs / SOICs – 16 to 100 pins (≤ 25), Leaded (≤ 10), CFPs / SOICs > 100 pins (≤ 10), connectors (≤ 4)
3	TD3	251 To 500	> TD2 and up to 200 X 200	FR4 / Polymide / ENIG	4 to 14	Passives(≤ 550), Diodes(≤ 10), Transistors(≤ 10), CFPs / SOICs – 16 to 100 pins (≤ 25), CFPs / SOICs > 100 pins (≤ 10), BGA / CCGA (≤ 2), Leaded (≤ 10), connectors (≤ 4)
4	TD4	501 to 1000	> TD3 and up to 300 X 300	FR4 / Polymide / ENIG	4 to 16	Passives(≤ 900), Diodes(≤ 10), Transistors(≤ 10), CFPs / SOICs – 16 to 100 pins (≤ 40), Leaded (≤ 10), BGA / CCGA (≤ 5), connectors (≤ 6)
5	TD5	1001 to 2000	> TD4 and up to 350 X 350	FR4 / Polymide / ENIG	4 to 18	Passives(≤ 1800), Diodes(≤ 20), Transistors(≤ 20), CFPs / SOICs (≤ 50), Leaded (≤ 10), BGA / CCGA (≤ 10), connectors (≤ 6)

Table 5: Package Types

SN	Package type	No of cards	Type of cards
1	TP1	1 to 3	TD1
2	TP2	2 to 5	TD1, TD2
3	TP3	2 to 6	TD3
4	TP4	7 to 10	TD3
5	TP5	1 to 2	TD4
6	TP6	3 to 4	TD4
7	TP7	1 to 2	TD5
8	TP8	3 to 4	TD5

Each package might have single or multiple cards of one or more types.

Many components on card requires special treatment like conformal coating, dam filling with epoxy, araldite application, local potting, H74 or application of any other epoxy / material. This is required for many reasons, like, strengthening or temperature control of components, corrosion control etc. Vendor is expected to have *Space qualified* materials that are commonly used for card development. However, any specialized material required for card development will be provided by SAC. Some of the space qualified materials expected at vendor's facility for card fabrication are as below

1. Solder material
2. Dam filling material
3. Araldite
4. Local potting adhesive
5. Conformal coating material (Poly urethane and parylene)
6. Packaging and harnessing material like shrinkable sleeves, cable tie, saddle etc.
7. Thermal interface materials

All the above items shall be as per SAC qualified material list. The above list is indicative and specific details will be provided at the time of order placement.

Table 6: Card Fabrication requirements

SN	PCB Type	No. of solder joints	No. of components for Araldite, local potting etc.	No. of components for dam filling
1	TD1	500 to 1000 ($\pm 20\%$)	1 to 3	0
2	TD2	1000 to 2000 ($\pm 20\%$)	5 to 7	1
3	TD3	2000 to 3000 ($\pm 20\%$)	8 to 11	2 to 4
4	TD4	3000 to 4000 ($\pm 20\%$)	12 to 25	5 to 20
5	TD5	4000 to 6000 ($\pm 20\%$)	26 to 35	21 to 30

Table 7: Typical Type of components (Tentative*)

Component	Package types / Size
Resistor	0705, 1206, 2512, 0402, 0603 and leaded
Capacitor Polarized	1505, 2005, 1510, 2010, 2214, 2711, 2915 and leaded
Capacitor Non Polarized	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225
Inductor	SMD and coil based
Connector	micro-D, D-sub, High density connectors from 9 pin to 120 pins and RF connectors from 3 to 16 pins
Diode	SMD and Leaded
Transistors	SMD and Leaded
Active devices	FP8 to FP352 pins, SOICs 8 to 48 pins, BGA, CCGA up to 1752 pins,

*Note: above list is tentative and may change at the time of actual work order depending on technical requirement. Vendor shall accept the same. All the components / PCBS / Hardware provided by SAC as FIM will be subject to Bank Guarantee as per section 12.

Mechanical components for card tray include fastener assemblies for mounting PCB with trays, fastener assemblies for connectors, fastener assemblies for thermal implementation (If applicable) etc. Mostly M2 to M4 type of fasteners are used.

Package assembly require stacking rods to stack the trays and its related fasteners. All the hardware will be provided by SAC as FIM.

Table 8: Typical Work load (not limited to)

SN	Type of package	Total quantity for 2 years
1	TP1	0 to 5
2	TP2	1 to 5
3	TP3	15 to 20
4	TP4	3 to 8
5	TP5	2 to 8
6	TP6	2 to 8
7	TP7	1 to 2

Table 9: Test parameters for different types of cards

Card type	Measurement parameters category	Approx. No. of parameters in each category	Approx. Time taken for card testing (Hr)
TD1	Analog and digital signal levels (AC and DC)	30 to 40	4 to 6
	Noise (On DC signals)	10 to 15	
	Current measurement on multiple voltage lines and power	10 to 15	
	Relay On/OFF behavior	3 to 5	
	Digital Timing measurements	30 to 40	
	Digital Data processing and analysis	5 to 10	
TD2	Analog and digital signal levels (AC and DC)	30 to 40	10 to 12
	Noise (On DC signals)	10 to 15	
	Current measurement on multiple voltage lines and power	10 to 15	
	Digital Timing measurements	30 to 40	
	Digital Data processing and analysis	10 to 20	

Card type	Measurement parameters category	Approx. No. of parameters in each category	Approx. Time taken for card testing (Hr)
TD3	Analog and digital signal levels (AC and DC)	30 to 50	15 to 18
	Current measurement on multiple voltage lines and power	10 to 15	
	Relay On/OFF behavior	10 to 15	
	Digital Timing measurements	30 to 50	
	Digital Data processing and analysis	40 to 50	
TD4	Analog and digital signal levels (AC and DC)	30 to 50	18 to 20
	Current measurement on multiple voltage lines and power	2 to 5	
	Digital Timing measurements	30 to 50	
	Digital Data processing and analysis	10 to 20	

Digital data processing may be manual or automatic based on complexity.

Table 10: Parameters Measurement Range (Tentative)

SN	Parameter	Measurement range	Remarks
1	Analog and digital signal levels (AC and DC)	100 mV to 50 V	
2	Noise (On DC signals)	10 μ V to 100 mV	
3	Current measurement on multiple voltage lines	0.1 mA to 10 A	
4	Power Measurement / tray	0.1 W to 50 W	
5	Relay On/OFF behavior	1 V to 42 V	
6	Digital Timing measurements	100 ps to 150 s	LVDS, LVCMOS, LVTTTL, TTL, CMOS, CAN, MIL1553 etc.
7	Digital Data processing and analysis	Data generation and acquisition at upto 100 MSPS	Analysis software will be provided by SAC
8	Standard protocol decoder	SPI, MIL1553, JTAG etc.	

Above ranges are indicative and actual measurements will most likely fall in these ranges, however, rarely, certain specialized measurement may be there falling outside these ranges.

6. Operational Procedure For Rate Contract

Following is the operational procedure for the rate contract for each work order / job (Work order and job are used interchangeably in this document):

- As and when the requirement of new package development and testing is there, SAC focal person shall send a new job requisition to the vendor through E-mail. Requisition will clearly indicate nature of job, list of input documents, special instructions etc.
- All the job related inputs shall be provided by SAC focal person. The job requisition shall carry a unique job order number. All the queries and communication related to any job shall be referred to this job order number only. Preferred mode of communication shall be email, VC and phone.
- After receipt of new job, the vendor shall acknowledge the same. Vendor must study the job requirements and in case of any query/clarification or insufficient inputs from SAC, must revert back within two days. Saturdays are considered as working days.
- Along with the acknowledgement, the vendor shall provide the tentative schedule of works along with break up for various stages.
- After job acceptance by the vendor, frequent interactions may take place between SAC and the vendor to understand the job requirements and workflow.
- After completion of a job, all the deliverables shall be delivered to SAC focal person.
- SAC will review the deliverables before clearing the invoice for billing.
- Once the deliverables are accepted by SAC, invoices along with covering letter certifying the work carried out under those invoices by concerned approving authority shall be forwarded to SAC accounts for payment to the vendor.
- For any technical / non-technical matters with SAC, vendors can contact SAC focal persons
- Regarding changes and modifications in jobs undertaken by the vendor, SAC may change the requirement of ongoing job by changing, adding or deleting part of the job with mutual understanding. Such changes may have impact on invoice amount and delivery schedules. All such changes shall be accounted for in the quantum of work and billed amount.

7. Work Scheduling and Progress Review

A system of "Work schedules and control" will be adopted by the vendor for monitoring the progress of work orders under this contract. Accordingly, SAC representatives may visit vendor's facility as mutually agreed upon, to hold discussions with the authorized engineers of the vendor and record plans to carry out the fabrication, inspection, testing etc., and monitor the progress. Vendor will submit a work report which should clearly mention the activities and time schedule etc.

8. Deliverables

- Final Tested Qualification and Flight Models (QM/FM)
- All remaining QM/FM/Screened components
- Test results and reports

- Test setup and test software, as agreed upon
- Test instruments taken on loan, as agreed upon
- Test Jigs and test harnesses
- All remaining mechanical components
- Anything overrun from FIM
- Other applicable documents
- Discrepancy Disposition Reports
- Warranty of 1 year on product performance

9. Delivery Schedule

Delivery schedule in case when all FIMs are delivered to vendor at the same time are as below

Table 11: Number of days required for each activity

SN	Activity	Maximum Time for Completion (Days)
1	Card wiring and assembly - TD1	10
2	Card wiring and assembly - TD2	12
3	Card wiring and assembly - TD3	15
4	Card wiring and assembly - TD4	17
5	PCB Fabrication - Card wiring and assembly - TD5	20
6	PCB Fabrication - Card Packaging	1
7	PCB Fabrication - Test setup harness and jig development	10
8	PCB Fabrication - card / tray level testing of TD1	2
9	PCB Fabrication - card / tray level testing of TD2	2
10	PCB Fabrication - card / tray level testing of TD3	3
11	PCB Fabrication - card / tray level testing of TD4	3
12	PCB Fabrication - card / tray level testing of TD5	4
13	PCB Fabrication - Package integration of TP1, TP2	1
14	PCB Fabrication - Package integration of TP3, TP4	2
15	PCB Fabrication - Package integration of TP5, TP6, TP7	3
16	PCB Fabrication - Package testing of TP1, TP2	2
17	PCB Fabrication - Package testing of TP3, TP4	3
18	PCB Fabrication - Package testing of TP5, TP6, TP7	4
19	PCB Fabrication - IBT and FBT for TP1, TP2	4
20	PCB Fabrication - IBT and FBT for package TP3, TP4	6
21	PCB Fabrication - IBT and FBT for package TP5, TP6, TP7	8
22	PCB Fabrication - temperature storage, Humidity storage with Pre and Post Functional test for TP1, TP2	5
23	PCB Fabrication - temperature storage, Humidity storage with Pre and Post Functional test for TP3, TP4	6
24	PCB Fabrication - temperature storage, Humidity storage with Pre and Post Functional test for TP5, TP6, TP7	7

SN	Activity	Maximum Time for Completion (Days)
25	PCB Fabrication - Life test with Pre and Post Functional test for TP1, TP2	86
26	PCB Fabrication - Life test with Pre and Post Functional test TP3, TP4	88
27	PCB Fabrication - Life test with Pre and Post Functional test TP5, TP6, TP7	90
28	PCB Fabrication - EMI / EMC test with Pre and Post Functional test for TP1, TP2	5
29	PCB Fabrication - EMI / EMC test with Pre and Post Functional test for TP3, TP4	6
30	PCB Fabrication - - EMI / EMC test with Pre and Post Functional test for TP5, TP6, TP7	7
31	PCB Fabrication - Operational Temperature Test with Pre and Post Functional test for TP1, TP2	4
32	PCB Fabrication - Operational Temperature Test with Pre and Post Functional test for TP3, TP4	6
33	PCB Fabrication - Operational Temperature Test with Pre and Post Functional test for TP5, TP6, TP7	8
34	PCB Fabrication - Burn in test with Pre and Post Functional test for TP1, TP2	10
35	PCB Fabrication - Burn in test with Pre and Post Functional test for TP3, TP4	12
36	PCB Fabrication - Burn in test with Pre and Post Functional test for TP5, TP6, TP7	14
37	PCB Fabrication - Vibration test with Pre and Post Functional test TP1, TP2	3
38	PCB Fabrication - Vibration test with Pre and Post Functional test TP3, TP4	5
39	PCB Fabrication - Vibration test with Pre and Post Functional test TP5, TP6, TP7	7
40	PCB Fabrication – Mechanical Shock test with post shock active thermal cycling and Pre and Post Functional test for TP1, TP2	7
41	PCB Fabrication - Mechanical Shock test with post shock active thermal cycling and Pre and Post Functional test for TP3, TP4	9
42	PCB Fabrication - Mechanical Shock test with post shock active thermal cycling and Pre and Post Functional test TP5, TP6, TP7	11
43	PCB Fabrication - Thermovac test with Pre and Post Functional test for TP1, TP2	7
44	PCB Fabrication - Thermovac test with Pre and Post Functional test for TP3, TP4	7
45	PCB Fabrication - Thermovac test with Pre and Post Functional test for TP5, TP6, TP7	7

In case all FIMS are not given at the same time, delivery schedule will start after receipt of last FIM

For multiple identical units, delivery schedule for first unit will be the sum of number of days required for activities mentioned in work order. Considering parallel execution for subsequent units, delivery schedule for subsequent units will be every 15 days after delivery and acceptance of first unit by SAC.

Time taken by SAC for verification and inspection on each phases of work order completion (log verification, results review etc.) shall be excluded from the above-mentioned delivery schedule and vendor shall not be held accountable. In case of modification requirements generated by SAC, the additional resources / time required for changes will be added in total delivery schedule and for the billing as per mutual agreement. Delivery schedule in case of rework/modification will be based on exclusive resources / time needed to carry out the required changes, which may or may not involve changes in previous versions of the designs. However, the billing shall be based on the actual resources / time consumed for realizing the complete design including the previous versions of the design.

10. Requirements Along-with proposal

- Details of expertise / experience/certification of vendor for On-board (Satellite) Hi-Rel / fabrication work
- Hi-Rel certificates of manpower, process and line from any ISRO center
- Vendor's infrastructure, organization setup and quality manual
- Detailed plan of execution of the proposal including details of any sub-contracting if applicable
- Compliance table including table in annexure C along with vendor's written understanding of compliance and method
- Costs with payment Milestones in separate envelope
- Detailed break-up of all costs
- Point by point Compliance to all the requirements of this RFP. (Marking such as "C" / "√" / "-" etc. are not acceptable) with applicable document as per requirements of each para.

Vendor shall agree with general terms & conditions and procedures of SAC.

Note: Proposals without the details of all the above bullets are liable to be rejected.

11. Warranty

- The vendor shall provide warranty as given below;
"The units supplied here upon shall be free from any defects in material or workmanship and in accordance with the applicable specifications and drawings".
- This warranty shall run for a period of one year from the date of final acceptance of supplied units by SAC/ISRO and shall be in addition to any other rights available to SAC/ISRO.

12. Bank guarantee

- Cost of the components and modules issued by SAC require bank guarantee as per purchase norms.
- Maximum cost of FIMs per card is given in below table. Actual cost will depend on individual order

Table 12: Tentative Cost of FIM / Card*

SN	FIM type	Cost / Card
1	FM Active components	1.9 to 2.0 Cr
2	FM Passive components	2.5 to 5 Lac
3	FM Connectors	3 to 5 lac
4	Mechanical Hardware	2 to 5 Lac
5	Test Setup	85 Lac

* Instrument cost may not be applicable for each card as same instruments can be used for similar cards

13. Terms and Conditions

1. Bids from only those vendors, who have valid qualification / certification as per SAC/ISRO guidelines for all processes, work force and facility (required for the mentioned scope of work as specified in section 2), on the date of submission of bids will be considered. Vendor to submit the necessary certificates along with the technical proposal.
2. Vendor must be a reputed engineering company registered with government agencies and in existence for a minimum of 5 years on the date of submission of quotation to this tender, with necessary facilities and experience and valid licenses in providing such Technical Services/Products (attach relevant P.O. copies, documents etc. along with quotes).
3. Vendor shall have a trained technical Staff (Engineers) with minimum 2 years' experience in Flight Model card fabrication, mechanical assembly and testing as defined in scope of work. Vendor has to provide the list of such regular employees with their qualifications, experience etc. along with the technical proposal.
4. Vendor shall have necessary infrastructure, or may outsource after approval of SAC to carry out the defined jobs, like workstations, PCs, genuine software, test chambers, clean rooms etc.
5. Vendor shall attach certificates from reputed user agencies, ISO/High-level quality service certification in the relevant area, if available.
6. Vendor's Company/firm should not have been banned or black-listed by any Government Department/Central Government Unit/Public Sector Unit/Financial Institutions/Court and submit a declaration in this regard.
7. If required, SAC Officers may visit the Vendor's premises for verification of information related to work orders/space/manpower etc. and other infrastructure facilities and equipment claimed. The technical bid of Vendor, who is not able to substantiate/satisfy the technical requirements laid down in this RFP, is liable to be rejected.
8. All the processes including component soldering is to be carried out as per SAC/ISRO approved processes. Similarly, all materials used by vendor should be as per SAC approved material list.
9. Any materials shall be procured by vendor should be as per approval by SAC. The procurement specifications are to be generated by the vendor and approved by SAC before procurement/ placement of Purchase Order.
10. Vendor should have a controlled environment storage area for components, materials and fabricated hardware, class 100,000 clean room (24X7) with ESD safe storage as a minimum.
11. Vendor should have test equipment and environmental test facilities as per SAC requirements. In case of absence of any instrument / facility, vendor may opt for third party contract after agreement with SAC. Vendor to confirm the availability of the instruments and environmental facilities / tie ups with third parties in the quote.
12. Any changes carried out in the design, drawings or documents during the contract tenure, done by vendor or SAC shall be exclusive property of SAC and shall not be used for any purpose other than agreed upon.
13. SAC reserves the right to modify any part of the design as per project requirements.

14. Vendor shall take approval from SAC prior to third party outsourcing. R&QA requirements will be applicable to third party also.
15. In case, deliverables are rejected / delayed due to various domestic constraint of third party / sub-contractor engaged by contractor, SAC shall not be held responsible & contractor has to make good of the loss. However, additional components will be given considering reasons of rejection and its failure analysis report.
16. Final approved fabrication document and Test Document shall be supplied to the vendor after the contract is awarded. All documents supplied by SAC are the exclusive property of SAC and shall not be used for any purpose other than agreed upon. These documents shall be returned to SAC after completion of the work.
17. R & QA requirement should be fully complied.
18. Any documents related to SAC qualified processes, materials etc. may be provided on request basis after pre bid conference.

All the points mentioned above are mentioned in compliance table (Annexure C) to be duly filled by vendor.

14. Payment Terms

100% payment will be made within 30 days on pro-rata basis after receipt & acceptance of material pertaining to each work order at SAC

Fall Clause

The prices charged for the stores supplied under this contract by the vendor should in no event exceed the lowest price at which the vendor sells the stores of identical description to any other person during the period of the contract. If at any time, the prices are reduced, the same shall be notified to the Purchaser and shall stand correspondingly reduced.

15. Contract Duration And Renewal

Total duration of the contract shall be 02 (two) years. The contract may be extended for one year on mutual consent, depending on the need and exigencies, subject to the agreed quality of services and other applicable terms and conditions. Minimum work order cannot be guaranteed. The work order will be loaded as and when required by SAC. SAC reserves the right to terminate the Contract or reduce the scope any time within the contract duration at short notice.

16. Contract Award Criteria

On price bid opening, the **overall** L1 offer will be considered to award the contract. Overall L1 is the sum of all the cost elements provided in response to this tender inquiry by vendor. No guarantee can be given regarding minimum order against this rate contract.

17. Typical Sequence of Events & Guidelines to Vendors for Submitting the Offer

The typical sequence of events in completion of Request for Proposal (RFP) for Fabrication, testing and delivery of HI –REL electronics subsystems is described as below:

1. The vendor to assess their technical capability, facility & infrastructure, manpower skill levels & certifications required to carry out the work specified in this RFP.

2. The pre-bid conference with interested vendors is essential and shall be organized at SAC, Ahmedabad. The date of same shall be communicated to vendor. The pre-bid conference/ meeting with Vendors at SAC, Ahmedabad is planned to clarify/ resolve doubts/ remarks of vendors.
3. Submission of final bids in two parts as per Tender document. Bids should reach to Space Applications Centre (SAC), Ahmedabad within due date from the publication of this tender.

Part-1: Technical proposal; including the following:

- i) Point by point compliance to all the requirements in RFP including R&QA requirements.
- ii) Vendor to submit the necessary certificates for all processes, manpower and facility required for the specified work along with the technical proposal on the date of submission of bids.
- iii) Duly filled check-list
- iv) Details of infrastructure/ facilities / test equipment available at vendor's site for fabrication & testing as per this RFP. In case vendor envisages outsourcing partial fabrication / testing work it should be indicated clearly.
- v) Any previous heritage of supplying space hardware. If yes, necessary documents to be enclosed.
- vi) Time schedule: Vendor to note that the time schedule is critical for the project. Past performance of vendor about previous contracts with SAC may be reviewed before awarding the contract.
- vii) Blank Format of the price bid **without disclosing price**, showing the list of quoted items and quantities.

Part-2: Commercial offer:

- i) Quotation with Applicable taxes.
4. Opening of Technical Proposal bids
5. The evaluation of Technical proposal by SAC (The vendor may be asked to make technical presentation at SAC Ahmedabad during the process of evaluation).
6. Commercial assessment of only the technically suitable offers.
7. Awarding the contract to successful vendor.

18. Billing For The Services

Billing of work shall be based on acceptable completed work orders. Package configuration and details of work to be carried out, will be provided at the time of individual order placement. Configuration at the time of individual order placement may be discussed and all pricing related parameters may be finalized before arriving at final cost, before placement of work order. Afterwards, the value shall not be changed and the billing shall be made against agreed upon parameters only. However, if any changes/modifications are requested in the original design by SAC at later stage after mutual agreement, while the job is being carried out by the vendor or at later stage, the additional resources required to carry-out the changes/modifications shall be

taken into account. In case of the changes required due to mistake of vendor, the additional resources shall not be considered for billing.

Annexure A: R&QA Requirements for Fabrication, Assembly and Testing of Payload Electronics

1.0 INTRODUCTION:

This document describes the Product Assurance requirements to be followed during design, fabrication, and assembly and testing of subsystems by Indian industry.

Mandatory requirements: It is mandatory that PCB fabrication and assembly process line of the vendor shall be qualified by ISRO including work force at the time of quote. Necessary certificate shall be attached along with the quote. SAC may visit the vendor facility to access their capability after receiving the quote.

2.0 APPLICABLE DOCUMENTS:

ISRO-PAS-207	Storage, Handling and Transportation requirements for Electronic Hardware
ISRO-PAX-300	Workmanship Standards for the Fabrication of Electronic Packages
ISRO-PAX-304	Test Specifications and Requirements for Multilayer Printed Circuit Boards
ISRO-PAS-400	Contamination control and Cleanliness Requirements
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-STD – 883E	Test Method Standard for Microcircuits

3.0 ENVIRONMENTAL SPECIFICATIONS:

3.1 Non-Operating Environment:

The units will be tested in thermovac/thermal chamber for following environmental conditions:

- a) Temp. Range* : - 30°C to +70°C
- b) Pressure : Ambient and hard vacuum better than 10^{-6} torr.
- c) Relative Humidity : Up to 95% without condensation of water at +40°C
(Applicable for storage on ground only)

*non-operating/storage temperature range may change as per project requirements

3.2 Operating Environment:

The units will be tested in thermovac chamber for following environmental conditions:

a) Temp. Range:

- (i) FM : -10 °C to +50°C
- (ii) PFM / QM : -15°C to +55°C

b) Pressure: Ambient and hard vacuum better than 10^{-6} torr.

Power dissipation of packages under test may vary from 2W to 40W

Note: All temperatures are referred to the base plate. These are tentative and will be defined as per project requirements.

3.3 EMI / EMC tests:

Unit shall be tested for EMI/EMC compliance as specified in MIL-STD-461E for RE, CE, CS and RS tests with levels specified in package test document.

3.4 Vibration / Shock:

Unit shall undergo vibration and shock test as specified in unit specific test document.

4.0 Parts Quality and inspection requirements:

Vendor shall ensure that all the parts and fabricated hardware are stored under controlled environment in a Bonded-Stores till their actual use as per procedure outlined in ISRO-PAS-207.

4.1 Inspection of FIM received by from SAC :

- All the active & passive electronic parts, Materials and hardware shall be subjected to incoming visual inspection by Vendor QA in “as-received” condition. Traceability shall be maintained from incoming inspection to the final units.
- The parts shall be inspected by the ISRO certified inspector of the vendor. Traceability, including serial number and date code information, shall be maintained for parts with serial numbers, from incoming inspection to the final units including batch acceptance report of PCB (Lot No, Batch No, Date code etc). For passive chip components serialization is not required.
- Any defect / damage observed during visual inspection shall be informed to SAC.

4.1.1 Mechanical parts:

In case, mechanical packages, boxes, covers, clamps, test jig etc. are to be fabricated by Vendor / Sub-vendor as per SAC approved drawings, these shall undergo 100% visual inspection and dimensional measurements including plating / thermal painting workmanship point of view.

All the bought out mechanical components including fasteners, spring, plain washers, nuts etc.; wherever applicable, shall be procured by the vendor in accordance with procurement specifications approved by SAC. In such cases, Incoming screening of fasteners shall include review of Manufacturer's Test Report (MTR) containing measured values of mechanical, physical properties as well as chemical elemental analysis. & Certificate of Compliance (CoC), as well as inspection on 100% basis GO / NO-GO gauge inspection, and dimension inspection on sampling basis by the vendor.

Following traceability information shall be maintained by the vendor for records & SAC audit purpose.

- 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.

5.0 MATERIALS:

Vendor shall ensure to use SAC/ ISRO approved / qualified materials. Procurement of all the mechanical and electronic fabrication materials shall be done as per SAC Approved Materials List (AML). Vendor shall review & clear Material Test Report (MTR) & CoC of the manufacturer. 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 +125°C and 1×10^{-6} torr pressure for 24 hours. All inspection and clearance records for the materials shall be maintained by the vendor.

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 are essential. Materials, which are nutrients for fungus, shall not be used.

Any other materials, which are not available in SAC AML, shall first be qualified as per SAC test plan & cleared by SAC prior to their use. However, usage of such material will be at SAC discretion.

Materials list consisting of the name of vendor, shelf life, qualifying agency, location of application in the package shall be submitted to SAC for approval. Only Space qualified Printed Circuit Boards (PCBs), approved photo mask, etc. shall be used during fabrication of hardware. Bare PCBs shall only be procured from ISRO/ESA/MIL qualified vendor (whenever applicable).

All the materials shall be used within their shelf life.

6.0 PROCESSES:

ISRO-PAX-300 workmanship standards shall be followed for the fabrication work. All electronic fabrication processes like bare PCB fabrication and parts mounting/assembly, etc. shall be SAC/ISRO qualified. Similarly, the processes used for surface treatment of the box like plating and coating in realizing the hardware shall also be SAC/ISRO qualified. All the processes shall be carried out in accordance with PIDs reviewed by QA-SAC.

In case of processes qualified by other agencies, process qualification reports shall be submitted to QA, SAC for review. After review of previous qualification plan, SAC will decide for requirement of full qualification / delta qualification of such processes, if any. However, right for decision on feasibility of such a qualification activity will be retained by QA SAC.

Fabrication work shall be carried out on SAC/ISRO qualified fabrication line by SAC/ISRO certified operators.

7.0 FABRICATION DOCUMENTATION:

Product Realization Document (PRD):

All the activities involved for realization of FM units shall be addressed in this document. Vendor and SAC shall prepare PRD, identifying all the activities, methods / procedures & inspection check points that will be followed for realization of the units.

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.

Process Identification Document (PID):

The PID shall include 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. Vendor and SAC shall generate PID documents. Only approved PIDs shall be followed.

Fabrication Sequence:

A fabrication sequence detailing each step of fabrication and QC inspection shall be agreed upon between SAC and vendor before start of fabrication. SAC approved fabrication sequence shall only be implemented. The assembly flowchart shall include the following as a minimum:

- (a) Flow of fabrication activities
- (b) Approved drawing nos.
- (c) Name of processes and PID numbers.

- (d) Intermediate electrical testing (at module level)
- (e) Handling instructions
- (f) Permanent/Temporary torque values.
- (g) Specific instructions, caution notes etc., if any.
- (h) Any environmental test which is a part of fabrication process or for electrical performance check and selection TBD component values
- (i) Marking & Identification of unit.
- (j) QA-SAC audit stages

8.0 QUALITY CONTROL (QC):

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 SAC reviewed PID.

All fabrication and inspection work shall be carried out by ISRO certified fabricators / inspectors of vendor. Online inspection of all the fabricated hardware and witness samples shall be carried out by QC of the vendor. Required process control documents are to be generated and maintained by the vendor, which will be reviewed by QA - SAC during QA audit.

9.0 QA AUDIT:

The QA audit shall be carried by QA-SAC on vendor QC accepted hardware from both electronic & mechanical point of view at various stages of hardware realization. Following may be noted.

- The frequency for QA audit shall be decided by SAC and intimated to the Vendor.
- Audit shall cover Electronic & Mechanical aspects for the following, as applicable,
 - a) Wired PCB
 - b) Packaging & fixing of cards/ connectors & internal harness
 - c) Audit for integrated package level.
- SAC shall audit all related facilities, Fabrication processes, cleanliness records, overall documentation, parts & materials evaluation/test reports, etc.
- The Vendor shall generate close outs of discrepancies observed during audit and submit the same to QA-SAC for review and acceptance, stage wise clearance shall be given by QA SAC.
- **Real-time On-line Audit / Virtual Audit:** Based on confidence build-up on fabricated hardware, SAC may opt for virtual 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 SAC-QA requirements. Stage wise clearance for further fabrication and testing will be given by SAC.

10.0 MARKING AND IDENTIFICATION:

Marking on the package shall be as identified by SAC and mutually agreed upon. However, following are the general requirements. The units shall be identified by assigning unique serial number on the exterior surface of both package & cover by a suitable process applicable for space use. Marking shall not degrade the performance and quality of the unit. In addition to functional markings like input / output, etc. following marking shall appear on each unit.

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

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. The marking method to demonstrate the same shall be specified by the manufacturer.

11.0 TEST PROGRAMME:

11.1 Test & Evaluation Program

11.1.1 Ground checkout / test units:

- The calibration validity for instruments and Ground Checkout Units (GCU) is of one year normally.

11.1.2 Subsystem level:

Passive Cycling:

All units shall be subjected to passive thermal cycling before final cover closing as per following:

- No. of Cycle: 5
- Temp. limits: Non-operating temperatures
- Dwell Time: 2 Hr.
- Transition Rate $\leq 2^{\circ}\text{C}/\text{Min}$

Applicable tests for QM/ PFM / FM are given in table below.

Table A.1: Tests applicability

Sr. No.	Name of test	Active / Passive	Test facility	QM	FM	PFM
1	Initial Bench Test (IBT)	Active	Lab condition	✓	✓	✓
2	Burn-in Test	Active	Thermal/Climatic chamber	✓	✓	✓
3	EMI/EMC Tests	Active	EMI / EMC chamber	✓	✓	✓
4	Temperature Storage Tests	Passive	Thermal/Climatic Chamber	✓	NA	NA

Sr. No.	Name of test	Active / Passive	Test facility	QM	FM	PFM
5	Humidity Storage Test	Passive	Thermal/Climatic Chamber	✓	NA	NA
6	Operational Temperature Test	Active	Thermal/Climatic Chamber	✓	NA	NA
7	Sine Vibration test	Passive	Vibration table	✓	NA	✓
8	Random Vibration Test	Passive	Vibration table	✓	✓	✓
9	Post Vibration	Passive	Lab condition	✓	✓	✓
10	Mechanical Shock Test	Passive	Lab condition	✓	NA	NA
11	Active Thermal Cycling (Post Shock Test)	Active	Thermal/Climatic Chamber	✓	NA	NA
12	Thermo-vacuum test	Active	In Vacuum chamber as per profile	✓	✓	✓
13	Life Test (2000 Hrs)	Active	Thermal/Climatic Chamber at +55 °C	✓	NA	NA
14	Final Bench test	Active	Lab condition	✓	✓	✓

Note:

- At the start and end of each test, visual inspection and electrical performance check shall be carried out.
- Vendor shall send the Test data to SAC for review & clearance for next test.
- Suitable buffer connectors shall be made to protect input / output connectors of the unit from wear and tear due to mating / de-mating with other connectors during testing. Record of number of time mating / de-mating of connectors shall be maintained.
- Shorting buffers/ connectors to be used on stand-alone unpowered cards/ packages as precaution for ESD.

11.1.3 Failures during T&E

Deviation from the agreed electrical specifications shall be treated as non-compliance, and as cause to reject the units.

Any failure observed at any stage during testing shall be reported to SAC immediately. This shall be followed by detailed failure analysis by Vendor, clearly identifying the cause of failure as random or procedure related. Any modifications required in electrical, mechanical or process related aspects shall be approved by SAC. In case of mechanical or electrical 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 SAC. This may include re-qualification of process or the unit / Proto flight level testing.

12.0 TESTS:

Prior to start of the test, vendor is required to establish a test setup (Hardware & Software) for which necessary guidance, may be provided by SAC.

Acceptance of the test set-up shall be done jointly by SAC and vendor before the testing of the QM & FM units. This shall also be audited, during the testing activity. Vendor shall inform the readiness of the test set-up as well as the schedule well in advance. Representatives from SAC may participate in the testing. Grounding scheme will be provided.

Testing shall be done as per QA / SAC approved test procedure using calibrated test & measuring instruments. Before starting any test with test setup, a Lab model/DVM/QM will be connected with the test setup and test run shall be taken carrying out measurement of all parameters to be done on QM / FM. After successful completion of test run only, QM / FM will be connected. Test run results to be documented. All the inputs will be checked as mentioned in test procedure provided by SAC before starting any test.

History of measurements should be logged with reason & corrective actions for repeated measurement during the T&E.

(a) Measurement Accuracy:

All test & measuring instruments / unit shall have valid calibration status at the time of testing.

(b) Temperature Stabilization:

Stabilized temperature is considered to be achieved when the package base is within the allowed tolerance on the specified test temperature level. Also, the rate of change of stabilized temperature should be less than 3°C per hour. In practice, the temperature is observed for 30 minutes to meet this criterion.

(c) Maximum Allowable Tolerance in Test Conditions:

Table A.2: Tolerances in test conditions

Parameter		Tolerance
Temperature		±3°C
Atmospheric Pressure		
Greater than 0.1 Torr		±5%
Below 0.1 Torr		±50%
Vibration Frequency		±2% above 25 Hz 0.5 Hz below 25 Hz
Sine Vibration	Amplitude	±10%
	Frequency	± 2% above 25Hz and 0.5Hz below 25Hz
	Sweep rate	± 5%
Random Vibration -	Over all (g-rms)	±10%
Shock test	Amplitude (g)	± 10 %

NOTE: The instruments shall be capable of measuring at least 10 times better than tolerance limits.

12.1 TEST LEVELS & DETAILS

The test parameters shall be measured as per respective T & E document. Test levels given here are indicative and may vary with each unit fabricated. The test document will be provided at the initiation of fabrication of units. External visual inspection and electrical parameter measurement shall be conducted after each environmental test.

12.1.1 External Visual Inspection:

All the units shall be examined visually at 10X magnification before and after each environmental test.

12.1.2 Initial Bench Test (IBT):

This test shall be performed to verify compliance to all the electrical parameters and will be taken as reference for all subsequent tests. All parameters shall be measured as specified.

12.1.3 Burn-In Test:

Unit shall undergo burn-in in thermal/climatic chamber in power 'ON' condition. Duration will be 168 Hrs for QM and 96 Hrs for PFM & FM. Temperature will be +55°C for QM & PFM and +50°C for FM. Agreed parameters shall be measured and log of Time-Temperature and critical parameters shall also be kept for verification.

12.1.4 Post Burn-in Electrical Test:

This test shall be conducted at ambient temperature. After the burn-in test, electrical parameters shall be measured.

12.1.5 EMI/EMC Test:

Unit shall be tested for EMI/EMC compliance as specified in MIL-STD-461E for RE, CE and RS tests with levels specified in package test document.

12.1.6 Temperature Storage Test

Temperature storage test is applicable for QM units only. The unit shall be subjected to minimum storage temperature for 24 hours. After this storage, electrical and visual inspection shall be performed. The test shall be repeated for maximum storage temperature for 24 hours. Unit shall be in non-operating conditions for the storage duration. Storage temperatures will be project requirements.

12.1.7 Humidity Storage Test

This test is applicable to QM units only. The unit shall be subjected to test condition of 95% RH at 40°C for 24 hours. Unit shall be in non-operating conditions during the storage test. After the completion of test, EPC shall be inspected visually and electrical test shall be carried out for performance compliance verification.

12.1.8 Operational temperature test

This test is applicable to QM units only. This test shall be performed to check the performance specifications of the units at the specified Lowest and Highest qualification temperatures. The units shall be placed in a suitable thermal chamber, and connected with the external test set-

up. Dwell time at temperature extreme shall be at least 6 hours each at hot and cold temperatures. Parameters as specified in T&E document shall be measured after 4 hours from temperature stabilization.

12.1.9 Vibration Test

Sine / Random vibration tests shall be carried out on applicable QM / FM units. Visual & electrical measurement shall also be performed after each Sine & Random vibration test. Vibration levels given below are tentative. Levels may be changed depending upon mechanical configuration.

Vendor shall generate a vibration test report in a standard format as provided by SAC indicating non-conformance, if any, & its closeouts through SAC agreed mechanism. This report shall be sent to SAC for review and acceptance.

12.1.9.1 Resonance Search

Pre & Post Vibration, resonance search shall be carried out in all the three axes as per following levels. Natural resonance frequency (Fn) shall be greater than 100 Hz and drift in pre & post vibration 'Fn' shall be within 10%.

Table A.3: Resonance search

Frequency (Hz)	Amplitude
10 - 2000	0.5 g
Sweep rate	2 Oct / Minute for QM unit 4 Oct / Minute for FM unit

Resonance search success criteria as under,

- (i) < 5% in frequency shifts for modes with effective mass >10%
- (ii) < 20% in amplitude shifts for modes with effective mass >10%

Vibration test sequence shall be :

For QM Unit (all axis) LLS, Sine Vib, LLS, Random Vib, LLS

For shock test (all axis) LLS pre, SRS, LLS post

For FM Unit (all axis) LLS pre, Random Vibration, LLS post

12.1.9.2 Sine Vibration

Sine vibration test shall be conducted only on QM unit. The unit shall be in non-operating condition for the duration of vibration test.

Table A.4: Sine vibration

Normal to mounting plane (Z-axis)		Parallel to mounting plane (X & Y axes)	
Frequency (Hz)	Amplitude	Frequency (Hz)	Amplitude
5-20	12.4 mm (0 - peak)	5-20	9.3 mm (0 - peak)
20-70	20g	20-70	15g
70-100	10g	70-100	8g
sweep rate: QM	2 Oct./minute	sweep rate: QM	2 Oct./minute

1 sweep in each axis shall be performed.

12.1.9.3 Random Vibration

Units shall be subjected to random vibration tests with levels as given below in passive mode. Frequency verses PSD plots shall be obtained and shall be kept along with the test results for verification.

Table A.5: Random Vibration

For QM units:

Frequency (Hz)	Power spectral density (for mass < 1.0 kg)		Power spectral density (for mass > 1.0kg)	
	Normal to mounting plane (Z-axis)	Parallel to mounting plane (X & Y axes)	Normal to mounting plane (Z-axis)	Parallel to mounting plane (X & Y axes)
20-100	+ 3 dB/octave	+ 3 dB/octave	+ 3 dB/octave	+ 3 dB/octave
100-700	0.30 g ² /Hz	0.1 g ² /Hz	0.2 g ² /Hz	0.1 g ² /Hz
700-2000	-6 dB/octave	-3 dB/octave	-6 dB/octave	-3 dB/octave
Overall RMS	18.1 g	11.8 g	14.8 g	11.8 g
Duration	120 sec.	120 sec.	120 sec.	120 sec.

For FM units:

Frequency (Hz)	Power spectral density (for mass < 1.0 kg)		Power spectral density (for mass > 1.0kg)	
	Normal to mounting plane (Z-axis)	Parallel to mounting plane (X & Y axes)	Normal to mounting plane (Z-axis)	Parallel to mounting plane (X & Y axes)
20-100	+ 3 dB/octave	+ 3 dB/octave	+ 3 dB/octave	+ 3 dB/octave
100-700	0.13 g ² /Hz	0.044 g ² /Hz	0.09 g ² /Hz	0.044 g ² /Hz
700-2000	-6 dB/octave	-3 dB/octave	-6 dB/octave	-3 dB/octave
Overall RMS	12.1 g	7.9 g	9.9 g	7.9 g
Duration	60 seconds			

(**Note:** Above levels provided are tentative. These may change depending on the package configuration/application requirements)

12.1.9.4 Mechanical Shock Test

QM unit shall be subjected to mechanical shock test as per the following test levels in all the 3 axes. Number of shocks in each axis shall be 2 and Shock levels specified with Q = 10. Pre & post resonance search (LLS) shall be performed as per specification given in para of vibration test.

Table A.6: Shock test

Frequency	SRS (All Three Axes)
100-1000	12 dB/oct.
1000-5000	1000g

(Levels are tentative; it may change depending on mounting location of the unit)

12.1.10 Active Thermal Cycling (Post Shock)

This test is applicable only if mechanical shock test has been conducted. Test shall be conducted in climatic/thermal chamber. Cold temperature will be -15°C and Hot temperature will be +55°C.

Unit will remain in power-ON condition and thermal cycling will be done as per profile given below. Pre and Post cycling electrical measurements shall be carried out.

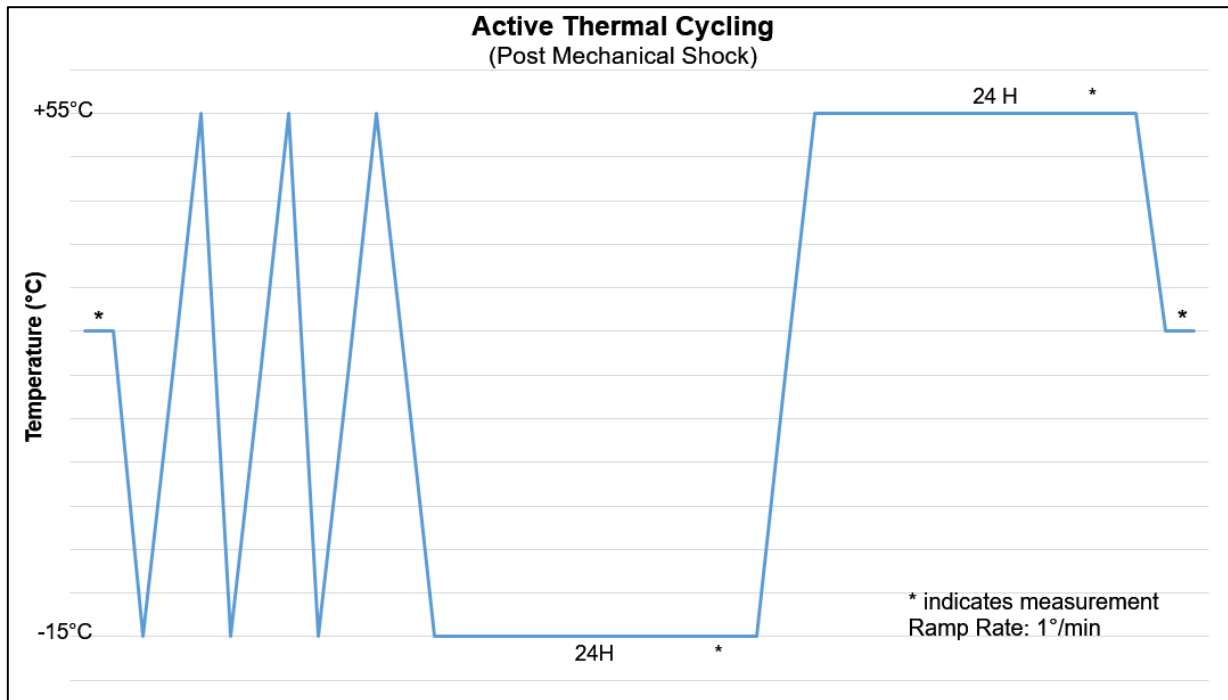


Figure A.1: Active thermovac Cycle

12.1.11 Thermo-vacuum Test:

All units shall be subjected to thermo-vacuum test as per the test profiles given below.

Following points shall be considered before starting thermo-vacuum test:

- It shall be ensured that the parameters of the thermo-vacuum chamber i.e. temperature, air pressure measuring device, etc. are properly calibrated prior to the start of the test.
- The input and output cables shall be properly identified and calibrated in lab temperature.
- The cables to be used in test setup shall be properly calibrated for the extreme cold and hot temperatures in vacuum and the correction factor shall be applied accordingly to the test data.
- It should be ensured that the temperature sensors are mounted at pre-determined locations for monitoring base plate and package temperatures.
- Thermovac chamber should have provision for 3 to 4 flanges with 4 to 5 D-sub 50 pins connector or equivalent number of interface pins (200 to 400 pins) available.

Electrical measurements shall be carried out at the points mentioned in test profiles. Time-Temperature and Pressure data shall be logged along with electrical results for verification. Electrical measurements shall be done before starting cycle at ambient pressure and temperature in the thermovac setup. This pre thermovac measurement will be considered as a reference for subsequent thermovac measurements. Electrical measurements shall be done after cycle completion in the same setup.

Thermovac Test Profile

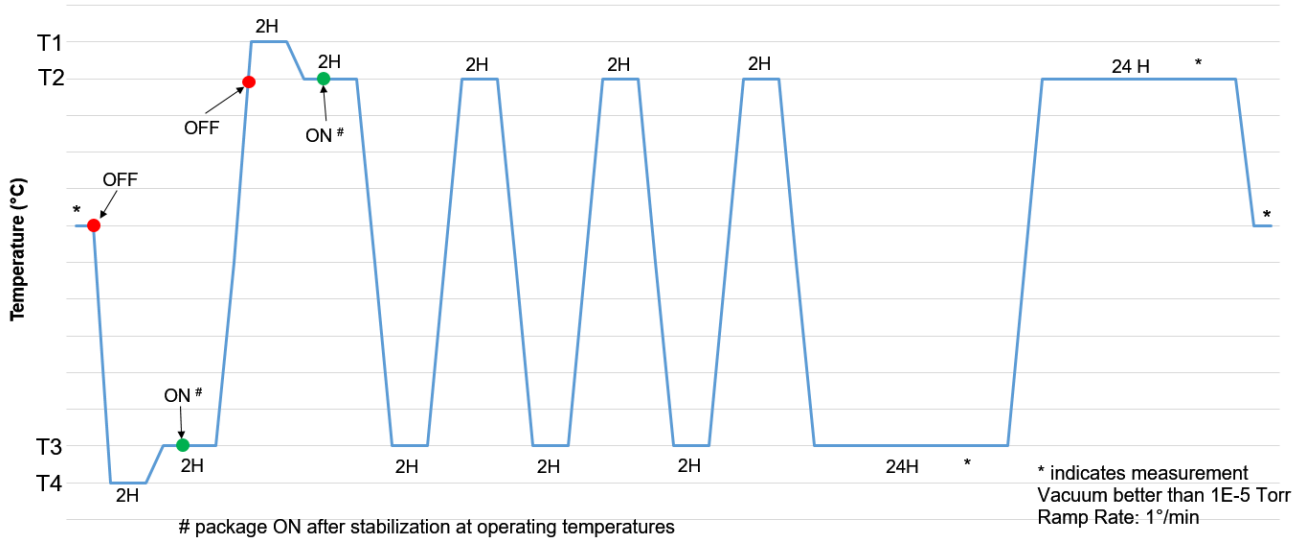


Figure A.2: Typical Thermo-Vacuum Test profile (Cycle, Soak and stabilization period may vary)

	T1*	T2	T3	T4*
QM/PFM	+70°C	+55°C	-15°C	-30°C
FM	+70°C	+50°C	-10°C	-30°C

*non-operating/storage temperatures may change as per project requirements

12.1.12 Life Test:

QM units shall be subjected to operating life test for 2000 hours at maximum operating temperature +55°C with unit being continuously ON. Electrical measurement shall be carried out at 240, 500, 1000 hours and at the completion of 2000 hours. During testing, critical electrical parameter values and temperature shall be logged at regular intervals.

12.1.13 Final Bench Test (FBT)

The final bench test shall be conducted for measurement of electrical parameters as given in test matrix. The test shall be conducted at ambient temperature. All the test results shall be recorded and any performance deviation with respect to Initial Bench Test shall be evaluated and shall be within specified limits.

12.1.14 Final Visual Inspection

The unit shall be inspected for plating, surface, finish, mechanical deviations, corrosion and workmanship related defects. No visual degradation shall be allowed after completion of test.

13.0 NON-CONFORMANCE MANAGEMENT:

Effective non-conformance management mechanism shall be established by the vendor. Major non-conformance at any stage, which affects the quality & reliability or the fabrication process of entire lot AND/OR reliability of unit; shall be reported to SAC immediately with photographs, nature of non-conformance observed, etc. Disposition shall be in consultation with QA, SAC. However, for all the minor non-conformances, approval from SAC is not mandatory, and shall

be reviewed and discussed by the vendor's NCR board. This NCR board shall be constituted by vendor in consultation with SAC. Non-conformance report shall be generated by the concerned agency and shall be reviewed and disposed-off by the NCR board. Compilation of such NCRs shall be sent to SAC periodically at agreed intervals, preferably every fortnight.

Any non-conformance affecting the fabrication and / or inspection procedure shall be reported to SAC. Changes in related documents shall be implemented and revision number of the document shall be updated. This shall be followed by updating all the documentation (fabrication, inspection, test, etc.).

All the non-conformances with the disposition given by the NCR board shall be reported to SAC periodically. This shall be followed by report of close out action completion, if any. For all the non-conformance report, SAC representative shall be the focal the person.

14.0 CONFIGURATION CHANGE CONTROL

The manufacturer shall follow an effective configuration change control procedure during the fabrication stages. Plans for both non-conformance and configuration change control shall be made for submission to SAC for review and approval before initiation of manufacturing activities.

15.0 STORAGE AND TRANSPORTATION:

15.1 Storage of hardware, parts & materials:

Storage of fabricated hardware, parts & materials shall be done as per ISRO-PAS-207. Active & Passive Component shall be stored in controlled area environment under Class 100,000 clean room with round the clock controlled temperature ($22\pm3^{\circ}\text{C}$) & humidity (50 to 60% RH). Parts shall be stored in such manner as to prevent damage due to undue stresses. ESD protection care shall be taken while receiving & issue of components. A manufacturer instruction for storage & handling of parts shall strictly be followed during the storage. Dry N_2 (Nitrogen) purged packaging and storage cabinets shall be used for storage of critical components and oxygen sensitive items like PCBs / mechanical hardware.

15.2 Transportation:

Suitable packing (as specified in ISRO-PAS-207) shall be provided for the transportation of the unit by air or road without any degradation / damage.

Each unit shall be packaged in individual ESD protective packaging and protect the unit from environmental conditions encountered during transportation, like heat, humidity & dust. Shorting buffers on card/tray/package connectors to be used. This individual container shall then be placed in a transportation container. More than one individual unit may be placed in the transportation container.

The individual unit packages and transportation containers shall be clearly marked with following instructions along with other mandatory markings.

“ESD sensitive units”

“To be opened only under clean environment with ESD precautions”

“High reliability space usage systems”

16.0 DOCUMENT TO BE SUPPLIED:

16.1 Following document shall be supplied along with quote

- Point by point compliance to all the requirements of this document.
- Details to be provided as per QA check list given in Annexure-A

16.2 The following documents shall be supplied during the contract:

- Materials & Process List to be used for the fabrication of units, detailing their quality level, procurement specifications, traceability information, out gassing test report etc.
- CoC, screening (at Vendors / sub-vendors) reports, incoming inspection report, batch acceptance test reports of Parts & Materials
- Record of Bias conditions (as applicable) for identifying the channel / junction temperatures of all the active devices
- Process Identification Document.
- Non-conformance management plan
- Configuration change control plan.
- Program management plan

16.3 Following documents shall be supplied during the programme with respect to relevant activity.

- Status report for the fabrication activity and test schedule.
- Schedule for Cover closing of the units
- Details of test set-up and readiness
- Non-conformance report
- Failure Report; as and when failure occurs

16.4 Following detailed documents shall be supplied for each unit along with deliverables,

- T & E report of each unit containing detailed test results, test history, conformance matrix, TBD values etc.
- CoC of the deliverable units
- CoC of parts & materials Including screening report
- All fabrication details supplied by SAC for fabrication
- Non- Conformance reports with close-outs

QA Check List

Vendor to provide complete details of following with relevant certificates.

Sr. No.	Details of information required				Vendor response	
1	Point by Point compliance provided?				Yes / No	
2	Pl. provide following information along with necessary valid certificate.					
	(a) Procurement of Bare substrate (Whichever applicable)		Name of Vendor to be procured from:		ISRO qualified?	
	PCB				Yes / No	
	Others (if any)					
	(b) Component mounting & Assembly process on,		Location	ISRO Qualified	Cert. attached?	Ref. Annex. for certificate
	PCB			Yes / No	Yes / No	Annex- xx
	Others (if any)					
	(d) Plating / Surface treatment		Location:		ISRO Qualified: Yes / No	
	(e) Mechanical Package Fabrication		Location:		Details of Heritage	
3	List of ISRO certified fabricator and Inspector for PCB assembly and wiring work available at the time of bid.					
		No. of fabricator	No. of Inspector	Certificate attached?	Annex. for certificate	
	PCB			Yes / No	Annex- xx	
4	Details of test engineer with experience available at the time of bid.				Attach in annex. no.: _____	
5	List of Test & Measuring instrument				Attach in annex. no.: _____	
6	Location of test facilities likely to be used for following tests shall be provided. (whichever applicable)				Location	

a) Physical Measurements & Passive thermal cycling	
b) Visual Inspection (internal & external)	
c) Electrical measurements	
d) Burn-in	
e) Temperature tests : Storage temperature test, Humidity Storage and Temp. operational test	
f) EMI / EMC	
g) Vibration test (sine & Random)	
h) Thermo-Vacuum	
i) Mechanical Shock	
j) Life Test	

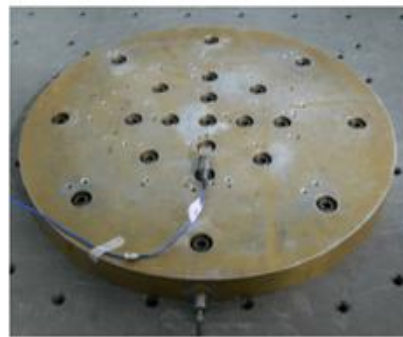
Company Logo	Name & Address of Company/Industry
REPORT No.	DATE

STANDARD FORMAT OF VIBRATION & SRS TEST REPORT FOR ISRO-SAC UNIT

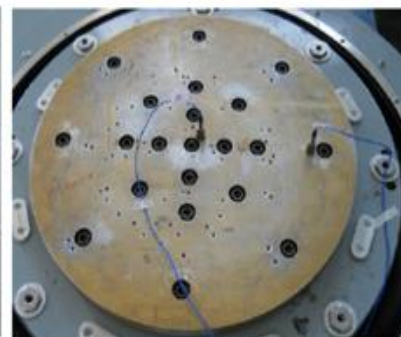
ISRO Specification Number
Subsystem
Sub Assembly details
Customer Part No
Model No
Serial No
Model
Weight
Test start date & Test End date
Drawing No. and T & E clearance certificate no with date :
Vibration Test Equipment & calibration details:

Sample of Photo graphs showing test set-up of Subsystem with control & measurement accelerometer location with Axis definition.

Fixture Characterization in LLS

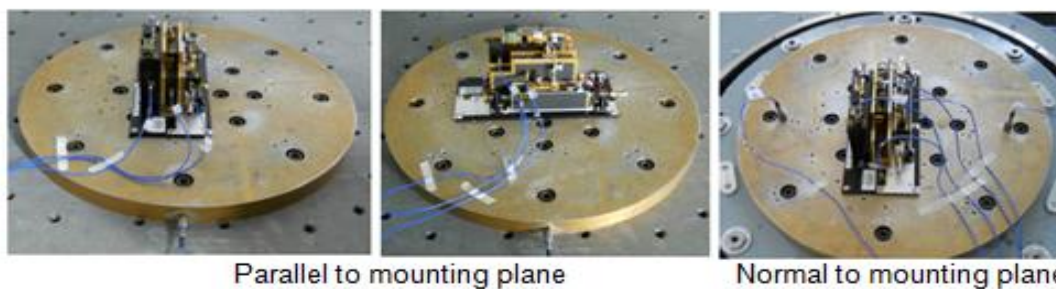


Parallel to mounting plane



Normal to mounting plane

Subsystem during Vibration test in each Axis



Test Description:

1. Vibration Test Set-up:

- 1.1 Fixture details [size, Material, No of mounting fasteners & torque details to shaker]
- 1.2 Mounting Torque: Fixture to subsystem: Size & -No. of Fastener
- 1.3 Torque Wrench Calibration details
- 1.4 Accelerometer details with calibration
- 1.4. Axis Definition with photo graph/sketch [Parallel to Mounting Plane, Perpendicular to Mounting Plane]

2. TEST SPECIFICATIONS:

2.1 Resonance Test [LLS]

Axis	(Frequency-Hz)	Amplitude	Sweep Rate Oct/Min.
X, Y & Z	10 to 2000 Hz	0.5 g	2

2.2 Sample of Sine & Random Test Levels:

Axis	SINE TEST (Frequency-Hz)	Amplitude	Sweep Rate Oct/Min.
X,Y			
Z			
Axis	RANDOM TEST (Frequency-Hz)	PSD (g^2/Hz)	OVERALL g.r.m.s.
X & Y			
Z			

2.3 Sample of SRS Test Levels:

Axis	SRS TEST (Frequency-Hz)	Amplitude	No. of Pulses
X,Y,Z			

3. Response of Random/SRS & Resonance search tests: Frequency (Hz) / Amplitude (g):

Axis	Measurement Accelerometer Ch. No	Measurement Accelerometer location	Pre- Sine/SRS Resonance Hz/g	Post-Sine Resonance Hz/g	Random response g _{rms}	Post Random/SRS Resonance Hz/g
X						
Y						
Z						

4. TEST SEQUENCE: For Vibration testing of QM

QM 1.[LLS-SINE-LLS-FUNCTION-TEST-LLS-RANDOM-LLS] in X, Y, Z Axis
PFM 2.[LLS-SINE-LLS-RANDOM-LLS] in X, Y, Z Axis
FM 3.[LLS-RANDOM-LLS] in X, Y, Z Axis
For SRS testing of QM[LLS-SRS-LLS] in X, Y, Z Axis

5. PASS/FAILURE CRITERIA:

Pass Criteria:

- Full functionality and structural integrity of subsystem following vibration testing as verified by visual inspection during and after test.
- Structural integrity is defined as no loose components (bolts backing out), cracking of structure, excessive buckling, or excessive displacements. Functionality is defined as full electrical and mechanical characteristics.
- First natural frequency greater than 100 Hz.
- "Before" and "After" Sine Survey Sweeps match each other within 10% of frequency & 20 % of Amplitude.

6. OBSERVATION/ ANALYSIS:

- Natural frequency of the package in each Axis above 120Hz.
- No apparent structural damage observed after & during vibration test. Pre & Post resonance signatures are matching within acceptable criteria.
- No loosening or damage found during or after Vibration test.
- Annexure should be attached for vibration test plots.

7. CONCLUSION

Sub-system withstood the specified severities of vibration / SRS tests successfully and hence, cleared for further activities.

Test carried out by

Test surveillance by

Annexure B: Confidentiality & Non-Disclosure Agreement

This Agreement is entered into on ____ day of _____ in the year _____

Between

Space Applications Centre situated at Ahmedabad, Gujarat, one of the major centers of the Indian Space Research Organization (ISRO) under Department of Space, Government of India, of one part,

And

M/s. _____, situated _____ at _____
of the other part.

M/s, _____, *further agrees as follows: -*

1. All Drawings, Documents, Components and subject matter contained therein and any other information passed on by SAC in connection with the design, Fabrication, Assembly & Testing of payload electronics shall be held confidential by M/s _____, and shall remain the property of SAC and shall not be passed on, sold or disclosed to third parties by M/s. _____.
2. All Drawings, documents, components, other material supplied in connection with this RFP shall be duly returned to SAC.
3. No hard copies or copies on hard disc, pen-drives, or CDs duplication or photocopy will be retained by M/s. _____.
4. All Intellectual Property Rights (IPRs), without limitation, the IPRs of the modification/improvements/alterations/additions made, vests with SAC/ISRO, irrespective of whether the modifications/improvements are initiated and/or executed by the vendor or jointly by the SAC/ISRO and the vendor or only by the vendor.

M/s. _____

SAC, AHMEDABAD.

Annexure C: Compliance table

S. No.	Description	Requirements	Compliance/Remarks
	Infrastructure		
1.	Vendor must have valid qualification / certification as per SAC/ISRO guidelines for all processes, work force and facility (required for the mentioned scope of work as specified in section 2), on the date of submission of bids	Vendor to submit the necessary certificates	
2.	Vendor must be a reputed engineering company registered with government agencies and in existence for a minimum of 5 years on the date of issue of this tender,	attach relevant P.O. copies, documents etc.	
3.	Vendor to have necessary facilities or tie ups with third parties, experience and valid licenses for providing such Technical Services/Products	attach relevant P.O. copies, documents etc.	
4.	Vendor shall have a trained technical Staff (Engineers) with minimum 2 years' experience in Flight Model card fabrication, mechanical assembly and testing as defined in scope of work.	Vendor has to provide the list of such regular employees with their qualifications, experience etc.	
5.	Vendor shall have necessary infrastructure, or may outsource after approval of SAC to carry out the defined work orders, like workstations, PCs, genuine software, test chambers, clean rooms etc.	Infrastructure and outsourcing details to be provided	
6.	Vendor shall attach certificates from reputed user agencies, ISO/High-level quality service certification in the relevant area, if available.	Documents to be provided	
7.	Vendor's Company/firm should not have been banned or black-listed by any Government Department/Central Government Unit/Public Sector Unit/Financial Institutions/Court.	declaration in this regard to be provided	
8.	Vendor should have a controlled environment storage area for components, materials and fabricated hardware	Details to be provided	
9.	Vendor should have test equipment and environmental test facilities at least for climatic, thermovac and vibration test as given in document	Vendor to provide details of the available instruments and environmental facilities	
10.	The vendor has completely gone through this RFP document, understood and complying all the requirements and has signed every page of the document.	Details	

Annexure D: Checklists for T&E

1.0 Test plan and test procedure documents:

Approved test plan document shall be available at vendor's place before start of T&E. The test plan shall contain at least following:

- a) Subsystem description
- b) Specification requirements
- c) Interface details including data card
- d) Test plan and test sequence
- e) Parameter test matrix
- f) Temperature limits
- g) Vibration and mechanical shock levels
- h) EMI / EMC test requirements
- i) Thermo-vacuum test requirements including thermal management and data logging.

2.0 DUT Details:

Details of the DUT shall be verified and recorded before start of T&E.

Sr. No.	Parameter	Yes / No / Remarks
1.	Package cleared for T&E?	
2.	Type of body surface finish?	
3.	Surface finish on mounting plane?	
4.	Solders available?	
5.	Electrical & mechanical ground isolation checked?	

A test history sheet shall be maintained for each DUT in the following format mentioning the date and time of activity along with observations from start of T&E up to end and report generation

Project Name:			
Unit Name:			
Unit Id:			
Date & Time	Activity	Observation	Remarks / Sign

3.0 Test setup checklists

3.1 Harness checklist

Sr. No.	Parameter	Yes/No/Remarks
1.	DUT Input Power Requirement.	
2.	Wire Gauge for Raw Bus Live/Return	
3.	Connector Type should be different at source and destination	
4.	Single connection from source to destination. Joints are not allowed.	
5.	For wire junction, Use wire distribution box or PCB.	
6.	Wire colour code should be different for RAW Bus Live, Return, Analog and Digital lines.	
7.	Labelling on wire at both end	
8.	Continuity verification 1 st Level	
9.	Continuity verification 2 nd Level	
10.	Voltages verification at DUT end	

3.2 Test Jig Check List

Sr. No.	Parameter	Yes/No/Remarks
1.	Test Jig Internal Connection should comply DC Harness Check List	
2.	If any active elements or simulator is part of test jig, 168Hrs Ambient Burn is applicable	
3.	Test Jig Verification 1 st Level	
4.	Test Jig Verification 2 nd Level	
5.	Test Jig Serial Number	

3.3 DC Power Supply Check List

Sr. No.	Parameter	Yes/No/Remarks
1.	Voltage and current requirements	
2.	OVP and UVP settings	
3.	Current limits and fold back settings	
4.	Power Supply should have soft power On /Off capability	
5.	On/Off Sequencing	
6.	Use of in-line switches (AO meters)	
7.	DC Power Supply Tested As Per Plan Given In Annexure-A	

3.4 Telecommand-telemetry simulator / GCU Check list

Sr. No.	Parameter	Yes/No/Remarks
1.	Interface circuit approved?	
2.	GCU T&E completed?	
3.	Software quality assurance (SQA) clearance available for any software in GCU?	

3.5 Test Instruments Calibration Status Check List

Sr. No.	Instrument Name	Calibration Valid? (Y/N)	Calibration due date
1.			
2.			
3.			
4.			

3.6 Test Set Up Grounding Check List

3.3.7.1 AC Line Leakage Measurement				
Sr. No.	Measuring Point	Earth Vs Neutral	Neutral Vs Phase	Phase Vs Earth
1.	AC Mains			
2.	Ext Board-1			
3.	Ext Board-2			
4.	Ext Board-3			

3.3.7.2 Resistance and AC Voltage Measurement			
Sr. No.	Reference Point	Resistance	AC Voltage
1.			
2.			
3.			
4.			

Sequence of activities to verify grounding:

1. Disconnect Extension Board from AC Mains.
2. Disconnect all Harness as well as RF cables from DUT.
3. Measure resistance from DUT Plate to all instrument chassis.
4. Connect Extension Board with AC Mains.
5. Measure AC Voltage w.r.t DUT plate and all instrument chassis.

4.0 Environmental Test Setup Checklists

4.1 Electrical Test Setup check list

Electrical test setup check lists shall be same as explained in section 3.3.

4.2 DUT Temperature Limits

Sr.No	Condition	Temperature
1.	Max Operating	
2.	Min Operating	
3.	Max Non Operating	
4.	Min Non Operating	

4.3 Climatic Chamber Requirements

Sr. No.	Parameter	Y/N/Remarks
1.	Will cater to DUT Operating and Storage temperature limits?	
2.	Temperature monitor sensor locations identified?	
3.	Temperature controlling Sensor location identified?	
4.	Programmable temperature transition rates capability?	
5.	Provision to prevent condensation on DUT?	
6.	Power Dissipation/Unit *No of Units	
7.	Power Dissipation when all units on	
8.	Chamber Power Handling Capacity	
9.	Approved Mounting Configuration? If yes, it should be part of this check list	
10.	Is there any special grounding requirements? Chamber Plate isolation?	

4.4 Thermo-Vacuum Test Setup Requirements

Sr. No.	Parameter	Y/N/Remarks
1.	Availability of suitable flange for interconnections.	
2.	Suitable size of chamber platform (Base plate)	
3.	Number of temperature sensors required?	
4.	Temperature monitor sensors location identified?	
5.	Temperature controlling sensor location identified?	
6.	Power Dissipation/Unit *No of Units	
7.	Power Dissipation when all units on	
8.	Chamber power handling capacity	
9.	Approved mounting configuration? If yes, it should be part of this check list	

10.	Test Setup AC Voltage supply interlock with chamber vacuum level? Applicable for High Power Subsystem	
11.	Temperature transition requirements achievable?	
12.	Any special grounding requirements? Chamber Plate isolation.	
13.	Continuous recording of temperature and vacuum level? Define sampling rate.	
14.	Continuous monitoring and logging of DC and RF parameters?	
15.	Temperature correction for RF interconnecting cables?	
16.	Provision to take care of voltage drop in long harness for high current DUTs.	

5.0 Vibration and Mechanical shock Tests Checklists

Sr. No.	Parameter	Y/N/Remarks
1.	Test levels available as per test document?	
2.	Model Identification (QM/PFM/FM)?	
3.	Weight and size identified?	
4.	Suitable vibration fixture available?	
5.	Fastener details and torque values available?	
6.	Test sequence available as per test plan?	
7.	Clearance available from previous tests?	
8.	Test report to be generated in specified format including vibration test and resonance search plots.	
9.	Availability of approved test facility?	

6.0 EMI / EMC Tests Checklists

Sr. No.	Parameter	Y/N/Remarks
1.	List of applicable tests available?	
2.	Test levels and specifications available as per test plan?	
3.	Availability of suitable type of test harness (Same as used on-board)?	
4.	Harness, grounding and test setup verification as per section 3.4.	
5.	Test report to be generated in specified format including test plots.	
6.	Availability of approved test facility?	

7.0 Non-Conformance Management

Non-conformance in any test parameter during any test phase shall be reported to SAC with following information.

Sr. No.	Parameter	Spec.	Measured.	Test Condition	Test plot / Raw data attached	Remarks
1.						
2.						
3.						

Detailed root cause analysis of the deviation shall be submitted and clearance shall be obtained before proceeding further.

8.0 Failure Reporting

Failures or anomalies observed during any stage of fabrication, development and testing shall be reported to SAC with following information:

- Design details and block diagram of DUT.
- Failure observed at which stage?
- Which tests were over before failure?
- Was there and deviation/MRB cleared during fabrication?
- Details of failure observed with relevant test results and plots.
- Root cause analysis.

9.0 Report Generation

A detailed test report shall be prepared by the vendor for each DUT. The report shall contain:

- DUT information and brief description.
- Specification requirements.
- Details of tests conducted.
- Test results in the form of summary sheets, test plots and parameter logging plots.
- EMI / EMC test report.
- Vibration test report.
- Non-conformance, failures and anomalies details.

Annexure E: DC POWER SUPPLY TESTING REQUIREMENTS

1. DC Power supplies used in the test setups shall have following mandatory features:
 - a. Soft power ON
 - b. Over Current Protection
 - c. Over Voltage Protection
 - d. Provision for remote logging of parameters.
2. DC Power supplies shall be tested as per following plan on procurement.

Table 1 Test Plan for Power Supply Testing

Sr. No	Test
1	IBT
2	24Hrs Burn-In @ Lab Ambient
3	FBT

Table 2 Test Matrix for Power Supply Verification

Sr. No	Parameter	IBT	BURN-IN	FBT
1	Load Regulation	X		X
2	Output Voltage at No Load	X		X
3	Measurement at Load condition C1			
	Output Voltage	X		X
	Output Current	X		X
	DC Input Current	X		X
	Ripple	X		X
	Spike	X		X
4	Measurement at Load condition C2			
	Output Voltage	X	X*	X
	Output Current	X	X*	X
	DC Input Current	X	X*	X
	Ripple	X	X*	X
	Spike	X	X*	X
5	Isolation between earth point & dc output terminal	X		
6	Transient on DC O/P Line with AC Power On	X		X
7	Transient on DC O/P Line with DC Out On	X		X
8	Over Current Protection	X		X

C1: Mid-Point of Load Range of power supply

C2: Max Point of Load Range of power supply

*: Record result at every 6 hours

3. DC Power supplies shall be tested as per following plan before use in test setup

Table 3 Parameter to be verified before interfacing with FM H/W

Sr. No	Parameter	Bench Test
1	Required Output Voltage at No Load	X
2	Transient on DC O/P Line with AC Power On	X
3	Transient on DC O/P Line with DC Out On	X
4	Over Current Protection	X