REQUEST FOR PROPOSAL
FOR
FABRICATION, TESTING AND DELIVERY
OF
SPACE QUALIFIED
ELECTRONIC POWER CONDITIONERS (EPCS)

DOC. NO.: SAC/SNPD/May/2024/02

GOVERNMENT OF INDIA

DEPARTMENT OF SPACE

SPACE APPLICATIONS CENTRE, ISRO

AHMDEDABAD - 380 015

Contents

PART -1: TECHNICAL DETAILS 3
INTRODUCTION 3
Exhibit A: Scope of Work 4
A1 Scope of the work. 4
Exhibit B: Vendor eligibility requirements and general guideline to vendor 7
B1: Vendor eligibility requirements 7
EXHIBIT-C: Guidelines to Vendor for quotation 11
C1: Guideline to prepare response for the RFP 11
C2: Checklist for Vendor regarding Technical Proposal 12
C3: Bid Evaluation Process and Criteria 12
EXHIBIT-D: Deliverables, Quantities, Schedule, and Warranty. 13
D1: Deliverables: 13
Hardware Delivery 13
Documents 14
D2 Delivery Schedule & Free Issue Material (FIM) 14
Delivery Schedule for PFM 14
Free Issue Material (FIM) 15
D3: Warranty 15
EXHIBIT-E: Responsibilities of SAC & Vendor 15
E1: Responsibilities of SAC 15
E2: Responsibilities of Vendor 16
EXHIBIT – F Electrical and Mechanical specifications 18
F1: EPC Introduction 18
EPC Configuration: 18
EPC Block diagram 18
Mechanical Details of EPC 20
Exhibit G: Free Issue Material 21
Annexure - 1 Typical general purpose fabrication Material to be procured by vendor 22
Annexure-2 Guidelines for TC/TM test jig 23
Annexure - 3 NON-DISCLOSURE UNDERTAKING 25

Part-2 R&QA Requirements ……..26

PART -1: TECHNICAL DETAILS

INTRODUCTION

Space Applications Centre is a unit of ISRO involved in design and development of various communication, navigation and remote sensing payloads. As new projects are being continuously taken up, it has been ISRO's policy to transfer existing designs to Indian industry for fabrication and production as per project requirements and to develop vendors for fabrication of space subsystems.

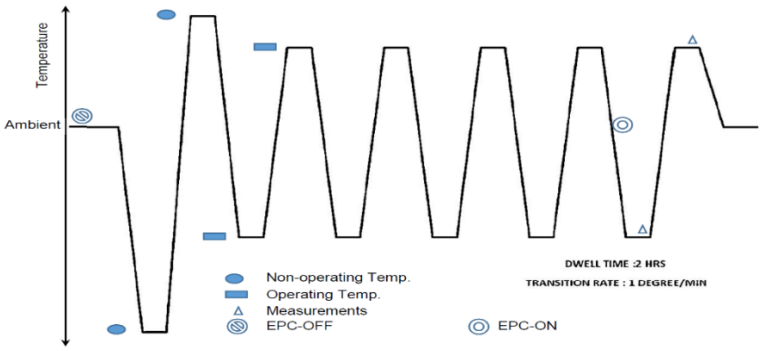
In keeping with this policy, it is intended to offload to industry the production of Electronic Power Conditioners (EPC), wherein, design would be done by SAC whereas industry has to carry out the fabrication and testing of EPCs. These EPCs shall be used to supply voltages to various RF and Digital subsystems used in the ISRO programs.

PART -1: TECHNICAL DETAILS

PART -2: R&QA REQUIREMENTS

Sr. No.	RFP REQUIRMENTS	Compliance
Exhibit A: Scope of Work		
A1 Scope of the work. Electronic power conditioner is a DC-to-DC converter along with the tele-command and telemetry circuits to supply multiple output DC voltages to various RF and Digital subsystems. EPC design will be provided by SAC. All EEE components except assembly and fabrication material (tentative fabrication material given in Annexure 1) will be provided by SAC. The vendor is required to fabricate, test, and deliver the EPC Units for space flight usage.		
A1.1	Collection of FIMs & Approved Drawing Sets will be the responsibility of the vendor.	
A1.2	Realisation of PFM & FM with compliance to the required electrical and environmental specifications. Fabrication, assembly, integration and testing of PFM & FM EPC Units as per the agreed process identification documents and test plan to meet the required specifications.	
A1.3	Vendor will be given Free Issue Material (FIM) for fabrication of PFM and FM units given in Exhibit G as per ISRO purchase procedure. FIM will consist of magnetic cores, all active devices like Power MOSFETs & Rectifier diodes, PWM and low drop out regulator ICs, D-sub miniature connectors, passive components etc.	
A1.4	SAC will provide the approved Mechanical drawings and photo films/artworks/masks for bare PCB fabrication of EPC for PFM/FM EPC.	
A1.5	The total work quantum can be typically divided in five stages as given below. All the following activities are to be carried out by vendor as per ISRO qualified processes, with quality control at each step, as per the SAC approved fabrication and test documents: • Procurement of space qualified consumable material • Fabrication of PCB and Mechanical package • Components mounting, assembly and packaging • Testing and performance optimization at EPC card level and package level. • Acceptance/PFM level environmental testing, as given in R&QA requirements.	
A1.6	Vendor shall procure all materials/parts (general purpose fabrication material list given in Annexure 1) related to fabrication of mechanical package, mechanical parts, and electronics hardware to carry out the fabrication and assembly. This material may include Al Alloy to fabricate mechanical package for Space Product, SS fasteners, multi-layered FR4 PCB material for bare PCB fabrication, RTV3145, Chotherm sheet, preform and other solder material, 22/24/26/28/30/32/ AWG Cu-enamel wire, Tantalum sheet, material for conformal coating, araldite, thermal paint / black anodize, H74 etc. Vendor shall take prior approval of procurement specifications from SAC.	
A1.7	Incoming inspection of mechanical parts and materials by the vendor as per ISRO standards.	
A1.8	All required documents for fabrication of mechanical hardware, assembly, testing as per R & QA are to be prepared by vendor and its approval has to	

Sr. No.	RFP REQUIRMENTS	Compliance
	be taken from SAC QA. In case of modifications, vendor shall generate related documents and get them approved from SAC.	
A1.9	Fabrication of PCB and package assembly include both mechanical and electronic fabrication activities. It is to be carried out as per the approved drawings supplied by SAC at SAC / ISRO space qualified facilities. Mechanical fabrication • SAC will provide the approved drawings in Autocad DXF/Gerber format for Mechanical drawings and PCBs of EPC. • Based on SAC supplied drawing Vendor will manufacture the mechanical package and surface treatment (black anodizing) as per SAC qualified process and by ISRO qualified vendor. Approval and fabrication of mechanical boxes & processes with 100% inspection. • Post fabrication mechanical compatibility check of package with all PCBs, DC connectors and components. After successful completion of this activity, unit can proceed to next stage of production Bare PCB Fabrication • Vendor will be given photo films/artworks/masks for bare PCB fabrication. • Vendor to fabricate PCBs as per SAC qualified process/ by SAC/ISRO approved vendors.	
A1.10	The mounting, assembly and packaging shall be as per SAC/ISRO qualified process of ISRO –PAX-300. SAC approved Fabrication Sequence document is strictly to be adhered to for EPC fabrication steps. All operations like components' mounting, coil fixing etc. mentioned therein should be in sequence as per the document only. Typical operations include the followings: • Preparation of test document and process identification document and approval from SAC. • PCB backing, tinning, mounting, and soldering of sub miniature connectors, active / passive components, magnetic coils fabrication and mounting on the PCB as per the flow defined in approved fabrication details using the jig for mechanical box. • Coil/Transformer winding and test for turns ratio, magnetic inductance and leakage inductance using RLC Meters/ Inductance/ magnetic analyzer. • Mounting of toroidal core on the PCB/ box wall with fasteners or bonding with adhesive epoxy. • Fitting of all the parts in package as per approved drawing. • Harnessing of all the magnetic coils and wall mounted device. • Functional testing at card level at various stages of fabrication to finalize the TBD component optimize the performance. • Tantalum sheet cutting and application. Mounting of Tantalum sheet by RTV 3145. • Conformal coating of PCBs and RTV application at required locations. Local potting on the defined components, DC harness whenever applicable.	

Sr. No.	RFP REQUIRMENTS	Compliance
	• PCB wiring and assembly in mechanical package • Functional testing of EPC. • Vendor QC at every stage and stage wise SAC QA audit.	
A1.11	Testing and performance optimization at EPC card level and package level • Vendor will carry out EPC functional tests in systematic manner after populating all components including magnetics and Power MOSFETs/BJTs/Rectifiers (in PCB/Package). Few connections are kept open initially and in a phased manner, those connections will be made permanent as testing of each section progresses. Document for phase wise testing steps will be provided at the time of execution. • Functional test with electronic load for entire input line variations and output load variations. Optimizations of EPC for maximum efficiency and other performance parameters. • Vendor to carry out passive (5) & active (1) thermal cycles (cold and hot) & burn-in test before application of local potting, conformal coating and final cover closing. For this purpose, temporary cover closing may be applied. • Passive cycling: 1 Cycle at Non-operating temperature range, 4 Cycles at PFM temperature range • Active Cycle: 1 Cycle at operating temperature range (As applicable for PFM and FM). The mentioned passive and active thermal cycles (as shown below) are done over the operating temperature limits to characterize and rule out any probable rework on the test unit, before application of LP/CC & final cover closing. Temperatures limits are as given in the R&QA requirements.  Unit is to be tested and optimized for specified performance over the operating range of temperature during active cycle.	
A1.12	On line inspection of fabricated units at each stage and final visual inspection	
A1.13	Audit inspection of fabricated unit by SAC QA.	
A1.14	The PFM/FM assembly will go through test as per R&QA requirements. Test matrix for testing PFM/FM units is given in QA annexure of this RFP. Test Plan generation by vendor, review, and approval by SAC • PFM testing is a set of environmental tests carried out on each unit to verify the performance of fabricated EPC unit with a given set of part process and material. This also demonstrates the available performance margins of the unit under given operating conditions. It includes various	

Sr. No.	RFP REQUIRMENTS	Compliance
	tests such as Burn-in, EMI/EMC tests, vibration, thermal vacuum test, etc as per list and details included in R&QA section of this RFP. FM unit of EPC with additional PFM test as per R & QA annexure is considered as PFM unit. • Acceptance testing is a set of tests carried out on each FM unit to verify the workmanship and performance of the unit under given operating conditions. It includes various tests as defined in R & QA requirements.	
A1.15	Test report generation by vendor, review, and approval by SAC. T & E test data of each individual PFM/FM EPC shall be provided for clearance from SAC.	
A1.16	All the test jigs for EPC testing developed for functional, parametric, environmental, and mechanical, burn-in, etc. shall be manufactured by the vendor. Fabrication of the required handling fixtures, jigs etc. in adequate numbers necessary for performing all the internal fabrication and testing. The fabrication drawings for these have to be generated by the vendor.	
A1.17	Test jig set up for compatible tele-command signals and telemetry and other capture interface circuits/data loggers and their compatibility should be as per RFP requirements. (Refer Annexure-2) Vendor needs to realize appropriate EPC Test Jig for emulating TC & TM functions, for internal use and for delivery along with deliverable EPCs, one per Lot as per delivery schedule.	
A1.18	Any correction required on FM due to non-conformance/failure observed in PFM at any stage of optimization/testing shall be at the risk and responsibility of the vendor.	
A1.19	The final acceptance of FM is subjected to successful completion, and clearance from SAC.	
A1.20	Delivery of PFM/FM along with the test data and screening documents	
A1.21	Report on the "Status of fabrication & progress" shall be submitted to SAC, during 1st week of every month.	
Exhibit B: Vendor eligibility requirements and general guideline to vendor		
B1: Vendor eligibility requirements Vendor should have capability in terms of qualified FM fabrication facility, storage facility and test facility as well as necessary technical expertise to build, optimise, test, and deliver the high reliability product. Vendor must meet the following conditions to submit quote against this RFP		
B1.1	Experienced Indian Company: (i) Vendor must have experience in development and delivery of space qualified EPC for ISRO in the span of past 5 years. The experience should be for built to print (turnkey) delivery of EPCs. (ii) Necessary details including copies of contract/PO executed in the last five years shall be attached along with quotation. For each of undertaken projects in the stated period, the Vendor must provide the details like quantity of delivered EPCs and total time of execution, commencing from the date of award of contract until its delivery.	
B1.2	Fabrication Facility Qualifications/Certification:	

<table>
<tr><td>Sr. No.</td><td>RFP REQUIRMENTS</td><td>Compliance</td></tr>
<tr><td></td><td>(i) Vendor must have ISRO certified PCB wiring, assembly facility & processes as per ISRO-PAX-300.
(ii) Vendor must have controlled environment storage facility to store parts, material & assemblies for Hi-Rel fabrication of space-hardware.</td><td></td></tr>
<tr><td>B1.3</td><td>Availability of certified manpower:
Vendor must have at least five experienced ISRO certified fabricators, QC inspectors for PCB assembly & wiring as per ISRO-PAX-300.
The stated workforce requirement is to be met and certified proof of it is to be submitted on the date of bid submission along with technical bid.</td><td></td></tr>
<tr><td>B1.4</td><td>Availability of test facilities:
Vendor should have all test facilities available with them. Before the actual test, facilities shall be audited by SAC and can be used only after SAC clearance. The capability of facility shall be adequate to carry out the test specified under this RFP within the required time schedule.
<table>
<tr><th>S. No.</th><th colspan="2">Parameter</th><th>Vendor Comments</th></tr>
<tr><td rowspan="7">1</td><td rowspan="7">Environmental facilities to meet requirements*</td><td>Thermal Chamber</td><td></td></tr>
<tr><td>Thermovac Chamber</td><td></td></tr>
<tr><td>Data recorder for thermal vacuum test</td><td></td></tr>
<tr><td>Vibration Facility</td><td></td></tr>
<tr><td>EMI/EMC facility</td><td></td></tr>
<tr><td>Chemical facilities – Black anodization, conformal coating etc.</td><td></td></tr>
<tr><td>Clean Room (100000 cleanliness)</td><td></td></tr>
<tr><td colspan="4">*Make/Model numbers to be provided. Vendor shall clearly mention the Third party outsourcing (if any).</td></tr>
</table></td><td></td></tr>
<tr><td>B1.5</td><td>Availability of test equipment:
Vendor must have at least following equipment’s at the time of biding: -
<table>
<tr><th>Sl. No.</th><th>Equipment</th><th>Year of procurement /Make /model no. etc.</th><th>Quantity (min)</th></tr>
<tr><td>(i)</td><td>Frequency Response Analyser for close loop characteristic measurement of EPC.</td><td></td><td>01</td></tr>
<tr><td>(ii)</td><td>Oscilloscope (500 MHz Band width minimum) with waveform storage capability, along with Voltage and Current probes.</td><td></td><td>01</td></tr>
</table></td><td></td></tr>
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<tr><th>Sr. No.</th><th>RFP REQUIRMENTS</th><th>Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>(iii)</td><td>Oscilloscope (200MHz Band width minimum) with waveform storage capability, along with Voltage and Current probes.</td><td></td><td>02</td></tr>
<tr><td>(iv)</td><td>Magnetic Analyzer / Precision LCR meter for measurement of magnetic coil parameters.</td><td></td><td>01</td></tr>
<tr><td>(v)</td><td>DC Electronic load Mainframe / Dual Channel Modules.</td><td></td><td>03 / 12</td></tr>
<tr><td>(vi)</td><td>Power Supplies with inbuilt soft-start functionality.</td><td></td><td>2</td></tr>
<tr><td>(vii)</td><td>True RMS Digital Multi Meters (resolution ≤ 1mV, for up to 20V measurement)</td><td></td><td>02</td></tr>
</table>
Vendor is required to provide the details of the available test equipment like make, model number, brief specifications, year of procurement, number of equipment’s, etc. along-with the technical bid.
</td><td></td></tr>
<tr><td>B1.6</td><td>Hi-Rel Parts & Materials procurement experience:

Vendor must have previous experience of procurement of Space Qualified Hi-Rel mechanical parts and materials.</td><td></td></tr>
<tr><td>B1.7</td><td>Technical competence:
Vendor must possess and must be able to demonstrate, through technical discussions, availability of engineering expertise to understand total requirements, explain, discuss, and defend the aspects related to development, and testing of space qualified EPCs under defined delivery schedules. Vendor may be required to make a presentation to SAC expert committee about all above aspects.
Vendor shall provide list of power engineers and technicians available on the date of bid submission along with technical bid.</td><td></td></tr>
<tr><td>B1.8</td><td>Based on the details provided by the vendor, SAC will assess the capability of the vendor to take up this work.</td><td></td></tr>
<tr><td colspan="3">B2: General guidelines to Vendor</td></tr>
<tr><td>B2.1</td><td>Vendor must substantiate their claim of meeting the delivery schedule with proper justification. Past performance of vendor about previous contracts with SAC may be reviewed before awarding the contract.</td><td></td></tr>
<tr><td>B2.2</td><td>Proprietary Information and Non-Disclosure Undertaking related:
(a) The technical information, drawings, and other related documents, disclosed by SAC/ISRO to the vendor and forming part of the order, are property of Government of India, Department of Space and shall not be used for any other purpose except for execution of this order.
(b) All rights, including rights in the event of grant of patent and registration of designs are reserved.
(c) The technical information, drawings, specifications, records, and other documents shall not be copied, transcribed, traced, or reproduced in any other forms or otherwise in whole and/or duplicated, modified divulged and/or disclosed to a third party nor misused in any other form</td><td></td></tr>
</table>

Sr. No.	RFP REQUIRMENTS	Compliance
	whatsoever without SAC/ISRO's consent in writing except to the extent required for the execution of this order. (d) The technical information, drawings, specifications, and other related documents shall be returned to SAC/ISRO with all approved copies and duplicates, if any, immediately after they have been used for the agreed purpose. (e) SAC will have a right to use the EPC fabricated under this purchase order for any program. Intellectual property right for EPCs fabricated by vendor shall rest with SAC, ISRO. Vendor is not permitted to use the EPC and circuits designed for this purpose in any program unless approved by SAC. Vendor shall furnish an undertaking that the design will not be used in part or full for any other purpose. Vendor shall furnish undertaking regarding Non-Disclosure Agreement (NDA), as per Annexure-3. Intellectual property right for EPCs fabricated by vendor, under this RFP, shall rest with SAC, ISRO. (f) Any changes carried out in the design, drawings, or documents during the contract/ purchase order tenure, done by vendor or SAC shall be exclusive property of SAC and shall not be used for any purpose other than agreed upon.	
B2.3	Free Issue Material related guidelines: (a) Supply of FIM will be issued according to Bank Guarantee by purchase terms and conditions (b) Collection of FIMs & other details from SAC will be the responsibility of the vendor. (c) The vendor should maintain all records of inventory of FIM received, utilized, balance etc., and update them continuously. (d) The Vendor shall be responsible for proper storage & security of FIM. (e) The Vendor shall be responsible for any mishandling and loss of FIM held under their custody. Vendor shall reimburse Purchaser for any shortages / loss of FIM. (f) The Vendor shall return the unused / excess / spoiled FIM, if any, to Purchaser on the advice of the Focal Point at SAC. (g) In-case of rejection, a request letter from vendor clearly indicating reasons for rejections, preventive action thereof should be submitted to SAC. (h) A maximum of 10% Failures/Rejection will be acceptable for FIMs. (i) In the event of failures of FIM beyond the permissible limits, SAC will provide replacement FIM for completion of jobs. However, the cost of such FIM issued by SAC beyond permissible limits has to be borne by the vendor. (j) In the event of establishment, that the cause for the rejection in FIM is due to material defect, then the same shall be replaced free of cost by SAC.	
B2.4	Calibrated Test & measuring instruments shall be used during the tests. Calibration certificates of all test equipment's used shall be made available for SAC audit at any stage. Details of Instrument shall be logged in proper formats for traceability point of view.	

Sr. No.	RFP REQUIRMENTS	Compliance
B2.5	Any non-conformance or failure observed during any of the test shall be reported to SAC at the earliest & shall be documented. Proper evidence or photograph shall be taken wherever possible. Any non-conformance during testing against SAC specification to be rectified by the party.	
B2.6	Handling during test as well as before and after storage shall be done with utmost care. In case damage is attributed to handling, storage, assembly or at any stage of testing, the same shall be recorded with reason and shall be reported to SAC at the earliest. Damaged samples shall not be subjected to further test. Damaged parts to be handed over to SAC.	
B2.7	If any modification in design, specifications and interfaces are required due to change in project requirements, vendor has to implement the same in PFM and FM units.	
B2.8	SAC may modify test requirements during fabrication of unit PFM/FM units, if required, after placement of order. SAC reserves the right to modify any part of the design as per project requirements. Modification should be mutually discussed and agreed upon before implementation.	
B2.9	Vendor shall take approval from SAC prior to third party outsourcing. R&QA requirements will be applicable to third party also. The vendor shall provide the list of activities carried out by their sub-contractors.	
B2.10	The electrical and mechanical specifications of EPCs are mentioned in RFP. However, final electrical specifications shall be provided at the time of ordering.	
B2.11	SAC team may visit and audit the facilities of a vendor in order to evaluate the vendor's capabilities to execute the work as detailed in this RFP. Based on the evaluation by SAC team, SAC reserves the right to reject an offer from a vendor. SAC/ISRO reserves the right to review and audit the work at any time.	
B2.12	SAC reserves all rights to terminate the purchase order at any stage, in case of major non-compliance with respect to technical parameters or delivery schedule. In case the contract is terminated due to unsatisfactory execution, progress or performance, vendor shall be responsible to return the unused FIM components to SAC as per purchase procedure.	
EXHIBIT-C: Guidelines to Vendor for quotation Vendor shall submit their offer in two parts. The first part will be technical proposal and second part will be Cost proposal. The vendor must ensure to submit their quotation along with all the details before the due date.		
C1: Guideline to prepare response for the RFP		
C1.1	Vendor is requested to examine this RFP thoroughly and offer compliance or non-compliance, point-by-point to all the requirements of this RFP including R&QA requirements with supporting documents, without which their offer shall not be considered. Vendor may seek clarifications, if required, before submitting their offer. In case of non-compliances against any parameter, the vendor is required to specify the same in detail for review by SAC. Failing to provide these information, offer may be considered as rejected.	
C1.2	Vendor must provide the delivery schedule in bar chart showing sequence and time of all important activities for fabrication and testing of EPC units.	

<table>
<tr><td>Sr. No.</td><td>RFP REQUIRMENTS</td><td>Compliance</td></tr>
<tr><td>C1.3</td><td>Vendors are requested to participate in pre-bid technical discussion at SAC in order to understand all the technical requirements. The dates of pre-bid technical discussion will be at least 21 days before tender due date.</td><td></td></tr>
<tr><td>C1.4</td><td>It is mandatory that vendor’s proposal must be for all the line items of the tender. Offer will be processed only if the vendor’s proposal for EPC development, testing and delivery is found acceptable.</td><td></td></tr>
<tr><td>C1.5</td><td>The quotation for FM EPCs should include all the charges for screening and acceptance level testing.
Charges for tests additional to FM level tests, as per R & QA exhibit for PFM of EPCs to be quoted in price bid.</td><td></td></tr>
<tr><td colspan="2">C2: Checklist for Vendor regarding Technical Proposal</td><td></td></tr>
<tr><td>C2.1</td><td>Information related to the company shall be provided as per Table C2.2 with supporting documents at the time of bidding.
Table C2.2 Information related to the company
<table><tr><td>Sr. No.</td><td>DESCRIPTION</td><td>DETAILS</td></tr><tr><td>1.</td><td>Vendor’s Area of Core Competence.</td><td></td></tr><tr><td>2.</td><td>Year of Establishment</td><td></td></tr><tr><td>3.</td><td>Power Supply Design/Test Capability.
(List of Design and fabrication Tools)</td><td></td></tr><tr><td>4.</td><td>ISRO qualified PCB/MLB Fabrication.
(Name/Address of External Tie-Up)</td><td></td></tr><tr><td>5.</td><td>Package Design And Fabrication.
(In-House / Address of External Tie-Up)</td><td></td></tr><tr><td>6.</td><td>In-house infrastructure details. (Area, Test facility etc.)</td><td></td></tr><tr><td>7.</td><td>Details of Customer Base In India.</td><td></td></tr></table></td><td></td></tr>
<tr><td>C2.2</td><td>Vendor should support any rework or re-testing for any deviations and non-conformances that may occur during the ground storage requirement as specified in R&QA section.</td><td></td></tr>
<tr><td colspan="3">C3: Bid Evaluation Process and Criteria</td></tr>
<tr><td>C3.1</td><td>(1) Technical Bid Evaluation: -
The technical expert team of SAC shall review the technical-offer and statement of compliance from the vendor to assess the compliance against RFP technical requirements. SAC may hold detailed technical discussions with the vendor if felt necessary. In the process vendor may have to make a technical-presentation to expert committee at SAC.
Based on the compliance against the RFP requirements vendor shall be shortlisted for further process.
(2) Commercial bid evaluation & evaluation of Lowest offer:
The technically compliant offers shall be eligible for consideration for price-bid opening subject to compliance to commercial terms and conditions as per tender. Lowest technically suitable offer shall be evaluated based on ‘comprehensive sum’ of all applicable line items of EPCs to meet the RFP deliverables.</td><td></td></tr>
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<table>
<tr><td>Sr. No.</td><td>RFP REQUIRMENTS</td><td>Compliance</td></tr>
<tr><td colspan="3">EXHIBIT-D: Deliverables, Quantities, Schedule, and Warranty.</td></tr>
<tr><td colspan="3">D1: Deliverables:
Vendor shall submit their offers for following Quantity as mentioned in Table-D1.1. The delivery schedule is given in D2.1. One set of electrical Test Jigs including TC & TM emulator and environmental test jigs shall be shipped to SAC along with the deliverable EPC.</td></tr>
<tr><td>D1.1</td><td>Hardware Delivery
Vendor shall submit their offers for following Quantity as mentioned in Table-D1.1. Vendor has to deliver fabricated and tested EPCs to SAC stores after the review and acceptance of the test results by SAC.
Table D1.1 EPC Quantities
<table><tr><th>Sr.no.</th><th>Quantity</th><th>Numbers for Additional PFM test charge on FM unit</th></tr><tr><td>Type-1</td><td>6</td><td>01 (out of Six)</td></tr></table>
✓ However, vendor shall quote as per requested slabs.
✓ Depending upon requirements SAC has right to place PO of EPC in any slab
✓ FM units with additional PFM test as per QA annexure of R & QA section, will be considered as PFM unit.
✓ In case of multiple vendors qualifying for tender, order will be placed to one party only based on lowest –technically suitable quote.</td><td></td></tr>
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<table>
<tr><td>Sr. No.</td><td>RFP REQUIRMENTS</td><td>Compliance</td></tr>
<tr><td>D1.2</td><td>Documents
Table D1.2<table><tr><th>Sr. No.</th><th>Documents to be provided by vendor during stages of realization of PFM/FM EPCs</th></tr><tr><td>1</td><td>Procurement specifications of materials etc.</td></tr><tr><td>2</td><td>Test jig drawings in CAD format.</td></tr><tr><td>3</td><td>Final PID and test plan document</td></tr><tr><td>4</td><td>Performance results and environment test reports of all units. The results to be provided in Excel spreadsheets and also in softcopy and as bound hardcopies.</td></tr></table>Table D1.3<table><tr><td>Sr. No.</td><td>Documents to be provided by Vendor along with deliverables</td></tr><tr><td>1</td><td>Detailed test report of all deliverable PFM & FM EPCs.</td></tr><tr><td>2</td><td>Certificate of compliance for all deliverable EPCs.</td></tr><tr><td>3</td><td>Copy of failure/deviation analysis reports, if any.</td></tr><tr><td>4</td><td>.Circuit drawing and interface details of test jig</td></tr><tr><td>5.</td><td>All documents as per R & QA annexure</td></tr></table>Table D1.4<table><tr><td>Sr. No.</td><td>List of Documents to be provided by SAC to Vendor</td></tr><tr><td>1.</td><td>All ISRO guideline ISRO –PAX -300 for FM fabrication.</td></tr><tr><td>2.</td><td>Vendor will be given photo films/artworks/masks for bare PCB fabrication.</td></tr><tr><td>3.</td><td>SAC approved package drawing of EPC in CAD format.</td></tr><tr><td>4.</td><td>SAC approved fabrication sequence</td></tr></table></td><td></td></tr>
<tr><td colspan="3">D2 Delivery Schedule & Free Issue Material (FIM)</td></tr>
<tr><td>D2 .1</td><td>Delivery Schedule for PFM<table><tr><th>Sr. No.</th><th>Milestones</th><th>Delivery Schedule of EPCs for Batch -1</th><th>Remark / Responsibility</th></tr><tr><td>1</td><td>BG submission for FIM, collection of schematic and Approved drawing set from SAC</td><td>T1= T0+2 weeks</td><td>Vendor</td></tr><tr><td>2</td><td>FIM submission</td><td>T2= T1+ 2 weeks</td><td>SAC</td></tr></table></td><td></td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>RFP REQUIRMENTS</th><th>Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>3</td><td>PFM EPC</td><td>T3= T2+4 months.</td><td>Vendor</td></tr>
<tr><td>4</td><td>FM EPCs (Qty. as per PO)</td><td>T4= T3+ 5 # months</td><td>Vendor</td></tr>
</table>
Vendor shall provide BG within 2 weeks after PO placement against the FIM for PFM.
T0= Indicates the date of purchase order placement
#Clearance for LP/CC/RS process for FM EPCs (Sr. No.4) will be given after delivery & acceptance of PFM unit.
For LD calculation following guidelines will be followed;
T0 will be referred for LD calculation.
In case SAC is not able to provide FIMs within stipulated time, then Last FIM issue date will be referred for LD calculation.
</td><td></td></tr>
<tr><td>D2.2</td><td>Free Issue Material (FIM)</td><td></td></tr>
<tr><td></td><td>
The indicative list of free issue material as per Exhibit-G and estimated cost is as tabulated below. The lists are tentative and subject to 20% increment or decrement in total quantity.
Typical Cost Value of Free Issue Material FIM per EPC :
<table>
<tr><th>SN</th><th>FIM cost per unit (Lakh)</th><th>Quantity</th><th>Total FIM Cost (Lakh)</th></tr>
<tr><td>1</td><td>17.66</td><td>06</td><td>105.96</td></tr>
</table>

Vendor shall execute bank guarantee against free issue material delivered to them, as per Department of Space purchase rules and procedure.
The Bank Guarantee submitted against FIMs shall be valid until delivery and acceptance of the ordered products against respective phases.

</td><td></td></tr>
<tr><td colspan="2">D3: Warranty
(a) The units supplied here upon shall be free from any defects in material or workmanship and in accordance with applicable specifications and drawings.
(b) This warranty shall run for a period of TWO years from the date of final acceptance of supplied units by SAC/ISRO.</td><td></td></tr>
<tr><td colspan="3">EXHIBIT-E: Summary of Responsibilities of SAC & Vendor.</td></tr>
<tr><td colspan="3">E1: Responsibilities of SAC</td></tr>
<tr><td>E1.1</td><td>Provide complete circuit schematic, list of components, DXF/ Gerber file, Mechanical fabrication, and assembly drawings.</td><td></td></tr>
</table>

Sr. No.	RFP REQUIRMENTS	Compliance
E1.2	SAC will issue the "Flight Quality" components as "Free Issue Material" (FIM) to the vendor as given in Exhibit "G".	
E1.3	Tentative Test plan / test procedures will be provided.	
E1.4	ISRO guidelines and relevant procedures.	
E1.5	SAC may provide the electrical performance results of the circuit proposed for the fabrication under this indent	
E1.6	Review the procurement specifications generated by vendor for parts and fabrication materials other than the free issue materials and give clearance for the procurement of components.	
E1.7	Review and approve the test jig circuits and test setups prepared by vendor for the functional testing and screening of the EPCs.	
E1.8	Review and approval of Process Identification Document.	
E1.9	Review and approve agreed test procedure document.	
E1.10	Review the test results of PFM/FM units and give clearance for LP/CC/RS.	
E1.11	Audit of manufacturing activity of card wiring, packaging etc.	
E1.12	Review the T&E test results of FM EPCs and give clearance for shipment.	
E2: Responsibilities of Vendor		
E2.1	All the fabrication materials and mechanical parts shall be procured by Vendor as per details given in R&QA section. Strict QA guideline for procurement of material has to be followed and screening results of these components has to be submitted to SAC for analysis.	
E2.2	Generate the procurement specifications as per QA requirements and obtain approval from SAC for all procurement specifications before placement of purchase orders.	
E2.3	Fabrication of bare PCB and batch acceptance report shall be approved by SAC.	
E2.4	Fabrication of all magnetic coils and verification for turns, inductance value etc.	
E2.5	Fabrication of mechanical packages for PFM/FM EPCs. Lot acceptance test reports for packages are required to be approved by SAC before using the packages for fabrication.	
E2.6	Development and fabrication of jigs for connectors, component soldering and PCB card level testing and test setups for T&E of EPCs for PFM/FM. Test jigs and setups are required to be approved by SAC before its use.	
E2.7	Generate fabrication Process Identification Document (PIDs) for all the fabrication activities as per ISRO PAX 300 and take the approval from SAC.	
E2.8	Generate test document and are required to be approved by SAC.	
E2.9	Incoming inspection of components including PCBs and fabrication materials like components, solder, flux, epoxy etc. Apart from environmental controls of temperature and humidity, the electronic storage area shall meet class 100,000 cleanliness requirements as a minimum and shall have all the ESD safety precautions implemented. The work area shall meet the requirements of ISRO-PAX-300.	
E2.10	Fabrication of PFM/FM EPCs and testing as per Test Plan given under R&QA requirements.	
E2.11	Development and fabrication of jigs for components mountings and to take	

Sr. No.	RFP REQUIRMENTS	Compliance
	out signals from TBD pads for testing and test setups for the testing of EPCs for FM. Fabrication of the required handling fixtures, jigs etc. in adequate numbers necessary for performing all the internal fabrication and testing. The fabrication drawings for these have to be generated by the vendor.	
E2.12	Fabrication of PCBs for FM EPCs as per the component placement diagrams and layout provided.	
E2.13	Fabrication of FM EPCs and testing as per the Test Plan given under R&QA requirements.	
E2.14	Delivery of EPCs to SAC along with test data as per contract. The test data should also be supplied in soft form and in a format which facilitates quick review.	
E2.15	Complete the actions arising out of non-conformances at various stages to the satisfaction of SAC. It will be vendor's responsibility to obtain the necessary approvals/clearances from SAC at every stage.	

EXHIBIT – F Electrical and Mechanical specifications

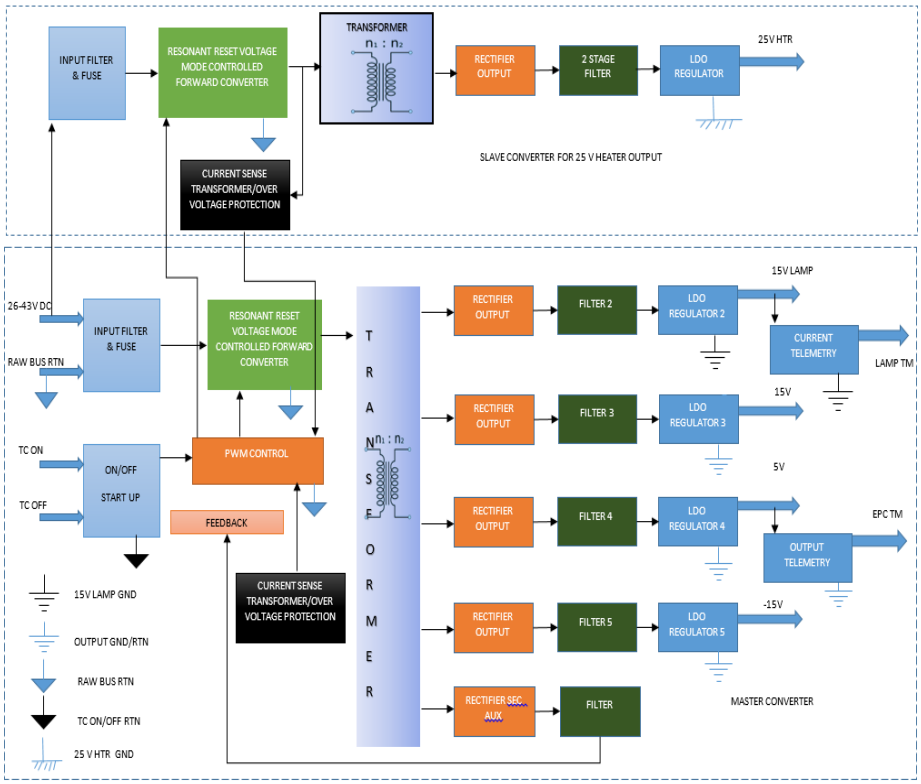
<table>
<tr><th>Sr No.</th><th>RFP Requirement</th><th>Compliance</th></tr>
<tr><td colspan="2">F1: EPC Introduction
The Electronic Power Conditioners are required to provide DC power at required supply voltages to multiple RF subsystems. EPC is operating from Raw bus voltage variation of +26V to +42V with all the required compatible interfaces with spacecraft bus and tele-command/telemetry. EPC shall meet all the performance requirements when supplied with a primary DC input voltage from spacecraft bus, in the range of input Raw bus voltages, and under different environmental conditions as indicated in this document.</td><td></td></tr>
<tr><td>F1.1</td><td>EPC Configuration:
Single EPC package contains two identical PCBs for Main and Redundant configuration
Table no F1.1
<table>
<tr><th>Sr.no.</th><th>EPC package</th><th>No. of PCBs in a package</th></tr>
<tr><td>1</td><td>Vertical mount mechanical package</td><td>Two PCBs (Power+Bleeder)</td></tr>
</table></td><td></td></tr>
<tr><td>F1.2</td><td>EPC Block diagram:
 

Fig: F1.1 Block schematic of EPC</td><td></td></tr>
<tr><td>F1.3</td><td>Electrical specifications</td><td></td></tr>
</table>

Sr No.	RFP Requirement	Compliance

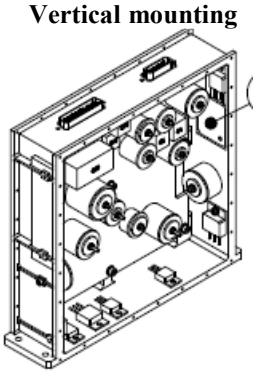
No	Specifications									
1	Input Voltage	26 to 43V								
2	EPC output voltages	O / P 1		O / P 2		O / P 3		O/P 4		O/P 5	
		Vo 1	Io1 max/ min	Vo2	Io2 max /min	Vo3	Io3 max /min	Vo 4	Io 4 max /min	Vo5	Io5 max/ min
		25 V	1750mA / No Load	+15V Lamp	500mA/ No Load	+15V	880mA / 370mA	-15V	160mA / 50mA	5V	850mA/ 670mA
	Nominal load current		1 A (57% duty)		310 mA		420mA		50mA		580mA
3	Line Regulation	<10%		<0.5%		<0.5%		<0.5%		<0.5%	
4	Load Regulation	<10%		<0.5% (over steady-state range: 120-300mA)		<0.5%		<0.5%		<1%	
5	Temperature Regulation	<10%		<1%		<1%		<1%		<1%	
6	Ripple	<2.5Vp-p		<5mVrms		<5mVrms		<5mVrms		<5mVrms	
7	Spikes	<2.5Vp-p		<50mVp-p		<50mVp-p		<50mVp-p		<50mVp-p	
8	Initial Setting	<10%		<50mV (at specified steady-state current & ambient temperature)		<1%		<1%		<1%	
	Capacitive loading	0.5uF		30uF		65uF		60uF		150uF	
9	No of O/p pins	4		2		4		2		2	
10	Isolation			Return of i/p & all the o/p voltages are isolated. +15V lamp output ground is isolated from all other outputs. +25V heater output ground is isolated from all other outputs. TC ON/OFF return is isolated from all other grounds, however at time of integration TC ON/OFF return to be connected to raw bus return.							

11	Input / Output Interface		Input Connector:15 Pin Std. D-type Plug Connector (Primary Input includes raw bus, TC on/off & return) Output Connector:25 Pin Std. D-type Plug Connector (Secondary Output includes 3 TMs live & return)
12	Tele-Command		26V - 42V HIGH LEVEL 128mS Pulse to turn ON/OFF
13	Noise Immunity		TC interface should have noise immunity to signals with 28V amplitude and strobe duration of up to 5 ms
14	Telemetry		Digital status monitoring interface Power ON (5V)/OFF (0V) status Internal temperature monitoring NTC thermistor (10k) 2 wire. CW 15V lamp current telemetry: 0 to 5V
15	Operating Temperature		-5^0C to 15^0C -25^0C cold turn on: EPC should turn "ON" and "OFF" without any damage at -25 ºC after stabilization. However, the unit need not to meet all the performance parameter but the output voltage should maintain the soft-start and voltage regulation within 10 % at -25ºC.

Note:-

(a) Minor change in above specification may be anticipated , however it will be informed at the time of execution.

<table>
<tr><th>Sr No.</th><th>RFP Requirement</th><th>Compliance</th></tr>
<tr><td></td><td>(b) Output voltage at nominal load, nominal input voltage and ambient temperature shall be considered as the reference measurement for all regulation calculations.</td><td></td></tr>
<tr><td>F1.4</td><td>Mechanical Details of EPC

Table-F1.3: Mechanical Details of EPC
<table>
<tr><td>1</td><td>PCB Size</td><td>165 X 165 X 2.4 mm³ (8-Layer)
37 x 28 x 1.6 mm³ (6-layer)</td></tr>
<tr><td></td><td>PCB material</td><td>FR4</td></tr>
<tr><td>1</td><td>Package Material</td><td>Aluminum Alloy 6061T651</td></tr>
<tr><td>2</td><td>Package Size (Max)</td><td>203 X 189 X 52 mm³</td></tr>
<tr><td>3</td><td>Package Mass (Max)</td><td>~1.6 Kg</td></tr>
<tr><td>4</td><td>Surface treatment</td><td>Black Anodizing / Thermal paint on all surfaces with masking (Bottom mounting surface, lug area etc.) as per approved drawing</td></tr>
<tr><td>5</td><td>Package configuration:</td><td>Vertical mounting
 
Vertical Mounting configuration, Single package. subminiaturized D-type connecters shall be at the top-side of the EPC.</td></tr>
</table></td><td></td></tr>
</table>

Sr No.	RFP Requirement	Compliance

Exhibit G: Free Issue Material

The following table shows the type of components which will be used in EPC. The Bill of Materials (BOM) will be given at the time of order:

G1.1

Component Type	Quantity/ EPC (2 PCBs)
Inductor MPP cores	15
Transformer cores	5
D-sub connectors 15 Pin, 25 pin	2
SMD Diodes	26
Transistors/ MOSFETS	13
Fuse	2
16-pin DIP IC	6
16-pin CFP IC	2
8-pin DIP IC	3
LCC6 package IC	2
10-pin CFP IC	1
SMD resistors	125
SMD capacitors	85
Leaded Resistors	14
Leaded capacitors	7
CNC/CH style capacitors	7

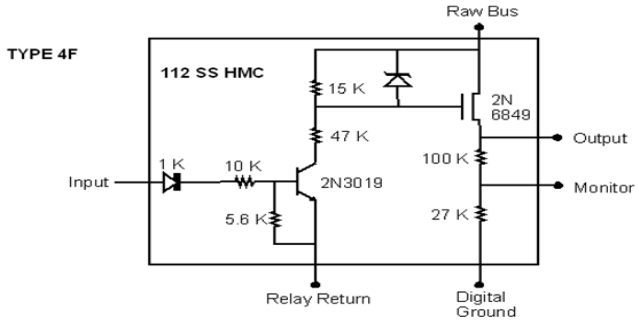
Note: FIM list is tentative and there may be minor modifications in actual FIM (Two PCBs will form one EPC housed in single mechanical package)

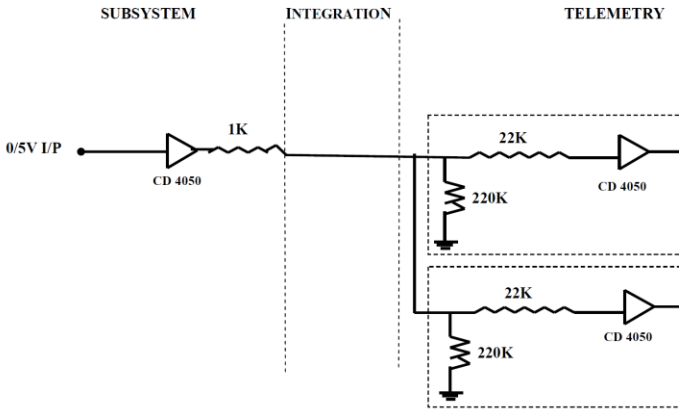
Sr No.	RFP Requirement	Compliance
	Annexure - 1 Typical general purpose fabrication Material to be procured by vendor	

Sr. No.	Material	Part Description	Vendor
1	Araldite	AV138, HV998	
2	Chotherm	(0.5mm, 1.2mm) 62-50-080-1671 62-60-0808/0810-1671 62-15-0808/0810-1671	Chomerics
3	Kapton Tape	3M5419	3M
4	Lacing thread	M43435-1B-BLK	Wirenetics
	PTFE tape		
5	Potting Compound	RTV 3145	Dow Corning
6	28, 26, 22, 20, 34 AWG	ENAMELED COPPER WIRE	MWS wire industries, Sanghavi Aerospace
7	Kynar Sleeves -	1.6mm, 2.4 mm PEP 1000	P.E.P. Charles Limpens Pvt Ltd.
8	Eco bonding	Stycast 2850 & Catalyst 24 LV	Emerson and Curing
9	Conformal Coating	CE-1155 (CE1155(Part-A) & CE-1155 (Part-B)	Cytec
		Thinner CONAP Solvent (S-8)	
10	Mechanical parts	Slotted CH head screw, SP washer, socket head cap screw, slotted head screw etc.	SSK material
11	Tantalum Sheets	Radiation Shielding in accordance with SAC QA guideline with required size and thickness	
12	Thermal Epoxy	H-74	
13	FR4 Spacers	Spacers for Coil Mounting	

<table>
<tr><th>Sr No.</th><th>RFP Requirement</th><th>Compliance</th></tr>
<tr><td></td><td>Annexure-2 Guidelines for TC/TM test jig
Guidelines for TC TM Test-jig are as followed: -

Vendor needs to realize appropriate EPC Test Jig for emulating TC & TM functions, for internal use and for delivery along with deliverable EPCs

<u>Note:</u> Appropriate protections should be provided such that any failure in TC circuit or in Test-Jig should not impact EPC functionality or should not result into excessive loading / tripping of EPC.</td><td></td></tr>
<tr><td>1</td><td>● Electrical Interface with EPC: It shall have tele-command and telemetry interface for EPCs, similar to the space-craft side interfaces as given below: -
 

Tele-command Interface Block Diagram
 

EPC ON/OFF Telemetry Interface Block Diagram

<u>Current Telemetry (+15V lamp) to be monitored for low load-full load current ranges in 50mA steps.</u>

TC Interface shall include the circuit as given in above figure OR equivalent circuit to be applied.</td><td></td></tr>
<tr><td>2</td><td>Below are suggested modes:

<table>
<tr><th>Switch No</th><th>Pulse width in ms</th><th>Nomenclature</th></tr>
<tr><td>SW 1</td><td>128</td><td>128 ms TC-ON Pulse</td></tr>
<tr><td>SW 2</td><td>128</td><td>128 ms TC-OFF Pulse</td></tr>
<tr><td>SW 3</td><td>5</td><td>5 ms TC-ON Pulse</td></tr>
<tr><td>SW 4</td><td>5</td><td>5 ms TC-OFF Pulse</td></tr>
</table></td><td></td></tr>
</table>

Sr No.	RFP Requirement	Compliance
	Usage related provisions: Manual triggering of any desired telecommand with suitable display/indication for confirmation shall be provided. Provision for measurement of all TM lines coming from EPC. The Jig supply and EPC Bus input shall always be kept separate. Delivery shall be made along with design details, drawings, schematic & layouts, BoM, and realization details.	

Annexure - 3 NON-DISCLOSURE UNDERTAKING

NON-DISCLOSURE UNDERTAKING

This affidavit is to be made on Judiciary/ Non-Judiciary Stamp paper of Rs.

and to be attested by 1st class Magistrate etc.

We, (M/S _____), hereinafter called the Vendor, fully understand and accept that Document No. : SAC/GYT/FEB/2020/EPC entitled **"Request For Proposal For Fabrication, Testing And Delivery Of Space Qualified Electronic Power Conditioners (EPCS)"** consisting of technical information and drawings related to fabrication and testing of electronic hardware, is the exclusive property and Copyright of "Space Applications Centre (ISRO), Ahmedabad-380015, Department of Space, Government of India", hereinafter called SAC.

We, the Vendor, further undertake and guarantee that the contents of the said "Request for Proposal" (RFP) or any part thereof, including documents and drawings appertaining thereto, shall not be used for any purpose other than the sole purpose of preparation and submission to SAC of technical and commercial proposals in response to the said "Request for Proposal". In the event of our proposal being accepted and an order being awarded by SAC to us, we undertake to use the said RFP and associated documents and drawings, strictly in compliance with the terms and conditions of such contract.

We further accept and agree that any changes carried out in the design, drawings or documents, whether by us, M/s _____ or by SAC at any time, shall be the exclusive property and copyright of SAC.

We further undertake and assure that we shall not make the RFP or any part thereof, available to any third party for any reason, without first obtaining written permission from SAC. All the above clauses, terms & conditions applicable to the Vendor M/s _____, will be equally applicable to any such third party, and we (Vendor) hereby undertake responsibility for compliance with the same.

(Authorised Signatory)

Designation

Part 2: R & QA specifications discrete EPC fabrication, assembly & TESTING

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td>1.0</td><td>TRODUCTION:
This section describes the Reliability and Quality Assurance requirements to be followed by Vendor during fabrication, assembly and testing of ordered subsystems.
Mandatory requirements: It is mandatory that ISRO qualified PCB / MIC / Duroid (whichever applicable) fabrication and assembly process line of the vendor including fabricator & inspector shall be used for fabrication of ordered units. Necessary certificate shall be attached along with the quote. SAC may visit the vendor facility to access their capability after receiving the quote.
Vendor shall have capability in terms of SAC/ISRO qualified fabrication, test and storage facilities as well as necessary technical expertise to build, optimize, test and deliver the high reliability product.</td><td></td></tr>
<tr><td>2.0</td><td>APPLICABLE DOCUMENTS:
Following reference documents are applicable during realization of the hardware.
<table><tr><td>ISRO-PAS-100
Issue-3 Nov 2012</td><td>Non-conformance control requirements for ISRO projects</td></tr><tr><td>ISRO-PAS-201
Issue-3 Nov 2012</td><td>Failure Reporting, Analysis and corrective Action procedures</td></tr><tr><td>ISRO-PAS-202
Issue-2 Aug 2014</td><td>Environmental Test Specification Requirements for ISRO Space Craft.</td></tr><tr><td>ISRO-PAS-207</td><td>Storage, Handling and Transportation requirements for Electronic Hardware</td></tr><tr><td>ISRO-PAX-300
Issue-5, Nov 2012</td><td>Workmanship Standards for the Fabrication of Electronic Packages</td></tr><tr><td>MIL-PRF-19500M</td><td>Performance specifications for Semi-conductor devices</td></tr><tr><td>ISRO-PAS-502</td><td>Procurement Specifications for Austenitic stainless steel Bolts and Screws</td></tr></table></td><td></td></tr>
</table>

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
3.0	**RELIABILITY:** The unit is designed and qualified by SAC, for use in on board communication satellites with a minimum design life of 15 years. **Reliability Analysis:** Electrical, Mechanical & thermal design is by SAC, hence all reliability analysis will be carried out by SAC.	
3.1	**LIFE:** The unit shall meet all the fabrication requirements for use on-board spacecraft with a minimum life of 15 years. Additionally, unit shall be capable of meeting all the functional requirements at various stages of spacecraft assembly and storage as follows: 3-year storage life at various levels of spacecraft assembly 5-year in controlled environmental conditions. The vendor shall follow the SAC recommended method for storage and re-test criteria, in case of longer storage.	
3.2	**OPERATING CONDITION FOR ACTIVE COMPONENTS:** The electrical designs are made compliant to the SAC derating requirements. During optimization the electrical operating conditions of active devices shall be selected such that junction/ channel temperatures of all solid-state devices shall not exceed +110ºC under nominal operating and worst case environmental conditions.	
4.0	**ENVIRONMENTAL SPECIFICATIONS**	
4.1	**NON-OPERATING ENVIRONMENT:** The units shall be capable of withstanding following environmental conditions: Temp. Range : - 40ºC to +60ºC Pressure : Ambient and hard vacuum better than 10^{-6} torr. Relative Humidity : Up to 95% without condensation of water at +40ºC (Applicable for storage on ground only)	
4.2	**OPERATING ENVIRONMENT:** The unit shall meet all the performance requirements as given in electrical specifications under the following environmental conditions:	

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td></td><td>
a) Temp. Range:
i) FM : -5ºC to +15ºC
ii) PFM: -10ºC to +20ºC

b) Pressure: The units shall be capable of operating and compliant to these specifications at ambient pressure as well as vacuum level of 10^{-5} torr and hard vacuum of the order of 10^{-13} torr.

c) Turn On : -25 ºC

Note:
1. All temperatures are referred to the base plate. Temperature up to +60ºC of base plate should not affect the life, operation and performance of the unit.
2. The above temperature limits may be modified at the time of testing.

Table-1: Non-operating, Operating and Turn ON Temperature
<table>
<tr><td rowspan="2">Non-Operating</td><td colspan="2">Operating Temperature</td><td rowspan="2">Turn ON</td></tr>
<tr><td>QM / PFM</td><td>FM</td></tr>
<tr><td>- 40 to +60°C</td><td>- 10 to +20°C</td><td>- 5 to +15°C</td><td>- 25 °C</td></tr>
</table>
</td><td></td></tr>
<tr><td>4.3</td><td>
EMI / EMC:

EMI / EMC requirements are shown in Table-2 and Annexure-4. Unit shall meet the requirements.
</td><td></td></tr>
<tr><td>4.4</td><td>
SPACE RADIATION:

The unit shall operate without any degradation in performance or life for the following radiation environment:

a) 1.5 X 10^{07} Rads Ionising dose absorbed in silicon (TID).

b) Parts shall be ELDRS free

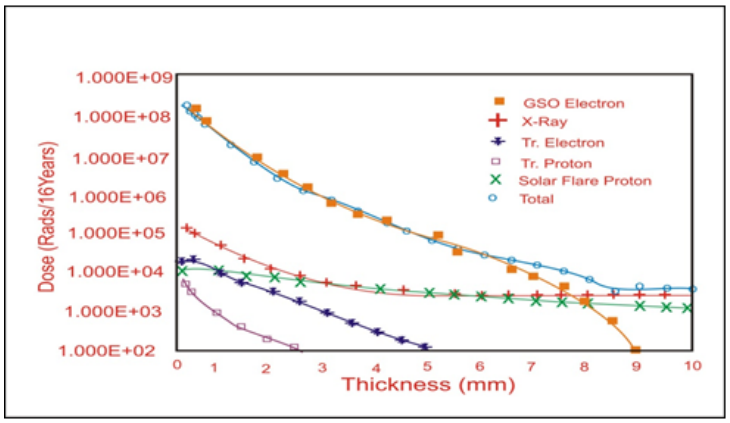
c) 6.0 X 10^{14} elec./cm^2 (3 MeV bulk damage equivalent)

d) Immunity against SEE / SEL / SEU (Single Event Effect / Single Event Latch-Up/ Single Event Upset): LET 80 MeV /mg/cm^2

e) Immunity against SEGR/SEB up to LET of 60 Me V /mg/cm^2.

f) It is desirable that devices shall have SEU LET threshold greater than 40 MeV/mg/cm^2. If low SEU threshold devices are used proper mitigation, technique shall be implemented and analysed.

Localized shielding requirements for TID wherever applicable are defined and applicable drawings are supplied. Any modification in package design may result
</td><td></td></tr>
</table>

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	in modification of these local shielding requirements. The components supplied by SAC are selected for compliance to SEE.  Figure-1: Dose at center of spherical aluminium shield Vendor shall carryout radiation shielding as per SAC drawing.	
5.0	**PARTS:**	
5.1	**ELECTRONIC PARTS:** **Quality specifications of parts (for PFM/FM):** ***All electronics parts are FIM, hence quality specifications of parts are internal to SAC.*** ▪ **Usage of parts for PFM/FM:** ○ Vendor shall ensure that all the parts and fabricated hardware are stored under controlled environment in a Bonded-Store till their actual use as per procedure outlined in ISRO-PAS-207. ○ Parts exceeding usage validity date (in case of FIM) may be submitted for approval of re-lifing as per SAC guidelines. This is subject to SAC approval and shall be used only after approval. ○ Any failure observed in above components during fabrication, optimization and testing shall need to be informed to SAC immediately with condition under which failure observed. If the failure of above components is more than 10% of lot, than same lot shall not be used until further clearance from SAC. ○ These R&QA requirements including part quality level requirement are applicable for any sub-contractors/sub-vendors (if any) also.	
5.2	**MECHANICAL PARTS:** Mechanical packages, boxes, covers, shall be supplied by SAC along with plating/coating.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	All the bought out mechanical components including fasteners, spring, plain washers, nuts etc. shall be procured by the vendor in accordance with procurement specifications approved by SAC. 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.	
6.0	**INSPECTION OF PARTS**	
6.1	**ELECTRONIC PARTS:** **6.1.1 Inspection of Electronic parts received by Indian vendor as FIM from SAC:** 6.1.1.1 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. 6.1.1.2 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 / MIC / Duroid (Lot No, Batch No, Date code etc). For passive chip components serialization is not required. Active components in bare die version, if used, high magnification visual inspection shall be carried out just prior to the assembly in the module. 6.1.1.3 Any defect / damage observed during visual inspection shall be informed to SAC.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	6.1.2 Inspection of EEE parts procured by Indian vendor (as per R&QA requirement defined by SAC): ***Not applicable***	
	6.1.3 Vendor fabricated electronic sub-assemblies/modules:	
	6.1.3.1 All the active modules, if fabricated by vendor, shall be subjected to screening as per a plan mutually agreed between SAC and vendor. Active components procured in bare die version, visual inspection shall be carried out just prior to the assembly in the module. Additionally, if required, SAC may perform the die visual inspection on sample basis.	
	6.1.3.2 CoC of inspected units shall be submitted to SAC for audit as well as along with Data package of unit.	
6.2	**MECHANICAL PARTS:** Mechanical parts shall undergo dimensional measurements and visual inspection including plating / thermal painting workmanship point of view. All inspection and clearance records for the materials shall be maintained by the vendor. Only approved and cleared materials shall be used.	
6.3	**MATERIALS** **Selection:** Vendor shall ensure use of ISRO approved / qualified materials. Procurement of all the mechanical and electronic fabrication materials shall be done as per SAC/ISRO Approved Materials List (DML) and specifications. Materials list consisting of the name of vendor, shelf life, qualifying agency, location of application in the sub-systems shall be submitted to SAC for approval. Any other materials, which are not available in SAC DML, shall first be qualified & cleared by SAC prior to their use. **Acceptance:** Vendor shall review compliance of 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 +125ºC and $1x10^{-6}$ torr pressure for 24 hours. If CoC contains outgassing parameters, then separate test not required. 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	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	nutrients for fungus, shall not be used. ***Pure tin-plated (greater than 97% purity) items are not recommended due to inherent risk of tin-whisker growth***. On receipt of the material, all information inclusive of CoCs, Reports and vendor's verification shall be shared with SAC for review and final approval **<u>Storage & Usage:</u>** All the materials shall be stored as per manufacturer's recommendation. These shall be mandatorily used within their shelf life. **Bare PCB / Duroid / MIC Substrates / Plated / Painted Parts Procurement and Acceptance** Vendor shall procure / use only SAC/ISRO qualified PCBs/patterned MICs/Duroid circuits/plated/painted parts etc. and subject these to SAC/ISRO acceptance plan prior to FM hardware realization. Witness samples shall be prepared for all fabricated batches/lots of Bare PCBs / Duroid / MIC Substrates Plated / Painted mechanical parts. Batch Acceptance testing shall be carried out by SAC-QA approved test plans. Only items from accepted batches will be cleared for use in FM fabrication. QC shall visually examine the actual parts/components at 100% basis and the same shall be cleared based on acceptance/test results of witness sample. Any non-conformances observed on these samples shall be a cause for rejection of fabricated batch/lot and a final disposition shall be taken after discussion with SAC.	
7.0	**PROCESSES:** Vendor shall have own line / facility qualified as per ISRO-PAX-300/305/206, whichever applicable, for electronic fabrication & assembly along with ISRO certified operators & inspectors. ISRO-PAX-300/ISRO-PAX-305/ISRO-PAS-206 workmanship standards shall be followed for the fabrication work for PCB/MIC/HMC respectively. All electronic fabrication processes to be used for FM hardware realization shall be ISRO qualified. Similarly, the processes used for surface treatment of the box like plating and coating in realizing the hardware shall also be ISRO qualified. All the processes shall be carried out in accordance with PIDs reviewed by SAC.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	Vendor is required to provide a list of processes to be used to realize the hardware along with their qualification status, at the time of bid. In case of processes qualified by space agencies other than SAC, process qualification reports shall be submitted to SAC for review. After review of previous qualification plan, SAC will decide for requirement of full qualification / delta qualification of such processes. Process qualification should have a validity throughout the contract period. In case of expiry of certification within contract tenure, vendor shall get him re-certified without proceeding for further work. In case any delta qualification is required during the tenure of contract, the same shall be executed by vendor as per SAC approved qualification plan. The vendor shall provide the list of activities carried out by their sub-contractors (if any) along with the qualification status of the processes concerned, with intimation to SAC for all such cases prior to subcontracting. Fabrication work shall be carried out on ISRO qualified fabrication line by ISRO certified operators. In case, where consistent poor workmanship is observed, Verification of the Process Qualification (VOQ) / operator re-certification shall be carried out at the discretion of SAC.	
7.1	**VERIFICATION OF PROCESS QUALITY (VOPQ):** All the active and passive electronic parts (packaged) including received from SAC as FIM	
8.0	**FABRICATION DOCUMENTATION** **Product Realization Document (PRD):** All the activities involved for realization of FM like 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. **Process Identification Document (PID):** The PID shall include detailed manufacturing process flow chart indicating critical process parameters, inspection checks points, instruments used in	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	manufacturing these components including parameter setting etc. for all stages of fabrication, assembly and testing. Only approved PIDs shall be followed for FM hardware realization. **Fabrication Sequence:** Before start of wiring and assembly activity, a generalized fabrication sequence / flowchart detailing each step of fabrication, functional verification stages, QC and QA inspection/audit etc. shall be prepared by the vendor in consultation with SAC and to be submitted SAC for approval. SAC approved fabrication sequence shall only be implemented. The fabrication / assembly flowchart shall include the following minimum: a) Flow of fabrication activities b) Approved drawing nos. c) Name of processes and PID numbers, as applicable. d) Intermediate functional verification / electrical testing e) Specific instruction for Storage & Handling, including proper ESD protection. f) Permanent/Temporary torque values. g) Fabrication alerts / Specific instructions, caution notes etc., if any. h) Potting/ Dam-fill requirement for components. i) Any environmental test which is a part of fabrication process or for electrical performance check and selection of TBD component values. j) Marking & Identification of unit. k) QA-SAC audit stages 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.	
9.0	**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. Non-destructive bond-pull test (NDT) on gold ribbon shall be carried out on 100 % basis, prior to sealing / cover closing of the units or DT on 11 trial bond at beginning of each shift. All fabrication and inspection work shall be carried out by ISRO certified fabricators / inspectors of vendor. Online inspection of all the fabricated hardware	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	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.	
9.1	**QA AUDIT** The QA audit shall be carried by QA / SAC from both electronic & mechanical point of view at vender along with qualified subcontractors also. Following may be noted. a. The frequency for QA audit shall be decided by SAC and intimated to the Vendor. b. All the fabricated PCBs / Packages shall be first inspected and accepted by QC/QA of the vendor and proper records shall be generated. Audit by QA/SAC shall be carried out on QC accepted hardware. c. Audit by SAC shall cover Electronic & Mechanical aspects for the following, i) Patterned MIC Substrate / PFT / Bare PCB, as applicable ii) Machined package/ cover etc. iii) Surface finishing (plating / painting) iv) Wired Substrate / PCB v) Packaging & fixing of cards/ substrates/ connectors & internal harness vi) Audit for integrated package level. vii) Test setup and unit level testing. d. SAC shall audit/ inspect all related facilities, activities which the vendor will carryout to realize the hardware. Fabrication processes, cleanliness records, QC inspected hardware, process log books/history records, overall documentation, parts & material evaluation/test reports, facilities, procedures followed etc. shall be followed as per ISRO guidelines. e. The audit report will be generated by QA/SAC. The Vendor shall generate close outs on the discrepancies observed during audit by taking appropriate corrective actions and submit the same to SAC for review and acceptance. f. The disposition on the non-conformances on actual hardware, if any, which cannot be closed by the auditee, shall be closed through vendor's NCRB, with approval from SAC, after reviewing the impact of the non-conformance on reliability of the non-conformed hardware for intended use. g. The corrective actions implemented by the vendor shall be documented after necessary review and approval by QA/SAC. h. Based on the compliance to ISRO guidelines and closeouts for audit observations by the vendor, stage wise clearance shall be given by QA/SAC.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	i. **Real-time On-line Audit / Virtual Audit:** Based on confidence level build-up on fabricated hardware, SAC may opt for on-line audit of hardware, provided vendor facility, process line, their quality system, etc. found satisfactory. Vendor shall have the required resources / infrastructure for Real-time On-line Audit, as per SAC-QA requirements.	
10.0	**MARKING AND IDENTIFICATION:** The units shall be identified by assigning unique serial number (may be assigned by SAC) 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, frequency etc. following marking shall appear on each unit. SAC Logo — ISRO Logo 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	**STORAGE & TRANSPORTATION** **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±3ºC) & humidity (45 to 55% 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 including proper ESD protection shall strictly be followed during the storage. Dry N_2 (Nitrogen) purged packaging and storage cabinets shall be used for storage of critical components like MMIC bare dice and oxygen sensitive items like PCBs / mechanical hardware. **TRANSPORTATION** Transport container shall be with damping material inside for the transportation of the unit by air or road without any degradation / damage. Each unit shall be packaged in individual ESD protective packaging. This package shall protect the unit from environmental conditions encountered	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	during transportation, like heat, humidity & dust. This individual container shall then be placed in a transportation container. More than one individual unit may be placed in the transportation container. The transportation container shall protect the units from heat, humidity, dust, mechanical shock & vibrations during transportation. 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"**	
12.0	**MODEL PHILOSOPHY** Following Model shall be fabricated. (a) Proto Flight Model (PFM) (b) Flight Model (FM) **Proto Flight Models (PFM):** Wherever qualification by similarity is established, the first FM unit shall be subjected to PFM level testing. The PFM unit shall undergo testing as per Table-2 at Qualification level severity. However, the duration of the tests shall be restricted to acceptance levels. (**Note**: The PFM unit shall undergo testing as per Table-2 at Qualification level severity. However, the duration of the tests shall be restricted to acceptance levels.)	
12.1	**FLIGHT MODEL** The FM units represent the final electrical & mechanical design and configuration using screened Hi-Rel parts, material and processes of qualified standard and workmanship.	
12.2	**TESTS APPLICABILITY** Applicable tests for PFM and FM are given in Table-2 below.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

Table-2 Tests applicability

Sr. No.	Test	PFM	FM
1	Physical Measurements	X	X
2	Passive Thermal Cycling (Before cover closing)	X	X
2	Visual Inspection	X	X
3	Initial Bench Test (IBT)	X	X
4	Burn-in-Test (168 Hrs)	X	X
5	Post Burn-in electrical tests	X	X
6	EMI / EMC Tests (Annexure-4)		
	1) Radiated Emission	X	X
	2) Radiated Emisssion Notches	X	X
	3) CE-DM, Conducted Emission Differential Mode	X	X
	4) CE-CM, Conducted Emission Common Mode	X	X
	5) CE- Transient (CE-07), Conducted Emission Transient Time domain	X	-
	6) CS-DM-CS01, Conducted Susceptibility Differential Mode 7) CS- DM-CS02, Conducted Susceptibility Differential Mode	X	-
	8) CS-DM-Transient (CS-06),, Conducted Susceptibility Transient, Time Domain	X	-
	9) CS-BCI-CW(CS-114), Conducted Susceptibility-BCI,	X	-
	10) Radiated Susceptibility-Electric Field (RS):	X	-

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

	Sweep frequency mode (CW)		
7	Sine Vibration	X	--
8	Random Vibration	X	X
9	Thermo-Vacuum test	X	X
10	Final Bench Tests (FBT)	X	X
11	Final Visual inspection	X	X

Note:

1. 'X' denotes applicability of test.
2. At the end of each environmental /mechanical test, visual inspection and electrical performance check shall be carried out.
3. For PFM unit, burn-in, temp. Operational and Thermovac testing shall be carried out at qualification temperature level.
4. Vendor shall send the Test data to SAC for review & clearance for next test.
5. Suitable buffer connectors shall be provided to protect input / output connectors of the device 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.

12.3 **FAILURE:**

Deviation from the agreed electrical specifications shall be treated as noncompliance, and may be as cause to reject the units.

Any failure observed at any stage 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 design related. Any modifications required in electrical, mechanical or process related aspects shall be approved by SAC. In case of mechanical or electrical design related failures; a retest plan or modification in the test plan may be necessary. Based on the failure analysis, such retest plan / modified test plan shall be decided and implemented after approval by SAC. This may include re-qualification of process or the unit / Proto flight level testing.

13.0 **TESTS**

All the specification requirements of this RFP shall be verified by testing. Vendor is required to generate test plan and procedure document, clearly showing test

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td></td><td>
set-up and connection details including groundings. This test plan and procedure document shall be sent to SAC for review & clearance. Testing shall be done as per SAC approved test procedure using calibrated test & measuring instruments. It is preferred that cable types used by the vendor for harnessing during testing shall be similar or very close to cable type to be used in harnessing of FM unit in the Space craft.

Acceptance of the test set-up shall be done jointly by SAC and vendor before the testing of the PFM and 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. Grounding scheme will be provided Representatives from SAC may participate in the testing.

Input level required for testing need to be as per specified by the project.

a) Measurement Accuracy:

The measurement accuracy, calibration, etc. of the test instruments shall be verified and the factors shall be stated in the test plan and procedures document submitted by the vendor.

b) Temperature Stabilization:

Temperature stabilization shall be considered achieved when all the temperature readings are within ± 3 °C of the specified temperature for at least three consecutive readings taken at ten minutes intervals.

c) Maximum Allowable Tolerance in Test Conditions:
<table>
<tr><th>Parameter</th><th>Tolerance</th></tr>
<tr><td>Temperature</td><td>±1°C Amb. Pressure
±3°C under vacuum</td></tr>
<tr><td>Atmospheric Pressure
Greater than 0.1 Torr
Below 0.1 Torr</td><td>
±5%
±50%</td></tr>
<tr><td>Relative Humidity</td><td>+5%, –5 %</td></tr>
<tr><td>Random Vibration
Power Spectral Density

Overall grms
Duration</td><td>
±1.5 dB for 20-300 Hz & ±3.0 dB for 300-2000 Hz
±10%
+10% / - 0%</td></tr>
</table>
</td><td></td></tr>
</table>

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	Note: The instruments shall be capable of measuring at least 10 times better than tolerance limits.	
14.0	**TEST CONDITION & DETAILS** Following paragraphs give details of various tests to be performed on ordered units. Electrical test shall be carried out within 96 hours after completion of each environmental test. The test parameters to be measured during / after each of following test are given in Annexure-1 for FM unit. External visual inspection shall be conducted after each environmental test.	
14.1	**PHYSICAL MEASUREMENT** All the units shall be examined for a) Mass & Flatness b) Dimensions	
14.2	**VISUAL INSPECTION**	
14.2.1	**Internal Visual Inspection (Pre-Cap)** After completion of Non-destructive bond-pull test, internal visual inspection of the units shall be carried out to detect any workmanship related deviation and non-conformance w.r.t respective ISRO standards. SAC will participate / audit the pre-cap visual inspection. Vendor shall inform the schedule of sealing / cover closing of units.	
14.2.2	**Passive Thermal Cycling:** All units shall be subjected to passive thermal cycling before cover closing as per following: 1. No. of Cycles: 05 o One cycle: Non-operating temperature limits o Four Cycles: PFM/Qualification temperature limits 2. Dwell Time: 2 Hrs 3. Transition rate: ≤ 2 ^{0}C/Min Detailed internal and external visual inspection shall be carried out after cycling.	
14.2.3	**External Visual Inspection:** All the units shall be examined visually at 10 X magnification before and after each environmental test. The units shall be inspected for surface finish, plating, mechanical and workmanship related defects.	
14.3	**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. Electrical parameters shall be measured as specified.	

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td>14.4</td><td>Burn-In Test
Burn-in shall be carried out at in power 'ON' condition. The duration of Burn-in shall be 168 hrs unit. FM and PFM units shall be subjected to Burn-in test at +50^{0}C and +55^{0}C respectively. Continuous monitoring of DC shall be done during the test. Data log for Time-Temperature shall be kept for verification.</td><td></td></tr>
<tr><td>14.5</td><td>Post Burn-in Electrical Test
This test shall be conducted at ambient temperature. Electrical parameters shall be measured during Post burn-in functional tests.</td><td></td></tr>
<tr><td>14.6</td><td>EMI /EMC Test
The units shall be subjected to EMI / EMC tests as per test applicability shown in Table-2 and Annexure-4. Any additional tests, if required by SAC, shall also be carried out by the vendor. Plots taken during all the tests shall be kept for verification.</td><td></td></tr>
<tr><td>14.7</td><td>Vibration Test:
Sine and Random vibration tests shall be carried out on applicable PFM unit & only Random vibration in all FM units. Visual & electrical measurement shall also be performed after each Random vibration test. Vibration levels given below are tentative. Levels may be changed depending upon mechanical mounting configuration, location and weight of unit. Levels will be finalised at the time of testing.
Vendor shall generate a vibration test report in a standard format, as shown in Annexure-3, which will be sent to SAC for review and acceptance</td><td></td></tr>
<tr><td>14.7.1</td><td>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 120 Hz and drift in pre & post vibration 'Fn' shall be within 10%.
<table>
<tr><th>Frequency (Hz)</th><th>Amplitude</th></tr>
<tr><td>10 - 2000</td><td>0.5 g</td></tr>
<tr><td>Sweep rate</td><td>2 Oct / Minute</td></tr>
</table></td><td></td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td></td><td>
Resonance search success criteria are as under,
i) < 10% in frequency shifts for modes with effective mass >10%
ii) < 20% in amplitude shifts for modes with effective mass >10%
Vibration test sequence:
1. For PFM Unit (all axes) LLS, Sine Vib, LLS, Functional test, LLS Random Vibration, LLS
2. For FM Unit (all axes) LLS Random Vibration, LLS
Vendor shall use valid calibrated torque wrenches for fixture & package mounting.
</td><td></td></tr>
<tr><td>14.7.2</td><td>
Sine vibration
Sinusoidal vibration test shall be conducted on PFM units. The unit shall be in non-operating condition for the duration of vibration test.
Table-3: Sine vibration levels
<table>
<tr><th colspan="2">Normal to mounting plane</th><th colspan="2">Parallel to mounting plane</th></tr>
<tr><th>Frequency (Hz)</th><th>Amplitude</th><th>Frequency (Hz)</th><th>Amplitude</th></tr>
<tr><td>5-20</td><td>12.4 mm (0-peak)</td><td>5-18</td><td>11.5mm(0-peak)</td></tr>
<tr><td>20-70</td><td>20 g</td><td>18-70</td><td>15 g</td></tr>
<tr><td>70-100</td><td>10 g</td><td>70-100</td><td>8 g</td></tr>
<tr><td>Sweep rate</td><td colspan="3">4 oct / min</td></tr>
</table>
</td><td></td></tr>
<tr><td>14.7.3</td><td>
Random Vibration:
Random vibration test shall be conducted on PFM and all FM units as per vibration levels specified below. The unit shall be in non-operating condition.
Table-4: Random vibration levels for PFM
For unit mass > 1 Kg
<table>
<tr><th></th><th colspan="2">Power Spectral density</th></tr>
<tr><th>Frequency (Hz)</th><th>Normal to mounting plane</th><th>Parallel to mounting plane</th></tr>
<tr><td>20-100</td><td>+3dB / oct</td><td>+3dB / oct</td></tr>
<tr><td>100-700</td><td>0.28 g^2 / Hz</td><td>0.1 g^2 / Hz</td></tr>
<tr><td>700-2000</td><td>- 6 dB / oct</td><td>-3 dB / oct</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>QA REQUIRMENTS</th><th>Vendor's Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>Overall</td><td>17.5 grms</td><td>11.8 grms</td></tr>
<tr><td>Duration</td><td colspan="2">1 minutes / axis</td></tr>
</table>
FM 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.

For FM units mass > 1 Kg

:
<table>
<tr><th rowspan="2">Frequency (Hz)</th><th colspan="2">Power spectral density</th></tr>
<tr><th>Normal to mounting plane (z-axis)</th><th>Parallel to mounting plane (X & Y axes)</th></tr>
<tr><td>20-100</td><td>+ 3 dB/octave</td><td>+ 3 dB/octave</td></tr>
<tr><td>100-700</td><td>0.12 g2/Hz</td><td>0.044 g2/Hz</td></tr>
<tr><td>700-2000</td><td>-6 dB/octave</td><td>-3 dB/octave</td></tr>
<tr><td>Overall RMS</td><td>11.7 g</td><td>7.9 g</td></tr>
<tr><td>Duration</td><td>60 sec.</td><td>60 sec.</td></tr>
</table>
(Note: Above levels provided are tentative. These may get changed in case weight & mounting configuration are changed)
</td><td></td></tr>
<tr><td>14.8</td><td>Thermo Vacuum Test:

Unit shall be subjected to Thermo-vacuum testing, under vacuum conditions of 10^{-05} torr or better. The units shall be subjected to the thermo-vacuum cycles as per the profile shown in following figures. The number of cycles shall be minimum five (5).
The first cycle shall consist dwell time of two hours at non-operating temperature. It shall follow demonstration of cold turn-on at -25°C after stabilization of 2 hours at the cold turn-on temperature (-25°C).
The temperature limits for the remaining cycles shall be applicable operating temperature limits as shown in following figures. The first four cycles shall have at least 2 hours of stabilization period in each cold and hot temperatures and detailed measurements shall be carried out at the end of 12 Hr plateus of last cycle shown in the profile.
Measurements during cycles may be limited to monitoring of important parameters for all EPCs. Detailed measurements of parameters as per Annexure-1 shall be carried out at the places marked in cycle. Thermo Vacuum test profiles are shown in Figure-2 and 3.</td><td></td></tr>
</table>

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

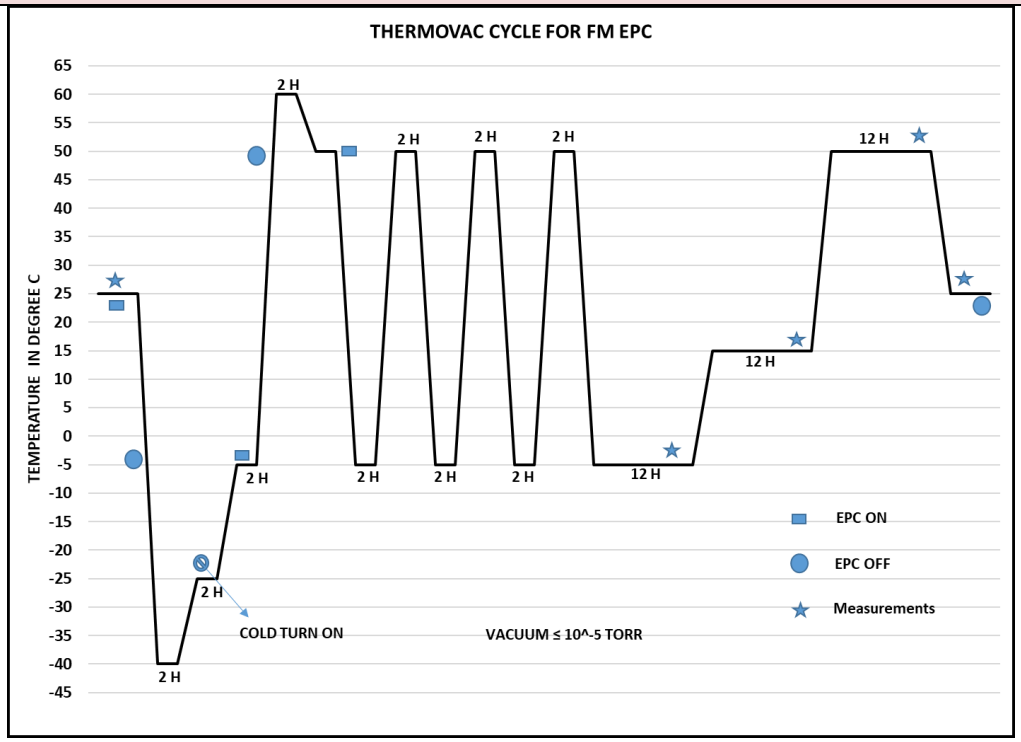


Figure-2: Thermo Vacuum Test Profile for FM EPC

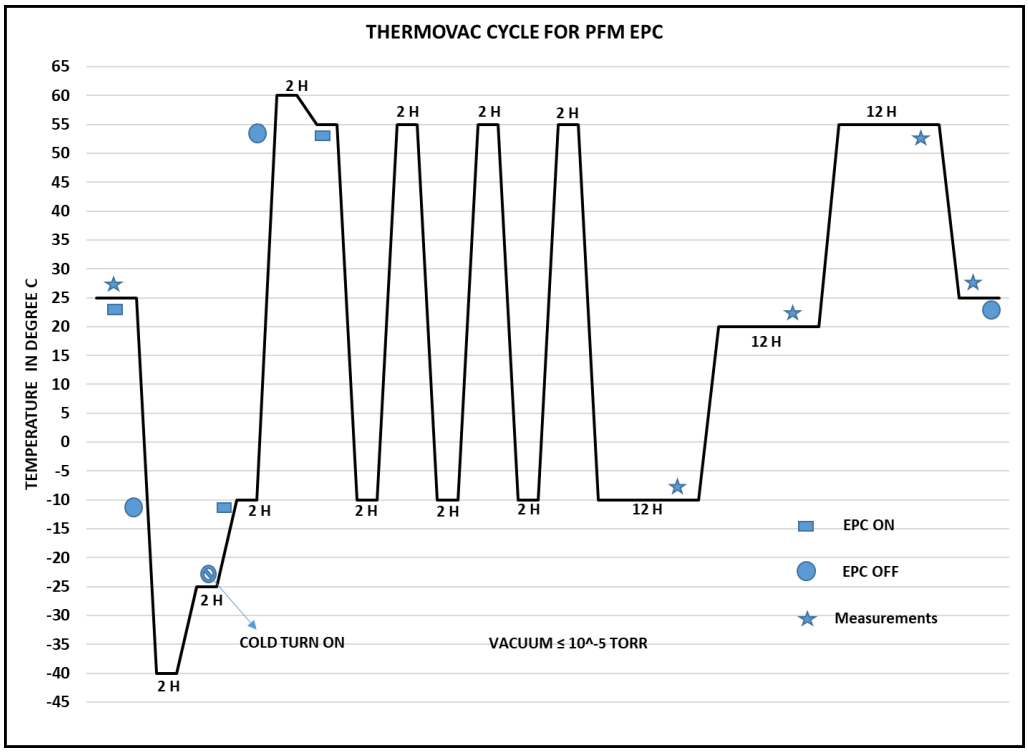


Figure-3: Thermo Vacuum Test Profile for PFM EPCs

Note:
Temp. transition rate: 0.5 °C/min
Vacuum level: Better than 1 X 10^{-05} torr.

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
14.9	**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.	
14.11	**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 tests.	
15.0	**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, shall be reported to SAC immediately with photographs, nature of non-conformance observed, etc. Disposition shall be taken 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. 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.	
16.0	**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.	
17.0	**DOCUMENT TO BE SUPPLIED:**	
17.1	The following documents shall be supplied along with the quote:	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance
	a) Pont by point compliance to all the requirements of this document. b) Details to be provided as per QA check list given in Annexure-2.	
17.2	The following documents shall be supplied: a) Materials & Process List to be used for the fabrication of units, detailing their quality level, procurement specifications, traceability information, out gassing specifications etc. b) CoC, screening (at Vendors / sub-vendors) reports, incoming inspection report, batch acceptance test reports of Parts & Materials c) Record of Bias conditions of identifying the channel / junction temperatures of all the active devices d) Interface control drawing (AutoCAD soft copy) e) Details of design modifications (wherever applicable) with respect to the given details f) Process Identification Document. g) Test procedure documents for Qualification and Acceptance tests with test conditions, procedures, list of equipments and their calibration status, for review & approval by SAC h) Non-conformance management plan i) Configuration change control plan. j) Program management plan	
17.3	Following detailed documents shall be supplied during the program with respect to relevant activity a) Status report for the fabrication activity and test schedule. b) Schedule for Cover closing of the FM units c) Details of test set-up and readiness d) Non-conformance report at agreed intervals e) Failure Report; as and when failure occurs	
17.4	Following detailed documents shall be supplied for each unit **along with deliverables, in soft copy on CD/ DVD**. a) T & E report of each unit containing detailed test results, test history, conformance matrix, TBD values etc. b) CoC of the deliverable units c) CoC materials Including test report d) All fabrication details supplied by SAC for fabrication e) Non- Conformance reports with close-outs.	

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

Annexure-1

TEST MATRIX for PFM and FM

Sr. No.	Electrical Parameters	Initial Bench Test/ Post Burn-In test	Burn –in Test	Post Sine vibration	Post Random vibration	EMI/EMC Test	Thermo-Vacuum Test	Final Bench Test
1.	Input Voltage Range	√	√	√	√	√	√	√
2.	Input Current	√	√	√	√	√	√	√
3.	EPC off state current with raw bus on	√						√
4.	Output Voltage (Heater output at no-load, 10%, 50%, 90%, full load)	√	√	√	√	√	√	√
5.	Output Current Range	√	√	√	√	√	√	√
6.	Efficiency	√			√		√	√
7.	Accuracy in initial setting	√			√		√	√
8.	Load Regulation	√			√		√	√
9.	Line Regulation	√			√		√	√
10.	Cross Regulation	√			√		√	√
11.	Temp. Regulation						√	
12.	Ripple/Spike in time domain	√		√	√	√	√	√
13.	Transient change in output for step load change	√		√	√		√	√

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

14.	Telemetry (EPC-ON/OFF, Current TM at 100mA steps)	√	√	√	√		√	√
15.	Tele command on	√		√	√		√	√
16.	Tele command off	√		√	√		√	√
17.	Output On/Off response	√					√	√
18.	Soft Start capability. Start-up Capture (Rise Time)	√		√	√		√	√
19.	Inrush Current (@Max/Min Load & Max/Min Input)	√						√
20.	Tele command ON/OFF Noise Immunity	√					√	√

Test Matrix may be modified during testing in consultation with the vendor

Annexure-2

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	List each applicable process ISRO qualified at your / sub-vendor's facility, their qualification report & qualification certificate.		
	Process Name	**Facility**	**Certi. No.**
	a) Manufacturing facilities (if applicable): Bare PCB		
	a) Component mounting & Assembly process on PCB		

Sr. No.	QA REQUIRMENTS			Vendor's Compliance
		b) Plating / Surface treatment (type wise)		
	3	List of ISRO certified fabricator and Inspector for PCB attached?		
	4	Details of Test engineer with experience available at the time of bid attached?		
	5	List of Test & Measuring instrument for optimising RF circuits with major specification like frequency range, etc. attached?		
	6	Location of test facilities likely to be used for following tests shall be provided. (whichever applicable)		
		a) Physical Measurements		
		b) Visual Inspection (internal & external)		
		c) Electrical measurements		
		d) Burn-in		
		e) EMI / EMC		
		f) Vibration test (Sine and Random)		
		g) Thermo-Vacuum		

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

Annexure-3

Standard format of vibration & SRS Test Report

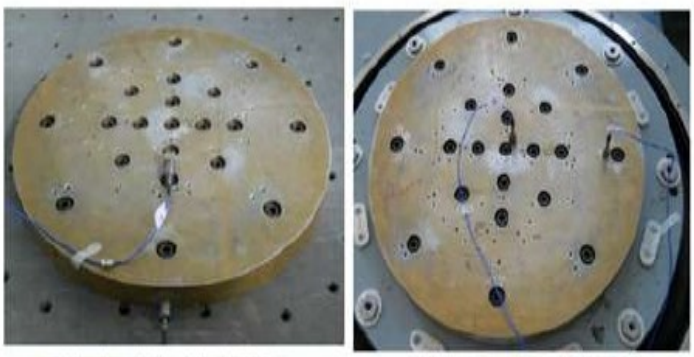
Company Logo	Name & Address of Company/Industry
REPORT No.	DATE

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

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

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 grms	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

Sr. No.	QA REQUIRMENTS	Vendor's Compliance

Annexure-4

EMI/EMC Test Requirements:

Sr. No.	Test Description	Test Specifications	Applicability	
			PFM	FM
1)	Radiated Emissions- Electric Field - (RE)	• 10KHz - 400MHz: 50dBµV/m • 400MHz–18GHz: 50dBµV/m -83dBµV/m	A	A
2)	Radiated Emissions- Electric Field-Notches (RE-Notches)	• Notches shall be defined at the time of testing	A	A
3)	Conducted Emission-Differential Mode (CE-DM) – Power lines (Live and Return)	• 50Hz -1KHz: 100dBµA • 1KHz – 1MHz: 100-40dBµA • 1MHz - 50MHz: 40dBµA	A	A
4)	Conducted Emission-Common Mode (CE-CM) – Power lines (Live and Return)	10KHz -200MHz: 60dBµA	A	A
5)	Conducted Emission –Time domain, Turn ON /OFF Transient (CE- Transient) CE07	• Amplitude:50%-150% Raw bus Voltage • Time: T1(50uS), T2(1mS)	A	NA
6)	Conducted Susceptibility - Sinusoidal, Power Leads	CS-DM-CS01 (50Hz to 150kHz): 1Vrms	A	NA
7)	Conducted Susceptibility Sinusoidal, Power Leads (Note-2)	CS-DM-CS02 (150KHz to 50MHz): 1Vrms	A	NA
8)	Conducted Susceptibility Transient, Power leads	• Epeak = Bus voltage +8Vi.e. 42V+8V=50V	A	NA

Sr. No.	QA REQUIRMENTS				Vendor's Compliance
		(CS-DM-Transient, Time domain) CS06 (Note-1,2)	• Pulse width:10uS ± 20% • Repetition rate: 10PPS • Duration: 5- 15 minutes		
	9)	Conducted Susceptibility-Bulk Cable Injection, only on Power leads (CS-BCI-CW) CS114 (Note-2)	10KHz - 200MHz: 84dBµA	A	NA
	10)	Radiated Susceptibility-Electric Field (RS): Sweep frequency mode (CW)	50MHz to 18GHz: 5V/m	A	NA
	Note-1: Maximum rating of input components of DC-DC converter shall be verified before applying the CS06 spike. Note-2: Parameters and required specifications to be tested during Conducted Susceptibility (CS) test shall be defined by designer.				