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S. H. Kulkarni
29/12/2014

R. H. Kulkarni
11/12/2014

Acronyms


ATP	:	Acceptance Test Procedure
COC	:	Certificate of Compliance
DSP	:	Digital Signal Processor
ECC	:	Equipment Control Cubicle
FO	:	Fiber Optic
IEC	:	International Electro technical commission
LD	:	Liquidated Damage
OEM	:	Original Equipment Manufacturer
QAP	:	Quality Assurance Plan
RHVPS	:	Regulated High Voltage Power Supply
Rx	:	Receiver
SPM	:	Switched Power Module
Tx	:	Transmitter
TC	:	Test certificate
TR	:	Test report
UART	:	Universal Asynchronous Receiver/Transmitter
WDT	:	Watch Dog Timer

Definitions

Customer	:	BARC, Mumbai
Vendor	:	Selected Party

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	ELECTRONICS CORPORATION OF INDIA LIMITED Control and Automation Division	RHVPS Rev.3
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Electronics Corporation of India Limited

(A Government of India Enterprise)

Control and Automation Division (CAD-3 Building)

ECIL Post, Hyderabad-500 062, India.

TEL: 040-2718-2242/6465/6878/2395

Email: gvrao@ecil.co.in; yhemalatha@ecil.co.in

INSTRUCTION SHEET

Instruction to tenders indicating the tender number, last date and time for receipt of tender, place at which the tender can be submitted and the date/time and venue wherein the tenders will be opened.

Tender No. ECIL/PUR/CAD/1964-

- 1.0 Last date for receipt of both part-I up to
(Technical and Commercial bid)
And Part-II (Price bid) of the tender in sealed
Envelopes at the following address:

2015.02.16

Senior Dy. General Manager
(purchase)
Control And Automation Division,
Electronics Corporation of India
Limited, ECIL post,
Hyderabad-500062.

- 2.0 DUE DATE FOR OPENING
OF PART-I OF THE TENDER i.e.,
(Technical and commercial bid)

2015.02.18

- 3.0 Due date for receipt of price Revision, if any, and Opening of part-II (price bid) of the bidder will be decided by the ECIL and the same shall be intimated only to those Bidders whose offers are found acceptable in part-I. The Likely date of opening of Part-II (price bid) will be about one month from the date of opening of part-I.

- 4.0 Venue for opening of the tenders: PURCHASE Section, CAD-3 Building,
ECIL HYDERABAD-500 062

- 5.0 All communications in respect of this tender shall be addressed as indicated in clause 1.0 above.

- 6.0 The vendor shall submit clause wise compliance statement along with the part-I (Technical and commercial bid). Such Bids are only considered for evaluation.

S. A. H. A. U. L. L. A. H.
09-12-2014

Def. P. A. T. H. E. D.
- 9/12/2014

TWO PART TENDER

1. INVITATION TO TENDERER & PRE REQUISITE CONDITIONS

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1.1. Invitation to Tender

The Electronics Corporation of India Limited (A Government of India Enterprise under Department of Atomic Energy) invites sealed tenders for Design, Development, Fabrication, Testing, Supply of supply of 220 Nos. of Switched Power Modules for REGULATED HIGH VOLTAGE POWER SUPPLY as per specifications given in "Section C" of the Tender document. The conditions of contract, which will govern the contract pursuant to the Tender, are as contained in section A of this tender document.

If you are in a position to quote for supply in accordance with the technical specifications indicated in section "C" to this tender document and as per conditions in section A, please submit your offer in a manner and method specified hereinafter.

1.2. Qualifying Requirements

If the tender specifies qualifying requirement, then the Vendor shall submit all supporting documents / information necessary for establishing the qualification of the Vendor along with part-I (Technical & Commercial bid except price) and Part II (commercial Bid) of the tender. Failure to comply with this requirement will lead to rejection of the tender.

1.2.1. Manner and Method for Submission of Offers

- All tenders in response to this invitation shall be submitted in TWO PARTS and in different envelopes. All technical specifications and technical details along with commercial terms and conditions (except price) shall be included only in Part-I of the tender, which is herein after, referred as part-I (Technical and Commercial bid except price). It shall comprise of two sections namely Technical Section and Commercial section and both sections shall be submitted in a single envelope only. Part-II (price bid) comprising of price and quantity schedule of items shall be submitted in a separate envelope. The above two envelopes shall be put in a single envelop and shall be submitted to Sr. Dy. General manager (Purchase), Control and Automation Division (CAD), CAD-3 Building, Electronics corporation of India, ECIL Post, Hyderabad 500 062, India.
- The tender will co-relate the price and quantity schedule of terms in PART-II (Price bid) of the tender with the description of equipment indicated in Part – I (Technical & Commercial bid except price).

1.2.2. Opening of Tenders

Unless otherwise advanced or postponed with advance intimation to the Vendors, Tenders will be opened in two stages at Purchase section, CAD – 3 Building, Electronics Corporation of India Limited, ECIL P.O, Hyderabad-500062 as indicated in the Instruction Sheet of this document.

S. H. Haulah
09-12-2014

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1.2.3. Clarification regarding part-I (technical and commercial bid except price)

Opening Tender Part-I

After opening of the Part - I (Technical & Commercial bid except price) of the tender, if it becomes necessary for ECIL to seek clarification from the Vendors regarding technical and commercial terms and conditions of the tender, the same will be sought from the Vendors. In such an event, the Vendor will:

- Furnish all the technical and commercial information/clarification in the envelope sent for this purpose duly sealed to reach Sr.Deputy General Manager, Purchase, CAD – 3 Building, Electronics Corporation of India Limited, ECIL P.O, Hyderabad-500062 super scribing the ECIL's tender reference and due date and time on or before specified date by the Vendor or his authorized representative. If the technical and commercial clarifications sought for, do not reach on or before the due date and time specified, the tenders are liable to be rejected without any further notice.
- Have an option to modify the price based on the clarification regarding technical and commercial terms and conditions. In case any change in price is effected by the Vendors based on technical and commercial clarification or otherwise, justifications for such changes are to be furnished with the breakup of change in price applicable. However, change/modifications in price should be sent only to the Sr. Dy. General Manager (Purchase), CAD, Electronics Corporation of India Limited, ECIL P.O, Hyderabad-500062, duly sealed and superscripted with the tender number and last date and time for receipt specified therein, to reach on or before such due date and time for its receipt.
- ECIL reserves the right to reject any tender which is not meeting the common commercial terms and conditions proposed by the ECIL, without making any reference to the Vendor.
- All technical and commercial points pertaining to part –I (Technical & Commercial bid except price) of tender shall be discussed and finalized prior to opening of part-II (price bid) and no change in this regard will be accepted after opening of part-II (price bid).

Opening of part-II (price bid)

The part-II bid of only such Vendors whose Part-I bids are found acceptable will be opened. Due date and time for opening of the Part-II will be decided by the ECIL and the same shall be intimated in advance only to such Vendors whose offers are found acceptable in Part-I.

1.3. Criterion for Vendor

Offers of the vendors who meet the following criterion shall only be considered for technical evaluation:

1	Vendor shall have in-house R&D and manufacturing facility for 1.1kV (input) class or above, 100kW (output) or above, IGBT based rectifier-chopper modules/AC drives with DSP controllers. Vendors should have their own testing facilities or access to testing facilities.
2	Vendor shall have in-place certified quality management system (ISO 9001:2008).
3	Vendor shall have a dedicated team to carry out the job.
4	Vendor shall have dedicated QA and QC team to implement the relevant codes and Standards.
6	Vendor shall have demonstrated relevant experience in the similar product in the past. Vendor shall have complied with IEC prescriptions for its products.
7	The vendor shall take the responsibility for PCB assembly in temperature & humidity controlled, ESD protected environment, dust free PCB assembly shop including SMD components mounting and soldering.
8	The vendor shall have In-house PCB designing facilities with latest related softwares. The vendor shall have In-house test facilities and also shall have mechanical design/ drafting workstation with 3D modelling features.
9	The vendor shall be a regular vendor to Government bodies such as DAE, etc.
10	The vendor shall have well equipped receipt quality control methods (Inward material Inspection). The vendor shall have safe and compact storage facility.
11	The vendor shall have in-house facilities of service/repair of hardware and software.
13	The vendor shall have sufficient experience in handling EMI/EMC related issues.
14	Annual Turnover for last three years shall be not less than INR 200 million.
15	Vendor shall furnish copies of purchase orders executed by them (above INR 100 lakhs in a single PO) for similar items supplied in the last recent 3 years.
16	Vendor shall have Audited Balance Sheets and Profit & loss accounts of last 3 years. Vendor shall furnish the same.

Vendor shall submit all the relevant documentary evidence for the above clauses to substantiate their compliance.

1.4. Other Terms & Conditions

1.4.1. EMD

Earnest Money Deposit shall be submitted in the form of Bank guarantee / DD for Rupees Ten Lakhs along with the quotation in a separate envelope.

1.4.2. Terms of Price

Vendor shall quote the prices on FOR-Destination, i.e., to ECIL, Hyderabad for 220 Nos. 110NOs. of SPMs shall be supplied to ECIL, Hyderabad for carrying out integrated testing. After the completion of testing these modules shall be transported to BARC, Mumbai for final Installation and Commissioning. The balance 110 SPMs will be directly transported to BARC, Mumbai.

Excise duty exception certificate will be provided by BARC.

Tender Document for Switched Power Modules (SPMs) of RHVPS Page 9 of 62

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D. K. Ramesh
09-12-2014

1.4.3. Delivery

The delivery of SPMs shall be completed within 6 months for Batch-I (110 SPMs) and another 6 months for Batch-II (110 SPMs) after the supply of Batch-I.

1.4.4. Warranty

36 months from the date of supply of last consignment.

1.4.5. Performance Bank Guarantee

The Vendor shall execute the performance Bank guarantee for 5% of the order value during the Warranty period.

1.4.6. Non-disclosure agreement

The design is the intellectual property of ECIL and the source code either partially or totally should not be utilized by the Vendor without written consent of ECIL. The contract will be pronounced as completed only on submitting as built design documentation to the ECIL.

Confidential Information and Non-disclosure agreement shall be provided on Rs.100/- Non-Judicial Stamp paper. (The format will be provided to successful bidder).

1.4.7. Liquidated Damages Clause

In case of delayed supply of the equipment Liquidated damage at the rate of 0.5% per week of the Purchase Order value subject to a maximum of 5% of the Purchase Order value will be charged if the delay is attributable to Vendor.

However in case of anticipated delay Vendor shall approach ECIL for extension of delivery date with a request for waiver of LD for the extended period.

1.4.8. Risk Purchase Clause

In the event of failure of the vendor to comply with the purchase order terms, ECIL has a right to cancel the order and proceed with an alternative source. In the event of proceeding with such an alternate source, the default vendor shall be liable to bear the extra cost, which may be incurred by ECIL. Such extra cost could be on account of either a higher unit price or any higher rate of foreign exchange conversion rate by such delayed alternative procurement. Recovery of such extra cost would be recovered from the available credit in the account of default vendor by invocation of any guarantees issued in favour of ECIL available.

1.4.9. Dispute Resolution

Any dispute arising out of Contract / Purchase Order or interpretation of any clause or terms and conditions hereof shall be settled through conciliation by both the ECIL and the Vendor / Seller, under the specific provisions of Arbitration and Conciliation Act 1996. Only courts in Ranga Reddy District, Andhra Pradesh have exclusive jurisdiction over this order/contract notwithstanding the claim for concurrent jurisdiction of other courts.

1.4.10. Security Deposit

Security deposit of value 5% of the contract value by way of bank guarantee from any nationalized bank shall be submitted immediately after awarding the contract. This BG shall be valid till the end of the contract.

1.4.11. Short Closure

ECIL reserves the right to accept or reject any offer without assigning any reason whatsoever. The pre-qualified/Unsuccessful tenderers will not have any right to ask ECIL for further details of qualification and verification of other tenderers such as his experience, financial stability and other relevant matter etc., even after the price bid is opened and considered. The vendor will not have any right to question ECIL in considering again the qualification etc. of the tender. Also ECIL reserves the right to split the order to more than one successful tenderers by matching the L1 price if required.

1.5. General Terms & Conditions

The vendor shall be responsible for and shall perform all the tests and inspections. These tests are necessary to assess the required performance of the switched power supply modules as per detailed test procedures and QAP prepared by vendor and approved by the ECIL. The performance of the module shall confirm to the specification. The tests shall be witnessed by ECIL/BARC as per approved Manufacturing & Inspection Plan.

Failure to meet the inspection or test requirements specified herein shall be reported to ECIL and shall be considered as sufficient cause for rejection of particular item.

The vendor shall generate documents for "Acceptance Test Procedure" and "Test Report" having detailed test procedure and test report for the Routine test, functional tests and type tests like environment tests, vibration, Shock & impact, EMI/EMC, Temperature test, Voltage Proof test for enclosure as per given specifications.

1.5.1. Inspection

Mechanical dimensions and electrical wiring shall be inspected and checked for conformance with the relevant drawings. All components used in the modules shall be checked for mechanical and electrical requirements during incoming inspection stage.

1.5.2. Testing

Functional tests shall be carried out under prevalent ambient conditions to check that the switched power supply module conforms to the input output specifications. For this suitable test jigs shall be designed, fabricated and supplied by the vendor for PCBs coming inside the unit and also for Unit testing. The test jigs related to PCBs and SPMs shall be part of contract.

1.5.3. Acceptance

Acceptance of the modules shall be subject to its meeting the specifications and fulfilment of various requirements covered in this document.

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1.5.4. Certification

Three copies of inspection reports and test reports covering all aspects of inspection and testing shall be signed by both the vendor and ECIL before delivery of the modules.

1.6. Inspection and Testing

The switched power supply modules covered by this Contract shall be subjected to inspection and testing. The Vendor shall provide all services to establish and maintain quality of workmanship to ensure the mechanical and electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and modules.

- The Vendor shall perform his internal inspection and testing before offering the switched power modules for ECIL/BARC inspection. Only after ensuring that his inspection and test results are satisfactory, Vendor shall offer these SPMs for ECIL/BARC inspection.
- The minimum inspection requirements for all components and modules shall conform to the design and fabrication requirements. It shall include, if applicable, inspection procedures prescribed by codes and regulations recognized by the governmental/statutory authority having jurisdiction over the installed goods.
- The Vendor shall intimate to the ECIL for the material being ready for testing. Such tests shall be to the Vendor's account. Unless the inspection of the tests is waived, ECIL/BARC shall witness such tests on mutually agreed date.
- ECIL will give notice in writing to the Vendor of any objection to any drawings or any module and workmanship, which in his opinion is not in accordance with the Contract. The Vendor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to ECIL giving reasons therein that no modifications are necessary to comply with the 'Contract'. However, ECIL has the final authority to accept or reject the Vendor's views. The equipment or material after rectification by the Vendor shall be offered to the ECIL/BARC for his final inspection and acceptance without any additional cost to ECIL.
- When the factory tests have been completed at the Vendor's works to the satisfaction of ECIL/BARC, ECIL shall issue a certificate to this effect within fifteen (15) days after completion of tests. If the tests are not witnessed by ECIL/BARC, the certificate shall be issued within fifteen (15) days of the receipt of the Vendor's test report by ECIL, provided the test results are satisfactory and conform to the specified parameters. Failure of the ECIL to issue such certificate shall prevent the Vendor from proceeding with the subsequent work. The completion of these tests or the issue of the certificate shall not bind the ECIL to accept the equipment should it, on further tests after erection, be found not to comply with the 'Contract'.
- In all cases where the 'Contract' provides for tests whether at the premises or at the works of the Vendor, except where otherwise specified shall provide free of charge such as Labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by ECIL/BARC to carry out effectively, such tests of

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the equipment in accordance with the 'Contract' and shall give facilities to ECIL to carry out testing.

- The inspection by ECIL and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of the Vendor in respect of agreed quality assurance programme forming a part of the 'Contract'.
- In the case of stage inspection, the Vendor shall proceed from one stage to another only after ECIL gives and permission given to proceed further inspect the component. The same procedure shall be adopted for any rectifications and / or repairs suggested by ECIL. At all customer hold points the Vendor shall compulsorily offer for inspection to ECIL waiver, if any, by ECIL, shall be obtained in writing for record purposes.
- None of the SPMs to be furnished or used in connection with the contract shall be dispatched until shop inspection, satisfactory to ECIL/BARC has been made and ECIL issues specific dispatch instructions for the modules. However, such shop inspection shall not relieve the Vendor of his responsibility for furnishing the equipment conforming to the requirement of the contract nor prejudice any claim, which ECIL may have because of the use of defective or unsatisfactory items of the modules. Should ECIL waive the right to inspect any item of the equipment, such waiver shall not relieve the Vendor in any way from his obligation under the Contract. In the event of ECIL/BARC on inspection revealing poor quality of goods, ECIL shall be at liberty to specify additional inspection procedures, if required, to ascertain the Vendor's compliance with the equipment specifications.

1.7. Quality Assurance and Surveillance

- The Contract requires conformance to international and national standards/codes for assured quality and reliability. In line with these requirements, the Vendor shall have documented Quality Assurance Plan to assure quality at all stages, i.e. design, engineering, procurement, manufacture, handling, Shipment.
- The Quality Plan (QP) of the Vendor shall be in consonance with the Quality Plan of ECIL (The sample QP of ECIL is enclosed). The Vendor's quality system shall have
 - Organization structure and interfaces between various agencies.
 - Functions and responsibilities of the Vendor.
 - Requirements on qualifications and training of personnel in each area of activity, viz. design, engineering, procurement, manufacturing, inspection and testing and Quality Assurance.
 - Control of design.
 - Control of procurement and manufacturing.
 - Inspection and test control.
 - Calibration and control of measuring, examination and testing equipment.
 - Manufacturing environment, equipment and special process control.
 - Handling shipping and storage control.
 - Non-conformance control.
 - Corrective actions.
 - Quality assurance records.

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R. K. Reddy
29/12/2014

- Document control, their storage and retrieval.
- Internal audits.

Applicable quality plan for various components of SPMs are covered in this Section G. Any deviations to the enclosed quality plan shall be brought out in the offer clearly. Vendor to indicate the sampling plan, reference document and acceptance norms and testing agency, etc.

- Hold points are critical steps in manufacturing, inspection and testing where the Vendor is obliged to notify ECIL in sufficient advance of the start of operation test. Final release prior shipment is a mandatory hold point. The Vendor is not to proceed with the work past a hold point except by a witness waiver agreement with ECIL.
- The performance of waiver of QA activities by ECIL at any stage of manufacturing does not relieve the Vendor of any obligation to perform in accordance with and meet all the requirement of the procurement documents and also all the codes & reference Documents mentioned in the procurement document nor shall it preclude subsequent rejection by ECIL.
- On award of the P.O., the VENDOR shall prepare detailed test procedure identifying the various Stages of manufacture; quality checks performed at each stage and the customer Hold points. The document shall also furnish details of method of checking, Inspection and acceptance standards / values and get the approval of ECIL before proceeding with manufacturing. However, ECIL shall have the right to review the inspection reports, quality checks and results of Vendor's in house Inspection department.
- The Vendor provides test details as required by ECIL to determine the quality of material supplied under this contract. If any test fails to comply with the requirements, ECIL may reject the whole material. ECIL shall have right to select particular test piece of his choice from the lot in case of samples testing. In case the results are found to be not satisfactory ECIL shall have the right to test more number of pieces or each piece additionally from the lot for testing or reject whole lot. Vendor should have QPs for cleaning, painting, packing, identification and documentation. On completion of manufacture the items can be dispatched only after issue of shipping release by ECIL.
- Vendor shall implement, in compliance with its Quality Plan approved by ECIL, the monitoring activities including quality audits and any inspections to verify the compliance with the requirements.
- ECIL shall designate appropriate certified auditors to conduct quality audits to verify compliance with Vendor's Quality Plan. The audit teams may be composed of ECIL personnel and/or specialist contracted personnel.
- Vendor will ensure that supplied items conform to the requirements of the European Installation.

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2. SCOPE OF SUPPLY & WORK

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2.1. Scope of Supply

- a. Production units: 220 Nos. (Batch-1 of 110 SPMs & Batch-2 of 110 SPMs)
- b. Test Jigs to test SPMs in all aspects: 4sets.
- c. Input auto transformer and resistive load to test SPM for maximum prescribed duty cycle of operation and 100% load.
 - a. 3-Ph Autotransformer: 1No.
 - b. Resistive load: 1No. with facility to tap at 10%, 50% and 100% load to perform all the tests as per section 4.2.1.3
- d. 22 spare Control Cards of SPM.

2.2. Scope of Work

- a. Design, development and manufacturing of 220 SPMs.
- b. Inspection and Testing of SPMs as per the Acceptance Test Procedure consisting of routine tests, type tests, Third party tests as per IEC Standards approved by the ECIL.
- c. Packing, delivery of Batch-1 of 110 SPMs to ECIL, Hyderabad for integrated testing. After the testing, these modules shall be transported to BARC, Mumbai for final Installation, Commissioning and Site acceptance.
- d. Packing, delivery of Batch-2 of 110 SPMs to ECIL, Hyderabad for integrated testing. After the testing, these modules shall be transported to BARC, Mumbai for final Installation, Commissioning and Site acceptance.

2.2.1. List of Documents to be submitted

All the documents shall be submitted both in hard and soft format.

2.2.2. Documents along with Quotation

The following Documents to be submitted along with the quotation:

1. Power Schematic and Control block diagrams
2. General Arrangement and tentative bill of material
3. Recommended Spares list
4. Schedule of activities
5. Quality Plan
6. Manufacturing Inspection Plan

Vendor shall submit Quality Plan mentioning the steps followed to ensure quality of the product for items fabricated at their works and for bought out items. The MIP shall be prepared to ensure that all the tests on components/ equipment of the system and final assembled system are included for quality assurance.

2.2.3. Documents after purchase order

The following Documents to be submitted to ECIL for approval within one month after placing Purchase order:

1. Detailed QP and MIP shall be submitted for ECIL's approval and approved QP and MIP shall be followed to ensure the quality of the product. A Typical Quality Plan is given in Section-7 for vendor's guidance.

S. Alkhalaf
09-12-2014

P. K. Ramesh
9/12/2014

2. Functional analysis (simulation study for the specified parameters under different conditions viz. load, duty etc.) with Design report. Approximate life cycle assessment shall be required considering Continuous operating mode.
3. Estimated Heat losses and thermal design of SPM.
4. Heat sink temperature simulation results
5. Mechanical assembly drawings
6. Control & power wiring diagram
7. Control and protection function sequence and methodology along with on-board controller source code / .out file / Hex File
8. Detailed catalogue and datasheets of all the components used in this job.
9. Acceptance Test Procedure

The Acceptance Test Procedure (ATP) for the main supply in detail covering all the functional requirements of this specification shall be prepared mentioning the step-wise inspection and test procedures.

2.2.4. Documents along with delivery of 220 modules

Following documents shall be submitted along with the delivery of 220 SPMs:

1. 3 copies of all as built drawings such as Schematic diagram, Bill of material, Control and Power wiring diagram etc.
2. The COC (Certificate of Compliances) shall be submitted for the components /material used in this job.
3. 3 Copies of Acceptance Test procedure & Test reports.
4. 3 copies of Operation & Maintenance Manuals.
5. Instructional & Maintenance Manual.
 - The manual shall include technical description in detail with reference to schematics. The working of all subsystems shall be described. The description shall be specific to the equipment furnished and not of general nature. It shall consist of data of the equipment, adjustment, calibration, complete instruction of installation, commissioning, working & operation of the equipment & parts, catalogue datasheets and drawings.
 - The module operation instructions shall be descriptive and in detail. Step by step operating instructions shall be given for operation of the system. Various adjustments & calibrations shall be clearly defined and mentioned.
 - Troubleshooting methods/charts, routine and periodic maintenance with test jigs, test equipment to be used, test point with test voltages and pattern/wave shapes shall be covered.

2.2.5. General Practice during Execution of Contract

Following general practices to be followed by Vendor during the execution of this Contract:

1. All the material shall be procured from the reputed OEMs.
2. All the components used shall be able to function in the temperature range of -40°C to +85°C.
3. All aluminium housed resistor shall be checked 100 % at factory inward stage.

S. Arshad
02/12/2014

R. K. Khatkar
02/12/2014

4. All the Electrolytic capacitors shall have adequate temperature rating of 105°C and a life of 25 years at 50°C ambient temperature and worst case ripple current. Guaranteed Specifications from Capacitor Supplier shall be provided if special design.
5. PCBs shall be fabricated using 35-micron copper clad with gold plating. For power grid lines 70 micron copper clad shall be provided.
6. The PCB's shall have green masking on both sides with legend print on component side. Wired PCBs shall have conformal coating on both sides.
7. The equipment should be designed for a maintainable life of 25 years. All components should be chosen to guarantee life.
8. Components found unsatisfactory as to workmanship shall be removed by the vendor and replaced with acceptable ones without any additional cost.
9. The vendor has to arrange the necessary equipment & jigs required for testing of SPMs.
10. The Vendor shall submit all the documents made for this job for the ECIL's approval at appropriate stages.
11. In the case of power semiconductor devices vendor shall ensure that the individual components are adequately protected by snubber circuits, limiting inductors, paralleling impedances etc. These shall ensure that the maximum voltage (including transients), dv/dt, current, di/dt etc. which can appear in service under load or fault conditions is below the declared rating by suitable margin. The vendor shall describe in Design report about these margins and its implementation.
12. All nuts, bolts, studs, washers etc. shall be of standard isometric sizes. Other sizes may be permitted only after approval by the ECIL.
13. The vendor shall ensure that adequate test points, with easy access, shall be included in equipment to enable maintenance and trouble-shooting to be carried out as speedily as possible.
14. All major components should be suitably marked for identification.
15. Safety requirements for use of capacitors shall in compliance with the IEC 61071.
16. All used cables shall be selected, sized and laid according to applicable IEC standards.
17. All Power, measurement, control and auxiliary cables shall be made of copper. Cable insulation shall be Low Smoke Zero Halogen Flame Retardant.
18. Enclosure shall be made up of Stainless less steel (SS), preferably magnetic. All copper Busbar shall be CNC cut and nickel plated with glossy finish, free from scratches, burrs.
19. All hardware/structural part shall be selected according to vibration/shock test requirement.

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3. TECHNICAL SPECIFICATIONS

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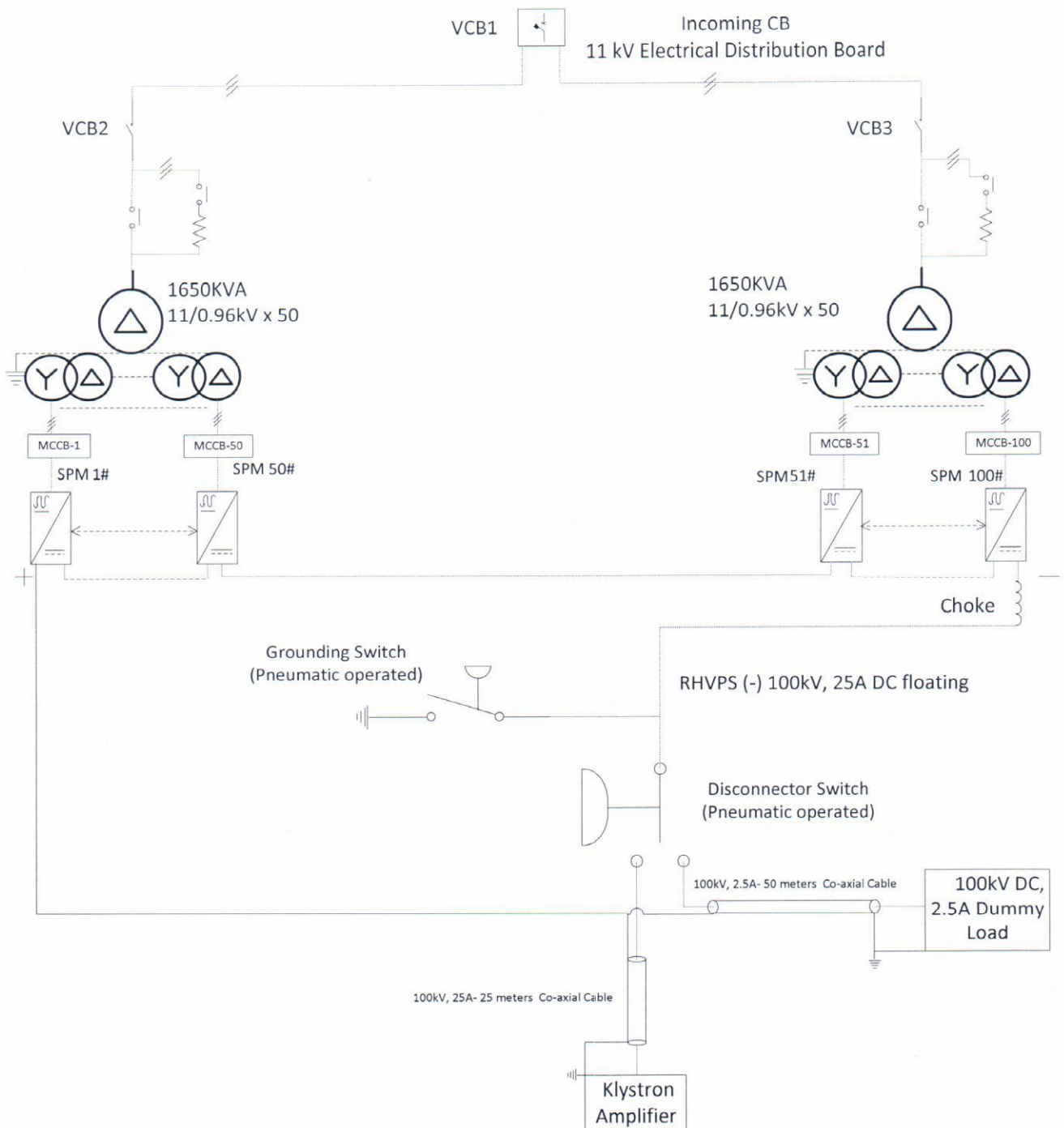
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3.1 Application

Switched Power Modules (SPMs) are the building blocks of Regulated High Voltage Power supply (RHVPS) with output -100kV, 25A. The proposed RHVPS supply will be based on Pulse Step Modulation (PSM) technology. The proposed scheme will use two multi-secondary transformers and 100 (50+50) Switched Power Modules (SPMs) with DC link nominal voltage of 1000V and rated current of 25A. The modules will be forced air cooled and stacked in HV rack.

The power supply uses the series connection of 100 Switched Power Supply Modules (like a DC chopper), switched in tandem from a controller. The switching pulses of all SPMs are phase shifted in such a way that the total output at the terminals is controlled and has ripple of high frequency and low magnitude. A high frequency ripple, fixed amplitude (one stage voltage) ripple is synthesized due to the specific switching pattern. All 100 SPMs shall function without tripping.

The controller regulates the RHVPS output voltage from 0 to – (-) 100kV DC. The final output is controlled by switching IGBT in each SPM. They are also used for fast protection shut-off in case of a fault on the load side. All SPMs are identical for ease of spares and maintenance. **The Schematic diagram of RHVPS is shown below in the next sheet:**



3.2 SPM Specifications

Sr. No	Attributes	Specifications
Output		
1	Output power	34kW (Maximum)
2	DC link Voltage	1230V DC (1500 V DC max at No Load and +10% Input Voltage variations) switched at a frequency of 5kHz
3	Output Peak Current	25 A (Pulsed with IGBT duty cycle variation from 10% to 95%)
4	Overall efficiency of Module	Better than 97% at maximum switching frequency
5	Circular Connector	2-pin with contact size of 6
Input		
6	No load Input voltage	3 phase, 3 wire, 960V \pm 10 % , 50 Hz \pm 3 Hz SPM must have capability to isolate Power Circuit Components from mains by use of contactors
7	Transformer Impedance	8%
8	Semiconductor Fuses(F1,F2,F3)	Provided at the input of SPMs to protect the diode modules
9	Soft Charging of DC Link within 10 seconds (approx.)	Through Contactors and Resistors
10	Input side surge prevention (ZNR1, ZNR2, ZNR3)	Suitable MOVs shall be provided
11	Circular Connector	4-pin with contact size of 8
12	Input Inrush Current	Shall be finalised after mutual discussion with the selected party.
Components		
13	Power Diodes (Dual Modules – D1, D2, D3)	Power Diodes with PIV of 3400V SPM will be tested at +10% of the nominal input voltage. Hence, safety margin of 120% has to be considered.
14	Coupled Inductors (L1)	Used to overcome step changes in the input voltage

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15	DC link capacitance (C1, C2, C3, C4)	1.7 mF equivalent approximately <ul style="list-style-type: none"> Capacitors having adequate ripple current capability (assessment from Design to validate the selection) Suitable resistor balancing network shall be used for proper voltage sharing All the Electrolytic capacitors shall have adequate temperature rating of 105°C and a life of 25 years at 50°C ambient temperature and worst case ripple current. Guaranteed Specifications from Capacitor Supplier shall be provided if special design.
16	Crow-bar at SPM level with clearing time $\leq 5\text{ms}$	Through Thyristor and Resistor, PIV of Thyristor shall be more than 3.3kV Thyristor should be reset within 60 seconds
17	Semiconductor switches (S1, S1', S2, S2')	Dual pack 1700V IGBT with Fast Recovery Diode and max. junction temperature of 150 deg.C <ul style="list-style-type: none"> Turn on delay + Turn on rise time $\leq 1.4\mu\text{s}@ 10\%$ Load Turn off delay + Turn off fall time $\leq 1.4\mu\text{s}@ 10\%$ Load Transient over voltage at SPM output during IGBT turnoff $< 100\text{V}$ Proper voltage sharing network shall be designed by the vendor for series IGBTs
18	Semiconductor Switch driver	<ul style="list-style-type: none"> It must be having IGBT fault detection facility like IGBT short circuit protection. IGBT driver with propagation time: 100nS (max.)
19	Bleeder resistors (R12, R13)	As required to assist fast turnoff during light load conditions and achieving above specifications, to be verified during sample testing.
20	Output Side Surge prevention (ZNR5)	Suitable MOVs shall be provided
Control & Interface		
21	Control Supply	Input transformers shall be used to provide isolated power to Control electronics, switchgear etc.
22	Fiber Optic Connectivity (Supply of FOC not in the scope of the vendor)	SPM should be able to communicate with ECC through 4 NOs. Fibre Optic cables (1 Transmitter and 3 Receivers), each having a minimum 5M baud data transfer speed up to 25m length

23	Serial Link Communication	Shall be finalised after mutual discussion with the selected party.	
24	Voltage feedback	DC bus voltage feedback signals from SPM shall be transmitted with two signal standards over FO link (using Transmitters) to ECC. These are as follows:	
		ADC internal to DSP, Resolution shall be at least 10 bit. Accuracy:±0.5 LSB	V/F converted, linear Center frequency: 200 kHz at 1300V Linear range: 1030-1560 V Accuracy: 0.1 % or better
25	Cooling	Forced air Cooling shall be provided with thermal cut out provision. At thermal cut out dust filters shall be used.	
General Requirements			
26	Physical arrangement	<ul style="list-style-type: none">• Horizontal layout• Closed architecture with an enclosure of non-corrosive magnetic grade SS is required in order to be EMI/EMC compatible• Rear:<ul style="list-style-type: none">○ Input power terminations through suitable 4-pin circular connectors• Front:<ul style="list-style-type: none">○ Output power terminations through suitable 2-pin circular connectors○ 4Fiber Optic terminations through suitable 4-pin circular connector <p>NOTE: The Vendor shall provide the mating connectors along with the consignment.</p> <ul style="list-style-type: none">• Mounting at site: slide in/out; nylon buttons shall be required at bottom.• Locking arrangement to arrest SPMs• Dimension for unit SPM: 320(W) x 610 (D) x 260 (H) approx.	
27	Indications	<ul style="list-style-type: none">• Visual indications (LED) at front side for Module charged and for IGBT Trigger• Module fault conditions and states by suitable displays (LEDs). <p>Fault Indications to include</p> <ul style="list-style-type: none">• IGBT Short circuit• Over Current Fault	

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		<ul style="list-style-type: none"> • Over Voltage Fault • Under Voltage Fault • Heat sink Over Temperature • Controller (WDT) fault • Charging Fault • Crowbar Circuit Fault • Frequency Fault
28	Duty Cycle of Operation	Continuous Wave Mode
29	Temperature	Operating Ambient: 5 °C to 50 °C
30	Humidity	< 95% non-condensing
31	Other information	<ul style="list-style-type: none"> • Insulated copper wires or bus bars to be properly laid with ferrules, ends terminated with crimped lugs or connectors. • On control board, power supply section to be segregated from the rest of the control circuit. • Control circuit should have adequate shielding against internal / external noise. • Sandwiched busbar arrangement is preferred from DC link to IGBT. • Direct measurement of temperature of Heat sink with appropriate device. • Audible noise level < 60dB at 1 meter. • Provision shall be provided to connect half of the DC bus to the Module chassis.

3.3 Essential Features of SPMs

- Capable to isolate Power Components from input voltage.
- 3 phase bridge rectifier with coupled inductors and DC link.
- Crow-bar at the SPM level for dumping the energy in the DC link.
- IGBT based chopper with protection circuits.
- Communication ports with external devices.
- Forced air cooling for power devices.

Specific Requirements

It must be noted that SPM will see frequent short circuits of load in actual application, the capability of the SPM to sustain such consecutive short-circuits at regular intervals (~20ms) is an essential feature of the SPM.

It should also be noted that short circuit threshold for the SPM and the RHVPS shall be coordinated in the field; selection of IGBTs should be in conformance with this requirement having repeated short circuit capacity of ~1kA.

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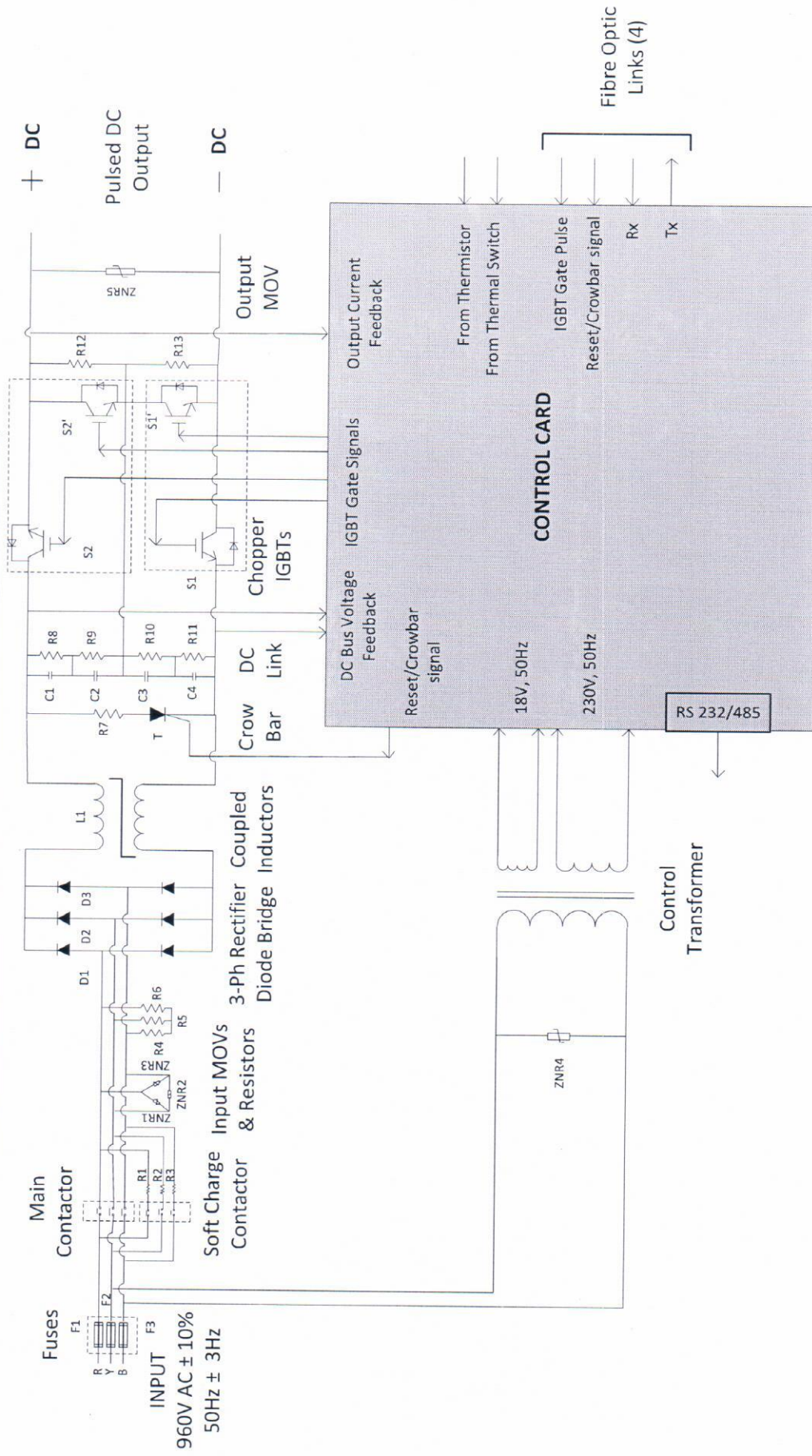
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3.4 Brief Description of SPMs

On application of mains input, the SPM should start the soft charge circuit after a state transition command from ECC. The power circuit may be ready after the soft charge time, once the module is fully charged. During soft start, usually no trigger pulse is applied to any of the switches. The control circuit should inhibit the IGBTs from firing unless the SPM transits to ready state. The SPM is ready for operation after the mandatory protection check-up done by the control section. Schematic for the SPM is shown below:

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Note: The vendor shall note that the schematic diagram shown above is indicative only. The Vendor shall workout minute details and make the detailed design based on this conceptual design and shall submit to the ECIL for approvals.

3.5 Interface to SPMs

The main interfaces between the SPMs and other sub-systems of RHVPS system include:

- The 960V AC input from multisecondary transformers
- Equipment Control cubicle (ECC)
- The High voltage rack needed to accommodate the SPMs

3.5.1 Interface with input multisecondary transformers

Each SPM will receive AC power from each secondary of the multisecondary transformer having following characteristics:

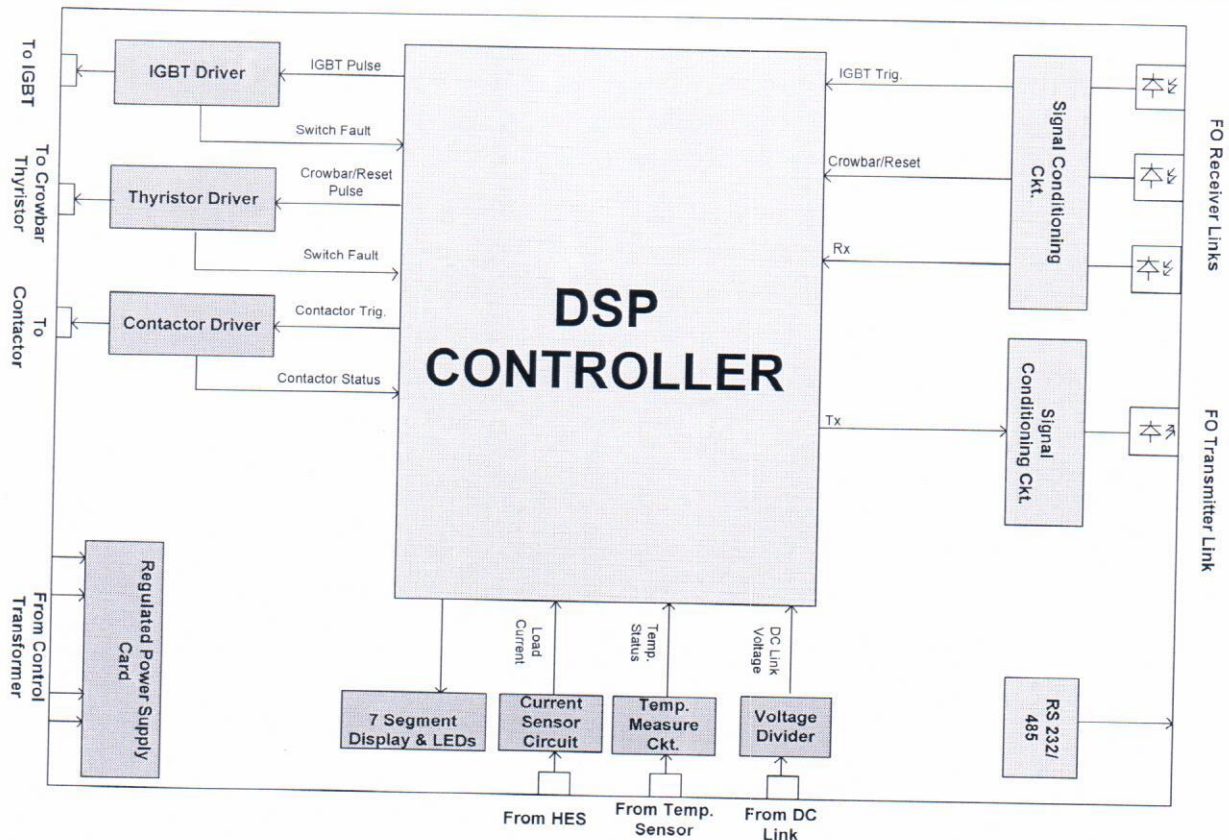
Parameters	Characteristic
Voltage	3 phase, 3 wire, 960V \pm 10 % , 50Hz \pm 3 Hz
Impedance	~8% for each input going to the module

3.5.2 Interface with Equipment control cubicle (ECC)

The specified voltage regulation and control of the RHVPS unit is achieved by the PSM control through ECC. The ECC receives feedback from each SPM (voltage) and generates trigger pulses for all SPMs. ECC is also informed about any faults in any of the SPMs, keeps history of SPMs, and sets/resets parameters of the modules. This includes FO communication links (4#) from each SPM to the ECC that is located ~25m away from the SPMs. Supply of FO links is not in the scope of the vendor.

3.6 Controller

The SPM shall have its own intelligent controller which should function as described in subsequent sections. Additional functions shall be provided by vendor for safe and more efficient operation. Those shall be discussed and evaluated for improvisation on present understanding. The Control Circuit Block Diagram is as shown in below:



3.6.1 Control Circuit-Basic Parts

3.6.1.1 Controller

The on-board controller is an interfacing device between the SPM and the ECC (not in the present scope). The main function of the on-board controller is to facilitate

- IGBT switching; dynamics of the trigger pulse from the ECC should be reproduced in the same time scale.
- Self-protection of the SPM against abnormal events
- State transitions and health checks and acknowledges the ECC.
- Communicates data, logs fault history and communicate to ECC.
- Setting threshold values for the fault indications from the ECC.
- DC link voltage information shall be repeated for every $\sim 500\mu\text{s}$.
- Controller shall communicate with ECC using serial UART.
- DSP shall be a standard one used for Industrial Power Electronics application.
- Delays shall be deterministic (including driver delay) for every module with fine tolerance. A typical example could be $150\text{nS} \pm 8\text{nS}$.

3.6.1.2 Control Supply

The control supply is derived from input power supply $960\text{V} \pm 10\%$, 3-Phase, 50Hz. Step down transformer of $960\text{V} / 220\text{V}$ may be used for this purpose. The secondary voltages of the control transformer are decided after requirement of voltage at different stages of control board.

3.6.1.3 Fiber Optic Cables and Connector

For isolation purpose, all incoming and outgoing signals from SPMs are transferred via fiber optic link. For achieving very low signal attenuation during transmission of signal, a fiber optic cable with connector at both side required. The F.O. cable of 25 mtrs. length and connector should support a minimum 5 M baud data transfer speed.

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 09-12-2014

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3.6.1.4 Voltage to Frequency Converter

The DC link feedback voltage is converted to frequency signal by Voltage to frequency converter. The center frequency is 200 KHz. The V to F converter should have good linearity for 80 % to 120 % of DC link voltage (absolute value).

3.6.1.5 Analog to Digital Converter

The DC link feedback voltage shall also be communicated to ECC in digital coded form through FO link. The ADC may be internal to the on-board DSP controller with at least 10 bit resolution and accuracy of ± 0.5 LSB.

3.6.1.6 Signal Conditioning

Tx & Rx signals shall be converted in Optical/Electrical signals with conditioning circuit. Suitable 4-pin circular connectors of reputed make shall be used.

3.6.1.7 Contactor Driver Circuit

Contactor shall be driven from relay. A TTL pulse generated from controller should be processed by relay driver IC and then given to Relay. Contactor coils to be supplied by 230 V AC and controlled by relay. The 230 V AC supply shall be taken from an isolated secondary winding of control transformer.

3.6.1.8 Display

The ERROR count or ERROR description should be display on SPS Module. The display might be discrete LED for status and error code.

3.6.1.9 Hall Effect Sensor Circuit

For measuring the load current at each SPM, a Hall Effect Sensor with signal conditioning shall be used.

3.7 List of Signals

3.7.1 F.O. Link Description

Each SPM shall have suitable connectivity for 4 fiber optic links and should provide the following functionality. The working description of each link is as follows.

IGBT GATE PULSE LINK:

This signal decides the output voltage of the SPM depending upon the duty cycle. The input gate pulse could be 5 kHz

CROWBAR/RESET LINK:

The CROWBAR/RESET link is a multi-functional link and there are three different pulse patterns available on this link. The absence of this link will be considered as "CROWBAR CIRCUIT FAULT". The three conditions identified by the pulse pattern of this are:

Condition1: If the SPM is tripped, this link will work as fault RESET.

Condition2: If the SPM is healthy, a pulse of 1ms (or longer) will inhibit the IGBT switches. The IGBT switches will be enabled 1ms after the light comes.

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Condition3: If the SPM is healthy, the pulse pattern of 10 kHz will initiate the CROWBAR action. The main contactor shall be deenergised and the DC link will be discharged through the crowbar resistor by triggering the crowbar Thyristor.

RECEIVER LINK:

The information transmitted by the user is received through this link. This link works in two modes.

- The link receives threshold parameters from ECC to the SPM during “Set parameter mode”.
- It works as TRIP signal during “operation mode”.

TRANSMITTER LINK:

The information is transmitted to the user through this link.

3.7.2 Incoming Signal/interfacing points

The tentative list of incoming signals to controller has been identified as below. Any possible change is subject to evaluation with further improvisation.

From	Signal Name	Type
ECC to On-board controller of SPM	IGBT Trigger Pulse Link	Optical
	Crowbar/Reset Link	Optical
	Receiver link	Optical
POWER CIRCUIT to On-board controller within SPM	Y and B Phase	Input to the control PS
	DC Bus Voltage	Analog
	Load Current signal from H.E.S.	Analog
	Temperature Transducer	Analog
	IGBT Error –(from Driver)	Digital

3.7.3 Outgoing Signal

The tentative list of outgoing signals from controller has been identified as below. Any possible change is subject to evaluation with further improvisation.

To	Signal Name	Type
	Transmitter link	Optical
On-board controller to POWER CIRCUIT within SPM	IGBT Gate Pulse	Digital
	Crowbar Thyristor Gate Pulse	Digital
	Contactor 1 Trigger via relay	Digital
	Contactor 2 Trigger via relay	Digital
	LED Display	Digital

3.7.4 Error and State Display

LED may be used to display the error in coded format while each state shall be identified with a dedicated LED. DC link charge may be shown with LED blink.

Error may be identified based on 4 LEDs with code as shown below. As on now 14 errors have been identified. Further improvisation could be done on evaluation basis, suggestions will be considered.

Sr. No	Error
1	Short Circuit Fault
2	DC Link Under Voltage Fault
3	DC Link Over Voltage Fault
4	Over Temperature Fault
5	Over Current Fault
6	Charging Fault
7	WDT Fault
8	IGBT Frequency Fault
9	DC Bus Unbalance Fault
10	I/P Phase Failure Fault
11	Crowbar Circuit Fault
12	SPM Bypassed
13	Eeprom Fault
14	Communication Loss

State shall be displayed using dedicated different colour LEDs as listed in below table.

Sr. No.	Status	Display LED
1.	OFF/PAS	Green
2.	DC Link UP	Green Blinking
3.	STANDBY	Blue
4.	READY	Orange
5.	POWER ON	Red

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3.8 State wise Action List (Tentative, subject to change based on further evaluation)

STATES	RHVPS State	Main Conditions for state Acquisition
➤ OFF	➤ OFF ➤ (safe state) ➤ Controller Power ON	➤ Controller Power ON ➤ DC Disconnectors OPEN, Circuit Breaker OPEN ➤ SPM Contactors OPEN, SPM IGBT Disabled, SPM IGBT OFF
➤ No Pulse	➤ No Pulse/IDLE ➤ (Continuous check for Protections) ➤ Normal Standby-1 ➤ State in which RHVPS can remain for undefined time	➤ DC Disconnectors CLOSED, Circuit Breaker OPEN ➤ SPM Contactors OPEN, SPM IGBT Disabled, SPM IGBT OFF ➤ DC Disconnectors CLOSED, Circuit Breaker CLOSED ➤ SPM Contactors OPEN, SPM IGBT Disabled, SPM IGBT OFF
➤ PAS and Check	➤ PAS ➤ RHVPS manages parameter setting and checking ➤ Normal Standby-2 ➤ State in which RHVPS can remain for undefined time	➤ PARAMETER PASSING & CHECKING ➤ DC Disconnectors CLOSED, Circuit Breaker CLOSED ➤ SPM Contactors OPEN, SPM IGBT Disabled, SPM IGBT OFF ➤ DC Disconnectors CLOSED, Circuit Breaker CLOSED ➤ SPM Contactors CLOSED, SPM IGBT Disabled, SPM IGBT OFF
➤ Ready	➤ Ready ➤ remain only for limited time	➤ DC Disconnectors CLOSED, Circuit Breaker CLOSED ➤ SPM Contactors CLOSED, SPM IGBT ENABLED, SPM IGBT OFF
➤ Pulse on	➤ Pulse on/Power ON ➤ State in which RHVPS feeds power into load.	➤ DC Disconnectors CLOSED, Circuit Breaker CLOSED ➤ SPM Contactors CLOSED, SPM IGBT Enabled, SPM IGBT FIRED*
➤ Abnormal Standby	➤ Abnormal Standby	➤ State in which RHVPS manages abnormal conditions went to Normal standby or No Pulse state based on severity of fault.

3.9 Customised serial protocol

3.9.1 Transmission Format

Packet of 8 bit UART is shown below:

Start Bit	Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0	Parity Bit	Stop Bit	Stop Bit
-----------	--------	--------	--------	--------	--------	--------	--------	--------	------------	----------	----------

Data information may be sent using multiple packets at Baud rate of 100kbps. Each Parameter information is of three UART data packets as shown below:

Packet 1:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Status Bit 2	Status Bit 1	Status Bit 0	Data Bit 11	Data Bit 10

Packet 2:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Data Bit 9	Data Bit 8	Data Bit 7	Data Bit 6	Data Bit 5

Packet 3:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Data Bit 4	Data Bit 3	Data Bit 2	Data Bit 1	Data Bit 0

Health Bit 0 = SPM is Healthy

Health Bit 1 = SPM is Faulty

Change in health or state shall be updated only after completion of word (3packets) transmission.

Five different status of the SPM can be identified using the following status bits:

- 000 OFF/PAS
- 001 DC LINK UP
- 010 STANDBY
- 011 READY
- 111 Power ON

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By using 12 bits for passing the parameter information, we can accommodate a maximum of 4096 decimal value.

For example, if Over Voltage value of 1650V (Equivalent Binary Value: 110 0111 0010) to be transmitted with **ready** state it can be formatted as described below:

Packet 1:

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

Packet 2:

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

Packet 3:

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

3.9.2 Transmission modes

Three modes have been identified for communication according to operation and states of the SPMs.

3.9.2.1 Set Parameters Mode

After booting up, SPM will wait for initialization from ECC. ECC sends Set parameters to the SPM in standard transmission format along with one predefined start code. SPM sets receive parameters from ECC and acknowledge ECC by transmitting same packages. After ECC receives this parameter, it compares the parameters it had sent. If they match it sends confirmation packet with predefined two packets with standard transmission format.

If received parameters are erroneous, ECC do not declare as PAS state achieved. It can be retried manually as many times as it needed. SPM may wait for infinite to receive those 14 Packets if any of them is missing.

If some error is there in SPM, SPM sends Fault History instead of PAS data.

If Parameters are correctly received by ECC it sends confirmation code, As soon as SPM receives confirmation code, SPMs clears all the faults saved in permanent memory and waits for state change command to DC LINK UP from ECC.

Let us say following parameters are to be passed:

Sr.	Parameters	Settable Value Range	Factory Default Value
1	Frequency	5 KHz	5 KHz
2	Temperature	35 to 50°C	35°C
5	IGBT Switch (S1')	0(Disable) 1(Enable)	, 0(Disable)
6	IGBT Switch (S2')	0(Disable) 1(Enable)	, 0(Disable)
7	Crowbar Thyristor (T)	0(Disable) 1(Enable)	, 0(Disable)
8	Under Voltage	800-900V	800 V
9	Over voltage	1550-1650V	1550 V
10	Over Current	10A - 40A	25 A

In case the set parameter exceeds beyond the settable range, as described in the above table, SPM should return factory default value.

Total 33 packets have to be sent which includes start code (055555) having three UART Packets and 30 UART Packets for parameters as defined in sequence below: (Three UART packets for each parameter information).

Information is coded as below:

Word	Parameters	Information	Value to be passed(Decimal)
0	Start Code	--	012A55 (Hex)
1	Frequency	5kHz	2100
2	Temperature	5°C To 55 °C	2200to2250
3	IGBT Switch (S1)	0(Disable) , 1(Enable)	2300 2301
4	IGBT Switch (S2)	0(Disable) , 1(Enable)	2302 2303
5	IGBT Switch (S1')	0(Disable) , 1(Enable)	2304 2305

6	IGBT Switch (S2')	0(Disable), 1(Enable)	2306 2307
7	Crowbar Thyristor (T)	0(Disable), 1(Enable)	2308 2309
8	Under Voltage	800 to 900V	2400 to 2700
9	Over Voltage	1550 to 1650V	3100 to 3300
10	Over Current	10A to 40A	3400 to 3430

For example,

Word 0-Start code can be:

Packet 1:

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

Packet 2:

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

Packet 3:

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

Word 8 -Under Voltage of 850V, we can transmit 2550 (by making thrice), so that the equivalent binary value will be 1001 1111 0110.

Packet 1:

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

Packet 2:

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

Packet 3:

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

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3.9.2.2 Operation Mode

After receiving the forced transition command to go to “DC LINK UP” state, module will start sending the DC link voltage along with the status bits.

Packet 1:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Status Bit2	Status Bit1	Status Bit 0	Data Bit 11	Data Bit 10

Packet 2:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Data Bit 9	Data Bit 8	Data Bit 7	Data Bit 6	Data Bit 5

Packet 3:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
Health Bit	Packet ID Bit 1	Packet ID Bit 0	Data Bit 4	Data Bit 3	Data Bit 2	Data Bit 1	Data Bit 0

ECC will also be sending the same kind of format data to SPMs where only status bits in the first packet are important for forced state transition. The transmitting and receiving formats are the same for all operational states like DC LINK UP, STANDBY, READY and POWER ON. Only during READY and Power ON state Rx link will act as trip for module.

Whenever any fault occurs in SPM, it sends health bit 1 in its packet. Other data in that packet describes different errors. Error data is also in three packet format, so total 11 errors can be defined.

Example of the errors is identified as shown in the below table with fault level. When level 0 error occurs SPM will go to OFF state. In case of level 1 fault, SPM will go to OFF state and can never be revoked until hard reboot i.e. power restart.

Error Packet description:

Sr. No.	Bit Position	Fault	Fault level
1.	Bit 11	Over Current Fault	Level 0
2.	Bit 10	Over Voltage Fault	Level 0
3.	Bit 9	Over Temperature Fault	Level 0
4.	Bit 8	Short Circuit Fault	Level 0
5.	Bit 7	DC Bus Unbalance Fault	Level 0
6.	Bit 6	I/P Phase Failure Fault	Level 0
7.	Bit 5	Loss of Communication	Level 0
8.	Bit 4	Under Voltage Fault	Level 1
9.	Bit 3	Charging Fault	Level 1
10.	Bit 2	Crowbar Circuit Fault	Level 1
11.	Bit 1	WDT fault	Level 1
12.	Bit 0	Eeprom fault	Level 1

Packet 1:

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

Packet 2:

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

Packet 3:

Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0
0	1	0	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11

S. Alhamed
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Trip

Due to some external events, it may be possible that ECC receives external TRIP command. At that time ECC needs to inhibit the IGBT pulses and should convey this TRIP command to all the SPMs as early as possible.

TRIP mode operation is performed using Rx channel. TRIP command is needed to execute only when SPM is in ON or READY state. During these states, Rx channel is always high and is not being used for any other communications. Whenever ECC receives the TRIP command, it forces Rx channel to go low. Detecting this change as interrupt. SPM can inhibit the IGBT pulses by going into STANDBY state.

3.9.2.2.1 Offline Mode

Offline mode can be executed when SPM is in OFF/PAS mode. Fault history can be read in this mode only. After parameters are passed, SPM should delete the fault history.

When queried SPM sends error packets followed by the description of errors and fault history packets. These packets also follow the same format of two UART packets as others.

For example, if other information of 18 packets is there as a fault history, then total 21 packets (7 words) are to be transmitted at the time of fault.

Word (3 Packets)	Parameters
0	Error Packet
1	Over Voltage Value
2	Over Current Value
3	Temperature Value
4	0
5	0
6	Counter Value

These values are recorded instantaneously when error was occurred. Counter increments every time whenever the error is recorded. Counter value is to identify the error occurrence and to avoid reading repeat information. Counter resets after 4096 (12 bit counter).

3.10 Mapping of ECC states by SPMs

Using Customised serial protocol SPM should perform following actions:

RHVPS/ECC State	ECC Action	Module State	Module Action
OFF (Auto)	ECC Power ON. Connectivity with the main controller established Protections Check Performed OFF state Acquired	OFF	Module in OFF condition
IDLE (Auto)	Check Protections Continuously	OFF	Module in OFF condition
PAS (Forced)	11kV ON ECC establish communication with the module Receive threshold/configuration parameters from the main controller Pass threshold parameters <ul style="list-style-type: none"> PASS state Acquired 	IDLE/PAS (Forced)	Module receives input power Establish communication with ECC Module Receives threshold parameters from ECC
STANDBY (Forced)	Force "DC LINK UP" State transition command to module Receive "STANDBY" status from required number of SPMs, in predefined timeout <ul style="list-style-type: none"> Standby state Acquired 	DC LINK UP (forced) ↓ STANDBY (auto)	On receipt of "DC LINK UP" command, module turns on the contactor for soft charging After DC link charges fully; module acquires "STANDBY" state automatically and declares the same to ECC. IGBTs still disabled
READY (Forced)	Force "READY" State transition command to module Keeps required number	READY (Forced)	On receipt of "READY" command from ECC, module go

	of modules in “READY” state, in predefined timeout <ul style="list-style-type: none"> READY state Acquired 		to ready state by enabling IGBTs
POWER ON (Forced)	PS shall be turned ON only after receipt of hardwired Enable signal from main controller On receipt of enable trigger, Fire IGBT Pulses <ul style="list-style-type: none"> Power ON state Acquired Follows the Analog voltage reference link and fires the module	ON (Forced)	Module detects the IGBT firing pulse and turn ON the SPM.



4. INSPECTION & TESTING

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4.1 General

The ECIL or his authorized representative shall have access to the Vendor's premises to check compliance with the provision of this specification. A detailed Manufacturing and Inspection Plan (MIP) shall be prepared by the vendor to check and ensure the compliance with this specification and shall be submitted to the ECIL for approval.

Mechanical dimensions and electrical wiring shall be inspected and check-up for conformance with the relevant drawings. All components used in the unit shall be checked for mechanical and electrical requirement during incoming inspection stage as per the approved MIP.

A thorough testing of the system shall be carried out as per the approved inspection procedure before dispatch to ECIL, Hyderabad.

The Vendor has to make suitable test setup to conduct all functional type tests as mentioned in Acceptance test Procedure (Approved by ECIL) to establish the performance of the system. Vendor shall provide all the necessary test and measuring equipment for conducting the tests.

4.2 Test

The test shall be followed generally as per the IEC 60146-1-1 and as per the specific requirements.

4.2.1 Routine Tests

4.2.1.1 Visual Inspection

1. Components make and ratings as per Product BOM
2. PCB test reports verified
3. Internal layout and terminations as per the drawing.
4. Physical dimensions and weight of the module as per drawing.

4.2.1.2 Insulation test

1. Voltage Proof Test:

The Voltage Proof test shall be performed for all input-output terminals to the chassis. The test voltage shall be 2200 VrmsAC (3110 V DC) for 1 minute for all the terminals. Test equipment shall be having capability of 0.1 A.

2. Insulation Resistance Test:

The insulation test shall be performed with a 500VDC megger and the IR value shall be more than 100MΩ. The purpose of this is, to test insulation strength of the isolating pads.

4.2.1.3 Functional Tests

1. Soft start Test

- Measure soft start resistor values in all the phases.
- Observe soft start for dc link build-up at +10% input voltage.

S. Athaulah
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2. Output Voltage Test at 5 kHz at rated input voltage

Sl. No.	Duty Cycle (%)	Load Condition	Ripple & Voltage across DC Capacitors (In Volts)	Voltage waveform across Series IGBTs	Voltage waveform at output	Waveforms (OK/Not OK) Refer section 4.3 for waveform storage
1	95%	10%				
2	95%	50%				
3	95%	100%				
4	50%	100%				
5	20%	100%				
6	20%	10%				

3. DC bus feedback signal (Accuracy and Linearity)

4. IGBT Driver test

Propagation delay from driver input to driver output to be measured on the waveform Rising & Falling.

5. IGBT trigger pulse test

Waveform comparison between test jig output and driver input for delay, rising, falling and flat top of the pulse.

6. IGBT characteristic test at 10% load, waveform for rising, falling and flat top

7. Simulation of External trip with observation of fast turn-off

8. Minimum duty test

With 1% duty (at 10 kHz switching) for the IGBT, driver should reproduce the output pulse.

9. Protection Test

- Over Temperature Test (simulated test)
- Under Voltage Test (simulated test)
- Over Voltage Test (Simulated test)
- Trip signal (from test jig)
- Error signal (to be communicated with test jig)
- Loss of on-board control power (simulated for safe state)
- Simulated Crowbar Test – Discharge time of DC link and temperature rise of dissipating resistor shall be noted.
- Short circuit test:
 - With precondition as no-load, short circuit applied at SPM output terminals
 - With precondition as rated load, short circuit applied at output terminals with 25m cable length.

4.2.1.4 Temperature Rise Test

The test shall be conducted at rated voltage and current, loss injection period should not be less than 1 hour on all the SPMs.

4.2.2 Type Tests

4.2.2.1 Power loss and power factor measurement Test

The test shall be conducted at No load and rated load at rated input voltage with 95% IGBT duty cycle.

4.2.2.2 Determination of Safe operation time limit

Test shall be performed at rated load condition. Time should be noted.

4.2.2.3 EMI/EMC Test

Immunity test as per IEC-61000-6-2 (Enclosure Port, DC output port and Input AC port); refer Table- 1, 3 & 4. Basis for test specification: Equipment considered as typical industrial equipment.

4.2.2.3.1 Test Setup:

As SPM input voltage is non-standard (960 V), limitation if imposed by the test labs on the input voltage and current, to be accommodated by the Vendor.

4.2.2.3.2 Test details:

	Environmental Phenomena	Test Specifications	Basic Standard	Observation
Enclosure Port	Power-frequency Magnetic field	50 Hz 30 A/m	IEC 61000-4-8	B
	Radio-frequency Electromagnetic field. Amplitude modulated	80 to 1000 MHz 10 V/m 80 % AM (1 KHz)	IEC 61000-4-3	B
	Electro Static Discharge	Indirect - Contact Discharge ±15 kV	IEC 61000-4-2	B
Input AC Port	Radio-frequency common mode	0.15 to 80 MHz 10 V 80 % AM (1 kHz)	IEC 61000-4-6	B
	Fast transients	±2 kV (open circuit test voltage) Tr/Th : 5/50 (ns) Repetition frequency : 5 kHz	IEC 61000-4-4	B
	Surges (line-to-line)	Tr/Th : 1.2/50 (8/20) us ± 1kV	IEC 61000-4-5	B
Output DC Port	Radio-frequency common mode	0.15 to 80 MHz 10 V 80 % AM (1 kHz)	IEC 61000-4-6	B

S. A. Chaudhary
09-12-2014

R. K. Raut
09/12/2014

	Fast transients	± 2 kV (open circuit test voltage) Tr/Th : 5/50 (ns) Repetition frequency : 5 kHz	IEC 61000-4-4	B
	Surges line-to-earth	Tr/Th : 1.2/50 (8/20) μ s ± 1 kV	IEC 61000-4-5	B

4.2.2.3.3 Operating Conditions during test

Port	Environmental Phenomena	Operating Conditions
Enclosure Port	Power-frequency magnetic field	SPMs shall be feed by Isolation Transformer of 400 V. Test shall be done for 2 conditions as follows, SPM in Ready State SPMs switched at 5 KHz frequency with 25 % duty and reduced load Vendor has to arrange Isolation Transformer and Resistor load at Test Laboratory.
	Radio-frequency Electromagnetic field.	
	Electro Static Discharge	
Input AC Port	Radio-frequency common mode	SPMs shall be feed by Isolation Transformer, allowable limits of the voltage with respect to the coupling network, if any must be assessed. Test shall be done for 2 conditions as follows, <ul style="list-style-type: none"> SPM in Ready State SPMs switched at 5 KHz frequency with 25 % duty and reduced load. For Surge Test, IGBT to be kept continuously ON. Vendor has to arrange Isolation Transformer and Resistor load at Test Laboratory.
	Fast transients	
	Surges	
Output DC Port	Radio-frequency common mode	SPMs shall be feed by Isolation Transformer, allowable limits of the voltage with respect to the coupling network, if any must be assessed. Test shall be done for 2 conditions as follows, <ul style="list-style-type: none"> SPM in Ready State SPMs switched at 5 KHz frequency with 25 % duty and reduced load. For Surge Test, IGBT to be kept continuously ON. Vendor has to arrange Isolation Transformer and Resistor load at Test Laboratory.
	Fast transients	
	Surges	

4.2.2.4 Audible Noise Test

Audible noise level < 60dB at 1 meter, under all operating conditions.

4.2.2.5 Vibration

Test shall be done as per IEC 60068-2-6 in packed conditions. Same type of packing as proposed for transportation to be used. A suitable fixture shall be arranged by the vendor.

- Pre-test observation:** The SPM will be visually examined for mechanical integrity and tested for functionality.

- b. **Resonance Search Test:** The Resonance search will be carried out at 0.5 g from 5 Hz to 500 Hz in all three cardinal axes separately for a period of 15 minutes per axis. This test will be done with SPM in OFF condition. Frequency sweep rate during resonance search will be one octave per minute. These vibration characteristics, their frequencies and the level at which they occur are to be noted.
- c. **Endurance test at Resonance frequencies:** The SPM is to be subjected to Endurance at one of the resonance frequencies detected in the resonance search test for duration of 2 Hours with 0.5 g acceleration in the direction in which resonance is noted. The selection of a resonant frequency for endurance test shall be decided by customer.

Following tests shall be done after vibration tests:

1. Visual Check, Dimensions Check, Component observation by opening enclosure.
2. Demonstration of Functional Test at 10% load

4.2.2.6 Shock test

Test shall be done as per IEC 60068-2-27. Test shall be done without packing. A suitable fixture shall be arranged by the vendor.

Sr.No.	Test	Value	Reference
1	Magnitude of the shock in terms of 'g'	15g	Table A-1, IEC 60068-2-27
2	Pulse width of shock in terms of m sec	11 ms	
3	Shape of the pulse whether half sine wave or saw tooth wave	Half Sine	
4	No. of shocks per direction	3	Section 5 , IEC 60068-2-27
5	No of directions	Six	A-7, IEC 60068-2-27

Following test shall be done after shock tests:

- Visual Check, Dimensions Check, Component observation by opening enclosure.
Demonstration of Functional Test at 10% load.

4.2.2.7 Drop Test

Sr.No.	Test	Value	Reference
1	Drop test	Height 250 mm	Table B.1 , IEC 60068-2-31

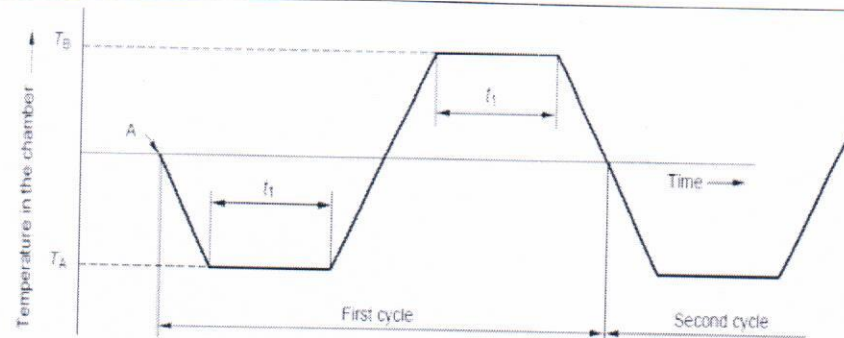
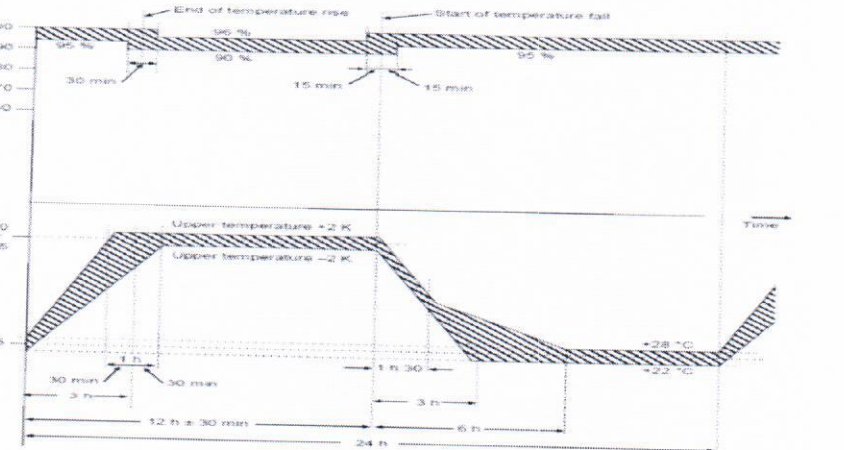
Following test shall be done after shock tests:

- Visual Check, Dimensions Check, Component observation by opening enclosure.
Demonstration of Functional Test at 10% load.

S. Atchannah
09-12-2014

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9/12/2014

4.2.2.8 Dry heat & Damp heat Test

Dry Heat	 <p>Applicable standard: IEC 60068-2-14</p> <p>Observation: After application of specified heat cycle, following test shall be performed</p> <ol style="list-style-type: none"> 1. Insulation Resistance 2. Visual Check, Dimensions Check, Component observation by opening enclosure. 3. Functional Test <p>Demonstration of Functional Test at 10% load</p>	<p>$T_A = 15^\circ\text{C}$ $T_B = 55^\circ\text{C}$ Slope: 1°C/Minute $t_1 = 3\text{hrs}$ $R_H = 40\%$ 2cycles to be applied</p>
Damp Heat	 <p>Applicable standard: IEC 60068-2-30</p> <p>Observation: After application of specified heat cycle, following test shall be performed</p> <ol style="list-style-type: none"> 4. Insulation Resistance 5. Visual Check, Dimensions Check, Component observation by opening enclosure. 6. Functional Test <p>Demonstration of Functional Test at 10% load</p>	<p>Upper temperature 55°C, lower 22°C, 96hours cycle</p>

4.2.2.9 Burn-in Test

4.2.2.9.1 Burn-in test for PCBs

The assembled PCBs after testing shall be subjected to burn-in test for 24 hours at 60°C in a chamber and Main Contactor shall be in ON condition, Soft Charge Contactor shall be in OFF condition and IGBT status in OFF condition.

4.2.2.9.2 Burn in test for SPMs

The SPMs after successful assembly and after completion of Functional tests shall be subjected to Burn-in test for 12 hours. The performance of the unit shall be checked after the test and there shall not be any deviation from the specified performance requirement. During this test, temperature rise on heat sink shall be monitored.

Continuous Wave Mode:

- SPM shall be kept ON for complete 12 hours continuously.

4.3 Schedule of Test

Tests to be performed	Production units (100% unless, otherwise specified) (Test waveform shall be stored for possible functional test for randomly selected 5 SPMs)	Site Acceptance (100% unless, otherwise specified)
Routine Tests		
Visual Inspection		
4.2.1.1: 1	√	x
4.2.1.1: 2	√	x
4.2.1.1: 3	√	x
4.2.1.1: 4	√	x
Insulation test ¹		
4.2.1.2: 1	√	√
4.2.1.2: 2	√	√
Functional test		
4.2.1.3: 1	√	x
4.2.1.3: 2	√	√ ²
4.2.1.3: 3	On randomly selected ten units	x
4.2.1.3: 4	On randomly selected ten units	x
4.2.1.3: 5	On randomly selected ten units	x
4.2.1.3: 6	On randomly selected ten units	x
4.2.1.3: 7	On randomly selected ten units	x
4.2.1.3: 8	On randomly selected ten units	x
4.2.1.3: 9 (a to g)	On randomly selected ten units	x
4.2.1.3: 9 (h)	√	x

¹At site, voltage proof test shall be performed at 80% of the voltage.

²Test shall be done as per functional test table without any waveform storage.

S. Atharrah
09-12-2014

D. H. Rathod
09/12/2014

Temperature rise test	√	x
Type Tests		
Power loss and PF measurement test	On randomly selected ten units	x
Determination of safe operation time limit	On randomly selected ten units	x
Audible noise test	On randomly selected ten units	x
Burn-in test -PCBs	On randomly selected ten units	x
Burn-in test-SPMs	On randomly selected ten units	x
EMI/EMC test	On randomly selected one unit	x
Vibration Test	On randomly selected one unit	x
Shock test	On randomly selected one unit	x
Drop Test	On randomly selected one unit	x
Dry heat	On randomly selected five units	x
Damp heat	On randomly selected five units	x

S. Alhadi
09-12-2014

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5. FORMAT FOR SUBMISSION OF PART I (TECHNICAL & COMMERCIAL BID)

S. Athaulah
09-12-2014

S. Athaulah
.. 9/12/2014

5.1. Schedule of Vendor's Particulars

The Vendor shall furnish here the following particulars:

1	Name of the vendor	
2	Address of the vendor	
3	Telegraphic and email addresses of the Vendor	
4	Name and designation of the Officer of Vendor to whom all Reference shall be made for Expeditious technical Co-ordination	
5	Place of manufacture & assembly	
6	Current registration number	
7	Whether service facilities available, if so details	
8	Whether sufficient spares are Available in stock	
9	Validity period	

Signature	
Designation	
Company	
Date	

SEAL OF COMPANY

S. Athaulah
09-12-2014

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9/12/2014

5.2. Schedule of Vendor's Experience

The Vendor shall furnish here a list of all similar jobs executed by him. (INR100 Lakhs and above in a single PO)

Sr. No	Description Of work Including Qty. of items	Work Order Or P.O.NO & Date	Value Of Work	Delivery Date as per P.O	Actual Date of Delivery
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

The Vendor shall submit the documentary evidence along with the Customer feedbacks (if any) along with the offer for evaluation.

Signature	
Designation	
Company	
Date	

SEAL OF COMPANY

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09-12-2014

Doth Rashed
21/12/2014

5.3. Schedule of Performance Guarantee

The Vendor shall furnish performance guarantee in respect of the following:

All switched power modules supplied shall conform to the requirements listed in this specification as well as the requirements of all applicable standards. Not meeting any of these requirements will result in rejection of the equipment.

Signature	
Designation	
Company	
Date	

SEAL OF COMPANY

S. A. Kaulah
09-12-2014

Devi Kaulah
9/12/2014

5.4. Schedule of Manufacturing Delivery and Other Related Activities

The VENDOR shall indicate the time for manufacture, testing, delivery and other activities as shown below:

Time required to manufacture 110 SPM units (Batch-I) (Days/Months)	Time required to manufacture 110 SPM units (Batch-II) (Days/Months)	Time required to conduct tests and supply of 110 SPM units (Batch-I) (Days/Months)	Time required to conduct tests and supply of 110 SPM units (Batch-II) (Days/Months)	Total Time to execute the contract

We the undersigned hereby undertake to meet the above time schedule from the date of release of Purchase order

Signature	
Designation	
Company	
Date	

SEAL OF COMPANY

6. FORMAT FOR SUBMISSION OF PART II (PRICE BID)

(To be submitted in a separate sealed envelope)

Sl.No	Item Description	Price (Rs)	Taxes (Rs)	Total Price (Rs)
1.	Manufacture & Supply of 110 SPMs (Batch-I)			
2.	Manufacture & Supply of 110 SPMs (Batch-II)			
3.	3-Ph Autotransformer – 1No.			
4.	Resistive Load with facility to tap at 10%, 50% and 100% load – 1No.			
5.	Test Jigs (4nos.)			
6.	22 Spare Control Cards			
Total Price (Rs.)				

Note:

For all items quoted above, the F.O.R. site prices on door deliver basis by road transport without transshipment shall be included. Ex-works price without the bidder responsibility for safe delivery to site may not be acceptable.

All prices shall be indicated both in figures and in words.

7. QUALITY PLAN

S. H. Handale
09-12-2014


09/12/2014

INTRODUCTION

The objective of the "QUALITY PLAN" is to ensure that the product quality requirements and customer requirements are accurately determined and satisfactorily complied.

PURPOSE

The purpose of this document is to implement the methodology to be adopted and ensure that the quality policy adopted for design, procurement, manufacturing, factory inspection and testing, shipping release, testing at site to meet ECIL quality requirements as per the guide lines prescribed in the subsequent sections.

(a) Structure for Quality Plan

Vendor shall submit a detailed quality plan specific to the job as per the following format.

1. Scope

[This section shall describe the scope of work to be covered by this Quality Plan]

2. Quality Management

2.1 Description of Quality Management System of the organization:

[Provide certifications of recognized Quality Standards and valid date of the certifications, if any]

2.2 Detailed the breakdown of responsibilities within the organization:

[Add the organization flow chart]

2.3 Identify the different (external) organizations involved:

[Add the relationship flow chart between different organizations]

2.4 Identify within the different organizations involved the key individuals responsible for:

[Ensuring that the activities performed in connection with the particular contract are planned, implemented and controlled and their progress monitored,

Communicating requirements peculiar to the contract to all affected organizations,

Resolving problems that may arise at interfaces between the organisations involved]

2.5 Identify any access restrictions of ECIL to the premise of the Vendor or its subcontractors that may apply:

3. Contract Review

[Indicate how, when and by whom contract requirements are to be reviewed and the review recorded]

4. Documents

[Show how, when and by whom documents will be controlled, and what kinds of documents will be submitted to ECIL]

5. Design

5.1 *[Indicate, if an organization performs design activities for the contract;*

5.2 *how, when and by whom design will be controlled, including:*

- when, how, and by whom the design process is to be carried out, controlled and documented,
- the arrangements for the review, verification and validation of design output conformity to design inputs requirements.

5.3 Where applicable, indicate the extent to which the ECIL will be involved in design activities, such as participation in design reviews and design verification.

5.4 Reference applicable codes, standards and regulatory requirements.

5.5 A list the computer programs to be used and indicate how, when, and by whom they will be controlled. Otherwise "not applicable"

6. Procurement

6.1 [Show how, when and by whom procurements will be controlled.

6.2 Any important Items or activities that are to be purchased or subcontracted.

6.3 (Proposed) suppliers or subcontractors.

6.4 Relevant Quality Assurance Requirements and the methods to be used to satisfy regulatory requirements, which apply to, purchased or subcontracted products.

7. Identification and control of items

7.1 [Where traceability is a requirement or necessary for the adequate control of the work, define its scope and extent, including;

7.2 How affected items are to be identified?

7.3 How contractual and regulatory traceability requirements are identified and incorporated into working documents?

7.4 What records relating to such traceability are to be generated and how and by whom they are to be controlled?]

8. Manufacture

8.1 [Indicate how processes, manufacture, assembly, inspections and tests will be controlled. Where appropriate, introduce or refer to:

8.2 Relevant documented procedures and work instructions.

8.3 The methods to be used to monitor and control processes.

8.4 Criteria for workmanship.

8.5 Use of special and qualified processes and associated personnel. Tools, techniques and methods to be used.]

9. Inspection and testing

[Show how, when and by whom inspection and test would be controlled, including :

9.1 Any inspection and test plan to be used, and how and by whom they are reviewed and approved.

9.2 How and by whom inspection and test reports are reviewed and approved?

9.3 Acceptance criteria to be applied.

9.4 Acceptance of purchased or subcontracted items.

9.5 Any specific requirements for the identification of inspections and tests status

10. Measuring and Test Equipment

[Indicate the control system to be used for measuring and test equipment specifically used in connection with the contract, including:

- Identification of such equipment,
- Method of calibration,
- Method of indicating and recording calibration status.]

11. Handling, Storage, Packing, Shipping and Delivery

[Show how, when and by whom handling, storage, packing, shipping and delivery will be controlled:

- how contract requirements for handling, storage, packaging and shipping are to be met,
- how the item will be delivered to the specified site in a manner that will ensure that its required characteristics are not degraded.]

12. Records

[This section should indicate:

- 12.1 How records are to be controlled, including how legibility, storage and retrievability will be satisfied
- 12.2 What records are to be kept
- 12.3 What records are to be supplied to the ECIL, when and by what means
- 12.4 How and by whom the records are reviewed and approved prior to inclusion in the deliverables handed over to the ECIL
- 12.5 What form the records will take (such as paper, microfilm, tape, disc or other medium) and in what language the records will be provided.]

13. Deviation and Non-Conformities

[Indicate how, when and by whom deviations and non-conformities will be processed including those originating from suppliers and subcontractor.]

14. Training and Qualification

[Address any specific training requirement for personnel and how such training is accomplished and recorded.]

15. Assessment

[Indicate how, when and by whom the implementation and effectiveness of the Quality Plan will be monitored.]

16. Reference and Others (If any)

[A list of documents referenced in this Quality Plan].