

Government of India
Bhabha Atomic Research Centre
Control Instrumentation Division

Ref : BARC/EmA&ID/KS/2022 / P-43036

Date : 05.05.2021

Sub : Minor fabrication job of “Fabrication, assembly and qualification of series antiparallel arrangement passive quench protection circuit”

Dear Sirs,

1. Quotations are invited for the minor fabrication job of “Fabrication, assembly and qualification of cryogenic grade power diode assembly TSP/KS/2022/37.
2. Bidder shall quote for the machining and fabrication along with raw materials. Taxes, shall be quoted separately.
3. The quotation must reach Head, EmA&ID by due date **17.05.2022** and must be sent in a sealed envelope **super scribed with the reference number & the due date given above.**
4. The address on the envelop should read:

**Head,
Electromagnetic Applications & Instrumentation
Division,
RCnD Building,
BARC, Trombay,
Mumbai - 400 085.
(Kind Attn: Smt Kumud Singh)**
5. Any modification required during the fabrication process shall be made after approval from our engineer.
6. The bidder shall complete the same within 20 weeks from the date of firm work order issued to the bidder.
7. Head, EmA&ID reserves the rights to accept / reject any or all quotations without assigning any reason.
8. Delivery charges if any must be clearly mentioned in the offer.
9. Quotation must also indicate the validity of offer.
10. Quotation should be submitted on printed format along with PAN, VAT & CST. Computer generated format and without PAN, VAT & CST, the quotation will be rejected.

Encl.:

01) Technical specification : TSP/KS/2022/37

Kumud Singh
SO(F), EmA&ID

Technical Specifications for minor fabrication job of “Fabrication, assembly and qualification of series antiparallel arrangement passive quench protection circuit”

Specification no.	Revision no.	Date of Issue	Total Number of pages
TSP/KS/2022/37	0	14.09.2021	6

1.0 INTRODUCTION

Cryogenic compatible high power diodes shall be used as passive protection devices for superconducting coils in back to back connection mode. The diodes shall be clamped and pressed with suitable clamping arrangements to maintain contact continuity during cool down of the cold mass assembly consisting of superconducting coils, current lead and diode packs. Key factors to demonstrate the required level of design safety & operational requirements like peak voltage forward bias voltage; reverse recovery rate etc. shall be established in the design stage. Cryogenic testing shall be performed on the diode pack assembly to demonstrate short circuit performance.

2.0 SCOPE OF SUPPLY

The successful bidder shall deliver the “**Fabrication, assembly and qualification of series antiparallel arrangement passive quench protection circuit**” and all relevant documentation as defined in this technical specification.

2.1 Supplier’s Responsibility:

1. Supplier needs to make manufacturing design of the cold diode assembly based on the requirements stated in this specification. Certain interaction with the purchaser during the initial stage of the design activity must be made possible. The design must be approved by the Purchaser before fabrication starts.

The supplier is responsible for:

- (a) A complete manufacturing file, containing detailed information about the design, the production and quality control;
- (b) The procurement of raw materials and subcomponents
- (c) The design and construction of all necessary tooling for the manufacture, assembly, and qualification.
- (d) Jigs and fixture for clamping of parts.
- (e) Factory acceptance tests
- (f) The Quality Control Records (QCR), Inspection and test plans records (ITP)

2.2 Deliverables included in the supply:

Sr. No	Job description	Quantity
1.	Fabrication, assembly and qualification of series antiparallel arrangement passive quench protection circuit (8 diode stack)	2 set
2.	Qualification test reports	1 Set

2.3 Free Issue material

No free issue material is involved. Raw material shall be arranged by the supplier.

3.0 TECHNICAL REQUIRMENTS

3.1 Technical specification: The assembly shall be fabricated as per attached drawing. The drawing and the specifications are enclosed in this document. It shall be fabricated, tested, inspected to meet the requirements:

Scope of fabrication and Supply

- a) Fabrication, testing, supply of cold diode assembly and its components as per attached Drg. and safe delivery to Purchaser's site.
- b) Suitable clamping screws (assembly) with suitable clamping force to maintain contacts.
- c) Suitable bus bars for interconnections and terminations .
- d) Transportation and safe delivery to purchaser's site including protection for all machined and sealing surfaces to mitigate any damage during transportation.

4.0 RAW MATERIALS

4.1 Cold diode

Features:

- High Surge Current Ratings
- High Rated Blocking Voltages
- Special Electrical Selection for Parallel and Series Operation
- Single or Double-sided Cooling
- Long Creepage and Strike Paths
- Hermetic Seal

Type	Voltage		Current		Recovery Time		Recovery Time Circuit		Leads	
	VRRM (Volts)	Code	I _{F(av)} (A)	Code	t _{rr} (μsec)	Code	Circuit	Code	Case	Code
	200	02	300	30	11	X	JEDEC	X	R62	OO
	400	04								
	600	06	400	40	9	X				
	800	08								
	1000	10	500	50	6	X				
	1200	12			(Typical)					
	1400	14								
	1600	16								
	1800	18								
	2000	20								
	2200	22								
	2400	24								

Reverse biased characteristic for the diode of intended application

Characteristics		
RMS Forward Current	785	Amperes
Average Forward Current	500	Amperes
One-half Cycle Surge Current	6500	Amperes
3 Cycle Surge Current	5050	Amperes
10 Cycle Surge Current	3900	Amperes
I^2t (for Fusing), Times = 8.3 milliseconds	175000	A ² sec
Max. I^2t of Package (t = 8.3ms)	20 x 10 ⁶	A ² sec
Storage Temperature	-65 to +190	°C
Operating Temperature	2200V to 2600V	°C
	-65 to +150	
Mounting Force	1000 to 1400	lbs

Absolute maximum ratings

Current - Conducting State Maximums

Forward Voltage Drop	V_{FM}	1.40	Volts
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Voltage - Blocking State Maximums

Repetitive Peak Reverse Voltage (Rated Limit)	V_{RRM}	2400	Volts
Non-rep. Trans. Peak Rev. Voltage (Rated Limit)	V_{RSM}	2600	Volts
Reverse Leakage Current	I_{RRM}	50	mA

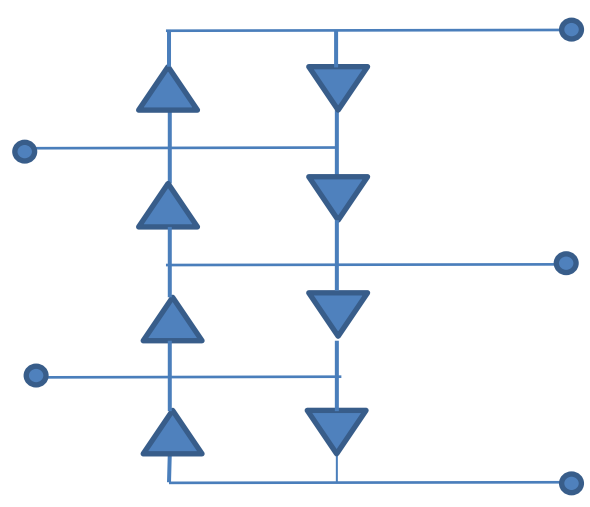
Switching

Typical Reverse Recovery Time	t_{rr}	2200V to 2600V	μ sec
		11	

Thermal

Maximum Resistance, Double-sided Cooling, Junction to Case	$R_{\theta(j-c)}$	0.095	°C/Watt
Maximum Resistance, Case to Sink (Lubricated)	$R_{\theta(c-s)}$	0.02	°C/Watt

Electrical and thermal characteristics



Electrical connection

5.0 PERFORMANCE OF THE CONTRACT

5.1 Fabrication and Delivery Schedule

Delivery of is expected in **about twenty (20) weeks after the contract is awarded.**

Container and packaging design is subject to review and approval by Purchaser, but approval shall not relieve Manufacturer of any responsibility for damage to the assemblies during transit due to improper packaging or handling.

5.2 Manufacturing Plan

The Subcontractor shall submit a manufacturing plan to the purchaser for approval. The plan shall identify and describe all aspects of work to be executed from the point of design work through delivery of the Solenoid Lenses. The Manufacturing Plan shall include and document the following stages:

- Manufacturing drawings
- Parts Procurement
- Clamping procedures
- Thermal and Electrical testing

In cases where the Subcontractor modifies the design and/or develops its own tooling, an approval of the purchaser would be necessary to proceed to the next step of the manufacturing phase.

The Purchaser must accept the Manufacturing Plan prior to use. Sections of the Manufacturing Plan may be submitted earlier for acceptance. This will allow the Subcontractor to commence some fabrication tasks earlier.

5.3 Progress Report

The Subcontractor shall submit a monthly progress report to the purchase representative. The progress report shall be submitted within the 15th day of the month following the one for which progress is reported.

5.4 Quality Assurance Plan

The Subcontractor shall submit a Quality Assurance (QA) Plan to the Purchaser for approval before the fabrication process starts. The plan shall ensure that each item offered for acceptance conforms to the requirements herein. As a minimum requirement the QA plan shall include:

- Description of manufacturing traceability.
- Proposed layout of Travelers. Details of each step of the fabrication process must be well described in a traveler-type document, which must be made available to the Purchaser be approved before the fabrication starts.
- QA plan must include methods for inspection and dimensional control of mechanical parts and subassemblies including description of the measuring

equipment, sequence and frequency of inspection, methods for defect/ flaw determination, criteria for rejection of parts including corrective action and plan for record keeping.

- QA document must include Non-Conformance reporting. Discrepancies shall be reported in the Subcontractor's Non-Conformance Reports and submitted to the Purchaser for acceptance. Work shall be placed on hold until the corrective action has been accepted by the Purchaser.

5.5 Identification marking

The Subcontractor shall transfer identification information and alignment information according to the method of labelling and referencing developed by the Subcontractor and accepted by the Purchaser. Each diode assembly is to be given a unique serial number and labelled according to the corresponding assembly drawing. The identification marking shall be legible, and shall be applied by engraving on the outside of the vessel flange. The marking shall have no deleterious effect upon the diode assembly intended performance and shall not deteriorate in the cryogenic environment.

6.0 CONFORMANCE TESTS

The conformance tests required to be performed are as stated below:

Sr. no	Qualification	Acceptance criteria
1.	Visual inspection	Visual signs of damage, deterioration and oxidation shall not be present on any component of the assembly.
2.	Thermal Qualification	Supplier/ fabricator shall test the diode assembly for its intended current carrying application (Short circuit test) at 4.2K
3.	Geometrical inspection	Parts and final assemblies shall be measured to check the geometrical properties of the components and their adherence to released drawings

7.0 GENERAL DESCRIPTION

- Supplier shall quote with material; no free issue material is involved in this tender.

- Overall cost will be compared and include packaging, forwarding and safe delivery to BARC at RCZ stores.
- Suppliers shall give complete details of their product, facilities, fabrication, facilities, list of users and compliance certificates form users for technical evaluation. Quotations submitted with incomplete details are viable for rejection. A technical committee will visit the facilities
- Vendors with test facilities for qualification of diode assembly, electrical qualifications, Thermal qualifications and basic metrology equipment's for dimensional checks will be given preference. In case vendor plans of sub-contracting the job, same shall be clearly brought out in quotations. The sub-contracting can only be carried out only after prior permission of the purchaser. In all circumstances the responsibility of completion of job up to the satisfaction of the purchaser lies with the supplier. Vendors shall list down the details of qualification checks performed on the fabricated parts by self or in collaboration with other laboratories.