

Government of India
Bhabha Atomic Research Centre
Electromagnetic Application and Instrumentation Division

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Design, development, assembly and qualification of 2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure as per Technical Specification sheet no: EmA&ID/VARF/01

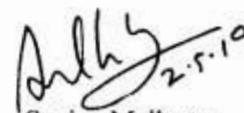
Dear Sir/Madam,

Quotations are invited for "Design, development, assembly and qualification of 2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure as per Technical Specification sheet no: EmA&ID/VARF/01".

Bidder shall quote for deliverables as per the technical specifications.

1. No Free Issue material is involved.
2. Taxes shall be quoted separately. Form AF/H whichever is applicable shall be provided, if required.
3. **The quotation must reach The Head, EmA&ID by 20/5/2019 (12:00 Noon) and must be sent in a sealed envelope super scribed with the reference number & the due date given above. Courier are not allowed in BARC premises; the quotation shall be sent by speed post/registered post.**
4. The address on the envelope should read: **The Head,
Electromagnetic Application Section,
Electromagnetic Application and Instrumentation Division,
RCnD Bldg., North Site
BARC, Trombay,
Mumbai - 400 085.
(Kind Attn: Elina Mishra, SO/D)**
5. The bidder shall complete the job within 16 weeks from the date of firm work order issued to the bidder. The finished components shall be delivered by the bidder at **RCZ stores, BARC, Trombay, Mumbai-400 085.**
6. Head, EMAS, Electromagnetic Application and Instrumentation Division reserves the rights to accept/reject any or all quotations without assigning any reason.
7. Delivery charges if any must be clearly mentioned in the offer. Quotation must also indicate the validity of offer. Quotation must also indicate the GST no and PAN no of the party.
8. Drawings / Sketches must be returned along with the offer.
9. The quotation has to be signed by authorized person with company seal.
10. Payment will be made by cheque only after satisfactory completion of work on production of bill, delivery challan and advance stamped receipt. It may be noted that IT @ 2% and surcharge on tax at 15% shall be deducted from your bills.

Encl.: Technical Specification Sheet no: - EmA&ID/VARF/01


Sanjay Malhotra,
Head, EmA&ID

Technical Specification Sheet

Specification no.	Revision no.	No of sheets	Date of Issue
EmA&ID/VARF/01	0	4	30.4.2019

Design, development, assembly and qualification of 2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure as per Technical Specification sheet no: EmA&ID/VARF/01

1.0 Scope

This specification specifies “Design, development, assembly and qualification of 2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure as per Technical Specification sheet no: EmA&ID/VARF/01”.

The job includes design, development, fabrication, testing and supply of 2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure. The frequency of the amplifier is varied using a VCO which is in turn a function of the input DC voltage. Also the supplier has to fabricate an RF enclosure to shield EMI, EMC signals and noise around the setup. Testing of the fabricated products includes electrical tests of the amplifier and EMI/EMC tests of the enclosure. Safe packaging of the products is also in the supplier’s scope.

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2.0 Statement of purpose

Low power RF amplifiers are used for carrying out different types of RF based experiments in fields like accelerator cavities, medical science, biomedical sample analysis etc depending on the frequency of operation. The range of frequency we are interested in is 2.3 GHz to 2.5 GHz. In this frequency range, low power amplifiers of output energy of 30 W can be used to analyse different types of biomedical samples. The frequency of operation can be varied using a Voltage Controlled Oscillator (VCO). It is an oscillator that produces output signal over a wide range of frequencies. The frequency at the output is determined by the input DC voltage. VCO has a variety of applications depending on the frequency range and the output power strength. The frequency of operation desirable to us is 2.45 GHz. At this frequency, a low power output signal is to be used for analysis of biomedical samples to understand the effect of subjecting the samples at such low power. For analysis purpose, the output power has to be reduced to less than 10 W for study of effect of low power on the samples. 3-way and 4-way power splitters can be used to reduce the output power to such low powers. These have very good isolation and also very less insertion loss. At such high frequency, the signal may produce different radiation. Also, the RF signal may be

interfered by different other background noises and EM signals of nearby frequencies. To sustain the purity of the signals, an RF enclosure has to be fabricated to shield the internal circuits from external EMI/EMC.

3.0 Details of deliverables and scope of supplier

The list of the items to be fabricated, tested, packed and safely delivered to the purchaser includes:

Item no.	Description	Quantity
1.	2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure	1 no

The scope of the supplier includes:

- Preparation of manufacturing drawings on the basis of engineering drawings provided by the purchaser. Approval shall be taken from the purchaser on the prepared manufacturing drawings before the start of fabrication.
- Purchase of raw material as per technical specifications and produce test certificates for approval from purchaser before procuring.
- Inspection of the fabricated components.
- Packing of the tube fittings and shipment of the same.

4.0 Vendor Qualification

Suppliers will be qualified based on technical evaluation. The supplier must have technically qualified and trained staff for electrical and electronics jobs. Supplier must have required infrastructure and past experience of similar jobs. Supplier will be evaluated based on the information provided by the supplier as requested below. Purchaser's specialists may visit the supplier facilities for evaluation and for detailed technical discussions.

SN	Type of job	Outsourcing permissible (Yes/No)
1.	Preparation of manufacturing drawings on the basis of engineering drawings provided by the purchaser.	No
2.	Fabrication of the customised RF enclosures and shields as per the technical specifications	No

Purchaser's specialists may visit the supplier facilities for evaluation and for detailed technical discussions. Details to be furnished by the vendor related to facilities and expertise:

Particulars	To be filled by the vendor
Human resource (The supplier must give the complete detail of human resources including Engineers, Consultants (if any), Draftsmen, Electricians, Technicians, Welder, Assembly Mechanic, quality control inspector, machinist etc.)	
Infrastructure: The supplier must give the details of infrastructure suitable for this jobs such as PCB layouts, electronics lab, electronic measurement instruments, Inspection and Metrology facilities, etc..	

4.0 Details of Free Issue Material to be provided by the purchaser

No free issue material will be provided to the supplier. The physical, chemical, geometrical inspection reports of the raw materials should be provided to the purchaser by the supplier and the raw material shall be purchased only after approval from the purchaser.

5.0 Technical description of the job

This section describes the general and technical specifications of the products to be fabricated. The block diagram of the entire setup is given in the annexure-A. The general specifications of the low power RF amplifier are:

SN	Parameter	Value
1.	Frequency of operation	2.3 GHz to 2.5 GHz
2.	Output power	Up to 30 W
3.	Output gain	Better than or equal to 50 dB
4.	Output at 1 dB compression	At least +43 dBm
5.	Gain flatness	Better than ± 1.5 dB
6.	Nominal Output impedance	50 Ω
7.	Noise Figure	Better than 6 dB
8.	Output load	Should be operational in both short and open loads
9.	RF Output port	N type female connection or SMA female connection
10.	Cooling	Air Cooling
11.	Temperature interlock	Interlock must be present to turn off the RF amplifier when temperature exceeds above 80 deg C with auto recovery at temperature below 70 deg C.
12.	Interlocks	Integrated protection and alarm system should be present.
13.	Operating temperature	10 to 40 °C
14.	Power supply	25 V-28 V
15.	Current Consumption	Less than 4 A
16.	Warranty	At least 1 year

The general specifications of the Voltage Controlled oscillator to be used to vary the frequency of operation of the amplifier is

SN	Parameter	Value
1.	Frequency range	Within 2200-2600 MHz
2.	Tunable voltage	Better than 0.5-10 VDC
3.	Supply Voltage	Within 5-10 VDC
4.	Output power	< 10 dBm
5.	Harmonic Suppression (2 nd harmonic component)	Better than -10 dBc
6.	Tuning sensitivity	Better than 50 MHz/V
7.	Phase Noise	Better than -100 dBc/Hz
8.	Load impedance	50 Ω
9.	Operating temperature range	-40 °C - 80°C

The dimension and other general specifications of the RF enclosure is given as:

SN	Parameter	Value
1.	Dimension	More than 150 mm X 150 mm
2.	Height	Greater than 100 mm
3.	Raw Material	Aluminium

For reducing the output power of the amplifier, 3-way and 4-way power splitters are required with specifications as follows.

SN	Parameter	Value
1.	Frequency range	Better than 1-2.5 GHz
2.	Insertion Loss	Less than 0.5 dB avg
3.	Isolation	Better than 25 dB avg
4.	VSWR	Better than 1.2:1 avg
5.	Input power handling capacity	Greater than 30 W
6.	Connectors	N-type or SMA type
7.	Operating temperature	Better than -60 °C to 80 °C

5.4 4-way Power splitter

SN	Parameter	Value
1.	Frequency range	Better than 1-2.5 GHz
2.	Insertion Loss	Less than 0.5 dB avg
3.	Isolation	Better than 25 dB avg
4.	VSWR	Better than 1.2:1 avg
5.	Input power handling capacity	Greater than 30 W
6.	Connectors	N-type or SMA type
7.	Operating temperature	Better than -60 °C to 80 °C

Note: All the internal connections must be done using RF shielded cable with N-type or SMA type end connections as and where required.

6. Acceptance criteria

Following are the acceptance criteria of the components and coils and other relevant parameters:

S.N.	Particulars	Acceptance criteria
1.	Visual Qualification	Any signs of damage, deterioration and oxidation shall not be present on any component.
2.	Geometrical Qualification	All the geometrical dimensions of the RF shielding enclosures should comply with the technical specifications documented.
3.	Electrical Qualification	The electrical qualification tests include testing the RF amplifier, Voltage Controlled oscillator to determine whether the desired frequency is achieved and to determine the output power level. RF shielding enclosure should be within the geometrical specs mentioned and should be able to attenuate the RF signals effectively.

6 Price

The supplier shall give overall price and its break-up for all the deliverables mentioned. The overall price will be compared. The supplier shall offer prices in following format.

Item no.	Description	Quantity	Price per unit (Rs)	Total price (Rs)
1.	2.3 GHz-2.5 GHz low power RF amplifier in an EMI shielded enclosure	1 no		

7 General conditions

- a. All intellectual property rights belong to purchaser for work done under this technical specification/PO.
- b. Supplier shall maintain the authenticity of drawings or any related drawings/document provided by the purchaser.
- c. All activities would normally be carried with due professional care. However, purchaser shall not be responsible for any loss or personnel accident during execution of the work pertaining to the technical specifications under this PO.
- d. Supplier shall agree to hold in confidence all information provided by the purchaser.
- e. All the raw materials required for deliverables except the Free Issue Material mentioned is in scope of supplier and the supplier should quote accordingly.
- f. Overall cost of all the items in the deliverables will be compared including packaging, forwarding and safe delivery to BARC RCZ stores and shall be quoted separately.
- g. Suppliers shall give complete details of their product & list of users for technical evaluation.

ANNEXURE-A
(BLOCK DIAGRAM OF THE RF AMPLIFIER SYSTEM)

