

# RFSoc based Controller of Quantum Computer Processor (RCQCP)

## Background

RFSoc based Controller of Quantum Computer Processor (RCQCP) allows control and measurement of quantum states of upto 8 qubits. It is based on the Xilinx (AMD) ZCU 216 RFSoc development board. Control waveforms for characterisation and subsequent quantum programs may be written using Qiskit toolboxes. The results of measurement are available as raw In-Phase and Quadrature-Phase (IQ) data i.e. processed ADC samples, as ensemble average data and as logical data as per user requirement. All channels are subject to simultaneous measurement.

The system is specially targeted for qubits based on super-conducting circuits with control frequencies in the range of 4-5 GHz and readout frequencies in the range of 7-8 GHz. The signal generation relies on both first and second Nyquist zone and readout is performed using aliased signals with proper frequency planning.

Cavity spectroscopy, qubit spectroscopy and subsequent characterisation like Rabi, Ramsey, T1 decoherence and T2 decoherence, etc. can be performed using this single board solution.

## Features

- 8 Qubit control and measurement considering each qubit requires:
  - Control channel to qubit,
  - Read-out pulse channel to cavity,
  - Read-out pulse channel from cavity.
- Qubit Control frequency range: 4-5 GHz
- Qubit Read-out frequency range: 7-8 GHz
- Max Instantaneous BW at Intermediate Frequency (IF): 307.2 MSPS per channel
- Sequence Size / No. of Circuits: 600 @ 200 usec circuit window (user configurable)
- Shots: User configurable
- Streaming mode data acquisition for RF channel characterisation
- Custom Baseband Filter Update
- Qiskit based API

## Scope of Usage

RCQCP will enable a cost-effective solution to control and measure qubits in a quantum processor while allowing for easy scale-up of such systems at moderate increment of power budget. Therefore, it is expected to make quantum computing accessible to a wider audience in academia, industry and the scientific community.

Interested industries are requested to submit their financial bid in **sealed envelope mentioning name of technology on top of the envelope**, along with relevant documents as per the list in appendix-A, through one of the following agencies only, to DRDO before the bid ending date:-

S. No	Name of the Agency	Point of Contact
1	<p><b>The Associated Chambers of Commerce and Industry of India (ASSOCHAM)</b>            4th Floor, YMCA Cultural Centre and Library Building,            01, Jai Singh Road, New Delhi - 110001</p> <p>Phone: 46550555 (Hunting Line)            Fax: 01123347008/9            Website :www[dot]assocham[dot]org</p>	<p>Ms Kavita Sharma            Addl Director and Head - Energy and Infra            Mobile : 09871801002            Tele: 0091-11-23347040            Email:            kavita[dot]sharma[at]assocham[dot]com            Website : <a href="http://www.assocham.org">www.assocham.org</a></p>
2	<p><b>National Research Development Corporation</b>            Address :20-22, Zamroodhpur Community Centre,            Kailash Colony Extn. New Delhi - 110048</p> <p>Tel : +91-11-29240401 to 29240407            Fax: +91-11-29240409 / 29240410            General E-mail : write2[at]nrdc[dot]in</p>	<p>Sh. Rajendra Gondane            Sr. Manager (Business Development)            National Research Development Corporation            20-22, Zamroodhpur Community Centre,            Kailash Colony Extn. New Delhi - 110048            INDIA</p> <p>Mobile : +91-9910496554            EPABX : +91-11-29240401-07 (Extn. 444)            Fax : +91-11-29240409 -10            Email : rgondane[at]nrdc[dot]in            Website : www[dot]nrdcindia[dot]com</p>

3	<p><b>PHD Chamber of Commerce and Industry</b>  Address: PHD House, 4/2 Siri Institutional Area,  August Kranti Marg, New Delhi 110016</p> <p>Tel : 91-11-26863801-04, 49545454  Fax : 91-11-26855450, 49545451  Website : <a href="http://www.phdcci.in">www.phdcci.in</a>  E-mail : phdcci[at]phdcci[dot]in</p>	<p>Nasir Jamal  Joint Secretary  PHD Chamber of Commerce &amp; Industry  Address: PHD House, 4/2 Siri Institutional Area, August Kranti Marg, New Delhi 110016  INDIA</p> <p>Mobile : +91-9810185714, 8210343267  Phone : +91-11-49545454, 49545400  Extn : 279  Fax : +91-11-26855450</p>
4	<p><b>Confederation of Indian Industry (CII)</b>  Address: The Mantosh Sondhi Centre 23, Institutional Area, Lodi Road, New Delhi - 110 003 (India)</p> <p>Tel : 91 11 45771000 / 24629994-7  Fax : 91 11 24626149  E-Mail : info[at]cii[dot]in  Website : <a href="http://www.cii.in">www.cii.in</a></p>	<p>Amit Kumar  Deputy Director – Defence &amp; Aerospace Society of Indian Defence Manufacturers (SIDM)  C/o Confederation of Indian Industry (CII)  Address: 3rd Floor, IGSSS, 28 Institutional Area, Lodhi Road, New Delhi – 110003  INDIA</p> <p>Mobile : +91-9990059163  Phone : +91-11-45772062  Fax : +91-11-45772022  Email : amit[dot]kumar[at]cii[dot]in  Website : <a href="http://www.sidm.in">www.sidm.in</a></p>

#### Appendix-A

#### List of Support documents to be attached

- (a) Memorandum and Articles of Association (Should be incorporated as per Indian Companies Act, as amended time to time)
- (b) Certificates of registration as a manufacturing unit, if any.
- (c) Audited Balance Sheet for the preceding three years.
- (d) Income Tax returns for the preceding three year period
- (e) Details of shareholding/ownership pattern especially foreign partners/ shareholders, foreign employees, directors, etc. The company must adhere to the prevailing Govt of India policies and regulations on Foreign Direct Investment (FDI)/DIPP norms as applicable.
- (f) Annual budget for R&D during last three years.
- (g) Numbers and details of IPR or patents, etc., held by the company.
- (h) Number of technically or professionally qualified personnel.

- (i) Record of past performance (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).
- (j) Availability of adequate infrastructure (List of machines and their production capacities) and technical expertise.
- (k) List of Testing and Support equipment's
- (l) ISO/ ISI certification or any other certification
- (m) Relevant clearances form the authorities/ ministries (if any)
- (n) Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.
- (o) Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.
- (p) PESO and DPIIT license for explosive handling if ToT is for high energy Material, explosives, propellants, and component/ system dealing with it etc.
- (q) Under taking form company seeking ToT that none of its Directors, Independent Directors, non-executive Directors, Key management personnel are involved in any corrupt practices, unfair means and illegal activities.
- (r) Details of the industrials license for defence manufacturing be provided by the industry seeking ToTs.