IISc/SSCU/NPH/PC99345-T03

Tender Notification for a Multichannel Potentiostat/Galvanostat/Impedance analyzer

(Last Date for Submission: Tuesday, 17th Dec 2019)

Kindly send your best quotation for a multichannel potentiostat/galvanostat/impedance analyzer with the following technical specifications on C.I.P. Bangalore basis (by ***Air Freight*** only). Your quotation should clearly indicate the terms of delivery, delivery schedule, estimated delivery date, and payment terms. The tender should be submitted in two separate sealed envelopes - one containing the technical bid and the other containing the commercial bid, both of which should reach us, duly signed on or before 1700 hours on Tuesday, 17th Dec 2019.

The bids should be addressed to:

The Chairman,
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.

The sealed bids should be sent to:

Naga Phani B Aetukuri
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.
Ph: +91-80-2293-3534
email: phani@iisc.ac.in

Please enclose a compliance statement along with the technical bid in the format provided in Annexure I.

Technical specifications for a multichannel potentiostat/galvanostat/impedance analyzer

1. Base System Hardware Specifications

1.1. A multi-channel potentiostat/galvanostat with at the least 16 channels should be quoted. All 16 channels should be compatible for integrating with stand-alone frequency response analyzers (FRAs).

1.2. At least 8 channels should have been integrated with FRA modules (specifications as given in **2**). The other channels should all be upgradeable to have FRA modules in the future.

1.3. The channels that do not have integrated FRA should be multiplexed with a stand-alone FRA as specified in **3**.

1.4. All the channels should have independent auxiliary voltage measurement option with a voltage range of 0 to 10 V or better. Necessary cables should be provided. In addition to the required number of cables for the channels quoted, **4** additional cables must be provided.

1.5. All the channels should have independent temperature measurement options that is compatible with commonly used thermocouples. A list of compatible thermocouples should be included in the technical bid.

1.6. Each channel should be operable over a voltage range of -2 V to 10 V.

1.7. The maximum current of each channel should be ± 4 A or better.

1.8. The maximum continuous power should be 40 W or greater. *Measurement data over 24 hours should be provided in support of this technical specification.*

1.9. Current and voltage measurement accuracy should be ±0.1% of full-scale range (FSR). *Data that proves this measurement accuracy should be provided*

1.10. The measured voltage resolution at the lowest voltage range setting should be 3 μV or lower on all channels. *Data that proves this measurement resolution should be provided*.

1.11. The measured current resolution should be 1.5 nA or lower on the lowest current range on all the channels. *Data that proves this measurement resolution should be provided*.

1.12. All the channels should have independent four-point cables of at least 1 m length. Cables of 2 m in length are preferable. In addition to the required number of cables for the channels quoted, **4** additional cables must be provided.

2. Integrated Frequency Response Analyzer Specifications

2.1. The frequency range of FRAs on all 8 channels should be 10 μHz to 1 MHz or higher.

2.2. The FRAs should be capable of operating in both voltage and current modes – the operation mode should be user selectable in the software.

2.3. Frequency generation error should not exceed ±100 ppm and the frequency resolution of the generator should be better than 1 in 50 million.

2.4. The frequency generator should be capable of generating signal amplitudes of 100 μV to 3 V_{rms}.

2.5. Frequency analyzer should be capable of processing signals over a frequency range of 10 μHz to 1 MHz with a voltage resolution of 1 μV or smaller.

2.6. Analyzer accuracy should be ± 0.1% or better.

2.7. Analyzer phase resolution should be 0.01º or better.

2.8. Signal integration over tens of thousands of cycles should be possible. The maximum number of integration cycles should be clearly mentioned.

2.9. *An accuracy contour plot showing the accuracy of electrochemical impedance spectroscopy, measured on an identical FRA as is being quoted, should be provided along with the technical bid. The contour plot should be plotted to cover the following range: Total impedance on Y-axis from 1 mΩ to 1 GΩ; Frequency on X-axis from 10 μHz to 1 MHz; color contours should clearly demarcate regions of differing accuracy.* This data will be used to independently assess the technical compliance of the FRAs.

3. Multiplexed FRA

3.1. The frequency range of the stand-alone FRA should be 10 μHz to 32 MHz or higher. This entire frequency range should be accessible when the FRA is multiplexed to the DC channels mentioned in **1**.

3.2. The software should have allow for the channels to automatically queue when simultaneous EIS requests are received.

3.3. The FRA should be capable of operating in both voltage and current modes – the operation mode should be user selectable in the software.

3.4. Frequency generation error should not exceed ±100 ppm and the frequency resolution of the generator should be better than 1 in 50 million.

3.5. The frequency generator should be capable of generating signal amplitudes of 100 μV to 1 V_{rms} over the entire frequency range.

3.6. Frequency analyzer should be capable of processing signals over a frequency range of 10 μHz to 32 MHz with a voltage resolution of 1 μV or smaller.

3.7. Analyzer accuracy should be ± 0.1% or better.

3.8. Analyzer phase resolution should be 0.1º or better.

3.9. Signal integration over tens of thousands of cycles should be possible. The maximum number of integration cycles should be clearly mentioned.

3.10. *An accuracy contour plot showing the accuracy of electrochemical impedance spectroscopy, measured on an identical FRA as is being quoted, should be provided along with the technical bid. The contour plot should be plotted to cover the following range: Total impedance on Y-axis from 1 mΩ to 100 MΩ; Frequency on X-axis from 10 μHz to 32 MHz; color contours should clearly demarcate regions of differing accuracy.* This data will be used to independently assess the technical compliance of the FRA.

3.11. Multiplexing to at least 8 channels without an FRA should be performed at the factory. Any necessary hardware/software for multiplexing should be included in the quotation.

3.12. Multiplexing should be fully integrated with the software such that the user can set up any combination of DC and EIS experiments similar to that possible with a channel specific FRA. *Documentation showing that this can be done and data collected on a similar multiplexed system should be provided along with the technical bid.*

4. Software

4.1. The multichannel potentiostat/galvanostat/impedance analyzer equipment being quoted should be multi-user friendly with an easy to use software interface, modular hardware design that allows for rapid user training and should also be easy to change from one measurement mode to another with relative ease. For

example, the change from a constant current measurement mode to constant voltage measurement option should be relatively easy so that our students can set-up measurements and collect reliable and reproducible experimental data.

4.2. The software should allow operation through a computer using an advanced software system with a wide range of technical parameters like current, voltage, power etc., for testing different electrochemical systems.

4.3. All channels should be controllable via an advanced software using GPIB/Ethernet/USB connectivity for all the functions of the system being quoted. This should enable setting several different types electrochemical characterization/battery testing protocols

4.4. The software should allow for setting up simultaneous DC and impedance tests on multiple cells.

4.5. At the least, the software should enable measurements in the galvanostatic (constant current), potentiostatic (constant voltage) and a combination of galvanostatic and potentiostatic modes.

4.6. In addition, the software should allow for C-rate controlled charge/discharge of batteries, constant power charge/discharge of electrochemical devices, should allow current and voltage ramp/staircase measurements.

4.7. The software should allow for setting up all major voltammetry techniques, potentiodynamic, galavanodynamic, electrochemical titration techniques such as PITT and GITT.

4.8. The software should also allow for GEIS, PEIS measurements using the channel specific FRAs or the multiplexed FRA.

4.9. The software should have the capability to allow for cycling of cells and should also allow for setting up measurement loops with a combination of above listed control modes.

4.10. Preferably, the software should also allow for the electrochemical titration such as PITT and GITT.

4.11. The software should allow for simulation of impedance data and allow for comparison of data across several different impedance measurements.

4.12. Charge, coulombic efficiency analysis should also be possible with the software.

4.13. Step termination limits should include voltage, current, charge, power and resistance.

5. Options and Accessories

5.1. **One** 6 V 100 A Power booster should be quoted as an option. The power booster should be compatible with any of the channels provided. Necessary cables and interfacing hardware must be included.

5.2. **One** 50 V 5 A Power booster should be quoted as an option. The power booster should be compatible with any of the channels provided. Necessary cables and interfacing hardware must be included.

5.3. Suitable computer(s) for the software control of the cell tester should be quoted as an option. The vendor should provide the option of necessary software installation on a computer provided by us. The required computer specifications and numbers should be clearly mentioned.

6. Terms and Conditions

6.1. The vendor is responsible for the installation of the system at the institute.

6.2. The price quotation should include the cost of installation and training of potential users.

6.3. The system should be provided with at least two years of warranty, on all parts and labor, from the date of installation.

6.4. The vendor should have a track record of having previously supplied at least **15** equipment similar to the requirements in the tender document. Details of such systems with model numbers and users should be provided.

6.5. The vendor should have qualified technical service personnel for the equipment based in India and should assure a response time of <2 business days after receiving a service request.

6.6. Vendor must provide a user list (with contact details including emails and phone numbers) of at least 5 customers from Indian Institutes/Labs where similar measurement systems are installed.

6.7. The lead-time for the delivery of the equipment should not be more than 3 months from the date of receipt of our purchase order.

6.8. Wherever requested in this specifications sheet, data must be supplied along with technical compliance documents. Technical bids without supporting data will be deemed as technically non-compliant.

6.9. All guaranteed specifications will have to be demonstrated, upon request, in an active installation. *Failure to demonstrate any promised specifications will be deemed as technical non-compliance.*

6.10. Printed literature and published papers in support of compliance to all the prescribed specifications may be provided.

6.11. The vendor must provide compliance statement in a tabular form with respect to each technical hardware and software specification in the tender document duly supported by the manufacturer's literature and published papers. Any other claim will not be accepted and may lead to technical non-compliance.

6.12. Technical evaluation by the institute may include demonstration to verify functionalities and capabilities of the system quoted. Any discrepancy between the promised specifications and demonstrated specifications will be deemed as technical non-compliance.

6.13. The vendor must quote, as an option, a non-comprehensive irrevocable AMC price beyond the 2-year warranty, with a price lock in for 2 years beyond the standard 2-year warranty period. 2 services per year should be included in the AMC.

6.14. The quote should also include additional spares sufficient for two years of system usage assuming an average usage of 120 hours of operation per week.

6.15. The validity of commercial quotation should be at least 60 days from the last date for the submission of tender documents. The validity of the quotation should be clearly mentioned in the technical bid.

6.16. The indenter reserves the right to withhold placement of final order. The right to reject all or any of the quotations and to split up the requirements or relax any or all of the above conditions without assigning any reason is reserved.

Annexure I: Technical Compliance Sheet

S. No.	Technical Specifications	Complied? Yes or No.	Data or Specs Provided where requested? (please write NA if data is not requested)
1. Base System Hardware Specifications			
1.1.	A multi-channel potentiostat/galvanostat with at the least 16 channels should be quoted. All 16 channels should be compatible for integrating with stand-alone frequency response analyzers (FRAs).		
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1.3.	The channels that do not have integrated FRA should be multiplexed with a stand-alone FRA as specified in **3**.		
1.4.	All the channels should have independent auxiliary voltage measurement option with a voltage range of 0 to 10 V or better. Necessary cables should be provided. In addition to the required number of cables for the channels quoted, **4** additional cables must be provided.		
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6.15	The validity of commercial quotation should be at least 60 days from the last date for the submission of tender documents. The validity of the quotation should be clearly mentioned in the technical bid.		
6.16	The indenter reserves the right to withhold placement of final order. The right to reject all or any of the quotations and to split up the requirements or relax any or all of the above conditions without assigning any reason is reserved.		