INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076.

Ref. PR No. 1000059012 **Rfx. No. 6100003215**

Technical Specification of Modular Potentiostat (Qty - 1)

Sr. No.	Item Description	Detailed Technical Specification	Technical Compliance (Yes / No)	Additional Information (if any)
1	**MODULAR POTENTIOSTAT**	**A. Potentiostat** I. The potentiostat shall have a modular and expandable architecture, allowing integration of additional compatible hardware modules/accessories for extending measurement capabilities and interfacing with different electrochemical or ancillary experimental systems, as required. II. Modular Potentiostat supplied with cell cable, USB cable, OS-based software, license, and getting-started manual. This workstation will be coupled with EIS for electrochemical applications. III. Real-time display/monitoring of current, potential/voltage and open-circuit potential shall be available either on the instrument hardware or through the supplied control software. IV. Compliance voltage: at least ±30 V suitable to be used as a DC power supply V. Minimum current range: ±2 A or better at ±30 V VI. Potential range: ±10 V or better VII. Potentiostat gain bandwidth: ≥1 MHz or better VIII. Bandwidth of electrometer: Electrometer bandwidth sufficient to support the specified EIS measurement range and system performance or better. IX. Input bias current: <1 pA or less X. Current measurement capability covering at least 10 nA to 1 A through suitable measurement ranges, auto-ranging and/or equivalent architecture. XI. Resolution of measured potential: 0.3 µV or better XII. Resolution of measured current: 0.0003% of current range without any additional boosters. XIII. Best current measurement resolution: ≤30 fA or equivalent/better measurement capability.		

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		XIV. Electrometer input impedance: ≥1 TΩ, with input capacitance sufficiently low for the specified measurement bandwidth. XV. Potentiostat response/rise time: ≤250 ns or equivalent performance sufficient to meet specified bandwidth. XVI. Maximum scan rate: ≥100 V/s or better XVII. Data acquisition system with resolution of at least 16-bit or equivalent/better measurement performance; sufficient simultaneous acquisition channels for the specified electrochemical measurements. XVIII. IR compensation capability using current-interrupt, positive-feedback, dynamic compensation and/or equivalent established compensation methods. XIX. Electrode connection: 4 (WE, sense, CE and RE) or equivalent terminology/configuration. XX. Digital interface to control computer through USB, Ethernet and/or equivalent standard interface. **B. Frequency Response Analyzer / Electrochemical Impedance Spectroscopy (EIS)** I. Hardware and software for EIS measurements should be available in potentiostatic and galvanostatic control, over a frequency range of at least 10 μHz to 1 MHz. II. It should be possible to perform EIS measurements over the entire frequency range from 10 μHz to 1 MHz up to ±2 A currents or better. III. It should be possible to apply a frequency from the EIS option in the range of 10 μHz–30 MHz or better. IV. The measurable frequency range in combination with the potentiostat should be in the operating range of 10 μHz–1 MHz or better. V. The applied frequency resolution should be adequate to achieve the specified EIS accuracy over the measurement range. VI. The potentiostat hardware should have a provision for EIS configuration for “as and when” future upgradation of frequency range to 10 μHz–10 MHz. VII. A valid contour plot is required to understand the accuracy of EIS. VIII. The supplied EIS software shall support acquisition, visualization, fitting, simulation and analysis of impedance data. It shall provide commonly used representations including Nyquist and Bode plots and, where applicable, Lissajous, admittance, dielectric and Mott-Schottky representations. The software shall support equivalent-circuit fitting using commonly used electrochemical circuit		

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		elements/models, including Randles-type and transmission-line models or equivalent. Equivalent software functionality meeting the intended EIS analysis requirements shall be acceptable. IX. Simultaneous visualisation plots the more, the better. **C. Multiplexer (MUX)** I. Qty. 1 required now for performing 4 experiments sequentially. II. Cell connections: Independent RE, CE, WE, sense or better III. Minimum 4 independent measurement channels/positions for sequential experiments, with provision for future expansion to a substantially larger number of channels/positions through additional compatible multiplexer modules. IV. Minimum current: 2 A or better V. Maximum compliance voltage: ±30 V or better VI. Channel switching time: ≤10 ms or better, or sufficiently fast to meet the specified sequential electrochemical measurement requirements. **D. ±20 A Booster Upgrade** I. The offered potentiostat shall have provision for future expansion using a compatible high-current booster/power stage capable of providing at least ±20 A, without requiring replacement of the main control system. II. Maximum current: ±20 A or better III. Compliance voltage range: ±20 V or better IV. Potential range: ±10 V or better V. Bandwidth: 20 kHz or better **E. Software** I. The potentiostat shall be supplied with comprehensive licensed software for instrument control, experimental procedure development, data acquisition, real-time visualization, data analysis and reporting. The software shall be compatible with the computer/operating system supplied with the instrument. All software and licenses required for operation of the offered system and the specified electrochemical techniques shall be included and shall be perpetual. II. The software shall meet the following minimum functional requirements: a) Experiment design and automation: The software shall allow creation, modification, saving and execution of electrochemical measurement		

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		procedures. It shall support user-defined experimental sequences involving multiple electrochemical techniques. Facility for loops/repetitions, variables, conditional or logical operations, and automated sequential execution of measurement steps shall be available. Commonly used measurement procedures/templates shall be available and/or user-configurable. Procedures shall be saveable and reusable for repeat measurements and sharing of validated methods. b) Real-time data acquisition and visualization: The software shall provide real-time acquisition and graphical display of electrochemical measurement data during an experiment. It shall allow simultaneous visualization of relevant measured/calculated parameters and enable the user to monitor experimental progress without interrupting the measurement. Graphical functions shall include appropriate axis scaling, zooming, overlay/comparison of datasets and multiple-axis plotting, wherever applicable. c) Electrochemical data analysis: The software shall provide integrated tools for processing and analysis of electrochemical data. Appropriate analysis capabilities shall include curve fitting, baseline correction, peak analysis, Tafel analysis, corrosion-related analysis/calculations and other standard electrochemical data-processing functions applicable to the supported techniques. d) EIS acquisition and analysis: The software shall support acquisition, visualization, processing and analysis of Electrochemical Impedance Spectroscopy (EIS) data over the frequency range supported by the offered instrument. It shall provide commonly used representations including Nyquist, Bode and phase plots. Equivalent-circuit fitting and simulation using commonly used electrochemical circuit elements/models shall be supported. The software shall also provide facilities for comparison of multiple EIS spectra and analysis of multiple datasets/batches. Real-time visualization of EIS data during measurement shall be available. e) Supported electrochemical techniques: The software shall support the electrochemical techniques required for corrosion, coating, fuel-cell and general electrochemical research, including, as applicable, Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Chronoamperometry (CA), Chronopotentiometry (CP), Electrochemical Impedance Spectroscopy (EIS), Differential Pulse Voltammetry (DPV), Square Wave Voltammetry (SWV), galvanostatic charge/discharge and Mott-Schottky analysis.		

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		The software shall also support linear polarization/polarization resistance measurements and Tafel analysis for corrosion studies. Equivalent measurement techniques or nomenclature providing the same functionality shall be acceptable. f) External device integration: The system/software shall provide provision for interfacing and/or synchronizing with external instruments or accessories through suitable analog/digital I/O, trigger signals, communication interfaces or equivalent means, wherever supported by the offered system. This shall enable integration with other characterization or experimental equipment for combined/hyphenated electrochemical measurements. g) Programming and external control: A documented Software Development Kit (SDK), Application Programming Interface (API), scripting interface or equivalent programming facility shall be available for external control of the potentiostat, automated execution of measurements and retrieval of experimental data. The interface should permit integration with commonly used scientific programming/automation environments such as Python, LabVIEW or equivalent environments. No particular programming language or third-party software platform shall be mandatory provided equivalent external control and automation functionality is available. h) Data handling and export: The software shall permit viewing of measured current, potential/voltage, time and other relevant experimental parameters in graphical and/or tabular form, as applicable. Experimental data shall be exportable in commonly used non-proprietary formats such as CSV, ASCII/text or equivalent for further processing using third-party software. Graphs/plots shall be exportable in publication-quality vector and/or high-resolution image formats. i) Software licensing and updates: The required software license(s) for operation, data acquisition and analysis shall be supplied with the system. The bidder shall clearly specify the type and validity of the supplied license, the number of installations/users permitted, and the policy for software updates/upgrades. Any software modules required to perform the quoted electrochemical techniques shall be included in the offered configuration. j) Documentation and user support: User manuals, operating instructions and/or tutorials for the supplied software shall be provided. The software shall provide facilities for saving experimental methods/procedures and associated measurement parameters to		

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		facilitate reproducibility and reuse of established experimental protocols. **F. Computer** A suitable computer/workstation shall be supplied for instrument control, data acquisition and analysis, fully compatible with the offered potentiostat and software. Minimum requirements: I. Processor: 64-bit multi-core processor with performance equivalent to or better than a current-generation Intel Core i7 processor II. RAM: 16 GB III. Storage: 500 GB SSD IV. Graphics: Integrated or discrete graphics adequate for the supplied acquisition/analysis software V. Monitor: 27-inch LCD display, Full-HD or better VI. Keyboard and optical mouse VII. Minimum 3 suitable USB/data-interface ports or equivalent connectivity required for the complete system. **G. Accessories, Scope of Supply, Warranty and After-Sales Support** I. Corrosion Cell Setup: Complete corrosion measurement cell setup compatible with the offered potentiostat/galvanostat and suitable for standard three-/four-electrode corrosion experiments. The setup shall include all necessary cell components, connectors, electrode holders and accessories required for operation. (Quantity - 1) II. Specimen / Sample Holder: Corrosion specimen holder suitable for holding flat metallic/coated samples during electrochemical corrosion measurements. The holder shall provide reliable electrical contact and expose a defined sample area to the electrolyte. Materials exposed to electrolyte shall be chemically resistant and suitable for commonly used corrosion test electrolytes. (Quantity - 4) III. General-purpose Sample Holder: Suitable sample/electrode holder compatible with the supplied corrosion cell(s) and capable of accommodating commonly used laboratory samples/electrodes. Equivalent or superior holder configurations shall be acceptable. (Quantity - 4) IV. Standard Electrochemical Corrosion Cell: Approximately 100 mL capacity corrosion/electrochemical cell with minimum five ports or equivalent arrangement, suitable for working electrode/specimen, counter electrode, reference electrode and other required accessories. The cell shall be chemically resistant and suitable		

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		for routine corrosion/electrochemical testing. (Quantity - 1) V. Platinum Counter Electrode: Platinum mesh counter/auxiliary electrode, approximately 10 mm × 10 mm or larger/equivalent effective surface area, complete with suitable electrical connection and compatible with the supplied corrosion cell. (Quantity - 8) VI. Reference Electrode: Ag/AgCl reference electrode or equivalent stable reference electrode suitable for aqueous corrosion/electrochemical measurements, complete with compatible connection and cell-fitting arrangement. (Quantity - 8) VII. Flat Corrosion Cell: Approximately 100 mL flat corrosion test cell suitable for electrochemical testing of flat specimens/coatings without requiring preparation of the complete specimen as a conventional immersed electrode. The setup shall include suitable sealing arrangement, sample mounting/holding components and necessary electrodes/accessories for operation. (Quantity - 1) VIII. Cell Cables and Connections: Complete set of cell cables, leads, connectors, clips/adapters and other interfaces required to connect the supplied cells and electrodes to the potentiostat/galvanostat. No additional essential cable/connector shall be required for normal operation of the quoted configuration. (Set – 4 pair) IX. Dummy/Test Cell: Suitable dummy/test cell or equivalent verification device for checking basic potentiostat and EIS functionality and for routine system verification/troubleshooting. (Quantity - 1) X. Consumables / Spares for Initial Operation: All essential seals, O-rings, gaskets, fittings and other minor consumables required for installation, demonstration and initial operation of the supplied corrosion cells shall be included. **H. Comprehensive Warranty** I. The complete system, including potentiostat, EIS hardware, supplied modules, multiplexer, computer, interfaces and other electronic/electromechanical accessories, shall carry a comprehensive warranty of a minimum of three (3) years from the date of successful installation, commissioning and acceptance**.** II. The comprehensive warranty shall include parts, labour, service-engineer visits, travel, boarding/lodging, transportation/freight of equipment or modules requiring repair, and return transportation to IIT Bombay. No additional charges shall be payable by IIT Bombay for warranty service. III. Consumable items having a defined service life may be excluded from comprehensive warranty; however, the bidder shall clearly identify such items		

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		in the technical bid. Any item not specifically declared as a consumable shall be treated as part of the supplied system for warranty purposes. IV. Warranty replacement/repair shall not adversely affect the original warranty entitlement. Any replaced component shall carry the remaining system warranty or the manufacturer's standard warranty for the replaced component, whichever is longer. **I. Spare Parts, Accessories** I. The bidder shall indicate the recommended replacement interval/service life, wherever applicable, for consumable components such as reference electrodes, seals, O-rings and other routinely replaced items. II. The bidder/OEM shall confirm availability of essential spare parts, accessories and service support for a minimum period of 7 years after successful installation/commissioning of the equipment. **J. Delivery, Transportation, Loading/Unloading and Installation** I. The quoted price shall be inclusive of packing, forwarding, insurance, freight/transportation, delivery at IIT Bombay, loading/unloading, movement up to the designated laboratory/site, unpacking, assembly, installation, commissioning, testing and demonstration of the complete system. II. The supplier shall be responsible for safe transportation and delivery of the equipment and all accessories up to the designated installation location at IIT Bombay. Any damage occurring before successful delivery/installation shall be rectified/replaced by the supplier without additional cost to the Institute. III. Installation shall include installation/configuration of all supplied hardware modules, accessories, computer, instrument-control software, EIS/analysis software, licenses, drivers and communication interfaces required for operation of the system. IV. All necessary interconnecting cables, adapters, connectors, power cables and minor installation accessories required to make the system fully operational shall be included in the quoted price. **K. Training Scope and Completion Criteria** I. The supplier/OEM shall provide on-site comprehensive application and operation training at IIT Bombay for a minimum of 2 working days for BETIC users, at no additional cost. II. Training shall cover instrument operation; electrode/cell connections; corrosion cell and flat-cell setup; CV/LSV; chronoamperometry/chronopotentiometry;		

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		corrosion polarization and Tafel analysis; EIS measurement and equivalent-circuit analysis; method/procedure creation; data analysis/export; routine verification; basic troubleshooting; care of reference/counter electrodes; and safe operation of the system. III. Training shall also cover operation of the modular/expandable features supplied with the system and basic procedure for integration of future compatible modules/accessories. IV. Training shall be considered complete only after users are able to independently set up a cell, configure and execute a representative electrochemical measurement, acquire and analyse the data, save/export the results, and perform basic system verification using the supplied dummy/test cell or equivalent verification method. V. Training material, operating manuals, standard operating procedures and relevant application notes shall be provided in electronic form. A basic SOP covering system startup, shutdown, electrode connection, routine measurement and system verification shall be provided. **L. After-Sales Service and Response Time** I. The bidder/OEM shall have arrangements for technical and service support in India and shall provide details of the service contact/escalation mechanism with the bid. II. During the warranty period, initial technical response shall be provided within 2 working days of reporting a fault. Where the problem cannot be resolved remotely, an on-site service visit shall normally be arranged within 5 working days, subject to access/site requirements. III. If the equipment/module has to be transported to a service facility during warranty, packing, insurance, transportation to the service facility and return transportation to IIT Bombay shall be entirely in the supplier's scope and cost. IV. After every service intervention, a service report indicating the reported problem, diagnosis, corrective action and replaced parts shall be provided. V. AMC for 3 (three) years after warranty period.		

Terms and Conditions:

a) 100% payment shall be made by ICICI Foundation on behalf of IIT Bombay within 30 days from the date of successful delivery and installation.