

PARSTAT[®] MC Family

multi-channel potentiostat / galvanostat

MORE

MORE... potentiostat models
MORE... dynamic current range
MORE... polarization voltage
MORE... **capability** in one chassis



Isn't it time your potentiostat did **MORE?**

Designed from the ground up to protect your valuable data by the only Engineers in the field with 50+ years of potentiostat design and development experience the PARSTAT® MC gives you MORE...

- MORE... dynamic useable current range**
- MORE... polarization voltage**
- MORE... capability in a single chassis**
- MORE... potentiostat models to choose from**



When a chassis isn't just a box...

The foundation of the PARSTAT MC is the smart-design of the chassis which does far more than just house the potentiostats. It is purpose built to accept all available potentiostat models to tailor fit your new instrument to your specific application demands without paying for capability you simply do not require. The chassis utilizes user-replaceable modules for industry-leading robustness and serviceability. The system is designed to allow for additional modules to be added or removed without impacting on-going experiments ("Hot-Swappable") while a buffer protects your data from communication interruption or delay which leads to higher productivity for you and your laboratory.

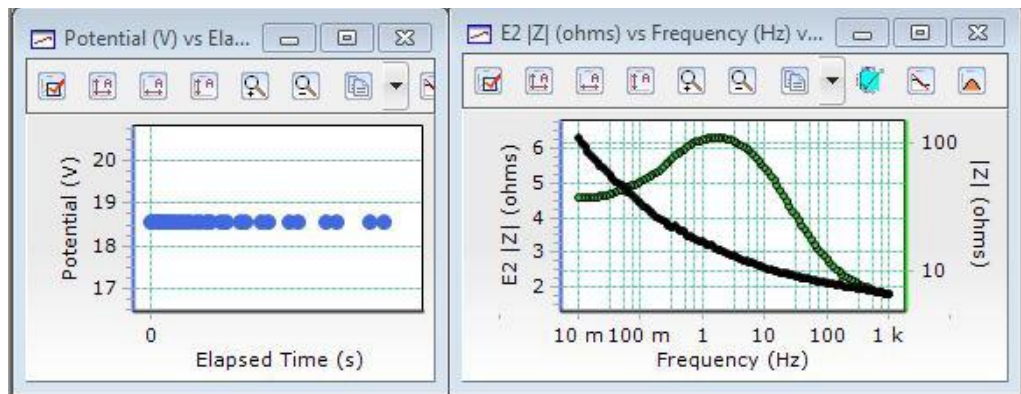
- Provides power, communication and thermal dissipation to different models of channels
- Constructed completely of user-replaceable functional blocks: Power Supply, Backplane, and Fans. The chassis will never have to leave your lab once it is installed
- Designed with footprint in mind. Maximizes valuable bench space and fits within a standard rack
- Intelligent management of data transfer through on-board buffering. Protects against communication interruptions and allows for high-speed data acquisition experiments
- Electrical isolation of each channel is maintained allowing multiple working electrodes to be controlled. Asynchronous experiments will not impact each other
- Manages the installation and removal of channels as to not influence ongoing experiments

PARSTAT® MC 2000A

multichannel potentiostat/galvanostat

The potentiostat family of the PARSTAT MC has reset expectations with the inclusion of the unparalleled research grade PMC 2000A potentiostat/galvanostat. With market leading specifications in current range, input impedance, applied voltage range and frequency range, all as standard features of the PMC 2000A, it sits atop our potentiostat family and the multi-channel potentiostat market-place.

Compliance Voltage	± 30 V
Polarization Voltage	± 30 V, ±6 V
Standard Maximum Current	1 A
Standard Lowest Current Range	4 nA
Number of Current Ranges	10 ranges
EIS Frequency Range	7 MHz to 10 μHz
Data Acquisition Rate	1000 kS/sec
PMC-2000 PSTAT Card	AC/DC
Auxiliary Voltage (6-WIRE)	Standard
Connectivity	USB



Using the 6-WIRE function of the PMC-2000A, a single Potentiostatic EIS experiment simultaneously measures the impedance of a single battery (black, 2-6 Ohms) and 2-battery stack (green, 10-100 Ohms) of 9 Volt commercial batteries. Even in its standard configuration without a booster or option, the PMC-2000A determines one of these batteries dominates the impedance of the stack, though still producing 18 V DC.

feature

allows for



High Frequency EIS
7 MHz

Data Acquisition Rate
1000 kS/Sec

Compliance Voltage
30 V

Polarization Voltage
30 V Range

6 V Range

6-WIRE

Solid-state energy materials analysis

Fast transients in electrochemical capacitors

Studying stacks up to: 6 Li-ion batteries or 20 NiMH batteries

Allows the study of Pb-Acid batteries

Accuracy for single cell tests

Simultaneous DC and EIS measurements of Anode/Cathode or a single cell during stack testing

Kinetics and mechanism investigations

Fast Scan Rate CVs for detection of biological species and rapid kinetics

Tolerates the use of smaller counter electrodes (CE), frits on CE and nonaqueous electrolyte

Large voltage fields for electrophoretic deposition

Resolution for aqueous testing

Additional sensor measurements and multiple cell impedances

Determination of uncompensated resistance for iR compensation

Oversampling and averaging for noise reduction

Studies in low conductivity environments such as rebar in concrete

Anodization of Titanium or materials that form robust oxides

Resolution for LPR and ZRA tests

Measurements of a pH probe or compliance voltage



PMC
1000

PWR
OVLD

AUX

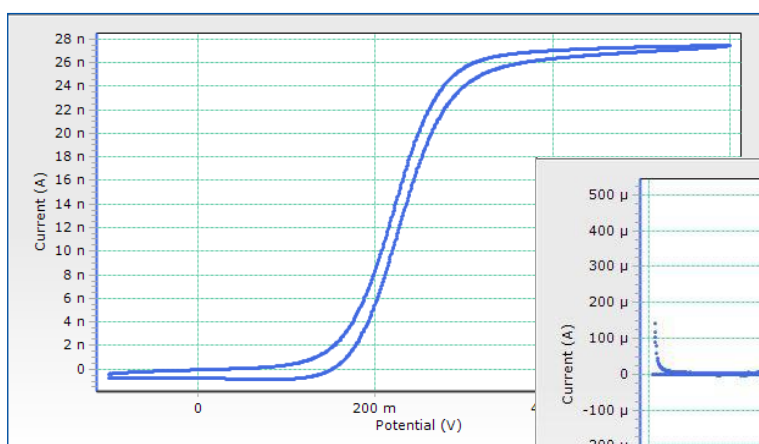
ANALOG

PARSTAT® MC 1000

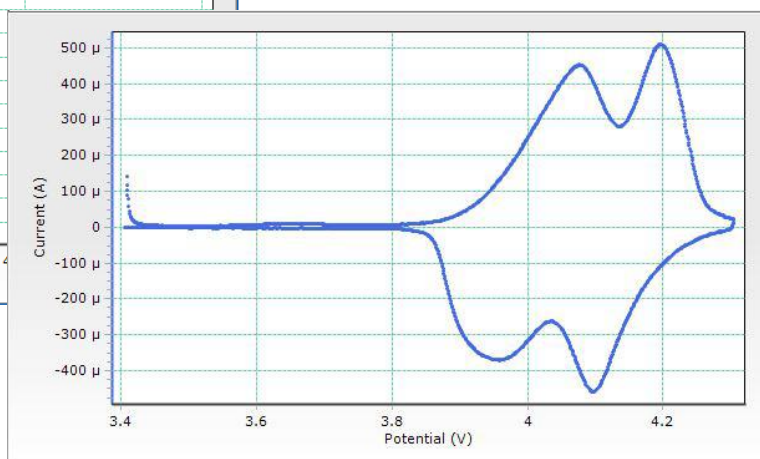
multichannel potentiostat/galvanostat

The PMC-1000 potentiostat cards are designed with the widest range of applications in mind. With the widest native current range of the PARSTAT MC line the PMC-1000 cards allow for the complete characterization of low current nano devices as well as high current batteries all with a single potentiostat card. This current range width is not available from any other manufacturer without the addition of low current amplifiers or boosters which add significant additional cost and take up valuable chassis space. The PMC-1000 cards are configured with ten (10) current ranges which allows for a full palette of applications and techniques from Corrosion to Energy Storage.

Compliance Voltage	± 12 V
Polarization Voltage	± 10 V
Standard Maximum Current	2 A
Standard Lowest Current Range	4 nA
Number of Current Ranges	10 ranges
EIS Frequency Range	1 MHz to 10 μHz
Data Acquisition Rate	500 kS/sec
PMC-1000 PSTAT Card	AC/DC
PMC-1000/DC PSTAT Card	DC only
Connectivity	USB



Cyclic Voltammogram of a Pt ultramicroelectrode in a ferrocene solution



Cyclic Voltammogram of a Coin Cell (CR2032) Li-ion battery.

feature

allows for



Energy

**High Current
2 A Standard**

Market leading high current bandwidth and accuracy

**Low Current
4 nA Standard**

Development of nanobatteries



Physical Echem

Application of large pulses and use of high surface area electrodes

Analysis of ultramicro and nanoelectrodes



Corrosion

Study of large sample

Determination of low corrosion rates; EIS measurements on coatings



Current Expansion Options

Low Current Interface

The Low Current Interface is ideal for applications requiring low current accuracy and resolution. Applications such as ultramicroelectrodes, coatings research, corrosion testing of bio-implants, and sensor research are all areas where greater current sensitivity may be needed.



The Low Current option can be purchased at any time as a plug-in option. It consists of an interface cable to connect to the PARSTAT MC, a main body containing the high input impedance electrometer, additional current ranges, and the cell leads which are attached to the PARSTAT MC system. The entire system is then calibrated with the built-in DC calibration routine.

Model Number	Option
VersaSTAT-LC	Low Current Interface

Power Boosters

Current extending boosters add to the already impressive high current capabilities of the PARSTAT MC potentiostat cards by extending the current ranges to either 5 Amps or 10 Amps. Designed specifically for the PARSTAT MC system, these boosters are capable of both DC and EIS (AC) experiments and can be installed directly into the PARSTAT MC chassis alongside any of the PMC cards that you have chosen instead of requiring a booster-only chassis. Not only does this save you money on your project but it also helps you reduce the overall space your new system will occupy in your laboratory. These boosters can also be added after your purchase and are field-upgradeable thanks to the design of the PARSTAT MC chassis.

Model Number	Option
PMC BOOSTER5A	PMC Internal Booster -1 to +6 V, 5 A
PMC BOOSTER10A	PMC Internal Booster -1 to +6 V, 10 A

Accessories

Glassware

Corrosion Cell

- The Corrosion Cell Kit is ideal for testing and evaluation of metal specimens in corrosive environments. It is fashioned after a well known cell configuration and is a standard in many ASTM methods.

Model Number	Option
K0047	Corrosion Cell Kit

Flat Cell

- The practical design of the Flat Cell makes it simple and easy to use for corrosion and/or coatings research. It can accommodate a wide range of electrode sizes, eliminating the need for machining or special mechanical procedures. It disassembles quickly and easily, operates with a 250 mL sample volume and simplifies electrochemical measurements.

Model Number	Option
K0235	Flat Cell Kit

Micro-Cell Kit

- The Micro-Cell Kit comes as a complete kit to which you need only add the working electrode and electrolyte of your choice. A Pt Wire Counter Electrode and Ag/AgCl Reference Electrode are included in addition to a Purge Tube Assembly that allows for either purging of the bulk solution or providing a blanket purge over the solution during the experiment to prevent atmospheric gases from dissolving back into solution.

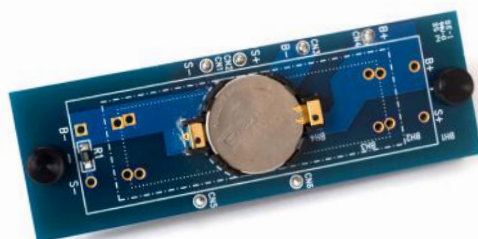
Model Number	Option
K0264	Micro-Cell Kit

Battery Holders



Through our collaboration with the world's leading battery cycler manufacturer, MACCOR, we are proud to offer battery holders designed specifically for the PARSTAT MC connect directly to any of the PMC cards completely replacing the cell cable. This clean design provides for a cleaner lab area, cleaner applied signal and ultimately a cleaner measured response. These holders are designed in a slim form factor to allow installation on adjacent PMC channels and are available in common/standard form factors including - 18650, AA, AAA, coin cell (2032) and a flexible screw-based design for custom cell geometries.

Model Number	Option
BUTTONCELL1	Button Cell Battery Holder PMC-1000
18650BATT1	18650 Battery Holder PMC-1000
AABATT1	AA Battery Holder PMC-1000
AAABATT1	AAA Battery Holder PMC-1000
2032BATT1	Coin Cell Battery Holder PMC-1000
BUTTONCELL2	Button Cell Battery Holder PMC-2000A
18650BATT2	18650 Battery Holder PMC-2000A
AABATT2	AA Battery Holder PMC-2000A
AAABATT3	AAA Battery Holder PMC-2000A
2032BATT2	Coin Cell Battery Holder PMC-2000A



VersaStudio software Versatile Software with Powerful Research Capabilities

The PARSTAT MC operates within the popular VersaStudio software which provides access to a full suite of electrochemical tests. This range of experiments is specifically designed to assist researchers in Energy Storage, Corrosion, and Physical Electrochemistry, including Voltammetry and Pulsing applications.

The PMC-1000/DC card without FRA runs all of the DC experiments. The PMC-1000 and PMC-2000A build on that base function by providing access to AC experiments for conducting Electrochemical Impedance Spectroscopy (EIS) tests, which can be run individually or combined with available Advanced Actions to execute powerful, flexible sequences.

VersaStudio software provides full access to the capabilities of the PARSTAT MC, including the ultra low current option and high current boosters when present. An impressive list of electrochemical experiment types are provided that can be run individually or combined in powerful experimental sequences.

- Flexible experiment setup that can automatically sequence the potentiostatic, galvanostatic and impedance capabilities of the PARSTAT
- Advanced actions such as message prompts, external applications prompts, and email notification are available to add even more flexibility and functionality to VersaStudio
- Powerful yet easy Copy/Paste and Export capabilities for custom data analysis and/or data presentation outside of VersaStudio
- Display data in tabbed single or multiple graph windows with a wide variety of graphing options for both DC and EIS experiments
- DC data analysis and fitting routines including Line, Peak, Rp, and Tafel Fits, as well as special graphing options for Capacity vs. Cycle Number, Coulombic efficiency, Corrosion Rate vs. Time, and EC Noise
- Circle fitting for basic EIS data analysis, and estimation of cell parameters such as solution resistance and polarization resistance
- Comprehensive EIS analysis and fitting techniques are available by importing data into the popular ZSimpWin Software option package
- Cut, Copy, Paste experiment actions for more convenient setup of experimental sequences

VersaStudio provides a comprehensive range of facilities, yet is incredibly easy to use making it the ideal software for both novice and advanced users. Basic experiments such as cyclic voltammetry are up and running with surprisingly few menu entries. Using the carefully designed menus, even complicated experimental sequences (e.g. battery charge / pulse discharge / EIS or multi-step electrochemical applications) are simple and logical to set up.



Energy



The energy systems package provides techniques designed for testing and research of energy devices such as batteries, supercapacitors, and fuel cells. These techniques include:

- Static (constant) applied techniques for current, potential, power, and resistance aimed at charging/discharging energy devices
- Multi-Vertex Scan technique for application of a linear ramp voltage with up to three separate vertices
- Cyclic Charge/Discharge (CCD) techniques which can be easily modified for addition or subtraction of different actions including EIS if system is properly equipped
- Data acquisition variables to control the volume of data acquired, and stop limits for actions that include Potential (V), Current (A), and Capacity (Ah)

Impedance



Electrochemical Impedance Spectroscopy (EIS) capabilities are standard on all PARSTAT MC 1000 and 2000A channels. This provides a range of fully integrated techniques for studying the impedance of electrochemical cells, sensors, batteries / fuel cells, corrosion / coatings etc.

- Potentiostatic EIS - widely used for the analysis of electrochemical, battery and corrosion cells providing information on electrode kinetics, diffusion and mass transfer
- Galvanostatic EIS - particularly useful for characterizing batteries and fuel cells under DC current load conditions
- EIS analysis of batteries and fuel cells using the high current capability or external power boosters
- Automatic charge / discharge / EIS experiment sequencing for battery, supercapacitor and fuel cell lifetime investigations
- Automatic sequencing of loop, EIS and delay steps to investigate trends of impedance over time, (e.g. the development of corrosion induced defects in a coating)
- Automatic sequencing of EIS and linear polarization resistance (LPR) techniques to verify corrosion rate data and to provide impedance analysis of corrosion mechanisms

Corrosion



The corrosion system package provides a range of DC electrochemical measurement techniques that are of particular importance for the corrosion scientist investigating coatings, rebar corrosion, inhibitors, biomedical implants etc. These techniques include:

- Coatings and Inhibitor Evaluation: EIS, Rp-versus-Time, Loop functions
- Uniform Corrosion: Linear Polarization (LPR), Split LPR, Tafel
- Non-uniform Corrosion: Cyclic Non-uniform Corrosion: Cyclic Polarization, Potentiodynamic
- Galvanic Couples: Galvanic Corrosion, Electrochemical Noise in ZRA mode
- Disbondment: Potentiostatic, Galvanostatic

Physical Electrochemistry



The advanced voltammetry package provides a range of scan, step and pulse techniques that are of importance in analytical electrochemistry, microelectrode studies, sensor research, electrodeposition and battery/fuel cell analysis.

- Normal and differential pulse voltammetry - used in analytical electrochemistry applications e.g. for trace metal analysis
- Recurrent pulse techniques - used in battery / fuel cell analysis (including equivalent series resistance ESR analysis and GSM / CDMA mobile phone pulse test applications). Also used in electrodeposition applications
- Chronoamperometry and chronopotentiometry used in many electrochemical applications
- Control of power booster options for testing high power cells for electrodeposition and energy storage applications

Voltammetry / Pulse

- Open Circuit
- Linear Scan Voltammetry
- Cyclic Voltammetry (single)
- Cyclic Voltammetry (multiple cycles)
- Staircase Linear Scan Voltammetry
- Staircase Cyclic Voltammetry (single)
- Staircase Cyclic Voltammetry (multiple cycles)
- Multi-Vertex Scan
- Chronoamperometry
- Chronopotentiometry
- Chronocoulometry
- Fast Potential Pulses
- Fast Galvanic Pulses
- Recurrent Potential Pulses
- Recurrent Galvanic Pulses
- Square Wave Voltammetry
- Differential Pulse Voltammetry
- Normal Pulse Voltammetry
- Reverse Normal Pulse Voltammetry

Corrosion

- Zero Resistance Ammeter (ZRA)
- Electrochemical Noise (EN)
- Galvanic Corrosion
- Cyclic Polarization
- Linear Polarization
- Tafel
- Potentiostatic
- Potentiodynamic
- Galvanostatic
- Galvanodynamic
- Split LPR
- Galvanic Control LPR

Energy

- Constant Current
- Constant Potential
- Constant Resistance
- Constant Power
- Current CCDPL
- Charge-Discharge

EIS

- CC-CV
- GITT
- PITT
- Power CCD
- Resistance CCD
- Potentiostatic EIS
- Galvanostatic EIS
- Mott-Schottky

Sequence

- Loop
- Time Delay
- Message Prompt
- Measure OC
- Auxiliary Interface
- Run External Application
- DAC Output Control
- Email
- Auto Current Range Setup

Pre-experiment

- Condition
- Deposition
- Equilibration
- Purge
- iR Determination

Specifications

PARSTAT MC 2000A

Compliance Voltage	± 30 V
Polarization Voltage	± 30 V (5 µV resolution, measured) ± 6 V (46 µV resolution, measured)
Standard Maximum Current	1 A
Standard Lowest Current Range	4 nA
Number of Current Ranges	10 ranges
EIS Frequency Range	7 MHz to 10 µHz
Data Acquisition Rate	1000 kS/sec
PMC-2000 PSTAT Card	AC/DC
Auxiliary Voltage (6-WIRE)	Standard
Connectivity	USB

PARSTAT MC 1000

Compliance Voltage	± 12 V
Polarization Voltage	± 10 V
Standard Maximum Current	2 A
Standard Lowest Current Range	4 nA
Number of Current Ranges	10 ranges
EIS Frequency Range	1 MHz to 10 µHz
Data Acquisition Rate	500 kS/sec
PMC-1000 PSTAT Card	AC/DC
PMC-1000/DC PSTAT Card	DC only
Connectivity	USB

- Each PARSTAT MC chassis can be configured with up to eight (10) potentiostat channels of any PARSTAT MC family variety. Each potentiostat card provides a wide range of functionality as standard and installs in the same chassis. Configure your system to meet your specific requirements.
- Channels can operate simultaneously for high-throughput routine testing, individually for different experiments on distinct cells or in a complex matrix of multiple electrodes in a single test environment. Additional channels can be added on-site by the user, even while other channels are in operation.
- Running on Princeton Applied Research's popular VersaStudio software the PARSTAT MC provides a platform to expand with you as your research needs grow and evolve.



www.princetonappliedresearch.com

Ordering Information

Configurable Modules:

PMC CHS08A	Chassis
PMC-1000	PSTAT Channel AC/DC
PMC-2000A	PSTAT Channel AC/DC
PMC AUX01	Digital AUX cable (1 m)
PMC ALG01	Analog AUX cable (1 m) PMC1000
PMC ALG02	Analog AUX cable (1 m) PMC2000A

Booster Options:

PMC Booster5A	Internal Booster -1 to ±6 V, ±5 V
PMC Booster10A	Internal Booster -1 to ±6 V, ±10 V
234625	PMC-2000 to PMC Booster Analog Cable
234626	PMC-1000 to PMC Booster Analog Cable
234637	PMC Booster Parallel Operation Kit

User Replaceable Modules:

PMC FAN01	Fan module
PMC BPLN01	Backplane module
PMC PWR01	Power supply module
223945	PMC-1000 Cell cable (2 m)
234272	PMC-2000A Cell Cable (2 m)



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Please see our website for a complete list of our global offices and authorized agents

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