PARSTAT 4000
potentiostat/galvanostat/ EIS Analyzer

For leading researchers in electrochemistry whose field of study demands performance, reliability, and versatility, the PARSTAT 4000 is a high-end electrochemical system that allows them to meet their present and future needs unlike any other system on the market today. With its wide-ranging specifications backed by a brand with a 50+ year history as the leader and most referenced line of research-grade potentiostats/galvanostats in the world, save a spot in the "Materials and Methods" section for the PARSTAT 4000... it's ready for your next project.

The PARSTAT 4000 builds on the performance-oriented PARSTAT series of systems with improved key specifications and much improved functionality and flexibility via the VersaStudio software interface. An impressive combination of performance and versatility, the PARSTAT 4000 is perfect for the majority of electrochemical applications and techniques carried out in the foremost laboratories throughout the world today.

- High current booster option for research in energy storage devices such as Li-ion batteries or supercapacitors.
- Low current sensitivity for DC and AC corrosion measurements on corrosion resistant materials such as bio-implant devices or new coatings technology.
- Fast data acquisition rate for capturing fast transients, applying fast pulse trains, or fast scans on microelectrodes.
- Built-in calibration components and circuits for any-time-calibrations assuring highly accurate measurements.
- Capable of "floating" for operation with grounded cells and electrodes.
- Front panel LCD with customer selectable parameters and custom text input
- Universal Serial Bus Interface (USB)
- VersaStudio® Software

Data Acquisition	
Data acquisition	3x18-bit 1M samples per second ADC's synchronized-voltage/current/aux
Time base resolution(min)	1µs (1M samples/second)
Automatic noise filters	enabled/disabled
Power amplifier (CE)	
Voltage compliance	± 48V
Current compliance	± 4A (standard) ± 20A (with 20A option)
Potentiostat bandwidth	3.75MHz (typical), 2mA range, 1k Ohm load
Stability settings	high-speed, high-stability
Slew rate	≥ 25V per µs typical (no load)
Rise time (-1.0V to +1.0V)	<100ns typical (no load)
Voltage Control (potentiostatic mode)	
Applied voltage range	± 10V
Applied voltage resolution (technique dependent)	for ± 10mV signal = 300nV for ± 100mV signal = 3µV for ± 1V signal = 30µV for ± 10V signal = 300µV
Applied voltage accuracy	± 0.2% of value ± 2mV
Maximum scan rate	5000Vs^{-1} with 10mV step
Maximum scan range / resolution	± 10V / 300µV
Current Control (galvanostat mode)	
Applied current range	± full scale (depends on range selected) ± 4A (standard)
Applied current resolution	± 1/32,000 x full scale
Applied current accuracy	± 0.2% of reading, ±0.2 % of range, ±2pA
Maximum current range / resolution	± 4A / 123µA
Minimum current range / resolution	± 40pA / 1.5fA
Electrometer	
Max input range	± 10V
Bandwidth	≥ 10MHz (3dB)
Input impedance	≥ $10^{13}\Omega$ in parallel with ≤ 2pF (typical)
Leakage current	≤ 2pA at less than 25°C (typical)
Voltage Measurement	
Voltage range	± 10V
Voltage resolution	1.5µV (2.5V range, X50 gain applied)
Voltage accuracy	± 0.2% of reading, ± 2mV
Current Measurement	
Current ranges (Auto-ranging)	20A to 40pA (13 ranges)
Current resolution	1.5fA (40pA range)
Current accuracy (DC)	2nA to 20A, ±0.2% of reading, ±0.2% of range 40pA to 200pA ± 0.5% range, ±4pA
Bandwidth	>5MHz (signal ≥20mA range typical)
Bandwidth limit filter	Yes, 7 total
IR Compensation	
Positive feedback	Yes
Dynamic IR	Yes
Impedance (EIS) Option	
Mode	Potentiostatic/Galvanostatic
Frequency range	10µHz to 5MHz
AC amplitude range	0.1 - 1000mV RMS
Sweep	Linear or Logarithmic

PARSTAT 2273
potentiostat/galvanostat

The PARSTAT 2273 is the ultimate potentiostat/galvanostat/FRA, boasting superior quality and high reliability. The 2273's exceptional impedance capability, resolution, speed, high current, and high compliance voltage continues to be the standard against which all other systems are measured.

The 2273 is designed to be the most comprehensive potentiostat/galvanostat/FRA in your laboratory. We have incorporated customer feedback to provide not only more internal maximum current but the ability to boost up to 20A and the ability to interface all the ancillary equipment customers need today for their unique research.

The PARSTAT 2273 provides most all the capabilities you need in your laboratory:

- 2A current max. (20A boosted)
- 100V compliance
- 1.2fA current resolution
- $>10^{13}$ Ω input impedance
- <5pF of capacitance
- 10μHz to 1MHz built in analyzer for impedance

The PARSTAT 2273 is designed to support the following applications:

- Research Electrochemistry
- Corrosion
- Sensors
- Batteries/Fuel Cells
- Electrodeposition/Plating
- Biomedical Applications

OPTIONS:

- 8A booster option
- 10A booster option
- 20A booster option

Power Amplifier	
Compliance Voltage	±100V
Maximum Current	±2A
Rise Time	<250ns (No Load)
Slew Rate	>15V/μs (No Load)
System Performance	
Minimum Time Base	20μs
Minimum Potential Step	2.5μV
Noise and Ripple	<50μV/rms (typical)
Minimum Current Range	2nA (hardware)
Minimum Current Range	40pA (after 50X gain)
Minimum Current Resolution	1.2fA
iR Compensation	
Positive Feedback Range	2000MΩ to 2Ω (depending on current range)
Current interrupt	16 bit DAC Potential Error correction
Current Measurement	
Ranges	12 decades, 2A to 40pA (with internal gain applied)
Accuracy (dc)	20μA to 2A: <0.4% Full Scale 20nA and 1μA Ranges: <0.5% 2nA < 0.75%
Differential Electrometer	
Input Bias Current	< 5pA at 25°C
Max. Voltage Range	± 10V
Max. Input Voltage Differential	± 10V
Bandwidth	3dB @ >15MHz
Common Mode Rejection	>80 dB at 100Hz
	>60dB at 100 kHz
Input Impedance	$>10^{13}$ Ω in parallel with <5pF
Impedance (EIS)	
Mode	Potentiostatic / Galvanostatic
Frequency Range	10μHz to 1MHz
Minimum AC Voltage Amplitude	0.1mV RMS
Sweep	Linear or Logarithmic
Interface	
Digital inputs / Outputs	5 TTL logic outputs, 2 TTL logic inputs
Interface	
Ext In	±10V analog input. Input impedance is 4.0 k Ω
E Monitor	Front panel analog output of current readings.Range ±10V, 50Ω output impedance
I Monitor	Front panel analog output of current readings.Range ±10V, 50Ω output impedance, 0 to ±2V corresponds to ±full scale current range
Interface	
DAC Voltage Output	±10V range
	BNC Connector (for stirrers, rotating disk electrodes, etc.)
PC / Software	
Communications Interface	Universal Serial Bus (USB)
Software	PowerSUITE

VersaSTAT Series
potentiostat/galvanostat

TheVersaSTAT series is our most popular brand of potentiostats/galvanostats, combining over fifty years of Princeton Applied Research knowledge and expertise in the development of world leading electrochemical test products with advanced performance from the very latest measurement technology.

The versatility and power of the VersaSTAT systems are evident in every aspect of the system from the flexible, included VersaStudio software to the ability of the VersaSTAT's three high speed (500ksamples / second) analog to digital converters providing fully synchronized measurements of the cell voltage, cell current, and auxiliary voltage input. An optional built-in frequency response analyzer (FRA) is able to characterize a wide range of electrochemical cells. Since the FRA is fully integrated into the system, it allows for high speed switching between DC and EIS measurements.

The VersaSTAT series is designed to support the following applications and more:

- Research Electrochemistry
- Batteries/Fuel Cells/ Super Capacitors
- Electrodeposition/Plating
- Sensors
- Biomedical Applications
- Corrosion

OPTIONS:

- Built-in 1 MHz Frequency Response Analyzer (FRA)
- Built-in 2A High Current Booster
- External 8A, 10A, or 20A Power Booster
- Low Current Interface (LCI)
- Advanced Auxiliary Interface (AA)

The impressive combination of the performance and versatility makes the VersaSTAT series a tremendous value for researchers and scientists.

VersaSTAT 3
potentiostat/galvanostat

Data Acquisition	
Data Acquisition	3 x 16 bit 500k samples per secondADCs synchronized-voltage/current/auxiliary
Time Base Resolution (minimum)	10µs (100k samples/second)
Automatic Noise Filters	enabled/disabled
Power Amplifier	
Voltage Compliance	± 12V
Current Compliance	± 650mA (standard) ±2A (with 2A option)
Potentiostat Bandwidth	1 MHz
Stability Settings	high speed, high-stability
Slew Rate	> 8V per µs typical (no load)
Rise Time (-1.0V to +1.0V)	<350ns typical (no load)
Voltage Control (potentiostat mode)	
Applied Voltage Range	± 10V
Applied Voltage Resolution	for ±10mV signal = 300nV for ±100mV signal = 3µV for ±1V signal = 30µV for ±10V signal = 300µV
Applied Voltage Accuracy	±0.2% of value ±2mV
Maximum Scan Rate	5000Vs^{-1} with 50mV step
Maximum Scan Range	±10V / 300µV
Current Control (galvanostat mode)	
Applied Current Range	±full scale(depends on range selected) ±650mA (standard),±2A (with option)
Applied Current Resolution	±1/32,000 x full scale
Applied Current Accuracy	±0.2% of reading, ±0.2% of range
Max. Current Range/Resolution	±650mA /60µA
Min. Current Range/Resolution	±200nA /60pA
Electrometer	
Max. Input Range	±10V
Bandwidth	≥ 10MHz (-3dB)
Input impedance	≥ $10^{12}\Omega$ in parallel with ≤ 5pF (typical)
Leakage current	≤ 5pA at less than 25°C
CMRR	60dB at 100kHz (typical)
Voltage Measurement	
Voltage range	±10V
Minimum resolution	6µV
Voltage accuracy	±0.2% of reading, ±2mV
Current Measurement	
Current ranges	Auto-ranging (8 ranges) 650mA to 200nA (8 ranges) 2A to 200nA (with option)
Current resolution	6pA (200nA range)
Current accuracy (DC)	±0.2% of reading, ±0.2% of range
Bandwidth	1MHz (signal ≥ 2mA range typical)
Bandwidth limit filter	Yes
Impedance (EIS) Option	
Mode	Potentiostatic / Galvanostatic
Frequency range	10µHz to 1MHz
AC amplitude range	0.1 - 1000mV RMS
Sweep	Linear or Logarithmic
PC / Software	
Communication Interface	Universal Serial Bus (USB)
Software	VersaStudio®

VersaSTAT 4
potentiostat/galvanostat

Data Acquisition	
Data Acquisition	3 x 16 bit 500k samples per secondADCs synchronized-voltage/current/auxiliary
Time Base Resolution (minimum)	2µs (500k samples/second)
Automatic Noise Filters	enabled/disabled
Power Amplifier	
Voltage Compliance	± 12V
Current Compliance	± 1A (standard) ±2A (with 2A option)
Potentiostat Bandwidth	1MHz
Stability Settings	6 settings; high stability, 1Mhz-100 Hz
Slew Rate	> 8V per µs typical (no load)
Rise Time (-1.0V to +1.0V)	<350 ns typical (no load)
Voltage Control (potentiostat mode)	
Applied Voltage Range	± 10V
Applied Voltage Resolution	for ±10mV signal = 300nV for ±100mV signal = 3µV for ±1V signal = 30µV for ±10V signal = 300µV
Applied Voltage Accuracy	±0.2% of value ±2mV
Maximum Scan Rate	5000Vs^{-1} with 10mV step
Maximum Scan Range	±10V / 300µV
Current Control (galvanostat mode)	
Applied Current Range	±full scale(depends on range selected) ±1A (standard),±2A (with option)
Applied Current Resolution	±1/32,000 x full scale
Applied Current Accuracy	±0.2% of reading, ±0.2% of range ±200pA
Max. Current Range/Resolution	±1A / 60µA
Min. Current Range/Resolution	±4nA / 120fA
Electrometer	
Max. Input Range	±10V
Bandwidth	≥ 10MHz (-3dB)
Input impedance	≥ 10^{12} Ω in parallel with ≤ 5pF (typical)
Leakage current	≤ 5pA at less than 25°C
CMRR	60dB at 100kHz (typical)
Voltage Measurement	
Voltage range	± 10V
Minimum resolution	6µV
Voltage accuracy	±0.2% of reading, ±2 mV
Current Measurement	
Current ranges	Auto-ranging (10 ranges) 1A to 4nA (10 ranges) 2A to 4nA (with option)
Current resolution	120 fA (4nA range)
Current accuracy (DC)	20nA to 2A ±0.2% of reading, ±0.2% of range 4nA <0.5% ± 20pA
Bandwidth	1MHz (signal ≥2mA range typical)
Bandwidth limit filter	Yes, five total
Impedance (EIS) Option	
Mode	Potentiostatic / Galvanostatic
Frequency range	10µHz to 1MHz
AC amplitude range	0.1 - 1000mV RMS
Sweep	Linear or Logarithmic
PC / Software	
Communication Interface	Universal Serial Bus (USB)
Software	VersaStudio®

Superior to the VersaSTAT 3

VersaSTAT 3F
potentiostat/galvanostat

Data Acquisition	
Data Acquisition	3 x 16 bit 500k samples per secondADCs synchronized-voltage/current/auxiliary
Time Base Resolution (minimum)	10µs (500k samples/second)
Automatic Noise Filters	enabled/disabled
Power Amplifier	
Voltage Compliance	± 12V
Current Compliance	± 650mA (standard) ±2A (with 2A option)
Potentiostat Bandwidth	1 MHz
Stability Settings	6 settings; high stability, 1MHz-100Hz
Slew Rate	> 8V per µs typical (no load)
Rise Time (-1.0V to +1.0V)	<350ns typical (no load)
Voltage Control (potentiostat mode)	
Applied Voltage Range	± 10V
Applied Voltage Resolution	for ±10mV signal = 300nV for ±100mV signal = 3µV for ±1V signal = 30µV for ±10V signal = 300µV
Applied Voltage Accuracy	±0.2% of value ±2mV
Maximum Scan Rate	5000Vs^{-1} with 10mV step
Maximum Scan Range	±10V / 300µV
Current Control (galvanostat mode)	
Applied Current Range	±full scale(depends on range selected) ±650mA (standard),±2A (with option)
Applied Current Resolution	±1/32,000 x full scale
Applied Current Accuracy	±0.2% of reading, ±0.2% of range ±200pA
Max. Current Range/Resolution	±650mA / 60µA
Min. Current Range/Resolution	±4nA / 120fA
Electrometer	
Max. Input Range	±10V
Bandwidth	≥ 10MHz (-3dB)
Input impedance	≥ 10^{12} Ω in parallel with ≤ 5pF (typical)
Leakage current	≤ 5pA at less than 25°C
CMRR	60dB at 100kHz (typical)
Voltage Measurement	
Voltage range	± 10V
Minimum resolution	6µV
Voltage accuracy	±0.2% of reading, ±2mV
Current Measurement	
Current ranges	Auto-ranging (10 ranges) 1A to 4nA (10 ranges) 2A to 4nA (with option)
Current resolution	120fA (4 nA range)
Current accuracy (DC)	20nA to 2A ±0.2% of reading, ±0.2% of range 4nA <0.5% ± 20pA
Bandwidth	1MHz (signal ≥ 2mA range typical)
Bandwidth limit filter	Yes, five total
Impedance (EIS) Option	
Mode	Potentiostatic / Galvanostatic
Frequency range	10µHz to 1MHz
AC amplitude range	0.1 - 1000 mV RMS
Sweep	Linear or Logarithmic
PC / Software	
Communication Interface	Universal Serial Bus (USB)
Software	VersaStudio®

Superior to the VersaSTAT 3

VersaSTAT MC

mulit-channel potentiostat/galvanostat

Princeton Applied Research recognizes that traditional single channel systems do not always satisfy the demands for economy and throughput, yet many multi-channel systems are designed to satisfy only specific markets and/or applications. The VersaSTAT MC was designed to have the broad capabilities of a research-grade single-channel electrochemical system along with the value and increased throughput provided by multi-channel systems.

Each VersaSTAT MC can be equipped with up to four (4) channels. The system can be ordered fully loaded, or for those with limited budgets, the VersaSTAT MC can be purchased initially with only a single channel then upgraded later to add additional channels or options as needed or budget permits. If more than four channels are needed, multiple units can interface to the same computer with all channels controlled independently from the VersaStudio software.

- Versatile performance in choice of 1-4 channels at an affordable price – the ideal choice for performance, productivity, and value
- ±650mA / ±10V polarization range as standard – ideal for most electrochemical applications including corrosion, sensors, and biomedical
- Impedance measurement capability standard on all channels simultaneously and/or independently from 10µHz to 1MHz with no separate analyzer required
- Options for each channel include ± 2A high current option and boosters up to 20A for battery, fuel cell, or electroplating applications
- High speed DC measurement and experiment sequencing (e.g. for step / pulse analysis)
- VersaStudio software designed for versatility and ease of use

OPTIONS:

- 2A high current option
- 20A Current Booster
- Advanced Auxiliary Interface

Data Acquisition	
Data Acquisition	3 x 16 bit 500k samples per secondADCs synchronized-voltage/current/auxiliary
Time Base Resolution (minimum)	10µs (100 k samples/second)
Automatic Noise Filters	enabled/disabled
Power Amplifier	
Voltage Compliance	± 12V
Current Compliance	± 650mA (standard) ±2A (with 2A option)
Potentiostat Bandwidth	1MHz
Stability Settings	high speed, high-stability
Slew Rate	> 8V per µs typical (no load)
Rise Time (-1.0V to +1.0V)	<350 ns (no load)
Voltage Control (potentiostat mode)	
Applied Voltage Range	± 10V
Applied Voltage Resolution	for ±10mV signal = 300nV for ±100mV signal = 3µV for ±1V signal = 30µV for ±10V signal = 300µV
Applied Voltage Accuracy	±0.2% of value ±2 mV
Maximum Scan Rate	5000Vs^{-1} (50 mV step)
Maximum Scan Range / Resolution	±10V / 300µV
Current Control (galvanostat mode)	
Applied Current Range ±650mA (standard),±2A (with option)	±full scale(depends on range selected)
Applied Current Resolution	±1/32,000 x full scale
Applied Current Accuracy	±0.2% of reading, ±0.2% of range
Max. Current Range/Resolution	±650mA / 60µA
Min. Current Range/Resolution	±200nA / 60pA
Electrometer	
Max. Input Range	±10V
Bandwidth	≥ 10MHz (-3dB)
Input impedance	≥ 10^{12} Ω in parallel with ≤ 5pF (typical)
Leakage current	≤ 5pA at less than 25°C
CMRR	60dB at 100kHz (typical)
Voltage Measurement	
Voltage range	± 10V
Minimum resolution	6µV
Voltage accuracy	±0.2% of reading, ±2mV
Current Measurement	
Current ranges	Auto-ranging (8 ranges) 650mA to 200nA (8 ranges) 2A to 200nA (with option)
Current resolution	6pA (200nA range)
Current accuracy (DC)	±0.2% of reading, ±0.2% of range
Bandwidth	1MHz (signal ≥ 2mA range typical)
Bandwidth limit filter	Yes
Impedance (EIS) Option	
Mode	Potentiostatic / Galvanostatic
Frequency range	10µHz to 1MHz
AC amplitude range	0.1 - 1000mV RMS
Sweep	Linear or Logarithmic
PC / Software	
Communication Interface	Universal Serial Bus (USB)
Software	VersaStudio®

Model 263A
potentiostat/galvanostat

The 263A potentiostat/galvanostat is the ideal system for many laboratories. Perfect for the budget conscious researcher who demands high performance. The 263A may be upgraded with many different options. This impressive combination of price and performance makes it a tremendous value for today's electrochemist or corrosion specialist.

The 263A provides all the capabilities you need in your laboratory:

- Computer controlled potentiostat and galvanostat operation
- 20V compliance and 200mA current output
- ±8V scan range
- Fast data acquisition (30µs)
- Optional full front panel control
- Impedance capable (requires external analyzer)
- Optional float capability (263A/99)
- Optional 2A current module (2A/263A)
- Optional auxillary input (263A/98)

Use the 263A in the following market segments:

- Research Electrochemistry
- Corrosion
- Sensors
- Batteries/Fuel Cells
- Electrodeposition/Plating
- Biomedical Applications

Power Amplifier	
Compliance Voltage	±20V
Maximum Current	±200mA
Rise Time	<1µs (no Load)
Slew Time	>1V/µs (No Load)

System Performance	
Minimum Time Base	30µs
Minimum Potential Step	250µV
Noise and Ripple	<50mV/rms (typical)
Minimum Current Range	100nA (hardware)
Minimum Current Range	1nA*
Minimum Current Resolution	2pA

iR Compensation	
Positive Feedback Range	20MΩ to 20Ω (depending on current range)
Current interrupt	12 bit DAC Potential Error Correction

Current Measurement	
Ranges	7 decades, 100mA to 100nA
Accuracy (dc)	10µA to 100µA: <0.4% Full Scale 100nA and 1µA Ranges: <0.5% ±5nA Full Scale

Differential Electrometer	
Input Bias Current	<50pA at 25°C
Max. Voltage Range	± 10V
Max. Input Voltage Differential	± 10V
Bandwidth	-3dB @ >4MHz
Offset Voltage	<100mV
Offset Temperature Stability	<50mV°C
Common Mode Rejection	>70dB at 100Hz
	>60dB at 100kHz
Input Impedance	$>10^{12}$ Ω in parallel with 20pf

General	
Power	90 - 130V ac or 200 - 260V ac, 50 - 60Hz
Dimensions	17.5" W x 18.5" D x 5.5" H
Weight	16 kg (35 lbs)
Temperature	0 - 50° C
Humidity	95% maximum relative humidity, non-condensing
Altitude	Up to 2,000 m

* This sensitivity is achieved through our proprietary application software

Specification Summary

	VersaSTAT 3	VersaSTAT 4	VersaSTAT 3F	VersaSTAT MC	PARSTAT 2273	Model 263A	PARSTAT 4000
Specification							
Compliance Voltage	±12V	±12V	±12V	±12V	±100V	±20V	±48V
Max Current Output	±650mA	±1A	±650mA	±650mA	±2A	±200mA	±4A
Rise Time typical (no load)	<350ns	<350ns	<350ns	<350ns	<250ns	<1µs	<100ns
Slew Rate (no load)	>8V/µs	>8V/µs	>8V/µs	>8V/µs	>15V/µs	>1V/µs	>25V/µs
Current Measurement							
Max Current Range	±2A	±2A	±2A	±2A	±2A	±100mA	±20A
Min Current Range	±200nA	±4nA	±4nA	±200nA	±2nA	±100nA	±40pA
Accuracy / Range	±0.2%	±0.2%	±0.2%	±0.2%	±0.4%	±0.4%	±0.2%
Min Resolution	6pA	120fA	120fA	6pA	1.2fA	2pA	1.5fA
Differential Electrometer							
Max Voltage Range	±10V	±10V	±10V	±10V	±10V	±10V	±10V
Input Impedance (typical)	$>10^{12}$	$>10^{12}$	$>10^{12}$	$>10^{12}$	$>10^{13}$	$>10^{11}$	$>10^{13}$
Input Capacitance	<5pF	<5pF	<5pF	<5pF	<10pF	<50pF	<2pF
Input Bias Current	<5pA	<5pA	<5pA	<5pA	<5pA	<20pA	<2pA
System Performance							
Max Scan Range	20V	20V	20V	20V	20V	16V	20V
ADC	16 bit	16 bit	16 bit	16 bit	16 bit	12 bit	18 bit
EIS Capable	Option	Option	Option	Yes	Yes	Option	Yes
Floating Capabilities	No	No	Yes	No	No	Option	Yes
Current Booster Option	2A - 20A	2A - 20A	2A - 20A	2A - 20A	8A - 20A	2A - 20A	20A
Computer Control							
Software	Versa Studio®	Versa Studio®	Versa Studio®	Versa Studio®	Power SUITE®	Power SUITE®	Versa Studio®
Communications Interface	USB	USB	USB	USB	USB	GPIB	USB

Please refer to individual product brochures for more detailed specifications

VersaSTAT LC
Low Current Interface

The VersaSTAT LC Low Current Interface is a plug-in, research grade option for the VersaSTAT Series of potentiostats/galvanostats, along with the PARSTAT 4000, designed for the measurement of ultra-low currents with greater accuracy and resolution than the base system. With the addition of a VersaSTAT LC option, any VersaSTAT Series system will acquire a lowest current range of 4pA and current resolution as small as 122aA.

The VersaSTAT LC is ideal for applications requiring low current accuracy and resolution. Applications such as ultra micro electrodes, coatings research, corrosion testing of bio-implants, and sensor research are all areas where greater current sensitivity may be needed.

The VersaSTAT LC option can be purchased at any time as a plug-in option. It consists of an interface cable to connect to the VersaSTAT or PARSTAT 4000, a main body containing the high input impedance electrometer and additional current ranges, and the cell leads. Once attached to the VersaSTAT or PARSTAT 4000 system and calibrated with the built-in DC Calibration routine, additional bandwidth stabilization filters are provided with the VersaSTAT LC option to provide maximum stability over a wide range of experimental conditions and applications.

- Femtoampere accuracy and attoampere resolution for both DC and AC (EIS) measurements
- Expands E and I filter selection for VersaSTAT 3 and VMC Systems
- Plug-in add-on for VersaSTAT Series potentiostats/ galvanostats
- Auto-current ranging capability from 200mA - 4pA

System Performance	
Minimum Current Range	4pA (4 x 10^{-12} A)
Minimum Current Resolution	122 aA (122 x 10^{-18} A)

Power Amplifier	
Maximum Current	± 200mA

Differential Electrometer	
Input Bias Current	<200 fA at 25°C
Maximum Voltage Range	± 10V maximum
Input Voltage Differential	± 10V
Bandwidth	700kHz (-3dB)
Common Mode Rejection	>60dB @ 100Hz, >50dB @ 100kHz
Input Impedance	>10^{14} Ω in parallel with <200fF, typical

Current Measurement	
Ranges	12 decades, 200mA to 4pA
Accuracy (dc)	2µ to 200mA < 0.2% full scale
	20nA and 200nA ranges < 0.5% full scale
	200pA - 4pA ranges < 1.0% full scale ± 500fA full scale

Current Control	
Applied Current Range	± full scale per range
Applied Current Resolution	± 1/32,000 x full scale
Applied Current Accuracy	± 0.5% of range, ±0.5% of reading
Max. Current Range/Resolution	± 200mA / 10µA
Min. Current Range/Resolution	± 4pA / 122aA

All other specifications not listed default to the connected potentiostat. Specifications subject to change.

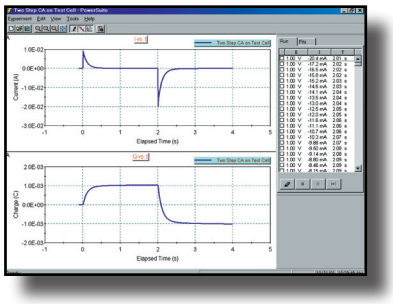
Power Boosters

The Princeton Applied Research Power Boosters are designed to boost the current measuring / applying capabilities of our potentiostats. Each power booster consists of an external power supply interfaced to additional internal circuitry on the rear panel of the potentiostat. A simple cable connection and switch setting converts the potentiostat from normal to boosted mode. The boosters are compatible with both our PowerSUITE and VersaStudio software packages. These boosters can be supplied as a complete system at the time of original potentiostat purchase or can be added (factory installation required) at a later time.

- 8, 10, and 20 Amp Options
- Operates in boosted or normal mode - Simple cable connection converts potentiostat from normal to boosted operation
- Compatible with PowerSUITE or VersaStudio software
- Internal 2A booster options for VersaSTAT 3, VersaSTAT 3F, VersaSTAT 4, VersaSTAT MC, and 263A

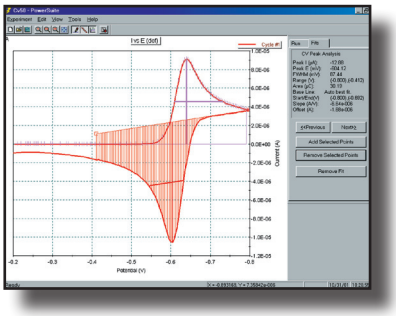
PowerSUITE® software

Available for PARSTAT 2263/2273 & GPIB 273A/263A Systems (purchase modules individually or as a package)



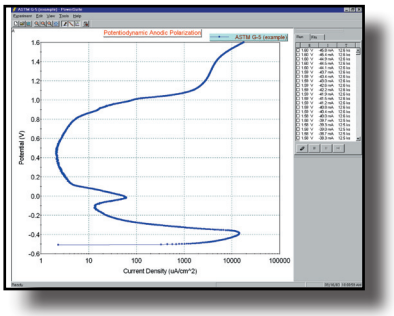
PowerSTEP®

- One Step Chronoamperometry
- Two Step Chronoamperometry
- Chronopotentiometry



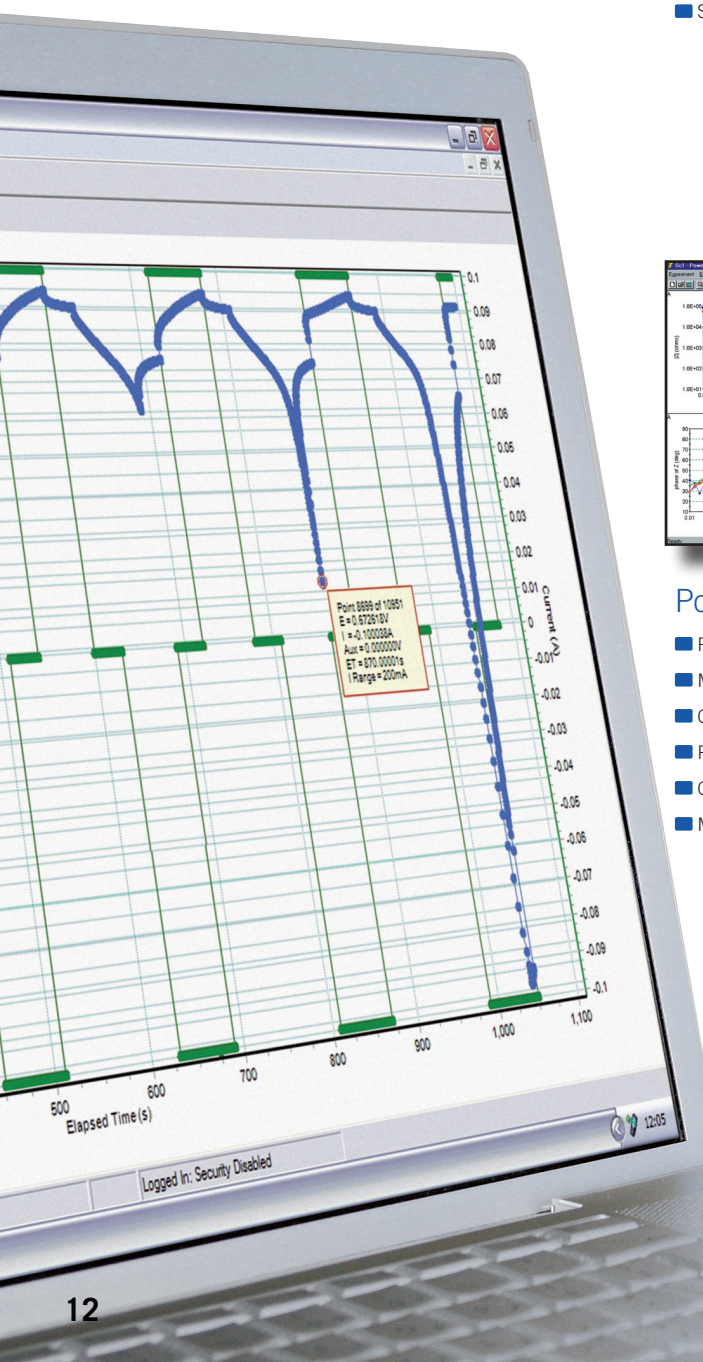
PowerCV®

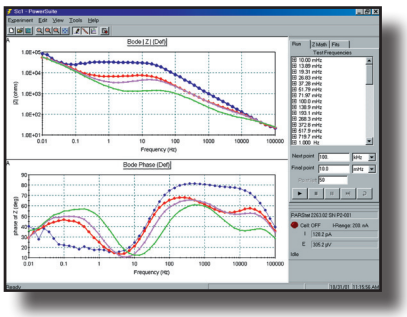
- Linear Scan Voltammetry
- Ramp Cyclic Voltammetry
  - One Vertex
  - Two Vertex
  - One Vertex/Multi Cycle
  - Two Vertex Multi Cycle
- Stair Case Cyclic Voltammetry
  - One Vertex
  - Two Vertex
  - One Vertex/Multi Cycle
  - Two Vertex Multi Cycle



PowerCORR®

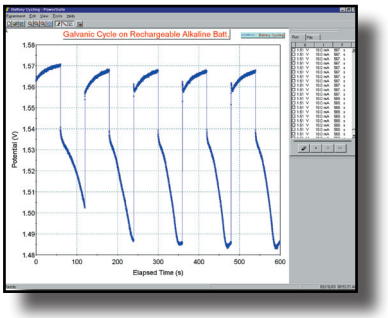
- Tafel Plot
- Anodic Polarization
- Linear Polarization
- Potentiostatic
- Galvanostatic
- Ecorr versus Time
- Galvanic Corrosion
- Cyclic Polarization
- Cyclic Polarization (no reverse)
- Zero Resistance Ammeter
- Galvanodynamic
- Galvanodynamic (no reverse)





PowerSINE®

- Potentiostatic EIS
- Multi-Sine EIS
- Galvanostatic EIS
- Potentiostatic Impedance versus Time
- Galvanostatic Impedance versus Time
- Mott-Shottky



PowerPULSE®

- Recurrent Potential Pulsing
- Recurrent Galvanic Pulsing
- Square Wave Voltammetry
- Cyclic Square Wave Voltammetry
- Differential Pulse Voltammetry
- Cyclic Differential Pulse Voltammetry
- Normal Pulse Voltammetry
- Reverse Normal Pulse Voltammetry

PC Requirements

Communication Interface:	Universal Serial Bus (USB)
Operating System:	Windows XP Professional (preferred) Windows 2000/VISTA/Windows 7
Compatibility:	**32-bit only**

Software Summary - PowerSUITE®

	PARSTAT 2273	PARSTAT 2263	Model 273A	Model 263A
PowerCV®				
Linear Sweep Voltammetry	●	●	●	●
Cyclic Voltammetry - Single Vertex	●	●	●	●
Cyclic Voltammetry - Double Vertex	●	●	●	●
Uncompensated Resistance Determination	●	●	●	●
PowerSTEP®				
Chronoamperometry - One Step	●	●	●	●
Chronoamperometry - Double Step	●	●	●	●
Chronopotentiometry	●	●	●	●
Chronocoulometry - One Step	●			
Chronocoulometry - Double Step	●			
PowerPULSE®				
Recurrent Potential Pulse - Two Step	●	●	●	●
Recurrent Potential Pulse - Three Step	●	●	●	●
Recurrent Potential Pulse - Four Step	●	●	●	●
Recurrent Galvanic Pulse - Two Step	●	●	●	●
Reccurent Galvanic Pulse - Three Step	●	●	●	●
Recurrent Galvanic Pulse - Four Step	●	●	●	●
SquareWave Voltammetry	●	●	●	●
Cyclic SquareWave Voltammetry	●	●	●	●
Differential Pulse Voltammetry	●	●	●	●
Cyclic Differential Pulse Voltammetry	●	●	●	●
Normal Pulse Voltammetry	●	●	●	●
Reverse Normal Pulse Voltammetry	●	●	●	●
PowerCORR®				
Linear Polarization	●	●	●	●
Tafel	●	●	●	●
Potentiodynamic	●	●	●	●
Cyclic Polarization	●	●	●	●
Ecorr vs. Time	●	●	●	●
Galvanic Corrosion	●	●		●
ZRA Mode	●	●		●
Potential Step	●	●	●	●
Galvanic Step	●	●	●	●
Galvanic Sweep	●	●	●	●
PowerSINE®				
Potential Single Sine	●	●	Y	Y
Potential Multi Sine	●	●	Y	Y

Y - Models 273A and 263A require additional analyzer hardware

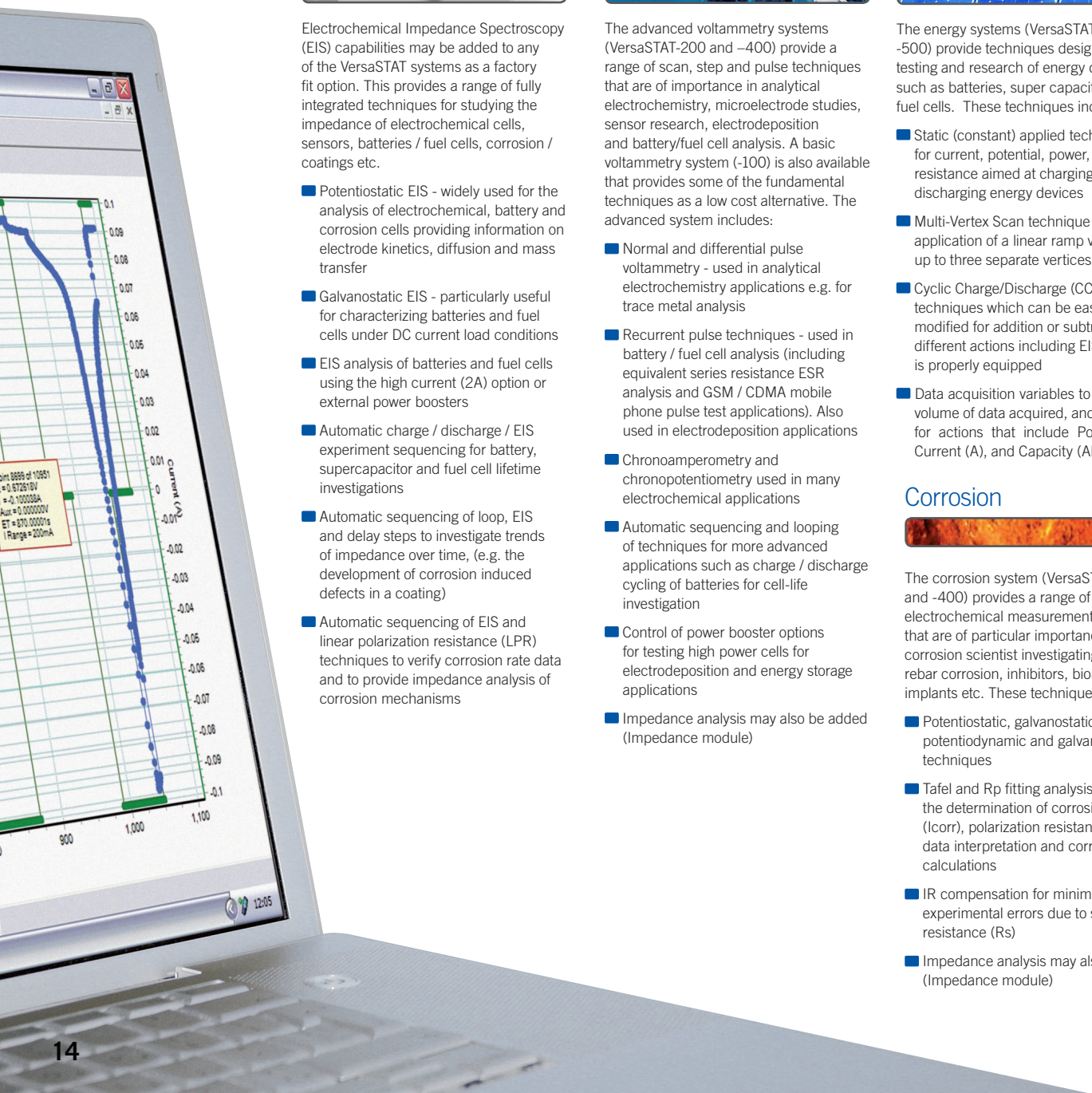
VersaStudio® software

The complete VersaStudio software provides full access to the capabilities of the instrument, including the high current option and power booster when present. Various systems combining hardware and the VersaStudio software are provided to focus on particular application areas and to minimize cost.

Systems may be upgraded at any time as budget becomes available or as requirements change. An impressive list of corrosion and electrochemical experiment types are provided that can be run individually or combined in powerful experiment sequences.

VersaSTAT100 basic DC voltammetry techniques
VersaSTAT200 advanced DC voltammetry techniques
VersaSTAT300 DC corrosion techniques
VersaSTAT400 complete DC voltammetry and corrosion techniques
VersaSTAT450 energy and voltammetry system
VersaSTAT500 voltammetry, corrosion, and energy system
VersaSTAT MC voltammetry, corrosion, and energy system
PARSTAT 4000 voltammetry, corrosion, and energy system

Impedance facilities may be added to any of these systems as a factory fit option



Impedance

Electrochemical Impedance Spectroscopy (EIS) capabilities may be added to any of the VersaSTAT systems as a factory fit option. This provides a range of fully integrated techniques for studying the impedance of electrochemical cells, sensors, batteries / fuel cells, corrosion / coatings etc.

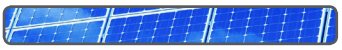
- Potentiostatic EIS - widely used for the analysis of electrochemical, battery and corrosion cells providing information on electrode kinetics, diffusion and mass transfer
- Galvanostatic EIS - particularly useful for characterizing batteries and fuel cells under DC current load conditions
- EIS analysis of batteries and fuel cells using the high current (2A) option 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

Voltammetry

The advanced voltammetry systems (VersaSTAT-200 and –400) provide 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. A basic voltammetry system (-100) is also available that provides some of the fundamental techniques as a low cost alternative. The advanced system includes:

- 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
- Automatic sequencing and looping of techniques for more advanced applications such as charge / discharge cycling of batteries for cell-life investigation
- Control of power booster options for testing high power cells for electrodeposition and energy storage applications
- Impedance analysis may also be added (Impedance module)

Energy



The energy systems (VersaSTAT-450 and -500) provide techniques designed for testing and research of energy devices such as batteries, super capacitors, 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)

Corrosion

The corrosion system (VersaSTAT-300 and -400) 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:

- Potentiostatic, galvanostatic, potentiodynamic and galvanodynamic techniques
- Tafel and Rp fitting analysis – providing the determination of corrosion current (Icorr), polarization resistance (Rp), data interpretation and corrosion rate calculations
- IR compensation for minimizing experimental errors due to solution resistance (Rs)
- Impedance analysis may also be added (Impedance module)

Software Summary - VersaStudio®

	-100	-200	-300	-400	-450	-500	PARSTAT 4000
Open Circuit	●	●	●	●	●	●	●
Linear Scan Voltammetry	●	●		●	●	●	●
Cyclic Voltammetry (single)	●	●		●	●	●	●
Cyclic Voltammetry (multi cycles)	●	●		●	●	●	●
Staircase Linear Scan Voltammetry		●		●	●	●	●
Staircase Cyclic Voltammetry (single)		●		●	●	●	●
Staircase Cyclic Voltammetry (multi cycles)		●		●	●	●	●
Chronoamperometry	●	●		●	●	●	●
Chronopotentiometry		●		●	●	●	●
Chronocoulometry		●		●	●	●	●
Recurrent Potential Pulses		●		●	●	●	●
Recurrent Galvanic Pulse - Two Step		●		●	●	●	●
SquareWave Voltammetry		●		●	●	●	●
Differentail Pulse Voltammetry		●		●	●	●	●
Normal Pulse Voltammetry		●		●	●	●	●
Reverse Normal Pulse Voltammetry		●		●	●	●	●
Zero Resistance Ammeter (ZRA)			●	●		●	●
Galvanic Corrosion			●	●		●	●
Cyclic Polarization			●	●		●	●
Linear Polarization			●	●		●	●
Tafel			●	●		●	●
Electrochemical Noise			●	●		●	●
Split LPR			●	●		●	●
Potentiostatic			●	●		●	●
Potentiodynamic			●	●		●	●
Galvanostatic			●	●		●	●
Galvanodynamic			●	●		●	●
Dynamic iR			●	●		●	●
Constant Current						●	●
Constant Potential					●	●	●
Constant Resistance					●	●	●
Constant Power					●	●	●
Multi-Vertex Scan					●	●	●
Current CCDPL					●	●	●
Power CCD					●	●	●
Resistance CCD					●	●	●
Potentiostatic EIS*	●	●	●	●	●	●	●
Galvanostatic EIS*	●	●	●	●	●	●	●
Loop		●	●	●	●	●	●
Time Delay		●	●	●	●	●	●
Message Prompt		●	●	●	●	●	●
Measure OC		●	●	●	●	●	●
Auxiliary Interface		●	●	●	●	●	●
Run External Application		●	●	●	●	●	●
DAC Output Control		●	●	●	●	●	●
Condition		●	●	●	●	●	●
Deposition		●	●	●	●	●	●
Equilibration		●	●	●	●	●	●
Purge		●	●	●	●	●	●
iR Determination		●	●	●	●	●	●

VersaSCAN
Electrochemical Scanning System

The VersaSCAN is a single platform capable of providing spatial resolution to both electrochemical and materials-based measurements. Traditional electrochemical experiment measure an average response over the entire electrode/electrolyte interface. Rarely is a sample homogenous. Samples often consist of local sites of passivate/active nature or sites of anodic/cathodic character. This need to investigate localized phenomenon led to the emergence of scanning probe electrochemistry.

By making the measurement at a probe placed just above the surface of the sample, the response is taken from a subset of the sample. A small measurement probe positioned very close to the surface, but non-contact, reduces the sampling volume and provides a high spatial resolution. However, these small responses require superior measurement technology to record the measured parameter. The VersaSCAN integrates capabilities of proven models of AMETEK instrumentation, such as the low-current measurement technology of the VersaSTAT and the high dynamic reserve of the Signal Recovery 7230 to extract these data.

The positioning system of the VersaSCAN is based entirely on piezoelectric motors. These motors give long travel (100-mm) and superior resolution (50-nm) in a small footprint.

Different auxiliary pieces interface to the positioning system to provide functionality for several different scanning probe experiments.

Features

- Superior piezo electric motor-based design provides greater resolution, longer travel, better repeatability, and superior accuracy compared to more commonly used lead screw technology
- The most complete and compact multi-technique workstation on the market today
- The best connectivity option providing higher transfer rates, no-fuss setup, and remote operation and data visibility
- The most easy-to-use software includes connection diagrams, navigation tree design for experiment setup, and 3-D graphics with rotational ability.
- Integration of AMETEK potentiostats and lock-in amplifiers
- Professional on-site installation

SECM
Scanning Electrochemical Microscope System

The SECM integrates a microelectrode-based tip and a 2-channel potentiostat with the positioning system. The SECM both controls and monitors electrochemical reactions at the tip and sample. The versatility and high spatial resolution of SECM make it popular.

SVET
Scanning Vibrating Electrode Technique

The SVET maps the electric field in solution, which is a result of local currents at the sample surface. These currents at the sample can be naturally occurring or controlled by an external source. Successive experiments provide time-lapse images of these currents.

LEIS
Localized Electrochemical Impedance System

The LEIS measures local impedance, phase angle, and currents by measuring AC response. The ratio of the locally measured current and the applied AC voltage gives the local impedance. This provides spatial resolution to applications that traditionally benefit from the high information content of EIS.

SKP
Scanning Kelvin Probe

The SKP is a non-destructive capacitance-based measurement of the relative surface work function difference of the probe and the local location on the sample. These experiments are typically performed in ambient conditions, in the absence of electrolyte.

SDC
Scanning Droplet Cell

The SDC confines the electrochemical measurement to a droplet of electrolyte at the sample surface. The droplet may be flowing or stagnant. The droplet can remain stationary or scanned during the experiment. Sections of samples can be investigated with traditional electrochemical techniques without cutting the sample.

OSP
Optical Surface Profiling

OSP uses a displacement sensor to measure topography (change in Z) of the sample. This measurement is fast and accurate. The resulting topographic maps can be integrated with other techniques to provide Constant-Distance operation.

VersaSCAN Options

VersaSCAN L-Cell

- Screws into optical table of VersaSCAN
- Approximately 1 Liter in volume
- Level adjustment mechanism
- Accepts large flat samples and 32mm diameter mounted samples
- Recommended for all techniques, particularly LEIS, SVET, SKP, SDC, OSP

VersaSCAN mL-Cell

- Screws into optical table of VersaSCAN
- Approximately 7 mL in volume
- Level adjustment mechanism
- Accepts a range of samples including 32mm diameter mounted samples and non-standard samples
- Specifically engineered for low-volume SECM applications.

VersaCAM

- Camera:

  Color
  Number of Pixels: 795 (H) x 596 (V)
  Minimum illumination 0.02 lx. F1.2
  Power: 12V DC +/- 10%
  CS-mount or C-mount with provided adapter.

- Lens:

  C-Mount
  Manual focus.

- Display:

  8 inch color TFT display
  PAL & NTSC auto selection
  640 x 480 (307,200 pixels) screen resolution

Ancillary Instrumentation

QCM922
Quartz Crystal Microbalance

- Sensitive enough to measure weight changes in a monolayer
- Quantify both elastic and viscous changes in your system
- Front panel display of resonant frequency and resistance
- Analog outputs for frequency and resistance changes
- Frequency range of 1MHz to 10MHz
- Designed for EQCM with a potentiostat, not included, or stand alone operation

Quartz Crystals

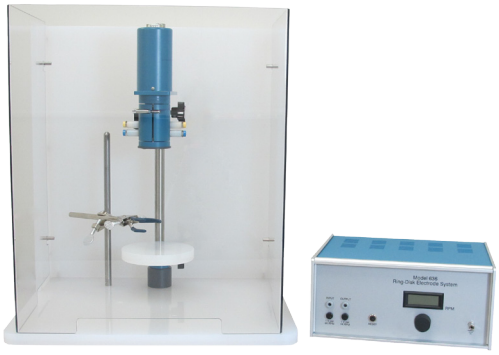
- 9MHz AT-cut: Gold or Platinum sputtered on Ti (Standard or Mirror Finish)
- Electrode Area: 0.2cm^2
- Electrode Thickness: Au or Pt ~300 nm

5210EC
Dual-Phase Lock-In Amplifier

- Provides EIS capabilities for 263A, 273A, and 283 potentiostats up to 100 kHz
- Continuous Full-Scale Sensitivity Control
- Sinewave or Squarewave Demodulation
- Powerful fourth-order signal channel bandpass, low pass or notch filter
- Two independent line frequency rejection filters
- Up to 130 dB Dynamic Reserve

K0269B
Faraday Cage

- Heavy gauge steel enclosure for Low / Ultra-Low Current Measurements
- Ideal for use with VersaSTAT LC Low Current Interface
- Hinged door with cam latch
- Dimensions (L x W X H) 10.75 x 12.00 x 16.00 in (27 x 30 x 41 cm)

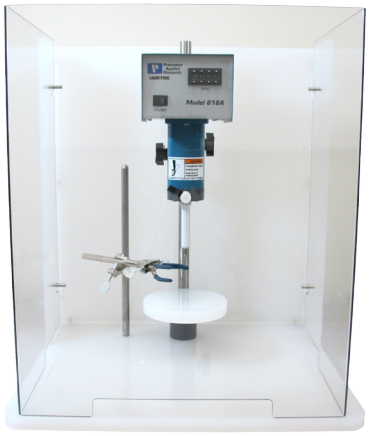


636A
Rotating Ring-Disk Electrode

- Operates in Disk or Ring-Disk configuration
- Remote analog speed control (input is summed with front-panel settings)
- On/Off and Rotational Rate Control (50 – 10,000 RPM)
- Includes Enclosure (L x W x H) 18.8 x 15.5 x 21.0 in (48 x 40 x 54 cm)

Accessory Options

- Permanent Disk Electrodes*
- Permanent Ring-Disk Electrodes
  - Platinum Disk - Platinum Ring
  - Glassy Carbon Disk - Gold Ring
  - Glassy Carbon Disk - Platinum Ring
- Quick-Change Disk and Cylinder Electrodes for Corrosion Studies
- Arbor Options
  - Disk Arbor
  - Ring-Disk Arbor



616A
Rotating Disk Electrode

- Front-panel speed controls (100 – 8,000 RPM)
- Remote analog speed control (input is summed with front-panel settings)
- Front-panel and remote (TTL) on/off switching (using PAR stir-control signals)
- Integral ring-stand for convenient cell mounting
- Includes Enclosure (L x W x H) 18.8 x 15.5 x 21.0 in (48 x 40 x 54 cm)
- A variety of electrode assemblies for a wide range of experiments, including: High-precision Corrosion measurements, Ultra-Trace Analytical determinations, Automated Levich Plots, Hydrodynamically-Modulated Voltammetry, Cyclic Stripping Voltammetry

Accessory Options

- Quick-Change Disk Electrodes
- Quick-Change Cylinder Electrodes
- Permanent Disk Electrodes
  - Platinum
  - Gold
  - Glassy Carbon

Electrochemical Accessories

potentiostat/galvanostat

Corrosion Cell Kit

Model K0047

The K0047 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 some ASTM methods.

The cell permits a variety of metal specimens and liquid environments to be tested quickly and uniformly. Most of the common electrochemical techniques for corrosion testing can be employed under aggressive conditions (except for HF) and at ambient or elevated temperatures.

The K0047 Kit includes:

Model	Qty.	Description
G0091	2	Graphite Rod
G0094	1	Purge Tube
G0095	1	Reference Electrode Bridge Tube
G0096	1	Corrosion Flask (1 liter flat bottom flask with ground glass joints)
G0097	1	Electrode Holder
G0098	2	Threaded Adapter for T24/40 Joint
G0099	1	Ball and Socket Clamp
G0300	1	Replacement Porous Glass Frits 4mm (pkg of 5)
K0077	1	Saturated Calomel Reference Electrode
MP0630	1	Replacement Teflon Gaskets for Mounting Sample (pkg of 5)
MP0631	1	Electrode Mounting Rod
MP0751	1	Cylinder Specimen, 430 Stainless Steel
2806-0043-0	1	Knurled Thumb Nut
2815-0043-0	1	Flat Washer
2815-0093-0	1	Flat Teflon Washer

Tait Cell

Model K0307

The Tait Cell was developed to address coatings/corrosion studies on flat specimens where the electrolyte under study cannot support a standard reference electrode. The diameter and exposed sample area are approximately 6.35cm and 32cm^2, respectively.

The Tait Cell is offered with counter and reference electrodes made from Hastelloy steel.

- Excellent for coatings studies in difficult media
- Designed for long term exposure times
- Quick, easy changing of electrodes
- Allows electrolyte volumes as small as 80mL

Micro-Cell Kit

Model K0264

For routine analytical voltammetry applications, we offer the K0264 Micro-Cell Kit. The kit includes:

Model	Qty.	Description
G0300	1	Porous Glass Frits, 4mm (pkg of 5)
K0265	1	Silver/Silver chloride reference electrode (includes tube, wire, and frit)
K0266	1	Counter Electrode Assembly (includes counter electrode bridge tube, 2 ml. volume, Vycor frit and Platinum 0.3mm diameter counter electrode wire)
SL0070	1	3M NaCl/saturated AgCl filling solution for K0265
219581	1	Cell Top (ring stand mountable which accommodates a variety of microelectrodes)
219600	1	Glass Cell Bottom
220196	1	Threaded Blushing (three, used to secure the reference, counter, or optional thermometer)
220253	1	Threaded Bushing (used to secure the working electrode)
220262	1	Threaded Plug (to plug thermometer port)
220325	1	Threaded Plug (to plug sample port)
220553	1	Cell Support Cap
230125	1	Knob
230197	1	Bev A Line Tubing (2 ft)
230259	5	Ferrule Fitting
231572	1	Stopcock
231573	1	Luer Lock Ring
231574	1	Fitting
231575	1	Fitting
231576	1	Fitting
231581	1	Fitting
2504-0102-0	1	Quad Ring, Viton

Microelectrodes (10 µm diameter)

G0224	Gold Microelectrode
G0225	Platinum Microelectrode
G0226	Glassy Carbon Microelectrode

Milli-electrodes (2 mm diameter)

G0227	Gold Milli-electrode
G0228	Platinum Milli-electrode
G0229	Glassy Carbon Milli-electrode

Flat Cell Kit

Model K0235

The practical design of the Model K0235 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 250mL sample volume and simplifies electrochemical corrosion measurements. The Kit includes:

2517-1343A	Clamping Screw
222594	Clamping Frame
2806-0086	Nut, Rivnut
2800-0042	Resting Foot
219806	Sample End Cap
219808	Glass Cylinder
2805-0043	Drain Plug
2805-0044	Rubber Well Plug
219810	Counter Electrode

2517-1345A	Shoe Assembly
2811-0280-0	Screw (#10-32) SS
MP1239	Gasket, TFE
800877	Screw (#4-40) SS x 3/8”
OR0142	Gasket, Viton
3100-0094-0	Tubing, Tygon
219995	Reference Electrode
232117	Tubing, TFE
230213	Cap and Silicon Tubing