twice as nice.

Our WaveDriver USB potentiostat/galvanostat system is a powerful instrument for traditional single working electrode methods, and it is also available as a fully functional bipotentiostat that can be used with dual working electrode techniques such as Rotating Ring-Disk Electrode (RRDE) voltammetry.

single.

The WaveDriver 10 is an affordable benchtop **potentiostat/galvanostat** system capable of performing a wide variety of traditional single working electrode methods, including cyclic voltammetry, square wave voltammetry, pulse methods, and battery charge/discharge sequences. The instrument is capable of applying and measuring potential over a ±10 volt range and current from ±1 ampere down to a few picoamperes, and iR compensation supports measurements in resistive electrolytes.

double.

The WaveDriver 20 is a **bipotentiostat** capable of controlling two working electrodes located in the same electrochemical cell. Dual electrode techniques such as rotating ring-disk voltammetry (RRDE), microfluidic generator/collector experiments, and interdigitated array (IDA) methods require a bipotentiostat. The WaveDriver can apply independent excitation signals to each working electrode while simultaneously measuring the current and potential at each electrode.

flexible.

The WaveDriver connects to your laptop or PC via a standard USB cable and is controlled by our powerful AfterMath software package. Rear panel connections allow **rotation rate control** when using rotating disk, cylinder, or ring-disk electrodes. Additional connections for analog input/output and synchronized timing permit the WaveDriver to be used in conjunction with other instrumentation.

PINE research

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Standard Electrochemical Methods:

Basic Methods
- Open Circuit Potential (OCP)
- Bulk Electrolysis (BE)

Potentiostatic Methods
- Chronoamperometry (CA)
- Double Potential Step Chronoamperometry (DPSCA)
- Cyclic Step Chronoamperometry (CSCA)

Galvanostatic Methods
- Chronopotentiometry (CP)
- Ramp Chronopotentiometry (CRP)
- Staircase Potentiometry (SCP)
- Cyclic Step Chronopotentiometry (CSCP)

Voltammetric Methods
- Cyclic Voltammetry (CV)
- Linear Sweep Voltammetry (LSV)
- Staircase Voltammetry (SCV)
- Differential Pulse Voltammetry (DPV)
- Square-Wave Voltammetry (SWV)
- Normal Pulse Voltammetry (NPV)

Stripping Voltammetry
- Stripping Voltammetry (ASV)
- Differential Pulse Stripping Voltammetry (DPSV)
- Square Wave Stripping Voltammetry (SWSV)

Rotating Methods (optional)
- Rotating Disk Voltammetry (RDE)
- Rotating Disk Koutecky-Levich Series (KL-RDE)
- Rotating Disk Electrolysis (BE-RDE)
- Rotating Disk Chronopotentiometry (CP-RDE)
- Rotating Disk Ramp Chronopotentiometry (RCP-RDE)

Dual Electrode Methods (optional)†
- Dual Electrode Electrolysis (DEBE)
- Dual Electrode Voltammetry (DECV)

Corrosion Methods (optional)
- Linear Polarization Resistance (LPR)
- Rotating Cylinder Voltammetry (RCE)
- Rotating Cylinder Electrolysis (BE-RCE)
- Rotating Cylinder Eisenberg Study (EZB-RCE)
- Rotating Cylinder Polarization Resistance (LPR-RCE)

wavedriver 10
single channel potentiostat
part number: AFP1

Electrode Control Modes & Connections
Control Modes: potentiostat (POT), galvanostat (GAL), open circuit potential (OCP), zero resistance ammeter (ZRA)
iR Compensation: yes

Electrode Connections
Cell Port: combination coaxial DSUB connector
Reference Electrode: sense line with driven shield
Counter Electrode: drive line
First Working Electrode: separate sense and drive lines, each with driven shield (current measurement via passive shunt)
Second Working Electrode†: separate sense and drive lines, each with driven shield (current measurement via active shunt)

Accessories
Dummy Cell: external dummy cell (included)
Cell Cable: various designs available separately

Power Amplifier *(counter electrode amplifier)*
Compliance Voltage: > ± 16.5 V
Output Current : ±1.0 A (maximum)
Speed : 9 available speed settings
Bandwidth: > 200 kHz (on fastest speed setting)
Rise Time: 10 V/µsec (on fastest speed setting)

Applied Current *(galvanostat mode)*
Ranges: ±1 A, ±100 mA, ±10 mA, ±1 mA, ±100 µA, ±10 µA, ±1 µA, ±100 nA
Resolution (at each range): 31.3 µA, 3.13 µA, 313 nA, 31.3 nA, 3.13 nA, 313 pA, 31.3 pA, 3.13 pA
Accuracy: ± 0.2% setting; ±0.05% of range
DAC Output: 16 bits

Electrometer *(reference electrode amplifier)*
Input Impedance: > 10^{13} Ω in parallel with < 10 pF
Input Current: < 10 pA leakage/bias current at 25°C
CMRR: > 84 dB at 0 to 1 kHz; > 74 dB at 10 kHz
Bandwidth: > 11 MHz (3 dB)

Measured Current
Ranges: ±1 A, ±100 mA, ±10 mA, ±1 mA, ±100 µA, ±10 µA, ±1 µA, ±100 nA
Resolution (at each range): 31.3 µA, 3.13 µA, 313 nA, 31.3 nA, 3.13 nA, 313 pA, 31.3 pA, 3.13 pA
Autoranging: yes
Practical Range§: 100 pA to 1.0 A
Accuracy: ± 0.2% setting; ±0.05% of range
Leakage Current: 10 pA at 25°C
ADC Input: 16 bits
Filters: 10 Hz, 30 Hz, 100 Hz, 1 kHz, 10 kHz (2-pole, low-pass Bessel filters)

Grounding
Signal Ground: isolated from USB port; floats with respect to instrument chassis
Instrument Chassis: banana binding post connection

Applied Potential (potentiostat mode)
Ranges: ±10.0 V, ±2.5 V
Resolution (at each range): 313 µV, 78 µV
Accuracy: ±0.2% of setting, ±1.0 mV
DAC Output: 16 bits
CV Scan Rate (min): 10 µV / sec (313 µV per 31.3 sec or 78 µV per 7.8 sec)
CV Scan Rate (max): 125 V/sec (10 mV step per 80 µsec)

Measured Potential
Ranges: ±10.0 V, ±2.5 V
Resolution (at each range): 313 µV, 78 µV
Accuracy: ± 0.2% setting; ±0.05% of range
ADC Input: 16 bits
Filters: 10 Hz, 30 Hz, 100 Hz, 1 kHz, 10 kHz (2-pole, low-pass Bessel filters)

Data Acquisition
Clock Resolution: 10 nsec (minimum time base)
Point Interval*: 160 µsec (minimum)
Synchronization: simultaneous sampling of all analog input signals
Raw Point Total: <10 million per experiment

wavedriver 20
dual channel bipotentiostat†
part number: AFP2

Rotator Control Connections (back panel)
Connector A: 7-pin mini circular DIN includes analog and digital signal grounds, digital rotator enable signal, auxiliary digital output signal, and analog rotation rate control signal
Connector B: 3-pin connector includes analog signal ground, digital rotator enable signal, and analog rotation rate control signal
Rate Control Signal: ±10.0 V, ±2.5 V
Digital Enable Signal: open drain (TTL compatible)

Auxiliary Connections (back panel)
Connector C: 9-pin DSUB connector includes digital signal ground, three digital input signals, and two digital output signals
Trigger Input: BNC female, TTL compatible
Trigger Output: BNC female, TTL compatible
K1 Input, K2 Input†: BNC female, ±10 V differential input, 20 kΩ impedance, ±0.5% accuracy; allows external waveform to be summed directly to the working electrode excitation signal.
Auxiliary Analog Output: BNC female, ±10 V bipolar output, 313 µV resolution, 0.2% accuracy
Auxiliary Analog Input: BNC female, ±10 V differential input, 313 µV resolution, 20 kΩ impedance, 0.2% accuracy (available only when second working electrode not in use)

General Specifications
Power Required: 24.0 VDC (±5%), 4 A (low voltage DC device)
Power Adapter: 100 to 240 VAC, 2.3 A, 50 to 60 Hz
Power Cable: various international cables available separately (C13 type)
LED Indicators: power, USB, and status
Instrument Dimensions: 140 x 305 x 248 mm (5.5 x 12.0 x 9.75 in)
Instrument Weight: 3.6 kg (8 lbs)
Shipping Dimensions: 254 x 356 x 457 mm (10 x 14 x 18 in)
Shipping Weight: 6.4 kg (14 lb)
Temperature Range: 10°C to 40°C
Humidity Range: 80 %RH maximum, non-condensing

† *Note that the second working electrode is only available on the WaveDriver 20 Bipotentiostat/Galvanostat. The lower priced WaveDriver 10 Potentiostat/Galvanostat has only one working electrode.*

§ *The "practical range" of measurable currents goes from the maximum current output of the amplifier down to the current level at which noise begins to interfere with the signal. Using proper grounding, a cell shielded by a Faraday cage, and coaxial cell cables, it is possible to routinely measure signals as low as 100 pA.*

aftermath DATA ORGANIZER

Software & Interface Cable *(included)*
Software: Pine AfterMath™ Data Organizer
Interface Type: USB 2.0
Cable: USB A / B cable (914 mm L)

Host PC Requirements *(the PC is not included)*
Operating System: Windows 8, 7, Vista, XP (32 bit)
Processor Class: Pentium IV or equivalent
Processor Speed: 1 GHz or faster
Physical Memory: 512 MB or higher
GUI Platform: Microsoft .NET 2.0
Screen Resolution: 1280 x 1024 pixels recommended

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