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Find the *Princeton Applied Research / EG&G 273* at our website: *Click HERE*

Princeton Applied Research

273A
Potentiostat/Galvanostat



The Benchmark for Electrochemical Research Instrumentation

The Model 273A's advanced design, superior quality, and high reliability make it unmatched by any potentiostat in the world. Whether you control your experiments from the front panel or from your computer, the Model 273A lets you make almost any electrochemical measurement you want.

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Easy Front Panel Operation

A pushbutton front panel gives you unusual versatility and convenience in defining your experiments. With the touch of a button, you can key in setups for cyclic staircase voltammetry, Tafel plot corrosion measurements-or a variety of other pulse and staircase techniques. A graphic LED display gives you an instant picture of the progress of a measurement; an alphanumeric LCD display gives you a continuous readout of current and potential values during a measurement.

With another touch of a button, you can start automatic current ranging or current interrupt iR compensation. Standard BNC connectors on the front and rear panels make it easy for you to send signals to an analog recorder or an oscilloscope.

Powerful Computer-Based Experiments

As easy as it is to run experiments from the Model 273A front panel, running from a computer adds flexibility, automation, data storage and manipulation, and powerful calculation and plotting capability to your experimental toolbox. With both GPIB (IEEE-488) and serial (RS-232C) connectors on the Model 273A rear panel, running experiments from your computer is a snap.

But the most important advantage of computer control is that you can use Princeton Applied Research's Electrochemical Command Set, created specifically for electrochemical applications. A set of more than 100 commands lets you completely define an electrochemical experiment from pre-measurement operations to data acquisition and transfer. Your computer sends the commands to the Model 273A, which then performs the entire experiment automatically. You can set up your experiment to transfer data back to your computer for plotting or for additional calculations.

If you don't have time to develop your own software, you can pick from several different optional applications packages.

Princeton Applied Research Applications Software: Powerful Tools for Electrochemistry

The Model 273A comes with the versatile Virtual Potentiostat-32 software package which lets you control every function of the potentiostat, from the simple setting of a potential to a multi-cycle cyclic voltammetry experiment. Besides giving you a way to control the potentiostat from the computer, VP-32 helps you learn how to run electrochemical experiments and gain experience with the Model 273A Command Set. More advanced users can develop their own techniques from scratch.

We offer other proven, easy-to-use software that:

- Automates the collection and interpretation of data for kinetic and mechanistic studies, coatings evaluation, and other electrochemical impedance applications.
- Helps you apply various electrochemical corrosion measurement techniques such as potentiodynamic polarization, Tafel plots, polarization resistance, cyclic polarization, potentiokinetic reactivation, potentiostatic, galvanostatic, and galvanic corrosion studies, and open circuit vs. time measurements.
- Provides a complete selection of electrochemical techniques to quickly and thoroughly evaluate a reduction/oxidation system. These methods include cyclic and square-wave voltarnmetry, chronoamperometry, chronocoulometry, and a variety of pulse techniques,

For more information on any of our software packages, refer to the back of this brochure. If you would like to discuss your electrochemistry needs with our experts, just give us a call.

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The remarkable performance of the Model 273A reflects Princeton Applied Research's long experience in analog electroincs. Many of its features are optional extras for other potentiostats. Look at some of the characteristics that make it the world's finest potentiostat:

High Compliance Voltage for Rapid, Accurate Potential Control

With its 100 V compliance and 1 A output capability, the Model 273A is capable of rapidly and accurately controlling the potential in virtually any electrochemical cell. This high compliance voltage ensures accurate potential control in high resistance cells, such as those with dilute electrolytes or non-aqueous solvents.

Low Noise Electronics Assures Sensitivity and Repeatability

Electronic noise, the ultimate limitation in all measurements, has many sources. The Model 273A is designed to minimize the noise generated at each of these sources. Our engineers have selected all amplifiers and other critical components for low noise specifications. They have also carefully laid out the digital and analog grounds, shielded all critical circuitry, and placed components to avoid picking up stray electromagnetic radiation and cross-talk.

As even the most carefully designed system will sense cell noise, our engineers have taken steps to minimize its effect. You can select either of two low- pass filters to further reduce cell noise.

High Speed Current Measurement

Princeton Applied Research engineers have designed the Model 273A's current measurement circuitry to minimize the effects of stray capacitance and maximize current measurement speed. The current-to-voltage converter is a four-terminal device yielding current measurements that are highly accurate, unlikely to drift, and independent of cell cable impedance. You can collect data every 50 microseconds, or hook up an oscilloscope to monitor the analog current signal at thousands of volts per second.

External Differential Electrometer

An electrometer is a high-impedance amplifier that measures the potential difference between the reference electrode and the working electrode. The Model 273A uses an external differential electrometer, which has these advantages:

- It allows you to use two electrodes to control the potential across an interface such as a membrane.
- It minimizes problems due to the resistance, inductance, and stray capacitance of the cell cable.
- It can be configured to provide a remote sensing contact for the working electrode and eliminate potential error caused by contact resistance.
- It always controls the potential, even when the current overloads.

HOW COMPLIANCE VOLTAGE AFFECTS YOUR EXPERIMENT

Compliance voltage is the voltage applied by the counter electrode to bring the working electrode to the programmed potential. Because of the solution resistance in your cell, it is often much higher than the working electrode potential desired. The compliance voltage is determined by the cell resistance and the current flowing in the cell:

$$E_{compliance} = i_{cell}\, R_{cell}$$

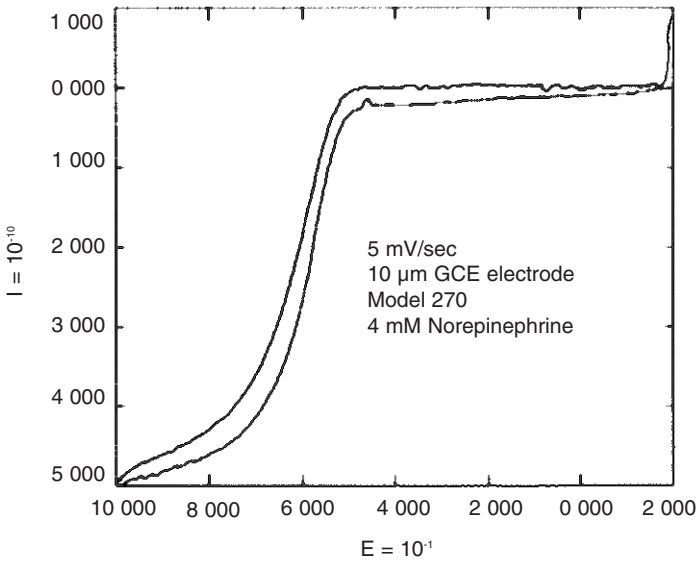
Thus, if a current of 50 mA flows in a cell with 700 Ω resistance, the potentiostat must provide a compliance voltage of at least 35 volts. If the cell resistance is high and the cell capacitance is large, excess compliance voltage results in faster charging of the cell capacitance. Thus, a high compliance voltage gives the potentiostat the ability to respond rapidly to step transitions in the control potential.

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Advanced Solid State Technology

High-power VMOS transistors in the power output stage make the Model 273A a faster, more reliable potentiostat. During a current overload, VMOS transistors are not prone to thermal runaway so the Model 273A is less likely to have a failure in the power output stage than potentiostats using lower quality components.

High-speed switching using VMOS devices not only is faster than mechanical switching, it also eliminates transients due to contact bounce. The Model 273A prevents large voltage transients in the cell by using VMOS devices for the cell on switch.



ADVANCED FEATURES OF THE MODEL 273A POTENTIOSTAT

- Waveform Generation. Versatile waveforms are a snap with our two built-in, microprocessor-controlled D/A converters. Design simple scans and steps from the front panel, or use a computer to define the waveform of your dreams. If you can imagine it, the 273A can run it.
- Digital Coulometer. No need for optional accessories-just hook up your cell and go. The LCD displays the integrated current value in coulombs at all times, if desired. You need a high performance coulometer for short-timescale chronocoulometry experiments? Well, it's still standard! The 273A can handle both long-timescale bulk electrolyses and short-timescale pulse experiments.
- Versatile Output. You can output your data to an X-Y recorder. Pick from output connectors for current, potential, charge, and log current. All of these values can also be monitored with the LCD display. And you avoid the high expense of the log recorder needed with other systems.
- Wide Range of Current Measurement Capabilities. From the front panel, select from current ranges between 100 nA and I A or Autoranging. With computer control, add 10 nA and 1 nA current ranges as well. With current resolutions of down to 2 pA, the Model 273A is perfect for microelectrode work; our optional electrochemical analysis software automatically takes full advantage of this capability.
- Filters. Two selectable low-pass filters discriminate against high-frequency noise. They're convenient for experiments at very low current levels, but can be turned off for better accuracy at high scan rates.
- iR Compensation. Both positive feedback and current interrupt iR compensation are standard. Choose positive feedback for fast scan rates when uncompensated solution resistance is known, or current interrupt for convenient measurement of uncompensated solution resistance and higher accuracy at slow scan rates. You can also choose no compensation.
- Rack Mounting. May be mounted in a standard 19 inch (47.5 cm) rack assembly.
- Battery Backup. Assures that all parameters retain the values in effect at the end of the previous operating session. If desired, the default values can be restored.
- 273A/92 Electrochemical Impedance Interface Option. Allows superposition of an externally generated ac excitation signal on the de signal generated by the Model 273A. It also allows dc suppression and output signal offset for improved accuracy in electrochemical impedance spectroscopy experiments.
- 307A Interface Option. This accessory allows the Model 273A to be used with our popular Model 303A Static Mercury Drop Electrode.

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Model 273A Front Panel

A. SCAN SETUP Section: The keypad in this section lets you define a staircase or a pulse waveform. Setup is simple: Select the parameter by pressing the appropriate pushbutton, key in the desired number, and press ENTER.

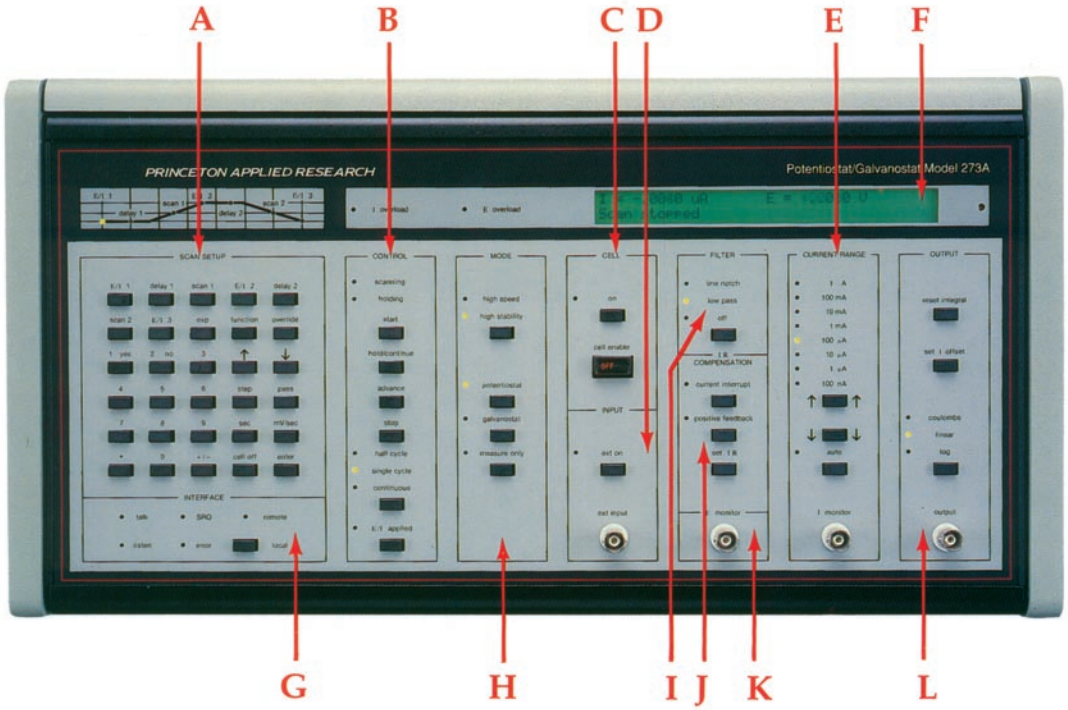
B. CONTROL Section: This section lets you start, stop, hold, or continue your measurements. The ADVANCE key lets you skip to the next part of your experiment. Other pushbuttons let you select half-cycle, full-cycle, or continuous-cycle measurements. Pressing E/I APPLIED applies a programmed potential or current to the cell.

C. CELL Section: To provide an extra margin of safety, both switches in this section must be set to apply the programmed potential or current to the cell. The CELL ENABLE switch allows you to override computer control of the cell at any time. The CELL ON/OFF button controls a solid state, transient-free switch without the contact bounce of mechanical switches.

D. INPUT Section: For rapid-scan cyclic voltammetry, connect an external waveform programmer to the BNC connector in this section. The Princeton Applied Research Model 175 Universal Programmer provides scans of up to 10,000 V/s.

E. CURRENT RANGE Section: This section lets you select from among eight current ranges - from 1 A to l 00 nA fullscale - as well as autoranging. LEDs indicate the option currently selected. Under software control, you can access 10 nA and 1 nA current ranges with resolutions as low as 2 pA! The I monitor BNC lets you connect to the 1 V full-scale output of the current-to-voltage converter.

F. DISPLAY: A graphic LED display gives you an instant picture of the progress of a measurement. Current and potential overload indicators warn you of any overload conditions. The alphanumeric LCD displays a continuous readout of current, potential, or charge. It also displays help and error messages, and you can use it to view or change experimental settings.



G. INTERFACE Section: When the Model 273A is connected to a computer through the GPIB (IEEE-488) interface, the LED indicators in this section let you monitor communications with the computer. The LOCAL pushbutton lets you switch back to entering parameters from the front panel of the Model 273A.

H. MODE Section: This section allows you to choose between potentiostatic, galvanostatic, or measure-only modes.

I. FILTER Section: If high-frequency noise becomes a problem, this section lets you apply either of two available low- pass filters.

J. iR COMPENSATION Section: If you have high uncompensated solution resistance in your cell, this section lets you select either positive feedback or current interrupt iR compensation. The SET IR pushbutton allows adjustment of the positive feedback iR compensation level.

K. E MONITOR Section: The BNC connector in this section lets you send an analog voltage to an X-Y recorder.

L. OUTPUT Section: The RESET INTEGRAL and SET I OFFSET pushbuttons are used for integrating current. This section also lets you send an analog output to another device. A pushbutton lets you specify the output as current, log current, or coulombs.

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273A
Potentiostat/Galvanostat

Specifications

The following specifications apply at the nominal line voltage ±10% and at a temperature of 25°C (77°F) unless otherwise stated.

POWER AMPLIFIER

Compliance Voltage: >±100 V
Maximum Output Current: >±1.0 A
Slew Rate: 10 V/µS (high speed)
Bandwidth, Open Loop, Unity Gain: >2.5 MHz
Voltage Temperature Stability: <50 µV/°C

DIFFERENTIAL ELECTROMETER

Input Impedance: $>10^{10}$ Ω in parallel with <50 pF
Input Bias Current: <20 pA at 25°C
Maximum Input Voltage
Differential: ±10 V
Reference Input: ±11 V
Common Mode Rejection
>70 dB at 100 Hz
>60 dB at 100 kHz
Bandwidth
Small Signal: >8 MHz
Full Signal: >400 kHz
Offset Voltage: <10 µV
Offset Temperature Stability: <10 µV/°C

IR COMPENSATION

Positive Feedback
Range: 20 MΩ to 2 Ω depending on current range
Resolution: 0.05% of current range
Current Interrupt
Digital Potential Error Correction: 12 bit DAC
Total Interruption Time: <200 µS
Switching Time, ON/OFF: <1 µS (1 kΩ resistive cell)

CURRENT MEASUREMENT

Ranges: 8 decades, 1 A to 100 nA
Accuracy (dc) at Monitor
10 µA to 1 A: Better than 0.2% of range
100 nA and 1 µA Ranges: Better than 0.5% of range ±5 nA max (±1 nA typical)

Frequency Response (small signal)
1 mA Range: –3 dB at >1 MHz,
1 kΩ source impedance
10 µA Range: –3 dB at >75 kHz,
100 kΩ source impedance

POTENTIAL/CURRENT CONTROL

Digital/Analog Converters (DACS)
Bias DAC
Resolution: 14 bits
Range: ±8 V (potentiostat) ±200% of full-scale current (galvanostat)
Modulation DAC
Resolution: 14 bits
Range (Potentiostat): ±2 V, ±0.2 V, and ±0.02 V
Range (Galvanostat): ±200%, ±20.00%, and ±2.000% of full-scale current
Accuracy
Applied Potential: 0.2% of reading ±2 mV
Applied Current: 0.2% of full-scale current

SYSTEM

Rise Time (10% to 90% on high-speed setting)
No Load: <750 ns
1 Ω, 1 A: <3 µs
10 kΩ, 100 µA: <2 µs
Noise and Ripple: typically <25 µV rms referred to external input

COMPUTER INTERFACES

RS-232C
IEEE-488 (GPIB)

WEIGHT: 31 kg (68 lb)

DIMENSIONS

48 cm W x 30 cm H x 51 cm D
(19" W x 12" H x 20" D)

POWER REQUIREMENTS

100–130 V or 200–260 V, 50–60 Hz, 350 watts maximum

Recommended Options and Accessories

PowerCV Cyclic Voltammetry Software
PowerSTEP Chronoamperometry and Chronopotentiometry Software
PowerCORR Corrosion Measurement Software
PowerSINE Electrochemical Impedance Software
Model 273A/92 Electrochemical Impedance Option
Model 303A Static Mercury Drop Electrode
Model 307A Interface for Model 303A
Model 377A Coulometry Cell System
Model 616 Rotating Disk Electrode
Model 636 Ring/Disk Electrode
Model G0224 Gold Microelectrode
Model G0225 Platinum Microelectrode
Model G0226 Glassy Carbon Microelectrode
Model K0047 Corrosion Cell Kit
Model K0206 Rack Mounting Kit
Model K0235 Flat Cell Kit
Model K0264 Microcell Kit
Model K0269 Faraday Cage Kit

These accessories are available separately or as part of a complete system. All software operates with Windows 95/98/2000/NT/XP. For the latest features, prices, and availability, contact your local salesman or the factory.

Specifications subject to change
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