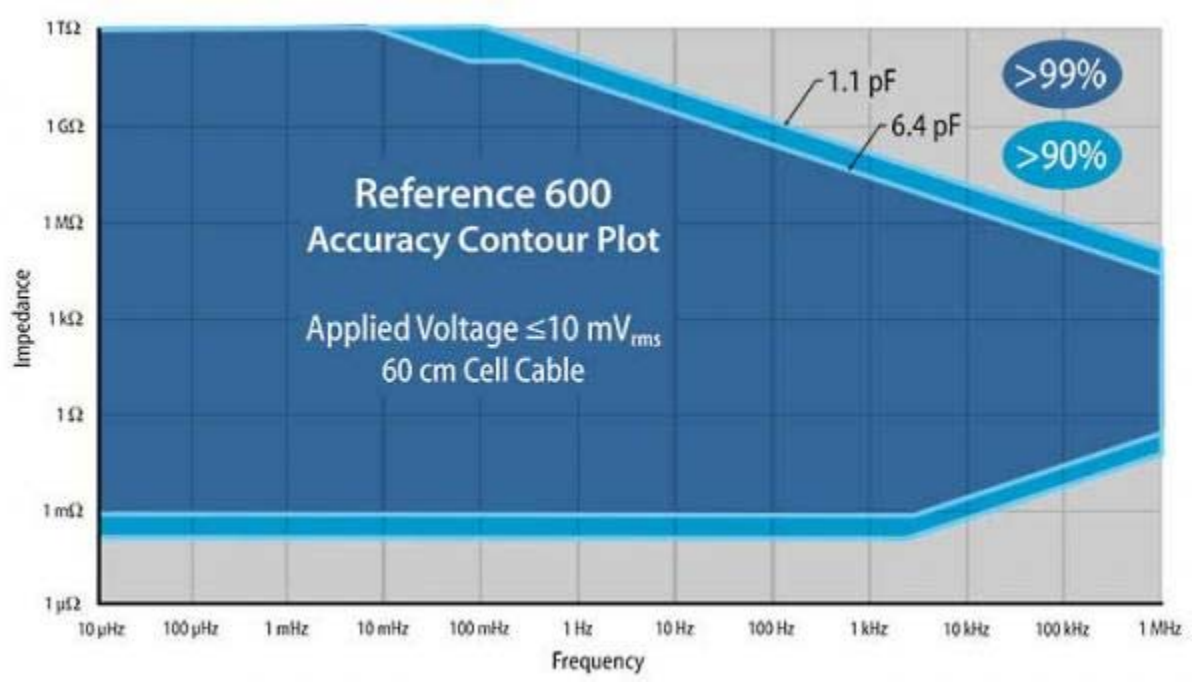
# GAMRY REFERENCE 600: POTENTIOSTAT/GALVANOSTAT/ZRA

## Overview

The Reference 600 is a high-performance, research-grade potentiostat/galvanostat/ZRA designed for fast, low-current measurements. It does well for a variety of applications such as physical electrochemistry (especially at microelectrodes), fast cyclic voltammetry, electrochemical corrosion, electrochemical noise measurements, paints and coatings, and sensors. It has a number of auxiliary input and outputs designed to help you interface or control ancillary equipment such as a rotating disc electrode. It also has a thermocouple for temperature measurements.

## Electrochemical Impedance Spectroscopy

The Reference 600 comes fully equipped to perform electrochemical impedance spectroscopy. The Accuracy Contour Plot shown below provides a detailed look at the performance you can expect from your instrument in real-world situations. The results include the cell cable.




Below are additional details regarding the capabilities of the Reference 600 potentiostat. Each bullet point contains a list of the type of techniques available for the instrument to run.

- **Physical Electrochemistry -** Techniques such as cyclic voltammetry, chronoamperometry, and chronopotentiometry and derivatives of these techniques.
- **Pulse Voltammetry -** Techniques such as pulse voltammetry, square wave voltammetry, and associated stripping techniques such as anodic stripping voltammetry.
- **DC Corrosion** - Run standard DC corrosion tests such as polarization resistance, potentiodynamic, cyclic polarization, and galvanic corrosion in addition to a number of others.

- **Electrochemical Energy -** Test single-cells and stacks of various batteries, fuel cells or supercapacitors. Includes charge, discharge, cyclic charge-discharge techniques, potentiostatic, galvanostatic, self-discharge, leakage rate, and read cell voltage.
- **Electrochemical Signal Analyzer -** Designed specifically for the acquisition and analysis of time-dependent electrochemical noise signals. Cell voltage and current are continuously monitored at rates from 0.1 Hz to 1 kHz. A full featured set of analysis tools provides powerful analysis features such as statistical analysis, detrending, impedance spectra, and histogram analysis.
- **Electrochemical Frequency Modulation -** A non-destructive corrosion rate measurement technique. It allows for measurement of the corrosion rate without prior knowledge of the Tafel constants. In addition, the technique determines the Tafel constants and provides 2 internal validity checks.
- **Critical Pitting Temperature -** controls a Gamry Potentiostat, TDC4 Temperature Controller, and associated accessories to automatically measure the Critical Pitting Temperature of a material.
- **Electrochemical Noise -** A more general form of electrochemical noise testing. It is also an ECM8 Multiplexer compatible electrochemical noise software package.
- **Electrochemical Impedance Spectroscopy -** includes experimental scripts for potentiostatic, galvanostatic and hybrid impedance spectroscopy experiments in addition to single frequency techniques like Mott-Schottky. We also have our unique power-leveling multisine technique that improves signal-to-noise across the spectrum. On the analysis side, it provides tools for fitting spectra to equivalent circuit models, Kramers-Kronig transform for data validation and a graphical model editor. Our software even includes a script for EIS simulation.
- **eChemAC** - Includes full capabilities of eChemDC Toolkit plus allows electrochemical impedance spectroscopy (EIS) and EFM experiments.

**Other options**

- 2, 3, and 4 electrode measurements
- Electrical Isolation
  - Floating instrument: use with autoclaves, mechanical stress apparatus, or pipeline probes.
- Portable
  - Size of a chemistry textbook, weighing only 3 kgs (6.6 lbs). Easy USB 2.0 connection to a Windows computer.
- Built-In EIS
  - On-board DDS to perform EIS from 10 μHz to 1 MHz.
- DSP (Digital Signal Processing) Mode
  - Oversamples for improved signal-to-noise and accurate capacitance measurements.
- Current Interrupt and Positive Feedback iR Compensation
  - Gamry potentiostats and their controlling software use control loop algorithms to accurately measure and correct for uncompensated resistance.
- Auxiliary I/O
  - Control additional equipment via additional I/O interfaces: external signal input, analog voltage output, analog current output, auxiliary A/D input, and digital I/O connector.
- Warranty
  - Protected by 2-year factory service warranty.

**SPECIFICATIONS:**

| | **REFERENCE 600** |
|---|---|
| **Potentiostat** | YES |
| **Galvanostat** | YES |
| **Zero Resistance Ammeter** | YES |
| **Cell Connections** | 2, 3, or 4 |
| **Floating (Isolated from Earth)** | YES |
| | |
| ***WEIGHT*** | 3 kg |
| ***DIMENSIONS*** | 9 (W) x 19 (H) x 27 (D) cm |
| | |
| ***SYSTEM*** | |
| **Max Current** | ± 600 mA |
| **Current Ranges** | 11 (60 pA - 600 mA) |
| **Current Ranges (w/Internal Gain applied)** | 13 (600 fA - 600 mA) |
| **Min Voltage Resolution** | 1 μV |
| **Min Current Resolution** | 20 aA |
| **Max Applied Potential** | ± 11 V |
| **Rise Time** | <250 ns |
| **Noise and Ripple** | <10 μV rms |

| | |
|---|---|
| **Noise and Ripple (typical)** | <2 µV rms |
| **Min Time Base** | 3.333 µs |
| **Max Time Base** | 715 s |
| **Min Potential Step** | 12.5 µV |
| | |
| ***EIS MEASUREMENT*** | |
| **Frequency Range** | 10 µHz - 1 MHz |
| **EIS Accuracy** | See Accuracy Contour Plot |
| **Max AC Amplitude** | 3 V max<br>600 mA max |
| | |
| ***CONTROL AMP*** | |
| **Compliance Voltage** | ± 22 V |
| **Output Current** | > ± 600 mA |
| **Speed Settings** | 5 |
| **Unity Gain Bandwidth** | 980, 260, 40, 4, 0.4 kHz |
| | |
| ***ELECTROMETER*** | |
| **Input Impedance** | $>10^{14}\,\Omega$ |
| **Input Current** | <5 pA |
| **Input Current (typical)** | <2 pA |

| | |
|---|---|
| **Bandwidth (-3dB) (typical)** | >15 MHz |
| **Common Mode Rejection Ratio** | >80 dB (3 Hz)<br>>60 dB (1 MHz) |
| | |
| ***APPLIED POTENTIAL*** | |
| **Accuracy** | ± 1 mV ± 0.2% of setting |
| **Accuracy (typical)** | ± 375 µV ± 0.04% of reading |
| **Resolution** | 12.5 µV, 50 µV, 200 µV/bit |
| **Drift** | <20 µV/°C |
| **Potential Scan Range** | ± 0.4 V, ± 1.6 V, ± 6.4 V |
| | |
| ***MEASURED POTENTIAL*** | |
| **Accuracy** | ± 1 mV ± 0.2% of reading |
| **Accuracy (typical)** | ± 250 µV ± 0.05% of reading |
| **Full-Scale Ranges** | 12 V, 3 V, 300 mV, 30 mV |
| **Resolution** | 400 µV, 100 µV, 10 µV, 1 µV/bit |
| **Offset Range** | ± 10 V |
| | |
| ***CURRENT*** | |
| **Applied/Measured Accuracy** | ± 10 pA ± 0.05% of range<br>± 0.2% of value (600 mA-6 nA)<br>or 0.75% of value (600 pA)<br>or 1.5% of value (60 pA) |

| | |
|---|---|
| **Applied/Measured Resolution** | 0.0033% full-scale/bit |
| **Bandwidth (-3 dB)**<br>**NOTE: Bandwidth is current-range dependent.** | > 10 MHz (600 mA – 600 µA)<br>> 1.5 MHz (60 µA)<br>> 0.15 MHz (6 µA) |
| **Stability Settings** | 4 |
| **Post Offset Gain** | 1, 10, 100 |
| **Offset Range** | ± 1X full-scale |
| | |
| ***iR COMPENSATION*** | |
| **Mode** | Current Interrupt and<br>Positive Feedback |
| **Min Interrupt Time** | 33 µs |
| **Max Interrupt Time** | 715 s |
| | |
| ***AUXILIARY A/D INPUT*** | |
| **Range** | ± 3 V |
| **Resolution** | 0.1 mV |
| **Input Impedance** | >100 kΩ or >10 GΩ |
| | |
| ***AUXILIARY D/A OUTPUT*** | |
| **Range** | 0-4 V |
| **Resolution** | 1 mV |