



Redefining Electrochemical Measurement

## Overview of Gamry Software

### Introduction to Gamry Software

Gamry Instruments provides a wide range of electrochemical software that controls Gamry potentiostats to perform a variety of electrochemical experiments. Gamry software is compatible with the Reference and Interface families of Gamry potentiostats and Windows® 7 or newer.

#### Gamry Framework Software

Corrosion Techniques

Critical Pitting Temperature

Electrochemical Noise (Basic)

Physical Electrochemistry

Pulse Voltammetry

Electrochemical Impedance Spectroscopy

Solar Cells

Electrochemical Energy

Spectro-electrochemistry and Raman spectro-electrochemistry

Gamry software employs Open Source Scripting, both easy to use for standard experiments and flexible for special applications. Most users find that the standard experiments are all they ever need. In case you need a special experiment or a unique analysis, you—or our own software support staff—can modify the scripts. You are never locked into a rigid experimental sequence. Thanks to Open Source Scripting, Gamry offers an unprecedented degree of flexibility for electrochemical measurements.

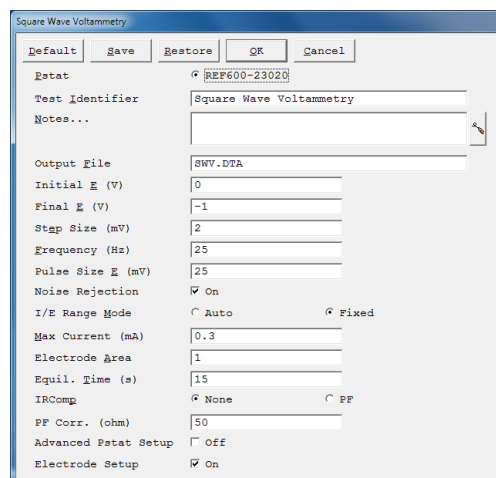
Gamry has a several different software programs for data-acquisition:

- Framework™ User-modifiable scripts written in Explain™, Gamry’s experiment control language, with over 85 standard experiments.
- Echem Analyst™ Our data-analysis software package of user-modifiable scripts written in Mi-

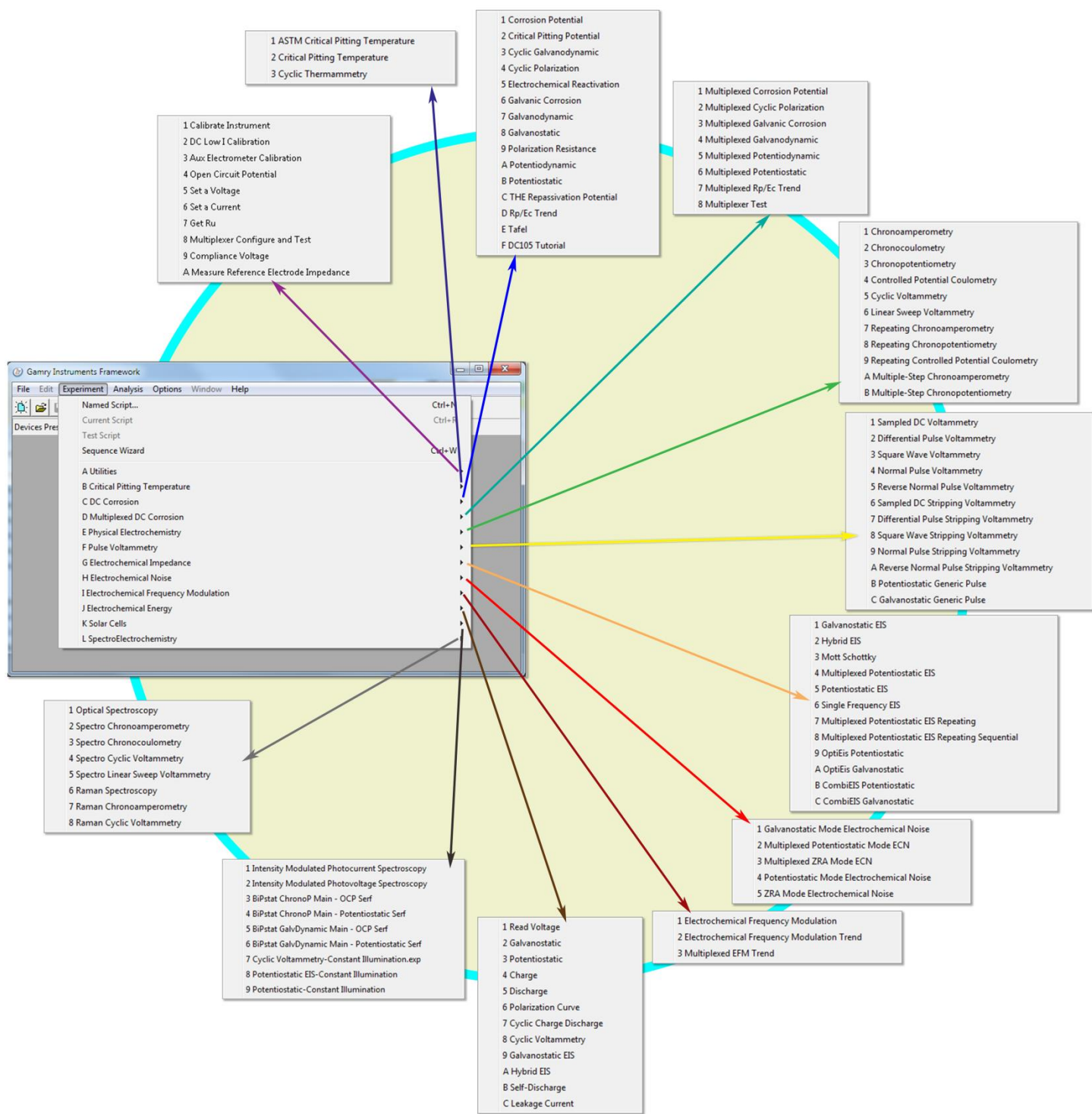
crosoft® Visual Basic® for Applications.

- Electrochemical Signal Analyzer™ A LabVIEW™ application for advanced electrochemical-noise measurements. Acquire and analyze noise data with this program.
- Virtual Front Panel™ A LabVIEW application meant to look like an old analog potentiostat. Useful for quick experiments. Outputs data in x,y format.
- Resonator™ A LabWindows™ application for controlling the eQCM 10M™ and a Gamry potentiostat. Analyze data using Echem Analyst.
- eChem Toolkit™ A series of software toolkits for developing your own interface to a Gamry potentiostat. Includes examples for LabVIEW, C, C++, C#, VB.Net and Visual Basic®.

The Gamry Framework and the Gamry Echem Analyst provide a common user-interface for acquisition and analysis, respectively. These packages smooth your transition to a new electrochemical application.



Typical setup window in the Gamry Framework. Setting the parameters for an electrochemical experiment in the Framework is easy—just fill in the fields! Click **Notes** to add specific information to the data file about your sample. Save data in the **Output File**. The text boxes “remember” the last entered value, accelerating parameter entry. Click **Default** to re-enter the default values. **Save** a setup and **Restore** it later. Click **OK** to run the experiment.



The Gamry Framework is the platform for a complete range of Gamry electrochemical software, including Corrosion Techniques and Multiplexed DC Corrosion, Critical Pitting Temperature, Electrochemical Noise, Physical Electrochemistry, Pulse Voltammetry, Electrochemical Impedance Spectroscopy, and more. You can perform every major application of electrochemistry with the Gamry family of software.

With Gamry's exclusive Sequence Wizard, you can easily build measurement sequences beginning from simple structures up to complex measurement procedures for experiments not listed in the chart above. The Sequence Wizard has the advantage that you can create complex measurement sequences using a drag-and-drop approach. In this way, you can customize experiments to execute consecutively without interfering disruptions. Our website, [www.gamry.com](http://www.gamry.com), has tutorials and videos explaining how to use this versatile tool.

## Gamry Framework

In a Gamry system, the electrochemical experiments are defined by scripts written in Explain. Framework is, in effect, an Explain interpreter. Portions of the Framework are compiled code, including device drivers for Gamry potentiostats, the elements to construct the user-interface for the various experiments, and a selection of routines for plotting, saving, printing, and so on.

An experiment running on a Gamry system is a careful mix of fast compiled software to control timing of the electrochemical experiment, and interpreted software (Explain) for flexibility in experiment customization. The compiled portion runs in the background and handles time-critical functions such as signal-generation and data-acquisition. Explain scripts let you modify the input parameters to these time-critical objects.

The result is software that combines the best of both flexibility and accuracy. Modify the software easily for a special application, while insuring both instrumental accuracy and convenience. The Gamry website has more information on Explain plus examples of how to modify a script to perform specific tasks.

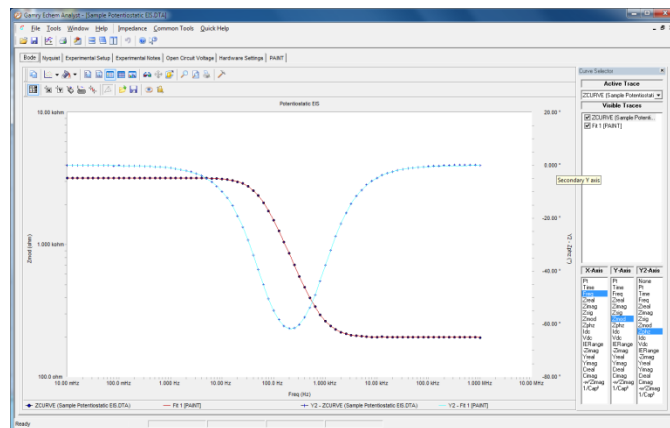
For the user, the Framework is a pleasure. Setup for each experiment is a simple window in which you enter the parameters required for the experiment. The intuitive real-time data-display keeps you informed throughout data-acquisition. Regardless of the experiment, the Framework gives you a consistent instrument display.

## Gamry Echem Analyst

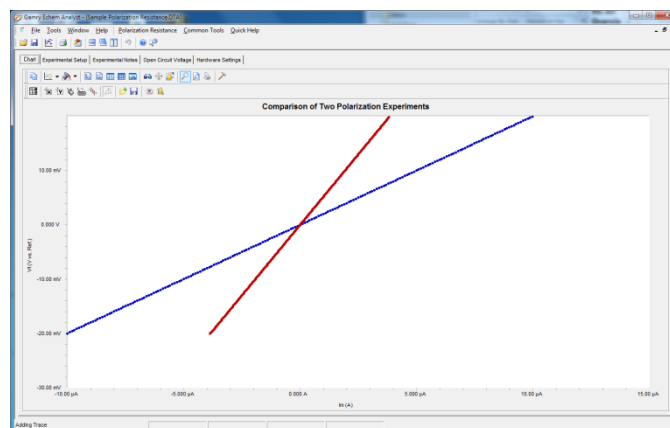
The Gamry Echem Analyst is the starting point for nearly all data-analysis. While the Gamry Echem Analyst is powerful, the clever implementation of toolbars, left versus right mouse-clicks, accepted Windows® conventions, and the use of standard drawing tools give you a friendly interface and intuitive operation. And because the Echem Analyst incorporates Visual Basic® for Applications, you can modify the VBA scripts for special analysis protocols.

The Gamry Echem Analyst provides a set of general and technique-specific functions for display, manipulation, and presentation of your data. General functions include **File>Open**, and **File>Save**. You may overlay two or more curves (up to 128!) for easy visual comparison. Click a button to open the VBA script. Display multiple windows. Turn on the **Curve Selector** to change the plot, hide a trace for clarity, or delete a fit or a line. If your chart gets too busy, you can hide a trace with a single mouse-click. Select an x- or y-region for mathematical manipulation such as integration. A portion of a curve may also be selected for manipulation—for example, to determine the slope for corrosion-rate calculation in Polarization Resistance. Draw a freehand line to use as a baseline in Cyclic Voltammetry...and then automatically measure the difference between the peak and the baseline! Add a vertical or a horizontal grid to the

curve, which is most useful when comparing curves. There's a **Zoom** control to get close and personal with your data.



An EIS curve in the Gamry Echem Analyst. This Bode plot demonstrates the crisp display and information content of the Echem Analyst. Impedance and phase data contain both markers and lines. A Nyquist plot is available on a second tab. The right side of the display is the **Curve Selector**, to show or hide any trace, and change the parameters plotted on the chart—useful if many traces are displayed simultaneously. Activate the **Curve Selector** by clicking the toolbar. To fit a model to the data, select **Impedance**, then either **Fit A Model**, or **Model Editor** to create a new model.



Two Polarization Resistance plots overlaid for comparison. The title has been completely changed. The **Annotation toolbar** is visible at the bottom of the display. The two plots are color-coded so they can be distinguished from each other (see the legend above the **Annotation toolbar**). The marker styles can also differentiate the traces. To calculate corrosion rate, select the portion of the curve with two mouse-clicks, then select **Polarization Resistance**.

## Choices in Viewing Your Data

Every experiment contains several pages. Each chart occupies a page selected by a tab. In EIS, for example, select the appropriate tab for a Bode or a Nyquist plot. Select the **Experimental Setup** page to review the experimental parameters. Enter any unique comments about the sample on the **Experimental Notes** page. Review the potentiostat configuration on the **Hardware Settings** page.

For a quick look at a specific data point on the chart, we offer several cursor modes. Place the cursor over the trace, and the x- and y-coordinates appear. Click and hold the left mouse-button with the cursor anywhere on the chart, and the x- and y-coordinates of that position appear. For EIS curves, detailed information (frequency,  $Z_{real}$ ,  $Z_{imag}$ , etc.) can be displayed, which is particularly useful for Nyquist plots.

### Display and Print with Flexibility

You have remarkable control over the appearance of the chart:

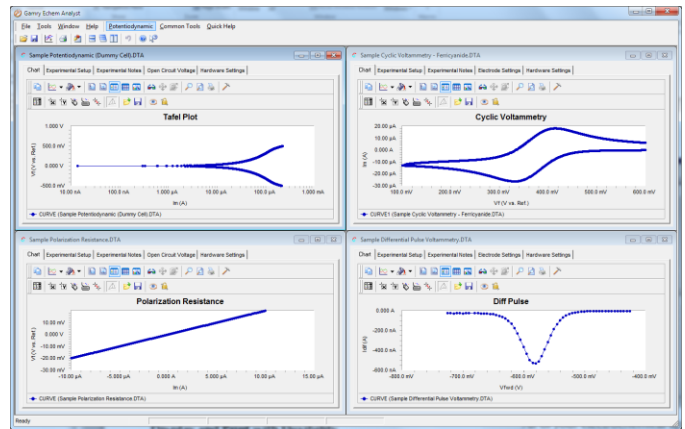
- Change text, font, size, color, and style of the title and axes
- Change spacing and placement of major and minor tick marks on the axes
- Change font, size, color, and rotation of the legend
- Use linear or logarithmic axes
- Interchange axes
- Change color, weight, and type of line for each trace.
- Change shape of the data points.
- Add annotations and other items, and change the background color of the chart.

Your control extends to the printing process:

- **Print Preview** is available.
- Print in landscape or portrait mode
- Print only the chart or include the setup parameters, experimental notes, and the results.
- Adjust the margins on the hardcopy for convenient archiving in a laboratory notebook.
- Create a custom report using the VBA script.

### Common Tools

The Gamry Echem Analyst includes a set of Common Tools that are available for all techniques. These include **Add E Constant**, **Add I Constant**, **Linear Fit** (applied to a selected portion of the data), and **Smooth Data** (a Savitzky-Golay or a sliding-window smoothing routine). There are also specific mathematical functions determined by the type of data under examination. Long-time Gamry users will be pleased to know that a file converter is included so that you can open your older data files in the Echem Analyst.



View and process all of your electrochemical applications in the Gamry Echem Analyst. Select the curve to activate it, then perform the analysis. Everything gets done in one place in one program with a common set of tools. There's no need for the confusion of multiple software packages for each electrochemical technique. Golf is hard...electrochemistry with Gamry is easy.

The analysis of electrochemical data in the Gamry Echem Analyst is performed using scripts written in Visual Basic for Applications. With Gamry's Open Source Scripting, you may open and change these scripts to perform special analytical procedures as you desire.

VBA is an object-oriented language, as is Explain. Anyone familiar with computers can learn programming in VBA. Because of the popularity of VBA, programming resources are readily available at your local bookstore or on-line. Contact Gamry for custom modifications.

### System Specifications

Gamry software requires Microsoft® Windows® 7 or newer Operating System. Gamry software controls the Reference series and Interface series instruments.

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