

in your cyclic voltammogram. An X or a Y region may be selected 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, very useful when comparing curves. There's a Zoom control to get up close and personal with 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, there are several cursor modes. Place the cursor on a trace and the X and Y coordinates will be displayed. Click-and-hold the left mouse button with the cursor anywhere on the chart and the X and Y coordinates of that position will be displayed. For EIS curves, detailed information (frequency, Zreal, Zimag, etc.) can be displayed, particularly useful for Nyquist Plots.

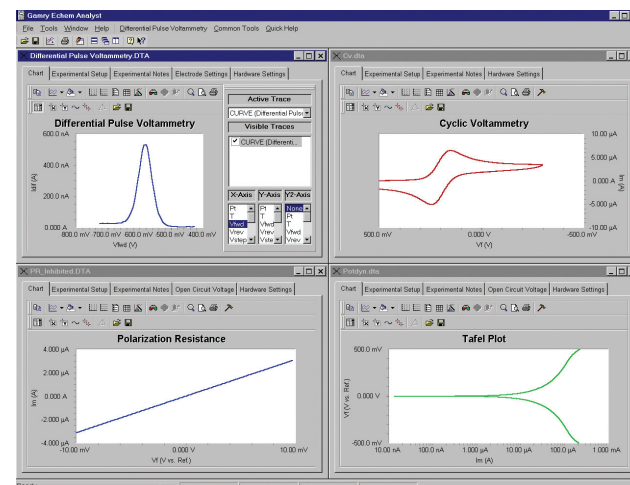
You have remarkable control over the appearance of the chart. What would you like to change? The title...then right click on it. Change the text, the font, the size, the color, and make it bold! The X-axis...right click on it. Change the spacing of the major tick marks and the minor tick marks, and put the tick marks either inside, outside, or across the axis. Change the font, size, and color of the legend, then rotate it 45°. Change the axis to logarithmic.

How about a trace? Right click on it and change the color, the line type (solid, dashed, etc.), and the weight of the line. Change the data point markers from squares to triangles to circles to none. Bring up the Annotate Curve toolbar and add text or other items to the chart to highlight specific features of the trace.

Finally, 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 (applies 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 your older data files can be opened seamlessly in the Echem Analyst.

User control extends to the printing process. Print in landscape or portrait mode. Click the Print Preview to see what the hard copy looks like. You can print only the chart or you can include the setup parameters, experimental notes, and the results.



All of your electrochemical applications may be viewed and processed in the Gamry Echem Analyst. Select the curve to activate it, then perform the analysis. Everything is 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.

The analysis of electrochemical data in the Gamry Echem Analyst is performed using scripts written in Microsoft Visual Basic for Applications. With Gamry's Open Source Scripting, these scripts may be opened and modified to perform your custom analytical procedures. VBA is an object-oriented language, as is Explain. Programming in VBA can be learned by anyone who is familiar with computers. Because of the popularity of VBA, programming resources are readily available at your local bookstore. Contact Gamry for custom modifications.

System Specifications

Gamry software requires Microsoft® Windows® 2000 or XP Operating System. Gamry recommends a minimum computer specification of 450 MHz processor or higher and 256 MB of RAM. Installation of all Gamry software requires approximately 80 MB of hard drive space.

Gamry also supplies the LabVIEW-based ESA400 Electrochemical Signal Analyzer and the VFP600 Virtual Front Panel.

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Redefining Electrochemical Measurement

An Overview of Gamry Software

Gamry manufactures software for every major application of electrochemistry. Our software is written for specific applications, which has two advantages when compared to general-purpose do-everything software:

1. You pay for only the software you need.
2. It's very easy to use, because the software is written for specific electrochemical techniques.

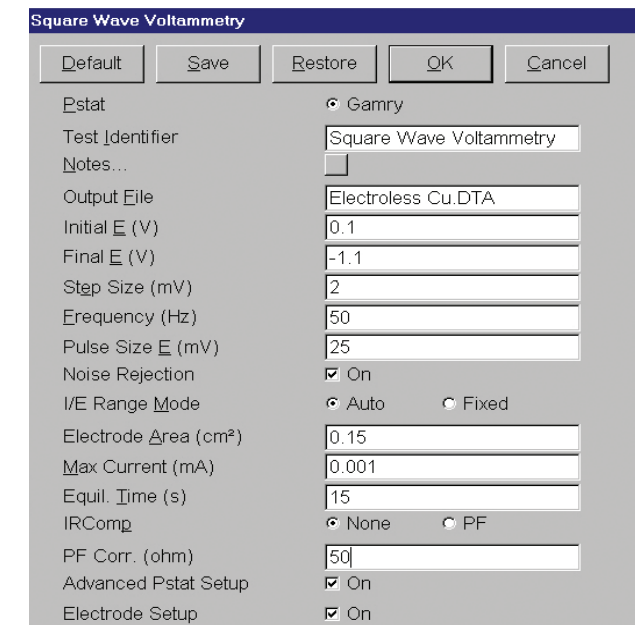
Gamry Software
DC105 Corrosion Techniques Software
CPT110 Critical Pitting Temperature Software
EN120 Electrochemical Noise Software
EFM140 Electrochemical Frequency Modulation
PHE200 Physical Electrochemistry Software
PV220 Pulse Voltammetry Software
EIS300 Electrochemical Impedance Spectroscopy Software
FC350 Fuel Cell Monitor

Gamry software employs Open Source Scripting™ that is both easy-to-use for standard electrochemical experiments and flexible for special applications. Most users will find that the standard experiments are all they ever need. In the event that a special experiment or a unique analysis is required, the scripts can be modified either by the user or by the Gamry software support staff. You are never locked in to a rigid experimental sequence. Thanks to Open Source Scripting, Gamry offers an unprecedented degree of flexibility for electrochemical measurements.

The electrochemical experiment with a Gamry system consists of two steps:

- Data acquisition in the Gamry Framework™ using modifiable scripts written in Explain™. Gamry's experiment control language.
- Data analysis in the Gamry Echem Analyst™ using modifiable scripts written in Microsoft® Visual Basic for Applications™.

The Gamry Framework and the Gamry Echem Analyst provide a common user interface for acquisition and analysis, respectively. This commonality smooths your transition to a new electrochemical application.



Typical Setup Window from the Gamry Framework. Setting the parameters for a given electrochemical experiment in the Framework is easy – just fill in the blanks! Click on Notes to add specific information to the data file about your sample. The data is saved in the Output File. The text boxes "remember" the last entered value, accelerating parameter entry. Press Default to restore the default values. You can Save a setup and Restore it later. Press OK to run the experiment.

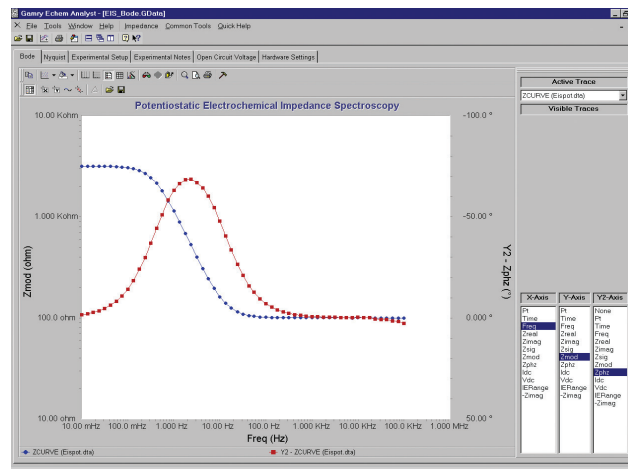
Gamry Framework

In a Gamry system, the electrochemical experiments are defined by scripts written in Explain. All experiments are launched from the Gamry Framework. The Framework is, in effect, an Explain interpreter. Portions of the Framework are compiled code. These areas include device drivers for Gamry Potentiostats, the elements to construct the user interface for the various experiments, and a selection of utility routines for plotting, saving to a file, printing, etc.

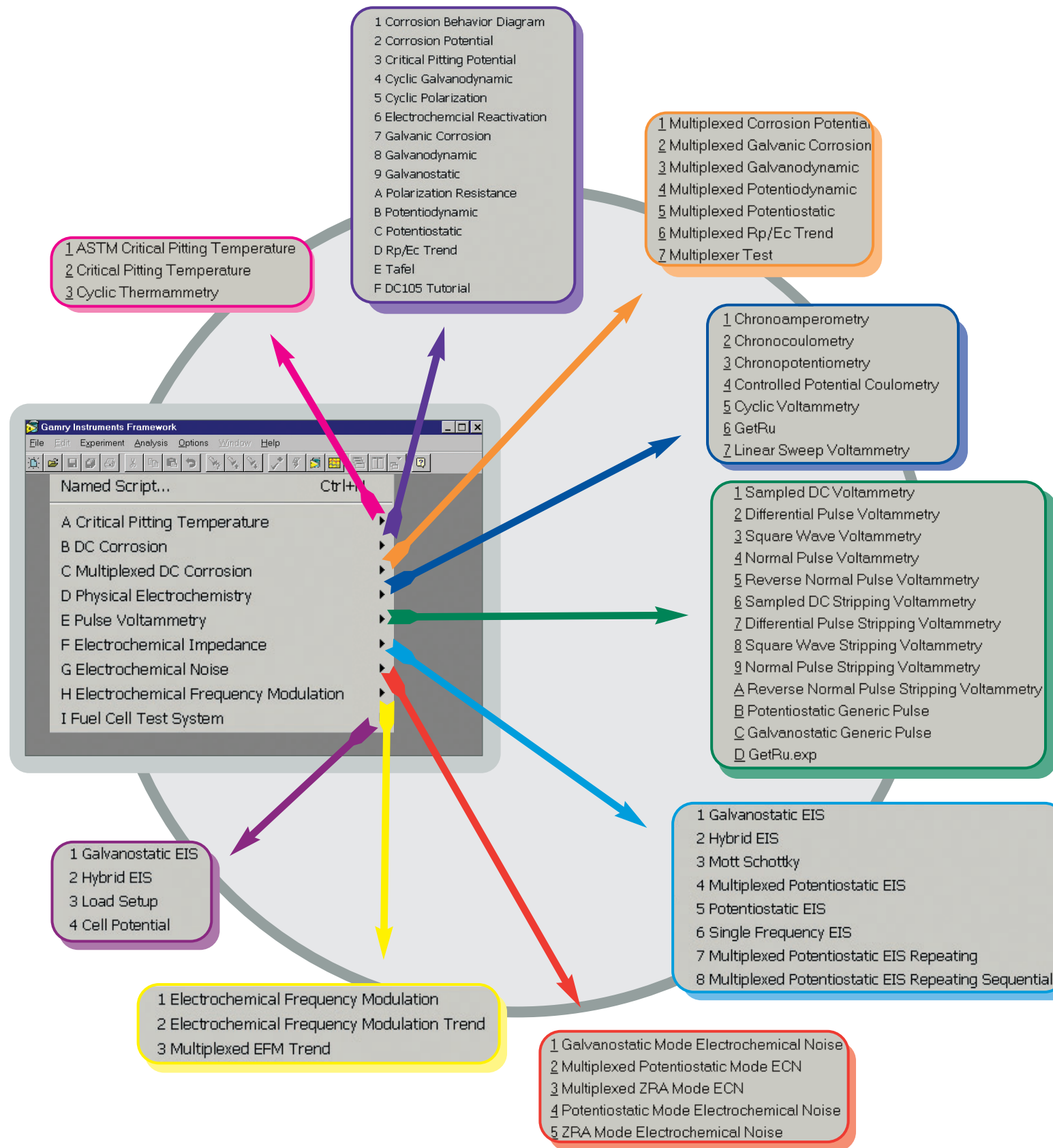
An experiment running on a Gamry system is a careful mix of fast compiled software for proper control of the timing of the electrochemical experiment and interpreted software (Explain) for flexibility in experiment customization. The compiled portion of the Framework runs in the background and handles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

The result is software that combines the best of both worlds. The software can be easily modified for a special application while insuring both instrumental accuracy and personal computing convenience. See the Gamry website for more information on Explain and some examples of script modification to perform specific tasks.

For the user, the Framework is a pleasure. The Setup for each experiment is an easy-to-use dialog box in which the parameters required for the experiment are entered. During data acquisition, the intuitive real-time data display keeps you informed throughout the experiment. Regardless of the electrochemical experiment, the Framework gives you a consistent user interface and instrument display.



An EIS curve in the Gamry Echem Analyst. This Bode Plot demonstrates the crisp display and information content of the Echem Analyst. The impedance and the phase data contains both markers and lines. A Nyquist Plot is available on a second tab. The right side of the display is the Curve Selector, which allows the user to show or hide any trace and change the parameters plotted on the chart. This feature is very useful if a large number of traces are displayed simultaneously. The Curve Selector can be turned on or off by clicking on the Toolbar. To fit a model to the EIS data, select Impedance, then either Fit A Model or Model Editor to create a new model.



The Gamry Framework is the platform for a complete range of Gamry electrochemical software, including the DC105 Corrosion Techniques and Multiplexed DC Corrosion, CPT110 Critical Pitting Temperature, EN120 Electrochemical Noise, EFM140 Electrochemical Frequency Modulation, PHE200 Physical Electrochemistry, PV220 Pulse Voltammetry, EIS300 Electrochemical Impedance Spectroscopy, and FC350 Fuel Cell Monitor. Every major application of electrochemistry can be performed with the Gamry family of software.

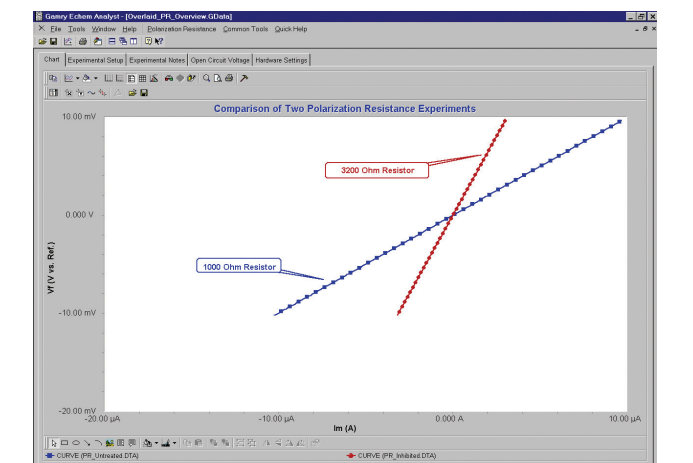
Gamry Echem Analyst

The Gamry Echem Analyst is the starting point for all data analysis. While the Gamry Echem Analyst is very powerful, the clever implementation of toolbars, left vs. right mouse clicks, accepted Windows conventions, and the use of standard drawing tools has resulted in a friendly interface and intuitive operation. And since the Echem Analyst incorporates Visual Basic for Applications, the VBA scripts can be modified for special analysis protocols.

The Gamry Echem Analyst provides a set of both general and technique-specific functions for data display, manipulation, and presentation. General functions include axes settings and paths. Two or more curves (up to 128!) may be overlaid for easy visual comparison. Press a button to open the VBA script. Display multiple Windows in a horizontal, vertical, or cascade format.

The control of the technique-specific functions is a major convenience. These functions primarily involve display parameters such as current units (current or current density), voltage units (Eref or Eoc), time units, and axes. Plot current on the X-axis for Potentiodynamic Plots and on the Y-axis for Cyclic voltammetry. Plot current density in Polarization Resistance and current in Square-Wave Voltammetry. Set time for seconds in Chronoamperometry and hours for Galvanic Corrosion. Set it once for each technique and you're done!

Turn on the Curve Selector to change the plot, hide a trace for clarity, or delete a fit or a line. Collect your Quartz Crystal Microbalance signal at the Auxiliary Input and display it versus potential along with current vs. potential



Two Polarization Resistance Plots Overlaid for Comparison. Note that 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.