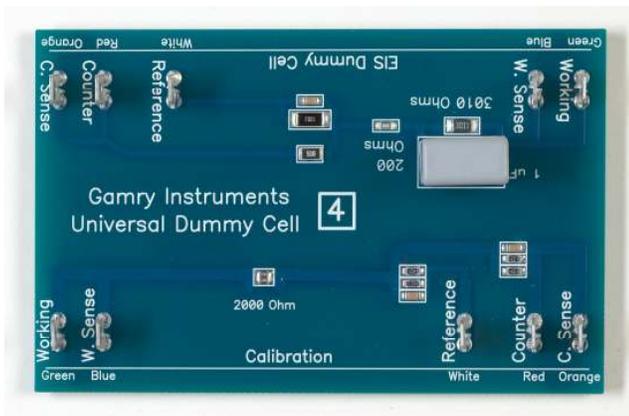


Troubleshooting Your Gamry Potentiostat with the Universal Dummy Cell 4

Introduction

The Universal Dummy Cell 4 (UDC 4) is a printed circuit board used for calibration and troubleshooting of your Gamry Potentiostat and is supplied with every Gamry Potentiostat.



It has two sides, equipped with tabs, labeled "Calibration" and "EIS Dummy Cell". The tabs are marked with labels corresponding to the leads on a Gamry Cell Cable.

NOTE: As the name implies, the UDC 4 is the fourth revision of the Universal Dummy Cell. You should not use the UDC 1 (labeled "Universal Dummy Cell") to calibrate a PCI4, Series G, or Reference Family Potentiostat. Using a UDC 2 or UDC 3 is OK. Some Universal Dummy Cells include a "DC Dummy Cell". The "DC Dummy Cell" was removed from the UDC 4.

Calibration

If you suspect that your Gamry Potentiostat is misbehaving, the first step is to calibrate it. The Calibration element on the UDC 4 is a 2000 ohm precision resistor (with some protection components). Its value measured with a Potentiostat is typically between 1.994 kohm and 2.006 kohm.

To calibrate your Gamry Potentiostat, connect the cell cable to the appropriate tabs on the Calibration side of the UDC 4. Be sure to place the UDC 4 inside the Calibration Shield included with your Potentiostat. This is very important for the Reference 600 because of the high sensitivity of this Potentiostat. Run the Calibration by opening the Gamry Framework Software and clicking Experiment-Utilities-Calibrate Instrument.

When you select Calibrate Instrument, you have a choice of a DC Calibration, an AC Calibration, or Both.

If your Potentiostat is not connected to an ECM8 Multiplexer, then select Both.

If you are using an ECM8 Multiplexer with your Potentiostat, then calibration is a two-step process:

- (1) Perform the DC Calibration with the ECM8 Multiplexer disconnected from your Potentiostat.
- (2) Perform the AC Calibration with the ECM8 Multiplexer connected to your Potentiostat. In this case, you must set a Multiplexer channel to connect to the UDC4 -- click Experiment-Named Script-Multiplexer Set.exp and click the radio button for the channel you wish to use.

If you are using a Reference 600 or 3000 Potentiostat, AND you have more than one cell cable, you should be aware that the EIS capability of a Potentiostat is affected by the length of the cell cable. DC measurements, in general, are not affected by the length of the cell cable. For the best EIS measurements, you'd like to calibrate the Potentiostat using each cell cable. The Reference 600/3000 is a smart instrument and it knows which cell cable is connected, so you can run the "AC only" calibration for each cell cable. The calibration data for each cell cable is saved in the instrument and used whenever that cable is used in an EIS measurement.

Of all the components of a potentiostat, the Cell Cable is the one that is constantly being flexed and exposed to

corrosive environments and is often the first component to fail. Be sure to check the integrity of your Gamry Cell Cable, as explained in our Technical Note outlining the process

http://www.gamry.com/Support/Cell_Cable_Check.htm

DC Low I Calibration

When you click Experiment-Utilities in the Framework, you will notice an entry called "DC Low I Calibration". This is a special calibration procedure used to insure that ultralow DC currents are measured as accurately as possible. This procedure is recommended for users of the Gamry PHE200 Physical Electrochemistry Software and the Reference 600 Potentiostat.

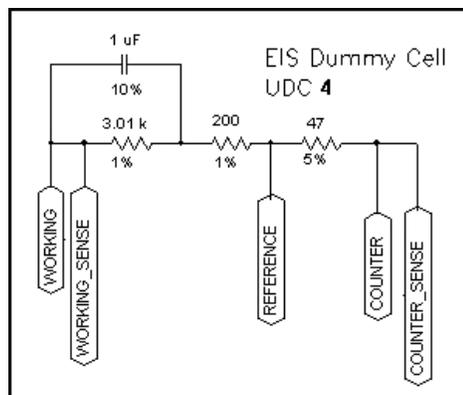
You can also use the Calibration circuit in the UDC 4 to test for proper operation of your Potentiostat. Using "Chronoamperometry" in the PHE200 Software or "Polarization Resistance" in the DC105 Software, apply +/- volt to the 2000 ohm Calibration resistor. The current should equal that given by Ohm's law, $I = E/R$. At 1 Volt, for example, the current should be 500 microAmps ($1\text{ V}/2000\text{ ohms} = 5 \times 10^{-4}\text{ Amps}$).

You can also do scanning experiments with the 2000 ohm resistor, such as Polarization Resistance or Cyclic Voltammetry. For these tests, the current-voltage curve should be perfectly linear and the data should obey Ohm's Law.

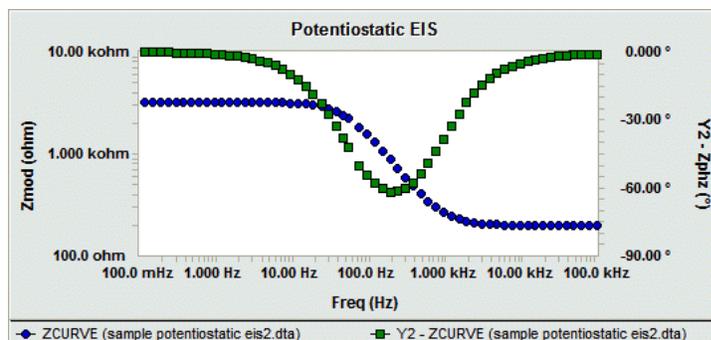
Checking the EIS Performance of Your Potentiostat

The EIS Dummy Cell on the UDC 4 is a Simplified Randle's Cell. If you have a license for Gamry's EIS300 Electrochemical Impedance Spectroscopy software, you can measure this Cell's EIS spectrum to check your system's EIS operation.

A circuit diagram of the EIS cell and a typical spectrum of the cell in Bode format is seen below. In "electrochemistry speak", R_p is 3000 ohms, C_{dl} is $1\ \mu\text{F}$, and R_u is 200 ohms.



A visual examination of the spectrum is usually sufficient to determine if your EIS system is working. Most instrument malfunctions either prevent recording of the spectrum or cause gross errors that dramatically change the shape of the curve.



If you want a numerical confirmation of the system's performance, fit the dummy cell's spectrum to the Randles model in the Echem Analyst. The calculated values should be between:

$$R_p = 2.95\text{ kohm and }3.07\text{ kohm}$$

$$R_u = 196\text{ ohms and }204\text{ ohms}$$

$$C_f = 0.90\ \mu\text{F and }1.10\ \mu\text{F}$$

Troubleshooting Your Gamry Pstat With the UDC4. Rev. s.0
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