

## Interpreting the Calibration Data of Your Potentiostat

### Purpose of This Note

This technical note is intended to help you better understand the meaning of calibration results for your Gamry potentiostat. Often a quick glance at these results can assist you in deciding if any problems are internal to the instrument or an external issue.

### Introduction

Proper calibration of your Gamry potentiostat is a requirement for reproducible, accurate data. This diagnostic test helps you determine if there is a problem with the instrument, and can be the first step in troubleshooting.

Usually the self-test runs with no failures, but on occasion, a failure in a particular sub-test appears, and you have to decide what to do. This technical note can help you interpret the results of the self-calibration.

Both the Gamry Interface family and Reference family of potentiostats automatically run the self-calibration. A comparison of the results from the two families of instruments shows that they are fundamentally very similar.

### Laboratory Setup

Whenever you run the calibration of a Gamry potentiostat, be sure that it is properly grounded (earthed) and warmed up, and the cell is shielded within a Faraday cage against stray electromagnetic fields. If one or more of these factors is not included in the laboratory setup, your instrument may fail because of external problems, not a failure of the instrument's electronics.

### Abort, Retry, or Ignore?

The message, "Abort, Retry, or Ignore" appears if a calibration subtest fails. In general, we recommend that if you see the question "Abort, Retry, or Ignore", click the **Ignore** button, so that the instrument saves the calibration report for later analysis.

### Channel Offsets

The first set of self-calibration tests that your Gamry potentiostat undergoes examines the *channel offsets*.

It is rare for these tests to fail. If these fail, the problem lies within the potentiostat itself. Therefore, if any of the "Ich Channel Offset" or "Vch Channel Offset" tests fail, you will have to send us the potentiostat for further testing and analysis. Contact Gamry Instruments at [techsupport@gamry.com](mailto:techsupport@gamry.com) for assistance.

### Esig Attenuation Offset

The *Esig Attenuation* test, checking the voltage signal, is run for the Reference family only. If this set of tests fails, the cable may be the problem. Swap for an identical cable, and see if the problem vanishes. If it does not, contact us at [techsupport@gamry.com](mailto:techsupport@gamry.com).

### IE Offset

#### Reference family

For the Reference family of potentiostats, if the first four *IE Offsets* fail the test, this is not necessarily a fatal problem. The Reference series of instruments are extremely sensitive—down to picoamperes—so the smallest stray discharge nearby, or even moisture build-up on the electronics inside your potentiostat, may create noise within the system. Be sure that the laboratory set-up (warmed up, enclosed, and grounded) is correct, and retry the calibration. If the test fails after several attempts, contact Gamry technical support with a copy of the test report.

Below is an example of a Reference 3000 with a likely stray voltage interfering with the system. The failed tests are in red. Note how the failures are in the low ranges, and they get closer and closer to passing as the range increases. Rerunning the calibration solved the problem.

```
IE Offset [0]: 0 (+/-0.003) - PASSED
IE Offset [1]: 0 (+/-0.003) - PASSED
IE Offset [2]: -2.499907 (+/-0.1530099) - FAILED
IE Offset [3]: -0.3623838 (+/-0.0180118) - FAILED
IE Offset [4]: -0.0360763 (+/-0.0044999) - FAILED
```

IE Offset [5]: -0.0031543 (+/-0.00315) - FAILED  
 IE Offset [6]: -0.0001412 (+/-0.003015) - PASSED  
 IE Offset [7]: 0.000234 (+/-0.0030015) - PASSED  
 IE Offset [8]: 0.000261 (+/-0.0030001) - PASSED  
 IE Offset [9]: 0.000876 (+/-0.003) - PASSED  
 IE Offset [10]: 0.0006043 (+/-0.003) - PASSED  
 IE Offset [11]: 0.0006585 (+/-0.003) - PASSED  
 IE Offset [12]: 0.0005845 (+/-0.003) - PASSED  
 IE Offset [13]: 0 (+/-0.003) - PASSED  
 IE Offset [14]: 0 (+/-0.003) - PASSED  
 IE Offset [15]: 0 (+/-0.003) - PASSED

## Interface family

For the Interface family of potentiostats, if the first two *IE Offsets* fail the test, it is not always an instrument flaw. The lowest ranges may be responding to a random, stray electrical discharge nearby. Rerun the test, and if it fails, contact us, as with the Reference family.

### For all Gamry potentiostats

The error bars can be confusing. The test report displays an allowed error bar of  $\pm 0.003$  V, but the instrument's calibration can correct up to  $\pm 0.005$  V on the *IE Offset*. Therefore, if the error is up to 5 mV, even if marked as "FAILED", the potentiostat is okay and usable. A failure of up to  $\pm 0.005$  V on the IE Offset tests does not affect system performance. If the IE Offset tests fail beyond  $\pm 0.005$  V, however, contact Gamry for assistance.

**NOTE:** Though the instrument is usable in the short-term with failures below  $\pm 0.005$  V, please plan to contact Gamry about sending us the instrument during time when your equipment will not be used.

Below is an example of a perfectly good Reference 600 instrument that failed because of tolerances (shown in red) within 5 mV but beyond the "PASS" value of 3 mV. The instrument is safe to use for your experiments.

IE Offset [0]: 0 (+/-0.003) - PASSED  
 IE Offset [1]: 0.1395359 (+/-0.5029737) - PASSED  
 IE Offset [2]: 0.0125915 (+/-0.0529929) - PASSED  
 IE Offset [3]: -0.0009198 (+/-0.0079992) - PASSED  
 IE Offset [4]: -0.0029896 (+/-0.0035) - PASSED  
 IE Offset [5]: -0.0034733 (+/-0.00305) - FAILED  
 IE Offset [6]: -0.0033375 (+/-0.003005) - FAILED  
 IE Offset [7]: -0.0033915 (+/-0.0030005) - FAILED  
 IE Offset [8]: -0.0040573 (+/-0.0030001) - FAILED  
 IE Offset [9]: -0.0030547 (+/-0.003) - FAILED  
 IE Offset [10]: -0.0030556 (+/-0.003) - FAILED  
 IE Offset [11]: -0.0030545 (+/-0.003) - FAILED  
 IE Offset [12]: 0 (+/-0.003) - PASSED  
 IE Offset [13]: 0 (+/-0.003) - PASSED  
 IE Offset [14]: 0 (+/-0.003) - PASSED

IE Offset [15]: 0 (+/-0.003) - PASSED

## EL Offset

The *EL* (or electrometer) *Offset* test often causes confusion. The test report displays an allowed error bar of  $\pm 0.003$  V, but the instrument's calibration can correct up to  $\pm 0.005$  V. Therefore, if the error is up to 5 mV, even if marked as "FAILED", the potentiostat is okay and usable. A failure of up to  $\pm 0.005$  V on the EL Offset tests does not affect system performance. If the EL Offset tests fail beyond  $\pm 0.005$  V, however, contact Gamry for assistance.

**NOTE:** Though the instrument is usable in the short-term with failures below  $\pm 0.005$  V, please plan to contact Gamry about sending us the instrument during time when your equipment will not be used.

## Pstat Control Offset, Scan DAC Offset, ZRA Scan Offset, Pstat Bias DAC Offset, DDS Offset, and Positive Feedback Offset

These various tests are used for either the Interface or Reference, or both families of instruments. If one or more of these tests give a failure, the problem may be in the cable. Try swapping the cable with an identical one and rerun the calibration sequence.

If, however, one of these tests fails but all the *Applied DC* tests (see below) pass, then the problem is probably within your potentiostat. Contact Gamry for assistance.

## Applied DC tests

If the *Applied DC* tests fail, but the tests described in the previous paragraph pass, then the problem is probably within your cell cable. Swap the old cable for a new identical cable.

Below is an example of a good Reference 3000 with a bad cable. The failed subtests are in red.

Pstat Control Offset [0]: 7.540061E-006 (+/-0.008) - PASSED  
 Scan DAC Offset [0]: 6.794175E-006 (+/-0.008) - PASSED  
 Scan DAC Offset [1]: 9.42243E-007 (+/-0.008) - PASSED  
 Scan DAC Offset [2]: 1.817607E-008 (+/-0.008) - PASSED  
 ZRA Scan Offset [0]: 0.0001081 (+/-0.008) - PASSED  
 ZRA Scan Offset [1]: 0.000112 (+/-0.008) - PASSED  
 ZRA Scan Offset [2]: 0.000115 (+/-0.008) - PASSED  
 Pstat Bias DAC Offset [0]: 8.403379E-006 (+/-0.008) - PASSED  
 Positive Feedback Offset [0]: 2.085462E-005 (+/-0.005) - PASSED  
 APPLIED DC PSTAT: 9.053656E-008 (0.0005 +/- 10%) - FAILED  
 APPLIED DC PSTAT: 1.424587E-008 (-0.0005 +/- 10%) - FAILED  
 APPLIED DC GSTAT: -3.99024E-005 (-1 +/- 10%) - FAILED

APPLIED DC GSTAT: -3.892947E-006 (1 +/- 10%) - FAILED

If the *Applied DC* tests fail along with those in the previous paragraph, contact Gamry for assistance.

## Summary

This technical note describes the various self-calibration tests, and how to quickly interpret them to isolate many problems between the cell cable and the potentiostat.

As always, if you have any questions about the operation of your Gamry equipment, you can always contact us at [techsupport@gamry.com](mailto:techsupport@gamry.com).

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