

How To Guide



Subject: Performing an External Dummy Cell Checkout Test

Introduction

Our Global Support Team has decades of experience providing our users practical solutions to common issues in electrochemical measurements. This document is part of a series to formalize these suggestions and make them directly available to our users. This series provides users with tools to trouble-shooting hardware, software, cables, and cell design.

After a successful internal dummy cell test, that vets many of the functions of the potentiostat, the next step is to perform an external dummy cell test in order to evaluate the potentiostat and cell cable. Like the internal dummy cell test, the external dummy cell test uses a Linear Scan Voltammetry Action to apply a voltage sweep across a resistor of known value. This resistor is *external* to the potentiostat and connected using the cell cable. Based on Ohm's Law ($V = IR$), the slope of the Current (A) versus Potential (V) graph will then be used to confirm that the measured resistance, in Ω , agrees with that of the resistor being measured. While the internal dummy cell test verifies the functionality of the instrument itself under the given conditions, the external dummy cell test verifies the functionality of the potentiostat and the cell cable.

Procedure

A resistor, preferably 1 k Ω , will be required. If using a 1 k Ω resistor, the exact same procedure for the internal dummy cell test can be used here. Please see the [How To Guide – Subject: Performing an Internal Dummy Cell Checkout Test](#) for instructions. If starting from the Voltammetry Checkout experiment file, with the Advanced Panel open change the “Cell to Use” from Internal to External. If a 1 k Ω resistor cannot be obtained, another resistor can be used, but the experimental parameters will need to be adjusted to fit the capabilities of the instrument. For example, if a 100 k Ω resistor is used and the voltage is swept from -1 to +1 V, the maximum current will be 10 μ A. Therefore, the current range should be set to the 20 μ A range, not the 20 mA range used previously with the internal dummy cell (1 k Ω). If a small resistor is used, such as 1 Ω , the maximum measurable current of the instrument may need to be considered as this would generate a maximum of 1 A of current if the voltage is swept from -1 to +1 V. Regardless of the resistor being used, it should be connected using the cell cable and the 4-electrode configuration shown in Figure 1. Notice that the reference (RE) and sense (SE) leads are closest to the resistor, while the counter (CE) and working (WE) leads are further away. This configuration separates the current carrying leads (CE and WE) from the voltage carrying leads (RE and SE) and positions the voltage carrying leads closest to the resistor to ensure the most accurate measurement.

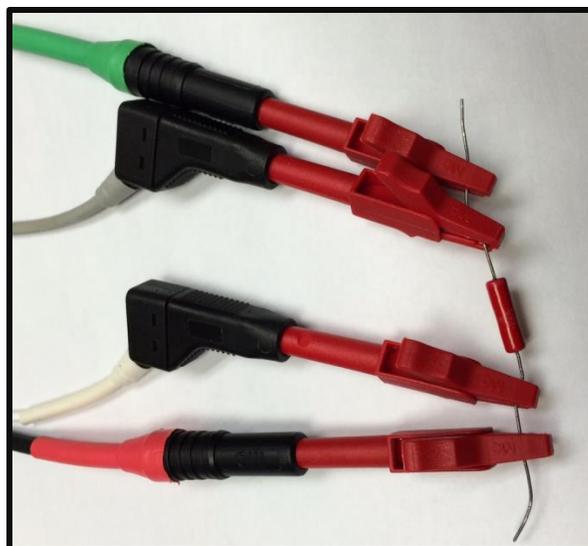


Figure 1: Picture demonstrating how to connect to a resistor using the 4-electrode configuration.

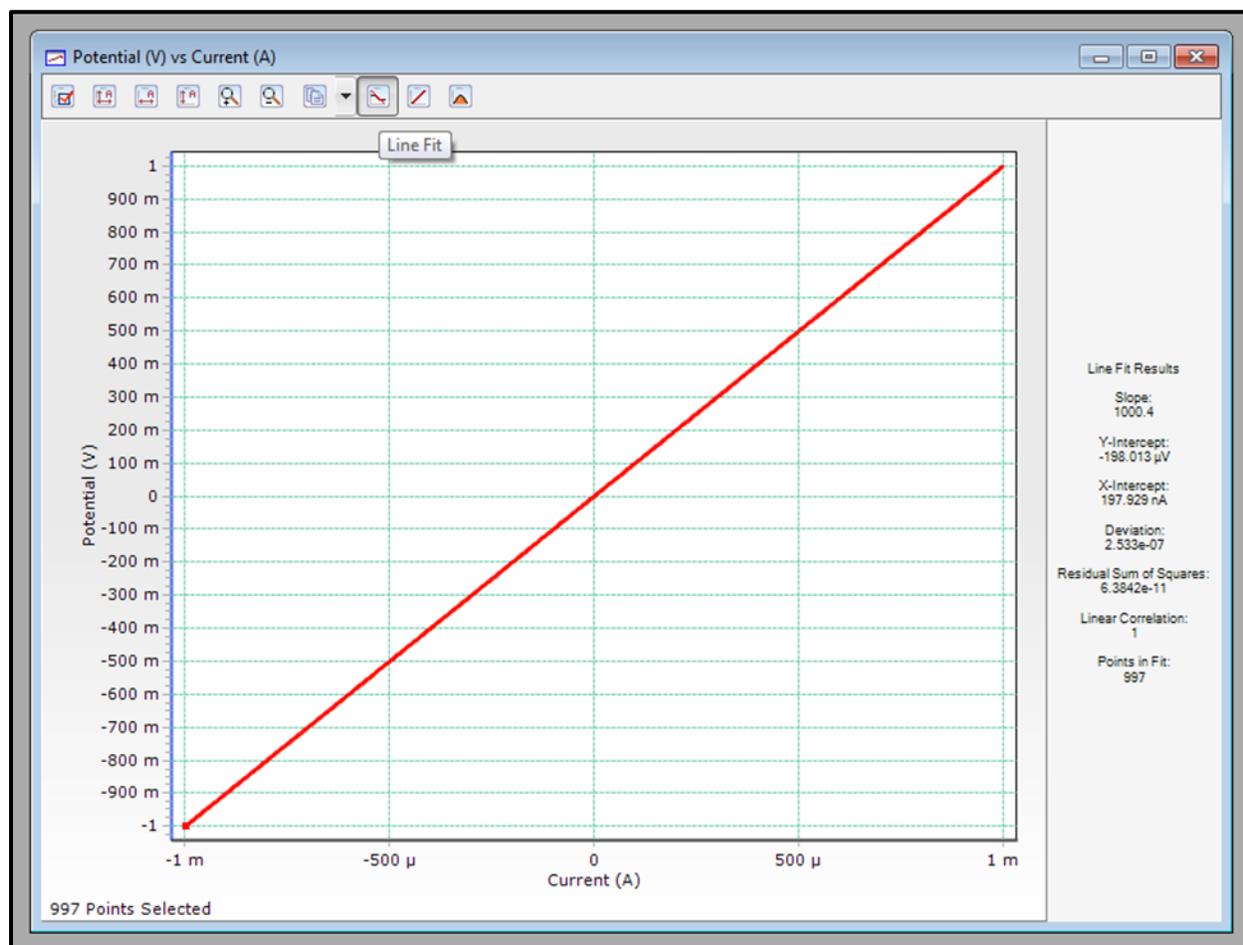


Figure 2: Typical data and Line Fit Results of a Voltammetry Checkout performed on an external 1 k Ω dummy cell using a VersaStudio compatible instrument.

The acceptable ranges for the Line Fit Results depend on the tolerance of the resistor combined with the accuracy specifications of the potentiostat. Therefore, the key points of this test are whether or not the experiment executed without any overloads and that the slope agrees with that of the resistor value +/- 10%, assuming the appropriate current range was used. If the slope is outside of the 10% error range, first verify the current range and check the resistor value using a digital voltmeter. If that is not the issue, run the DC Calibration by navigating to Tools → Options, selecting the Instrument tab and clicking on the Calibrate Now button. Be sure that the correct instrument is selected. The Calibration process takes approximately 2 minutes, but can take up to 10 minutes. That lack of a failure notice confirms a successful calibration. There is no message to confirm a successful calibration.

Note: After calibration, the potentiostat will automatically restart, disappearing from the VersaStudio Select Instrument window. It will take ~30 seconds for the instrument to reappear in this window.

Conclusion

If the experiment ended due to an overload or if the results are still not within the ranges specified above then the cell cable may be damaged. Please see the [How To Guide – Subject: Checking Your Potentiostat's Cable for Continuity](#) for instructions verifying the electrical continuity of your cell cable. If the calibration fails 3 times in a row, it could mean that your system is in need of repair. Further troubleshooting and/or arranging to have the instrument repaired, will require assistance from technical support. Please contact Technical Support at <http://www.princetonappliedresearch.com/support-center/contact-us/index.aspx> or PARSOLSR.support@ametec.com.