POTENTIOSTAT
USER MANUAL

Manual Version: 1.0.C
Product Code: T2006A
Product Version: 1.0
Software Version: 1.0

Ossila.com

Contents

1. Overview

Ossila's Potentiostat is low-cost and easy-to-use system for performing cyclic voltammetry measurements. Cyclic voltammetry is one of the most widely used electrochemical techniques, providing important information about materials including:

- Reduction and oxidation potentials
- Reversibility of a reaction
- Electron transfer kinetics
- Energy levels of semiconducting polymers

The Potentiostat is capable of outputting potentials up 10 V, and measuring currents as low as 10 nA, allowing for a wide range of material characterisation. The easy-to-use PC software included with the system allows anyone to perform the measurement.

2. EU Declaration of Conformity (DoC)

We

Company Name: Ossila Limited
Postal Address: Solpro Business Park, Windsor Street.
Postcode: S4 7WB
City: Sheffield
Telephone number: +44 (0)114 2999 180
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declare that the DoC is issued under our sole responsibility and belongs to the following product:

Product: Potentiostat (**T2006A1**)
Serial number: T2006A1-xxxx

Object of declaration:

Potentiostat (**T2006A1**)

The object of declaration described above is in conformity with the relevant Union harmonisation legislation:

EMC Directive 2014/30/EU
RoHS Directive 2011/65/EU

Signed:

Name: Dr James Kingsley
Place: Sheffield
Date: 01/10/2019

[Декларация] **за съответствие на ЕС**
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Декларира с цялата си отговорност, че посоченото оборудване съответства на приложимото законодателство на ЕС за хармонизиране, посочено на предходната(-ите) страница(-и) на настоящия документ.

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Tootja: Ossila Ltd., Solpro Business Park, Windsor Street, S4 7WD, UK
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Declaramos bajo nuestra única responsabilidad que el siguiente producto se ajusta a la pertinente legislación de armonización de la UE enumerada en las páginas anteriores de este documento.

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[Svenska] **EU-försäkran om överensstämmelse**
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3. Safety

3.1 Warning

- Do NOT connect external voltage sources to the WORKING channel.
- The absolute maximum input voltage for the REFERENCE channel is ±12 V.
- DO NOT apply input while not powered.

3.2 Use of Equipment

The Ossila Potentiostat is designed to be used as instructed. It is intended for use under the following conditions:

- Indoors in a laboratory environment (Pollution Degree 2)
- Altitudes up to 2000m
- Temperatures of 5°C to 40°C; maximum relative humidity of 80% up to 31°C.

The unit is supplied with a 24 V / 2 A DC power adapter with a power cord for the country of purchase, in accordance with European Commission regulations and British Standards. Use of any other electrical power cables, adaptors, or transformers is not recommended.

3.3 Hazard Icons

The following symbols can be found at points throughout the manual. Note and read each warning before attempting any associated operations associated with it:

Table 3.1. Hazard warning labels used in this manual.

Symbol	Associated Hazard
	Electrical shock

3.4 General Hazards

Before installing or operating the Ossila Potentiostat, there are several health and safety precautions which must be followed and executed to ensure safe installation and operation.

3.5 Power Cord Safety

Emergency power disconnect options: use the power cord as a disconnecting method and remove from wall. To facilitate disconnect, make sure the power outlet for this cord is readily accessible to the operator.

3.6 Servicing

If servicing is required, please return the unit to Ossila Ltd. The warranty will be invalidated if:

- Modification or service has been carried out by anyone other than an Ossila engineer.
- The unit has been subjected to chemical damage through improper use.
- The unit has been operated outside the usage parameters stated in the user documentation associated with the unit.
- The unit has been rendered inoperable through accident, misuse, contamination, improper maintenance, modification, or other external causes.

3.7 Health and Safety – Servicing

Servicing should only be performed by an Ossila engineer. Any modification or alteration may damage the equipment, cause injury, or death. It will also void your equipment's warranty.

4. Requirements

Table 4.1 details the power requirements for the system, and the minimum computer specifications for the Ossila Cyclic Voltammetry software.

Table 4.1. Potentiostat and Ossila Cyclic Voltammetry software requirements.

Power	24 V / 2 A DC (supplied with the system)
Operating Systems	Windows Vista, 7, 8, or 10 (32-bit or 64-bit)
CPU	Dual Core 2.5 GHz
RAM	2 GB
Available Hard Drive Space	110 MB
Monitor Resolution	1280 x 900
Connectivity	USB 2.0

5. Unpacking

5.1 Packing List

The standard items included with the Ossila Potentiostat are:

- The Ossila Potentiostat.
- 24 V / 2 A DC power adapter with a cord set specifically for country of operation (UK, USA, EU, or AU).
- Cell connection cable.
- USB-B cable.
- USB memory stick pre-loaded with the user manual, USB drivers, QC data, and Ossila Cyclic Voltammetry software installer.
- Printed copy of the user manual.
- Test cell chip.

5.2 Damage Inspection

Examine the components for evidence of shipping damage. If damage has occurred, please contact Ossila directly for further action. The shipping packaging will come with a shock indicator to show if there has been any mishandling of the package during transportation.

6. Specifications

The Potentiostat specifications are shown in **Table 6.1** below.

Table 6.1. Potentiostat specifications.

Potential range	±7.5 V
Potential compliance	±10 V
Applied potential resolution	333 µV
Applied potential accuracy	±10 mV offset
Maximum current	±150 mA
Current ranges	±10 nA to ±150 mA (5 ranges)
Communication	USB-B
Overall Dimensions	Width: 125 mm, Height: 55 mm, Depth: 175 mm
Weight	600 g

7. System Components

The Ossila Potentiostat comprises four items: the Ossila Potentiostat, banana cables, power adaptor, and Ossila Cyclic Voltammetry software.

Figure 7.1. Ossila Potentiostat.

Figure 7.2. Cell connection cable.

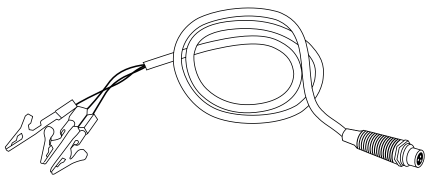


Figure 7.3. The 24 V DC power adapter.

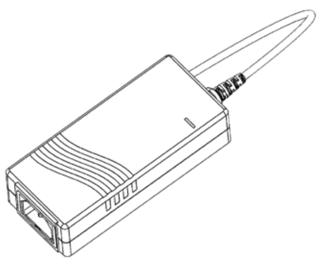
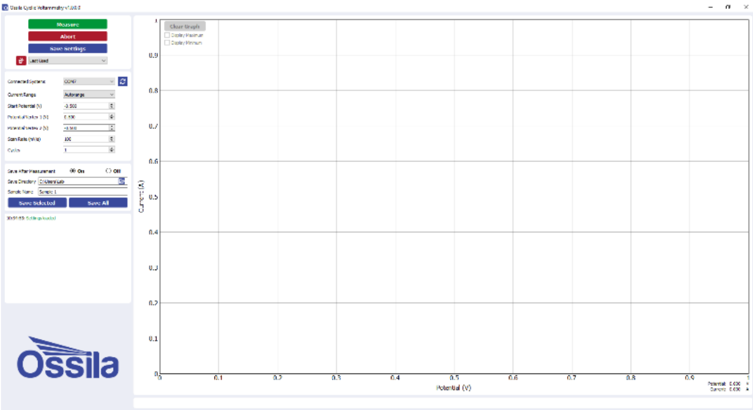


Figure 7.4. Ossila Cyclic Voltammetry PC software.



8. Installation

1. Install the Ossila Cyclic Voltammetry software on your PC.
   I. Run the file 'Ossila-Cyclic-Voltammetry-Installer-vX-X-X-X.exe' on the USB memory stick provided.
   II. Follow the on-screen instructions to install the software.
2. Install the USB drivers on your PC.
   I. On the USB memory stick provided, open the 'SMU-Driver' folder and run either 'Windows 32-bit SMU Driver' for 32-bit operating systems or 'Windows 64-bit SMU Driver' for 64-bit operating systems.
   II. Note, on Windows 10 the drivers will install automatically when the unit is connected.
   III. If the drivers fail to install, please refer to the SMU USB Driver Installation Guide found on the USB memory stick.
3. Connect the 24 V / 2 A DC power adaptor to the power socket on the rear of the unit.
4. Connect the unit to your PC using the provided USB-B cable.
   I. If you are using a USB connection and the unit is not detected, please refer to the SMU USB Driver Installation Guide found on the USB memory stick.

Note: The Ossila Cyclic Voltammetry software and SMU USB drivers can also be downloaded from **ossila.com/pages/software-drivers**

9. Operation

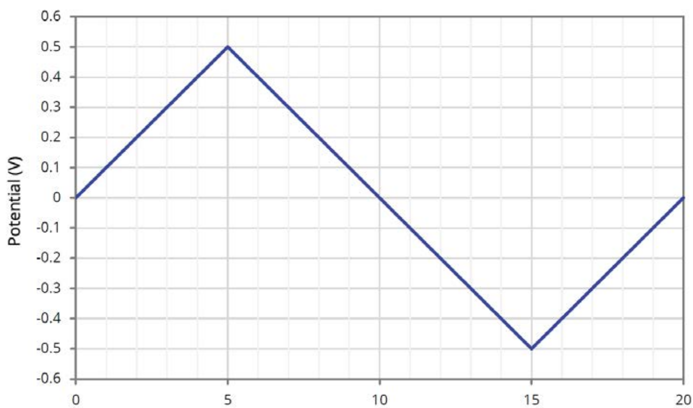
9.1 Taking a Measurement

1. Add your appropriate electrolyte solution into the electrochemical cell.
2. Place the lid on the cell and insert the working, counter, and reference electrodes.
3. Use the cable and crocodile clips to connect the sockets on the front of the Potentiostat to the appropriate electrodes.
    I. The red clip connects to the working electrode.
    II. The black clip connects to the counter electrode.
    III. The blue clip connects to the reference electrode.
4. Start the Ossila Cyclic Voltammetry software. The window shown in **Figure 9.2** will open.
5. Enter the appropriate settings for your experiment into the software (explained in more detail in **Section 9.2**).
6. Click the 'Measure' button.
    I. The system will sweep the potential between the working electrode and reference electrode, whilst measuring the current between the working electrode and counter electrode, in the follow steps:

Start Potential → Potential Vertex 1 → Potential Vertex 2 → Start Potential

    II. This will be repeated for the specified number of cycles.
7. If 'Save After Measurement' is turned on, the measurement data and settings will be saved once the sweep has completed.

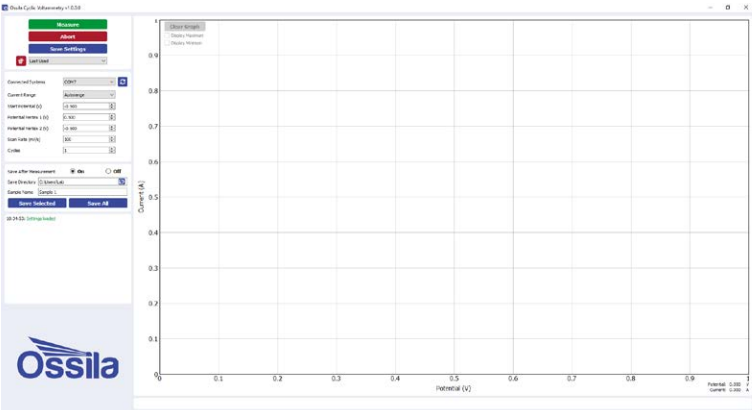
Figure 9.1. Example of a cyclic voltammetry scan profile for a start potential of 0 V, potential vertex 1 of 0.5 V, potential vertex 2 of -0.5 V, and scan rate of 100 mV/s.



9.2 Software Settings and Controls

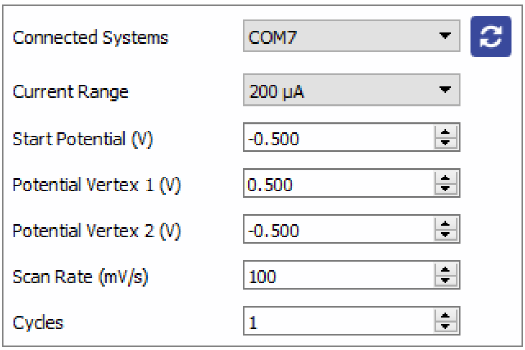
There are several settings in the software which must be entered before taking a measurement. These are found on the panel to the left of the window as shown in **Figure 9.2**.

Figure 9.2. Ossila Cyclic Voltammetry software.



9.2.1 Measurement Settings

Figure 9.3. Measurement settings.



(I) Connected Systems

- Select the COM port of the connected unit you intend to use.
  I. This box will be populated automatically with the addresses of any units connected to the computer when the software starts.
  II. To rescan for connected units (in case the connection is changed) click the refresh icon next to the drop-down box.

(II) Current Range

- Select the range of currents to be used for the measurement or automatic range selection.
    I. This defines the upper limit, accuracy, and resolution of the current measurements that can be performed by the system.
    II. Automatic range selection will start on the lowest current range and automatically switch to higher ranges if the current increases above the maximum for a range.

(III) Start Potential (V)

- The potential in volts at which the measurement starts.

(IV) Potential Vertex 1 (V)

- The first potential in volts at which the scan changes direction.

(V) Potential Vertex 2 (V)

- The second potential in volts at which the scan changes direction.

(VI) Scan Rate (mV/s)

- The rate at which the potential will be changed during the scan, measured in millivolts per second.

(VII) Cycles

- The number of times the scan will be repeated.

9.2.2 Saving and Loading Settings

Figure 9.4. Controls for saving and loading settings profiles.

(I) Save Settings

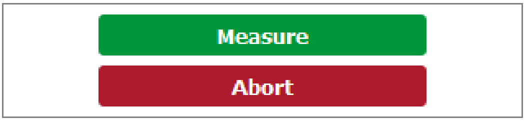
- Saves the current settings as a profile that can be loaded quickly for use at another time.
- When clicked, you will be prompted to name the settings profile.
    I. If the name is already in use, you will be asked if you wish to overwrite the previous profile.
    II. The name cannot contain the characters: \ / : * ? " < > |
    III. You can change the default settings by choosing the name 'Default'.
- The settings profile will be added to the drop-down box using the given profile name.

(II) Settings Profiles

- Select a saved settings profile from the drop-down box.
    I. The settings fields will be populated with the saved values from the selected profile.
- Settings profiles can be deleted by selecting the profile and then clicking the red 'delete' icon next to the drop-down box.

9.2.3 Measurement Controls

Figure 9.5. Controls to start and stop the measurement.



(I) Measure

- Clicking this button will start the measurement using the chosen settings.
- This button cannot be clicked if the software has not detected a unit.

(II) Abort

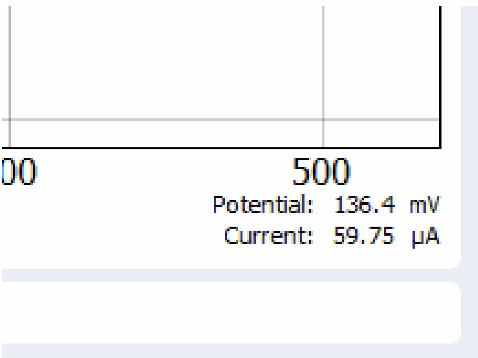
- Stops a measurement that is currently in progress.

9.2.4 Graph Controls

(I) Potential and Current Readout

- Whilst the mouse cursor is over the graph, the potential and current of its location are displayed to the bottom-right of the graph, as shown in **Figure 9.6**.

Figure 9.6. Readout of the potential and current at the mouse cursor location.



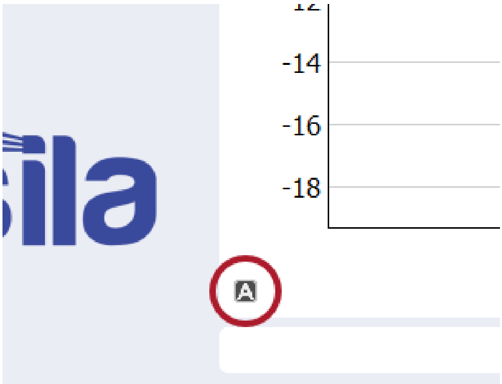
(II) Graph Display Controls

By default, the graph will automatically scale the axes of the graph to display all the data within it. The view can be controlled manually using the following mouse controls:

- Left/Middle click and drag – pan the axes.
- Right click and drag – scale the axes.
- Scroll wheel – scale the axes.

A specific axis can be controlled by using these controls on the axis labels. The axes can be reset by clicking the 'A' button in the bottom-left of the graph, as shown in **Figure 9.7**.

Figure 9.7. Button to reset the graph axes.

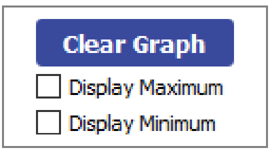


(III) Selecting and Removing Curves

When there are multiple curves on the graph, one of them is considered the active curve. This curve will be displayed in blue, whilst the other curves will be grey. By default, the last curve to be measured is the active curve. You can change which curve is the active curve by clicking on any curve using the left mouse button.

To remove an individual curve from the graph, click on it using the left mouse button to make it the active curve, then press the Delete key.

Figure 9.8. Controls for the graph.



(IV) Clear Graph

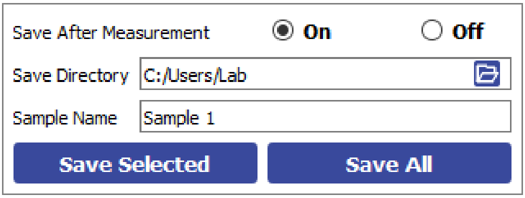
- Removes all data from the graph.

(V) Display Maximum/Display Minimum

- Highlights the maximum or minimum point of the active curve and displays the potential and current values of the point.

9.2.5 Saving Results

Figure 9.9. Saving results.



(I) Save After Measurement

- The program allows for data to be saved automatically, as well as manually once the measurement is complete.
    I. For automatic saving, the ‘Save Directory’ and ‘Sample Name’ fields must be filled in before the measurement can start, these are detailed below.

(II) Save Directory

- Sets the location in which to save the results.
- This can be set either by:
    I. Manually typing the directory into the field.
    II. Copying and pasting it from your file explorer.
    III. Clicking the folder icon in the field, which will open a dialog box to allow the selection of a folder to save to.

(III) Sample Name

- Sets the name of the comma-separated values (.csv) file in which the data will be saved.
    I. The name cannot contain the characters: \ / : * ? “ < > |

(IV) Save Selected

- Clicking this button will manually save the measurement results of the active curve.

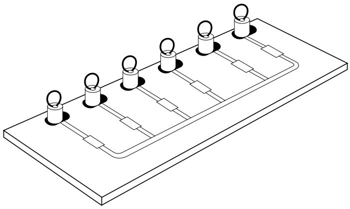
(V) Save All

- Clicking this button will manually save all the measurement results that are currently displayed in the graph.

9.3 Test Cell Chip

The Ossila Potentiostat includes a Test Cell Chip, shown in **Figure 9.10**, which can be used to check that your Potentiostat is operating correctly. It simulates an electrochemical cell by providing a response which differs depending on the direction of the potential scan.

Figure 9.10. Ossila Test Cell Chip.



9.3.1 Taking a Measurement

1. Plug in and turn on the Potentiostat.
2. Use the cell connection cable to connect the Potentiostat to the same colour connectors on the Test Cell Chip.
    I. Red connector to WE1, 2, 3, or 4.
    II. Black connector to CE.
    III. Blue connector to RE.
3. Start the Ossila Cyclic Voltammetry software. The window shown in **Figure 9.2** will open.
4. In the software enter the settings shown in **Figure 9.11**.

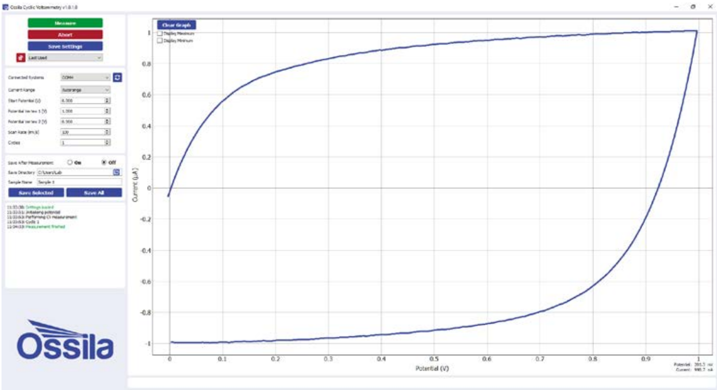
Figure 9.11. Settings for measuring the Test Cell Chip.

Current Range	Autorange
Start Potential (V)	0.000
Potential Vertex 1 (V)	1.000
Potential Vertex 2 (V)	0.000
Scan Rate (mV/s)	100
Cycles	1

5. Click the 'Measure' button.

For the WE3 connector, if the Potentiostat is working and the measurement has been set up correctly, you will see the response shown in **Figure 9.12**.

Figure 9.12. Example voltammogram for WE3 on the Test Cell Chip.



WE1 and WE2 will give responses that are the same shape as WE3, but with maximum currents of approximately 30 nA and 100 nA respectively. WE4 is a simple resistor and will produce a straight line from 0 to 1 µA when performing a scan from 0 to 1 V.

9.4 Performing Cyclic Voltammetry of Ferrocene

9.4.1 Preparing an Electrochemical Cell

Here we will give an example on how to prepare a simple electrochemical cell to take a measurement of ferrocene (Fc), which is the standard reference used for cyclic voltammetry.

(I) Before Starting

We recommend switching on the Potentiostat 30 minutes prior to use. This allows it to warm up and reach a stable temperature, ensuring a stable measurement.

Furthermore, ensure that all apparatus, solvents and electrolytes are dry. This is because the presence of water and its redox by-products may reduce the solvent potential window or react with the solvent or analyte.

(II) Clean and Dry the Electrochemical Cell and Electrodes

The cell and electrodes should always be thoroughly rinsed immediately after each experiment with the solvent that was used in your electrolyte. Always set the cell to dry, preferably in an oven, before you prepare your electrolyte. This helps reduce contamination of your solution.

(III) Prepare the Electrolyte Solution

We use a 0.1 M solution of tetrabutylammonium hexafluorophosphate (TBAPF6) in acetonitrile as our background electrolyte, but other electrolyte salts and solvents can be used. The solvent and electrolyte choice are determined by the solvent potential window and the solubility of your analyte. Most electrolytes are hygroscopic, so should be stored in a desiccator or inert atmosphere.

Weigh out into a dry volumetric flask 0.775 g of dry tetrabutylammonium hexafluorophosphate (387.4 g/mol) necessary to make up 20 ml of 0.1 M solution. Add acetonitrile up to mark of the volumetric flask and stir until the electrolyte has dissolved.

Secure the electrochemical cell with a clamp to ensure it is stable before adding the 20 ml of electrolyte solution. Once dissolved, add approximately 10 mg of Fc to the solution and stir to dissolve it.

(IV) Set up the Electrodes

Place the cap on the electrochemical cell, then insert the working and counter electrodes into two of the holes. We will now prepare the reference solution; a 0.01 M solution of silver nitrite in acetonitrile. Prepare the solution in a volumetric flask and add it into the reference electrode tube with the help of a syringe and needle until the tube is approximately 2/3 full. Insert this electrode into the final hole in the cap.

(V) Degas the Solution

Gently bubble inert gas through the solution using a thin tube or needle for approximately 10 minutes to remove dissolved oxygen.

(VI) Connect the Potentiostat and Cell

Use the cable to connect the Potentiostat and electrodes. The connector colour corresponds to which electrode it connects to:

- Red -> Working electrode
- Black -> Counter electrode
- Blue -> Reference electrode

9.4.2 Taking a Measurement

(I) Start-up Procedure

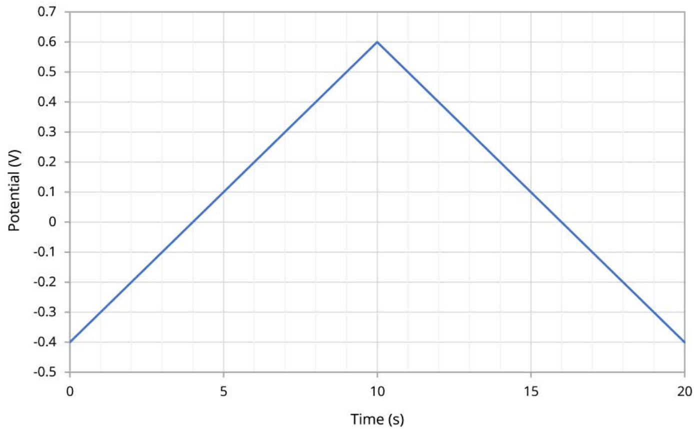
Please allow 30 minutes for the potentiostat to warm up after turning on. Once warmed up, start the Ossila Cyclic Voltammetry software. Ensure that the potentiostat is detected by the software. If it is, the “Connected Systems” drop-down box will be populated, and the “Measure” button will be green. If there is nothing in the “Connected Systems” drop-down box and the “Measure” button is greyed out, please refer to the troubleshooting guide in Section 10.

(II) Experimental Parameters

Choose the appropriate current range for the material being measured. Fc will give a signal in the tens to hundreds of microamps, therefore the 200 µA range should be selected from the drop-down box (Autorange can also be used).

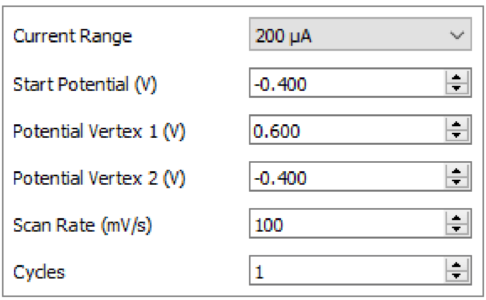
The scan profile needs to be defined. In a cyclic voltammetry measurement Fc undergoes a reversible single electron transfer between 0 and 0.2 V (versus $Ag/AgNO_3$). We can therefore use the scan profile shown in **Figure 9.13**, sweeping the voltage from -0.4 V to 0.6 V and back to -0.4 V. Set the “Start Potential” and “Potential Vertex 2” fields to -0.4 V and the “Potential Vertex 1” field to 0.6 V.

Figure 9.13. Potential scan profile for the ferrocene measurement.



The scan rate and number of cycles need to be set. The scan rate will affect the magnitude of the current peaks in the scan, with faster scan rates resulting in greater measured currents. In this measurement we will use a scan rate of 100 mV/s, so set the “Scan Rate” field to 100 mV/s. The number of cycles is how many times the measurement will be performed, and typically is set to “1”. The full settings used are shown in **Figure 9.14.**

Figure 9.14. Measurement settings for ferrocene.

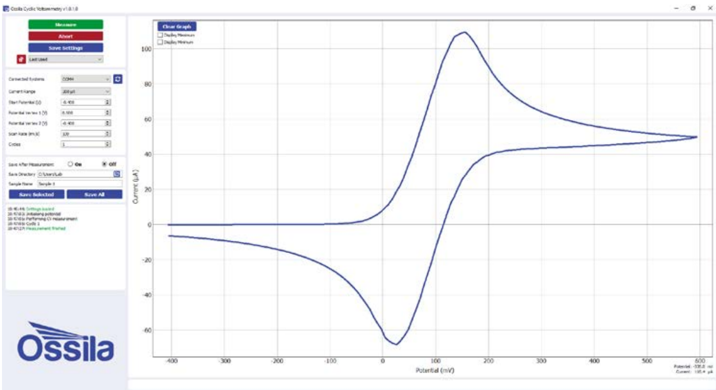


Finally, withdraw the tubing or needle used to degas the cell until it is no longer in the solution, so that it does not interfere with the measurement.

(III) Measure

Now that the settings have been defined, we can start the measurement. Simply click the "Measure" button and watch the electrochemical reaction in real time. If the cell has been prepared correctly and the appropriate settings used, you should see a plot similar to that in **Figure 9.15**. Please note, you can stop the measurement at any time by clicking the "Abort" button. However, if a measurement is aborted part way through, you may need to clean the working electrode to remove any material which has built-up there.

Figure 9.15. A typical voltammogram for ferrocene.



9.5 Maintenance

The cell and electrodes should always be thoroughly rinsed immediately after each experiment with the solvent that was used in your electrolyte. Always set the cell to dry, preferably in an oven, before you prepare your electrolyte. This helps reduce contamination of your solution.

10. Troubleshooting

Most of the issues that may arise will be detailed here. However, if you encounter any issues that are not detailed here, then contact us by email at **info@ossila.com**. We will respond as soon as possible.

Table 10.1. Troubleshooting guidelines for the Ossila Potentiostat

Problem	Possible cause	Action
No power	a. The power supply may not be connected properly. b. The power supply adaptor has a fault.	a. Ensure the system is firmly plugged into the power supply, and that the plug is connected to both the adaptor and a working power socket. b. Contact Ossila for a replacement power supply adaptor.
Software does not start	a. The wrong version of Windows is installed on the computer. b. The software has not installed properly.	a. Install the software on a computer with Windows Vista or newer. b. Try reinstalling the software.
Cannot connect to the system via USB	a. The USB cable may not be connected properly. b. The USB cable may not be connected to a working USB port. c. The USB drivers may not be installed or may not have installed properly. d. The USB cable is defective.	a. Ensure the USB cable is firmly plugged in at both ends. b. Try connecting the unit to a different USB port on the computer. c. Try installing or reinstalling the USB drivers. If the drivers on the USB provided are not working, follow the Windows 7 installation instructions found in the Installation section. d. Use a different USB-B cable, and contact Ossila if necessary.

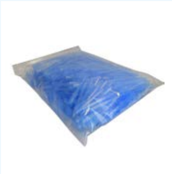
11. Related products

11.1 Related Consumables

Micropipette

Accurate pre-calibrated and tested micropipettes available in a range of volumes.

Product code: C2001V1



Pipette Tips

Available in bulk quantities in resealable plastic bags or pre-packed boxes.

Product code: C2002V3

Vial Racks

Holds 20 substrates for a variety of processing techniques.

Product code: C2005R1

Glass Vials

Clear and amber screw top vials suitable for storage of solvents, solutions, and samples.

Product code: C2005A1

11.2 Related Equipment

Four-Point Probe

An easy-to-use tool for the rapid measurement of sheet resistance, resistivity, and conductivity of materials.

Product code: T2001A3

Solar Cell I-V Test System

Reliable and accurate characterisation of photovoltaic devices – no programming knowledge necessary!.

Product codes: T2003B2

Source Measure Unit

Source voltage, measure current, get data. Simplify and accelerate your data collection!

Product code: P2005A2

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