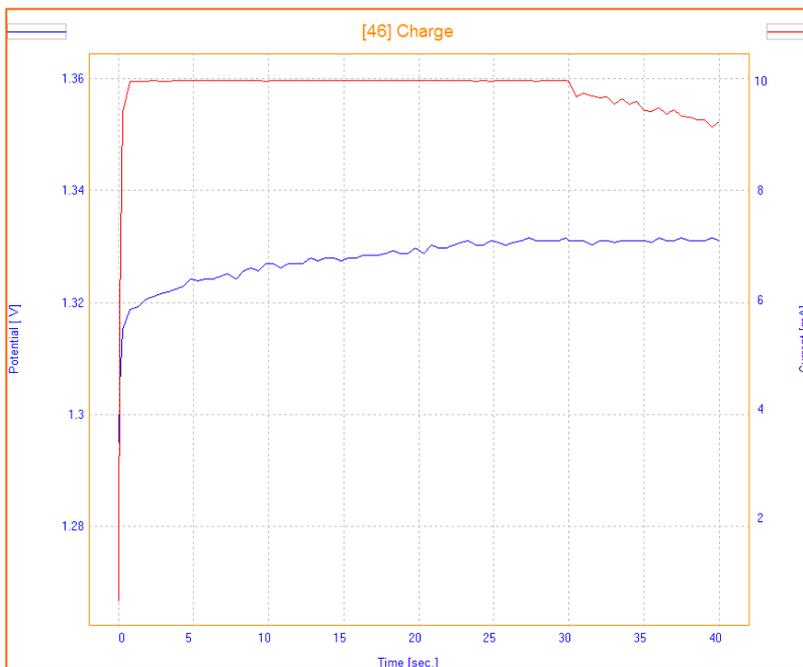


## Battery AP-B02



## Single Charge or Discharge



This Application Note describes how the Single Charge or Discharge method works by giving an example with a Ni-Cd 1.2V 600 mAh battery.



## Introduction

Nowadays batteries play a significant role in our life. Qualification tests on batteries are important to design and choose the right material for the battery according to the use, and will cause saving money, time and energy. One of the main basic battery test is charge/discharge test. In the charge process the positive current is imposed and in discharge process the negative current is imposed. There are different methods of charge/discharge in OrigaMaster software. Single charge or discharge is the most user friendly and simple on in this application note it is discussed.

Different kind of batteries found in the market can be tested by OrigaMaster software:

- Cylindrical Battery
- Coin Cell Battery
- Mobile Battery
- Laptop Battery
- Car Battery
- And so on



Figure 1: Different types of battery



Note that before testing the battery, the user must know the battery' specifications to put the correct parameters in the software. In case of putting wrong parameters, there is a risk of destruction or explosion of the battery.



Figure 2: Examples of problems with batteries

## Parameters

A Single Charge or Discharge method consists of a galvanostatic phase where the battery is charged (or discharged depending on the polarity of the current applied) followed by a potentiostatic phase where the current is measured versus a fixed applied potential.

<b>Single Charge or DisCharge</b>	
<b>Galvanostatic Phase</b>	
⊕ Set Current I	10, mA
⊕ For Duration	10, hour
⊕ Or exit if potential is	>, 4500
⊕ Record every dt	10, sec.
Or record every dE (mV)	10
<b>Potentiostatic Phase</b>	
⊕ Hold potential	1, hour
⊕ Or exit if   current   <	0, mA
⊕ Record every dt	0, sec.
⊕ Or record every dQ	1, mA.h
<b>Exit conditions</b>	
<b>Global parameters</b>	

Figure 3: Parameters of the method

This sequence can also be repeated several times through configuration as below:

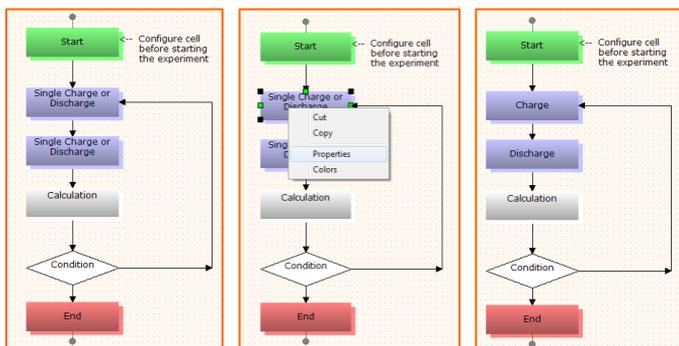


Figure 4: Repeating the methods, manual loop

The name of the method can be changed by right click on the box and through Properties window.

More information on making manual loop could be found in User Manual of the OrigaMaster Software.

To get examples of manual loops:

- contact us on [sales@origalys.com](mailto:sales@origalys.com)
- Or contact your local agent



In this configuration, two single charge or discharge methods are performed respectively, and are repeated thanks to calculation and condition boxes and linkable lines.

Condition	
Condition	A>20

The number of repetition is defined in the condition box.

Figure 5: Parameter of the condition tool

## NOTE:

Before testing a battery through charge-discharge method, it is very important that the user knows about the parameters of the battery. The most important parameters that must be known are as below:

- **Capacity:** A battery's capacity is the amount of electric charge it can deliver. The unit is mAh (mA per hour).
- **Nominal Voltage:** It describes the voltage of a battery in the middle of its discharge cycle. This is also where the voltage stays for the longest period during the discharge. For example, most lithium ion batteries have a nominal voltage of 3.6 volts. When fully charged, it's 4.2 volts.
- **Maximum current for discharge:** The maximum current that can be applied on the battery during discharge phase.
- **Maximum current for charge:** The maximum current that can be applied on the battery during charge phase.
- **Maximum voltage of charge:** The maximum limit of potential that the battery can have during the charge.
- **Minimum voltage of discharge:** The minimum amount of potential that the battery can have during the discharge.

- ❖ For industrial batteries all these parameters are **available** in the brochure or website of the manufacturer.
- ❖ For homemade batteries the user **must know** all these parameters to run the test correctly and safely.



## 1- Explanation of method

This Phase consists in 3 main subphases:

[-] Single Charge or DisCharge	
[-] Galvanostatic Phase	
⊕ Set Current 1	10, mA
⊕ For Duration	30, sec.
⊕ Or exit if potential is	>, 1600
⊕ Record every dt	0.5, sec.
Or record every dE (mV)	10
[-] Potentiostatic Phase	
⊕ Hold potential	30, sec.
⊕ Or exit if   current  ...	0, mA
⊕ Record every dt	0.5, sec.
⊕ Or record every dQ	10, A.h
[-] Exit conditions	
⊕ If   Charge variatio...	600, A.h
⊕ If Total Duration >	1, hour
⊕ Global parameters	

Figure 6: Parameters if charge

[-] Single Charge or DisCharge	
[-] Galvanostatic Phase	
⊕ Set Current 1	-10, mA
⊕ For Duration	30, sec.
⊕ Or exit if potential is	<, 1200
⊕ Record every dt	0.5, sec.
Or record every dE (mV)	10
[-] Potentiostatic Phase	
⊕ Hold potential	30, sec.
⊕ Or exit if   current  ...	0, mA
⊕ Record every dt	0.5, sec.
⊕ Or record every dQ	10, A.h
[-] Exit conditions	
⊕ If   Charge Variatio...	600, A.h
⊕ If Total Duration >	1, hour
⊕ Global parameters	

Figure 7: Parameters if discharge

- **Galvanostatic Phase** where the current is imposed. The most important parameter in this subphase is to put correct "exit potential" according to "maximum voltage of charge" during charge of battery and "minimum voltage of discharge" during discharge of battery.

- **Potentiostatic Phase** where the potential is hold.

- **Exit condition Phase**, where the condition in which the test stops. The most important parameter is to put the correct amount in "charge variation" which directly depend to the "capacity of battery".

The charge and discharge currents are set to 10 mA and -10 mA. The exit potentials are set according to battery parameters. It can be seen in the graph that the imposed current changed from charge mode to discharge mode after 30 seconds even if the potential limitation is not reached.

In fact, the Phase no. 1 finishes after the duration or if the potential limit is reached. The first parameter to be reached becomes the exit condition.



## 2- Examples

Az in the condition part, the number of repetition is defined 20 ( $A > 20$ ), so 20 charge and discharge cycles will be achieved. In total, 40 curves will be available and opened once finished.

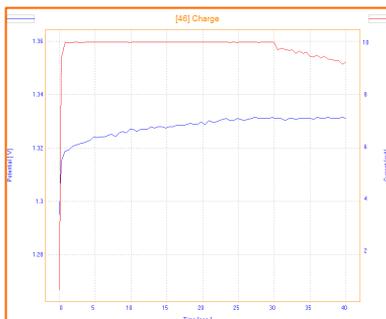


Figure 8: Single charge curve

**TIP:** each time a method is finished, the result is opened as a curve. In this example, as 40 curves will be opened, it could be not convenient to get 40 curves. If a manual loop of 1000 cycles is performed, 2000 curves will be opened, the PC Software may crash because the computer cannot manage such amount of data. In the Home section, an option allows the user to not display the curve after the experiment.

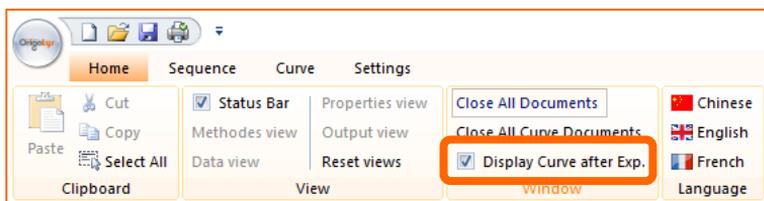


Figure 9: Curves will be displayed after the Experiment

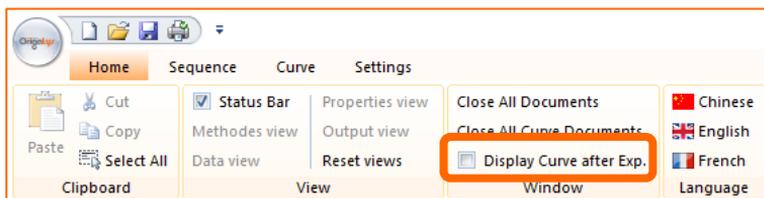


Figure 10: Curves will not be displayed after the Experiment



## 3- Final results

In order to get the evolution of the charge/discharge cycles on the same graph, the user needs to use the **"Process"** tool (available in the curve section). To proceed:

- 1- Open the first curve of the experiment, the 1<sup>st</sup> curve out of 40.
- 2- Then, overlay with all the rest of the curves (click right on the graph), from manual loop of 20 cycles of charges and 20 cycles of discharges, it means you need to overlay the 1<sup>st</sup> curve with the 39 other curves.
- 3- Finally, click on **"Process"** bottom to get all the curves vs time.

1

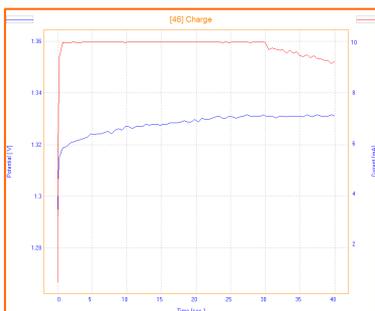


Figure 11: 1st curve

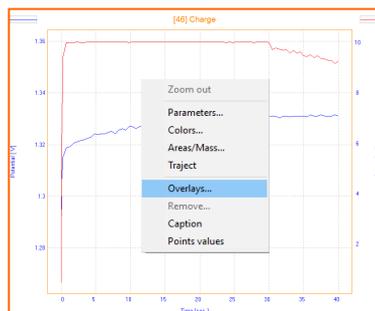


Figure 12: Overlay tool

2

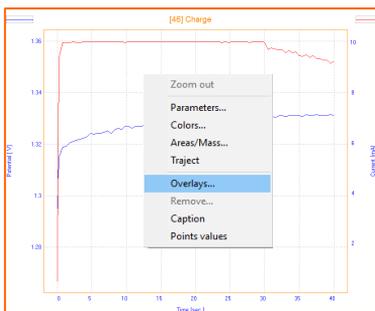


Figure 12: Overlay tool

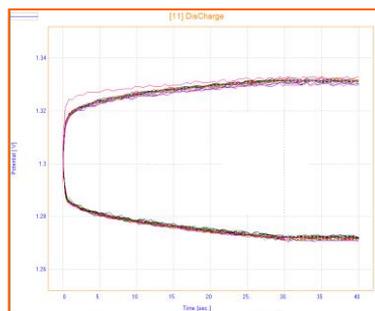


Figure 13: 40 curves in one graph



3



Figure 14: Process tool (in curve section)

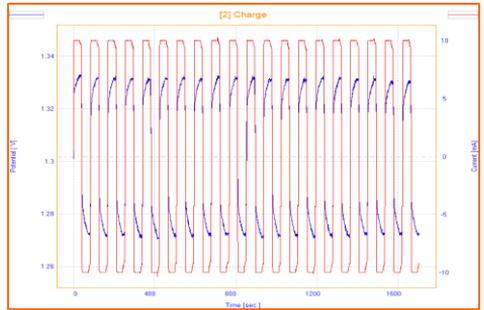


Figure 15: 20 cycles of Charge/Discharge vs Time

## Instrument and Electrodes



Figure 16: OrigaFlex OGF500

### Electrode setup

Battery	Ni-Cd 1.2V, 600 mAh
Electrode system	2 electrodes
Instrument	OrigaFlex OGF500
Software	OrigaMaster

**Connection:** the battery was connected thanks to a dedicated cable to the WRK and T°C (to monitor the temperature) connectors.

**Consult us to get more information on this cable.**

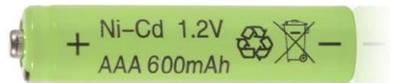


Figure 17: Ni-Cd 1.2 V Battery

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