Contents

1. Introduction

Professional Laptop Battery Analyzer (NLBA) is a hardware and software product developed by NLBA1 team which can be used to diagnose, charge and discharge almost all laptop batteries on the market. The device is capable of reading battery information even the battery is not detected by the laptop, it is faulty or it is over discharged. It is also capable of reading each cell voltage for these kind of non working batteries. It has another great feature to revive over discharged batteries manually or automatically by pressing one button. By discharging the battery with a constant current it can be easily analyze which cells are unbalanced or have a higher internal resistance helping in replacing them to avoid a complete battery failure.

NLBA can also be used to measure the real capacity of a laptop battery.

The product is designed in Romania and produced in China. The company that created the device can be contacted over email: **contact@laptopu.ro**

2. Major features

Professional Laptop Battery Analyzer major features are the following:

- reading inner battery information stored inside the battery controller

- reading inner battery information even the battery is over discharged (not detected by laptop, faulty, not powered microcontroller, etc)

- capable to generate variable voltage pulses to revive the battery if it is over discharged

- track each cell voltage by applying a constant discharging current, so unbalanced cells or cells with a higher internal resistance can be easily detected

- calculating battery Health

- charging battery with a lot of custom parameters

- discharging battery with a lot of custom parameters

- displaying correct cell voltage

- calibrating / autocycle with many options

- checking each cell separately and displaying which are GOOD, POOR or BAD

- calculating the internal cell resistance based on a special algorithm

- measuring the real capacity of the battery by discharging it from Fully Charged to Fully Discharged

- the hardware device can charge the battery with a maximum current of 3A and discharge the battery with maximum current of -3A

- it has built in reverse polarity protection (if battery cable is connected incorrectly)

- it has built in short circuit protection on the output connector

- it has hardware protection against connecting data lines (SMCLK and SMDAT) to battery VBat

- it has current limit and over temperature protection

3.Hardware device

3.1 Device Presentation

The input/output ports are presented in the picture bellow:

Power LED

Battery Connector:
V – Vbatt
C – Clock
D – Data
G - GND

Output LED:
The LED is connected on the Vbatt line, it lights according to the voltage generated by the device or the voltage from battery

USB 2.0 Communication

DC Input Power: 19-20V, 3A

3.2 Cables and connectors

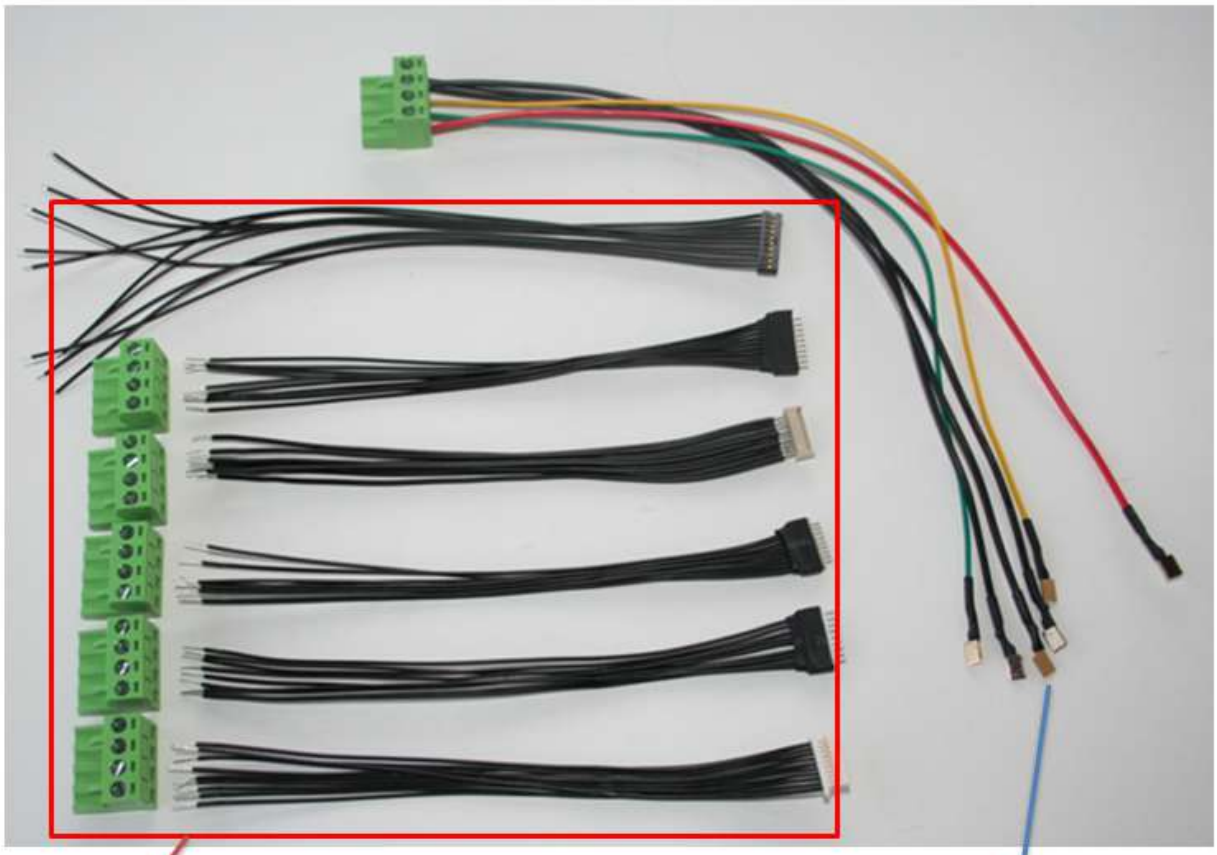
Wire colors meaning:

- RED - VBatt

- GREEN - clock

- YELLOW - data

- BLACK - gnd



These cables are used for newer laptop batteries that have ribbon cable interface. The order of Vbat, Clk, Data and GND can be easily changed using the screws from green connector.

These cables are used for classic laptop battery interface.

3.3 Example of battery connections


▲M2 L5
BP02XL Rechargeable Battery
HP part number 849569-421
Regulatory Model Number 型號/型号: HSTNN-LB7H
Rechargeable Li-ion Battery 2ICP7/61/80
FOR USE WITH HP SERIES TPN-Q172,TPN-Q175
European Regulatory Address : HP, HQ-TRE 71025 Boeblingen, Germany
CELL ORIGIN CHINA FURTHER PROCESSED IN CHINA
5150mAh
⚠WARNING!
Li-ion
IS 16046/IEC 62133

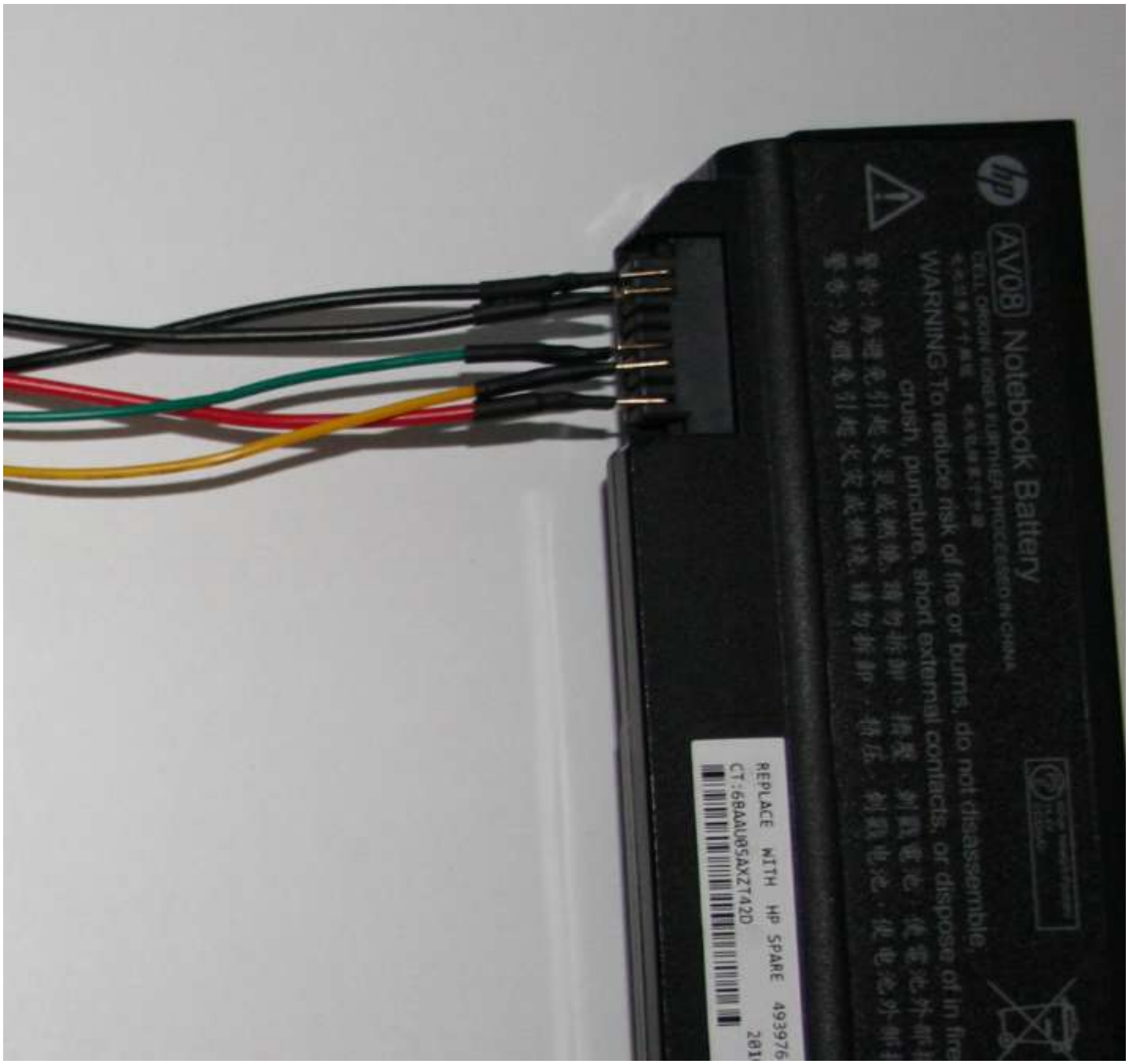

SAMSUNG
Rechargeable Li-Polymer Battery (리튬폴리머 배터리 팩)
Rating (정격): DC 7.4V 45Wh
Product ID: AA-PBYN8AB
Standard Battery Pack
Battery cells made in China, Assembled in China
A/S 문의: 1588-3366
CAUTIONS
PRECAUTIONS


Li-ion
Battery Pack C21-X202


Please Disconnect and Remove Battery Before Accessing
DELL
Battery Questions?
Go to www.dell.com
Cells made in China
Assembled in China
42Wh
Standard
Rechargeable
Li-ion Battery


lenovo
®Registered Trademark of Lenovo
Rechargeable Li-polymer Battery
For use with Lenovo personal computer
Cell made in China
Further processed in China
NOM 3.75V 8.8Ah 33Wh
For Use With ThinkPad
PLEASE REFER TO USER MANUAL OR FOLLOW LOCAL ORDINANCES AND/OR REGULATIONS FOR DISPOSAL
CAUTION : Replace with same type only.
Use of another battery may present a fire or
DANGER DO NOT OPEN OR EXPOSE


lenovo
Li-ion00
55++


AV08 Notebook Battery
WARNING To reduce risk of fire or burns, do not disassemble,
crush, puncture, short external contacts, or dispose of in fire
REPLACE WITH HP SPARE 493976
CT:6BAAU05AXZT42D


10/18/16
0 %

▲M2 L5
BP02XL Rechargeable Battery
HP part number 849569-421
Regulatory Model Number 型號/型号: HSTNN-LB7H
Rechargeable Li-ion Battery 2ICP7/61/80
FOR USE WITH HP SERIES TPN-Q172, TPN-Q175
FAMILY OF COMPUTER PRODUCTS ONLY
European Regulatory Address : HP, HO-TRE 71025 Boeblingen, Germany
CELL ORIGIN CHINA FURTHER PROCESSED IN CHINA
5150mAh
⚠WARNING!
To reduce the risk of fire or burns, do not disassemble, crush or puncture;
do not short external contacts; do not dispose of in fire or water.
7.7V ⎓ 41 Wh Nom: 5350mAh
STORE BETWEEN 0°C TO 60°C | 32°F TO 140°F
Li-ion
IS 16046/IEC 62133
R-41015936


DELL
42Wh
Standard


lenovo
Li-ion00
55+

4.Device Specification and PC Requirements

Device specification:

- input voltage 20V DC 3A

- output voltage 2.3V to 18.4V DC

- maximum power 60W

System requirements for running PC Software

Software:

- Professional Laptop Battery Analyzer supports the following operating systems: Windows XP SP3 x86/x64, Windows Vista x86/x64, Windows 7 x86/x64, Windows 8 x86/x64

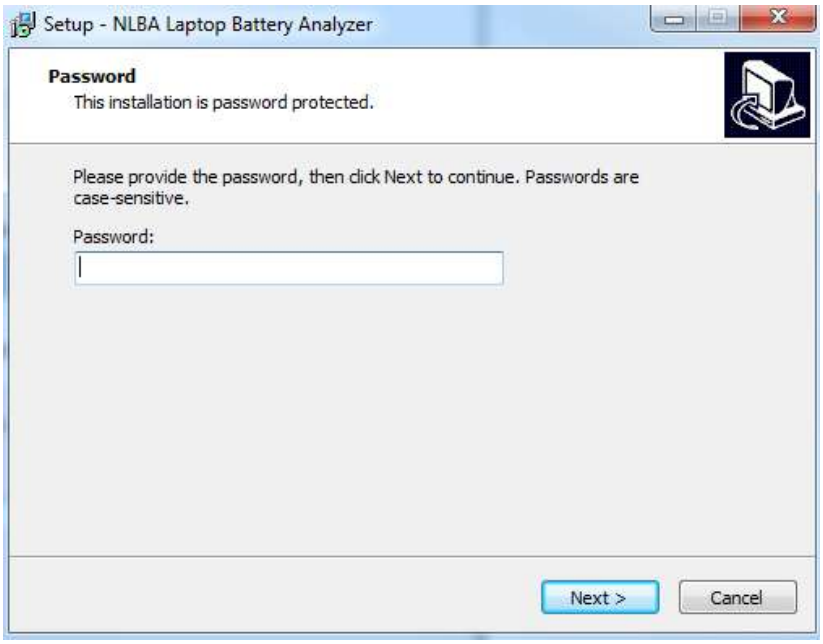
Hardware:

- 2.0Ghz CPU or higher
- 2Gb RAM
- 512Mb free hard disk space
- Minimum 1024x768 screen resolution

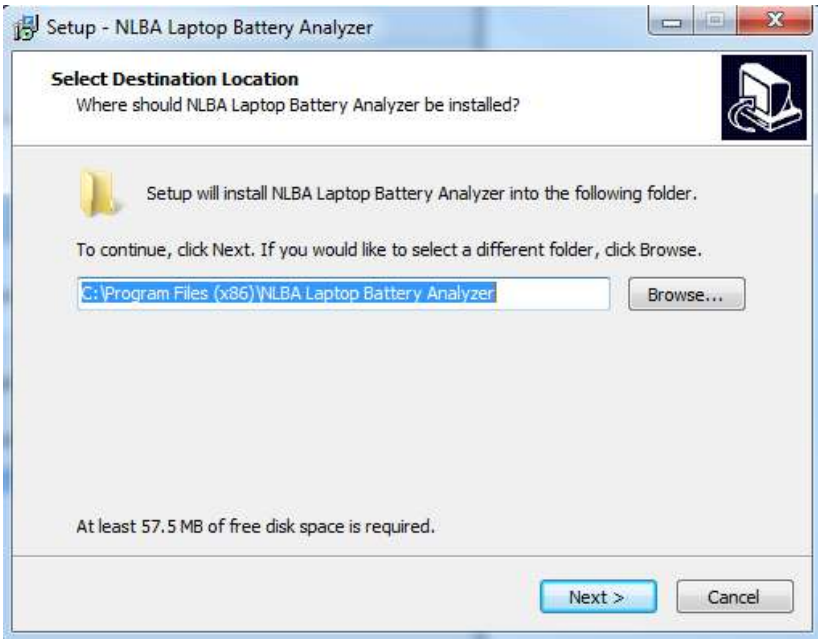
5. PC Software Instalation

The software is compatible with Windows XP, Vista, 7, 8 and 10 both platforms x86 and x64.

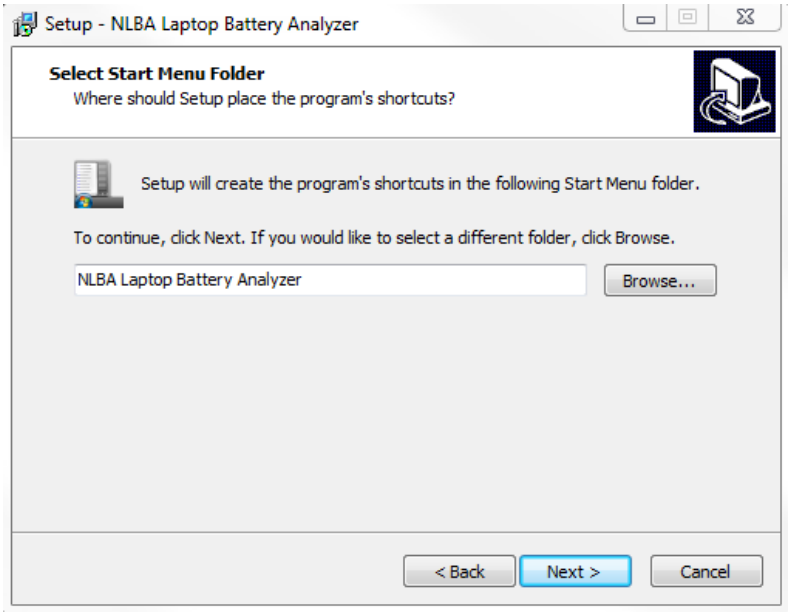
1. Enter the password (provided in the product package or via email **contact@laptopu.ro**).



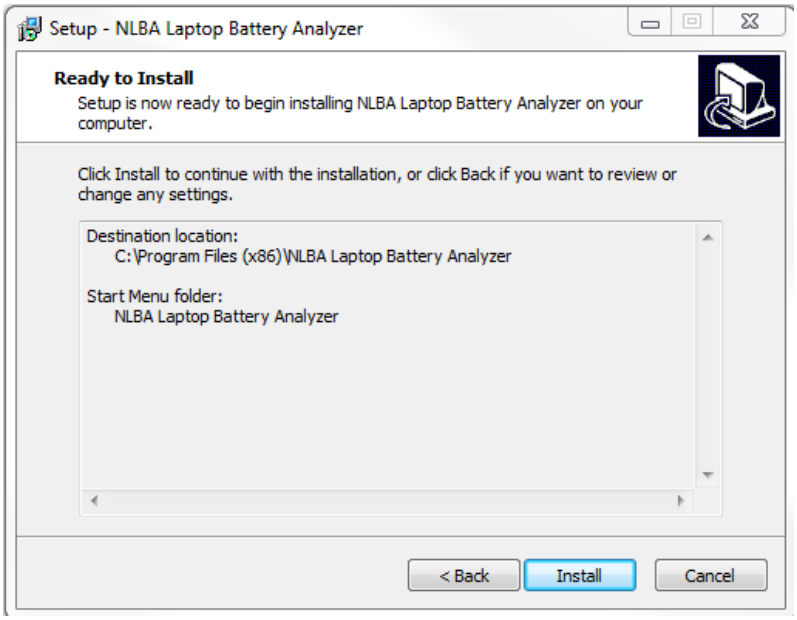
2. Choose instalation folder.



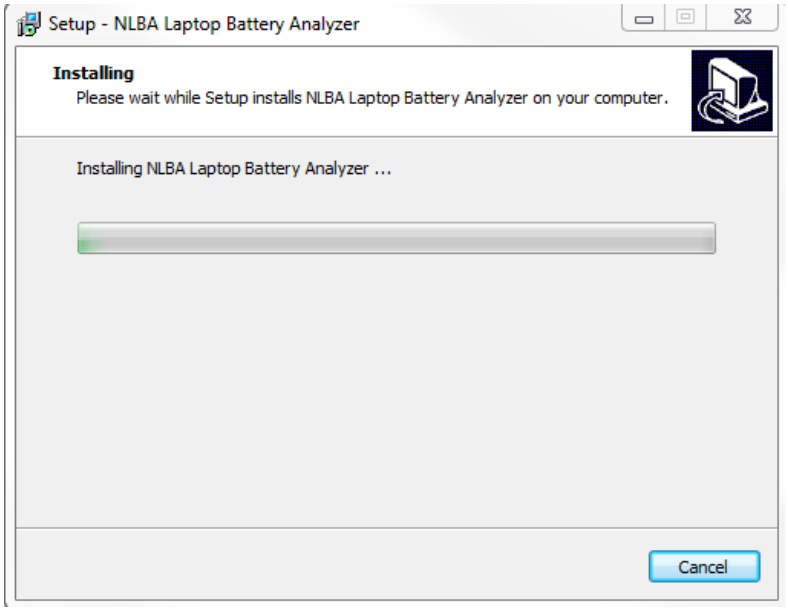
3. Choose folder name in Start Menu bar.



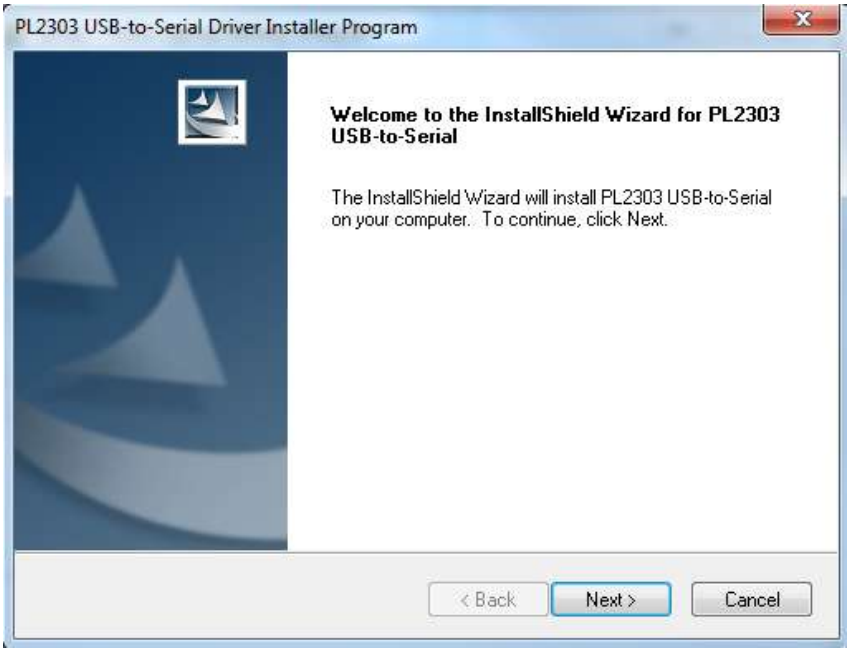
4. Press *Install*.



5. Wait until instalation is finished.



6. The USB-to-Serial driver for PL2303 will prompt to be installed if it is not already installed.



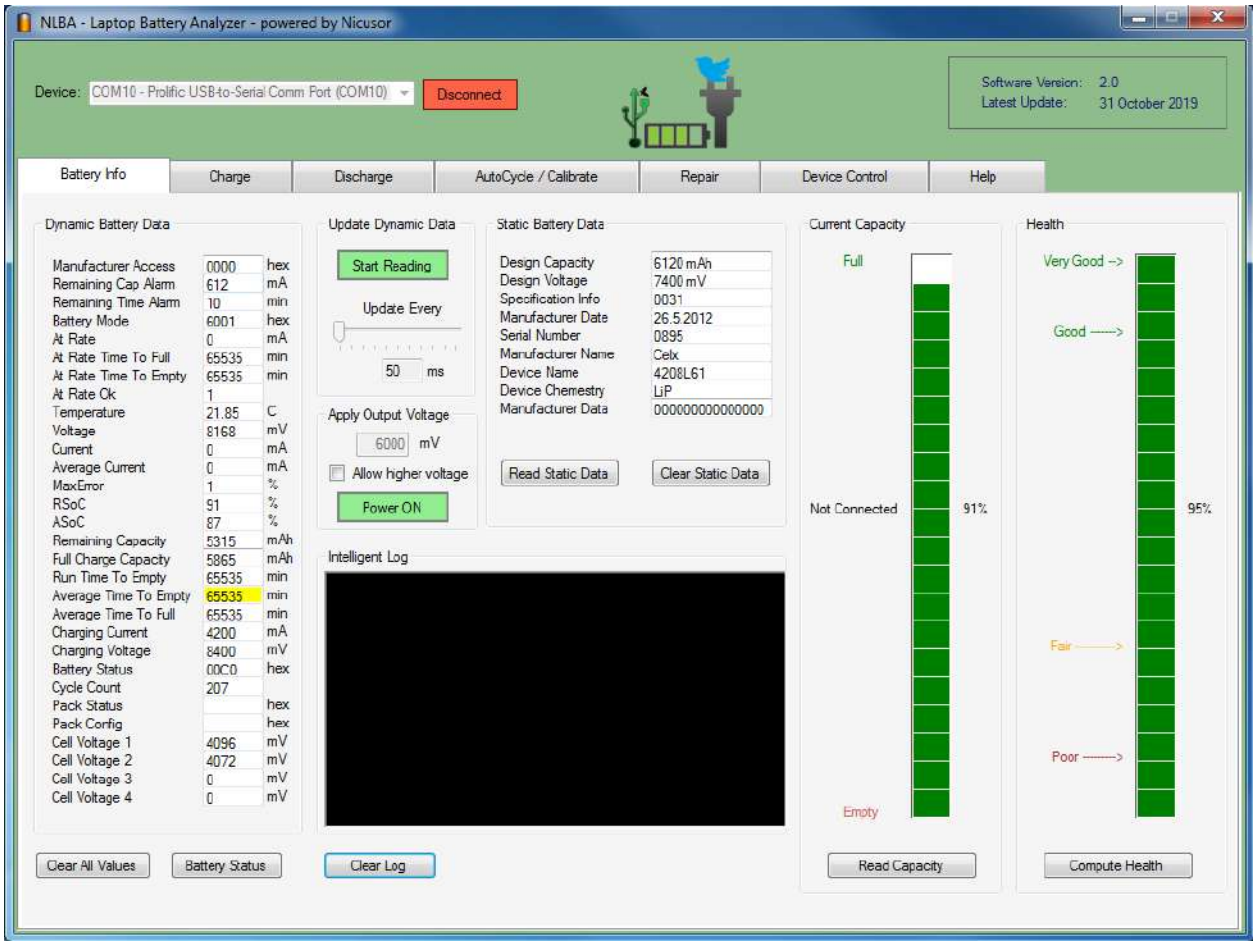
7. After the Prolific driver is installed the complete instalation process is finished.

8. Launch *NLBA Laptop Battery Analyzer* tool.

6. PC Software description

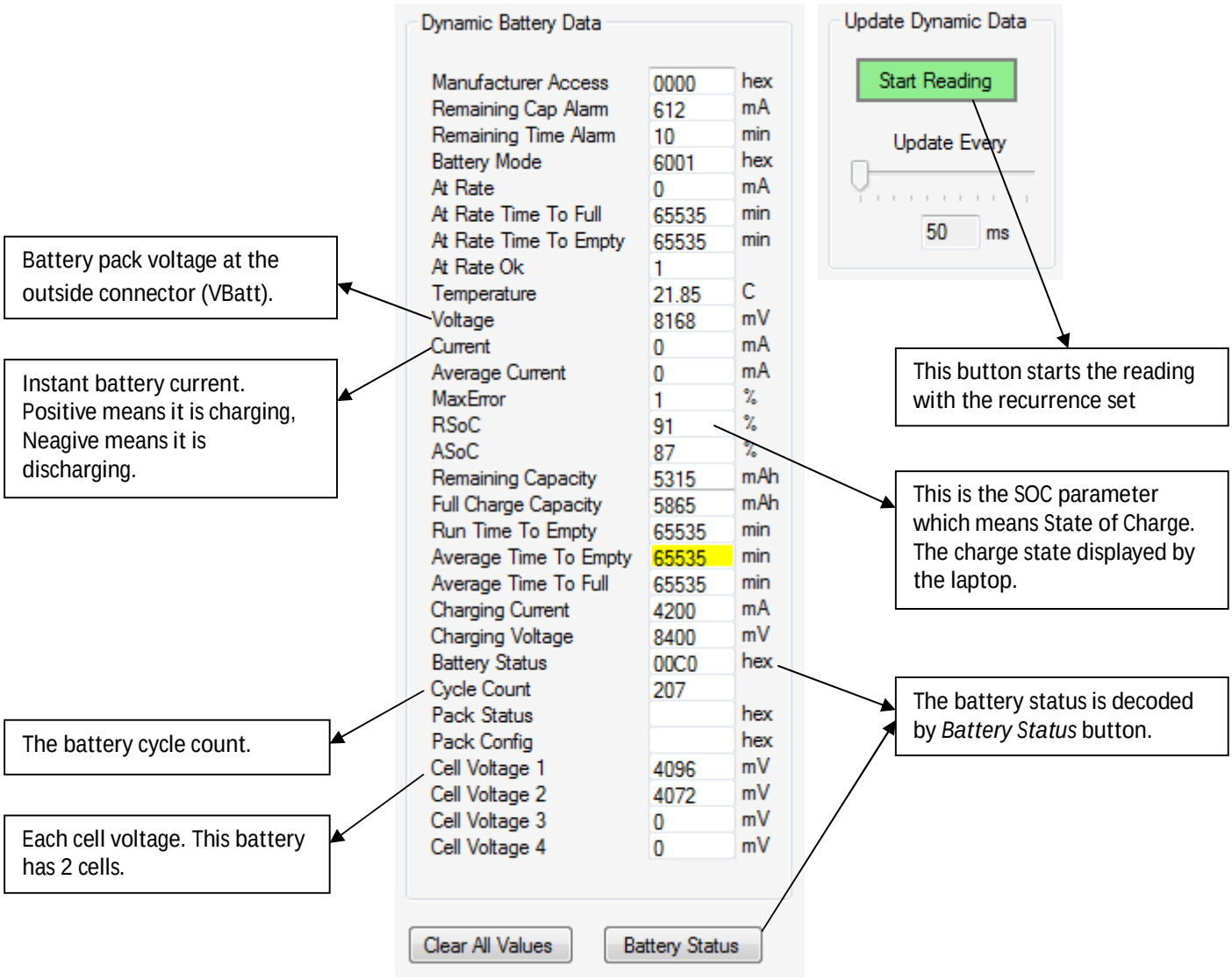
6.1 Tab ***Battery Info***

All battery information can be read under "Battery Info" tab. This tab is tab is presented bellow:



Each functionality group will be presented in the next pages separately.

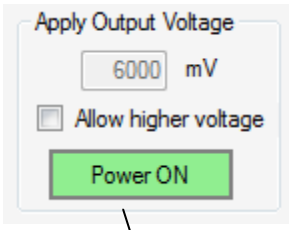
Dynamic Battery Data



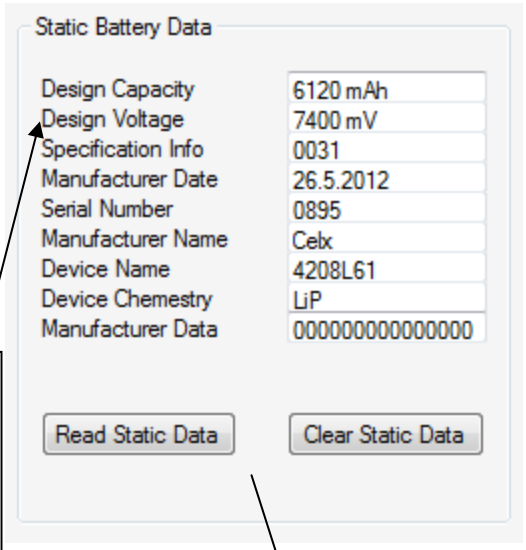
All battery dynamic parameters are display in this group. Above are explained just few of them. The complete description of all parameters can be found here:
http://sbs-forum.org/specs/sbdat110.pdf

Battery Status button decodes the hex value, possible values:

```
OVER_CHARGED_ALARM
TERMINATE_CHARGE_ALARM
OVER_TEMP_ALARM
TERMINATE_DISCHARGE_ALARM
REMAINING_CAPACITY_ALARM
REMAINING_TIME_ALARM
INITIALIZED
DISCHARGING
FULLY_CHARGED
FULLY_DISCHARGED
```



Static Data



Static data is displayed in this group. This data is not changed during battery life time.

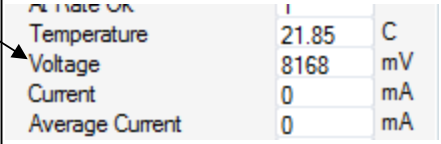
Important

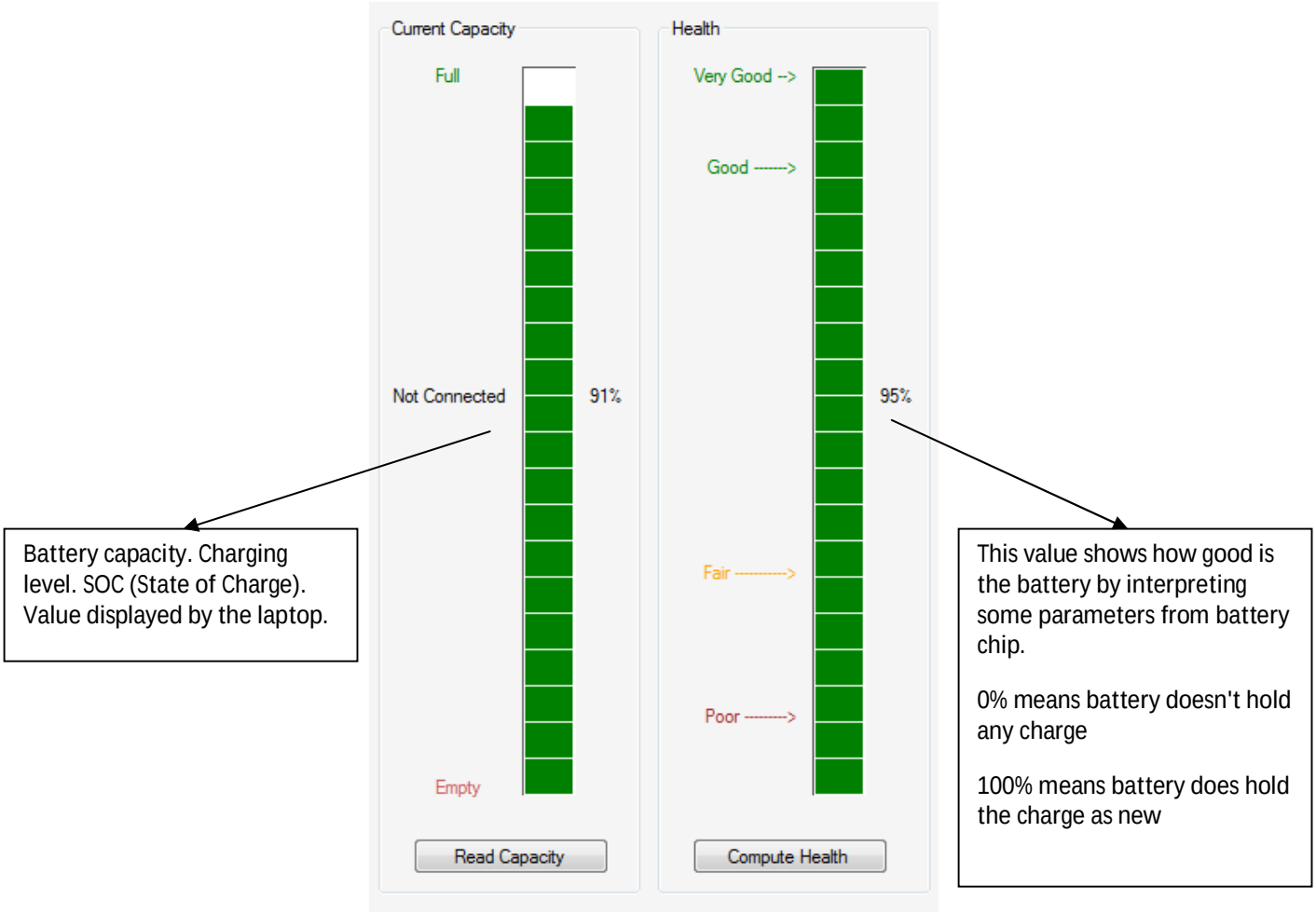
This feature offers the possibility to set a specific voltage on the output battery connector. It is very useful in case the battery chip is not powered due to an over discharged cells.

If the static or dynamic data are not displayed it is recommended to power up the battery chip externally using this feature. Very important is to set a lower voltage at the beginning and then to try reading battery data. It is recommended to set a voltage lower than ***Design Voltage*** by 1-2Volts.

In case a good battery is connected (chip data can be read), this feature can be used carefully to charge the battery. Example: Check first the battery ***Voltage***, then apply an output voltage higher by 200mv. In this case set 8368mV to ***Apply Output Voltage*** feature, as a result a ***Current*** will be drain into battery cells. Note: a higher voltage set will lead to a higher drain current. Do not set a voltage higher by 500mV than the actual battery voltage.

Note: Also note that there are batteries that are good but cannot be charged due to a missing charging request, e.g. Dell batteries.





Current Capacity - Panel

This panel contains a vertical bar which displays the capacity of the battery (State of Charge) as following:

- if the state of charge is between 0-15% vertical bar is colored in brown
- if the state of charge is between 15-30% vertical bar is colored in orange
- if the state of charge is between 30-100% vertical bar is colored in green

A label placed in middle-left side of the vertical bar is used to show if a charger is connected:

- "Not Connected" - not current flows from/to battery
- "Charging" - current flows from charger to battery
- "Discharging" current flows from battery to load

Health - Panel

This panel contains a vertical bar which displays the health of the battery (how good is the battery/how much can hold the charge/ full charge capacity) as following:

- if health is between 0-10% vertical bar is colored in brown
- if health is between 10-30% vertical bar is colored in orange
- if health is between 30-100% vertical bar is colored in green

6.2 Tab ***Charge***

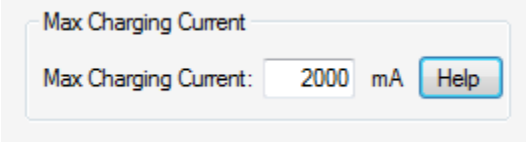
The battery can be charged using ***Charge*** tab. This tab is tab is presented bellow:

Stop Charging Condition

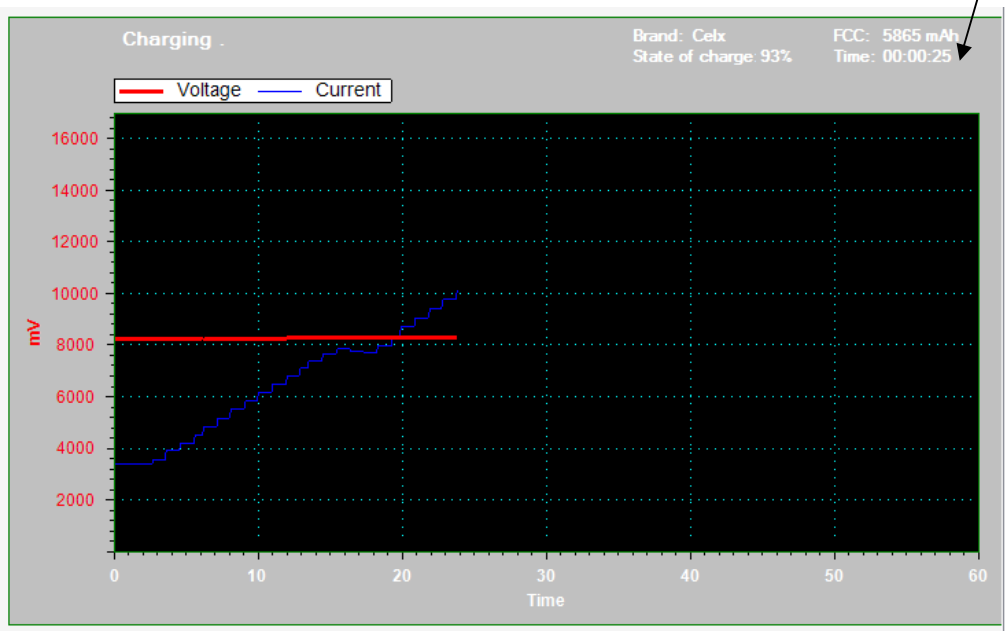
The charging process stops if at least one parameters from the table bellow is reached.

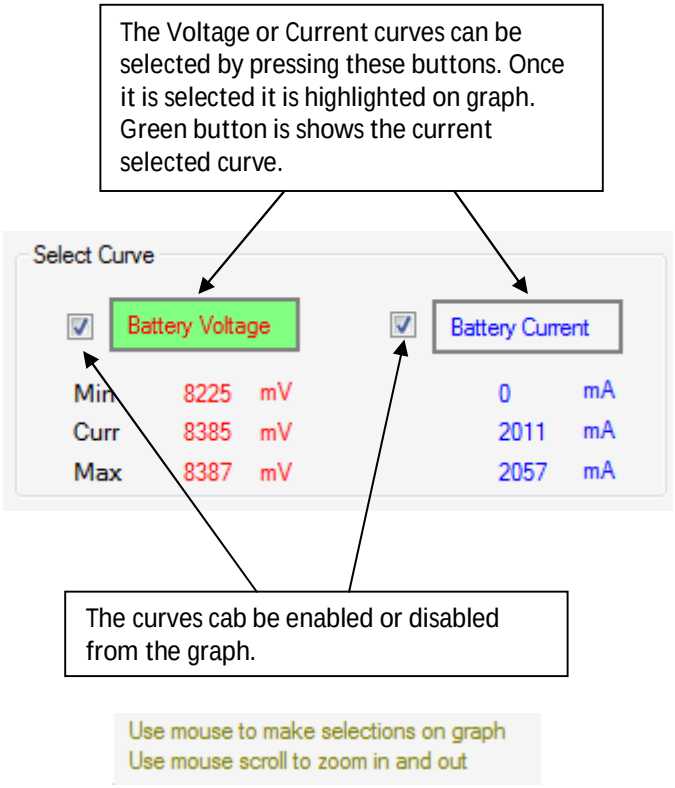
	Value	Help
STOP Charging Conditions		
State of charge (%)	100	Help
Max. Temperature (Celsius)	50	Help
Max Charging Time (min)	600	Help
Max Cell Voltage (mV)	4350	Help

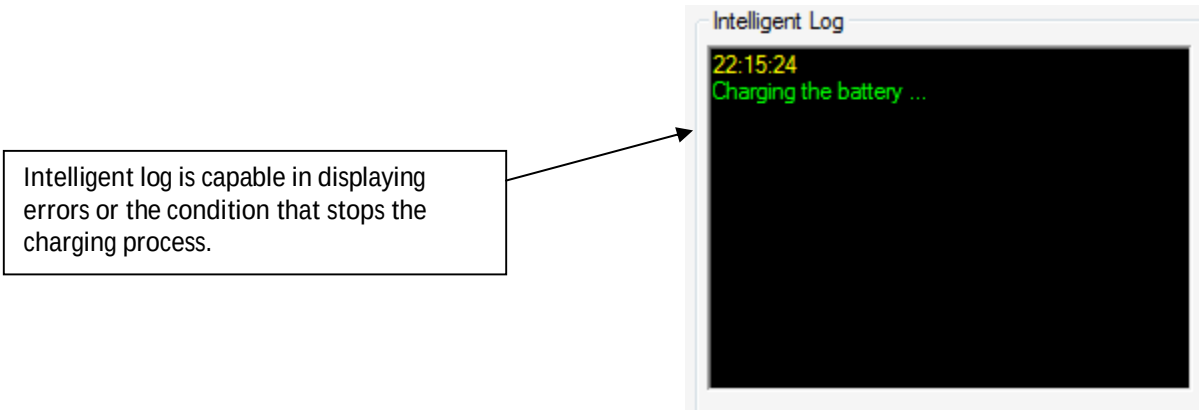
Maximum charging current can be configured in the bellow field. The charging process is done with this maximum current. The maximum current supported by the device is 3000mA



The charging current and battery voltage are displayed in real time. The **charging time** is counted

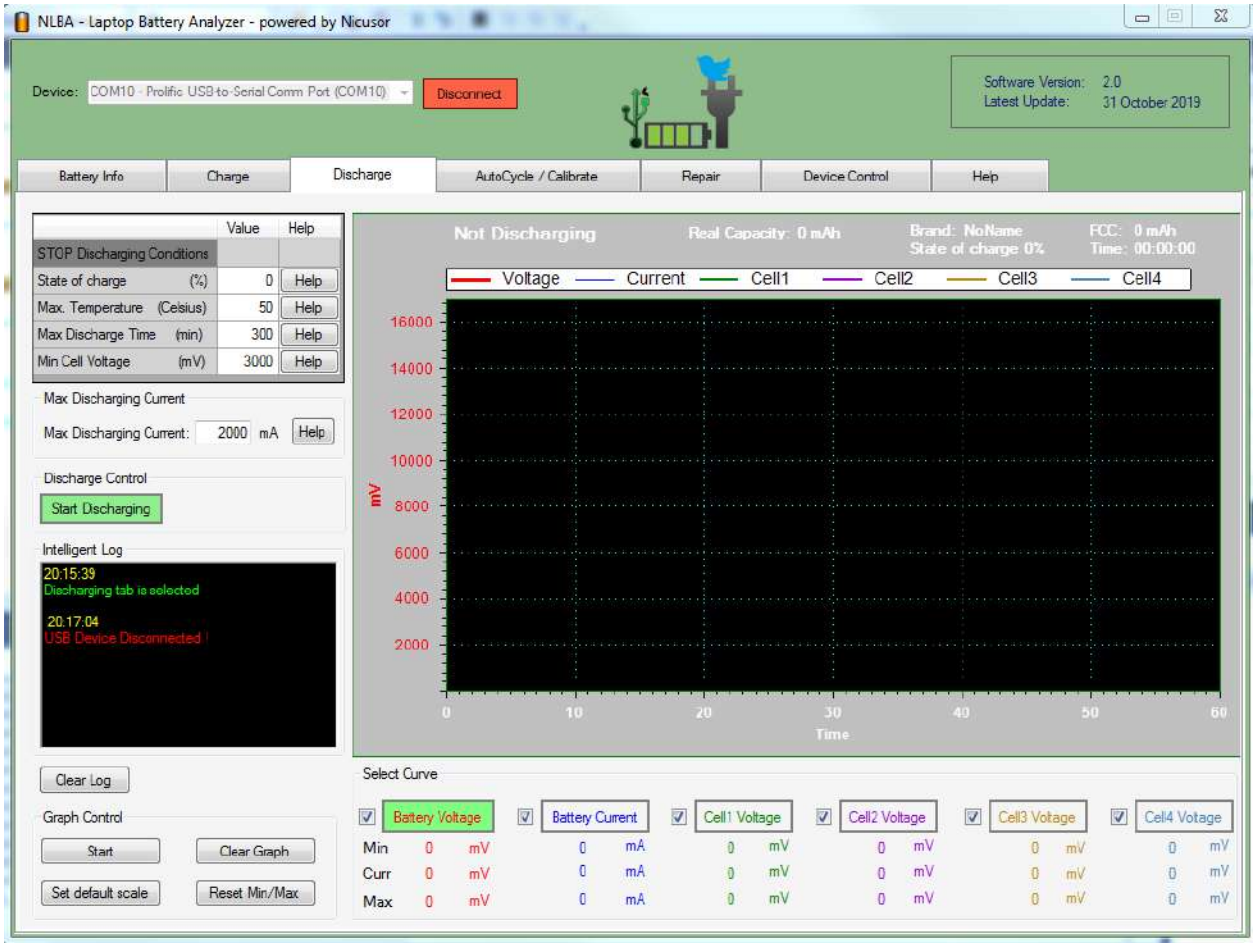



The Voltage or Current curves can be selected by pressing these buttons. Once it is selected it is highlighted on graph. Green button is shows the current selected curve.
Select Curve
Battery Voltage
Battery Current
Min 8225 mV
Curr 8385 mV
Max 8387 mV
0 mA
2011 mA
2057 mA
The curves cab be enabled or disabled from the graph.
Use mouse to make selections on graph
Use mouse scroll to zoom in and out


Intelligent log is capable in displaying errors or the condition that stops the charging process.
Intelligent Log
22:15:24
Charging the battery ...

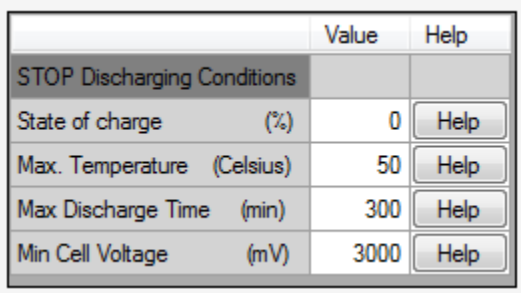
6.3 Tab ***Discharge***

The battery can be discharged using ***Discharge*** tab. This tab is tab is presented bellow:



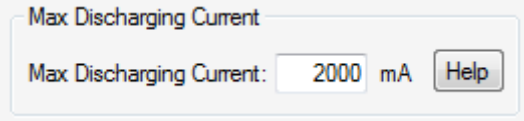
Stop Discharging Condition

The discharging process stops if at least one parameters from the table bellow is reached.

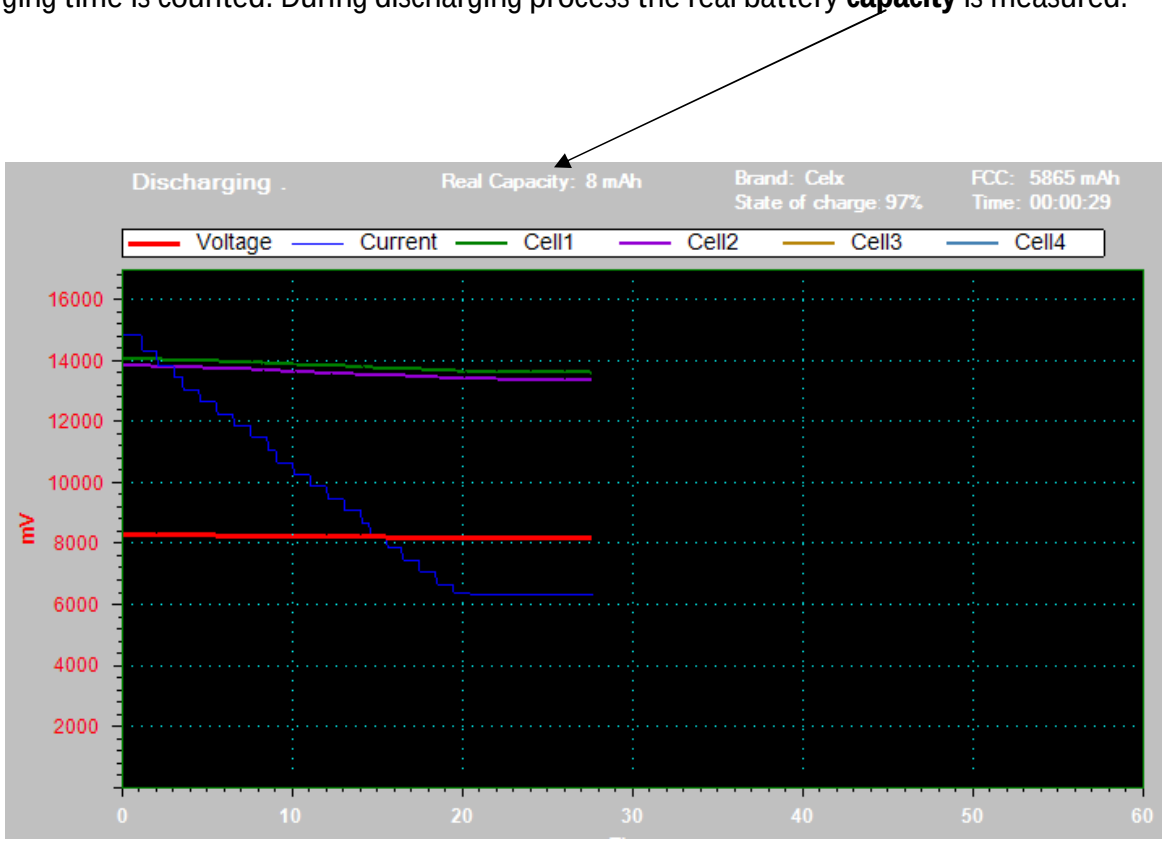


	Value	Help
STOP Discharging Conditions		
State of charge (%)	0	Help
Max. Temperature (Celsius)	50	Help
Max Discharge Time (min)	300	Help
Min Cell Voltage (mV)	3000	Help

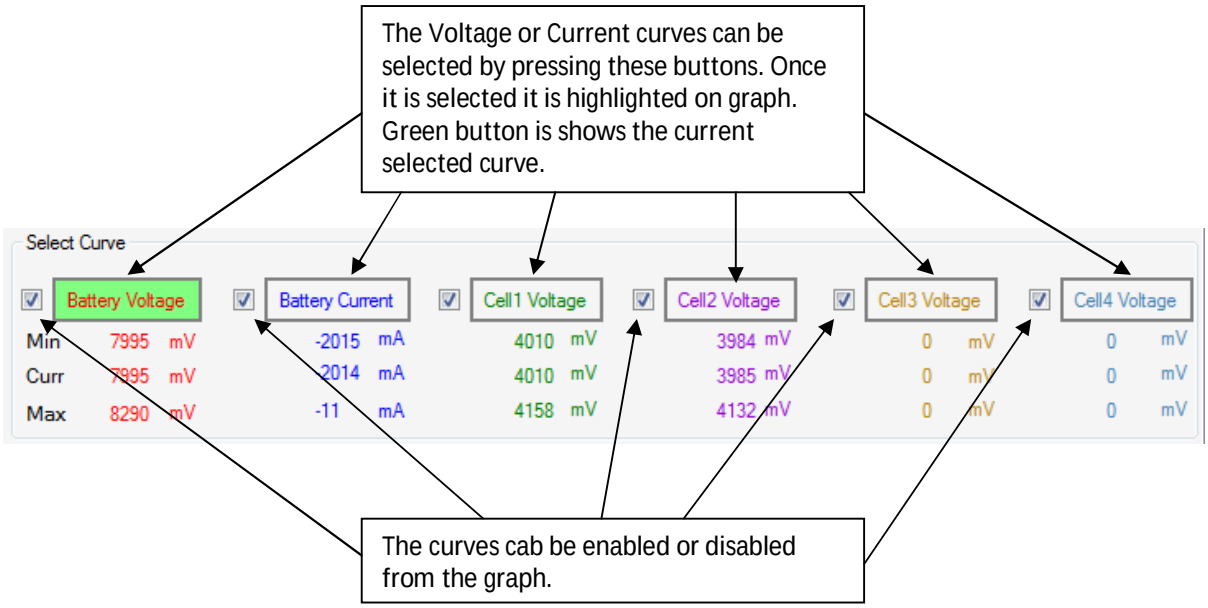
Maximum absolute discharging current can be configured in the bellow field. The discharging process is done with this absolute maximum current. The absolute maximum current supported by the device is 3000mA.



The discharging current, battery voltage and cells voltage are displayed in real time. The charging time is counted. During discharging process the real battery **capacity** is measured.



By having the cells voltage curves it is easy to get a fast impression how good the cells are. A lower voltage drop in the cell voltage means a better cell.

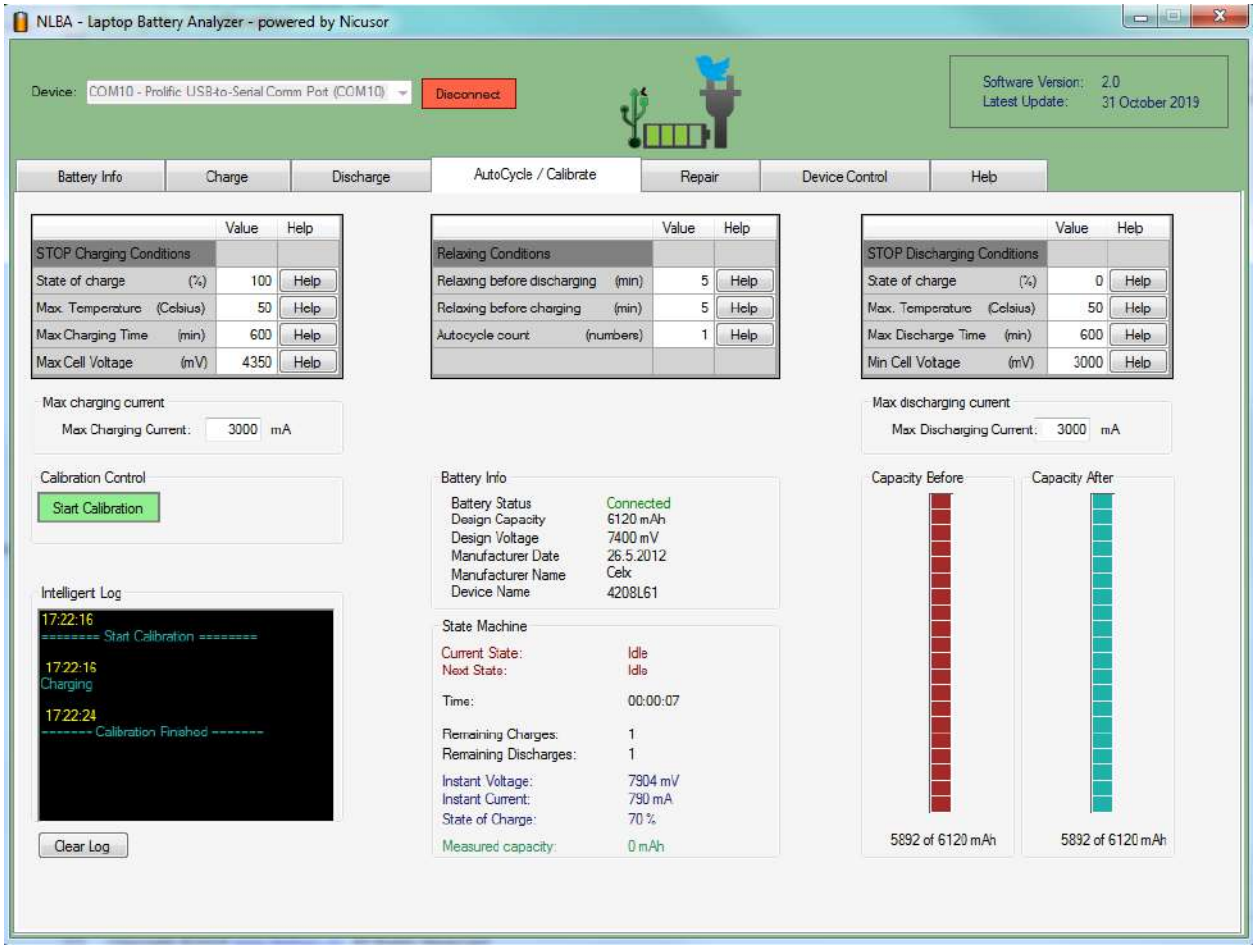


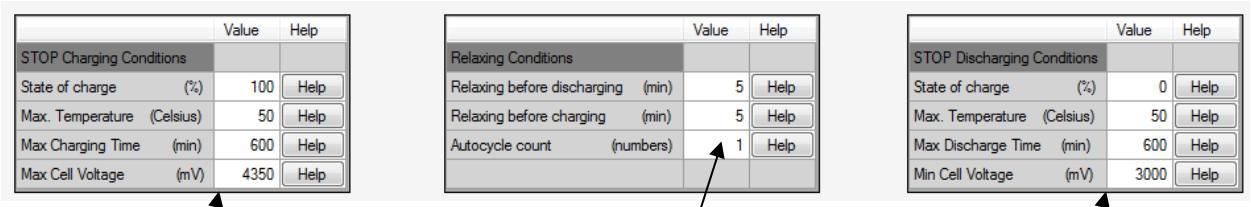
6.4 Tab ***Autocycle/Calibrate***

This feature can be used to perform one or more charging-discharging cycles. It's usefull to do from time to time a cycle like: Fully Charged > Fully Discharged -> Fully Charged in order to recalibrate the battery data inside the internal chip. If data inside the battery is calibrated then the battery reports correctly the state of charge to the laptop, otherwise it will report wrong information (e.g. battery reports 3hours autonomy because remaining capacity is higher than 4000mAh but in real the capacity is lower than 500mAh, the results are the laptop shuts down after few minutes). After a calibration cycle
the FCC parameter is updated.

Important: Not all batteries can be fully charged to 100% due to charger protection.

Bellow is the main window of calibration feature:





If at least one of STOP charging conditions are met then the charging is considered finished.

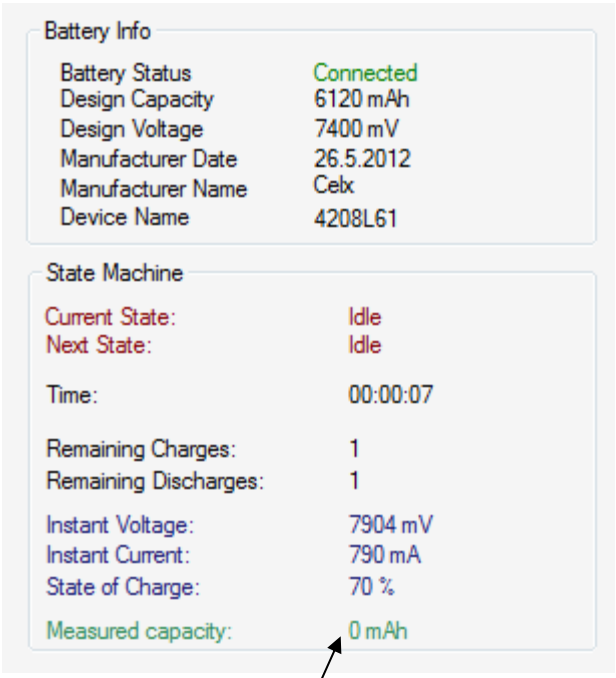
Note: It is recommended to charge the battery to 100%

Number of cycles.

1 cycle means: 1 Fully Charged -> Relaxing before discharging -> 1 Fully Discharged -> Relaxing before charging -> 1 Fully Charged

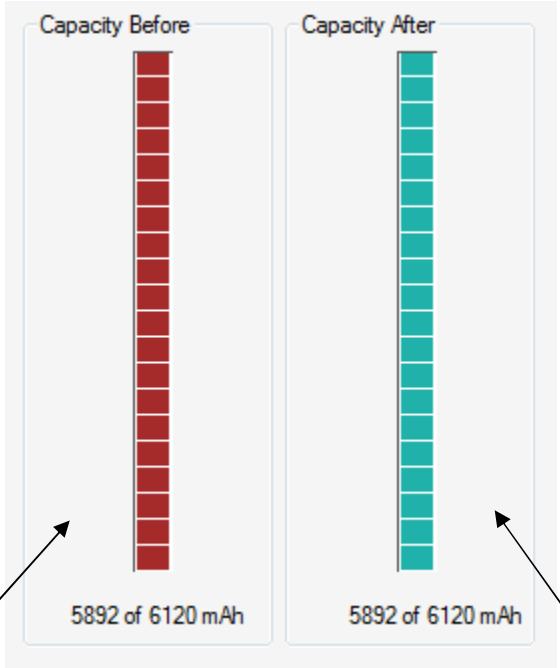
If at least one of STOP discharging conditions are met then the discharging is considered finished.

Note: It is recommended to discharge the battery to 0%



During discharging process the real battery capacity is measured.

If there are more than one cycle then the capacity for last discharge is shown.



First column shows the battery capacity before starting the calibration process.

5892mAh is the current capacity (FCC=Fully Charged Capacity) while 6120mAh is the capacity when battery

Second column shows the battery capacity after finishing the calibration process.

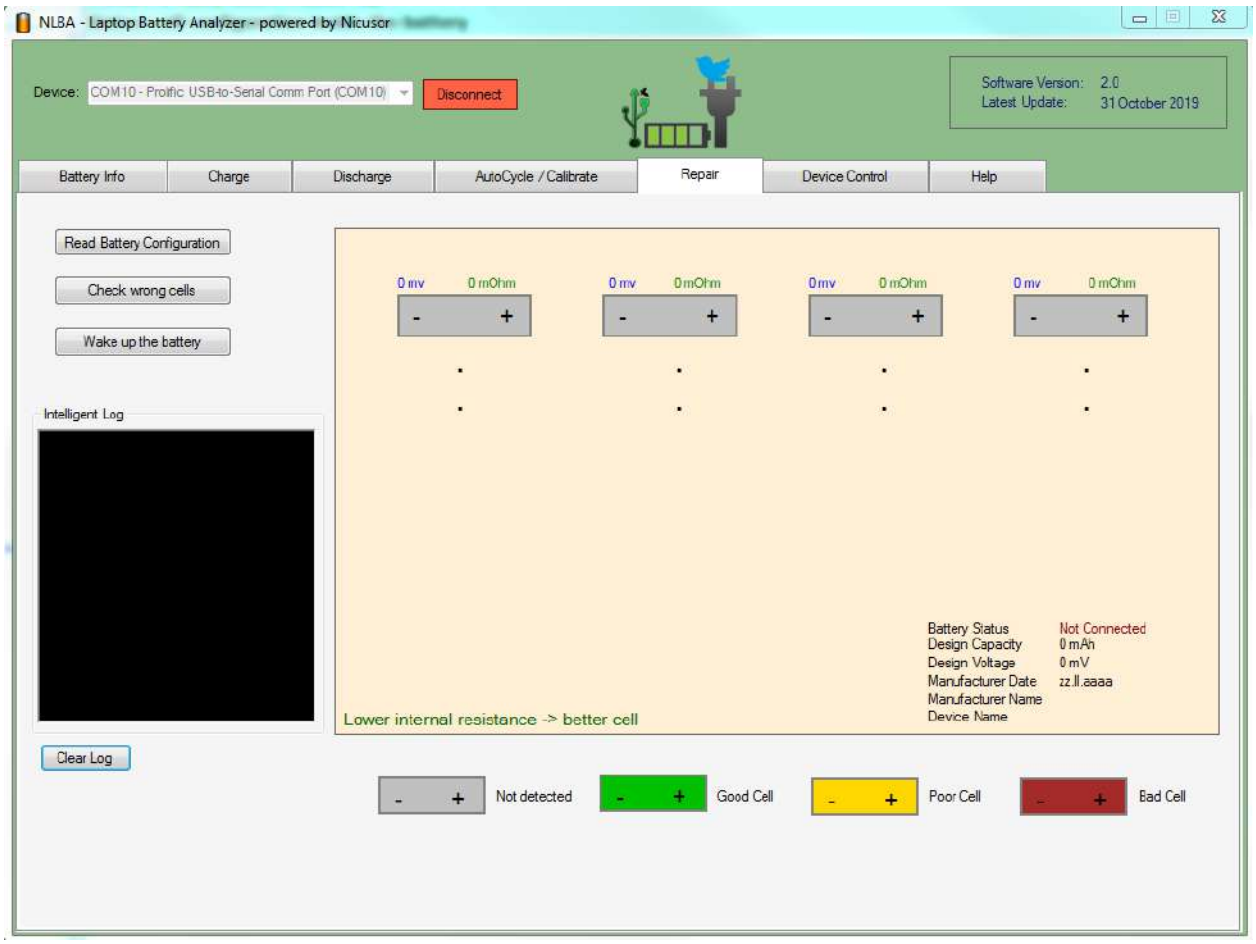
5892mAh is the current capacity (FCC=Fully Charged Capacity) after finishing the calibration

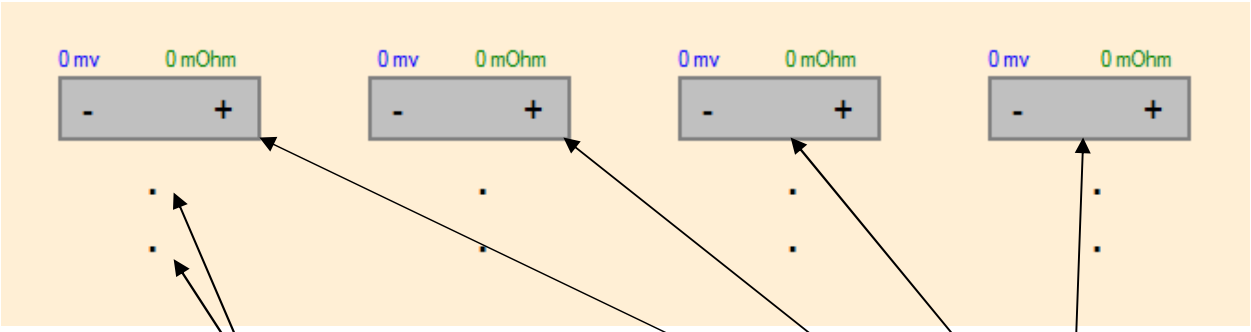
6120mAh is the capacity when battery was new, capacity from factory

If an error occurs during calibration process then same current capacity will be shown like before starting the calibration. If calibration process finishes with success then in principle a different current capacity will be shown

6.5 Tab ***Repair***

This great feature offers to possibility to check how good are the cells inside the battery.



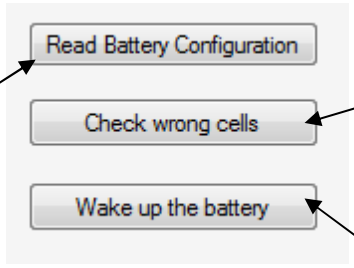


Number of parallel cells is not displayed since every cell in one parallel group has in principle the same internal resistance

All laptop batteries that have 1, 2, 3 or 4 cells connected in series are supported. In principle almost all laptop batteries.

The internal resistance is calculated based on a special algorithm that analyze the cells under discharging. The internal resistance can tell how good is the cell. A lower resistance means a better cell. A higher resistance means a worst cell.

The cells are colored in green yellow and red based on some resistance intervals.



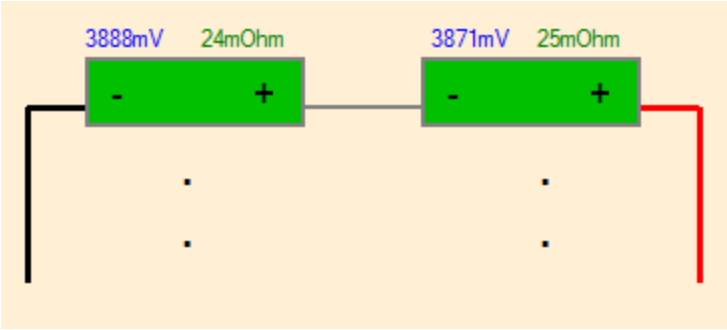
This button shows how the cells are connected inside the battery.

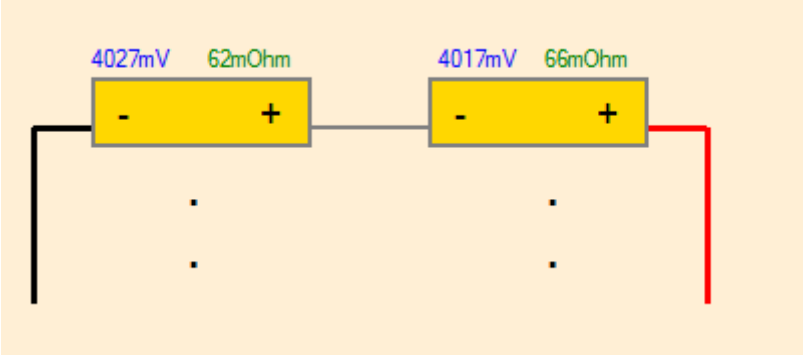
This button starts the process to calculate the internal resistance for each group of cells.

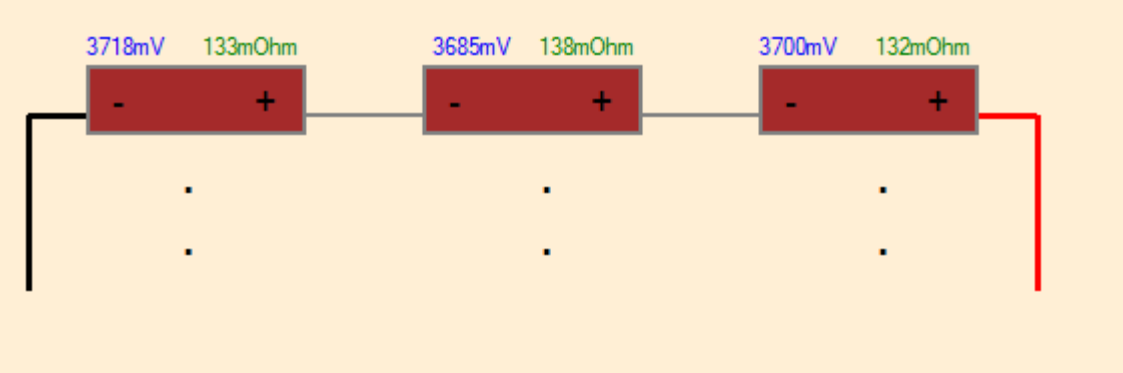
Wake up the battery is a special feature that wakes up the battery chip in case the battery was stored for a long time and the cells have lower voltage than the nominal values but still in range.

Note: this feature doesn't wake up a chip that has over discharged cells. In that case the chip is locked and the battery cannot be revived anymore. In tab Battery Information each cell voltage can be checked.

Some examples of how the internal resistance is computed for different batteries:

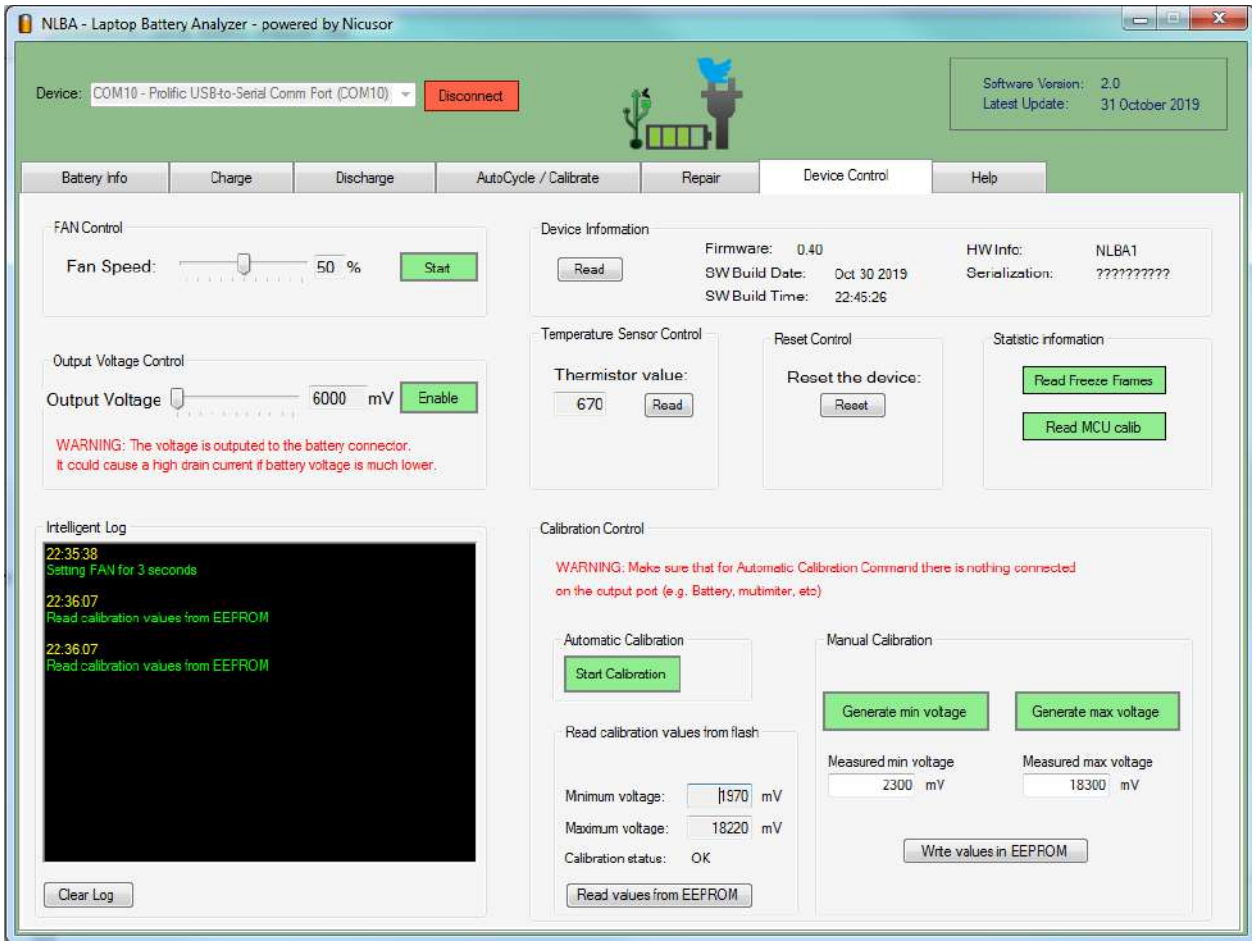


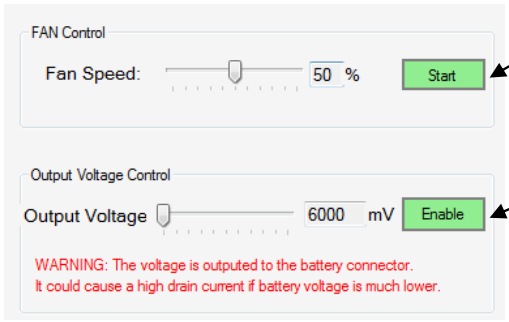




6.6 Tab ***Device Control***

This tab can be used to control the hardware device even for diagnosis purposes or for hardware calibration:



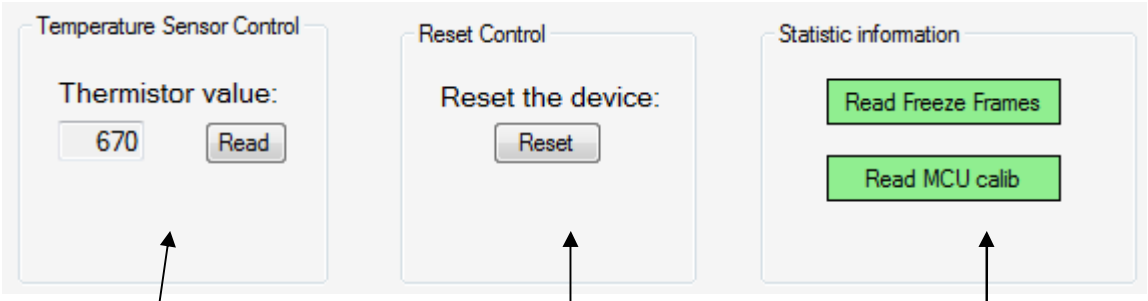


The FAN located inside the device is turned with a specified speed.

This feature offers the possibility to set a specified voltage directly on the output connector.

If the requested voltage has a difference higher than 300mV than the measured voltage on the output connector then a calibration is required.

Note: if there is a battery connected it could damage the battery.

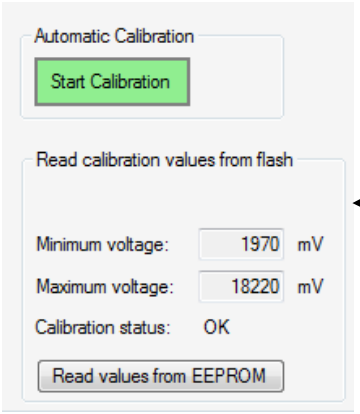


The device has a built in temperature sensor to control the speed of FAN. With this option the raw thermistor value can be read.

This command performs a software reset.

Freeze frames represent logging data saved inside the microcontroller. It can be read and send to the manufacturer for diagnosis in care there are malfunction.

MCU calib contains MCU calibration data like clk, ADC, etc. It can be sent to manufacturer for diagnosis in care there are malfunction.

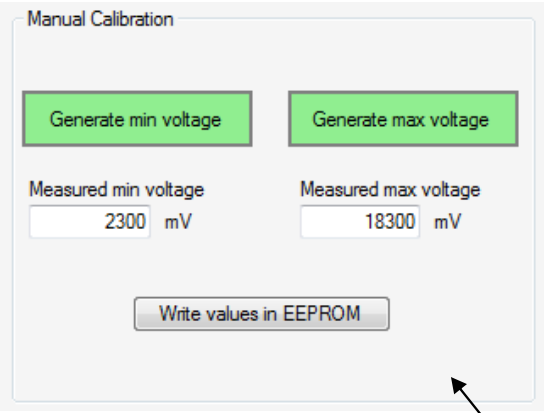


This calibration is for internal voltage generator between Minimum and Maximum voltage. This calibration is done automatically. In the factory an automatic calibration is performed.

Values are stored in the EEPROM and can be read.

After performing a calibration a device Reset is required to be taken in account.

Note: Disconnect all wires connected to the output port, it has to be kept unconnected while calibration is performed.



This is manual calibration feature that involves a technician with minimum hardware knowledge.

Steps to perform manual calibration:

1. Press **Generate min voltage** to generate a voltage on the output connector.

2. Measure the voltage on the device output connector.

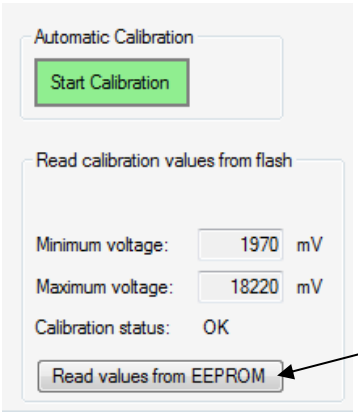
3. Fill the measured voltage in mV in the **Measured min voltage**

4. Repeat steps 1 to 3 for Maximum voltage

5. Press **Write values in EEPROM** to save the new values.

6. Reset the device.

7. Read the new values.



7. How to identify Battery pins

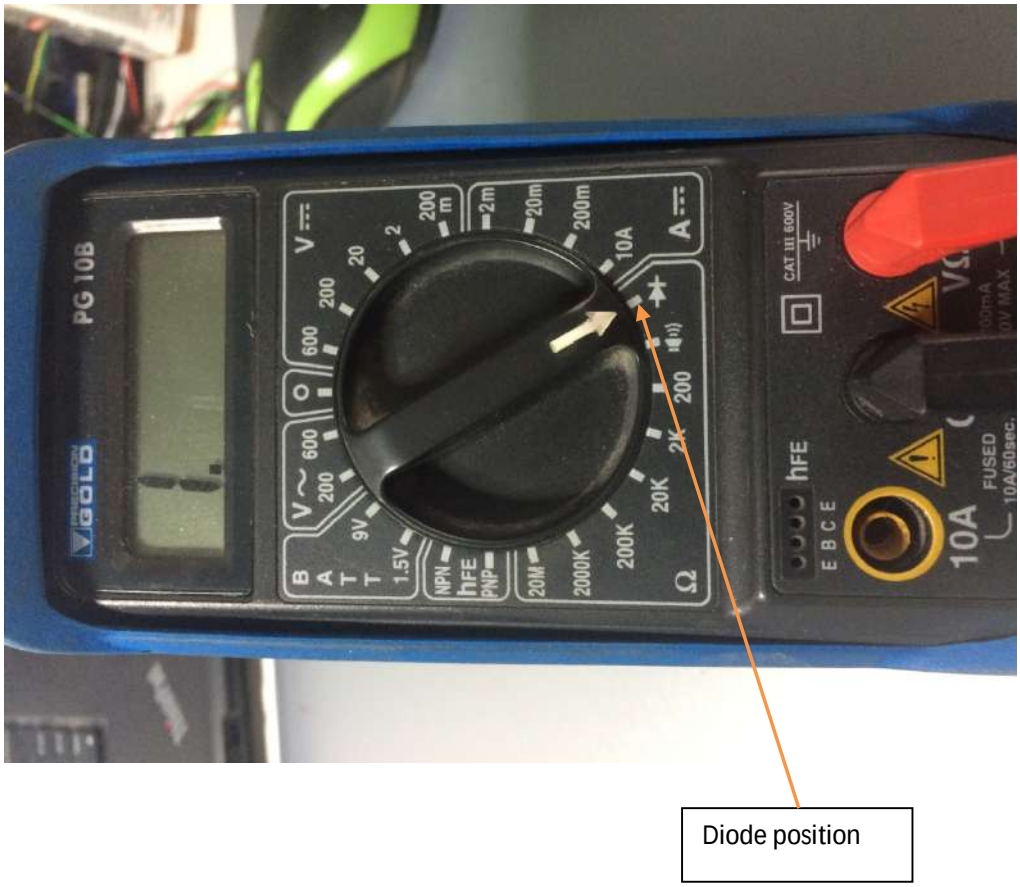
This section describes how to identify the battery pins needed by the NLBA device.

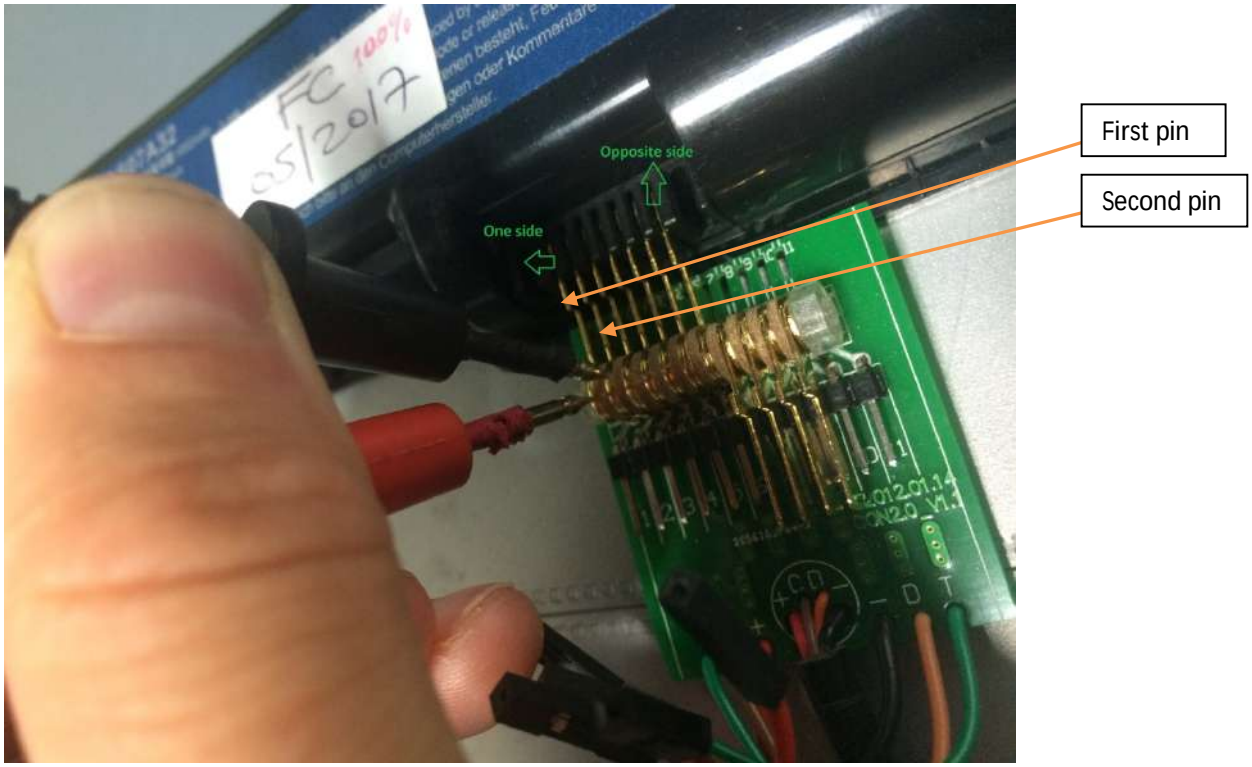
For battery communication 3 pins are needed: GND (ground), SMBCLK (clock), SMBDAT (data).

For charging/discharging the battery you need also VBAT and, if necessary, TEST pin connected to GND in order to enable voltage on VBAT.

Steps:

1. First, GND pin should be identified. Use a multimeter and switch it to "diode" position (see bellow picture). Connect red probe on first battery pin and the black probe on the second/next battery pin.





2. If a value between .500 and .800 is displayed then the pin connected to the red probe is our GND and the pin connected to the black probe is SMBCLK or SMBDAT (which one is unknown in this step, both have same diode value).

3. If other value is displayed by multimeter then keep the red probe connected to first pin and move the black connecter to the third pin until the end/opposite side.

4. If the all pins are checked and the expected value was not found then the procedure continues by checking the pins with red probe connected on the last pin, so, connect the red probe on opposite side (last pin) and the black connector on the next pin (in mirror). In principle GND is located in the exterior/boundary of the connector.

5. The battery can be connected to the device to check if battery information are read correctly. This can be done by starting the PC software and reading continuously Dynamic Battery Data. If there is communication then GND, SMBCLK and SMBDAT are located. If there is no communication switch/inverse the SMBCLK and SMBDAT lines.

6. In principal, almost all batteries have GND and VBAT connected to the borders. Some batteries have one or two TEST pins that have to be connected to GND in order to output the voltage (enabling the voltage output). After connecting GND, SMBCLK and SMBDAT to the device try to identify VBAT pin, in principle it should be the opposite pin of GND. If there is a voltage between GND and VBAT that's the pin, if not try to connect the remained pins to GND one by one (TEST pins) and check the voltage between GND and VBAT. If still nothing, the battery could be in Fault mode or overdischaged, then the NLBA could be used to set output voltages (Apply Output Voltage) to the battery hopping it could be waked up.

Many batteries have first 2 pins connected together (GND or VBAT) and the last two pins connected together (GND or VBAT). Many Apple batteries have first 3 pins connected together and last 3 pins connected together. This is used to assure a higher current transfer.