Battery Analyzer

User manual

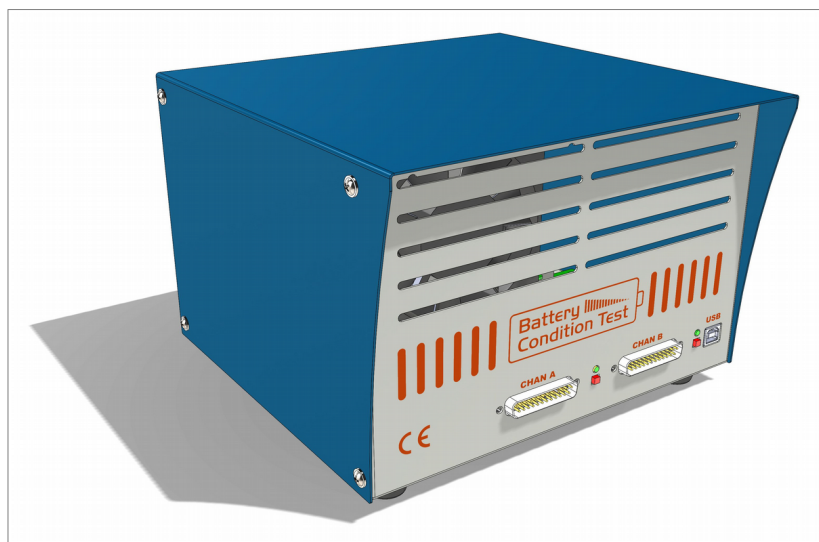| File:	BatteryAnalyzer User manual_EN.odt
Creation date	9-20-18 9:22 PM
Last edited	10-10-18 10:17 AM
Version	1.0

Table of Contents

Revision Sheet

Release No.	Date	Revision Description
Rev. 1.0	Aug 20, 18	Initial document

http://www.batteryconditiontest.com

Models: BA610, BA760, BA910

1 Introducing the Battery Analyzer

1.1 System Overview

The BAxxx analyzers are used to measure the capacity, energy and power of batteries and the quality of their chargers. The sequence is to fully charge the battery (using the external charger), measure the capacity by discharging it and subsequently recharge the battery.

The analyzer is designed for testing at currents, similar to actual usage. Therefor, cell problems will be detected and the testing time will be minimal.

Up to 32 BAxxx's can be connected to 1 PC and run under the control of the software, allowing 64 batteries to be tested in one go. For most e-bike batteries, a test cycle of 2 batteries will take about 8 hours (mostly depending on the charger's capacity).

The Analyzer is connected to a PC using USB and operated under software control. The supplied PC program, shows graphs and reports that can be stored and printed.

- Open circuit voltage and voltage under load.
- Charge and discharge current in Ampere.
- Charge and discharge capacity in Ah.
- Battery impedance.
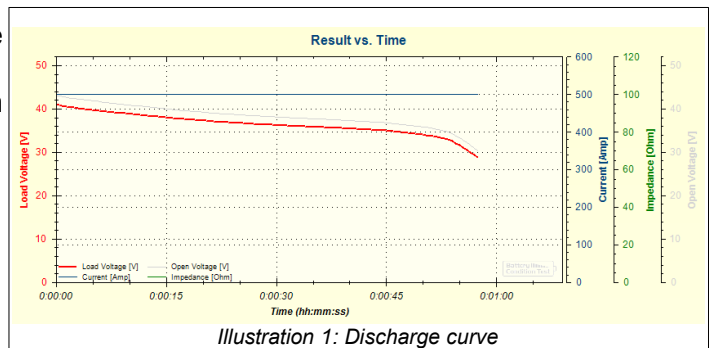
Features:

- Tests 1 or 2 batteries in sequence with concurrent charging and re-charging.

Illustration 1: Discharge curve

- Battery voltages: 7.2 upto 72V (4-wire measurement).
- Test any type of battery: NiCd, NiMH, Li-Ion, Li-Poly, LiFePO4, lead-acid.
- Automatic sequence:
  Charge → Discharge → Recharge.
  (Also multiple cycling tests)
- Fast constant current discharge with currents up to 16A, digitally controlled.
- Automatic and user controlled turn-off voltage.
- Readout of battery management system (BMS) through HDQ, SMBus/I^{2}C (with special cable only).
- Works through USB, PC program included.
- Storage and printing of measurement reports on the PC and external backup locations.
- Report in PDF and cycling tests results in spreadsheet format.
- Recover from power failure.
- Safe shutdown after USB disconnect.

1.2 Safety information

WARNING: Warnings contain directions that you must follow for your personal safety. Follow all directions carefully.

You must read the following safety information carefully before you install or remove the unit.

AVERTISSEMENT: Les avertissements présentent des consignes que vous devez respecter pour garantir votre sécurité personnelle. Vous devez respecter attentivement toutes les consignes.

Nous vous demandons de lire attentivement les consignes suivantes de sécurité avant d'installer ou de retirer l'appareil.

WARNHINWEIS: Warnhinweise enthalten Anweisungen, die Sie zu Ihrer eigenen Sicherheit befolgen müssen. Alle Anweisungen sind sorgfältig zu befolgen.

Sie müssen die folgenden Sicherheitsinformationen' sorgfältig durchlesen, bevor Sie das Gerät installieren oder ausbauen.

1.2.1   Important safety information
- Installation and removal of the unit must be carried out by qualified personnel only.
- If installing the BAxxx unit stand-alone or in a stack, the units must be installed with sufficient spacing to allow air flow for cooling.
- The unit should <u>never be connected</u> to an A.C. outlet (power supply) without an earth (ground) connection.
- The unit must be connected to an earthed (grounded) outlet to comply with European safety standards.

1.2.2   L'information de Sécurité Importante
- L'installation et la dépose de ce groupe doivent être confiés à un personnel qualifié.
- En cas d'installation de l'unité BAxxx autonome, ou en stack, les unités doivent être installé avec d'espacement suffisant pour permettre l'écoulement d'air pour refroidir.
- L'unité ne devrait pas être branchée a une prise de courant C.A. (source de courant) sous aucun prétexte sans un branchement mise à la terre (mise à la masse).
- Vous devez raccorder ce groupe à une sortie mise à la terre (mise à la masse) afin de respecter les normes européennes de sécurité.

1.2.3   Wichtige Sicherheitsinformationen
- Die Installation und der Ausbau des Geräts darf nur durch Fachpersonal erfolgen.

- Wenn die BAxxx Einheit selbständig oder in einem Stapel eingebaut wird, müssen die Einheiten mit ausreichendem Abstand installiert werden, um den Luftstrom für die Kühlung zu ermöglichen.

- Das Gerät ist unter keinen umständen an einen Wechselstrom (A.C.) Netzstecker anzuschließen ohne Erdungsleitung.

- Das Gerät muß an eine geerdete Steckdose angeschlossen werden, die die europäischen Sicherheitsnormen erfüllt.

- Der Anschlußkabelsatz muß mit den Bestimmungen des Landes übereinstimmen, in dem er verwendet werden soll.

1.3 Declaration of origin

The Battery Condition Test analyzer BAxxx is designed and manufactured in the Netherlands.

Company details can be found on the web site www.batteryconditiontest.com.

2 Installation

2.1 System requirements

Upto 32 BAxxx's can be connected to 1 Laptop or Desktop PC.

The PC requirements are:

- CPU: Pentium 4, 1 GHz or better.
- 1 or more USB 2.0 ports.
- 2 GByte of memory
- Windows 7, 8, 10.
- At least 2 GB of free disk space.
- A Backup facility to be used for the measurement data.

2.2 Hardware connections

A complete system for battery capacity measurement consists of:

- 1 battery to be tested.
- The discharge and measurement device (BAxxx).
- The charger

The BAxxx can also work with only 1 battery/charger connected.

Illustration 2: Connection diagram
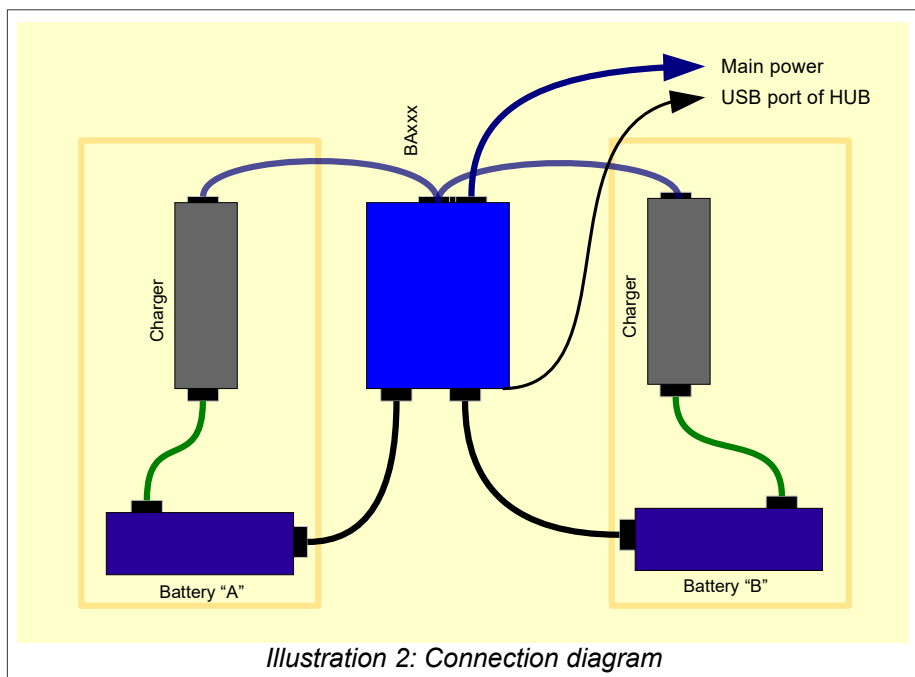
2.2.1   BAxxx, Mains and PC

The BAxxx is connected to the PC using a Powered USB-HUB and a USB cable (type A-B). The Mains power connection is made with a IEC cable.

> **Important:** For a BAxxx, first check if it is either 230 or 115Vac. This should match the operating voltage of your power grid.

> **Important:** Make sure that your power grid outlet is providing a proper ground / safety earth connection.

2.2.2   USB connection

The USB connector is connected through a <u>Powered Hub</u> to the PC.
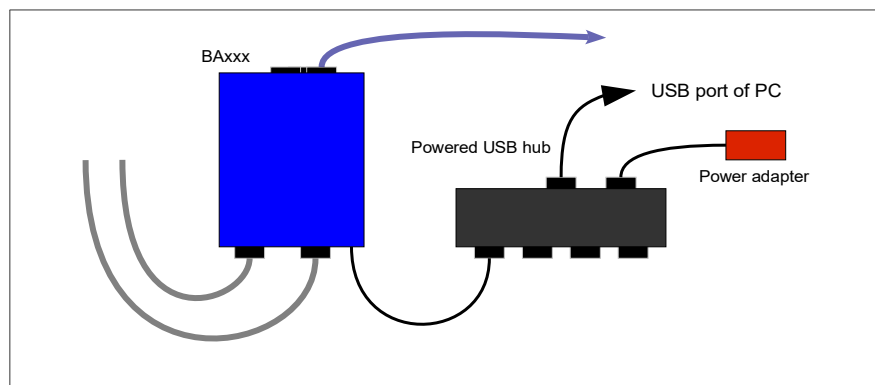
2.2.3   Battery connection (General)

On the front, the batteries can be connected through the DB25 connectors. A pre-wired connector is available separately. It only requires the specific connectors for the type of battery you want to connect.

Alternatively, a cable my be made to suite a specific requirement.

> **IMPORTANT:** *batteries must NOT be connected to a cable, when not connected to the BAxxx.*
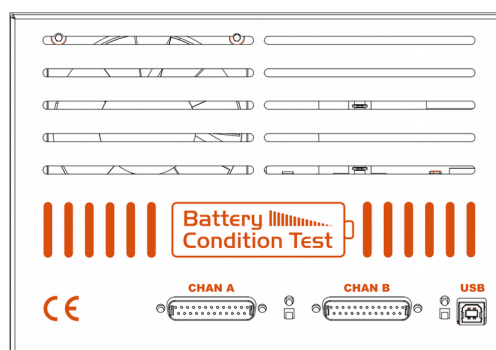
2.2.4   Terminal Converter Set

This is a universal connection system that supports rectangular & round female battery connectors, as well as male Faston tabs. With this custom-made Terminal Converter Set the majority of batteries can be connected.

Select the correct thickness and connect the converters (red to red (plus) – black to black (minus) to the male bullet. If the thickness is unknown, try smaller thicknesses until a reliable connection is achieved without force. If you do not own the Terminal Converter Sets or wish more information please go to the Shop.

2.2.5   Bosch cables

A custom cable with activation control is available for the Classic and Active/Performance line batteries. The cables are available from our website.

2.2.6   TranzX (BL03, BL07, BL15)

Custom cables with BMS support are available for TranzX batteries. If you are a TranzX dealer, you may use their TranzX-Cloud-Service support system (contact TranzX). The cables are available from our website.

2.2.7   BionX (all systems)

This is a custom cable for testing of BionX batteries. This cable goes from the Battery Analyzer battery connector to the BionX battery and the BionX BBI system. The cable is available from our website.

It makes use of the BionX BBI E-Bike Test System (a valid license from BionX is required).

> Although BionX implemented the use of the BAxxx analyzers in their BBI-2 software, it has been disabled, to prevent testing, for internal reasons.

Now, BionX batteries can be tested by connecting the BBI-2 interface and running the software to keep the battery active. Then the test can by done using the Battery Analyzer software.

2.2.8   Custom & Manual

If you want to create your own custom cable or connect to a battery not covered by the Terminal Converter Set or a custom cable, you can also make a direct connection from the (2) universal battery cables supplied with the battery analyzer.

The universal cables end with 2 (red and black) bullet plugs. Use the (included) female bullet terminals to make the connection, either direct (to the wires) or with the (included) terminal blocks.

2.2.9   Charger connection(s)

The chargers are powered from the BAxxx rear connections. This allows the chargers to be switched on/off when required.

- Connect one of the 2 AC charger cables to the back of the battery analyzer. Make sure to use the same channel as you used for discharging –at the front of the battery analyzer-
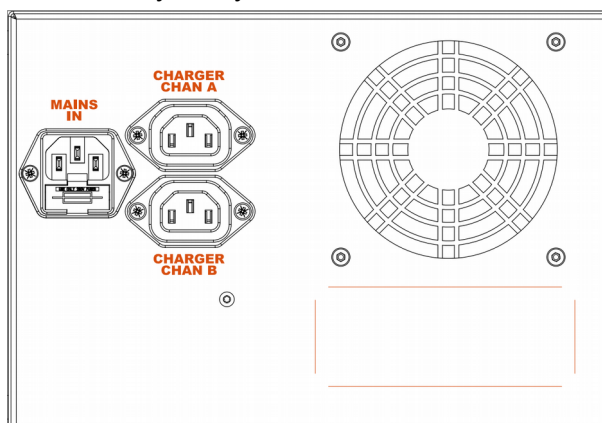
- Connect the charger (DC charge to the Charge Input of the battery or parallel to discharge if no Input).

- Use the charger supplied with the battery to avoid warranty issues. The charger is checked by the battery analyzer on voltage and charge operation.

2.3   Multiple BAxxx's on one PC

The Battery Condition Test program supports upto 32 BAxxx units on 1 PC. This requires a 'tree' of USB Hubs. An example of a tree for 16 units is drawn below.
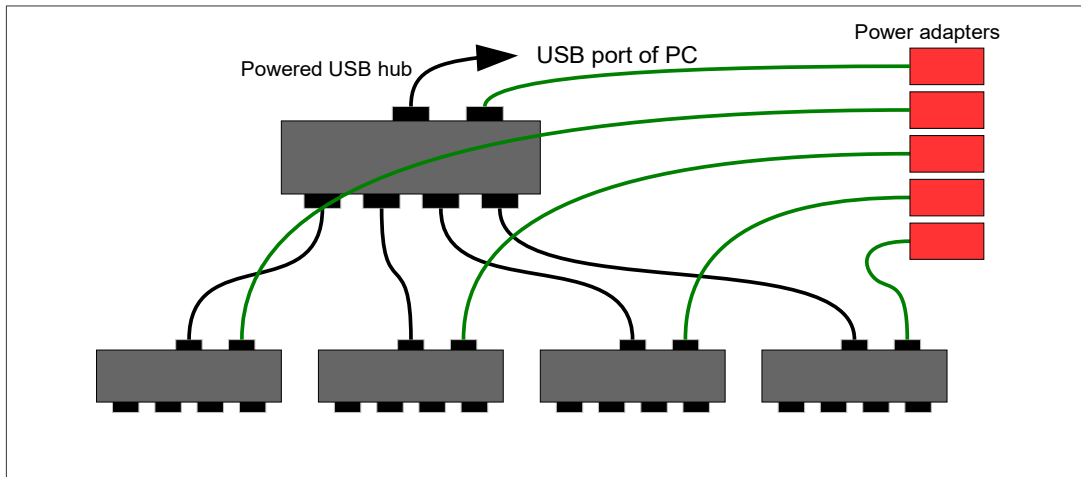
Note: All hubs must be <u>powered with their own power supply</u>!

3 How to use the Battery Condition Test software

3.1 Software installation

The battery condition test software is compatible with Windows Vista, Windows-7, Windows-8 and Windows-10 32-bit and 64-bit versions. The installer program is downloaded from https://www.batteryconditiontest.com and immediately "run", or stored for subsequent running.

Run the installation program BatteryAnalyserSetupVx.x.x.x.exe (The Vx.x.x.x represents the version number).
Select the "Typical" installation and continue.

3.2 Software overview

Measurements can be started, data collected and stored. Graphs of the measurements are visible in real-time. Additionally, reports are generated in PDF format.

Measurement can be done using Profiles. A Profile determines exactly how a measurement is to be done, so that different measurements can be compared and are done according to the specifications of the battery manufacturer.

The measurement data and pdf-reports are output files that need to be included in the backup.
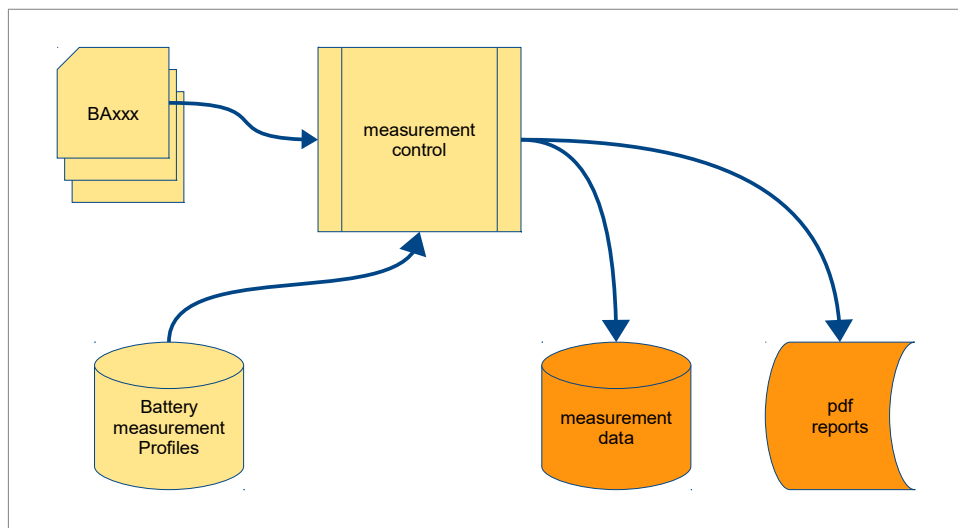
3.3 Program start

3.4 Main screen

On start-up, the main screen looks like:
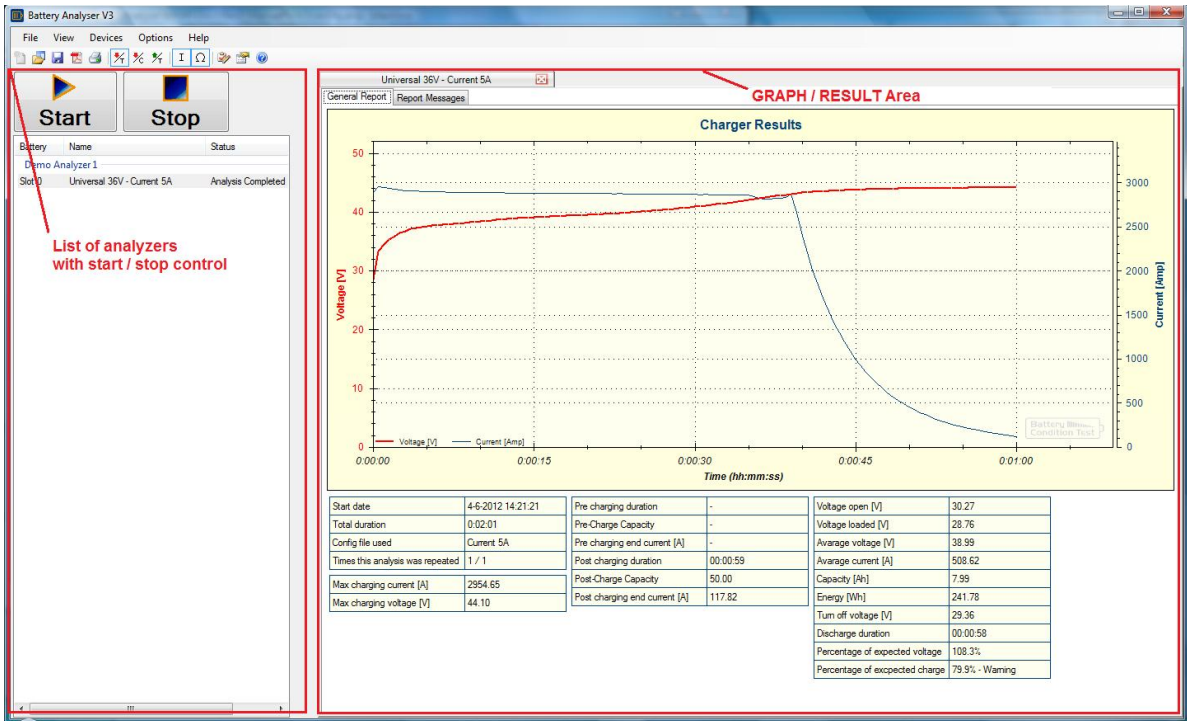
3.5 View example and measurement results

Select from the "File" menu; "Open" (for your measurement results) or "Open Examples" (for example results).
Now view the 3 Tab pages: Progress, Graph and Values.
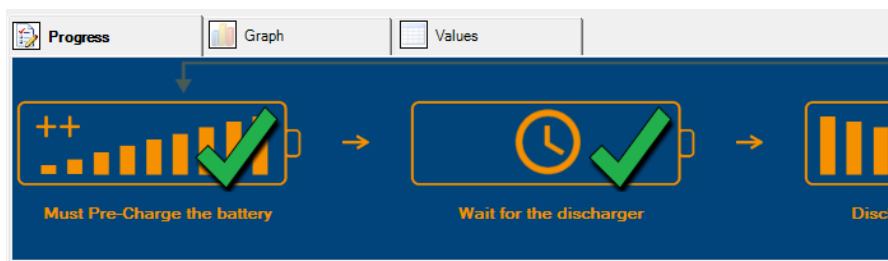
When a measurement files is opened for viewing, it is possible to zoom the graphs to check details. Result reports in PDF format only show the entire graph.

3.6 *Viewing of different Graphs*

Different graphs may be selected for viewing. They will show the measured data and allow zooming.

3.6.1 Discharge result vs. Time

The button ⊞ activates the discharge result (Volt, Current, Impedance) vs. test Time.

3.6.2 Discharge result vs. Capacity

The button ⊞ activates the discharge result (Volt, Current, Impedance) vs. Capacity (in Ah).

3.6.3 Charge result vs. Time

The button ⊞ activates the Charge result (Volt, Current) vs. charge Time. This graph shows the re-charge phase.

> **Note:** If the re-charge is not set to 100% (see the Battery Profile in 3.8), the plot will be partial, since the re-charge is partial.

3.6.4 Showing Current

The button I activates the display of the Current in the graph(s).

3.6.5 Showing Impedance

The button Ω activates the display of the Impedance in the graph(s).

3.7 Quick start Measurement

The steps to start a measurement quickly, are:

1. Connect the battery and charger

2. After the software is started, press the red button of the battery channel to be started.

3. In the dialog, fill in:

   ◦ Test Name

   ◦ Battery Parameters (Voltage, Capacity)

   ◦ Charger Parameters (Current and maximum Voltage)

   ◦ Motor Parameters (Pedelecs are normally 250W)
     The Peak power is used to simulate acceleration.
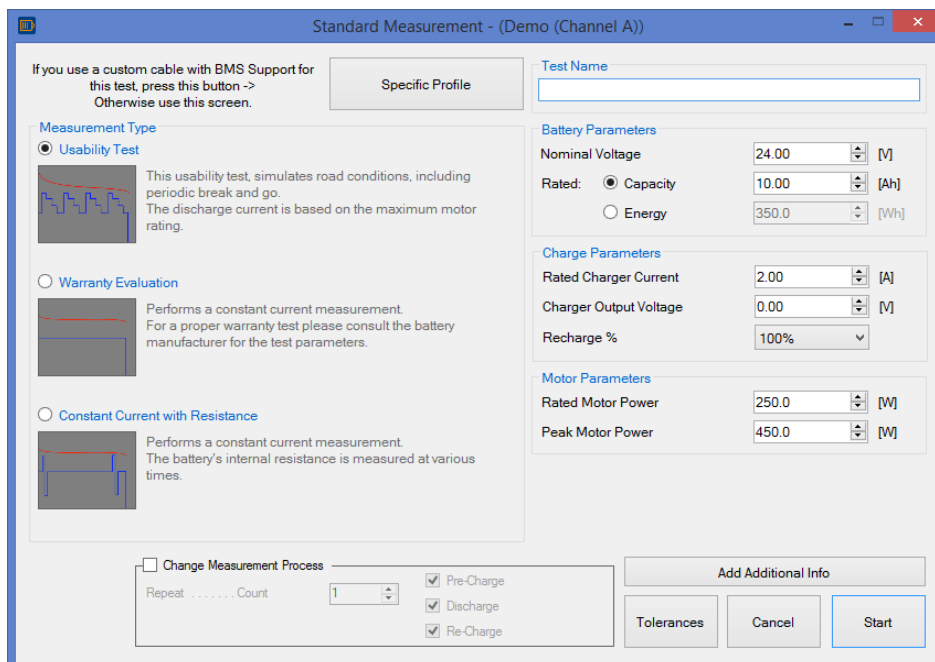
4. If you have a battery with a predefined test profile press "Custom + BMS" and select the battery profile from the list.
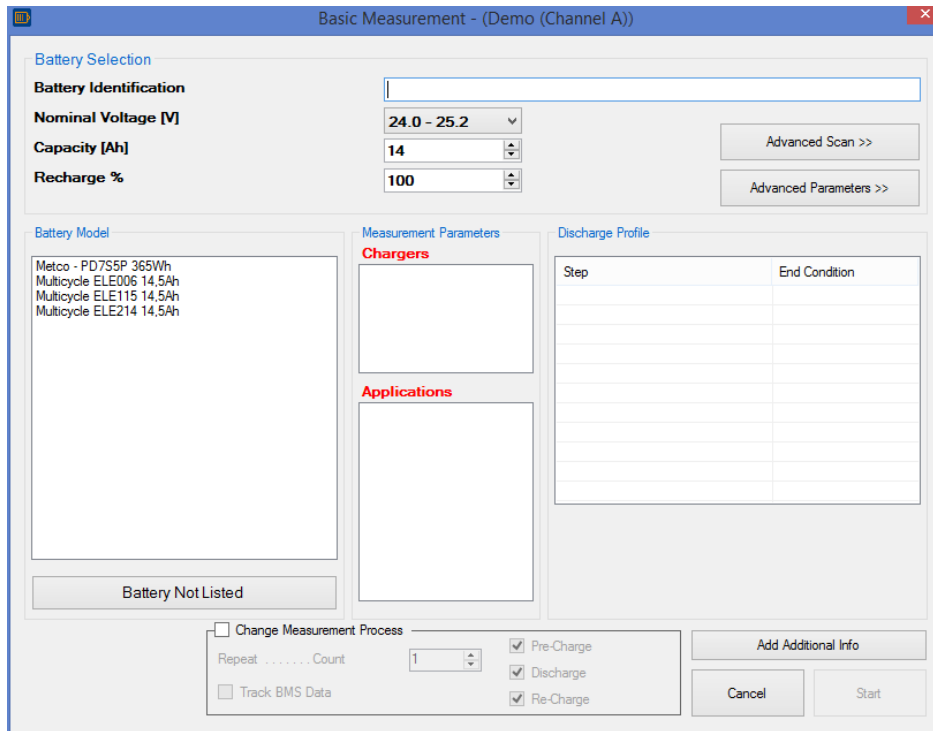
5. Press "Start".

Now the measurement will start with a (pre-)charge phase, followed by a discharge phase in which the capacity is measured. After that, a post-charge phase will re-charge the battery for shipment to the customer.

The measurement report is generated and printed automatically (you may change this in the settings).
You may locate the measurement reports through: "File" | "Explore ..." | "Reports".

3.8 The measurement results

A measurement produces several output files:

- The measurement data file (BctData file).

- The printable report (PDF file).

- The cycle result(s) of the same battery (CSV file).

3.9 Push button use and LED status indication

The BAxxx has a LED and push button for each battery channel. When a battery is connected, and the push button is pressed, the software will perform a "Start" on that channel.
This makes it easy to start the correct channel, after connecting a battery.

The LED status is given in the table below:

Indication	Status
Off	No battery connected/detected
Orange	Battery is connected, but to test in progress
Green	Test is completed
Red (slow flash)	Test in progress (Re-charging, Charging or discharging)
Orange (slow flash)	Test in progress (but waiting for discharger)
Red (fast flash)	Self-test error

4 Customization

The system defaults are set in the preference dialog (Options | Preferences).
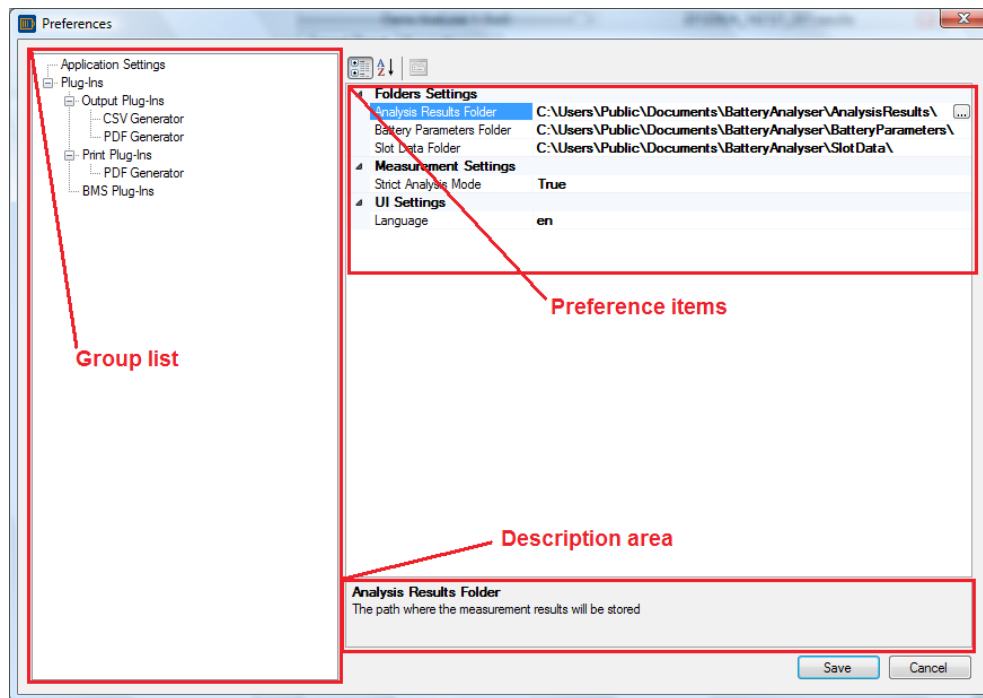
There are several different groups (in the "Group list area") of items (in the "Preference items area") that may be customized. In general, a description of the item is given in the "Description area".

4.1 Selecting a different language

The Battery Condition Test V3 software is shipped with a different user interface languages. To change the language, go to Options | Preferences.

Under "UI Settings", the language may be selected from the list.

> Note that newer versions of the software may provide extra languages.

4.2 Data storage locations

The program stores it's data on several locations, depending on the type. The application can be configured to allow easy backup plans by the IT department.

Use the Preference dialog (Option | Preferences) in the "Group list": Application settings.

- Battery profiles
  The Battery profiles are XML files, one file per profile.
  The location is set in the Preference dialog: Application Settings: Battery Profile Folder.

- Test results
  The test results are directories per Battery serial number. If no serial number is used, they are placed in the "Unknown" directory.

The location is set in the Preference dialog: Application Settings: Analysis Result Folder.

4.3 Logo on Report

The PDF reports may be customized with a private header and/or background. This is done by creating a JPG background that has the size of the paper (A4).
The current files may be used as an example and are located in the Analysis Result Folder ("C:\Users\Public\Documents\BatteryAnalyser").

4.4 Backup synchronization

In Options | Preferences | Backup modules | File copier, the synchronization to other storage can be configured. Upto 5 locations may be specified. When a location is not available, synchronisation is postponed until the location is available again.

This is usefull for storage systems like: (in random order)

DropBox
(www.dropbox.com)

HiDrive
(www.free-hidrive.com)

Cubby
(www.cubby.com)

Google Drive
(http://drive.google.com)

SpierOadk
(www.spideroak.com)

JustCloud
(http://www.justcloud.com)

OneDrive
(http://onedrive.live.com)

TransIP

https://www.transip.nl/stack/

There may be other services that also provide online storage as a drive on your computer.

Please check for the amount of storage, encryption (pivacy), prices.

Note that the average storage requirement for a single charge-discharge-recharge cycle is about 1 Mbyte. A typical storage requirement for intensive use (2 batteries per day) is 1MB * 2 batteries * 260 days = 520 MByte.

5 Battery Testing Explained

When using batteries for e-bikes and scooters, the user has to deal with rechargeable batteries. The condition (health) and charge level are often hard to see from the outside.

When the time of use is less than can be expected, an independant measurement is required.

5.1 Normal use

The definition of normal use may be different for different applications. For an e-bike, this can be that a person of 70kg can ride 15 km/h on a horizontal road.

But in practice, not all reads are horizontal, and acceleration from 0 to 15km/h puts a serious load on the battery. And then, wind can be a factor.
In the end, many factors influence the energy consumption of the motor.

Because of these variations, the use-time of a battery may easily vary by a factor of 2.

5.2 Battery properties

5.2.1 Voltage

The voltage on the battery terminals depends on the battery type and charge level. Below is a table with cell voltages for cells that are almost empty, 50% and 100% charged.

	Volt		
Type	1%	50%	100%
Lead acid	1.95	2.1	2.4
NiCad	0.95	1.2	1.4
NiMH	0.95	1.2	1.45
Lithium	3.2	3.7	4.2

The actual voltage also depend on the temperature.

With most cell types, the cell voltage drops when the level decreases. This is partly caused by an increase in internal resistance.

Because of the load current, the output voltage decreases with V = I * R (Ohm's law).

Example: If we discharge with 6A (I) and the internal resistance (R) of a cell changes from 0.01 Ω in fully charged condition to 0.1 Ω in empty condition, the voltage drop is – (0.01 * 6 – 0.1 * 6) = - (0.06 – 0.6) Volt, is 0.54V.

$$V = I * R$$
$$Full: V = 0.01[Ohm] * 6[A] = 0.06[V]$$
$$Empty: V = 0.1[Ohm] * 6[A] = 0.6[V]$$

Apart from the voltage drop due to the internal resistance, the voltage is also lower when the charge level is lower.

A proper tester, always gives a curve of the voltage without load, and the curve with load.

5.2.2 Capacity in Ah

The capacity of a battery is expressed as:

The time a battery can source 1 Amp,

or

The current that a battery can source during 1 hour.

In technical terms, this is written as: The Capacity (C) is the number of Amp's (A) per hour (h): Example: C = 10 Ah (pronounce: Amphour).

With smaller batteries, this is often expressed in mili-Amp-hour. The number of mili-Amp's per hour: 1 Ah = 1000 mAh.

$$C = I * T \quad [Ah]$$
I = current in Amp
T = time in hours

5.2.3 Battery packs

Batteries are often used as a pack of cells, in series connected groups of cells, called a "Battery Pack". So a pack is at least built of 2 or more cells.

The terminal voltage is the sum of the series connected cell voltages. Since the current flows through all series connected cells, the maximum current of a pack is equal to the maximum current of a cell (or group).

The capacity in Ah also equals that of 1 cell (group). But, since the voltage is higher, the energy of the pack is also higher.

A 24V LiPo pack is often built from 7 cells (7 x 3.6 = 25.2 V).

Due to the difference in cell voltage of a full and empty cell, pack voltages can vary over quite a range:

Lithium		Volt	
Volt	Series Cells	Minimum	Maximum
12V	4	12.8	16.8
24V	7	22.4	29.4
36V	10	32	42

5.2.4 Battery Management System

Since Lithium packs can supply a high power, they are potentially dangerous when short circuited or overloaded. Fire or an explosion can be the result.

For this reason, Lithium packs are always equipped with a short circuit protection. Often, this circuit also provide protection against over-load, over charging and under dis-charging.

A proper battery management system also takes care of equalization of the cell voltages, without overcharging any cells. If this is not done properly, the weakest cell will never be fully charged, and its charge-level will decrease every charge cycle. This continues until the use notices that the pack performance has decreased too much.

The entire pack will behave as if it is only half-full, and will not provide the ful Ah.

There are battery management systems that have a communication interface. This allows the readout of battery parameters and status by the bicycle. There are several interfaces with even more protocols. Most popular are:

- Smbus (System Management bus) that resembles I2C, using the Smart Battery Systems (SBS) protocol.
- CAN-bus using a proprietary protocol

5.3 Battery problems

Every type of battery carries it's own type of problems. Below are the most important ones:

	Lead-acid	NiCad	NiMH	Lithium
De-hydration	Yes	No	No	No
Memory effect	No	Yes	No	No
Overcharging	De-hydration	**Damage**	**Damage**	**Damage**
Deep discharging		Avoid	Avoid	**Damage**
Charge cycles	200~500	100~200	200~400	400~1000
Capacity	Gem.	Gem.	Gem.	Hoog

In practical situations, there are a number of possibilities to damage a Lithium pack of an e-bike:

- Deep-discharge when the pack is not charge before winter storage.
- Freezing temperatures.

In all of these damaging situations, the measured Amp-hours will be much lower.

6 Trouble Shooting

6.1 Possible problems

6.1.1 I do not know how to start the Analysis program
The program is found under Windows "Start", "Battery Condition Test", "Battery analyzer V3".

6.1.2 The "Device List" does not show.
The list can be shown and hidden with the button "Device list" in the top left.

6.1.3 My BAxxx does not show in the "List of analyzers" area.
I have a BAxxx connected to my computer, but it does not show in the "List of analyzers" area.
Possible problems:
- A faulty USB cable; Try another cable.
- Defective USB port; Try another port.
- Make sure that the HUB power adapter is plugged.

6.1.4 The BAxxx shows in the list but in RED.
Make sure that the HUB power adapter is plugged.

6.1.5 I do not have a bar code read. Can I still use the bar code?
Yes you can. Just use the "Quick start methode" (section 3.7) or type the barcode of the battery in the "Battery Serial Nr" field and the code of the charger in the "Charger Serial Nr" field.

6.1.6 My battery is not supported in the list of profiles
No problem, just use the "Quick start methode" (section 3.7) and enter the battery and charger parameters.

6.1.7 After Start, the test stops immediately
When the test starts, some checking is done to prevent a faulty measurement or to avoid dangerous conditions. If so, an error will be displayed in the Tab-page "Report Messages".
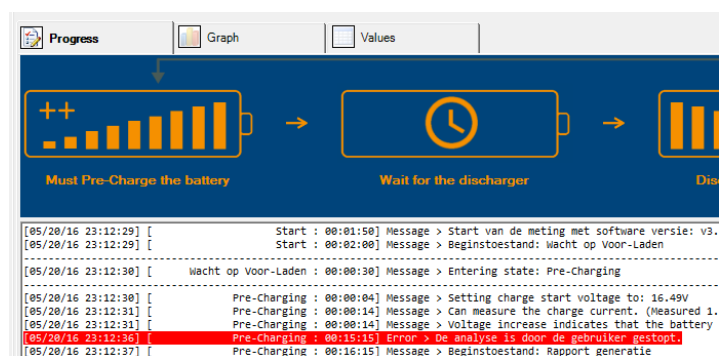
6.1.8   The software tells me there is a newer version. Do I need to update?

The newer software will probably offer new features or solve some problems. So updating is advised. If you have a production environment where you test lots of batteries each day, first test the new release on a different computer. If some problems arise, you will have time to solve them, before putting it in 'production'.

6.1.9   The software wants to update the BAxxx. What does that mean?

Internally, the BAxxx also has a program. That works closely together with the PC program (*Battery Analyzer software V3*). Sometimes, improvements are made that require the BAxxx internal program (firmware) to be updated. This process is automatic.

6.1.10   I have unplugged the USB connector of the BAxxx during the update process. Now it does not work.

When the update process is not completed, the BAxxx may stop working properly. The update process needs to be restarted manually. This is done with the following procedure:
1. Disconnect the USB cable of the BAxxx.
2. Start the *Battery Analyzer software V3*.
3. Press both buttons on the BAxxx front and keep them both pressed.
4. Re-connect the USB cable of the BAxxx.

Now the *Battery Analyzer software V3* program will recognize the BAxxx for update and start the process. You can now release the buttons.

6.2   Useful Tips

- When a customer wants to trade-in his old e-bike, always do a Usability Test. The independent test report will convince the customer that your trade-in offer is reasonable.

- Keep your batteries in stock at 50% and provide a test report when you offer & deliver the e-bike (battery) to the customer.

6.3   Instruction videos and Help Desk

The web site www.batteryconditiontest.com provides instruction videos and a forum with FAQ and support questions.

7 General

7.1 Product warranty

Thank you for purchasing a BAxxx Product.

Battery Condition Test warrants the Battery Analyzer to be free from defects in material and workmanship for a period of 2 years from date of initial retail purchase. We will, at our option, repair or replace the defective product. The limited warranty does not cover any losses or damage that occur as a result of:
  • Improper installation
  • Misuse or negligence or operation with faulty equipment.
  • Repair or modification by anyone other than Battery Condition Test or an authorized repair agent.

Name :   …………………………………..

Address :   …………………………………..

City   :   …………………………………..

Country :   …………………………………..

E-mail :   …………………………………..

Product name :   …………………………………..

Purchasing date :   …………/…………/........………… (mm/dd/yyyy)

Serial Number :   ……………………………………………………
                         You can find it on the bottom of the unit.

Reseller name: ……………………………………………………

Place of purchase: ……………………………………………………

If you require a repair service, you must present the warranty card and invoice.
Therefore, please keep copies of these safely.

7.2 Disclaimer

All product specifications and data are subject to change without notice.

Battery Condition Test, its affiliates, agents, and employees, and all persons acting on its or their behalf, disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Battery Condition Test disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Battery Condition Test's terms and conditions of purchase, including but not limited to the warranty

expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Battery Condition Test.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Battery Condition Test products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Battery Condition Test for any damages arising or resulting from such use or sale. Please contact authorized Battery Condition Test personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.

Battery Condition Test BV

Angstelkade 2A-1.11b

3631NA Nieuwersluis

8 Specifications BA610/760/910 series

Item	Limit			Unit
Number of channels (Battery + Charger)	2			
Absolute maximum input voltage	86			V_{DC}
Minimum input voltage @ 8A at rate Power supply voltage (230/115)	5			V_{DC}
Voltage Measurement range	0 ~ 56			V_{DC}
Voltage measurement accuracy	< ±1% of Reading, ± 0.1V			
Voltage measurement resolution	0.1			V
Voltage measurement technology	4-wire; True RMS			
Testing Power	*Cont*	*Peak 10s*	*Peak 3s*	
Maximum allowable continuous discharge power (BA 610)	300	500	600	W
Maximum allowable continuous discharge power (BA 760)	400	625	750	W
Maximum allowable continuous discharge power (BA 900)	500	750	900	W
Maximum allowable continuous discharge current **	16			A
Maximum allowable peak discharge current **	24			A
Current measurement range	From 0.5 ~ 40			A
Current measurement accuracy	< ± 2.0% of Reading, ± 0.02A			
Current measurement resolution	0.01			A
Current measurement technology	True RMS			
Capacity measurement range	0 ~ 500000			Ah
Capacity measurement resolution	~ 0.01			Ah
Capacity measurement accuracy	< 2.5			%
Impedance measurement technology	Cont. AC at 50			Hz
Power supply	100 ~ 250			V_{AC}
Fuse (Slow acting type) (5 x 20 mm)	4			A
Max Mains Power	1000			W
Operating ambient temperature	0 ~ 40 / (32 ~ 104)			°C / (°F)
BMS communication mode (battery dependent)	HDQ and SMBus/I2C (extra convertors optional)			
USB connection	USB 2.0			
USB Power requirement (max 8 devices on 1 port)	50			mA
IP rating P 20	IP 20			
Size (w x d x h)	230 x 225 x 175 (9 x 8.9 x 6.9)			mm / (inch)
Weight	4.0 / (8.8)			Kg / (lbs)

** Depending on peak time.