

Where's the Power Switch?

The UBA4 & UBA5 Let's Get Started Guide

The UBA (Ultimate Battery Analyzer) is a battery analyzer, charger, discharger and reconditioner. It can also be used as a data logger, logging temperature or as an electronic load.

The first three chapters in this guide explain how to setup the UBA, and take you step by step through a complete battery analysis. Once you've done your first battery analysis, you can read the rest of this guide and use the online help feature that comes with the UBA Software to learn more. We recommend that you read the first three chapters before you run your first battery analysis.

Notes:

- The latest version of software and online help is available in the Support section on our web site. To get there, run UBA Console and click on **Get Latest News from Vencon Technologies Inc** on the **Help** menu
- If you need help using the software or testing batteries, don't hesitate to call or email us. You can also email us your battery analysis results for assistance in their interpretation.

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Disclaimer: the UBA S/W has been undergoing upgrading and the addition of new features these past couple of years. Because of this, this manual might be different then the S/W version that you have. We're confident that you'll figure things out despite the confusion (if not, just ask us or press F1 for online help).

Batteries are electro-chemical devices that have the potential to burn, explode, or emit harmful chemicals. Please read these safety warnings:

Safety Warnings:

- Observe battery temperature. Allow cold batteries to warm up and hot batteries to cool before charging. Stop the battery test if the battery becomes very hot.
- Do not attempt to charge non-rechargeable batteries such as alkaline, carbon-zinc, or non-rechargeable lithium batteries. Attempting to charge them may result in explosion.
- Do not short the positive and negative battery terminals together.
- Do not exceed the battery manufacturer's recommended charge current and voltage limits. Doing so may damage the battery and result in venting or explosion.
- Charge and discharge lithium batteries in a fire proof container.
- Double check the settings before starting a battery analysis.

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Regulatory Compliance

FCC Class B Information

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential or commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on. The user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

CE Compliance for Europe

This equipment has been verified to comply with

CISPR22/EN55022 - Class B - Limits and methods of measurements of radio disturbance characteristics of Information Technology Equipment and

EN50082-1 - Generic Immunity Standards, Residential, Commercial and Light Industry.

1. Setting Up The UBA

- Unpack the UBA shipping box and check that you've received the following:
- The UBA battery analyzer and charger.
- UBA Console CD, which contains the software for the UBA or web link.
- A two metre 9 pin male to female shielded serial cable to connect the UBA to the PC or to another UBA.
- Two sets of 18AWG test leads with alligator clips.
- A printed copy of this guide.
- A power supply (depending on the configuration purchased).
- A USB adapter (depending on the configuration purchased).

What you need to get started (in addition to the above):

- A power supply (if one didn't come with your UBA). See section below.
- A PC with a free serial port or USB port and a USB to serial adapter.

1.1. Connecting the UBA to a Power Supply

The UBA requires a power supply with a DC voltage from 15 to 24V (see section 5.2 *Choosing and Setting Up a Power Supply* for more information). Connect the power supply output cable to the back of the UBA and plug the power supply's AC cable into a wall outlet.

The UBA will do a self test first. If it passes the red LEDs on the front of the UBA will flash once, the fan will momentarily turn on and the power LED will turn on. If this doesn't happen check the voltage on the power cable. It should be at least 15V with the centre pin positive.

If you use your own power supply ensure that it has a 2.1mm DC barrel plug that mates with the power input on the back of the UBA. The UBA is reverse polarity protected. Also ensure that the power supply voltage is no more than 26V, otherwise you risk damaging the UBA.

1.2. Connecting the UBA to a Computer

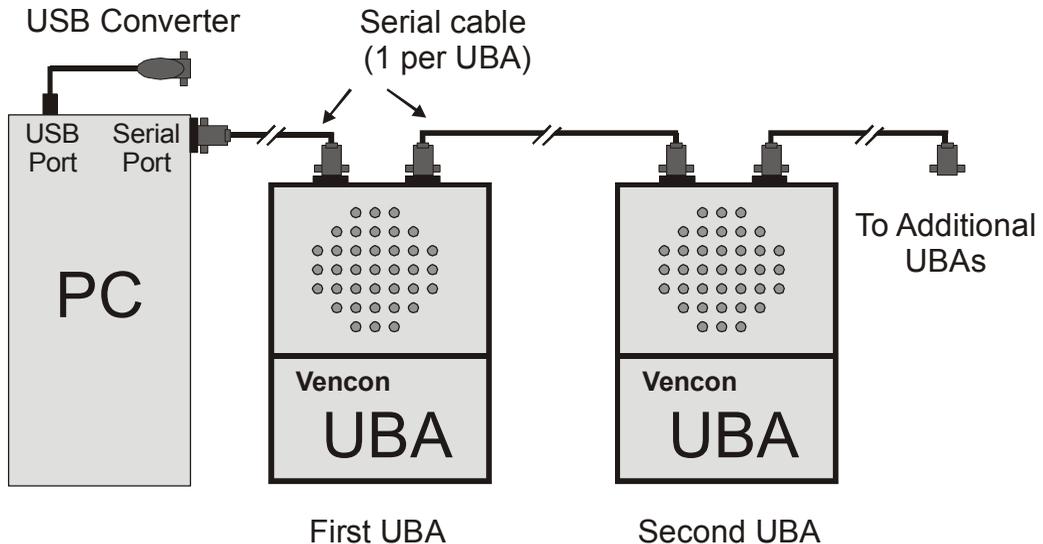


Figure 1: UBA serial port connections for one or more UBAs.

In this setup the first UBA can connect to the PC's serial port or the USB Adapter.

The UBA connects to any unused serial port the PC or to a USB to serial adapter (see below). Connect one end of the supplied serial cable to the DB9 connector on the UBA marked "RS232 from Computer or other UBA" and the other end to the PC serial port or USB converter.

1.3. Connecting more than one UBA to a computer

If you are using more than one UBA, connect the first one to the PC as explained above and the second UBA to the first UBA. No adapters or gender changers are required. Repeat this for any additional UBAs (the maximum is 100 UBAs per serial port, but performance and memory limits are reached at about 30 UBAs). Any new UBAs added to an initialized UBA network won't be recognized until the network is re-initialized.

UBA4s and UBA5s can be networked together.

1.4. Connecting to the UBA using a USB Port

The UBA comes with a high quality USB to serial port adapter so that you have the option of using a serial port or USB port on your PC. The driver for the USB adapter, which needs to be installed before you can use it, can be found on the UBA Console CD.

If you don't have the USB adapter that normally comes with the UBA then you can buy one at your local computer store. Unfortunately not all USB to serial port adapters are created equal. Some work well, some need a bit of tweaking in the UBA software, and some just don't work. If you just have one or two UBAs connected then most USB adapters will work (you still may have to tweak the settings in the UBA software – **Serial Port** tab in the **File** → **Options** settings, click the **Advanced** button). If you have more than two UBAs then you need a good serial port adapter (like the one that comes with the UBA).

If you're using a USB adapter it's important that you check for resent commands in the communication port display the first time you use it (accessible in the production setup by right clicking on the serial port). There shouldn't be any. If there are it means that there's a communication problem. Although the UBA is designed to detect and correct transmission errors, it's best if there aren't any.

This is an image from our burn-in station where UBAs are run for at least 12 hours. Twenty one million commands were sent without error, which is the way it should be.

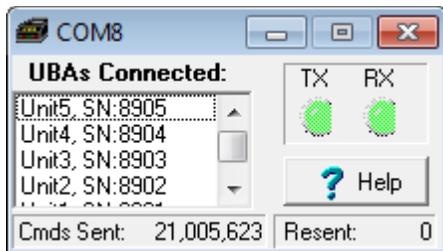


Figure 2: Communication port display showing UBAs connected and the number of commands sent and resent (commands are resent if there is a communication error).

It's been suggested to us that we convert the UBA to USB control. We haven't done that for the following reasons: the serial port connection is more robust than a USB connection (try momentarily unplugging and then reconnecting the serial cable to the UBA in the middle of a battery analysis – it will recover with no loss of data), the serial port can be daisy chained, and finally the UBA is designed to work now and in the future. Twenty year old UBAIII+s are running fine under 64bit Windows 10.

1.5. Extending the Serial Cable

You can extend the UBA's serial cable with a shielded extension cable. We have successfully run the UBA with a 30m (100ft) cable. Check for reset commands (see above for instructions).

1.6. Connecting to the UBA using WiFi or Ethernet

You can control your UBA (or UBAs) over your Ethernet or your WiFi network. We sell modules which allow you to do that. With these modules you don't need a serial port or USB adapter and you can locate your UBA5 a distance from your PC. See our website for purchase information or contact us.

1.7. Ventilation

The UBA can generate up to 90 Watts of heat during a high power battery discharge. Do not obstruct the air vents on the top or bottom. Be careful when touching the UBA during a high power discharge or charge, as it can get quite warm (the fan automatically turns on when the UBA gets too warm). Avoid running a high power discharge or charge when the UBA is in a hot environment (greater than 30 degrees Celsius).

It is normal for the UBA to get warm (some might call it hot) before the fan turns on. You can check that the fan is functioning by watching if it turns on when power is applied to the UBA or during network initialization. Additionally you can turn it on from the Multitester instrument.

There is an option for turning the fan on at lower power levels in the **Options...** menu (under **File**, click on **Options...** and select the **General** tab). The UBA has over temperature protection: if it gets too hot, it will reduce the load or charge current.

1.8. Battery Cables

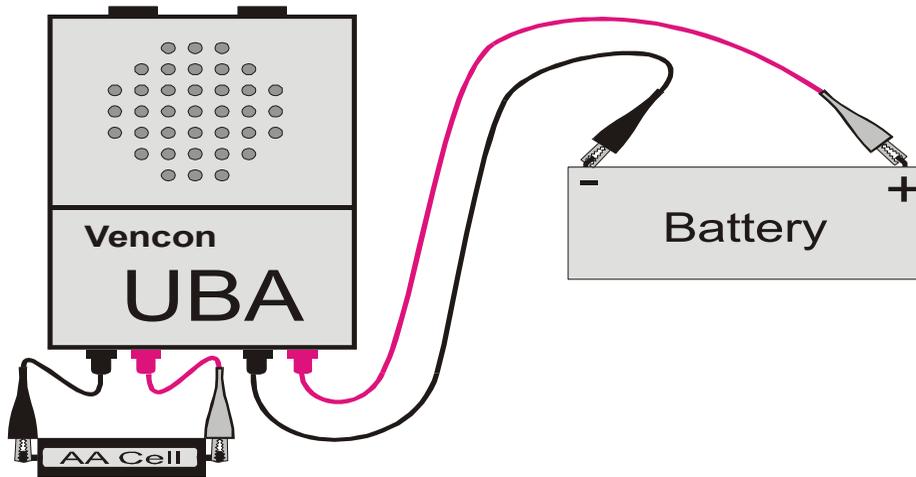


Figure 3: Connecting a battery to the UBA.

The UBA uses standard banana jacks for battery connections and comes with two sets of battery cables with alligator clips. We sell additional banana plugs or assembled cables. Plug the cables into the front of the UBA and connect the red clip to the positive terminal of the battery being tested and the black clip to the negative terminal.

NOTE: The UBA battery inputs are polarity protected so you won't damage your UBA or battery if you reverse the positive and negative leads.

CAUTION: When the battery cables are connected to a battery but not plugged into the UBA, if the banana plugs exposed part touch each other it can result in a very high current potentially causing burns or the battery to gas or explode. In our lab we use small blocks of wood with two 11/64" (4.3mm) holes drilled in them to keep the banana plugs safely apart.

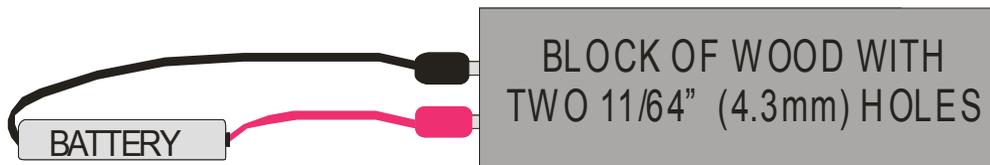


Figure 4: Using a block of wood or plastic to keep battery banana plugs from shorting.

2. UBA Console Installation Instructions

The software that runs on the PC and controls the UBA is called UBA Console. Install it on a PC running Microsoft Windows (from Win95 to Windows 10, 32 & 64 bit) or Linux (we have an application note on our website explaining how to run UBA Console under Wine).

2.1. Installing UBA Console

The latest version of UBA Console can be found on our website (in the Support section) – download it from there and run it, or if your UBA5 came with a CD, you can use that.

You are given a choice to install UBA Console for "Anyone who uses this computer (all users)" or just for you. The "all users" installation requires administrator privilege. Once installed, any other user on that computer can use UBA Console. Settings and results are shared across all users so that in a production environment all users will be using the same settings and can see any test results from any other user.

If you install for single user then administration privilege isn't required. More than one person on a PC can install for a single user. This way their settings and results are kept separate. You can even install UBA Console for a single user on a PC that already has UBA Console installed for all users (and visa versa).

If you change your mind, UBA Console has an uninstall feature that removes the S/W and optionally, all results.

Files Location:

Only for me (single user) Installation:

The UBA Console executable is installed in:

C:\Users\Users_Name\AppData\Local\Vencon

The user files are stored in either your **My Documents** or **AppData** folders (your choice):

C:\Users\Users_Name\Documents\VenconUBA

or

C:\Users\Users_Name\AppData\Local\VenconUBA

Settings are stored in your copy of the Windows Registry (HKEY_CURRENT_USER).

Anyone who uses this computer (all users):

This option installs the UBA Console executable to:

C:\Program Files (x86)\Vencon

The user files are stored in either **ProgramData** or **Public\Documents** folders (your choice):

C:\ProgramData\VenconUBA

or

C:\Users\Public\Documents\VenconUBA

Shared settings are stored in the PC's Windows Registry (HKEY_LOCAL_MACHINE), and your personal settings (for example, last location of a window) in your copy of the Windows Registry (HKEY_CURRENT_USER).

The following four user folders are created in the **VenconUBA** data folder:

The **Database&Cal** folder stores the database, calibration, setup and sound files. Each UBA requires a calibration file which is in the form SN.cal, where SN is the serial number of the UBA.

The **BARs** folder stores the Battery Analysis Routines (.bar). Each BAR file specifies the algorithm to use for a battery analysis.

The **Analysis Results** folder stores the analysis results. These are the .uba files which contain the data points and results of each battery analysis.

The **Reports and Logs file** folder stores any Log files.

You can change the location of the data folders in the UBA Console's **Options** page **Folders** tab.

2.2. Starting UBA Console

Start UBA Console from the Windows Start menu.

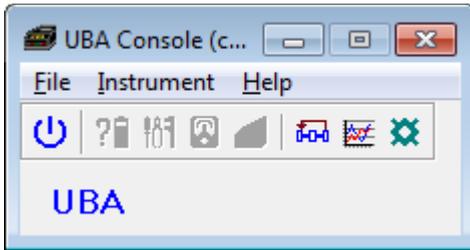


Figure 5: UBA Console Classic Setup.
UBA Network not yet initialized.

If you don't get this, see **Appendix A – Troubleshooting** or the section below.

Don't be surprised if your version of UBA Console appears slightly different from this image as we're constantly upgrading the software.

2.3. Production Setup

UBA Console has two ways to organize the various windows: the *Production* setup and the *Classic* setup. The *Production* setup is designed to make it easier to run UBA Console especially in a production environment where limited operator control is desired. Both setups have optional password protection but the *Production* setup has customized buttons. In the figure below, the customized buttons that come with UBA Console are: *Start Battery Analysis*, *Start a Multitester*, *VI*, and *DVM*. You can change their names, their functions, delete them or add your own. You can set them up so that a specific battery analysis is run with just one click.

You can select it or the *Classic* setup by clicking the appropriate button in the options settings, under the **General** tab. We'll be using the *Classic* setup in this guide.

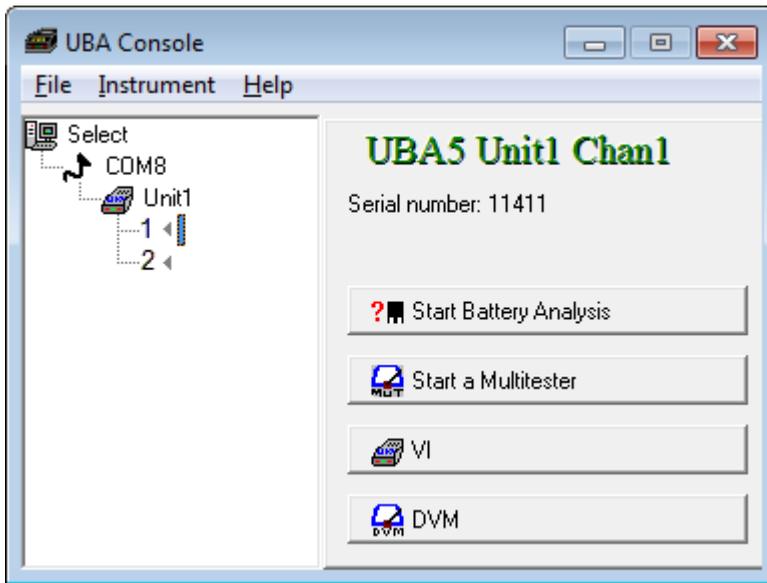


Figure 6: Production Setup of an initialized UBA ready to start a battery analysis, Multitester, virtual Instrument or DVM on channel 1.

2.4. Initializing the UBAs

UBA Console is now running, but hasn't yet established communication with the UBA. For this to happen, you have to initialize the UBA Network. But first you have to specify which serial port(s) to use on the **Serial Port** tab in the **Options** dialog box (**File** menu). Only free serial ports are displayed, and you can select more than one – each one selected will be checked for the presence of a UBA every time you initialize the UBA network.

You initialize the UBA Network by clicking on the first icon on the main menu (the “on/off” switch) or from *File* then *Open/Close UBA Network*.

UBA Console will try to connect to the UBA using the serial ports that you have selected.

2.5. Locating and Installing the UBA Calibration File(s)

Every UBA requires a calibration file which is where its calibration parameters are stored along with any accessories that it uses. The calibration file is supplied on the installation CD that came with your UBA. When you install UBA Console from the CD, your UBA's calibration files is copied to your computer. Otherwise you'll be prompted for it the first time the S/W is run.

Every time UBA Console initializes a UBA Network, it reads the calibration file for each UBA that it detects. If it can't locate the calibration file in the *Database&Cal* folder, it will put up a **Calibration file not found** dialog box. After the calibration file is found, it will be copied to the *Database&Cal* folder so you won't be asked again.

Don't lose the UBA's calibration file: if you do, don't panic; we keep a copy.

If you've made it so far you should see this:

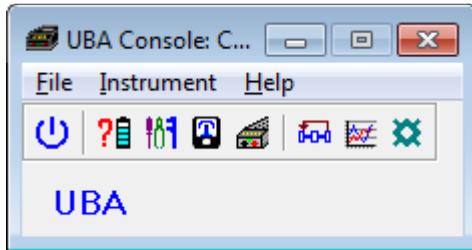


Figure 7: UBA Console with the UBA network initialized and instrument icons enabled.

UBA Console has now established communication with the UBA(s) and all the icons are enabled.

3. Is My Battery any Good? Running a Battery Analysis

In this chapter, we are going for a quick tour of the UBA's operation and how to run a battery analysis. First, start up UBA Console and initialize the UBA Network.

3.1. The Multitester

Before starting a battery analysis, let's do some exploring. Click on the third icon, which starts the Multitester. This is a great place to start, as it allows you to check the battery's voltage and the operation of the UBA.

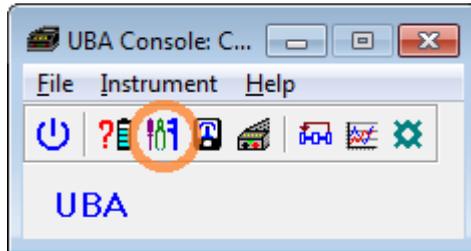


Figure 8:
UBA Console ready to start an instrument. Click on the circled icon to start the Multitester.

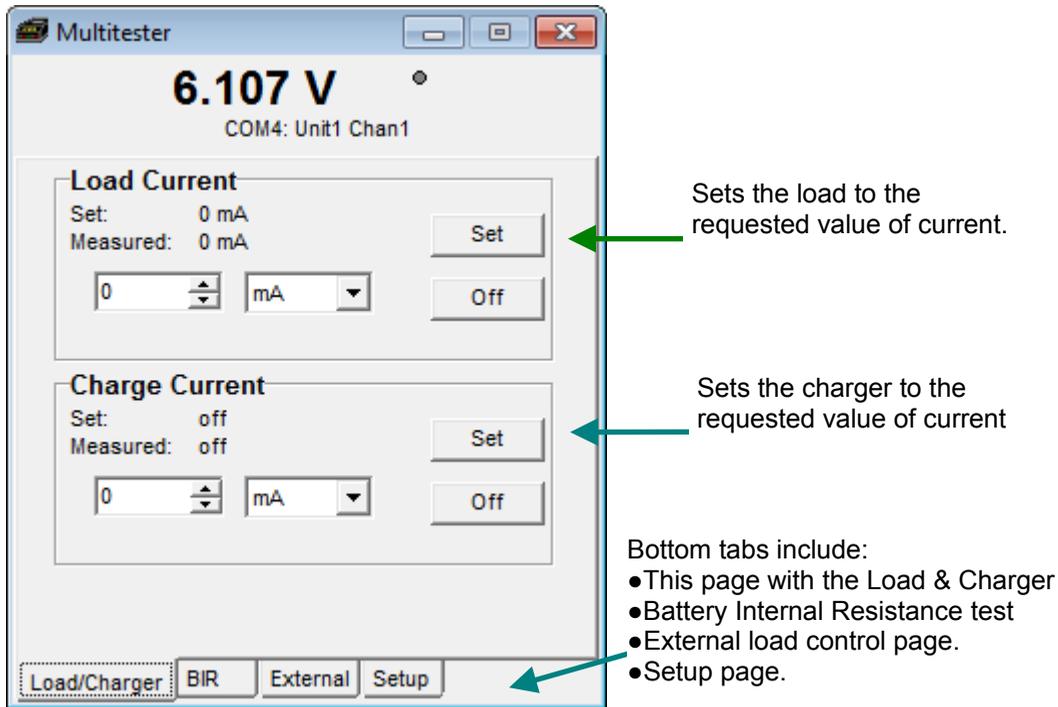


Figure 9: Multitester Instrument.

Use it to monitor the battery voltage while applying a load or charge current.

If the Multitester says 0V (zero volts) with a battery connected, check the battery. It should be connected to the appropriate channel (channel one in this example) with the correct polarity.

For this test don't use a battery pack that has any protective circuitry that might interfere with the testing. You can test those batteries once you are comfortable using the UBA.

Enter a small test current (100mA for example) into the Load Current or Charge Current input boxes and click the corresponding **Set** button. The battery voltage should rise a bit if you set a charge current or drop a bit if you set a load current. This verifies that the UBA charger and load are functioning and that you have a good connection to the battery.

Besides applying a load or charge current, the Multitester can also measure the battery's internal resistance or, if installed, read the UBA temperature probes.

Warning: The Multitester does not check the suitability of the charge or load current that you are using. Unless you know the condition of your battery, you should limit the charge and load current to just a few seconds so you don't damage it.

Close the Multitester window so that you can start a battery analyzer on that channel as it is not possible to run two instruments on the same channel simultaneously

3.2. Setting up the Battery Analysis

Setup for a battery analysis by clicking on the battery analyzer icon on the tool bar

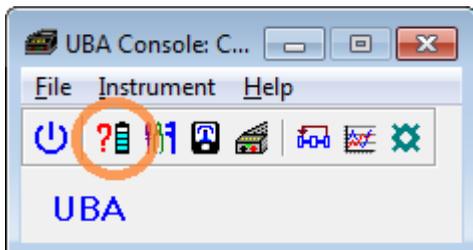
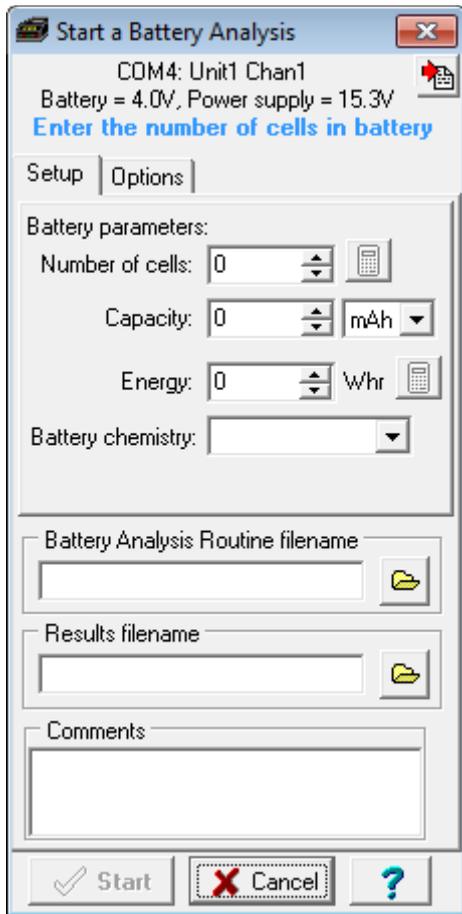


Figure 10: UBA Console ready to start an instrument. Click on the circled icon to start the battery analysis.

This opens up the **Start a Battery Analysis** dialog box:



Battery Parameters

Choose an existing BAR file.

Specify a filename to store the results.

Figure 11: Setup for a Battery Analysis by entering the required parameters.

There are three sections that need to be filled in before you can start the analysis.

Battery Parameters: Number of Cells and Capacity

Enter the number of cells (in series) and rated capacity of the battery. Battery packs should have the rated capacity and nominal voltage printed on the pack. You can calculate the number of cells by dividing the nominal pack voltage by the following nominal cell voltages:

Nominal single cell voltage used in battery pack ratings:

Battery Chemistry	Nominal Cell Voltage (Volts per cell)
Li-ion / Li-polymer	3.7 V
NiCd / NiMH	1.2 V
Lead Acid	2 V

Common battery packs:

Battery Chemistry	Rated Battery Pack Voltage	Number of Cells
Li-ion / Li-polymer	3.7 V	1 cell
	7.4 V	2 cells
	11.1 V	3 cells
NiCd / NiMH	4.8 V	4 cells
	7.2 V	6 cells
	9.6 V	8 cells
	12 V	10 cells
Lead Acid	6 V	3 cells
	12 V	6 cells

Sometimes the battery pack manufacturer prints a nominal voltage that is slightly higher than the standard value, in this case round down the number of cells to a whole number.

In general, NiCd, NiMH, lead acid and gel cell battery packs have their cells in series.

Therefore, the number of cells that you enter is the number of cells in the battery pack and the capacity is the capacity of each cell, not their sum (i.e. the capacity of the battery pack is the same as the capacity of a single cell). For example, the following pack, which consists of three 1Ah cells, has a rated capacity of 1Ah and a cell count of three.



Figure 12: Example battery pack. Pack capacity: 1Ah, cell count: 3.

Lithium-ion packs can have cells in parallel and series. The number of cells that you enter is the number of cells in series and the capacity is the rated capacity of the pack (sum of the capacity of parallel cells). For example, the following pack, which consists of six 1Ah cells, has a capacity of 2Ah and a cell count of three.

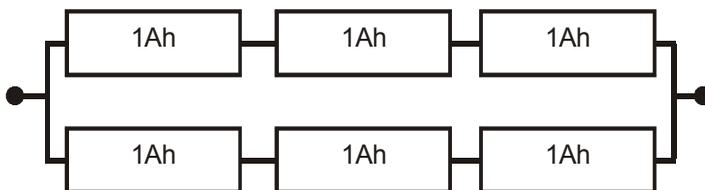


Figure 13: Example battery pack. Pack capacity: 2Ah, cell count 3.

Short cut: If you've specified a battery chemistry, then the calculator button (to the right of the Number of cells entry field) can be clicked to calculate the number of cells in your pack based on the measured battery voltage. It's up to you to accept or reject the suggested value.

Note, you have to enter a battery capacity, even if it's not required for the BAR that you'll be using. For example, if you are using the Datalog BAR you can enter any value for the capacity – 1mAh works fine.

Battery Parameters: Energy (optional)

Enter the rated energy in Watt-hours of the battery. Normally only used for lithium ion batteries. This value is used to calculate the percentage of rated energy that the battery provides during a battery discharge test.

If you know the battery's energy but not its capacity, then the calculator button beside the Energy field can be used to calculate the capacity from the energy field. For this to work, the battery chemistry must be selected.

Battery Parameters: Battery chemistry (optional)

Choose the type of battery, i.e. NiCd, li-ion, SLA, etc. This is used to check that the battery voltage matches the voltage expected for the specified chemistry and number of cells. If left blank, and the battery parameter field in the BAR (Battery Analysis Routine) is also blank, the battery voltage isn't checked against the number of cells.

Battery Analysis Routine filename

The BAR contains a sequence of actions that describes the battery analysis to be performed. UBA Console includes BARs that you can use right away. Click on the folder icon beside the BAR filename to display them. Select the BAR you want to use and click **Open**.

In **Chapter 4 Creating a Battery Analysis Routine** we'll show you how to create your own BARs.

Hint: Double clicking on the BAR filename will open that BAR in the BAR designer.

Analysis Results Filename

In the **Analysis Results Filename** edit field, enter a filename to store the analysis results. We suggest that you use a filename that contains information describing the battery that you're testing. For example, use the job number, warranty return number or battery serial number.

Hint: hold your mouse cursor over the text box for some advanced filename options. Further information can be found in the on-line help.

Comments (optional)

Enter any comments that you would like stored in the battery analysis results file. You can edit the comment text in the results file after the analysis using a text editor.

3.3. Starting the Battery Analysis

Once you've entered in all the parameters, start the battery analysis by clicking on the **Start** button. If the **Start** button is grayed out then some information is missing or the channel is being calibrated. The reason will be displayed near the top.

Example: Testing a Lithium Ion Cell and a NiCd Battery

For this example we'll show the versatility of the UBA by starting a single 1.3Ah lithium ion battery on channel 1 and a 4 cell NiCd 600mA battery on channel 2.

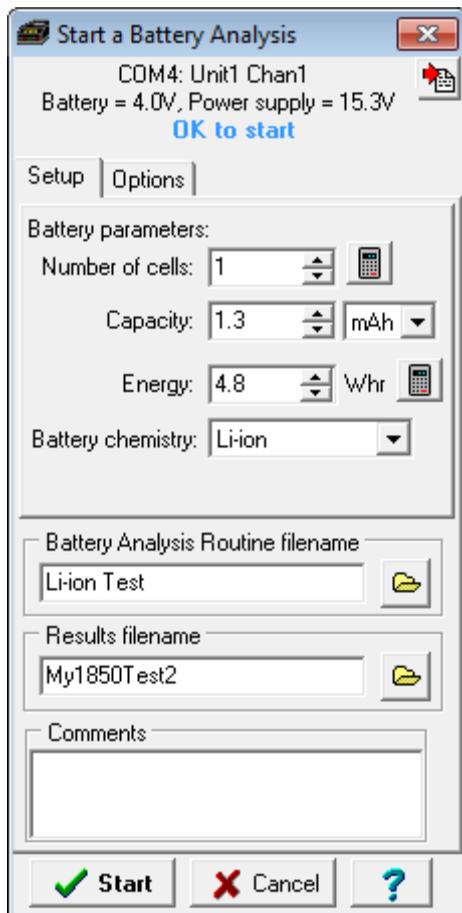


Figure 14: Starting a Li-ion battery analysis on a single 1850 cell.

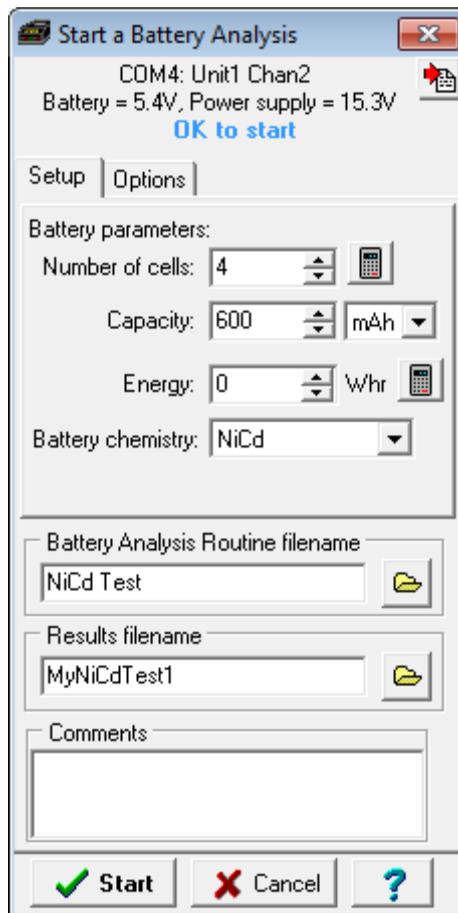


Figure 15: Starting a NiCd battery analysis on a 4 cell pack.

The first action in both BARs is to measure the no-load voltage of each battery (i.e. OCV), and allows you to cancel the test if you change your mind before the load turns on). After that both analyses start the discharge action as shown below:

You might have to right click on the battery analyzer window and select **Show More**.

Hint: In the UBA Console File | Options page, Battery Analysis tab, you can choose to have the battery analysis always start showing more.

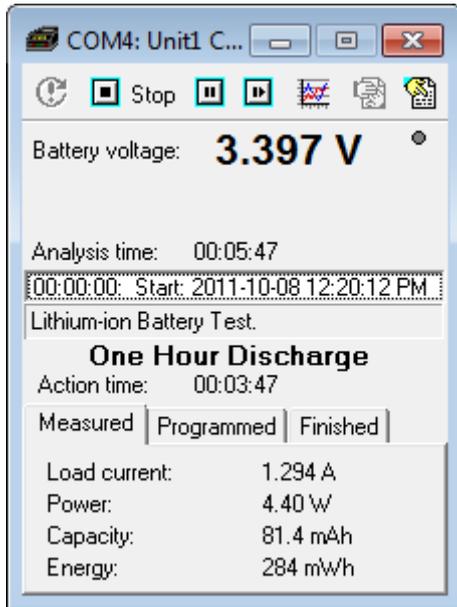


Figure 16: Li-ion battery in discharge.

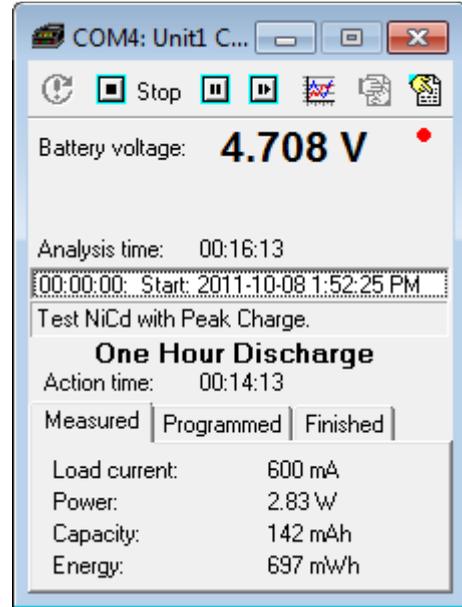


Figure 17: NiCd pack in discharge.

The buttons on the tool bar offer the following options (from left to right):

1. Restart the battery analysis (grayed out while battery analysis is running).
2. Stop the battery analysis.
3. Pause the battery analysis at the end of the current action.
4. Skip to the next step in the battery analysis.
5. Show the results graph.
6. Dock this window (if in production setup).
7. Show the starting parameters and some running ones.

3.4. Monitoring the Battery Analysis

The discharge action continues until the battery voltage reaches the cut-off value (the voltage where the battery is considered fully discharged). At this point the load is shut off and the charging starts (after an optional recovery stage).

Click the **View Results** button on the tool bar to get a graphical view and summary of the progress so far.

3.5. Interpreting the Results – Is My Battery any Good?

When the analysis finishes, the results page is displayed. The pass criteria of the battery is specified in discharge action in the BAR. It can be a minimum capacity, energy or both. For our examples, the pass criteria is having the battery reach 80% of its rated capacity. Since the measured capacity of these two tests is 85% and 87% of the rated capacity, these batteries passed.

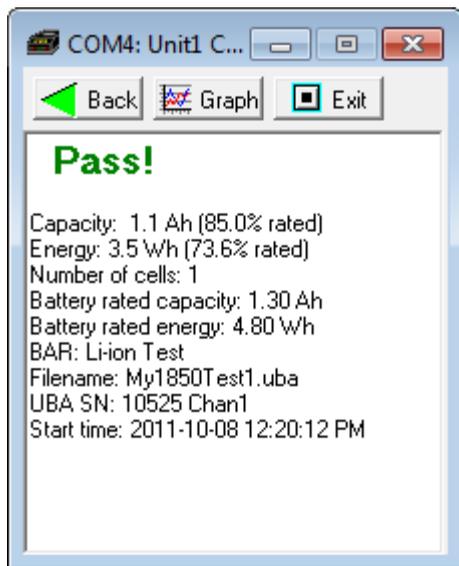


Figure 19: Li-ion analysis results.

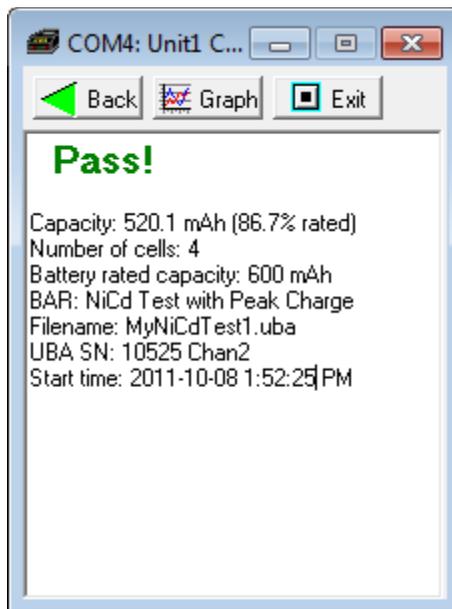


Figure 18: NiCd analysis results.

A used battery with a capacity of over 90% of its rated value is considered in good condition. One with between 80% and 90% of its rated capacity might be acceptable depending on the application; however, one below 70% to 80% should be replaced (these figures depend on the battery type and its intended application). For the discharge capacity to be used as an acceptance criteria, the battery must be fully charged before the test. The NiCd and NiMH BARs that come with UBA Console run two cycles: the first cycle discharges the battery then charges it back up so that the next cycle can give an accurate result. For SLA and lithium batteries either start the test with a fully charged battery or modify the BAR so that the discharge follows a charge or run the BAR twice.

The batteries that we used for these examples are old batteries that we use for testing. Even though the li-ion cell passed the capacity test, it only had 74% energy result – this is due to its age and thus higher internal resistance that adversely effects its measured energy more than its capacity.

The buttons on the top of the results page allow you to return to the analysis page, view the graph or exit from the analysis.

3.6. Viewing the Results Graph

The second best feature of the UBA S/W is the ability to view the results graph (the best feature is the powerful BAR programming). This is useful in that it allows you to check the analysis and assist you to understand what happened if a battery fails. You can view the graph during the analysis or afterward by clicking on the *Graph* button. Analysis results are stored on your computer's hard drive so you can always go back and view them. The results file is in text format so you can look at the data or load it into a spreadsheet.

3.6.1. Graph result from Li Ion Analysis

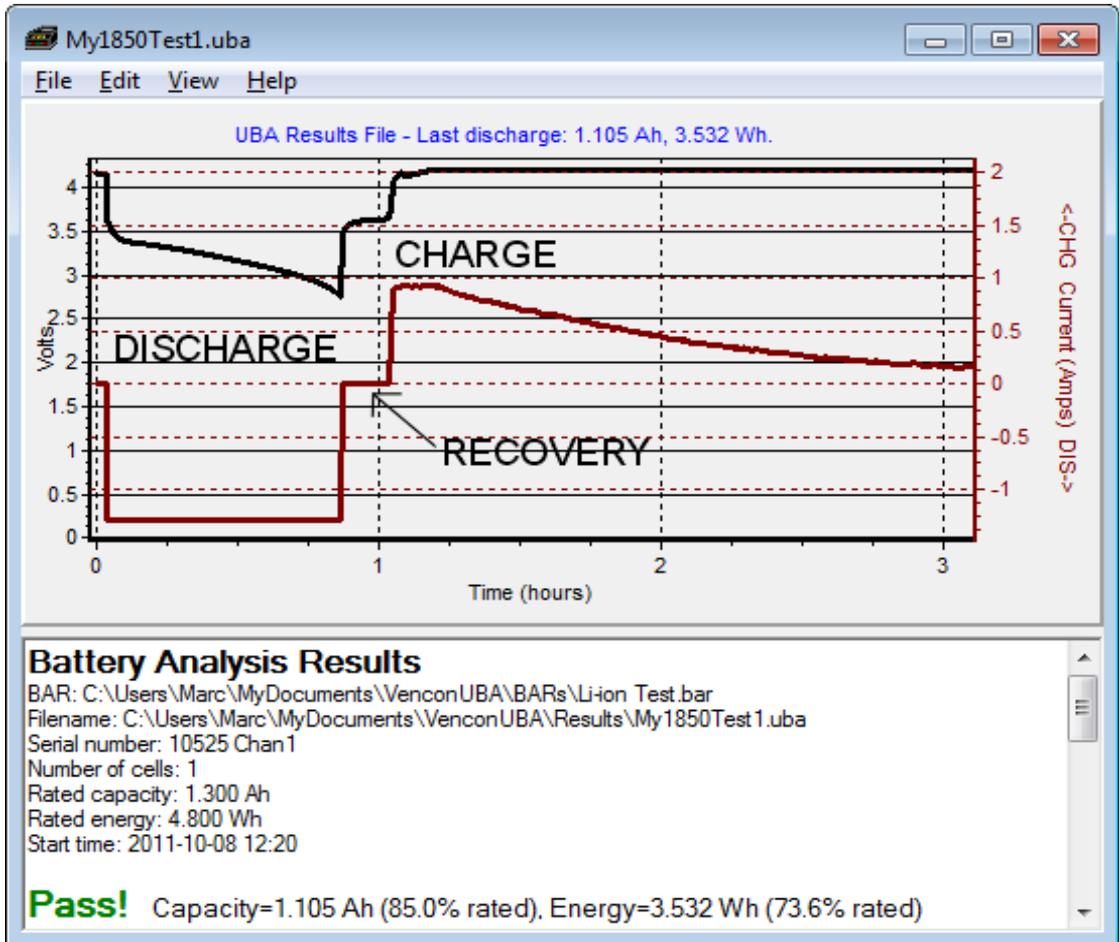


Figure 20: This graph shows the three phases of the analysis: the initial discharge, the recovery, and the 4.2V constant voltage charge. During the discharge, the current is held steady at 1C (1.3A for our 1.3Ah cell) while the voltage drops to 2.75V. For the charge phase the current ramps up to 0.7C (0.9A), stays there until the battery reaches 4.2V and then slowly drops down to almost zero.

3.6.2. Constant Voltage Charging Explained

In this graph, the constant voltage charging phase of our li-ion test is expanded. Constant voltage charging can be broken into three stages, the ramp-up, the constant current stage (CC) and the constant voltage (CV) stage.

During the one or two minute ramp-up stage the current is increased up to the specified value (0.9A in this example) or until the target voltage (4.2V in this example) is reached. If the battery doesn't reach the target voltage during the ramp-up (and it won't unless the battery was almost fully charged) then the UBA will hold the charging current at the specified value (the CC stage) until the target voltage is reached.

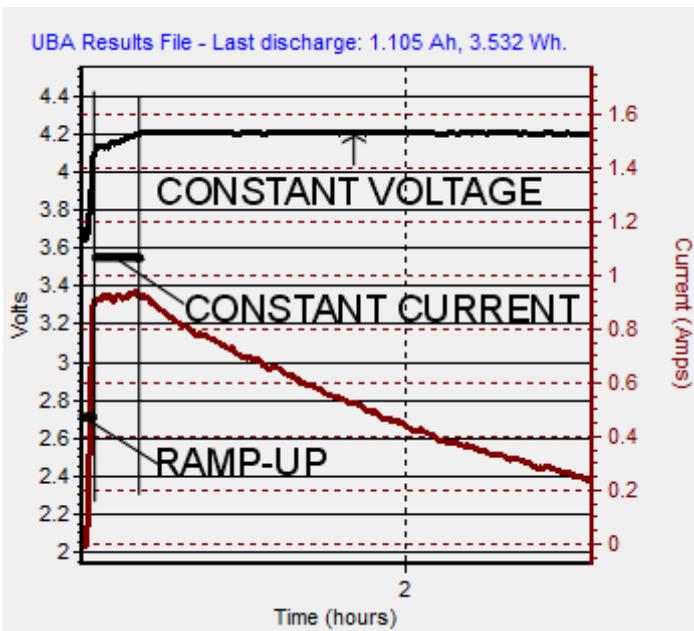


Figure 21: Constant Voltage Graph

When the target voltage is reached, the UBA will hold the battery at that voltage (the CV stage) and the charge current will naturally taper off to almost zero. When the current reaches a fraction of the specified CC current (usually set to 5%) the charging is considered complete.

For advanced testing: if you know that the battery is starting the charge cycle discharged then you can specify in the BAR that the current ramp-up be immediate (but only do this if you really don't want the ramp-up stage).

In general, the maximum recommended charge current is 1C for li-ion cells. The li-ion BARs that come with the UBA charge at a more conservative 0.7C. Charging at 1C will shorten the CC stage, but extend the CV stage. If you want to shorten the charge cycle, then you can increase the exit charge current from the standard 5% value, but that will leave the cell slightly under charged.

3.6.3. Result Graph from NiCd battery Analysis

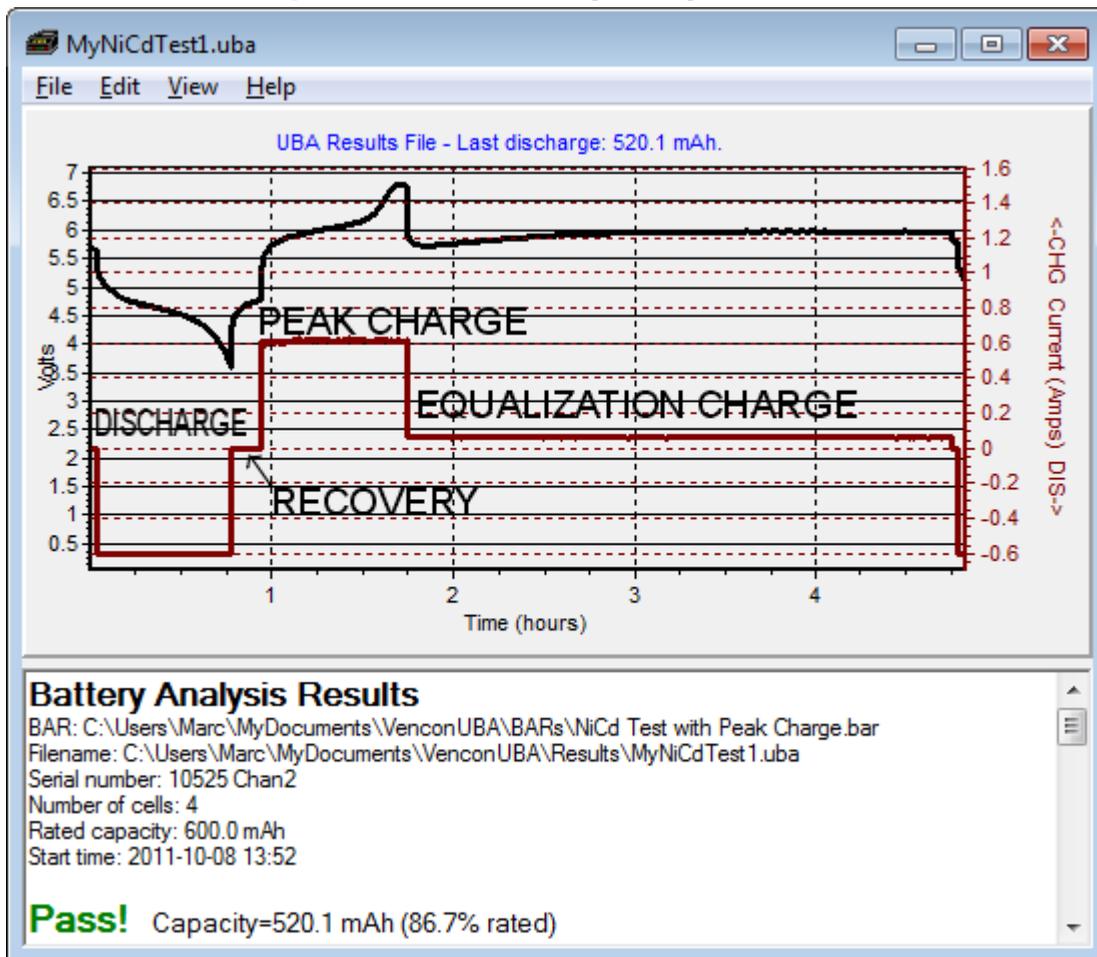


Figure 22: Result graph from a NiCd battery analysis.

This analysis has four phases, the discharge, recovery, peak charge and equalization charge. During the discharge at 1C (600mA for our 600mAh battery) the battery is discharged down to 3.6V (0.9V/cell). Then the battery is allowed to recover for a few minutes (it reaches almost 1.2V/cell in our example) at which point the 1C peak charge starts. The peak charge ends with the detection of the drop in voltage (*delta peak*) and the C/10 equalization charge starts.

3.6.4. Peak Charging Explained (used for NiCd and NiMH only)

In this figure, the delta-peak of the peak charge from our example is expanded. The delta-peak, which signifies the end of the charge, is shown by the 40mV drop in voltage. The voltage quickly drops after this as the charge current is reduced and the battery enters the equalization charge stage. In equalization charge the battery is typically charged at C/10 which ensures that all cells are fully charged.

Not all batteries exhibit a well defined delta-peak when they are fully charged. New batteries and those that haven't been used in a while can sometimes peak early, i.e. before the battery is fully charged (in the peak charge action you can have these premature peaks ignored) and batteries with mismatched cells can have poorly defined peaks. After a couple of full charge/discharge cycles you should be able to reliably peak charge your battery.

If there's no discernible delta-peak, the UBA will continue to charge the battery until either the maximum time or charge is reached. If you're using the temperature probe to monitor battery temperature, then the charge can be terminated on temperature (rise rate or absolute value).

3.7. Congratulations

You've completed a battery analysis. You now know how to setup and initialize the UBA, start a battery analysis and interpret the results. The next stage is to create your own BARs so that you can get the UBA to do any analysis you want.

Hints when viewing the results graph:

- To zoom, use your mouse to select an area (top left to bottom right).
- To pan, press the right mouse button and drag.
- To change the title, click on **Options** in the **Edit** menu.
- You can also change the colours, ranges and other items in the Options page

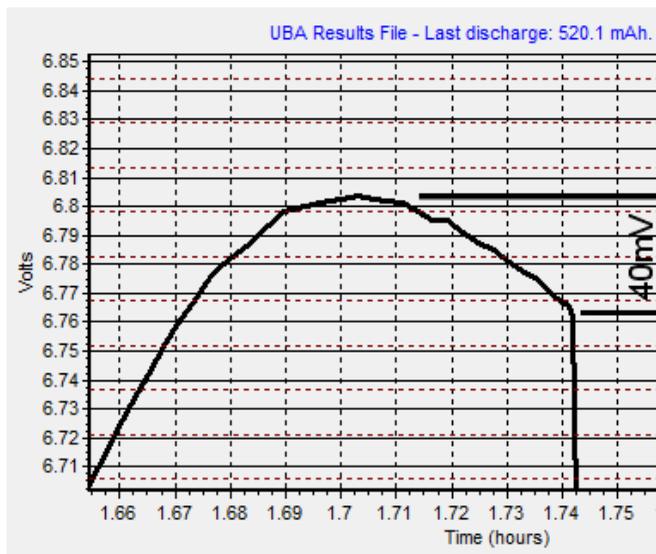


Figure 23: NiCd/NiMH end-of-charge delta-peak.

4. Creating a Battery Analysis Routine

I consider the battery analysis routines the most exciting part of UBA Console. We designed the battery analysis routine from the ground up to be so powerful and expandable that you'll be able to analyze your batteries using methods that you never thought possible — this has certainly been our experience. Once you've used our battery analysis routine designer you'll never want to go back to the old "fill in the blank" type of battery analysis.

Marc A. Venis P.Eng., M.A.Sc

President Vencon Technologies Inc.

The Battery Analysis Routine (BAR) Designer allows you to create a battery analysis using graphical techniques. Once you learn the basics of how to design a simple BAR, you'll be able to design your own advanced BARs that can, for example, life test batteries, form, recondition, create and/or erase memory in NiCd/NiMH cells, mimic an actual device, and many other advanced functions.

4.1. Li-ion Cell Test (based on IEC 61960-2)

For this example, let's create a BAR that does the IEC li-ion capacity test.

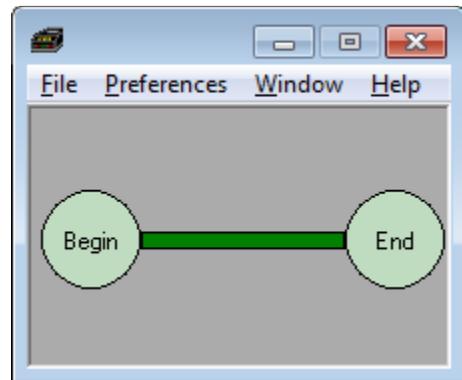
It will have the following steps:

1. Initial discharge at 0.2C current down to 2.75V
2. Charge cell to 4.2V.
3. Wait one hour
4. Discharge cell at 0.2C current down to 2.75V and record the capacity.
5. If capacity is greater then rated, then cell passes.
If not, then repeat above test up to four more times.

4.1.1. Create a new empty BAR

Start with a new empty BAR by selecting *Battery Analysis Routine Designer* under the *File* menu.

You should get this:



*Figure 24:
Empty Battery Analysis Routine*

4.1.2. Start with the initial discharge action

Right click on the background of the BAR (the grey area) and select: Li-ion | Discharge:

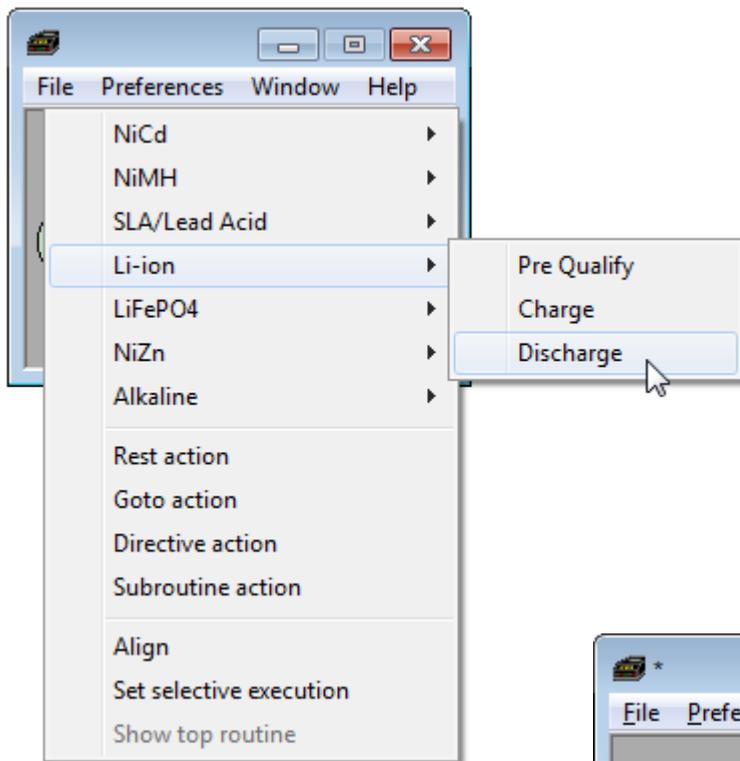


Figure 25: Adding a Discharge action to a BAR.

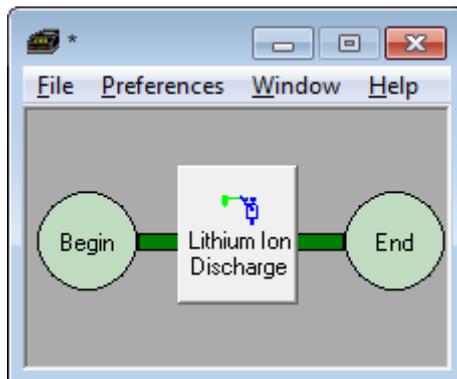


Figure 26: The BAR with the added Discharge action.

4.1.3. Set the parameters for the initial discharge action

Click on the action icon that you have just created and you'll get this parameter page.

Here you enter all the parameters for this discharge action. The action comes with default values (the BAR file, *BARTemplate.bar*, has the default values which you can open, modify, then save with the BAR Designer).

Since we want a 0.2C discharge (a 1C rate means that the discharge current will discharge the entire battery in 1 hour, a 0.2C discharge will take 5h) enter 0.2 instead of the default value of 1.

The *Write to results file every* 10 seconds can be changed to the less often value of 60 seconds as the discharge can take as long as 5h and we don't need to store so many points.

The **External** tab is for specifying external load or charge devices that are controlled using the UBA's accessory port.

The **Finished** tab already has the default value of 2.75V for the cutoff voltage set.

The **Report** tab has the *Capacity* option checked. Since the capacity of the initial discharge is meaningless (i.e. entirely dependent on the cell's initial state of charge) we can uncheck it.

The **Extras** tab has more options. Now is a good time to change the name of the action to something more descriptive, such as *Initial 0.2C discharge*. Alternatively you can right click on the action icon and rename it.

You can always click on the help button to learn about the other options, but for now, we're done setting up the initial discharge, so click the OK button to save our changes.

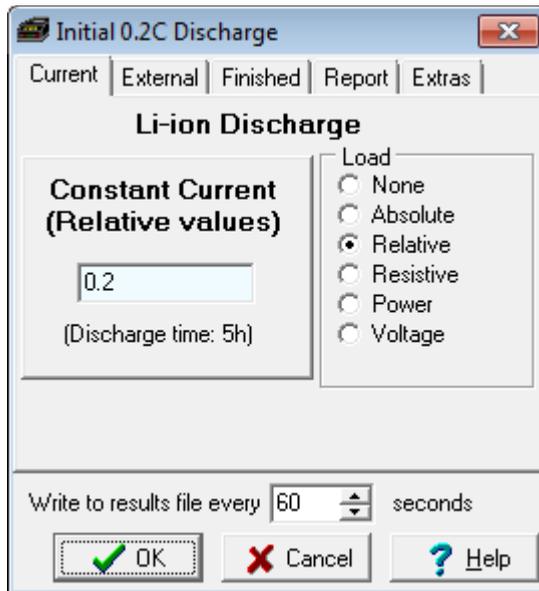


Figure 27: Discharge action parameters.

4.1.4. Add an action to charge the battery to 4.2V

Right click on the background of the BAR (the grey area) and select: Li-ion | Charge.

Now click on the newly added charge action and you should get this page →

You can click on the different tabs to see the default values. There's no need to change any of them, except maybe on the **Report** tab where you can uncheck the capacity option as it just adds extra information to the results which we don't need. On the **Advanced** tab (or right click on the icon after closing the action & select **rename**) change the name to **4.2V Charge**.

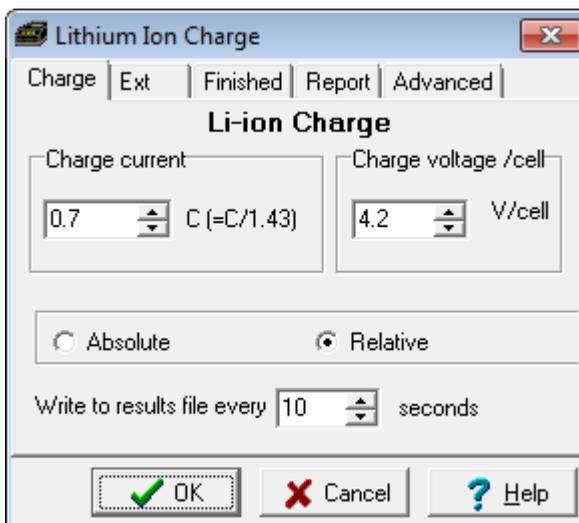


Figure 28: Constant voltage charge parameters.

4.1.5. Add a rest action

Right click on the background and select *Rest action*. Click the new rest action and set the rest time to 1 hour, close the action, rename it to *1h Rest* (right click on the rest action button to rename it).

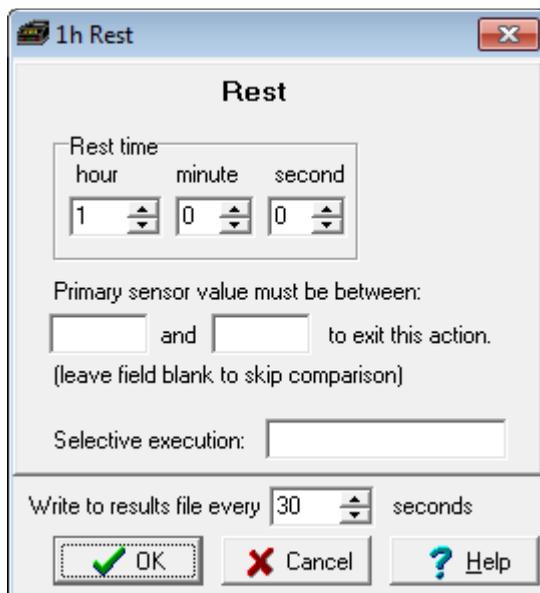


Figure 29: One hour rest action.

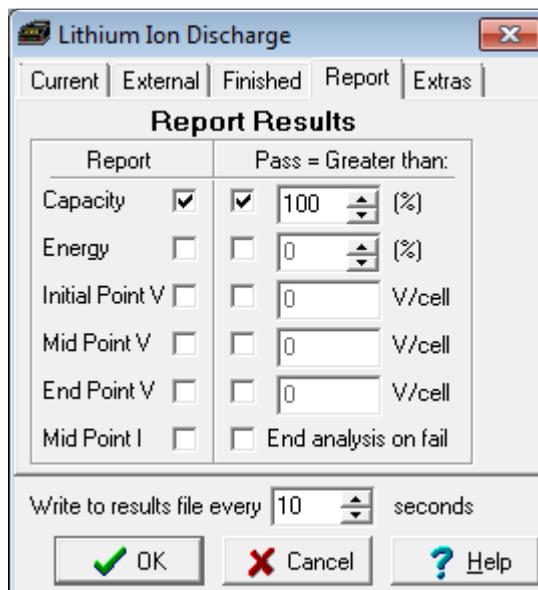
4.1.6. Add an action to do the discharge test

Right click on the background of the BAR (the grey area) and select: Li-ion | Discharge.

The default values for load current is 1C and cutoff voltage 2.75V, which is what we want.

Select the **Report** tab, check the capacity pass checkbox and change the pass value to 100%, which is the pass value required by the IEC test. On the **Extras** tab you can change the name to Discharge Test.

Figure 30: Set the pass criteria to 100%



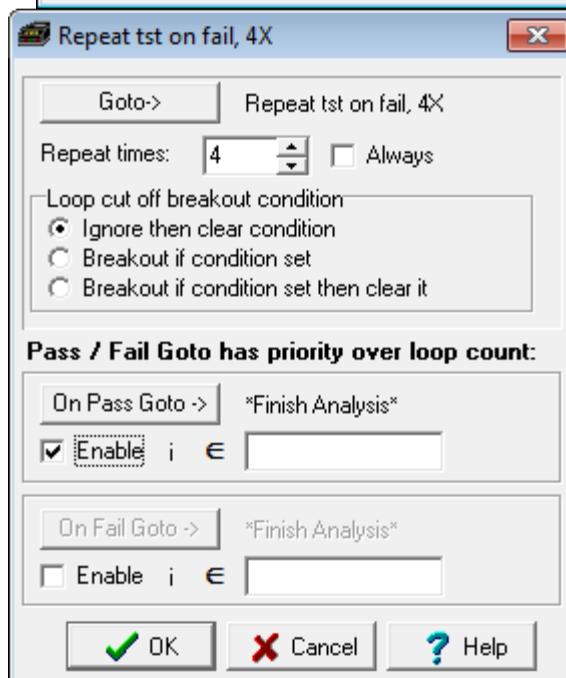
4.1.7. Add a Goto action

The IEC test allows the battery test to be repeated 5 times, so we'll add a Goto action which will allow the test to be repeated.

Right click on the background of the BAR (the grey area) and select the *Goto action*.

The Goto action can either do nothing or jump to another action based on the previous pass, fail, or repeat count.

Figure 31: Repeat 4 times, but end analysis if battery passes discharge.



For our example we want it to jump back to the charge action if the capacity test fails, but not to do it more than 4 times. So to get 5 iterations of the charge/discharge test set the repeat count to 4, click on the *Goto* action and select the charge action. Now to get the test to end on the first time the battery passes, enable the *On Pass Goto* button, click it, and select *No to All* which will end the analysis on a pass.

4.1.8. Bonus action - charge battery 30% for storage or shipping

This finishes the IEC test BAR. But it leaves the cell fully discharged, which isn't a good way to store the battery. Let's charge the battery back up a bit.

Add a li-ion charge action in our BAR, click on it and select the **Finished** tab. Change the *Amount of charge* to 0.3. This will charge the battery up 30%, which is a nice level to leave it at for storage or shipping. After adding this final charge action, go back to the Goto action and change the Pass Goto action to this action.

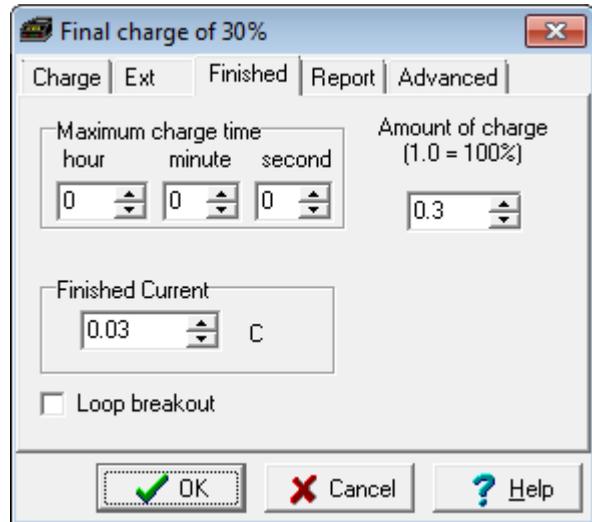


Figure 32: Final 30% charge for storage.

The final BAR will look like this after you save it with a filename:

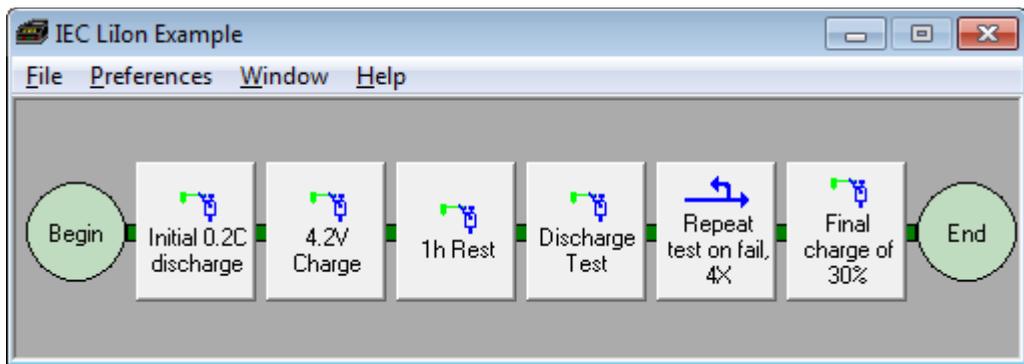


Figure 33: The finished Battery Analysis Routine.

4.2. Advanced BAR Concepts

Renaming and Deleting Actions

Right click on an action to rename or delete it.

Rearranging Actions

Actions are executed from left to right. You can easily rearrange their order by dragging them.

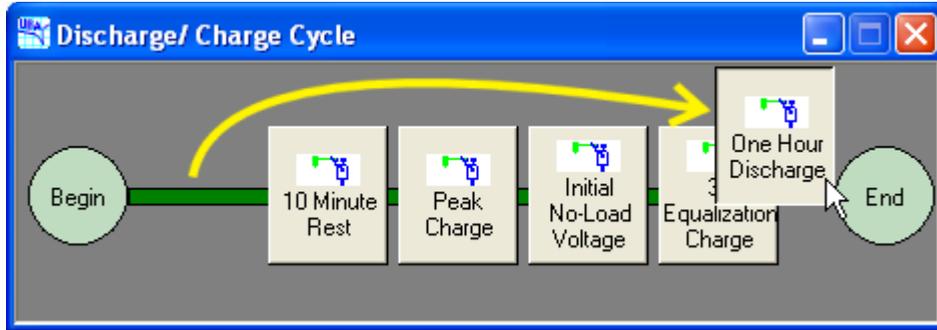


Figure 34:

The **One Hour Discharge** action is dragged to be after the **3h Equalization Charge**.

Using BAR Subroutines

In order to keep the BAR layout uncluttered and easy to maintain you can use subroutines to group actions together. Right click on the background and choose: **Subroutine action**. Clicking on the Subroutine action will open a new BAR designer window that you can add actions to. Click on **Window | Animate** to get an animation of the program flow.

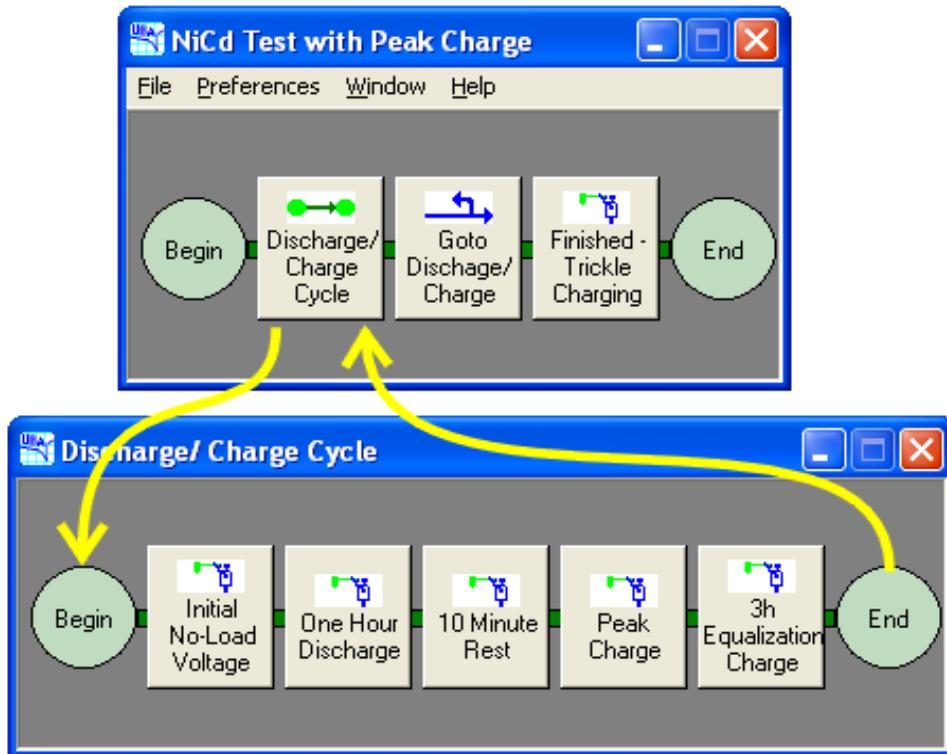


Figure 35: Action flow in a subroutine.

Selective Execution

Selective execution is a feature that allows you to specify which iterations in a loop that the action is run. For example, you might want to check the difference between timed charging, peak charging or temperature charging (for NiCd/NiMH) or the effect of different charge voltages for Li-ion. You'd make a charge/discharge BAR but with more than one charge action, with the first charge action having a selective execution of "1", the second "2" and the third "3", so that only one charge action is executed each loop iteration. See online help for more information.

Relative Currents

UBA Console supports relative currents (based on the battery's C current). This is different from other battery analysis systems.

The use of relative currents allow you to design BARs that work independently of battery capacity. If you prefer, you can still specify absolute values.

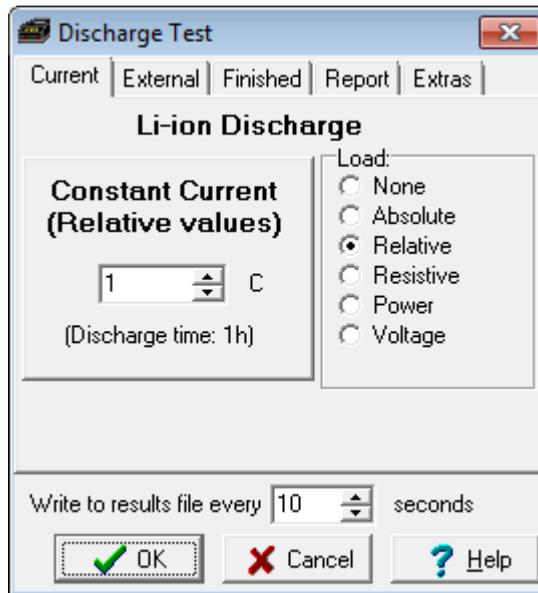


Figure 36: Here we have a relative load current of 1C. If you ran this BAR on a 600mAh battery you'd get a 600mA load, on a 2Ah battery you'd get a 2A load.

Relative Capacity

UBA Console also supports relative capacity. In this example we don't want to charge the battery more than 1.4 of its rated capacity. This is done instead of specifying a time of 2 hours. You can also specify the maximum time.

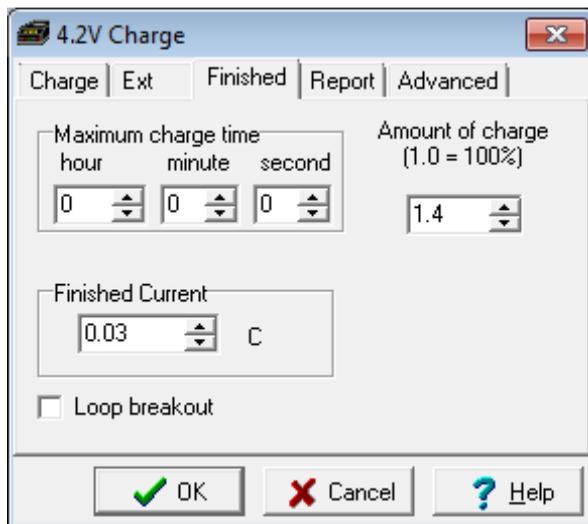


Figure 37: Here we can specify the maximum amount to charge the battery.

4.3. Available BAR Actions:

A BAR can only contain these seven fundamental actions.



Figure 38: Actions that you can use to build a BAR.

NiCd or NiMH Quick Charge, Standard Charge and Trickle Charge Action

These are actually all the same – a constant current charge action that can be terminated by a number of methods. You would normally use this for charging NiCd and NiMH cells. But you can use it for other chemistries where a constant current charge is desired.

Li-ion or SLA Standard Charge

This is the constant voltage (CV) charging action designed for lithium and SLA batteries. CV charging always starts with a constant current which brings the battery voltage up to the desired (target) voltage. Then the UBA automatically switches into constant voltage mode where it reduces the charge current in order to maintain a constant voltage on the battery. When the charge current is almost zero (specified in the BAR), the charging is done.

Any Chemistry Discharge

These are the same discharge action – they only vary in the default load current and the cut off voltage.

Rest

Use this for no load (quiescent current still exists) rest periods. Same as a 0A discharge.

Goto

The goto action branches to another action, either forward or backwards. You can specify the number of times to branch (i.e. run a charge/discharge cycle 10 times) and allow a discharge action to break out of the loop before the repeat count is reached. You can also branch on the pass or fail results of a previous discharge action.

Directive

The Directive action offers a few options:

Loop Results is typically used to sum up the capacity from a discharge loop. A discharge loop is a collection of rests and discharges (and sometimes short charge actions) that are repeated over a predetermined number of times or until the battery voltage reaches the cut off value.

Sound to play allows you to set a sound that is played when the directive is run, normally after an analysis completes or the battery fails a test.

Cycle Markers allow easy display of individual cycles when viewing results

Expression to execute:

See online help for more information.

Selective execution allows you to run this directive only on specific iterations in a goto loop. See online help for more information.

Directive

Loop results (accumulated capacity discharged)

Report	Pass Criteria
Capacity <input checked="" type="checkbox"/>	<input type="checkbox"/> > 80 (%)
Energy <input type="checkbox"/>	<input type="checkbox"/> > 0 (%)

End analysis on fail
 Reset loop values

Sound to play

Repeat times: 0

<system sound>

Cycle Markers (for analysis results display)

Begin End None

Expression to execute:

Selective execution:

Action name: Directive

OK Cancel Help

Subroutine contains a collection of actions that are executed when the subroutine is entered. Subroutines are used to make the BAR program flow easier to understand. They also allow you to use more actions in your BAR than can fit on your computer screen.

4.4. BARs Included with UBA Console

Although making your own BARs isn't difficult (we just did one in the last section), there's no glory in reinventing the wheel. Therefore we've included a few BARs with UBA Console that have been written by our resident battery guru. I suggest that you use them, at least until you have gained enough confidence to write your own. And remember, when using a new BAR for the first time, watch the battery analysis while it's running to ensure that it does what you intended it to do.

Actually the easiest way to create BARs is to modify existing ones. Modify ours, we don't mind. There are many parameters in a BAR and it's easy to overlook something. By modifying a working one you increase the chance of getting it to work the first time.

*Hint: the BARs that came with UBA Console have protection from being overwritten (specifically, the **Owner** field is filled in), but if you do, you can get a new copy from your install CD in the Image/DataFolders/BARs folder.*

The following is a list of some of the BARs included with UBA Console:

Battery Analysis Routine	Chemistry	Used for:
NiCd Test	NiCd	Cycles and exercises a battery to determine its capacity. Charges the battery using delta-V peak charge.
NiMH Test	NiMH	
NiCd Forming	NiCd	Forms new batteries or those that haven't been charged for a few months. It slow charges the battery for 16 hours followed by a discharge and then charge.
NiMH Forming	NiMH	
NiCd Recondition	NiCd	Reconditions NiCd and NiMH batteries with low capacity. It uses a two step discharge which is repeated twice. Restoration of capacity works best on cells that don't suffer from physical deterioration
NiMH Recondition	NiMH	
Li-ion Test	Lithium-ion Lithium-polymer	Cycles a lithium ion or lithium polymer battery to determine its capacity.
SLA Test	SLA, gel cell or lead acid	Cycles a SLA or gel-cell battery to determine its capacity then charges it using a two step algorithm.
Cyclone Test	Cyclone Sealed- Lead cells	Cycles a Cyclone Sealed-Lead cell. This routine discharges the cell and then charges it back up.

5. Advanced Topics

5.1. Combining Channels

Combining both channels doubles the charge and discharge current and power capability of the UBA.

First you need to connect both channels to the battery as shown here using the channel combiner (that we sell) or by direct battery connection.

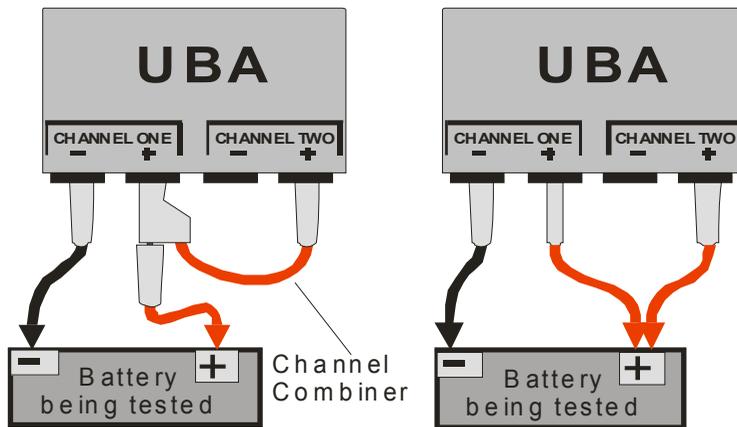


Figure 39:
Combining channels with the Channel Combiner and without

Now you have to set up the combined channels in software.

On the production setup you just need to select the UBA icon (instead of the individual channel icon) and a combined channel battery analysis or multimeter will start up when you click on the Battery Analysis or the Multitester button.

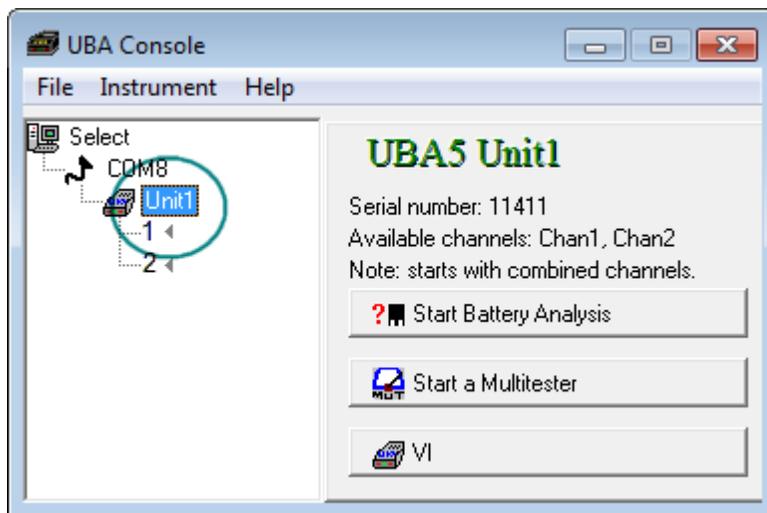


Figure 40: Starting a combined channel in the production setup.

Starting a combined channel using Virtual Channels

If you're not using the production setup or you want to combine channels between different UBAs, then you have to open a **virtual** UBA with one of the channels and add the combined channels to it. You can start the virtual channel from the toolbar, as shown on the right, or from the production version as shown on the previous page (the VI button) which allows you to start the virtual channel with one or two channels.

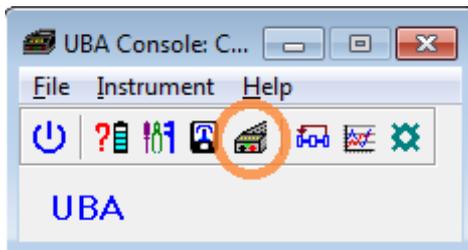


Figure 41: Select the virtual channel to start setting up for a combined channel analysis.

Once the Virtual channel is started, you add channels to it as shown here:

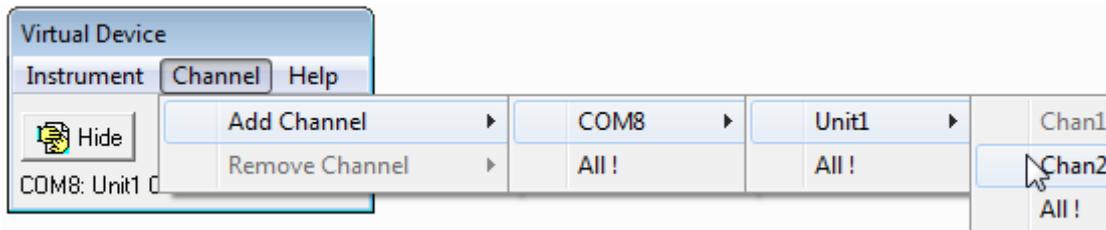


Figure 42: Adding channels to a Virtual UBA

Then when you've finished adding all the channels that you want combined, start the battery analysis or Multitester from the **Instrument** menu.

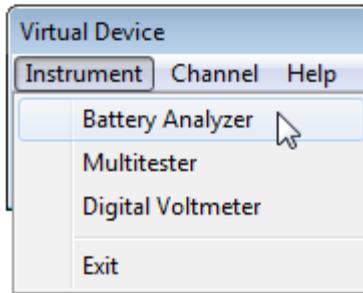


Figure 43: Starting a Battery Analysis or Multitester from a virtual UBA.

Channel Combining Using Two or More UBAs

In order to combine channels from more than one UBA, in addition to connecting the positive inputs in parallel, you have to connect the negative inputs between the UBAs. If you don't do this, battery current will flow through the serial cable and the power supply lines. The figures below show how to combine channels from more than one UBA.

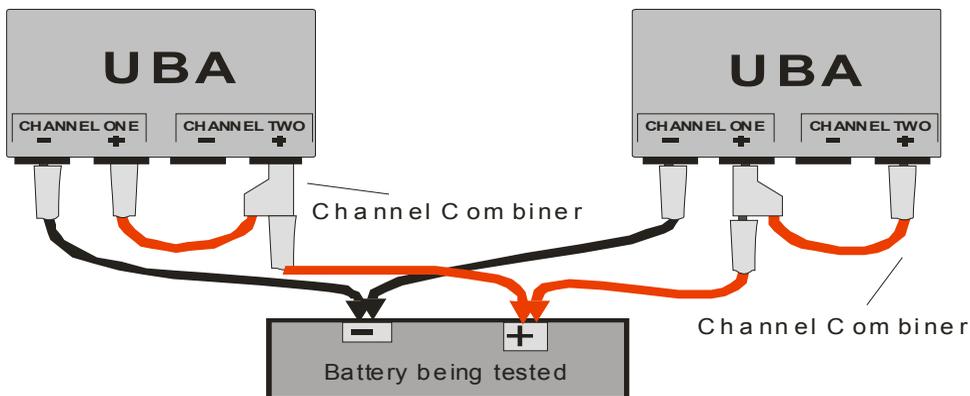


Figure 44: Combining channels with two UBAs using the channel combiner. Connecting the channel two negative lead is optional, but doing so will result in lower resistance which will give more accurate results.

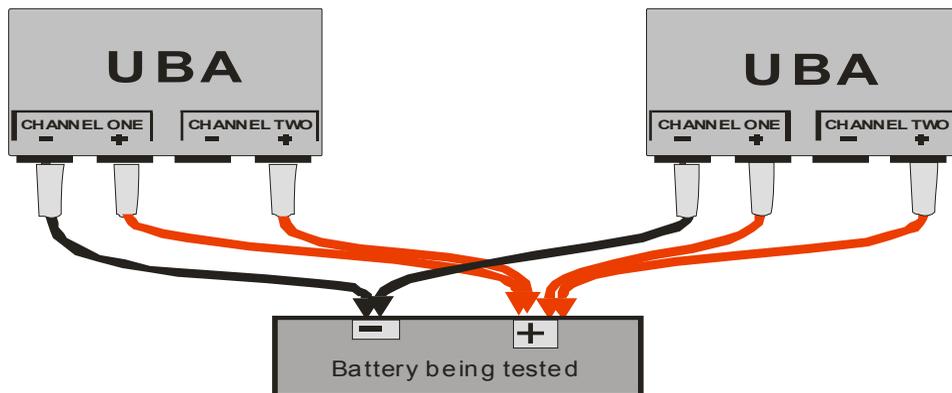


Figure 45: Combining channels by connecting to the battery directly. Similar Figure 45, connecting the channel two negative lead results in lower resistance for better accuracy.

5.2. Choosing and Setting up a Power Supply

The UBA requires a regulated 15 to 24V DC voltage at sufficient current to power both its internal chargers. The UBA5 does not have voltage boost circuitry, this means that in order for the UBA to be able to charge a battery, it needs a power supply of at least 3V greater than the battery voltage during charge (which is higher than the battery's rated voltage).

If you're using a power supply that's rated for less than 4.5A, then you can set the maximum current that the UBA will draw in the calibration file. See the calibration file settings in the online help.

Variable Voltage Power Supplies

For most of your battery testing you can set the power supply at 19V. Drop it down to 15V if testing single cell batteries, increase it up to 24V if testing batteries greater than 12V. On the selectable voltage power supply that we supply, there's a slide switch that you can use to set the voltage.

The voltage of the battery during charge depends on the number of cells and the chemistry. For constant voltage charged batteries (li-ion and SLA), the voltage per cell is what you specify in the BAR. For constant current charged batteries (NiCd/NiMH) the voltage depends on the charge current, the condition of the batteries and the resistance of the battery leads.

Chemistry	Maximum Volts per Cell During Charge
li-ion	4.2V
SLA	2.45
NiCd/NiMH	1.6 to 1.7V

Once you know the Volts per Cell you can multiply this by the number of cells to get the battery voltage during charge. Then add 3V to get the minimum power supply voltage for your battery. Setting the voltage a bit higher than necessary will just result in the UBA getting a bit warmer during charge. If you set the voltage too high, the UBA can reduce the charge current to limit its internal power dissipation.

Recommended Settings:

Li-ion:

Rated battery voltage	Number of cells	Recommended power supply setting
3.7 to 7.4V	1 to 2	15V to 19V
11.1V	3	19 to 24V
14.8 to 18.5V	4 to 5	24V

Lead Acid / Gel Cell:

Rated battery voltage	Number of cells	Recommended power supply setting
2 to 6V	1 to 3	15V to 19V
8 to 12V	4 to 6	19 to 24V
14 to 16V	7 to 8	24V

NiCd/NiMH:

Rated battery voltage	Number of cells	Recommended power supply setting
1.2 to 8.4V	1 to 7	15V
4.8 to 10.8V	4 to 9	19V
9.6 to 15.6V	8 to 12	24V

If you set the power supply voltage too low the UBA might not be able to charge the battery, if you set it too high, the UBA might drop the charge current to prevent itself from overheating.

5.3. Importing Results into a Spreadsheet

You can import the battery analysis results file (.uba file) directly into a spreadsheet for further analysis or graphing. Alternatively you can have UBA console strip out non graphing lines from the results file and save it to a new file. You do this by viewing the results file and then selecting File | Write Data (all samples...).

Microsoft Excel

In Microsoft Excel, select **Open...** (File menu). For **Files of type:** choose **Text Files (*.prn *.txt, *.csv)**, type **"*.uba"** into the **Filename:** box and press **Enter** or click **Open**. Choose a results file and click **Open**. In the **Text Import Wizard** dialog box choose **Delimited**, click **Next** and then select **Comma** as the delimiter. Click **Finished**.

A faster method is to add a “.csv” file extension after the “.uba” on the results file (i.e. *My Test.uba.csv*). Double click on the file and Excel will start up and import the results file.

OpenOffice.org Calc

In OpenOffice.org Calc, select **Open...** (**File** menu). For **Files of type** choose **Text CSV (*.csv, *.txt)**, type “.uba” into the **Filename** box and click **Open**. Now locate the file you want to import. The **Text Import** window will pop open. Choose **Comma** for the **Separator options** and click **OK**. The UBA results file will be imported into Calc ready for graphing.

5.4. UBA Grounding / Negative Battery Inputs

The negative battery inputs on both channels are connected to the ground on the PC (via the serial cable) and to the ground/earth on the UBA power supply (via a grounded negative line). Only test batteries that are floating (i.e. not electrically connected to anything). We sell a self powered RS232 opto-isolator designed specifically for the UBA that will isolate the UBA from the PC's ground for testing batteries that aren't floating (contact us for more information).

5.5. Current and Power Limitations

Load Limit: 3A and 45W

The UBA can discharge up to 3A per channel. During discharge, the UBA converts the battery current into heat. The power is limited to 45W per channel to prevent the UBA from over heating. The UBA internal fan turns on at a power dissipation of 10W on either channel or when the UBA gets too warm.

Thus, for batteries 15V and lower, the UBA can discharge at the full 3A. For batteries higher than 15V, the UBA will reduce the load current to keep within its 45W limit.

If you want a higher load current, combine both channels which gives you 90W of load (see section **5.1 Combining UBA Channels**) or use a series power resistor (see on line help). Don't worry about damaging the UBA from over-current or over-power as UBA Console automatically limits the current to safe values.

Charger Limit: 2A (and 28W internal dissipation)

The UBA can charge up to 2A per channel (provided you have a power supply with at least 4.5A of output current). It uses a low noise linear constant current charger. The difference between the power supply voltage and the battery voltage is regulated by the UBA's charger. The UBA internal power is limited to 28W per channel to prevent overheating.

Thus, when charging a low voltage battery pack or single cell, the UBA might limit the charge current. For example if you have a UBA5 with a 19V power supply and you want to charge a single 1.2V cell at 2A, the UBA would have to dissipate about 35W $((19 - 1.5V) \times 2A)$. This is the worst case since it's actually less as any wiring would drop the power supply voltage. So in this case the UBA would reduce the charge current to about 1.7A. If you want to charge single cells or low voltage battery packs at high currents then either combine two or more channels, use a lower voltage power supply (but not less than 15V), or charge the cell in series with other cells (i.e. higher battery voltage).

5.6. Minimum Guaranteed Load Voltage

For a given load current the UBA has a minimum voltage that guarantees the requested load current. For example, with a 2A load you can discharge a battery down to 1.1V and still maintain the 2A load. Below 1.1V the load current will start to drop, and at 0.7V the load current will be about 1.0A. You can double the load current at a given voltage by combining channels. More information can be found in the UBA Console online help or by contacting us.

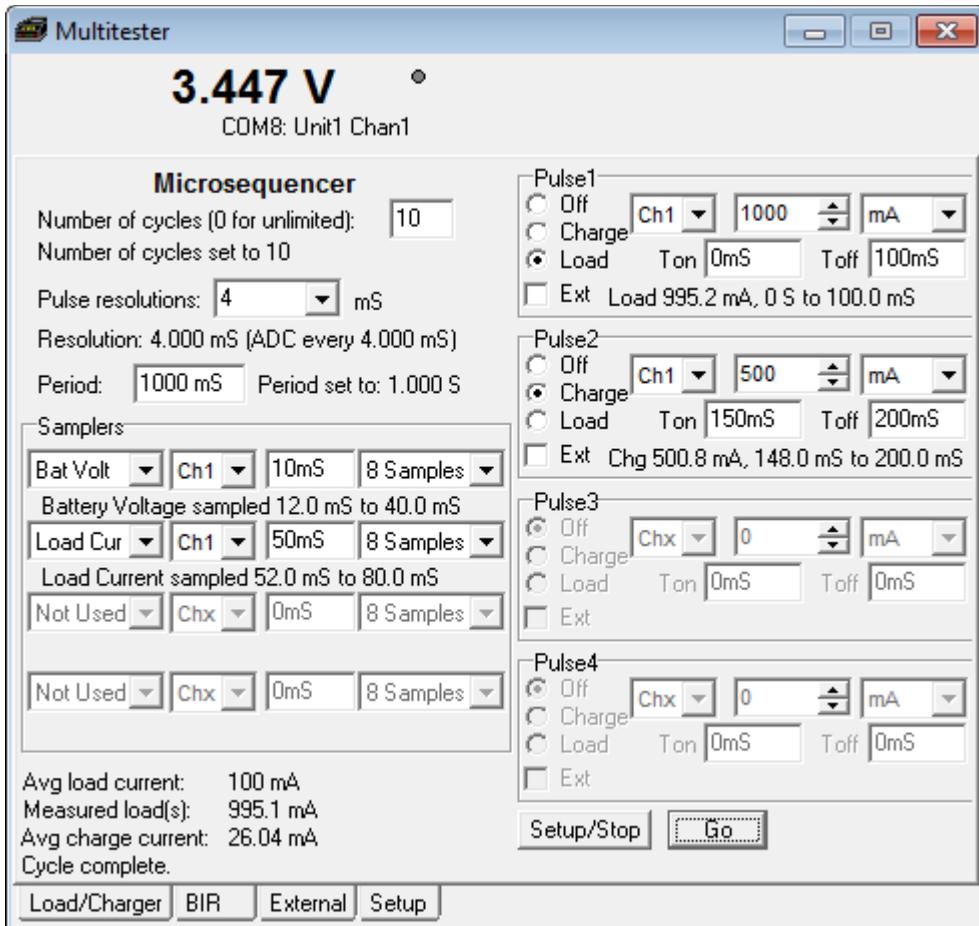
Load Current	Minimum Guaranteed Load Voltage
1.0A	0.7V
1.5A	0.9V
2.0A	1.1V
2.5A	1.3V
3.0A	1.5V

5.7. Maximum Guaranteed Charge Voltage

The UBA is able to maintain its maximum charge current at up to 3V below the power supply voltage. Once the battery voltage gets within 3V of the power supply voltage the charge current will start to drop off. If you're running a battery test and notice that the UBA isn't charging the battery, the first thing to check is if the power supply has enough voltage.

5.8. The Microsequencer

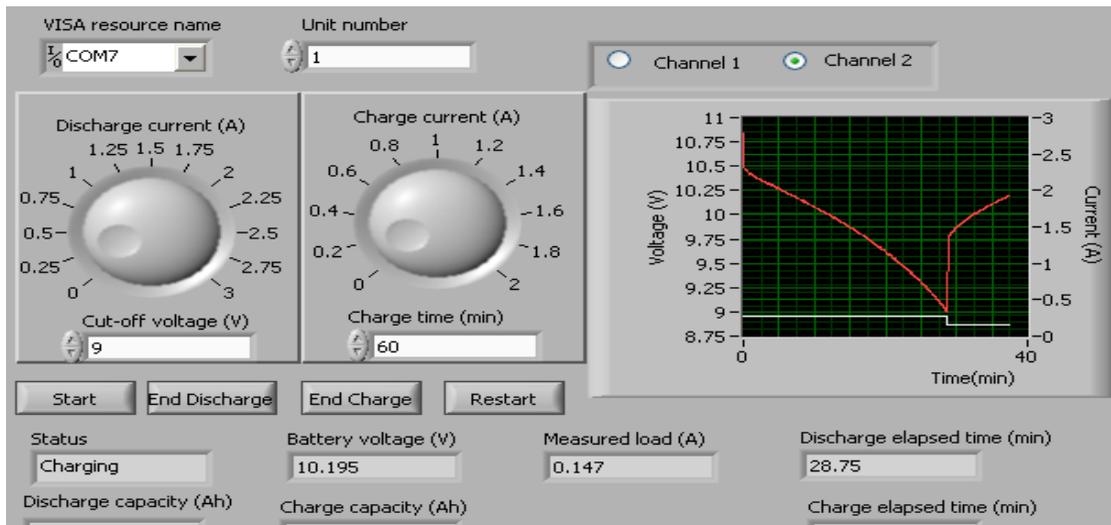
The UBA has a Microsequencer function with the ability to charge and discharge at pulses as short as 4mS. In Multitester right click and choose Microsequencer. Once you have it working to your satisfaction (see online help for more information), right click and copy the settings to the clipboard. You can then paste them into the Microsequencer page in the load action in a BAR. If the Microsequencer isn't enabled, then go to the UBA **Options** settings, **Security** tab, and enable it there.



5.9. National Instruments LabVIEW UBA Driver

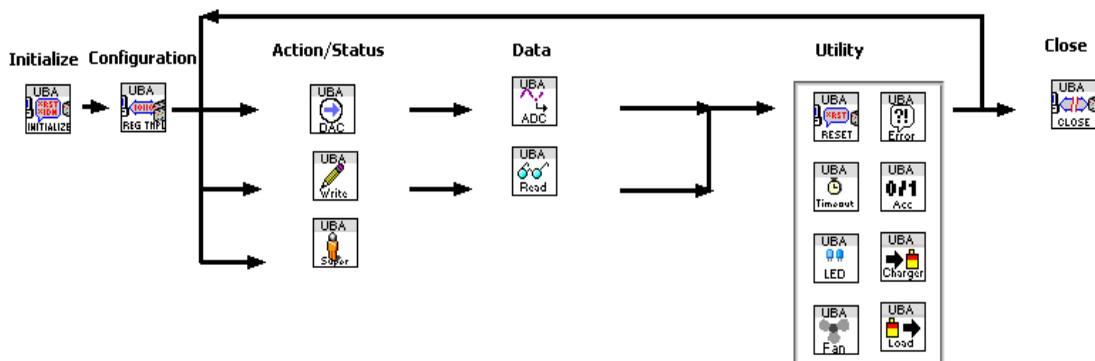
We have drivers and examples written in LabVIEW for the UBA.

Contact us for more information.



Use the Example Finder to find examples demonstrating the usage of this instrument driver. To launch Example Finder, select "Find Examples..." from the LabVIEW Help menu.

Examples



Appendix A – Troubleshooting

Self Test

The UBA does a self test every time it's turned on. If the self test passes, it will flash the channel LEDs and the fan will briefly turn on. You can also test the serial communications by connecting the serial cable that came with the UBA between the two serial connectors on the back and then powering on the UBA. The UBA will continually do a self test and you'll see the front channel LEDs flash.

Communication Monitor

Before the UBA is initialized, the channel one red LED will show very short flashes when it detects any activity on the serial port. If you are having problems connecting to the UBA and the channel one LED isn't flashing during initialization, then the UBA isn't receiving any commands. Check the serial port connection and the device driver in Windows.

Software Installation Problems

For Win95/98 and NT only:

UBA Console will run these old versions of Windows, but you might need some Windows updates, especially if you haven't installed Internet Explorer or Microsoft Office.

Update files can be found on your UBA Console install CD in the "Installation Help" folder or at www.vencon.com/downloads/Win95-NT.html

No Communication

If your PC isn't communicating with your UBA then if you have another serial port on your PC you can try that. If you're using a USB adapter that didn't come with your UBA, then go to **File | Options, Serial Port** tab and click on **Advanced**. Change the setup and see if that helps. If none of the above helps, you can try the UBA on a different PC to determine if the problem is with the UBA or the computer.

Appendix B – FAQs

Battery Testing

How do I run a battery life test?

Change the repeat times in the goto action in a BAR that cycles the battery to **Always**. Have the charge or discharge actions only write to the results file every minute or so in order to reduce the size of the results file. When the life time test is over (either by the number of cycles or the battery capacity), view the results file in the **Battery Analysis Results Viewer** (**File** menu) and select **Write Report (cycle by cycle summary)** (Results Viewer **File** menu). This writes a comma separated table of capacity vs cycle number which can be loaded into your favorite spreadsheet program. Note, a long life test can take a few minutes to display. It's best that you not view it while a battery test is running since you can lose communications. Use a second computer, or start up a second instance of UBA Console for viewing the results file.

How do I know how many cells are in my battery pack?

In order to get the number of cells in a battery pack, divide the battery pack's nominal voltage (usually printed on the pack) by 3.7V for li-ion cells, 1.2V for NiCd/NiMH cells or by 2V for SLA cells. See section 3.2.

What's the quickest I can test a battery?

You can do a Battery Internal Resistance Test (in the Multitester Instrument) in just a few seconds which measures your battery's internal resistance. This tells you how bad the battery is, but isn't a reliable indicator of as how good it is. A high internal resistance means a battery is in poor shape, a low internal resistance gives little indication about its capacity but is a good indicator of the battery's ability to supply a high current load.

If you have the time, a full battery discharge is best. This can be done in as little as 1 hour (or even 30 minutes depending on the battery), provided the battery is initially fully charged and the load current is within the UBA's capabilities. Unless the battery is designed for high rates of charge and discharge, discharging or charging it in less than one hour is not advisable as it unnecessarily stresses the battery and gives low capacity results. A full charge-discharge cycle can take as little as three hours on a NiCd, NiMH, li-ion or li-polymer battery and as long as a day on a SLA or gel cell battery. If you have a specific test requirement feel free to contact our technical support department for assistance.

How complicated can I make a Battery Analysis Routine (BAR)?

You can make a BAR as complicated as you want. We've designed BARs with nested loops where the inner loop simulated the device's dynamic load (for example a two way radio: 100mA load for five seconds and then 2A load for one second) and the main loop did a life cycle test. The only limit is screen size, and you can get around that by using subroutines.

Can I test primary (non rechargeable) batteries with my UBA?

Yes. But you can only discharge them and the test is destructive (i.e. you can't use the battery afterward).

My battery pack has four 800mAh cells in series. What's the pack's capacity?

In this case, the packs capacity is 800mAh. It would be 3200mAh had the cells been in parallel.

I have a lot of batteries (or cells) to test. Can I test them by putting them in series?

Yes and no. If the batteries are voltage charged, like lead acid or lithium ion, then the answer is no you can't charge them since any imbalance will result in some cells being overcharged and some undercharged. For NiCd or NiMH batteries, you can charge them in series provided they are the same model and initial state of charge. For discharging you'll get the capacity of the weakest cell.

I need to charge my battery at a constant current to a certain voltage and have the current then automatically drop. How can I get the UBA to do that?

This is how constant voltage charging works. The UBA charges at the constant current that you specify in the charge action in the BAR. When the battery reaches the desired voltage, the UBA will automatically reduce the charge current down to a low value.

General

How to I pronounce UBA?

Spell it out, “U” “B” “A”. Do not call it an “Ooba”!

How many UBAs can be connected together?

Theoretically 253, although nobody has every tried that many (at least as far as we know). We have customers run 30 UBAs on one serial port (that’s 60 channels). For Win95 and Win98 the limit is about 10 UBAs (due to limited graphical resources), for Win2000 or XP the limit is 30 and for Windows 7 or later the limit is 253 UBAs.

How often does the UBA need to be calibrated?

Based on our experience with UBAs that have been in the field for years, however we recommend a two year calibration interval. The UBA's load circuitry is tightly regulated, the charge circuit does show some drift with age. If you suspect that your UBA is no longer within spec, we have a Calibration Manual on our website, and on the install CD that shows how to check your UBA. If it is out of calibration or you'd prefer that we check it, please return it to us to be re-calibrated (contact us first before shipping it).

Can I use a UBA to turn on my charger?

The accessory port on the UBA has two digital outputs and two analog inputs. You can control the output lines with your BAR (use external load setting) and respond to the analog input signals (simulate temperature). We sell a connector to bring the accessory port to the back of the UBA and also an optical isolated output connector. More information can be found in our **External Devices Manual** located in the **Support : Reference Manuals** section of our website, on the online help and on the UBA Console CD.

My UBA gets warm during operation. Why isn't the fan turning on?

The fan only turns on when the UBA gets really warm, this keeps the unit quiet and minimizes dust collection. You can have the fan turn on earlier by reducing the turn-on power limit on the **General** tab in the **Options** dialog box (**File** menu). Enter a power less than 10 Watts (6 for example) and the fan will turn on when that power is being dissipated inside the UBA.

My battery is very small and the minimum charge and load current are too high for it.

For small batteries, less than 50 to 100mAh, you might consider having the UBA customized by us for low currents. We have expertise in customizing the UBA all the way down to nano-amps.

We run Linux in our lab, do you have a version for us?

The UBA S/W runs fine under Wine on Linux machines.

We use National Instruments LabVIEW in our lab. Do you have LabVIEW drivers?

Yes we do, contact us for further information.

We need to test 20 batteries at once. Do you have a system that can do that?

Not specifically, but you make a multichannel system by combining many two channel UBAs.

We need to discharge at a higher current or power then the 3A/45W limit of the UBA channel. How can we?

The easiest way is to combine channels. For example, combine channel 1 and 2 on your UBA and you'll have a 6A 90W load. Combine the four channels of two UBA5s and you'll have 12A and 180W.

For high current battery testing we sell a 10A per channel UBA5. It still has the 45W power limit of the regular UBA5 so is best suited for batteries less than 5V. If you combine the channels you can have 20A of load current with a 90W limit.

If the 45W limit is too low (i.e. your battery is higher then 15V), then you can insert a power resistor in series with your battery that will drop the voltage that the UBA "sees". The UBA can account for the resistor voltage drop and give you the correct battery voltage.

Alternatively, we sell a High Current Load Module that interfaces with the UBA5 or make your own using the digital outputs on the UBA's accessory output.

So where is the power switch?

There is none. The UBA draws so little current when it's not in use that there was no point in installing a power switch.

UBA Accessories – Temperature Probes

If your UBA came with temperature probes then you are be able to view and record the battery temperature during a battery analysis. The temperature points are stored in the results file and can be plotted along with battery voltage and current.

In addition, you can program the software to stop battery charging when the battery reaches a certain temperature or rate of temperature rise (dT/dt) for NiCd/NiMH charging or pause the analysis when the battery gets too hot and wait for the battery to cool down.

Connecting The Temperature Probes to the UBA

The temperature probe set comes with two temperature probes, a blue and a white one, and a connector on the back of the UBA. Except for the colour, they are identical. The two temperature probes plug into the back of the UBA. In the calibration file the probes are named “BlueTherm” and “WhiteTherm”. If you wish, you can edit the calibration file in order to change their names.

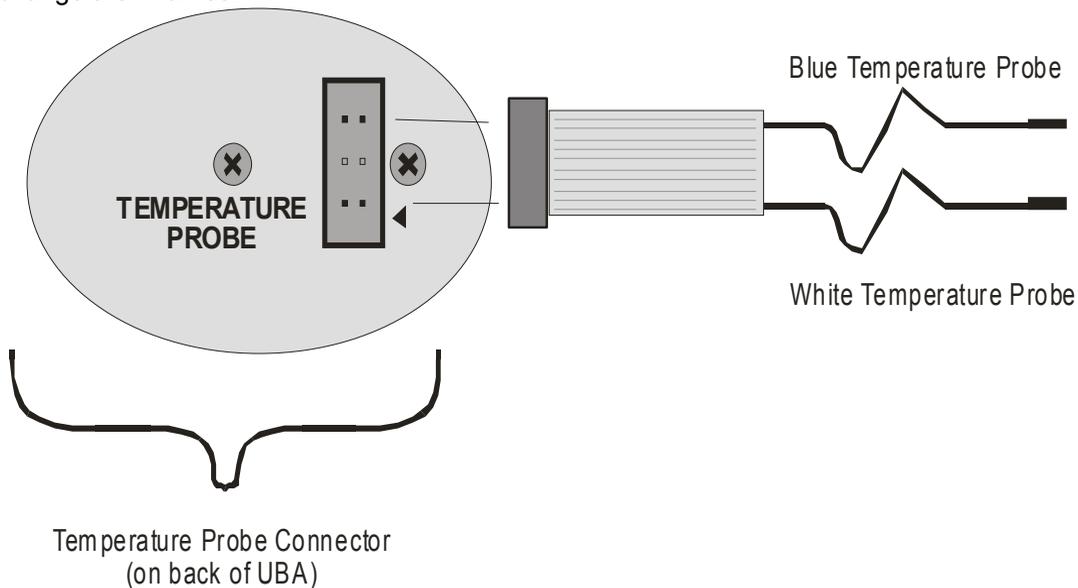


Figure 46: Temperature Probe connections on back of UBA chassis.

Checking the Operation of the Temperature Probes

Start a Multimeter and choose the **Setup** tab on the bottom. Click on the **Choose a sensor:** drop down list and choose a temperature probe (if a probe is in use, or an other accessory is using the same analog input, it won't appear as an option). If there are no temperature probes listed then your calibration file isn't set up for temperature probes – contact us for assistance. Shortly after selecting a temperature probe, that probe's temperature should appear.

Connecting the Temperature Probes to the Battery

We sell two types of temperature probes. The non-magnetic ones can be taped to the battery, ideally near the centre. The magnetic ones will stick to batteries that are encased in steel. If the battery is non-metallic then you can tape the magnetic probe to it. You want the probe to contact the warmest part of the pack which normally is in the middle.

Connecting to an Existing Thermistor Inside the Battery

If the battery pack has a built in 10k thermistor with both leads floating or one connected to battery negative then you can use it as the temperature sensor (you'll need a temperature probe connector on the back of the UBA for this). Contact us for more information.

Running a Battery Analysis

When you are setting up a battery analysis, click on the **Options** tab and select a temperature probe.

For NiCd/NiMH charging, open the BAR in the BAR designer and click the charging action. Select the **Finished** tab and check **Sensor (Temperature)**. On the **Sensor** tab you can set the temperature rise rate and maximum temperature. When enabled, if either of these conditions are met then the charging action ends. Note: we use "sensor units" instead of °C or °F as we have customers who terminate the analysis on conditions other than temperature, i.e. pressure.

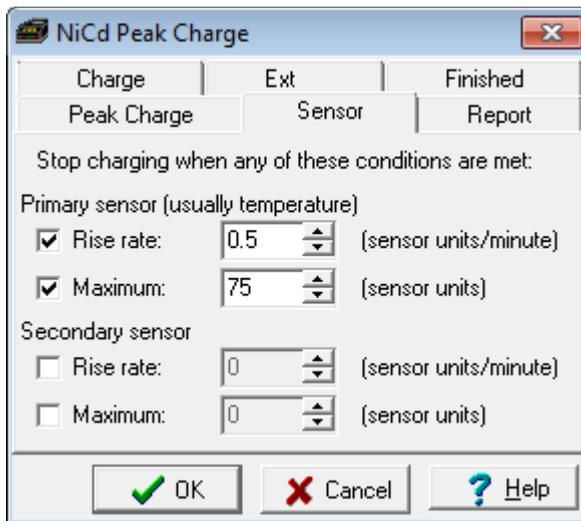


Figure 47: Temperature termination conditions.

For constant voltage charging, you can have the charging voltage as a function of temperature. For example, if charging a SLA battery you can program in the $-6\text{mV}/^\circ\text{C}$ as shown here:

Note: since the temperature probe inputs can also accept measurements from other sources, we're using "primary sensor input" to mean temperature when using temperature probes.

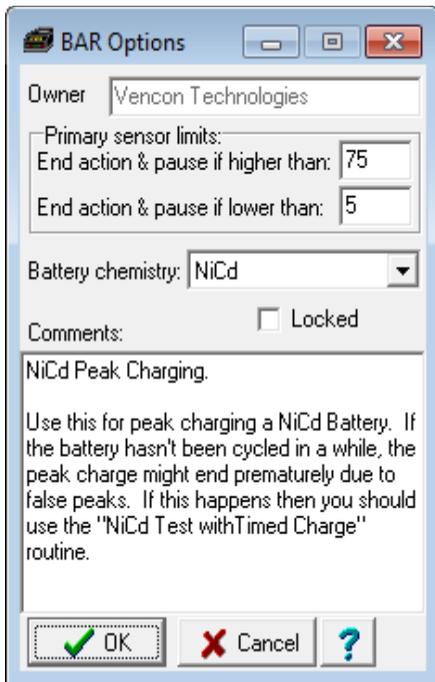


Figure 49: Maximum sensor value (temperature) in a BAR



Figure 48: In the Advanced page you can have the accessory input (i.e. temperature) alter the charge voltage.

The BAR Designer has an option where if the temperature probe reaches a specified temperature or drops below one, the battery analysis is paused.

Note: temperature is called "Primary sensor".

More Accessories for your UBA

Dual Opto-isolated Digital Output and Temperature Probes Module (DODOTP)

The DODOTP is a module that has two temperature probes for measuring battery temperature and two opto-isolated outputs that can be controlled from the BAR file and can be used to turn on and off external loads or chargers.

High Current Load Module (HCLM)

The HCLM is a high current (50A) electronic switch that's controlled by your UBA and it also measures the load current. It works in conjunction with your load, either electronic or resistive.

High Current Relays

These are either mechanical or electronic relays that can be used to control an external load or charger for the battery that's being tested.

Calibration Certificate

Is your lab ISO 9000 or has a calibration standard to meet? You can always return your UBA to us for recalibration. We'll check all the operating parameters with our calibration equipment which are traceable to NIST or NRC. Contact us for current pricing.

Technical Reference Manual

This manual explains the protocol that the UBA uses over the serial port, explains the internal circuitry and proves a schematic of the UBA.

Wifi or Ethernet Modules

These modules allow you to control your UBA using WiFi or Ethernet instead of using a serial or USB port. This is a great solution when the UBA5 is located a distance from your PC.

Resources for more information

Additional information, including the external devices manual and calibrating your UBA guide, can be found on our website and on your install CD.

Custom UBAs – High Voltage and Low Current

If you have batteries higher than 20V, then the UBA5-44V, the UBA5-60V or the UBA5-70V might interest you. The UBA5-44V can accept battery voltages up to 44V, and the UBA5-60V can accept battery voltages up to 60V, and the UBA-70V up to 70V

If you need more load current than 3A per channel, then consider the UBA5-12A, UBA5-16A and UBA5-20A that we sell. These UBAs5 have their load currents increased to 6A, 8A, and 10A per channel respectively. The 45W power limit per channel still holds, so these UBA5s are best for single cell or low voltage batteries.

If you have small cells that need to be tested with currents below 50mA, then our customized UBAs will interest you. We build them to the current ranges that you need, right down to nano-amps. Contact us for further information.

Two Year Limited Warranty

Vencon Technologies Inc (“Vencon”) warrants that the UBA and accessories (the Product) are free from defects in materials and workmanship for a period of two years from the date of purchase. Within this period contact Vencon to obtain a RMA number then send any malfunctioning units to an authorized repair centre prepaid. We will repair or replace it at our option without charge for parts and labour and return it in a timely manner at our expense. Any product which has been subject to misuse or accidental damage is excluded from this warranty.

The foregoing limited warranty is Vencon’s sole warranty and is applicable only to products sold as new. The remedies provided herein are in lieu of a) any and all other remedies and warranties, whether expressed, implied or statutory, including but not limited to, any implied warranty of merchantability or fitness for a particular purpose.

In no event shall Vencon be liable for any damages including, but not limited to accidental, consequential, or special damages, or any financial loss, lost profits or expenses, or lost data arising out of or in connection with the purchase, use or performance of the Product.