(This pdf version of the guide is formatted for letter or A4 size paper. The guide is normally printed as a booklet).

Where's the Power Switch?

The UBA Let's Get Started Guide

The UBA (Ultimate Battery Analyzer) is a battery analyzer, charger, discharger and reconditioner. It's also a data logger, thermometer and electronic load . Wow! That's a lot of features in such a small box. How do we do it? Easy. We get the PC to do most of the work.

The first three chapters in this guide explain how to setup the UBA then 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 (it won't take that long).

Notes:

- The latest version of software and online help is available at the private area of our web site. To get there, run UBA Console and click on **Get latest news on Vencon Website (Help** menu)**,** use the shortcut on the installation CD, or the **Vencon | UBA Help** page from the Windows program 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 their interpretation.

This guide is written by:

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

Printed in Canada September 2008 for UBA4 and UBA5 Console version 1.0

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 in 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.

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.

1. Setting Up The UBA

- Unpack the UBA shipping box and check that you've received the following:
- The UBA battery analyzer and charger,.
- Vencon UBA Console CD, which contains the software for the UBA.
- A 2 metre 9 pin male to female shielded serial cable.
- Two sets of test leads with alligator clips.
- A printed copy of this guide.
- A power supply (if you purchased a UBA Combo).

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

- A power supply (included with the UBA Combo).
- A PC with a free serial port or a USB port and a USB to serial converter.

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 5.1 "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 and if it passes the battery red LEDs will flash once, the fan will spin a couple of times 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 voltage protected. Also ensure that the power supply voltage is no more than 25V, otherwise you risk damaging the UBA.

1.2. Connecting the UBA to a Computer

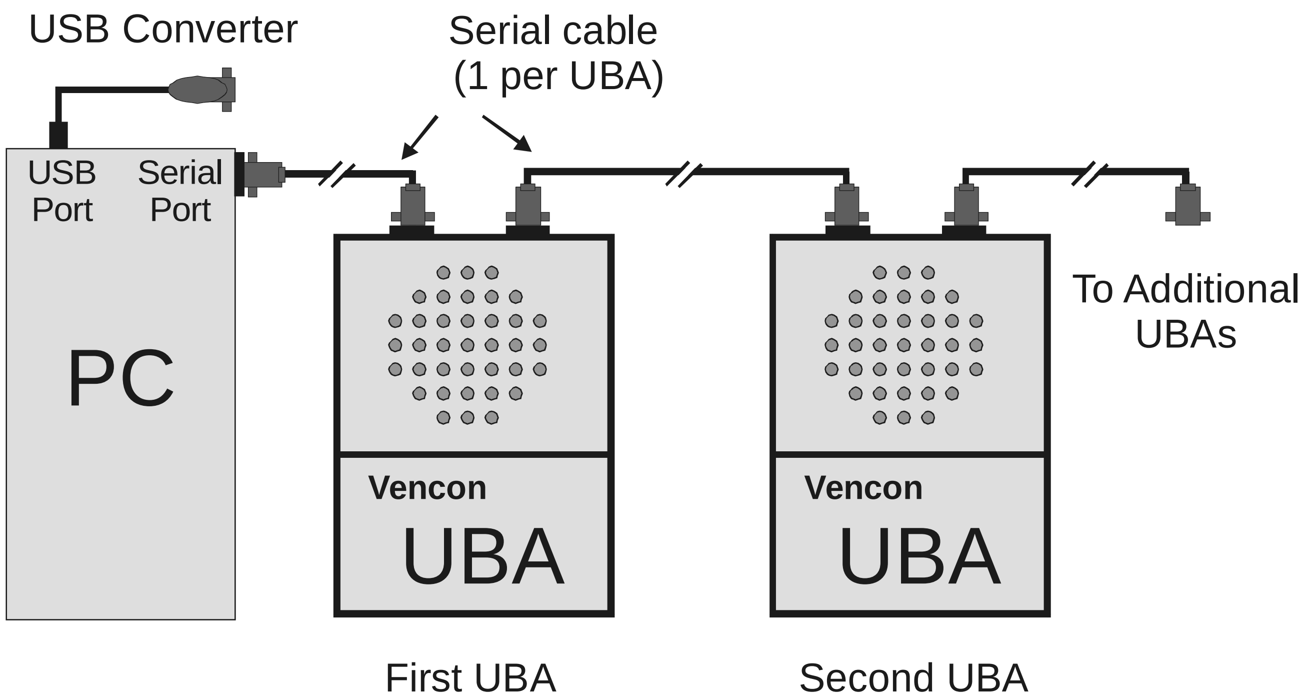


Figure 1: UBA serial port connections for one or more UBAs.
In this setup the first UBA can connect to the PC's serial port or the USB Converter.

The UBA connects to any unused serial port the PC. You can use a USB port with a USB to serial port converter - contact us for purchase information. Connect one end of the supplied serial cable to the UBA (the connector 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 described above and the second to the first UBA. No adapters or gender changers are required. Repeat this for any additional UBAs (the maximum is 253 UBAs per serial port, but performance and memory limits are reached before that). Each UBA requires its own power supply or can share a single power supply with enough current to power them all. You can connect the UBAs while they are on, but you will have to re-initialize the UBA network for any new UBAs to be recognized.

1.4. 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 resent commands in the communication port display (accessible from the UBA Network window by right clicking on the comm port). You shouldn't have any, but if you do, don't worry as the UBA uses error correction so that any corrupted transmissions are resent.

This is an actual image from our burn-in station where UBAs are run for at least 12 hours. Here 21 million commands were sent without error.

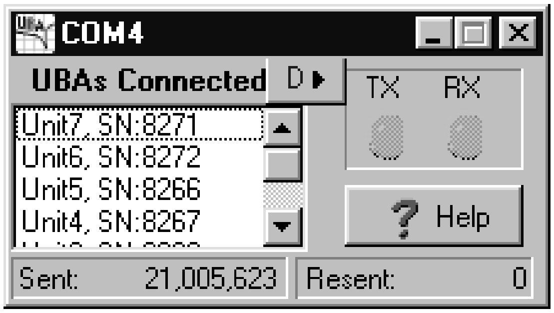


Figure 2: Communication port display showing UBAs connected and the number of commands sent and resent (commands are resent if there is a communication error).

1.5. Ventilation

The UBA can generate up to 90 Watts of heat during a high current battery discharge or charge. Do not obstruct the air vents on the top or bottom. Be careful when touching the UBA during a high current 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 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 or you can turn it on from the Multitester instrument (described later).

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).

1.6. Battery Cables

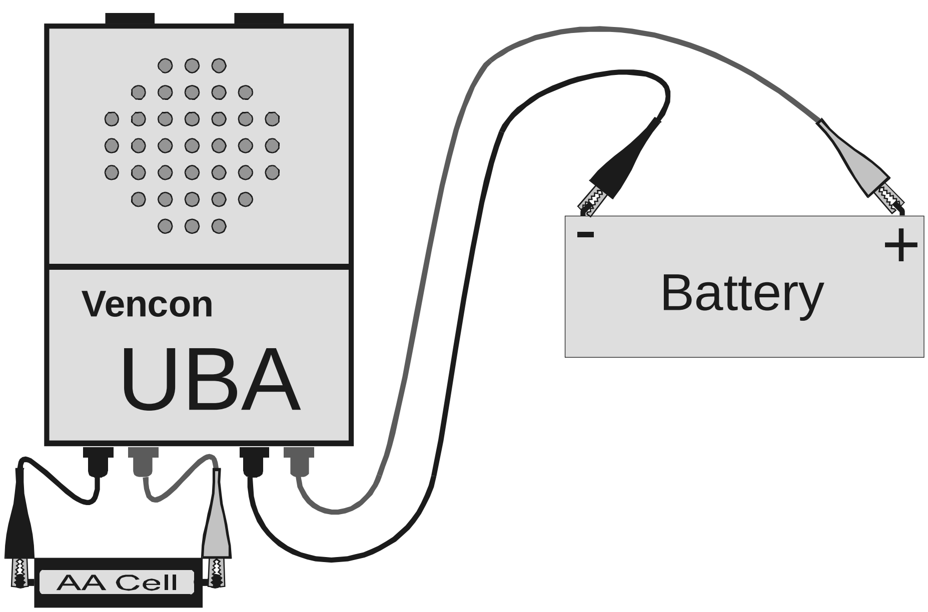


Figure 3: Connecting a battery to the UBA.

The UBA uses standard banana jacks for battery connections and comes with two sets of battery cables with alligator clips. Additional plugs or cables are available from us. 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 of the battery.

NOTE: The UBA battery inputs are polarity protected.

CAUTION: When the battery cables are connected to a battery but not plugged into the UBA, the banana plugs can touch each other resulting in very high currents potentially causing burns or the battery might gas or explode. For this reason, we recommend that the banana plugs be plugged into the UBA before connecting them to your battery. In our lab we keep banana plugs connected to a battery inserted into a piece of wood with 11/64" (4.5mm) holes that keep the plugs safely apart.

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

Hint: If you expect to be testing cylindrical cells (like AA, AAA, C, ...) then consider using magnetic battery connectors. Contact us for ordering information.

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 (Win95 or later) or Linux (we have an application note on our website explaining how to do run UBA Console under Wine).

Windows 95 and NT users: *If you will be installing UBA Console on a PC with a fresh install of Windows 95 or NT you might have to install the HTML help application and some other upgrades to your operating system. See the troubleshooting section at the back of this guide.*

2.1. Installing UBA Console

Insert the UBA CD into the PC's CD drive. Installation should start automatically. If it doesn't, run SETUP.EXE on the CD. If you're installing from a file that you downloaded from our website, run that file.

Important -- Data Location:

During the installation you will be asked where to locate the "application's database". This folder, called *VenconUBA*, is where the files containing battery analysis routines and analysis results are stored. By default this folder is put in the same folder as UBA Console, i.e.:

C:\Program Files\Vencon\VenconUBA   **<- default (not ideal)**

We recommend you choose a different location which is regularly backed up. For example on our PCs we put it in My Documents:

C:\Documents and Settings\UserName\My Documents\VenconUBA   **<- recommended**

You can change the folder location after UBA Console has been installed by moving (or dragging) the *VenconUBA* folder to the new location then specifying its location on the **Folder** tab in the **Options** dialog box (**File** menu).

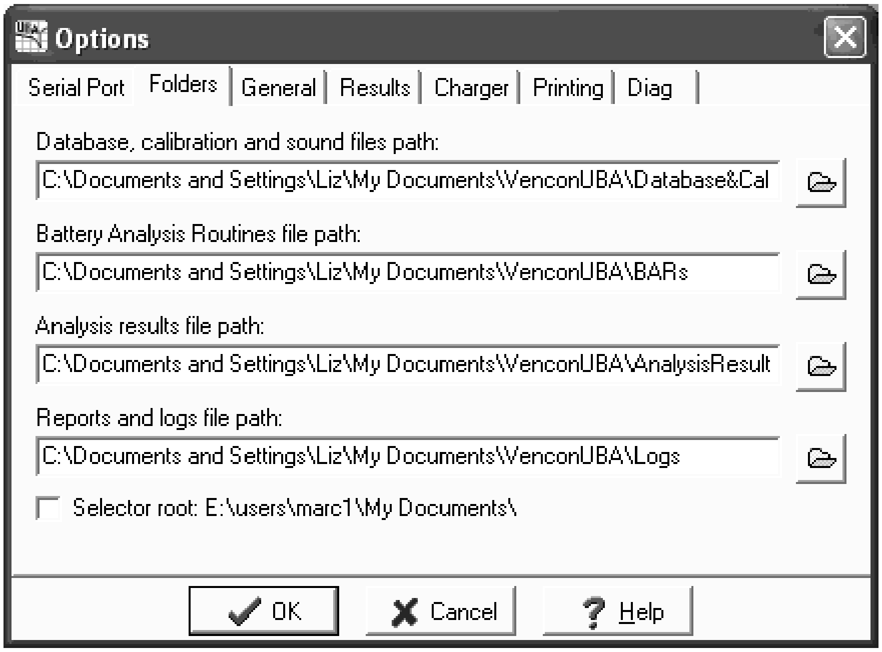


Figure 5: Example folder paths.

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

AnalysisResults – Analysis results are stored here.

BARs – Battery Analysis Routines are stored here.

Database&Cal – Database, calibration, and sound files are stored here.

Logs – Log files are stored here.

2.2. Starting UBA Console

Start UBA Console (from the Windows Start menu).

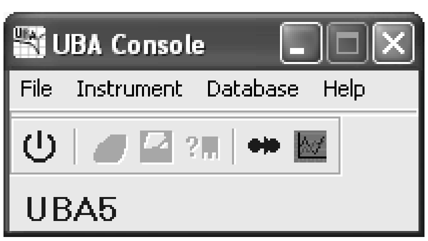


Figure 6: UBA Console - UBA Network not yet initialized.

For additional information see **Appendix A - Troubleshooting**.

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

2.3. 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. Tell the software which comm port(s) to use on the **Serial Port** tab in the **Options** dialog box (**File** menu). Only free comm ports are displayed. You can choose more then one comm port. **UBA Console** will check them all for a UBA each time you initialize the UBA network.

You can initialize the UBA Network by clicking on the first icon on the main menu (the “on/off” switch) or by other ways shown below.

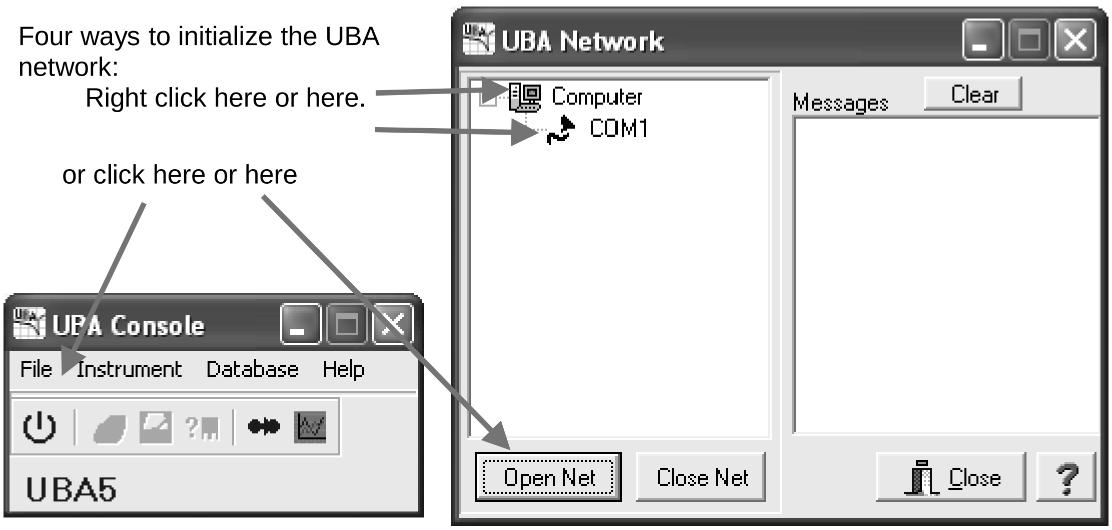


Figure 7: Multiple ways to initialize the UBA Network.

UBA Console will try to connect to the UBA using the serial ports that you have selected. You can close the UBA Network window (just the window, not the UBA network) by clicking on the **Close** button or the **X**.

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

Every UBA comes with a calibration file. It can be found on the installation CD. After the first Network Initialization UBA Console copies it into the *VenconUBA\Database&Cal* folder so that it can find it next time.

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 *VenconUBA\Database&Cal* folder, it will put up a **Calibration file not found** dialog box.

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:

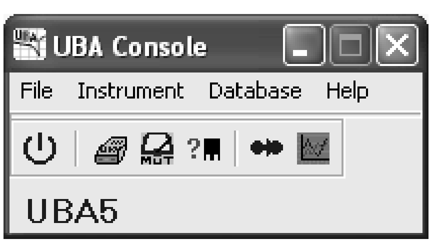


Figure 8: UBA Console with the UBA network initialized (Instrument icons are enabled).

UBA Console has now established communication with the UBA(s).

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

In this chapter, we're going for a quick tour of the UBA and to run a battery analysis. 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 you can check the battery's voltage and the operation of the UBA.

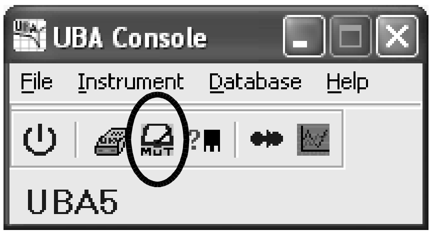


Figure 9:
UBA Console ready to start an instrument. Click on the circled icon to start a Multitester.

This is what the Multitester looks like:

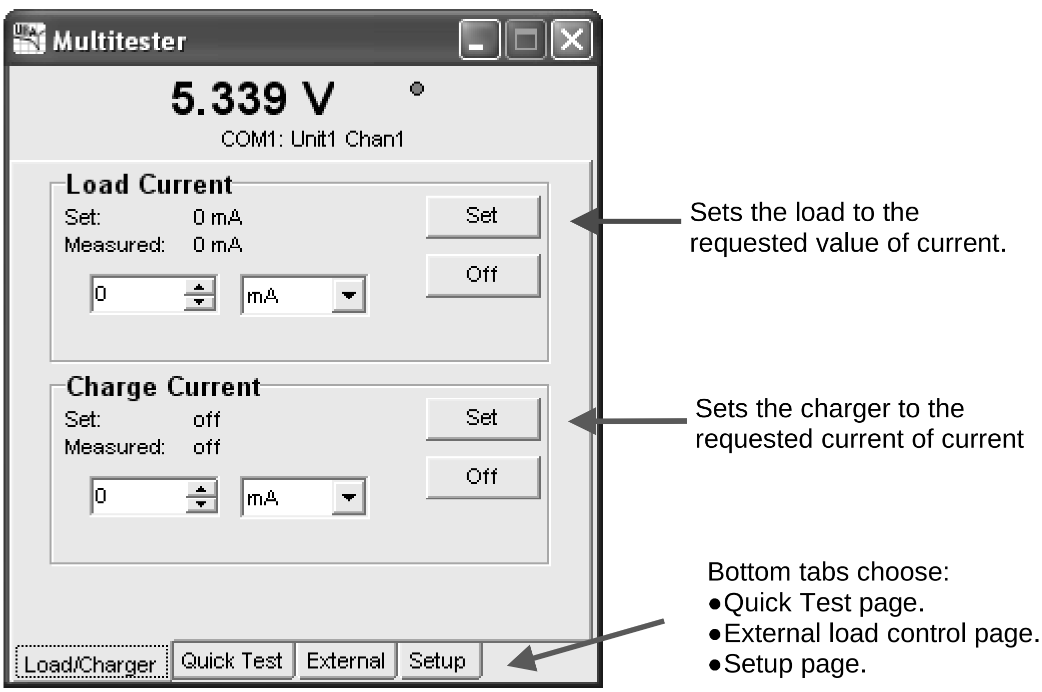


Figure 10: Multitester Instrument.
Use it to monitor the battery voltage while applying a load or charge current.

If the Multitester says 0V (zero volts) with a battery connected, check the connection to your 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 protection circuitry inside that might interfere with the testing. You can test those batteries once you are comfortable using the UBA.

In this example, I am using a four cell 600mAh NiCd battery.

Enter a small test current (100mA for example) into the load or charge current edit 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. Note, you can't run the load and the charger at the same time.

Besides applying a load or charge current, the Multitester can also do a quick test (measures battery internal resistance) or read the UBA temperature probes (if connected). Press F1 for more information from the online help. Experiment with some of the options.

> *Warning: The Multitester does not check the suitability of the charge or load current that you are using. Unless you know your battery's condition, 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: it is not possible to run two instruments on the same channel simultaneously

3.2. Setting Up the Battery Analysis

Open a battery analyzer by clicking on the battery analyzer icon on the tool bar.

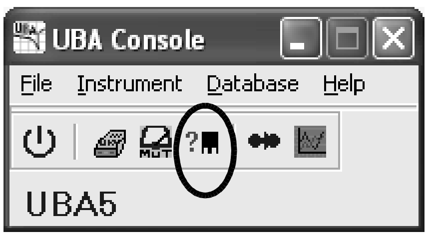
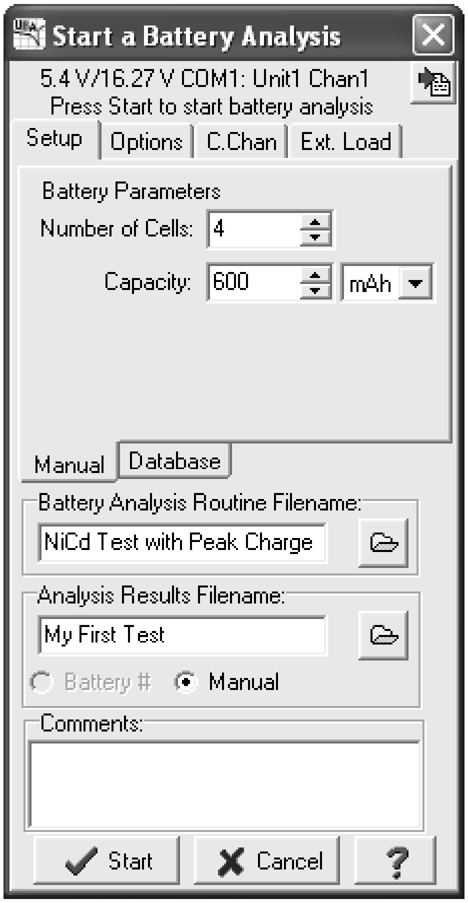


Figure 11: UBAConsole: Click on the circled icon to start a battery analysis.

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



Battery Parameters

Choose an existing BAR

Specify a filename to store results.

Figure 12: Start a Battery Analysis dialog box: Entering analysis 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. For battery packs the rated capacity and nominal voltage should be printed on the pack. If not, you can calculate the number of cells by dividing the nominal pack voltage by the nominal cell voltage.

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's a bit higher then the standard values, 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 all the 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 the sum of the capacity of all the cells (i.e. the pack's capacity is the same as the cell's capacity). For example, the following pack, which consists of three 1Ah cells, has a rated capacity of 1Ah and a cell count of three.

Figure 13: 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.

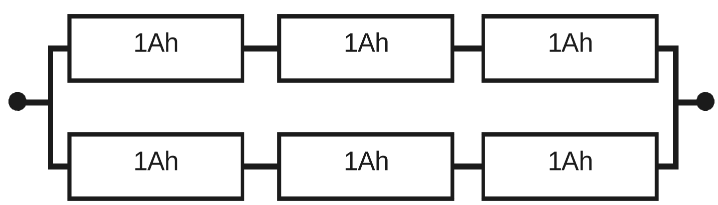


Figure 14: Example battery pack. Pack capacity: 2Ah, cell count 3.

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 Analysis Routine Filename

The battery analysis routine (BAR) contains a sequence of actions that describe the battery analysis that is 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**.

Select *NiCd Test with Peak Charge, NiMH Test with Peak Charge, SLA Test* or *Li-ion Test*, depending on the chemistry of the battery that you'll be testing. Note, lithium batteries have a nasty habit of exploding or catching fire if over charged, they should be tested in a fireproof container.

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

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

Analysis Results Filename

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

Comments (optional)

Enter any comments that you would like stored in the battery analysis results file; for example, "This battery was returned by a customer who says that it doesn't work.". You can always edit the comment text in the results file after the analysis ends 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 battery analysis window should look like this:

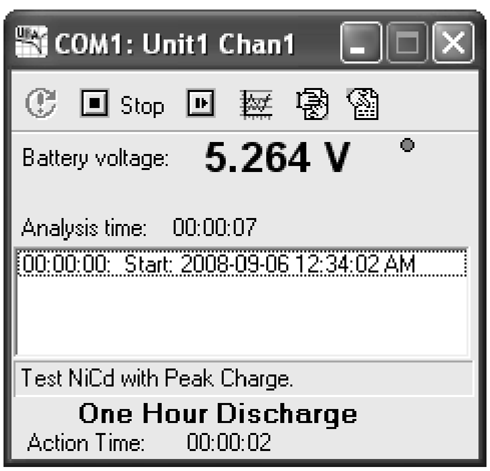
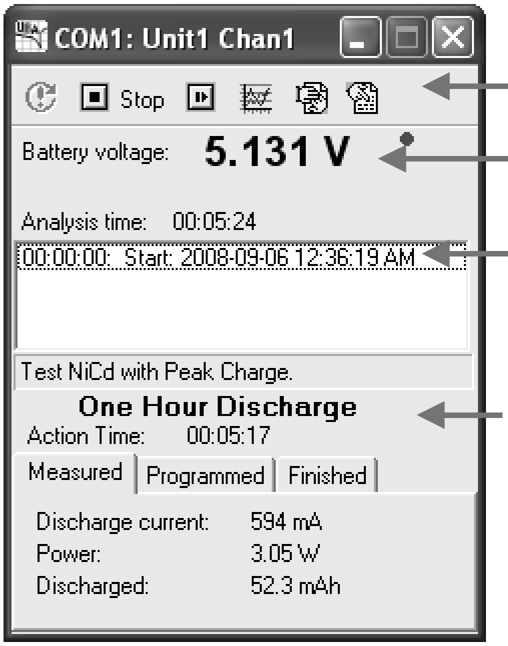


Figure 15: A running Battery Analysis.

The battery analysis is now running. The buttons on the tool bar offer the following options (from left to right):

- Restart the battery analysis (grayed out while battery analysis is running, click on stop first).
- Stop the battery analysis.
- Skip to the next step in the battery analysis.
- Show the results graph.
- Hide this window (use **Active Instruments** on the **Instruments** menu to redisplay).
- Show the starting parameters.

Right click on this battery analyzer window and select **Show More** in order to get the following display:



Tool bar

Battery voltage. Move the mouse cursor over the voltage to get the per cell value.

Summary of events and test results.

Current action and the elapsed time.

Additional information available on these tabs:
Measured: various measured values.
Programmed: the “set to” values.
Finished: conditions for the current action to finish.

*Figure 16: Battery Analysis window (after right clicking on it and selecting **Show More**).*

*Hint: hold your mouse cursor over the **Discharged** value for percentage discharged, double click on it to change the displayed value to percentage. Double click again to switch back.*

3.4. Monitoring the Battery Analysis

Note that in this example the battery analysis starts in discharge. When the battery voltage reaches the cut-off value (the voltage where the battery is considered fully discharged) the load is shut off and the charging starts (after an optional rest).

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

The battery analysis is finished when either the word “Finished” appears or the battery is in trickle charge (if trickle charge is the last action in the BAR).

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

When the analysis is over, press the **View Results** icon on the tool bar to get a graph of the battery voltage and the test results. If you've closed the battery analysis window, you can view the results from **Battery Analysis Results File Viewer** from the **File** menu.

The analysis that I received is shown on the next page. During the discharge portion the battery voltage follows the classic NiCd/NiMH form: an initial fast drop in voltage, a gradual decrease as the battery loses its charge, and a fast drop at the end when the battery is fully discharged. After discharge, the charger is turned on and the battery voltage rises quickly as it recovers, then rises gradually as the battery accepts the charge, and then peaks when it’s fully charged. The voltage drops after the peak as the charge current is reduced from the 600mA peak charge current to the 60mA equalization charge current.

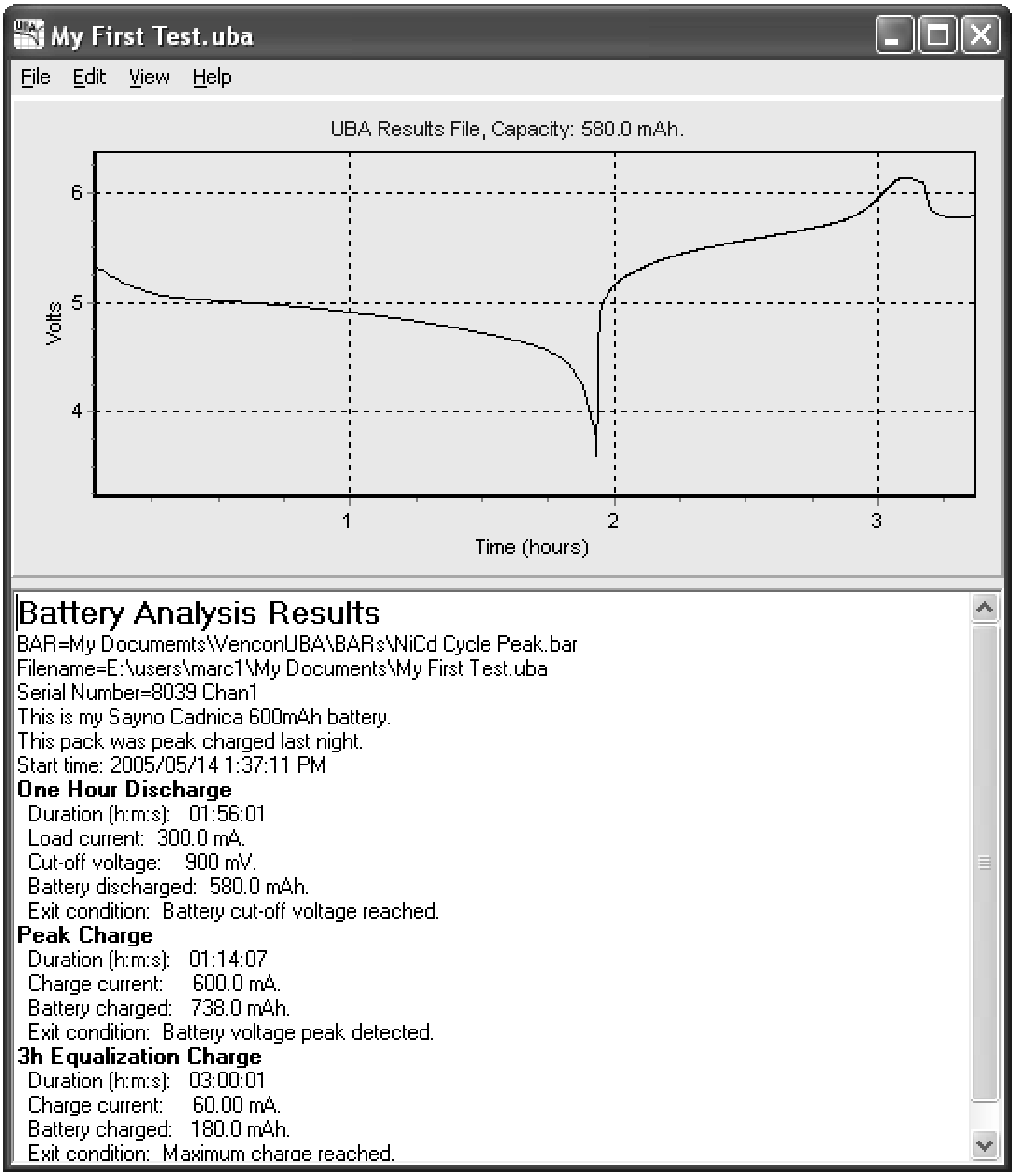


Figure 17: Sample battery analysis result of a discharge followed by a charge cycle.

Now look at the text below the graph. In the **One Hour Discharge:** section you can see that the battery with a rated capacity of 600mAh, was discharged 580mAh. This battery tested at 97% of rated capacity (580mAh / 600mAh x 100%). A 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 is acceptable; however, one below 70% to 80% should be replaced (these figures depend on the battery and it's 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 for two cycles: the first cycle leaves the battery fully charged 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 edit the BAR so that the discharge follows a charge or run the BAR twice.

You will notice that in the **Peak Charge** section the battery was quick charged for 738mAh. This is greater than the measured capacity of the battery, which is to be expected since charging is always less than 100% efficient. This also means that the battery received the full peak charge and didn't false peak. A false peak is a voltage peak that can occur during the beginning of the charge action. It normally occurs on a new battery or a battery that hasn't been cycled in over a couple of months. Also, a poor electrical connection to the battery can cause a premature peak. It is possible that, had the charged capacity been less than the discharged capacity something interrupted the charging, and the battery wasn't fully charged. The **3h Equalization Charge** is programmed for 3 hours at 60mA which equalizes the cells and ensures that each one is 100% charged.

> *Note: for this example we used a simplified version of the "NiCd Test with Peak Charge.bar" BAR with just one discharge and one charge action.*

Conclusion:

This battery is in good condition. Cycle it regularly to keep it effective and replace it when its capacity drops to below 70 or 80%.

> *Hints:*
>
> - *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 **Title** (**Edit** menu).*

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 exactly the analysis that you want.

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*

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 life test batteries, form, recondition, create and erase memory in NiCd/NiMH cells and many other advanced functions.

Let's create a simple BAR: a NiCd (or NiMH) battery test based on IEC (International Electrotechnical Commission) specifications. From the UBA Console main window select **Battery Analysis Routine Designer** (**File** menu). You should get an empty routine like this:

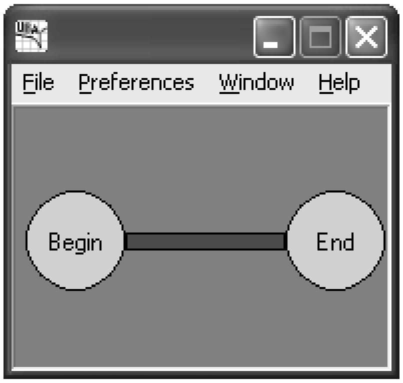


Figure 18: An empty BAR (Battery Analysis Routine).

We want our BAR to first charge the battery, so we'll add a quick charge action. Actions are the building blocks of the BAR. There's no limit to the number of actions that a BAR can contain.

Right click on the gray background and choose:
NiCd / NiMH | Add Action | Quick Charge.

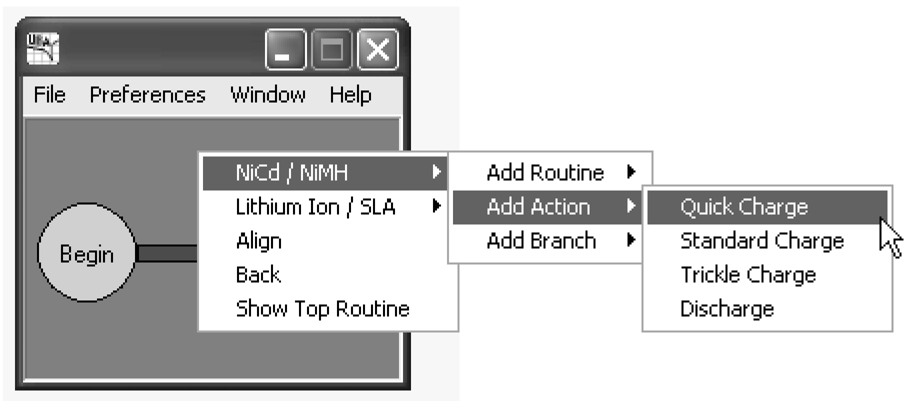


Figure 19: Adding a new action (Quick Charge) to the BAR.

Now add a standard charge by right clicking and choosing **NiCd / NiMH | Add Action | Standard Charge.**

Finally, add an action that will discharge the battery and measure its capacity. Right click again and choose **NiCd/NiMH | Add Action | Discharge**. Now would be a good time to save what you've done. Choose **Save As...** (**File** menu) and save the file as *NiCd IEC Test*. You should get this:

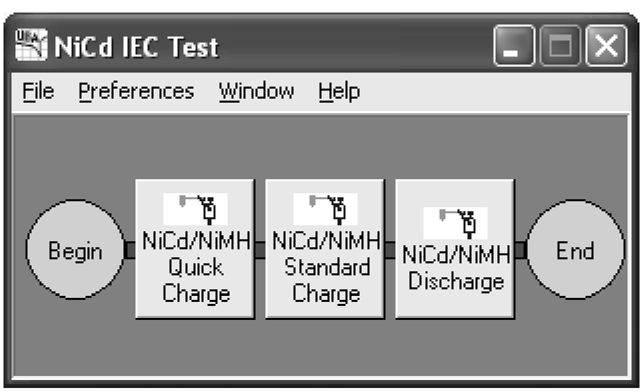
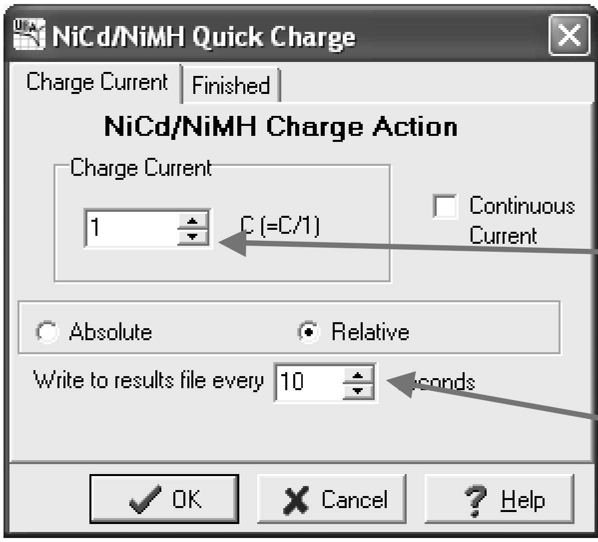


Figure 20: BAR with charge & discharge actions (action parameters not yet specified).

The BAR starts at the "Begin" circle and proceeds from left to right to the "End" circle. Each action is executed in this left to right sequence. Click **Animate** (**Window** menu) to see this.

Now to get this BAR to actually analyze a battery you need to set the charge and discharge values. Click on the **NiCd/ NiMH Quick** action and enter the parameters as shown below.

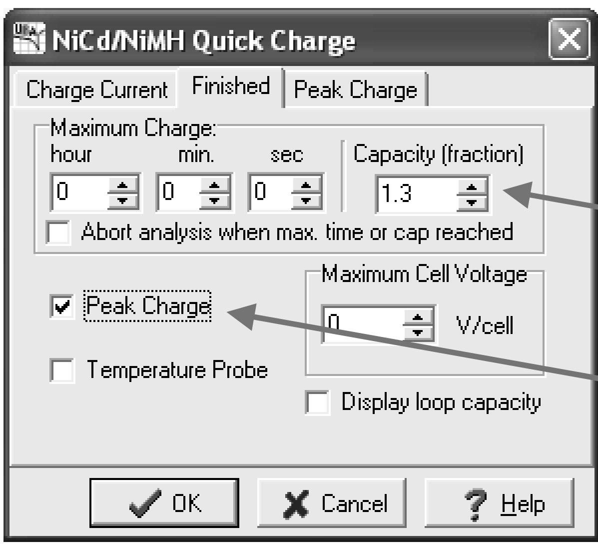


Enter “1” for the **Charge Current** which gives a current of 1C. This will charge the battery in approximately one hour.

Enter “10” for the **Sample Time**. The battery voltage and charge current will be saved every 10 seconds to the results file.

Figure 21: Charge Action: Entering the charge current parameters.

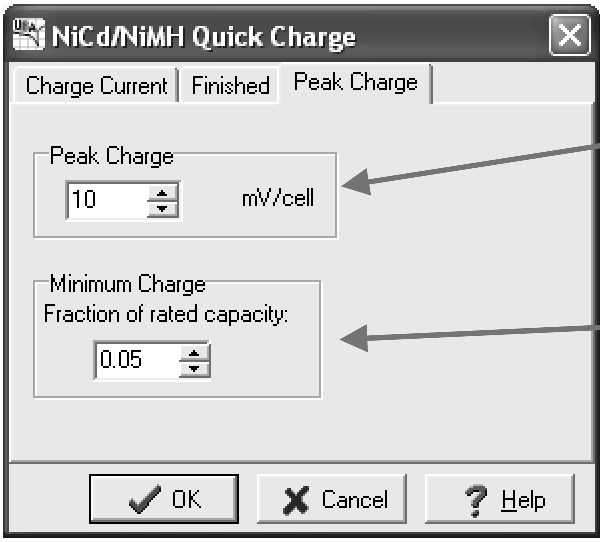
Click the **Finished** tab to enter the parameters that determine when this action ends.



Enter “1.3” for the **Maximum Charge Capacity**. Thus quick charging will end when the battery has been charged 1.3 times its rated capacity. This is a fail safe feature to limit over charging.

Click on the **Peak Charge** checkbox. This adds a Peak Charge page.

Figure 22: Charge Action: Entering the finished parameters.



Enter “10” (mV/cell) for the **Peak Charge** finish criteria. Thus when the cell voltage drops 10mV below its peak value, charging stops. For NiMH cells enter 4mV.

Enter “0.05” for the **Minimum Charge** so that during the first 5% of the charging voltage peaks are ignored. This skips false peaks that can occur at the beginning.

Figure 23: Charge Action: Entering the peak charge parameters.

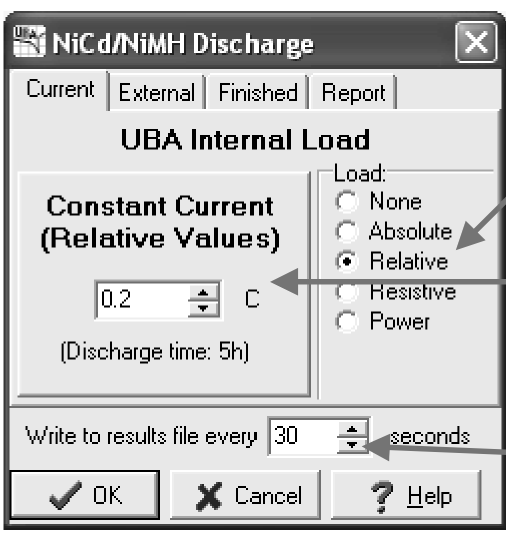
Click **OK** to save the changes.

Repeat for the **NiCd / NiMH Standard Charge** action but use these parameters:

- **Charge Current**: 0.1 C (this is a slow C/10 charge that equalizes the cells without overcharging).
- **Write to results every:** 30 seconds (saving the results more often than this gives no additional useful information).
- **Capacity (fraction)**: 0.3 (at the C/10 charge rate this gives about 3 hours of charge).

Click **OK** to save these changes.

Now click on the **NiCd / NiMH Discharge** action and fill in the fields as show below:



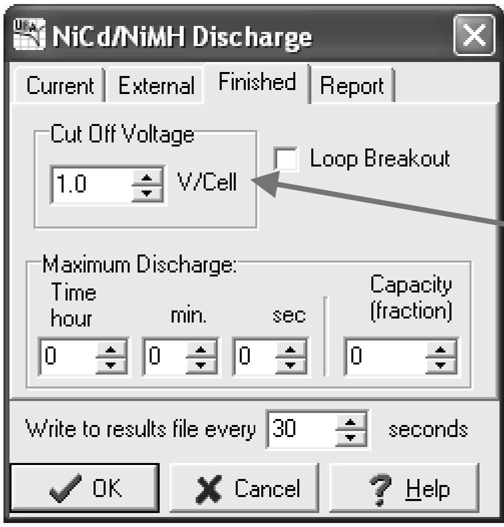
Load:
Select **Relative**.

Enter “0.2” for the **Discharge Current**. This is the IEC standard and will discharge the battery in approximately five hours.

Enter “30” for the **sample time**. Since it will take five hours to discharge the battery it's not necessary to save the voltage and current more often then this.

Figure 24: Discharge Action: Entering the discharge current parameters.

Click the **Finished** tab:



Enter "1.0" for the **Cut Off Voltage**. This is the value specified in the IEC standard.

Figure 25: Discharge Action: Entering the finished parameters.

Click **OK** to save these parameters and then **Save** (**File** menu) to save the BAR file.

That's it. You've created a new BAR that you can use whenever you want.

> *Warning: The BAR parameters that you specify are not checked by UBA Console. Nothing prevents you from setting a charge voltage of 5V, for example, for a lithium cell. This makes the UBA a very powerful tool, and also a dangerous one if you aren't careful.*

4.1. "Advanced" BAR Concepts

Renaming and Deleting Actions

Right click on an action to rename or delete it.

Rearranging Actions

If you would prefer to have the order of actions changed, drag any action to a new location. Don't forget to save the BAR afterwards.

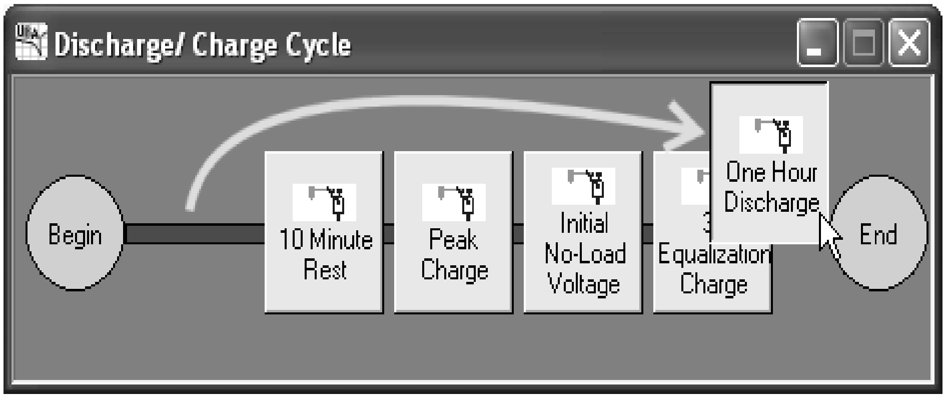


Figure 26:
*The "**One Hour Discharge**" action is dragged to be after the "**3h Equalization Charge**."*

Using BAR Routines

In order to keep the BAR layout uncluttered and easy to maintain, you can use subroutines, called routines, to group actions. For example, to add a battery analysis routine (a discharge followed by a charge action) right click on the background and choose: "**NiCd/NiMH | Add Routine | Battery Analysis Routine**. Now if you click on the newly created button you'll get the BAR subroutine. Click on **Animate** (**Window** menu) to see the action flow.

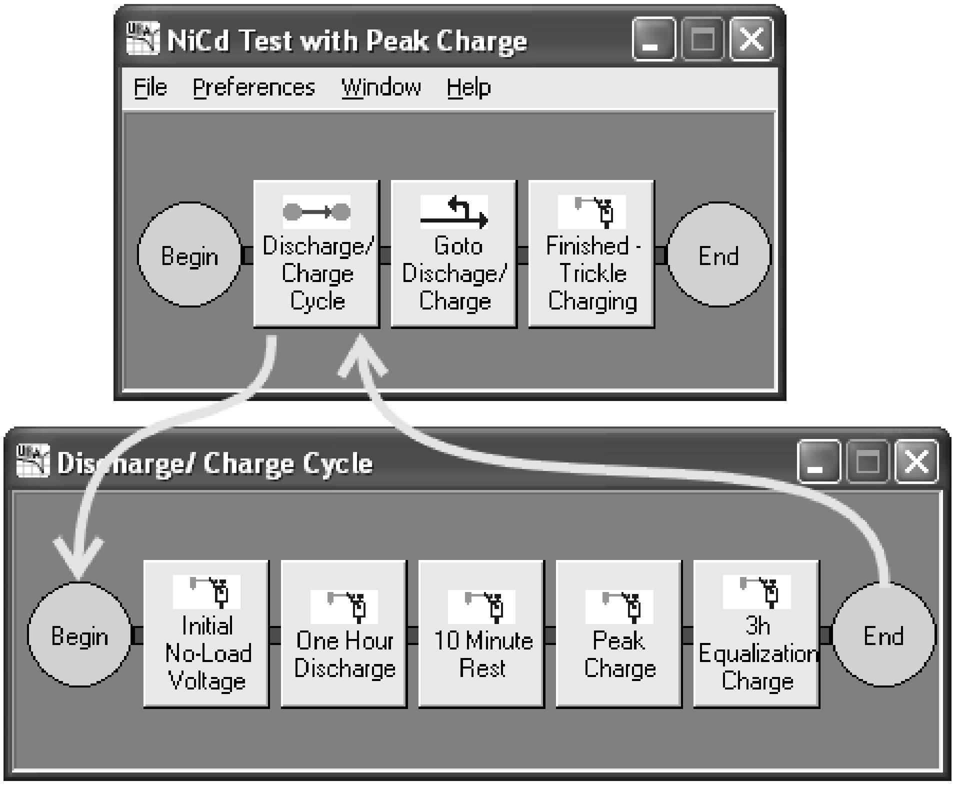


Figure 27: Action flow in a subroutine.

Relative Currents and Time

You might have noticed the use of relative currents (based on the battery's C current) and time based on capacity. This is different from other battery analysis systems. The use of relative currents allow you to design BARs that work independent of battery capacity. If you prefer, you can still specify absolute values.

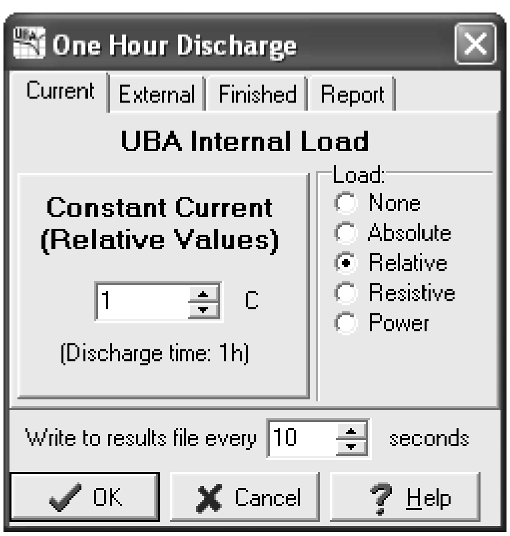


Figure 28: Here we have a relative load current of 1C. If you ran this BAR on a 600mAh battery you'd get a 600mA load, on a 2Ah battery you'd get a 2A load.

4.2. BAR Actions

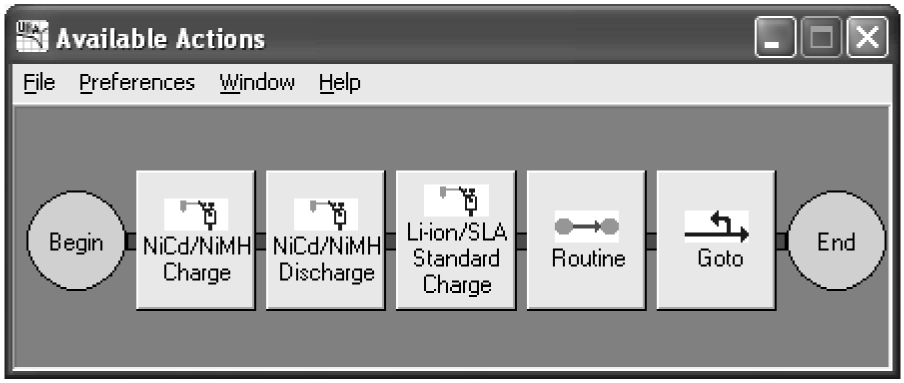


Figure 29: The five actions that you can use to build a BAR:

NiCd/NiMH Quick Charge, Standard Charge and Trickle Charge Action:

These are actually all the same – just a blank constant current action than 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 functions where a constant current charge is desired. We use it to prequalify a lithium ion battery in our lithium ion BARs.

NiCd/NiMH Discharge and Li-ion/SLA Discharge:

These are the same discharge action. You can choose the load (constant current, power, or resistance) and the termination method. You would specify about 1 V per cell for the cut off for NiCd or NiMH, about 2.75 V for lithium, and about 1.75 V for SLA.

Li-ion/SLA Standard Charge

This is the constant voltage charging action designed for lithium ion, lithium polymer and SLA/gel cells/lead acid batteries.

Routine (from NiCd/NiMH->Add Routine->Empty Routine)

This is an empty routine. Click on it to open the subroutine. There a couple of routines already populated with some actions. They are accessible from right clicking: **NiCd/NiMH->Add Routine->**.

Goto

This branches 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. See the online help for more information.

4.3. BARs Included with UBA Console

Although making your own BARs isn't very difficult (we just did one last section, remember?), 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 expert. 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 sure 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 over look something. By modifying a working one you increase the chance of getting it to work the first time.

*Hint: the BARs that came with your software are designed to minimize the chance of your overwriting them (specifically, the **Owner** field is filled in), but if you do, you can get a new copy from your install CD in the Image/BARs folder.*

See **Appendix C** for a list of the BARs included with UBA Console.

5. Advanced Topics

5.1. Choosing and Setting Up a Power Supply

The UBA requires a 15 to 24V DC voltage at sufficient current to power both its internal chargers. The voltage needs to be at least 3V greater than the maximum battery pack voltage during charge (for NiCds and NiMH this would be about 1.6V per cell, for sealed lead acid: 2.5V per cell and for Li-ion: 4.2V per cell). An unregulated power supply can be used, but the charge current measurements will be less accurate.

If you are using a power supply that can't provide the full 2A per channel charge current with an additional 250mA for the UBA itself then you can set the UBA to limit the current that it draws. This is done in the calibration file or entered manually each time UBA Console is run, as explained below.

Power Supply Description Lines in Calibration File

Each UBA has its own calibration file (xxxx.*cal*, where xxxx is the serial number of the UBA). In the calibration file the following three lines describe the power supply that's powering the UBA:

```
PowerSupplyV:
PowerSupplyI:
PowerSupplyR:
```

If you purchased a UBA combo from us then we've already entered the power supply parameters into the calibration file or left them blank if the power supply has enough current to fully power the UBA. If the UBA is used with a different power supply or if it wasn't purchased as a combo then you can edit the calibration file to prevent overloading of the power supply.

You can edit these lines with a text editor (notepad works fine). UBA Console only uses the maximum current value (`PowerSupplyI`). The voltage and resistance lines are ignored. Note, a value of 0 for the power supply current means that no current limiting is necessary (i.e. your power supply has a current output of at least 4.25A).

Temporarily Changing the Power Supply Current Limit

You can view the current limit by clicking on the "General" tab in the UBA Window:

*Figure 30: UBA Display window (click on the UBA icon in the **UBA Network** window to get this display, then click on the **General** button). In this example, the UBA Console S/W will limit its power supply current draw to no more than 1.0A.*

You can change this value by entering in a new one, but note that this number is not saved into the calibration file.

Remember that a value of 0 (zero) means that the UBA will not limit its power supply current draw (but will never exceed 4.25 A).

Sharing Power Supply Current Between Both Channels

You can specify that both channels equally share the power supply current by checking the **Evenly divide between channels** radio button on the **Charger** tab in the **Options** dialog box (**File** menu). This divides the power supply current evenly among both channels so that each can have up to half the maximum current.

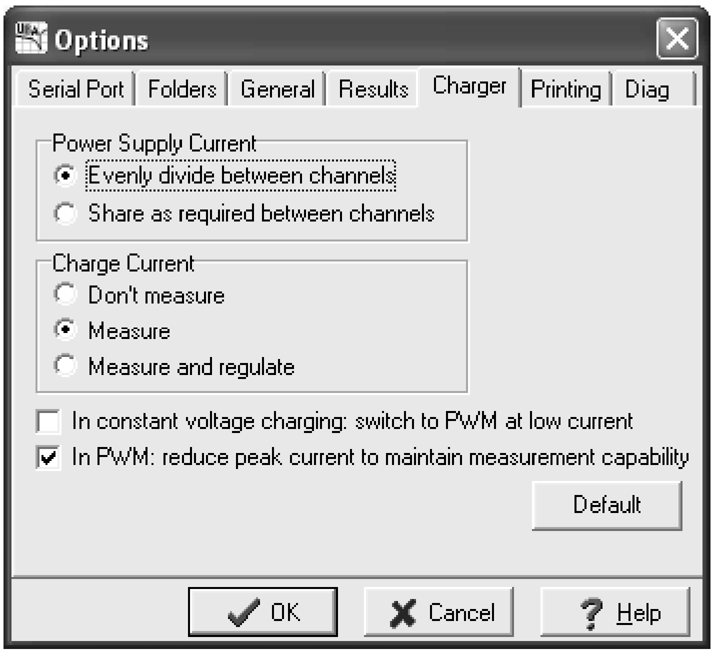


*Figure 31: Option dialog box showing the **Charger** current settings.*

Examples:

1. You have a power supply with a 4.25A or greater output current rating. Since the power supply can supply both channels with their maximum current rating (2A) with at least 250mA left over for the UBA's electronics, no output current limiting is necessary. Either a setting of 4.25 or greater or 0 in the power supply rating box is acceptable. The **Power Supply Current** radio button selection has no effect.

2. You have a 1.0A power supply which doesn't supply enough current to power both channels at their maximum charge current. You should enter 1.0 as the power supply current in the UBA's calibration file. The setting of the **Power Supply Current** radio selection box is important. If **Evenly divide between channels** is selected then each channel will get up to almost 500mA charge current. If **Share as required between channels** is selected then one channel can use almost the full 1A charge current and the other channel gets nothing.

Notes:

- If you enter in a power supply rating higher than what your power supply can provide you risk damaging your power supply.

- If your power supply can't provide the maximum current to each channel and you have checked the **Share as required between channels** radio button you should only run one battery analysis at a time. Otherwise one channel can have little or no current available for charging. The software isn't able to delay starting a charging action on a channel until the required current is available.

- If you are running the UBA off of two power supplies, one for the UBA's electronics and one for charging (i.e. the UBA5-30V) enter a negative number, i.e. -3.0 if you have a 3A power supply. The negative sign means that the power supply is not powering the UBA's electronics so the full current is available for charging.

- The UBA uses the peak current from each channel for sharing the power supply current. Therefore, if one channel is on PWM charge (i.e. the charge current is pulsing) the peak current is used.

- If you are using the UBA exclusively for testing primary batteries , set the maximum power supply current to 0.001 (1mA), not 0. The UBA will never turn on the charger.

5.2. Importing Results into a Spreadsheet

You can import the battery analysis results file (.uba file) into a spread sheet for further analysis or graphing. For example with a spread sheet you can calculate watt-hours and average voltage or plot multiple batteries on one graph.

Microsoft Excel

In Microsoft Excel, select **Open...** (**File** menu). For **Files of type:** choose **Text Files (*.prn *.txt, *.csv)**, type "*.uba" into the **File name:** 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 C**omma** 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.

In the private section on our web site you'll find a macro for Excel that imports and graphs results files automatically.

OpenOffice.org Calc

In OpenOffice.org Calc, select **Open...** (**File** menu). For **Files of type** choose **Text CSV (*.csv, *.txt)**, type "*****.uba" into the **File name** 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.

5.3. 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 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 assistance).

5.4. Current and Power Limitations

Load Limit: 3A and 45W

The UBA can discharge at 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 over heating the UBA. The UBA's 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 you will be able to use the full discharge current of 3A. The UBA will reduce the load current to keep within it's 45W maximum for batteries higher then 15V.

If you want a higher load current, combine both channels which gives you 90W of load (see the section **UBA Accessories - Channel Combiner**) or use a series power resistor (contact us for more details). 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 at up to 2A per channel (power supply permitting). It uses a low noise linear constant current charger. The difference between the power supply voltage and the battery voltage is absorbed by the UBA's charger. The 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 UBA5GP 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) x 2A). This is worst case, it's actually less than this 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), charge the cell in series with other cells or add a resistor in series with the cell (contact us for more details).

5.5. Minimum Guaranteed Voltage

For a given load current the UBA has a minimum voltage that guarantees the 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 at least 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 contact us.

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

5.6. Maximum Guaranteed Charge Voltage

The UBA is able to maintain it's maximum charge voltage 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 your power supply has enough voltage.

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. 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. Power 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 fast flashes when it detects any activity on the serial port. So 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.

Software Installation Problems

For Win95/98 and NT only: Missing updates
UBA Console requires files that don't come with a fresh install of Windows 95 or NT4. Microsoft Internet Explorer or Microsoft Office automatically install the missing files. Otherwise you can get the missing files off of our website (www.vencon.com/downloads/Win95-NT.html), the UBA Console install CD (in the "Win95_NT"), or Microsoft's website.

For Win95/98 and NT only: Icons on UBA Console Aren't Displayed
If the icons on the tool bar don't display correctly you need to upgrade your comctrl32.dll file (Microsoft Windows Common Controls). The file *50comupd.exe* installs the Internet Explorer version 5.0 version of this DLL. See above for location of files.

For Win95/98 and NT only: A required .DLL file, HHCTRL.OCX, was not found
If you get this error then you don't have the Microsoft's HTML Help software installed. Install it by running the *hhupd.exe* file. See above for location of files.

For Win95/98 and NT only: The DLL with the name "SHLWAPI.DLL" is not found
If you receive this error message, you will need to install s*hlwapi_Win95.exe* or *shlwapi_NT4.exe*. See above for location of files.

Appendix B – FAQs

Battery Testing

How do you run a battery life test?

Change the repeat count in a BAR that cycles the battery to a large value (99,999 for example). 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** (Results Viewer **File** menu). This writes a comma separated table of capacity vs cycle number which can be loaded into your favorite spreadsheet. 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 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 5 seconds low load and 1 second high load for a two-way radio) and the main loop did a life cycle test. The only limit is screen size, and you can get around that by using routines.

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?

Well you can do a Quick Test (on the Multitester Instrument) in just a few seconds which measures your battery's internal resistance. This tells you how bad the battery is, but not 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.

If you have the time, a full battery discharge is best. This can be done in as little as 1 hour (or 30 minutes if you don't mind stressing your battery a bit), provided the battery is initially fully charged and the load current is within the UBAs 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.

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

Sure. 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.

General

How to you 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). The record is 30 UBAs on one serial port (that's 60 channels). Don't try this with Win95, Win98 or WinMe as they have limited graphical resources.

How often does the UBA need to be calibrated?

We recommend a one year calibration interval. We have found that it's rare for a UBA being recalibrated to require any changes to the calibration file since there are no adjustable parts inside that can drift.

Can I use a UBA to turn on my charger?

The accessory port on the UBA, which is located inside, has two digital outputs and two analog inputs. You can control the output lines with your BAR (use external battery 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.

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 (or more) is being dissipated.

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

For small batteries, less than 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 1uA full scale.

I have a question about the database.

Stay away from the database functions in UBA Console (unless you really need them). They are only partially implemented and are not written very well. We will be rewriting them in the future and can't guarantee backwards compatibility.

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.

Appendix C – Included Battery Analysis Routines

The following BARs are included with the UBA. You're free to examine and modify them in the Battery Analysis Routine Designer and save them under a different name.

Battery Analysis Routine	**Chemistry**	**Used for:**
NiCd Peak Charge	NiCd	Peak charging a NiCd or NiMH battery in any initial charge state. If the battery hasn't been cycled in a while, the peak charge might end prematurely due to false peaks. If this happens then you should use the *NiCd Test with Timed Charge* or *NiMH Test with Timed Charge* routine.
NiMH Peak Charge	NiMH	
NiCd Test with Peak Charge	NiCd	Cycling a battery to determine its capacity and exercising it. Use this routine if the battery is regularly cycled. If you're getting premature false peaks while charging then you should use the *NiCd Test with Timed Charge* or *NiMH Test with Timed Charge* routine.
NiMH Test with Peak Charge	NiMH	
NiCd Test with Timed Charge	NiCd	Cycling a battery to determine its capacity and exercising it. This routine takes longer then the *NiCd Cycle with Peak Charge or NiMH Cycle with Peak Charge* routine but it won't false peak on a battery that hasn't been cycled in a while.
NiMH Test with Timed Charge	NiMH	
NiCd Forming	NiCd	Forming 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 peak charge.
NiMH Forming	NiMH	
NiCd Recondition	NiCd	Reconditioning NiCd and NiMH batteries with low capacity. It uses a two step discharge: the battery is discharged then deep discharged followed by a peak charge. This cycle is repeated twice. Restoration of capacity works best on cells that don't suffer from physical deterioration (normally the separator).
NiMH Recondition	NiMH	

Battery Analysis Routine	Chemistry	Used for:
Li-ion Charge	Lithium-ion Lithium-polymer	Charging a lithium ion or lithium polymer battery. Before using this routine, check that the default charge voltage (4.2V) is appropriate for the battery otherwise the battery can be damaged or explode.
Li-ion Test	Lithium-ion Lithium-polymer	Cycling a lithium ion or lithium polymer battery to determine its capacity. Before using this routine, check that the default charge voltage (4.2V) is appropriate for the battery otherwise the battery can be damaged or explode.
SLA Charge	SLA, gel cell or lead acid	Charging a sealed lead acid (SLA) or wet lead acid battery. It uses a two step charge algorithm consisting of a current limited charge to 2.40V/cell followed by a float charge at 2.3V/cell.
SLA Test	SLA, gel cell or lead acid	Cycling your battery to determine its capacity and exercising it. It discharges the battery and then charges it back up using a two step charge algorithm.
Cyclone Test	Cyclone Sealed-Lead cells	Cycling a Cyclone Sealed-Lead cell. This routine discharges the cell and then charges it back up.
Datalog	N/A	Logging the voltage on the battery or accessory inputs and logging temperature.

UBA Accessories – Optional Temperature Probes

If the UBA came with temperature probes then you'll be able to view and record the battery temperature during a battery analysis. Afterwards you can load the results into a spreadsheet and plot the temperature curve along with battery voltage and current.

That's not all. You can program the software to stop battery charging when the battery reaches a certain temperature or rate of temperature rise (dT/dt).

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, the blue one into the upper two pins and the white one into the lower two pins. The centre two pins are not used. 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.

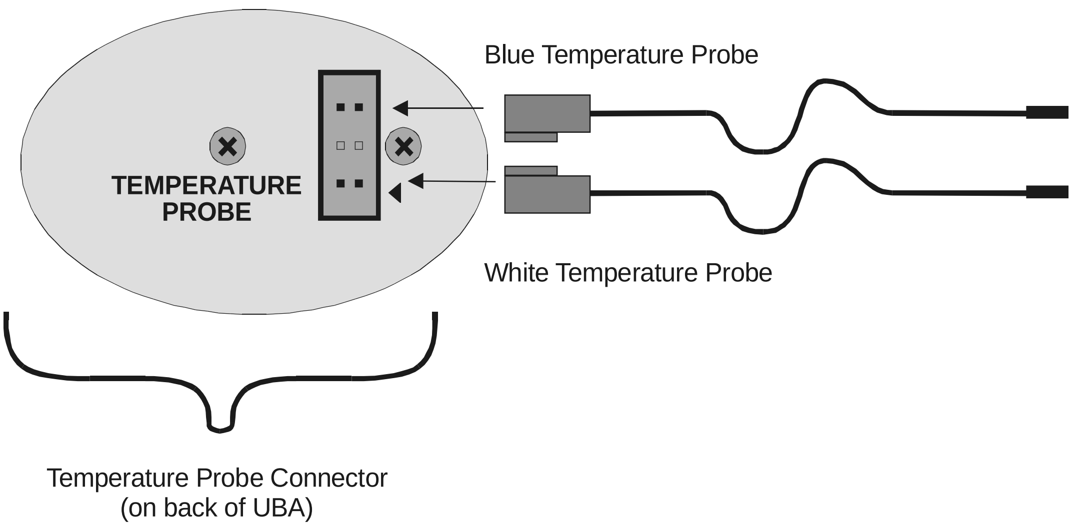


Figure 32: Temperature Probe connections on back of UBA chassis.

Checking the Operation of the Temperature Probes

Start UBA Console and initialize the UBA network. Start a Multitester and choose the **Setup** tab. Click on the **Get Battery temperature from:** 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 a selection). If there are no probes listed then your calibration file isn't set up for temperature probes. 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 the battery. If the battery is non-metallic then you can tape the magnetic probe on. You want the probe to contact the warmest part of the pack.

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. If you want the charging to be controlled by temperature then you'll need to set this in the BAR. For NiCd/NiMH charging, open the BAR in the BAR designer and click the charging action. Select the **Finished** tab and check **Temperature Probe**. On the **Temperature** 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.

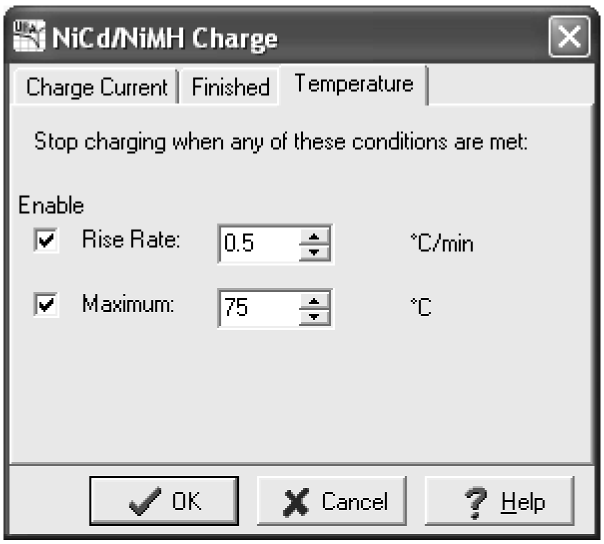


Figure 33: Temperature conditions that terminate battery charging for NiCd/NiMH cells.

The BAR Designer has a option where if the temperature probe reaches a specified temperature, the battery analysis is ended (not just the action).

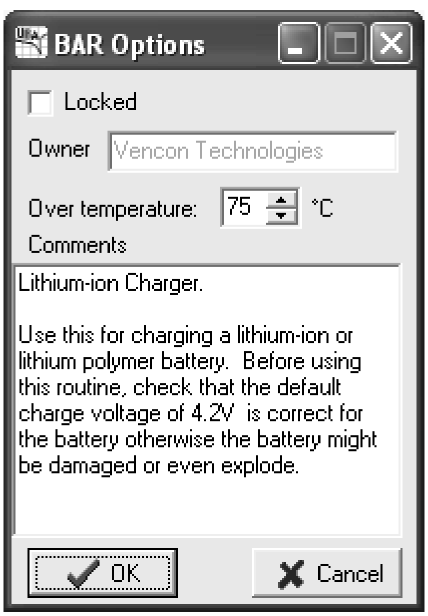


Figure 34: Maximum battery temperature in a BAR (mainly used for lithium cell charging).

When Is a Battery Fully Charged?

The most important part in fast charging is knowing when to stop. Overcharging a battery is dangerous and can damage it. In the graph on the next page we deliberately overcharged a NiMH battery to show you what happens. Look at the battery temperature line. It rises slowly at first then quickly rises when the battery is almost 100% charged. The fast charging stops when the temperature reaches the maximum temperature of 45ºC as set in the BAR. If the fast charging didn't stop then the temperature would continue to rise and the battery would eventually vent (release electrolyte) causing permanent battery degradation. Overcharging a lithium-ion or lithium-polymer battery can result in the battery bursting into flames.

Now look at the voltage graph. This is the most common method to terminate a NiCd/NiMH quick charge as it requires no temperature sensing. The "X" axis is the fraction of charge being put into the battery. At "1.0", in theory, the battery would be fully charged. In actuality the battery isn't fully charged until a bit past this value. The line at "**A**" is the point where the battery voltage has dropped enough (about 2mV/cell) so that a peak charge would have stopped there. Notice at "**A**" the battery receives about a 5% overcharge (based on a theoretical 100% efficiency charge) which is acceptable.

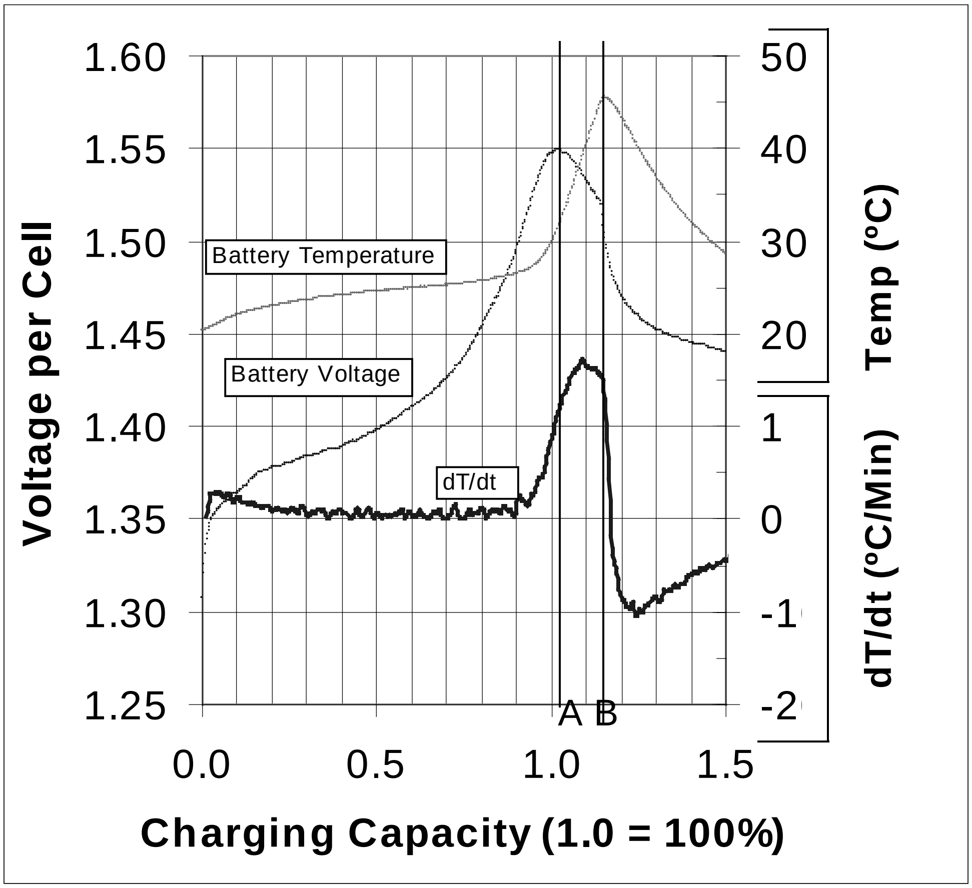


Figure 35: Test results from deliberately over charging a NiMH battery pack.

Now look again at the temperature graph. We've drawn two temperature curves - one for the battery temperature and the other for the rate of battery temperature change. The temperature peaks at line "**B**" which is when the charger was turned off. A temperature cut-off works best as a backup method of ending the battery charge action. Temperature rate of change (dT/dt) is a better method of determining when the battery is fully charged. In this example, if you would have specified a maximum temperature rise of 1ºC/minute then the charging would have terminated exactly at the 100% efficiency fully charged mark. Since rate of temperature change is dependent on the battery pack construction (the less cooling the faster the temperature will rise) it's difficult to come up an optimum value to use.

What's best? We recommend that you start with a maximum battery temperature of 35 to 40ºC and a maximum dT/dt of 0.5ºC/minute to 1.0ºC/minute. If the charging is stopping too early then increase these values. You can tell what caused the charging to stop from the text at the bottom of the results viewer.

You can use the UBA to create your own voltage and temperature graph. Run a battery test with a temperature probe. Then import the results file into a spreadsheet program and use a simple formula to get the dT/dt (in degrees Celsius per minute): ((Temp2-Temp1)/(Time2-Time1) * 60). For this graph shown here we matched up the end of fast charge and beginning of slow charge which compensates for the voltage drop of the cable (during peak charge the battery voltage is sampled with the charge current on, afterwards the battery voltage is sampled with the charge current off).

UBA Accessories - Channel Combiner

Channel Combining on a Single UBA

The channel combiner allows you to combine both channels of the UBA doubling the charge and discharge current and power. To do this, connect the battery positive terminal to both positive battery inputs and the battery negative terminal to either negative battery input (the negative battery inputs are already wired together).

The Channel Combiner makes this easy to do. Plug one end of the channel combiner into either positive input (red) on the front of the UBA and the other end into the other positive input. The battery to be tested is then connected to either of the negative (black) inputs and to the banana input on the channel combiner. See diagram below.

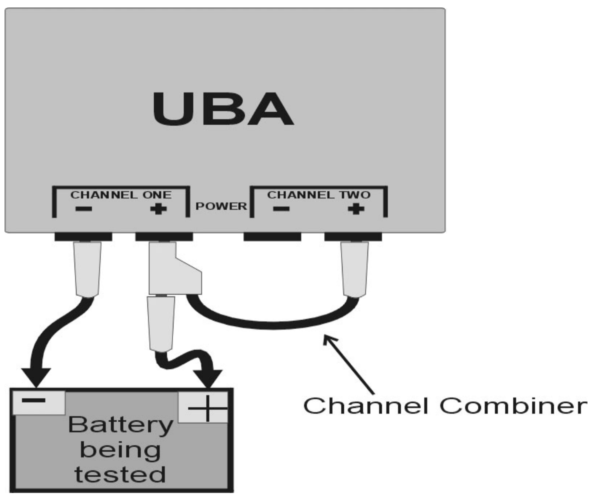


Figure 36: Using the UBA Channel Combiner.

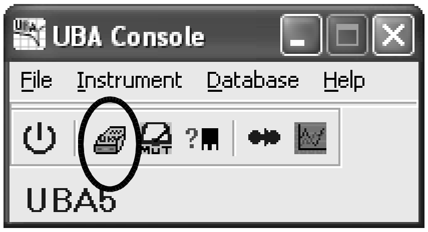
Channel Combining on Two or More UBAs

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, the battery current will flow through the serial cable and the power supply lines.

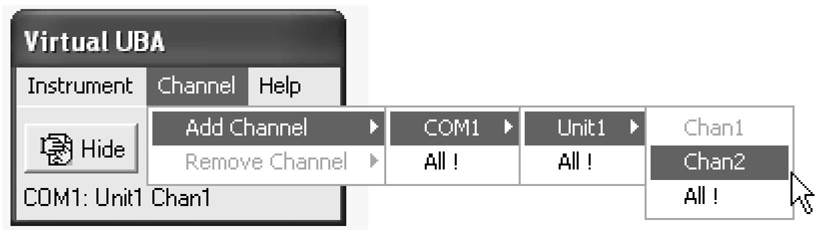
Software Instructions

Once you've physically connected the channels in parallel you have to set up a “virtual UBA” that controls these combined channels. The virtual UBA acts as if it's a single channel, but with higher current and power limits plus the ability to choose which physical channel or channels sample the voltage and which physical channel or channels supply the load.

1. Start a virtual UBA by clicking on the circled **Virtual UBA** icon:



2. Add channels to it by clicking on the **Channel** menu:



3. Then start a battery test on the virtual UBA by clicking on the **Instrument** menu:

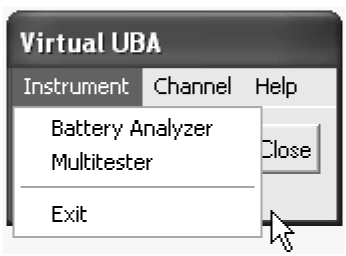


Figure 37: Software instructions for combining channels and starting a battery analysis.

UBA5 Specifications

Battery Types

Chemistry:	NiCd, NiMH, lead acid, gel cell, Li-ion, Li-poly and all primary cells.
Voltage & Number of cells (in series):	0 to 6.5V & 0 to 24V (accuracy ±0.2% rdg ±10mV) o Li-ion, Li-poly cells: 1 to 5 cells in series o NiCd, NiMH: 1 to 16 cells in series o Lead acid, gel cell: 1 to 9 cells in series
Capacity:	20mAh to 120Ah (or more)

Internal Load (one per channel)

Type:	Programmable constant current or pulse discharge.
Current:	12mA to 3A in 12mA increments with 45W limit.
Load terminated by any of the following conditions:	Cut off voltage, maximum time, maximum capacity, or temperature with optional temperature probe.
Accuracy:	0.5% reading ±2mA
Resolution:	0.1mAh

Internal Charger (one per channel)

Type:	Programmable constant current, constant voltage, duty cycle or any combination.
Current:	1mA to 2.0A
Charge terminated by any of the following conditions:	Maximum time or capacity, minimum current (for constant voltage charging) peak/deltaV (for NiCd & NiMH) and absolute or rate of temperature change using optional probes.

Miscellaneous

Battery input:	Banana connectors (two pairs of cables included).
Accessory ports:	Two (extra analog and digital lines for accessories).
Power:	DC: 15V to 26V, 4.5A max. 120/230VAC universal power supply comes with UBA “combos”.
Approvals:	CE and FCC, RoHS and WEEE compliant.
Size, Weight:	130mm x 170mm x 75mm (WxLxH), 820g
Warranty:	Two year parts and labour against defective materials and workmanship.
Software:	UBA Console included (for Win9X/NT4/2000/XP/Vista/Linux-Wine)