Configuring Smart-UPS® and Smart-UPS XL

Executive Summary

Smart-UPS and Smart-UPS XL behavior can be flexibly adjusted to the actual operating condition through an extended set of user-configurable parameters. Proper parameter setting highly enhances the UPS performance thus considerably increasing reliability and availability of the power protection as a whole.

This application note is intended for Smart-UPS and Smart-UPS XL users.

The purpose of this note is to help Smart-UPS and Smart-UPS XL users further enhance the quality of power protection by providing a detailed discussion on how to properly adjust Smart-UPS behavior in order for it to deliver the best performance in the particular conditions.

Table of contents

Introduction

Smart-UPS is called smart by no accident. Featuring sophisticated microprocessor control it can adapt to a wide variety of conditions. Nonetheless its performance can be further enhanced by fine-tuning its behavior through several parameters, which users can configure according to their needs. Every Smart-UPS leaves the factory preset with default settings. These settings are optimal for a typical, or an average situation. However, you situation may be different therefore some adjustment may be desirable.

Also, if you purchased Smart-UPS XL and a few external batteries you just have to let the Smart-UPS XL know the actual number of external batteries, otherwise Smart-UPS XL will not be able to accurately calculate the remaining runtime, which may lead to premature shutdown.

Getting access to the user-configurable parameters of Smart-UPS

In order to gain access to the user configurable parameters of a Smart-UPS you may use one of the three approaches:

1. Using PowerChute Business Edition software (included with every Smart-UPS);
2. Using Internet browser like Internet Explorer (provided your UPS is equipped with a SmartSlot Network Interface Card, available from APC),
3. Using PowerView remote display (available from APC).

Additionally, you may select sensitivity level and (in some models) low battery warning threshold using the button on the rear panel of the UPS

The exact procedures will be described below.

User-configurable parameters of Smart-UPS

Read the functional descriptions of user configurable parameters given below and decide if they are applicable to your situation. Also, please refer to you UPS user manual in order to verify that your UPS allows this parameter to be configured. Some models of Smart-UPS, especially Smart-UPS SC, have limited feature set and therefore might have some parameters unavailable for user configuration.

Power parameters

Nominal output voltage (230VAC models only)

The 220/230/240 VAC Smart-UPS's on-battery output voltage may be configured to allow the user to adapt the UPS for use with loads that were designed strictly for particular nominal utility voltage. In order to provide your load with exactly the voltage it's been designed for read the specification on the load or find a sticker that specifies nominal voltage it requires, and adjust Smart-UPS's output voltage accordingly. Such a sticker can usually be found on the back panel of the device.

Sensitivity

The Smart-UPS's sensitivity to rapid changes in utility voltage (e.g. spikes, abrupt sags) or abnormal changes in utility frequency may be configured to allow use of the UPS in "noisy" electrical environments where it might otherwise continually transfer to on-battery operation. For example, such an environment is often created by inexpensive fuel-powered generators. Frequent transfer to on-battery operation not only annoys the user, but also shortens the operating life of the battery. The Smart-UPS better protects loads that are insensitive to such line voltage fluctuation because the battery remains fully charged. The UPS offers three levels of sensitivity settings:

1. High (default)
2. Medium
3. Low

Transfer points

The Smart-UPS may be configured to transfer to on-battery operation over a wide range of utility voltages. Loads designed to operate over a wide input voltage range can be protected without the annoyance of frequent transfers.

Understanding Smart-UPS transfer points is not as easy as it seems though not really difficult, either.
Let's take SUA1000XL as an example. With its nominal voltage specified at 120V, the available upper transfer point options are 127, 130, 133 and 136V. The available lower transfer points are 106, 103, 100 and 97V.
At the same time the specification for SUA1000XL (*which at the moment this application note was being prepared could be found at* http://www.apc.com/resource/include/techspec_index.cfm?base_sku=SUA1000) states the input voltage range as:

Table 1 – Input voltage ranges for SUA1000XL

Input voltage range for mains operations	82-144 V
Input voltage adjustable range for mains operation	75-154 V

What is the relationship between these numbers?
The key fact here is that the upper and lower transfer points specify the maximum and minimum output voltages, respectively. E.g., setting the upper transfer point to 127V and the lower transfer point to 106V would guarantee that the load will never see the voltage beyond the range of 106 to 127V.
Let's consider a scenario. Suppose the upper transfer point of a SUA1000XL is set to 127V and the lower transfer point is set to 106V. At the beginning let input voltage be 120V, hence the output voltage of SUA1000XL being 120V as well. Then the input voltage begins to decrease. The output voltage decreases along with the input voltage until it hits the lower threshold of 106VAC. At this point the Automatic Voltage Regulator (AVR) kicks in and boosts the output voltage by a certain extent, which is 15% in the case of SUA1000XL. The output voltage rises up to 106 x 1.15 = 121.9V. If the input voltage continues to decrease, the output voltage follows it, staying 15% higher than the input voltage. But once the output voltage hits the lower threshold of 106V again, the input voltage at this point being 92.2V, the AVR doubles the boost (in models where equipped, and enabled by operating conditions) by yet another 15% (in case of SUA1000XL). The output voltage rises to 92.2 x 1.30 = 119.8VAC again. Should the input voltage keep on decreasing, the output voltage would also decrease proportionately until it hits the lower threshold of 106VAC yet one more time. At this point the input voltage is 82VAC, and the AVR has no more taps to switch to. Only now the UPS goes to battery and the output voltage rises to 120V.
On the opposite side, when the voltage increases above nominal, Smart-UPS works in a similar way. The AVR in this case makes only one attempt to trim the input voltage (by 13% in case of SUA1000XL) in order to keep the output voltage below the threshold of 127VAC. If the input voltage increases further the UPS goes to battery, generating output voltage of 120V.

The following two graphs illustrate the explanation given above. Here, the light blue and green beams represent the upper and lower transfer points, respectively. Together, they comprise the allowed output voltage range. The output voltage may not drift beyond these limits.
The red line reflects the transfer points when the voltage is decreasing and the dark blue line designates the transfer points when the voltage is increasing.

Graphs are given for two situations: for the narrowest and for the widest output voltage ranges.

Figure 1 – SUA1000XL transfer voltages with upper transfer point set to 127V and the lower transfer point set to 106V

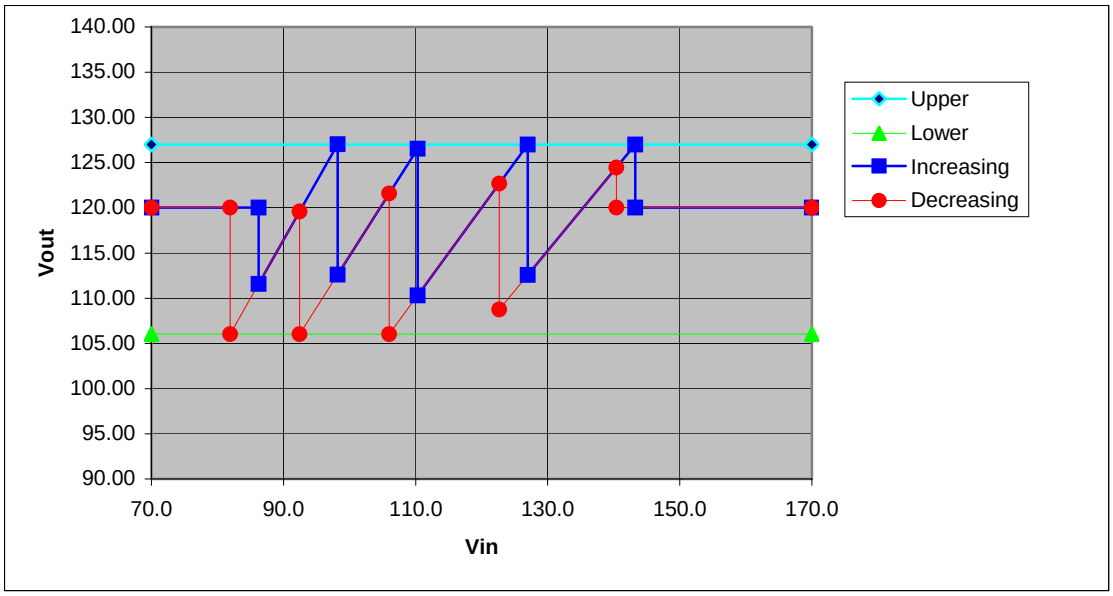
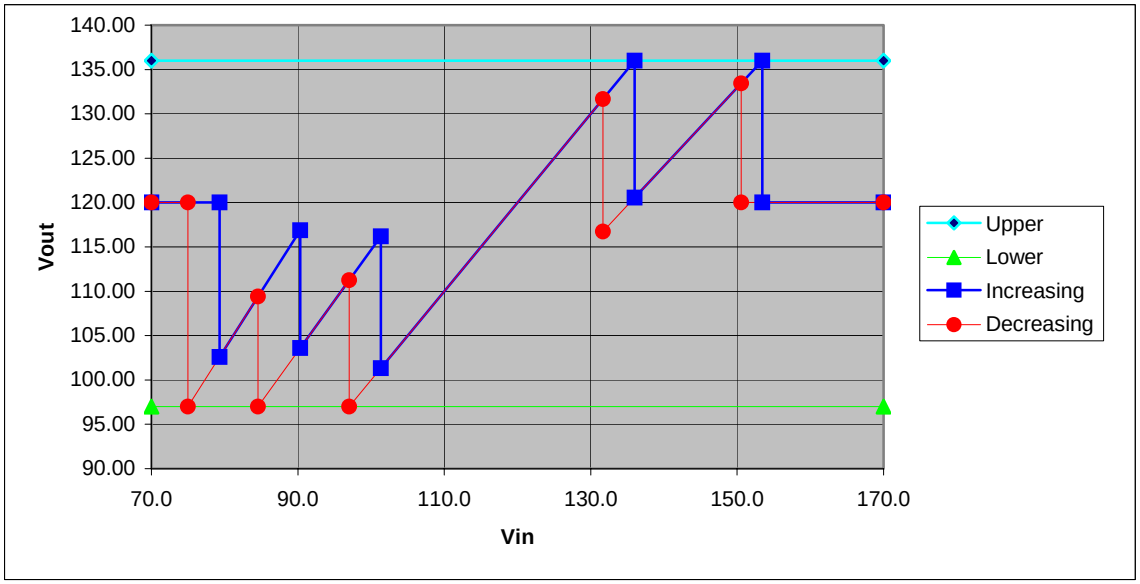


Figure 2 – SUA1000XL transfer voltages with upper transfer point set to 136V and the lower transfer point set to 97V



Smart-UPS models other than SUA1000XL operate in the same fashion; with the only difference that the actual transfer point voltages and AVR correction ratios may be different.

The user bears the responsibility to decide how wide the output voltage range his or her load is capable of withstanding. By default, every Smart-USP is preset at the factory to provide the narrowest output voltage range.

Battery management

Automatic self-test

Smart-UPS is equipped with diagnostic functionality which ensures early detection of potential problems by periodic testing of UPS components. During the self-test the UPS momentarily transfers to battery in order to verify its readiness to support the load for the time when the real black-out occurs. It is during this procedure when the bad battery condition can be revealed and reported to the operator. APC recommends testing the UPS on a regular basis. It is better to reveal bad battery condition before the real black-out strikes and the bad battery renders the UPS useless just when it's most needed.

The parameter that defines the self-test occurrence has 4 options available:

1. At turn-on and every 14 days thereafter (default),
2. At turn-on and every 7 days thereafter,
3. At turn-on only
4. Never.

APC does not recommend setting it to "never". This option is for service purposes only. The self-test procedure is completely safe for the load. Even if the battery is bad, the load will not suffer because if the battery is found to be incapable of supporting the load the UPS will instantaneously retransfer back online in a matter of milliseconds.

Date of last battery replacement

Usually the batteries life is predicted to be anywhere between 3 to 6 years. Therefore if the UPS is used for longer than that then the batteries would probably have to replaced at least once. In order to keep track of the date of replacement and to be able to plan for the date of the next replacement, Smart-USP provides this data field for you to store the date of last battery replacement.

The number of battery packs (for XL only)

When on battery, Smart-UPS is continuously calculating the remaining runtime based on the battery capacity, age, load, etc. In order for these calculations to be accurate it is very important to inform the UPS about how many external batteries are connected. This is done through setting the number of external batteries. If this parameter is not set correctly the runtime calculation will not be accurate resulting in premature shutdown.

Shutdown behavior

Alarm Delay After Line Fail

For applications where the Smart-UPS is used as a remote power source or where the UPS frequently transfers to on-battery operation due to poor utility power quality, operation of the audible alarm can be altered so that it will not become an annoyance. The unit may be set to silence the audible alarm until the utility failure has lasted for more than 30 seconds. The alarm can also be silenced until low battery, or defeated for all utility and battery conditions using power management software.

There are four options:

1. The UPS starts beeping after 5 seconds on battery (default).
2. The UPS starts beeping after 30 seconds on battery.
3. The UPS starts beeping only when the Low Battery threshold has been reached.
4. Never.

Low battery warning

Because shut down and file saving routines can take longer than the default 2 minute low battery warning interval, the Smart-UPS offers a choice of extended intervals up to 20 minutes.

Shutdown delay

When the shutdown sequence has been initiated by the low battery warning of a UPS, the operating system sends the USP shutdown command at the end of its own shutdown sequence, in order to turn the UPS off. However, some computer networks are unable to issue UPS shutdown commands as the last part of a shutdown routine. In these cases, it is up to the UPS to provide some delay before actual shut down to allow the network to finish the shutdown routine. The Smart-UPS's shut down delay in response to a shutdown command can be extended from 20 seconds (default) to as long as 16 minutes.

Minimum capacity before return from shutdown

Many networks and multi-user computer systems cannot withstand unexpected shutdowns and demand a known interval of protection under all circumstances. However, repetitive power outages can cause a UPS to shut down in a period less than the low battery interval due to reduced battery capacity caused by the earlier power outages. Hence, the shutdown is unexpected and could cause lost or corrupted data. In such cases, it is preferred to keep a UPS shut down following an extended power outage until the batteries have had the opportunity to sufficiently recharge. The battery capacity necessary to restart may be set so that the Smart-UPS will always provide a known minimum run time.

Synchronized turn on delay

Where multiple network servers are required to be powered in a known sequence, this parameter determines the delay, from 0 seconds to 16 minutes (the range varies among different Smart-UPS models, see the user manual for a particular UPS), after which the Smart-UPS's outputs will be energized following return of normal utility voltages or a scheduled shut down.

UPS identification

The UPS may be assigned a name in order to differentiate among multiple UPS on the network. The name must be 8 characters long and may be comprised of any combination of numbers, Latin alphabet letters, space and underscore characters.

Adjusting sensitivity and low battery warning signal using the controls on the back panel of the UPS

On the back panel of a Smart-UPS there are voltage sensitivity control button (1) and indication LED (2). Using these controls one can set the UPS sensitivity (see discussion above), and, in some models, low battery warning.

Setting sensitivity:

Press voltage sensitivity button (1). Use a pointed object (such as a pen) to do so. The sensitivity will be changed and the LED (2) will reflect the current setting:

- Brightly lit: High sensitivity
- Dimly lit: Medium sensitivity
- Off: Low sensitivity

Setting Low Battery Warning

(some models only, refer to your User Manual to check if your Smart-UPS supports this feature)

Press the On/Test button on the front panel of the UPS and, holding it, press the voltage sensitivity button (1). The Low Battery Warning setting will be changed and the LED (2) will reflect the current setting:

- Brightly lit: 2 minutes
- Dimly lit: 5 minutes
- Off: 8 minutes

Note: Other settings may include 10, 12, 15 and 18 minutes and are accessible via software, web-interface or PowerView display (see below)

Note: If you hold the On/Test button for 4 seconds or longer, the self-test will begin. Self-test does not affect the procedure of setting low battery warning via voltage sensitivity button.

Configuring Smart-UPS using PowerChute Business Edition

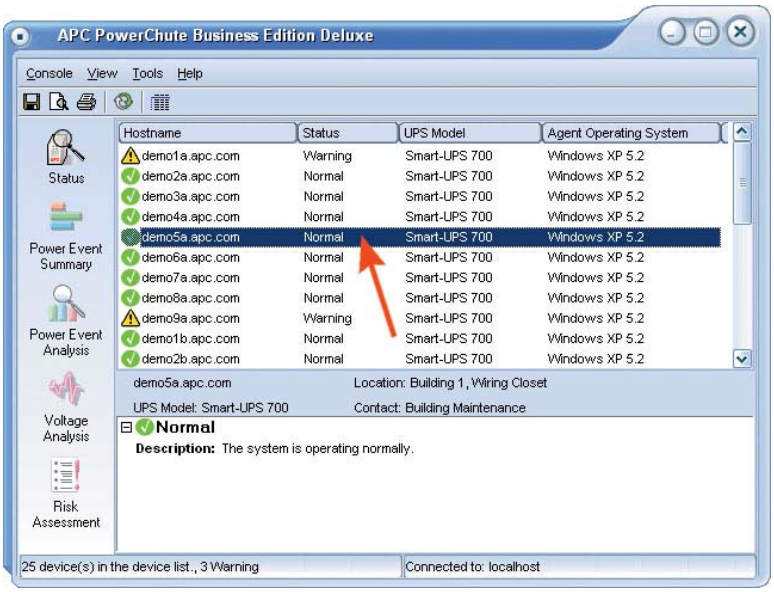
At the time this application note was being prepared the latest version of PowerChute Business Edition Basic software was 7.0.2 and was available for free download at

http://www.apc.com/tools/download/software_comp.cfm?sw_sku=SFPCBE702

Not all of the user configurable parameters can be set or modified using PowerChute.

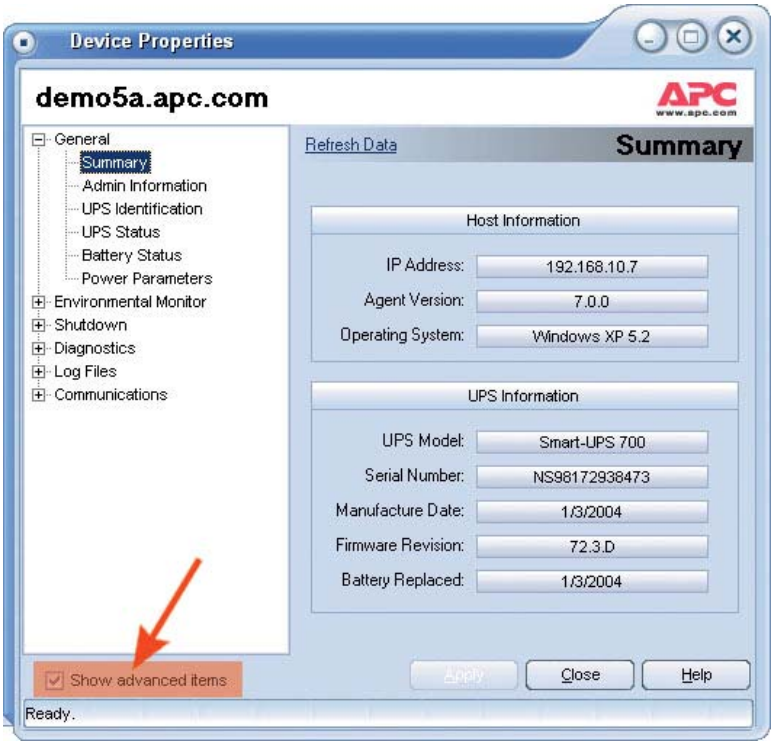
Start PowerChute Business Edition Console.
(please refer to PowerChute Business Edition user's manual for installation and operation instructions)

You should see a screen similar to the one on the right:



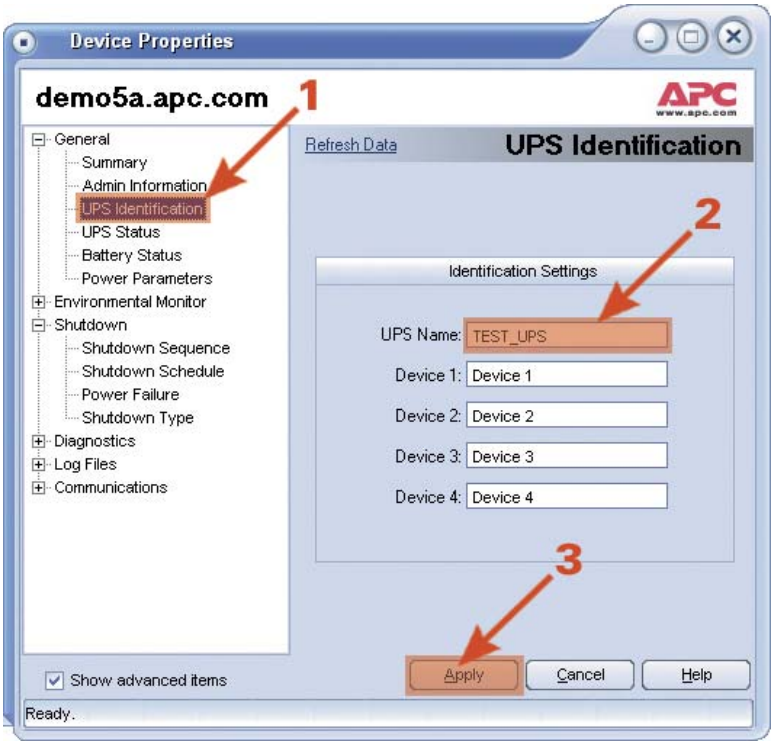
Find the UPS you want to configure from the list and double-click on it.

The Device Properties dialog will open:

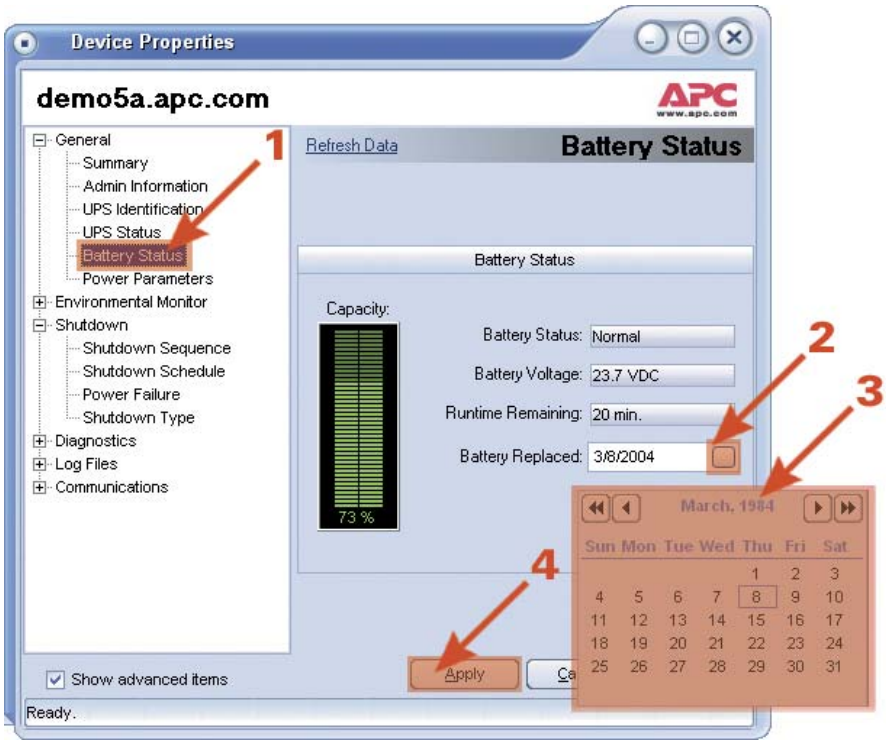


Make sure the you've checked "Show advanced items" in the lower left corner

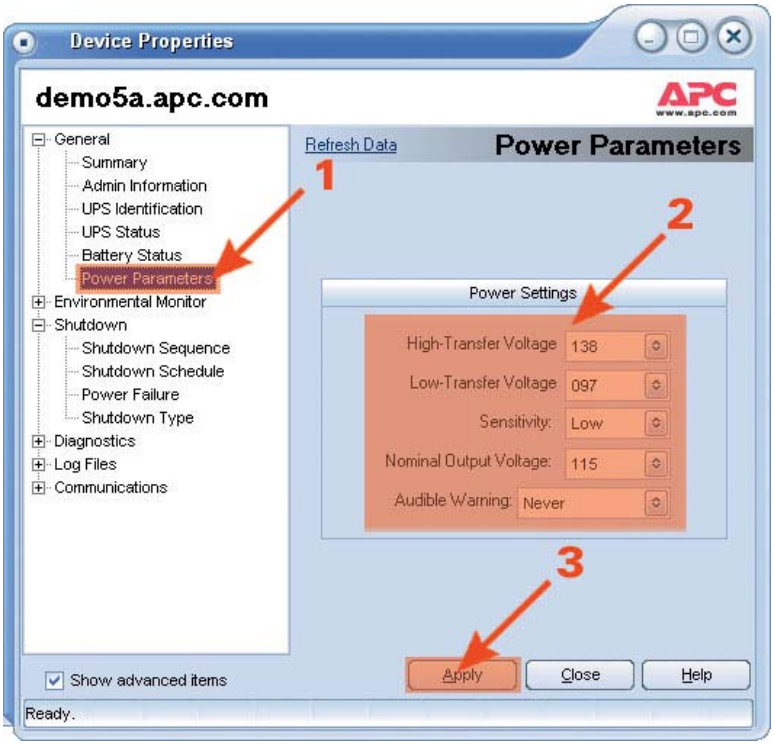
Changing the UPS identification:



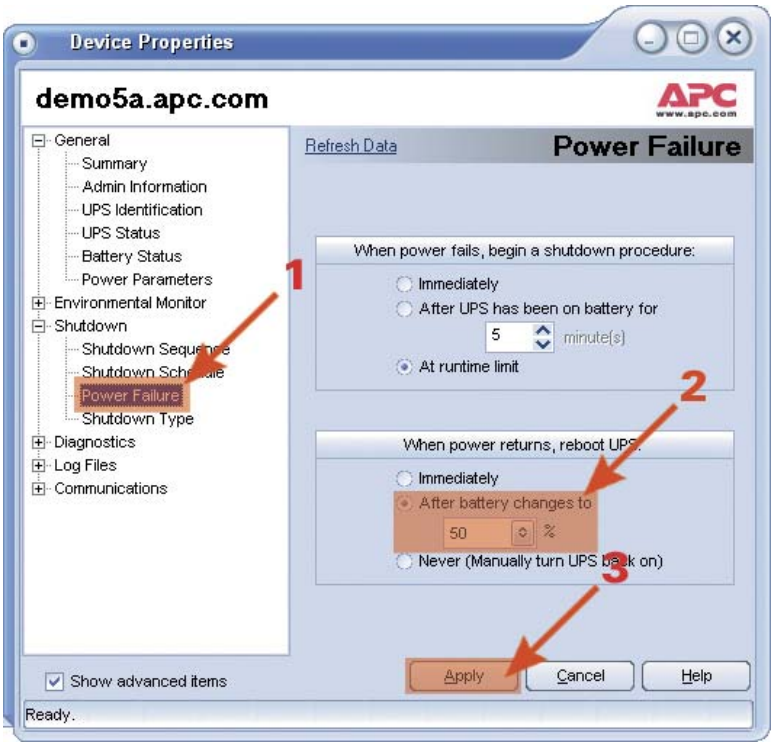
Updating the date of latest battery replacement:



Adjusting transfer points, output voltage, sensitivity and audible alarm:



Adjusting the minimum capacity before return from shutdown:



Configuring Smart-UPS using Web-interface

In order to gain access to Smart-UPS via web it has to be equipped with a SmartSlot® Network Interface Card.

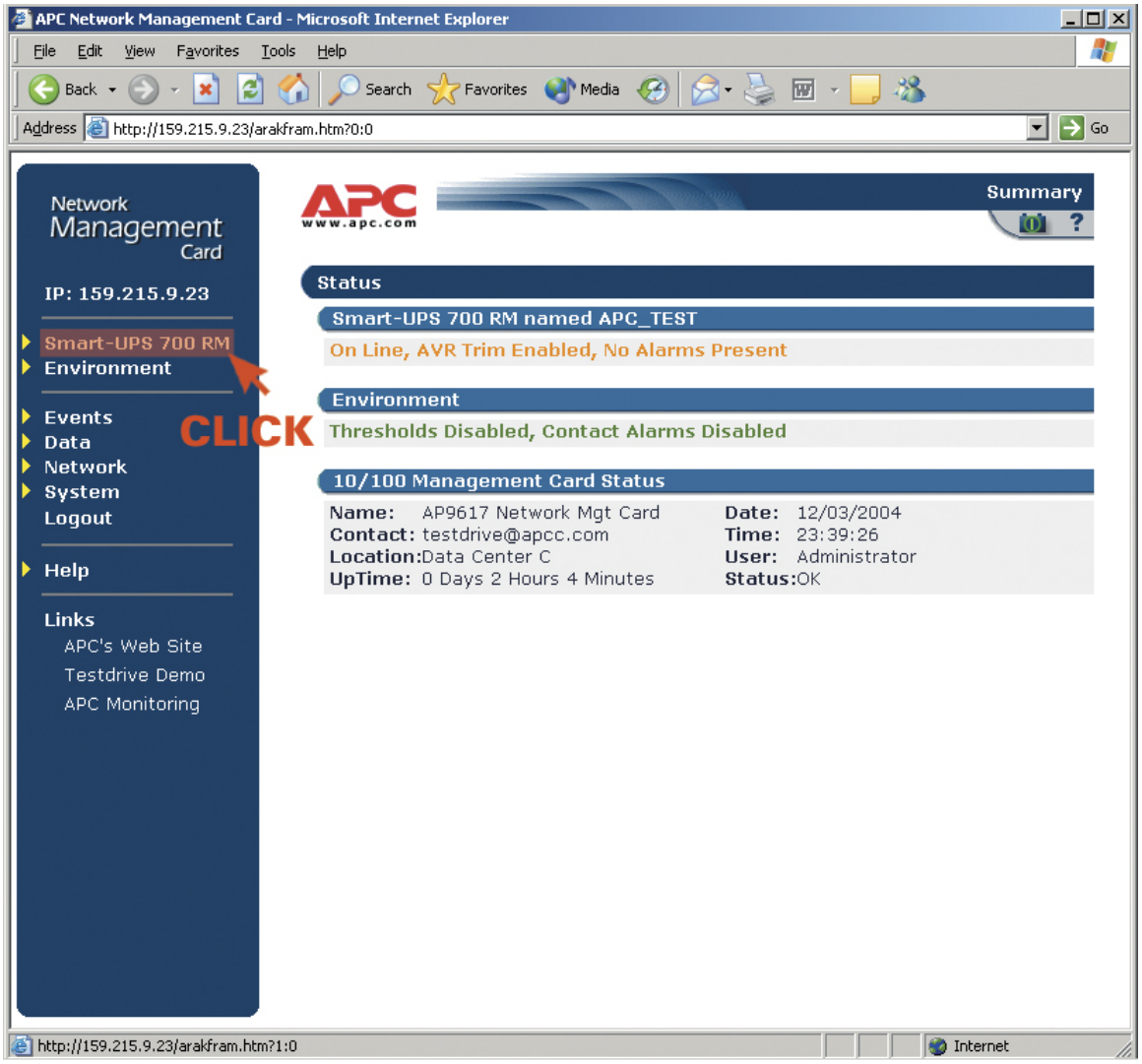
At the time this application note was being prepared there were three network interface cards available from APC: AP9617, AP9618, AP9619. Information on those was available at http://www.apc.com/products/family/index.cfm?id=98

Pleaser refer to Network Management Card User Manual for installation and operation instructions.

Launch a web browser, such as Microsoft Internet Explorer.

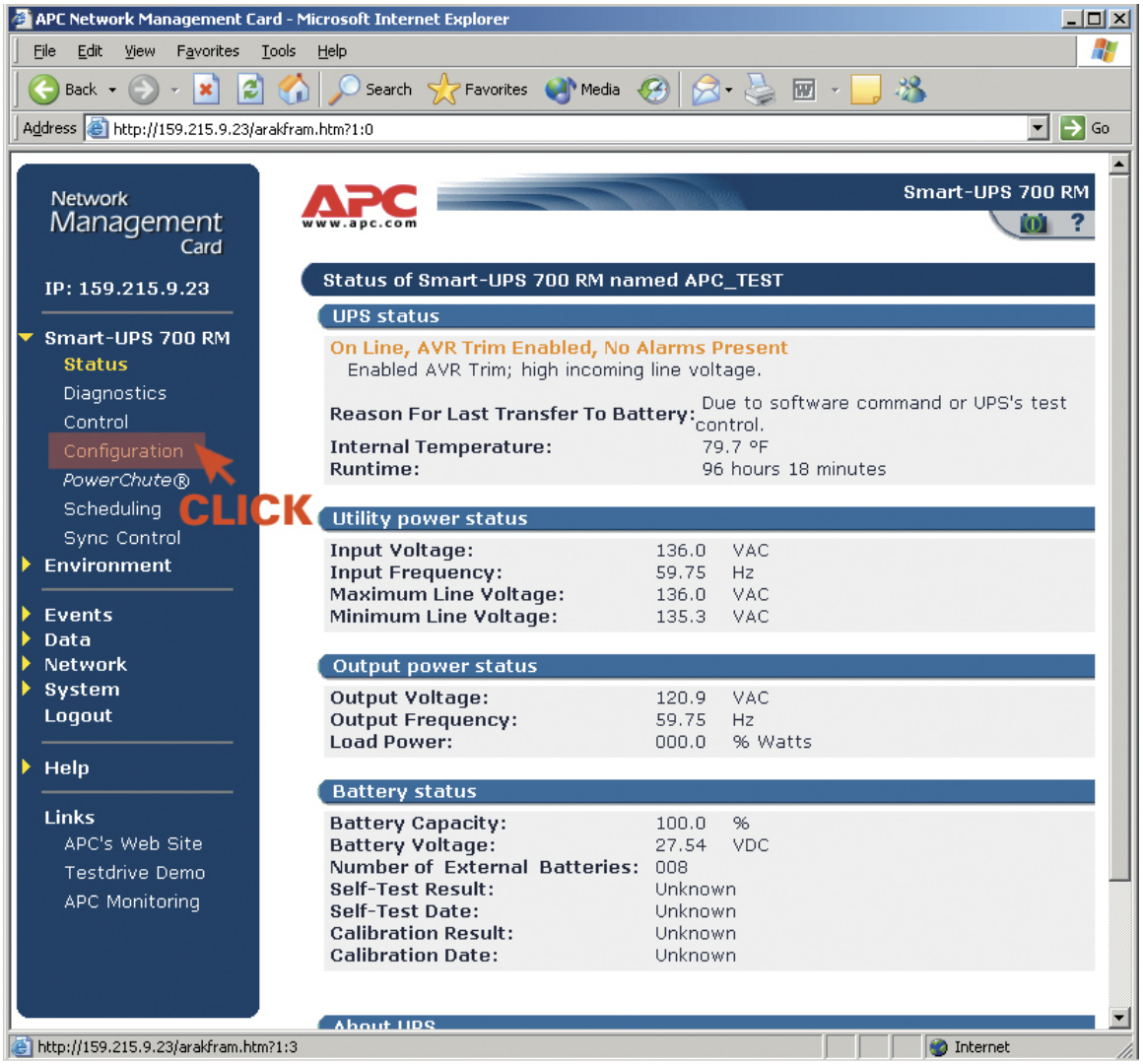
In the address line, type in the network address of the Network Interface Card inserted in the UPS you want to configure.

The front page is the general UPS status page. On the right hand side there's a menu. Click on the UPS name.



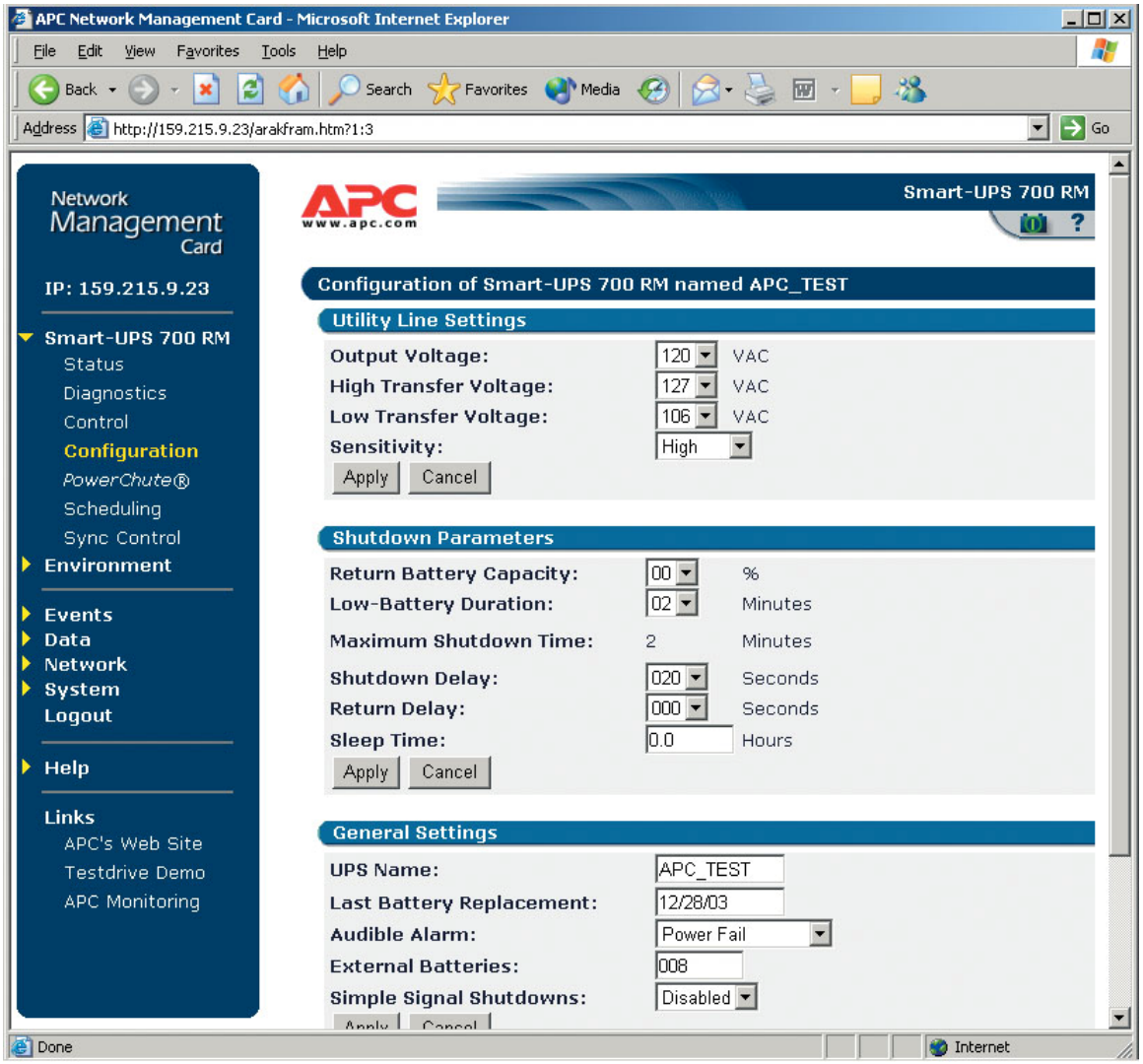
The UPS status screen will appear.

Click on “Configuration”



The configuration screen will appear.

Change the parameters to whatever you like and then click the “Apply” buttons located in the section you’ve just modified.



Configuring Smart-UPS using PowerView

PowerView is handheld control panel to configure and control APC UPSs.

At the time this application note was being prepared PowerView was available as SKU AP9215 and was described at http://www.apc.com/products/family/index.cfm?id=42

Please refer to PowerView User Manual in order to properly connect PowerView to Smart-UPS.

Once you've connected PowerView to Smart-UPS you'll see something like this on PowerView display:

```
Fuel  90% ||||||||''
Load  75% ||||||''''
120Vin 120Vout 60Hz
Runtime:  0hr  20min
```

Press the key with ↵ symbol on it in order to activate the main menu.

Using ↑ and ↓ keys navigate to “Setup” and press ↵ key in order to enter the configuration submenu (Setup)

```
 Control     Logging
 Status      Display
➡Setup       Diags
 Accessories Help
```

The configuration submenu (Settings) opens:

```
      Settings
➡Transfer  UPS Info
 Shutdown  Copy
 Other     Default
```

Using ↑ and ↓ key navigate to one of three items in the submenu:
“Transfer”, “Shutdown” or “Other”. Press the ↵ key.

The contents of these three submenus is given below:

Transfer

```
➡Low Xfer: 106V
 High Xfer: 127V
 Sensitivity: High
 Output: 120V
```

This submenu provides access to the following user-configurable parameters:
(in the order listed in the submenu)
Lower transfer point;
Upper transfer point;
Sensitivity;
Output voltage.

Shutdown

```
➡Low Batt Dur:  2min
 Shutdown Dly: 180sec
 Return Dly:    0sec
 Return Bat Cap:  0%
```

This submenu provides access to the following user-configurable parameters:
(in the order listed in the submenu)
Low battery warning;
Shutdown delay;
Synchronized turn-on delay;
Minimum capacity before return from shutdown.

Other

```
➡Self Test: 14 days
 UPS ID: UPS_IDEN
 Bat Date: 06/08/04
 #Ext Bat Packs:   0
```

This submenu provides access to the following user-configurable parameters:
(in the order listed in the submenu)
Automatic self-test;
UPS identification;
Date of last battery replacement;
The number of external battery packs.

Using ↑ and ↓ buttons navigate to an parameter you wish to modify and press ↵button. Then, using ↑ and ↓ buttons modify the parameter. Use ↵or Esc buttons to confirm your selection.

Conclusion

Smart-UPS and Smart-UPS XL behavior can be flexibly adjusted to the actual operating condition through an extended set of user-configurable parameters. Proper parameter setting highly enhances the UPS performance thus considerably increasing reliability and availability of the power protection as a whole.