



## APCUPSD User Manual

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**Apcupsd is a UPS control system that permits orderly shutdown of your computer in the event of a power failure.**

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This manual documents apcupsd version 3.14.x

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For more information on the project, please visit the main web site at <http://www.apcupsd.com>

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<b>Important Legal Disclaimer</b>	<b>6</b>
<b>How To Use This Manual</b>	<b>7</b>
<b>Basic User's Guide</b>	<b>7</b>
Quick Start for Beginners	7
Supported Operating Systems	8
Platform Support	8
Supported UPSes and Cables	9
Choosing a Configuration Type	10
Configuration types	10
<b>USB Configuration</b>	<b>12</b>
Linux USB Configuration	12
Known Linux USB Issues	12
Verifying Device Detection and Driver	12
Device Nodes	14
Miscellaneous	16
BSD USB Configuration	16
Known BSD USB Issues	16
Platforms and Versions	16
Kernel Configuration	16
Verifying Device Detection and Driver	17

Device Nodes	17
Windows USB Configuration	18
Platforms and Versions	18
USB Driver Installation	18
Verifying Device Detection and Driver	18
Solaris USB Configuration	18
Platforms and Versions	18
Building Apcupsd with USB	18
Verifying Device Detection and Driver	19
Device Nodes	19
Mac OS X (Darwin) USB Configuration	19
Platforms and Versions	19
Building Apcupsd with USB	19
Verifying Device Detection and Driver	19
<b>Building and Installing apcupsd</b>	<b>20</b>
Installation from Binary Packages	20
RPMS	20
Microsoft Windows	20
Installation from Source	20
Verifying a Source Installation	21
Configure Options	23
Recommended Options for most Systems	25
Compilers and Options	26
Operating System Specifics	26
Debian	26
FreeBSD	27
HPUX	27
NetBSD	27
Mac OS X Darwin	27
OpenBSD	27
Red Hat Systems	27
Slackware	27
SUSE	27
Sun Solaris	28
Unknown System	30
Windows Systems	30
<b>After Installation</b>	<b>30</b>
Checking Your Configuration File	30

Arranging for Reboot on Power-Up	30
Making sure apcupsd Is Running	31
<b>Configuration Examples</b>	<b>32</b>
A Simple USB Configuration	32
A Simple Configuration for a Serial SmartUPS	32
A Simple Configuration for a Simple Signaling or Dumb	32
NIS Server/Client Configuration Using the Net Driver	33
Differences between NIS Client/Server and the old (now removed) Master/Slave modes	34
PowerChute Network Shutdown Driver (PCNET)	34
<b>Testing Apcupsd</b>	<b>35</b>
Process-Status Test	35
Logging Test	35
apcaccess Test	35
Communications Test	37
Simulated Power Fail Test	38
System Shutdown Test	39
Full Power Down Test	39
apctest	40
<b>Monitoring and Tuning your UPS</b>	<b>41</b>
apcaccess	41
Apcupsd Notification and Events	43
apcupsd Network Monitoring (CGI) Programs	43
Setting up and Testing the CGI Programs	43
Using the CGI Programs on Windows	44
multimon.cgi	45
upsstats.cgi	45
upsfstatus.cgi	45
A Tip from Carl Erhorn for Sun Systems:	46
CGI Credits	47
Security Issues:	47
Firewall Settings	47
TCP Wrappers	47
Configuring Your EEPROM	47
Using apctest to Configure Your EEPROM	47
<b>Maintaining Your UPS Batteries</b>	<b>48</b>
Battery Technology	48
Battery Life	48

Flashing Battery Charge Graph LEDs	49
Battery Replacement	49
Battery Installation	50
"Soft" Runtime Calibration	50
"Manual" Runtime Calibration	51
Resetting the UPS Battery Constant	52
<b>Frequently-Asked Questions</b>	<b>54</b>
<b>Customizing Event Handling</b>	<b>56</b>
apccontrol Command Line Options	57
<b>Controlling Multiple UPSes on one Machine</b>	<b>59</b>
Multiple UPS Example	59
<b>Support for SNMP UPSes</b>	<b>61</b>
Planning and Setup for SNMP Wiring	62
Planning and Setup for SNMP Configuration	62
Assign SNMP Card IP Address	62
Set SNMP card General Parameters	63
Set SNMP card Shutdown Parameters	63
Configure Event Trap Receivers	64
Connecting APCUPSD to a SNMP UPS	64
Building with SNMP support	65
SNMP Trap Catching	65
Known Problems	65
<b>apcupsd System Logging</b>	<b>66</b>
Logging Types	66
Data Logging	66
Status Logging	66
EVENTS Logging	67
Implementation Details	67
<b>The Windows Version of apcupsd</b>	<b>68</b>
Installing Apcupsd on Windows	68
Configuring Apcupsd on Windows	68
Starting Apcupsd on Windows	68
Apctray	69
Testing Apcupsd on Windows	69
Upgrading	70
Post-Installation	70
Problem Areas	70
Email Notification of Events	70

Killpower under Windows	70
Power Down During Shutdown	71
Command Line Options Specific to the Windows Version	71
<b>Installation: Serial-Line UPSes</b>	<b>72</b>
Overview of Serial-Interface UPSes	72
Connecting a Serial-Line UPS to a USB Port	72
Testing Serial-Line UPSes	72
Establishing Serial Port Connection	73
Once you have established serial communications	74
Troubleshooting Serial Line communications	74
Bizarre Intermittent Behavior:	74
<b>Cables</b>	<b>74</b>
Smart-Custom Cable for SmartUPSes	74
Simple-Custom Voltage-Signalling Cable for "dumb" UPSes	75
Custom-RJ45 Smart Signalling Cable for BackUPS CS Models	76
Other APC Cables that apcupsd Supports	77
Voltage Signalling Features Supported by Apcupsd for Various Cables	78
Voltage Signalling	78
The Back-UPS Office 500 signals	78
Analyses of APC Cables	79
940-0020B Cable Wiring	79
940-0020C Cable Wiring	79
940-0023A Cable Wiring	80
940-0024C Cable Wiring	80
940-0095A Cable Wiring	81
940-0095B Cable Wiring	82
940-0119A Cable Wiring	82
Serial BackUPS ES Wiring	83
940-0128A Cable Wiring	83
940-0128D Cable Wiring	84
940-0127B Cable Wiring	85
Win32 Implementation Restrictions for Simple UPSes	86
Internal Apcupsd Actions for Simple Cables	86
<b>Recalibrating the UPS Runtime</b>	<b>87</b>
<b>Configuration Directive Reference</b>	<b>88</b>
General Configuration Directives	88
Configuration Directives Used by the Network Information Server	89
Configuration Directives used during Power Failures	89

Configuration Directives used to Control System Logging	92
Configuration Directives for Sharing a UPS	92
Configuration Directives Used to Set the UPS EEPROM	92
<b>apcupsd Status Logging</b>	<b>94</b>
Status report format	94
Status Report Example	94
Status Report Fields	95
Logging the STATUS Information	98
<b>The Shutdown Sequence and its Discontents</b>	<b>98</b>
Shutdown Sequence	98
Shutdown Problems	100
Master/Slave Shutdown	100
Startup	100
Windows Considerations	101
<b>APC smart protocol</b>	<b>101</b>
Description	101
RS-232 differences	101
The Smart Protocol	101
Dip switch info	107
Status bits	107
Alert messages	108
Register 1	108
Register 2	109
Register 3	109
Interpretation of the Old Firmware Revision	109
Interpretation of the New Firmware Revision	110
EEPROM Values	111
Programming the UPS EEPROM	112
<b>Apcupsd RPM Packaging FAQ</b>	<b>112</b>
<b>Credits</b>	<b>114</b>
Contributors	114

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## Important Legal Disclaimer

No person should rely on the contents of the APCUPSD Manual ("the manual") without first obtaining advice from APC Technical Support.

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## How To Use This Manual

This is the manual for `apcupsd`, a daemon for communicating with UPSes (Uninterruptible Power Supplies) made by American Power Conversion Corporation (APC). If you have an APC-made UPS, whether sold under the APC nameplate or OEMed (for example, the HP PowerTrust 2997A), and you want you get it working with a computer running Linux, Unix, or Windows, you are reading the right document.

This manual is divided into parts which increase in technical depth as they go. If you have just bought a state-of-the-art smart UPS with a USB or Ethernet interface, and you are running a current version of Red Hat or SUSE Linux, then `apcupsd` is very nearly plug-and-play and you will have to read only the [Basic User's Guide](#).

If your operating system is older, or if you have an old-fashioned serial-line UPS, you'll have to read about serial installation (see [Installation: Serial-Line UPSes](#)). If you need more details about administration for unusual situations (such as a master/slave or multi-UPS setup) you'll need to read the sections on those topics as well. Finally, there are a number of technical reference sections which gives full details on things like configuration file directives and event-logging formats.

You should begin by reading the Quick Start (see [Quick Start for Beginners](#)) instructions.

## Basic User's Guide

### *Quick Start for Beginners*

`apcupsd` is a complex piece of software, but most of its complexities are meant for dealing with older hardware and operating systems. On current hardware and software getting it running should not be very complicated.

The following is a help guide to the steps needed to get `apcupsd` set up and running as painlessly as possible.

1. Check to see if `apcupsd` supports your UPS and cable (see [Supported UPSes and Cables](#)).
2. Check to see if `apcupsd` supports your operating system (see [Supported Operating Systems](#)).
3. Plan your configuration type (see [Choosing a Configuration Type](#)). If you have just one UPS and one computer, this is easy. If you have more than one machine being served by the same UPS, or more than one UPS supplying power to computers that are on the same local network, you have more choices to make.
4. Figure out if you have one of the easy setups. If you have a USB UPS, and a supported operating system and you want to use one UPS with one computer, that's an easy setup. APC supplies the cable needed to talk with that UPS along with the UPS. All you need to do is check that your USB subsystem is working (see [USB Configuration](#)); if so, you can go to the build and install step.
5. If you have a UPS designed to communicate via SNMP over Ethernet, that is also a relatively easy installation. Details are provided in [Support for SNMP UPSes](#).

6. If you have a UPS that communicates via an RS232C serial interface and it is a SmartUPS, then things are relatively simple, otherwise, your life is about to get interesting.
  1. If you have a vendor-supplied cable, find out what cable type you have by looking on the flat ends of the cable for a number, such as 940-0020A, stamped in the plastic.
  2. If you don't have a vendor-supplied cable, or your type is not supported, you may have to build one yourself (see [Cables](#)). Here is hoping you are good with a soldering iron!
7. Now you are ready to read the Building and Installing (see [Building and Installing apcupsd](#)) section of the manual and follow those directions. If you are installing from an RPM or some other form of binary package, this step will probably consist of executing a single command.
8. Tweak your `/etc/apcupsd/apcupsd.conf` file as necessary. Often it will not be.
9. Change the BIOS settings (see [Arranging for Reboot on Power-Up](#)) on your computer so that boots up every time it gets power. (This is not the default on most systems.)
10. To verify that your UPS is communicating with your computer and will do the right thing when the power goes out, read and follow the instructions in the Testing (see [Testing Apcupsd](#)) section.
11. If you run into problems, check the apcupsd users' email list archive for similar problems. This is an excellent resource with answers to all sorts of questions. See [http://sourceforge.net/mailarchive/forum.php?forum\\_name=apcupsd-users](http://sourceforge.net/mailarchive/forum.php?forum_name=apcupsd-users).
12. If you still need help, send a message to the apcupsd users' email list ([apcupsd-users@lists.sourceforge.net](mailto:apcupsd-users@lists.sourceforge.net)) describing your problem, what version of apcupsd you are using, what operating system you are using, and anything else you think might be helpful.
13. Read the manual section on [Monitoring and Tuning your UPS](#).

## ***Supported Operating Systems***

apcupsd supports many UNIX-like operating systems as well as several variants of Windows. Due to lack of API standardization, USB support is not available on every platform. See [Platform Support](#) below for details.

In general it is recommended to obtain a prebuilt package for your platform. Given how apcupsd must integrate into the shutdown mechanism of the operating system and the rate at which such mechanisms are changed by vendors, the platform ports in the apcupsd tree may become out of date. In some cases, binary packages are provided by the apcupsd team (RedHat, Mandriva, SuSE, Windows, Mac OS X). For other platforms it is recommended to check your vendor's package repository and third party repositories for recent binary packages. Note that some vendors continue to distribute ancient versions of apcupsd with known defects. These packages should *not* be used.

### ***Platform Support***

#### **LINUX**

- RedHat <sup>1 2</sup>
- SuSE <sup>2</sup>
- Mandriva/Mandrake <sup>2</sup>
- Debian <sup>3</sup>
- Slackware <sup>3</sup>
- Engarde <sup>3</sup>
- Yellowdog <sup>3</sup>
- Gentoo <sup>3</sup>

#### **WINDOWS**



- Windows NT 4 <sup>2 4</sup>
- Windows 98/ME/2000 <sup>2 4</sup>
- Windows XP/Vista (including 64 bit) <sup>1 2</sup>
- Windows Server 2003/2008 (including 64 bit) <sup>2</sup>
- Windows 7 <sup>2</sup>

## OTHERS

- Mac OS X Darwin <sup>1 2</sup>
- Solaris 8/9 <sup>4</sup>
- Solaris 10
- NetBSD
- FreeBSD
- OpenBSD
- HP-UX <sup>3 4</sup>
- Unix <sup>3 4</sup>
- QNX <sup>4</sup>

## Supported UPSes and Cables

apcupsd supports nearly every APC brand UPS model in existence and enough different cable types to connect to all of them.

The `UPSTYPE <keyword>` field is the value you will put in your `/etc/apcupsd/apcupsd.conf` file to tell apcupsd what type of UPS you have. We'll describe the possible values here, because they're a good way to explain your UPS's single most important interface property: the kind of protocol it uses to talk with its computer.

### apcsmart

An APCSmart UPS and its computer communicate through an RS232C serial connection. They use it as a character channel (2400bps, 8 data bits, 1 stop bit, no parity) and pass commands back and forth in a primitive language resembling modem-control codes. The different APC UPSes all use closely related firmware, so the language doesn't vary much (later versions add more commands). This class of UPS is in decline, rapidly being replaced in APC's product line by USB UPSes.

### usb

A USB UPS speaks a universal well defined control language over a USB wire. Most of APC's lineup now uses this method as of late 2003, and it seems likely to completely take over in their low- and middle range. Other manufacturers (Belkin, Tripp-Lite, etc.) are moving the same way, though with a different control protocol for each manufacturer. As long as USB hardware can be mass-produced more cheaply than an Ethernet card, most UPSes are likely to go this design route. Please note that even if you have a USB UPS, if you use a serial cable with it (as can be supplied by APC), you will need to configure your UPS as `apcsmart` rather than `usb`.

- |   |   |
|---|---|
| 1 | Platforms on which apcupsd is regularly developed and tested                          |
| 2 | Platforms for which apcupsd team distributes binary packages                          |
| 3 | Port included in apcupsd source tree but may be out of date, unmaintained, or broken. |
| 4 | USB not supported   |

**net**

This is the keyword to specify if you are using your UPS in Slave mode (i.e. the machine is not directly connected to the UPS, but to another machine which is), and it is connected to the Master via an ethernet connection. You must have apcupsd's Network Information Services NIS turned on for this mode to work.

**snmp**

SNMP UPSes communicate via an Ethernet NIC and firmware that speaks Simple Network Management Protocol.

**dumb**

A dumb or voltage-signaling UPS and its computer communicate through the control lines (not the data lines) on an RS232C serial connection. Not much can actually be conveyed this way other than an order to shut down. Voltage-signaling UPSes are obsolete; you are unlikely to encounter one other than as legacy hardware. If you have a choice, we recommend you avoid simple signalling UPSes.

**pcnet**

PCNET is an alternative for SNMP available on APC's AP9617 family of smart slot modules. The protocol is much simpler and potentially more secure than SNMP.

## ***Choosing a Configuration Type***

There are three major ways of running apcupsd on your system. The first is a standalone configuration where apcupsd controls a single UPS, which powers a single computer. This is the most common configuration. If you're working with just one machine and one UPS, skip the rest of this section.

Your choices become more interesting if you are running a small cluster or a big server farm. Under those circumstances, it may not be possible or even desirable to pair a UPS with every single machine. apcupsd supports some alternate arrangements.

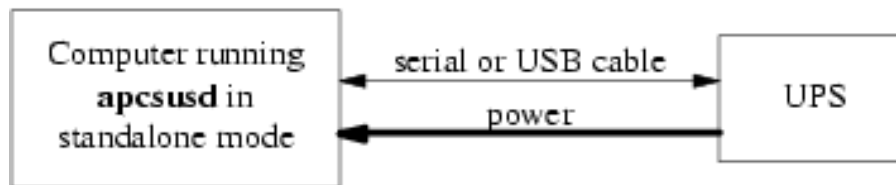
The second type of configuration is the NIS (Network Information Server) server and client. In this configuration, where one UPS powers several computers, a copy of apcupsd running on one computer will act as a server while the other(s) will act as network clients which poll the server for information about the UPS. Note that "NIS" is *not* related to Sun's directory service also called "NIS" or "Yellow Pages".

The third configuration is where a single computer controls multiple UPSes. In this case, there are several instances of apcupsd on the same computer, each controlling a different UPS. One instance of apcupsd will run in standalone mode, and the other instance will normally run in network mode. This type of configuration may be appropriate for large server farms that use one dedicated machine for monitoring and diagnostics

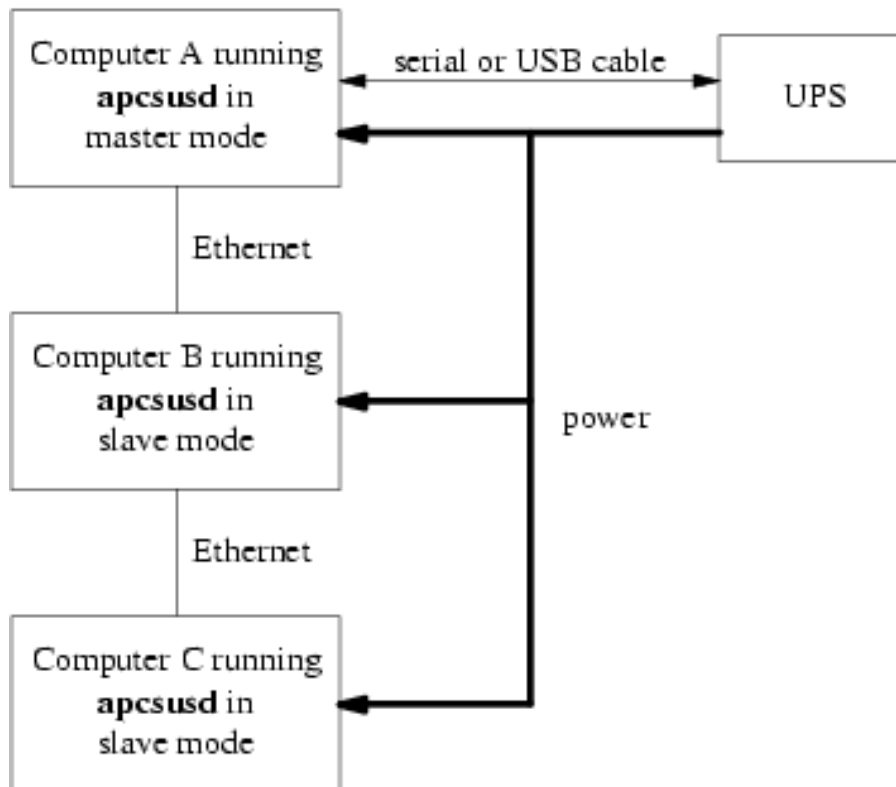
Here is a diagram that summarizes the possibilities:

## ***Configuration types***

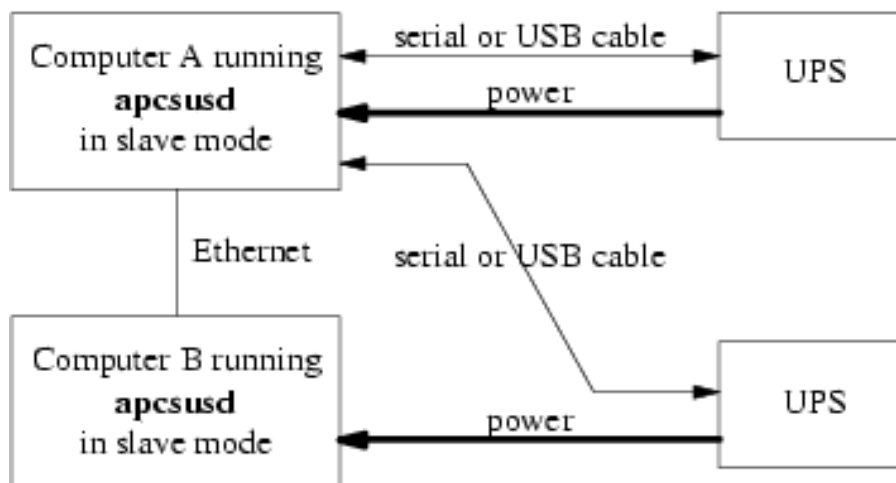
### Stand alone configuration



### Typical Master/Slave Configuration



### Multi-UPS configuration



If you decide to set up one of these more complex configurations, see the dedicated section on that particular configuration.

## USB Configuration

Apcupsd supports USB connections on all major operating systems: Linux, FreeBSD, OpenBSD, NetBSD, Windows, Solaris, and Mac OS X Darwin. If you plan to use a USB connection, please read the appropriate subsection in its entirety. You can skip this section if your UPS has a serial (RS232-C) or Ethernet interface or if you are not running one of the platforms listed above.

### *Linux USB Configuration*

#### **Known Linux USB Issues**

##### **Problem**

Linux 2.4 series kernels older than 2.4.22 (RH 9, RHEL 3) do not bind the USB device to the proper driver. This is evidenced by `/proc/bus/usb/devices` listing the UPS correctly but it will have "driver=(none)" instead of "driver=(hid)". This affects RHEL3, among others.

##### **Workaround**

Upgrade linux kernel to 2.4.22 or higher. Alternately, you apply the `linux-2.4.20-killpower.patch` and `linux-2.4.20-USB-reject.patch` patches to your kernel and rebuild it. These patches can be found in the `examples/` directory in the `apcupsd` source distribution.

##### **Problem**

Mandrake 10.0 and 10.1 systems with high security mode enabled (running kernel-secure kernel) use static device nodes but still assign USB minor numbers dynamically. This is evidenced by `hiddev0: USB HID v1.10 Device [...]` instead of `hiddev96: ...` in `dmesg` log.

##### **Workaround**

Boot standard kernel instead of kernel-secure or disable `CONFIG_USB_DYNAMIC_MINORS` and rebuild kernel-secure.

##### **Problem**

USB driver `linux-usb.c` fails to compile, reporting errors about `HID_MAX_USAGES` undefined. This is due to a defect in the linux kernel `hiddev.h` header file on 2.6.5 and higher kernels.

##### **Workaround**

Upgrade to `apcupsd-3.10.14` or higher. These versions contain a workaround for the defect.

##### **Problem**

On some systems such as Slackware 10.0, no USB devices will show up (see the next section).

##### **Workaround**

Add the following to `rc.local`

```
mount -t usbdevfs none /proc/bus/usb
```

##### **Problem**

2.6 kernels use `udev` and some distributions do not configure it to automatically create `/dev/usb/hiddev??` as they should, causing `apcupsd` to fail to locate the UPS.

##### **Workaround**

Edit the file `/etc/udev/rules.d/50-udev.rules`, and add the following:

```
KERNEL="hiddev*", NAME="usb/hiddev%n"
```

More details are provided in the following section ...

### **Verifying Device Detection and Driver**

To make sure that your USB subsystem can see the UPS, just do this from a shell prompt:

```
cat /proc/bus/usb/devices
```

This information is updated by the kernel whenever a device is plugged in or unplugged, irrespective of whether apcupsd is running or not. It contains details on all the USB devices in your system including hubs (internal and external), input devices, and UPSes.

You should get some output back that includes something like this, featuring a BackUPS RS 1000:

```
T:  Bus=02 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=  3 Spd=1.5 MxCh=  0
D:  Ver= 1.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS=  8 #Cfgs=   1
P:  Vendor=051d ProdID=0002 Rev= 1.06
S:  Manufacturer=American Power Conversion
S:  Product=Back-UPS RS 1000 FW:7.g3 .D USB FW:g3
S:  SerialNumber=JB0308036505
C:* #Ifs=  1 Cfg#=  1 Atr=a0 MxPwr= 24mA
I:  If#=  0 Alt=  0 #EPs=  1 Cls=03(HID ) Sub=00 Prot=00 Driver=hid
```

The important things to check for are the `S:` lines describing your UPS and the `I:` line showing what driver is handling it. If on the `I:` line, `Driver` is listed as `Driver=none` then you do not have the HID driver loaded or the driver did not attach to the UPS. One common cause is having a Linux kernel older than 2.4.22 (such as a stock RedHat 9 or RHEL 3 kernel). If this is the case for your system, please upgrade to at least kernel version 2.4.22 and try again. If you are already running a 2.4.22 or higher kernel, please read further for instructions for other possible courses of action.

Here is another example, this time featuring a Back-UPS 350:

```
T:  Bus=01 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=  2 Spd=1.5 MxCh=  0
D:  Ver= 1.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS=  8 #Cfgs=   1
P:  Vendor=051d ProdID=0002 Rev= 1.00
S:  Manufacturer=American Power Conversion
S:  Product=Back-UPS 350 FW: 5.2.I USB FW: c1
S:  SerialNumber=BB0115017954
C:* #Ifs=  1 Cfg#=  1 Atr=a0 MxPwr= 30mA
I:  If#=  0 Alt=  0 #EPs=  1 Cls=03(HID ) Sub=00 Prot=00 Driver=hid
E:  Ad=81(I) Atr=03(Int.) MxPS=   8 Iv1= 10ms
```

In general, if you see your UPS model in the `S:` field, which means `Manufacturer=`, `Product=`, and `SerialNumber=`, and you see `Driver=hid` in the `I:` field, you know the UPS has been recognized and is bound to the correct driver.

If your UPS doesn't appear in the list at all, check the obvious things: The UPS must be powered on, and a cable must be properly seated in both the data port of the UPS and one of your machine's USB ports. Many UPSes have phone ports to provide surge protection for phones or modems -- make sure you haven't plugged your USB cable into one of those rather than the data port (which will usually be near the top edge of the case.)

Also, ensure that the correct drivers are loaded. Under Linux-2.4.x, you can check this out easily by examining the `/proc/bus/usb/drivers` file. Here's how you can do that:

```
cat /proc/bus/usb/drivers
```

...and you should get:

```
usbdevfs
hub
96-111: hiddev
hid
```

On Linux-2.6.x, make sure the sysfs filesystem is mounted on /sys and do:

```
ls -l /sys/bus/usb/drivers/
```

...where you should get:

```
total 0
drwxr-xr-x  2 root    root          0 May  1 18:55 hid
drwxr-xr-x  2 root    root          0 May  1 18:55 hiddev
drwxr-xr-x  2 root    root          0 May  1 18:55 hub
drwxr-xr-x  2 root    root          0 May  1 18:55 usb
drwxr-xr-x  2 root    root          0 May  1 18:55 usbfs
```

...or perhaps something like:

```
total 0
drwxr-xr-x  2 root    root  0 Jan  6 15:27 hiddev
drwxr-xr-x  2 root    root  0 Jan  6 15:28 hub
drwxr-xr-x  2 root    root  0 Jan  6 15:28 usb
drwxr-xr-x  2 root    root  0 Jan  6 15:27 usbfs
drwxr-xr-x  2 root    root  0 Jan  6 15:28 usbhid
```

If your 2.6.x system does not have the /sys/bus/usb directory, either you do not have sysfs mounted on /sys or the USB module(s) have not been loaded. (Check /proc/mounts to make sure sysfs is mounted.)

A USB UPS needs all of these drivers -- the USB device filesystem, the USB hub, the Human Interface Device subsystem driver, and the Human Interface Device driver. If you are compiling your own kernel, you want to enable

```
CONFIG_USB
CONFIG_USB_HID
CONFIG_USB_HIDDEV
CONFIG_USB_DEVICEFS
```

...as well as at least one USB Host Controller Driver...

```
CONFIG_USB_UHCI_HCD (linux-2.6.x)
CONFIG_USB_OHCI_HCD (linux-2.6.x)
CONFIG_USB_UHCI     (linux-2.4.x)
CONFIG_USB_OHCI     (linux-2.4.x)
```

## Device Nodes

Apcupsd accesses USB UPSes via the hiddev device nodes. Typically these are located in /dev/hiddevN, /dev/usb/hiddevN or /dev/usb/hiddev/hiddevN (where N is a digit 0 thru 9). Some distributions (some Debian releases, possibly others) do not provide these device nodes for you, so you will have to make them yourself. Check /dev, /dev/usb, and /dev/usb/hiddev and if you cannot find the hiddevN nodes, run (as root) the examples/make-hiddev script from the apcupsd source distribution.

Modern Linux distributions using the 2.6 kernel create device nodes dynamically on the fly as they are needed. It is basically a hotplug system, giving a lot more power to the user to determine what happens when a device is probed or opened. It is also a lot more complicated.

Some early 2.6 distributions (Fedora Core 3, for one) do not include hiddev rules in their default udev rule set. The bottom line for apcupsd on such a system is that if the `hiddevN` is not created when you plug in your UPS, apcupsd will terminate with an error. The solution to the problem is to add a rule to the udev rules file. On Fedora FC3, this file is found in `/etc/udev/rules.d/50-udev.rules`. Start by adding the following line:

```
BUS="usb", SYSFS{idVendor}="051d", NAME="usb/hiddev%n"
```

*Note that this rule uses obsolete udev syntax and is specific to FC3 and other distributions of similar vintage.*

Then either reboot your system, or unplug and replug your UPS and then restart apcupsd. At that point a `/dev/usb/hiddevN` node should appear and apcupsd should work fine.

If you have several UPSes or you just want to give your UPS a fixed name, you can use rules like the following:

```
KERNEL=="hiddev*", SYSFS{serial}=="JB0319033692", SYMLINK="ups0"  
KERNEL=="hiddev*", SYSFS{serial}=="JB0320004845", SYMLINK="ups1"
```

*Note that this rule uses modern udev syntax and is appropriate only for more recent distros such as RHEL4 and FC4.*

Replace the serial number in quotes with the one that corresponds to your UPS. Then whenever you plug in your UPS a symlink called `ups0`, `ups1`, etc. will be created pointing to the correct hiddev node. This technique is highly recommended if you have more than one UPS connected to the same server since rearranging your USB cables or even upgrading the kernel can affect the order in which devices are detected and thus change which hiddev node corresponds to which UPS. If you use the symlink-by-serial-number approach the link will always point to the correct device node.

You can use...

```
udevinfo -a -p /sys/class/usb/hiddev0/
```

...to get more information on the fields that can be matched besides serial number.

An additional device-node-related problem is the use of dynamic minors. Some distributions, such as Mandrake 10, ship with a kernel having `CONFIG_USB_DYNAMIC_MINORS` turned on. This is not ideal for running with apcupsd, and the easiest solution is to turn `CONFIG_USB_DYNAMIC_MINORS` off and rebuild your kernel, or find a pre-built kernel with it off. For a kernel with `CONFIG_USB_DYNAMIC_MINORS` turned on to work with apcupsd, you must enable `devfs`. The following will tell you if `devfs` is enabled:

```
$ ps ax | grep devfs
```

...which should give something like the following:

```
533 ?          S          0:00 devfsd /dev
```

What complicates the situation much more on Mandrake kernels is their security level since `CONFIG_DYNAMIC_USB_MINORS` is turned on, but on higher security levels `devfs` is turned off. The net result, is that in those situations hiddev is completely unusable so apcupsd will not work. So, in these cases, the choices are:

1. Reduce the security level setting of the system (not sure if this is possible after the initial install).

2. Custom build a high security kernel with devfs enabled and make sure devfs is mounted and devfsd is running.
3. Custom build a high security kernel with dynamic minors disabled
4. Use udev

### **Miscellaneous**

If all these things check out and you still can't see the UPS, something is more seriously wrong than this manual can cover -- find expert help. If you are unable to list USB devices or drivers, your kernel may not be USB-capable and that needs to be fixed.

## **BSD USB Configuration**

### **Known BSD USB Issues**

#### **Problem**

FreeBSD lockups: Some users have experienced lockups (apcupsd stops responding) on FreeBSD systems.

#### **Solution**

Recent versions of Apcupsd have addressed this issue. Please upgrade to apcupsd-3.10.18 or higher.

#### **Problem**

FreeBSD kernel panics if USB cable is unplugged while apcupsd is running.

#### **Solution**

This is a kernel bug and is most easily worked around by not hot-unplugging the UPS while apcupsd is running. This issue may be fixed in recent FreeBSD kernels.

### **Platforms and Versions**

The \*BSD USB driver supports FreeBSD, OpenBSD and NetBSD. (Thanks go to the \*BSD developers who kept a nearly identical interface across all three platforms.)

### **Kernel Configuration**

Users of OpenBSD, NetBSD, and some versions of FreeBSD will need to rebuild the kernel in order to *enable the ugen driver* and *disable the uhid driver*. uhid is not sufficient for apcupsd at this time and we need to prevent it from grabbing the UPS device. You should *make the following changes* to your kernel config file:

#### **FreeBSD (v5.4 and below, v6.0)**

(you **will not** lose use of USB keyboard and mouse)

**Disable:** uhid

**Enable:** ugen

#### **FreeBSD (v5.5, v6.1 and above)**

(you **will not** lose use of USB keyboard and mouse)

**Disable:** (nothing)

**Enable:** ugen

This is the default configuration for a GENERIC kernel on many platforms so you most likely will not need to recompile.

#### **NetBSD (v3.x and below)**

(you **will** lose use of USB keyboard and mouse)

**Disable:** uhiddev, ums, wsmouse, ukbd, wskbd, uhid

**Enable:** ugen



### **NetBSD (v4.0 and above)**

You can use apcupsd on single USB port without disabling the USB keyboard and mouse on other ports, though all other devices will be disabled on the port you pick for your UPS.

First, decide which hub and port you wish to use. You can find out the hub and port numbers for any particular physical connector by plugging a USB device into it and looking at the messages printed by the kernel; you should see messages something like this:

```
uxx0 at uhub0 port 1
uxx0: <some device name>
```

To use your APC UPS on this port, configure the kernel to prefer attachment of the ugen driver over other drivers on this hub and port only, by adding a line like this to your kernel config file:

```
ugen*   at uhub0 port 1 flags 1
```

(The "flags 1" forces the ugen to attach instead of anything else detected there.)

Configure and build that kernel as per the references below, and your UPS will now attach as a ugen device when plugged into that port.

Don't forget to 'cd /dev' and './MAKEDEV ugen1' (and 2 and so on) if you have more than one generic usb device on your system.

### **OpenBSD**

(you **will** lose use of USB keyboard and mouse):

**Disable:** uhiddev, ums, wsmouse, ukbd, wskbd, uhid

**Enable:** ugen

For detailed information on rebuilding your kernel, consult these references:

#### **FreeBSD**

[http://www.freebsd.org/doc/en\\_US.ISO8859-1/books/handbook/kernelconfig.html](http://www.freebsd.org/doc/en_US.ISO8859-1/books/handbook/kernelconfig.html)

#### **NetBSD**

<http://www.netbsd.org/guide/en/chap-kernel.html>

#### **OpenBSD**

<http://www.openbsd.org/faq/faq5.html#Building>

### **Verifying Device Detection and Driver**

After building a properly configured kernel, reboot into that kernel and plug in your UPS USB cable. You should see a dmesg log message like the following:

```
ugen0: American Power Conversion Back-UPS RS 1500 FW:8.g6 .D USB FW:g6, rev 1.10/1.06, addr 2
```

Note that the ugen driver is called out. If you see uhid instead, it probably means you did not properly disable the uhid driver when you compiled your kernel or perhaps you're not running the new kernel.

You can also check with 'usbdevs -d' to get a list of USB devices recognized by the system as well as the drivers they are associated with. For example:

```
# usbdevs -d
addr 1: UHCI root hub, VIA
  uhub0
addr 2: Back-UPS RS 1500 FW:8.g6 .D USB FW:g6, American Power Conversion
  ugen0
```

### **Device Nodes**

Apcupsd communicates with the UPS through the USB generic device, `ugen`. You may or may not need to manually make `ugen` device nodes in `/dev`, depending on what OS you are using.

### **FreeBSD**

No manual intervention needed. FreeBSD automatically creates the `ugen` nodes on demand.

### **NetBSD**

By default, NetBSD only creates nodes for the first `ugen` device, `ugen0`. Check `usbdevs -d` to see which device your UPS was bound to and then create the appropriate node by running `'cd /dev ; ./MAKEDEV ugenN'`, where `ugenN` is the `ugen` device name shown by `usbdevs`. It is probably a good idea to create several sets of `ugen` nodes in case you add more USB devices.

### **OpenBSD**

Similar to NetBSD, OpenBSD creates nodes for `ugen0` and `ugen1`. Check `usbdevs -d` to see which device your UPS was bound to and then create the appropriate node by running `'cd /dev ; ./MAKEDEV ugenN'`, where `ugenN` is the `ugen` device name shown by `usbdevs`. It is probably a good idea to create several sets of `ugen` nodes in case you add more USB devices.

## **Windows USB Configuration**

### **Platforms and Versions**

Apcupsd supports USB UPSes on Windows XP and newer, including 64 bit systems.

### **USB Driver Installation**

USB connected UPSes on Windows require a special driver. In most cases, this driver is automatically installed when you install Apcupsd. However in some cases you may need to install the driver manually. For detailed instructions, please see the `install.txt` file located in the driver folder of your Apcupsd install.

### **Verifying Device Detection and Driver**

After installing Apcupsd (and the Apcupsd USB driver, if necessary), plug in your UPS USB cable and open the Windows Device Manager. You should see a `American Power Conversion USB UPS (Apcupsd)` listed under the `Batteries` section. If a device of that name does not appear, check that your UPS is powered on and that the USB cable is connected at both ends. Reinstall the driver as directed above if needed.

## **Solaris USB Configuration**

### **Platforms and Versions**

Apcupsd supports USB UPSes on Solaris 10 and higher. Both x86 and SPARC platforms are supported.

### **Building Apcupsd with USB**

Some specific packages are necessary when building Apcupsd with USB support on Solaris. You must install the `SUNWlibusb` and `SUNWlibusbugen` packages **BEFORE** attempting to build Apcupsd. These packages can be found on the Solaris installation CDROMs and should be installed with the `pkgadd` utility.

You also should build using the `gcc` compiler and `ccs make`, not Sun's compiler. The appropriate `make` utility can be found in `/usr/ccs/bin`. `gcc` can be installed from packages included on the Solaris installation CDROMs.

Configure and build Apcupsd normally, as described in [Building and Installing Apcupsd](#). Be sure to include the `--enable-usb` flag to configure.

After building, install Apcupsd as root using `'make install'`, then *perform a reconfigure boot* (`'reboot -- -r'`). During installation, Apcupsd will automatically configure your USB subsystem to attach APC USB devices to the `ugen` driver. This is a critical step and must be completed by a reconfigure boot. Note that

the USB config changes will be reversed if you remove Apcupsd using 'make uninstall'.

### Verifying Device Detection and Driver

After installing Apcupsd as described above and performing a reconfigure boot, plug in your UPS USB cable. You should see a series of dmesg log messages similar to the following:

```
Dec  5 17:50:50 sunblade usba: [ID 912658 kern.info] USB 1.10 device (usb51d,2) operating at low speed (USB 1.x) on USB 1.10 root hub: input@4, ugen0 at bus address 3
Dec  5 17:50:50 sunblade usba: [ID 349649 kern.info]   American Power Conversion Smart-UPS 1000 FW:600.1.D USB FW:1.2 AS0127232356
Dec  5 17:50:50 sunblade genunix: [ID 936769 kern.info] ugen0 is /pci@1f,0/usb@c,3/input@4
Dec  5 17:50:50 sunblade genunix: [ID 408114 kern.info] /pci@1f,0/usb@c,3/input@4 (ugen0) online
```

Note that the `ugen` driver is called out. If you do not see any dmesg entries related to your UPS, ensure that it is turned on and that the USB cable is connected at both ends. Also verify that you installed Apcupsd as root using the 'make install' command and that you performed a reconfigure boot afterward.

### Device Nodes

Apcupsd communicates with the UPS through the USB generic device, `ugen`. The reconfigure boot performed after Apcupsd installation will ensure the correct device nodes are created. Once your UPS has been recognized in dmesg as shown above, you can check `/dev/usb` to see if the device nodes have appeared:

```
[user@sunblade /]$ ls /dev/usb/51d.2/*
cntrl0      cntrl0stat  devstat     if0in1      if0in1stat
```

(51d.2 is the vendor/product id for APC UPSes.)

## Mac OS X (Darwin) USB Configuration

### Platforms and Versions

Apcupsd supports USB UPSes on Mac OS X (Darwin) 10.4.x and higher. Both Intel and PowerPC platforms are supported.

### Building Apcupsd with USB

Some specific packages are necessary when building Apcupsd with USB support on Darwin. You must install `libusb-0.1.12` which can be obtained from MacPorts (<http://www.macports.org>) (formerly DarwinPorts) or Fink (<http://fink.sourceforge.net>) or downloaded and built by hand (<http://www.libusb.org>). *You must not use libusb-1.x or higher (apcupsd does not support the new 1.0 APIs) nor any version earlier than 0.1.12 (earlier versions have a bug that apcupsd triggers). Generally that means you must use exactly 0.1.12.* Note that Apcupsd is sensitive to the install location of libusb, so beware if you change it from the default.

Apcupsd should be built using `gcc`, preferably from the XCode development tools. Currently the maintainer is using `gcc-4.0.1` from XCode 2.4. Other versions of `gcc` from other sources may also work.

Configure and build Apcupsd normally, as described in [Building and Installing Apcupsd](#). Be sure to include the `--enable-usb` flag to `configure`.

After building, install Apcupsd as root using 'make install' and then reboot. During installation, Apcupsd will automatically install a simple dummy `kext` driver designed to prevent Apple's monitoring software from taking over the UPS. It is necessary to reboot in order to activate the `kext`. Note that this `kext` will be automatically removed if you uninstall Apcupsd using 'make uninstall', allowing Apple's monitoring tool to once again access the UPS.

### Verifying Device Detection and Driver

After installing Apcupsd as described above and rebooting, plug in your UPS USB cable. You should notice that Darwin does **NOT** display the battery monitor tool in the menu bar. You can also check Apple

Menu -> About This Mac -> More Info... -> USB to ensure that your UPS appears in the list of USB devices.

## Building and Installing apcupsd

In general it is recommended to obtain a prebuilt binary package for your platform. Given how apcupsd must integrate into the shutdown mechanism of the operating system and the rate at which such mechanisms are changed by vendors, the platform ports in the apcupsd tree may become out of date. In some cases, binary packages are provided by the apcupsd team (RedHat, Mandriva, SuSE, Windows, Mac OS X). For other platforms it is recommended to check your vendor's package repository and third party repositories for recent binary packages before resorting to building apcupsd from scratch. Note that some vendors continue to distribute *ancient* versions of apcupsd with known defects. These packages should **not** be used.

### Installation from Binary Packages

#### RPMS

For systems based on RPM packages, such as Red Hat and SuSE, apcupsd is available in binary RPM format. This is the simplest way to install. If you have no previous version of apcupsd on your machine and are creating a standalone configuration, simply install the RPM with a normal `'rpm -ihv'` command. You're done, and can now skip the rest of this chapter and go straight to tweaking your run-time configuration file. (see [After Installation](#))

If you have a previous installation, you can upgrade with a normal `'rpm -Uhv'`, but this may not upgrade the halt script. It may be better to do the upgrade as a remove `'rpm -e'` followed by a fresh install `'rpm -ihv'`.

After installation of the binary RPM, please verify carefully that `/etc/rc.d/init.d/halt` was properly updated and contains new script lines flagged with `***APCUPSD***`.

Since there is no standard location for cgi-bin, the rpm will place the binary CGI programs in the directory `/etc/apcupsd/cgi`. To actually use them, you must copy or move them to your actual cgi-bin directory, which on many systems is located in `/home/httpd/cgi-bin`.

#### Microsoft Windows

The Windows version of apcupsd is distributed as a simple double-click installer. Installation is very simple and straight-forward: Simply double-click the installer executable and follow the instructions. See [The Windows Version of apcupsd](#) for further details.

### Installation from Source

Installation from source might have to be done different ways depending on what system you are running. The basic procedure involves getting a source distribution, running the configuration, rebuilding, and installing.

For building the system, we suggest that you run the configure and make processes as your normal UNIX user ID. The `'make install'` must be run as root. But if your normal ID has an environment setup for using the C compiler, it's simpler to do that than to set up root to have the correct environment.

apcupsd requires `gcc` and `g++` compilers as well as GNU `make`. Other compilers or BSD `make` will **not** work. GNU `make` is sometimes installed as `gmake`. The configure script will check for this and will inform you of what command to use to invoke GNU make.

The basic installation from a tar source file is rather simple:

1. Unpack the source code from its tar archive.
2. Go into the directory containing the source code.
3. Run `'./configure'` (with appropriate options as described below)

4. 'make' or 'gmake' as instructed by configure
5. 'su' (i.e. become root)
6. Stop any running instance of apcupsd. The command to do this will look like 'system-dependent-path/apcupsd stop'
7. uninstall any old apcupsd This is important since the default install locations may have changed.
8. 'make install' or 'gmake install'
9. edit your /etc/apcupsd/apcupsd.conf file if necessary
10. ensure that your halt script is properly updated
11. Start the new apcupsd with: 'system-dependent-path/apcupsd start'

If all goes well, the './configure' will correctly determine which operating system you are running and configure the source code appropriately. `configure` currently recognizes the systems listed below in the [Operating System Specifics](#) section of this chapter and adapts the configuration appropriately. Check that the configuration report printed at the end of the `configure` process corresponds to your choice of directories, options, and that it has correctly detected your operating system. If not, redo the `configure` with the appropriate options until your configuration is correct.

Please note that a number of the `configure` options preset `apcupsd.conf` directive values in an attempt to automatically adapt `apcupsd` as best possible to your system. You can change the values in `apcupsd.conf` at a later time without redoing the configuration process by simply editing the `apcupsd.conf` file.

Other configuration options can be used to set up the installation of HTML documentation and optional modules, notably the CGI interface that enables the UPS state to be queried via the Web. You will find a complete reference later in this chapter.

In general, you will probably want to supply a more elaborate `configure` statement to ensure that the modules you want are built and that everything is placed into the correct directories.

On Red Hat, a fairly typical configuration command would look like the following:

```
CFLAGS="-g -O2" LDFLAGS="-g" ./configure \
--enable-usb \
--with-upstype=usb \
--with-upscable=usb \
--prefix=/usr \
--sbindir=/sbin \
--with-cgi-bin=/var/www/cgi-bin \
--enable-cgi \
--with-css-dir=/var/www/docs/css \
--with-log-dir=/etc/apcupsd
```

By default, 'make install' will install the executable files in /sbin, the manuals in /usr/man, and the configuration and script files in /etc/apcupsd. In addition, if your system is recognized, certain files such as the startup script and the system halt script will be placed in appropriate system directories (usually subdirectories of /etc/rc.d).

## Verifying a Source Installation

There are a number of things that you can do to check if the installation (make install) went well. The first is to check where the system has installed `apcupsd` using 'which' and 'whereis'. On my Red Hat system, you should get the following (lines preceded with a \$ indicate what you type):

```
$ which apcupsd
/sbin/apcupsd
$ whereis apcupsd
apcupsd: /sbin/apcupsd /etc/apcupsd /etc/apcupsd.conf
/etc/apcupsd.status /usr/man/man8/apcupsd.8.gz
/usr/man/man8/apcupsd.8
```

If you find an apcupsd in /usr/sbin, /usr/local/sbin, /usr/lib, or another such directory, it is probably a piece of an old version of apcupsd that you can delete. If you are in doubt, delete it, then rerun the 'make install' to ensure that you haven't deleted anything needed by the new apcupsd. Please note that the files specified above assume the default installation locations.

As a final check that the 'make install' went well, you should check your halt script (in /etc/rc.d on SUSE systems, and in /etc/rc.d/init.d on Red Hat systems) to see that the appropriate lines have been inserted in the correct place. Modification of the halt script is important so that at the end of the shutdown procedure, apcupsd will be called again to command the UPS to turn off the power. This should only be done in a power failure situation as indicated by the presence of the /etc/powerfail file, and is necessary if you want your machine to automatically be restarted when the power returns. On a Red Hat system, the lines containing the # \*\*\*apcupsd\*\*\* should be inserted just before the final halt command:

```
# Remount read only anything that's left mounted.
#echo "Remounting remaining filesystems (if any) readonly"
mount | awk '/ext2/ { print $3 }' | while read line; do
    mount -n -o ro,remount $line
done

# See if this is a powerfail situation.
if [ -f /etc/apcupsd/powerfail ]; then
    echo "APCUPSD will now power off the UPS"
    /etc/apcupsd/apccontrol killpower
    echo "Please ensure that the UPS has powered off before rebooting"
    echo "Otherwise, the UPS may cut the power during the reboot!!!"
fi

# Now halt or reboot.
echo "$message"
if [ -f /fastboot ]; then
    echo "On the next boot fsck will be skipped."
elif [ -f /forcefsck ]; then
    echo "On the next boot fsck will be forced."
fi
```

The purpose of modifying the system halt files is so that apcupsd will be recalled after the system is in a stable state. At that point, apcupsd will instruct the UPS to shut off the power. This is necessary if you wish your system to automatically reboot when the mains power is restored. If you prefer to manually reboot your system, you can skip this final system dependent installation step by specifying the `disable-install-distdir` option on the './configure' command (see below for more details).

The above pertains to Red Hat systems only. There are significant differences in the procedures on each system, as well as the location of the halt script. Also, the information that is inserted in your halt script varies from system to system. Other systems such as Solaris require you to make the changes manually, which has the advantage that you won't have any unpleasant surprises in your halt script should things go wrong. Please consult the specific system dependent README files for more details.

Please note that if you install from RPMs for a slave machine, you will need to remove the changes that the RPM install script made (similar to what is noted above) to the halt script. This is because on a slave

machine there is no connection to the UPS, so there is no need to attempt to power off the UPS. That will be done by the master.

## Configure Options

All the available `configure` options can be printed by entering:

```
./configure --help
```

When specifying options for './configure', if in doubt, don't put anything, since normally the configuration process will determine the proper settings for your system. The advantage of these options is that it permits you to customize your version of `apcupsd`. If you save the './configure' command that you use to create `apcupsd`, you can quickly reset the same customization in the next version of `apcupsd` by simply re-using the same command.

The following command line options are available for `configure` to customize your installation.

<code>--prefix=path</code>	This defines the directory for the non-executable files such as the manuals. The default is <code>/usr</code> .
<code>--sbindir=path</code>	This defines the directory for the executable files such as <code>apcupsd</code> . The default is <code>/sbin</code> . You may be tempted to place the executable files in <code>/usr/sbin</code> or <code>/usr/local/sbin</code> . Please use caution here as these directories may be unmounted during a shutdown and thus may prevent the <code>halt</code> script from calling <code>apcupsd</code> to turn off the UPS power. Though your data will be protected, in this case, your system will probably not be automatically rebooted when the power returns
<code>--enable-cgi</code>	This enables the building of the CGI programs that permit Web browser access to <code>apcupsd</code> data. This option is not necessary for the proper execution of <code>apcupsd</code> .
<code>--with-cgi-bin=path</code>	The <code>with-cgi-bin</code> configuration option allows you to define the directory where the CGI programs will be installed. The default is <code>/etc/apcupsd</code> , which is probably not what you want.
<code>--with-css-dir=path</code>	This option allows you to specify where you want <code>apcupsd</code> to put the Cascading Style Sheet that goes with the <code>multimoncss.cgi</code> CGI program.
<code>--enable-apcsmart</code>	Turns on generation of the APC Smart driver (default).
<code>--enable-dumb</code>	Turns on generation of the dumb signalling driver code (default).
<code>--enable-usb</code>	Turns on generation of the USB driver code. By default this is disabled.
<code>--enable-net</code>	Turns on generation of the NIS network driver for slaves. For each slave, this is the only driver needed. This driver works by reading the information from the the configured master using the NIS (Network Information Services) interface.
<code>--enable-snmp</code>	Turns on generation of the SNMP driver. This driver accesses the UPS over the network using SNMP. This is compatible only with UPSes equipped with an SNMP or Web/SNMP management card. By default this is enabled.



<code>--enable-net-snmp</code>	Turns on generation of the obsolete NET-SNMP driver. This driver was the precursor to the current snmp driver and is now obsolete. It is available as a fallback if the new driver cannot be used for some reason. By default this is disabled.
<code>--enable-pcnet</code>	Turns on generation of the PCNET (PowerChute Network Shutdown) driver. This driver accesses the UPS over the network using APC's custom protocol. This driver can be used as an alternative to SNMP for UPSes equipped with a modern Web/SNMP management card.
<code>--enable-test</code>	This turns on a test driver that is used only for debugging. By default it is disabled.
<code>--enable-gapcmn</code>	This option enables building the GTK GUI front-end for apcupsd. Building this package requires numerous GNOME libraries. The default is disabled.
<code>--enable-apcagent</code>	This option enables building the apcagent menubar application on Mac OS X platforms. The default is disabled.
<code>--with-libwrap=path, --with-libwrap</code>	This option when enabled causes apcupsd to be built with the TCP WRAPPER library for enhanced security. In most cases, the path is optional since configure will determine where the libraries are on most systems.
<code>--with-nologin=path</code>	This option allows you to specify where apcupsd will create the nologin file when logins are prohibited. The default is /etc
<code>--with-pid-dir=path</code>	This option allows you to specify where apcupsd will create the process id (PID) file to prevent multiple copies from running. The default is system dependent but usually /var/run.
<code>--with-log-dir=path</code>	This option allows you to specify where apcupsd will create the EVENTS and STATUS log files. The default is /etc/apcupsd. This option simply sets the default of the appropriate path in the apcupsd.conf file, which can be changed at any later time.
<code>--with-lock-dir=path</code>	This option allows you to specify where apcupsd will create the serial port lock file. The default is system-dependent but usually /var/lock. This option simply sets the appropriate path in the apcupsd.conf file, which can be changed at any later time.
<code>--with-pwrfail-dir=path</code>	This option allows you to specify where apcupsd will create the powerfail file when a power failure occurs. The default is system dependent but usually /etc.
<code>--with-serial-dev=device-name</code>	This option allows you to specify where apcupsd will look for the serial device that talks to the UPS. The default is system dependent, but often /dev/ttyS0. This option simply sets the appropriate device name in the apcupsd.conf file, which can be changed at any later time.



`--with-nis-port=port`

This option allows you to specify what port apcupsd will use for the Network Information Server (the CGI programs). The default is system dependent but usually 3551 because that port has been officially assigned to apcupsd by the IANA. This option simply sets the appropriate port in the apcupsd.conf file, which can be changed at any later time.

`--with-nisip=ip-address`

This option allows you to specify the value that will be placed on the NISIP directive in the configuration file. The default is 0.0.0.0. No checking is done on the value entered, so you must ensure that it is a valid IP address.

`--with-net-port=port`

This option allows you to specify what port apcupsd will use for Master and Slave communications. The default is system dependent but usually 6666. This option simply sets the appropriate port in the apcupsd.conf file, which can be changed at any later time.

`--with-upstype=type`

This option allows you to specify the type of UPS that will be connected to your computer. The default is: smartups. This option simply sets the appropriate UPS type in the apcupsd.conf file, which can be changed at any later time.

`--with-upscable=cable`

This option allows you to specify what cable you are using to connect to the UPS. The default is: smart. This option simply sets the appropriate UPS cable in the apcupsd.conf file, which can be changed at any later time.

`--disable-install-distdir`

This option modifies the apcupsd Makefiles to disable installation of the distribution (platform) directory. Generally, this is used to do a full installation of apcupsd except the final modification of the operating system files (normally /etc/rc.d/halt, etc.). This is useful if your operating system is not directly supported by apcupsd or if you want to run two copies of apcupsd on the same system. This option can also be used by those of you who prefer to manually reboot your system after a power failure or who do not want to modify your system halt files.

## ***Recommended Options for most Systems***

For most systems, we recommend the following options:

```
./configure --prefix=/usr --sbindir=/sbin --enable-usb
```

and you can optionally build and install the CGI programs as follows:

```
./configure --prefix=/usr --sbindir=/sbin --enable-usb \
--enable-cgi --with-cgi-bin=/home/httpd/cgi-bin
```

## Compilers and Options

Some systems require unusual options for compilation or linking that the './configure' script does not know about. You can specify initial values for variables by setting them in the environment. Using a Bourne-compatible shell, you can do that on the command line like this:

```
CFLAGS="-O2 -Wall" LDFLAGS= ./configure
```

Or on systems that have the `env` program, you can do it like this:

```
env CPPFLAGS=-I/usr/local/include LDFLAGS=-s ./configure
```

Or for example on the Sun Solaris system, you can use:

```
setenv CFLAGS -O2
setenv LDFLAGS -O
./configure
```

You can get a listing of all available options by doing:

```
./configure --help
```

or simply see the previous section of this manual.

## Operating System Specifics

With the exception of Linux SUSE and Linux Red Hat systems used by the developers, we rely on users to help create installation scripts and instructions as well as to test that `apcupsd` runs correctly on their system. As you can imagine, most of these people are system administrators rather than developers so they are very busy and don't always have time to test the latest releases. With that in mind, we believe that you will find that a lot of very valuable work has been already done to make your installation much easier (and probably totally automatic).

Below, you will find a list of operating systems for which we have received installation files:

- Debian (see [Debian](#))
- FreeBSD (see [FreeBSD](#))
- HPUX (see [HPUX](#))
- NetBSD (see [NetBSD](#))
- Mac OS X Darwin (see [Mac OS X Darwin](#))
- OpenBSD (see [OpenBSD](#))
- Red Hat (see [Red Hat Systems](#))
- Slackware (see [Slackware](#))
- SUSE (see [SUSE](#))
- Solaris (see [Sun Solaris](#))
- unknown (see [Unknown System](#))
- Win32 (see [Windows Systems](#))

### Debian

This port is complete and is being used by several users. Since Debian build and install procedures are somewhat particular, we have put the extra Debian information into the following two subdirectories: `platforms/debian/examples` and `platforms/debian/packageinfo`

You can also find the official Debian packages on the Debian site at:

- <http://packages.debian.org/stable/apcupsd>
- <http://packages.debian.org/testing/apcupsd>
- <http://packages.debian.org/unstable/apcupsd>

### ***FreeBSD***

This port is complete and is being used by several users.

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

On the FreeBSD OS, there is no known way for a user program to get control when all the disks are synced. This is needed for apcupsd to be able to issue the killpower command to the UPS so that the UPS shuts off the power. To accomplish the same thing on FreeBSD systems, make sure you have a SmartUPS and that your UPS shutdown grace period is set sufficiently long so that your system will power down (usually 2 minutes), then use the `--kill-on-powerfail` option on the apcupsd command line.

### ***HPUX***

Status of this port is unknown.

### ***NetBSD***

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

### ***Mac OS X Darwin***

On OS X (Darwin), apcupsd can be built with `configure` defaults. The USB driver can be enabled, as per the directions on [Mac OS X \(Darwin\) USB Configuration](#). Apcupsd *may* be usable on OS X with a smart serial device, but certainly *does* work as a NIS client or using a USB interface.

The startup information will be installed in `/Library/StartupItems/apcupsd` which is part of darwin's SystemStartup.

### ***OpenBSD***

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

Ensure that you read the `distributions/openbsd/README` file before running apcupsd. There are some critical differences in how the OpenBSD implementation operates when the UPS batteries are exhausted. Failure to take this into account may result in the system not being fully halted when power is lost.

### ***Red Hat Systems***

Red Hat systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

### ***Slackware***

Slackware systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

### ***SUSE***

SUSE systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

### **Sun Solaris**

Please read this before attempting to compile or install the beta software. It contains important information that will make your efforts easier.

Before running './configure', please be sure that you do not have /usr/ucb on your path. This may cause the `configure` to choose the wrong shutdown program. If `configure` detects that /usr/ucb is on your path, it will print a warning message. Please follow the advice to avoid shutdown problems.

Your normal UNIX user ID must own the source tree directories, and you must have the normal development tools in your path. This includes `make`, the compiler, the M4 preprocessor, the linker, and `ar` or `ranlib`. If the user you are logged in as can compile and link a C program from a source file, then you have all the required tools available.

You will want to install the executables in a directory that remains mounted during the shutdown. Solaris will unmount almost everything except the root directories. Since the ability to power the UPS off requires access to the executable programs, they need to be in a directory that will never be unmounted. And since they should also be in a directory that normal users cannot get into, /sbin is the default. However, please be aware that if you want to follow Sun's filesystem conventions you would use the following:

```
./configure \
--prefix=/opt/apcupsd \
--sbindir=/etc/opt/apcupsd/sbin \
--sysconfdir=/etc/opt/apcupsd \
--with-cgi-bin=/opt/apcupsd/cgi-bin
```

The way to setup the /sbin directory as the executables directory is to pass `configure` the `--sbindir=/sbin` option. No other arguments should be required, and your setup and platform should be detected automatically by `configure`.

Once you have run `configure`, you will need to do a '`gmake`'. Once the make has completed with no errors, you must `su` to root to complete the install. After the `su`, you may not have a path to the `make` program anymore. In that case, you should do the '`gmake install`' step as:

```
gmake install
```

Once the install completes, you must edit the /sbin/rc0 script as detailed below, then exit from the `su`'ed shell.

In order to support unattended operation and shutdown during a power failure, it's important that the UPS remove power after the shutdown completes. This allows the unattended UPS to reboot the system when power returns by re-powering the system. Of course, you need autoboot enabled for your system to do this, but all Solaris systems have this by default. If you have disabled this on your system, please re-enable it.

To get the UPS to remove power from the system at the correct time during shutdown, i.e., after the disks have done their final sync, we need to modify a system script. This script is /sbin/rc0.

We do not have access to every version of Solaris, but we believe this file will be almost identical on every version. Please let us know if this is not true.

At the very end of the /sbin/rc0 script, you should find lines just like the following:

```
# unmount file systems. /usr, /var and /var/adm are not unmounted by umountall
# because they are mounted by rcS (for single user mode) rather than
# mountall.
# If this is changed, mountall, umountall and rcS should also change.
```

```
/sbin/umountall
/sbin/umount /var/adm >/dev/null 2>\&1
/sbin/umount /var >/dev/null 2>\&1
/sbin/umount /usr >/dev/null 2>\&1

echo 'The system is down.'
```

We need to insert the following lines just before the last 'echo':

```
#see if this is a powerfail situation
if [ -f /etc/apcupsd/powerfail ]; then
    echo
    echo "APCUPSD will power off the UPS"
    echo
    /etc/apcupsd/apccontrol killpower
    echo
    echo "Please ensure that the UPS has powered off before rebooting"
    echo "Otherwise, the UPS may cut the power during the reboot!!!"
    echo
fi
```

We have included these lines in a file called rc0.solaris in the distributions/sun subdirectory of the source tree. You can cut and paste them into the /sbin/rc0 file at the correct place, or yank and put them using vi or any other editor. Note that you must be root to edit this file.

You must be absolutely sure you have them in the right place. If your /sbin/rc0 file does not look like the lines shown above, do not modify the file. Instead, email a copy of the file to the maintainers, and we will attempt to figure out what you should do. If you mess up this file, the system will not shut down cleanly, and you could lose data. Don't take the chance.

You will then need to make the normal changes to the /etc/apcupsd/apcupsd.conf file. This file contains the configuration settings for the package. It is important that you set the values to match your UPS model and cable type, and the serial port that you have attached the UPS to. People have used both /dev/ttya and /dev/ttyb with no problems. You should be sure that logins are disabled on the port you are going to use, otherwise you will not be able to communicate with the UPS. If you are not sure that logins are disabled for the port, run the 'admintool' program as root, and disable the port. The 'admintool' program is a GUI administration program, and required that you are running CDE, OpenWindows, or another XWindows program such as KDE.

Solaris probes the serial ports during boot, and during this process, it toggles some handshaking lines used by dumb UPSes. As a result, particularly for simple signalling "dumb" UPSes it seems to kick it into a mode that makes the UPS think it's either in a calibration run, or some self-test mode. Since at this point we are really not communicating with the UPS, it's pretty hard to tell what happened. But it's easy to prevent this, and you should. Disconnect the UPS, and boot the system. When you get to a login prompt, log in as root. Type the following command:

```
eeeprom com1-noprobe=true
```

or

```
eeeprom com2-noprobe=true
```

depending on which com port your UPS is attached to. Then sync and shutdown the system normally, reattach the UPS, and reboot. This should solve the problem. However, we have some reports that recent versions of Solaris (7 & 8) appear to have removed this eeeprom option and there seems to be no way to suppress the serial port probing during boot.

At this point, you should have a complete installation. The daemon will load automatically at the next boot. Watch for any error messages during boot, and check the event logs in `/etc/apcupsd`. If everything looks OK, you can try testing the package by removing power from the UPS. NOTE! if you have a voltage-signalling UPS, please run the first power tests with your computer plugged into the wall rather than into the UPS. This is because dumb serial-port UPSes have a tendency to power off if your configuration or cable are not correct.

As a user, your input is very helpful in solving problems with the package, and providing suggestions and future directions for the development of the package. We are striving to provide a useful package that works across all platforms, and welcome your feedback.

### ***Unknown System***

During the `./configure`, if `apcupsd` does not find one of the systems for which it has specific installation programs, it will set the Operating System to `unknown` and will use the incomplete installation scripts that are in `platforms/unknown`. You will be on your own, or you can ask the developers list ([apcupsd-users@lists.sourceforge.net](mailto:apcupsd-users@lists.sourceforge.net)) for installation instructions. This directory also contains a hint file for Linux From Scratch, which could be helpful for other systems as well.

### ***Windows Systems***

Appropriate scripts (actually Windows batch files) are included with the Apcupsd Win32 installer package.

## **After Installation**

### ***Checking Your Configuration File***

Once you have installed `apcupsd`, either from a binary package or by building from source, your next step should be to inspect your `/etc/apcupsd/apcupsd.conf` file to make sure it is valid.

You can read the complete reference on configuration directives ([Configuration Directive Reference](#)), but if you are setting up a normal standalone configuration you should only need to check (and possibly fix) the first three items listed below.

Your `UPSTYPE` should be the UPS's protocol type: `dumb`, `apcsmart`, `usb`, `net`, `pcnet`, or `snmp`. Your `UPSCABLE` should be the type of cable you are using.

`DEVICE` should be set to the path of the device node (usually in `/dev`) to use to communicate with the UPS. This is used primarily for serial port connections. If you have a USB device, it is better not to specify a `DEVICE` directive by leaving it blank or commenting it out. Apcupsd will automatically search for your device in the standard places. If you specify a `DEVICE`, it should be the name of the device that `apcupsd` is to use to communicate with the UPS.

If the first time you execute `apcupsd`, you get a message to the effect that the Apcupsd USB driver is missing, it means that you most likely forgot to put `--enable-usb` on your `./configure` command line.

The [Configuration Examples](#) chapter of this manual provides the essential characteristics of each main type of configuration file. After those elements are correct, `apcupsd` should run, and then it is only a matter of customization of your setup.

### ***Arranging for Reboot on Power-Up***

The final consideration for a automatic reboot after a full power down is to ensure that your computer will automatically reboot when the power is restored.

This is not the normal behavior of most computers as shipped from the factory. Normally after the power is cut and restored, you must explicitly press a button for the power to actually be turned on. You can test your computer by powering it down; shutting off the power (pull the plug); then plugging the cord back in. If your computer immediately starts up, good. There is nothing more to do.

If your computer does not start up, manually turn on the power (by pressing the power on button) and enter your computer's SETUP program (often by pressing DEL during the power up sequence; sometimes by pressing F10). You must then find and change the appropriate configuration parameter to permit instant power on.

Normally, this is located under the `BOOT` menu item, and will be called something such as `Restore on AC/Power Loss` or `Full-On`. The exact words will vary according to the ROM BIOS provider. Generally you will have three options: `Last State`, `Power On`, and `Power Off`. Although `Last State` should normally work, we recommend setting your computers to `Power On`. This means that whenever the power is applied they are on. The only way to shut them off is to pull the plug or to have a special program that powers them off (`/sbin/poweroff` on Linux systems).

If after making all the changes suggested above, you cannot get your computer to automatically reboot, you might examine your halt script (`/etc/rc.d/init.d/halt` in the case of Red Hat Linux) and see if the final line that performs the halt or reboot contains the `-p` option for powering down the computer. It should not with the logic used by `apcupsd`, but if it does, the `-p` option could cause your computer to power off while the UPS is still supplying power (i.e. before the UPS kills the power). Depending on the setting of your BIOS, it may prevent your computer from restarting when the power returns. As already mentioned, this should not apply, but in case of problems it is worth a try.

## ***Making sure apcupsd Is Running***

The simplest way to invoke `apcupsd` is from the command line by entering:

```
/sbin/apcupsd
```

To do so, you must be root. However, normally, you will want `apcupsd` started automatically when your system boots. On some systems with installation support (e.g. SUSE and Red Hat), the installation procedure will create a script file that you will be automatically invoked when your system reboots. On other systems, you will have to invoke `apcupsd` from your `rc.local` script.

On Red Hat systems, this script file that automatically invokes `apcupsd` on system start and stops is `/etc/rc.d/init.d/apcupsd`

To start `apcupsd` manually (as you will probably do immediately following the installation), enter the following:

```
/etc/rc.d/init.d/apcupsd start
```

To understand how this file is automatically invoked at system startup and shutdown, see the man pages for `chkconfig(8)`.

On SUSE systems, the script file that automatically invokes `apcupsd` on system start and stops is `/etc/rc.d/apcupsd`.

To start `apcupsd` manually (as you will probably do immediately following the installation), enter the following:

```
/etc/rc.d/apcupsd start
```

Normally, when properly installed, `apcupsd` will be started and stopped automatically by your system. Unfortunately, the details are different for each system. Below, we give the commands for selected systems. Alternatively, there are simple `stopapcupsd` and `startapcupsd` scripts in the `examples` directory, or you can modify one of the scripts in the `distributions` directory to meet your needs.

To stop `apcupsd` you can do the following:

On Red Hat systems:

```
/etc/rc.d/init.d/apcupsd stop
```

On SUSE systems:

```
/etc/rc.d/apcupsd stop
```

Please see the [Testing Apcupsd](#) chapter for more details on insuring that apcupsd is running properly.

## Configuration Examples

### *A Simple USB Configuration*

If you have a USB UPS, the essential elements of your apcupsd.conf file should look like the following:

```
## apcupsd.conf v1.1 ##
UPSCABLE usb
UPSTYPE usb
DEVICE
LOCKFILE /var/lock
UPSCCLASS standalone
UPSMODE disable
```

Notice that we have not specified a device. In doing so, apcupsd will try all the well known USB ports. We strongly recommend you use this (empty device address) form unless you have a good reason to do otherwise.

Please use the explicit specifications of a device only if you know exactly what you are doing. In general, it is much easier to let apcupsd find the device itself.

Please see [USB Configuration](#) for detailed help on setting up your system to work with a USB UPS.

### *A Simple Configuration for a Serial SmartUPS*

If you have a Smart UPS using the serial cable supplied by APC, or you build a CUSTOM SMART cable outlined in the cables chapter, a very simple configuration file would look like the following:

```
## apcupsd.conf v1.1 ##
UPSCABLE smart
UPSTYPE smartups
DEVICE /dev/ttyS0
LOCKFILE /var/lock
UPSCCLASS standalone
UPSMODE disable
```

Normally you would have many more configuration directives to completely customize your installation, but this example shows you the minimum required.

### *A Simple Configuration for a Simple Signaling or Dumb*

If you have a simple signaling or dumb UPS such as a BackUPS, you will need to know exactly what cable you have and specify it on the UPSCABLE directive. Please see the list of UPSes versus cables in the beginning of this document for more information. The cable number is normally stamped in the plastic at one end of the cable. If you specify the wrong cable, it is very likely that at the first power failure, your computer will be immediately shutdown. This is an unfortunate consequence of the dumb signaling mode. To avoid this, first replace /etc/apcupsd/apccontrol with safe.apccontrol found in the examples directory, then test until everything works correctly. Once you have the correct cable, be sure to remember to



reinstall the correct apccontrol file and test that your computer is correctly shutdown during a power failure.

```
## apcupsd.conf v1.1 ##
UPSCABLE (number of cable you have)
UPSTYPE dumb
DEVICE /dev/ttyS0
LOCKFILE /var/lock
UPSCCLASS standalone
UPSMODE disable
```

If your cable does not have low battery detection, as is the case with some older models, you will also need to define `TIMEOUT nnn` where you set `nn` to be the number of seconds on a power failure after which a shutdown is effected.

Normally you would have many more configuration directives to completely customize your installation, but this example shows you the minimum required.

### ***NIS Server/Client Configuration Using the Net Driver***

NIS (Network Information Server) mode allows for communication between instances of apcupsd running on different hosts. Only one of those hosts, the server, needs to talk to the UPS directly. The others, clients, obtain information about the state of the UPS by querying the server. NIS is *not* related to Sun's NIS/YP services.

NIS clients and servers require that apcupsd be compiled with the Net Driver `--enable-net`. This is typically enabled by default.

The NIS server is connected to the UPS and should be configured exactly as a standalone configuration, but with `NETSERVER on`. In all other respects, the server should be configured in standalone mode. You may also set the NIS server specific options `NISIP` to restrict which IP address of the server which apcupsd listens on. The default, 0.0.0.0, means to list on all of the server host's IP addresses; `NISPORT` (default 3551) to set which TCP port the server listens on; and `EVENTSFILE` and `EVENTSFILEMAX` to provide information about the last few events to clients. You may also need to modify your firewall rules on the server's host to allow traffic to the `NISPORT`.

For the NIS client computer, you will have a configuration that looks something like what follows. What is important is that you get the information from an `UPSCABLE ether` with `UPSTYPE net` over the network and you must specify the address of a NIS server using `DEVICE`. The client apcupsd will then poll the NIS server specified in `DEVICE` every `POLLTIME` seconds (formerly `NETTIME`).

```
## apcupsd.conf v1.1 ##
UPSCABLE ether
UPSTYPE net
LOCKFILE /var/lock
DEVICE server-network-address:3551
UPSCCLASS standalone
UPSMODE disable
POLLTIME 10
```

The `DEVICE` is set to `server-address:port`, where `server-address` is the fully qualified domain name or IP address of the apcupsd NIS server, and `port` is the `NISPORT` that the server is listening on. The default is 3551, but older versions of apcupsd used port 7000.

If you set `POLLTIME` too large, your client may not see the change in state of the NIS server before the server has shutdown. Normally, you have at least 30 seconds of grace time between the time the NIS server decides to shutdown and the time it no longer responds. Your slave must poll during this interval.

Any client run using the Net driver will shutdown when its own timers expire or when the NIS server shuts down, whichever occurs first. This means that if you want the slave to shutdown before the server, you need only set `BATTERYLEVEL`, `MINUTES` or `TIMEOUT` on the client for a faster shutdown than the values defined on the NIS server. This can often be useful if the slave is less important than the master and you wish to reduce battery power consumption so that the master can remain up longer during a power outage.

NIS clients work principally by reading the `STATFLAG` record that is sent by the NIS server (present in the output of `apcaccess`). The low 16 bits are the standard APC status flag, and the upper 16 bits represent the internal state of `apcupsd`, so the slave can see when the power fails and know when to shutdown.

It would be possible to have a client also work as a server, but that would increase the delay of information getting from the UPS to the secondary client.

### ***Differences between NIS Client/Server and the old (now removed) Master/Slave modes***

The difference between the NIS mode and the removed master/slave mode is that the NIS server has no explicit knowledge of the slaves. The NIS server makes its information available via the net (NIS), and the NIS slaves read it. When the NIS server is going to shutdown, it makes the information available to any NIS slave that polls it, but the NIS server does not explicitly call each NIS slave as is the case in the Master/Slave networking described several sections above.

Think of the difference as push (Master/Slave) vs. pull (NIS-based). In the case of M/S, the master makes all the shutdown decisions and notifies the slaves when they are to shut down or when some other interesting event happens. The slaves just do whatever the master says, whenever the master says to. On the other hand, with the NIS-based network config you basically "publish" the UPS status from one server and then your clients view that status and make their own decisions.

### ***PowerChute Network Shutdown Driver (PCNET)***

As of 3.14, `Apcupsd` supports the PowerChute Network Shutdown protocol. This is an alternative to SNMP for use with APC's AP9617 family of network smartslot modules. Note that the older AP9606 modules do **not** support PCNET.

To enable PCNET support, configure with the `--enable-pcnet` flag. This is typically enabled by default.

The required `apcupsd.conf` settings are straightforward:

```
## apcupsd.conf v1.1 ##
UPSCABLE ether
UPSTYPE pcnet
LOCKFILE /var/lock
DEVICE ipaddr:user:passphrase
UPSCCLASS standalone
UPSMODE disable
```

The `DEVICE` setting specifies the IP address of the UPS as well as the username and authentication passphrase to use. Note that the username and passphrase are **not** the Web/SNMP login credentials. They are separate settings. The default username on a new card is "apc" and the default passphrase is "admin user phrase". To change the passphrase, log in to the Web UI and go to the UPS tab, then to PowerChute -> Configuration. (This assumes firmware v3.3.1. Other versions may place the setting elsewhere.) *The password must be a minimum of 15 characters long.* The web UI will silently ignore shorter passwords and does not give an error message. There is no apparent way to change the username.

Note that you may leave `DEVICE` blank and `Apcupsd` will accept information from any PCNET UPS on the network, **however it will be very insecure since an attacker could easily send packets crafted to cause your server to shut down.** Using the `ipaddr`, `user`, and `passphrase` will prevent this behavior.

You may need to take steps to ensure networking stays active during your OS's shutdown sequence in order for the PCNET driver to power off the UPS (the so-called "killpower" operation). On a Linux distro, you can use commands such as...

```
chkconfig --level 0 network on
chkconfig --level 0 iptables on
```

...to make sure networking stays up.

## Testing Apcupsd

The following testing procedures apply for the most part to SmartUPSes, whether USB or serial. If you have a dumb voltage-signalling UPS, your testing procedures will be somewhat different, and you should see the section on Testing Serial UPSes (see [Testing Serial-Line UPSes](#)).

### Process-Status Test

After you start apcupsd, execute the following command:

```
ps fax
```

or the equivalent for your system. You should see something similar to the following output.

```
632 ?      S      0:00 /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
841 ?      S      0:00 \_ /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
842 ?      S      0:00 \_ /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
```

This indicates that apcupsd is up and running and has started the two standard threads in addition to the main thread.

If you see only one instance of apcupsd running, don't worry about it as this is normal on most non-Linux systems, and on Linux 2.6.x kernels.

If you do not find that apcupsd is in the above list, the most likely problem is a configuration file glitch. If no messages were printed, you should check your system log (normally `/var/log/messages`) where you will find one or messages indicating the nature of the problem.

### Logging Test

Once you have established that the proper processes are running, do a tail of the system log file, normally `/var/log/messages`:

```
tail /var/log/messages
```

You should see output that looks similar to the following:

```
Dec 5 17:01:05 matou apcupsd[5917]: apcupsd 3.7.2 startup succeeded
```

These messages should also appear in the temporary file (`/etc/apcupsd/apcupsd.events`) if you are using the default configuration file. If you have installed the RPM, they will probably be in `/var/log/apcupsd.events`.

### apcaccess Test

This test consists of running `apcaccess` to see if apcupsd is properly updating its internal variables. Please note that you must enable the apcupsd Network Information Server in your configuration file for

apcaccess to work. This is done by setting:

```
NETSERVER on
NISPORT 3551
```

in your apcupsd.conf file.

To run the apcaccess test, use the following command:

```
apcaccess status
```

Depending on the type of UPS you have, you will get slightly different output, but an example For a Smart-UPS is as follows:

```
APC      : 001,048,1088
DATE     : Fri Dec 03 16:49:24 EST 1999
HOSTNAME : daughter
RELEASE  : 3.7.2
CABLE    : APC Cable 940-0024C
MODEL    : APC Smart-UPS 600
UPSMODE  : Stand Alone
UPSNAME  : SU600
LINEV    : 122.1 Volts
MAXLINEV : 123.3 Volts
MINLINEV : 122.1 Volts
LINEFREQ : 60.0 Hz
OUTPUTV  : 122.1 Volts
LOADPCT  : 32.7 Percent Load Capacity
BATTV    : 26.6 Volts
BCHARGE  : 095.0 Percent
MBATTCHG : 15 Percent
TIMELEFT : 19.0 Minutes
MINTIMEL : 3 Minutes
SENSE    : Medium
DWAKE    : 000 Seconds
DSHUTD   : 020 Seconds
LOTRANS  : 106.0 Volts
HITRANS  : 129.0 Volts
RETPCT   : 010.0 Percent
STATFLAG : 0x08 Status Flag
STATUS   : ONLINE
ITEMP    : 34.6 C Internal
ALARMDEL : Low Battery
LASTXFER : Unacceptable Utility Voltage Change
SELFTEST : NO
STESTI   : 336
DLOWBATT : 05 Minutes
DIPSW    : 0x00 Dip Switch
REG1     : N/A
REG2     : N/A
REG3     : 0x00 Register 3
MANDATE  : 03/30/95
SERIALNO : 13035861
BATTDATA : 05/05/98
NOMOUTV  : 115.0
NOMBATTV : 24.0
```

```
HUMIDITY : N/A
AMBTEMP  : N/A
EXTBATTs : N/A
BADBATTs : N/A
FIRMWARE : N/A
APCMODEL : 6TD
END APC   : Fri Dec 03 16:49:25 EST 1999
```

For a simple signaling or dumb UPS such as BackUPS, your output will be very minimal as follows:

```
APC       : 001,012,0319
DATE      : Mon Feb 18 09:11:50 CST 2002
RELEASE   : 3.8.5
UPSNAME   : UPS_IDEN
CABLE     : APC Cable 940-0128A
MODEL     : BackUPS
UPSMODE   : Stand Alone
STARTTIME : Mon Feb 18 09:11:45 CST 2002
LINEFAIL  : OK
BATTSTAT  : OK
STATFLAG  : 0x008 Status Flag
END APC   : Mon Feb 18 09:15:01 CST 2002
```

If you see the above output, it is a good sign that `apcupsd` is working. Assuming that the output looks reasonable, check the following variables:

#### **LINEV**

This is the line voltage and it should be a value that is appropriate for your equipment. In the USA, it is typically about 120 Volts while in Europe, it is about 220 Volts.

#### **BATTV**

Unless you have additional battery packs, this should be near 24 Volts plus or minus 5 Volts.

#### **STATUS**

This is the status of the UPS and it should normally be `ONLINE`.

A very disturbing tendency is for some of the newer (Mar 2004) RS and ES UPSes to have no Voltage information. This is an annoying bug, but not serious. On the other hand, some of those UPSes now have no battery charge information `BCHARGE`. If `BCHARGE` is zero in your listing and you are running a Smart or a USB UPS, then you will have to set the `BATTERYLEVEL` directive in your `apcupsd.conf` file to -1.

If you see a message to the effect of:

```
APCACCESS FATAL ERROR in apcaccess.c at line 336
tcp_open: cannot connect to server localhost on port 3551.
```

It means that you have probably not enabled the Network Information Server in your configuration file for `apcaccess` to work. This is done by setting `NETSERVER` and `NISPORT` in your `apcupsd.conf` file as shown above.

## ***Communications Test***

At this point, you should ensure that `apcupsd` is handling the connection to the UPS correctly. This test assumes you have a UPS that speaks `apcsmart` protocol, over either USB or a serial port. If you have an old-style voltage-signaling UPS, please skip to the next section ([Simulated Power Fail Test](#)).

When `apcupsd` detects a problem, it generates an `EVENT`, which consists of sending a message to the system log then invoking the `apccontrol` script (normally in `/etc/apcupsd/apccontrol`) to handle the

event.

In order to create an event, remove the serial port plug from the back of your computer or from the back of the UPS. Within 6 seconds, `apcupsd` should detect the lack of serial port communications and broadcast a `wall` message indicating that the serial port communications was lost:

```
Warning communications lost with UPS lost.
```

At the same time, it sends the same message to the system log and to the temporary EVENTS file (`/etc/apcupsd/apcupsd.events`).

Plug the serial port plug back into your computer, and within about 12 seconds, `apcupsd` should reestablish communications and broadcast and log the following message:

```
Communications with UPS restored.
```

If these messages are logged but not broadcast, either you have your `mesg` permission set to `no` (see `'man wall'` or `'man mesg'`), or there is a problem with `apccontrol`. If you are running a window manager such as GNOME and don't have a console window open, you may not receive the `wall` messages. However, you should find them in your system log file (normally `/var/log/messages`) and in the temporary EVENTS file, `/etc/apcupsd/apcupsd.events`. For example, to observe these events in the temporary EVENTS file, you might do a

```
tail -f /etc/apcupsd/apcupsd.events
```

Note, if you have installed from the RPM, the proper events file may be `/var/log/apcupsd.events`. You can find the actual filename by checking your `apcupsd.conf` file before running the test.

If you do not observe these messages, you should correct this problem before proceeding with additional tests.

## ***Simulated Power Fail Test***

At this point, you should verify that in the event of a power fail `apcupsd` properly calls `apccontrol`. This test is appropriate for all models of UPSes (smart or dumb).

To avoid the possibility that `apcupsd` might shut down your system, locate where `apccontrol` resides on your system (normally, `/etc/apcupsd/apccontrol`). Move this script to another location e.g. `apccontrol.save` and replace it with the script found in `examples/safe.apccontrol`. When that is done, ensure that your UPS battery is fully charged and that you have at least 5 minutes of remaining runtime on the batteries. This can be done by examining the values of the `BATTCHG` and `TIMELEFT` variables in the printout of `'apcaccess status'`.

Although this should not be necessary, as an extra precaution, you can shutdown your machine, remove the plug from the UPS you are testing, and plug your machine into another UPS or directly into the wall. Doing so, will ensure that the UPS doesn't cut the power to your machine at a bad time. Remember at the end of the testing to plug your machine back into the UPS.

You can also minimize the risk from an unexpected shutdown by using a journaling filesystem such as Linux's EXT3. All modern disk drives park themselves safely when they power down, rather than ploughing up oxide on your disk's recording surface. Thus, unexpected power loss has to hit very narrow timing windows in order to trash an EXT3 transaction.

To begin the test, pull the power plug from the UPS. The first time that you do this, psychologically it won't be easy, but after you have pulled the plug a few times, you may even come to enjoy it. If all goes well, `apcupsd` should detect the power failure and print several warning messages. The first should appear after 5 to 6 seconds and read:

```
Warning power loss detected.
```

Then generally 6 seconds later, `apcupsd` is sure that it isn't a transient effect, so it sends:

```
Power failure. Running on UPS batteries.
```

After a few more seconds (total around 15 seconds), plug the power cord back in and ensure that `apcupsd` is aware that the power has returned. It should print:

```
Power has returned...
```

If you do not observe the above messages, please correct the situation before proceeding. The most likely cause of problems are:

- `apcupsd` doesn't recognize the power failure because the configuration directives are not correct. E.g. wrong cable.
- The file `/etc/apcupsd/apccontrol` doesn't exist or is not marked as executable.

## System Shutdown Test

This is an intermediate test that you can do, for all UPS models before doing the Full Power Down Test. First modify the `/etc/apcupsd/apccontrol` file so that in the `killpower` case, the line that re-executes `apcupsd` with the `--killpower` option is commented out. The original line probably looks something like:

```
${APCUPSD} --killpower
```

when it is commented out, it looks like:

```
#${APCUPSD} --killpower
```

Now when you pull the power plug, and either the timer expires or the batteries are exhausted (see the next section for more details), the system should be fully shutdown.

After performing this test, please be sure to restore `/etc/apcupsd/apccontrol` to its previous state.

## Full Power Down Test

To complete the testing, you should do a power fail shutdown of your system. This test is applicable to all UPS models. Please do a backup of your system or take other precautions before attempting this to avoid the possibility of lost data due to a problem (I have been through this at least 10 times and never once had problems, but we all know that someday something will go wrong).

Before proceeding, please ensure that your halt script or the equivalent has been properly updated by the install process to contain the logic to call `apcupsd --killpower` or `apccontrol killpower` when it detects a power failure situation (the presence of a `/etc/powerfail` file). See the [Building and Installing apcupsd](#) section of this manual, or the README files for additional details about the halt modifications necessary.

When you are ready to do the test, either simply pull the plug and wait for the batteries to become exhausted, or set the `TIMEOUT` configuration directive to something like 60 so that the system will shutdown before the batteries are exhausted. We recommend doing the full shutdown without using `TIMEOUT` to correctly simulate a real power failure, but the choice is yours (I did it once here, but now use `TIMEOUT 30`).

If all goes well, your system should be shutdown before the batteries are completely exhausted and the UPS should be powered off by `apcupsd`. Please be aware that if you do the full power down, you must ensure that your UPS is totally powered off. Otherwise, it may have been given the command to power off, but due to a long grace period it is still waiting. If you were to reboot your computer during the grace

period, the UPS could then suddenly turn off the power (this happened to me). To avoid this problem, always wait for your UPS to power itself off, or power it off manually before restarting your computer. On my system, the UPS is configured as at the factory to have a 180 second grace period before shutting off the power. During this type of testing, 180 seconds *seems* like an eternity, so please take care to either wait or manually power off your UPS. To determine what grace period is programmed into your UPS EEPROM, run `'apcaccess eprom'` and look at the "Shutdown grace delay".

If you experienced so problems with the above testing procedures, or if you are porting `apcupsd` to another system, or you are simply curious, you may want to know exactly what is going on during the shutdown process. If so, please see the [Shutdown Sequence](#) section of this manual.

## ***apctest***

`apctest` is a program that allows you to talk directly to your UPS and run certain low-level tests, display all known values from the UPS's EEPROM, perform a battery runtime calibration, program the EEPROM (serial connection only), and enter in TTY mode with the UPS. Here we describe how to use it for a SmartUPS. The menus and options for USB and simple signaling UPSes are different but mostly self-explanatory.

Shutdown `apcupsd` if it is running. Make sure your `/etc/apcupsd/apcupsd.conf` file has `UPSTYPE apcsmart` and `UPSCABLE` has one of the smart cables that are supported.

Run `apctest` by invoking it with no arguments.

It will read your installed `apcupsd.conf` configuration (so it knows where to find the UPS) and then it will present you with the following output:

```
2003-07-07 11:19:21 apctest 3.10.6 (07 July 2003) redhat
Checking configuration ...
Attached to driver: apcsmart
sharenet.type = DISABLE
cable.type = CUSTOM_SMART

You are using a SMART cable type, so I'm entering SMART test mode
mode.type = SMART
Setting up serial port ...
Creating serial port lock file ...
Hello, this is the apcupsd Cable Test program.
This part of apctest is for testing Smart UPSes.
Please select the function you want to perform.

1) Query the UPS for all known values
2) Perform a Battery Runtime Calibration
3) Abort Battery Calibration
4) Monitor Battery Calibration progress
5) Program EEPROM
6) Enter TTY mode communicating with UPS
7) Quit

Select function number: 1
```

Item 1 will probe the UPS for all values known to `apcupsd` and present them in rather raw format. This output can be useful for providing technical support if you are having problems with your UPS.

Item 2 will perform a Battery Runtime Calibration. This test will only be performed if your battery is 100% charged. Running the test will cause the batteries to be discharged to approximately 30% of capacity. The exact number depends on the UPS model. In any case, `apctest` will abort the test if it detects that the battery charge is 20% or less.



The advantage of doing this test is that the UPS will be able to recalibrate the remaining runtime counter that it maintains in its firmware. As your batteries age, they tend to hold less of a charge, so the runtime calibration may not be accurate after several years.

We recommend that perform a Battery Calibration about once a year. You should not perform this calibration too often since discharging the batteries tends to shorten their lifespan.

Item 3 can be used to abort a Battery Calibration in progress, if you some how became disconnected.

Item 4 can be used to restart the monitoring of a Battery Calibration if you should some how become disconnected during the test.

Item 5 is used to program the EEPROM. Please see the [Configuration Directives Used to Set the UPS EEPROM](#) chapter of this manual for the details.

Item 6 will initiate a direct communication between your terminal and the UPS, at which point you can enter raw UPS commands. Please be aware that you should be careful what commands you enter because you can cause your UPS to suddenly shutdown, or you can modify the EEPROM in a way to disable your UPS. The details of the raw Smart mode UPS commands can be found in the [APC Smart Protocol](#) chapter of this manual.

Item 7 will terminate apctest.

## Monitoring and Tuning your UPS

After you have verified that your UPS is working correctly, you will probably want to query the state of its health occasionally. The tools apcupsd gives you to do this include one command-line utility (apcaccess) and a GUI you can use through a Web browser. You can also use apctest to tune some parameters of the UPS itself.

### ***apcaccess***

apcaccess is a program (normally found in /sbin/apcaccess) that permits you to print out the complete status of your UPS.

apcaccess will use the Network Information Server to obtain the necessary information. You can specify a second optional argument to apcaccess in the form of `host:port` where the `:port` is optional. The default is `localhost:3551`. Please note that in versions prior to 3.10.6, the default NIS port was 7000, so if you are mixing versions, you will need to take a lot of care to ensure that all components are using the same port.

To enable the apcupsd Network Information Server, which is normally the default, you set:

```
NETSERVER on
NISPORT 3551
```

in your `apcupsd.conf` file.

The full form of the apcaccess command is:

```
apcaccess status localhost:3551
```

where only `apcaccess status` should normally be needed. `localhost` may be replaced by any machine name, fully qualified domain name, or IP address, which means that apcaccess can access any UPS on the network running the Network Information Server.

The `status` command line option of apcaccess will produce a full printout of all the STATUS variables used by apcupsd. This can be very helpful for checking the condition of your UPS and to know whether or not apcupsd is properly connected to it.

Please note that if you invoke apcaccess within the first 30 seconds of launching apcupsd, you will likely get an error message such as:

```
APCACCESS FATAL ERROR in apcaccess.c at line 336
tcp_open: cannot connect to server localhost on port 3551.
```

This is because apcupsd is still in the process of initializing the UPS. The solution is to wait at least 30 seconds after starting apcupsd before launching apcaccess.

For a SmartUPS 1000 apcaccess will emit the following output:

```
DATE       : Fri Dec 03 12:34:26 CET 1999
HOSTNAME   : matou
RELEASE    : 3.7.0-beta-1
CABLE      : Custom Cable Smart
MODEL      : SMART-UPS 1000
UPSMODE    : Stand Alone
UPSNAME    : UPS_IDEN
LINEV      : 232.7 Volts
MAXLINEV   : 236.6 Volts
MINLINEV   : 231.4 Volts
LINEFREQ   : 50.0 Hz
OUTPUTV    : 232.7 Volts
LOADPCT    : 11.4 Percent Load Capacity
BATTV      : 27.7 Volts
BCHARGE    : 100.0 Percent
MBATTCHG   : 5 Percent
TIMELEFT   : 112.0 Minutes
MINTIMEL   : 3 Minutes
SENSE      : Low
DWAKE      : 060 Seconds
DSHUTD     : 180 Seconds
LOTRANS    : 204.0 Volts
HITRANS    : 253.0 Volts
RETPCT     : 050.0 Percent
STATFLAG   : 0x08 Status Flag
STATUS     : ONLINE
ITEMP      : 29.2 C Internal
ALARMDEL   : Low Battery
LASTXFER   : U command or Self Test
SELFTEST   : NO
STESTI     : 336
DLOWBATT   : 02 Minutes
DIPSW      : 0x00 Dip Switch
REG1       : 0x00 Register 1
REG2       : 0x00 Register 2
REG3       : 0x00 Register 3
MANDATE    : 01/05/99
SERIALNO   : GS9902009459
BATTDATE   : 01/05/99
NOMOUTV    : 230.0
NOMBATTV   : 24.0
HUMIDITY   : N/A
AMBTEMP    : N/A
EXTBATTs   : 0
BADBATTs   : N/A
FIRMWARE   : 60.11.I
APCMODEL   : IWI
END APC    : Fri Dec 03 12:34:33 CET 1999
```

For the various smaller, cheaper APC USB UPSes, such as the CS, ES, ..., you will get much of the information that is presented above, but not all of it. For example, you will not get `MAXLINEV`, `MINLINEV`, `LINEFREQ`, ... and in particular, the `LOADPCT` will be zero when you are running on mains. `LOADPCT` will display when the UPS is on batteries. You must remember that the non-SmartUPSes are much simpler (and less expensive) and therefore produce less information.

## ***Apcupsd Notification and Events***

When a major event is generated within `apcupsd`, control is passed to the script `apccontrol` normally found in `/etc/apcupsd/apccontrol`. The event name, and a number of other important parameters are passed to the script.

The major function of the `apccontrol` script is to perform a shutdown of the system (as well as the killpower operation). In addition, another major task for this script is to notify you by email when certain events such as powerfail occur.

Since `apccontrol` is a script, you can customize it to your own needs using any text editor. To do so, you must have a minimal knowledge of Unix shell programming. In addition, another feature is that you can write your own scripts that will be automatically called by `apccontrol` before any of its own code is executed. Details of the events and how to program them are contained in the Advanced topics section entitled [Customizing Event Handling](#).

## ***apcupsd Network Monitoring (CGI) Programs***

There are four CGI programs (`multimon.cgi`, `upsstats.cgi`, `upsfstats.cgi`, and `upsimage.cgi`). To have them properly installed, you must run the `./configure` command with `--enable-cgi` and you should specify an installation directory with `--with-cgi-bin=` or load them manually. The default directory for installation of the CGI programs is `/etc/apcupsd`, which is not really where you want them if you are going to use them. Normally, they should go in the `cgi-bin` of your Web server.

Once built and loaded, they will give you the status of your UPS or UPSes via a web browser.

Normally only `multimon.cgi` is directly invoked by the user. However, it is possible to directly invoke `upsstats.cgi` and `upsfstats.cgi`. `upsimage.cgi` should never be directly invoked as it is used by `upsstats.cgi` to produce the bar charts.

## ***Setting up and Testing the CGI Programs***

Before using `multimon` and the other CGI programs, first ensure that `apcupsd` is configured to run the Network Information Server. This is done by setting `NETSERVER on` in `/etc/apcupsd/apcupsd.conf`. This switch is on by default.

Next you must edit the hosts file `/etc/apcupsd/hosts.conf` and at the end, add the name of the hosts you want to monitor and a label string for them. For example:

```
MONITOR matou "Server"
MONITOR polymatou "Backup server"
MONITOR deuter "Disk server"
```

`matou`, `polymatou`, and `deuter` are the network names of the three machines currently running `apcupsd`. Please note that the network names may either be IP addresses or fully qualified domain names. The network name (or IP address) may optionally be followed by `:port`, where the port is the NIS port address you wish to use. This is useful if you are running multiple copies of `apcupsd` on the same system or if you are running in a mixed vendor environment where the NIS port assignments differ. An example could be the following:

```
MONITOR matou "Server"
MONITOR polymatou "Backup server"
MONITOR deuter "Disk server"
```

```
MONITOR polymatou:7001 "APC USB UPS"
```

where the USB copy of apcupsd has been configured to use port 7001 by modifying apcupsd.conf. Note, the default NIS port is 3551 on most platforms.

To test multimon.cgi, you can execute it as non-root directly from the source cgi build directory. To do so, enter at a shell prompt:

```
./multimon.cgi
```

If everything is set up correctly, it will print a bunch of HTML with the values of the machines that you have put in the hosts.conf file. It should look something like the following (note, only a small portion of the output is reproduced here):

```
Content-type: text/html

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN"
    "http://www.w3.org/TR/REC-html40/loose.dtd">
<HTML>
<HEAD><TITLE>Multimon: UPS Status Page</TITLE></HEAD>
<BODY BGCOLOR="#FFFFFF">
<TABLE BGCOLOR="#50A0A0" ALIGN=CENTER>
<TR><TD>
<TABLE CELLPADDDING=5>
<TR>
<TH COLSPAN=10 BGCOLOR="#60B0B0">
<FONT SIZE="+2">APCUPSD UPS Network Monitor</FONT>
<BR>Sun Jan 16 12:07:27 CET 2000</TH>
</TR>
<TR BGCOLOR="#60B0B0">
<TH COLSPAN=1>System</TH>
<TH COLSPAN=1>Model</TH>
<TH COLSPAN=1>Status</TH>
...
```

If you do not get similar output, check the permissions of the /etc/apcupsd directory and of those of /etc/apcupsd/hosts.conf to ensure that your web server can access it. At many sites, the Apache server is not running as root, so you must be careful to ensure that that /etc/apcupsd/hosts.conf and /etc/apcupsd/multimon.conf are world readable.

To invoke multimon in your Web browser, enter:

```
http://your-site/cgi-bin/multimon.cgi
```

You should get something similar to the screen shot shown below.

If you wish additional control over the colors, type faces, and sizes of the multimon output, you may simply edit the apcupsd.css file to specify the styles you prefer.

### ***Using the CGI Programs on Windows***

The CGI programs compiled for Windows are included in the Windows package starting with apcupsd-3.14.7.

The CGI programs included with the Windows package are intended to be run on Windows. If your web server is running on Linux or another operating system, you will need to obtain binary packages for that platform (or build them from source) instead. The windows build of the CGI programs has been tested with the Apache web server for Win32. They should also work with MS Internet Information Server (IIS).

To use the programs, copy the contents of the `cgi/` directory from your `apcupsd` installation directory to the `cgi-bin/` directory of your web server. Consult your web server's documentation for how to enable CGI programs to be executed. Sometimes special security settings are required.

Configure the `hosts.conf` file as described above. The programs expect to find the `hosts.conf` file and the `apcupsd.css` file in the directory `\apcupsd\etc\apcupsd` on the same drive letter as the web server's `cgi-bin` directory. If you installed `apcupsd` into `C:\apcupsd` (the default) and your web server's `cgi-bin/` directory is also located on the `C:` drive, no further changes are necessary. If you installed `apcupsd` into a different directory or your web server `cgi-bin` is on another drive, you will need to relocate `hosts.conf` and `apcupsd.css` from the `apcupsd` install location to `\apcupsd\etc\apcupsd` on the appropriate drive.

### ***multimon.cgi***

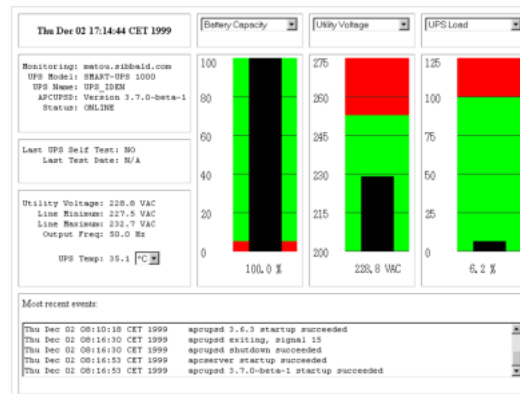
This program monitors multiple UPSes at the same time. A typical output of `multimon.cgi` as displayed in your Web browser might look like the following:

APCUPSD UPS Network Monitor								
Thu Dec 02 17:08:27 CET 1999								
System	Model	Status	Battery Chg	Utility	UPS Load	UPS Temp	Batt. Run Time	Data
<a href="#">Server</a>	SMART-UPS 1000	ONLINE	100.0 %	228.8 VAC	6.2 %	35.1 °C	147.0 min	<a href="#">Data</a>
<a href="#">Backup server</a>	SMART-UPS 1000	ONLINE	100.0 %	228.8 VAC	11.4 %	35.2 °C	312.0 min	<a href="#">Data</a>
<a href="#">Disk server</a>	SMART-UPS 1000	ONLINE	100.0 %	228.1 VAC	6.2 %	35.1 °C	367.0 min	<a href="#">Data</a>

The machines monitored as well as the values and their column headings are all configurable (see `/etc/apcupsd/hosts.conf` and `/etc/apcupsd/multimon.conf`)

### ***upsstats.cgi***

By clicking on the `system` name in the `multimon.cgi` display, you will invoke `upsstats.cgi` for the specified system, which will produce a bar graph display of three of the monitored values. For example,



You can display different bar graphs by selecting different variables from the drop down menus at the top of each of the three bar graphs.

As with `multimon`, if you have your local host configured in the `/etc/apcupsd/hosts.conf` file, you can execute it from a Unix shell from the source `cgi` directory as follows:

```
./upsstats.cgi
```

As with `multimon`, quite a few lines of html should then be displayed.

### ***upsfstatus.cgi***

If you would like to see all of the STATUS variables available over the network, click on the `Data` field of the desired system, and your browser will display something like the following:

```
APC      : 001,048,1109
DATE     : Thu Dec 02 17:27:21 CET 1999
```

```
HOSTNAME : matou.sibbald.com
RELEASE  : 3.7.0-beta-1
CABLE    : Custom Cable Smart
MODEL    : SMART-UPS 1000
UPSMODE  : Stand Alone
UPSNAME  : UPS_IDEN
LINEV    : 223.6 Volts
MAXLINEV : 224.9 Volts
MINLINEV : 222.3 Volts
LINEFREQ : 50.0 Hz
OUTPUTV  : 223.6 Volts
LOADPCT  : 6.2 Percent Load Capacity
BATTV    : 27.9 Volts
BCHARGE  : 100.0 Percent
MBATTCHG : 5 Percent
TIMELEFT : 167.0 Minutes
MINTIMEL : 3 Minutes
SENSE    : High
DWAKE    : 060 Seconds
DSHUTD   : 020 Seconds
LOTRANS  : 196.0 Volts
HITRANS  : 253.0 Volts
RETPCT   : 050.0 Percent
STATFLAG : 0x08 Status Flag
STATUS   : ONLINE
ITEMP    : 35.1 C Internal
ALARMDEL : Low Battery
LASTXFER : U command or Self Test
SELFTEST : NO
STESTI   : 336
DLOWBATT : 02 Minutes
DIPSW    : 0x00 Dip Switch
REG1     : 0x00 Register 1
REG2     : 0x00 Register 2
REG3     : 0x00 Register 3
MANDATE  : 01/11/99
SERIALNO : GS9903001147
BATTDATA : 01/11/99
NOMOUTV  : 230.0
NOMBATTV : 24.0
HUMIDITY : N/A
AMBTEMP  : N/A
EXTBATT  : 0
BADBATT  : N/A
FIRMWARE : 60.11.I
APCMODEL : IWI
END APC  : Thu Dec 02 17:27:25 CET 1999
```

You should get pretty much the same output mixed in with html if you execute `upsfstats.cgi` directly from a Unix shell in the `cgi` subdirectory as explained above for `upsfstats.cgi` and `multimon.cgi`.

#### ***A Tip from Carl Erhorn for Sun Systems:***

It is possible to run the CGI code to monitor your UPS using the answerbook HTTP server that runs on Solaris. As long as your server has the Answerbook2 web server installed and running, you can insert the cgi scripts into the `cgi` directory of the web server, and access the cgi using something like:

`http://hostname:8888/cgi/multimon.cgi`

### **CGI Credits**

Many thanks go to Russell Kroll [rkroll@exploits.org](mailto:rkroll@exploits.org) who wrote the CGI programs to work with his UPS Monitoring system named Network UPS Tools (NUT). Thanks also to Jonathan Benson [jbenson@technologist.com](mailto:jbenson@technologist.com) for initially adapting the `upsstatus.cgi` program to work with `apcupsd`.

We have enhanced the bar graph program and hope that our changes can be useful to the original author in his project.

### **Security Issues:**

- `apcupsd` runs as root.
- If you have `NETSERVER ON` in your `apcupsd.conf` file (which is the default), be aware that anyone on the network can read the status of your UPS. This may or may not pose a problem. If you don't consider this information privileged, as is the case for many, there is little risk. In addition, if you have a perimeter firewall or NATting router with typical settings only users on your local network access to your UPS information. You may also restrict access using using firewall settings (see below) or TCP Wrappers (see below).

### **Firewall Settings**

If you are running `apcupsd` as an NIS server, you will need to ensure that the clients can reach it by opening up `NISPORT` (default: TCP 3551) on any firewall running on the server. You may wish to configure your firewall(s) to *only* allow connections from your local network or specifically from the masters, slaves, and servers as needed.

### **TCP Wrappers**

If your operating system does not support a host based firewall (a firewall running on the local machine) then you may try to get some of the functionality of such a firewall with TCP Wrappers. As of `apcupsd` version 3.8.2, TCP Wrappers are implemented if you turn them on when configuring `./configure --with-libwrap`. With this code enabled, you may control who may access your `apcupsd` via TCP connections (the Network Information Server). This control is done by modifying the file: `/etc/hosts.allow`. This code is implemented but untested. If you use it, please send us some feedback.

### **Configuring Your EEPROM**

If you have a SmartUPS, there are depending on the UPS at least 12 different values stored in the EEPROM that determine how the UPS reacts to various conditions such as high line voltage, low line voltage, power down grace periods, etc.

In general, for the moment, we do not recommend that you change your EEPROM values unless absolutely necessary. There have been several reported cases of problems setting the Low Transfer Voltage. Consequently, if at all possible, do not attempt to change this value.

### **Using `apctest` to Configure Your EEPROM**

*To make the EEPROM changes with `apctest` you must first stop the `apcupsd` daemon. After `apcupsd` is stopped you may invoke `apctest` (as root).*

We recommend that you change the EEPROM as little as is absolutely necessary since it is a somewhat delicate process that has occasionally produced problems (i.e. improper EEPROM values are displayed after the update).

`apctest` will present a menu of options which are generally self-explanatory. Note that USB connections will show a difference set of options than smart serial connections.

# Maintaining Your UPS Batteries

## ***Battery Technology***

Sealed Lead Acid (SLA) batteries, otherwise known as Valve Regulated Lead Acid (VRLA) batteries, were originally known as "dry batteries". When first introduced in the 1950s, they used a gel electrolyte. The otherwise free acid was immobilised with a fine silica powder and formed a gel substance.

In the 1970s the technology moved to Absorbed Glass Mat (AGM) where the separators between the lead plates are made of highly porous micro-fine glass fibres which absorb and immobilise the acid and prevent it from spilling. A crack or hole in the casing of a VRLA battery using AGM technology will not result in a measurable electrolyte spill. Spill containment with VRLA batteries is therefore not meaningful or appropriate.

AGM has become the preferred VRLA technology for use in standby or float applications and is used in UPSes in the telecommunications, power, and many other mission critical industries where the power supply must not be interrupted. APC UPSes use VRLA batteries. VRLA batteries are designed to recombine hydrogen and oxygen and emit only extremely small amounts of hydrogen under normal operating conditions. Normal room ventilation is sufficient to remove any hydrogen, so special ventilation is not required.

## ***Battery Life***

Most brand name UPS batteries should last 3-5 years. Some APC Back-UPS models may have a shorter battery life expectancy. Refer to the user's manual of your APC Back-UPS to determine the exact battery life expectancy or contact APC Technical Support.

Below are some APC guidelines for ensuring optimum battery life expectancy:

1. Make sure that you keep your APC UPS in a cool, dry location with plenty of ventilation. Ideally, the temperature where your UPS is kept should not exceed 75 Deg F (24 Deg C). Also, for ventilation purposes, leave roughly one to two inches on each side for proper airflow.
2. The optimum operating temperature for a lead acid battery is 25 Deg C (77 Deg F). Elevated temperature reduces longevity. As a guideline, every 8 Deg C (15 Deg F) rise in temperature will cut the battery life in half. A battery which would last for 6 years at 25 Deg C (77 Deg F), will only be good for 3 years if operated at 33 Deg C (95 Deg F). Keep in mind that the battery temperature inside your UPS will always be warmer than the ambient temperature of the location where the UPS is installed.
3. Only perform runtime calibrations on your UPS one or two times a year, if necessary. Some of our customers want to check their systems to verify that their runtime is sufficient. However, consistently performing these calibrations can significantly decrease the life expectancy of your battery.
4. Do not store batteries for extended periods of time. New batteries can be stored for 6 to 12 months from date of purchase. After this period, the battery should be used or it will lose a great deal of its charge. It is not advisable to store batteries that have already been in use.
5. Do not exceed 80 percent of a UPS unit's rated capacity due to the reduction in run time. When you increase your load, your runtime decreases. In the event of a utility power failure, a UPS loaded to full capacity will drain and discharge its battery quickly and will decrease the life expectancy.

The Smart-UPS detects line voltage distortions such as spikes, notches, dips, and swells, as well as distortions caused by operation with inexpensive fuel-powered generators. By default, the UPS reacts to distortions by transferring to on-battery operation to protect the equipment that you are plugging into the UPS. Where power quality is poor, the UPS may frequently transfer to on-battery operation. Battery longevity and service life of the UPS may be conserved by reducing the sensitivity of the UPS, as long as your equipment can operate normally under the conditions detailed below. Any type of voltage disturbance includes; High/Low/No RMS Voltage, Total Harmonic Distortion(THD), Change in Voltage over Time(dv/dt), Frequency (Hz) out of tolerance.



### **High Sensitivity Mode**

In the event of any type of voltage disturbance, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. The transfer time in this mode depends on how far the line voltage deviates from the sinewave reference.

### **Medium Sensitivity Mode**

In the event of a RMS voltage-out-of-tolerance(High/Low/No) and RMS-rate-of-change disturbances(dv/dt) in the line voltage, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. In this mode the transfer times are longer but still within acceptable limits to insure the continuity of a computer's operation.

### **Low Sensitivity Mode**

In the event of a RMS voltage-out-of-tolerance disturbances(High/Low/No) in the line voltage, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. In this mode the transfer times are longer but still within acceptable limits to insure the continuity of a computer's operation.

To change the sensitivity of the UPS, press the small, white "sensitivity" button on the rear of the UPS. Use a pointed object (such as a pen) to do so. The default setting is "high"; press the button once to set the sensitivity to "medium", and press it again to set it to "low"; pressing it a third time will set it back to "high". The sensitivity setting change will take effect immediately. The green LED next to the button is a sensitivity setting indicator - brightly lit is "high" sensitivity, dimly lit is "medium", and off is "low" sensitivity.

### ***Flashing Battery Charge Graph LEDs***

The battery charge graph LEDs on the front panel of a Smart-UPS will flash in unison when the UPS is operating online and the runtime remaining (calculated by the Smart-UPS microprocessor) is less than two minutes more than the low battery signal warning time (minimum of two minutes).

This would usually indicate that you need to either decrease the load or install new batteries. If the batteries are new, then you need to perform a runtime calibration (see below).

At a pinch, you could also decrease the low battery warning time. There are four possible settings: 2, 5, 7, or 10 minutes.

### ***Battery Replacement***

If you own your UPS for long enough, you will inevitably need to replace the UPS battery or battery cartridge. An APC battery cartridge comprises two batteries physically stuck together with double-sided tape and wired in series.

After the decision to replace the batteries, you will face another decision almost immediately: whether to purchase genuine APC replacement batteries or not. There are pros and cons to purchasing genuine replacement APC batteries.

#### **APC Battery Pros**

- APC batteries are supported by APC
- APC batteries come with all the necessary hardware
- APC batteries come as pre-made cartridges
- APC batteries will physically fit your UPS

#### **APC Battery Cons**

- APC batteries cost up to 4 times the cost of third party batteries

There are also pros and cons to purchasing third party batteries.

#### **Third Party Battery Pros**

- A third party battery may cost up to 1/4 the price of APC batteries
- A third party battery may have a higher capacity for the same physical size

### **Third Party Battery Cons**

- You will need to recycle your battery hardware (cables, connectors etc)
- You will need to create your own battery cartridges (with double-sided tape)
- You will need to ensure the third party battery is the right physical size
- You will need to ensure the third party battery is the right capacity
- Use of a third party battery will void APC's Equipment Protection Policy
- Use of a third party battery may void UL, CSA, VDE, and other safety certifications (according to APC)

If you do decide to use third party replacement batteries, please do not choose the cheapest available generic SLA batteries. These batteries will, almost without exception, not last as long as brand name batteries and will need replacing within 12-18 months instead of 3-5 years. Even when using brand name replacement batteries, make sure that you choose the UPS version (aka "standby") which may cost slightly more, but which will last significantly longer in typical UPS usage (long periods of standby punctuated with infrequent deep discharges).

The brands of battery found in genuine APC battery cartridges have included: Panasonic and B&B Battery (aka Best & Best Battery and BB Battery). Yuasa (aka Genesis) is also a recommended brand, albeit a bit on the pricey side.

**Note:** When substituting a third party battery with a higher capacity than the original, make sure that it still physically fits in the UPS casing. If the battery does not fit, do not be tempted to install it "externally". The UPS may not be able to charge it in a timely manner and/or it may damage the UPS charging circuitry without appropriate modifications which are generally beyond an end user's capability.

### ***Battery Installation***

Although you can do a hot swap of your batteries while the computer and any other connected equipment is running, it may not be very satisfactory because the UPS will not always detect that the batteries have been swapped and apcupsd will continue to report "Low Battery".

There are several ways to correct this situation:

1. If you have a "smart" UPS model, you can force a self-test to make the UPS notice that the battery has been replaced.
2. If after a self-test, the UPS does not detect that the battery has been replaced, you can use apctest to do a soft battery runtime calibration. For details of doing this, refer to the "Soft" Runtime Calibration section below.
3. If after the soft battery runtime recalibration, the UPS does not detect that the battery has been replaced, you will need to do a manual battery runtime calibration. For details of doing this, refer to the "Manual" Runtime Calibration section below.

### ***"Soft" Runtime Calibration***

A runtime calibration causes the UPS to recalculate its available runtime capacity based on its current load.

Caution: a runtime calibration will deeply discharge the UPS batteries, which can leave a UPS temporarily unable to support its equipment if a utility power failure occurs. Frequent calibrations reduce the life of batteries. APC recommends performing a runtime calibration only annually, semiannually, or whenever the load on the UPS is increased.

In order to perform a "soft" runtime calibration it is necessary to wait for the UPS to recharge its batteries to 100% capacity. Once this has been done, you can then initiate a runtime calibration through apctest.

#### APC Documentation Notes:

1. In order for the calibration to be accurate, the output load has to be more than 40% (some APC documentation recommends at least 30%). Also, it is advisable not to increase or reduce the load when the UPS is calibrating its run time.
2. Under no circumstances should the UPS be turned off during a run time calibration procedure! Once initiated, the calibration must be allowed to run until completion.
3. The run time calibration procedure is not necessary nor advisable for a new UPS. Only old UPSes with batteries that are not subject to discharge for long periods of time should be allowed to perform a run time calibration.
4. Matrix-UPS and Smart-UPS recalculate the runtime-related parameters every time the UPS goes on battery.

When doing a runtime calibration with "older" batteries, APC Technical Support recommend doing a complete discharge and recharge first.

If you have "dumb" UPS (aka simple signalling) like a Back-UPS, then your only option is to do a manual runtime calibration.

### ***"Manual" Runtime Calibration***

Most of the information in this section is taken from APC's website. Any non-APC additions have been inserted in square brackets.

For a "smart" or "smart signalling" Back-UPS Pro or Smart-UPS:

Perform a Runtime Calibration. This is a manual procedure and should not be confused with the runtime calibration performed through PowerChute plus [or apctest]. The batteries inside of the Smart-UPS are controlled by a microprocessor within the UPS. Sometimes it is necessary to reset this microprocessor, especially after the installation of new batteries. Stop the PowerChute plus [or apcupsd] software from running and disconnect the serial cable. There must be at least a 30% load attached to the UPS during this procedure, but the process will cause the UPS to shut off and cut power to its outlets. Therefore, attach a non-critical load to the UPS and then force the UPS on battery by disconnecting it from utility power [suggest not disconnecting, but simply turning off utility power thereby preserving earthing]. Allow the unit to run on battery until it turns off completely. Make sure a 30% load is present! Plug the UPS back into the wall outlet [switch utility power back on] and allow it to recharge (it will recharge more quickly turned off and with no load present). Once the unit has recharged, the "runtime remaining" calculation should be more accurate. Remember that if the unit is an older model, then the runtime will not improve significantly.

#### Background:

An APC Smart-UPS has a microprocessor which calculates runtime primarily based on the load attached to the UPS and on its battery capacity. On the right side of the front display panel there is a vertical graph of five LEDs. Each LED is an indication of battery charge in increments of twenty percent: 20, 40, 60, 80, 100% (bottom to top). For example, if the battery charge is 99%, then only four of the five LEDs are illuminated.

To ensure that an operating system receives a graceful shutdown when using PowerChute plus or a SmartSlot accessory, an alert is generated by the Smart-UPS indicating that the UPS has reached a low battery condition. The alert is audible (rapid beeping), visual (flashing battery LED or LEDs), and readable through the graphical interface of PowerChute plus software (or a native UPS shutdown program within a particular operating system.) In order to calculate this "low battery condition," all Smart-UPS products have a preconfigured low battery signal warning time of two minutes (this is the factory default setting). There are a total of four user-changeable settings: 2, 5, 7, or 10 minutes. If the low battery signal warning time is set for 2 minutes, then the alerts will activate simultaneously two minutes prior to shutdown. Similarly, if the total runtime for a particular UPS is 30 minutes with a

low battery signal warning time set at 10 minutes, then the UPS will run on battery for 20 minutes before the low battery alert begins.

Total runtime is primarily based on two factors, battery capacity and UPS load. UPS load and runtime on battery are inversely proportional: as load increases, battery runtime decreases and vice versa. When utility power is lost, the UPS begins discharging the battery in order to support the attached load. Once power returns, the Smart-UPS will automatically begin to recharge its battery.

For a Matrix UPS:

It is unnecessary to subject a battery bank to an excessively long calibration. Remove battery packs or increase the load (space heaters are good dummy loads) to obtain a reasonable time length for the calibration (under an hour if possible).

At the start of a calibration, the Matrix microprocessor saves the Estimated Run Time displayed.

The unit will then go to battery power until the capacity is 25%. After this run time has been completed, the original Estimated Run Time is compared with the actual run time. It will then increase or decrease this value to correspond to the new run time achieved. If, at any time during the discharge, one of the following rules is violated the calibration will be aborted or corrupted:

1. Battery capacity must be 100% at start of calibration (all packs must indicated as float).
2. Initial "Estimated Run Time" must not exceed 128 minutes (remove battery packs if necessary).
3. Load must be above 25%.
4. Load must not fluctuate more than  $\pm 5\%$ .
5. The UPS must be allowed to run down to 25% battery capacity. PowerChute [or apcupsd] and Accessories must be removed since they can abort the calibration prematurely.

For a "dumb" or "simple signalling" UPS (eg a Back-UPS):

This could be done if you have changed your equipment load or battery. Stop the PowerChute [or apcupsd] software from running; disconnect the serial cable between the computer and UPS. Next unplug the UPS from the wall [suggest not disconnecting but simply turning off the utility power thereby preserving the earthing] and let it run on battery until it reaches low battery. Once it reaches low battery plug it back into the wall outlet [turn the utility power back on] and let it recharge. Recharge time can take up to 4 hours.

## ***Resetting the UPS Battery Constant***

In some cases none of the battery runtime calibration methods result in the UPS reporting a reasonably correct battery runtime. It has been speculated that this is because the battery constant value has drifted so far from normal that the microprocessor in the UPS cannot correct it.

The good news is that if you are located in the USA, all you have to do is contact APC Technical Support and they will send you a serial port *dongle* which plugs into the serial port of your UPS and reprograms the battery constant value for you to the correct value.

The bad news is that for many users outside the USA, this service does not appear to be available. It is, however, recommended that you first try contacting APC Technical Support to verify the correct battery constant value. The APC representatives in the Support Forum on the APC website are also very helpful in this regard.

*If all else fails*, the information below is for you.

**WARNING:** Only the values for the Smart-UPS 700 model SU700 and Smart-UPS 1400 model SU1400, both with international firmware (and therefore international voltage), have been verified. YOU, gentle reader, USE THIS INFORMATION AT YOUR OWN RISK in the full knowledge that you may render your UPS inoperable and perhaps irreparable, and you will have no-one to blame but yourself. *Caveat Utilitor!*

The battery constant is the hex number in the column labelled "0", presumably for register 0, in the following table:

UPS Model	4	5	6	0	Hex	Firmware
SU250		EE	F8	B1		
SU400		EE	F8	9F	E1	
SU600		EA	F4	9F	E5	
SU900		F3	FC	9F	ED	
SU1250		EE	FA	9F	F5	
SU2000		F1	F9	9F	FD	
SU450,700	28	F2	FA	96	07,RM=47	52.11.I
SU450XL,700XL	28	EE	F8	9F	700XL=27	51.9.I
SU1000,INET	35	EF	F9	A0	0B	60.11.I
SU1000XL	34	EE	FC	9A	2B	61.9.I
SU1400	35	EE	FC	9A		70.11.I
SU1400RM	28	ED	FA	89		
SU1400R2IBX135	08	B4	10	A3		
SU1400RMXLI3U	45	F6	F4	80		73.x.I
SU1400RMXLI3U	20	F3	FD	81		73.x.I
SU2200I	35	EE	FB	AF		90.14.I
SU2200XL,3000	35	EE	FB	AF	3000=17	90.14.I
SU3000RMXLI3Ublk	35	F3	F4	AF	77	93.14.I
SU5000I white	20	F2	FA	91	1F	110.14.I
SU1400XL,XLI,RM	45	F6	E4	80		
SU420I	25	95	09	85	16	21.7.I
SU420SI	0E	95	0A	8C		
SU620I	29	99	0B	8A	1A	
BP420SI	0E	95	0A	8C	06	11.2.I
BP650SI	10	97	0C	91	0A	12.3.I
Power Stack 250	0C	95	0F	B2		26.5.I
Power Stack 450	0D	96	10	99	36	26.5.I
SC250RMI1U	0C	95	0F	B3	32	735.a.1
SC420I	0E	95	0A	8C	16	725.1.I
SC620I	10	97	0B	99	1A	726.x.I
SC1000I	08	95	10	94	8A	737.x.I
SC1500I	07	95	14	8F	1E	738.x.I
SU1000XL	17	EE	F9	D5		
MATRIX 3000,5000		E9	F5	B0		
SU700RMI2U	07	B1	0D	92	8A	152.4.I
SU1000RMI2U	08	B5	0D	C7	8E	157.3.I
SU1400RMI2U	08	B4	10	A3	92	162.3.I
SUA1000I	07	B5	13	BC	0A	652.12.I
SUA1000XLI	0B	BD	0F	7F	4A	681.13.I
SUA750XLI	0A	B9	0C	86	46	630.3.I
SUA750I	04	B6	14	82	06	651.12.I
SUA750RMI2U	07	B1	0D	82	86	619.12.I
SUA1500I	09	B9	13	A1	0E	601/653.x.I
SUA1500RMI2U	08	B4	10	A1	8E	617.3.I
SUA2200I	08	B8	12	B3	26	654.12.I
SUA2200RMI2U	09	BC	11	81	A6	665.4.I
SUA2200XLI	0A	B7	0F	7F	66	690.x.I
SUA3000RMI2U	04	B9	0E	70	AA	666.4.I
SUA3000RMXLI3U	0A	B6	0E	89	xx	xxx.x.x
SUOL1000I	06	B6	1B	A6		
SUOL2000XL	0D	BD	14	75	52	416.5.I
SURT1000XLI	0A	BB	19	A8	4E	411.x.I
SURT3000XLI	06	B6	0F	CC	56	450.2.I
SURT5000XLI	05	BA	15	86	5A	451.13.W
SURT7500XLI	03	BB	20	97	63	

SURT10000XLI	06 B8 19 AB	476.12.W
SUM1500RMXLI2U	03 B7 0D A5 62	716.3.I
SUM3000RMXLI2U	03 B7 0D A5 6A	715.3.I
BP500AVR	26	17.1.I

The instructions for resetting the battery constant are as follows:

1. Shutdown the apcupsd daemon;
2. Run apctest;
3. Choose option 6 to enter terminal mode;
4. Enter Y (UPS should respond SM);
5. Enter 1 (one, not el; wait 4 seconds);
6. Enter 1 (one, not el; UPS should respond PROG);
7. Enter 0 (zero, not oh; UPS should respond with current constant);
8. Write down the existing value so that if something goes wrong, you can at least put it back to that value;
9. Enter + (plus) or - (minus) to increment/decrement the value;
10. Enter R to reprogram constant value (UPS should respond Bye);
11. Enter Y (UPS should respond SM);
12. Enter 0 (zero, not oh; UPS should respond with the new constant);
13. Enter Esc to exit terminal mode;
14. Choose option 7 to exit apctest.

## Frequently-Asked Questions

See the bugs section of this document for a list of known bugs and solutions.

**Question:** Why all the craziness with custom serial cables?

**Answer:** It was nothing more nor less than a form of customer control. For a long time APC wanted to keep other people from talking to its UPSes so it could lock out potential competition for its PowerChute software. Scrambling the leads on its serial cables was a cheap way to accomplish this -- in fact, they tended to be wired so that if you tried a straight-through cable, opening a serial link to the UPS would be interpreted as a shutdown command!

(Hardware companies often think like this -- they lock up interfaces by instinct, cornering a small market rather than growing a bigger one. It's fundamentally stupid and self-defeating, but it's the kind of stupid that tends to sound good at an executive meeting.)

**Question:** What UPS brands does apcupsd support?

**Answer:** Currently apcupsd supports only APC UPSes. However, some companies such as Hewlett Packard put their own brand name on APC manufactured UPSes. Thus even if you do not have an APC branded UPS, it may work with apcupsd. You will need to know the corresponding APC model number. apcupsd supports all the popular APC models. See the installation and configurations sections of this document for more details.

**Question:** Does apcupsd support Windows?

**Answer:** Yes.

**Question:** I don't have a cable, which one should I build?

**Answer:** First you must know if you have an apcsmart UPS or a voltage-signalling UPS. If you have a apcsmart UPS, we recommend building a Custom Smart cable. (see [Smart-Custom Cable for SmartUPSes](#)) If you have a voltage-signaling UPS, we recommend that you build a Custom Simple cable. (see [Simple-Custom Voltage-Signalling Cable for "dumb" UPSes](#))

**Question:** How much CPU resources does apcupsd use?

**Answer:** Depending on your CPU speed, you may see more or less of the CPU consumed by apcupsd. On a 400MHz Unix system, the CPU usage should fall well below 0.1%. On slower systems, the percentage will increase proportionally to the decrease in the CPU speed. On a 400Mhz Win98 machine, the CPU usage will be on the order of 0.5-1.0%. This is higher than for Unix systems. However, compared to the 30% CPU usage by APC's PowerChute (the version on the CDROM shipped with my UPS), apcupsd's 0.5-1.0% is very modest.

**Question:** What language is apcupsd written in?

**Answer:** It is written in C and C++.

**Question:** To test apcupsd, I unplugged the UPS to simulate a power outage. After the machine went into the shutdown process I plugged the UPS back into the commercial power source. This caused the shutdown process to hang after the daemon tried to shut-off the ups. Have you run into this problem, and if so do you have a remedy?

**Answer:** Normally, once the shutdown process has begun, we cannot stop it -- how do you stop a shutdown that has killed off half of the daemons running on your system? Most likely you will be left with an unusable system. In addition, when apcupsd is re-executed in the halt script after the disks are synced, it tries to shut off the UPS power, but the UPS will generally refuse to do so if the AC power is on. Since we cannot be 100% sure whether or not the UPS will shut off the power, we don't attempt to reboot the system if we detect that the power is back as it might then get caught by a delayed power off (at least for Smart UPSes).

**Question:** After running apcupsd for a while, I get the following error: "Serial communications with UPS lost." What is the problem?

**Answer:** We use standard Unix serial port read() and write() calls so once a connection is made, we generally have few problems. However, there have been reports that APC's SNMP Management Card can cause serial port problems. If you have such a card, we suggest that you remove it and see if the problem goes away. It is also possible that some other process such as a getty is reading the serial port.

**Question:** I get the following error:

```
Starting apcupsd power management.  
Mar 20 21:19:40 box apcupsd[297]: apcupsd FATAL ERROR in apcserial.c at line 83.  
Cannot open UPS tty /dev/cua01: No such file or directory.
```

What is the problem?

**Answer:** The two most likely causes of your problem are: 1. You have the wrong serial port device name in the `apcupsd.conf` file. 2. The device name is not defined on your system. Suggestions for proceeding: For the first item, check what your serial port device should be named. You might be able to find the name with an:

```
ls /dev
```

Normally there will be hundreds or even thousands of names that print. If that doesn't produce anything useful, you can try step 2. Perhaps your device is not defined. To get more information on your devices try `'man MAKEDEV'` or `'find / -name MAKEDEV'`. It is often located in `/dev/MAKEDEV`. Looking at the documentation may tell you what the correct name is, or at least allow you to create the device.

**Question:** How do I ensure that the slaves shutdown before the master?

**Answer:** Slaves make their shutdown decision independently from the master. Therefore you can use the `TIMEOUT`, `MINUTES`, and `BATTERYLEVEL` settings in the slaves' `apcupsd.conf` to configure them to shut down before the master.

**Question:** How do I ensure that my database server is correctly shutdown?

**Answer:** You simply add whatever commands are necessary in the appropriate case statements in `/etc/apcupsd/apccontrol`, which is a standard script file that is called to actually do the shutdown. Alternatively, you can add your own script file that will be called before doing the commands in `apccontrol`. Your script file must have the same name as the appropriate case statement in `apccontrol`; it must be executable; and it must be in the same directory as `apccontrol`.

## Customizing Event Handling

When `apcupsd` detects anomalies from your UPS device, it will make some decisions that usually result in one or more calls to the script located in `/etc/apcupsd/apccontrol`. The `apccontrol` file is a shell script that acts on the first argument that `apcupsd` passes to it. These actions are set up by default to sane behavior for all situations `apcupsd` is likely to detect from the UPS. However, you can change the `apccontrol` behavior for every single action.

To customize, so create a file with the same name as the action, which is passed as a command line argument. Put your script in the `/etc/apcupsd` directory.

These events are sent to the system log, optionally sent to the temporary events file (`/etc/apcupsd/apcupsd.events`), and they also generate a call to `/etc/apcupsd/apccontrol` which in turn will call any scripts you have placed in the `/etc/apcupsd` directory.

Normally, `/etc/apcupsd/apccontrol` is called only by `apcupsd`. Consequently, you should not invoke it directly. However, it is important to understand how it functions, and in some cases, you may want to change the messages that it prints using `wall`. We recommend that you do so by writing your own script to be invoked by `apccontrol` rather than by modifying `apccontrol` directly. This makes it easier for you to upgrade to the next version of `apcupsd`.

In other case, you may want to write your own shell scripts that will be invoked by `apccontrol`. For example, when a power fail occurs, you may want to send an email message to root.

To write your own routine for the `powerout` action, you create shell script named `powerout` and put it in the `lib` directory (normally `/etc/apcupsd`). When the `powerout` action is invoked by `apcupsd`, `apccontrol` will first give control to your script. If you want `apccontrol` to continue with the default action, simply exit your script with an exit status of zero. If you do not want `apccontrol` to continue with the default action, your script should exit with the special exit code of 99. However, in this case, please be aware that you must ensure proper shutdown of your machine if necessary.

Some sample scripts (`onbattery` and `mainsback`) that email power failure messages can be found in `/etc/apcupsd` after an install or in the `platforms/etc` directory of the source code.



## ***apcccontrol Command Line Options***

When apcupsd detects an event, it calls the apcccontrol script with four arguments as:

```
apcccontrol event ups-name connected powered
```

where:

### ***event***

is the event that occurred and it may be any one of the values described in the next section.

### ***ups-name***

is the name of the UPS as specified in the configuration file (not the name in the EEPROM).

### ***connected***

is 1 if apcupsd is connected to the UPS via a serial port (or a USB port). In most configurations, this will be the case. In the case of a Slave machine where apcupsd is not directly connected to the UPS, this value will be 0.

### ***powered***

is 1 if the computer on which apcupsd is running is powered by the UPS and 0 if not. At the moment, this value is unimplemented and always 0.

The following *event* names are supported:

### ***annoyme***

When a shutdown is scheduled, and the time specified on the ANNOYME directive in the apcupsd.conf file expires, this event is generated.

*Default:* `wall` a message

### ***changeme***

When apcupsd detects that the mains are on, but the battery is not functioning correctly, this event is generated. It is repeated every x hours.

*Default:* `wall` a message

### ***commfailure***

This event is generated each time the communications line with the computer is severed. This event is not detected on dumb signaling UPSes.

*Default:* `wall` a message

### ***commok***

After a commfailure event is issued, when the communications to the computer is re-established, this event will be generated.

*Default:* `wall` a message

### ***doreboot***

This event is depreciated and should not be used.

*Default:* Shuts down the system using `shutdown -h` or similar

### ***doshutdown***

When the UPS is running on batteries and one of the limits expires (time, run, load), this event is generated to cause the machine to shutdown.

*Default:* Shuts down the system using `shutdown -h` or similar

### ***emergency***

Called for an emergency system shutdown. (What triggers such a shutdown is unclear...) After completing this event, apcupsd will immediately initiate a `doshutdown` event.

*Default:* `wall` a message

### ***failing***

This event is generated when the UPS is running on batteries and the battery power is exhausted. The event following this one will be a shutdown.

*Default:* `wall` a message

**loadlimit**

This event is generated when the battery charge is below the low limit specified in the `apcupsd.conf` file. After completing this event, `apcupsd` will immediately initiate a `doshutdown` event.

*Default:* `wall` a message

**powerout**

This event is generated immediately when `apcupsd` detects that the UPS has switched to batteries. It may be due to a short powerfailure, an automatic selftest of the UPS, or a longer powerfailure.

*Default:* `wall` a message

**onbattery**

This event is generated 5 or 6 seconds after an initial powerfailure is detected. It means that `apcupsd` definitely considers the UPS to be on batteries. The onset of this event can be delayed by the `ONBATTERYDELAY` `apcupsd.conf` configuration directive.

*Default:* `wall` a message

**offbattery**

This event is generated when the mains return only if the `onbattery` event has been generated.

*Default:* `wall` a message

**mainsback**

This event is generated when the mains power returns after a `powerout` condition. The shutdown event may or may not have been generated depending on the parameters you have defined and the length of the power outage.

*Default:* nothing

**remotedown**

This event is generated on a slave machine when it detects either that the master has shutdown, or that an `onbattery` situation exists and the communications line has been severed.

*Default:* `wall` a message

**runlimit**

This event is generated when the `MINUTES` value defined in the `apcupsd.conf` file expires while in a power fail condition. The `MINUTES` is the remaining runtime as internally calculated by the UPS and monitored by `apcupsd`. After completing this event, `apcupsd` will immediately initiate a `doshutdown` event.

*Default:* `wall` a message

**timeout**

This event is generated when the `TIMEOUT` value defined in the `apcupsd.conf` file expires while in a power fail condition. It indicates that the total time in a power failure has been exceeded and the machine should be shutdown. After completing this event, `apcupsd` will immediately initiate a `doshutdown` event.

*Default:* `wall` a message

**startselftest**

This event is generated when `apcupsd` detects a self test by the UPS. Normally due to the 6 second `onbattery` delay default time, self test events are not detected.

*Default:* nothing

**endselftest**

This event is generated when the end of a self test is detected.

*Default:* nothing

**battdetach**

This event is generated when `apcupsd` detects that the UPS battery has been disconnected.

*Default:* nothing

**battattach**

This event is generated when `apcupsd` detects that the UPS battery has been reconnected after a `battdetach` event.

*Default:* nothing

## Controlling Multiple UPSes on one Machine

*The following discussion does not apply to Windows servers. Apcupsd on Windows is limited to a single instance and cannot support monitoring multiple UPSes.*

If you have multiple UPSes in use, you may wish to consolidate the monitoring of all of these UPSes onto a single machine, which we shall call the "UPS server". Generally one of the UPSes is powering the "UPS server" itself (and possibly other machines as well). The remaining UPSes are powering additional machines.

Apcupsd can work quite well in this environment by running one instance of apcupsd on the UPS server for each UPS to be controlled. That is, you install a single copy of apcupsd but launch it multiple times using different configuration files and scripts. (Older versions of apcupsd required you to actually compile the daemon multiple times with different `configure` options. This is no longer required, as all necessary adjustments can be made in `apcupsd.conf`.)

Additionally, you will run one instance of apcupsd on each of the machines you wish to be shut down. You will configure each of these apcupsd's to use the 'net' driver to read UPS status from the proper instance of apcupsd on the UPS server. See [NIS Server/Client Configuration Using the Net Driver](#) for more information on the 'net' driver and setting up net clients.

### Multiple UPS Example

There are many ways one could set up multiple apcupsd instances. Here I will present the way I have used with great success on Red Hat Linux.

I have two apcupsd.conf files (this is for a 2 UPS setup, easily expandable to N):

```
[adk0212@mail apcupsd]$ ls -l /etc/apcupsd/*.conf
-rw-r--r-- 1 root root 11799 Aug  3 08:39 /etc/apcupsd/apcupsd.ups0.conf
-rw-r--r-- 1 root root 11822 Aug 25 14:31 /etc/apcupsd/apcupsd.ups1.conf
```

In my case, ups0 is the UPS powering the UPS server running the multiple apcupsd instances, so only ups0 should initiate a shutdown of the local machine. The differences between the confs are minor since both UPSes are USB (although that is not a requirement; mixing cable types works fine too):

```
[adk0212@mail apcupsd]$ diff -u apcupsd.ups0.conf apcupsd.ups1.conf
--- apcupsd.ups0.conf      2007-08-03 08:39:26.000000000 -0400
+++ apcupsd.ups1.conf      2007-08-25 14:31:17.000000000 -0400
-UPSNAME ups0
+UPSNAME ups1
-DEVICE /dev/ups0
+DEVICE /dev/ups1
-SCRIPTDIR /etc/apcupsd
+SCRIPTDIR /etc/apcupsd/null
-PWRFAILDIR /etc/apcupsd
+PWRFAILDIR /etc/apcupsd/null
-NOLOGINDIR /etc
+NOLOGINDIR /etc/apcupsd/null
-ANNOY 300
+ANNOY 0
-NISPORT 3551
+NISPORT 3552
-EVENTSFILE /var/log/apcupsd.events
+EVENTSFILE /var/log/apcupsd.2.events
```

The important difference to note is that ups1 has its `SCRIPTDIR`, `PWRFAILDIR`, and `NOLOGINDIR` set to a special "null" directory that I have created. This directory contains a copy of the event handling scripts

modified to avoid shutting down the local machine. (Details below). Also the UPSes are given different `EVENTSFILE` and `NISPORT` settings. Plus I disable the "annoy" feature on ups1. Since the state of that UPS does not impact local users, there's no reason to annoy them.

I have the following files in the special "null" directory:

```
[adk0212@mail apcupsd]$ ls -l /etc/apcupsd/null
total 32
-rwxr--r-- 1 root root 4176 Aug  3 08:24 apccontrol
-rwxr-xr-x 1 root root  475 Aug  3 08:28 changeme
-rwxr-xr-x 1 root root  502 Aug  3 08:28 commfailure
-rwxr-xr-x 1 root root  503 Aug  3 08:28 commok
-rwxr--r-- 1 root root    8 Aug  3 08:22 doshutdown
-rwxr-xr-x 1 root root  470 Aug  3 08:27 offbattery
-rwxr-xr-x 1 root root  435 Aug  3 08:27 onbattery
```

The important change here is the addition of a 'doshutdown' script which overrides apccontrol's shutdown action:

```
[adk0212@mail null]$ cat /etc/apcupsd/null/doshutdown
exit 99
```

The "exit 99" tells apccontrol to skip its normal processing for that event. apccontrol itself is unchanged; it is a direct copy of the original. The other scripts are also direct copies and have simply been modified to generate status email from NISPORT 3552 instead of 3551.

I also have a custom init.d start/stop script to manage multiple instances. The start, stop, and status handlers are modified to iterate over all `/etc/apcupsd/apcupsd.*.conf` files. This is derived from the standard apcupsd redhat rc script:

```
#!/bin/sh
#
# apcupsd      This shell script takes care of starting and stopping
#              the apcupsd UPS monitoring daemon.
#
# chkconfig: 2345 60 99
# description: apcupsd monitors power and takes action if necessary
#

if test -f /etc/whitebox-release ; then
    f=/etc/whitebox-release
else
    f=/etc/redhat-release
fi
if test `cat $f | grep release | \
    cut -f 3 -d ' ' `x = "Enterprise"x ; then
    DISTVER="Enterprise "`cat $f | grep release | \
    cut -f 6 -d ' '`
else
    DISTVER=`cat /etc/redhat-release | grep release | \
    cut -f 5 -d ' '`
fi

# Source function library
. /etc/rc.d/init.d/functions
```

```

case "$1" in
    start)
        rm -f /etc/apcupsd/powerfail
        rm -f /etc/nologin
        for conf in /etc/apcupsd/apcupsd.*.conf ; do
            inst=`basename $conf`
            echo -n "Starting UPS monitoring ($inst):"
            daemon /sbin/apcupsd -f $conf -P /var/run/apcupsd-$inst.pid
            RETVAL=$?
            echo
            [ $RETVAL -eq 0 ] && touch /var/lock/subsys/apcupsd-$inst
        done
        ;;
    stop)
        for conf in /etc/apcupsd/apcupsd.*.conf ; do
            inst=`basename $conf`
            echo -n "Shutting down UPS monitoring ($inst):"
            killproc -p /var/run/apcupsd-$inst.pid apcupsd
            echo
            rm -f /var/run/apcupsd-$inst.pid
            rm -f /var/lock/subsys/apcupsd-$inst
        done
        ;;
    restart|force-reload)
        $0 stop
        sleep 15
        $0 start
        ;;
    reload)
        echo "$0: reload not implemented"
        exit 3
        ;;
    status)
        for conf in /etc/apcupsd/apcupsd.*.conf ; do
            inst=`basename $conf`
            status -p /var/run/apcupsd-$inst.pid apcupsd-$inst
            RETVAL=$?
            if [ $RETVAL -eq 0 ]
            then
                NISPORT=`grep ^NISPORT < $conf | sed -e "s/NISPORT *\[0-9\]\|/1/"`
                /sbin/apcaccess status localhost:$NISPORT | egrep "(STATUS)|(UPSNAME)"
            fi
        done
        ;;
    *)
        echo "Usage: $0 {start|stop|restart|status}"
        exit 1
        ;;
esac
exit 0

```

That's about all there is to it. There are still some rough edges to clean up, but overall this is a *lot* easier with apcupsd 3.14.x than it used to be.

## Support for SNMP UPSes

To run apcupsd with a SNMP UPS, you need the following things:

- An SNMP UPS, for example a Web/SNMP (AP9716) or PowerNet SNMP (AP9605) card installed into the SmartSlot. Apcupsd also has support for some non-APC SNMP UPSes using RFC1628 or

MGE MIBs, however the majority of the information in this section is for APC UPSes.

## ***Planning and Setup for SNMP Wiring***

SNMP packet requests are relayed to the UPS from monitoring APCUPSD servers over Ethernet via a switch, hub, or router. Protecting these Ethernet devices with UPS supplied power is necessary to ensure reliable SNMP communication during power failures. Servers may fail to shutdown quietly during power failures if SNMP communication is lost.

## ***Planning and Setup for SNMP Configuration***

To establish communication to the UPS SNMP card installed in the UPS, the SNMP card will need the following:

- Assign SNMP card IP Address
- Set SNMP card General Parameters
- Set SNMP card Shutdown Parameters
- Set SNMP card Event Trap Receivers (apcupsd-3.12.0 and later)

### ***Assign SNMP Card IP Address***

The following instructions come from the APC knowledge base:

The Network Management Card (AP9617, AP9618, AP9619) must be configured with network settings before it can communicate on the network. Once the cards have been configured with an IP address, Subnet Mask, and Default Gateway the cards can be access, managed, and controlled from other computers on the network.

There are two ways to configure the Network Management Card (NMC) with its initial settings: the (windows) Wizard and Address Resolution Protocol (ARP).

1. The wizard is included on the CD that comes with the card. The wizard must run on a Windows operating system. You can configure the card using the wizard over the network via FTP. If using the wizard please note, the un-configured NMC must be on the same subnet as the computer running the wizard.

2. Address resolution protocol (arp) can also be used to configure the NMC. The MAC Address of the NMC is needed for this method of configuration. The MAC address is located on the quality assurance slip that is shipped with the NMC, and is also located on the white sticker on the NMC itself. From a computer on the same subnet as the un-configured NMC, follow the instructions:

Open up a command prompt and type the following (replacing <IPAddress> and <MacAddress> with the actual values):

```
arp -s <IPAddress> <MacAddress>
```

Next, use Ping with a size of 113 bytes to assign the IP address defined by the ARP command.

- Linux command format: ping <IPaddress> -s 113
- Windows command format: ping <IPaddress> -l 113

### ***Set SNMP card General Parameters***

After the SNMP Network Management Card is configured with an IP address, the SNMP Card is ready for general configuration. This is accomplished by telneting to the SNMP Card.

```
~$ telnet <IPaddress>
```

Login using "apc" for both the username and password and the following menu will display:

```
*****
American Power Conversion          Network Management Card AOS      v2.6.4
(c) Copyright 2004 All Rights Reserved  Smart-UPS & Matrix-UPS APP    v2.6.1
-----
Name      :                               Date : 07/03/2006
Contact   :                               Time  : 04:43:33
Location  :                               User   : Administrator
Up Time   : 0 Days 01 Hours 57 Minutes      Stat   : P+ N+ A+

Smart-UPS 1000 named : On Line, No Alarms Present

----- Control Console -----

1- Device Manager
2- Network
3- System
4- Logout

<ESC>- Main Menu, <ENTER>- Refresh, <CTRL-L>- Event Log
>
*****
```

Select **Option 2** for Network. Next select **Option 1** for TCP/IP settings.

At this point the following settings will be to be specified:

- Verify System IP: <IPaddress>
- Specify Subnet Mask: i.e. "225.225.225.0"
- Specify Default Gateway
- Specify Host Name
- Specify Domain Name

Specifying these parameters will complete the General Parameters setup. Additionally the SNMP Network Management Card can now be connected to from a web browser for monitoring and additional configuration.

### ***Set SNMP card Shutdown Parameters***

There are two shutdown parameters that must be set in the SNMP card to ensure that connected servers shutdown quietly. These parameters can be set via the telnet terminal or the web browser interface.

- Shutdown Delay (sec)

- Return Battery Capacity (%)

One of the draw-backs of SNMP communication to the UPS is that the Stand-alone or Primary server must issue the power down command to the UPS early in server halt procedure. This server must issue an early command to the SNMP UPS to power down before its ethernet service is halted. This creates a potential problem where the UPS may kill power to any connected servers before these affected servers' halt scripts complete a successful shutdown.

The SNMP **Shutdown Delay** parameter is used to delay the UPS from killing power to its load by a prescribed period of seconds. The delay should be long enough to ensure that the Stand-alone or Primary server has enough time to successfully halt. The prescribed time should at least be 180 seconds. Any additional computers connected to the SNMP UPS must not be configured to issue the command to initiate UPS power down. These servers can be thought of as secondary stand-alone server. The APCUPSD daemons of secondary servers should be configured to initiate server halt a prescribed period of time before the Primary server issues the UPS power down command.

The **Return on Battery Capacity** is useful during intermittent sequential power failures. This parameter insures that the UPS will not restore power to its loads until it has recharged its battery to a prescribed percentage. This parameter should be set to a value greater than value that the APCUPSD daemons configured "BATTERYLEVEL" shutdown of any connected servers. This will ensure that when the UPS restores power, any additional power failures will successfully re-trigger a server shutdown.

### ***Configure Event Trap Receivers***

(Requires apcupsd-3.12.0 and later)

By default, APCUPSD will poll the SNMP UPS card once per minute. In this case, server notification of UPS alarms could potentially be delayed one minute. Event trap catching mitigates this shortcoming. Any UPS alarms are instantly sent to prescribe servers connected SNMP UPS. These servers are referred to as Event Trap Receivers. The SNMP UPS card can be configure to send event traps to a maximum of four receivers that will "catch" these events.

Event trap receivers IP address can be set using a telnet terminal or web browser interface.

Also, be aware that servers configured to be Event Trap Receivers should have static IP set. Servers obtaining IPs from DHCP server will not catch instantaneous Events if the IP address changes from the address set in the SNMP UPS.

### ***Connecting APCUPSD to a SNMP UPS***

The previous sections describe configuration of the actual SNMP card. The remaining sections describe configuration of the APCUPSD to communicate using SNMP Protocol.

To enable the SNMP support it is enough to configure the correct device in your apcupsd.conf configuration file. The directive needed for this configuration is:

```
DEVICE <host>:<port>:<vendor>:<community>
```

...where the directive is made by four parts. All but the first may be omitted completely or left empty to accept the default.

- *host*: IP address or DNS hostname of the UPS (required)
- *port*: Remote SNMP port (optional, default: 161)
- *vendor*: The type of SNMP MIB available on the UPS (optional, default: autodetect). Allowable choices for vendor are:
  - APC : APC PowerNet MIB, used on most APC brand UPSes
  - RFC : RFC1628 MIB, used by some non-APC UPSes



- MGE : MGE MIB, used by many MGE brand UPSes
- blank : Autodetect

Append "\_NOTRAP" to the vendor name to disable SNMP trap catching (ex: "APC\_NOTRAP"). See [SNMP Trap Catching](#).

- *community*: The read-write community string, usually "private". You can specify a read-only community string, usually "public", if you do not require killpower support. If the community string is omitted, apcupsd will attempt to autodetect by trying "private" and "public". (optional, default: autodetect).

A NIS Server/Client (Master/Slave) configuration with multiple servers is still applicable. However, an alternative configuration is possible with an SNMP enabled UPS. In this arrangement, all connected servers will be configured as a standalone server. Each will independently communicate to the UPS. One (primary) server will be chosen to manage the task of commanding the UPS to power down. All remaining (secondary) servers will be configured to quietly power down before the primary server issues the UPS power down command.

## ***Building with SNMP support***

Follow the instructions in [Building and Installing apcupsd](#), being sure to include the following options (in addition to any others you need) on the './configure' line:

```
./configure --enable-snmp
```

## ***SNMP Trap Catching***

apcupsd-3.11.14 introduces support for SNMP trap catching. Previous versions polled the UPS status once per minute, leading to significant delays before UPS state changes were recognized. With SNMP trap handling, apcupsd monitors the SNMP trap port and will re-poll the UPS whenever a trap is received. This happens, for example, when the UPS switches on or off battery.

In order for this feature to work, you must configure your UPS to deliver traps to the server running apcupsd. This is generally done by connecting to your SNMP card via a web browser or telnet connection. You will need to enter your server's IP address as a trap receiver and make sure trap delivery is enabled.

Trap catching can lead to problems if you are already running another SNMP trap daemon on your server. Only one daemon can listen to the trap port, so whichever one is started first will succeed and the others will fail. Apcupsd will fall back to polling behavior if it is unable to open the trap port. You can also forcibly disable trap catching by appending \_NOTRAP to your vendor string in the apcupsd.conf `DEVICE` directive.

## ***Known Problems***

Currently (as of 3.10.0) the code to power off the UPS needs special configuration. The killpower command for SNMP UPSes can not be issued during shutdown as typically at some time during shutdown operations the network stack is stopped. To overcome this problem it is needed to modify the /etc/rc.d/apcupsd system control script to tell apcupsd to issue the power down command (killpower) to the UPS immediately before apcupsd initiates the system shutdown. For this reason it is paramount to set your UPS grace time to a value greater than 120 seconds to allow for clean shutdown operations before the UPS removes the power from its plugs. To enable correct shutdown operation during powerdown do the following:

- Connect to your Web/SNMP card using your favorite web browser, go to the UPS configuration menu and change the "Shutdown Delay" parameter to 180 seconds or more, depending on how much time your system shutdown requires to unmount all the filesystems.

- **Option 1 (non-windows)** Edit the server halt script. Relocate the `ups_kill_power()` function higher in the shutdown sequence, primarily before the command to bring down the ethernet service. This is the preferred method for shutting down the UPS. The UPS will power down after the prescribed "Shut Down Delay" time (in seconds) has elapsed.
- **Option 2** Change `/etc/rc.d/apcupsd` script adding the `--kill-on-powerfail` to the `apcupsd` invocation. This method is not preferred because the UPS is commanded to power down without delay. This creates the potential for UPS powering down before the server calling for UPS power down completes its shutdown. However, in the case of Microsoft Windows OS, this is the only method available for powering down the UPS.
- Restart your `apcupsd`

With this setup your UPS operations should be safe.

## apcupsd System Logging

The `apcupsd` philosophy is that all logging should be done through the `syslog` facility (see: '`man syslog`') This is now implemented with the exceptions that STATUS logging, for compatibility with prior versions is still done to a file, and EVENTS logging can be directed to a temporary file so that it can be reported by the network information server.

### Logging Types

`apcupsd` splits its logging into four separate types called:

1. DEBUG
2. DATA
3. STATUS
4. EVENTS

Debug logging consists of debug messages. Normally these are turned on only by developers, and currently there exist very few of these debug messages.

### Data Logging

This feature is somewhat outdated and not often used.

Data logging consists of periodically logging important data concerning the operation of the UPS. For the definitive definition of the format, see `log_data()` in `apcreports.c`. The format varies according to the UPS model and the information available from the UPS.

For UPS models, NBKPRO, SMART, SHARESMART, and MATRIX, the output is written in a format very similar to what PowerChute writes. That is:

MinLineVoltage, MaxLineVoltage, OutputVoltage, BatteryVoltage, LineFrequency, LoadPercent, UPSTemperature, AmbientTemperature, Humidity, LineVoltage, BatteryCharge, toggle

Any value that is not supported by your UPS such as AmbientTemperature and Humidity will be blank or possibly as 0.0. In any case the commas before and after that field will still be output. The toggle value alternates from 0 to 1 on each line. This was added at user request so that no two adjacent samples are identical.

An actual example from the log file is:

```
Nov  2 12:43:05 matou apcupsd[23439]: 224.9,227.5,226.2,27.74,50.00,100.0,30.6,,,226.2,50.0,1
```

### Status Logging



## The Windows Version of apcupsd

The Windows version of apcupsd has been tested on Win95, Win98, WinMe, WinNT, WinXP, and Win2000 systems. This version of apcupsd has been built to run natively on Windows (no Cygwin or other emulation layer needed). Even though the Win32 version of apcupsd is a port that relies on many Unix features, it is just the same a true Windows program. When running, it is perfectly integrated with Windows and displays its icon in the system icon tray, and provides a system tray menu to obtain additional information on how apcupsd is running (status and events dialog boxes).

Once installed apcupsd normally runs as a system service. This means that it is immediately started by the operating system when the system is booted, and runs in the background even if there is no user logged into the system.

### *Installing Apcupsd on Windows*

Normally, you will install the Windows version of apcupsd from the binaries. Starting with version 3.11.15, the Windows binaries are distributed with a full GUI installer driven by NSIS, the Nullsoft Scriptable Install System (<http://nsis.sourceforge.net>).

Installation is very simple and straight-forward: Simply double-click the installer executable and follow the instructions.

### *Configuring Apcupsd on Windows*

If you are installing Apcupsd for the first time, the installer will give you an opportunity to edit the apcupsd.conf configuration file to contain the values appropriate for your site. (Subsequent installations will maintain your existing apcupsd.conf, so you need not edit it again unless there are new features or syntax changes that must be accounted for.)

The default configuration calls for a USB connected UPS. This is the most common connection for modern UPSes, especially those used with Windows computers. All other apcupsd drivers are available (apcsmart, dumb, net, snmp, pcnet) and can be used simply by editing the configuration file UPSCABLE, UPSTYPE, and DEVICE settings as described elsewhere in this manual.

Note that on Windows, serial ports are specified using COM1, COM2, etc. notation instead of the UNIX-style /dev/tty\* notation.

Note also if you are using WinNT or Win2000, the operating system may probe the serial port attempting to attach a serial mouse. This will cause apcupsd to be unable to communicate with the serial port. If this happens, or out of precaution, you can edit the c:\boot.ini file. Find the line that looks something like the following:

```
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Windows NT Workstation Version 4.00"
```

and add the following to the end of the line: /NoSerialMice:COM1 (or COM2 depending on what you want to use). The new line should look similar to...

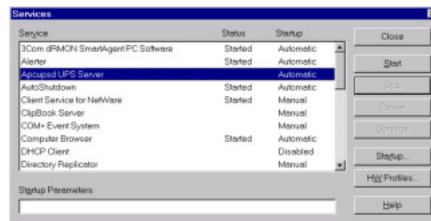
```
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Windows NT Workstation Version 4.00" /NoSerialMice:COM1
```

...where the only thing you have changed is to append to the end of the line. This addition will prevent the operating system from interfering with apcupsd

### *Starting Apcupsd on Windows*

The installer will give you an opportunity start the Apcupsd service immediately. If you choose to start it manually, you may do so by selecting the "Start Apcupsd" link from the Start->Programs->Apcupsd folder.



On Windows NT/2000/XP, you may alternatively go to the Control Panel, open the Services folder, select Apcupsd UPS Server, and then click on the **Start** button as shown below:





If the Services dialog reports a problem, it is normally because your `DEVICE` statement does not contain the correct serial port name.

You probably should also click on the **Startup...** button to ensure that the correct defaults are set. The dialogue box that appears should have **Startup Type** set to **Automatic\*** and **\*\*Logon** should be set to **System Account**. If these values are not set correctly by default, please change them otherwise apcupsd will not work.

For WinXP and Win2K systems, the dialogs are a bit different from those shown here for WinNT, but the concept is the same. You get to the Services dialog by clicking on: Control Panel -> Administrative Tools -> Component Services. The apcupsd service should appear in the right hand window when you click on **Services (Local)** in the left hand menu window.

That should complete the installation process. When the system tray icon turns from a question mark  into a plug , right click on it and a menu will appear. Select the **Events** item, and the Events dialogue box should appear. There should be no error messages. By right clicking again on the system tray plug and selecting the **Status** item, you can verify that all the values for your UPS are correct.

When the UPS switches to the battery, the battery icon  will appear in the system tray. While the UPS is online, if the battery is not at least 99% charged, the plug icon will become a plug with a lightning bolt in the middle  to indicate that the battery is charging.

## Apctray

Starting with version 3.14.2, the tray icon is provided by a separate program called 'apctray'. This cleanly separates the user interface from the daemon (service) and is required for tray icon support on Windows Vista. Note that if you close or disable the tray icon this does **not** stop or disable the apcupsd service which will continue to monitor the UPS and shutdown the computer when appropriate. To stop or disable the service, use the service control panel.

apctray has the capability of monitoring multiple apcupsd instances using apcupsd's Network Information Server (NIS). It will create a new icon for each instance being monitored. By default, apctray monitors the local apcupsd (localhost on port 3551). To add additional monitors, you can right-click an existing icon and choose "Add Monitor". To remove a monitor, right-click its icon and choose "Remove Monitor". To change the settings for an existing monitor (ip address, port, refresh rate), right-click its icon and choose "Configure...".

apctray can be installed standalone (without apcupsd) if you wish to use it only to monitor remote apcupsd instances. This can be convenient for keeping an eye on a room full of UPSes from your desktop. Download and run the normal apcupsd installer and simply uncheck all components except apctray. Then add as many monitors as you wish as described above.

## Testing Apcupsd on Windows

It would be hard to overemphasize the need to do a full testing of your installation of apcupsd as there are a number of reasons why it may not behave properly in a real power failure situation.

Please read the [Testing Apcupsd](#) section of this document for general instructions on testing the Win32 version. However, on Win32 systems, there is no Unix system log file, so if something goes wrong, look in the file `c:\apcupsd\etc\apcupsd\apcupsd.events` where apcupsd normally logs its events, and you will generally find more detailed information on why the program is not working. The most common cause of problems is either improper configuration of the cable type, or an incorrect address for the serial port. Additionally, check the application event log, if you're running a platform that supports it such as Windows 2000 or XP.

## ***Upgrading***

An upgrade may be accomplished by uninstalling the old version (using the Add/Remove Programs Control Panel or clicking the "Uninstall Apcupsd" link from Start -> Programs -> Apcupsd. Near the end of the uninstall you will be prompted about removing configuration and event files. You should answer "No" in order to preserve your existing apcupsd.conf file.

After the uninstall completes you may install the new version of Apcupsd as described above. If you preserved your existing apcupsd.conf file, the new apcupsd.conf will be installed as apcupsd.conf.new.

## ***Post-Installation***

After installing apcupsd and before running it, you should check the contents of the config file `c:\apcupsd\etc\apcupsd\apcupsd.conf`. You will probably need to change your UPSCABLE directive, your UPSTYPE and possibly your DEVICE directives. Please refer to the configuration section of this manual for more details.

## ***Problem Areas***

On some Windows systems, the domain resolution does not seem to work if you have not configured a DNS server in the Network section of the Control Panel. This problem should be apparent only when running a slave configuration. In this case, when you specify the name of the master in your apcupsd.conf file, apcupsd will be unable to resolve the name to a valid IP address. To circumvent this problem, simply enter the address as an IP address rather than a hostname, or alternatively, ensure that you have a valid DNS server configured on your system.

On WinNT, WinXP, and Win2K systems, you can examine the System Applications log to which apcupsd writes Windows error messages during startup.

Regardless of which Windows system you are running, apcupsd logs most error messages to `c:\apcupsd\etc\apcupsd\apcupsd.events`. This type error messages such as configuration file not found, etc are written to this file. Note that on some systems (WinXP, possibly others) Apcupsd is unable to write to this file when running as a service.

## ***Email Notification of Events***

It is possible to receive email notification of apcupsd events using some simple Visual Basic scripts contributed by Ed Dondlinger <[edondlinger@thepylegroup.com](mailto:edondlinger@thepylegroup.com)>. The scripts are automatically installed in the `etc/apcupsd` directory of your apcupsd installation but are disabled by default. To enable them, first open them in a text editor such as Notepad and edit the `USER VARIABLES` section to set your email preferences including address, server information, etc. Then rename the script files without the `*.example` suffix. Scripts are supplied for onbattery, offbattery, and commfailure events. You can copy the scripts to other filenames and modify the email body text to respond to other events as described in [Customizing Event Handling](#).

## ***Killpower under Windows***

If your batteries become exhausted during a power failure and you want your machine to automatically reboot when the power comes back, it is useful to implement the killpower feature of the UPS where apcupsd sends the UPS the command to shut off the power. In doing so, the power will be cut to your PC and if your BIOS is properly setup, the machine will automatically reboot when the power comes back. This is important for servers.

This feature is implemented on Unix systems by first requesting a system shutdown. As a part of the shutdown, apcupsd is terminated by the system, but the shutdown process executes a script where apcupsd is recalled after the disks are synced and the machine is idle. Apcupsd then requests the UPS to shut off the power (killpower).

Unfortunately on Windows, there is no such shutdown script that we are aware of and no way for apcupsd to get control after the machine is idled. If this feature is important to you, it is possible to do it by telling apcupsd to immediately issue the killpower command after issuing the shutdown request. The danger in



doing so is that if the machine is not sufficiently idled when the killpower takes place, the disks will need to be rescanned (and there is a possibility of lost data however small). Generally, UPSes have a shutdown grace period which gives sufficient time for the OS to shutdown before the power is cut.

To implement this feature, you need to add the `-p` option to the `apcupsd` command line that is executed by the system. Currently the procedure is manual. You do so by editing the registry and changing the line:

```
c:\apcupsd\apcupsd.exe /service
```

found under the key:

```
HKEY_LOCAL_MACHINE Software\Microsoft\Windows\CurrentVersion\RunServices
```

to

```
c:\apcupsd\apcupsd.exe /service -p
```

If you have a Smart UPS, you can configure the kill power grace period, and you might want to set it to 3 minutes. If you have a dumb UPS, there is no grace period and you should not use this procedure. If you have a Back-UPS CS or ES, these UPSes generally have a fixed grace period of 2 minutes, which is probably sufficient.

## ***Power Down During Shutdown***

Our philosophy is to shutdown a computer but not to power it down itself (as opposed to having the UPS cut the power as described above). That is we prefer to idle a computer but leave it running. This has the advantage that in a power fail situation, if the killpower function described above does not work, the computer will continue to draw down the batteries and the UPS will hopefully shutoff before the power is restore thus permitting an automatic reboot.

Nevertheless some people prefer to do a full power down. To do so, you might want to get a copy of PsShutdown, which does have a power down option. You can find it and a lot more useful software at: <http://www.sysinternals.com/ntw2k/freeware/pstools.shtml>. To use their shutdown program rather than the `apcupsd` supplied version, you simply edit:

```
c:\apcupsd\etc\apcupsd\apccontrol
```

with any text editor and change our calls to shutdown to `pssshutdown`.

## ***Command Line Options Specific to the Windows Version***

These options are not normally seen or used by the user, and are documented here only for information purposes. At the current time, to change the default options, you must either manually run `apcupsd` or you must manually edit the system registry and modify the appropriate entries.

In order to avoid option clashes between the options necessary for `apcupsd` to run on Windows and the standard `apcupsd` options, all Windows specific options are signaled with a forward slash character (/), while as usual, the standard `apcupsd` options are signaled with a minus (-), or a minus minus (--). All the standard `apcupsd` options can be used on the Windows version. In addition, the following Windows only options are implemented:

<code>/service</code>	Start <code>apcupsd</code> as a service
<code>/run</code>	Run the <code>apcupsd</code> application
<code>/install</code>	Install <code>apcupsd</code> as a service in the system registry
<code>/remove</code>	Uninstall <code>apcupsd</code> from the system registry
<code>/about</code>	Show the <code>apcupsd</code> about dialogue box
<code>/kill</code>	Stop any running <code>apcupsd</code>

/help

Show the apcupsd help dialogue box

It is important to note that under normal circumstances the user should never need to use these options as they are normally handled by the system automatically once apcupsd is installed. However, you may note these options in some of the .pif files that have been created for your use.

## Installation: Serial-Line UPSes

### **Overview of Serial-Interface UPSes**

If you have a UPS that communicates via serial port, you need to do two things before you can even think about configuring the software. First, you need to figure out whether it's a dumb (voltage-signalling) UPS or speaks the apcsmart protocol. Second, if you have an interface cable from APC, you need to figure out what kind it is. If you don't have such a cable, you need to build one. A straight-through serial cable won't work.

According to Bill Marr the Belkin F5U109, also sold as F5U409 also works with apcupsd for kernel versions 2.4.25 or higher and kernels 2.6.1 and higher. These newer kernels are needed to have the patch that makes the mct\_u232 (Magic Control Technology) module and other adapters work with RS-232 devices that do not assert the CTS signal.

### **Connecting a Serial-Line UPS to a USB Port**

By using a special adaptor, you can connect your serial-line UPS to a USB port. If you would like to free up your serial port and connect your existing serial port UPS to a USB port, it is possible if you have one of the later kernels. You simply get a serial to USB adapter that is supported by the kernel, plug it in and make one minor change to your apcupsd.conf file and away you go. (Kern adds: Thanks to Joe Acosta for pointing this out to me.)

The device that Joe Acosta and Kern are using is IOgear GUC232A USB 2 serial adapter. Bill Marr informs us that it also works with a Back-UPS Pro 650 and the 940-0095B cable.

At Kern's site, running Red Hat 7.1 with kernel 2.4.9-12, he simply changed his /etc/apcupsd/apcupsd.conf configuration line to be:

```
DEVICE /dev/ttyUSB0
```

Depending on whether or not you have hotplug working, you may need to explicitly load the kernel modules `usbserial` and `p12303`. In Kern's case, this was not necessary.

### **Testing Serial-Line UPSes**

If you have a serial-line UPS, there are some tests you should run before the general ones described in the [Testing Apcupsd](#) section.

To test your computer's connection with a serial-line UPS, you first need to establish that the serial line is functioning, and then that the UPS is responding to commands. This can be a bit tricky, especially with a dumb voltage-signalling interface, because it is completely quiescent when there are no commands being passed, and the command repertoire doesn't include any self-tests.

Because it is easy to configure a serial cable incorrectly in such a way as to cause premature shutdowns of the UPS power, we *strongly* recommend, especially for voltage- signaling (dumb) UPSes, that you do most of the initial testing with your computer plugged into the wall rather than your UPS. Thus if the UPS power is suddenly shut off, your computer will continue to run. We also recommend using safe-apccontrol as described below, until you are sure that the signaling is correct.

Also note that if you launch the execution of apcupsd while your voltage-signaling UPS is on battery power, it is very likely that your UPS will immediately shut off the power. This is due to the initialization of the serial port line signals, which often looks to the UPS like a shutdown command.



Finally, double-check the state of your cabling and UPS indicator lights frequently during testing. For voltage-signaling UPSes, apcupsd is not currently able to detect whether or not the serial cable is connected. In addition, some simple signaling UPSes with certain cable combinations are not able to detect the low battery condition. For more details please see [Voltage Signalling Features Supported by Apcupsd for Various Cables](#).

## ***Establishing Serial Port Connection***

Once you have compiled, installed, and invoked apcupsd, you should wait to allow apcupsd to configure itself and establish contact with the UPS.

If you see a message similar to the following about 30 seconds after starting apcupsd...

```
apcupsd FATAL ERROR in apcserial.c at line 156
PANIC! Cannot communicate with UPS via serial port.
```

it means that apcupsd tried for about 30 seconds to establish contact with the UPS via the serial port, but was unable to do so. Before continuing, you must correct this problem. Some of the possible sources of the problem are:

- You have not configured the correct serial port name on the `DEVICE` directive in your apcupsd configuration file.
- The serial port that you have chosen has logins enabled. You must disable logins on that port, otherwise, the system prevents apcupsd from using it. Normally, the file `/etc/inittab` specifies the ports for which a getty process is started (on Sun machines, the serial port program equivalent to getty is called `ttymon`). You must disable this for the port that you wish to use.
- Make sure you are doing your testing as root otherwise, you may have permissions problems accessing the serial port.
- You may have cabling problems, either with an incorrect cable, or the incorrect cable specification directive in the configuration file.
- You may have a problem with the `/etc/apcupsd/apcupsd.conf` file. For example, check that you have specified the correct type of UPS and the correct networking directives. For more details, see the [After Installation](#) section.
- If you have a SmartUPS 5000 RM 15U or similar model, that comes with a "Web/SNMP management card" in one of the "Smart Slots", this card may interfere with the serial port operation. If you are having problems, please remove this card and try again. Supposedly V3.0 of the card firmware has been corrected to properly release the serial port.
- Ensure that you have no other programs that are using the serial port. One user reported that he had problems because the serial port mouse (gpm) was using the same port as apcupsd. This causes intermittent seemingly random problems.
- Try connecting your UPS to another machine. If it works, then you probably have a bad serial port card. As unlikely as this may sound, at least two of our users have had to replace bad serial port cards.
- Try doing an `lsof /dev/ttyS0` where you replace the `/dev/ttyS0` with your serial port name. If you get no output, the port is free (or there is no physical port). If you get output, then another program is using the port, and you should see which one.
- Try doing a `dmesg | grep tty`. This may show you if a program has grabbed the port. (Thanks to Joe Acosta for the suggestion.)
- If all else fails, make sure your system is configured for serial port support.

The first thing to do is to look at your log file, usually `/var/log/messages` because apcupsd writes more detailed information to the log file whenever there is an error.

If you have a UPS that uses apcsmart protocol, you can manually test the serial communications with the UPS by starting a serial port communications program (such as minicom, tip, or cu) with the settings 2400 8N1 (2400 baud, 8 data bits, no parity, 1 stop bit). Be extremely careful what you send to your UPS as certain characters may cause it to power down or may even cause damage to the UPS. Try sending an upper case `Y` to the UPS (without a return at the end). It should respond with `SM`. If this is not the case, review the possible problems listed above. If you fat finger the `Y` and enter `y` instead, no cause for alarm, you will simply get the APC copyright notice.

Once you are sure that serial port communications is working, proceed to the next test.

## **Once you have established serial communications**

Once you have established that apcupsd can talk to the UPS over the serial part, go do the series of functional tests described in the main Testing section (see [Testing Apcupsd](#)).

## **Troubleshooting Serial Line communications**

*The most frequently encountered problem with voltage-signalling UPSes (e.g. BackUPS 650) is that you have incorrectly specified which cable is being used. All cables furnished by APC have the cable number stamped on the side of the computer connector end of the cable. Using this number with apcupsd will normally work fine. If you do not know what cable you have, you can use the apctest program to determine the type of the cable.*

For simple signaling UPSes, you should **not** use `simple` in the cable specification (i.e. `UPSCABLEsimple`) unless you have made the cable yourself according to the wiring diagram given in the cables chapter of this manual.

### **Bizarre Intermittent Behavior:**

In one case, a user reported that he received random incorrect values from the UPS in the status output. It turned out that gpm, the mouse control program for command windows, was using the serial port without using the standard Unix locking mechanism. As a consequence, both apcupsd and gpm were reading the serial port. Please ensure that if you are running gpm that it is not configured with a serial port mouse on the same serial port.

## **Cables**

You can either use the cable that came with your UPS (the easiest if we support it) or you can make your own cable. We recommend that you obtain a supported cable directly from APC.

If you already have an APC cable, you can determine what kind it is by examining the flat sides of the two connectors where you will find the cable number embossed into the plastic. It is generally on one side of the male connector.

To make your own cable you must first know whether you have a UPS that speaks the apcsmart protocol or a "dumb" UPS that uses serial port line voltage signalling.

If you have a smart UPS, and you build your own cable, build a Smart-Custom cable (see [Smart-Custom Cable for SmartUPSes](#)). If you have a voltage-signalling or dumb UPS, build a Simple-Custom cable (see [Simple-Custom Voltage-Signalling Cable for "dumb" UPSes](#)). If you have a BackUPS CS with a RJ45 connector, you can build your own Custom-RJ45 cable (see [Custom-RJ45 Smart Signalling Cable for BackUPS CS Models](#)).

## **Smart-Custom Cable for SmartUPSes**

*You do not have this cable unless you built it yourself. The Smart-Custom cable is not an APC product.*

SMART-CUSTOM CABLE

Signal Computer

UPS

	DB9F		DB9M	
RxD	2	-----	2	TxD Send
TxD	3	-----	1	RxD Receive
GND	5	-----	9	Ground

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE smart
UPSTYPE apcsmart
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

If you have an OS that requires DCD or RTS to be set before you can receive input, you might try building the standard APC Smart 940-0024C cable listed below (see [940-0024C Cable Wiring](#)).

## Simple-Custom Voltage-Signalling Cable for "dumb" UPSes

*You do not have this cable unless you built it yourself. The Simple-Custom cable is not an APC product.*

For "dumb" UPSes using voltage signalling, if you are going to build your own cable, we recommend to make the cable designed by the apcupsd team as follows:

SIMPLE-CUSTOM CABLE					
Signal	Computer			UPS	
	DB9F	4.7K ohm		DB9M	
DTR	4	--[####]--*			DTR set to +5V by Apcupsd
CTS	8	-----*		5	Low Battery
GND	5	-----		4	Ground
DCD	1	-----		2	On Battery
RTS	7	-----		1	Kill UPS Power

List of components one needs to make the Simple cable:

1. One (1) male DB9 connector, use solder type connector only.
2. One (1) female DB9/25F connector, use solder type connector only.
3. One (1) 4.7K ohm 1/4 watt 5% resistor.
4. rosin core solder.
5. three (3) to five (5) feet of 22AWG multi-stranded four or more conductor cable.

Assembly instructions:

1. Solder the resistor into pin 4 of the female DB9 connector.
2. Next bend the resistor so that it connects to pin 8 of the female DB9 connector.
3. Pin 8 on the female connector is also wired to pin 5 on the male DB9 connector. Solder both ends.
4. Solder the other pins, pin 5 on the female DB9 to pin 4 on the male connector; pin 1 on the female connector to pin 2 on the male connector; and pin 7 on the female connector to pin 1 on the male connector.
5. Double check your work.

We use the DTR (pin 4 on the female connector) as our +5 volts power for the circuit. It is used as the Vcc pull-up voltage for testing the outputs on any "UPS by APC" in voltage-signalling mode. This cable may not work on a BackUPS Pro if the default communications are in apcsmart mode. This cable is also valid

for use on a ShareUPS BASIC Port. It is reported to work on SmartUPSes, however the Smart Cable described above is preferred.

To have a better idea of what is going on inside apcupsd, for the SIMPLE cable apcupsd reads three signals and sets three:

**Reads:**

CD, which apcupsd uses for the On Battery signal when high.

CTS, which apcupsd uses for the Battery Low signal when high.

**RxD (SR), which apcupsd uses for the Line Down**

signal when high. This signal isn't used for much.

**Sets:**

**DTR, which apcupsd sets when it detects a power failure (generally**

5 to 10 seconds after the CD signal goes high). It clears this signal if the CD signal subsequently goes low -- i.e. power is restored.

**TxD (ST), which apcupsd clears when it detects that the CD signal**

has gone low after having gone high - i.e. power is restored.

**RTS, which apcupsd sets for the killpower signal -- to cause the UPS**

to shut off the power.

Please note that these actions apply only to the SIMPLE cable. The signals used on the other cables are different.

Finally, here is another way of looking at the CUSTOM-SIMPLE cable:

APCUPSD SIMPLE-CUSTOM CABLE					
Computer Side		Description of Cable	UPS Side		
DB9f	DB25f		DB9m	n/c	DB25m
4	20	DTR (5vcc) *below		n/c	
8	5	CTS (low battery) *below	<- 5		7
2	3	RxD (no line voltage) *below	<- 3		2
5	7	Ground (Signal)		4	20
1	8	CD (on battery from UPS)	<- 2		3
7	4	RTS (kill UPS power)	-> 1		8
n/c	1	Frame/Case Gnd (optional)		9	22

Note: the <- and -> indicate the signal direction.

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE simple
UPSTYPE dumb
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

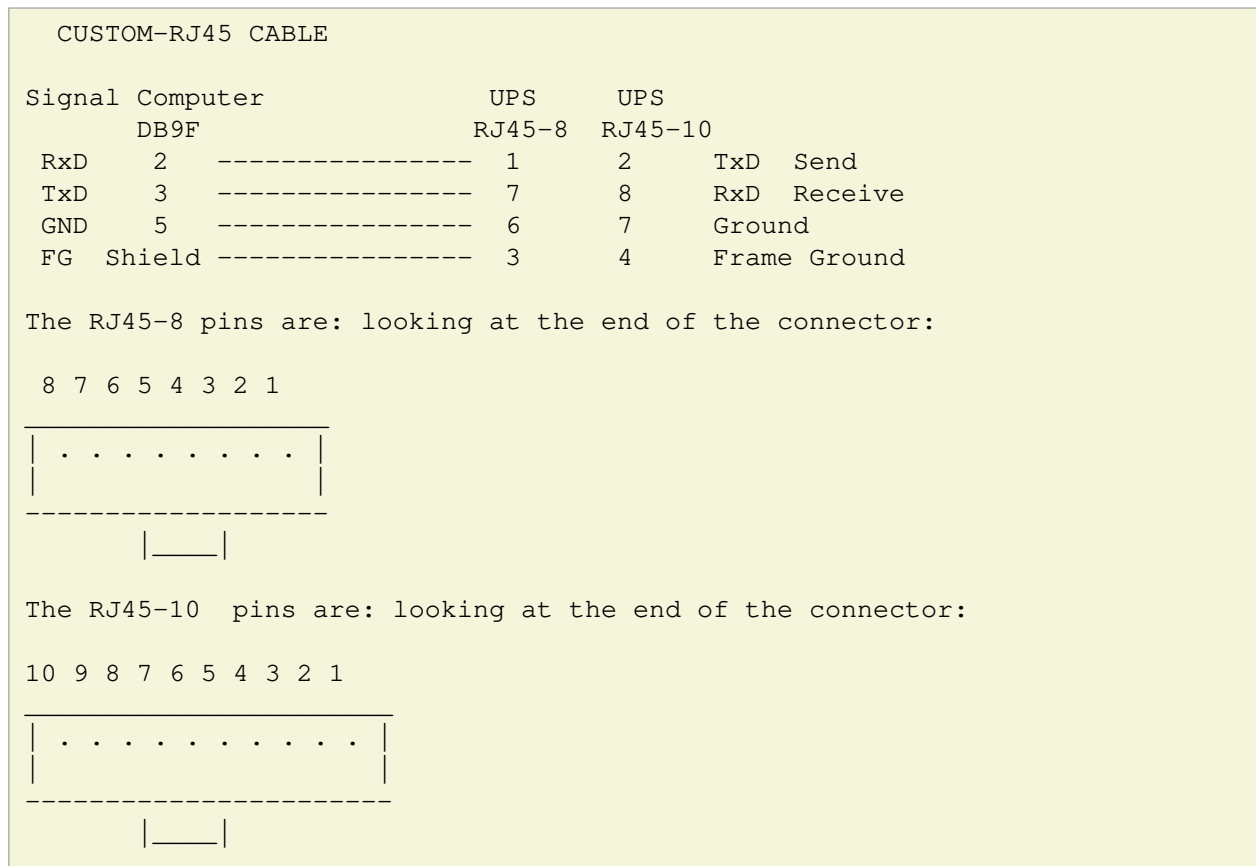
### ***Custom-RJ45 Smart Signalling Cable for BackUPS CS Models***

If you have a BackUPS CS, you are probably either using it with the USB cable that is supplied or with the 940-0128A supplied by APC, which permits running the UPS in dumb mode. By building your own cable, you can now run the BackUPS CS models (and perhaps also the ES models) using smart signalling and have all the same information that is available as running it in USB mode.

The jack in the UPS is actually a 10 pin RJ45. However, you can just as easily use a 8 pin RJ45 connector, which is more standard (ethernet TX, and ISDN connector). It is easy to construct the cable by cutting off one end of a standard RJ45-8 ethernet cable and wiring the other end (three wires) into a

standard DB9F female serial port connector.

Below, you will find a diagram for the CUSTOM-RJ45 cable:



For the serial port DB9F connector, the pin numbers are stamped in the plastic near each pin. In addition, there is a diagram near the end of this chapter.

Note, one user, Martin, has found that if the shield is not connected to the Frame Ground in the above diagram (not in our original schematic), the UPS (a BackUPS CS 500 EI) will be unstable and likely to rapidly switch from power to batteries (i.e. chatter).

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE smart
UPSTYPE apcsmart
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

The information for constructing this cable was discovered and transmitted to us by slither\_man. Many thanks!

### ***Other APC Cables that apcupsd Supports***

apcupsd will also support the following off the shelf cables that are supplied by APC

- 940-0020[B/C] Simple Signal Only, all models.
- 940-0023A Simple Signal Only, all models.
- 940-0119A Simple Signal Only, Back-UPS Office, and BackUPS ES.
- 940-0024[B/C/G] Smart mode Only, SU and BKPro only.
- 940-0095[A/B/C] PnP (Plug and Play), all models.

- 940-1524C Smart mode Only
- 940-0128A Simple Signal Only, Back-UPS CS in serial mode.
- All USB cables such as 940-0127[A/B]

### ***Voltage Signalling Features Supported by Apcupsd for Various Cables***

The following table shows the features supported by the current version of apcupsd for various cables running the UPS in voltage-signalling mode.

Cable	Power Loss	Low Battery	Kill Power	Cable Disconnected
940-0020B	Yes	No	Yes	No
940-0020C	Yes	Yes	Yes	No
940-0023A	Yes	No	No	No
940-0119A	Yes	Yes	Yes	No
940-0127A	Yes	Yes	Yes	No
940-0128A	Yes	Yes	Yes	No
940-0095A/B/C	Yes	Yes	Yes	No
simple	Yes	Yes	Yes	No

### ***Voltage Signalling***

Apparently, all APC voltage-signalling UPSes with DB9 serial ports have the same signals on the output pins of the UPS. The difference at the computer end is due to different cable configurations. Thus, by measuring the connectivity of a cable, one can determine how to program the UPS.

The signals presented or accepted by the UPS on its DB9 connector using the numbering scheme listed above is:

UPS Pin	Signal meaning
1 <-	Shutdown when set by computer for 1-5 seconds.
2 ->	On battery power (this signal is normally low but goes high when the UPS switches to batteries).
3 ->	Mains down (line fail) See Note 1 below.
5 ->	Low battery. See Note 1 below.
6 ->	Inverse of mains down signal. See Note 2 below.
7 <-	Turn on/off power (only on advanced UPSes only)

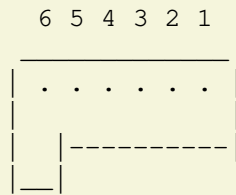
Note 1: these two lines are normally open, but close when the appropriate signal is triggered. In fact, they are open collector outputs which are rated for a maximum of +40VDC and 25 mA. Thus the 4.7K ohm resistor used in the Custom Simple cable works quite well.

Note 2: the same as note 1 except that the line is normally closed, and opens when the line voltage fails.

### ***The Back-UPS Office 500 signals***

The Back-UPS Office UPS has a telephone type jack as output, which looks like the following:

Looking at the end of the connector:



It appears that the signals work as follows:

UPS		Signal meaning
1 (brown)	<-	Shutdown when set by computer for 1-5 seconds.
2 (black)	->	On battery power
3 (blue)	->	Low battery
4 (red)		Signal ground
5 (yellow)	<-	Begin signalling on other pins
6 (none)		none

## Analyses of APC Cables

### 940-0020B Cable Wiring

**Supported Models:** Simple Signaling such as BackUPS

**Contributed by:** Lazar M. Fleysher

Although we do not know what the black box semiconductor contains, we believe that we understand its operation (many thanks to Lazar M. Fleysher for working this out).

This cable can only be used on voltage-signalling UPSes, and provides the On Battery signal as well as kill UPS power. Most recent evidence (Lazar's analysis) indicates that this cable under the right conditions may provide the Low Battery signal. This is yet to be confirmed.

*This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.*

APC Part# - 940-0020B

Signal	Computer DB9F		UPS DB9M	
CTS	8	-----	2	On Battery
DTR	4	-----	1	Kill power
GND	5	-----*	4	Ground
		*----	9	Common
DCD	1	---- /// -----	5	Low Battery
		\\		
RTS	7	---- ///		
		---		(probably a semi-conductor)

### 940-0020C Cable Wiring

**Supported Models:** Simple Signaling such as BackUPS

This cable can only be used on voltage-signalling UPSes, and provides the On Battery signal, the Low Battery signal as well as kill UPS power. You may specify UPSCABLE 940-0020C.

*This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.*

APC Part# - 940-0020C					
Signal	Computer			UPS	
	DB9F			DB9M	
CTS	8	-----		2	On Battery
DTR	4	-----		1	Kill power
GND	5	-----*		4	Ground
			*----	9	Common
RTS	7	-----[ 93.5K ohm ]-----		5	Low Battery
		or semi-conductor			

**940-0023A Cable Wiring**

**Supported Models:** Simple Signaling such as BackUPS

This cable can only be used on voltage-signalling UPSes, and apparently only provides the On Battery signal. As a consequence, this cable is pretty much useless, and we recommend that you find a better cable because all APC UPSes support more than just On Battery. Please note that we are not sure the following diagram is correct.

*This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.*

APC Part# - 940-0023A					
Signal	Computer			UPS	
	DB9F			DB9M	
DCD	1	-----		2	On Battery
		3.3K ohm			
TxD	3	--[####]--*			
DTR	4	-----*			
GND	5	-----*		4	Ground
			*----	9	Common

**940-0024C Cable Wiring**

**Supported Models:** SmartUPS (all models with DB9 serial port)

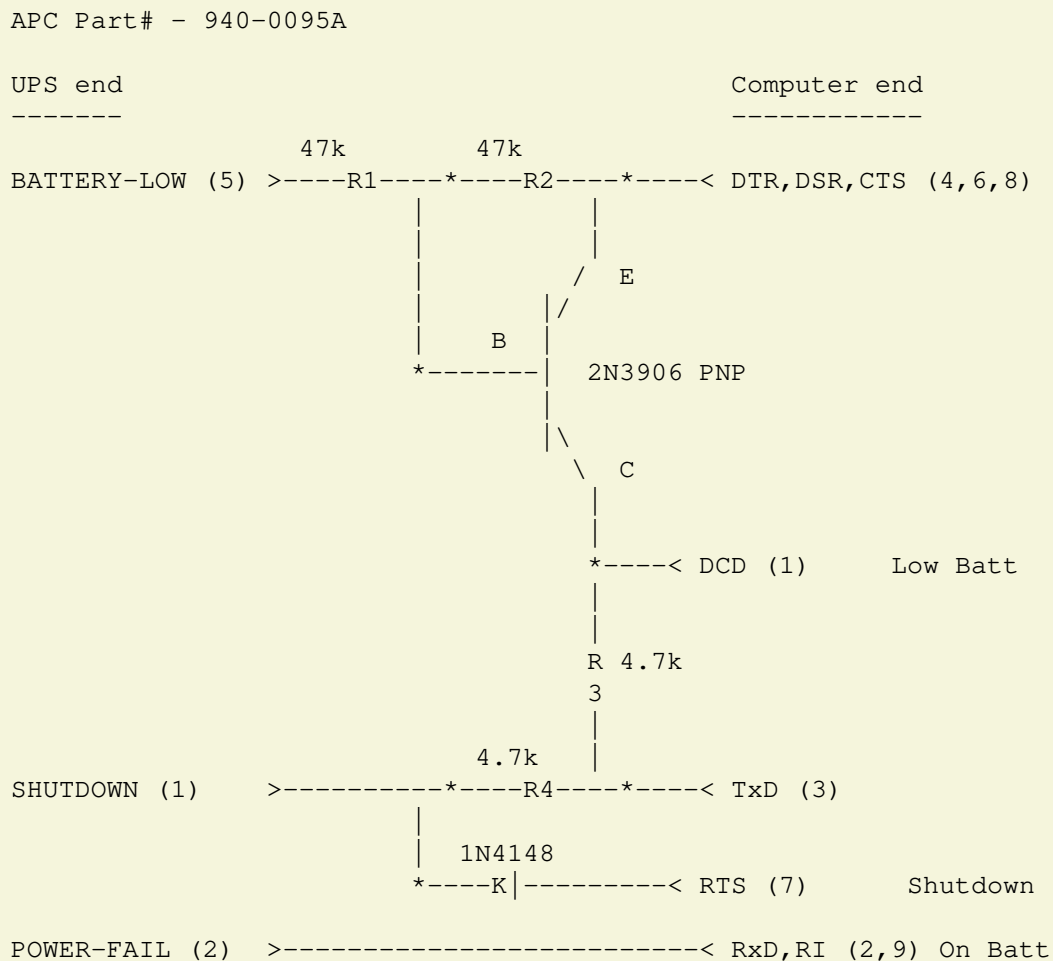
If you wish to build the standard cable furnished by APC (940-0024C), use the following diagram.



Signal	Computer	UPS
	DB9F	DB9M
RxD	2	2 TxD Send
TxD	3	1 RxD Receive
DCD	1	
DTR	4	
GND	5	9 Ground
RTS	7	
CTS	8	

**Supported Models:** APC BackUPS Pro PNP

This is the definitive wiring diagram for the 940-0095A cable submitted by Chris Hanson, who disassembled the original cable, destroying it in the process. He then built one from his diagram and it works perfectly.



GROUND (4, 9) >-----< GND (5)

#### Operation:

- DTR is "cable power" and must be held at SPACE. DSR or CTS may be used as a loopback input to determine if the cable is plugged in.
- DCD is the "battery low" signal to the computer. A SPACE on this line means the battery is low. This is signalled by BATTERY-LOW being pulled down (it is probably open circuit normally).

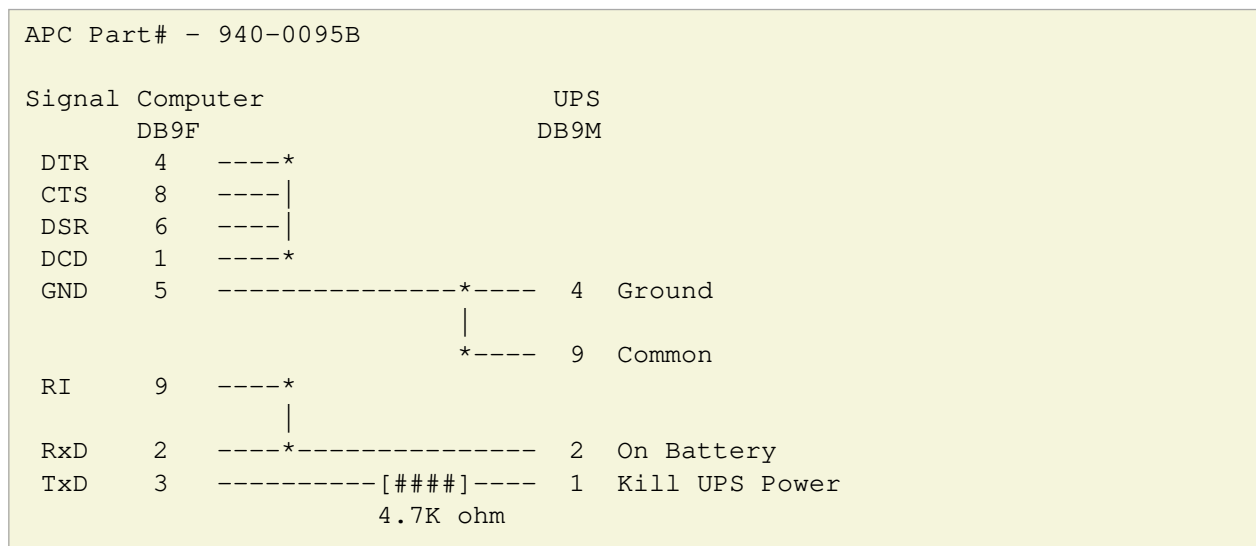
Normally, the transistor is turned off, and DCD is held at the MARK voltage by TxD. When BATTERY-LOW is pulled down, the voltage divider R2/R1 biases the transistor so that it is turned on, causing DCD to be pulled up to the SPACE voltage.

- TxD must be held at MARK; this is the default state when no data is being transmitted. This sets the default bias for both DCD and SHUTDOWN. If this line is an open circuit, then when BATTERY-LOW is signalled, SHUTDOWN will be automatically signalled; this would be true if the cable were plugged in to the UPS and not the computer, or if the computer were turned off.
- RTS is the "shutdown" signal from the computer. A SPACE on this line tells the UPS to shut down.
- RxD and RI are both the "power-fail" signals to the computer. A MARK on this line means the power has failed.
- SPACE is a positive voltage, typically +12V. MARK is a negative voltage, typically -12V. Linux appears to translate SPACE to a 1 and MARK to a 0.

#### 940-0095B Cable Wiring

**Supported Models:** Many simple-signaling (aka voltage signaling) models such as BackUPS

*This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.*



#### 940-0119A Cable Wiring

**Supported Models:** Older BackUPS Office

*This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.*

APC Part# - 940-0119A

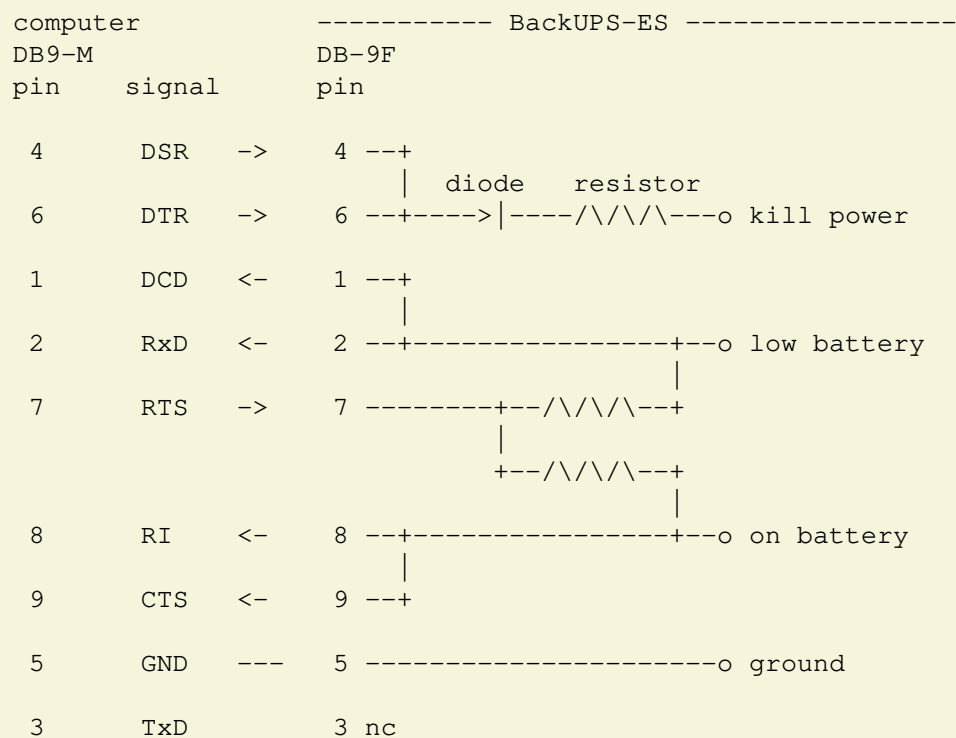
UPS pins	Computer pins	Signal	Signal meaning
1 (brown)	4,6	DSR DTR <-	Shutdown when set by computer for 1-5 seconds.
2 (black)	8,9	RI CTS ->	On battery power
3 (blue)	1,2	CD RxD ->	Low battery
4 (red)	5	Ground	
5 (yellow)	7	RTS <-	Begin signalling on other pins
6 (none)	none		

### Serial BackUPS ES Wiring

**Supported Models:** Older Serial BackUPS ES

**Contributed by:** William Stock

The BackUPS ES has a straight through serial cable with no identification on the plugs. To make it work with apcupsd, specify the { UPSCABLE 940-0119A} and { UPSTYPE backups}. The equivalent of cable 940-0119A is done on a PCB inside the unit.



### 940-0128A Cable Wiring

**Supported Models:** Older USB BackUPS ES and CS

**Contributed by:** Many, thanks to all for your help!

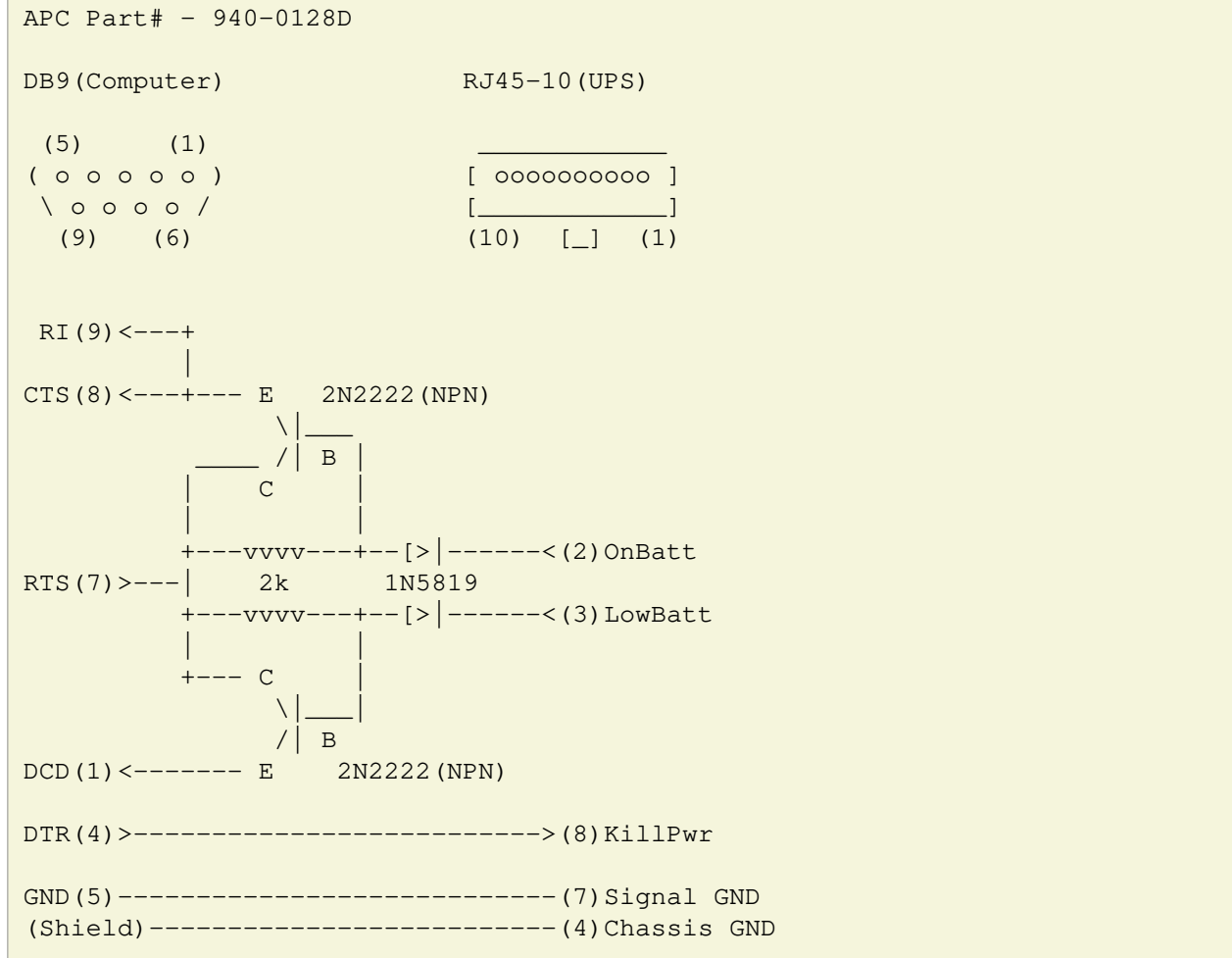
## 940-0128D Cable Wiring

**Supported Models:** BackUPS XS1000(BX-1000), Possibly other USB models

**Contributed by:** Jan Babinski jbabinsk at pulsarbeacon dot com

940-0128D is functionally similar to the 940-0128A cable except for NC on (6) DTR and (2) RD on the computer side.

Unverified: Try setting apcupsd to UPSTYPE dumb and UPSCABLE 940-0128A.

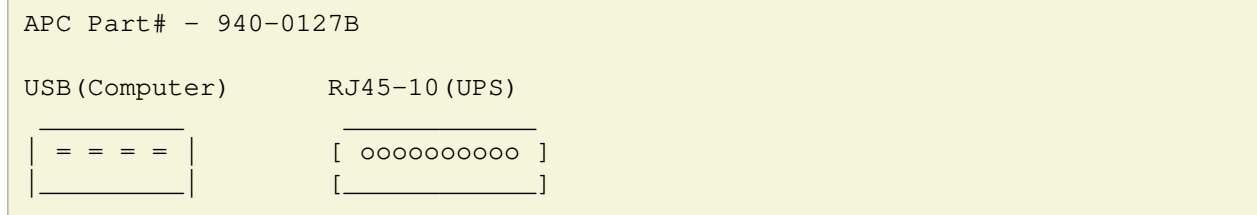


### 940-0127B Cable Wiring

**Supported Models:** BackUPS XS1000(BX-1000), Possibly other USB models

**Contributed by:** Jan Babinski jbabinsk at pulsarbeacon dot com

Standard USB cable for USB-capable models with 10-pin RJ45 connector.



(1)	(4)	(10)	[_]	(1)
+5V	(1)	-----	(1)	+5V
DATA+	(2)	-----	(9)	DATA+
DATA-	(3)	-----	(10)	DATA-
GND	(4)	-----	(7)	Signal GND
(Shield)		-----	(4)	Chassis GRND

## ***Win32 Implementation Restrictions for Simple UPSes***

Due to inadequacies in the Win32 API, it is not possible to set/clear/get all the serial port line signals. apcupsd can detect: CTS, DSR, RNG, and CD. It can set and clear: RTS and DTR.

This imposes a few minor restrictions on the functionality of some of the cables. In particular, LineDown on the Custom Simple cable, and Low Battery on the 0023A cable are not implemented.

## ***Internal Apcupsd Actions for Simple Cables***

This section describes how apcupsd 3.8.5 (March 2002) treats the serial port line signals for simple cables.

```
apcaction.c:
condition = power failure detected
cable = CUSTOM_SIMPLE
action = ioctl(TIOCMBS, DTR)          set DTR (enable power bit?)

apcaction.c:
condition = power back
cable = CUSTOM_SIMPLE
action = ioctl(TIOCMBS, DTR)          clear DTR (clear power bit)
action = ioctl(TIOCMBS, ST)           clear ST (TxD)

apcserial.c:
condition = serial port initialization
cable = 0095A, 0095B, 0095C
action = ioctl(TIOCMBS, RTS)          clear RTS (set PnP mode)

cable = 0119A, 0127A, 0128A
action = ioctl(TIOCMBS, DTR)          clear DTR (killpower)
action = ioctl(TIOCMBS, RTS)          set   RTS (ready to receive)

apcserial.c:
condition = save_dumb_status
cable = CUSTOM_SIMPLE
action = ioctl(TIOCMBS, DTR)          clear DTR (power bit?)
action = ioctl(TIOCMBS, RTS)          clear RTS (killpower)

cable = 0020B, 0020C, 0119A, 0127A, 0128A
action = ioctl(TIOCMBS, DTR)          clear DTR (killpower)

cable = 0095A, 0095B, 0095C
action = ioctl(TIOCMBS, RTS)          clear RTS (killpower)
action = ioctl(TIOCMBS, CD)           clear DCD (low batt)
action = ioctl(TIOCMBS, RTS)          clear RTS (killpower) a second time!
```

```

apcserial.c:
condition = check_serial

cable = CUSTOM_SIMPLE
action = OnBatt = CD
action = BattLow = CTS
action = LineDown = SR

cable = 0020B, 0020C, 0119A, 0127A, 0128A
action = OnBatt = CTS
action = BattLow = CD
action = LineDown = 0

cable = 0023A
action = Onbatt = CD
action = BattLow = SR
action = LineDown = 0

cable = 0095A, 0095B, 0095C
action = OnBatt = RNG
action = BattLow = CD
action = LineDown = 0

apcserial.c
condition = killpower

cable = CUSTOM_SIMPLE, 0095A, 0095B, 0095C
action = ioctl(TIOMCBIS, RTS)      set RTS (kills power)
action = ioctl(TIOMCBIS, ST)       set TxD

cable = 0020B, 020C, 0119A, 0127A, 0128A
action = ioctl(TIOMCBIS, DTR)      set DTR (kills power)

```

## Recalibrating the UPS Runtime

Note: In a future release of apcupsd this procedure will be replaced by a daemon operation that can be performed on all types of UPS.

This section does not apply to voltage-signalling or dumb UPSes such as the older BackUPS models.

Smart UPSes internally compute the remaining runtime, and apcupsd uses the value supplied by the UPS. As the batteries age (after say two or three years), the runtime computation may no longer be accurate since the batteries no longer hold the same charge. As a consequence, in the event of a power failure, the UPS and thus apcupsd can report a runtime of 5 minutes remaining when in fact only one minute remains. This can lead to a shutdown before you might expect it, because regardless of the runtime remaining that is reported, the UPS will always correctly detect low batteries and report it, thus causing apcupsd to correctly shutdown your computer.

If you wish to have the UPS recalibrate the remaining runtime calculations, you can do so manually as the current version of apcupsd does not support this feature. To do so,

- Shutdown apcupsd
- contact your UPS directly using some terminal program such as minicom, tip, or cu with the settings 2400 8N1 (2400 baud, 8 bits, no parity, 1 stop bit). Be extremely careful what you send to your UPS as certain characters may cause it to power down or may even cause damage to the UPS. Try sending an upper case Y to the UPS (without a return at the end). It should respond with SM. If this

is not the case, read the chapter on testing. If you fat finger the `Y` and enter `y` instead, no cause for alarm, you will simply get the APC copyright notice.

- when you are sure you are properly connected send an upper case `D` (no `cr`). This will put the UPS into calibration mode, and it will drain the battery down to 25% capacity (35% for a Matrix) at which point it will go back on the mains. In doing so, it will recompute the runtime calibration.
- If you wish to abort the calibration, enter a second `D` command.
- When you are done, restart `apcupsd`.

In principle, you should be able to do this with the computer powered by the UPS, but if you wish to be completely safe, you should plug your computer into the wall prior to performing the runtime calibration. In that case, you will need to artificially load the UPS with light bulbs or other means. You should supply a load of about 30 to 35% but not more than 50%. You can determine the load by looking at the output of the `apcaccess status` command while `apcupsd` is running.

You should not run the recalibration command more than once or twice per year as discharging these kinds of batteries tends to shorten their life span.

## Configuration Directive Reference

Configuration directives in `/etc/apcupsd/apcupsd.conf` control the behavior of the `apcupsd` daemon. For most installations it is only necessary to set a handful of general directives. The rest can be left at their defaults unless you have an exotic configuration.

### General Configuration Directives

In general, each of these directives is required (except that the `DEVICE` directive is ignored for `UPSCABLE ether` and not required for `UPSCABLE usb`).

#### UPSTYPE *driver*

The name of a driver. Should be one of `dumb`, `apcsmart`, `net`, `usb`, `pcnet`, `snmp`, or `test`. This describes your interface type. The `UPSTYPE` directive can be defined during installation by using the `--with-upstype=` option of the `configure` program.

#### UPSCABLE *cable*

Defines the type of cable connecting the UPS to your computer.

**Possible generic choices for `<cable>` are:**

`simple`, `smart`, `ether`, `usb`

**Or a specific cable model number may be used:**

`940-0119A`, `940-0127A`, `940-0128A`, `940-0020B`, `940-0020C`, `940-0023A`, `940-0024B`, `940-0024C`, `940-1524C`, `940-0024G`, `940-0095A`, `940-0095B`, `940-0095C`, `M-04-02-2000`

The `--with-upscable=` option of `configure` can be used to set a default for this directive during the your build.

#### DEVICE *device*

Specify which device is used for UPS communications. For serial ports, it is usually something like `/dev/ttyS0`. For USB ports, you may leave the name of the device blank (no specification) and `apcupsd` will automatically search the standard locations for the UPS.

Normally, the `configure` program will set an appropriate default value. You may also specify the `--with-serial-dev=` option of the `configure` program to set this directive at build time.

If you have specified `UPSTYPE net`, then the device name to be specified consists of `hostname:port` where the `hostname` is the fully qualified name or IP address of the host (NIS server) and the `port` (optional) is the port to use to contact the server.

If you specified `UPSTYPE snmp`, then the device name becomes `hostname:vendor:community`. Please see the [Support for SNMP UPSes](#) chapter in this manual for more details.



**POLLTIME *time in seconds***

The interval, in seconds, at which apcupsd polls the UPS for status. This rate is automatically set to 1 second if the UPS goes on batteries and reset to your specified value when the mains power returns. This setting applies both to directly-attached UPSes (UPSTYPE `apcsmart`, `usb`, `dumb`) and networked UPSes (UPSTYPE `net`, `snmp`). Lowering this setting will improve apcupsd's responsiveness to certain events at the cost of higher CPU utilization. The default of 60 is appropriate for most situations. This directive was formerly known as `NETTIME`.

**LOCKFILE *path to lockfile***

This option tells apcupsd where to create a lockfile for the USB or serial port in the specified directory. This is important to keep two programs from reading or writing the port at the same time. Please note that although the directive name is `LOCKFILE`, you are actually specifying the lock file path. apcupsd automatically appends the name of the device when creating the file. On most systems, this directive is automatically set by the `./configure` program. You may also explicitly set it during the build process by using the `--with-lock-dir=` option of the `configure` program.

***Configuration Directives Used by the Network Information Server***

None of these directives are required for proper operation of apcupsd.

**NETSERVER *[on / off]***

This configuration directive turns the network information server on or off. If it is on, apcupsd will spawn a child process that serves `STATUS` and `EVENTS` information over the network. This information is currently used by the Web-based CGI programs. The default is on. *This option is required to be turned on for net clients and apcaccess to function.*

**NISIP *IP-address***

This directive specifies the IP address of the network interface on which the NIS server will listen for incoming connections. Default value is `0.0.0.0` which means the NIS will listen for connections on all network interfaces. If your machine has more than one interface, you can specify the IP of a single interface to limit connections to only that interface. Furthermore, you can specify the loopback address (`127.0.0.1`) to accept connections only from the local machine. You may also use the `--with-nisip=` option of the `configure` program to set this directive during the build.

**NISPORT *port***

This configuration directive specifies the port to be used by the apcupsd Network Information Server. The default is platform dependent, but typically 3551, which we have received from IANA as the official apcupsd networking port. This value should only be changed if it conflicts with an existing service in use on your network or if you are running multiple instances of apcupsd on the same machine.

**EVENTSFILE *filename***

If you want the apcupsd network information server to provide the last 10 events via the network, you must specify a file where apcupsd will save these events. The default is: `/etc/apcupsd/apcupsd.events`. Currently, apcupsd will save at most the last 50 events. Periodically (once an hour by default), apcupsd will check the size of this file. When more than 50 events are recorded, apcupsd will truncate the file to the most recent 10 events. Consequently this file will not grow indefinitely. Although we do not recommend it, you may change these values by editing `apcevents.c` and changing the appropriate defines. Be aware that if you set these values to very large numbers, apcupsd may make excessive memory demands on the system during the data access and file truncation operations.

This filename may also be specified at build time by using the `--with-log-dir=` option of the `configure` program.

***Configuration Directives used during Power Failures***

In general, none of these directives are required. However, if you have a voltage-signalling (`dumb`) UPS with a cable that does not support the Low Battery signal, you must set the `TIMEOUT` directive to force a shutdown.

**BATTERYLEVEL *percent of battery***

If `BATTERYLEVEL` is specified, during a power failure, `apcupsd` will halt the system when the remaining battery charge falls below the specified percentage. The default is 5 percent. This directive is ignored for dumb (voltage-signalling) UPSes. To totally disable this counter, set `BATTERYLEVEL -1` in your `apcupsd.conf` file.

**MINUTES *battery runtime in minutes***

If `MINUTES` is specified, during a power failure, `apcupsd` will shutdown the system when the remaining runtime on batteries as internally calculated by the UPS falls below the time specified. The default is 3. This directive is ignored for dumb (voltage-signalling) UPSes. It should be noted that some UPSes report an incorrect value for remaining runtime when the battery is fully charged. This can be checked by examining the `TIMELEFT` value as printed in the output of an `'apcaccess status'` command. If the value is zero or otherwise unreasonable, your UPS is probably broken. In this case, we recommend that you disable this timer by setting `MINUTES -1` in your `apcupsd.conf` file.

**TIMEOUT *time in seconds***

After a power failure, `apcupsd` will halt the system when `TIMEOUT` seconds have expired. A value of zero disables this timer. Normally for all Smart UPS models and dumb UPSes with cables that support low battery detection, this should be zero so that the shutdown time will be determined by the battery level and/or remaining runtime (see above) or in the case of a voltage-signalling UPS, when the battery is exhausted. This command is required for dumb UPSes that do not provide a battery exhausted signal (only testing can determine this point). For more information, see the [Testing Apcupsd](#) section of this manual. This timer can also be useful if you want some slave machines to shutdown before other machines to conserve battery power. It is also useful for testing `apcupsd` because you can force a rapid shutdown by setting a small value (e.g. 60) and pulling the plug to the UPS.

`TIMEOUT`, `BATTERYLEVEL`, and `MINUTES` can be set together without problems. `apcupsd` will react to the first case or test that is valid. Normally SmartUPS users will set `TIMEOUT` to zero so that the system is shutdown depending on the percentage battery charge remaining (`BATTERYLEVEL`) or the remaining battery runtime (`MINUTES`).

**ANNOY *time in seconds***

Specify the time in seconds between messages requesting logged in users to get off the system during a power failure. This timer starts only when the UPS is running on batteries. The default is 300 seconds (5 minutes). `apcupsd` sends the annoy messages by invoking the `apccontrol` script with the `annoyme` argument. The default is to send a wall message on Unix systems and a popup message in Windows. The value of `ANNOYDELAY` must be greater than the value of `ANNOY` in order to receive annoy messages (this doesn't make sense, and means that the default values do not generate annoy messages: KES).

Note that if `NOLOGON disable` is set, the annoy messages will also be disabled.

**ANNOYDELAY *time in seconds***

Specify delay time in seconds before `apcupsd` begins requesting logged in users to get off the system during a power failure. This timer starts only after the UPS is running on batteries. This timer is reset when the power returns. The default is 60 seconds. Thus, the first warning to log off the system occurs after 60 seconds on batteries, assuming that `NOLOGON` is not set to `disable`.

### **NOLOGON *disable* | *timeout* | *percent* | *minutes* | *always***

Specifies when apcupsd should prevent user logins

The type specified allows you define the point when apcupsd will create the 'nologin' file and thus when user logins are prohibited. Once the 'nologin' file is created, normal users are prevented from logging in. Control of when this file is created is important for allowing systems with big UPSes to run as normally until the system administrator determines the need for preventing user logins. The feature also allows the system administrator to hold the "ANNOY" factor until the 'nologin' file is created. The default is always disable if no NOLOGON directive is specified.

The 'nologin' file will be created in the directory specified by the NOLOGINDIR directive described below.

As far as I can tell, the only useful types are disable and always since the difference in the time when the logout warning is given and shutdown occurs for the other types is very short (KES).

*disable* prevents apcupsd from creating the nologin file. Consequently, any user can login during a power failure condition. Also, the ANNOY feature is disabled so users will not be warned to logoff the system.

*timeout* specifies that apcupsd should prohibit logins after the UPS is on batteries for 90% of the time specified on the TIMEOUT configuration directive. Note! Normally you don't want to specify a TIMEOUT value, so this option is probably not too useful (KES).

*percent* specifies that apcupsd should prohibit logins when the remaining battery charge percentage reaches 110% or less than the value specified on the BATTERYLEVEL configuration directive. Thus if the BATTERYLEVEL is specified as 15, apcupsd will prohibit logins when the battery charge drops below 16% ( $15\% \times 110\% = 16\%$ ).

*minutes* specifies that apcupsd should prohibit logins when the remaining runtime in minutes reaches 110% or less than the value specified on the MINUTES configuration directive. Thus if MINUTES is set to 3, apcupsd will prohibit logins when the remaining runtime is less than 3 minutes ( $3 \times 110\% = 3$ ).

*always* causes apcupsd to immediately prohibit logins when a power failure occurs. This will also enable the ANNOY feature.

### **NOLOGINDIR *path to nologin dir***

This directive configures the directory into which apcupsd will write the nologin file, as described above for the NOLOGON directive.

Normally, the configure program will set an appropriate default value for your platform, often /etc. You may also specify the --with-nologdir= option of the configure program to change the default at compile time.

### **KILLDELAY *time in seconds***

If KILLDELAY is set, apcupsd will continue running after a shutdown has been requested, and after the specified time in seconds, apcupsd will attempt to shut off the UPS the power. This directive should normally be disabled by setting the value to zero, but on some systems such as Win32 systems apcupsd cannot regain control after a shutdown to force the UPS to shut off the power. In this case, with proper consideration for the timing, the KILLDELAY directive can be useful. Please be aware, if you cause apcupsd to kill the power to your computer too early, the system and the disks may not have been properly prepared. In addition, apcupsd must continue running after the shutdown is requested, and on Unix systems, this is not normally the case as the system will terminate all processes during the shutdown.

### **SCRIPTDIR *path to apccontrol dir***

This option configures the directory in which apccontrol and other event scripts are located.

Normally, the configure program will set an appropriate default value for your platform, often /etc/apcupsd.

**PWRFAILDIR *path to powerfail dir***

When apcupsd shuts down your system, it creates a temporary "flag file" which is used by the operating system halt scripts to know if this shutdown is due to a power failure. This directive configures which directory the flag file will be written into. The chosen directory must be writable by the user apcupsd is running as (normally root) and must not be cleared or unmounted early in the shutdown sequence.

Normally, the `configure` program will set an appropriate default value for your platform, often `/etc/apcupsd`. You may also specify the `--with-pwrfaildir=` option of the `configure` program to change the default at compile time.

***Configuration Directives used to Control System Logging*****STATTIME *time in seconds***

This directive supplies the time interval in seconds between writes to the STATUS file. If set to zero, the STATUS file will not be written. Please note that in a future version of apcupsd the STATUS file code will disappear since its functionality has been replaced by the Network Information Server and by `apcaccess status`, as a consequence, it is normally disabled by setting it to zero.

**STATFILE *file***

This directive specifies the file to be used when writing the STATUS information. The default is `/etc/apcupsd/apcupsd.status`.

**DATETIME *time in seconds***

This directives supplies the time interval in seconds between writes of PowerChute-like data information to the log file. See the [DATA Logging](#) section of this manual for additional details.

**FACILITY *log-facility***

The `FACILITY` directive can be used to change the system logging class or facility. The default is `DAEMON`. This parameter can be useful if you wish to direct the apcupsd system logging information to other than your system default files. See the [apcupsd System Logging](#) section of this manual for additional details.

***Configuration Directives for Sharing a UPS***

The following directives apply to sharing an UPS using a ShareUPS hardware module. Most users will not use this mode.

**UPSCCLASS *standalone | shareslave | sharemaster***

The default is `standalone` and should be used for all machines powered by the UPS and having a serial port or other direct connection to the UPS. This is the normal case.

Use `shareslave` if and only if you are using a ShareUPS and connected to a BASIC Port with Simple Signal. This code is not fully tested.

Use `sharemaster`, if and only if you are using a ShareUPS and connected to the ADVANCED Port Smart Signal control. This code is not fully tested.

**UPSMODE *disable | share***

For normal standalone operations, you will set `UPSMODE disable` to indicate that you are disabling the ShareUPS support.

Use `share` for two or seven additional simple signal ports on a SmartAccessories(tm) (internal/external box) for SmartUPSes. The `share` and `sharen` code is not fully tested.

***Configuration Directives Used to Set the UPS EEPROM***

*These directives have no effect on the operation of apcupsd but are reserved for use by apctest when bulk programming the values of the UPS EEPROM configuration variables in a Smart-UPS model.*

**UPSNAME *<string>***

Name of UPS. Maximum of 8 characters.

**BATTDATE** [ *mm/dd/yy* | *dd/mm/yy* ]

Last battery replacement date. Maximum of 8 characters.

**SENSITIVITY** [ *H* | *M* | *L* ]

H : High (most sensitive setting) M : Medium L : Low (least sensitive setting)

**WAKEUP** [ *000* | *060* | *180* | *300* ]

The time delay in seconds that the UPS waits after the return of utility power before "waking up" and restoring power to the connected equipment.

**SLEEP** [ *020* | *180* | *300* | *600* ]

The time delay in seconds for which the UPS waits or "sleeps" after it receives a request to power off the connected system.

**LOTRANSFER** <*voltage*>

Low line voltage causing transfer to battery power or activation of SmartBoost. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

D	106	103	100	097
M	177	172	168	182
A	092	090	088	086
I	208	204	200	196

where D = domestic (USA), M = Canada, A = Asia and I = International.

**HITRANSFER** <*voltage*>

High line voltage causing transfer to battery power or activation of SmartTrim. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

D	127	130	133	136
M	229	234	239	224
A	108	110	112	114
I	253	257	261	265

where D = domestic (USA), M = Canada, A = Asia and I = International.

**RETURNCHARGE** [ *00* | *15* | *50* | *90* ]

Percentage of battery charge needed for the UPS to restore power to the connected equipment.

**BEEPSTATE** [ *0* | *T* | *L* | *N* ]

Alarm delay.

0 : Zero delay after power fails.  
T : When power fails plus 30 seconds.  
L : When low battery occurs.  
N : Never.

**LOWBATT** <*minutes*>

Low battery warning occurs when the specified number of minutes remains before the UPS estimates battery power will be exhausted. There are four user-changeable settings: 2, 5, 7, or 10 minutes

**OUTPUTVOLTS** <*voltage*>

UPS nominal output voltage when running on battery. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

D	115			
M	208			
A	100			
I	230	240	220	225

where D = domestic (USA), M = Canada, A = Asia and I = International.

**SELFTTEST** [ 336 | 168 | ON | OFF ]

Self test interval in hours (336 = 2 weeks, 168 = 1 week, ON = at power on, OFF = never).

## apcupsd Status Logging

There is a good deal of information available about the UPS and apcupsd's status. This document describes the format of that information. Normally you will get at it via `apcaccess`, but there are other ways as well.

### Status report format

STATUS output is in ASCII format with a single data value or piece of information on each line output. Because not all UPSes supply the same information, the output varies based on the type of UPS that you are using. In general, if the information is not available for your UPS, the line will be missing entirely or the data portion of the output record will contain an N/A indicating that the information is not available.

Status logging consists of periodically logging ALL available information concerning the UPS. Since the volume of data is rather large (over 1000 bytes per status), the STATUS data is not automatically sent to the system log file. Instead, it is written as a series of data records in a specific file (normally `/etc/apcupsd/apcupsd.status`).

After each write, the file is rewound so that the size of the file remains constant. The STATUS file is kept for backward compatibility and will be eliminated in a future version of apcupsd. The preferred method for obtaining this information is from `apcaccess` or by using the CGI interface (see [apcupsd Network Monitoring \(CGI\) Programs](#)).

To make reading the status data reliable via a named pipe, the first record written contains a version number, the number of records that follow the first record, and the total number of bytes in those subsequent records. An actual example of such a status file (`/etc/apcupsd/apcupsd.status`) is shown below.

Consequently, the first record always consists of 24 bytes (23 characters followed by a newline). This record starts with APC and as indicated in the example is followed by 37 records consisting of 906 bytes. The last record begins with END APC and contains the date and time matching the DATE record.

When this data is written to a file, it is written as two records, the first record, and all the other records together. In reading the file, it can be either be read a record at a time, or in one big read.

When this data is written to `syslog()`, it is written a record at a time. The first record is the first 24 bytes. By having the number of records and the size in the first record, the complete status can be reliably reassembled.

### Status Report Example

An example of output from a BackUPS RS 1500 follows:

APC	: 001,037,0906
DATE	: Sun Apr 26 17:22:22 EDT 2009
HOSTNAME	: mail.kroptech.com

```
VERSION : 3.14.2 (10 September 2007) redhat
UPSNAME : ups0
CABLE : USB Cable
MODEL : Back-UPS RS 1500
UPSMODE : Stand Alone
STARTTIME: Sun Apr 26 10:22:46 EDT 2009
STATUS : ONLINE
LINEV : 123.0 Volts
LOADPCT : 24.0 Percent Load Capacity
BCHARGE : 100.0 Percent
TIMELEFT : 144.5 Minutes
MBATTCHG : 5 Percent
MINTIMEL : 3 Minutes
MAXTIME : 0 Seconds
SENSE : Medium
LOTRANS : 097.0 Volts
HITRANS : 138.0 Volts
ALARMDEL : Always
BATTV : 26.8 Volts
LASTXFER : Low line voltage
NUMXFERS : 0
TONBATT : 0 seconds
CUMONBATT: 0 seconds
XOFFBATT : N/A
SELFTTEST : NO
STATFLAG : 0x07000008 Status Flag
MANDATE : 2003-05-08
SERIALNO : JB0319033692
BATTDATE : 2001-09-25
NOMINV : 120
NOMBATTV : 24.0
FIRMWARE : 8.g6 .D USB FW:g6
APCMODEL : Back-UPS RS 1500
END APC : Sun Apr 26 17:22:32 EDT 2009
```

## ***Status Report Fields***

The meaning of the above variables are:

### **APC**

Header record indicating the STATUS format revision level, the number of records that follow the APC statement, and the number of bytes that follow the record.

### **DATE**

The date and time that the information was last obtained from the UPS.

### **HOSTNAME**

The name of the machine that collected the UPS data.

### **UPSNAME**

The name of the UPS as stored in the EEPROM or in the UPSNAME directive in the configuration file.

### **VERSION**

The apcupsd release number, build date, and platform.

### **CABLE**

The cable as specified in the configuration file (UPSCABLE).

**MODEL**

The UPS model as derived from information from the UPS.

**UPSMODE**

The mode in which apcupsd is operating as specified in the configuration file (UPSMODE)

**STARTTIME**

The time/date that apcupsd was started.

**STATUS**

The current status of the UPS (ONLINE, CHARGING, ONBATT, etc.)

**LINEV**

The current line voltage as returned by the UPS.

**LOADPCT**

The percentage of load capacity as estimated by the UPS.

**BCHARGE**

The percentage charge on the batteries.

**TIMELEFT**

The remaining runtime left on batteries as estimated by the UPS.

**MBATTCHG**

If the battery charge percentage (BCHARGE) drops below this value, apcupsd will shutdown your system. Value is set in the configuration file (BATTERYLEVEL)

**MINTIMEL**

apcupsd will shutdown your system if the remaining runtime equals or is below this point. Value is set in the configuration file (MINUTES)

**MAXTIME**

apcupsd will shutdown your system if the time on batteries exceeds this value. A value of zero disables the feature. Value is set in the configuration file (TIMEOUT)

**MAXLINEV**

The maximum line voltage since the UPS was started, as reported by the UPS

**MINLINEV**

The minimum line voltage since the UPS was started, as returned by the UPS

**OUTPUTV**

The voltage the UPS is supplying to your equipment

**SENSE**

The sensitivity level of the UPS to line voltage fluctuations.

**DWAKE**

The amount of time the UPS will wait before restoring power to your equipment after a power off condition when the power is restored.

**DSHUTD**

The grace delay that the UPS gives after receiving a power down command from apcupsd before it powers off your equipment.

**DLOWBATT**

The remaining runtime below which the UPS sends the low battery signal. At this point apcupsd will force an immediate emergency shutdown.

**LOTRANS**

The line voltage below which the UPS will switch to batteries.

**HITRANS**

The line voltage above which the UPS will switch to batteries.



**RETPCT**

The percentage charge that the batteries must have after a power off condition before the UPS will restore power to your equipment.

**ITEMP**

Internal UPS temperature as supplied by the UPS.

**ALARMDEL**

The delay period for the UPS alarm.

**BATTV**

Battery voltage as supplied by the UPS.

**LINEFREQ**

Line frequency in hertz as given by the UPS.

**LASTXFER**

The reason for the last transfer to batteries.

**NUMXFERS**

The number of transfers to batteries since apcupsd startup.

**XONBATT**

Time and date of last transfer to batteries, or N/A.

**TONBATT**

Time in seconds currently on batteries, or 0.

**CUMONBATT**

Total (cumulative) time on batteries in seconds since apcupsd startup.

**XOFFBATT**

Time and date of last transfer from batteries, or N/A.

**SELFTTEST**

The results of the last self test, and may have the following values:

- OK: self test indicates good battery
- BT: self test failed due to insufficient battery capacity
- NG: self test failed due to overload
- NO: No results (i.e. no self test performed in the last 5 minutes)

**STESTI**

The interval in hours between automatic self tests.

**STATFLAG**

Status flag. English version is given by STATUS.

**DIPSW**

The current dip switch settings on UPSes that have them.

**REG1**

The value from the UPS fault register 1.

**REG2**

The value from the UPS fault register 2.

**REG3**

The value from the UPS fault register 3.

**MANDATE**

The date the UPS was manufactured.

**SERIALNO**

The UPS serial number.

**BATTDATE**

The date that batteries were last replaced.

**NOMOUTV**

The output voltage that the UPS will attempt to supply when on battery power.

**NOMINV**

The input voltage that the UPS is configured to expect.

**NOMBATTV**

The nominal battery voltage.

**NOMPOWER**

The maximum power in Watts that the UPS is designed to supply.

**HUMIDITY**

The humidity as measured by the UPS.

**AMBTEMP**

The ambient temperature as measured by the UPS.

**EXTBATTS**

The number of external batteries as defined by the user. A correct number here helps the UPS compute the remaining runtime more accurately.

**BADBATTS**

The number of bad battery packs.

**FIRMWARE**

The firmware revision number as reported by the UPS.

**APCMODEL**

The old APC model identification code.

**END APC**

The time and date that the STATUS record was written.

***Logging the STATUS Information***

If specified in the configuration file, the STATUS data will also be written to the system log file. Please note, that it would not normally be wise to write this data to a normal system log file as there is no mechanism in syslog() to rewind the file and hence the log file would quickly become enormous. However, in two cases, it can be very useful to use syslog() to write this information.

The first case is to set up your syslog.conf file so that the data is written to a named pipe. In this case, normally not more than about 8192 bytes of data will be kept before it is discarded by the system.

The second case is to setup your syslog.conf file so that the status data is sent to another machine, which presumably then writes it to a named pipe. Consequently, with this mechanism, provides a simple means of networking apcupsd STATUS information.

Although we mention system logging of STATUS information, we strongly recommend that you use apcaccess or the CGI interface to get this information.

**The Shutdown Sequence and its Discontents*****Shutdown Sequence***

If you experienced so problems with the testing procedures, or if you are porting apcupsd to another system, or you are simply curious, you may want to know exactly what is going on during the shutdown process.

The shutdown sequence is as follows:

- apcupsd detects that there is a power problem and it calls `/etc/apcupsd/apccontrol powerout`. By default this event does nothing, but it can be overridden to notify users, etc.
- After the configured `ONBATTERYDELAY`, apcupsd calls `/etc/apcupsd/apccontrol onbattery`, which normally sends a message to all users informing them that the UPS is on batteries.
- When one of the conditions listed below occurs, apcupsd issues a shutdown command by calling `/etc/apcupsd/apccontrol doshutdown`, which should perform a shutdown of your system using the `system shutdown(8)` command. You can modify the behavior as described in [Customizing Event Handling](#).

The conditions that trigger the shutdown can be any of the following:

- Running time on batteries have expired (`TIMEOUT`)
- The battery runtime remaining is below the configured value (`BATTERYLEVEL`)
- The estimated remaining runtime is below the configured value (`MINUTES`)
- The UPS signals that the batteries are exhausted.

A shutdown could also be initiated if apcupsd detects that the batteries are no longer functioning correctly. This case, though very unusual, can happen at any time even if there is proper mains voltage, and `/etc/apcupsd/apccontrol emergency` is called.

Just before initiating any shutdown through the apccontrol script, apcupsd will create the file /etc/apcupsd/powerfail. This file will be used later in the shutdown sequence to recall apcupsd after syncing of the disks to initiate a power off of the UPS.

If the `/etc/nologin` file has not already been created, it will normally be created during the shutdown sequence to prevent additional users from logging in (see the `NOLOGIN` configuration directive).

Even though `apcupsd` has requested the system to perform a shutdown, it continues running.

- When the system signals apcupsd to do exit, it does so. This is part of the normal system shutdown (at least on Unix and Linux systems) and the exact time that apcupsd receives the termination signal depends on how the shutdown links (usually in /etc/rc.d) are set.

Note that on Windows NT systems, apcupsd apparently continues to run as a Service even though the machine is "shutdown".

- During the shutdown of the system after `apcupsd` has been forced to exit, one of the last things done by the system shutdown is to call the halt script, which is usually in `/etc/rc.d/halt` or `/etc/rc.d/init.d/halt`, or possibly in `/sbin/init.d/rc.0` depending on your system. If `apcupsd` was properly installed, this standard halt script was modified to include a bit of new logic just before the final halt of the system. It first tests if the file `/etc/apcupsd/powerfail` exists, and if it does, it executes `/etc/apcupsd/apccontrol killpower`. It is this last step that will cause `apcupsd` to be re-executed with the `--killpower` option on the command line. This option tells `apcupsd` to inform the UPS to kill the power.

This final step is important if you want to ensure that your system will automatically reboot when the power comes back on. The actual code used on the Red Hat version is:

```
# See if this is a powerfail situation. # ***apcupsd***
if [ -f /etc/apcupsd/powerfail ]; then # ***apcupsd***
    echo # ***apcupsd***
    echo "APCUPSD will now power off the UPS" # ***apcupsd***
    echo # ***apcupsd***
    /etc/apcupsd/apccontrol killpower # ***apcupsd***
    echo # ***apcupsd***
    echo "Please ensure that the UPS has powered off before rebooting" # ***apcupsd***
```

```
echo "Otherwise, the UPS may cut the power during the reboot!!!" # ***apcupsd***
echo # ***apcupsd***
fi # ***apcupsd***
```

The above code must be inserted as late as possible in the halt script. On many systems, such as Red Hat, all the disk drives were unmounted, then remounted read-only, thus permitting access to the /etc files and the apcupsd executable. If your system does not explicitly remount the disks, you must remount them in read-only mode in the code that you add. Examples of code fragments that do this can be found in the distributions/suse subdirectory of the source.

If you are not able to insert the above code in your halt script because there is no halt script, or because your halt script calls the init program as some Unix systems do, you can either just forget about powering off the UPS, which means that your machine will not automatically reboot after a power failure, or there is yet another alternative, though not at all as satisfying as inserting code in the halt script.

Only if you cannot insert the appropriate code in the halt script, when you start apcupsd, normally from the /etc/rc.d/init.d/apcupsd script, use the `--kill-on-powerfail` option. This will cause apcupsd to program the UPS to shutoff the power just before it (apcupsd) does the system shutdown. Please note that this is not the most ideal solution. Read on to understand why.

A very important consideration is that you must set the EEPROM in your UPS so that it waits a sufficient time for the system to halt before it shuts off the UPS power.

When using a USB connection, apcupsd automatically sets this value to 60 seconds. When using a serial connection to a SmartUPS, you must configure the value in the UPS EEPROM by hand using `apctest`.

## **Shutdown Problems**

Obviously if your halt script is not properly modified, apcupsd will not be able to shut off the power to the UPS, and if the power returns before the batteries are exhausted your system will not automatically reboot. In any case, your machine should have been cleanly shut down.

## **Master/Slave Shutdown**

In master/slave configurations, however, the master cannot be 100 percent sure that the slaves have all shutdown before it performs the power off. To avoid this situation, be sure to configure any slaves (clients) to shut down before the master by setting different `TIMEOUT`, `BATTERYLEVEL`, or `MINUTES` parameters in the config file.

Also, on a slave machine, you do not want to use the modified halt script since it will recall apcupsd, which will detect that it is a slave (i.e. no connection to the UPS) and will complain that it cannot do the killpower. This situation is not harmful just annoying and possibly confusing.

One possible problem during shutdown can be caused by remnants of old versions. Please be sure to delete or rename all prior versions (`/usr/local/sbin/apcupsd` or `/sbin/powersc`).

## **Startup**

Normally, apcupsd is automatically started when your system is rebooted. This normally occurs because the startup script apcupsd is linked into the appropriate places in /etc/rc.d. On most Linux systems, there is a program called `chkconfig(8)` that will automatically link the startup script. This program is invoked by the `make install` scripts, or it is explicitly done for those systems that do not have `chkconfig(8)`. If this is not the case, you can either link it in appropriately yourself or explicitly call it from your `rc.local` file. The appropriate manual way to startup apcupsd is by executing:

```
<path>/apcupsd start
```

where *path* is normally `/etc/rc.d` or `/etc/rc.d/init.d` depending on your system. Using this script is important so that any files remaining around after a power failure are removed. Likewise, shutting down apcupsd should be done with the same script:

```
<path>/apcupsd stop
```

## Windows Considerations

Please see the [Killpower under Windows](#) chapter of this manual for considerations pertaining to shutdown and killpower on Windows.

## APC smart protocol

The APC UPS protocol was originally analyzed by Pavel Korensky with additions from Andre H. Hendrick beginning in 1995, and we want to give credit for good, hard work, where credit is due. After having said that, you will see that Steven Freed built much of the original apcupsd information file.

The start of this chapter of the apcupsd manual in HTML format was pulled from the Network UPS Tools (NUT) site (<http://www.networkupstools.org/protocols/apcsmart.html>). It has been an invaluable tool in improving apcupsd, and I consider it the Bible of APC UPS programming. In the course of using it, I have added information gleaned from apcupsd and information graciously supplied by APC.

## Description

Here's the information on the elusive APC smart signaling protocol used by their higher end units (Back-UPS Pro, Smart-UPS, Matrix-UPS, etc). What you see here has been collected from a variety of sources. Some people analyzed the chatter between PowerChute and their hardware. Others sent various characters to the UPS and figured out what the results meant.

## RS-232 differences

Normal 9 pin serial connections have TxD on 3 and RxD on 2. APC's smart serial ports put TxD on pin 1 and RxD on pin 2. This means you go nowhere if you use a normal straight through serial cable. In fact, you might even power down the load if you plug one of those cables in. This is due to the odd routing of pins - DTR and RTS from the PC usually wind up driving the on/off line. So, when you open the port, they go high and \*poof\* your computer dies.

## The Smart Protocol

Despite the lack of official information from APC, this table has been constructed. It's standard RS-232 serial communications at 2400 bps/8N1. Don't rush the UPS while transmitting or it may stop talking to you. This isn't a problem with the normal single character queries, but it really does matter for multi-char things like "@000". Sprinkle a few calls to `usleep()` in your code and everything will work a lot better.

The following table describes the single character "Code" or command that you can send to the UPS, its meaning, and what sort of response the UPS will provide. Typically, the response shown below is followed by a newline (`\n` in C) and a carriage return (`\r` in C). If you send the UPS a command that it does not recognize or that is not available on your UPS, it will normally respond with "NA" for "not available", otherwise the response is given in the "Typical results" column.

Character	Meaning	Typical results	Other info
^A	Model string	SMART-UPS 700	Spotty support for this query on older models
^N	Turn on UPS	n/a	Send twice, with 1.5s delay between chars. Only on 3rd gen SmartUPS and Black Back-UPS Pros
^Z	Permitted EEPROM Values	<i>long string</i>	Gives the EEPROM permitted values for your model. See <a href="#">EEPROM Values</a> for details.
A	Front panel test	Light show + "OK"	Also sounds the beeper for 2 seconds

B	Battery voltage	27.87	Varies based on current level of charge. See also Nominal Battery Voltage.
C	Internal Temperature	036.0	Units are degrees C
D	Runtime calibration	!, then \$	Runs until battery is below 25% (35% for Matrix) Updates the 'j' values. Only works at 100% battery charge. Can be aborted with a second "D"
E	Automatic self test interval	336	Writable variable. Possible values: <ul style="list-style-type: none"> <li>• "336" (14 days)</li> <li>• "168" (7 days)</li> <li>• "ON " (at power on) note extra space</li> <li>• "OFF" (never)</li> </ul>
F	Line frequency	60.00	Units are Hz. Value varies based on locality, usually 50/60.
G	Cause of last transfer to battery	O	Possible values: <ul style="list-style-type: none"> <li>• R (unacceptable utility voltage rate of change)</li> <li>• H (high utility voltage)</li> <li>• L (low utility voltage)</li> <li>• T (line voltage notch or spike)</li> <li>• O (no transfers since turnon)</li> <li>• S (transfer due to U command or activation of UPS test from front panel)</li> <li>• NA (transfer reason still not available; read again)</li> </ul>
I	Measure-UPS Alarm enable	FF	<i>not decoded yet</i>
J	Measure-UPS Alarm status	0F,00	<i>not decoded yet</i>
K	Shutdown with grace period (no return)	OK or *	Send twice with > 1.5s delay between chars. Older units send "" instead of "OK". Length of grace period is set with Grace Period command. UPS will remain off and NOT power on if utility power is restored.
L	Input line voltage	118.3	Value varies based on locality. Does not always read 000.0 on line failure.
M	Maximum line voltage	118.9	This is the max voltage since the last time this query was run.
N	Minimum line voltage	118.1	This is the min voltage since the last time this query was run.
O	Output voltage	118.3	Also see on battery output voltage.
P	Power load %	023.5	Relative to capacity of the UPS.

Q	Status flags	08	Bitmapped, see <a href="#">status bits</a> below
R	Turn dumb	BYE	Only on 3rd gen SmartUPS, SmartUPS v/s, BackUPS Pro. Must send enter smart mode command to resume comms.
S	Soft shutdown	OK	Command executes after grace period. UPS goes online when power returns. Only works when on battery.
U	Simulate power failure	!, then \$	See <a href="#">Alert messages</a> section for info on ! and \$.
V	Old firmware revision	"GWD" or "IWI"	See <a href="#">Interpretation of the Old Firmware Revision</a>
W	Self test	OK	Tests battery, like pushing button on the front panel. Results stored in "X"
X	Self test results	OK	Possible values: <ul style="list-style-type: none"> <li>• OK = good battery</li> <li>• BT = failed due to insufficient capacity</li> <li>• NG = failed due to overload</li> <li>• NO = no results available (no test performed in last 5 minutes)</li> </ul>
Y	Enter smart mode	SM	This must be sent before any other commands will work. See also turn dumb command to exit smart mode.
Z	Shutdown immediately	n/a	Send twice with > 1.5s delay between chars. UPS switches load off immediately (no grace period)
a	Protocol info	<i>long string</i>	Returns three main sections delimited by periods: <ul style="list-style-type: none"> <li>• Protocol version</li> <li>• Alert messages (aka async notifiers)</li> <li>• Valid commands</li> </ul>
b	Firmware revision	50.9.D	See <a href="#">Interpretation of the New Firmware Revision</a> . Decoding the example: <ul style="list-style-type: none"> <li>• 50 = SKU (variable length)</li> <li>• 9 = firmware revision</li> <li>• D = country code (D=USA, I=International, A=Asia, J=Japan, M=Canada)</li> </ul>
c	UPS local id	UPS_IDEN	Writable variable. Up to 8 letter identifier for keeping track of your hardware.

e	Return threshold	00	<p>Writable variable. Minimum battery charge % before UPS will return online after a soft shutdown. Possible values:</p> <ul style="list-style-type: none"> <li>• 00 = 00% (UPS turns on immediately)</li> <li>• 01 = 15%</li> <li>• 02 = 25%</li> <li>• 03 = 90%</li> </ul>
f	Battery level %	099.0	Percentage of battery charge remaining
g	Nominal battery voltage	024	The battery voltage that's expected to be present in the UPS normally. This is a constant based on the type, number, and wiring of batteries in the UPS. Typically "012", "024" or "048".
h	Measure-UPS ambient humidity (%)	042.4	Percentage. Only works on models with Measure-UPS SmartSlot card.
i	Measure-UPS dry contacts	00	<p>Bitmapped hex variable. Mapping:</p> <ul style="list-style-type: none"> <li>• 10 = contact 1</li> <li>• 20 = contact 2</li> <li>• 40 = contact 3</li> <li>• 80 = contact 4</li> </ul>
j	Estimated runtime	0327:	Value is in minutes. Terminated with a colon.
k	Alarm delay	0	<p>Writable variable. Controls behavior of UPS beeper. Possible values:</p> <ul style="list-style-type: none"> <li>• 0 = 5 second delay after power fail</li> <li>• T = 30 second delay</li> <li>• L = alarm at low battery only</li> <li>• N = no alarm</li> </ul>
l	Low transfer voltage	103	Writable variable. UPS goes on battery when voltage drops below this point.
m	Manufacture date	11/29/96	Format may vary by country (MM/DD/YY vs DD/MM/YY). Unique within groups of UPSes (production runs)
n	Serial number	WS9643050926	Unique for each UPS
o	Nominal Output Voltage	115	Expected output voltage when running on batteries. May be a writable variable on 220/230/240 VAC units.
p	Shutdown grace delay	020	Seconds. Writable variable. Sets the delay before soft shutdown completes. (020/180/300/600)
q	Low battery warning	02	Minutes. Writable variable. The UPS will report a low battery condition this many minutes before it runs out of power



r	Wakeup delay	000	Seconds. Writable variable. The UPS will wait this many seconds after reaching the minimum charge before returning online. (000/060/180/300)
s	Sensitivity	H	Writable variable. Possible values: <ul style="list-style-type: none"> <li>• H = highest</li> <li>• M = medium</li> <li>• L = lowest</li> <li>• A = autoadjust (Matrix only)</li> </ul>
t	Measure-UPS ambient temperature	80.5	Degrees C. Only works on models with the Measure-UPS SmartSlot card.
u	Upper transfer voltage	132	Writable variable. UPS goes on battery when voltage rises above this point.
v	Measure-UPS firmware	4Kx	Firmware information for Measure-UPS board
x	Last battery change date	11/29/96	Writable variable. Holds whatever the user set in it. Eight characters.
y	Copyright notice	(C) APCC	Only works if firmware letter is later than O
z	Reset to factory settings	CLEAR	Resets most variables to initial factory values except identity or battery change date. Not available on SmartUPS v/s or BackUPS Pro.
+	Capability cycle (forward)	<i>various</i>	Cycle forward through possible capability values. UPS sends afterward to confirm change to EEPROM.
-	Capability cycle (backward)	<i>various</i>	Cycle backward through possible capability values. UPS sends afterward to confirm change to EEPROM.
@nnn	Shutdown and return	OK or *	UPS shuts down after grace period with delayed wakeup after nnn tenths of an hour plus any wakeup delay time. Older models send "*" instead of "OK".
0x7f	Abort shutdown	OK	Use to abort @, S, K
~	Register #1	<i>see below</i>	See <a href="#">Register 1</a> table
'	Register #2	<i>see below</i>	See <a href="#">Register 2</a> table
0	Battery constant		See <a href="#">Resetting the UPS Battery Constant</a>
4	???		Prints 35 on SmartUPS 1000
5	???		Prints EF on SmartUPS 1000
6	???		Prints F9 on SmartUPS 1000
7	DIP switch positions		See <a href="#">Dip switch info</a>

8	Register #3	<i>see below</i>	See <a href="#">Register 3</a> table
9	Line quality	FF	Possible values: <ul style="list-style-type: none"> <li>• 00 = unacceptable</li> <li>• FF = acceptable</li> </ul>
>	Number of external battery packs		SmartCell models return number of connected packs. Other models return value set by the user (use +/-).
[	Measure-UPS Upper temp limit	NO,NO	Degrees C. Writable Variable. Possible values: 55, 50, 45, ..., 05. Use +/- to change values.
]	Measure-UPS lower temp limit	NO,NO	Degrees C. Writable Variable. Possible values: 55, 50, 45, ..., 05. Use +/- to change values.
{	Measure-UPS Upper humidity limit	NO,NO	Percentage. Writable Variable. Possible values: 90, 80, 70, ..., 10. Use +/- to change values.
}	Measure-UPS lower humidity limit	NO,NO	Percentage. Writable Variable. Possible values: 90, 80, 70, ..., 10. Use +/- to change values.
<b>Matrix-UPS and Symmetra Commands</b>			
^	Run in bypass mode	BYP, INV, ERR	If online, "BYP" response is received as bypass mode starts. If already in bypass, "INV" is received and UPS goes online. If UPS can't transfer, "ERR" received
<	Number of bad battery packs	000	Count of bad packs connected to the UPS
/	Load current	<i>nn.nn</i>	True RMS load current drawn by UPS
\	Apparent load power	<i>nnn.nn</i>	Output load as percentage of full rated load in VA.
^V	Output voltage selection		Writable variable. Possible values: <ul style="list-style-type: none"> <li>• A = automatic (based on input tap)</li> <li>• M = 208 VAC</li> <li>• I = 240 VAC</li> </ul>

^L	Front panel language		Writable variable. Possible values: <ul style="list-style-type: none"> <li>• E = English</li> <li>• F = French</li> <li>• G = German</li> <li>• S = Spanish</li> <li>• 1 = <i>unknown</i></li> <li>• 2 = <i>unknown</i></li> <li>• 3 = <i>unknown</i></li> <li>• 4 = <i>unknown</i></li> </ul>
w	Run time conservation		Writable variable. Minutes of runtime to leave in battery (UPS shuts down "early"). Possible values: <ul style="list-style-type: none"> <li>• NO = disabled</li> <li>• 02 = leave 2 minutes of runtime</li> <li>• 05 = leave 5 minutes</li> <li>• 08 = leave 8 minutes</li> </ul>

### Dip switch info

Bit	Switch	Option when bit=1
0	4	Low battery alarm changed from 2 to 5 mins. Autostartup disabled on SU370ci and 400
1	3	Audible alarm delayed 30 seconds
2	2	Output transfer set to 115 VAC (from 120 VAC) or to 240 VAC (from 230 VAC)
3	1	UPS desensitized - input voltage range expanded
4-7		Unused at this time

### Status bits

This is probably the most important register of the UPS, which indicates the overall UPS status. Some common things you'll see:

- 08 = On line, battery OK
- 10 = On battery, battery OK
- 50 = On battery, battery low
- SM = Status bit is still not available (retry reading)

Bit	Meaning when bit=1
0	Runtime calibration occurring (Not reported by Smart UPS v/s and BackUPS Pro)
1	SmartTrim (Not reported by 1st and 2nd generation SmartUPS models)
2	SmartBoost
3	On line (this is the normal condition)
4	On battery

5	Overloaded output
6	Battery low
7	Replace battery

## Alert messages

These single character messages are sent by the UPS any time there is an Alert condition. All other responses indicated above are sent by the UPS only in response to a query or action command.

Character	Meaning	Description
!	Line Fail	Sent when the UPS goes on-battery, repeated every 30 seconds until low battery condition reached. Sometimes occurs more than once in the first 30 seconds.
\$	Return from line fail	UPS back on line power. Only sent if a ! has been sent previously.
%	Low battery	Sent to indicate low battery. Not implemented on SmartUPS v/s or BackUPS Pro models
+	Return from low batt	Sent when the battery has been recharged to some level Only sent if a % has been sent previously.
?	Abnormal condition	Sent for conditions such as "shutdown due to overload" or "shutdown due to low battery capacity". Also occurs within 10 minutes of turnon.
=	Return from abnormal condition	Sent when the UPS returns from an abnormal condition where ? was sent, but not a turn-on. Not implemented on SmartUPS v/s or BackUPS Pro models.
*	About to turn off	Sent when the UPS is about to switch off the load. No commands are processed after this character is sent. Not implemented on SmartUPS v/s, BackUPS Pro, or 3rd generation SmartUPS models.
#	Replace battery	Sent when the UPS detects that the battery needs to be replaced. Sent every 5 hours until a new battery test is run or the UPS is shut off. Not implemented on SmartUPS v/s or BackUPS Pro models.
&	Check alarm register for fault (Measure-UPS)	Sent to signal that temp or humidity out of set limits. Also sent when one of the contact closures changes state. Sent every 2 minutes until the alarm conditions are reset. Only sent for alarms enabled with I. Cause of alarm may be determined with J. Not implemented on SmartUPS v/s or BackUPS Pro.
	Variable change in EEPROM	Sent whenever any EEPROM variable is changed. Only supported on Matrix UPS and 3rd generation SmartUPS models.

## Register 1

All bits are valid on the Matrix UPS. SmartUPS models only support bits 6 and 7. Other models do not respond.

Bit	Meaning when bit=1
0	In wakeup mode (typically lasts < 2s)
1	In bypass mode due to internal fault (see <a href="#">Register 2</a> or <a href="#">Register 3</a> )
2	Going to bypass mode due to command
3	In bypass mode due to command

4	Returning from bypass mode
5	In bypass mode due to manual bypass control
6	Ready to power load on user command
7	Ready to power load on user command or return of line power

## Register 2

Matrix UPS models report bits 0-5. SmartUPS models only support bits 4-6. SmartUPS v/s and BackUPS Pro report bits 4, 6, 7. Unused bits are set to 0. Other models do not respond.

Bit	Meaning when bit=1
0	Fan failure in electronics, UPS in bypass
1	Fan failure in isolation unit
2	Bypass supply failure
3	Output voltage select failure, UPS in bypass
4	DC imbalance, UPS in bypass
5	Battery is disconnected
6	Relay fault in SmartTrim or SmartBoost
7	Bad output voltage

## Register 3

All bits are valid on the Matrix UPS and 3rd generation SmartUPS models. SmartUPS v/s and BackUPS Pro models report bits 0-5. All others report 0-4. State change of bits 1,2,5,6,7 are reported asynchronously with ? and = messages.

Bit	Meaning when bit=1
0	Output unpowered due to shutdown by low battery
1	Unable to transfer to battery due to overload
2	Main relay malfunction - UPS turned off
3	In sleep mode from @ command (maybe others)
4	In shutdown mode from S command
5	Battery charger failure
6	Bypass relay malfunction
7	Normal operating temperature exceeded

## Interpretation of the Old Firmware Revision

The Old Firmware Revision is obtained with the "V" command, which gives a typical response such as "GWD" or "IWI", and can be interpreted as follows:

Old Firmware revision and model ID String for SmartUPS & MatrixUPS

This is a three character string XYZ

where X == Smart-UPS or Matrix-UPS ID Code.  
range 0-9 and A-P

```

1 == unknown
0 == Matrix 3000
5 == Matrix 5000
the rest are Smart-UPS and Smart-UPS-XL
2 == 250      3 == 400      4 == 400
6 == 600      7 == 900      8 == 1250
9 == 2000     A == 1400     B == 1000
C == 650      D == 420      E == 280
F == 450      G == 700      H == 700XL
I == 1000     J == 1000XL   K == 1400
L == 1400XL   M == 2200     N == 2200XL
O == 3000     P == 5000

where Y == Possible Level of Smart Features, unknown???
G == Stand Alone
T == Stand Alone
    V == ???
W == Rack Mount

where Z == National Model Use Only Codes
D == Domestic      115 Volts
I == International 230 Volts
A == Asia ??       100 Volts
J == Japan ??      100 Volts

```

## ***Interpretation of the New Firmware Revision***

New Firmware revision and model ID String in NN.M.L is the format

```

where NN == UPS ID Code.
12 == Back-UPS Pro 650
13 == Back-UPS Pro 1000
52 == Smart-UPS 700
60 == SmartUPS 1000
72 == Smart-UPS 1400

where NN now Nn has possible meanings.
N  == Class of UPS
1n == Back-UPS Pro
5n == Smart-UPS
7n == Smart-UPS NET

    n == Level of intelligence
N1 == Simple Signal, if detectable WAG(*)
N2 == Full Set of Smart Signals
N3 == Micro Subset of Smart Signals

where M == Possible Level of Smart Features, unknown???
1 == Stand Alone
8 == Rack Mount
9 == Rack Mount

where L == National Model Use Only Codes
D == Domestic      115 Volts
I == International 230 Volts

```

```
A == Asia ??      100 Volts
J == Japan ??     100 Volts
M == North America 208 Volts (Servers)
```

## EEPROM Values

Upon sending a ^Z, your UPS will probably spit back approximately 254 characters something like the following (truncated here for the example):

```
#uD43132135138129uM43229234239224uA43110112114108 ....
```

It looks bizarre and ugly, but is easily parsed. The # is some kind of marker/ident character. Skip it. The rest fits this form:

- Command character - use this to select the value
- Locale - use 'b' to find out what yours is (the last character), '4' applies to all
- Number of choices - '4' means there are 4 possibilities coming up
- Choice length - '3' means they are all 3 chars long

Then it's followed by the choices, and it starts over.

Matrix-UPS models have ## between each grouping for some reason.

Here is an example broken out to be more readable:

```
CMD DFO RSP FSZ FVL
u  D  4  3  127 130 133 136
u  M  4  3  229 234 239 224
u  A  4  3  108 110 112 114
u  I  4  3  253 257 261 265
l  D  4  3  106 103 100 097
l  M  4  3  177 172 168 182
l  A  4  3  092 090 088 086
l  I  4  3  208 204 200 196
e  4  4  2  00  15  50  90
o  D  1  3  115
o  J  1  3  100
o  I  1  3  230 240 220 225
o  M  1  3  208
s  4  4  1   H   M   L   L
q  4  4  2   02  05  07  10
p  4  4  3  020 180 300 600
k  4  4  1   0   T   L   N
r  4  4  3  000 060 180 300
E  4  4  3  336 168  ON  OFF
```

CMD == UPSlink Command.

```
u = upper transfer voltage
l = lower transfer voltage
e = return threshold
o = output voltage
s = sensitivity
p = shutdown grace delay
q = low battery warning
k = alarm delay
```

r = wakeup delay  
E = self test interval

DFO == (4)-all-countries (D)omestic (I)nternational (A)sia (J)apan  
(M) North America - servers.

RSP == Total number possible answers returned by a given CMD.

FSZ == Max. number of field positions to be filled.

FVL == Values that are returned and legal.

## Programming the UPS EEPROM

There are at this time a maximum of 12 different values that can be programmed into the UPS EEPROM. They are:

Command	Meaning
c	The UPS Id or name
x	The last date the batteries were replaced
u	The Upper Transfer Voltage
l	The Lower Transfer Voltage
e	The Return Battery Charge Percentage
o	The Output Voltage when on Batteries
s	The Sensitivity to Line Quality
p	The Shutdown Grace Delay
q	The Low Battery Warning Delay
k	The Alarm Delay
r	The Wakeup Delay
E	The Automatic Self Test Interval

The first two cases (Ident and Batt date) are somewhat special in that you tell the UPS you want to change the value, then you supply 8 characters that are saved in the EEPROM. The last ten item are programmed by telling the UPS that you want it to cycle to the next permitted value.

In each case, you indicate to the UPS that you want to change the EEPROM by first sending the appropriate query command (e.g. "c" for the UPS ID or "u" for the Upper Transfer voltage. This command is then immediately followed by the cycle EEPROM command or "-". In the case of the UPS Id or the battery date, you follow the cycle command by the eight characters that you want to put in the EEPROM. In the case of the other ten items, there is nothing more to enter.

The UPS will respond by "OK" and approximately 5 seconds later by a vertical bar (|) to indicate that the EEPROM was changed.

## Apcupsd RPM Packaging FAQ



### How do I build Apcupsd for platform xxx?

The apcupsd spec file contains defines to build for several platforms: RedHat 7.x (rh7), RedHat 8.0 (rh8), RedHat 9 (rh9), Fedora Core (fedora\_core), RedHat Enterprise Linux and clones (rhel3 and rhel4), SuSE 9 & 10 (suse), and Mandrake (mdk). The package build is controlled by a define set at the beginning of the file. These defines basically just control the dependency information that gets coded into the finished rpm package. So while you could technically build a package without defining a platform, or with an incorrect platform, and have it install and run it would not contain correct dependency information for the rpm database. The platform define may be edited in the spec file directly (by default all defines are set to 0 or "not set"). For example, to build the RedHat 7.x package find the line in the spec file which reads

```
%define rh7 0
```

and edit it to read

```
%define rh7 1
```

Alternately you may pass the define on the command line when calling rpmbuild:

```
rpmbuild -ba --define "build_rh7 1" apcupsd.spec  
rpmbuild --rebuild --define build_rh7 1" apcupsd-x.x.x-x.src.rpm
```

### How do I control whether usb support gets built?

Up through version 3.12, by default standard serial port support was built and the apcupsd-std package was produced. The usb package pre-configured the configuration files for usb devices and installed a couple additional tools in /etc/apcupsd but the usb driver was built regardless. To get the usb package and support in those versions either set the

```
%define usb 0
```

to

```
%define usb 1
```

in the spec file directly or pass it to rpmbuild on the command line:

```
rpmbuild -ba --define "build_rh7 1" --define "build_usb 1" apcupsd.spec
```

With the release of 3.14 USB support is now considered standard and the apcupsd-std and apcupsd-usb packages are obsoleted in favor of a single apcupsd package configured for usb connected UPS's. The serial port driver is still built and can be configured accordingly after installation. If you are performing an upgrade it will of course not replace your current config file. The build directive:

```
--define "build_usb 1"
```

is no longer recognized.

### What other defines are used?

There is a define for the initdir for the daemon control script. On RedHat or Mandrake systems this is set to /etc/rc.d/init.d/. On SuSE systems this is set to /etc/rc.d. You would only need to edit this if packaging for a platform that uses a different directory.

A second define controls whether the Gnome monitoring application, new in the 3.14 release, is built. This application requires the Gtk2 version to be  $\geq 2.4$ . If you want to build the apcupsd-gapcmon package add:

```
--define "build_gapcmon 1"
```

A third define controls whether the SNMP driver is built. If you want to build the net-snmp driver add:

```
--define "build_snmp 1"
```

### Can I supply packages for other platforms you do not publish?

Yes, there are tools provided for contributors to supply rpm packages for platforms for which support is provided in the spec file but for which the development team chooses not to release binary packages, usually due to lack of interest or lack of an available platform. Please see platforms/contrib/README in the source package.

### I'm getting errors about not having permission when I try to build the packages. Do I need to be root?

No, you do not need to be root and, in fact, it is better practice to build rpm packages as a non-root user. Apcupsd's packages are designed to be built by a regular user but you must make a few changes on your system to do this. If you are building on your own system then the simplest method is to add write permissions for all to the build directory (/usr/src/redhat/). To accomplish this execute one of the following commands as root depending on your distribution, RedHat, SuSE or Mandriva, respectively:

```
chmod -R 777 /usr/src/redhat
chmod -R 777 /usr/src/packages
chmod -R 777 /usr/src/RPM
```

If you are working on a shared system where you can not use the method above then you need to recreate the /usr/src/redhat (or other) directory tree with all of it's subdirectories inside your home directory. Then create a file named

```
.rpmmacros
```

in your home directory (or edit the file if it already exists) and add the following line:

```
%_topdir /home/myuser/redhat
```

## Credits



The success of apcupsd is due to the many people that helped in development, testing and in many other ways.

Thank all the developers that worked hard to make APCUPSD one of the best piece of software for UPS management.

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