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The Care and Feeding of MinisPorts

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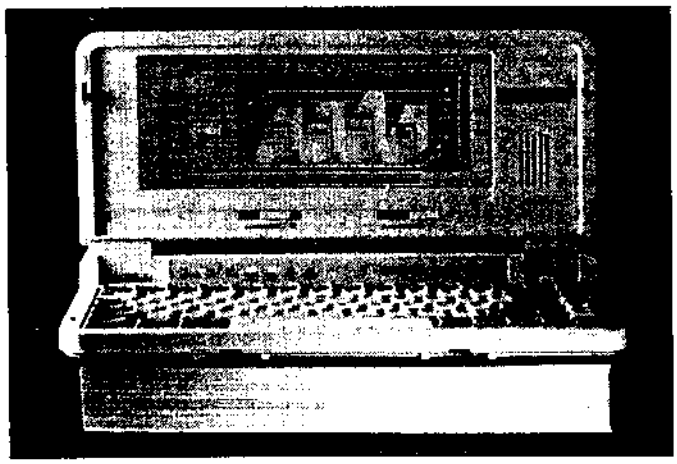

Ever had one of those days? You took your MinisPort out of the closet (it's been in mothballs all summer), plugged in the charger, and let it charge for three hours (almost) while you got ready for class. Ran out the door (leaving the charger on the kitchen table) and off to class. It's going to be high tech this term, no paper – notes, assignments, schedules the whole kit and caboodle on disk – and then disaster. Twenty minutes into the two hour lecture, the battery light comes on. Two minutes later the computer shuts down. What happened? You charged it just like the manual said. Where's that three hours they said you had?

Or how about this one? You've been making presentations to clients for weeks. Now that you've gotten used to it, this computer bit is really OK. Yes sir! You flip through that twenty minute presentation once more, but this time the guy is a hard sell. He keeps asking questions. You flip back and forth through the screens, explaining in more detail, reviewing the information. Twenty minutes is getting closer to forty, but the guy is just about sold – and then... disaster. The battery light comes on and a second later, the computer shuts down. "What happened?", you ask as you trudge out to the car to get the AC adapter. You charge the battery every time you go back into the office, just to make sure that you've got lots of power for guys like this. Where's that three hours they said you had?

Had one like this? You saved up enough to get that new modem. Finally, you can send those articles right into the editor from wherever you are. It's such a hassle to go into SETUP, enable the thing and reboot. It hasn't hurt anything to leave the serial and parallel ports on. What's the difference? Off to the beach you go to get that morning's work done. The sun is shining, the water is beautiful, the words are flowing (so well that you haven't even thought to save) – and then . . . disaster. The computer shuts down, and an hour and a half's work is gone. Where was that annoying beep? Oh yeah, you turned it off. Who thought to look at the light, you always get at least two and a half hours of power. What happened? Where's that three hours they said you had?

What happened in all these cases is that the battery packs were acting exactly like rechargeable NiCad batteries. Read on to learn a bit more about rechargeable batteries and how to avoid the disasters.

History of Rechargeable Batteries

Believe it or not, there would be no batteries as we know them today, had it not been for an Italian frog. In 1791, Luigi Galvani, a scientist working in Bologna discovered that muscles in frogs contracted when touched by metal. Based on this animal electricity phenomenon, a second principle was discovered in 1800 by another Italian, the Conte Alessandro Volta. Electricity was generated when two dissimilar metals were placed in an electrolytic solution. The electrolytes acted chemically on one or both of the metals and generated electromotive force. Volta used this discovery to build the world's first battery, the voltaic cell. Finally, in 1831 Michael Faraday, an English chemist and physicist deduced the last piece of information required for the development of the modern battery. Faraday's law of electromagnetic induction provided a stable foundation for the study of electricity. Fast and furious development of different types of cells followed.

In 1859, the first rechargeable battery, a lead storage battery, was introduced. When the electrical generator was invented in 1866, rechargeable batteries began to play a major role in energy storage. Improvements in this original lead battery led to the sealed lead acid batteries used today to power automobiles and larger battery backed-up computers. In 1899, the first NiCad battery, a rechargeable alkaline storage battery using nickel for the positive electrode and cadmium for the negative electrode was invented. Thomas Edison, in 1900, produced an alternative design that used nickel and iron. Both batteries were shelved until 1932, since the alkaline battery materials were so much more expensive than dry cell or lead batteries, without any real advantage in terms of power or number of discharge cycles.

In 1932, two scientists (Shlecht and Ackermann) managed to increase the number of discharge cycles and improve the discharge characteristics of NiCad batteries dramatically by using a sintered pole plate. Conventional batteries packed the active materials into a metal tube or pocket; these new batteries placed the active materials inside a porous pole plate. These porous plates were formed by sintering (heating a metal powder until it becomes a

becomes a solid, but without actually melting the metal) nickel. These cells however, like other storage cells, still leaked electrolytes, oxygen, and hydrogen (causing the electrolytes to dry up) when charging and discharging, and their use was limited.

Finally in 1947, when a fully sealed NiCad battery was developed, the NiCad came into its own. Further improvements over the years have lead to rechargeable batteries capable of delivering reliable power at a stable output voltage to a wide range of products with minimal maintenance. Amazing, and it all began with a frog.

MinisPort NiCad Battery Packs

NiCad batteries were chosen to power the MinisPort (and other portable) computer series because they deliver a reliable, constant voltage level over the majority of a discharge cycle and then drop off quickly at the end. Other batteries (such as carbon, lithium, and alkaline) deliver gradually decreasing voltages during their discharge cycle, resulting in less reliable computing time for the same battery capacity.

Two different battery packs are used in the MinisPort computers. The original packs (Model number ZA-1-2), used in ZL-1 and ZL-2 computers, were rated for 10.8 watt-hours. A higher capacity battery pack (Model number ZA-1-22) was introduced with the hard disk drive versions, ZL-1-H and ZL-1-HA. These new packs are rated at 13.2 watt-hours, to handle the more demanding internal hard disk drive. Both packs deliver 6 volts and can be expected to handle approximately 1000 charge/discharge cycles. Both contain built-in overcharge and short circuit protections.

The rechargeable battery packs contain sealed nickel-cadmium cells with sintered poles. They use nickel hydroxide for the positive pole, a cadmium compound for the negative pole, and potassium hydroxide (an alkaline) for the electrolyte. As they charge and discharge, the positive plate changes between nickel oxyhydroxide and nickel hydroxide and the negative plate changes between cadmium metal and cadmium hydroxide. These chemical changes produce the electricity used each time you power your computer with the battery.

The chemical changes inside the cell also make the battery subject to a phenomenon known as memory effect or voltage depression. Repeated short discharge cycles followed by long charge cycles seem to reduce the amount of computing time available to you. What appears to happen is that the battery "remembers" how much energy you used in the last few discharge cycles, and only charges enough to allow you that much energy for the next cycle. Your battery discharge time gets shorter and shorter with each cycle.

Some researchers believe that this phenomenon is caused by crystalline growth inside the cell. Each time a battery is not completely discharged before charging (and the MinisPort battery packs are charged every time you plug into AC) some crystal growth occurs. Overcharging can also cause this crystal growth. As the crystals grow bigger, they reduce the effective area of the poles and lower the voltage level available. Although the cell will still deliver the same amount of energy, more of the cycle is at a lower voltage level. This fact is used by some battery manufacturers to support claims that their batteries are not subject to memory effect. Since the same amount of total energy is available, their claims are somewhat valid, if not practical. The problem for the end user is that the energy available at the lower voltage level may not be enough to run the computer. The problem can be avoided by using full discharge cycles followed by full charge cycles or by exercising your battery at regular intervals. Abused batteries that do exhibit signs of memory effect can be restored to near full capacity. (There's hope for the salesman with the 40 minute battery.)

Another characteristic of NiCad batteries related to the chemical changes that occur during discharge is known as deep discharge. When a discharged battery pack is not recharged, but continues to have power drawn from it, the poles can actually reverse polarity, destroying the battery. MinisPort computers draw power first from AC, next from the battery pack, and then from the lithium backup batteries. When no lithium battery power is available, the computer continues to attempt to draw power from the NiCads. Battery packs left in computers during extended storage and those in computers left open after an automatic shutdown experience shortened discharge times or, in extreme cases, are destroyed. Abused batteries that exhibit early signs of deep discharge can also be restored to near full capacity with seasoning. (There's hope for the student with the 22 minute battery.)

Testing Battery Life

"So, wonderful", you say. "But where's my three hours?" Well, here it comes. Properly seasoned, exercised, and fully-charged MinisPort battery packs deliver approximately three hours of computing time while running a battery life test program set for 50% CPU usage, 20% disk drive accesses, and 30% video accesses, providing your computer is set up as follows:

- The LCD display enabled and no external video monitor connected.
- The serial, parallel, and modem ports disabled.
- The hard disk drive power down time set to 60 seconds.
- The RAMDISK off.
- The CONTRAST set so the display is readable with the BRIGHTNESS set to maximum.
- The external floppy disk drive disconnected.
- The operating speed set to FAST.
- The BACKLIGHT TIMEOUT set to ALWAYS ON.
- The keyboard locks set to NUM LOCK on, PAD LOCK off, CAPS LOCK off, and SCROLL LOCK off.
- No modem installed.
- One megabyte of memory installed.

Changing any of these parameters will affect the amount of computing time. Using the computer in real life is likely to change almost all of them. I generally get between two and two and a half hours of computing time while generating manuscripts; your particular application will determine your computing time. To get a good feel for the amount of computing time you can expect, using a seasoned and fully charged battery pack, run your applications on the computer until the power LED turns red and the low battery warning beep sounds. Check the time, save your work, turn off the computer and charge the battery pack for three hours. Repeat this process three or four times and you'll have a good idea of what you can expect from your MinisPort.

The way you use your battery pack also affects the amount of computing time you can expect. In the best of all worlds, you would have complete discharge cycles, followed by full charge cycles. Heaven knows that's not always practical or even possible. Even your brand new battery pack sat on someone's shelf long enough to reduce its discharge cycle. You used your computer for an hour and a half today and need to have it going for a two hour meeting tomorrow. Your three year old opened the computer, pushed the button, and went off to play. You've been using it at home on AC for months, and now you have to finish that project by Monday, with the family reunion at the campground scheduled for this weekend. With all this memory effect, deep discharge, reverse polarity, and the like, how can anyone keep a battery pack healthy? Just use some simple procedures, known as seasoning, exercising, and restoring.

Seasoning Battery Packs

All new battery packs and most battery packs that have been stored for an extended period of time require seasoning. This process takes the battery through a couple of full charge and discharge cycles, conditioning the battery for optimum computing time. To season a battery pack:

1. Remove the battery pack from the computer.
2. Attach the AC adapter and allow the battery to charge for at least 10 hours.

3. Disconnect the AC adapter.
4. Install the battery pack in the computer.
5. Open the computer and turn it on.
6. Allow the computer to run until the power LED turns red and the low battery warning beep sounds, and the computer shuts down. You can use the computer while the battery discharges, but remember that you may only have 20 minutes of computing time before the computer shuts down.
7. Close the computer and attach the AC adapter.
8. Allow the battery to charge for at least 3 hours.
9. Disconnect the AC adapter, run the computer until it shuts down, close it, and then recharge the pack for at least 3 hours.

Exercising Battery Packs

Exercising the battery pack at regular intervals minimizes the impact of memory effect. Exercising is the process of periodically forcing your battery through a complete discharge and full charge cycle. To exercise your battery pack:

1. With the AC adapter disconnected, open your computer and turn it on.
2. Run the computer until the power LED turns red, the low battery warning beeper sounds, and the computer shuts down. Again, you may use your computer while you discharge the battery. Just be sure you save any work in progress when the low battery warnings come on.
3. Close the computer and attach the AC adapter.
4. Charge the computer for at least 3 hours.

The way you use your computer dictates the exercise interval. If you operate primarily on AC power, exercise the battery pack at least once every 6 months. If you use the computer daily on battery power, exercise it every two weeks. If you use the computer on battery power every few days, exercise it every 3 to 4 weeks.

Restoring Battery Packs

Badly abused battery packs, with as little as 10 minutes of computing time left in each discharge cycle can be restored to near full capacity. Restoring is the process of intentionally forcing the battery pack into the early stages of deep discharge and then recharging it. Note that seasoning and regular exercising are much healthier for your battery pack, and, if the pack has been too badly abused, the restoring process does not always work. To restore a battery pack:

1. Disable the lithium backup batteries with the insulating strip or remove them from the computer.
2. Open the computer and turn it on.
3. Run the computer until it shuts down. Leave the computer on with the lid open for at least 10 hours after it shuts down.
4. Close the computer and remove the battery pack.
5. Attach the AC adapter to the battery pack and charge it for at least 10 hours.
6. Disconnect the AC adapter and install the battery pack in the computer.
7. Remove the insulating strip or re-install the lithium backup batteries.
8. Open the computer and turn it on.
9. Leave the computer on until the power LED turns red and the low power warning beep sounds.
10. Turn off the computer and close it.
11. Reconnect the AC adapter.
12. With the computer turned off, recharge the battery pack for at least 3 hours.

If short discharge time with each cycle persists, repeat the restoring procedure. If the problem continues, you'll have to replace the pack.

Power-Saving Options

If you have already been using (and not abusing) your batteries, but are still not getting the kind of battery-powered computing time you'd like, try using some of these power-saving options. If you still cannot live with the discharge time, you may want to consider upgrading your computer. Remember that the MinisPorts are pioneers. A newer computer with power conservation improvements like suspend mode may be what you need.

In addition to the power-saving options listed below, one other option is available for those of you with older MinisPorts. Purchase a higher capacity battery pack. The ZL-1-22 packs are the same size and install the same way as the ZL-1-2 packs. Using the higher capacity pack along with power saving measures may get you the computing time you need.

SETUP – The Setup program (found in the Monitor program) has two sets of parameters: one for AC power operation and one for battery operation. Use the power saving options in the battery operation SETUP. The computer will automatically invoke your power savings when operating from the battery pack and ignore them when operating from AC.

Modem – If you have an optional modem installed in your computer, remember that when enabled it draws a lot of power, even when you're not using it. Connect to AC power before using the modem whenever possible. Use the Setup program to disable the modem whenever you are not actually using it. It takes a few keystrokes to enable it when you need to use it, but the power savings are worth it. (There is hope for the author with the one and a half hour battery.)

Disk Drives – Disk drives are another major power draw. Connect to AC power before using an external floppy disk drive whenever possible. For MinisPorts with internal hard disk drives, use the Setup program to adjust the hard disk drive power down (WINCH POWER DOWN) time. A short timeout (60 to 120 seconds) allows the drive motor to be turned off when it is not actually being used. You can also save power by running programs from the silicon disks instead of the disk drive.

Other Peripherals – The serial and parallel ports also draw power when they are not being used, although not as much as the modem. Use the Setup program to disable the ports when you are not using them. Connect to AC before using a printer, scanner, mouse, or other peripheral whenever possible.

Operating Speed – When you invoke SLOW mode through the Setup program, the actual operating speed of the computer is reduced to 4.77 MHz and power is conserved. When you invoke SLOW mode through the keyboard (using the FN-F3 key combination) you merely add wait-states, causing slower operation without power savings.

Video – Use the LCD when operating on battery power; a CRT draws more power. If there is plenty of ambient light, turn the backlight off. You can also reduce the brightness and contrast, keeping the screen readable without drawing so much power. If there isn't much light to work by, set a short timeout for the backlight (1 to 5 minutes). This turns off the backlight when you aren't actually using the computer, saving power when your attention is elsewhere for a few minutes.

Extended Storage – The computer draws power from the batteries to maintain the date, time, Setup, and RAMDISK information even when it's turned off. If you are not going to use the computer for a while (a few days to a few months or more), remove the batteries from the computer.

Power Down – This is a novel concept, but turn the computer off when you are not actually using it. How many times have you stopped work for just a minute, and not gotten back to it for hours? With two small children running around, the habit of saving my work and turning the computer off when I stop working has saved me from a lot of nightmares.

The Lithium Backup Batteries

There are two other batteries in the MinisPort computer. These lithium backup batteries provide power to the real-time clock and RAMDISK when neither NiCad nor AC power is available. These can be real lifesavers when you absolutely have to have information stored on the RAMDISK, or real pains when they're dead again and you can't get the computer booted without entering Setup. Keeping a charge on your battery pack prevents these batteries from being drained.