Battery life, ET watching, secret Apple manuals, EPROM burner power supply, opening the Mac

By Don Lancaster

This month's column seems to involve lots of books and manuals, mostly since a bunch of really good ones showed up here in the past few weeks. Some old, some new, all great. Starting with the obvious, there's my very latest and brand new book, *Enhancing Your Apple II,* Volume II (SAMS #22425).

As usual, this is your column, so write or call me (between 8:00 A.M. and 5:00 P.M. weekdays Mountain Standard Time is best) per the box at the end. You will often get better results by calling rather than writing. Once again, all the names and numbers of manufacturers and suppliers mentioned here appear in the large box.

On to this month's really great stuff....

How Long will a Battery Last?

The reason you haven't found quick and simple answers to battery-life questions is that there aren't any quick and simple answers. However, far and away the best set of battery technical manuals I've ever seen appear in the four-volume *Eveready Battery Engineering Data* library ($5 each). Volume I is on Mercury and Silver Oxide batteries; Volume II is mostly on Alkaline batteries; Volume III covers good old Carbon-Zinc; and Volume IV is on rechargeable Nickel-Cadmium batteries. While the whole library is valuable, chances are you will find Volumes II and III most useful.

These manuals completely cover everything *Everyready* makes, but you will have to look elsewhere for info on lead-acid and lithium batteries.

Before going further, a quick review is in order. There are two basic types of batteries. Primary batteries are normally not supposed to be recharged. You use them once and, when they're exhausted, chuck them. Secondary batteries are rechargeable and may be used over and over again. A plain old, el-cheapo flashlight battery is a primary battery using carbon-zinc chemistry. If the battery is marked "heavy duty," it uses a variation of carbon-zinc chemistry that involves zinc chloride. If the battery is marked "alkaline," it uses manganeese dioxide chemistry. There also are primary lithium batteries that use, of all things, lithium chemistry.

The most common secondary batteries are lead-acid ones, such as are used in cars and motorcycles, and NiCd ones using nickle-cadmium chemistry and are used to power electric toothbrushes, carving knives, portable tools, and so on.

To grossly oversimplify, a heavy-duty primary battery offers twice the life at twice the cost of a plain one. An alkaline battery offers four times the life at four times the cost of a plain one. And lithium very reliably offers 10 times the life at 20 times the cost.

We'll note in passing that, while everyone calls them "batteries," most are really single cells. A flashlight usually has *one* battery in it that consists of two to five cells. A 12-volt car battery has six 2.0-volt cells in it. But a 9-volt transistor battery really *is* a battery, since it has six individual 1.5-volt cells inside it.

Much more on all this in the manuals.

Anyway, Table 1 shows an estimate of primary battery life for various currents that I worked up. I'd like to call these "ball park" figures, but they are not nearly that precise. Let's call them "county" figures instead, since they will get you within a ten-mile bicycle ride of what you really want to know.

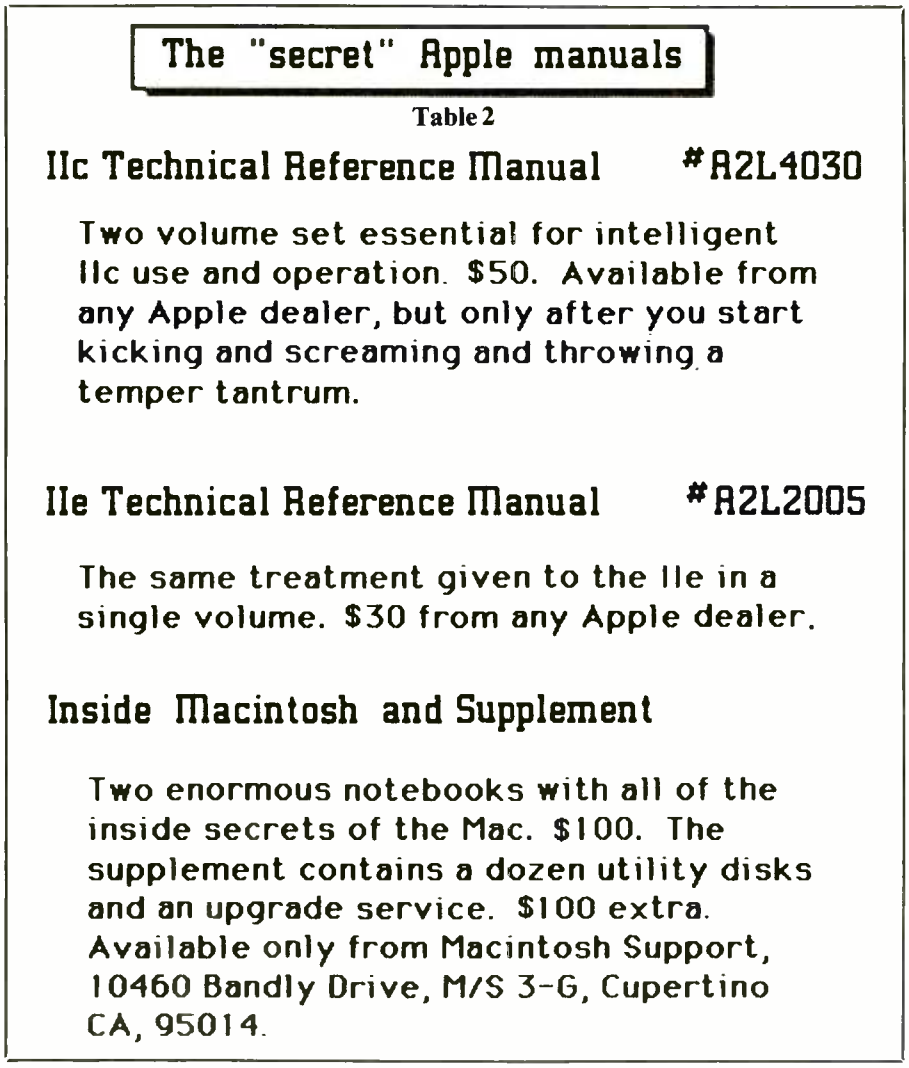
Why such variation? First, battery quality varies dramatically. Fresh batteries are much better than ones that have lain around a warehouse or wherever for years. Name-brand batteries are almost always much better than house-brand batteries, since the latter sometimes get swept out of a Hong Kong alley.

Secondly, the nature of the load has lots to do with battery life. Batteries that are run two hours per day will generally last much longer than batteries run continuously until they die. Some batteries have their chemistry further optimized for continuous low current, for occasion-

Table 1

		Load in Milliamperes			
BATTERY TYPE	EVEREADY	0.8	8.0	80	800
"AA" Standard	#1015	1100	97	4	---
"AA" Heavy Duty	#1215	1350	120	9	---
"AA" Alkaline	#E91	2000	190	16	20
"C" Standard	#935	2400	240	12	---
"C" Heavy Duty	#1235	3650	352	28	---
"C" Alkaline	#E93	5600	560	49	60
"D" Standard	#950	5600	560	21	60
"D" Heavy Duty	#1250	7020	702	68	107
"D" Alkaline	#E95	11500	1200	108	240
"9V" Standard	#216	481	18	---	---
"9V" Heavy Duty	#1222	500	20	---	---
"9V" Alkaline	#522	5500	53	4	---
"Camera"	#189	75	3	---	---
		Hours	Hours	Hours	Minutes

Table gives rough estimates of life for various types and sizes of batteries for different load conditions. Times given in rightmost column are in minutes!



These are the "secret" manuals you absolutely need if you hope to do anything worthwhile on a newer Apple computers. Text tells you how you might get them.

al high current, or for a mix of the two. Cell polarization affects performance at very low currents, while internal impedance and self-heating affects high-current ratings.

Thirdly, just what is a "dead" battery? As most batteries age, their output voltage drops. At some point, whatever the battery is connected to will either quit outright, distort badly, not put out useful power or not provide enough light. Yet these same batteries could possibly still be used for a long time in some other use.

The chart assumes a battery is "dead" when its output drops to 67% of its initial voltage. Thus, 1.5-volt cells are "dead" when they drop below 1.0-volt, while 9-volt transistor batteries are "dead" when their terminal voltage drops below 6.0 volts. This "deadness" criteria lies in the middle of the published curves.

Be sure to note that the rightmost column of Table 1 is in *minutes*, rather than hours! As a general rule, the life of all primary cells drops dramatically when you try to get more than 200 milliamperes out of them, unless they are optimized for high current service.

While we are on the subject, *Polaroid* has some interesting 6-volt batteries you might like to play with. These are very flat, very compact, offer very high power, and as with everything made by Polaroid, very expensive.

Their #606166 designers kit will get you started. It includes a pair of lithium batteries, a pair of ordinary ones, and a special and very thin battery holder. Cost is around $25. After playing with these, I wasn't very impressed, but maybe you will be by them.

How can I start ET watching?

The proper name of this activity is called SETI, short for *Search for Extra-Terrestrial Intelligence*. Surprisingly, there are a large number of amateur radio astronomers that are doing lots of very interesting, very impressive, and very legitimate research these days. All this on their own, without grants or federal help.

The center of amateur SETI activities seems to be a group called the *Society of Amateur Radio Astronomers,* which is headed by one Jeffrey M. Lichtman. Jeffrey has self-published several very interesting books. One is *Microwave Radio Astronomy, An Amateur Introduction,* a second is *Solar Amateur Radio Astronomy,* and a final nuts-and-bolts one is the *Amateur Radio Astronomers Circuit Cookbook*. Cost is around $35 total for all three.

It's interesting to note the similarity between many radio astronomy circuits and those things that *Modern Electronics* readers are already doing, such as legal access of satellite broadcasts. Much of the same circuitry can be adapted or used directly, and the larger market for the satellite stuff has driven the costs way down. Antenna mounts and tracking mechanisms, of course, scream robotics.

Another thing you can do is visit the free museum at the VLA (very large array) radio astronomy facility outside Magdalena, New Mexico. Visitors are most definitely welcome, but play down the ET watching if you expect to get behind the scenes and be treated seriously. And, while you are in the neighborhood, drop in on us here at Synergetics. The VLA is only a half day's drive away.

Where do I get those secret Apple manuals?

They weren't supposed to be secret.

Only a monumental communications foulup made them that way. You see, there is a "secret" manual for the IIe called, of all things, the *IIe Technical Reference Manual.* There is a similar "top-secret" manual pair for the IIc called the *IIc Reference Manuals.* And there is a humongous pair of "Q-level" security binders and dozens of support diskettes called *Inside Macintosh* and the *Macintosh Software Supplement.*

It is categorically impossible to do *anything* useful on *any* newer Apple machine without these manuals. Their pricing is not at all out of line with their contents. In fact, they are worth far more than the asking price. (For details, see Table 2.)

Here's how to get the manuals. First, politely but firmly go to a large Apple dealer with the exact part numbers and try to buy them. If the dealer turns a deaf ear, you might try to sweeten the pot with a bigger order; try to group at least three, or preferably five, orders for the same manual at once. Do this with some friends or through your local school or club.

Note that borrowing one of these manuals will not work, since no one in their right mind would ever let one out of their sight for more than a few moments, if at all. Note also that the IIe and IIc manuals are normally ordered through dealers, while the Macintosh stuff must be ordered directly from the address shown.

If all else fails, you may just have to bide your time. Rumor has it that the *McGraw-Hill Bookstore* is one mail-order source that normally stocks and quickly ships the IIe and IIc manuals. There is another rumor that *Addison Wesley* will shortly republish the manuals as a stock bookstore item.

Go for it.

I need an EPROM burner power supply

Most EPROMs need a special programming voltage of +12, +21 or +24 volts to do the blasting during the programming process. More often than not, all you have is a +5-volt supply to work with. What can you do?

The simplest way is to build your own switching dc-to-dc converter. While that sounds awful, all it takes these days is a $2.80 mini-DIP integrated circuit, a plain old coil, and a few other stock parts. Total cost is well under $5.

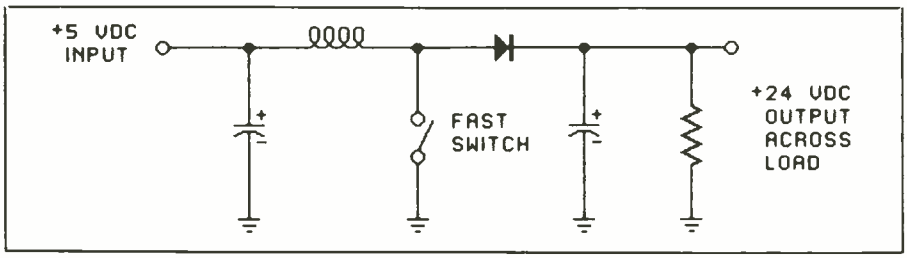


Fig. 1. Illustrated is general idea of switch-mode step-up converter.

The general idea of a switch-mode dc-to-dc step-up converter is shown in Fig. 1. Say you leave the switch open. The input voltage will appear at the output, minus a small diode drop. Thus, the *minimum* possible output voltage you can get roughly equals the supply voltage, and this circuit works to step-up only.

Now, suppose you rapidly flip the switch on and off. When the switch is closed, current through the inductor will increase. When the switch is opened, current through the inductor must go somewhere else, like through the diode and into the load. The greater the percentage of time the switch is closed, the higher the output voltage.

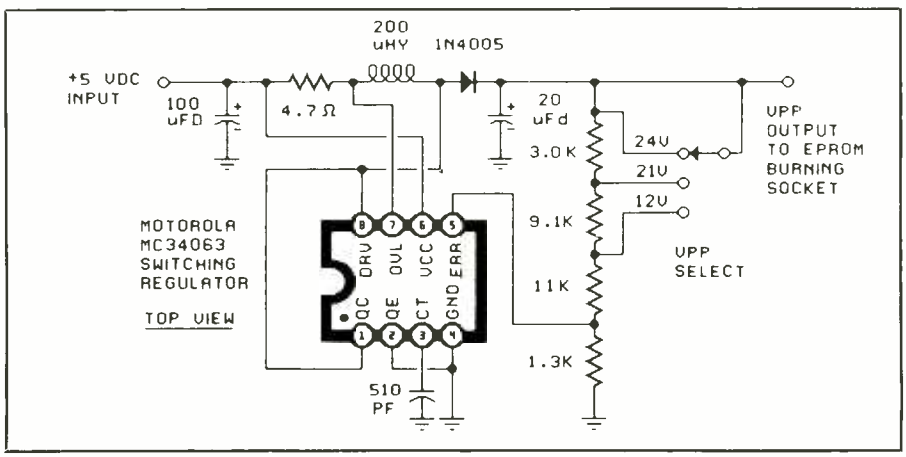
All you need to get this to work is some way of sensing the output voltage and comparing it against a reference voltage. The error signal you get is then used to vary the duty cycle, or the off/on time of the switch. Fortunately, all the fancy stuff is available ready to use in a *Motorola* MC34063 chip.

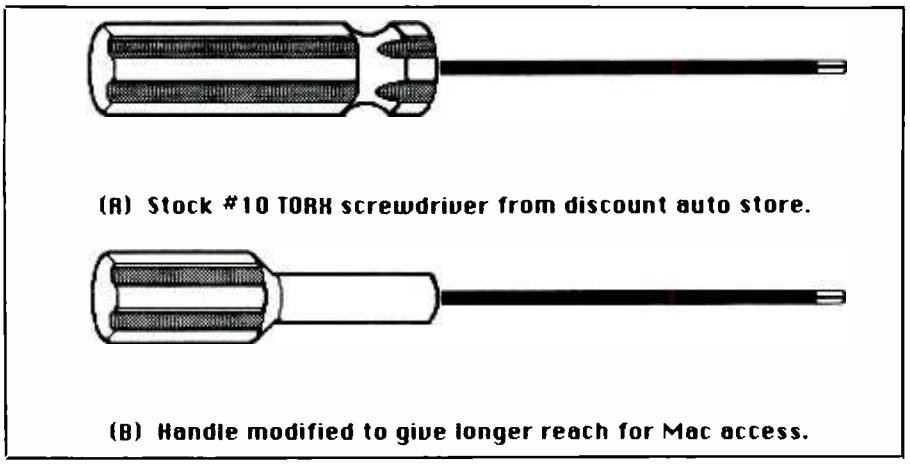
This circuit is very similar to a neat "free energy" machine called a *hydraulic ram.* The inductor acts as a large downhill pipe. The diode acts as a check valve and small diameter uphill pipe. The switch acts as a dump valve, except that you "close" the switch to dump water.

You first open the valve, dumping water. The mass of the water running down the pipe gets going good. Then you close the valve. All that mass of water running down the pipe wants to keep going in the worst sort of way, so the downhill water will force some water past the check valve and into the small uphill pipe.

By letting lots of water at fairly low pressure go downhill, you can force a little water uphill at very high pressure. Repeatedly opening and closing the valve ra-

Fig. 2. This is the complete circuit for the selectable burn switch-mode voltage step-up converter. It is built around a Motorola MC34063 switching regulator.





(A) Stock #10 TORX screwdriver from discount auto store.

(B) Handle modified to give longer reach for Mac access.

Fig. 3. Drawings show a stock Torx driver (top) and the same driver after modification to permit easy access to the recessed screws in the MacIntosh computer.

pidly, continuously pumps water uphill, with no energy input except gravity.

Figure 2 shows us the complete circuit. Jumpers or a switch select your choice of 12-, 21-, or 24-volt output. Be sure to use the correct value for your particular EPROM or you will either blow up the chip or else get a weak or missing blast.

The coil can be just about any old r-f choke, as long as it has a dc current rating of 100 mils or so. There is nothing critical about any of the parts. One warning, though. If you ever break the resistive divider feedback loop from the output, output voltage will try to go very high, with nasty results all around. Be careful!

This same chip can be used in other circuits to step down or step up, with either positive or negative output polarity. An extra pass transistor can also be added for higher currents.

Switching mode power supplies have gotten so simple and cheap that it is often unthinkable to do things the inefficient, high iron "old" way.

Names and Numbers

Addison-Wesley Publishing
General Books Division
Reading, MA 01867
(617) 994-3700

Bodine Electric
2500 West Bradley Place
Chicago, IL 60618
(312) 478-4515

Dr. Dobbs Journal
2426 Embarcadero Way
Palo Alto, CA 94303
(415) 424-0600

Eveready
270 Park Avenue
New York, NY 10017
(212) 551-4377

Garland Publishing
136 Madison Avenue
New York, NY 10016
(212) 686-7492

Jensen Tools
1230 South Priest Road
Tempe, AZ 85281
(602) 968-6241

MacIntosh Support
10460 Bandley (M/S 3-G)
Cupertino, CA 95014
(408) 973-4897

McGraw-Hill Bookstore
1226 Sixth Avenue
New York, NY 10020
(212) 512-4100

Modern Electronics
76 North Broadway
Hicksville, NY 11801
(516) 681-2922

Motorola
Box 20912
Phoenix, AZ 85018
(602) 244-6900

Polaroid
748 Memorial Drive
Cambridge, MA 02139
(617) 577-2000

Howard W. Sams
4300 West 62 Street
Indianapolis, IN 46206
(800) 428-SAMS

Society of Amateur Radio Astronomers
Jeffrey M. Lichtman
440 Winside Lane
Coram, NY 11727
(516) 331-1524

Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

Techni-Tool
5 Apollo Road
Plymouth Meeting, PA 19462
(215) 825-4990

Torx Camcar
Box 607
Rochester, IN 46975
(219) 223-3131

VLA Radio Astronomy Site
Visitor Center
Magdalena, NM 87825
(505) 772-4011

How do I open the case on a MacIntosh?

There are four screws with funny heads on them that hold the MacIntosh case together. These are #10 TORX screwheads. This is the same screw used on many cars for such things as mounting lights and trim. Unfortunately, a stock #10 TORX screwdriver will not reach two of the screws, since its shaft is an inch too short.

You can buy an *Xcellite* #XTD-10 Torx screwdriver from *Jensen Tools, Techni-Tool,* or most any larger electronics distributor. This one will work fine, but there is a sneakier and easier way.

Go to your local discount auto parts store and buy the cheapest #10 *Torx* driver you can find. Usually there will be only two sizes available. You want the smaller of these. Then grind, cut, file, melt, stomp, or otherwise molest the handle down to the shape shown in Fig. 3. The cut-down part of the handle should be 7/16" or less in diameter, and you need about 1½" removed. The modified driver should now reach all MacIntosh case screws, including the two buried screws.

By the way, if you are a hacker-type, and if you can latch onto one of the old 128K boards that get removed during a Fat-Mac upgrade, it's a fairly simple matter to add your own reworked monitor and keyboard. This lets you pick up a Mac-like machine for next to nothing.

Fortunately, the Mac will cold boot on either the external or internal drive. Thus, you can use an external add-on drive as your only drive.

Unfortunately, you have to know an insider or else get real lucky to do this.

HARDWARE HACKER...

Apple pays dealers a $300 bounty for the return of the old boards. Some Apple developers got upgrade kits without having to send the old board in. For some strange reason, these old boards seem to have a street value of $301.00.

It is also feasable to upgrade a 128K Mac to a 512K Fat Mac by yourself, buying RAMs from mailorder outlets. You must be willing to do the usual cutting, soldering, chopping and channelling. You also will void warranty if you try this. Full details appear in *Dr. Dobbs Journal,* January 1985, pages 4 and 18 through 23. The newest 128K boards are far easier to modify than the earlier ones. Details on both versions appear in the same issue.

I need a good book on motors for robitics

How about a great book instead, costing—are you ready for this?—only $3.50? It is called the *Small Gearmotor Handbook,* and *Bodine* publishes it. It's been around for a long time, but things in the motor world don't exactly happen in the fast lane. Very readable, very solid, and very heavy on fundamentals.

Where do I find a magazine on . . .
computers and dentistry
computers and the handicapped
computers and war gaming
computers and genealogy
computers and tinaja questing
computers and robotics
computers and . . .

It sure would be nice if there was some listing of *all* the computer magazines, particularly the smaller, regional, specialty, selft-published, or obscure ones. Often these smaller journals are where the real action is, particularly in some special interest field.

I've just found a real gem of a directory. And somehow it got up to its seventh year and its *eleventh* edition without anyone knowing it even existed.

It's called *Microcomputer Periodicals: An Annotated Directory.* It is written by George Shirinian and published by Garland Publishing. There are over a thousand microcomputer publications listed. Most are in the U.S., but some are international. Most listings are annotated, explaining what the publication is about, how much it costs and includes a critical review summary.

Other sections of the directory give you a by-subject cross reference listing, along with names of earlier publications that changed names or folded. Very nice. Also most useful. See you next month.

NEED HELP?

Phone or write your hardware hacker questions and comments directly to

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