HARDWARE HACKER

Superconductivity breakthroughs; modem eliminators; sync stripping circuits; small hardware sources; new tech literature

By Don Lancaster

Uh, let us start with a correction to that Apple IIGS disk drive adapter circuit that we looked at in April 1987. Instead of making no connection to the 3.5″ ENABLE line, ground pin 4 of the DB-19 connector by jumpering it to pin 3 of the same connector. Sorry about that. This lets the 3.5″ drive boot properly if there is nothing in either of the 5.25″ drives.

One problem remains, though: flaky protection schemes used on some early Apple disks may take too long to start booting and thus may get bypassed. The only solutions to this are to (1) boot the problem disks on an old disk card in slot 6 only, or (2) remove the inane protection from a backup copy of the disk.

It's really interesting to watch the computer people dropping virtually all copy protection as being conclusively proven to be both unworkable and counterproductive, while at the same time watching others who are trying to force highly elaborate, quality-degrading, easily-bypassed, and totally useless "hardware locks" onto the new digital audio tape systems. Dumb.

I recently looked into the economics of self-publishing, and the opportunities I found here are astonishing. Did you know you can self-publish a technical book for a production cost of around $6 each for as few as *20* copies? And that your copies can be on the way to reviewers a mere seventy minutes after the final author manuscript is received?

The power of the press lies in owning one. A laser printer and *Postscript*-speaking one, of course.

Let me know if you want to hear more on this. I definitely want to get some self-help networking going. The time is long past due.

But for now, let's warm up to a very cold topic . . . .

What is superconductivity?

The past few weeks have seen some interesting breakthroughs in the field of superconductivity. The field dates back a dozen or more years, to when scientists and engineers at IBM and other laboratories discovered that two remarkable things happen when certain materials, most notably lead and niobium, are cooled to extremely low temperatures.

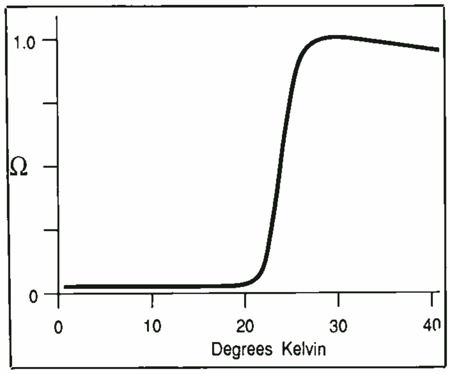

Fig. 1. Resistance curve for an older superconductor.

The first effect is that all electrical resistance drops magically to zero below a critical transition temperature. This is where the term "superconductivity" comes from. The second effect is that any and all internal magnetic fields also drop to zero. This is called the Meissner effect. For a true superconductor, both zero resistance and zero internal magnetic field are needed.

Until recently, these transition temperatures have been extremely low. In fact, the only way you could get them was by using liquid helium, a very expensive and rather inefficient way to cool things.

Superconductor critical temperatures are usually measured in degrees Kelvin. Zero degree K is in fact absolute zero; 273 degrees K is the usual melting point of ice; and 373 degrees K is the usual boiling point of water.

Figure 1 shows a resistance-versus-temperature curve for an older superconductor. Until very recently, superconductivity took place only in a few materials and then only at the frigid temperatures of 23 degrees K or lower.

As you might imagine, cooling costs have put a damper on uses for supercon-

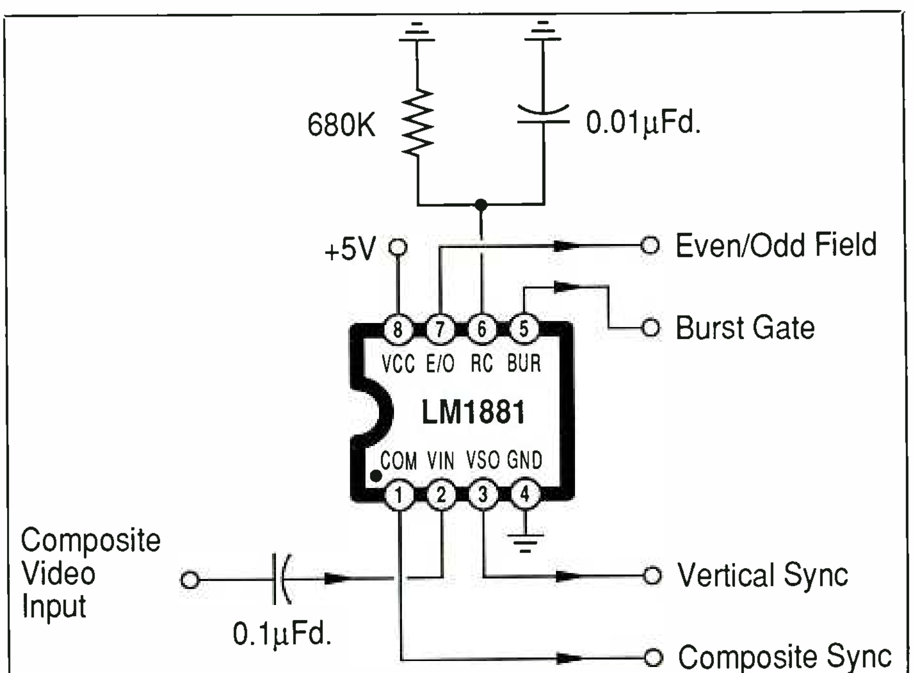

Fig. 2. A simple video sync stripper circuit.

ductors. To date, superconductivity is used for all the large magnets used in particle physics, where no other method is known that can create the intense magnetic fields required.

There is also a brand new oscilloscope out that makes used of superconductivity to achieve a 5-picosecond risetime. No, that's not a misprint. Five picosenconds! The time it takes light to travel the thickness of a quarter.

If you are going to worry about a little thing like a tank of liquid helium, you really don't need a 5-picosecond risetime scope. And if you have to ask how much this jewel costs, you can't afford it.

No, it's not in the Heath catalog—at least not yet. But let's dream a little. What if we had a room-temperature superconducting material that was cheap, ductile, strong, and easy to process? Nearly all electrical and electronic applications would be profoundly and permanently affected.

For instance, the 33 percent power loss involved in any long-distance electrical transmission could be eliminated. Levitated magnetic trains would be practical, as would much more efficient electric autos with far greater ranges. The expenses of elementary particle research would drop dramatically. In the computer area, the superconducting devices known as Josephsen junctions could be used as logic gates that are ridiculously faster, smaller, cooler, and more efficient than any logic we have today. And test equipment would never be the same; nor would be medical diagnostics.

Until several weeks ago, there seemed to be a 23-degree K barrier to superconducting materials, plus a bunch of theory that said that higher-temperature superconductors were impossible. Both have just been shattered. Hundreds of researchers in dozens of laboratories around the world have reported superconductors above 100 degrees K, and hints of superconductivity as high as 240 degrees K. The Russians even claim 250 degrees K. At -9 degrees Fahrenheit, that equals a typical January evening in Minneapolis, Minnesota.

Actually, the highest verified superconductivity transition temperatures are still in the 100-degree K range.

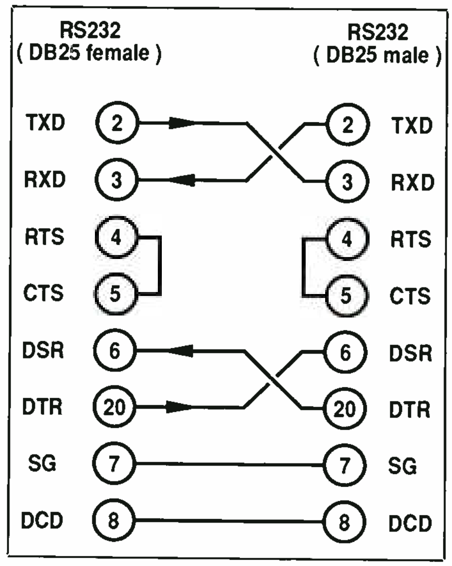

Fig. 3. A typical circuit for a modem eliminator.

These higher observations still remain unproved anomalies. But the chances are overwhelming that higher-temperature materials will be discovered and refined.

The new materials are simple. They are just ceramics made from copper oxides laced with rare-earth elements such as yttrium. Methods of forming them into thin films and other useful forms have already been described.

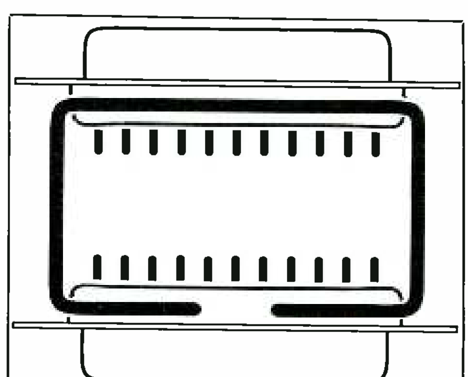
Fig. 4. Two wire loops hold modem eliminator together.

So, what's in this for a hacker? Liquid-helium cooling is beyond the means of all but the most gonzo super hacker. Liquid-nitrogen cooling, as needed by the 100-degree K materials, is within the bounds of what one or two dedicated individuals could handle on their own in a sophisticated home lab.

By way of comparison, liquid helium costs about the same as fine brandy, while liquid nitrogen costs about the same as draft beer.

With a 240-degree K superconductor, you're talking dry ice in a picnic basket on your kitchen table. And you now have a whole new ball game in which anyone has a chance to play.

Even with no lab of your own, superconductivity is a sure-fire winner for your school report or research topic.

Needless to say, the editors here at *Modern Electronics* will pay very well for the first superconducting hacker construction project that can be done on a kitchen table using reasonably available materials.

Where can I find tiny hardware?

Obvious places to look are your local hobby store, jeweler's supply houses and in model railroading magazines. One source of miniature taps, screws and nuts is J.I. Morris. The largest screw size they stock is 2-56, and they go down to 0000-160. These are available in both brass and stainless steel. Typical pricing is in the range of $10 per gross.

Show me a sync separator circuit.

The *National* LM1881 is a low-cost, easy-to-use sync stripper circuit you might find handy to use for converting composite computer video for use with split-sync monitors.

Figure 2 shows the simple circuit. You power this 8-pin mini-DIP from the usual + 5-volt supply and capacitor couple the input video as shown. Outputs include composite sync, vertical sync, burst and even/odd field.

While there is no horizontal sync output as such, the burst output can often be fattened a tad and used instead. The even/odd output will work on only "true" NTSC color video.

The NTSC color subcarrier can be regenerated by using the composite video and the burst gate as inputs to a chroma circuit or chip.

Let me know what additional uses you can come up with for this interesting integrated circuit.

What is a modem eliminator?

There are two different types of serial RS-232 data communications. When your computer is talking with a modem, all of the data lines and all of the handshaking likes are connected "straight through." On the other hand, when your computer is talking with another computer or to an intelligent printer, the data and handshaking outputs must be crossed so that output from one machine forms the input to the other.

Thus, in general, there are also two different types of serial data cables. Straight-through cables are used for modems, while crossed cables are used to talk to a printer or another computer.

Now, if you are talking from computer to computer through a pair of modems over the telephone line, you would use straight-through cables at both ends. But if you are sending your serial data directly from one computer to another without using a "real" modem, then you will need a single crossed cable.

We can call a straight-through cable a *modem* cable and a crossed cable a *printer* cable. More technically, the modem setup is called a DCE protocol, while the printer setup is called a DTE protocol.

The DTE stands for "data terminal equipment," while the DCE stands for "data communications equipment."

Many computer systems will offer other ways of crossing or not crossing cable pins. For instance, on the Apple IIe Super Serial Card, there is a small plug-in black box that goes arrow-down for printer use and arrow-up for modem use.

On the Apple IIGS, the control panel will select either "printer" or "modem" operation for either port. Much of the Macintosh software also gives you an option to cross or uncross your cables with software.

Newer serial communications standards, such as RS-422 and RS-423, also need ways of crossing cable lines, again crossing for computers and/or printers, and not crossing for modems.

A modem eliminator can be any connector lash-up that will either cross the wires on an uncrossed cable or will uncross those wires on a crossed cable. This is very handy if you are trying to use the "wrong" cable sometime, or you aren't sure what type of cable you have.

Figure 3 shows one possible RS-232 modem eliminator that seems to work well in both Apple and IBM environments. You can easily build this one from connectors picked up at *Radio Shack*, with total parts cost of under $6.

Pins 1 (safety ground), 7 (signal ground), and 8 (data carrier detect) go straight through. Pins 2 (transmitted data) and 3 (received data) are crossed. Pins 6 (data set ready) and 20 (data terminal ready) are separately crossed.

Pins 4 (ready to send) and 5 (clear to send) can be handled in several different ways, depending on your needs. These two pins are only rarely needed at all. If both ends of your application know what these signals are and how to use them, you should cross 4 to 5 and 5 to 4.

It is also possible to locally jumper pins 4 and 5 at both ends of your modem eliminator. I've done it this way, since this particular connection is very handy in getting from an IBM clone's COM1 port over to an Apple Laserwriter.

One hint on construction: if you do the obvious and use screws to hold the two back-to-back connectors, the screw heads will get in the way and cause hassles. Instead, take a foot of bare #12 wire (strip a scrap of house wiring) and bend it into a pair of rectangular loops as shown in Fig. 4.Then solder one loop to each side of each connector. Use a larger soldering gun or iron, and be sure to use a good grade of electronic solder flux.

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Harris Semiconductor
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Palm Bay, FL 32905

J.I. Morris Co.
394 Elm St.
Southbridge, MA 01550
(617)764-4394

National Semiconductor
2900 Kifer Rd.
Santa Clara, CA 95052
(408)721-5000

Precision Monolithics
1500 Space Park Dr.
Santa Clara, CA 95052
408727-9222

PostScript BBS
2504 Sycamore St., Bay City, TX 77414
(409)244-4075

Relay Specialties
17 Raritan Rd.
Oakland, NJ 07436
(800)526-5376

Standard Microsystems
35 Marcus Blvd.
Hauppauge, NY 11788
(526)273-3100

Toshiba America
2692 Dow Ave.
Tustin, CA 92680
(714)832-6300

Note that a modem eliminator will not automatically correct your serial communication problems. All it can do is cross or uncross cables. Beyond that, you have to make sure that both ends are speaking the identical baud rate, number of data bits, number of stop bits, parity and handshaking.

Much more information on data communications appears in my *Micro Cook-*

books. I also have available a free RS-232 handout and breaker box plans that you can request.

What's new?

There are lots of goodies this month. *Allied Electronics* has a brand new fat and free catalog. At one time, Allied was *the* best place to go for first-line electronic components. Unfortunately, they went steadily downhill for far too many years due to stiff surcharges over and above the list price for small-quantity orders, for greatly limiting selections, and through general mismanagement.

Thankfully, Allied seems to have gotten over most of its worst hangups, and the company once again merits consideration as a good and reasonable source of supply for hardware hackers.

Relay Specialties has an interesting free catalog that lists pretty near any relay from just about any source. There are no bargains here, just a very wide selection of first-rate products at the usual list prices. Be sure to ask for a complete price list with your catalog request.

Precision Monolithics has a new 1987 data book on linear and data-conversion integrated circuits. Their ap notes tend to be built into their data sheets, but there is a complete subject index. This is a great source of linear circuits and ideas.

Standard Microsystems also has a new data book out on dedicated integrated circuits used for data communications, video display systems, keyboard encoders, and such.

Harris Semiconductor has a new products guidebook on their digital and linear integrated circuits. They do tend to be a bit pricey at times. And *Toshiba* has released a new MOS Memory data book with lots of good info in it on RAM, ROM, and EPROM products.

Advanced Linear Devices now has a micro-power 555-style timer that will run on as little as 1 volt of supply power. This one looks like a great hacker toy.

Turning to my own stuff, currently hot products include my *Postscript Show and Tell* for laser printing with most any computer. I now also have a pair of new mailers for you that include lots of free and hard-to-find information. Just write or call per the Need Help? box. **ME**

NEED HELP?

Phone or write your **Hardware Hacker** questions directly to:

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