Apple IIGS Disk-Drive Adapter; Surplus Electronic Parts Sources; Current Mirrors; Microcomputer Voltage Inputs; More

By Don Lancaster

I just got word on a brand new *National* sync separator chip called the LM1881. This dude costs around $3, works off a single +5-volt supply, and needs only three external parts. It can handle NTSC, PAL, and SECAM, as well as nonstandard video. It even has a special logic output for even/odd fields. The LM1881 should be great for converting computer composite-video for split sync monitors and such.

I haven't had a chance to work with it yet, but I thought you might like to get a head start on a most-needed and most-asked-for new hacker component.

Moving right along . . . .

How can I use older disk drives on the Apple IIGS?

The Apple IIGS has an incredible variety of disk-drive options. For instance, there is a plug-in SCSI card that can access any number of floppy- or hard-disk drives that make use of this optional interface.

Then there are all the RAM-disk plug-in card options. Today, you could go as high as 8 megabytes of RAM disk. Just as soon as the prices drop a tad more on the 1-megabyte RAM chips, you can quadruple your storage to 32 megabytes.

In fact, you can do it today. One-megabyte RAM chips are certainly available, but they are not yet cost competitive with those older 256K dynamic RAMs.

And, should you attach a single "intelligent" drive to the usual DB-19 disk connector on the IIGS, you can control up to 128 different drives at once. This would, obviously, take a beefed-up power supply, but it can definitely be done. Astoundingly, the present firmware (but not the drives themselves) are capable of supporting up to 5 gigabytes per drive, for a mind-numbing total of *half a terabyte* of data on line at once! Which is not too shabby for a personal computer. Particularly since next year's CD ROMs should drop in just fine, thank you.

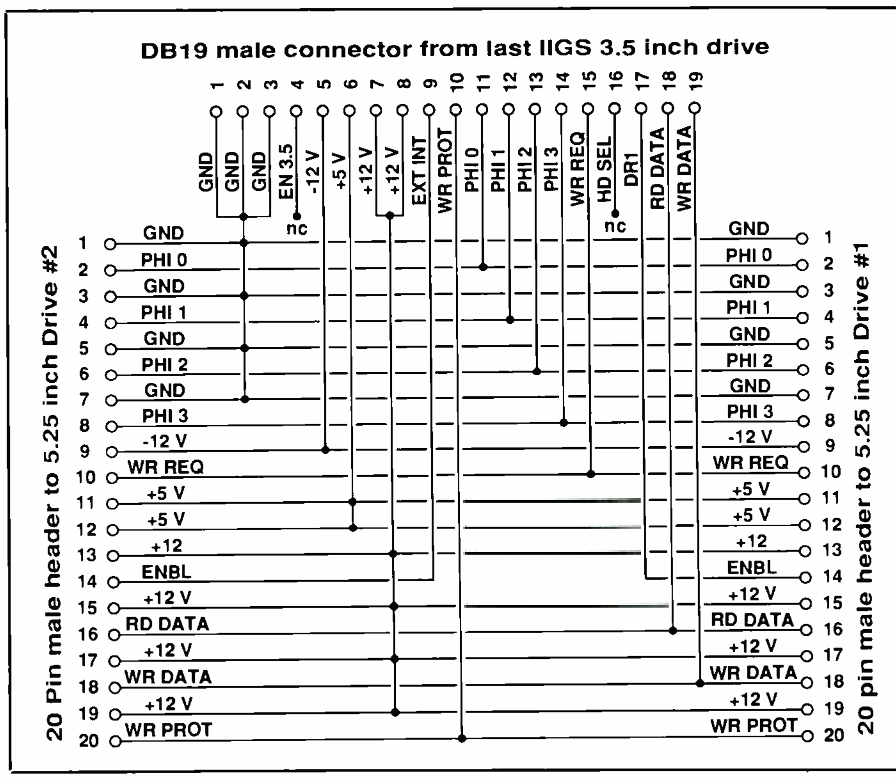

Fig. 1. This adapter lets you use older disk drives on an Apple IIGS.

The normal and usual setup for most IIGS users is to daisy chain four dumb disk drives, placing a pair of 3½-inch drives nearest the IIGS and using a pair of 5¼ inch drives as tail-end Charlies.

The only little problem here is that all of the newer Apple drives use a DB-19 connector. But, many of the much older Apple drives used a 20-pin DIP header connector that has wildly different pinouts. What can be done here?

There are at least two ways you can use these older 20-pin drives on the IIGS. The quickest and simplest is to go ahead and use an old slot six controller card, and change the IIGS front panel selection to "your card" for slot six.

Instead, Fig. 1 shows a simple adapter that you can build that will let you connect a pair of older 20-pin drives to a single DB-19 connector. This connector can either be plugged into the IIGS itself for a 5¼-inch-only system or into the last 3½-inch drive in use.

This adapter is certain to become commercially available soon, but for now, you might want to build your own. I would use a small printed-circuit board, being sure to use the type of 20-pin DIP header that has a plastic box around it.

Countless early Apple drive cards have been destroyed by plugging in this connector offset by one pin or even offset by one entire pin row. Make sure your adapter does not allow this.

Unfortunately, that DB-19 connector has been a bear to find. One good source is *JDR*. These are usually available in solder-tail only, so a short cable may be needed between your printed-circuit card and the DB-19 connector.

If you are only going to use one older drive, be sure it goes in the first slot on this adapter.

What are the best sources of surplus electronic components?

I guess I always have been a surplus junkie, and have been buying bargain and odd-lot mechanical and electronic stuff for longer than I care to remember. There's no better way to get hands-on electronic experience at low cost than by adapting and then reworking surplus components and systems to meet your own needs.

My all-time favorite surplus house has to be *Jerryco*. If not for their outrageous catalog, then for their incredible selection and bargain prices. They are not strong in the electronic area, but they more than make up for it in unusual materials, mechanisms, motors, far-out goodies, electromechanicals, and such.

For old-time, old-line military WWII surplus electronics, *Fair Radio Sales* is an excellent choice. One of the first surplus items I ever bought was from them. It was a complete APN-1 radar altimeter for $2.95. I sure was surprised when the Railway Express (Uh—I guess I may have been at this for a while) charges were a budget-breaking $8. During my college days, I earned some quick cash by buying surplus electronic castings from these people and converting them into far-out decorator lamps.

The yuppie reign of terror has mercifully ended over at *Edmund Scientific*. In fact, there is not one single Perrier-filled birdbath in its entire catalog these days. While they are the merest shadow of their former selves, they do have a fairly wide selection of optics, mechanics, and pneumatics on hand.

For "raw iron" in the form of motors, actuators, hydraulics, transformers, clutches, and such, *C&H Sales* has some fine offerings. No robotics hacker can afford to miss out on their catalog.

While not strictly surplus, a fine source

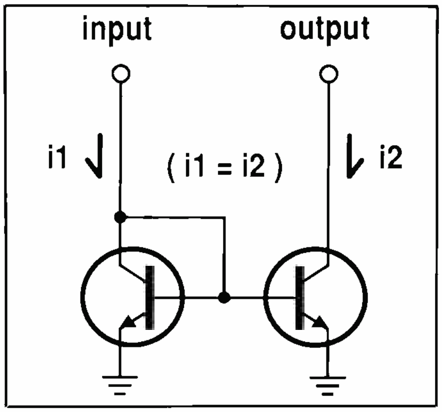

Fig. 2. An npn current mirror.

of low-cost electronic components is *Mouser Electronics*. They have a lot of brand-new stuff that is super hard to find elsewhere.

And those are pretty much my favorites. Besides these, while fairly pricey, *Herbach and Rademan* do occasionally has some real bargains. They are very strong in broadcast television surplus. *Marvin Jones* typically has outstanding electronic whatevers at very low prices. Good old *BNF Enterprises* have bargain priced assorted floor sweepings available, with an occasional gem buried in its

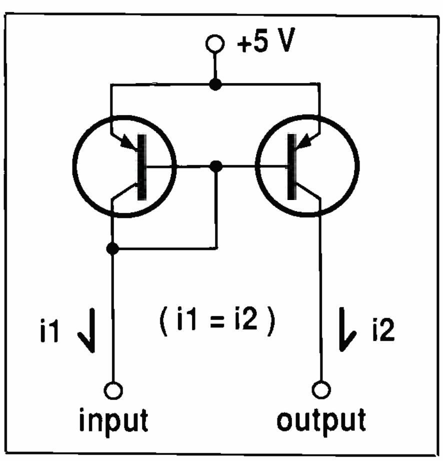

Fig. 3. A pnp current mirror.

big tabloid catalogs. Their prices are so low that "you buys your ticket and takes your chance."

Some newer outfits to look into include *Circuit Specialists, American Design Components*, and *Electrovalue International*. I'm sure you'll find other favorites of your own.

Finally, of course, there are the many fine advertisers right here in *Modern Electronics*.

What is a current mirror?

A current mirror is a very important and very powerful electronic circuit that sees very wide use in many integrated circuits. Yet it's almost unknown as a hacker tool.

Figure 2 shows a typical npn current mirror circuit. A current mirror lets you "bounce" a current off either a supply line or ground, while still having a very minimum voltage drop across itself. This is most handy for translating voltages or currents, for very-high gain amplification stages, for signal-level translation, for multi-current distribution including D/A conversion, and for letting you get by with much lower supply voltages than is normal.

The circuit behaves as follows: You set the current that is going into the left end, and the current mirror will then draw nearly that identical current into its right end. For the circuit to work properly, both transistors must be carefully matched and, preferably, on the same piece of silicon.

In theory, two matched transistors of identical gain and temperature will produce identical collector currents for any given base voltage input.

Now, what seems to be a dead short on the left transistor is really the key to the operation of the whole circuit. Believe it or not, a transistor can actually "transist" when it is connected this way. How? Well, a transistor only needs 0.2 or more volts at its collector to stay out of saturation. Since the base of a silicon transistor usually has a 0.6-volt drop across it, the left transistor is clearly in its active region, and is capable of amplification.

With a dead short from collector to base, the transistor cannot do much in the way of voltages. But it most certainly can decide the ratio of the base current to the collector current. What the dead short does when helped by the transistor is this: it adjusts the base voltage as a function of the transistor's current gain. The higher the gain, the lower the voltage, and vice-versa.

Since a transistor's gain will change with temperature, this circuit will automatically adjust the base voltage for both transistors in a way that gives a constant output current over temperature. Thus, an apparent dead short magically and automatically adjusts the output current so it exactly matches the input current over a wide temperature range. By the way, this is called a Wilson current mirror, after its inventor.

Figure 3 shows an "upside-down" current mirror, this time using a pair of pnp transistors. In the pnp mirror, the amount of current purposely sunk to ground on the left will cause an identical current to be sourced on the right.

For hacking, you can take a bag of bargain transistors and keep trying pairs until the mirrored currents end up fairly near each other. Clip the two transistors to the same heat sink, and glop them with silicon rubber for added thermal insulation.

It is far better to pick up a transistor array of some sort so you start out with matched devices. The Motorola MC3346 is an interesting choice. It is available from *Circuit Specialists* for $1.25 each.

Other sources of transistor arrays include *Sprague*, *National*, and *RCA*. These are usually best found as odd-lot bargains from the usual places.

Show me a hacker use for a current mirror.

What good is a current mirror to a hacker? Well, you could obviously put one on a 555 timer or an 8038 voltage-controlled oscillator to let you input a conventional 0-to-5-volt dc controlling signal. While this will certainly work, that single-chip voltage-controlled oscillator (vco) circuit we looked at last month might be a better choice.

Instead, Fig. 4 shows you an interesting concept for a current mirror circuit. Four current mirrors can convert an Apple II game input into a quad digital voltmeter, usable for any number of fairly non-precision measurement tasks.

An input of 0 to 5 volts dc is converted into an output current that, in turn, charges the game paddle timing capacitors internal to the Apple. The lower the input voltage, the higher the current through the current mirror, the faster the game capacitor will charge, and the lower the measured charging time.

Thus, low voltages give low numbers and vice-versa, varying in a linear manner. A simple X = PDL(0) can be used from Applesloth to read voltage inputs. As a more advanced project, you could easily write a "double-precision" game paddle routine in machine language. This would increase input resolution, but it is doubtful if you could get an overall "real-world" accuracy better than a few percent.

This circuit could obviously be extended to any personal computer that uses variable resistance ("volume-control") inputs. Let me know your experiences on this.

Aren't those current arrows backwards?

Hmmm. Here we go again.

Many years ago, somebody like Franklin or Faraday decided in which direction they thought current actually flowed in

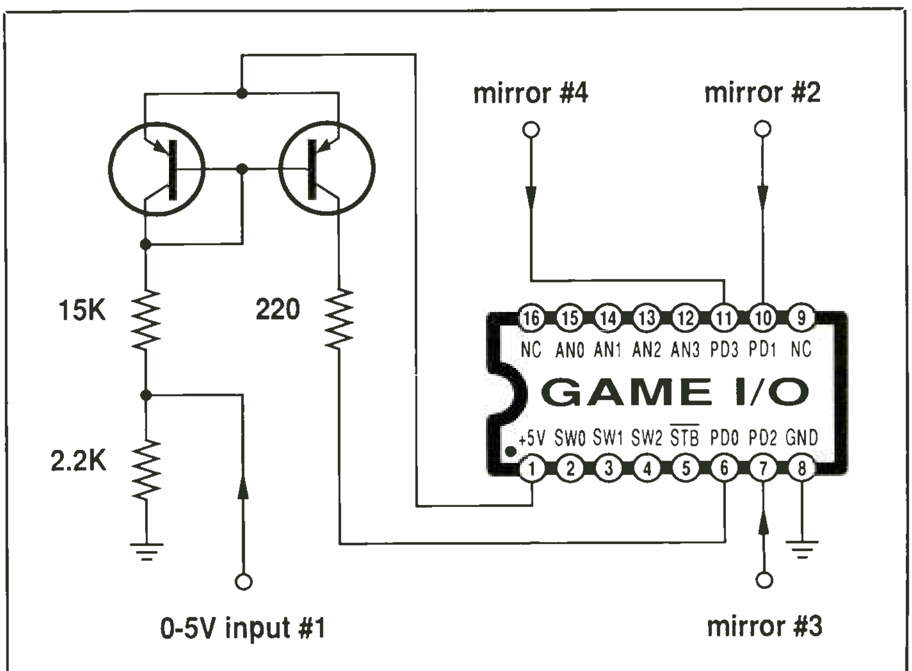

Fig. 4. Current mirror quad voltage inputs for an Apple computer.

NAMES AND NUMBERS

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BNF Enterprises 119 Foster St. Peabody, MA 01961 (617) 531-5774	**Electrovalue International** Box 376 Morris Plains, NJ 07950 (201) 267-1117	**Jerryco** 601 Linden Pl. Evanston, IL 60202 (312) 475-8440	**National Semiconductor** 2900 Semiconductor Dr. Santa Clara, CA 95052 (408) 721-3277
C & H Sales 2176 E. Colorado Blvd. Pasadena, CA 91107 (800) 325-9465	**Fair Radio Sales** 1016 E. Eureka St. Lima, OH 45802 (419) 227-6573	**Marlin P. Jones** PO Box 12685 Lake Park, FL 33403 (305) 846-8236	**RCA Solid State** Box 2900 Somerville, NJ 08876 (201) 685-6000
Circuit Specialists Box 3047 Scottsdale, AZ 85257 (800) 528-1417	**Herbach & Rademan** 401 E. Erie Ave. Philadelphia, PA 19134 (215) 426-1700	**Motorola Semiconductor** Box 20912 Phoenix, AZ 85036 (602) 244-6900	**Sprague Electric** PO Box 9102 Mansfield, MA 02048 (413) 664-4411

an electrical circuit. It turns out they made the wrong guess.

Today, all engineering schools, all graduate engineers, all electronic standards, all electronic manufacturers, all math equations, all "right-hand rules," and especially all of theose arrows on all of those schematic symbols make use of this "wrong" notation. This "wrong" method is called "conventional" current.

With conventional current, current flow in a load goes from positive to negative. With conventional current, current flow in a transistor or a diode goes in the direction shown by the arrows. The "hole" current in a semiconductor is the same as conventional current. Why, even that IEEE tie clasp is "wrong"!

Unfortunately, during World War II, some military types decided it would be easier to explain how a 35Z5 vacuum tube works by using the concept of the "electron" current. While technically correct, electron current runs backward from all of the symbols, changing all of the math equations, converting the "right-hand rules" into "left-hand rules" and creating various other absurdities.

In solid-state electronics, electron flow and hole flow are equally important and complimentary concepts. Trying to explain or understand transistors or integrated circuits by using only electron currents introduces all sorts of silly problems.

To this day, there are still a very few service schools and technician-level books that insist on the use of the electron-current concept. What happens when their students and readers graduate and go on to the real world? They end up both hopelessly confused and mystified as to why the entire rest of the world is doing things in exactly the "wrong" way.

As to having the entire electronics industry "correctly" convert to the "proper" current direction, it would take "extremely frigid conditions in a rather unpleasant locale" for that to ever happen. And there is no point whatsoever in even doing so.

The bottom line to all this? "When in Rome . . ." as the saying goes. 'Nuff said.

We will end up with a reminder about two of my newest products—my unlocked and unprotected Postscript Show and Tell for Apple, Mac and IBM that show you some laser printing tricks that others swear cannot even be done, and a new and complete set of reprints from my "Ask the Guru" column.

As usual, this is your column and you can get technical help per the "Need Help" box. If you haven't done so already, be sure to write or call for your copy of my brand-new free-stuff list. I do try to add one or two new items each month. **ME**

NEED HELP?

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

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