

# Do-It-Yourself Drive Swap

*If you can handle a screwdriver, the job isn't hard*

by Ted Silveira

**F**olklore says a computer will run almost forever if it makes it through the first 30 days. And that's largely true, because a computer has so few moving parts to wear out. But it's not true of floppy disk drives, which are full of delicate moving parts.

So what do you do when a drive suddenly gives up the ghost? You can pay a technician \$60 an hour (plus parts) to resuscitate the drive. But if you can handle a screwdriver, you have another option—buy a new drive for \$85 to \$100 and install it yourself. The price is right, and the job isn't hard.

In fact, the job is easy enough that you may want to install new drives even if your old ones are still working fine. Why? Because by installing new drives, you can upgrade from single-sided drives (191K) to double-sided drives (390K) or from either of those to double-sided quad-density drives (784K!). (To do so, you'll also need a new ROM chip, but these are cheap and easy to install. See "New ROMs for Old" on page 34.)

Here's a step-by-step guide to changing the disk drive on a Kaypro 2 or 4. The mechanical mounting of disk drives in Kaypro 10s is quite different and will not be covered in this article. Information on choosing and configuring drives applies to any CP/M Kaypro, but you should obtain a copy of the *Kaypro Technical Manual* if you are going to change drives on a Kaypro 10.

## Get your supplies

You can get a new disk drive from a local discount computer store or one of the mail-order supply houses that advertise in *Byte*, *InfoWorld*, *PC*, and *Computer Shopper*. The main disadvantage to buying from a reputable mail-order house is that if your new drive doesn't work properly, it will take longer to exchange.

Almost all the drives advertised now are double-sided, double-density, and half-height—the same kind used in the Kaypro 2X and 4'84. If you currently have single-sided drives, I still suggest installing a double-

sided drive—it will act like a single-sided drive if you don't change the ROM. If you decide later that you want double-sided operation, just change the ROM and you're ready.

If you have an older Kaypro with full-height drives, you can fit two half-height drives in the space now occupied by one drive, so you can (with the proper modifications) have four drives instead of two.

**Which Drives to Get.** To replace (or upgrade to) a standard Kaypro double-sided 390K drive, get a double-sided, double-density drive, usually advertised as double-sided, 40 tracks per side, or as double-sided, 48 tpi (tracks per inch). To upgrade to high-capacity 784K drives, get a double-sided, quad-density drive, usually advertised as double-sided, 80 tracks per side, or as double-sided, 96 tpi.

Shugart, Panasonic, TEAC, and Mitsubishi are all reliable brands. For double-sided, double-density drives, the Shugart SA-455 and the identical Panasonic J55 are quiet and cheap—as low as \$85 each. The TEAC 55B is usually a bit noisier and also fairly cheap—\$95 to \$100. The Mitsubishi 4851 is very quiet but sometimes sells for more—about \$120. You'll also find Toshiba, Tandon, Epson, and Qume drives, but I've had no experience with them.

For quad-density drives, get the Shugart SA-465, TEAC 55F, or Mitsubishi 4853, which are all similar in quality and cost to their double-density siblings.

Whichever drive you buy, try to get the necessary mounting screws with it; your old ones may not fit.

**Tools.** You'll need the following tools and supplies:

- Pencil and paper
- Tape and/or gummed labels for marking cables you disconnect
- Small jars or a tray to hold screws
- A Phillips-head screwdriver, normal size
- A 2.5 mm or 7/64-inch allen wrench, depending on which size screws are used to attach your drives
- A small adjustable wrench or nut driver set.

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**Work Space.** You need a roomy table, good light, an electrical outlet, and freedom from water, dust, static electricity, children, and other intruders. Work in a room you can close the door to, so you can leave your computer disassembled without it being disturbed.

### Get ready to work

Plan to do the job in one sitting, if possible. If you've never opened up your computer before, set aside a couple of hours, and double that if you're adding extra drives to an old Kaypro (which requires drilling new mounting holes) or doing some other extra upgrade. (These times are very generous.)

*Work in a room that is  
free of water, dust,  
static electricity, kids,  
and other intruders.*

**Avoid Static.** The integrated circuit chips inside your Kaypro are sensitive to static electricity. Some chips are more sensitive than others, but you can fry any chip with a large enough jolt of static electricity. Even if the chip doesn't keel over immediately, it can be weakened enough to fail later, or act up under high heat situations. To avoid damaging chips with static, touch them as little as possible. You shouldn't need to touch any chips at all while changing a drive, unless you're installing a new ROM chip at the same time.

More important, avoid building up a static charge yourself. Try to avoid nylon carpets, as well as clothes and shoes that produce static. When in doubt, work barefoot. Before you approach the computer, discharge any static you've built up by touching something metal like a water faucet or table leg. Then touch some bare metal part of the Kaypro chassis before you go sticking your hands inside. If you leave your work table, repeat this routine when you return.

**Unplug Everything.** Make sure you unplug your Kaypro before taking a screwdriver to its case. If you unplug the power cord from the computer itself, you'll know at a glance whether it's plugged in or not.

### Open up your Kaypro

Everything unplugged? If not, do it *now*. Remove the top of the Kaypro's case. This piece is held on by 10 screws—four on each side and two on the top. Remove these screws, and put them safely away. Grab the cover at the bottom of each side, flex the sides out *slightly* to free it, lift it straight up, and set it out of the way.

Before you go any further, make sure you've discharged any static you may have built up.

For your own sake, be careful when you reach inside the computer. The video monitor and power supply sections both contain large capacitors that hold a dangerous jolt for some time after you've turned the

computer off.

**Survey Your Kaypro's Insides.** As you face the front of the computer (where the screen is) and look down from the top, you'll see something like Figure 1, below.

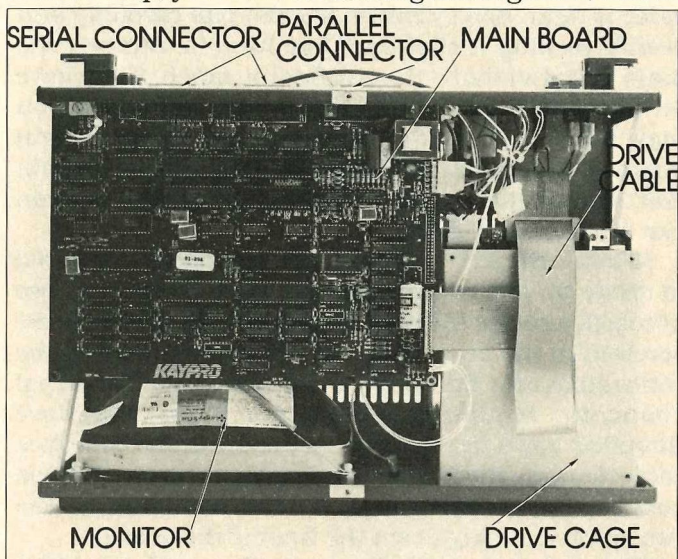


FIGURE 1: Top View of Kaypro With Cover Off

The large green board covering the left half of your computer is the main circuit board, and the black rectangular things with silver legs (like futuristic insects) are the integrated circuit chips that do the computing. You may see some empty chip sockets—black rectangular things with holes for the chip legs to fit in—for chips that weren't needed on your model.

Coming off the right side of the main board, near the front, is the broad, flat drive cable, which connects the circuit board to the floppy disk drives. Next to the drive cable is a small four-wire plug that connects to the reset button. Toward the back on the right side of the board is a larger plug whose wires go to the power supply, which is mounted on the back of the case, under the main board. Along the back of the main board are the serial and parallel port connectors, and in the back lefthand corner is a small plug that connects to the brightness control.

Near the left front of the computer is the monitor—the screen showing in front and the rest disappearing under the main board.

Finally, at the front on the right side, you'll see what looks like an aluminum box—the mounting cage for the disk drives. At its back, you'll see the back end of the disk drives with the drive cable plugged in.

### Out with the old

On the right side of the drive cage, you'll see four allen screws holding the drives in place. If you peer down the left side of the cage, you'll see four more that aren't as easily accessible. To get at them, you should disconnect and remove the main circuit board.

**Disconnect the Main Board.** Sketch a map of the circuit board, showing the location of each cable plug-



ged into the board, then number each location on the map, and attach a label with the corresponding number to each cable.

Once you've labeled the cables, unplug them. If a cable is tight, don't yank on it—just pull carefully and evenly, rocking it slightly if you have to. Support the main board so that it doesn't flex too much. If you have an '83 model Kaypro with a speed-up modification, you may have some extra wires running to your main board. If these are permanently attached (soldered), don't detach them. They'll cause some bother, but you can work around them.

**Remove the Main Board.** The main board is secured in front by two screws and in back by one or two brackets and the I/O port connectors, all of which are screwed to the case. Take out the screws holding the connectors and brackets to the case first. The serial connector mounting screws are brass and have threaded holes in the ends for securing the interface cable. Remove them with a 3/16-inch nut driver. Let the connectors rest loosely in their holes. Next, take out the two screws holding down the front of the board.

The main board should now be free, with no cables and no screws attached to it. Holding it by the left and right edges, pull it slightly forward until the port connectors clear the back of the case, and then lift it straight up. Set it out of the way, preferably on a wooden surface.

If there are wires connected to the main board that you can't remove, there should be enough slack to let you free the board from the case, turn it 90 degrees, and rest it on the top edges of the case, somewhat out of the way. (As you work, though, be careful not to knock the main board off its perch.) If there isn't enough slack in the wires, get a technically adept person to disconnect and then reconnect the wires for you.

### *Set the main board out of the way, preferably on a wooden surface.*

**Disconnect the Old Drive.** Each drive has three connections: the drive cable, which is a broad, flat cable that goes to the main board; the power cable, a white plug with three wires; and the ground wire, a single green wire. On the drive you're going to remove, label each one, noting what it is and which drive it goes to. Also note how the connector on the drive cable is oriented so that you can reconnect it the same way (the other plugs can only be connected one way). Unplug all three cables from the drive.

**Remove the Old Drive.** Each drive is held in place by four allen screws. To remove them you will need either a 7/64-inch or 2.5 mm allen wrench. The 7/64-inch size is by far the most common, but a 2.5 mm allen wrench will be needed for some drives. This is one area where

Kaypro is a little erratic, so there is no way to tell which one you will need. It would probably be safest to have one of each size.

First, remove the two front screws from the drive you want to replace. You don't have much room to get at the front screw on the left side, but you can manage it with the short arm of your allen wrench. Next, remove the two rear screws, using one hand to support the rear of the drive. Once all four screws are out, slide the drive carefully out through the front of the case. Set it in a safe place. If you're replacing both drives, label each one—you may need to put one back if one of your new drives doesn't work.

### **In with the new**

Before being installed, a disk drive must be configured according to whether it will be drive A or B and at the beginning or end of the cable. If you buy your drive from a local store, they may configure it for you. If not, you can do it yourself.

**Configure the Drive.** Each drive needs two options set—the *terminating resistor*, which tells the computer whether a drive is the last one on the cable, and the *drive select jumper*, which tells which drive it is (A, B, C, etc.). These two options are usually found on the top of the drive at the back, near the drive cable connector, though their exact location varies with different brands. Figure 2, below, shows their location on a Shugart drive. (*Editors' note: The preferred method to obtain drive configuration information is to purchase the manual, usually the OEM manual, for any drive that you will be working with.*)

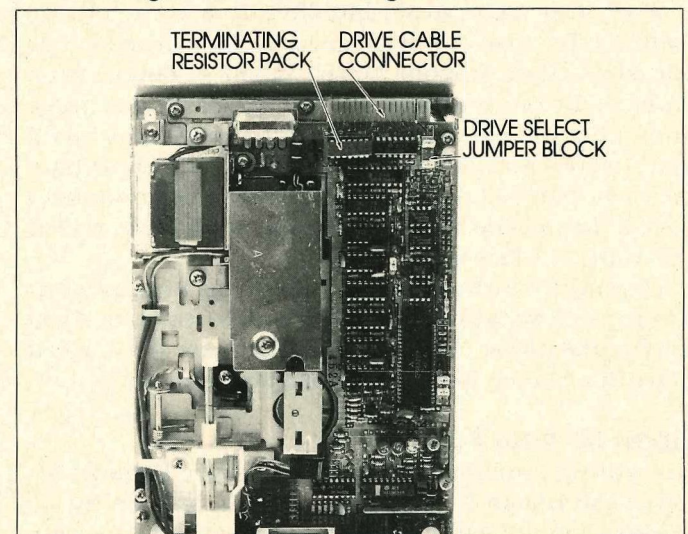


FIGURE 2: Top of Shugart SA455 Floppy Disk Drive

**Set the Terminating Resistor.** The terminating resistor is usually a shiny black or blue piece with legs plugged into a socket. Often the circuit board of the drive will have a silkscreened number, something like RP1 or RA1, near this resistor.

Leave this resistor in place if the new drive is going to be the last one on the drive cable—that is, the drive on



the end of the cable farthest away from the main board. It doesn't matter which drive this is (A, B, etc.) or how physically close it is to the main board, just that it is the last drive on the cable. If the drive is not the last one on the cable, remove the resistor. The resistors should be removed from all drives except the last one on the cable. If you can't find the terminating resistor, and you didn't get any documentation with your drive, call the place you bought it from, and ask them where it is. (Mitsubishi drives, for example, don't have a removable resistor, just a series of jumper blocks that you remove to defeat the resistor.)

**Set the Drive Select.** At the back of the drive, near the drive cable connector, look for some pins sticking up from the drive's circuit board. There will be eight or more of these pins, arranged in two parallel rows, as shown in Figure 3.

Next to the pins, you'll see numbers, either 0 through 3 or 1 through 4, possibly preceded by DS (for "drive select"). You'll also see a small jumper block—either metal or metal-lined plastic—covering one pair of pins, probably the first or second. This block determines whether the drive will act as drive A, B, C, or D. If the pins are numbered 1-4, then putting the block on pair 1 sets the drive as A, putting it on pair 2 sets the drive as B, and so on. If the pins are numbered 0 through 3, then 0 sets the drive for A, and 1 for B, etc. This procedure is

known as "jumpering."

If the jumper block is not in the right position for the new drive you're installing, pull it off and push it firmly down over the proper set of pins.

Some brands of drives also have additional jumper options. If you have pins labeled HM and HS, jumper

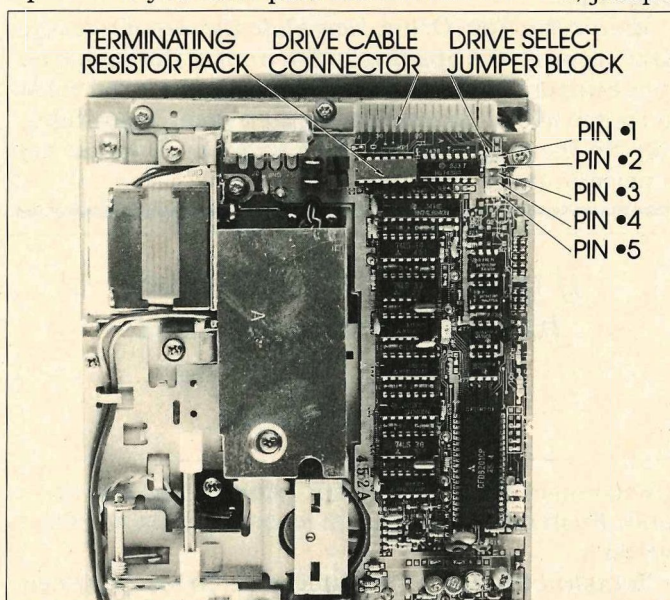


FIGURE 3: Blow-up of Top Back of Shugart SA455 Drive

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HM. If you have a Toshiba drive, jumper both HM and LD. If you have a Shugart or Panasonic drive, you'll find three pins labeled MX—jumper the left and center pins. If you find unexplained jumper pins, call the people who sold the drive and ask how to set the extra jumpers.

**Mount the New Drive.** Now slide the new drive into place through the opening in the front of the computer case. Support the back of the drive with one hand while you put in all four screws and tighten them finger-tight. Tighten them up with the allen wrench—firm but not Superman-tight.

*If you find unexplained jumper pins, call and ask how to set the extra jumpers.*

Reconnect the ground wire, power plug, and drive cable. Push each one on until it seats firmly, but don't overdo it.

**Reinstall the Main Circuit Board.** To test your new drives, hook up the main circuit board again. Pick up the board by its edges, slide the port connectors through their holes in the back of the computer case, set the board in position, and put in the two front screws. You can leave off the other screws until you've tested the new drive; just don't jostle the computer.

Plug in the cables, including the drive cable. Seat them firmly, supporting the board when you push them on so that it doesn't flex too much.

**Special Note on TEAC Drives.** For some reason known only to its designers, the TEAC drive cable connector is backward from the cable connector of other disk drives. On a typical drive, pin 1 is the bottom righthand pin on the drive connector, but on a TEAC, pin 1 is the top lefthand pin.

So, if you've substituted one or more TEAC drives for your previous non-TEAC drives, you must twist your cable around to get the connection right. Fortunately, the edge of the ribbon cable that goes to pin 1 is colored (usually red), while the rest of the cable is gray, and the connector on the cable itself has a mark (usually an arrow or wedge-shaped mark) on one edge that indicates pin 1. Guided by these two clues, you can twist and flop the cable to get it positioned correctly for each drive.

### **Test the new drive**

Now the big step. You're going to briefly hook up the power to your computer to test the drive. *While the power cord is plugged into the computer and the cover is off, don't stick your hands anywhere inside the computer.* Play it safe, even if you know what you're doing.

Plug the power cord back into your computer, turn the computer on, and stick a disk in the new drive (and also in drive A, if it's not the new one). Does the computer recognize the disk and start up properly? Can you get a directory of the new drive? Can you run a simple program from it? Does everything seem normal (no smoke, sparks, or weird noises)? If the answer to all these questions is yes, you're in business.

If anything out of the ordinary happens—especially if you see sparks or smell smoke—unplug the computer immediately. Double-check all connections, and call an expert. If sparks or smoke appear during this test, you will probably need to have repairs made before having a technician finish the modification.

**A Few Words About Drive Noise.** All drives have a certain maximum rate, called the step-rate, at which they can move the drive head from one track to another. Oddly enough, a drive moving at its maximum rate is usually quiet, while a drive forced to move more slowly

*(continued on page 68)*

## **New ROMs for Old**

Inside the Kaypro are two special ROM (read-only memory) chips that give your computer much of its personality. One of these ROMs contains part of the Kaypro's operating system and has a lot to do with how the disk drives operate.

Several companies sell custom ROMs that replace this standard Kaypro ROM and offer many improvements. Among other advantages, they make the disk drives read and write more quickly, let you use double-sided double-density or double-sided quad-density drives (or both together), and make it possible to run up to four drives on your system.

Installing one of these custom ROMs is quite simple. For most Kaypros, you just remove the cover, pull the old ROM out of its socket, and stick the new ROM in. For an old Kaypro II, you need one extra modification, which these companies also sell.

Prices for these ROMs range from \$25 to \$80. For more information, contact:

Pro-Monitor ROM  
Micro Cornucopia  
P.O. Box 223  
Bend, OR 97709  
(503) 382-5060

TurboROM  
Advent Products, Inc.  
3154-F E. La Palma Ave.  
Anaheim, CA 92806  
(714) 630-0446

Roadrunner ROM  
Highland Microkit  
P.O. Box 21B  
Highland, MD 20777