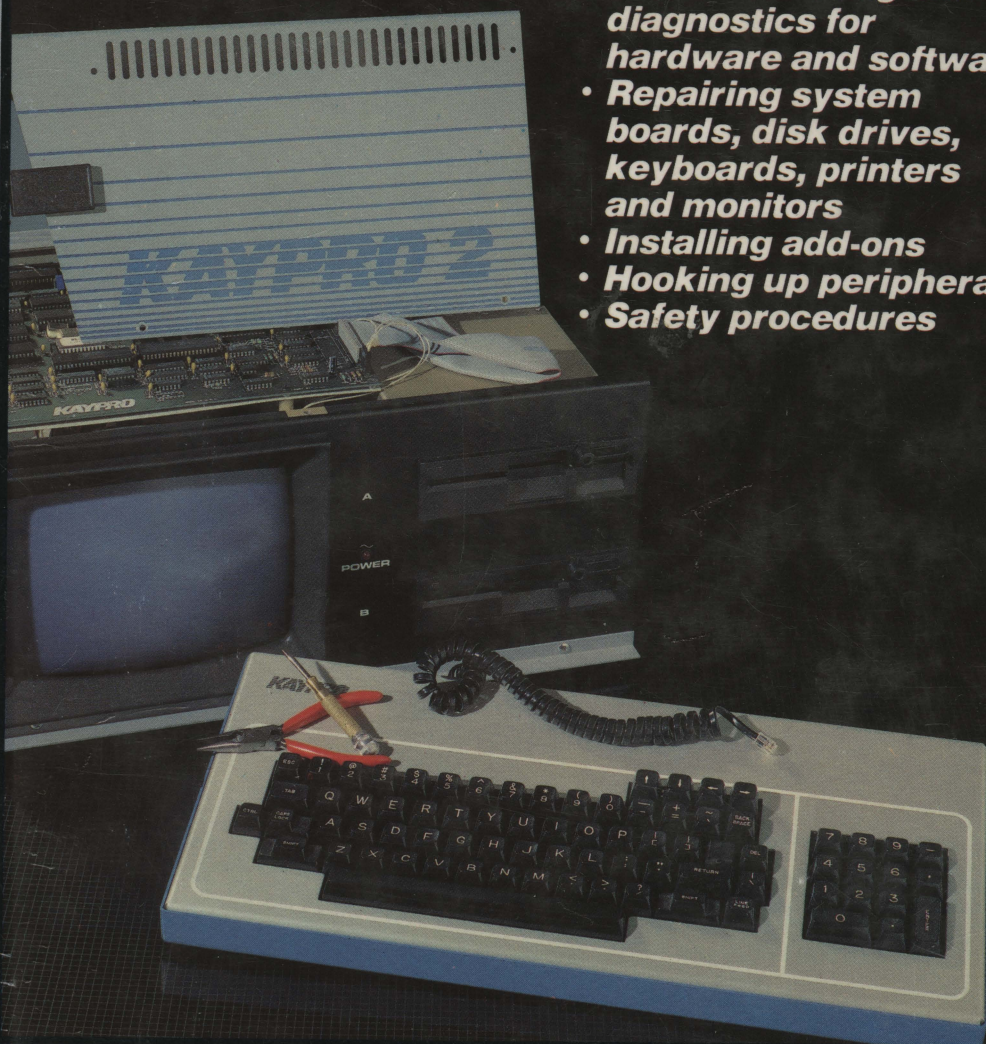


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CHILTON'S GUIDE TO
KAYPRO
REPAIR and
MAINTENANCE

Gene B. Williams

- **Troubleshooting and diagnostics for hardware and software**
- **Repairing system boards, disk drives, keyboards, printers and monitors**
- **Installing add-ons**
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CHILTON's Guide
to
Kaypro
Repair and Maintenance

Gene B. Williams

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To RUTH
and the new office
she made possible



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Preface

A few years ago I bought my first computer. I was facing a tight deadline. The computer was checked out before I packed it into my car and brought it to the office. Back in the office, I plugged it in, booted up the program. Nothing! The screen was blank.

I called the seller to explain the problem. He said that he couldn't be out until the following Wednesday. So much for my deadline. The only solution was to try a diagnosis by phone.

He told me to open the case. I was convinced that the second I did that, the machine would be ruined for all time. A look inside confirmed my fears. There were what seemed to be several hundred memory boards along with enough mysterious components to launch the next deep space probe. I had about as much desire to touch the insides of the machine as I have to jump out of a moving car.

Under the dealer's direction, each board was pulled, cleaned, and inserted back into the system board. What should have been a 30-second job took 30 minutes. I was so sure that every movement would break something important that I did everything very slowly.

I tried to get the computer to operate again, thinking that a reset might cure the trouble. Absolutely nothing! The dealer repeated, "I really can't make it there before Wednesday. Oh, by the way, have you checked the contrast control? Maybe you bumped it."

"Contrast control? What contrast control?"

"It's on the left, beneath the keyboard."

I reached under and felt a little wheel. "You mean that little wheel thingy?"

Suddenly the screen came to life with all the signs and symbols it was supposed to display. The problem was solved and I met the deadline.

As the months went by, I ran into other problems. I went through the same feelings of helplessness each time. A computer is an extremely complicated piece of machinery, isn't it? To repair one, doesn't it require years of training and experience, plus a room full of special tools and test equipment?

Most of my problems turned out to be minor. Repair was usually handled with tools no more complex than a screwdriver. A few times I had to get "technical" and use an ordinary voltmeter.

Then I became involved with other computers. The knowledge I'd gained from my first computer carried over. From conversations with other computer owners, I found out that most not only knew very little about their machines, but were practically terrified of them.

As a result, this handbook and guide was developed. It will help you in taking care of the most common failures in a personal computer system. With rare exception, the average person can do it. A computer is nothing all that grand and mysterious. It's just a machine—sophisticated perhaps, but a machine all the same. There are only so many reasons why a machine fails to work.

The purpose of this book is to save you *at least* ten times the cost of the book. More important to some, it will save you a great deal of time, both in waiting for the technician and in driving to and from the shop. If you're standing in a book store reading this, *buy this book!* If you've already bought it, congratulations! You won't regret it.

Kaypro offers several models. This book provides information on all of them. Although each model is different from the others, most of the steps are identical for all models. When there is a difference, it is noted in the text, photos, and drawings.

My thanks go to several people who were helpful in putting this book together for you. Jim Pearson helped with the technical side of things. Marc King at Kaypro went well out of his way to help make the book complete and accurate technically. Then there are several, such as Chris Mitchell, who read the book for ease of understanding.

A very special thanks goes to the owners (Larry Grebe, President, and Daryl Gardner, Vice President) and employees of Sigma American Technology Group, Inc., in Phoenix. Not only did they put themselves out to help get the book completed, their suggestions and technical input were invaluable. Emerson Cleveland deserves extra mention for tirelessly stripping down various computers so we could take the photos.

CHILTON'S Guide
to
Kaypro
Repair and Maintenance



Introduction

Not all that many years ago, the world of computing was more or less confined to big business. The average person couldn't hope to afford a computer. Special schooling was needed to operate one. Then along came the idea that computing need not be difficult or mysterious, followed immediately by the advent of home computers.

The popularity of home computers is due largely to the fact that they are becoming easier to operate. Not many years ago, the person who had a home computer was thought to be a genius (or a "nut"). There were very few commercial programs available, which meant that the owner of a home computer had to have a solid knowledge of programming. All that has changed now.

Ask any ten people today. Several will own a computer. More yet will be in the category, "We're thinking about it." Nine out of ten are likely to have some kind of computer around—a pocket calculator if nothing else.

Almost anyone can operate a computer. You might enjoy your computer more if you learn some programming, but all you really need are preprogrammed diskettes. Push one in, press a few keys, and you're ready to go.

Meanwhile the cost for technical work—repair, installing add-ons, etc.—has jumped. Charges of \$60 per hour or more for labor alone are common. Some shops charge a \$150 minimum just to look at a malfunctioning machine.

Average downtime for such a repair is 3 days. Having the machine tied up for a week or more isn't unusual. If the computer owner needs the technician to come to his or her home or place of business, all costs increase.

To avoid the high costs of repair, some owners purchase a repair contract. The normal charge for such a contract is between 5% and 10% of the purchase price per year. A fee of 20% isn't unheard of. Several sources say to expect repair costs to be at least 1% of the system purchase price per month without such a contract.

To make things even more depressing, it has been said that 95% of all repairs and other technical work could be taken care of by the computer owner without special tools or technical background. About one-third of all the repairs require nothing more complicated than your fingers. When tools are needed, it's rare that you'll need anything but simple ordinary tools you probably have already. (See "Tools You'll Need" at the end of this chapter.) There is often no need for you to spend those hundreds of dollars or to wait a week (or even a day) while the repair is being done, nor even the time you'd spend going to and from the shop.

ADVANTAGES OF THIS BOOK

The purpose of this book is to show you just how easy it is to diagnose and repair most computer malfunctions. It will also show you how easy it is to maintain a system to reduce repairs. You don't need a knowledge of electronics. It helps, but you can handle many normal repairs without it.

Chapter 1 acquaints you with the rules of the game. Its purpose is to show you what can cause trouble or damage, both to you and to the computer. Danger spots are revealed to prevent you from getting a shock. Cautions and precautions are given to keep you from making costly mistakes. If you read this chapter thoroughly and use the information in it, you are highly unlikely to run into trouble while working on your computer.

Chapter 2 shows you how to diagnose malfunctions and how to get your computer to diagnose itself. (A computer is a powerful tool, if you let it be one.) Additional tips are provided in this chapter on how to track down a problem. Chapters 3, 4, 5, and 6 take you deeper into the specific problem areas.

Proper maintenance can reduce repair costs dramatically. Chapter 7 will tell you how to reduce problems and repair costs by prevention. After you've read this chapter you'll know what to do and what not to do. Knowing how to do many of the little tasks to keep your computer happy and healthy can save you a great deal of time, expense, and frustration.

Unless you knew ahead of time exactly what you needed in a

computer system, there will come a time when you want to add something to your computer. It might be a second printer, a phone modem, or some modification to the hardware to make the computer even more versatile than it already is. Whatever you care to add, you'll find the help you need in Chapter 8.

By following the steps in Chapter 2 you'll have a good idea as to what the malfunction is. For those jobs you don't want to handle yourself (or can't), at the very least you'll have a good idea of what has gone wrong. This in turn will help to reduce the repair costs and will greatly reduce the risk of paying for unnecessary repairs. Chapter 9 will give you some additional tips to help you find a reliable technician, and how to deal with this person.

Even if you have no background in electronics, you can still handle most repairs and maintenance. However, the more you know, the easier it will be. Check with your local library for books on basic and advanced electronics. Your goal isn't to become an electronics whiz, but just to have a better understanding of what is going on, and consequently what is going wrong and why.

It is suggested that you read through this entire book before tearing into your computer. Even those sections you don't think you'll need are important. This will help give you an overall idea of what your computer does and how it does it. Don't be in so much of a hurry that you end up causing more problems.

Before you start yanking out parts or devices, go through Chapter 2 (Diagnosis) carefully. Imagine that something has gone wrong and the computer will not accept programs. If you just tear into the machine without thinking, you could spend hours trying to find out what is wrong (if you ever find the problem at all). Proper diagnosis will guide you to the source of the malfunction. If the problem is with the drives, why spend time with the video board? The few minutes you spend with this chapter can save you hours of wasted effort.

Once you've done this, you can go to the appropriate chapter for further details. For example, if diagnosis indicates that the problem is with the disk drives, turn to Chapter 4. If the problem seems to be with the power supply, go to Chapter 6.

Use this book correctly and it should save you at least ten times its cost in the first repair. (As a practical example, my own system board failed. By using the information in Chapter 5, I saved close to \$200.) Instead of spending that 1% per month (\$264 per year on a \$2200 system) or that 10% per year (\$220 on the \$2200 system), you could be spending only \$50 per year, or much less.

Why spend more than you have to?

Expenses aren't counted in dollars alone. There is the time involved. Time waiting for the technician to come, or time wasted in driving to and from the shop. If you're one of the many who live a considerable distance from the shop, you could spend an entire day driving to and from the shop, and waiting to have the technician look at your computer. Then there is downtime, when your valuable computer is useless.

You bought your computer to save time. Why use up what you've saved in waiting hours or days only to find out that you could have fixed the trouble yourself in a few seconds?

An added benefit will be that you will understand your system better. You'll know what can go wrong. You'll learn how to fix the most common problems, and even how to prevent troubles.

TOOLS YOU'LL NEED

The Kaypro is a highly sophisticated machine. It is also extremely well designed. The more you work with it, the more obvious this will become. Because of this intelligent design, you can troubleshoot and repair your computer with nothing more than a few basic tools. The main tool is the computer itself. An ordinary multimeter will help you perform various tests to spot the exact cause of the trouble. With this book as a guide, you have just about everything you need.

Unlike so many machines of "modern" manufacture, almost nothing in the Kaypro requires a special or expensive tool. Chances are, you already have all the tools you need. If you don't, the cash outlay to equip yourself will be small.

1. Screwdrivers—Using nothing more than a standard screwdriver and small and medium headed Phillips (with insulated handles to protect yourself), you can just about completely disassemble your Kaypro. The keyboard is held together with screws; the system board is held with screws; the drives are kept in place and held together by screws. There is very little in the computer that *doesn't* come apart with a tug of the fingers or a twist of an ordinary screwdriver.

2. Needlenose pliers—You'll rarely need regular pliers. However, having a needlenose at hand makes retrieving dropped parts easier. They also help to remove parts that are being desoldered.

3. Nut drivers—These are like fixed socket wrenches. Although none of the screws on the computer have hex heads, the screws on some peripherals can be removed and installed with either the screwdriver or a hex nut driver. A nut driver often makes removal and

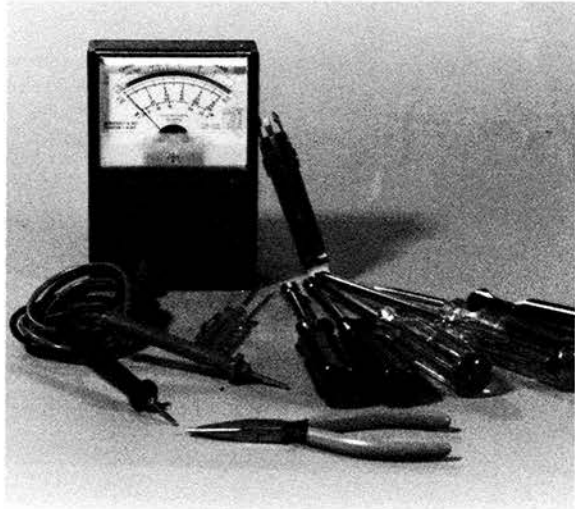


FIG. I-1 Tools you'll need: screwdrivers, needle-nose pliers, nut driver set, VOM, and IC extractor.

replacement of the bolts, nuts, and screws easier, faster, and safer. They are also handy when working on certain peripherals, such as printers.

4. Multimeter—To test for voltages, to measure component values, and to check for continuity you will need a fair quality multimeter. It doesn't have to be a fancy digital multimeter. Voltages measured will be in the 5 and 12 volt DC ranges, and 120 AC. It should also be capable of measuring resistance (in ohms). Accuracy is important, especially when measuring voltages. If you're not familiar with the use of a multimeter, practice using it before probing inside the computer. For example, take readings of the various outlets in your home to check for AC voltage. Use the meter to check some batteries (DC voltage). If you have some old resistors lying around, check these for correct resistance. It doesn't take long to learn how to use it efficiently and accurately.

5. IC extractor—Some of the integrated circuits (ICs) on the expansion boards in your computer are plugged into sockets. Replacement of these is a simple job, but a risky one if you try to do it with your fingers alone. The many prongs of the IC are easily damaged, and it is during removal that most of the damage to the prongs occurs. An IC extractor is used to remove the chip from its socket safely.

6. Hex wrench set—Some of the screws, such as those that hold the drives in place, have hexagonal heads. To remove these devices you'll have to have a set of hex wrenches (sometimes called Allen wrenches).

Optional Tools

With the screwdrivers, nut drivers, and the multimeter, you'll be able to take care of almost any problem. Other tools, such as those listed below, are merely to make the job easier.

1. Digital soldering tool—If you intend to change single components, you will have to have a high-quality soldering gun, one designed specifically for digital circuits. (If you will not be replacing soldered components, you won't need this tool. You can put off the investment—about \$50—until you need it.) The tool should have a rating of no higher than 40 watts. If possible, the tip should be grounded to avoid electrical damage to delicate components.

2. Desoldering tool—This is a fancy name for a heat-resistant syringe. Its function is to suck away solder from a heated joint. (Some people call this tool a "solder sucker.") Without it, removing components is possible, but difficult.

3. Wire cutter—New components often have metal leads that are too long. This means that they must be clipped to the proper length. A wire clipper handles this job correctly and efficiently. Some pliers have built-in clippers. These may be suitable for cutting wire but are not meant to trim the leads of components that are soldered in place.

4. Knife—A small, sharp knife can be used for many jobs. Used correctly it can be a valuable tool.

5. Alignment tools—It's rare that the video board will need to be

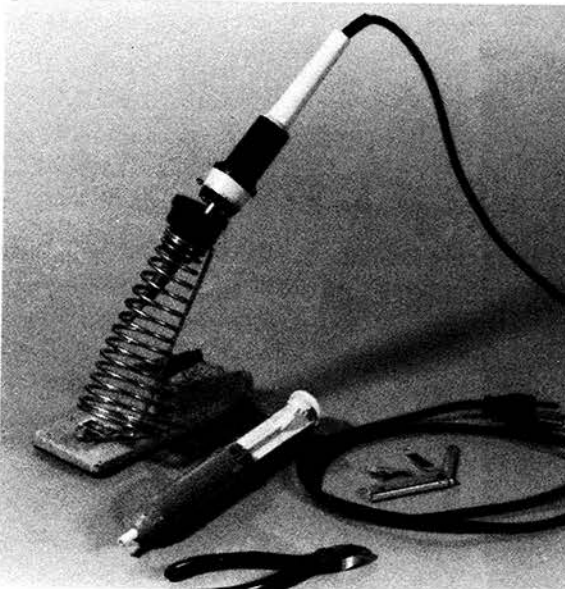


FIG. I-2 Optional tools: soldering and desoldering tools, wire cutters, knife, and alignment tools.

realigned, and it's far better to leave this job to a professional. However, if you wish to handle it yourself, a set of plastic alignment tools is essential. The only ones that will work are those that are all plastic. Do not use alignment tools that have metal tips. These cause subtle changes in the flow of current in certain adjustable components which makes alignment impossible.

Table I-1 lists the tools described in the above paragraphs. "RS" denotes that the part is available at Radio Shack at a competitive price. Anything equivalent will work as well. Do pay attention to the quality of the tools. Some have a thin metal plating that can flake off. These flakes can get down inside the computer and cause a variety of serious problems.

You may also find an assembled tool kit, such as the one available from Heath Company (part number GHP-1270, \$39.95), will suit your needs. Radio Shack carries a smaller, but adequate, tool set for \$14.95 (part # 64-2801). This set lacks a Phillips head screwdriver and hex wrenches, however.

Note: Most of the tools do not have to be specifically for electronics. For example, the screwdriver or pliers you use to work on the car will do just fine (as long as they are clean!).

TABLE I-1.
Required and Optional Tools

<i>Part</i>	<i>Part Number</i>	<i>Approximate Cost</i>
Screwdriver (blade)	Any	\$2.50-6.00
Screwdriver (Phillips)	Any	\$2.50-6.00
Multimeter (VOM)	RS 22-201	\$19.95
IC extractor/installer	RS 276-1574	\$6.95
Needlenose pliers	Any	\$5.00-10.00
Nut drivers	RS 64-1800	\$4.99
Hex wrench set	RS 64-1849	\$1.99
Soldering tool (Weller)	TC201 & TC202	\$79.95
Desoldering tool	RS 64-2085	\$8.79
Wire cutter	RS 64-1841	\$3.79
Knife	Any	Varies
Alignment tools	RS 64-2220	\$2.99
Cleaner/degreaser	RS 64-2322	\$1.99

Chapter 1

Best Results/Minimal Time

Have you ever watched a child take apart a toy? The usual way is for the pieces to go flying in all directions, without any order or planning. Parts that don't come off easily are broken off. Some roll under the couch; others get stepped on; some just disappear.

When it comes to reassembling the toy, the child rarely has the slightest idea of what to do or how to do it. That's when the child brings it to mommy or daddy with big, wet eyes and says, "My toy broke. Fix it for me."

A fair number of computer repair jobs come as a direct result of an adult "child" getting inside his or her electronic "toy" to find out how it works, or in an attempt to repair some malfunction. Quite often what started out as a minor problem turns into something expensive.

Sure, you can save yourself hundreds of dollars per year by doing your own repairs and maintenance and by installing any add-on equipment yourself. Approach it incorrectly, however, and your mistakes can end up costing many times what the repair should have cost to begin with. Sometimes in ways you didn't expect.

YOUR SAFETY

Nothing is more important than your safety. If you do something that destroys a circuit in the computer, that circuit can be replaced. Even if repair of the malfunction costs several hundred dollars, you can take out a loan if need be and get it paid off over a period of years. If you let something happen to you—well, there is no such thing as taking out a loan for more life, at any interest rate.

There are actually very few danger spots in your computer. Even

while in operation the voltage inside the computer (past the power supply and excluding the CRT monitor) is either 5 volts or 12 volts, both DC (direct current). The amount of current flowing through most of the circuit is so tiny that you wouldn't even feel it.

The direct current used in the operation of most digital circuits isn't at all dangerous to a human being. However, there are certain places where the voltage and current aren't safe. These spots are usually where AC (alternating current) power comes into the device. Touch one of these places and you're in for a bad time.

The power supply is exposed, along with several hot spots on that board. Due to the tight quarters inside the computer, it's all too easy to come into contact with 120 live (and deadly) AC volts. For example, as you reach inside to make some adjustment to the video board, the back of your hand can brush against the fuse block.

The Kaypro uses an internal CRT monitor. To operate, 13,000 volts are needed. Although the current is quite low, the combination of that current and that voltage is potentially deadly. Worse yet, the CRT has the tendency to store up this charge. Shut off the power, and unplug the machine, and the dangerous charge will still be present.

This charge can be drained off by shorting the high voltage lead to ground, which reduces the danger (Figure 1-1). However, it is best to leave any fiddling or testing of the CRT to someone who knows how to safely handle the high voltages. In short—stay away!

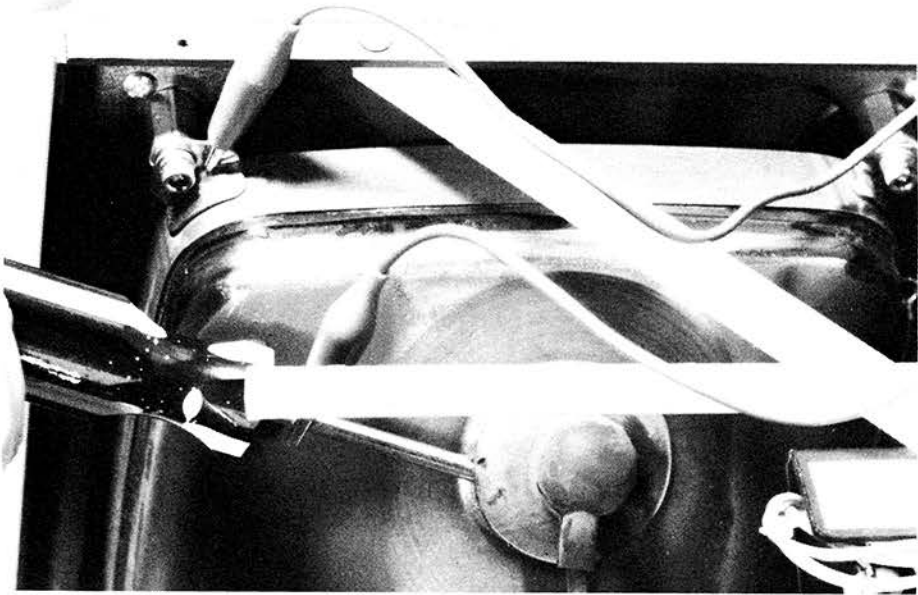


FIG. 1-1 Discharging the CRT.

EFFECTS OF CURRENT

The line coming into the power supply of your computer, and into most peripherals, is 120 volts AC (alternating current). The amperage can be as high as the physical limits of the wire and the circuit breaker or fuse. Usually this means that the line is 120 volts with a current of at least 15 amps steady, plus a surge limit in the hundreds of amps. This is enough power to melt a metal rod, and more than enough power to kill.

Tests were done by the U.S. Navy to learn the effects of alternating current with a frequency of 60 cycles per second. (The measure of frequency is sometimes made in hertz, with one hertz being the same as one cps.) It was found that a tiny trickle of just 1 milliamp (.001 amps, or one one-thousandth of an amp) would produce a shock that could be felt. A current of 10 milliamps (.01 amps, or one one-hundredth of an amp) would cause the muscles to become paralyzed, making it impossible for the person to let go of the source of the shock. In fact, the spasms caused by this amount of current can cause the person to grip the source more tightly. At 100 milliamps (one tenth of an amp) the shock is usually fatal if it continues for more than a second.

As you can see, it doesn't take much current to bring on a severe hazard. If you carelessly touch a hot spot, you will become a part of the power circuit. For a short time (until the fuse or circuit breaker pops) the current flows unhampered. You risk having a surge of perhaps a hundred amps flow through your body, which is more than 1,000 times as much as is needed to be fatal.

DANGER SPOTS

Anywhere there is AC power presents a risk to you. Most of these spots are obvious and are easy to avoid. The danger begins with the wall outlet (or the circuit box if you ever get to fooling around there). It moves up through the wires and into the power switches.

The wires come into the equipment and are connected in such a way as to make it difficult to touch the contacts. However, you might touch them accidentally if you're not careful. The power supply board is exposed in the Kaypro, and is attached to the chassis under the mainboard. The power supply is one of the two real electrical dangers to you inside the computer. (The CRT is the other.) Repair of the power supply is normally handled by replacement. You should not attempt to repair it.

The Most Dangerous Spots

- 1. Wall outlet**
 - 2. Power cord**
 - 3. Power switches**
 - 4. Power supply**
 - 5. CRT (monitor)**
 - 6. Filter capacitor**
 - 7. Printer and mechanical parts**
-

Another danger within the power supply circuitry is the filter capacitors.

There is rarely a need to fool with the power supply. Repair is handled by replacing the entire unit.

Past the switch and within the power supply are small “cans.” These are the capacitors. One of their functions is to help change the incoming AC to the needed DC. The AC comes into the power supply, where it is changed by a transformer in value to the 5 volts and 12 volts needed. The filter capacitor helps smooth out the flow. To do this it stores up current as it comes in, and then lets it flow out again in a steady stream.

Even after the computer is shut off, and even with the power cord pulled from the outlet, the capacitors can have a hefty charge inside. Theoretically they should drain themselves of all charge in a matter of seconds. Normally there is no danger. But if something goes wrong with the circuitry, you won't know it until you touch the capacitor contacts—at which point you'll find out all too quickly.

The Kaypro and most peripherals have power going directly to the switches. (With the computer, it passes through an AC filter and a fuse, but it is still hot at the switch.) It's a common misconception that a switch is safe when it is in the “off” position. It is not safe unless the power cord has been removed from the outlet. If you happen to touch the incoming contacts it would be the same as if you grabbed the bare power lines or stuck your fingers in the wall socket.

The power supply of the Kaypro has two fuses—one mounted in the chassis, and another mounted on the power supply circuit board.

The chassis mounted fuse is rated at 2 amps. The board mounted fuse is rated at 2.5 amps. This second fuse is best changed with a fuse puller because of the closeness of other components on the board. Many peripherals also have fuses.

With the switch "off," there is no current flowing through the circuitry or device beyond (assuming that everything is functioning properly). A fuse cannot do this. It is there for the protection of the circuits inside, not for your protection except in a limited sense. If a short circuit occurs, the power supply will begin to draw large amounts of current. In a very short time this increased flow can cause serious damage. It could also cause a fire. The fuse helps to prevent this from happening.

If the fuse is rated at 2 amps, this simply means that if the current reaches a level higher than this, the fuse wire will melt and current will not flow beyond the fuse. For a fraction of a second more current can flow, however. Worse, if you create a short circuit across the fuse, that fuse will do nothing at all. Your body, the screwdriver, or other tool becomes the new fuse. Normally this means that you're once again grabbing a bare wire with 120 volts and temporarily unlimited current.

With the power switched to "off" you can safely change the internal fuse, the fuse holder, and other power handling components inside the power supply. (Better yet, shut off the switch and unplug the computer or peripheral.) This again assumes that the switch is operating correctly, and that the wires are all connected as they should be. To work on the external fuse, the switch, or the incoming filter, unplug the computer from the wall.

Before you begin, take a moment to get out the voltmeter to measure if there is voltage present.

The monitor is another source of high voltage. There is the 120 volts AC coming to it. This is a danger in itself, but the danger doesn't stop here. The monitor is a CRT (cathode ray tube) which works by throwing electrons at the phosphor-coated screen. This requires a considerable charge. The larger the monitor is, the larger the voltage required to form an image. Even a small monochrome monitor, such as the one in the Kaypro, will require a few thousand volts (13,000 volts, in fact). The current (amperage) is low, but this doesn't make the monitor safe.

The built-in monitor of the Kaypro reduces the risk and increases it at the same time. It reduces it because the monitor is small and requires a relatively small voltage to operate. It increases the risk because the CRT and its circuitry are right there where you can bump

or touch them while working inside the cabinet. Be extremely careful while working anywhere near the monitor and the related circuits.

The monitor brings yet another danger, and one that has nothing to do with electricity. The screen tube has a vacuum inside and thin glass walls. Striking the tube can cause an implosion. This in turn will cause very sharp slivers of glass to be thrown around, each of them coated with the phosphor.

MEASURING VOLTAGE

Although most equipment manufacturers do their best to reduce the risks of accidents, you still have to be careful. I've never heard of it happening with the Kaypro itself, but there have been cases when electronic equipment, such as peripherals, have been shipped with the power wires connected in the wrong order. A "hot" was connected to a spot which should have been "dead." A technician who assumed that everything was as it should be could be in for a shock—literally.

If you are going to be working on the main lines coming into a piece of equipment, the power switches, or anywhere that an AC power might be present, don't take the chance that the spot or contact is dead just because it is supposed to be. Measure the voltage. Better yet, unplug the equipment—and then measure.

Don't trust anything unless you've measured it and know that no current is present. Even then, be careful. This rule applies whenever you're working around something electrical.

Testing for "hot" is easy to learn if you don't already know how. With a voltmeter or other testing device, touch one probe (usually black) to a known ground, such as the metal chassis of the computer. Be sure to hold the probe by the insulated handle only. The other probe (usually red) gets touched to the suspected point (Figure 1-2). Assuming that the meter is functioning properly, and that you've put it into the proper testing range, it will tell you if a charge is present, and how large that charge is. You can also test for an existing current by touching the two probes across the device, such as touching the two contacts of a switch.

Setting the meter to the correct range is important. If you intend to measure the voltage at the monitor screen, don't have the meter set for 3 volts. (The setting should be in the thousands of volts.) If you're testing for AC, don't have the meter set to test for DC. You're asking for trouble if you just jam the probes inside the computer without first looking to see if the meter is properly set.

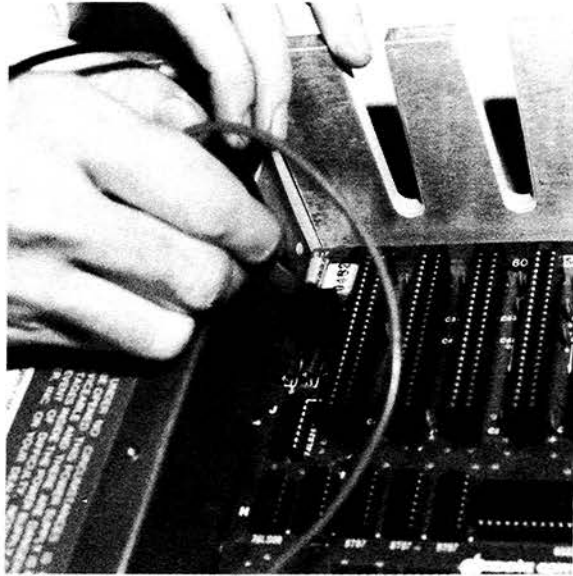


FIG. 1-2 Learn how to use a voltmeter.

SAFETY RULES

Working around electricity demands a set of safety rules. The first step is to shut off the power. The main switch will cut the flow to parts farther in. It doesn't protect you completely, though, since the wires between the switch and the wall outlet are still hot, and because there are certain stored charges inside the computer.

You might think that the best way to protect yourself completely would be to unplug the computer. This is true, with reservations. While pulling the plug does remove the current coming in from the wall outlet, it also removes the safety of a ground wire. This step is more to prevent damage to the computer than to yourself. Whether you unplug the computer or not depends on the repair you're doing. (Normally it's best to unplug.)

With or without the plug, assume that all circuits are live and carry a potentially dangerous current. (The vast majority do not, but if you treat them as if they do you are unlikely to cause damage to either the computer or to yourself.)

You can't see electricity, nor can you tell by sight if a circuit is hot (active). The only immediate indication of power flowing inside the computer is the light on the computer and the soft hum of the cooling fan (if you have one), which is easy to ignore once you become accustomed to it.

By making voltage measurements, you assure that you're not

sticking your fingers in places where damage will be done—damage to you or to the computer.

Never probe or poke inside the computer with any part of your body touching a conductive surface. Avoid leaning on the chassis, a metal work bench, or anything made of metal if you are reaching inside. Also take care that your feet aren't touching anything conductive (which includes a damp floor). In short, insulate yourself from your surroundings and from the equipment.

To further protect yourself use the "one-hand rule." This means, simply, don't reach in with both hands at the same time. Most often the rule states that one hand should be kept in a pocket. This is to avoid the temptation of breaking the rule. If one hand is in a pocket, you almost have to consciously remove it to reach inside the machine.

The idea behind this rule is to prevent your body from becoming a part of a circuit. If just one hand touches a spot and your body is insulated from all conductive surroundings, the current has nowhere to go. If a second hand touches a hot spot, the current can enter the one hand, pass through your body and out through the other hand.

A corollary to the one-hand rule is to keep the back of the hand toward any potential hot spot. The reason for this is the physical reaction you have to a shock. The muscles contract. If the fingers contract around the source of the shock, it will be much more difficult to break free. However, if the contraction is away from the source, the contraction could actually free you from the shock.

All tools should have insulated handles. Touch the tools only by these handles. It's sometimes tempting to grab a part of the blade of a screwdriver for better control, for example. Don't do it! The insulation is on the handle for a reason.

Personal Safety Rules

- 1. Probe carefully.*
- 2. Don't touch conductive surfaces.*
- 3. Observe the "one-hand rule."*
- 4. Use only insulated tools.*
- 5. Beware of jewelry, hair, neckties, loose clothing.*
- 6. Moving parts can be dangerous.*

Many people realize that grabbing a tool by the metal is foolish, and then forget that the necklace they are wearing is made of metal. It will conduct current just as well as the shaft of a screwdriver—better if it's made of gold or silver. The same caution applies to other jewelry, such as rings. These won't be as likely to fall onto a dangerous spot, but they can touch it and carry the current into your body.

A dangling necklace might also become entangled in some mechanical part. Inside the computer the only moving part is the fan for cooling the computer, if you have one. You're unlikely to catch yourself in this. Peripherals are another matter. Printers in particular are loaded with moving parts. Most have a tag inside warning you to remove jewelry and to be careful of long hair. (Having it yanked out by an angry printer is no way to get a haircut.)

There is no such thing as being *too* safe. Just when you think that you've taken every possible precaution, look for something you may have forgotten.

COMPUTER SAFETY

Once you've taken the necessary precautions to protect yourself, you can begin to think about the well-being of the computer. As with personal safety, computer safety is basically a matter of common sense. Things such as, "Don't punt the computer across the room no matter how angry you get" and "Don't resort to your hunting rifle just because you're losing at Pac-Man" are obvious (or should be, although you'd be surprised at some of the things people have done to their computers). Other don'ts are just as obvious if you take a moment to think them out.

In certain ways the computer is a surprisingly tough piece of machinery. If it operates for the first week or so, it's unlikely that anything major will go wrong for many, many years (unless you cause it). Even if you do make some mistakes in operating or repairing the computer, chances are good that you won't do too much damage.

This doesn't mean that you can be careless. Just as you assume that all circuits are holding deadly charges just waiting to get at you, assume that any mistake will cause the immediate destruction of a \$500 circuit. (It is possible.)

Again, there is no such thing as being *too* careful.

PREVENTING PHYSICAL DAMAGE

The most common damage done by the do-it-yourselfer is physical. Physical damage is also the least necessary. There is no reason or

excuse for it. By being in a hurry, by losing patience, or by being careless, the wrong thing is done at the wrong time and something snaps.

Most of the parts of your computer are tough. But others can be damaged all too easily. Caution is the key at all times, no matter how tough you think something is.

When removing a connection, do so with slow and steady pressure (Figure 1-3). These are supposed to be somewhat tight, to maintain a reliable contact. They're not in so tight as to require the strength of both arms and a foot. If it doesn't move, there is usually a logical reason.

One computer operator decided that the signal cable connectors to the disk drives were too difficult to remove. He took the probe of the voltmeter and jammed it into the slots of the cable to widen them. Then he was amazed that the operation of the drives was sporadic, at best. He ended up having to replace the cable at a premium cost.

NEVER force anything. Take the few extra seconds to find out why the board or component won't move easily.

The components inside your computer have anywhere between 2 and 40 connectors. Each of these leads is prone to physical damage, mostly from bending them too far. The ICs are particularly sensitive. They have a number of metal prongs projecting from them (Figure 1-4). More often than not, the prongs on a new IC are in the wrong positions for easy installation. Bending them manually is the usual solution for the computer owner who is installing chips. This brings

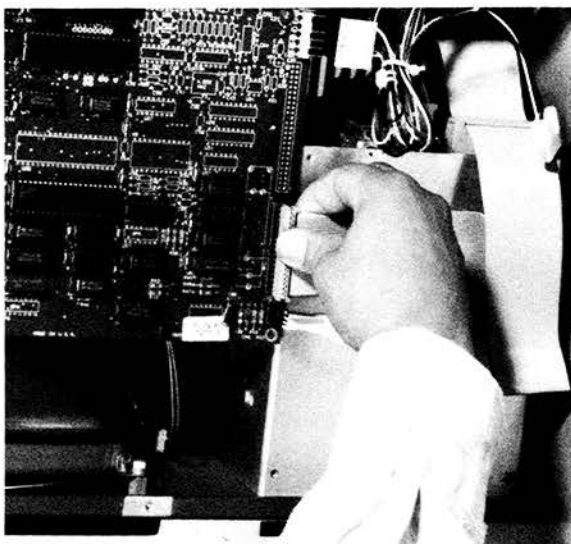


FIG. 1-3 To remove a connector, be firm, but don't force it.

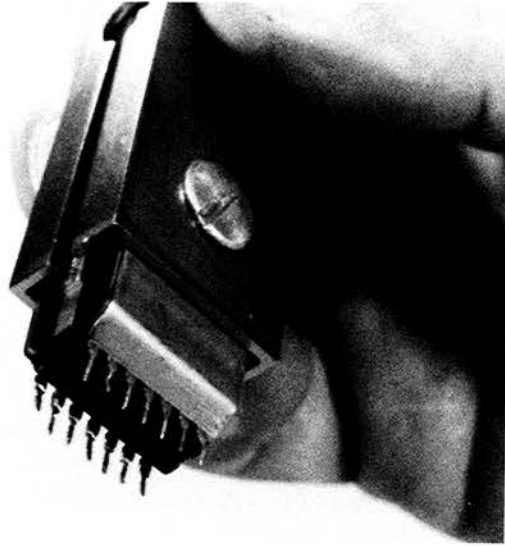


FIG. 1-4 IC extractor.

in the danger of bending the prongs too far (or too little), and then having to bend and rebend the prongs.

The prongs are thin, and this bending and rebending creates stress on the metal. The prong may break off. It may also crystalize in such a way that the current flow changes, making a seemingly good chip useless.

The solution to this and to related problems is to use the proper tools for the job at hand. Two special tools are available to handle the delicate chips. One is made to put the prongs into the correct places for installation (an "IC installer"). The other is designed to aid in the removal of chips (an "IC extractor"; see Figure 1-5). Both tools are fairly expensive for someone who plans to install or remove just one chip per decade. Both are inexpensive when you consider the cost per ruined chip. If you want to reduce the risk, at least get an IC extractor.

These tools offer an additional safeguard. Some of the chips in the Kaypro are extremely sensitive to static. Your body has the tendency to store up static charges. You have probably experienced a tiny shock when touching a doorknob or other metal object after walking across a rug. If the charge was enough for you to feel it, it was probably enough to fry the insides of a delicate chip. A static charge you cannot feel may still be enough to ruin a chip.

The IC extracting and installing tools will help prevent this from happening. You can reduce static build up by treating the carpets, either with a commercial product or with a dilute mixture of water

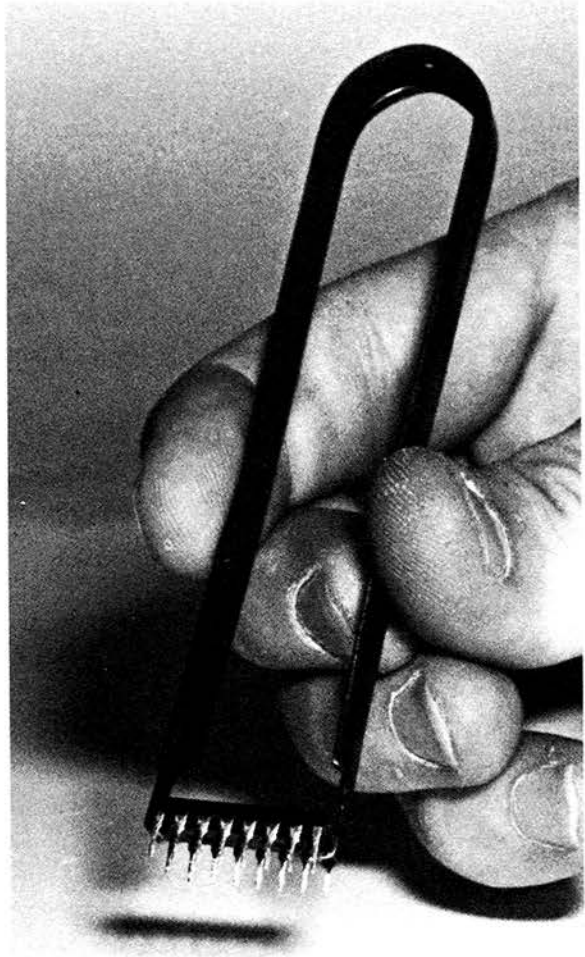


FIG. 1-5 The prongs of an IC are delicate and the inside can be ruined by static. *Handle with care!*

and standard fabric softener. You can also make use of a “static discharge device.” This is a device connected to a ground (such as a neutral screw on a wall outlet). You touch a metallic spot with your finger. Any static charge your body might have is drained off safely.

SHORT CIRCUITS AND OHM’S LAW

The second most common type of damage caused during repair is a short circuit. This can happen in several different ways.

The usual way is to touch the metal tip of a tool or probe across two points that are not meant to be connected. Most often this won’t

matter. Other times it will send a circuit off into oblivion with a cloud of smoke.

There is a mathematical relationship between voltage, amperage, and resistance. This is stated by Ohm's Law: $E = I \times R$, where E is the voltage, I is current in amps, and R is resistance in ohms. If you multiply the current times the resistance you'll know the voltage.

With some basic algebra you find out $R = E/I$ and $I = E/R$. By sticking some numbers into that last formula you can see what happens with a short circuit. It simply states that the current flowing is equal to the voltage divided by the resistance.

The voltage remains constant due to the design of the power supply. In most circuits this will be 5 volts. If the resistance is 10,000 ohms, the current flowing is .0005 amps. A short circuit effectively drops this resistance to near zero, which means that the current will flow to the limit allowed by the power supply (about 2.5 amps). For computer circuits designed to handle just fractions of a milliamp, the effect can be disastrous—like trying to instantly force a few hundred gallons of water through a tiny hose meant to carry just a few ounces.

In the previous section mention was made of the danger of necklaces and other jewelry causing current to flow into your body. While working inside the computer itself there isn't enough current flow to cause any harm to you. However, the rule about jewelry applies, this time to protect the computer. If that necklace swings down and creates an electronic bridge, you may not be able to feel the effect, but the computer probably will. Resistance drops to near zero. As a result, current swings in the other direction.

The human body normally has a very high resistance. Unless your hands are wet, touching an active circuit inside is unlikely to cause any damage. (This means a digital circuit, not one of those that carry high voltage or AC.) A ring on your finger or a watch on your wrist is another matter. The metal will act the same as if you had connected a wire from spot to spot.

All these are fairly easy to keep track of. Pay attention to what you're doing and you should have no problems. Other things that can cause shorts are more difficult to notice.

When taking things apart, keep careful track of the various screws, bolts, nuts, and other metal parts. Take notes. Make drawings if you think they are needed. It's all too easy for a part to fall inside the computer unnoticed, only to cause troubles later on. When you turn on the power, that forgotten chunk of threaded metal becomes a surprisingly efficient conductor.

It is less likely, but still possible, that small bits of metal will fall

inside the computer. The average computer owner won't have to worry about these unless a screw has been forced (which could strip off a piece of the thread) or unless the lead of a component has broken off.

PREVENTING ELECTRICAL DAMAGE

To prevent accidental short circuits, flip the switch to cut off the power before removing anything. There is only one reason for the power to be on while working inside the computer, and that is for testing, probing, and measuring (and those must be done carefully). For anything else, the power should be off and should remain off. Make shutting down the power your automatic response, and applying power what you stop and think about.

Computer Safety Rules

- | | |
|--------------------------------------|----------------------------------|
| <i>1. Shut off power.</i> | <i>5. Use the proper tools.</i> |
| <i>2. Take notes, make sketches.</i> | <i>6. Avoid short circuits.</i> |
| <i>3. Don't be in a hurry.</i> | <i>7. Check for screws, etc.</i> |
| <i>4. Never force anything.</i> | <i>8. Beware of static.</i> |
-

Imagine yourself going inside the computer for a simple repair, such as to replace a faulty IC. You forget the "rule" and leave the power on. You're being careful and use an IC extractor but touch the edges of the metal tool to active circuits ("zzzt, zzzt, zzzt"). The faulty chip is pulled and you go to install the new one. You've been careful about reinstallation and know that everything is where it is supposed to be. But nothing works. You scratch your head and say, "Now how could that have happened?"

This isn't likely to happen. What is important is that it *could* happen. If a board or component is removed while current is flowing through it, the current value often changes. As the value changes in one place, other changes will take place elsewhere. Small changes probably won't cause damage, although they can cause the circuit to "age." Larger sudden changes have effects similar to those of short circuits or static discharge, namely they destroy the circuit from the inside.

When working inside the computer (with the power off!) pay

attention to what you are doing. Look carefully at any connector you are going to remove. Make notes and sketches so you have something for reference. (Keep these notes and sketches handy for future times when you want to get inside the computer.) Before you turn the power on again, look around inside. Are all the connectors back in their proper places? Have you let any screws, nuts, or bits of metal inside?

COMPONENT REPLACEMENT

Most of the time a component failure will be handled by replacing an entire board. Even professional technicians use this method of repair. Although board replacement may sound expensive, the time involved in tracking down a problem to a single component often ends up costing more than a new board.

Since you probably do not have the equipment that the technician has, nor the knowledge to use it, you will probably confine most repairs to board replacement rather than component replacement. (When you handle the repair by replacement, keep in mind that the malfunctioning board or unit has a trade-in value.)

There will be times when you will be able to identify the exact component and will want to replace just this piece. When this is possible, the saving to you is large. Most of the components in your computer cost very little. Diodes, resistors, and capacitors cost just pennies. The ICs are often just a few dollars. Many of the ICs used in the computer can be purchased for under a dollar.

The first step in component replacement is to make certain that the new component is exactly the same as the one it replaces. (If you're uncertain about which parts are which or how to read the component values, pick up a book on basic electronics.)

Some components have polarity. An electrolytic capacitor, such as the filter capacitor in the power supply, has positive and negative leads. Install a new one backwards and it could explode! Other components won't react so violently but could cause damage throughout a circuit. Expensive damage. ICs that are not installed correctly can burn up and may take a whole string of other components and circuits with them.

Even when you aren't replacing a component, pay attention to polarity. To do many repairs you'll be disconnecting cables and other wires. Most of these have special keyed plugs, making it impossible to reconnect them with the wrong polarity. You may run into a few that don't have this intelligent design.

Taking notes and making sketches are important parts of any

repair. Get into the habit, even when you don't think that you'll need the notes and drawings. There is no need to be a professional artist or writer. What you do is primarily for your own use, a jog to your memory. Assume, though, that others will be using these. (It's possible that you'll have to consult a pro on the repair. The notes you take, and the drawings you make, could save you quite a bit of time and money, regardless of how bad they are.)

SOLDERING

Some components plug into place. The newer mainboards have quite a few socketed ICs. On older boards most are soldered into place. On both, the other components are soldered.

Despite what you might think, soldering is an art. It's not the kind of skill you can learn in a few minutes. With circuits as critical as those of a computer, you certainly shouldn't be practicing inside your computer. There are a number of books and pamphlets available on how to solder. *Heath* offers a course in soldering. Before you even consider soldering inside the computer, learn everything you can about it. Then practice, practice, practice.

The soldering iron used for digital circuits, such as those in the Kaypro, should be rated at no more than 30 to 40 watts (Figure 1-6). Anything hotter could easily damage the circuit or the board. Even with the lower-powered iron, anything more than a few seconds of contact is risky. Many components are very heat sensitive. The in-

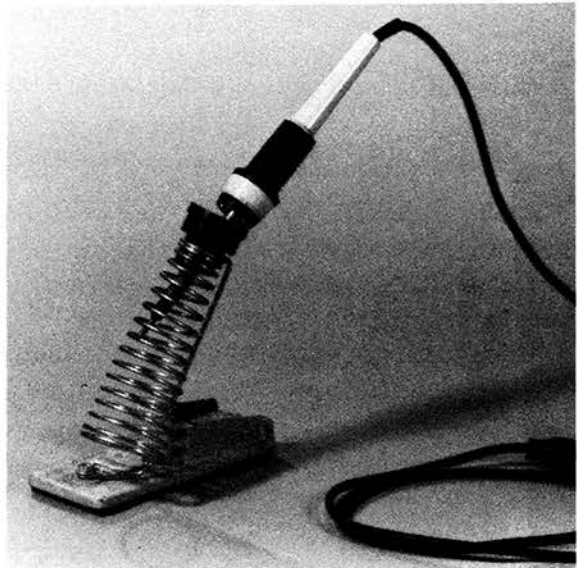


FIG. 1-6 A soldering tool for digital circuits.

ternal goodies can all too easily be fried. The board may also be damaged permanently. If this happens, you may as well scrap the board and buy a new one.

The soldering iron should be designed specially for digital soldering. These irons are more expensive, but the extra cost is a necessity. They have grounded tips, which prevents damage from any build-up of electrical charge. *DON'T* try to use any old soldering iron or gun for the job.

To remove a component, especially one with many contacts (such as an IC), be sure to use a desoldering tool. This inexpensive device removes the melted solder from the contacts, making it possible to simply pull the old component loose. Move slowly and carefully so as not to cause damage. The more contacts the component has, the trickier it is to remove it.

PREPARING TO WORK

Before you begin any repair you should have a solid understanding of the correct procedure. Diagnosis and repair is a logical sequence of steps. (More on this in Chapter 2.) Learn these steps. Follow them! They'll save you money, time, and a whole lot of trouble.

The first step is so simple that most people ignore it. Make backups of every bit of software. Many books and courses suggest this and mention making a copy. Instead, make at least two copies. Having the original plus the two copies helps to protect you in a number of ways.

If you don't know how to make a copy, refer to the "Copy" or "PIP" sections in your owner's manual. After copying, perform an accuracy test. Run each copy to be sure that it works properly or that it contains the correct data. Testing after copying is a step that should *always* be taken. Without it you don't know for certain if your copy is a copy or is just a useless diskette.

Protect Yourself

- 1. Make at least 2 backups*
 - 2. Test the backups*
 - 3. Store the original and one backup safely*
-

There are software losses through fire, water, forgetfulness, and so forth. These should always be of concern to you, however unlikely they might seem at the moment. You must also consider loss through the machine.

In one large computer repair house a certain technician fed in a working disk. There was a problem with the disk drive. The result was that the machine "ate" the diskette. His solution was to feed in a second diskette. The computer destroyed this one as well. So he booted up a third; then a fourth. By the time he figured out that the drive was annihilating the recorded programs, five copies were destroyed.

This may sound silly. A professional *should* know better. The average operator may not. If the problem is intermittent, it would be very easy for even an experienced operator to waste a program or two before realizing what the problem is.

If your machine doesn't accept the original, check it with a copy. If this copy doesn't work, chances are good that something is wrong with the drive. If the malfunction has erased the first two, you have the third to protect yourself.

WHERE IS THE PROBLEM?

Computers are extraordinarily reliable. Most people have come to think of machines as being at fault when something goes wrong. In many cases this is true. When a car suddenly stalls on the freeway, it is usually a machine error. When a television or radio refuses to work, it is usually the fault of the equipment. With a computer, the fault is more often with the person running it.

Most of the common machines are designed so that anyone can operate them. There aren't many things for the operator to change or vary. A television, for example, has very few controls. The owner can switch it on, change the channel, and change the contrast and color within limitations. Beyond this, about all the television operator does is to sit back and view.

Operating a computer normally involves pushing a variety of buttons, each of which does a different task. It's like having thousands of controls available instead of just a half dozen. Just as the computer offers more controls, it brings many more opportunities for making mistakes.

Before you tear into your computer, make sure that the fault lies with the computer. Chances are good that the fault is your own or is

the fault of the programmer. Most malfunctions are not the fault of the computer.

One of the first questions you should ask yourself is, "Has it ever worked?" An untried program may have flaws. Even a known program may have bugs in it. A tried-and-true program may give out after a number of uses. (Diskettes are well manufactured, but aren't without error, nor do they last forever.) Then there are those programs that you use every day for their normal functions, but that have other capabilities you haven't yet used. When you get around to trying out the other capabilities, you must ask "Has it ever worked?" again.

Your first suspicion should be with yourself (or the operator of the computer). Software documentation is notorious for being poorly written. Do you understand how to work the program? Have you read through the instruction manual completely? Are you trying a new function of the same program?

Second in the line of things to suspect is the software itself. If you have backup copies, try one of these. (If you have been using the program successfully and have tested the copies for all functions, you can eliminate the "Has it ever worked?" question.)

Another test is to boot up a different program. For example, if your word processing program isn't working, try your accounting program or one of the games you have. Kaypro gave you a number of programs with the computer, so there are plenty that you can try. (Be sure to read the manual for that piece of software if you're not already familiar with its operation.)

Important Questions to Ask Yourself

- 1. Has it ever worked?*
- 2. Has that function of the program ever worked?*
- 3. Do other programs work?*
- 4. What is working, and what is not?*
- 5. What did I do wrong?*

If you have checked out any possible operator and software failure, the next step is the visual check. Look for what doesn't look right. Don't start pulling boards and components until you've completed

this step. Look for the obvious. Much of the time you can solve the problem with very little effort.

Perhaps you've dropped a screw or nut and this is shorting one of the internal circuits. Maybe the door to the disk drive is cracked and won't allow the spindle to make proper contact with the diskette (an unfortunately common problem).

Software protection schemes can also cause operating problems. Some half-height drives are strictly 48 TPI (tracks per inch). One protection scheme puts certain information halfway between the tracks. The half-height drive may be incapable of seeking the information here, which in turn means that the program won't load.

Notes should be taken throughout your inspection. Even before you begin your diagnostics you should have something written down. What is working. What is not? Jot down all the symptoms along with any errors that the computer shows. As you go on with your diagnosis, continue to take notes.

Don't waste your time on parts that are functioning properly. Diagnosis is a process of elimination. If you know for a fact that the drives are accepting programs, that your printer is operating, that the monitor is giving a correct image for what is being sent to it, then eliminate or ignore these sections of the computer. If the problem is that the RAM won't hold data, why waste time taking apart the drive? All you can do is to cause more problems.

Where Is the Fault?

1. Operator

2. Software

3. Peripherals

4. Disk drives

5. Computer

Begin with the most obvious and the easy. Work your way to the more complex.

All checks begin with the cabinet closed. Make a note of what is happening, or is not happening. Check and recheck for operator error, then for software error or for diskette failure. Only then should you

think about opening the cabinet. You should have at least a fair idea of what you're looking for before opening the cabinet.

When this step comes along, move slowly and deliberately. With the box open look around for the obvious. Don't just start tearing into the computer. All you can cause is damage if you're in too much of a hurry.

PREVENTING PROBLEMS

Chapter 7 deals with maintenance. Your Kaypro has been designed and built to require very little maintenance. You can pretty much ignore your machine, almost to the point of abuse, and it will keep going.

But there are still some TLC requirements.

The greatest enemy of the computer is dust. A tiny fleck of dust that your eye can't even see can gouge a diskette to uselessness. Dust combined with humidity can cause short circuits.

Yet dust is everywhere. All you can really do is to reduce the amount that gets into your computer, particularly into the mechanical parts. Some dust on the boards is unlikely to cause any problems. Just a few invisible particles on the disk drive heads can slice the data on a diskette to shreds.

Keep the area around the computer as clean as possible. DO NOT use a feather duster or anything like it. A slightly damp rag will pick up the dust rather than toss it into the air, where it will do even more damage. Store all diskettes safely, both inside their jackets and inside a diskette storage box.

Computer Enemies

- | | |
|------------------|------------------------------------|
| <i>1. Dust</i> | <i>5. Other contaminants</i> |
| <i>2. Liquid</i> | <i>6. Humidity</i> |
| <i>3. Food</i> | <i>7. Weight or pressure</i> |
| <i>4. Smoke</i> | <i>8. Carelessness (i.e., YOU)</i> |

One threat you can eliminate entirely is that of food and drink. Make it a policy never to allow anything spillable within a 20-foot

radius of the computer. If you or some other operator wants a cup of coffee, it's time for a break away from the computer.

Liquids in particular are dangerous. A spill into the keyboard can require total replacement of the keyboard, plus possible repairs inside the computer due to short circuits.

SUMMARY

The do's and don'ts are little more than common sense put into practice. If something seems silly, don't do it. If it seems logical and sensible, think it over before you do it.

A computer is a logical machine. Things don't go wrong for no reason. There is always some reason. Just because you can't see it right away doesn't mean that the reason isn't there.

Don't attempt to do anything unless you have some idea as to what you are doing and how to do it. Likewise, don't attempt a repair without the proper equipment. To put it even more simply, "When in doubt, don't."

Some of the problems can be solved immediately, in less time than it takes to call in and wait for a repair. Others may take more time. You'll learn which problems to tackle yourself and which to save for a technician.

The First Steps

- 1. Read the book thoroughly.*
- 2. Read Chapter 1 again for safety tips.*
- 3. Perform diagnosis (Chapter 2).*
- 4. Read applicable repair chapter (3-6).*
- 5. Repair or replace.*
- 6. Consult a professional if needed (Chapter 9).*
- 7. Back in operation again!*

In making repairs, keep in mind that the design of the machine demands exact components. If a resistor goes out, the replacement for that resistor must have exactly the same value.

Suspect yourself first. Next, suspect the software and diskettes. After this, begin all checks with the cabinet still closed. Take notes constantly. Make sketches where applicable. Don't trust your memory.

Finally, do read through the entire applicable chapter before you attempt to work on a section of your computer. If you suspect the drives, for example, read Chapters 3 and 4 thoroughly before you begin. (Read Chapter 2 even more thoroughly before you do anything!)

Repair and maintenance of a computer is not difficult. People with less intelligence than you have are doing it every day and without making errors. At the same time, people with more intelligence are messing things up faster than they can be repaired, almost always because they refuse to follow "the rules."

Chapter 2

Diagnosis: What's Wrong with It?

When something goes wrong with your computer, it's tempting to immediately remove the cover and start poking around. Even if you have some idea as to what has happened (or has not happened), this is probably the worst way to begin. The cure of a problem *always* begins with the cabinet closed, and usually with the power off.

Diagnosis is a step-by-step process. One thing at a time. Often you can skip certain steps. When you do, you should know that you're skipping them and why. (This will be because the step has taken care of itself automatically, such as checking to see if the computer is plugged in. Obviously you don't have to check this if power is getting to the computer.)

The primary diagnostic steps are covered in this chapter. Once you have tracked a problem to a particular system or device by using these steps, you will be guided to the correct section of the book for further diagnosis and for the final repair or replacement.

For example, imagine that your computer refuses to accept a program. The problem could be caused by many things. This chapter will take you through a diagnosis until you have tracked the problem to a single part of the computer system. If the problem is in the software you would then turn to Chapter 3 for more details. If the preliminary diagnosis indicates that the problem is caused by the disk drives you would go to Chapter 4.

It's as simple as that. When a problem comes up, begin right here in this chapter (unless you already know for sure what is causing the problem). Diagnosis is little more than a process of isolating the cause of the problem. By using this chapter you can eliminate many of the

things that are not causing the problem. You can then more easily pin down what is malfunctioning.

Throughout the diagnosis process take notes, lots of them. What is happening? What is not happening? What symptoms are you noticing? If you have to take the computer to a technician later on, those notes will save you time and money. Even if you perform the repair yourself, the notes will help to guide you along, and will also serve for future reference.

The notes should include sketches. This way you'll have an easier time reassembling things after you're finished. Don't trust your memory. It's too easy to forget that screw #17 fits into such-and-such slot to hold this particular thing to that particular thing.

The plugs and connectors are keyed. Even so, keep track of which connector goes where. The more you disassemble, the more important will be the notes and sketches.

BEFORE OPENING THE CABINET

Most problems and malfunctions can be taken care of without ever taking the computer apart. Many can be spotted and cured without even turning on the power.

There are four steps before you open the cabinet: (1) check for operator error, (2) check for software error, (3) look for the obvious, and (4) observe symptoms.

CHECK FOR OPERATOR ERROR

A computer has remarkably few hardware malfunctions. Despite its appearance, the computer is relatively simple—much less complex than, for example, your television set. If something goes wrong with the television set, the chances are good that the fault lies in the set. After all, there is little chance of operator error. Even the new programmable television sets require little on the part of the operator compared to a computer.

The computer works because of what the operator does. It has hundreds of controls, generally accessed through the keyboard. The more controls you are required to operate, the more likely you are to mess up somewhere along the way. Then add to this the accidental flubs, such as pressing the wrong key, and you begin to appreciate the differences between operating a computer and operating a television set.

If you are the operator, much of the time you'll know when you

make a mistake. If the operator is someone other than yourself, this may not be true. It's possible that as an operator tries to recover from the error the problem gets worse, making your job of tracking it down more difficult.

Your first BASIC programs are excellent examples of how important operator error can be. Each command has to be just right. A program gives directions to the computer and guides it through the complex electronic maze inside. Give it incorrect directions and the computer will get "lost" (shown by the computer announcing an error).

Don't think that operator error can only occur with "homebrew" programs. Even software that has been professionally written and produced isn't free of suspicion. (See the next section.) A flawless program can present some very strange troubles if you don't understand its functions, characteristics, and quirks.

Does the operator know how to operate the program? Is it a new program, or perhaps a new feature of a familiar program? (Has the program or function ever worked?) If either is true then it's possible that the "malfunction" is nothing more than a lack of knowledge on the part of the operator.

If you could spend some time in a computer repair shop and listen to some of the malfunctions (and their solutions), you'd come to realize just how many things the operator can do wrong. It has nothing to do with being stupid or even careless. Most of the time the problem is due to an honest mistake. One operator was never shown how to start the machine, let alone how to run it after it was going. Another had the power cord kicked out by the family dog and couldn't figure out why the computer was dead. Still another erased a large amount of valuable data because he thought that the diskettes had to go through format each time before trying to load them.

If it's even remotely possible that the problem is operator error, check it out completely before blaming the computer. Of all computer "malfunctions," about a third are brought about by nothing more than operator error.

CHECK FOR SOFTWARE ERROR

One you've eliminated the operator as the source of error, be sure that the software isn't the cause. This includes both the data on the diskettes and the diskettes themselves. Both can produce errors that may seem to be machine problems. Of all problems that come in to a repair shop, the vast majority are brought on either by operator error

or by software error. In a sense, the software becomes a sort of operator once it's fed into the computer. It tells the computer what to do and how to do it when the human operator pushes the various keys.

New programs and diskettes are especially suspect. Just because the box and plastic wrapper are intact doesn't mean that nothing could have happened to it. In some ways the diskettes are as delicate as Christmas tree bulbs (see Chapter 3.) Despite all the care and testing, a flaw could have snuck in during the manufacture. Or the diskette could have been damaged in transit. A program on the diskette might have been imperfect to begin with, or may have faulty sections. (I have a chess game in which the king cheats whenever he is in trouble.) Newer programs are more open to suspicion than programs that have been around for a long time. After several thousand users run the program through its paces and find the errors, the manufacturer can release an improved version. (The fact that new programs often contain weaknesses of various sorts isn't necessarily the fault of the manufacturer, although there is little excuse for releasing a program and charging for it, before the bugs are taken out.)

Making backup copies of all software and data diskettes is a good way to protect yourself from software failure. You should have at least one backup copy of anything that is important to you. Two copies are better yet. Be sure to test the copy before storing it. Then, if something goes wrong with the original, you'll have a quick means of recovery. You'll also have a way to test to see if the problem is in the software or in the hardware.

LOOK FOR THE OBVIOUS

A new computer owner took his system home and pushed in the program diskette (just as he'd been shown at the shop), but nothing happened. That same afternoon he tucked all the equipment in his car and brought it back in. It operated flawlessly, so he took it back home again, only to have the system refuse to operate again. Next day he was back in the shop.

"I just don't understand it," he said. "I know the outlet is good because I plugged a lamp into it. Maybe something got jiggled inside the computer when it was in the car." Again the system operated perfectly while in the shop, and with the owner standing there watching. Then he saw the technician reach back to flip off the power. "What's that black switch for?" he asked.

That may sound silly, but it is a true story. Somehow he managed to get the idea that shoving in the disk automatically kicked in the

power. It's such an obvious thing that the sales rep hadn't even bothered to show the customer how to apply power to the computer.

This same customer might have been tempted to rip off the cabinet to see what was the matter. It probably would have done no harm. On the other hand, he could have caused actual damage before he realized that all he had to do was flip a switch. (Of course, if he'd bothered to read the manual, there wouldn't have been a problem in the first place.)

Look for the obvious before you do anything else. If the computer seems dead, look to see if the plug is still in the outlet and check to make sure that the power switch has been flipped before tearing apart the power supply.

The same applies to all cables and connectors. It's easy for them to become loose even if your computer sits perfectly still. You can't always tell if the connector is secure just by looking, either. Push them in to make sure that contact is being made.

Contrast and other controls on the monitor might have been bumped or accidentally turned so that something seems to be wrong. This is especially true if you're using an external monitor. (The internal monitor has only a brightness control externally.) The more people who touch your system the greater the chance that something has been bumped, nudged, or otherwise messed up by human action.

Not quite so obvious is a problem caused by an incompatible program, by some fancy protection scheme on the program, by the way a particular drive works, or by a combination of these. If a board is incompatible, it can keep certain programs, or all programs, from loading. It can also cause the computer to malfunction in other ways, or even prevent the computer from operating at all.

Some drives, especially half-height drives, are strictly 48 TPI (tracks per inch). One protection scheme (designed to foil software pirates) puts certain information halfway between the tracks, which in a sense forces the drive to be 96 TPI. If your drive is incapable of seeking the data stored on these tracks between the tracks, you could have what appears to be a serious problem, while in fact the problem is nothing more than a slight incompatibility. (You're unlikely to have this problem if the drives you are using are installed by Kaypro. It's rare in any case.)

A program that refuses to load could be caused by something as simple as accidentally inserting the disk upside down, or even putting in the wrong diskette. A flickering on the screen or recording error could be caused by someone in the next room turning on a vacuum cleaner or an electric mixer.

Then there are problems due to normal wear and tear. What might appear to be a major problem with a disk drive could be nothing more than a broken door. (They're plastic and all too breakable.)

Even inside the computer, keep your eyes open for the obvious. There are more connectors inside the cabinet. The connectors may have not been pushed all the way onto the contacts. A screw may have fallen and be causing a short. Even faulty components are sometimes obviously damaged. A capacitor might be leaking fluid, or a resistor might be obviously burned, or a soldered connection might be loose.

As you're going through the more detailed steps of diagnosis, keep looking for the obvious. Start with the simple, obvious things and then go to the more complex.

CHECK INCOMING POWER

If all connections seem sound and still nothing happens, it's time to check the incoming power. Checking for power in an outlet is easy. The easiest method is to plug something else into the socket, such as a lamp. If the lamp lights, you know that there is power coming in through the outlet. It won't tell you much more than this, though.

Using a meter is a more accurate gauge (Figure 2-1). (Set the meter to read in the 120 volt AC range!) It will tell you more than just if

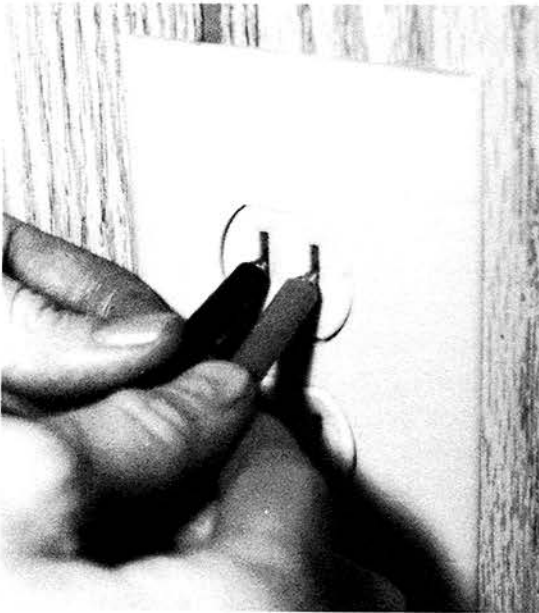


FIG. 2-1 Using a meter to check for power.

power is coming in. Power companies are famous for producing “dirty” power. It has periodic drops and surges. The problem is compounded during peak power times. In the middle of a hot summer afternoon, for example, the power company may be having a hard time keeping up with the demand placed on the lines by the thousands of air conditioners going. Line voltage is bound to drop.

The power supply in the Kaypro will easily tolerate any voltage between 100 and 130 volts. If the voltage goes beyond these limits, a built-in safety circuit will shut everything down. Even below the computer’s 100-volt minimum, a lamp will probably work just fine. The lamp seems to indicate that the outlet is good, yet the computer will still refuse to function. Using a meter to check the outlet voltage is more certain.

If you have a cooling fan installed, this can be an automatic clue if it is wired directly to the incoming 120V line. If the fan is running, the outlet and power cable are good. The problem is probably in the power supply.

Chapter 6 gives you information on how to check the power supply thoroughly. At this point you’ll just eliminate it as the possible source of the problem.

With the meter set for 120 volts AC, touch the probes to the two

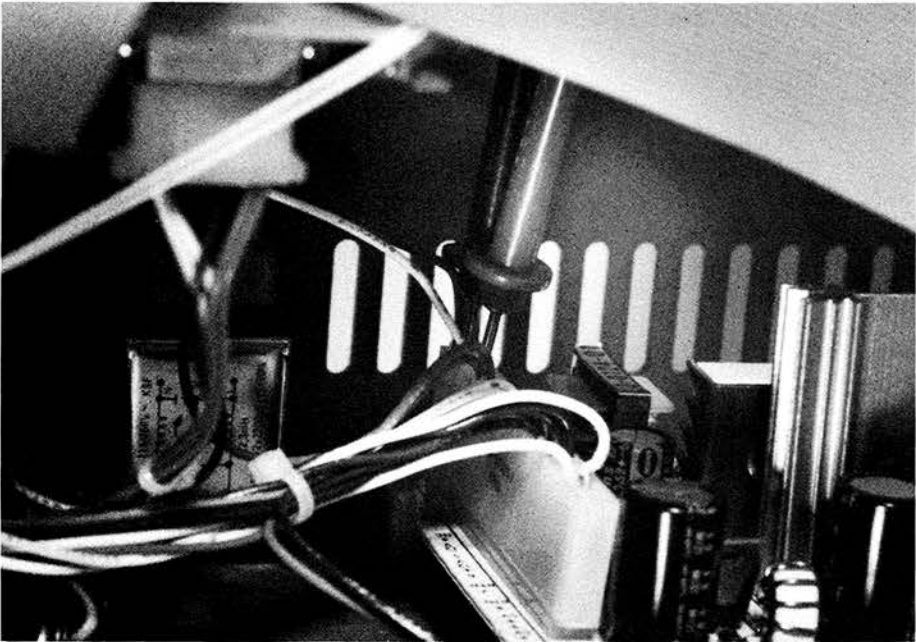


FIG. 2-2 Checking power coming to the power supply.

sides of the fuse that is mounted on the power supply. (Keep in mind that power is flowing, so BE CAREFUL!) If you get no reading, turn off the power and look at the fuse. It may have blown.

Most of the time you can visually check the fuse. If you are in doubt, remove the fuse (with the power OFF) and check it with the meter. To do this, set the meter to read ohms. If the fuse is good, the reading should be zero ohms. If the fuse is bad, the reading will be near infinite ohms.

If power is getting to the power supply, use your meter to find out if the power supply is doing its job. This is easiest to check at the six-pin plug going to the main board (Figure 2-3). Set the meter to read in the 12 volt DC range. Another way to check power output is at the ten-pin power connector, although this is harder to reach. Test pins 5 through 10, as shown in Figure 2-4.

OBSERVE SYMPTOMS

If there is a problem, it will usually show up as soon as you apply power. Observe how the computer comes on while everything is functioning properly.

The normal sequence is for the light on the chassis to indicate power. The LED on the front panel of the drive in use should come on, indicating that it is at least trying to do its job. This will normally be followed by the prompt on the monitor.

When nothing at all happens, you would usually suspect the

FIG. 2-3 Checking the output of the power supply at the plug to the main board.

Pin	Value
1	Not used
2	- 12 volts
3	+ 12 volts
4	Ground
5	Key
6	+ 5 VDC

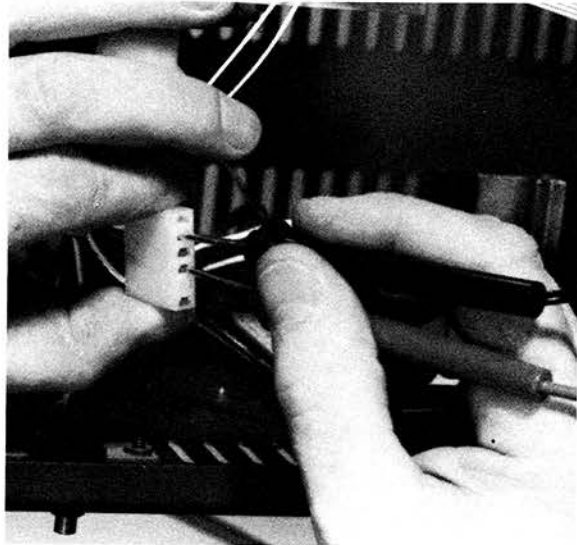
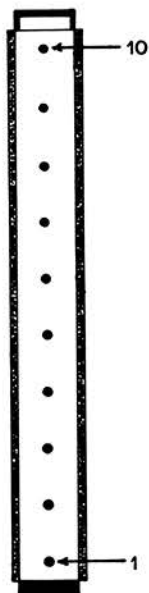


FIG. 2-4 Power connector outputs.

Pin	Use
1	AC (input)
2	AC (input)
3	Chassis ground
4	No connection
5	-12 VDC
6	+12 VDC
7	Ground
8	Ground
9	+5 VDC
10	-5 VDC



power supply. This may or may not be true. You can find out quickly. After checking the outlet and making sure that it is supplying the correct AC voltage, shut off the power, disconnect any external devices, and try again. If it still doesn't work, again shut off the power and check the external fuse (mounted in the back of the computer).

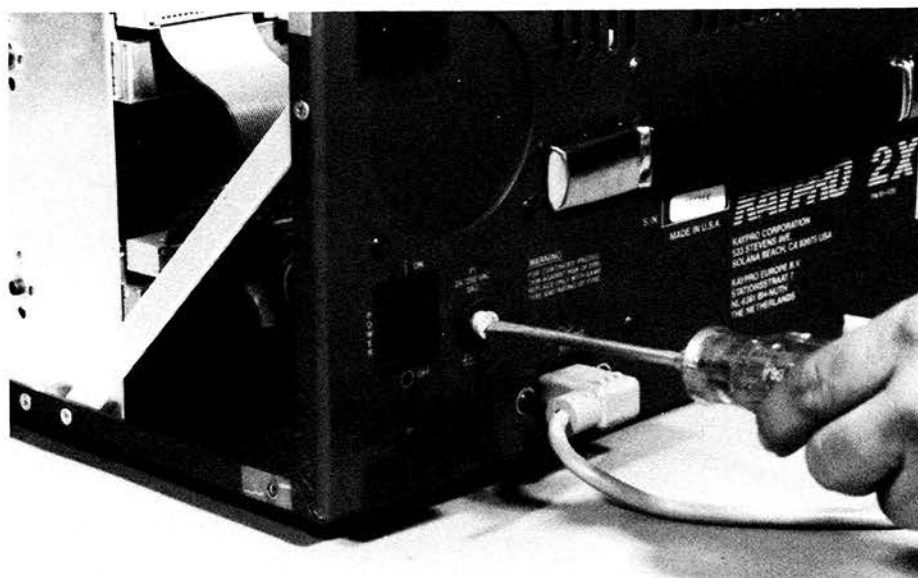


FIG. 2-5 Removing the chassis fuse for testing.

You can visually inspect this fuse as well as the one mounted on the power supply board. A better check is done with a meter. Remove the fuse from the holder. Then, with the multimeter set to read resistance, touch the probes to the two ends (Figure 2-6). If the fuse is good, you will get a reading of nearly zero ohms. A blown fuse will have a very high reading.

INSIDE THE CABINET

Only after performing the four steps outlined above should you open the cabinet. Look for obvious damage, disconnected wires, and at the power supply mounted fuse. (All this should be done with the power off and preferably with the power cord unplugged.) If everything is still dead, the problem is either in the power supply (go to Chapter 6) or in the system board (go to Chapter 5).

If power returns, the problem is either in one of the devices or is a weak power supply. This can be determined by disconnecting (unplugging) everything from the power supply, and then reinstalling each of the devices, one at a time (with the power OFF each time). When power fails again, you'll know which board or device to suspect.

To test for a weak power supply, follow the same steps, but do it several times. Each time connect the devices in a different order. If power flows, the power supply is at fault. If it doesn't, or if a fuse blows again, the board or device is the cause.

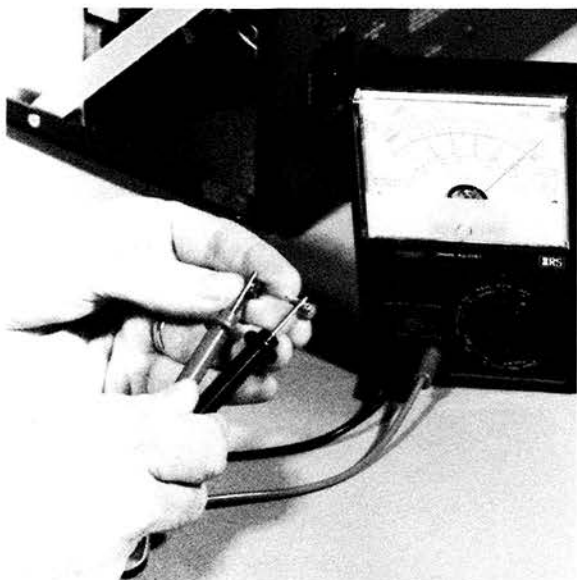


FIG. 2-6 Testing the fuse with a meter.

NORMAL RESPONSE

When the computer is turned on, the power light on the front of the case will come on; then the light of drive A will come on. Briefly, the screen will read, "Please place your diskette into Drive A." (You may not see this if the computer hasn't warmed up.) Within about 10 seconds the CP/M will have loaded and the grinding sound of the drive will stop. The display will now read something like, "Kaypro 63K CP/M Version 2.2G" and the drive prompt (A>). Unlike many other computers, the drive LED will stay on to show you which drive you are using. (On other computers, the LED comes on only when the drive is actually in use, such as when reading or writing.)

A reset from the keyboard (control-C) will show "Warm boot," clear the screen, and go through the same steps. A reset from the red switch on the rear of the computer will cause the screen to flash just before loading in the program.

If a diskette is not in the drive, if the drive door is not closed, if the drive is malfunctioning, or if the diskette does not have CP/M on it, everything will stop. Along with the "Please place your diskette into Drive A" will be "I cannot read your diskette."

Table 2-1 lists some symptoms of common problems during start-up and the appropriate check or cure. Chapter 10 has additional information on troubleshooting.

DIAGNOSTICS DISKETTES

There are a number of software programs available that can check various parts of your system. Some check only a single thing, such as the disk drives. Others check the circuits themselves, including the RAM.

Although these programs cannot totally replace your own efforts and common sense, they provide an excellent starting place for diagnosing problems. In many cases they are the only way to check certain things.

Testing the ICs of the main board, for example, cannot be done without complex equipment. A single, inexpensive RAM chip might be bad, but you won't be able to find it with your multimeter. Even with an oscilloscope, trying to spot the exact chip that is at fault can be time consuming, frustrating, and even useless. A diagnostics program (Figure 2-7) can help you to find the chip. Instead of a \$300 repair, you merely swap a \$3 chip.

Just as important as finding a problem after it happens is being

TABLE 2-1. Kaypro Troubleshooting Guide

Symptom	Possible Problem	Cure	Chapter	
Light on chassis does not come on or flickers	Light faulty	Replace		
	No power	Check obvious Check power supply	6	
	Bad mainboard	Replace mainboard	5	
Fuse blows	Bad power supply	Check power supply	6	
	Bad board	Check boards	5	
	Bad mainboard	Replace mainboard	5	
	Bad cable	Check cables		
Chirping sound	Bad board	Check boards	5	
No display or poor quality	Brightness control	Check the obvious		
	No signal to monitor	Check cables	6	
	No power to monitor	Check power	6	
	Bad monitor	Check monitor	6	
	Bad mainboard	Replace mainboard	5	
Drive LED does not come on or flickers; read/write errors	LED bad	Check LED	4	
	No power to drives	Check power	4,6	
	Disk drive bad	Check disk drive	4	
	Mainboard bad	Replace mainboard	5	
Keyboard does not work	Keyboard not plugged in	Check the obvious		
	Keyboard faulty	Check keyboard	6	
	Keyboard cable bad	Test cable	6	
	Bad mainboard	Replace mainboard	5	
Cannot load in programs	Broken drive door	Check for obvious		
	Bad diskette	Try backup		
	No CP/M on diskette	Use diskette with CP/M (sysgenned)	3	
	Incorrect jumper	Check drive jumpers	4	
	Drive not working	Check with diags		
		Check drive		4
		Replace drive		
	Bad drive cable	Check drive cable	4	
Bad memory	Check memory; replace if necessary	5,6		
Bad mainboard	Replace mainboard	5		



FIG. 2-7 Disk drive diagnostics programs.

able to keep track of how well the computer is functioning. Don't wait to buy a diagnostics program. Find one that you like. Then use it on a regular basis as a part of your regular maintenance routine.

SUMMARY

Diagnosis is a matter of listing the possible causes, and then eliminating those things (one at a time) that are not at fault until you find the one or two things that are causing problems. This is not nearly as difficult as it sounds. You have all the tools you need already.

Most problems have nothing to do with the computer or its devices. By careful observation you should be able to find out if the malfunction is within the computer, or is the fault of the operator (most common trouble) or within the software (second most common trouble).

The computer will normally tell you exactly what is wrong, and where. The symptoms will indicate what is causing trouble. From there it is a process of elimination until the exact cause has been found.

Anytime something seems to be malfunctioning, take notes. Make drawings if you do any disassembly. Both will guide you along and will provide valuable information if you have to consult a technician.

A summary of diagnostic ground rules:

1. Check for operator error.
2. Check for software error.
3. Visually check for the obvious.
4. Be sure to take notes throughout; make drawings when needed.
5. Repair or replace when you can.
6. Consult a technician when you can't, armed with all the above information to save time and money.

Chapter 3

Diskettes and Software

If you were to tell a repair technician that your computer was malfunctioning (assuming that the problem wasn't obviously something like a power supply failure), he or she would immediately try to find out two things. First, what was the operator doing at the time? Second, is the software functioning? (For that matter, has it ever functioned?)

Operator error occurs for many reasons. Even the most experienced operator can make a mistake now and then. The more complex the program is, the more likely it is that the fault is with the operator. Before you write a nasty letter to the software or hardware manufacturer, eliminate all possibility of operator error. (Don't be too surprised if you find that the fault is yours even if you're sure that it is not.)

Ask yourself, "What have I done wrong?" Then ask, "Has it ever worked?" Don't answer either too quickly. After all, would you rather spend hours and hours tearing apart a machine, or a few seconds to be honest with yourself?

Go through the manual and other documentation again. These materials are notorious for being poorly written. (I know several people who have erased \$500 programs due to confusing instructions in the "Installation" sections of the manuals.) If the software package was produced outside Kaypro, the people at Kaypro probably had very little control of what went into the manual (and what didn't—which can be even more important). Many manuals have an index, which can help you find the information you need on a particular subject quickly, even though the information may be scattered through the manual.

New programs are always suspect, both for software error and for operator error. If you've never tried to use the program before you

may not be putting in the proper commands. (Back to that lousy manual again.) Or you might be using a feature of the program for the first time. (Back to the manual.)

All clear? The fault is *definitely* not yours but with the diskette? Fine. Now we can proceed.

DISKETTES

The usual means of data input and data storage with the Kaypro is via 5 $\frac{1}{4}$ -inch diskettes. They are often called “floppies” because they are flexible. Sometimes they’re simply called “media.” If you think about what a diskette is and what it does, it might seem strange that they don’t cause even more problems.

Information can really be packed onto the surface of the diskette. Each byte is made up of eight bits (or pulses), yet each byte takes up little more than a ten-thousandth of a square inch. (The space used to store a byte is about one hundredth of an inch wide and a few thousandths of an inch in length.) Just as your Kaypro won’t accept a command with a character missing, it probably won’t accept a program with a scratch or blockage, even if the damage is less than a thousandth of an inch in any direction if this is over a critical spot.

Diskettes are the least expensive part of your system. They are also one of the most critical. Try to save by buying cheap or poor-quality diskettes and you’re taking the chance of losing in a larger sense. Although an unknown brand may be of equal quality to the name brands, you are generally better off dealing with a respected brand, at least for critical programs and data. Get the best possible.

HOW DISKETTES ARE MADE

The diskette begins as a thin sheet of flexible plastic. Mylar is the standard. (Mylar is a trademark of Dupont. The generic name for the material is polyethylene terephthalate.) The plastic comes to the disk manufacturer in rolls that are about a foot wide and often about a mile in length. The rolls are tested, inspected, and cleaned.

Next the plastic is given a magnetic coating on both sides (even if the diskette is later given the “single-sided” label). This coating is made up of extremely fine magnetic particles, a binder (like glue), and a lubricant. The microscopic particles have to be “glued” to make a perfectly uniform coating across the surface of the plastic. If they are not, there will be gaps and data will not be accurately recorded or read.

Once coated, the plastic is smoothed and placed back on the roll, and then each roll is given a number for identification so the manufacturer can keep track of it. It is then stamped into the disk shape and is polished (burnished). The rougher the surface is, the more damage it will do to the diskette read/write heads. (The lubricant also reduces head wear.) It isn't possible to get rid of all wear, but efforts to reduce this are made by the better manufacturers.

The finished diskettes are placed inside the square outer covering (usually made of PVC plastic). Inside this jacket is a layer of thin and very soft material which helps to keep the surface of the diskette clean. Without this layer the diskette would be constantly "attacking" the read/write head with particles of dust and other contaminants. The liner helps to protect the read/write heads by gently cleaning contaminants away. It also protects the diskette surface by preventing the soft diskette from rubbing against the harder plastic jacket. (See "Cleanliness" below.)

Throughout the manufacture of the diskette, tests are run. Its final label (single sided, double sided, single density, double density, quad density, etc.) is determined by these testings. A diskette that passes

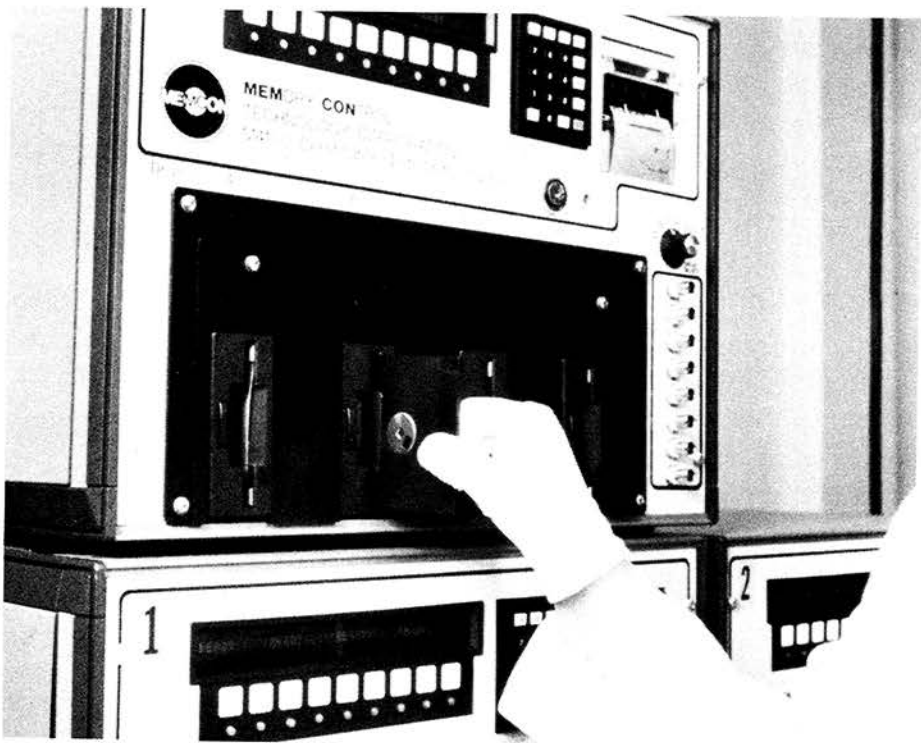


FIG. 3-1 Each disk is thoroughly tested after assembly. *Courtesy of Memorex Corp.*

all the tests is given the highest rating and carries the highest cost to you. The more tests the diskette fails, the lower its rating and the lower its price.

What this means in simple terms is that the least expensive diskettes (single side, single density) have the same basic surface and manufacture. They've just failed some highly sophisticated test along the way and the manufacturer doesn't want to guarantee that the diskette will accurately hold data in higher densities. It's a fairly common practice for computer owners to try to save money by buying the less expensive single-sided diskettes and use them as double-sided ones.

ANATOMY OF A DISKETTE

The computer's formatting program (in the COPY program on the CP/M master diskette) divides the diskette into the correct number of sectors and sets the size of those sectors. A diskette formatted by an IBM, for example, will simply not work in the Kaypro, unless you put that diskette through the formatting routine for your own computer (or use the MFDISK and INITDISK programs). The formatting routines destroy all data stored on the diskette, so do not attempt to format a diskette that has data on it you wish to save.

There are two basic disk types. A hard sector diskette has a series of index holes to mark the sectors. These are pre-set by the manufacturer and such diskettes are normally good only for certain machines. A soft sector diskette has a single index hole (to mark the first sector), after which all other sectors are marked magnetically.

For the Kaypro there are 40 tracks (numbered 0 through 39). These are like the grooves of a record except that they are concentric circles and not in a spiral. When you hear your disk drive grind, it is because the read/write head is moving from track to track. (The sound you hear is the head stepper motor causing the read/write head to move. For more information on this see Chapter 4.) Standard track width is about one hundredth of an inch, with normal density being capable of holding about 6000 bits per linear inch.

Each of these tracks is divided into ten sectors, with each sector capable of holding 483 bytes (a byte is a character or other piece of data that contains eight pulses). Each track, then, can hold 4,830 bytes of information. One side of a diskette can hold 193,200 bytes (40 tracks \times 10 sectors \times 483 bytes). To make things easier, this is called 190K.

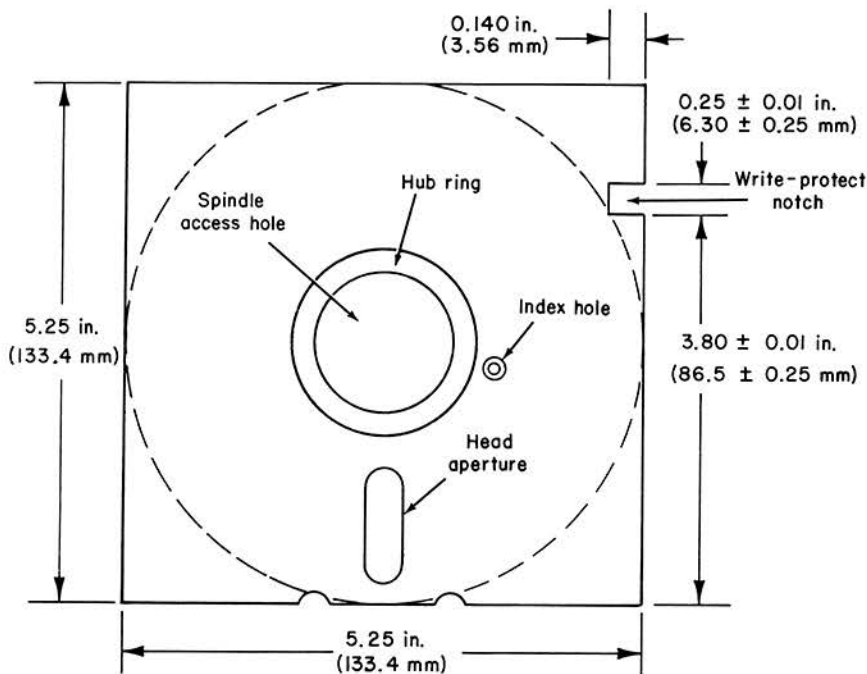


FIG. 3-2 Anatomy of a diskette.

Obviously, if you have double-sided drives, this storage is doubled, with the same specifications for each side of the diskette.

In the center of the diskette is a round hole about an inch in diameter. This allows the spindle in the drive to make contact with the diskette and spin it. Most diskettes also have a band of extra material called a *hub ring*, placed around the spindle access hole. This ring protects the diskette from damage by adding strength where it is needed most and allows a better contact between diskette and spindle.

The oblong cut from the diskette cover allows the read/write head of the drive to get at the information. This is the most sensitive part of the entire diskette. A fingerprint here can cause all sorts of troubles, both to the data (including format information) and to the read/write head in the drive.

When putting new labels on the diskettes, it is very important to keep the read/write access hole open and uncovered. If it is covered two things will happen. First, the diskette won't work. The machine will give an I/O error. To the computer there is nothing in the drive. Second and worse, the glue from the label may come off onto the recording surface of the diskette. If this happens, you might as well trash the diskette. You cannot clean a diskette, nor should you try.

Along the side of most diskettes is a small notch. This allows a small switch inside the drive (see Chapter 4) to activate the recording head. When this notch is covered with tape, the recording head cannot function and you cannot write information onto the diskette. (You can read from the diskette, however. It's a good habit to cover this notch on any diskette that has data you won't be changing.)

You can get diskettes that have a write-protect notch on both sides of the diskette. Such diskettes will also have a second index hole. When these extra notches are present, the diskette is usually called a "flippy floppy," which means that you can use the diskette as though it was two single-sided floppies. To make use of the second side all you have to do is to turn the diskette over. The second write-protect notch will allow the drive to look at the second side of the diskette as a new one.

A flippy floppy allows you to make use of all 380K of storage available on the diskette. You can have a program of up to 190K on each side, complete with the batch program to have the program boot up by itself. The primary advantage is convenience. Normally a flippy floppy costs about twice as much as a regular single sided diskette.

A flippy has a disadvantage in that it tends to wear out sooner. As it is used on one side it rotates in one direction. When you flip it over, it rotates in the opposite direction. This causes wear and may also increase the possibility of scratches on the surface from particles captured by the lining.

Some people physically cut a read/write notch into the diskette, thereby saving the added cost of buying a flippy. There are two problems with this. First, the manufacture warrants only what has been sold. That is, if the diskette was manufactured and sold as a single-sided diskette, the second side is not guaranteed to retain data. (In fact, cutting in the notch voids the warranty on both sides.)

Second and more important, the jacket of the diskette is usually made of PVC plastic. This stuff has the unfortunate tendency to shatter when you try to cut it. If the notch isn't cut just right, tiny flakes of PVC will contaminate the diskette, and possibly the disk drive.

Warning:

If you try to make a single-sided diskette into a flippy floppy, you could damage your computer drives.

HOW DELICATE IS A DISKETTE?

Despite its apparent fragility the diskette is surprisingly tough. Many professional technicians relate stories of playing catch with an un-jacketed diskette and then having it perform flawlessly. Diskettes that have been almost shredded by deep scratches zip through the drive as though brand new.

At the same time, a tiny piece of dust could cause a diskette to "crash" and become useless. You're never sure which will happen. Nor is lost data the only risk. Each speck of dust can be ruining the read/write head while it is slowly grinding the magnetic coating from the diskette surface.

The disk drive of the Kaypro reads and writes 48 tracks per inch (48 TPI), which means that the 40 tracks used for data, plus the empty spaces between the tracks, are squeezed into just 5/6 of an inch (which includes the gaps between the tracks). On a normal single-density drive, the 193,200 bytes per side are packed into about 6 square inches of surface area.

Now you can see why the diskettes and drives are so sensitive. The read/write heads record or retrieve information from tracks that are about a hundredth of an inch wide and separated from each other by about a hundredth of an inch, all this while the diskette is spinning merrily at about 300 rpm. If the accuracy is off by just a slight amount, or if something gets in the way, the data on the diskette may be inaccessible.

CARE OF DISKETTES

You can't easily "repair" software. If your business program is malfunctioning you won't be able to get inside to fix it. (Some programs can be fixed, such as those you've written yourself or those written in a language you can use such as BASIC.) Your goal is to prevent problems before they occur.

Software problems can be greatly reduced by simply taking care of the diskettes. The disk is tough, but it is not indestructible. It's also unpredictable at times. One day you can play catch with the diskette and have it work. The next day a speck of dust or particle of cigarette smoke could fall onto the diskette and wipe out everything. (Not only can you lose software and stored data, you can damage the disk drives by not properly caring for the diskettes.) According to *Verbatim*, at least 80% of all diskette failure is attributable to fingerprints.

Care of diskettes is not complicated, nor is it time consuming.

The manufacturers have taken great pains to ensure that the diskettes will last for a very long time, with a minimum of problems. Extensive testing is done before the diskettes are sold. Care is also taken to make the diskettes as tough as possible. It's not uncommon to find a manufacturer who guarantees that the diskette will not fail even after several million passes per track. In time this translates to nearly a year of constant running before the life expectancy is reached for a diskette. Since normal operation calls for the diskette to be running just seconds out of every operating hour, the disk should, and could, last a lifetime.

The lifespan of a diskette also varies on how it is used. Although the manufacturer might guarantee the diskette for three million passes per track, each time you use the diskette it goes to the "directory" track. Some applications refer to this track over and over again. Thus, the life of a diskette depends largely on how many times the one track can be used. As soon as this track wears out, the rest of the diskette is essentially dead.

The diskette can withstand any temperature between 50 and 120 degrees Fahrenheit (10 to 50 degrees Centigrade) and still operate without error. Even if the temperature happens to go beyond this range, the diskette is still likely to recover if you give it enough time to cool down or warm up. (See "Heat and Cold" below.)

Humidity does little actual damage. The official range for a diskette is between 20% and 80% (5% to 95% for storage). Drier environments tend to dry out the diskette (although it does take quite

TABLE 3-1.
Diskette Specification Standards

Tracks Per Inch	48 TPI
Tracks (number)	40 per side
Track Width	.0108-.0128
Track Density	6000 bits per inch
Temperature (operation)	50 to 112 F 10 to 44 C
Temperature (storage)	- 40 to 140 F - 40 to 60C
Humidity (operation)	20% to 80%
(storage)	5% to 95%
Disk Speed	300 rpm

a while). Worse, static can build up, causing changes in data. More humid areas may cause dust to stick to the diskette. Humidity can also cause the liner to swell. If this happens the diskette may not spin properly and you'll get an error display.

PHYSICAL DAMAGE

The soft liner inside the jacket doesn't just keep the diskette clean. It also serves as a cushion for the diskette to prevent damage. It does a fine job for most normal things, but it can't protect the disk against everything. This is up to you.

Anything that puts pressure against the diskette can cause a dent in the jacket, in the liner or in both. At best the diskette will have a hard time spinning in the drive. If this is all that happens, you may have enough time to make a copy of the ruined floppy.

This is why a felt tip pen is suggested for writing on the labels. Better yet, write on the label before sticking it onto the diskette. The tip of a ballpoint pen or pencil could easily damage the diskette. Even a soft felt tip can press a groove into the diskette. The pressure you use in writing may not seem like much, but remember that all that pressure is concentrated at the tip of the pen or pencil. You are pressing down with only a few ounces of force, but this is being applied against the diskette over a surface area of only the few thousandths of an inch of the pen tip. The force is effectively multiplied because of this.

Weight of any kind pressing against the floppy can cause damage. Diskettes are best stored vertically (standing up). This not only protects the diskettes, it reduces the risk that you might forget and drop a stack of books on top of a diskette.

The problem of weight is compounded if dust or other particles are trapped in the liner. Imagine having the pressure of five pounds of books concentrated onto the sharp edges of a millionth of an inch. Dust may seem to be soft. To get an understanding of what it can do, however, just take a look at the metal and glass of a car left in a dust storm.

Pretend that the soft liner of the diskette is made from coarse sandpaper. You know you wouldn't risk the information stored on such a diskette by placing even light weight objects on it.

STORAGE

When not in use, store all diskettes in their cover jackets and preferably standing vertically inside a box as well. This is to reduce the

amount of dust and other particles. The soft inner lining will help to protect the read/write heads but tends to capture those particles which in turn can cause scratches on the diskette. With the data being so tightly packed (193,200 bytes per side) even a small scratch can have devastating effects. That scratch may occur on an unimportant part of the diskette. It might also happen over a critical bit of data and make the rest of the diskette useless.

A quality storage box might cost \$30 or more. This sounds expensive until you think of what you're protecting. Many computer owners have hundreds of dollars invested in software, and perhaps thousands of hours spent in punching in data. It's not unusual for a computer owner to have more invested in software than in the computer system itself. Why take the chance of throwing all that down the drain just to save a few dollars?

If you can't afford to buy a diskette storage box, make one. Such a box should not be made of metal (because of magnetism). Use wood or plastic or even cardboard. The inside should be clean and unpainted (fumes). The top should close tightly enough to seal out dust. Beyond that it can be as fancy or as simple as you wish. (I know people who use modified shoe boxes with great success.)

Homemade storage boxes are not good solutions, however. Wood and paper both have large amounts of dust and other small particles, no matter how well you clean them. These particles can ruin the diskettes and possibly the drive. Plastic is a much better solution, but it is more difficult to work with. By the time you've bought the plastic



FIG. 3-3 Diskette storage box.

and built the case, you probably would have saved by just buying a disk storage box.

However you do it, keep dust and other particles and contaminants to a minimum. You've invested too much time and money to waste it on a dirty environment.

If a diskette gets dirty, do not attempt to clean it. Your cleaning is virtually guaranteed to cause more damage than any amount of dust. How dirty the diskette is and what kind of contamination it has will determine what you do with it. If it isn't too bad, store it for severe emergencies. Otherwise toss it out. A dirty diskette means that it's time to pull out one of the backups. (Make another backup before going to work.)

MAGNETISM

The data on the diskettes is stored magnetically. It should be obvious that you have to keep the diskettes away from other sources of magnetism. Yet computer operators are constantly erasing their valuable programs and data by not observing this precaution. Some cases are as blatant as setting the diskette next to the magnet of a speaker. Most involve less obvious sources of magnetism.

Inside the telephone is a small electromagnet. Normally it just sits there and does nothing. Whenever someone calls, that little device lets fly with enough magnetism to destroy a diskette. (It rings the bell in the telephone.)

Other potentially dangerous sources are the monitor, the printer, the modem, the cabinet of the computer, any tape recording machine, fluorescent lights, and even a calculator. Motors work by using magnetic fields. If you're not sure, don't trust it. (Anything metal is automatically suspect.)

It's unlikely that these subtle sources of magnetism will ruin a program, but why take the chance? It's easier to pay attention to the surroundings and keep the diskettes away from any possible danger.

HEAT AND COLD

More important than solar radiation is the heat generated by the sun. Since the diskette is usually black, it tends to gather more than its share of the heat. Leaving it in the open sunlight is very likely to cause damage. Even if it's close to an incandescent lamp it could pick up enough heat to cause harm.

Keep the diskettes away from all sources of heat. At best heat

will warp the jacket of the diskette. If this happens, the data you've recorded won't be in the same place on the diskette. It won't matter, though. If the diskette or jacket become warped, the diskette probably won't spin in the drive anyway.

The same things can happen with cold. Not only can extreme cold cause the diskette to crack, it can cause the recorded data to shift in position. A sudden change in temperature from cold to hot can cause other problems as well.

Even a slight change in temperature, and the contraction or expansion this causes, can cause the tracks to move away from where they are supposed to be. Keep in mind that the tracks are just barely over a hundredth of an inch wide, and that each byte of data covers a mere ten-thousandth of a square inch.

BACKUP COPIES

Always make backup copies of important programs (if copyable) and data. The cost of diskettes is low considering their value to you. Making backups is the least expensive method there is to protect yourself against software failure. Make at least two backup copies of all software and data diskettes that are important to you. The more important the original is, the more backups you'll want to make. If the data on those backups is no longer important, you can always reformat the diskettes and use them again if you decide later that you don't need that backup copy. In the meantime you'll be protected.

The manufacturer provides a guarantee that the diskette will function without error for a certain period of time, or for a certain number of passes. This does not guarantee the data on the diskettes, however. If a diskette goes bad, the manufacturer will replace it with a new diskette of the same kind, but the data is lost forever, as is the time you spent in punching it in.

SOFTWARE PROBLEMS

If you're writing your own programs you're almost bound to make some mistakes. The Kaypro will generally tell you that you have made a mistake, and will even show you the lines where the mistakes were made.

If your program doesn't work, accuse yourself before you accuse the computer. Refer to the CP/M and BASIC manuals to make sure that the commands you've punched in are correct. If you like pro-

gramming, take some courses in the subject. Get some books. Learn the most efficient (and the correct) ways to do things.

When it comes to purchased software, you have much less control over what has been done. Many programs are inaccessible for corrections. Unfortunately, so are all too many software companies. It isn't uncommon for a company to have a disclaimer in the package which says in effect, "If the program doesn't function as promised, tough! You bought it, now it's your problem." Other companies support their products, but at an additional cost. (The old "If you can't understand our poorly written manual, pay us an extra \$100 and we'll explain it to you" attitude.)

At other times you might be pleasantly surprised at the response. There are companies that do everything possible to make sure that the end user is happy and satisfied with the program.

When contacting a company about a software malfunction, be fair to them. Begin by doing everything you can to make sure that the error isn't your own. Read the manual carefully and thoroughly. If the problem still hasn't been solved, be as specific as possible in your communication with the company. Provide as many details as possible, including what you've done to correct the problem, and even the version of that piece of software. They can't give much of a response to "It doesn't work. Why?"

Notes of what you've done will be of help both to you and to the company representative. The more information you provide, the quicker will come the solution to the problem. Even jot down the page numbers in the instruction manual so you can readily refer to the proper sections for that particular function.

One of the advantages of working with a local dealer is that you have quicker access to information. Even if you haven't purchased a training course on a particular piece of software, they'll probably be happy to answer questions for you. Most will replace defective software without any hassle. (Bring your sales receipt! You can't expect them to guarantee a program you bought from someone else.)

FAILURE TO BOOT

There are a number of reasons a program will fail to load. The most common reason is a bad diskette. It may also be the fault of the drive, the power supply, the memory, or even the keyboard. Usually it is quite easy to find out what is causing the problem. Do one thing at a time, in a process of elimination, until you've located the trouble. Don't forget that the whole problem might be a board or program

incompatibility (in theory a program for the Kaypro should work on all Kaypros, but this isn't always true in practice), or a copy protect scheme that is causing an apparent (but not real) malfunction.

Eliminate all the obvious things first. Is there any power at all? (If the plug is in the wall, the outlet has been checked, and there is still no power, go to "The Power Supply" in Chapter 6.)

Are you using a new program? Has it ever worked? Perhaps the diskette you're using is very old and has simply worn out. Try another diskette, one that you know is good. If this one loads, you'll know that the fault lies with the software. (Use a diskette that is not critical. Although it is rare, it is possible for the drive to malfunction and write over the top of a diskette, even if it is write-protected.)

Before tearing anything apart, look for the obvious. Is the door to the drive intact? (If it isn't, the drive will spin without any apparent effect and "I can't read your diskette" will be displayed on the screen.) Are the cables firmly attached to the drives?

A test of the drives involves switching the drives. You may be able to simply change the default, causing drive B to become the primary drive, and drive A the secondary. If you can't do this, you can manually change the settings on the drives. To do this, you'll have to open the cabinet and change the way the drives are set up. This involves moving a terminating resistor package from one drive to the other, and moving some jumpers. (Detailed information on setting up each drive type is in Chapter 4.) After you've made the changes, what used to be drive B will operate as drive A, and vice versa.

You'll know quickly if the malfunction is in a drive or elsewhere. If drive A was refusing to load, and still refuses to load when configured as drive B, chances are good that the drive is at fault. If the drive swap doesn't change things, the problem is elsewhere. (See Chapter 4.)

OTHER PROBLEMS

There will be times when a program loads and operates normally, only to malfunction while the program is running. Data may suddenly come out changed or missing. The program could lock up the keyboard, causing the loss of the data you've been punching in.

If the problem is in the software (in the program itself) you should be able to reproduce the malfunction by pressing the same keys again. You may have already noticed where the failure occurs. (Don't forget

to check the manual and eliminate the possibility of operator error!) Notes will come in very handy in tracking down the problem.

Changed or garbled data are often the result of overediting. The computer will automatically assign a chunk of data to a spot on the diskette. If possible it will record these chunks in sequence. If something else has been placed in the next open spot on the diskette, the data will be moved along until a spot is found. This tends to break the file up all over the diskette. In reading such a broken file the computer might miss something.

The solution for this is to copy files occasionally. This will help to rearrange the file in sequential order. To make a copy of a single file you can use "PIP." This same routine can be used to copy the entire contents of a file by using "*.*" (called "star-dot-star" or "wild card"), or even "*.ext" (with the "ext" being the extension on the file name). Of course, you can use "COPY" to copy the entire diskette, but keep in mind that this produces an exact duplicate, including any fragmented files.

It is best to use a freshly formatted diskette for the copy, since a diskette with data on it could break up the files even more (to make it fit between the existing files).

One track on the diskette is set aside for file allocation. Each time you bring up the directory of the diskette, the computer goes to this track and displays the files. Each time you tell the computer to load in a program or data file, it again goes to the allocation table to find out where the needed file is.

Earlier in this chapter we talked about how many passes a diskette can withstand before malfunction (3 million passes per track). This seems as though the diskette could indeed last forever. It *will* last for many years. The main reason it wears out is the number of passes against the allocation track. Each time the file is read, recorded, or used in any way, the drive head goes back to the allocation track. After a few years of this, the track might fail. Despite the fact that the information is still good on the rest of the diskette, it is difficult to get at it because the allocation track no longer tells the computer where to look.

The allocation track can become faulty for other reasons. Some programs do not "exit gracefully." If the program is in use and you lose power, either purposely by shutting down or accidentally in a power outage, the allocation table can become messed up. The end result is about the same as if the track had worn out.

The solution for both is prevention. Make backup copies of everything important. The more you use a particular diskette, the more

important backups are. If a diskette has been in use for a long time, make a copy and replace it *before* it gives out.

SUMMARY

Most computer malfunctions are caused by either the operator or by the software. Eliminating operator error is a matter of proper training and of paying attention. Read the instructions. Learn how to work with the program and how to handle its functions—and its quirks.

Since you are unlikely to be the author of your functional programs, you cannot eliminate software problems. If the package comes to you with flaws in it, there won't be much that you can do, other than to return the package for a refund. As soon as possible after getting a new program, test it out. The longer you wait to do this, the more difficult it will be to get a refund or an exchange.

Make backups of all important software and data diskettes. Two backup copies of each is none too few. It's an inexpensive insurance against loss through operator goof-up, diskette flaw, or drive malfunction.

Taking care of the diskettes is simple, since there is nothing to maintenance other than to storing and handling them properly. Provide a clean environment. Keep the diskettes away from things that could damage them, such as magnetism, heat, contaminants, and physical dangers. Handle them properly and they can last a lifetime. When they finally wear out, you always have the backup copies to turn to.

Chapter 4

The Disk Drives

The electronics of a computer allows electrons to move through the proper components at the proper times. The only motion is that of the electrons, and virtually the only wear is that caused by heating and cooling. Something mechanical is bound to have more troubles than something that doesn't move physically at all.

The only mechanical parts of the Kaypro are the printer and the disk drives. (The keyboard is sometimes considered to be mechanical in that it requires a physical movement of the keys to operate.) Of all failures in your computer system, most will involve either the printer or the drives. (Printers are covered in Chapter 6.)

The disk drives are critical parts of the computer system. There isn't much that your computer can do without them.

The key to trouble-free operation is prevention. Turn to Chapter 7 and follow the maintenance information, and you'll have far fewer problems. When something *does* go wrong, this chapter can help you find the problem. If you can't fix the existing drive, turn to Chapter 8 for information on how to replace a disk drive.

DRIVE TYPES

There are eight basic drive types used for the Kaypro: Drivetec, Epson, Hi-Tech, Shugart, Tokyo Electric, Toshiba, and two versions from Tandon. Other manufacturers also make drives compatible for the Kaypro. Most of the steps for diagnostics and repair are the same no matter what you have. A few are different. With some drives, the construction will be such that certain tests or adjustments cannot be

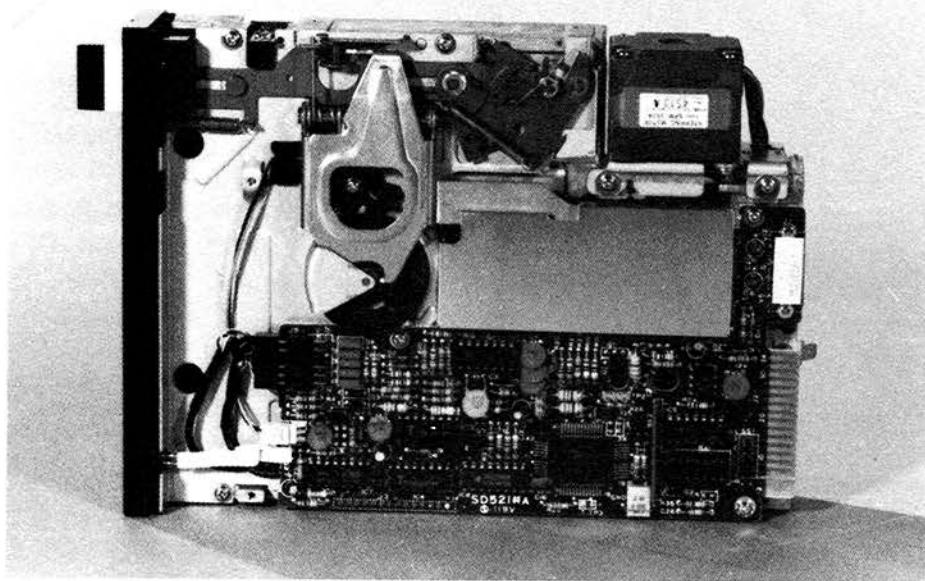


FIG. 4-1 Epson drive.

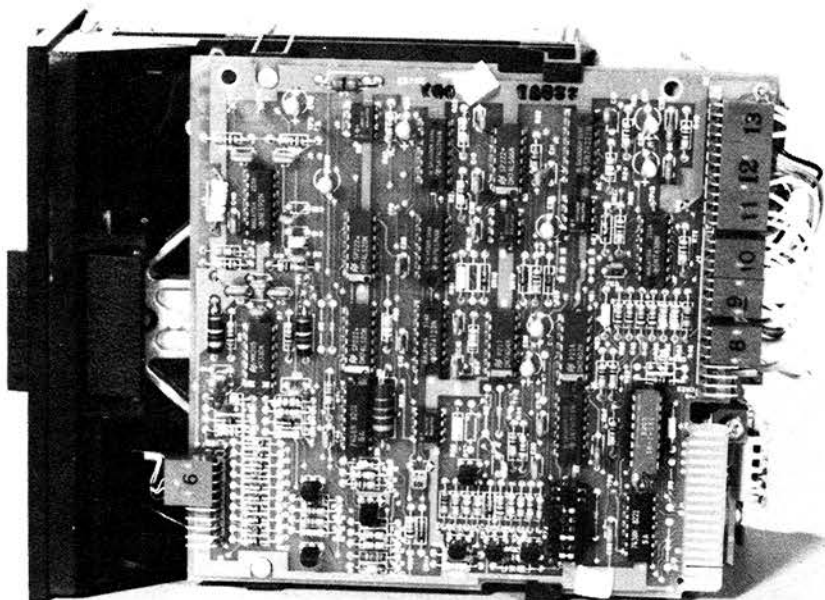


FIG. 4-2 Tandon drive.

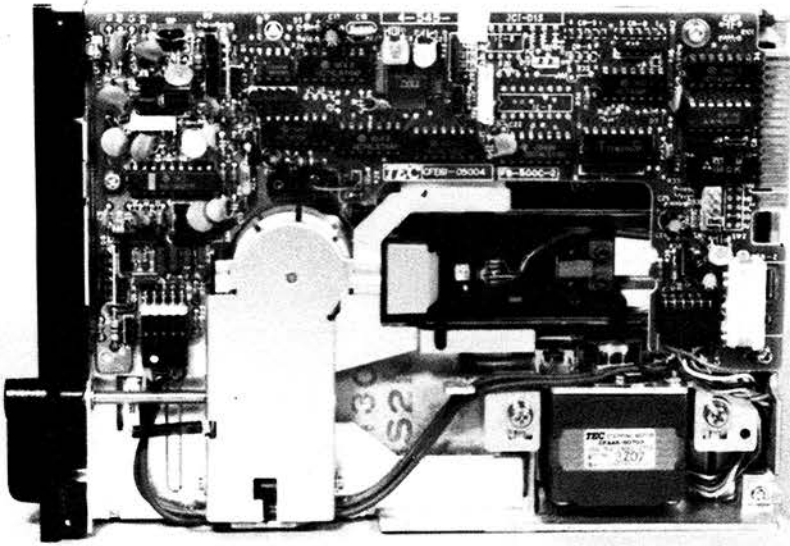


FIG. 4-3 Tokyo Electric (TEC) drive.

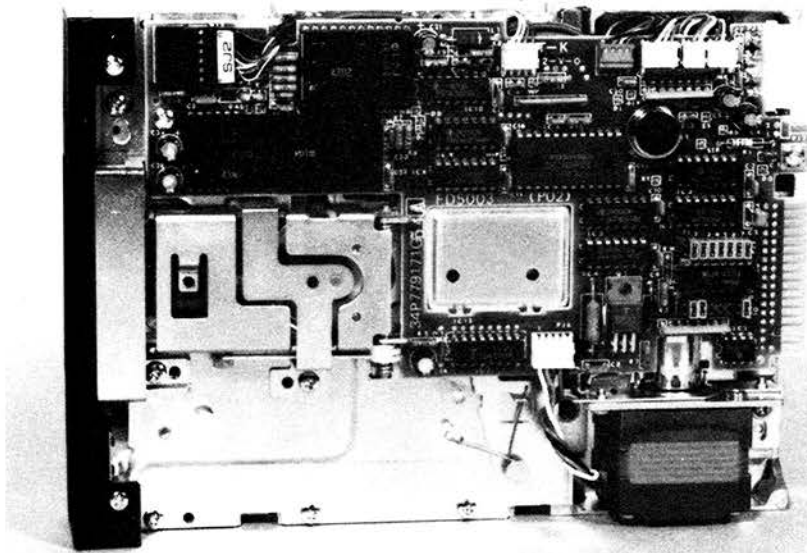


FIG. 4-4 Toshiba drive.

done without special equipment. Most differences are unlikely to be of concern to you.

If the time comes when you have to replace a drive, it's nice to know which drive type you have. The front of the drive will tell you what you have.

Most drive models are used with virtually any Kaypro made. Some are used with specific machines. Your own circumstance will depend on which model you have and when it was built. Some manufacturers make both single- and double-sided drives. If you have to replace your drive(s), the best thing to do is to explain to the dealer which system you have, and which drives, and ask for his recommendation.

If just one drive goes bad, the dealer may not have in stock the same drive you are replacing. If one of your two Shugart drives malfunctions, and the dealer has only Epsons or Qumes in stock, there is no problem other than appearance of the front panel. You can replace both drives, but this will only keep the appearance the same. Putting up with a slight difference in the appearance can save you the cost of another drive.

If you decide to spend the extra for the sake of appearance, it's a good idea to keep the good drive on hand for emergencies and for testing (such as swapping a known good drive for a suspected bad one).

Most notable of the drives is the Drivetec. This is a high-density drive used only in the 4X and the Robie. It requires special, preformatted diskettes. Unlike the other floppy drives which have 40 tracks per side, the Drivetec diskette has 160 tracks per side (or 320 tracks in all). The total capacity per diskette is a whopping 2.6 megabytes (2,600,000 bytes), which makes it more like a miniature hard drive than the usual floppy drive as far as storage. (Access time is still relatively slow, compared to the hard drive.) Each diskette is more expensive, but when you compare this large capacity to the standard (190,000 bytes per side), the high density diskettes are quite economical.

Most drives have the same basic construction. On the top of the drive is the analog card. This is the main circuitry of the drive. Half-height drives often have the top board linked with a second board on the bottom. Usually this second board contains the servo circuits. (The servo circuits on a Tandon full-height are on a separate board attached to the back of the drive.) This circuitry works together with the main analog board to control the mechanical parts of the drive, such as drive speed, head movement, and so forth.

On some drives you can perform certain tasks to determine if these boards are causing a malfunction; on others you cannot. Most of the time it doesn't matter since repair is by replacement of the entire drive. Half-height drives, in particular, are not meant to be repaired. In most cases, all you can do is to save money by performing the actual replacement yourself.

Even when you can track the problem to a board, you may not be able to find just that board as a replacement part. In fact, most of the time you'll be replacing the drive as a unit, regardless of the problem.

It's a good idea to check around in your area to see if individual parts are available before you spend a lot of time diagnosing. A look at your drives should give you a fair idea if you want to continue diagnosis to find a faulty part, or if you will be satisfied with simply identifying a faulty drive.

CHECK THE OBVIOUS

Serious malfunctions in the drive are relatively rare. Most problems are brought on by small things, and often by things that have nothing to do with drive operation directly. Don't yank out the drives and poke into them until you've eliminated all the easy things.

Always start with yourself. Are you doing something silly (but common) such as putting in the wrong diskette, or the right diskette but upside-down? Does the diskette you're trying to use have CPM on it?

Next, try different software. The diskette you are attempting to load could be faulty. This is more likely the problem than a faulty drive. (See Chapter 3 for more information on software and software problems.) You may also be trying to use one of the few programs that is meant for a specific Kaypro model (such as the Kaypro 10) but not for the model you own. This slight incompatibility can make it seem that something is wrong, when in fact you are merely using the wrong software. Try a different program, one that you know has worked before.

If you haven't cleaned the heads in some time, there could be deposits that are preventing the heads from operating. False or intermittent data read/write could mean that a dirty head is causing a problem. (See Chapter 7 for more information on cleaning the drive heads.)

Have you made any changes in your system? If so, you may have changed the way the computer "looks" at the world around it, in-

cluding the drives. If everything was working perfectly before the change, you've probably done something wrong in making the change.

If cabling was necessary in making the addition, have you used the correct kind of cable, with the correct pin allocations? Chapter 8 gives you a listing of the various I/O (input/output) ports of your computer. These, plus the information provided in the instruction manual that came with the peripheral, will help you to match everything correctly. It may seem strange to have the drives appear to be malfunctioning due to a printer connection, but it can happen.

It's also important that the cables are plugged in correctly. The connectors are usually keyed, which makes it virtually impossible to make a mistake. Still, it is important to look at the way the cable is plugged in. Make a sketch of the proper alignment of the cable and connector if you're in doubt. If the cable doesn't plug in easily, don't force it.

Are the cables and connectors secure? Try unplugging them and pushing them back into place (with the power off!). If the contacts appear to be a little dirty, clean them. For flat connectors, such as those for the drive signal cable, you can use a cleaner (see Table I-1, "Required and Optional Tools" in the Introduction) that doesn't leave a residue or use the eraser of a pencil (taking care to keep the eraser shreds out of the computer). Cleaning pin-type contacts requires a little more care, but if you use a quality cleaning fluid only, you'll have no problems. Be sure to shut down the power before removing

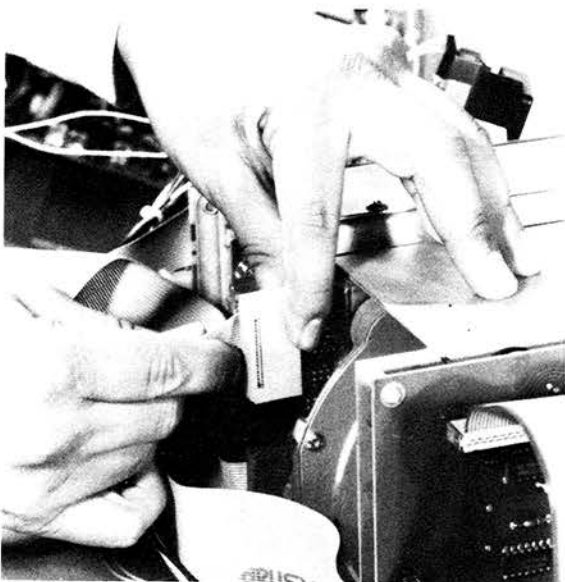


FIG. 4-5 Check the connectors, both as they fit on the board, and for good contact between the wiring at the connector.

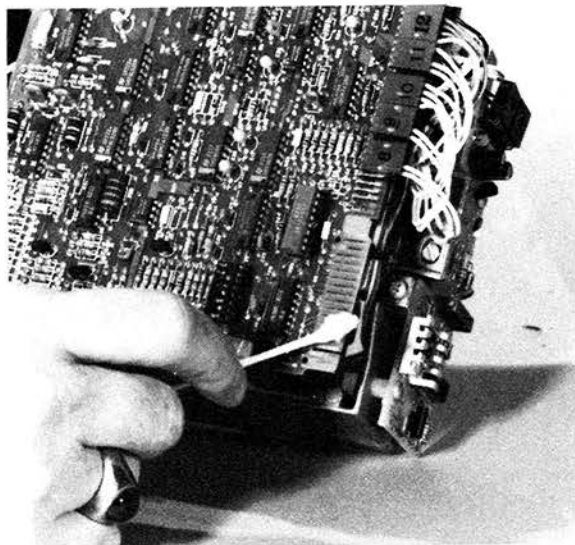


FIG. 4-6 Clean the connectors, especially if they appear dirty.

or inserting any cables or circuit boards. Failure to do so will almost certainly damage the board and the computer.

OBSERVE SYMPTOMS

Before you go into the actual diagnostics to find out what has gone wrong with a drive, you can try several easy things.

The first step is *always* to observe the symptoms and then to eliminate those things that are *not* causing the problem. Make a note of all errors.

Are programs able to load at all, even in part? Listen to the sound of the stepper motor. Is it trying to move across the tracks, or is it "stuck" somewhere? Does this happen with all programs you try to load, or just with one?

Are other functions working? If you can't write to a diskette or copy a file, can you format a diskette?

If drive A refuses to load a program, change the default and try to load the program with drive B. If you can't do even this, you may have to open the cabinet and reconfigure the drives so that drive A operates as drive B, and vice versa. (See "Drive Swap" below.)

Try to boot the CP/M system diskette. You're now loading only the system, and not a full program. (See Chapter 3, "Failure to Boot.")

Check all cable and board connections, and clean them if they appear to be dirty. When was the last time you cleaned the heads?

Try to eliminate all the obvious things before you spend a lot of

time and effort. Chances are good that you'll find that the problem isn't really a problem at all.

THE CLAMPING MECHANISM

As you insert the diskette and close the door (or turn the latch), the diskette clamping mechanism goes down and the diskette is placed in the correct position for the spindle to make a positive contact and for the read/write heads to be positioned. If the closing mechanism doesn't come down and lock into place properly, the computer is likely to see the drive as having an open door. The diskette can't spin, the program can't load. The usual result of a broken door or latch in drive A is that the computer will wait for you to close the door, which you won't be able to do since it is broken. The problem could also be intermittent, with data being read or recorded with errors.

The clamping mechanism is made of plastic and thin metal. Some, unfortunately, tend to break. Even if the break hasn't completely separated the door from the drive, it could still prevent the drive from functioning properly. The hub may not make a secure contact with the diskette or the drive may simply think that the door hasn't been closed.

To adjust or replace the drive door, such as in the Tandon, you'll have to remove the drives from the computer cabinet. Loosen the holding screws (Figure 4-8) and then move the door with your fingers until the door is flush with the front facing of the drive (Figure 4-9).

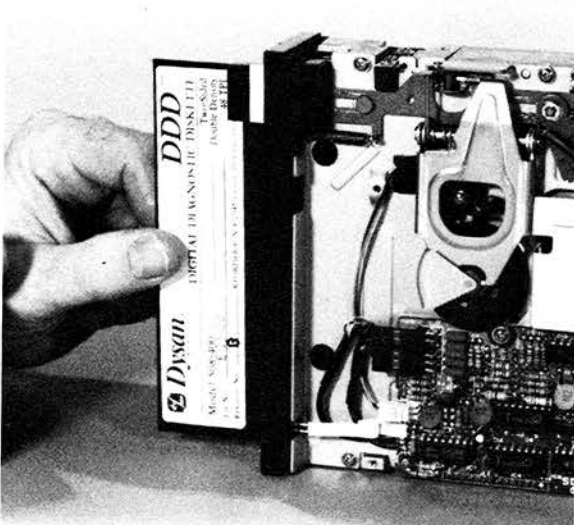


FIG. 4-7 Carefully insert a diskette to check clamping.

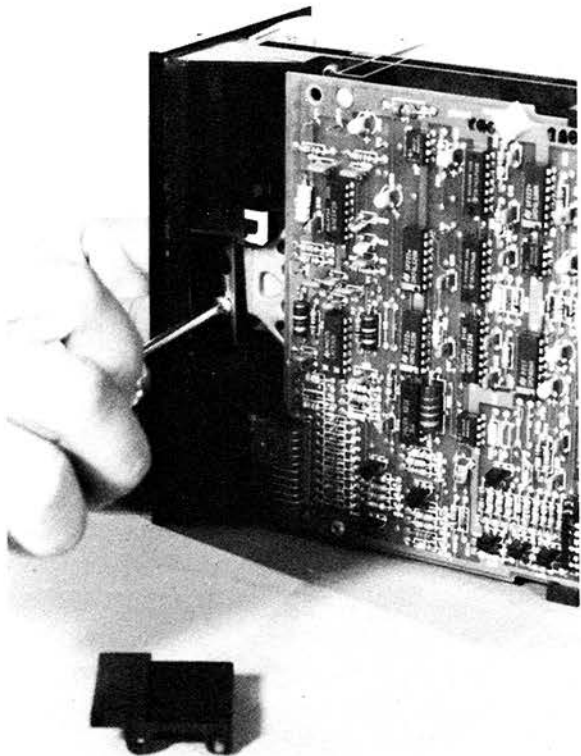


FIG. 4-8 Loosening the holding screws on the drive door.

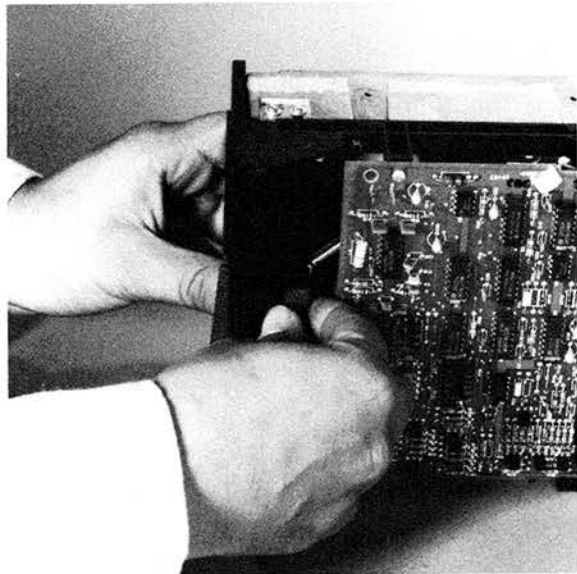


FIG. 4-9 Replacing a door assembly.

Changing a broken door requires little further effort. With the screws removed, the door will lift out easily, and the new door goes in just as easily. Attach the door with the screws, adjust and then tighten those screws.

Adjusting or repairing a drive with a latch is more difficult. Quite a few drives have latches that cannot be adjusted or repaired. In most cases, the only thing you can safely do (and that only if you're very careful) is to lubricate the mechanical parts of the closing mechanism (Figure 4-10). Even then, it is a last resort before you throw the drive away. There are some dangers involved. The Toshiba drive is particularly risky to lubricate. (Before you waste your time doing this, visually inspect the mechanism and try to find any obvious binding or other damage.)

The danger is that oil doesn't get along at all well with the floppies or the read/write heads. The tiniest bit of contamination will ruin the drive and destroy any diskettes placed into it.

Silicon-based lubricants are okay. Fine grade machine oil is a little better. Do not use standard motor oil.

Electronics supply houses sell needle-tipped oilers. Even these put out too much lubricant for the drive. They're meant more for oiling delicate motors through access holes.

To lubricate the mechanisms of the drive, use a swap with a very tight tip. (You don't want the threads to flake off.) Put a drop of oil on the tip of this, and gently apply the oil that way. Then work the

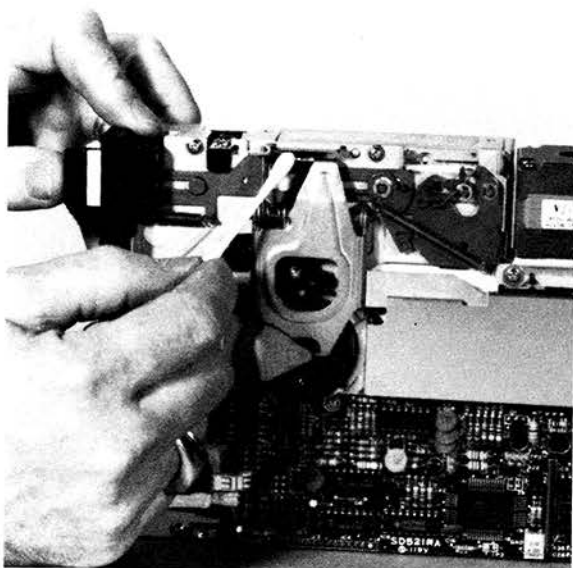


FIG. 4-10 Lubricating the closing mechanism might help, but this is a last resort.

mechanism by hand several times until it operates freely again. Most of the time you'll be able to see where the lubricant has been placed at the factory.

CHECK INCOMING POWER

If the LED on the front panel of the drive comes on, you might assume that power is getting to the drive and eliminate the power supply as the source of the problem. Chances are good that this assumption is valid. There is a simple check to make sure.

A 4-pin plug attaches to the analog board of the drive from the power supply. Normally there are exposed soldering points above the board which make probing the incoming power easy. Normally these are marked on the board as to which pin is which.

Facing the computer, to the far left is the 12V input; to the far right is the 5V input. The two pins in the center are the respective grounding pins. Set your voltmeter to read 12 V DC. Touch the black probe to one of the two center pins (Figure 4-12). The red probe is used to touch each of the two end pins in turn.

If you get readings within about a half volt of the stated value (4.5 to 5.5 across the 5V pins; 11.5 to 12.5 across the 12V pins), the power supply is kicking out the proper voltages as far as the drives are concerned. If power is getting to the suspected drive but that drive is dead, chances are good that it is the fault of the drive.

Don't forget to take notes and make sketches. This is especially

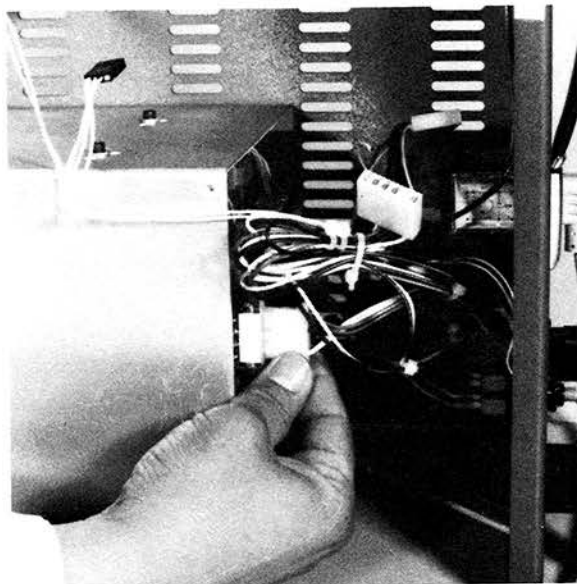


FIG. 4-11 Disk drive power connector.

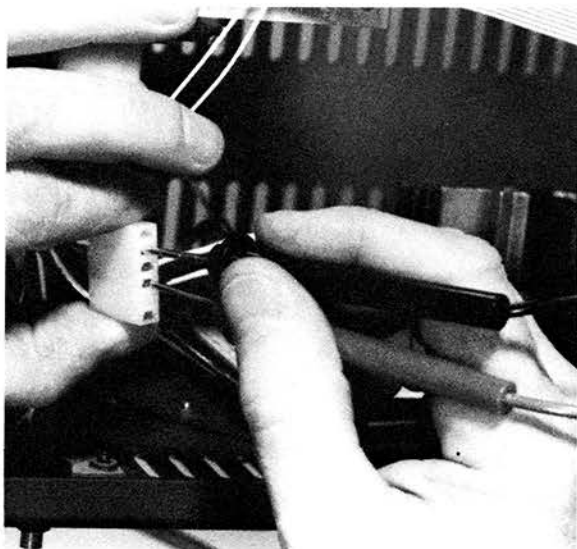


FIG. 4-12 Testing power to the disk drives.

important if you are going to be doing disassembly. But it is still an essential step to help you keep track of what you're doing, and what you've already done.

Testing power to a hard drive is much the same (Figure 4-13). You should get a reading of +5 volts DC between the white and black wires, and -5 volts between the other two pins.

DRIVE SWAP

Next, if you have two floppy drives, you can try a swap. This isn't easy to do, since you'll probably have to remove the drives from the

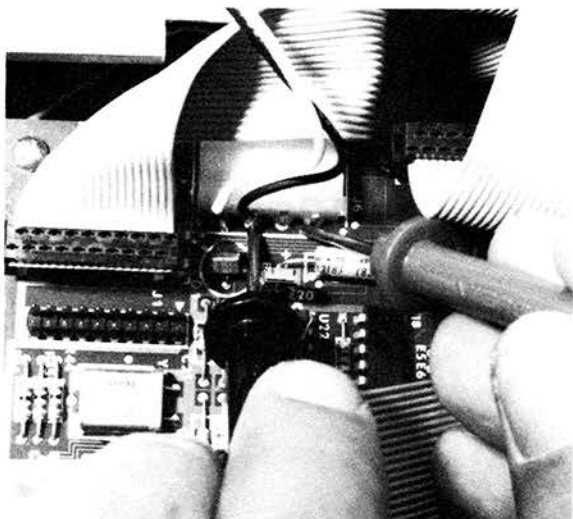


FIG. 4-13 Testing power to the hard drive.

computer cabinet to make the change. The time required might be worth it, though. This will almost certainly show you if a particular drive is bad.

For example, if drive A seems to be malfunctioning, but drive B is working fine, a swap will effectively change that suspected drive to B, and the good drive B to A. If the new drive A *still* malfunctions, you'll know that the drives are not at fault. If the new drive A now functions, but B is failing, the drive is at fault.

The easiest way to check drive malfunction is to connect the signal cable to another drive that you know is good (and is configured to operate as the suspected drive). This is the only way you can perform this step if you have just one floppy drive in your computer, such as with a Kaypro 10. If you have dual drives, you'll have to make a few changes to the drives to get them to act in the opposite configuration. (See below for information on removing the drives.)

Chapter 8 contains detailed information on how to configure the various drive models to act as drive A or drive B. It is best to refer to this information. At least read through the section that concerns the drives you have. Table 4-1 will serve as a quick reference. The jumper block and terminating resistor package socket are located near the signal cable connector. In all cases, the terminating resistor should be in place when the drive is being used as drive B, and removed

TABLE 4-1. Drive Swap

<i>Manufacturer</i>	<i>For Drive A</i>	<i>For Drive B</i>
Epson	Install jumper across "O" position	Install jumper across "1" position
Hi-Tech	Install jumper across "DSO" position	Install jumper across "DS1" position
Shugart	Install jumper across "1" position; also jumper left and center pins of "MX"	Install jumper across "2" position; also jumper left and center pins of "MX"
Tandon (full-height)	Install jumpers across pins 1 and 14, and pins 2 and 13	Install jumpers across pins 1 and 14, and pins 3 and 12
Tokyo Electric	Install jumper across "DSO" position	Install jumper across "DS1" position
Toshiba	Install jumpers across "LD," "HM," and "1" positions	Install jumpers across "LD," "HM," and "2" positions

when the drive is serving as drive A. (It's best to use an IC extractor for removing the terminating resistor package.)

REPLACING THE HEAD LOAD BUTTON

Single-sided drives have a read/write head on one side only. The other side has a small fiber pad to hold the diskette firmly against the head. Occasional I/O errors can result from a worn head load button. This button is a small felt pad on the bottom of the read/write head assembly. Its function is to push down against the diskette while the read/write head presses up from beneath. This holds the surface of the diskette flat against the head. If the pad wears, the diskette may not be held perfectly flat. Data may be lost. A heavily worn pad can also damage the diskettes. If the pad falls out (rare, but it happens), the diskette can become badly scratched or destroyed.

A worn pad will be skewed to one side. It might also look hard and dry. Either way it's time to replace it.

The method of attaching the head load pad to the arm varies with the drive being used. Some have a pad that snaps into place. Others are merely glued in. In these two cases replacing the pad is a matter

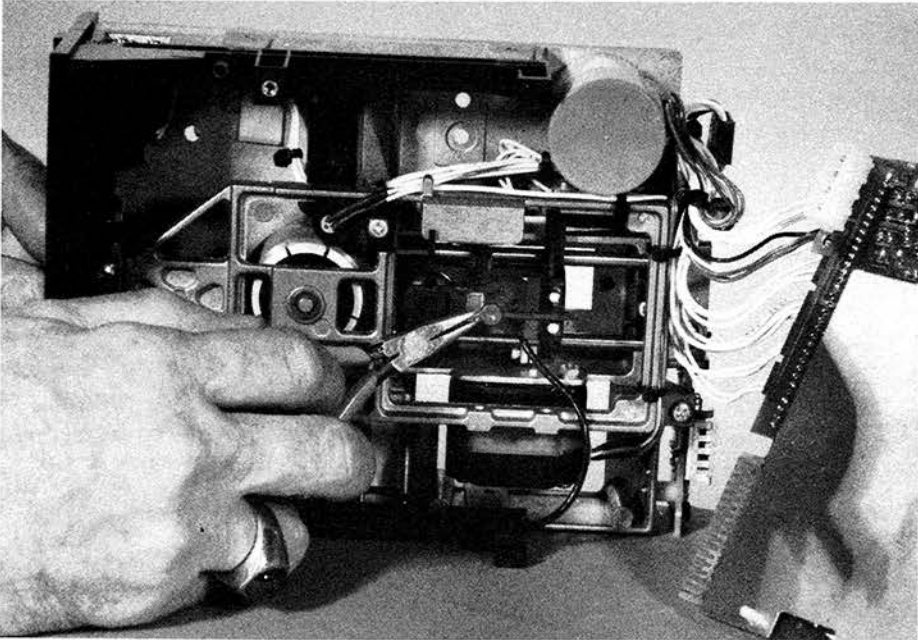


FIG. 4-14 Replacing the head load pad requires a partial disassembly—and care!

of pulling the old pad out with a needlenose pliers and just slipping the new one into place.

The top of the head load pad is sometimes a plastic cylinder with a round hemisphere on top. The cylinder and hemisphere have a notch cut into them. The assembly is forced up into the arm, and spreads apart to hold it in, so glue is not required. To change this kind of pad, lift the head load arm and grasp the pad carefully with a needlenose pliers. The button usually comes off easily. The new head load button gets inserted into the holder. A slight push will snap it into place.

You can usually get a head load button from your local dealer. Prices vary. Some dealers will give them to their regular customers without charge. When they do charge, the price is usually less than a dollar.

TESTING THE SIGNAL CABLE

The signal cable is the multiwired cable that connects the drives to the main board. It attaches to the main board on the left rear by the drives and is the only cable of its type in the computer. It's rare for this cable to go bad, but it is possible. Testing it is easy.

Set your meter to read ohms (resistance). The setting used doesn't matter. Touch one probe to a pin on one side of the cable and the other probe to the same pin in the opposite side of the cable. A reading of zero ohms means that the wire between those two pins is good. A reading of infinite ohms (no movement of the meter needle) means that the wire is broken somewhere along the cable. Usual repair is to replace the cable. (For those interested, this is checking for continuity and is the best way to test any wire or cable that is not presently carrying a current. You can even do this to test the wiring between your stereo and speakers.)

TESTING THE DRIVE CONTROLLER CHIP

The floppy drives are controlled by a chip and some related circuitry on the main board. Regardless of the model you have, this chip is some version of the 1793 IC. Where exactly this is located depends on which main board you have. On every one of them, the chip will be a 40-pin chip and will be fairly close to the drive signal cable and next to the CPU (the Z80 chip). See Figures 4-15 and 4-16 for examples.

The easiest way to test this chip is to replace it with one that is

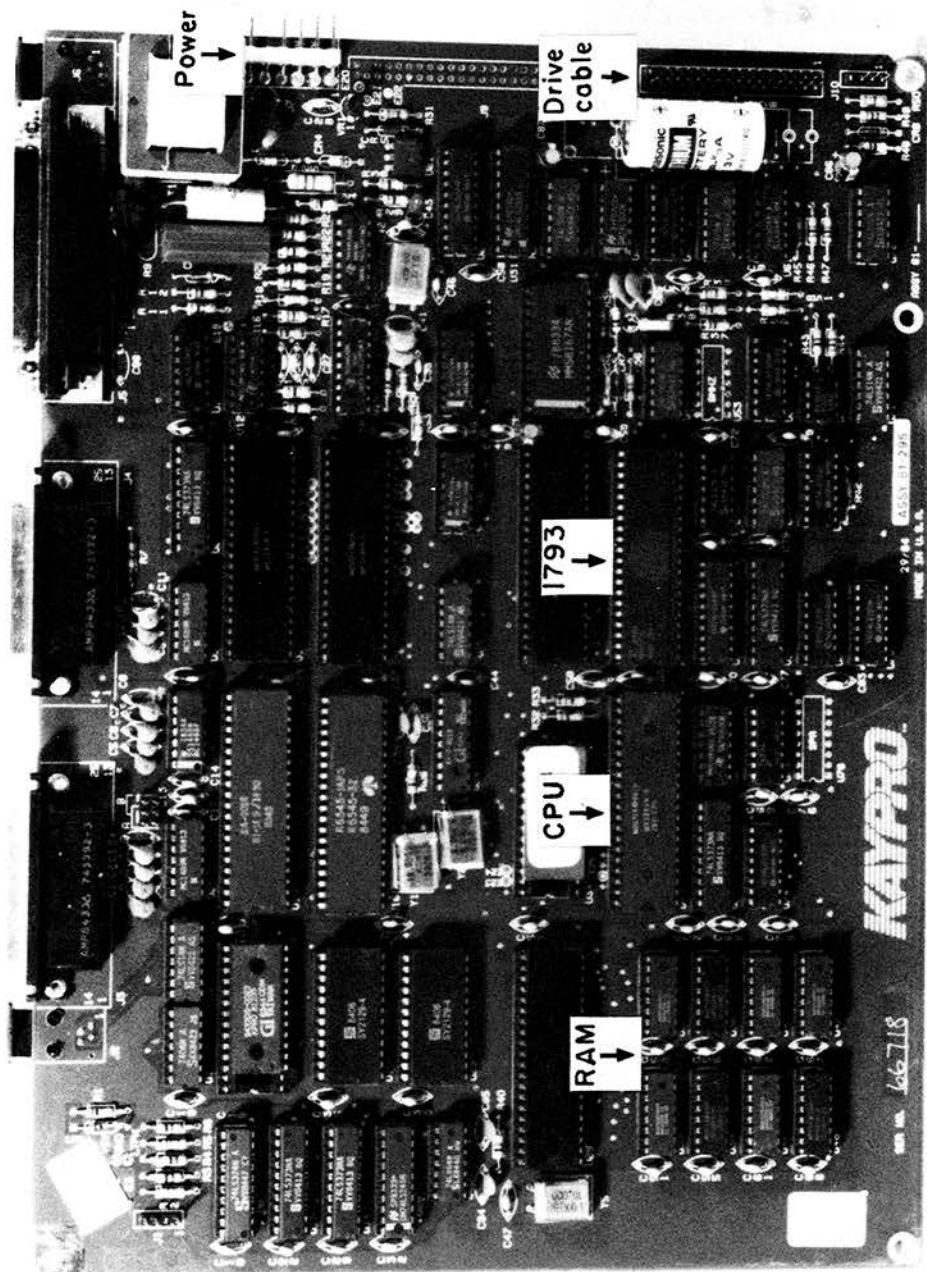


FIG. 4-15 Location of the 1793 IC.

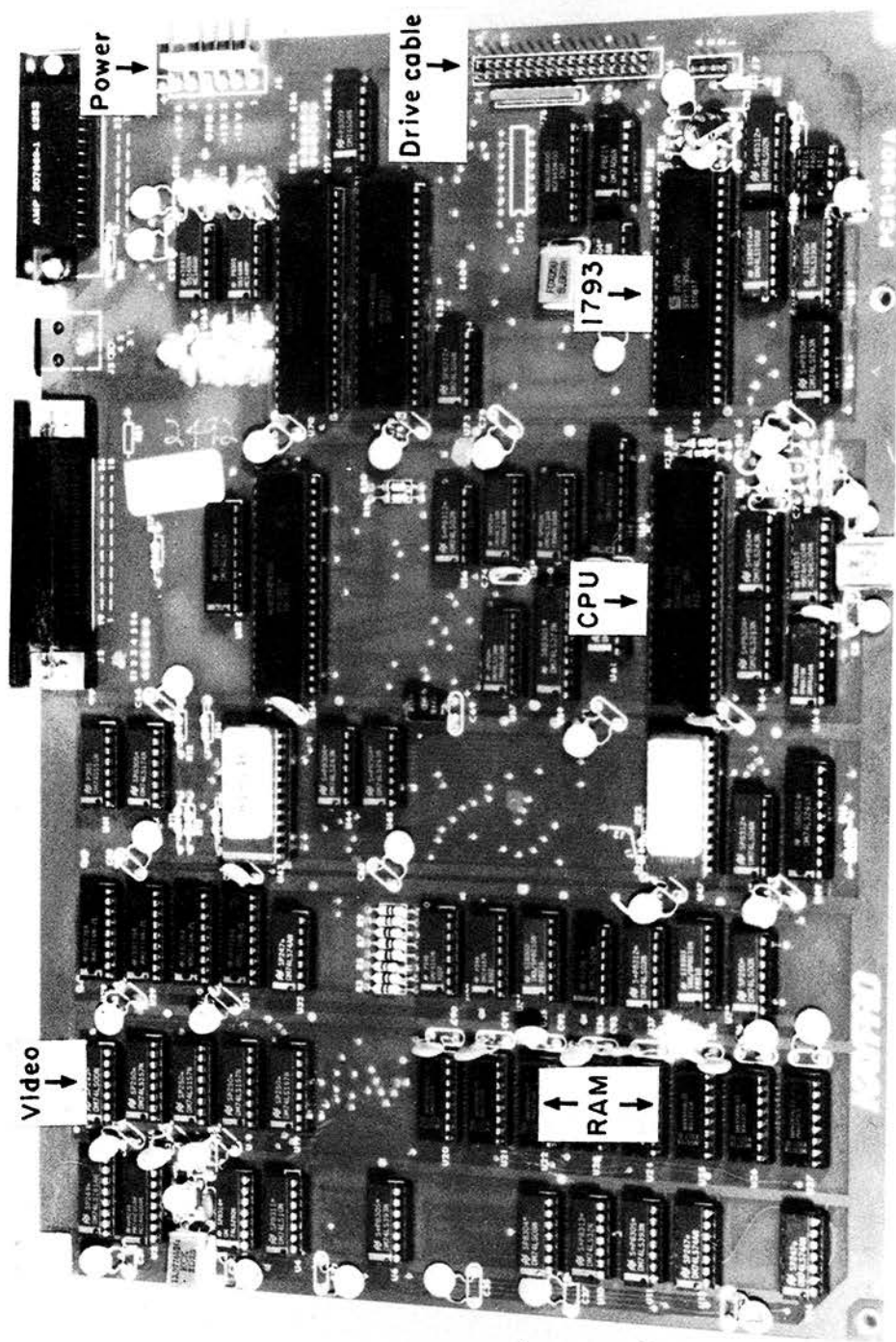


FIG. 4-16 Location of the 1793 IC.

known to be good. Drive problems that are not in the drives themselves could be solved by changing this one chip. But this is a gamble. The cost of the chip is about \$80, which makes it an expensive test if you're not sure. A whole new main board with trade in will be between \$300 and \$400. If you know that the driver chip has failed, replacing it is less expensive than replacing the entire main board. (If this *isn't* the trouble and you end up changing the main board, keep the chip on hand for future use—just in case.)

Also, the only time you can test the chip by swapping it is if the chip is socketed. If it is soldered into place, leave it alone. Desoldering those 40 pins and soldering in the 40 new ones can only lead to trouble.

Testing the chip with a meter won't tell you much. The chip is an intricate part with the rest of the computer's circuitry. The testing is also risky. Power has to be flowing for you to make the test. If your hand slips, if you cause a short circuit, or if you touch the wrong pins, you won't have to wonder if the chip is bad. After you've made this kind of mistake, it probably will be ruined, even if it wasn't before. You can also damage other parts of the circuit board.

It's best to leave the chip alone, or to leave the testing (and even the swapping) to the technician.

TESTING THE WRITE-PROTECT SWITCH

The notch on the side of the diskette is there to activate (or deactivate) the write-protect switch inside the drive. With the notch left open, you can write data on the diskette and can erase what is there. Cover this notch, such as with tape, and the data on the diskette cannot be changed. However, if this switch goes bad, the data and programs on the diskettes may be erased. If the drive malfunctions while the write-protect switch is faulty, you could find yourself with nothing but a blank diskette, even if all you've done is insert the disk and apply power. If you find that this switch is faulty, do not attempt to use the disk drive until you have made the repair.

If you suspect that the write-protect circuitry is faulty, or want to conduct an occasional safety check, you can perform a very simple test. Take a diskette that has nothing on it that can't be lost. Cover the write-protect notch. Then try to write onto the diskette, or try to erase it. If the switch is functioning properly, you won't be able to erase or change anything on the diskette.

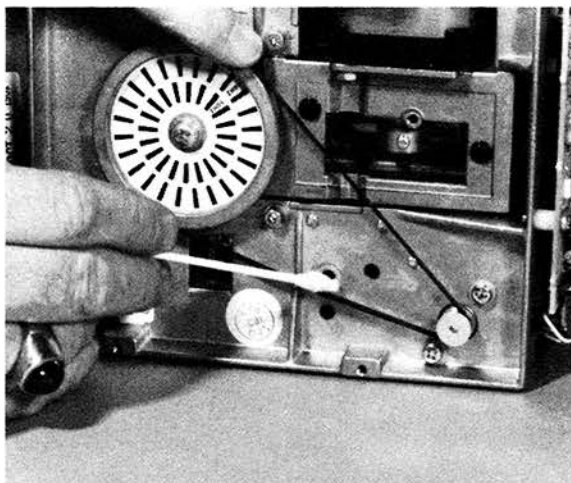


FIG. 4-17 Pulley and belt of the disk drive. Turn gently to check for sticking or binding.

PULLEY AND BELT

Some drives have a pulley and belt on the bottom of the drive (Figure 4-17). Others are driven directly by a low-speed DC motor and have only a flywheel (Figure 4-18). With the drive removed, turn the drive over. You'll see which kind your drive uses. If it has a belt, visually inspect the belt for wear. (It's also possible that the belt has fallen off or has broken, in which case you've found the problem right there.) Turn the pulley or wheel by hand to check for sticking, binding, or uneven turning.

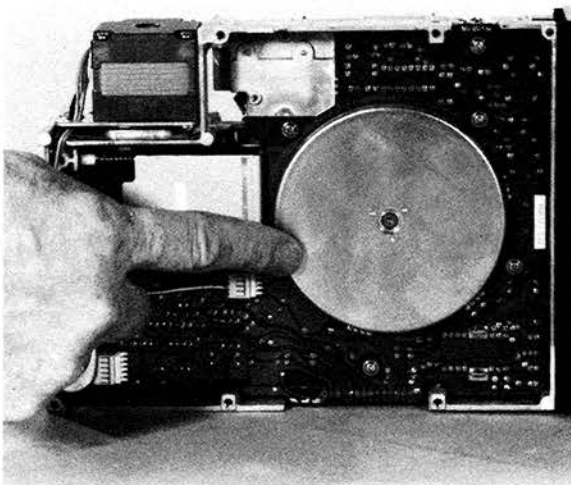


FIG. 4-18 Many newer drives use a direct drive motor. You can still check the flywheel for binding.

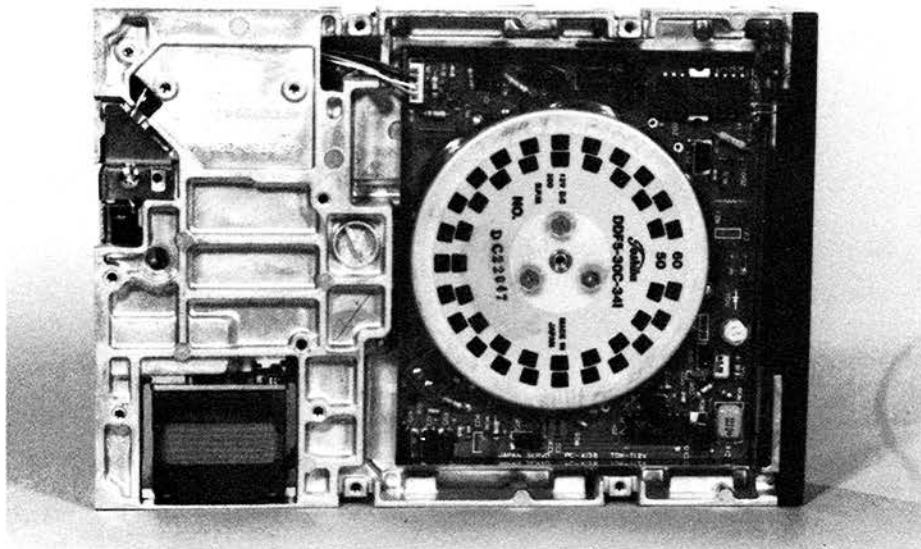


FIG. 4-19 The black squares on the wheel are the timing marks. The outer ring is for 60-cycle current; the inner ring is for 50-cycle current (European).

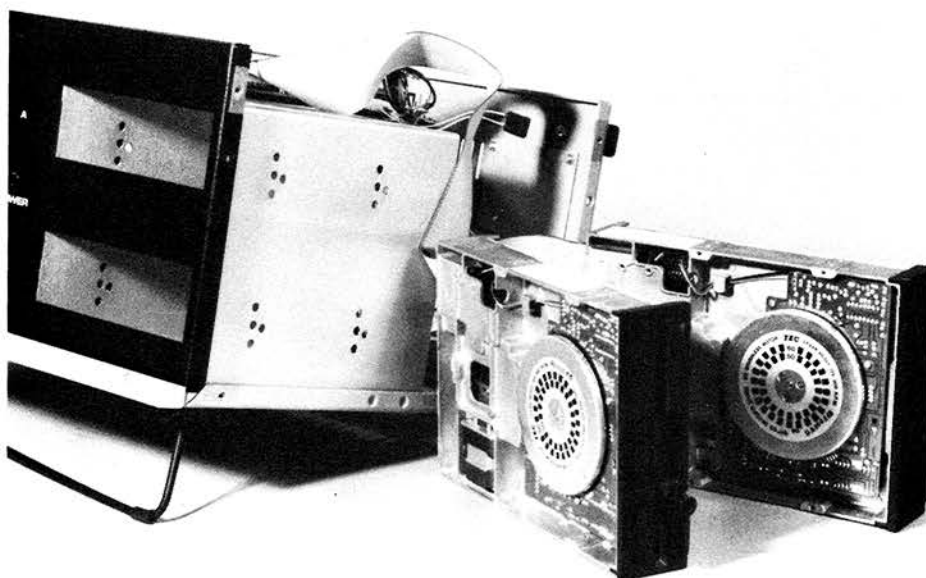


FIG. 4-20 Setting up to adjust drive speed.

SPEED ADJUSTMENT

There are several ways to test the speed of a drive. Many of the diagnostics diskettes available will do this and will allow you to adjust the drive speed. This is by far the easiest way to do it, and is an excellent means of periodically checking the drives. It's a wise investment to get one of these programs and to use it on a regular basis.

If you don't have a diagnostics diskette, you may still be able to test the drive speed by using a fluorescent light. To do this, the drives you have must have markings on the pulley or flywheel (Figure 4-19). Some drives do not have these, and they will have to be adjusted either with the special software program or with an oscilloscope.

Remove the drive and tip it on its side (Figure 4-20). Turn on the computer to get the drive to operate. You won't have much time and may have to press the reset button several times. (Each time you reset, the drive will try to load what is in the drive and the motor will spin.) Watch the pulley under the fluorescent light. If the drive is operating at the correct speed, the marks on the outer ring should seem to stand still. (The inner marks are for 50 hertz power.)

If the speed is off, adjustment is made by turning the variable resistor on the servo (motor control) section of the board (Figure 4-21). The Tandon drive has a separate servo board at the rear of the drive. Other drives will have this adjusting screw located through a hole in one of the boards, usually the bottom board. It may or may not be marked. Look around carefully. If you find a small slotted

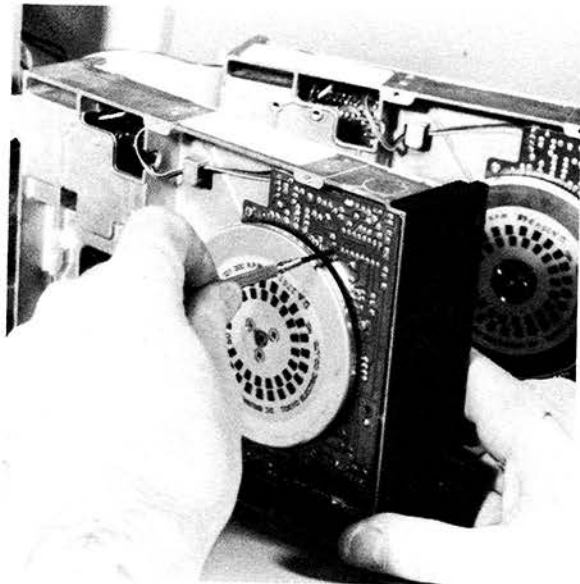


FIG. 4-21 Speed adjustment variable resistor.

screw, you've probably found the adjustment. (It will not be a Phillips head screw.)

By watching the marks on the pulley (under the fluorescent light), you should be able to tell which way to turn the variable resistor for correct adjustment. At the proper speed the marks will seem to stop moving. A diagnostics program will usually display what the speed is on the screen.

SOME OTHER PRECAUTIONS

You can avoid many drive problems simply by observing some precautions. Keep the environment as clean as possible. Dust and other contaminants can create havoc with the drive.

Regular cleaning of the read/write heads is a good practice. How often you do this will depend on your surroundings and how much the computer is used. *Don't skim* when you are buying a head cleaning kit. Get the best possible. (More information on regular cleaning and maintenance is contained in Chapter 7.)

If your drive has to be realigned, or if the drive speed is to be adjusted, make new copies of everything that has been recorded in that drive. Do this *before* you make the adjustments. Use that drive as the "source," with a drive that you know is good for the "target."

STOP!

Don't do anything to your drive until you've made copies of all data that was recorded on the maladjusted drive.

The reason for this is that the faulty drive has recorded the data according to its maladjusted characteristics. If you try to read that data on a properly operating drive, you'll probably get nothing but garbage. By using the faulty drive as the "source," you're allowing it to read the data with the characteristics embedded. The good "target" drive will record the data the way it should be.

The Kaypro is designed to be portable. The drives themselves are not. Whenever you move the computer from place to place, protect yourself and the drive heads by inserting either a blank diskette that you can afford to ruin, or a cardboard drive head protection card (two such cards is better yet).

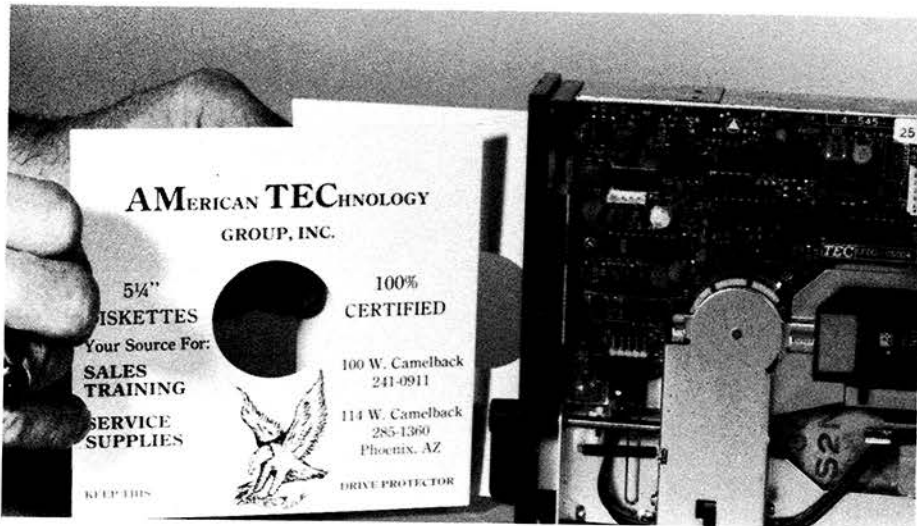


FIG. 4-22 When moving your computer more than a few inches, insert one or two head protection cards, or a blank diskette.

Earlier in this chapter it was mentioned that you might be able to “fix” a faulty latching mechanism by careful lubrication. The same is true for other mechanical parts of the drive (Figure 4-23). The same rules apply—namely, *extreme* caution, and very little lubricant. Lubrication is your last-ditch effort before throwing away the drive. Even then, don’t use any valuable diskettes in the drive until you are absolutely certain that you haven’t contaminated the heads.

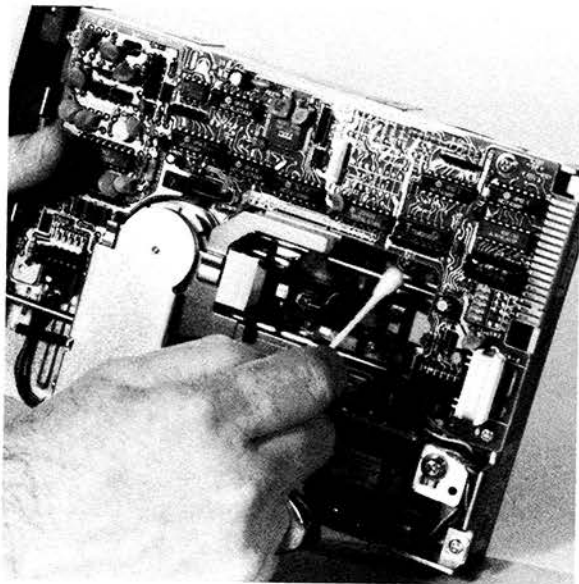


FIG. 4-23 Although it’s possible to cure some problems by lubrication, this is a desperate measure and must be done carefully.

REMOVING THE DRIVE

Getting the drives out of your Kaypro can be time-consuming and complicated. Since the entire computer is self-contained, the inside is prone to stray RF radiation (especially from the video section of your computer). To prevent this from damaging the drives and the diskettes, the drives are encased in a grounded shield (Figure 4-24).

With the cabinet off, you can access the mounting screws that hold the drives to the shield. Almost always these will be hex screws, requiring allen wrenches or an allen-headed screwdriver.

Before removing anything, carefully label all the wires and cables going to the drive (Figure 4-25). Then disconnect the wires and cables, and remove the holding screws (Figure 4-26). Now the drive should slide out of the casing without difficulty (Figure 4-27). Be very careful doing this. Some drives have components sticking up that could catch against the chassis (Figure 4-28). It's better to take the extra few seconds to look and to be careful than to ruin the drive's analog board.

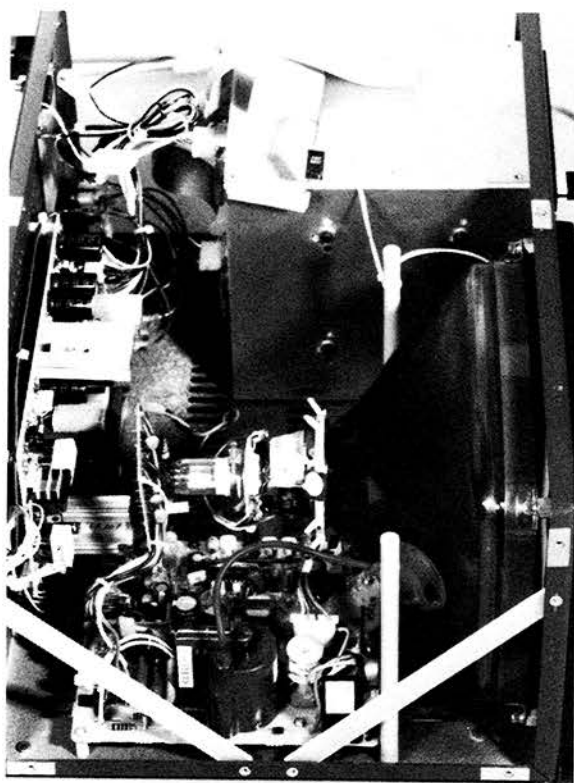


FIG. 4-24 The inside of the Kaypro with the main board removed. Note the drive shield casing.

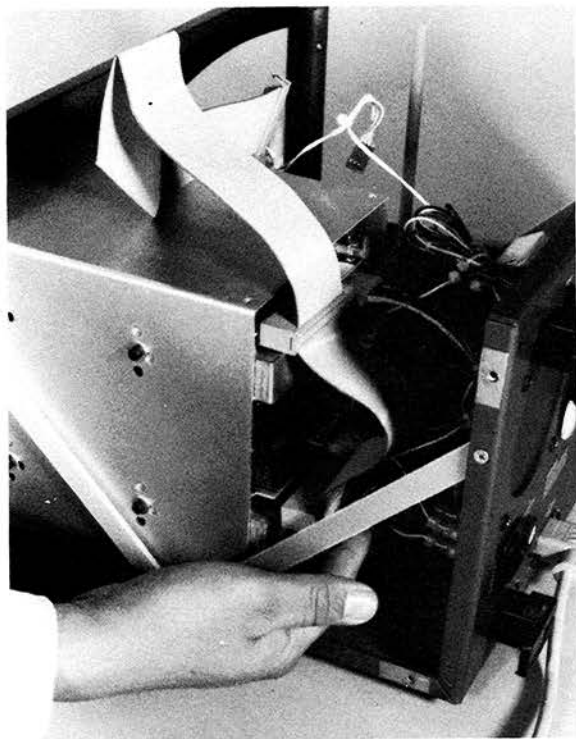


FIG. 4-25 Label and then remove all wires and cables going to the drives.

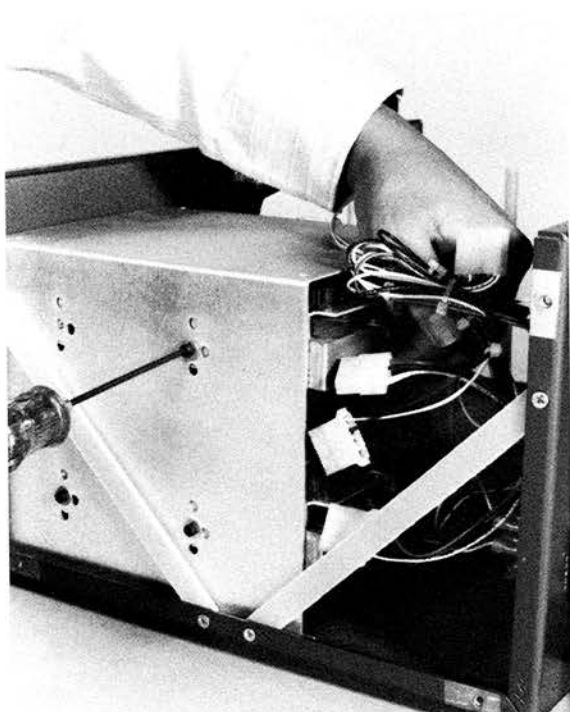


FIG. 4-26 Remove the holding screws.



FIG. 4-27 Carefully slide the drive forward through the opening.

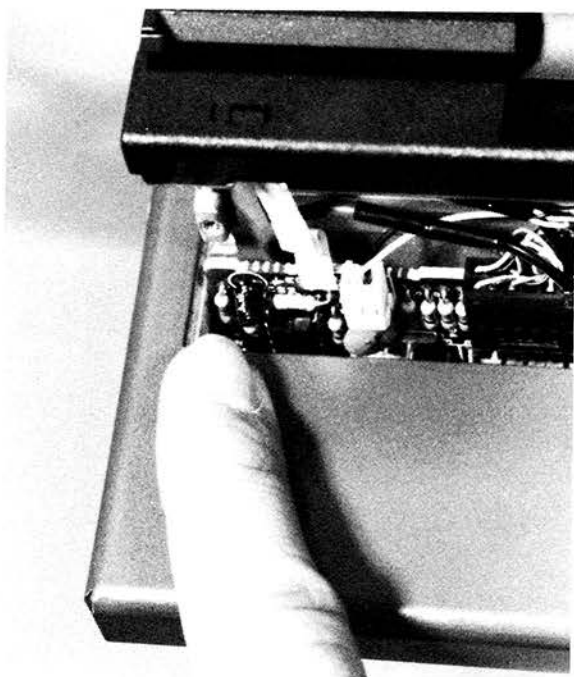


FIG. 4-28 Some drives have components sticking up that can catch and be damaged if you're not careful.

THE KAYPRO 10 HARD DRIVE

The Kaypro 10 has a hard drive along with a single floppy drive. Although the basic chassis is similar, the way the drives are mounted is slightly different. There are also more wires, which makes labeling even more important.

Attached somewhere inside the computer (usually on the hard drive itself) is a sheet of paper (Figure 4-29). This is a testing sheet with statistics concerning your particular hard drive. Take care of this sheet. Chances are you'll never need it, but if you *do* need it and it has been lost, you increase the risk of having to replace the hard drive instead of getting a simple repair. Some extra screws hold the Kaypro 10 drive and shield to the main chassis (Figure 4-30). These have to be removed to get the drives out of the cabinet. Even more screws are used to hold the drives to this shield (Figures 4-31 and 4-32). Use your common sense and you'll have no difficulty.

If you suspect problems with the hard drive, and go to the trouble of removing the unit, check the obvious. Check the connectors and the static eliminator (which may require cleaning) (see Figures 4-33 and 4-34). One of the most common problems with circuit boards of

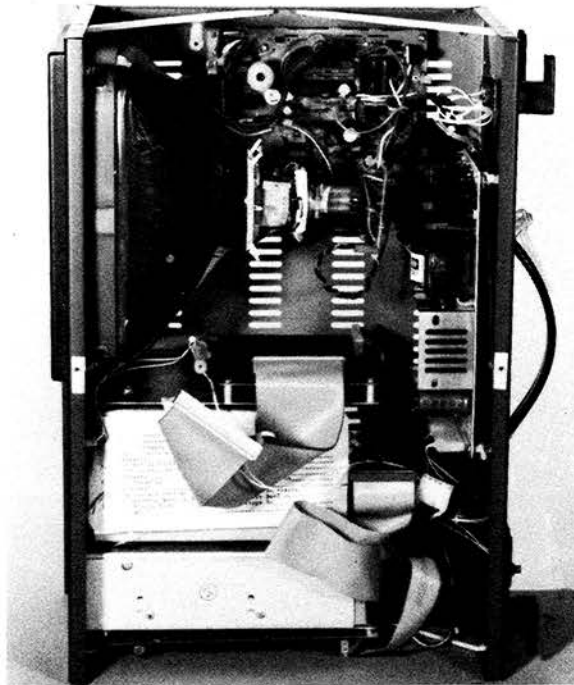


FIG. 4-29 Inside the Kaypro 10. Note the testing sheet attached to the hard drive. Take care to keep this sheet.



FIG. 4-30 The drives are held in place by additional screws through the chassis.

all kinds is loose ICs (Figure 4-35). Last but not least, don't forget to clean the contacts (Figure 4-36).

Once you've taken care of the obvious things—cleaning the contacts and static eliminator, reseated the chips, checked the connectors, etc.—about all you can do about a hard drive problem is to replace the unit, or bring your computer to the shop. Working further on a hard drive requires a special dust-free environment and some very expensive equipment.

SUMMARY

The disk drives are probably the most critical part of your computer system. Unfortunately, they are also the devices most likely to cause trouble. This is because they are one of the few mechanical parts in the system.

If the drive malfunctions, existing programs may not operate. Data recorded on a misaligned or otherwise maladjusted drive can disappear once the drive is put back into shape again.

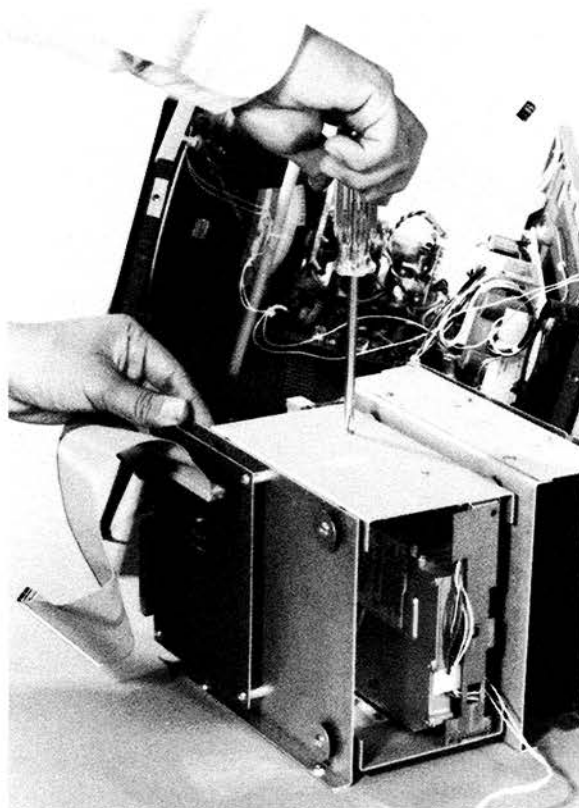


FIG. 4-31 Removing the drives from the shield isn't difficult.



FIG. 4-32 And even more screws. It's important to keep close track of which screws go where.

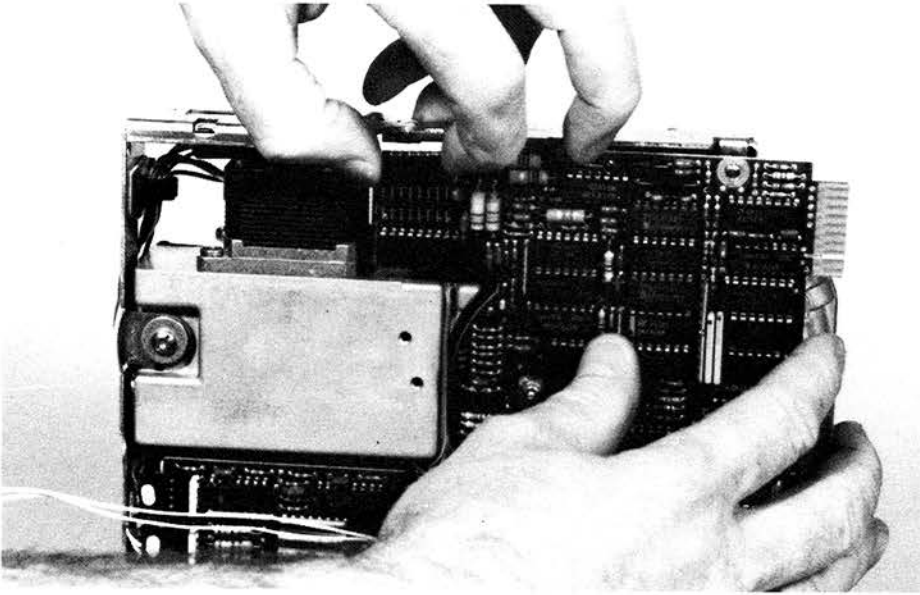


FIG. 4-33 Check the obvious, such as the connectors.

Only rarely will a drive suddenly fail. Most of the time it will give you warning symptoms, such as a faulty read or a faulty write. Both can be caused by other things, but both also indicate that it is time to check out the drives.

Make drive checks and drive maintenance a part of your regular schedule. Clean the heads occasionally. A diagnostics diskette is a

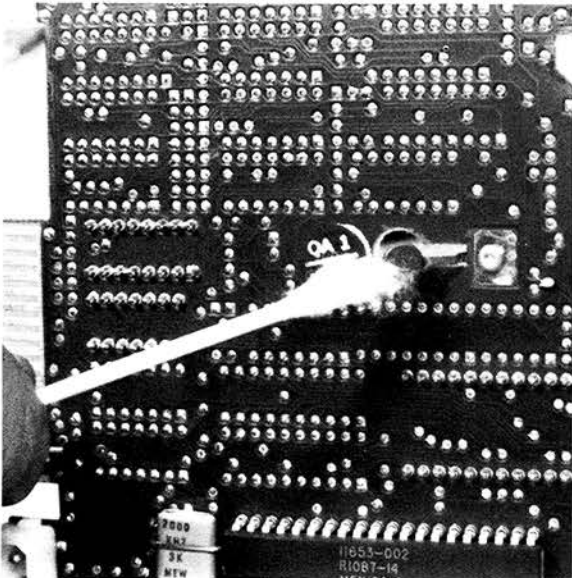


FIG. 4-34 Most hard drives have a static eliminator. This device sometimes requires cleaning.

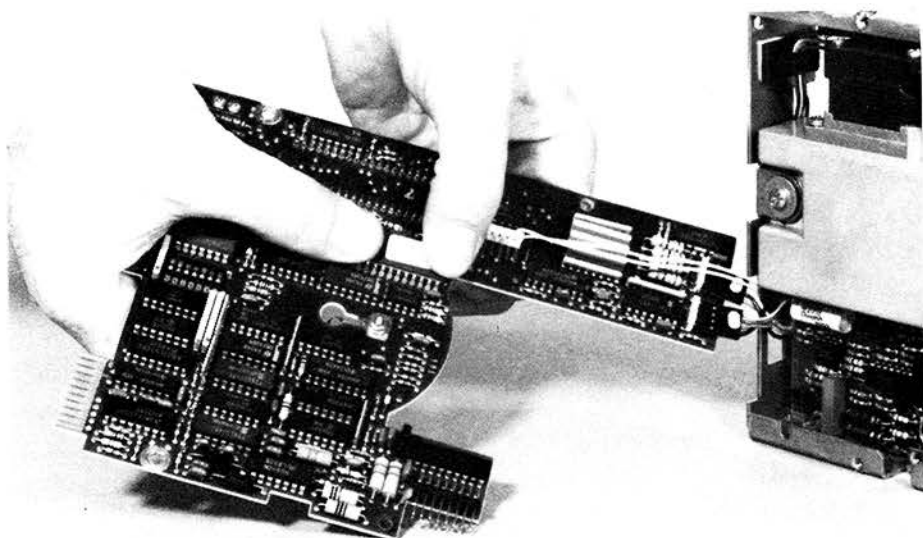


FIG. 4-35 One of the most common problems with circuit boards of all kinds is loose ICs.

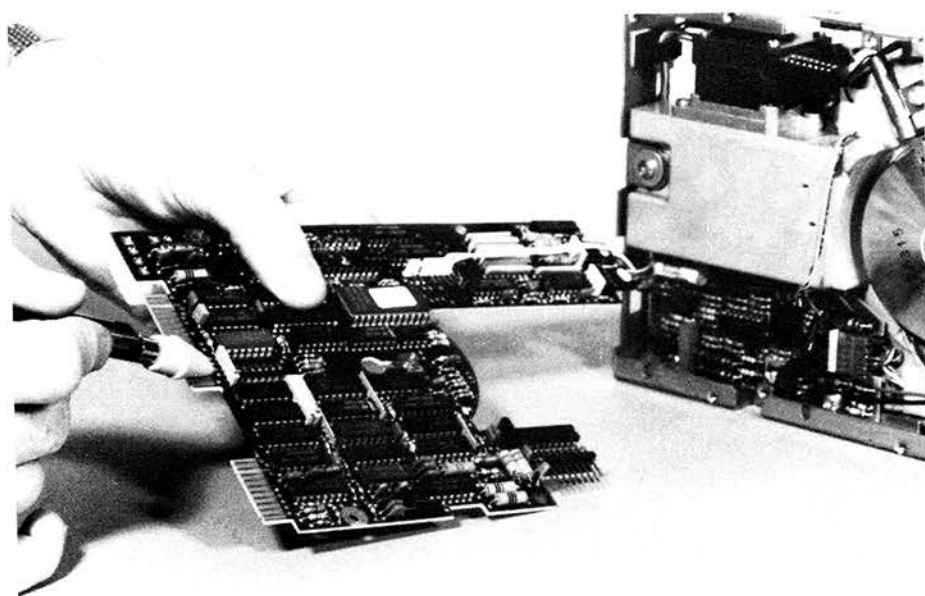


FIG. 4-36 Don't forget to clean the contacts.

good investment. Run the diagnostics on the drives regularly to keep track of how the drives are performing. This way you'll have ample warning if the drive is going bad.

Preventive maintenance is the best possible means of assuring that the drives will give you no problems. Backup copies of programs and data diskettes made while the drives are operating properly will help to ensure that a drive malfunction is not a disaster.

When you have finished the tests in this chapter, or when you have simply noted the symptoms, you'll have a very good idea where the problem is. If power is getting to the drives from the power supply, the problem is most likely with the drive or cable. A simple continuity test eliminates the cable as the possible cause.

Hard drives present a special problem. Their construction makes it impossible for you to work on them other than to check for some of the very simple and obvious things. Never attempt to disassemble the hard drive.

Chapter 5

Troubleshooting the Boards

There are many things on the circuit boards that cannot be tested without some very expensive equipment. Much of the time your diagnosis tells you no more than which board is malfunctioning. Only rarely will you be able to track the problem to a specific component. Repair is usually by replacing the entire board.

The professional in a repair shop has an advantage. If the video board is suspected, for example, another one is likely to be close at hand. This can be substituted for the suspected board. If things work again, the problem has been found and the repair is complete.

The same technique can be used for individual components, and once again the shop has a stock of components on hand. If the suspected component is socketed, the swap takes just a few seconds.

Unfortunately, neither avenue is open to the average end user. The cost of keeping all the spares on hand would be much higher than paying the shop. You'll almost certainly have to limit yourself to tracking the malfunction to a board rather than to a component.

More important than any tests you can perform is careful observation. Look for symptoms. What is happening? What is not happening? Then look for the obvious. Are all the connectors plugged in correctly? If the board has socketed components, give each and every one a push to make certain that they are seated in the sockets. (Don't fiddle with any connectors or components while the power is flowing.)

You should have a good idea of which board is causing the problem after you've completed your observation survey. By process of elimination, you should be able to locate what might be causing the problem. This way you won't waste time on things that can't be causing it. Before you begin any testing or measurement, you should al-

ready be fairly certain that the board you are testing is the cause of the malfunction. Chances are you won't have to make any actual tests other than for power.

THE MAIN BOARD

Kaypro uses the term *main board* to describe the main circuit board of its computers. Apple calls it the *mother board*. IBM calls it the *system board*.

The Kaypro has several versions of main boards, depending on when the computer was built and which particular model the board is in. All are quite similar. The major differences are the kinds of components used (different ROM, etc.). See Figures 5-1, 5-2, and 5-3.

Unfortunately, if something is wrong with the main board, you probably won't be able to do much about it other than to swap it with a new one or take it to an experienced technician who has the right test equipment. The technician will probably just replace the entire board. Even if the problem can be tracked to a single component, the labor charges involved with this lengthy search can cost you more than the new board.

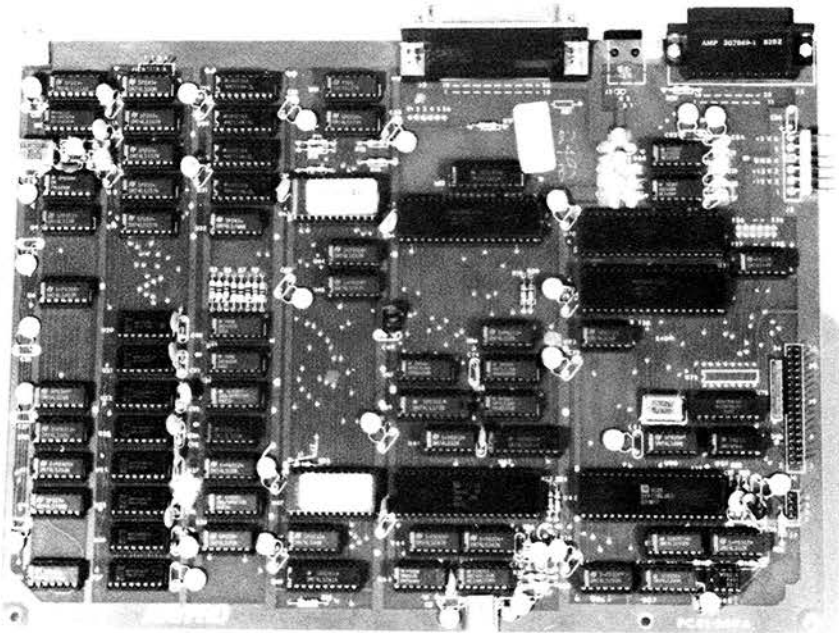


FIG. 5-1 An early main board.

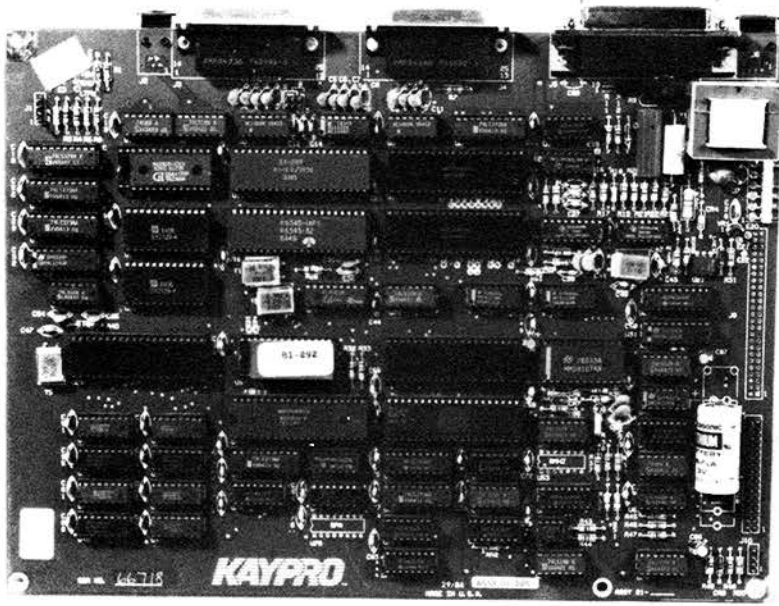


FIG. 5-2 A typical recent main board.

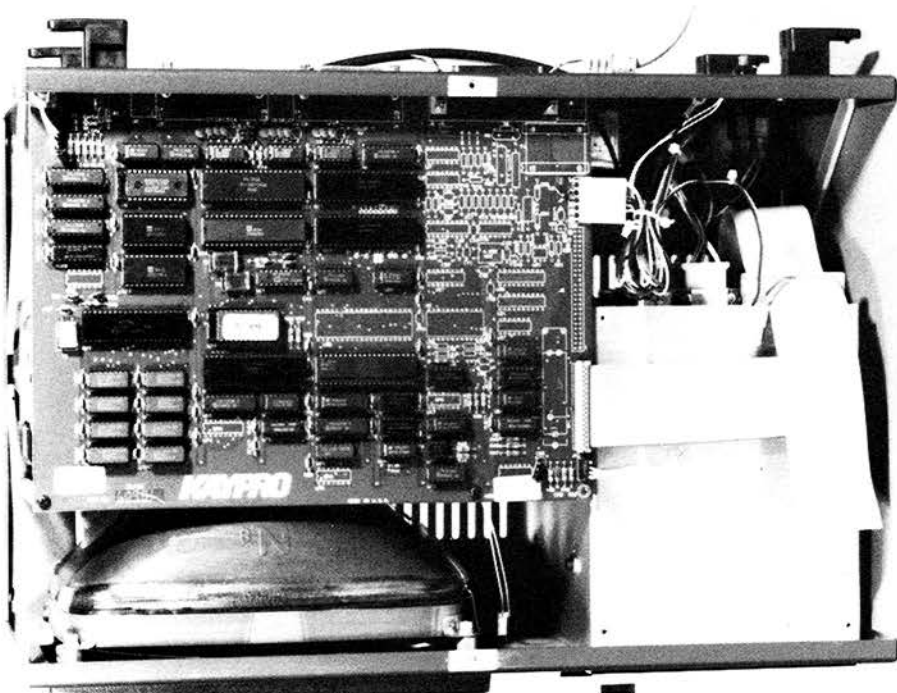


FIG. 5-3 Inside the Kaypro. Note that the modem section is not filled in.

If you're lucky, the service personnel might be able to guess at the cause of the problem by the symptoms you describe. Once again, it's important to take notes. The shop may then be able to swap individual components (such as socketed ICs) with known good ones in their stock. RAM and ROM in particular are easy to test this way. (Most repair shops have these chips around). This route to finding the problem isn't open to the average owner, though, since not many of us keep a shelf full of computer parts.

In some main boards, particularly the older ones, nearly all the components are soldered into place. This means that a problem with the RAM chips, for example, required the technician to desolder the multipinned ICs (16 pins per chip, with 8 chips in the RAM section of the main board) and then solder in the new chips. The usual solution was to avoid all this by replacing the entire circuit board. Newer main boards have more socketed components, which makes a simple swap considerably easier.

The malfunctioning board has a trade-in value. If you damage the board in some way, such as burning it with a soldering iron while attempting to change a chip, this trade-in value goes up in smoke. If you decide to attempt any repairs, do so with extreme caution. The same applies for any modifications to the hardware.

Before you yank out the main board and pay for a new one, try to determine if the main board is actually at fault. As mentioned, this isn't easy. Tests made with a voltmeter, or even with an oscilloscope, aren't necessarily conclusive. They are just indicators.

Shut off the power and check the system board carefully to be sure that all connectors are secure. Unplug them and inspect the contacts for signs of burning or corrosion. Cleaning them might not take care of a problem, but is so quick and easy that you might as well give it a try. Clean the silver or gold contacts (the "fingers") with a quality cleaner or a pencil eraser (or other soft eraser). If possible, do this away from the computer, especially if you use an eraser. Be sure that the eraser crumbs do not fall into the computer. Reinsert all the connectors.

With the power still off, gently press down on all socketed ICs to make sure that they are in good contact with their sockets. This is especially important if the computer has been moved around.

While you're going through these steps, visually inspect everything inside the computer. You might be able to spot a damaged component or something else that is obviously at fault. And don't forget to check the fuses. (Figure 5-4).

Now try the system again.

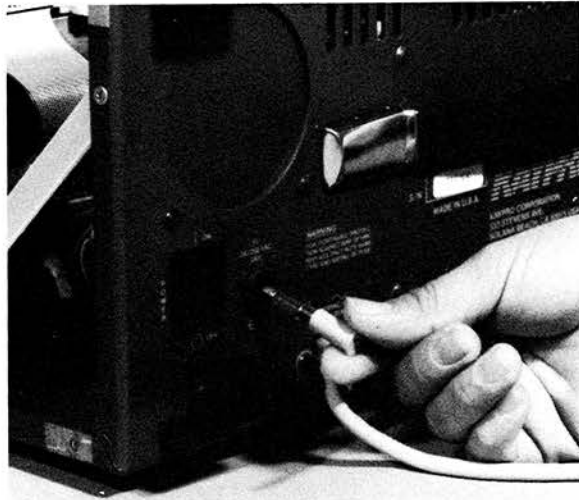


FIG. 5-4 Don't forget to check the fuses.

If things still don't function properly, get out your meter and set it to read 12 volts DC. You'll be testing the power flowing into the main board by measuring across pins of the six-pin power supply connector. This is located at the right rear corner of the main board (Figure 5-5). Note that the connector coming from the power supply is a female end, and that the plug is keyed to fit on the main board connector only one way. (Pin 1 is closest to the front of the computer.)

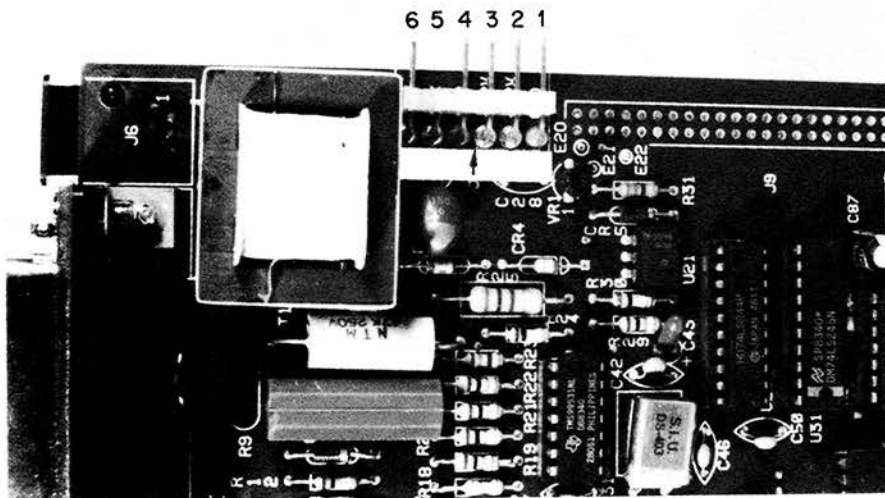


FIG. 5-5 Location of power connector to main board.

Even so, make a sketch to help you identify the pins of the main board (a male connector) so that you will plug the two together correctly. Here is a list of the six pins in the connector and their respective values:

Pin	Value	Pin	Value
1	Not used	4	Ground
2	- 12 volts	5	Key
3	+ 12 volts	6	+ 5 volts

You can do the test quickly without removing the connector. However, it is best to unplug it (while the power is off) and test the output of the drive directly. The power is flowing while you make the measurement, so be very careful.

Touch the common probe (black) to pin 4 of the cable coming from the power supply. This is ground. Touch the red probe to pin 6 of the cable and turn on the power. If you get a reading of 4.85 to 5.15 volts, the power supply is working in the 5-volt range. The power supply could be bad if the reading you get is outside this range (see Chapter 6).

If you get an acceptable reading, check the voltage across the 12-volt side as in the table. With the black probe still touching pin 4, touch the red probe to pin 3. The reading you get should be between 11.5 volts to 12.5 volts. If the readings for both the 5-volt and 12-volt outputs are correct, the power supply is providing the correct voltages. This means that the system board is at fault. If the readings *don't* match, the power supply is probably at fault. Go to the Chapter 6 section on "Power Supply" and run that series of tests.

If all readings are correct but the computer will still not power up, there are two possibilities. The power supply could be wearing out and is incapable of producing the needed amount of current. One of the other boards (including the main board) could be faulty and pulling too much current for the power supply to keep up. But this doesn't happen often, even with computers that have been in use for a long time.

In the case of a worn power supply, about all you can do is to get a new power supply. Fortunately, this is rarely needed. The next two tests will help to determine this. But before you pull out the old power supply, go to Chapter 6 and continue testing with the information under "The Power Supply."

While the power supply connector is still off, shut down the power and set your meter to read resistance in the X10 range. (It's important that you set your meter in the X10 range for this test. Otherwise you will get different readings than those given.) Touch the black probe to pin 4 on the main board connector. Then touch the red probe to each of the other pins.

The readings you get should be fairly close to those in Table 5-1. It isn't important if they are exact—the test merely gives you a general idea of continuity through the circuits. If the reading you get between pins 4 and 3 is 400 ohms, everything is probably just fine. You're more concerned by very large differences, such as a reading in the thousands of ohms. Such a reading would indicate that something is wrong.

You can extend this test to the video connector (located at the opposite side of the board). The black probe is still to touch pin 4 on the main board power connector. Now touch the red probe to the three pins of the video connector. Again, the readings are only approximations. You are concerned only if the reading you get is drastically different.

To make both tests more valid, the next time you open your computer, get out your meter and make the measurements while you know that everything is working correctly. Jot these numbers down in the spaces provided in the table.

What seems to be a problem with the main board could be caused by something connected to it. You've taken the first steps toward eliminating these other things earlier in this chapter by observing the symptoms. Unless you have boards to swap with the suspected board,

TABLE 5-1.
Main Board Resistance Check

<i>Power Connector Pin</i>	<i>Ohms</i>	<i>Your Reading</i>
1	Infinite	_____
2	Infinite	_____
3	@ 300	_____
6	@ 90	_____
1	@ 270	_____
3	@ 210	_____
4	@ 270	_____

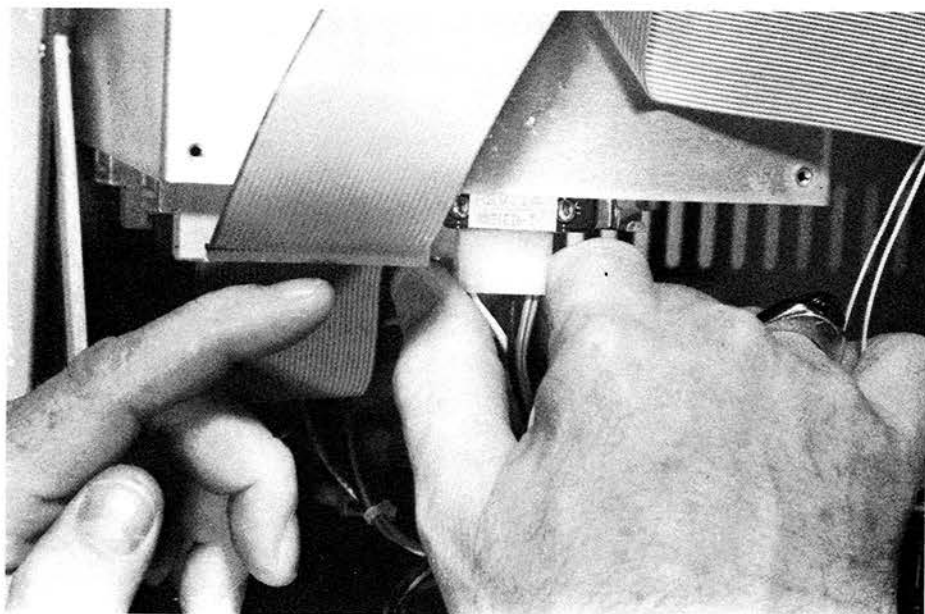


FIG. 5-6 Disconnecting internal devices and connectors.

you can generally check only external devices (printers, etc.) and internal devices for power. This is done by disconnecting all attached devices (Figure 5-6) and connecting them again one at a time until the system fails (assuming it works at all at any point).

Follow the procedure from Chapter 6 on unloading the power supply and then reconnecting the boards one at a time (with the power off each time) to find the one at fault. With all peripheral devices removed, and if the power supply will still not run the computer, you'll know that the problem is either with the main board or with the power supply. Go to Chapter 6 and thoroughly test the power supply.

If the main board passes all these tests, chances are you'll have to replace the main board. Unless you have a diagnostics diskette, you can't test the various sections. If you happen to have extra chips around the house that match those of the computer, you can try swapping them. Other than that, there isn't much you can do.

Before you go to a lot of trouble or expense, make sure that you've eliminated all other possible causes of trouble by looking for the obvious once more. Open the cabinet and visually inspect the inside. Is there anything that could be causing an accidental short (like a screw that has fallen onto the board)? Are all boards plugged firmly into place? Are all the cables and connectors secure? (For both things, unplug and reinsert, clean the contacts—always with the power off.)

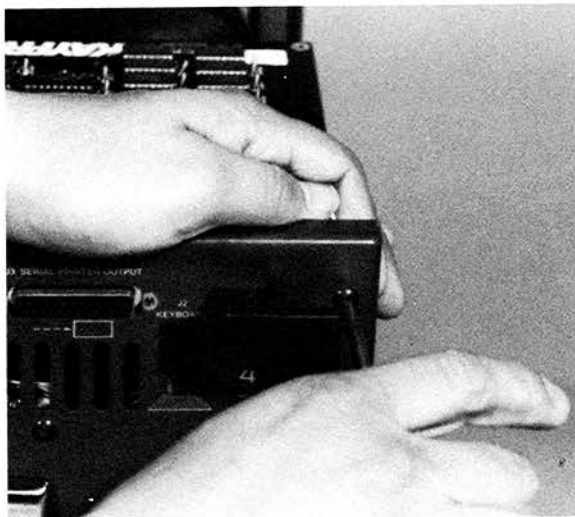


FIG. 5-7 Removing the screws from the rear chassis.

Outside the cabinet, are the plugs and cables secure? Even more important, are they in the right places?

REMOVING THE MAIN BOARD

If tests indicate that the entire main board has to be replaced (rare!), you may wish to do the work yourself. It's not difficult.

To remove the main board, unplug the computer, take off the case and disconnect everything going to the main board. Be sure to make detailed sketches so you'll know exactly how everything goes back together. Label everything.



FIG. 5-8 A nut driver is usually needed to remove the screws that hold the ports of the main board.

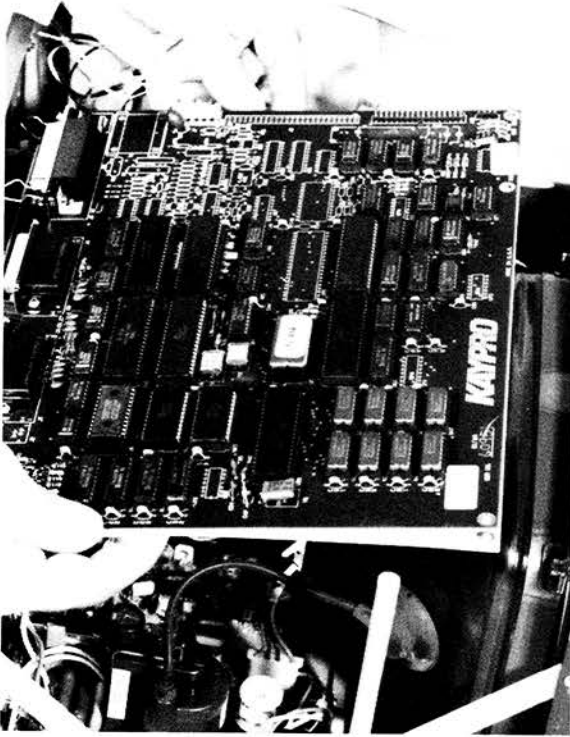


FIG. 5-9 After you remove all screws, the board will lift off easily.

The main board is held in place by 8 screws. There are 6 screws on the back of the cabinet (which also hold the ports in place) and 2 screws inside at the front of the main board. Remove these. You may need a nut driver to remove some of the screws on the back of the cabinet (Figure 5-8). The board is now free and can be easily lifted out (Figure 5-9). If it doesn't, you've missed something. *Don't force it!*

Installation is just the reverse. If you've made sketches and have labeled all cables and connectors, you'll have no problems.

OTHER BOARDS

Without sophisticated test equipment, you probably won't be able to find the specific problem with a circuit board. Generally, the fastest way to test a particular board is to swap it out with one you know to be good. If everything works again, you'll have found the problem.

However, you can do a few simple things on your own. First visually check the suspected board. Is it snugly connected? Are all cables going to it tight? Have any of the components worked loose? (Don't forget to shut down the power before removing or inserting

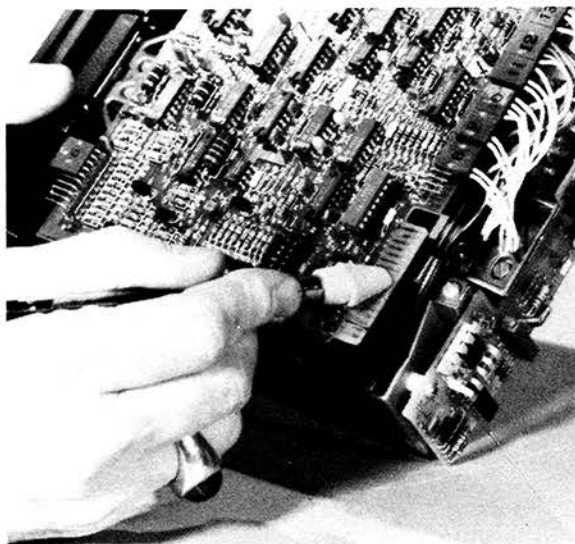


FIG. 5-10 Cleaning the contacts.

any board, cable, or device, and before pushing on the components to make sure that they are seated properly.)

Try cleaning the contacts with a high-quality electronic cleaner (not a television tuner cleaner. Don't use anything that could leave a residue!). If you don't have a cleaner around, you can use a soft pencil eraser, making sure that you don't get any particles inside the computer (Figure 5-10).

If the suspected board is new to your system, you must consider "Has it ever worked?" question. Have you made any other changes to the system?

SUMMARY

Diagnosis of circuit board problems is often difficult and time-consuming. Even professional repair shops commonly track the problem to a particular board and then just replace that board.

By observation and note taking, you should be able to isolate the malfunctioning board quickly.

As always, take some time to visually inspect for the obvious. Are all cables and wires firmly attached? Are they connected correctly? If the suspected board is not the original or an exact replacement, is it compatible and designed to work with your particular Kaypro model? Has it changed something else?

Fortunately, if a board operates when you first install it, it will probably continue to function for many years. No maintenance is required.

Chapter 6

Power Supplies, Keyboards, Printers, and Video

You can connect a number of different options and devices to your Kaypro. Since there are so many different options, so many different manufacturers, and so many variables, it is impossible to cover them all. We have included only the most common options in this chapter. These should give you some basic guidelines for repair.

Use the information in Chapter 2 before you begin poking around the machinery. The steps you took in Chapter 2 should have led you to this chapter.

THE POWER SUPPLY

The driving force behind the Kaypro (and all things electronic) is the power supply. It does just what the name implies. It takes the 120 volts at 60 cycles per second from the wall outlet and changes it to a clean, steady 5 and 12 volt DC supply.

Normally it does its job just fine and gives no problems. Unlike the power supplies of some other computers, the Kaypro power supply is relatively tough. Chances are you'll never have to worry about anything going wrong with the supply other than the mechanical on-off switch in the back.

If the power supply is acting up, you may not be readily able to spot it as the source of the problem. The computer might seem to be completely dead. This could be caused by the power supply, but it could also be a problem with the system board or from a combination of other things. Your computer could also seem to be operating normally except for a data read/write problem. You might be inclined to place the blame on the memory or on the drives, while the actual

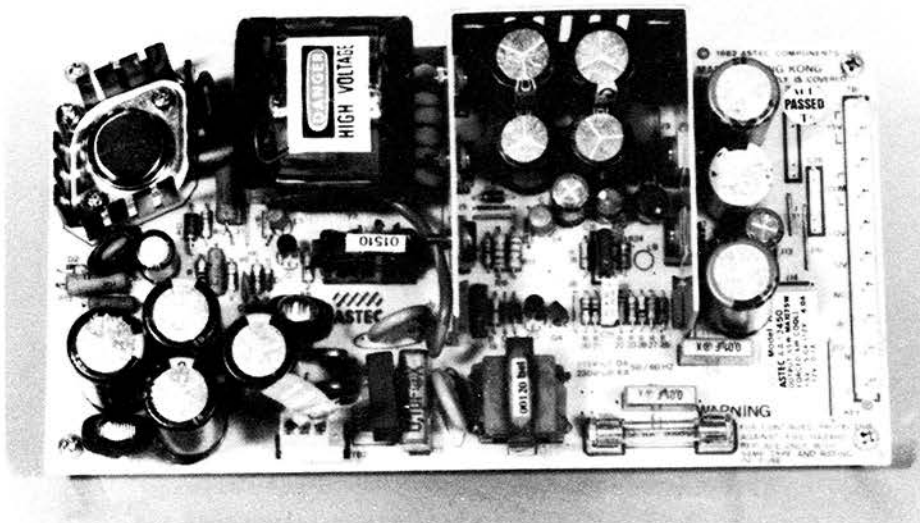


FIG. 6-1 An Astec power supply.

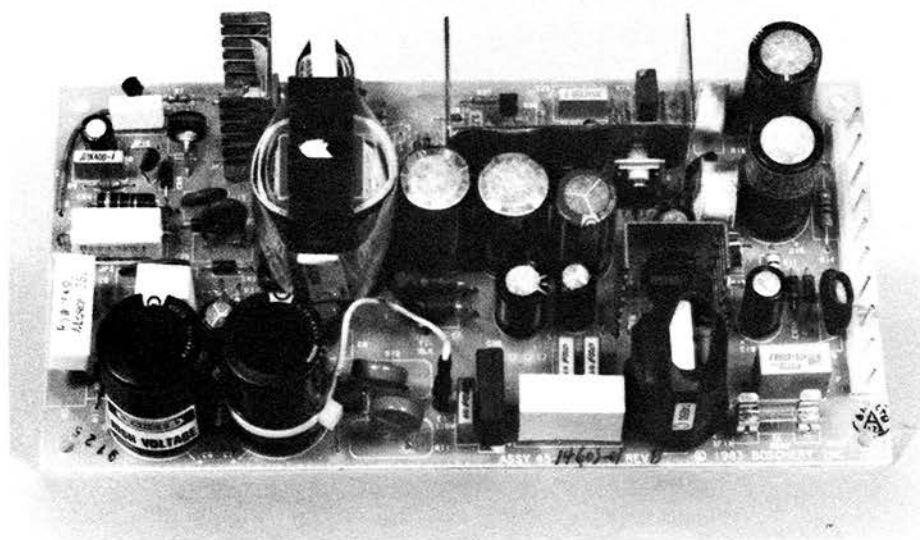


FIG. 6-2 A Boschert power supply.

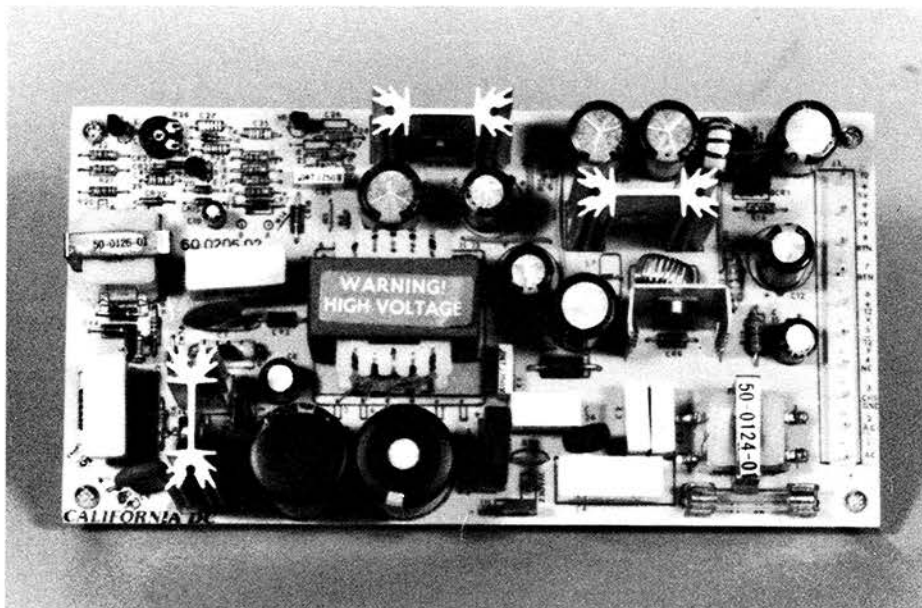


FIG. 6-3 A California DC power supply.

cause *could* be with the power supply. Don't replace it until you know for sure.

POWER SUPPLY DIAGNOSTICS

Kaypro uses three manufacturers to provide the power supplies: Astec, Boschert, and California DC. Each looks different, but the only difference that concerns the end user is how to jumper the power supply to operate at either 120 volts or 240 volts. (These jumper pins might have the labels of 110 and 220, 115 and 230, or 120 and 240. Regardless of the numbers used, they mean the same thing.) Normally the power supply will be used in the 120-volt input configuration. Configuring the power supply is simply a matter of placement of the jumpers.

TABLE 6-1. Power Supply Specifications

Input Power	(@ 100 to 130 VAC [120 nom] @ 60 Hz; 2.5 amps)	
DC Output (65 watts)	+5 VDC \pm 3%	5 amps
	+12 VDC \pm 6%	3.5 amps
	-12 VDC \pm 10%	.25 amps
Maximum Case Temperature	130F (55C)	

General diagnosis is the same for all three power supplies. Repair is normally by replacement of the power supply unit.

If nothing happens when you flip the power switch, you are likely to accuse the power supply without further thinking. This symptom could mean that the power supply has died. It could also mean that something else is wrong.

If the problem is outside the power supply, the power supply will try to reset itself. Each time this cycle occurs, the oscillator passes through an audible range and produces a soft click that you may be able to hear. If you hear this steady click, click, click, the power supply is working (or is trying to). Finding out for sure isn't difficult.

STEP 1. CHECK INCOMING POWER

If power is obviously present (i.e., the lights on the keyboard and computer come on, or you hear the power supply clicking) you can skip this first check and go to Steps 2 and 3. If nothing at all is happening begin with this step.

The first things to check are the fuses, the power cord, the plug, the outlets, and the power switches. Once you have done this and know that power is getting to the power supply you have eliminated the obvious. You've also started the process of isolating the problem.

As mentioned in Chapter 2, you can use a lamp or any number of other things to check the outlet for power. You are better off checking it with a meter. The power supply operates in the range of 107 volts and 132 volts. A lamp will operate beyond these ranges without any apparent difference but the power supply of the Kaypro will automatically shut itself down. Until you've checked the outlet with a meter you won't know for certain if the problem is in the computer or in the lines that supply the outlet. (More information on using a meter to check outlets is contained in Chapters 1 and 2.)

If the outlet is good, check for 120 volts across the fuse on the power supply (Figure 6-4). If you get no reading, then the problem is somewhere between the power supply and the wall outlet. One by one, eliminate the external fuse, switch, and power cord. If you do get the correct reading (and the power supply fuse is good), go to the next step and check the power supply output.

STEP 2. CHECK INTERNAL DEVICES

In the test above you disconnected the power supply from the rest of the computer. This allowed you to check the power supply itself while

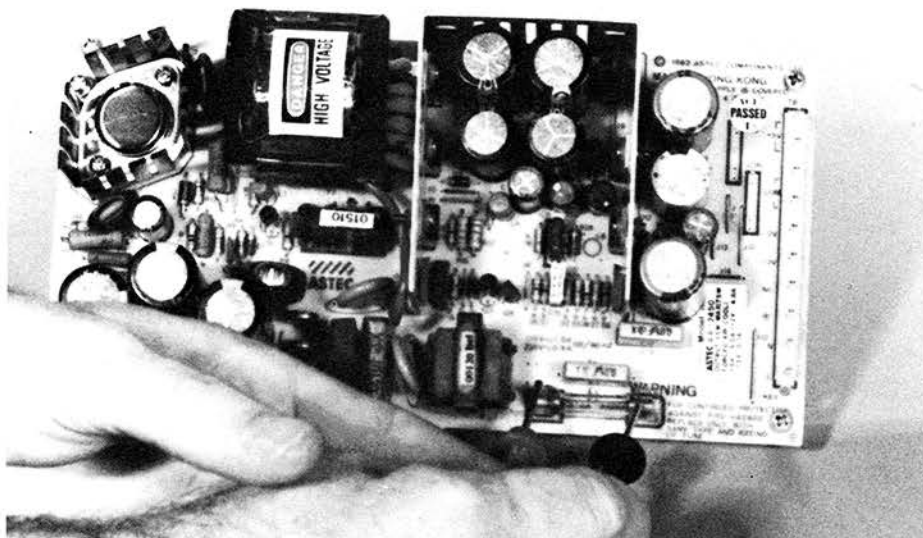


FIG. 6-4 A meter is a good way to check the fuse.

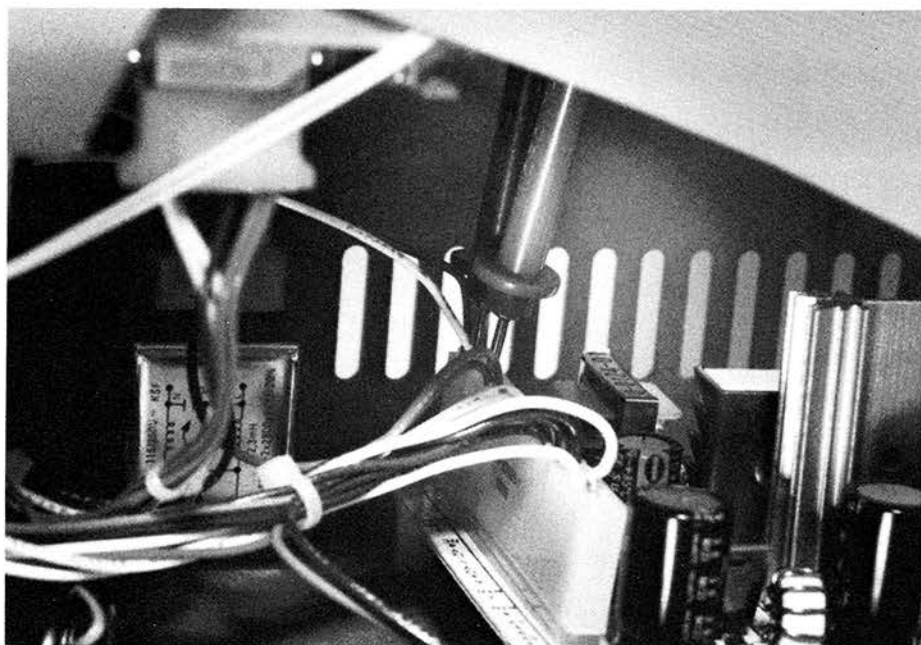
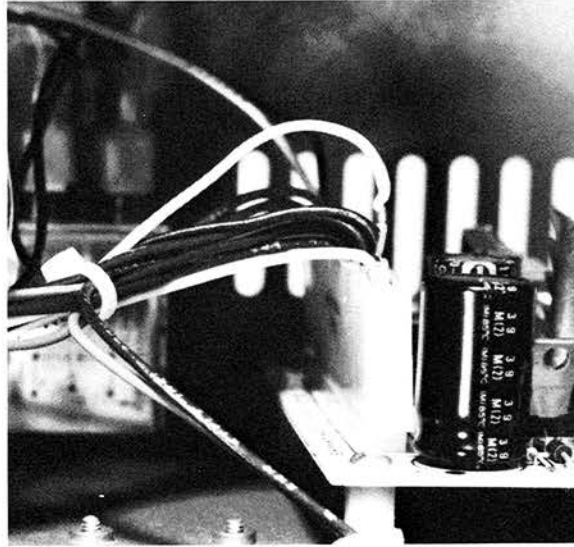


FIG. 6-5 Checking the voltage to the power supply.

FIG. 6-6 Don't forget to look for the obvious. Note the loose wire in the center of this photo.



it has no load on it. If a device connected to the power supply is faulty, it could be dragging the power supply down. This step is an easy way to find out to identify the malfunctioning device.

Shut off the power and disconnect each device at the device (not at the power supply). Then reconnect these devices one at a time until the power supply fails. Again, remember to shut off the power each time before making a new connection. You don't want to destroy your computer for the sake of the second it takes to shut down.

It's possible to get inconsistent results if the power supply is just starting to go. It may not be able to produce sufficient current to drive everything. The easiest way to find out is to go through this step a couple of times, reconnecting the devices in a different order. (Start with the device that caused the failure the previous time and you'll know very quickly if that device is really faulty.)

If a device is suspect, go to the appropriate section in this book for further help (e.g., if the offending device is the disk drive, go to Chapter 4).

STEP 3. CHECK VOLTAGES TO SYSTEM BOARD

In the previous step you should have been able to eliminate either the power supply or the various devices of the computer. Further testing can be done on the sections of the computer. These tests are also of value for double checking your findings from previous tests.

This step checks the main board. It involves the use of your

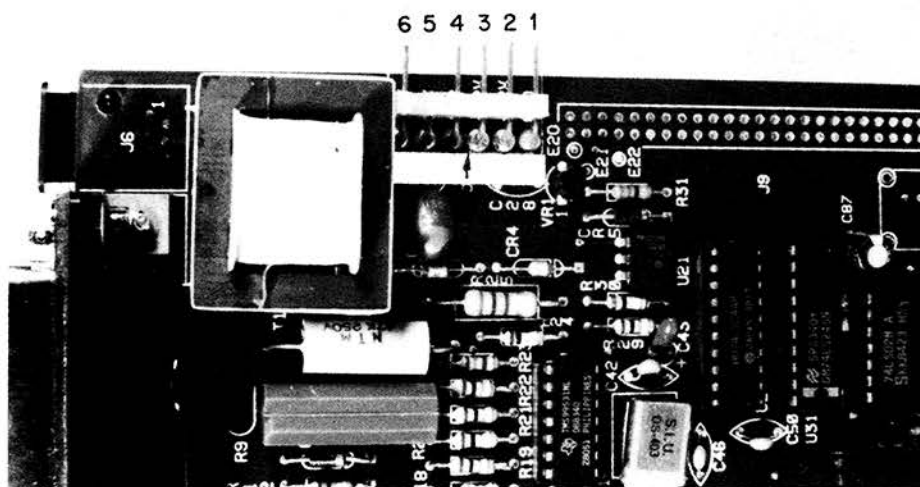


FIG. 6-7 Location of power supply connector.

multimeter set to the 12 volt DC range. The test points are where the cable from the power supply plugs into the system board (see Figure 6-7). Once again, the power is on during these tests. You must be extremely careful to not cause any short circuits.

Pin 6 of this connector is closest to the back of the computer, with pin 1 towards the front. Pin 4 is common (ground). The red probe is to touch pins 3 (± 12 v) and 6 (± 5 v).

The best way to do this test is to disconnect the connector from the main board and probe the connector directly. This tells you if the power supply is indeed providing the needed voltages and eliminates any voltage drag caused by a malfunctioning board. It also gives you the chance to visually inspect the pins. Look for any discoloration. Sometimes these pins overheat, which causes a poor connection and partially or completely blocks the flow of power. Remember to shut off the power before disconnecting and again before reconnecting.

If these voltages aren't correct, you'll know that the problem is definitely in the power supply. All you can do is replace the faulty unit (with an exact match). If they are correct proceed to the next step.

STEP 4. CHECK DISK DRIVE POWER

This step tests if power is getting to the drives. It can be skipped if the drives seem to be operating correctly. If the drives have been

causing trouble, you can find out quickly if the problem is in the drives, in the power supply, or in the drive cable.

Power to the drives comes from the power supply. The four-wire cable connects beneath the analog card on the rear left of the drive. As with the power connector to the main board, you can test for power either with the cable still attached, or with the cable unplugged. If you suspect that the drive is causing the problem, it is best to unplug the cable and test the cable itself.

STEP 5. CHECK POWER SUPPLY OUTPUT

If power is getting to the power supply, but nothing is happening, it's time to see if the power supply is putting out the correct voltages. It is designed to supply both 5 volts and 12 volts DC.

Actually, you've already tested the power supply output by testing the power going to the main board and disk drives. The following test merely confirms your findings. You may wish to skip it, because of the difficulty and the dangers involved.

On the right side of the power supply is the ten-pin output connector. These are usually marked. Pin 1 is at the bottom (closest to the fuse), with pin 10 at the top. It's important that you first identify the correct pin numbers. If you get them backwards, you could end up in trouble. You'll use pin 10 to test for 5 volts DC. If you make a mistake and touch the probe to pin 1, you're actually touching a

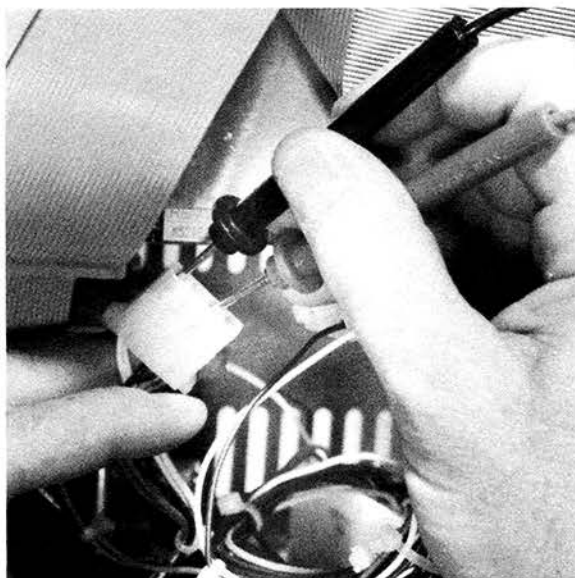


FIG. 6-8 Checking power supply output.

TABLE 6-2. Power Supply Pin Allocations

Pin	Use	Pin	Use
1	AC (input)	6	+ 12 VDC
2	AC (input)	7	Ground
3	Chassis ground	8	Ground
4	No connection	9	+ 5 VDC
5	- 12 VDC	10	+ 5 VDC

pin carrying the AC. The meter, the computer, and you are all in danger.

Pins 7 and 8 are common (ground). The black probe of the meter goes to either of these two. Set the meter to read 12 volts DC and remove the connectors from the power supply to the computer. (Keep in mind that the power is on during these tests. Proceed carefully!) Touch the red probe to pins 9 and 10 in turn. The reading should be 5 volts. Touching the red probe to pin 6 should give a 12-volt reading. If any of these are incorrect, you'll know that the power supply has failed and has to be replaced.

REPLACING THE POWER SUPPLY

The power supply is tucked beneath the main board of the computer. To make the removal and replacement of the power supply easier, remove the main board. (See Chapter 5.)

The power supply is held in place by four screws through the rear panel of the chassis. After you've labeled and disconnected all wires going to the power supply, remove these screws (see Figure 6-9). The power supply will lift out easily (Figure 6-10). Installation of the new power supply is just the reverse of this.

If the time comes when you have to replace the power supply, look at the new unit before it is installed to be sure that it is set for the correct incoming voltage (Figure 6-11). This is done with a jumper—either a wire or a jumper block.

The Astec and California DC power supplies both use jumper blocks (Figures 6-12 and 6-13). For the Astec, the block is labeled "TB2" on the circuit board. For 110 volts, the block covers the two pins to the left, and exposes the right-hand pin. For 220 volts, the block is moved to cover the two pins to the right, exposing the left pin. For the California DC power supply the jumper section is well marked on the circuit board, and boxed in. To configure this power

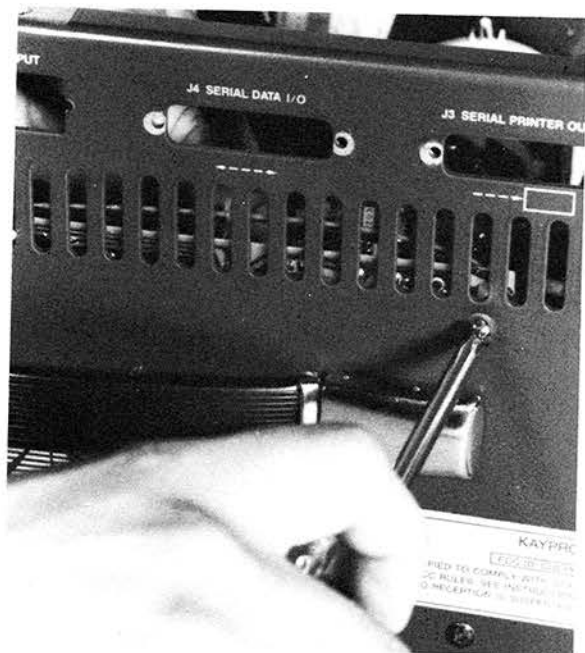


FIG. 6-9 Remove the holding screws from the back of the chassis.

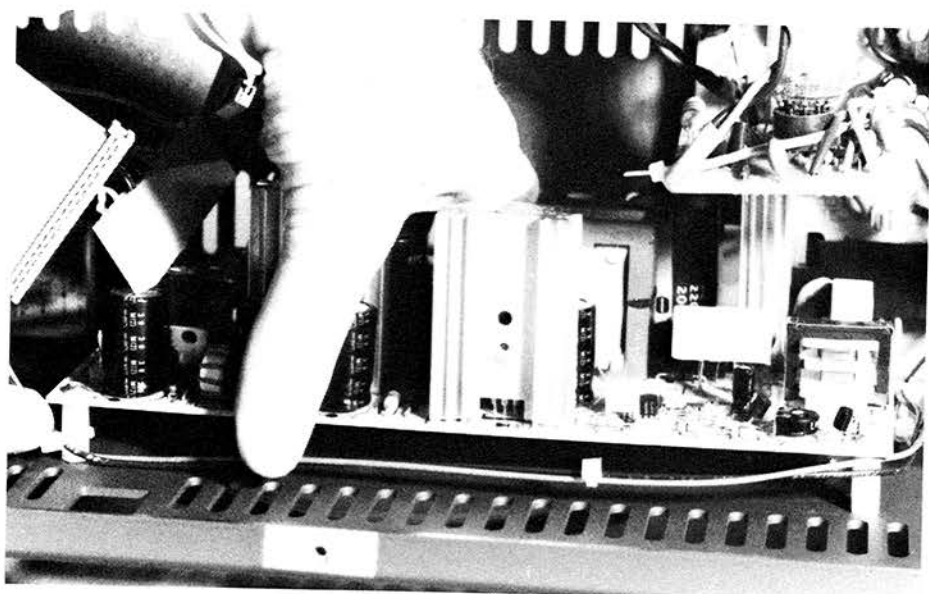


FIG. 6-10 The power supply will now lift out easily.

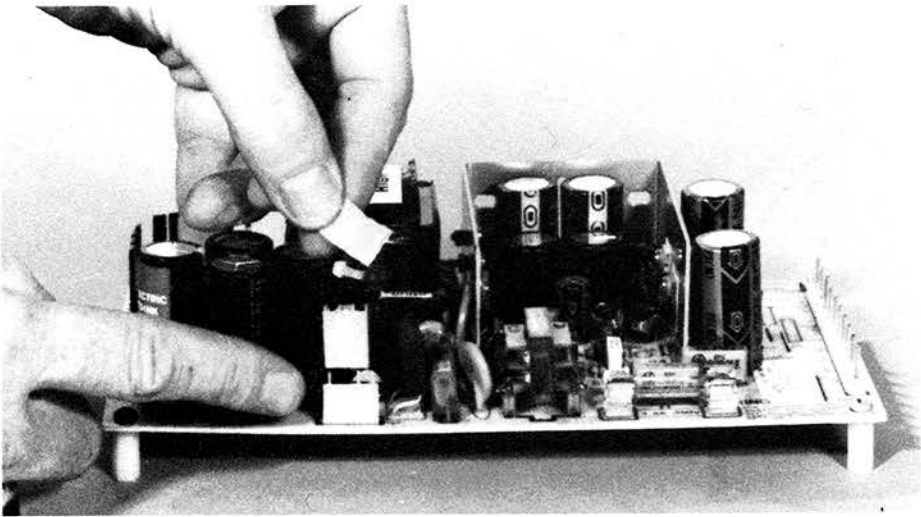


FIG. 6-11 Before installing a new power supply, be sure that it is set for the correct voltage.

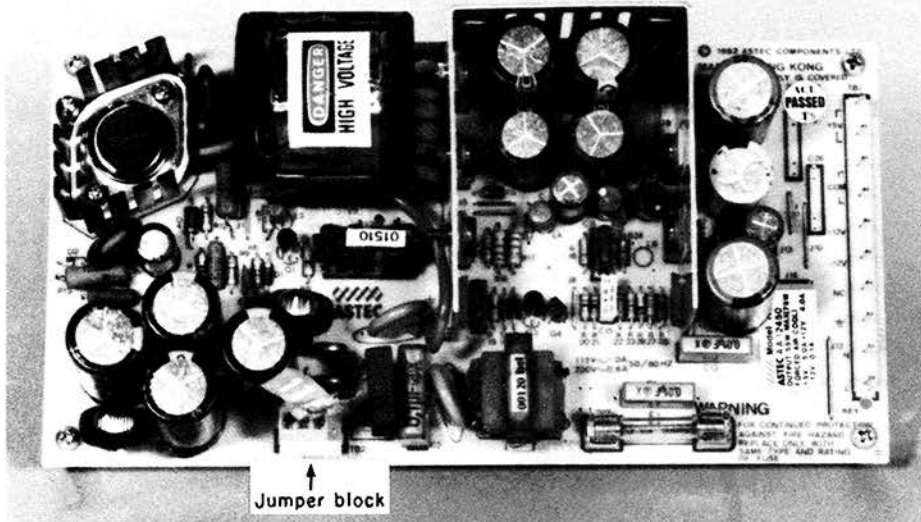


FIG. 6-12 Jumper block on Astec power supply. For 110 volts, the block covers the two pins to the left.

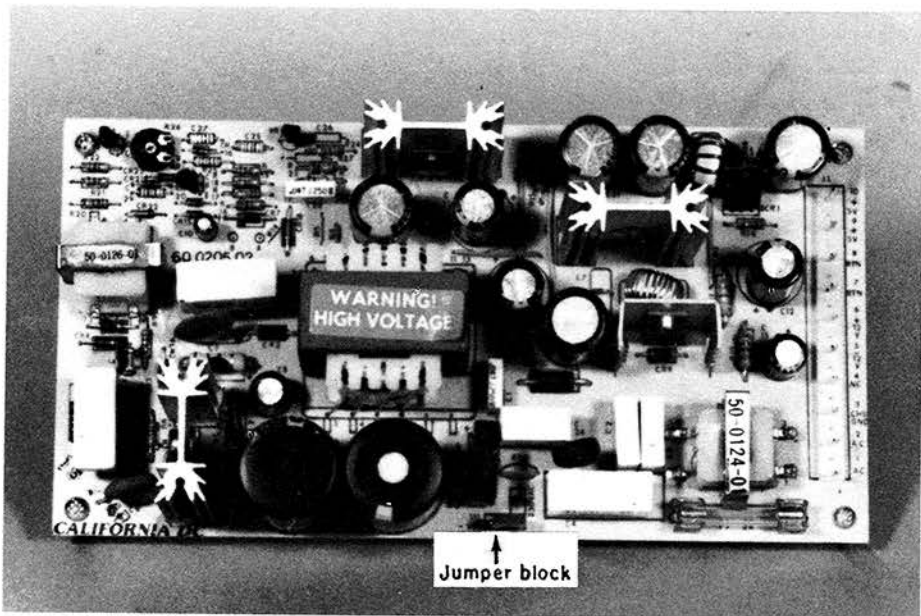


FIG. 6-13 The jumper section of a California DC power supply is marked on the board.

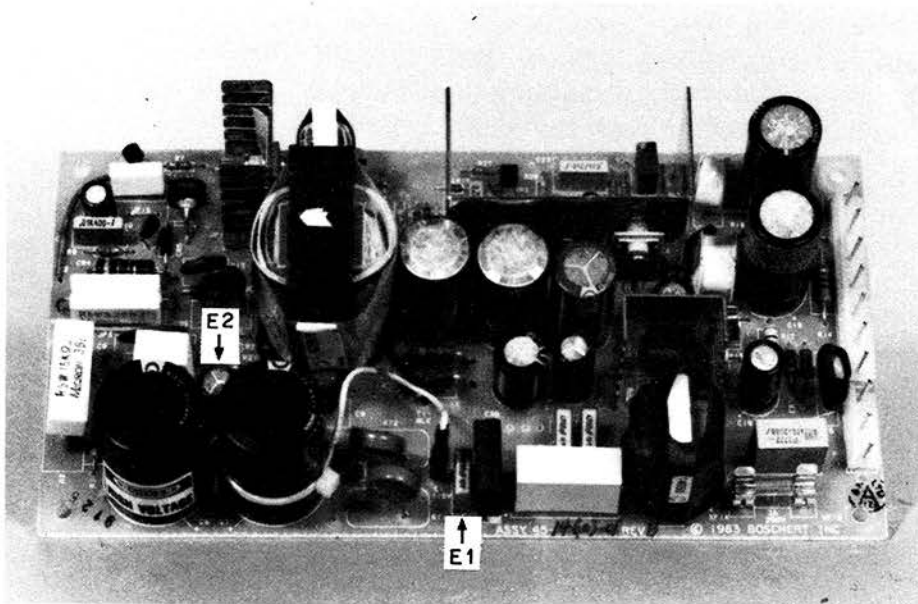


FIG. 6-14 A wire is used to set the Boschert power supply. For 110 volts the wire is plugged onto pin E1.

supply, merely place the jumper block in line with the correct box (marked 115 VAC and 220 VAC).

The Boschert power supply (Figure 6-14) uses a wire to make the jump. This wire is connected to one of two pins, labeled "E2" and "E1" on the circuit board. Beside these labels is the voltage rating. (By the E2 pin is "220V" and by the E1 pin is "110V.")

THE KEYBOARD

Each key is a switch. The keys are similar to the buttons on a joystick but much more durable. As you press down on the key, contact is made and the appropriate signal is sent to the computer by the circuitry.

Some of the IC chips on the keyboard are extremely sensitive to static electricity. They can be damaged if you even touch them with your fingers. If you *must* touch them, be sure that you have drained off any static charge in your body by placing your other hand on the case of the power supply or by touching some other reliable ground.

Although the keys and keyboard are durable, like anything else, they can cause trouble or quit working entirely. When this happens, the easiest and quickest solution is to replace the entire keyboard. But, before you toss out the malfunctioning keyboard, run a few simple tests. The problem might actually be elsewhere, or could be something that is easily fixed.

As always, begin with the obvious. Is the keyboard plugged in? Is it plugged in correctly? (You're not trying to operate the keyboard through the modem port, are you?)

If the keyboard is doing nothing but is attached correctly, it might not be getting power. Press the Caps Lock key. If the LED on this key comes on, then you know that the keyboard is getting the 5 volts it needs to work. (This can also be tested inside the keyboard, as detailed below.)

Set your meter to read resistance (ohms) to test the continuity in the cable. You can find out quickly if the problem is in the cable. This is done by touching the meter probes to the ends of each of the wires in the keyboard cable. The reading should be almost zero ohms between the ends of each of the four wires. If there is a break in the wire, the reading will be infinity. In this case, replace the cable, and you're back in business.

The top of the keyboard is held in place by six screws. These are the small screws located on the sides and back of the keyboard case

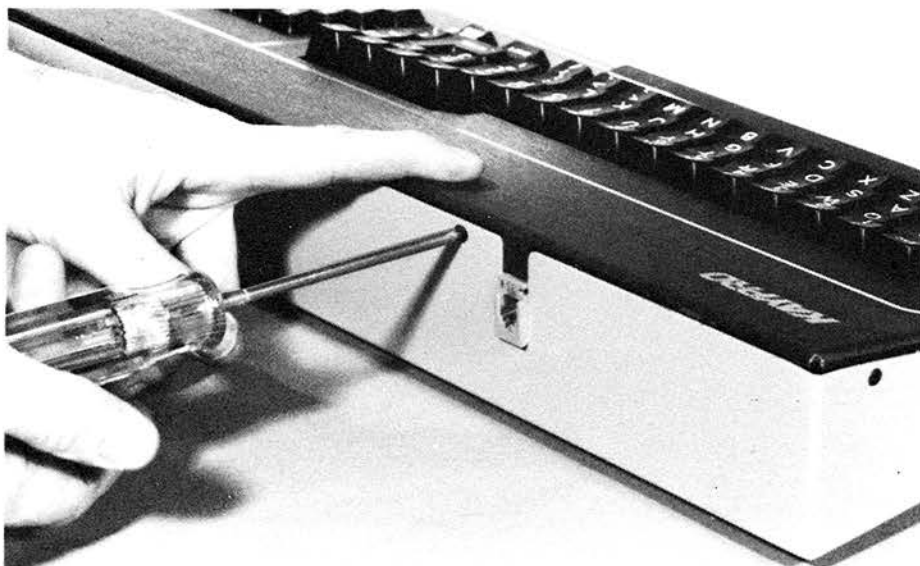


FIG. 6-15 Removing the top screws.

(Figure 6-15). The internal assembly is secured by four larger screws on the bottom of the case.

With the top cover off (Figure 6-16), you'll see where the cable connector attaches to the keyboard circuit (Figure 6-17). The active pins are the four to the left. Pin 3 (with the red wire) is ground. Pin 1 (yellow wire) is the 5 volt DC input. By touching the probes of your meter across these two pins (*carefully*—don't cause a short!) you can

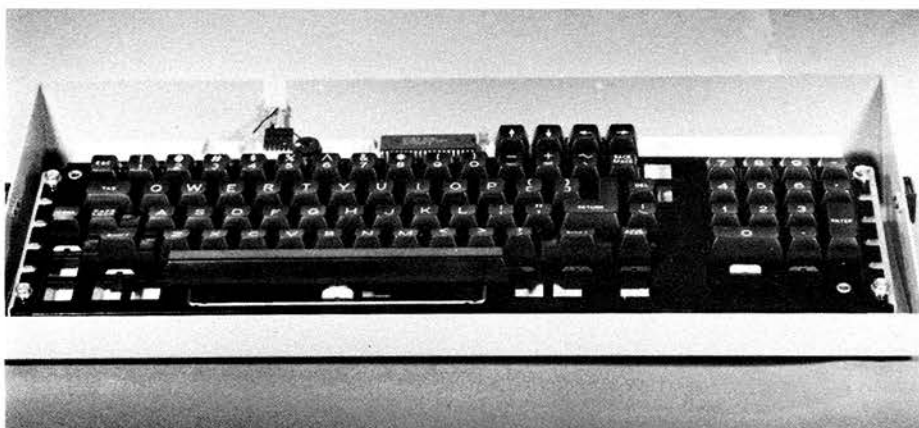


FIG. 6-16 Keyboard, with the top cover removed.

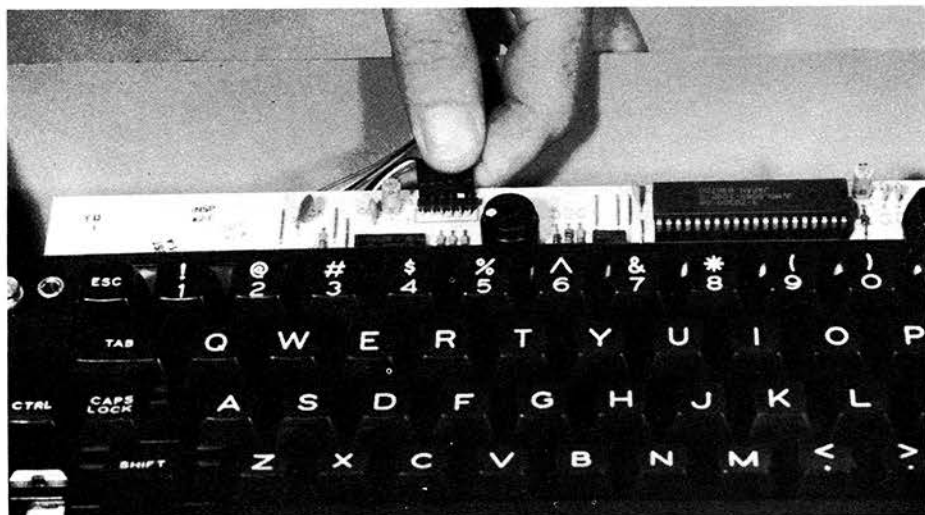


FIG. 6-17 The connector to the keyboard logic circuit board.

find out if power is getting to the keyboard. If it is, and if the keyboard is still dead, the keyboard circuitry is faulty.

Inside the keyboard are the electronics. Those electronics handle the signals between the keyboard and the computer. Unlike the keys themselves, the electronics are prone to damage from fluid. To protect your keyboard, keep *all* fluids away from it.

You've probably heard some of the horror stories about liquid falling into a computer keyboard. One of the strangest I've ever heard involves a man who decided that a cute photo would be one of his two-month old baby sitting on the keyboard in front of the computer. The child had an "accident." So did the keyboard. The acidic fluid caused bad connections on the soldered components and even damaged the circuit board. This made a simple repair impossible. The whole keyboard had to be replaced.

TABLE 6-3. Keyboard Pins

Pin	Wire Color	Use
1	Yellow	+5 volts DC
2	Green	Data to computer
3	Red	Ground
4	Black	Data from computer



FIG. 6-18 Removing the circuit board.

In a sense, you test the keys each time you use the keyboard. To test an individual key electronically, you'll have to remove the keyboard case and the assembly as in Figure 6-18. (The assembly is held in place by four screws on the bottom of the case.) Set your meter to read resistance (ohms). On the bottom of the assembly you'll see a number of traces (parts of the circuit board that act as wires—see Figure 6-19). Trying to locate which points are which isn't easy, but if you're patient you should be able to find the appropriate points. Touch the probes, one to each of the traces of that particular key. The reading should be infinite, showing that there is no pathway. When

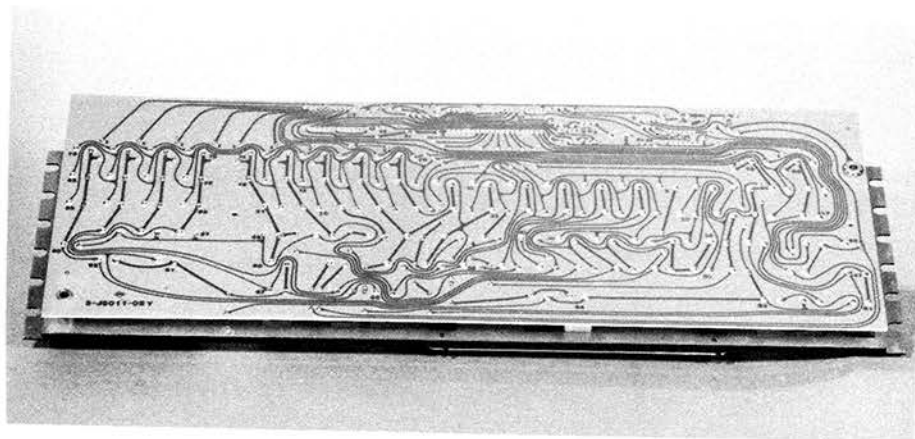


FIG. 6-19 The bottom of the circuit board. To replace a keyswitch, your first job will be to locate the two traces to that particular key.

you press the key, the resistance should drop to almost zero. If this doesn't happen, the keyswitch needs to be replaced.

CHANGING A KEYSWITCH

Changing a key isn't an easy job. To do it you will need a high quality soldering tool, and some experience in using it. If the heated tip touches the circuit board for more than about 3 seconds, the heat could lift the tracing from the board. Melt the solder on the pins of the switch. A desoldering tool is very helpful in removing the melted solder (Figure 6-20). If you've done everything right, the key should come out easily. *Don't force it.*

The new key is installed in reverse order. Once again, be very careful when using the soldering tool. If you don't have experience with soldering, leave the job to a professional. Soldering is not as easy as it seems. In fact, most people prefer to replace the whole assembly, rather than going through the time and bother.

Sometimes you can fix a keyswitch that has broken off by driving the broken pin farther into the cap and then refastening it (Figure 6-21).

PRINTERS

There are many different printers available. Each has its own characteristics and construction. One might require a partial disassembly to just reset the switches. Another will have a built-in memory buffer. Still another could have the dual capabilities of both computer printer

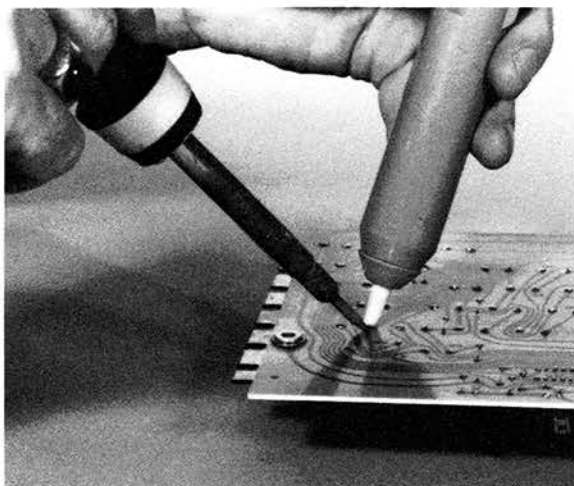


FIG. 6-20 Replacing the keyswitch.

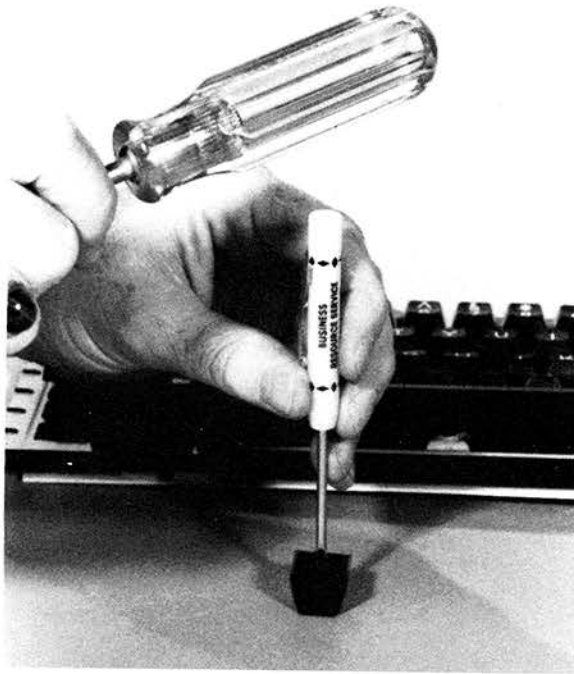


FIG. 6-21 Sometimes you can fix a keyswitch that has broken off by driving the broken pin farther into the cap and then refastening it.

and standard typewriter. There are differences in speed, print quality, and printing technologies. The printer may require a serial connection or a parallel connection or may allow you to choose which you prefer. Some may even require some special software patched to your regular programs. With the wide range available, it isn't possible to give repair information on all makes and models.

The manual that came with your printer is the best source for specific information. Become familiar with it and find out what capabilities your printer has and how to take care of various problems that could come up.

PRINTERS IN GENERAL

Many printers give you the option of connecting it either as a parallel device or as a serial device. Parallel is the more common means of connecting a printer for several reasons. If the computer has one port of each type, the serial port is usually kept open for communications. Devices such as modems require a serial connection. By connecting the printer as a parallel device, you can keep the serial port available.

Since the printer is a mechanical device, it is prone to more wear and tear than most things connected to the computer. It has at least

two motors (for head and platen) and may have more. The print head moves back and forth across the platen. It also either spins (as with a daisywheel printer) or has a print head that makes characters by punching at the paper with wires (dot matrix printer). All this motion causes wear. It can also create fair amounts of heat. If allowed to build up, heat can cause all sorts of damage, both mechanical and electronic.

The first thing to do is to get out the manual for your printer and get familiar with the information. Many manuals give specific error signals to let you know what has gone wrong. Also included will be information specific to your printer, such as how to remove the platen and other parts to free up a paper jam, how to load the ribbon, and so forth.

Paper can jam as it feeds through the printer. Even single sheets can cause a paper jam. Printers that use multiple sheets (with sheet loader or tractor) are even more prone to jams. Jams also tend to be more common if your printer is connected as a serial device. When a jam occurs, the printer can grind to a halt. Sometimes the jam isn't apparent. A few printers require a fairly complicated disassembly to get at it.

If the ribbon isn't installed properly, all sorts of strange things can happen. Part of a character might print, leaving the other part weak or nonexistent. It could shut down the printer entirely, or print a couple of characters and then act as though the signal had stopped.

In some printers the end of the ribbon is sensed by a small switch. As the ribbon reaches its end the switch stops the printer. This switch can also signal that the ribbon is used up if the cartridge isn't attached properly or if the switch fails. Other printers feed the ribbon through continuously. When the print gets light, you replace the ribbon.

Many printers have a safety switch in the lid. Lift the lid and the switch tells the printer to stop. It will tell the printer the same thing if the lid isn't closed all the way, or if the switch is faulty.

If the printer is not making an impression, remove the paper and look for indentations. The print head will make indentations in the paper if it is working, even if the ribbon is not. If the paper has the marks from the print head, the ribbon or ribbon advance mechanism is causing the problem.

There are lots of adjustments possible with most printers. There are the usual spacing and forms thickness (number of sheets) adjustments, the release catches, plus others. Just as a typewriter won't function properly if the adjustments aren't correct, neither will the computer's printer.

Checking for all of these things goes back to the standard rule,

"Look for the obvious." The majority of the time the problem will be something very simple.

By performing occasional maintenance checks and cleaning the printer, you can greatly reduce the number of malfunctions. Clean the ribbon guides, print shield, and the inside of the machine. A buildup of ink or paper dust can cause problems. If your printer has a built-in self-test, run it occasionally. (Run it once when you first get the machine and know that the printer is operating correctly. How else will you know what the results of the test are supposed to be?)

This self-test allows you to carry the diagnostics one step further. If the test shows that the printer is operating correctly, you'll know that the problem is in the printer interface, in the cable, or in the computer. You can eliminate the cable by testing for continuity with your meter. The diagnostics diskette can tell you if the printer adapter card and port are functioning correctly. About the only thing left is the interface in the printer itself.

PRINTER DIAGNOSTICS

If there seems to be no power going to the printer, check the outlet, the power cord, and the fuse before assuming that the problem lies in the power supply. If power is obviously present, you can skip all power checks and go to the more detailed diagnostic steps, such as running the self-test of the printer (if it has one).

If power is getting to the printer but nothing happens, check once again all cables, connectors, switches, and the software itself. You can eliminate some things simply by knowing that the printer once functioned as it should.

The self-test cycle of the printer (if it has one) should give you a good idea of where the problem is. If the self-test operates, the printer itself is likely to be just fine. The problem is then more likely to be inside the computer or with the cable.

You can easily eliminate the cable as the possible cause by using your meter. Disconnect the printer cable. With the meter set to read resistance (ohms), touch the black probe to a pin on one end of the cable, and the red probe to the same pin on the opposite side. A reading of near zero ohms means that the wire between the pins is good. An infinite reading shows that the wire in the cable is broken, or that those pins are not used.

The cable between the computer and the printer has up to 25 pins. Some are not connected to anything and will give a reading as if the wire inside is broken. The printer manual should tell you which

pins are used and which are not. Without this, you'll have to take the cable heads apart to know the wiring. Inside, the wires are probably color-coded. If even one wire is broken inside the cable, or if just one isn't making proper contact with the connector, the printer might refuse to function. (See Chapter 8 or the tables at the end of this book for a listing of the pin allocations for the ports on the computer.)

Refer to the manual for the correct switch settings. If these aren't set correctly, the best the printer can do is punch out meaningless garbage. It is also important to have the software you are using "installed" (getting that piece of software compatible with your printer), if the program calls for this. (The procedure for this is usually in the software documentation.)

Change just one thing at a time, in a step-by-step method. It's sometimes tempting to use a "shotgun" approach, but this can only cause confusion.

VIDEO PROBLEMS

Monitor problems are usually obvious. The screen may be blank. It may show an incorrect display. It could have an image that is tilted, too small, too large, out of focus, too dim, and so on. If the screen is blank, check the brightness control knob on the back of the computer

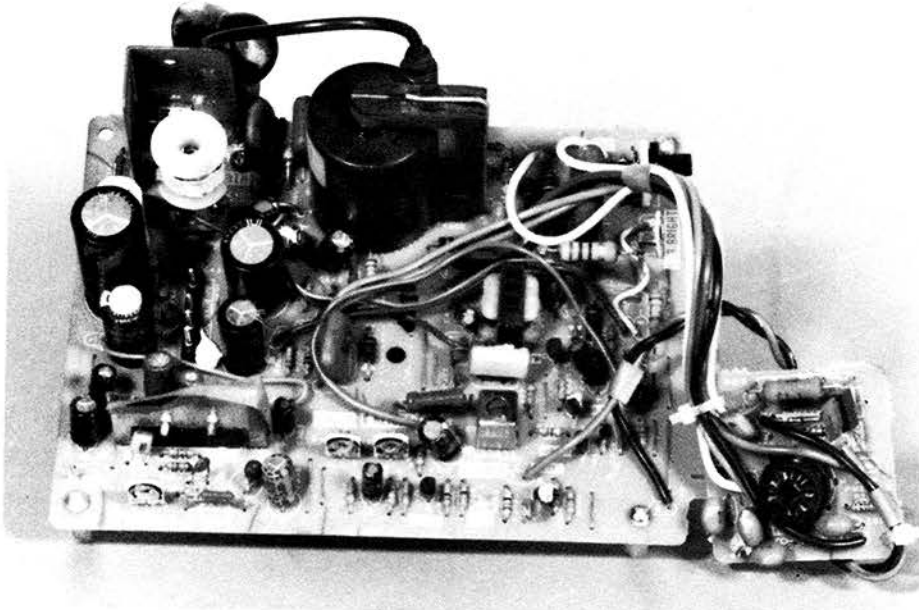


FIG. 6-22 A typical video board.

before you do anything else, even if you're sure that it hasn't been touched. All too often, it's the culprit. If the image on the screen is out of whack, the problem is probably with the monitor itself. If the problem isn't in the monitor, there are only a few other places it could be. You can find out quickly by running a few tests.

Unfortunately, working with the video circuits of the Kaypro presents several dangers. Testing and adjusting can be done only with power flowing. And the power you'll be coming into contact with is potentially deadly.

The CRT requires a high voltage to operate. If this doesn't scare you away from the monitor section, trying to reach those circuits often means that your hand will be very near the power supply and the incoming 120 volts. A piece of insulated tape, such as black electrical tape, placed over the fuse and other hot spots can reduce the risk to you. It can't remove it entirely. (Obviously, shut the power off when putting the tape over the fuse.)

One very simple thing can be done. With the cabinet off, look at (DON'T TOUCH!) the neck of the video tube. Under a dim light you should be able to see a soft glow. If this glow is present, chances are good that the CRT itself is not at fault. The problem is more likely in this case to be in the video board.

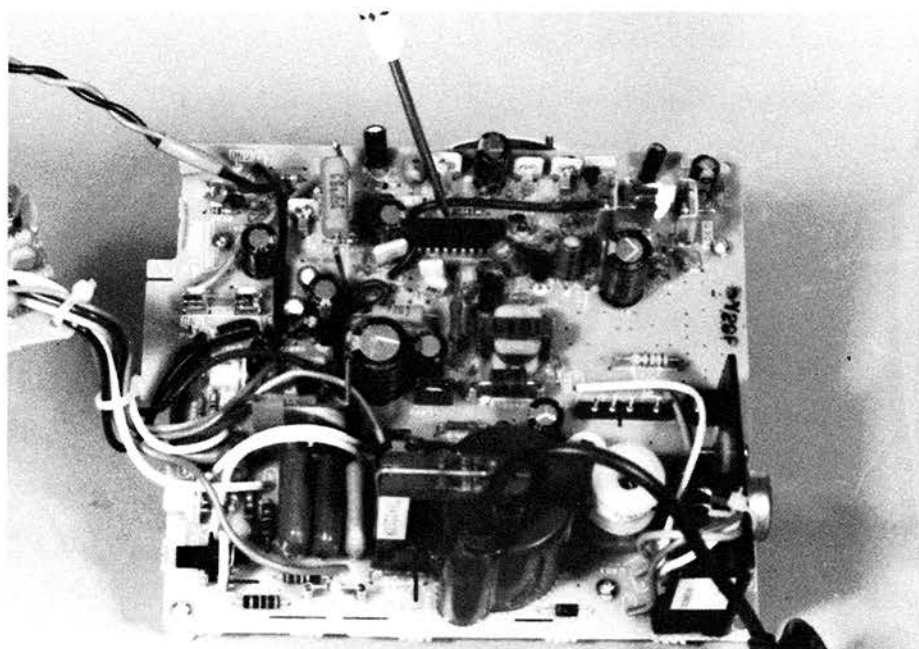


FIG. 6-23 A Toshiba video board. That IC is one of the most common causes of malfunction with this board.

Before going any further, it is advised that you leave any and all video problems to a professional. The money you spend is a worthwhile investment in your safety. Even if the circuits involved were safe, adjustments are difficult to make. That alone is a good reason for bringing this job to a professional.

All other adjustments are made on the video driver board inside the computer. Again, this is a dangerous job, and one best left to professionals. If you're determined to do it on your own, be extra careful, especially around the power supply. To make the adjustments you'll need a set of alignment tools. Use only the all plastic tools. Even a tiny metal tip will make adjustment impossible. (The professional also has the benefit of a special video alignment diskette—something unavailable to the computer owner. Without this diskette, all you do is make a guess.)

A sudden change in the display during operation indicates that something besides the manual adjustments is wrong. A simple adjustment probably won't help. If this happens, make detailed notes of what is happening and when. Then take your computer to a professional.

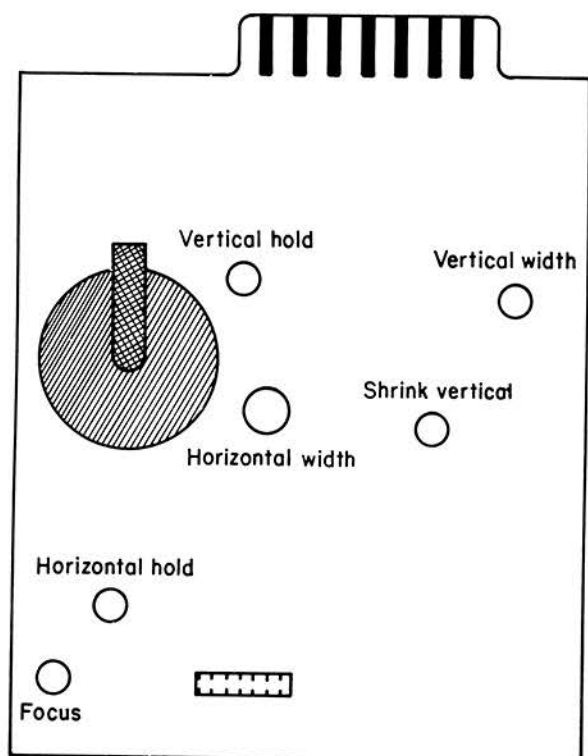


FIG. 6-24 Location of adjustments on Dotronix video board.

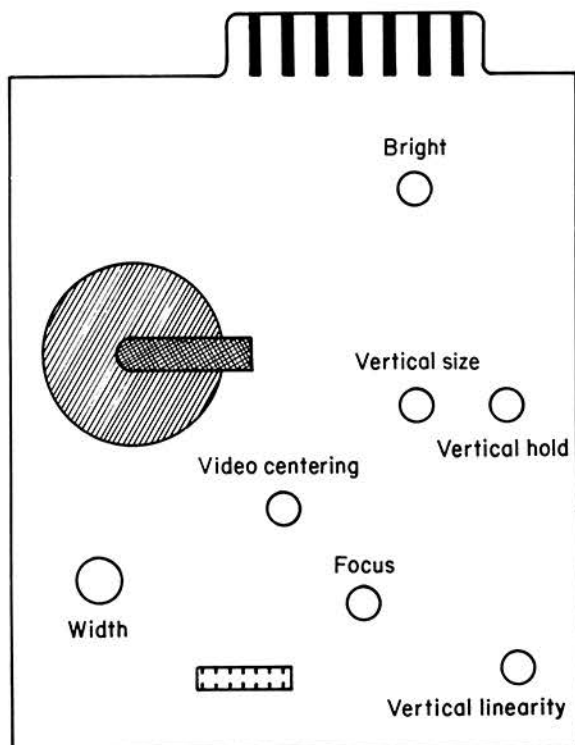


FIG. 6-25 Location of adjustments on Elston video board.

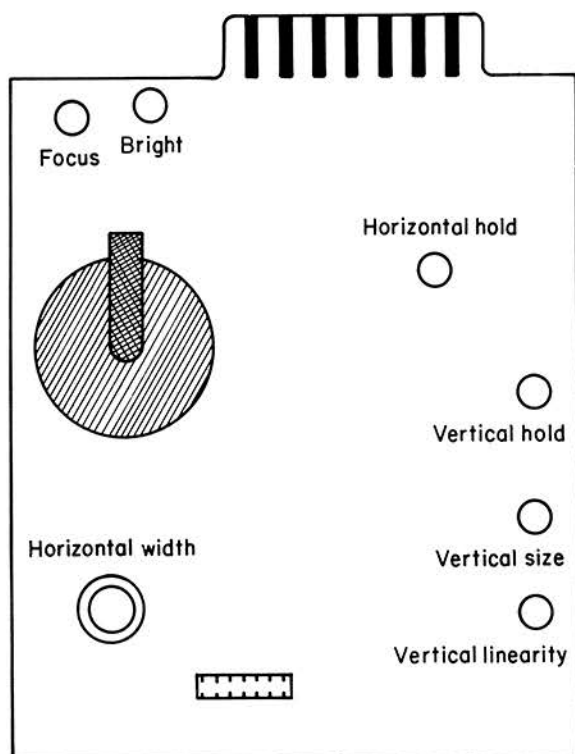


FIG. 6-26 Location of adjustments on Toshiba video board.

SUMMARY

Power supply problems are not always obvious. The built-in protective circuitry will shut down the power if something is wrong elsewhere in the system. A “nothing happens” situation does not necessarily mean that the power supply is at fault.

Testing the power supply is a matter of eliminating devices one at a time, and of taking a few voltage measurements. Within a few minutes you should be able to isolate the problem to something specific.

The keyboard is continually tested, merely by using it. If pushing a key consistently does nothing, or if the key simply feels wrong, you’ll know that it’s time to perform a more thorough testing, or that it’s time to replace the individual key or the keyboard itself.

Printers are famous for giving trouble. They are mechanical devices with at least two motors spinning along. Just connecting the printer in the first place can be a frustrating chore. Once it is up and working you can keep it that way by some occasional maintenance, such as cleaning out the paper dust.

As with printers, a malfunction of the monitor is generally obvious. Begin by eliminating other possible causes. If you haven’t found the problem after this, it is far better to abandon further attempts at repair and take the computer to a professional. There is considerable danger involved in working around the video section of your computer. Even if you don’t mind the risk of your life, proper repair or adjustment requires special tools. Leave it to someone who knows and who has the proper tools and software.

Chapter 7

Preventing Problems

The Kaypro is so well designed and so well constructed that there isn't much to be done as far as maintenance goes. As with all computers, most of the activity takes place inside the circuits. There is very little to adjust, very little to clean, almost nothing to go wrong.

Even so, you can reduce repair costs and aggravation by performing a few simple maintenance checks now and then.

THE ENVIRONMENT

The most important aspect to the overall health of your computer system is its surroundings. The more dust and other contaminants that are around, the more often your system will give you trouble.

One owner used his computer to keep track of his electroplating company. The computer was kept separate from the plant, but not separate enough. The acidic fumes were obvious, both to the nose and to the computer. Every few months he would have a major computer failure. Twice in the first year he had to replace the drives, and once the entire system board.

Another company hired an operator who smoked heavily. Within a few months one of the drives was malfunctioning. When opened it was discovered to have a heavy layer of grime. The second drive was in nearly as poor condition.

The cleaner you keep the computer room, the better. You won't be able to keep it sterile and totally dust free, but this isn't really necessary. Your goal is to reduce the amount of contaminants.

As electricity flows through the circuits, heat is generated inside the computer. The Kaypro 10 and 16 have even more of a heat problem

because of the hard drives. If the heat is allowed to build up inside, some strange things can happen. One of the most common is puzzling BIOS errors that seem to pop up for no reason. If the heat buildup continues, actual damage can occur.

To improve cooling, some Kaypros have a small fan. A filter is provided to reduce the amount of dust that gets pulled inside the computer. If this filter gets dirty, the fan can't do its job. What appears to be a serious malfunction (the BIOS errors) is likely to be nothing more than a dirty filter. It takes only a few minutes to clean the filter. It should be done at least once per week (see Figures 7-1 and 7-2).

When dusting around the computer, use a damp cloth. This will pick up and trap the dust, not just spread it around. It will help to keep dust out of the air. While you're cleaning the area, clean the computer equipment. Dust will gather on the equipment, particularly on the monitor screen.

On the dust cloth, use a gentle cleaner or just plain water (squeeze out the cloth so it is barely damp). Be especially careful with the monitor screen. It has a nonglare coating that can be damaged.

Do not have open containers near the computer! It's too easy for liquids, dusts, or whatever to spill. When they do, they have the unfortunate tendency to fall exactly where they can do the most damage.

Be very careful to avoid getting liquids of any kind into the electronics of the computer. A slightly damp cloth can be used to clean the cabinet, monitor, printer case, and the outer edges of the keyboard.



FIG. 7-1 The filter cover can be popped off with your fingers.



FIG. 7-2 If you are getting some puzzling BIOS errors, check to see if the filter needs cleaning.

Do not use a damp cloth inside anything electronic. You're asking for trouble if you do. Dust will have very little effect on the electronic components under normal use.

The inside can be cleaned with a vacuum cleaner (with a soft brush) if the dust has built up. This isn't really necessary, as the components inside the computer itself aren't sensitive to dust as long as it is dry. The internal parts of the printer are more important. Paper gives off a surprising amount of dust. This paper dust can collect in all the wrong places and can jam the mechanical parts.

There is no such thing as being *too* clean around a computer. Keep the area as clean as possible, and be sure that your cleaning doesn't just toss all the dust and grime into the air. For example, if you use a vacuum cleaner, move it slowly to keep down the amount of dust. Don't use anything like a feather duster anywhere around the computer, because it just throws dust into the air.

The computer circulates air inside it for cooling purposes. Dust may also enter the disk drives, the one spot where dust can do the most damage. Although a little dust is unlikely to affect the circuits, it's murder on anything mechanical.

“Dirty” power is another computer-environment problem. Power companies are well known for supplying “dirty” power (with surges, spikes, and brown-outs). Although it isn’t actually a maintenance step, keeping these electrical transients out of the computer is important to prevent damage to the circuits.

The AC filter built into the Kaypro will help to reduce damage caused by transient voltage. An external device (Figures 7-3 and 7-4) takes the protection one step farther (assuming that you invest in a high-quality unit).

If your area is prone to brown-outs (drops in line voltage) or regular and unpredictable power outages, you might also want to invest in a battery backup unit for your computer. These devices keep the power flowing at a steady level, even if the electricity coming into your home or office fluctuates or stops.

DRIVE HEAD CLEANING

There are two opinions about head cleaning. One is that it is never necessary and can only cause damage. The other is that you should clean the heads after every so many hours of use and that the cleaning will cause no damage at all.

Both are true, sort of. Obviously, you’re better off leaving the heads alone as much as possible. But, when cleaning is necessary, it



FIG. 7-3 A line protector for the computer. Courtesy of Electronic Specialists, Inc.

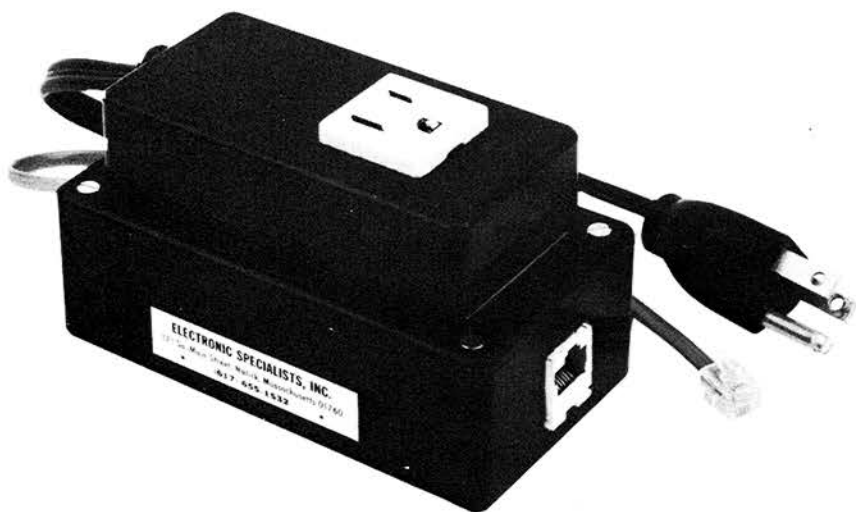


FIG. 7-4 Devices to protect your modem are also available. *Courtesy of Electronic Specialists, Inc.*

has to be done. Nor can you afford to wait until the recorded data is full of errors due to a dirty head.

Anything abrasive used on the heads is obviously capable of damaging the heads. The same goes for cleaning fluids that can affect other parts in the drive. If you stay with a well-known brand you should have no trouble at all.

The idea of cleaning the heads after so many hours can also be misleading. The key is your own environment. Obviously if you work in a sterile environment and use only the best quality diskettes, deposits will be minimal and you won't need to clean the heads very often. On the other hand, if you're a heavy smoker or have the computer in a poor air environment (shame on you!), you will have to clean the heads more often.

Head cleaners can only take off "new" deposits. If you let those deposits build up over a long period of time, they become permanent parts of the heads. No cleaning kit in the world will take off such deposits, at least not without destroying the head at the same time.

There are various ways of cleaning the heads. Before people realized how much damage could be caused, abrasive cleaners were used. These literally scratched away the contaminants. Fortunately, very few of these are around now. Such a cleaner will certainly take away all the built-up grime. It will also take away the surface of the head.

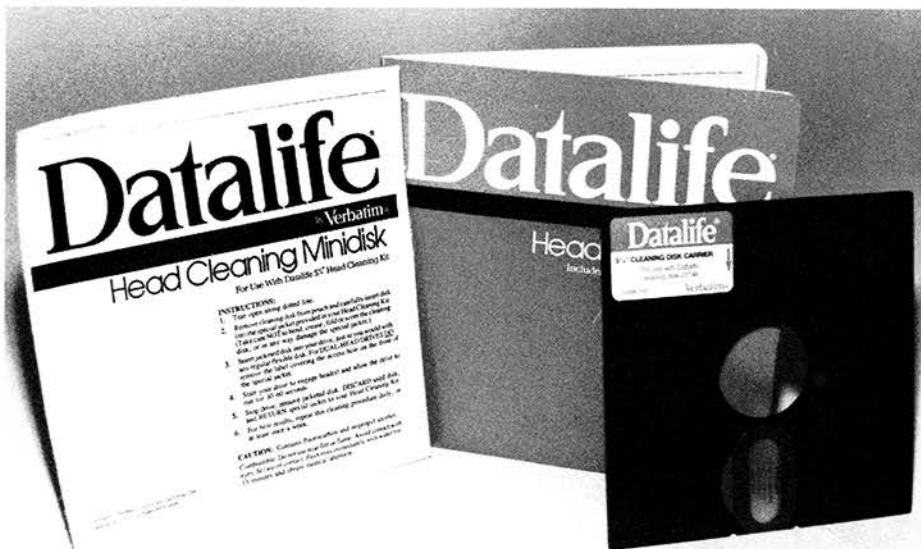


FIG. 7-5 Head cleaning kit.

The next step is a “nonabrasive” head cleaner with a bottle of fluid and rotating cleaning pad. Again you have to be careful of rotating pads that are too abrasive. Stick with a reputable brand and you won’t have much to worry about in this respect.

Be careful not to oversoak or undersoak the pad. Both can cause problems. If the pad is undersoaked, the abrasive action is increased. (It also won’t clean the head as well.) If it is oversoaked, you’ll have the excess fluid sloshing around inside the delicate parts of the drive. It will evaporate before too long, but in the meantime it can cause problems. Worse yet, there’s no way to know if harmful materials have been deposited elsewhere in the drive or if other damage has been caused that will show up at a critical moment.

The most expensive head cleaners are presoaked with cleaner. Carefully measured amounts are already on the diskette cleaning pad, which means that you have virtually no risk of having the cleaning fluid (and the stuff it has dissolved) dripping into places you don’t want it.

The disadvantage of such a cleaning kit is that the cleaning diskette not only costs more to begin with, it also wears out sooner. Since only the minimum amount of cleaning fluid is used, the fluid can evaporate more quickly from the cleaning pad, making the diskette useless, if not dangerous. This won’t happen if you follow the directions, though. The advantage is that you have much less risk of dam-

aging the heads, the drive itself, or other diskettes you put in. Personally, I believe that this lower risk easily warrants the slightly higher cost.

You can clean the heads manually, of course. This involves some work and risk on your part. To do this you'll have to remove the drive case and the circuit board inside. You simply can't access the heads safely otherwise. Each time you do this, you take up your own valuable time and risk damaging the circuit board. You may also knock the heads out of alignment. Generally this is *not* the way to go about it.

If you choose to clean the heads manually, you'll need some very clean cotton swabs (the tighter the better) and cleaning fluid. Isopropyl alcohol will do, but *only* if it is pure. Much of the alcohol available to the general public has water and certain oils in it. Some has other contaminants that could be harmful. Using alcohol that is available "off the shelf" is often a great way to guarantee damage to the heads and drive. Technical grade alcohol is available through chemical supply companies. Be sure that you specify *pure* isopropyl alcohol with no contaminants.

You can also use fluid head cleaner for audio tape players. Again, it is important that you get the very best possible. Don't try to save a few pennies. The heads of your disk drives are too important, and too expensive to replace.

DISKETTES AND SOFTWARE

The more you use a diskette, the greater the chance of trouble. In Chapter 3 you learned how tough, and how delicate, a diskette is. The best-made diskette can still present problems.

The major problem is that of the "allocation table" or "catalog." Each time you use the diskette, the computer seeks out this track to learn what you have on the diskette. This means that the life of the diskette is directly proportional to the number of times you use this track.

The second major problem is that of editing. Changes in a diskette file can scatter that file all over the diskette. A disjointed file is much more prone to hand out errors than one that is in a logical sequence.

Think of it as several very long letters to friends, and that you write these over a period of a year or more. Before you send them you want everything to be just right. So you go back to the loose pages and add little notes. Over a period of time you have a massive stack of scribbles and pages. It would be almost impossible for you to keep track of which pages go to which friends.

The computer doesn't have quite this much trouble, but it still has to keep track of which changes you've made, and to which files. Those changes may end up scattered all over the diskette, and it could be like having a heavy wind get hold of those letter files.

The solution is to make copies often. You can copy a single file, a group of files, or all the files on a diskette. Complete instructions are in your User's Guide. If you don't already know how to use the copying programs, take the time (right now!) to learn.

You have two basic choices. On the CP/M diskette are the COPY and PIP programs. Both are for copying files, and both provide friendly prompts along the way. The COPY routine is fast and will copy exactly what is on the original, including the "blank" temporary files used by some programs and your edited "scattered" files.

The PIP routine is slower and will ignore those temporary files. This program has the advantage in that it will take a disjointed original and arrange it on the copy diskette in the correct order. Fragmented files are thus restructured.

Programs used often should also be copied, if possible, on a regular basis. (Many can't be copied in order to thwart software pirates.) The new copy also has a new allocation track, which will bring a worn program back to life again.

If the program is "copy protected," you may be able to make a backup copy by using a program that breaks through the protection schemes of "uncopyable" programs. The purpose of such copy programs is not to help software pirates but to allow legitimate users to backup their important (and expensive) originals.

Don't wait until the program or data diskette has failed before making the backup. Do so immediately! Right now, in fact. If you have diskettes that are used often that haven't been backed up recently, put down this book and do it—NOW! If the backup sits on the shelf or in the box for a year, great. You don't make the backup to use, you make it to ensure that a diskette failure doesn't knock you down and out.

Before filing away the backup copy for safekeeping, take a moment to test it. If it is a program, try it out. Don't just see if it will load—actually work it. If it is a data diskette, check it to see if the data has been transferred intact and without errors.

DIAGNOSTICS PROGRAMS

There are a number of diagnostics software packages available to Kaypro owners. Some check out the whole system, including the

various circuits. Others test only the disk drives. If you don't already have one of these packages, invest in one as soon as you can.

Many people spend the money to get one of these packages, and then think that it is useful only to spot problems after they have happened. Actually this is its least important use, as far as the computer owner is concerned.

Using a diagnostics package should be a part of your regular maintenance schedule. Especially important are those programs that test the disk drives, since these are the most critical devices in your computer and the ones most prone to malfunction.

OTHER STEPS

It's all too easy to get used to the power of the computer and forget that it is quite delicate in certain ways. Each hour you spend with flawless operation tends to make you forget that things can go wrong, regardless of how well the Kaypro is built.

Make it a habit each time you sit down to the computer to review in your mind all the things that can go wrong. Pay close attention to what it is doing, and how things are working. The more you use a particular program or function, the more important this is.

If you have a friend with a Kaypro, sit down and use your friend's machine occasionally with your programs and data diskettes. Trade the opportunity and give your friend a session with your computer under the same conditions. This will tell both of you quite a bit about how well the computer system is functioning.

For example, if a diskette or program functions perfectly on your machine and not the other, something is wrong with one of the two. Don't assume that the problem is with your friend's Kaypro. Even if your own computer seems to be operating correctly, it could be having problems. For example, if the heads in your drive are misaligned, you'll be recording information that can only be read on a drive with heads that are misaligned in exactly the same way.

Such a swapping of computer time will help to keep you informed of any serious malfunctions that are occurring, especially if you do it on a regular basis. It gives you a basis for comparison that many people don't have.

If you don't have a friend with another Kaypro, contact your dealer. Chances are he'll let you make use of one of the floor machines for a short time, especially if you've been a good customer.

Lacking this, consider joining a users group. Other members in the group are likely to be after the same sort of cross checking. As

you check your system, they are checking theirs. (You'll also end up with a valuable source of information, and plenty of new friends with your same interests.)

SUMMARY

There is very little maintenance to be done with your computer system. Invest just a few minutes per week and you've done just about everything necessary to keep your system running without trouble.

The environment around the system is critical. The cleaner you keep the general area, the fewer problems you'll have, and the less maintenance you'll need. Keep dust and other contaminants away from the computer as much as possible.

If you ignore the drive heads for too long they could develop

TABLE 7-1. Maintenance Routine

Daily

1. Make backup copies of all data diskettes you've been using. This should be done at the end of each session and periodically during the session.

Weekly

1. Give the computer area a quick clean to cut down the amount of dust.
2. Use PIP or COPY on any data diskettes that have been used heavily.
3. Clean disk drive heads, if needed.
4. Clean fan filter.

Monthly

1. Thoroughly clean entire area, including the inside of the printer.
2. Clean disk drive heads.
3. Run a diagnostics program on your system.
4. Test devices and equipment that are rarely used.

Occasionally

1. Test backups already made.
 2. Make new backups of important programs and data, if needed.
 3. Spend some time with your diskettes on someone else's Kaypro.
 4. Learn something new about your system and its programs.
-

a permanent build-up of particles that no cleaner can remove. The result will be faulty reading and writing of data, at unpredictable times. A periodic cleaning of the heads, using the best quality head cleaning kit, will help to keep the heads working perfectly for many years. How often you clean the heads will be determined by how much your computer is used and what the surroundings are like.

The most delicate part of a computer system is the software. Handle the diskettes carefully. Just as important, make backups of all diskettes a regular part of your work schedule. The cost of diskettes is cheap compared to the cost of replacing lost programs or data.

Table 7-1 is a guide to regular maintenance of your system. The actual frequency the maintenance routines are performed will be determined by your usage of the system. For example, if you only work at the computer for a few hours per week you probably won't need to clean the drive heads as often. This listing is only a general guide. Set up a schedule to suit your own circumstances.

Chapter 8

Adding to Your System

Just when you think you have everything you need as far as computers go, something else comes along. The printer you have may not be printing fast enough for your needs, or perhaps the character quality needs to be improved. You may decide that the built-in monitor isn't large enough and that you want an external monitor. There are a number of modifications that can be done to the hardware. You're almost certain to be adding new software programs from time to time.

Even if you don't add something to your system, the day could easily come when an existing piece of equipment requires replacement. The steps in replacing a device are nearly the same as adding that device for the first time.

This chapter will show you how to handle some of the most common additions. Your own circumstances will be slightly different in some cases, depending on the equipment you're using. However, the general guidelines presented here should help.

When installing a new piece of equipment, try to change only one piece at a time. For example, if possible, don't add a new printer and a new, untested printer cable.

It's important that you become as familiar with the new device as soon as possible. If it has an installation manual with it (most accessories do), read it through carefully, cover to cover. Don't skim or skip. Certainly don't try to install it while reading the manual for the first time.

The biggest problem that most people run into is that of being in too much of a hurry. That new drive you've been waiting for arrives and seems to cry out for immediate use. Off comes the cabinet and

in goes the drive, with little more than a cursory glance at the manual. The result—the thing doesn't work.

Slow down. And then go slower yet. Take your time. If you don't understand the instructions, go back and read them again. Have a good idea of what you're doing before you start and you're much more likely to have the installation work.

You'll actually save time, and much frustration, by taking the time to become familiar with the information first.

Before actually installing anything, go through the procedure at least once mentally. Do you know which steps to take and when?

Check and double check any switch settings or jumper changes you've had to make. If no switches are to be changed, be sure that you know this as well.

Finally, NEVER install a device while there is power flowing. Shut off the switch. To further protect yourself, unplug the computer. If you leave the computer plugged in, be aware that the line and power switch are still "hot."

REPLACING A DRIVE

The most delicate part of any computer system is the disk drive. Since it's mechanical, it gets more wear and tear than the nonmechanical parts (the electronic circuits). Sooner or later you'll have problems of one type or another with the drives.

Chapter 4 gives you detailed information on how to determine what the cause of the trouble is, and how to fix some of those problems. The steps from Chapter 7 are important for preventing those malfunctions *before* they happen. Even so, the day may come when you have to replace one of the drives.

As said in Chapter 4, Kaypro drives may be made by several different manufacturers. Chances are good that one of these brands will be readily available at your dealer. If you can, buy an exact replacement for the drive you already have. This makes swapping the drive easy, since the various jumpers, etc. will be the same, and you have merely to look at the old drive to know how to set up the new one. Otherwise, follow the instructions below for how to install the various models. Operationally, the brand of drive makes no difference at all, unless you have one of the high-density drives, such as with the Kaypro 4X or Robie, for which an exact replacement is required.

THE BASIC STEPS

Whichever drive you use, there are certain installation steps that are always the same. The power should be off, and the power cord should be removed from the wall outlet.

Remove the cover by taking out the ten holding screws—four on each side and two on top (Figure 8-1). You can now access the holding screws of the drives. These might be standard screws, hex nut screws, or screws with allen heads.

Disconnect the signal and power cables from the rear of the drive to be replaced (Figure 8-3). These are keyed, but take note of where they go and how. The holding screws of the drive have hex heads. You'll need an allen wrench or a screwdriver with this kind of tip (Figure 8-4). The drive should now slide out easily (Figure 8-5). If it doesn't, look again to be sure that you haven't forgotten something. Be especially careful of banging the components on the chassis as you slide the drives out.

CONFIGURING THE DRIVE

Drive installation differs depending on whether the drive is installed as drive A or drive B. Usually you'll be inserting or taking out a jumper wire or jumper block and/or a terminating resistor (Figure 8-6).

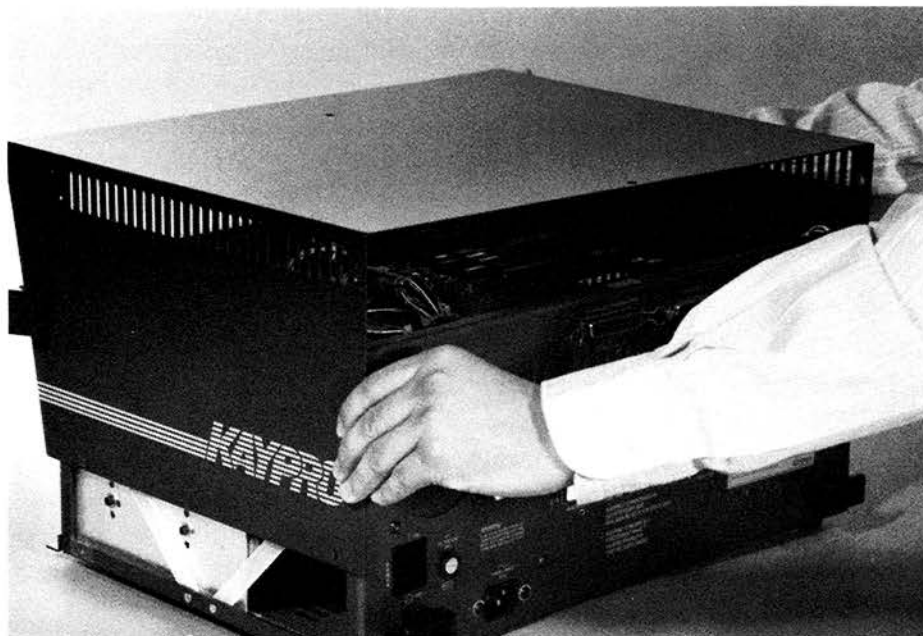


FIG. 8-1 Removing the cabinet.

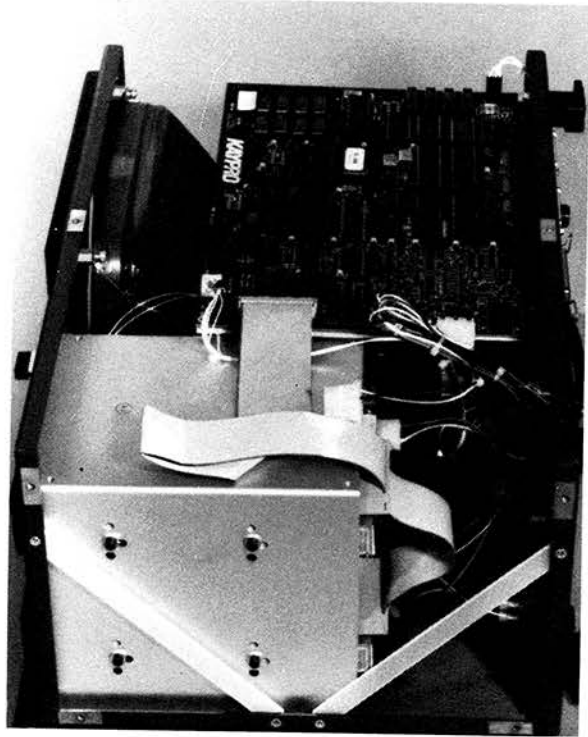


FIG. 8-2 Inside the computer. Note drive case.

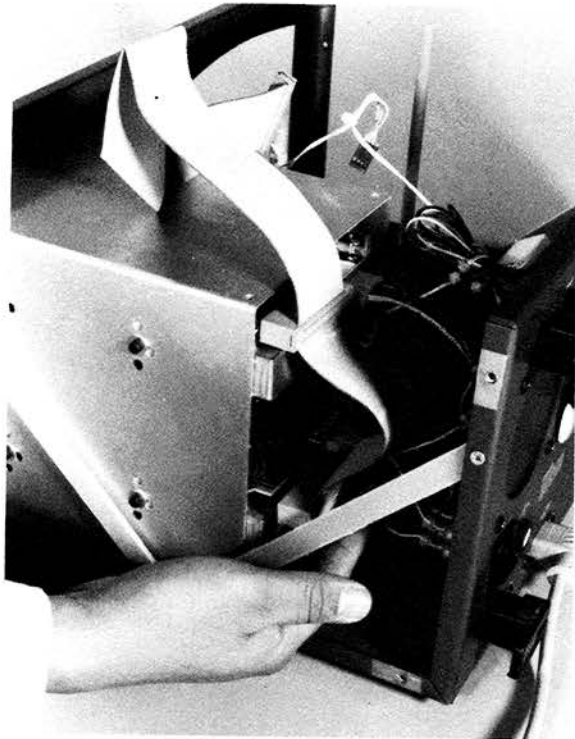


FIG. 8-3 Disconnect signal and power cables.

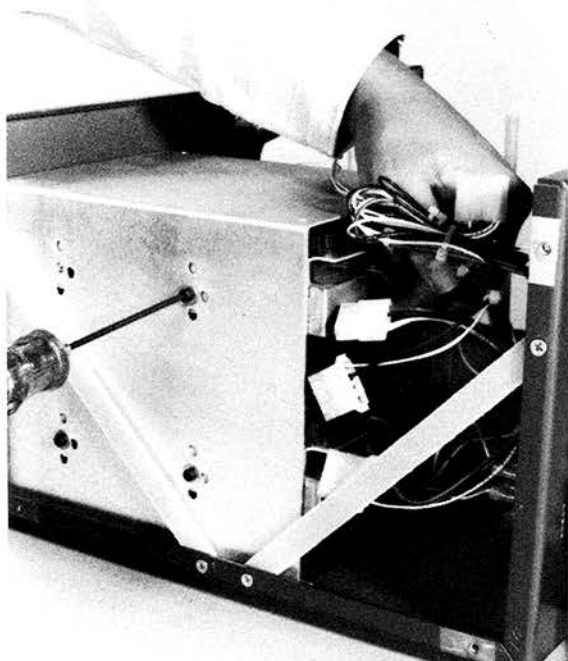


FIG. 8-4 Remove the holding screws.



FIG. 8-5 Remove the drive carefully. Some drives have components sticking up that can be damaged.

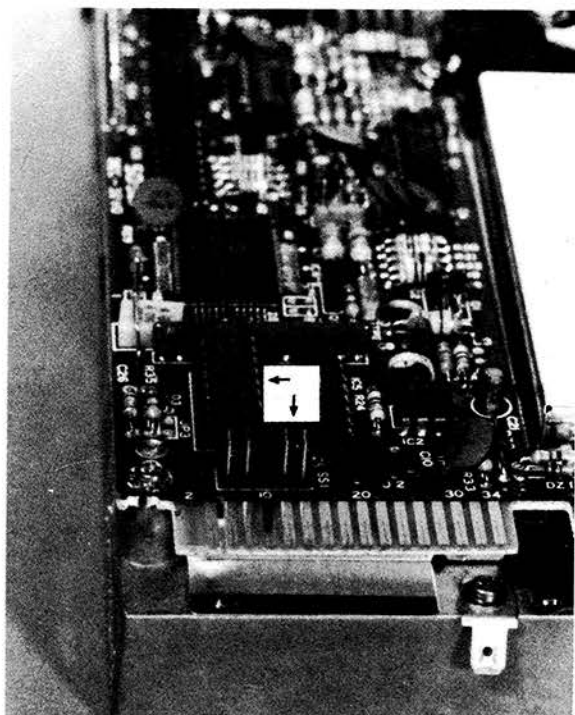


FIG. 8-6 A typical jumper block section and terminating resistor.

If the drive uses a jumper wire instead of a block, you can make the jumper from almost any small bit of wire, such as a clipped lead from a resistor or other component. In a pinch, an ordinary staple will do. Cut and bend the wire carefully for an exact fit, and be extremely careful that you put it in the correct spot.

If the drive has a jumper block, the job is much easier. You can do it with your fingers. A needlenose pliers makes it easier yet. All you have to do is to move that jumper block to the correct position. Be careful not to damage the block.

A terminating resistor is similar in appearance to an IC module. It is generally located very near the spot that requires the jumper wire or jumper block, and it will be socketed (quite often it is the only socketed component on the drive board). The terminating resistor package used by the Kaypro is a 470-ohm component. An IC extractor makes removing it much easier.

The terminating resistor package serves to identify the last disk drive. It is removed from a unit working as drive A, and kept in place in a unit operating as drive B.

In a Kaypro 10, the diskette drive operates as drive C, which makes it the "last" (or terminating) drive. The computer looks at the hard drive as drive A and B. For this reason, if you have a Kaypro 10

and use a drive model that has a terminating resistor package, it stays in the socket.

DRIVETEC

The drive manufactured by Drive-Tec is a high-density drive used on the Kaypro 4X or Robie. It cannot be used to replace a standard disk drive, nor can it be replaced with a standard-density drive.

To configure the drive, find the DIP switch (located near the signal cable connector—see Figure 8-7). All switches are to be in the “off” position (towards the cable connector) except the switch for the designation. For example, if the drive is operated as drive A, the #1 switch is “on” with all others “off.” To operate the drive as drive B, all switches are “off” except #2.

EPSON

The Epson drive may be used in all models that use a double-sided double-density diskette, including the Kaypro 10 (in which it is used as drive C).

Next to the signal cable connector is a double string of pins with a jumper block (see Figure 8-8). This should be across the pins labeled “0” (second from the right) for the drive to operate as drive A; across “1” to operate as drive B. Normally, the new drive will come with the jumper block set across the “0” pins and with the terminating resistor package in place.

Immediately in front of the jumper pins is the terminating resistor socket. (It is labeled “RA1” on the circuit board.) To operate the drive

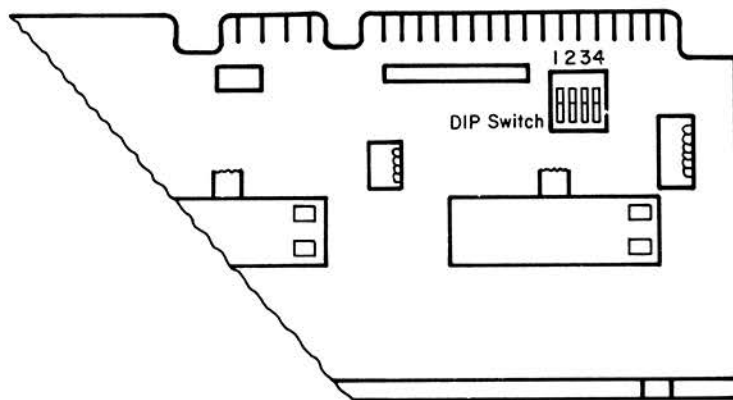


FIG. 8-7 Location of DIP switch on Drivetec board.

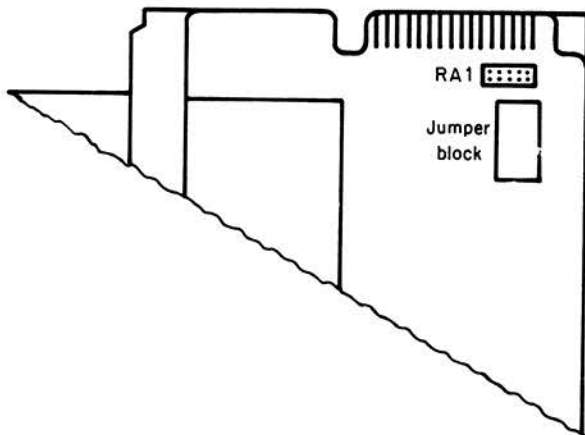


FIG. 8-8 Location of RA1 and jumper block on Epson board.

in the Kaypro 10, or to operate it as drive B, this package should be in place. To use the drive as drive A in a computer other than the Kaypro 10, remove the resistor package (and store it in a safe place, just in case you need it some day).

HI-TECH

The two option connectors are side by side near the signal cable connector (see Figure 8-9). The jumper section has eight pins labeled DS0, DS1, DS2, and DS3. The terminating resistor package has a "RP1" label on the circuit board.

A jumper block is used to designate the drive number. For drive

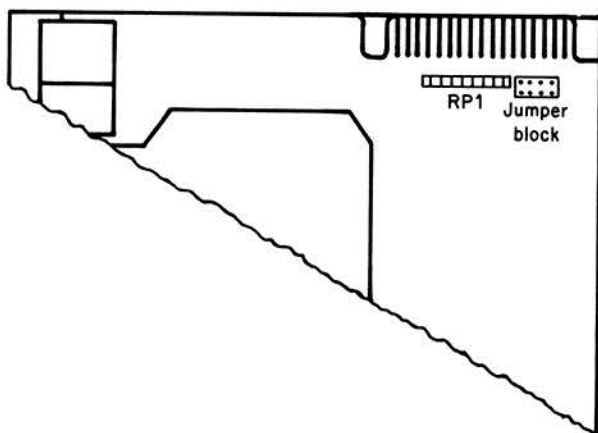


FIG. 8-9 Location of RP1 and jumper block on Hi-Tech board.

A, jumper the section across the DS0 position. To use the drive as B, place the block across the DS1 position.

The terminating resistor package stays in place if the drive is operating as drive B, or if the drive is being used in the Kaypro 10.

SHUGART

At the right rear of the Shugart drive and near the signal cable connector, is an 11-pin, L-shaped connector (see Figure 8-10). This connector is labeled 1, 2, 3, 4, and MX. (The MX part has three pins instead of two.) Two jumpers are needed to get the drive to function. In all cases, a jumper block is to be connected from the center pin to the pin on the left on the MX (three-pin, or extended) part.

For the drive to operate as drive A, a jumper is used in the "1" position. For drive B, the jumper block is in the "2" position.

The terminating resistor socket, labeled "RP1," is near the left end of the signal cable connector. As usual, it remains in place if the drive is to work as drive B or is installed in a Kaypro 10. For the drive to operate as drive A in anything but the Kaypro 10, remove the package.

TANDON HALF-HEIGHT

The half-height drive is used only in the Kaypro 10, which means that the terminating resistor package must be in place. The package is labeled "RP11" on the circuit board (see Figure 8-11).

Immediately next to this socket is a jumper option socket, labeled

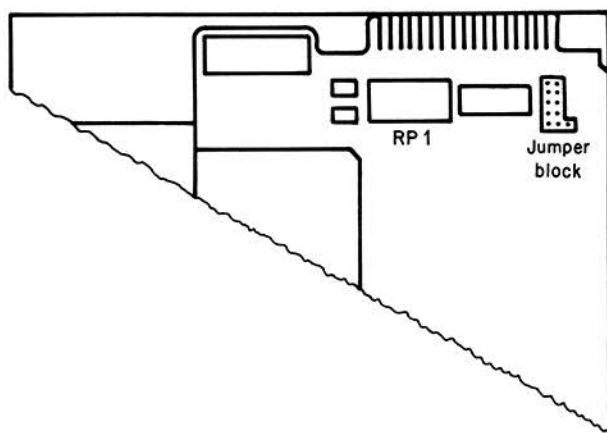


FIG. 8-10 Location of RP1 and jumper block on Shugart board.

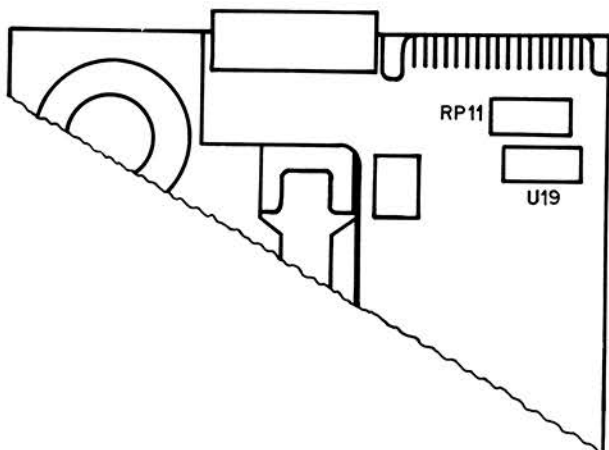


FIG. 8-11 Location of RP11 and U19 on Tandon half-height board.

“U19.” A jumper wire is used to shunt across pins 2 and 15, which are the two openings across from each other and second from the left.

TANDON FULL-HEIGHT

The full-height version of the Tandon is used in the Kaypro 2 and Kaypro 4. Two jumper wires are needed to make the drive work correctly. The option block (labeled “1E”) is located on the right-hand side of the circuit board near the signal cable connector (see Figure 8-12).

The first jumper goes between pins 1 and 14 (farthest to the left). To operate the Tandon as drive A, a second wire between pins 2 and

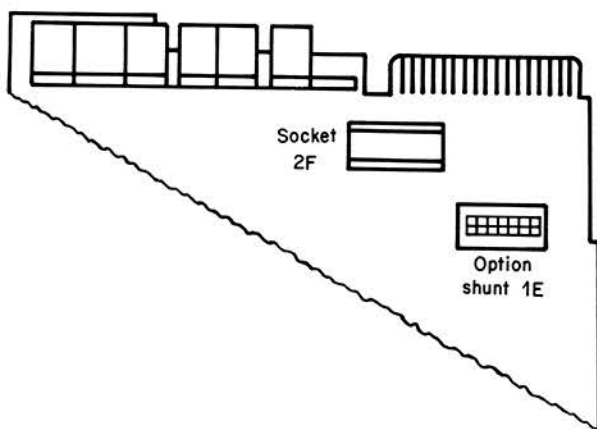


FIG. 8-12 Location of socket 2F and option 1E on Tandon full-height board.

13 (immediately to the right of the first jumper) is needed. For it to work as drive B, the second jumper wire is placed between pins 3 and 12. In other words, if the drive is to replace drive B, jumper the two pins to the farthest left, skip the next pair of holes, and jumper the third pair.

The terminating resistor socket (labeled "2F") is located next to and on the left side of the signal cable connector. It is removed if the drive operates as drive A, and remains in place if the drive is drive B.

TOKYO ELECTRIC (TEC)

The Tokyo Electric drive has the jumper block section and terminal resistor socket ("RA11") almost in the center rear of the circuit board and at right angles to each other (see Figure 8-13). Unlike the other drive types, the signal cable connector is on the left.

To work as drive A, a jumper block is placed across DSO on the jumper option. To work as drive B, a jumper block is placed across DS1. The terminating resistor must be in its socket when the drive is used as drive B, or in the Kaypro 10.

TOSHIBA

The Toshiba drive is the most complicated one to connect. The signal cable connector is located near the center of the drive circuit board. Below the signal cable connector are the jumper block (with a "RM" to the left and a "PJ5" to the right) and terminating resistor package

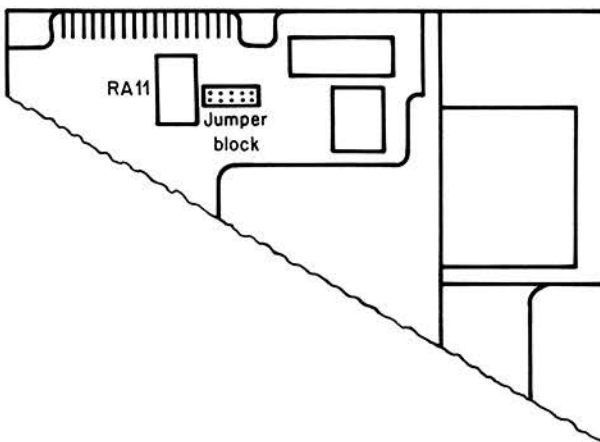


FIG. 8-13 Location of RA11 and jumper block on Tokyo Electric board.

(with a "DM" to the left of it) sockets. They are separated by an IC; the jumper section (a 16-pin socket) is on the right (see Figure 8-14).

First make sure that a jumper goes between the two pins labeled "LD" and the two labeled "HM." To get the drive to operate as drive A, jumper the two pins labeled "1." For drive B, jumper the two pins labeled "2."

When used as drive B, or as drive C in the Kaypro 10, the terminating resistor package must be in place. Then jumper all connections on the options block except the pair labeled "RM." When used as drive A in a computer other than the Kaypro 10, insert the terminating resistor package, but with only the jumpered pairs as in the previous paragraph.

HARD DRIVES

There are two main "Winchester" drives used in the Kaypro 10—Microscience and Seagate. Both are sealed units. The only repair or maintenance on a hard drive, other than cleaning the contacts or checking the external cabling, must be performed in a special, dust-free room.

The price you paid for the Kaypro 10 included the hard drive. Quite often the cost of a replacement, should your hard drive go down, includes the physical replacement of the drive. If you do have to make the swap yourself, it's an easy task.

As with a drive swap, by paying attention to the various settings and connections and making sketches, you should have no problem getting the new unit to work. Lacking this, the instructions that came with the new unit should tell you exactly what to do.

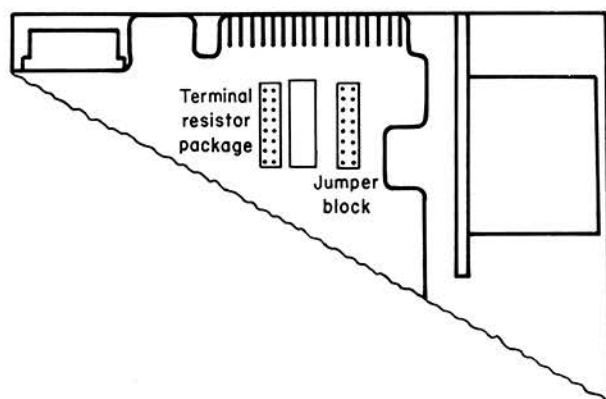


FIG. 8-14 Location of terminal resistor package and jumper block on Toshiba board.

CONFIGURING THE HARD DRIVE

There are two Microscience hard drives that are used in the Kaypro. One has a DIP (dual in-line package) switch with 9 switches on it; the other has 10 switches. This DIP switch block is located near the power connector. With the 9-switch version, switches 1, 2, and 4 should be on, with all others off. For the 10-switch version, switches 1, 3, and 4 are on, with all others off. See Figures 8-15 and 8-16.

The Seagate hard drive has a 16-pin jumper block, resembling an empty IC socket (Figure 8-17). Use a small piece of bare wire, such as a clipped lead from a resistor or other component, and jumper pins 7 and 10 (second pair from the end).

REMOVAL AND REPLACEMENT

Shut off the power and unplug the power cord, both from the wall outlet and from the computer. Then remove the cabinet (held in place by ten screws—two on top and four on each side). There are two diagonal braces on the right side of the computer by the drives. Remove these.

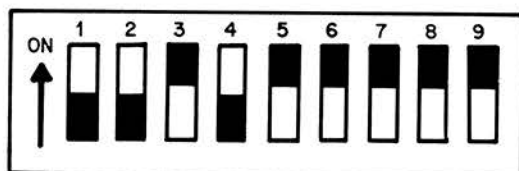
The drive shield is held in place by six screws on the bottom of the chassis. Turn the computer on end with the front placed on the worktable and carefully remove these holding screws. Even more carefully, set the computer flat on the table again.

Some masking tape can help you label the various cables and connectors. It wouldn't hurt to make some quick sketches as well.

You'll first be removing the flat ribbon cables from the main board. This will allow you to slide the drive shield and drives towards the back of the computer and lift the unit free of the computer.

On the back of the drive shield unit you'll find ribbon cables, power cables, and ground wires. It's easy to get them mixed up, so *be sure to label them!*

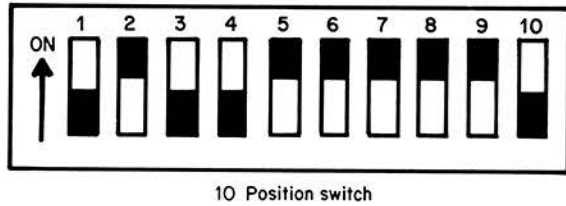
The drives are attached to the shield unit with four screws—two above and two on the bottom. Once you have removed the appropriate screws, the drive will slide out of the shield easily.



9 Position switch

FIG. 8-15 Microscience hard drive with nine switches.

FIG. 8-16 Microscience hard drive with ten switches.



Be sure that the new drive is configured correctly. Replacement is then merely a matter of reversing the steps. In other words, attach the drive(s) to the shield, reattach all wires and cables of the shield unit, insert the shield unit into the computer, replace the six holding screws on the chassis bottom, replace the two braces, and connect the ribbon cable to the main board.

The removal or installation of hard disk hardware is time-consuming, but it is simple if you take your time and pay attention to what you're doing.

PRINTERS

Printers come in two basic types, and in two basic configurations. The two types are dot matrix and those that use a wheel or ball (letter-quality). The two configurations are parallel and serial. A serial printer uses data that is sent one bit at a time. The parallel printer uses data that is sent one byte (eight bits) at a time. Each has advantages and disadvantages. Most people use the parallel configuration since this leaves open the serial connectors for other functions, such as modem communications.

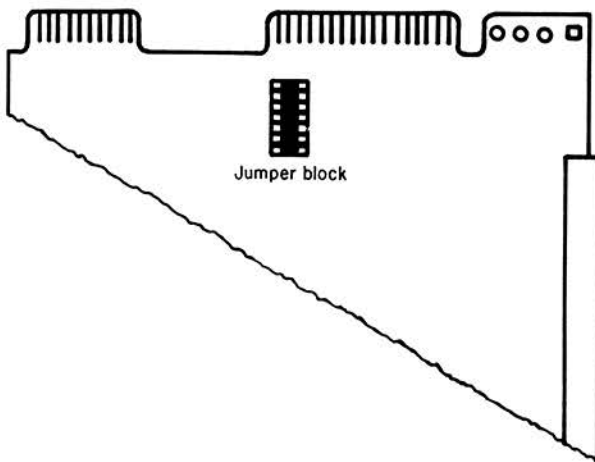


FIG. 8-17 Location of jumper block on Seagate hard drive.

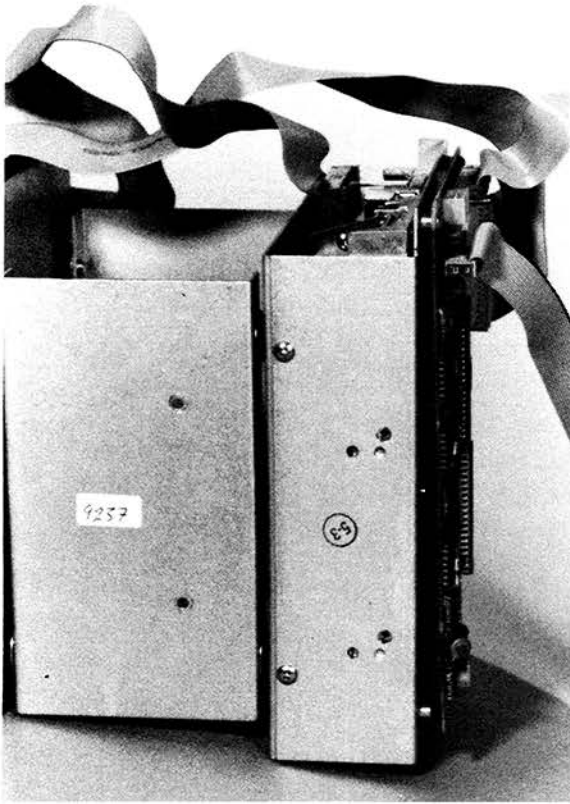


FIG. 8-18 The removed drive assembly.

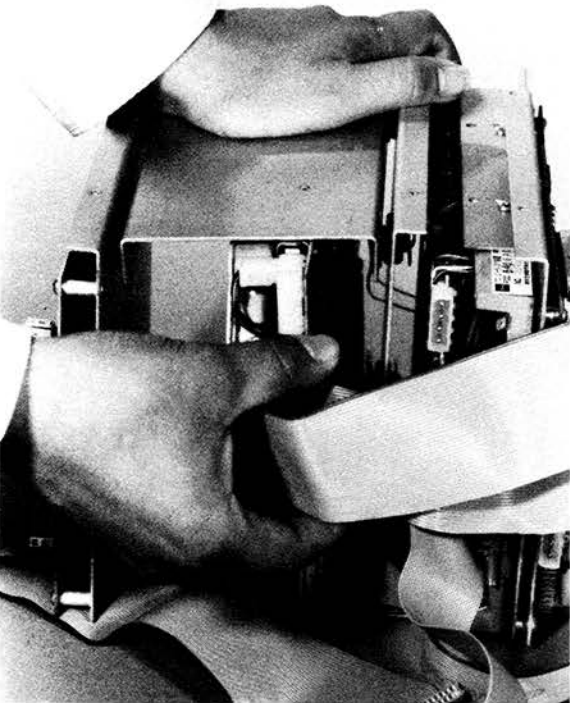


FIG. 8-19 Removing the drive from the shield. Pay close attention to where you removed all cables, wires, and screws.

Cabling is the biggest consideration when installing a printer. Fortunately, the Kaypro is so popular that finding the proper cable for any printer should be easy. The parallel output of the computer is a standard Centronix configuration. With very few exceptions, it will drive any printer that is meant to handle the information via parallel. Cabling a serial printer is a little more complicated, but not very much so.

Building a cable isn't that complicated. The manual that came with your printer will generally tell which pins are used for which function. Figures 8-20 and 8-21 identify the serial and parallel outputs from the computer. All you have to do is match these to the printer. (Don't forget to test the cable for continuity.)

Before even attempting to make any connections, get out the manual for your printer and read it cover to cover. Become familiar with the operations, options, switch settings, and so forth. The more you know, the better.

Visually inspect the printer. Locate the controls and learn how to use them, even if you don't think you'll need those options. Also look at the print head. Some are tied in place to reduce damage in shipping. Others may be packed along the sides.

As with many computer devices, printers often have DIP switches to set. The printer was designed and built to accommodate a variety of computers. The switches allow you to configure the printer to your needs. The switches may also set other functions of the printer. The printer manual is your guide in all this. You may not have to change them, but the only way to know is to read that manual.

Don't forget to shut down the power before changing any of the

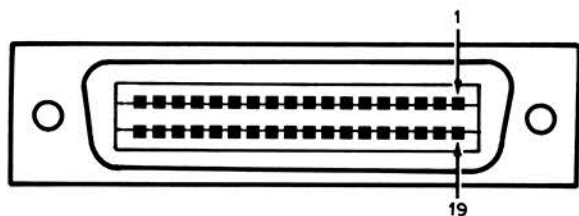


FIG. 8-20 A parallel connector and pin numbers.

PARALLEL PIN ALLOCATIONS

Pin	Use	Pin	Use	Pin	Use
1	Strobe	7	Data bit 5	16-17	Ground
2	Data bit 0	8	Data bit 6	18	Not used
3	Data bit 1	9	Data bit 7	19-30	Ground
4	Data bit 2	10	Not used	31-32	Not used
5	Data bit 3	11	Busy	33	Ground
6	Data bit 4	12-15	Not used	34-36	Not used

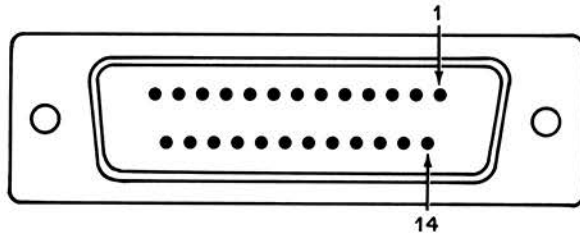


FIG. 8-21 Serial data connector and pin locations.

SERIAL PIN ALLOCATIONS

Pin	Use	Pin	Use	Pin	Use
1	Ground	5	Clear to send	8	Data carrier detect
2	Transmit data	6	Data set ready	9-19	Not used
3	Receive data	7	Signal ground	20	Data terminal ready
4	Request to send				

DIP switch settings. Most printers won't recognize switch setting changes while power flows. Others can be permanently damaged.

The manual that came with the printer should tell you everything you need to know about the switch settings. Read it carefully. You can't actually hurt anything if the settings are not correct, but the printer won't operate properly, if it works at all.

MODEMS

There are two basic types of modem currently available—internal and external. There are advantages and disadvantages to each. You don't have to worry too much about these, since the choice of which you would use was made when you bought your computer.

With the Kaypro 4 or 10, the internal type is built in. You can't easily install or change it after purchase of the computer since it is an integral part of the main board, with the components soldered into place. See Figure 8-22. But to add, upgrade, or replace the internal modem, you can buy a unit from Data Solvers, Inc. (440 Maple, Wichita, Kansas, 67213). They offer two internal modems for all Kaypros—a 300 baud (model DS300AD, \$199) and a 1200 baud (model DS1200SMT, \$427.50). Installation of these is easy and requires no soldering or other permanent changes to the circuitry of your computer. The new unit will bypass your factory-installed modem.

The major advantage of having a built-in modem is that it is tucked inside the computer and out of the way. Your desk is less

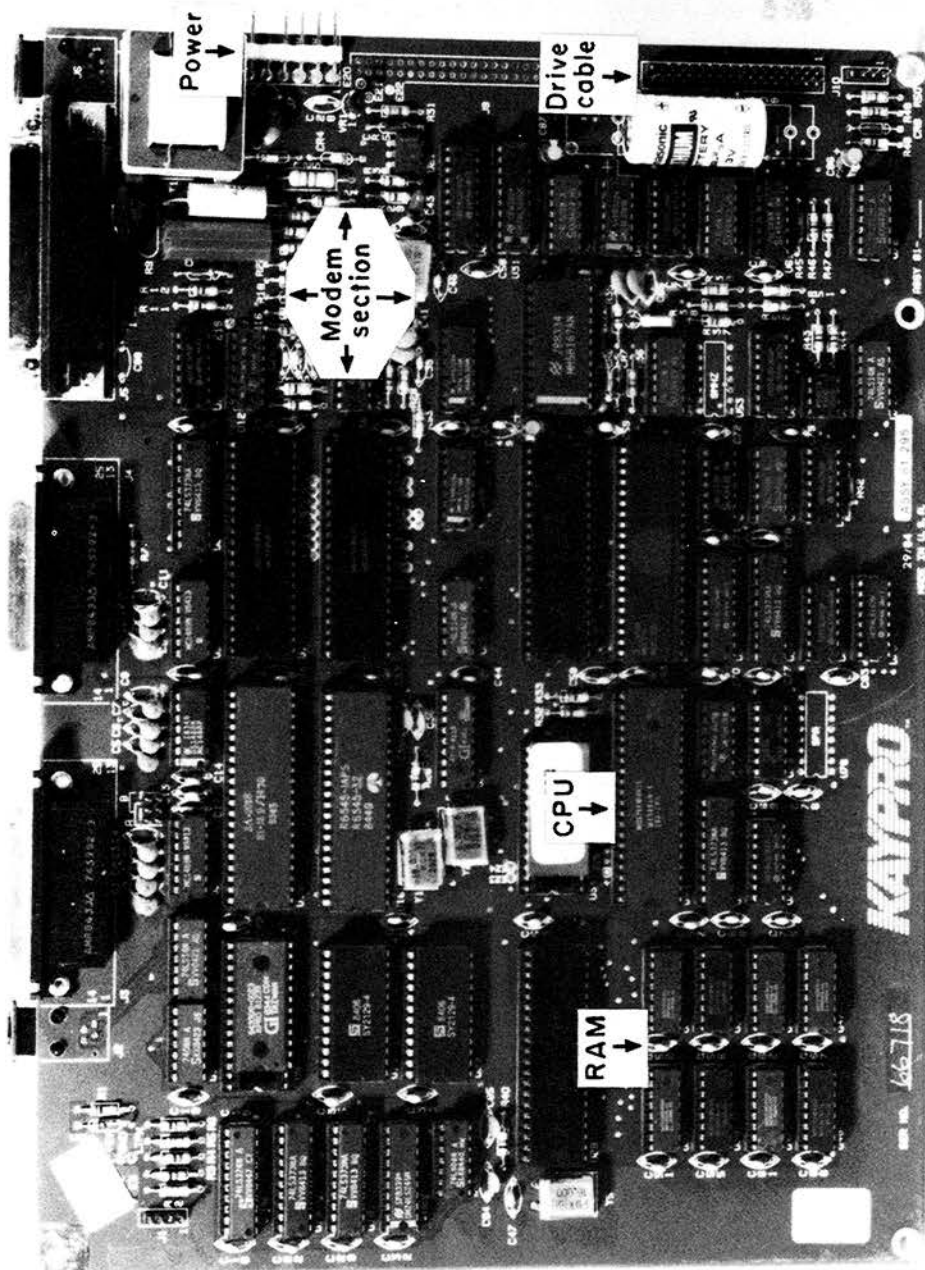


FIG. 8-22 The modem section of the mainboard.

cluttered and there are fewer wires strung about. It's also always there when you need it.

The major disadvantage of the internal modem is that you can't easily move it from computer to computer. If you have more than one computer, or if you decide to buy another, the modem is stuck where it is. (It can't be moved at all if your second computer is something other than a Kaypro.)

An external modem has the advantage of being "portable." You can move it from computer to computer by merely changing the cables from one computer to the other. Also, the controls are on the modem, making it easier to handle and monitor.

The external type is the usual solution if you have a Kaypro 2 or if you want a faster transmission speed than is normally available with the built-in modems of the other Kaypro models.

An external modem can be "direct connect" or "acoustic." Although the acoustic type modems have been in use for many years, they are now essentially obsolete. They have the advantage of being very inexpensive. These modems have a cradle for the telephone. The circuitry generates "beeps" to represent the data which is picked up by the telephone in the same way as it picks up your voice and other sounds.

This kind of modem has a severe disadvantage, however. As it picks up the beeps that are the data, it can also pick up any other sounds in the room. This can produce garbled or unusable data on the other end. The worse the fit of the telephone receiver into the cradle, the more garbage it will pick up from the room.

Direct-connect modems eliminate this problem and are generally preferred. A line connects the modem directly to the telephone outlet in the wall. No external sounds can invade. However, this increased reliability costs more.

Modems come in two common speeds: 300 and 1200 baud, with one baud being approximately one bit per second. For example, a 300-baud modem will transmit and receive data at 300 bits per second. The 1200-baud modem is four times faster, making it generally better. However, it's also much more expensive.

Many modems that handle 1200 baud can be switched to handle slower speeds. With them you can communicate with other computers that have only the slower models. A modem that cannot make this change will only save you \$150 (or less). You cannot work a 300-baud modem on 1200.

The upper limit for reliability across standard telephone lines is usually 1200 baud. Transmission and reception of data at speeds

higher than this could mean that the data will be garbled, and often unusable.

If you're planning to hook up a modem, an excellent reference for more information about modems, installing serial peripherals, and direct computer-to-computer communications links, is *PC + C*, by Phillip Good (Chilton Book Company).

ACCESSORY BOARDS

The Kaypro is designed to operate "as is." There are no expansion slots for additional circuit boards. The Z-80 CPU can't directly access more than 64K, so there is no way to add more RAM without making other modifications (such as bypassing the Z-80 CPU). There are some things that can be done to enhance your computer. These enhancements have found great popularity with computer users because of the increased power and versatility available. Print spoolers and RAM disks, for example, are wonderful features to have.

Quite often, the accessory board merely plugs into one of the chip slots. In effect, the board acts as a modified version of that chip. Other times installing these boards can be complicated, but by using a little common sense and following the directions that come with the board, you can install one with very little difficulty.

As always, begin by reading through the instructions completely. Don't skim past sections just because you think you won't be needing

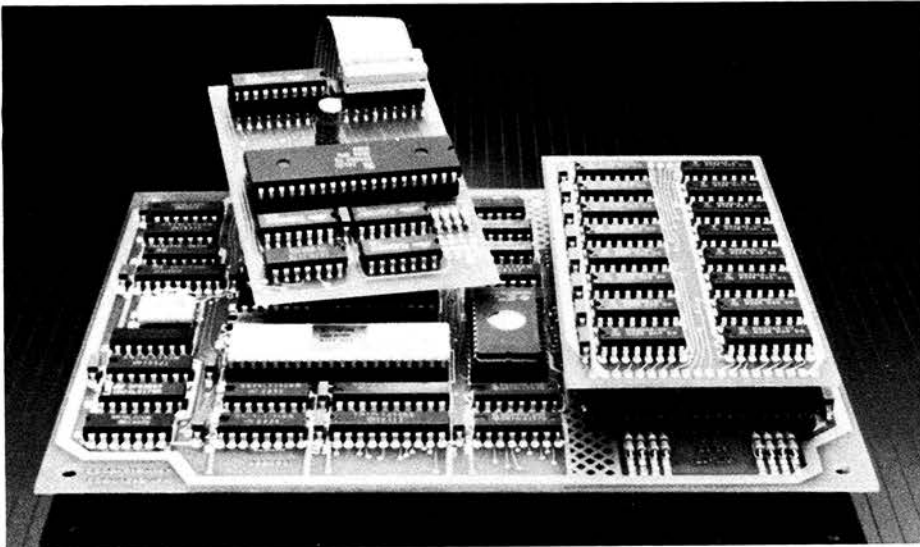


FIG. 8-23 Co-Power-88 board. Courtesy of SWP Microcomputer Products, Inc.

them. You simply can't know too much about the board and its features.

If you're not careful when installing an accessory board you can run into all sorts of problems. If the installation requires soldering or other physical changes to the main computer circuitry, there is always the chance of causing damage. There could also be electronic conflicts between the computer's circuits and those of the new board.

If your system functioned perfectly before the installation, and suddenly something isn't working any more, chances are good that you've missed a switch setting, or are trying to get the computer to do something it can't.

The software and hardware documentation should give you all the information you need as to what the board requires as far as installation and operation. Check both carefully.

It's possible that the board you choose will not be compatible with your system or with certain devices in your system. The dealer should be able to tell you what you need to know about compatibility. (The easiest way to avoid this problem is to use only known name products that have been proven to be fully compatible.)

SOFTWARE

Although the programs you use are not actually devices, there is often an installation procedure to follow. The manual that comes with the software should give you all the information you need to get the program up and working.

Just as you would when installing any other accessory, read through the manual before beginning. At least go through the installation section thoroughly. Despite what it seems at times, all the information you need is there (if you can understand it).

Some software is designed to work on a variety of computers. The manual might contain several sections, each for a different computer. If this is the case, be sure that you're using the one for your Kaypro.

If the program allows it, make at least one backup copy (preferably two) before you begin. Then if you make a mistake it won't be fatal.

I know one person who bought an expensive piece of software and didn't follow this simple rule. She was certain that she knew what to do, ". . . and besides, I'm following the instructions carefully." Within a few minutes that expensive software was turned into a blank diskette.

MISCELLANEOUS

There is very little that the Kaypro can't do if you install the proper devices and/or use the right software. It can be made to pretend to be a different computer by using an emulation package. (One accessory board, for example, makes it possible for you to use an external monitor with your Kaypro.) It can communicate with other computers with the use of a modem.

Installation of some accessories is as easy as attaching a cable. Others require major changes to the hardware, or special patches to the software (either to the software that comes with the device, to the CP/M operating system, or possibly to both). A few devices require custom software to get them to work.

The dealer should be able to inform you of any difficulty to be expected in installing a particular device you want to purchase. Buy it from the dealer, and the dealer is responsible for providing everything you need for proper operation. A part of the sale is to provide to the customer (free or at a reasonable price) the initial assistance needed for the installation, special software or software patching programs, and whatever else is needed.

Magazines such as *Profiles* and *Micro Cornucopia* describe a wealth of modifications that can be made to your computer. If you decide to make a modification, be sure that you fully understand what it is that you are about to do, and the consequences if you make a mistake. Take a long, realistic look at your personal abilities before jumping into a project.

SUMMARY

Adding options and devices to your system is sometimes as simple as plugging a cable from the device to the back of the computer. Other times it requires you to open the computer and make some physical changes to the existing circuitry.

Before making the purchase you should have some idea of just how difficult it is to handle the installation, and if you have the proper knowledge, skills, and equipment. If a more permanent modification is required, are you willing to make this kind of change to your system? Will you ever have to go through the bother of changing things back?

Before beginning the actual installation, read through the instructions completely. Then go through the steps of installation in your head. Do you understand what to do, when, and why?

If you're having trouble, read through the instructions again. Most of the time the information you need is right there.

Chapter 9

Dealing with the Technician

No matter how well you maintain your computer, or how much you learn about repairing it, there will be times when you have no choice but to call in a professional (and pay those professional fees!). It can't be helped. Certain repairs demand the use of special equipment. Others require special knowledge that is far beyond the scope of any single book.

This book is meant to reduce to a minimum those times when you have to hire a professional and to cut the amount you'll have to spend when those times occur. When you have to consult a professional, you'll have already taken care of many of the steps of diagnosis and can supply a great deal of time-saving information to the technician.

This book can go a long way toward these things. It can't reduce costs to zero.

MAIL ORDER

If you make purchases through the mail, do not expect to have a technician on call to help you. Very few mail order companies are set up to handle questions or problems. You get a discount price, but you are expected to take care of everything by yourself. The only responsibility that many mail order companies accept is to make sure that the equipment is "as advertised." While they do guarantee that the equipment will arrive in good condition, it is usually assumed that the buyer knows enough about what is going on to get the equipment or software functioning.

There is nothing dishonest in this, and it isn't because the mail

order companies don't care. They simply aren't set up in the same way as a local dealer. They don't have the technical staff on hand to take care of questions and problems. Their basic job is to fill your order, which they usually do quite well.

If you know for certain that you can handle any problems with the installation and that you can wait for the delivery (and for the delivery of the exchange if this is needed), mail order can save you some money.

If you have any doubts about your technical knowledge, you would probably be better off working with a local dealer.

RESPONSIBILITIES OF THE DEALER

When selling you some equipment or software, the dealer assumes a certain amount of responsibility. (If the dealer doesn't do this automatically, you should probably find another.) The dealer first makes sure that the computer is functioning when you get it. If you buy an entire system, the dealer should see to it that everything functions as a unit before turning it over to you. It should not be handed over as a pile of boxes. If the dealer operates this way, you might as well go through a mail order company and save some money. Don't be afraid to ask the dealer to put in writing the promises made for the support of the products you buy.

Many dealers include training in the purchase price. This training isn't meant to make you a computer expert. That takes years of work. The purpose of this training is to get you familiar with the computer and with the software.

Occasionally the dealer will charge a small fee for this training. This is often true for instruction in how to operate a complicated piece of software. Even a \$500 software program doesn't automatically bring with it a complete course. The more training you need, the higher will be the cost. Expect to pay a fair price for detailed training and instruction. But also expect the dealer to answer basic questions for you, without charge, concerning the purchases you have made.

After purchase of either hardware or software, the dealer continues to be responsible for customer care. If you have a problem a few weeks or months after getting the equipment home, you should feel welcome to call in with questions. Service during the warranty period is obvious. Within reason, the service should continue beyond this period, especially if it's a matter of answering questions.

Manufacturers of both hardware and software are famous for refusing to talk to the end user. They usually assume that the person

who sold you the item is responsible for that. Thus, the responsibility falls on the dealer to provide needed information to customers.

People who are new to computing (about 75% of the dealer's sales) won't know what questions to ask when they make a purchase. Something as simple as formatting a diskette is a major accomplishment for some newcomers. The more the buyer works with the computer, the more questions he or she will have. After a short time, certain questions and problems are bound to come up.

The dealer should provide competent technical assistance after the sale. The user needs a source of information when something goes wrong. This includes both technical questions involving operation of the software and hardware purchased, and repair when something goes wrong.

Simple questions should be answered without charge (if you're a customer). Questions that require some instruction or other lengthy personal attention will probably involve a fee. Repairs of any size will cost unless you're under warranty or have a service contract (which also costs).

Some dealers do not keep a technical staff in the shop. They can't afford to. If this is the case, the dealer should at least be able to guide you to the proper people for your needs or to find the answers to your questions. Being small is no excuse for being unable to provide customer service when it is needed.

YOUR RESPONSIBILITIES

If you expect assistance or information from a local dealer, start by giving that dealer some business. If you bought your computer through the mail, don't expect the local dealer to handle all your questions and problems free of charge.

Even if you didn't purchase your system from a particular dealer, you can build a working relationship around your other business. The next time you're in the market for a printer or software, stop in and see the dealer you plan to use for help. You might have been thinking about getting some training on how to operate one of your programs. Perhaps the dealer has a course available.

THE TECHNICIAN

With the information in this book you should be able to provide a considerable amount of information to the technician. Your goals are to reduce the cost of repair and the amount of time that repair will

take. You'll be gaining a secondary benefit in that you'll be letting the technical staff know that you have some idea of what you're talking about.

Before even calling, try to find out if the malfunction has been caused by operator error. It's unfortunate but true that most technicians are forced to wonder if the customer has even bothered to read the instruction manual.

Try to gather as much other information as you can. The more accurate information you provide, the easier will be the job of the technician. To you this means increased efficiency, lower cost, and less downtime.

A fair part of the technician's day is spent simply guiding the customer through the right questions, and the technician comes to expect a lot of "I don't know" answers. This can be frustrating. Some technicians get so frustrated that they don't even want to talk to the customers. "Just bring it in and I'll have a look," they say.

You have every right to ask about the qualifications of the person who will be working on your computer. Is the technician new to the business, with no background at all? Is the person's training more along the lines of television repair, or has he or she had schooling that concerns computers? Does the technician seem to understand the information you provide? Can he or she answer your questions without tossing around unnecessary technical jargon?

If you're observant, you can tell quite a bit about how well the technician "knows his stuff" even over the phone. Responses to your information should make sense. (At the same time, a reponse of "I can't tell without looking at it" could be true.) Of course, your information has to be accurate.

You also have the right to talk to the person who will be handling the repair, or to the service manager who handles that department.

Use common sense. The technician, the manager, the dealer are people. Treat them with respect and you'll get much more accomplished.

TERMS FOR REPAIR

Two-way communication is important in any transaction. Both parties should understand fully what is promised and what is expected before repairs begin. Misunderstandings can come up all too easily unless anticipated before things start.

You should have some idea of the terms and the cost before the work begins. They may not be able to tell you exactly until they've

actually found the problem. (For example, a problem that you think is something minor in the disk drive might be something major on the system board.)

An experienced technician will usually be able to give you a fairly accurate estimate. This should be given to you in writing before the actual work begins. If further testing and diagnosis reveals that the problem is something more expensive, be sure to have it (in writing) that the dealer will call you before going ahead (unless you honestly don't care).

Along with the price estimate you should have a time estimate. How long will your computer be tied up? If it goes beyond this period, can you get a "loaner," or at least be able to rent a machine to use while you're waiting?

What kind of warranty is given with the work? (It should be at least 30 days on both parts and labor.) Having the warranty in writing is important.

When the work is complete, ask for an itemized list of what was done, and what the cost was for each thing. This is your protection for any warranty service and is also a good thing to have around for future reference. Request the itemized list before the work begins. Some shops automatically keep an itemized list. Others do not.

Before turning over the computer, be sure that the technician knows as much as possible about the problem and what the symptoms are. The more information you can provide, the better.

Communication is important if you wish maximum efficiency and a good repair job.

SOLVING PROBLEMS

No matter how good the technician is, or how reputable the company is, there will be times when problems will arise. Many could have been prevented if communications between you and the shop were carried on properly to begin with. Others result from unforeseen malfunctions. Or perhaps one of the parts installed is faulty. Occasionally a mistake will have been made during repair.

If the work is not done to your satisfaction, say so—politely. The less polite you are, the less willing they'll be to take care of the problem. (You'd react the same way.)

Talk to the technician who did the work first. Chances are good that the problem is something manageable at that level. If not, go to the service manager, and then to the general manager. It might take

a little longer to go through the "chain of command," but the end results are often better.

SUMMARY

Before making a purchase, determine whether you'll need the fast and expert advice that can be provided by a local dealer. You can save money by using a mail order company, but you are not likely to get much help if you run into problems with the installation.

You have to decide whether or not you can handle the job. If you have doubts, you might be better off going with a local dealer.

Both the dealer and you have responsibilities. The dealer should be willing to stand behind the products carried. The staff should be competent enough to give sensible advice as to which products will best suit your needs.

Chapter 10

Troubleshooting Guide

Finding the source of malfunctions isn't as difficult as you might think. It is nothing more than applying a logical process of elimination.

For example, assume that the computer or peripheral is completely dead. If the wall outlet is good then the problem is definitely with the device. By checking the power supply (see Chapter 6), you'll have eliminated as the cause either the power handling circuitry or the rest of the computer. Continue this process and eventually you'll have located the offending module.

Always begin with a check of the obvious. Is the computer plugged in? (Is the wall outlet good? Have you paid your electric bill this month?) Is the fan filter clean? You'll find that the majority of malfunctions are a result of something silly.

The symptoms will help to guide you to the source of the trouble. There are just so many things that can cause a particular malfunction. If a program refuses to load but everything else seems functional, the symptoms indicate that the most likely problem is with either the software or the drive (chapters 3 and 4). Less likely, but possible, are things related to the drive. The power supply might not be providing sufficient power for the drive to operate properly (easily checked by testing the input to the drives). The program goes from the drive and into RAM, which means that a faulty loading can be a result of a RAM failure.

A quick troubleshooting guide is provided below. It gives you a starting place. The actual symptoms will help you to reduce the number of possibilities. (For example, if the drives are trying to load, chances are good that the power flow is just fine.)

Keep in mind that a troubleshooting guide is only the beginning of complete diagnostics. Sometimes the problem will be found quickly, using nothing more than the troubleshooting guide. Other times more complicated steps are needed. (See Chapter 2.)

Troubleshooting Table

<i>Symptom</i>	<i>Possible Problem</i>	<i>Cure</i>	<i>Chapter</i>
Nothing happens	No power	Check cord, switch fuse	2,6
	Power supply	Check power supply	6
		Check connectors	2,5
	Main board	Check main board	2,5
Fuse blows often	Power supply	Check power supply	6
	Cabling	Check all cables	
	Main board	Check main board	5
	Other boards	Check (if possible)	5,6
No display or poor display	Controls	Adjust controls	2,6
	No signal to video board	Check cables	6
	No power to video board	Check power	6
	Monitor	Check monitor	6
	Main board	Check main board	5
Drive LED does not come on	LED	Check LED	4
	No power to drives	Check power	4,6
	Disk drive bad	Check disk drive	4
	Drive controller chip bad (1793)	Replace	4
	Main board	Check main board	5
Keyboard does not work	Keyboard not plugged in	Plug it in!	
	Keyboard	Check keyboard	6
	Keyboard cable	Test cable	6
	Main board bad	Check main board	5
Cannot load in programs; other program problems	Something silly	Check the obvious	
	Bad diskette	Try backup	
	No CP/M on diskette	Install system	
	Drive not working	Check drive	4

<i>Symptom</i>	<i>Possible Problem</i>	<i>Cure</i>	<i>Chapter</i>
	Drive cable	Check drive cable	4
	RAM	Replace if necessary	5,6
	Main board	Check main board	5
	Clamping	Check clamping	4
	Drive heads	Clean or replace	4
Printer problems	Something silly	Check the obvious	6,8
	No output from computer	Check cable	6
		Check connector	6
		Check main board	5
	Printer	Check printer	6,8
Hard drive problems	Cables	Check cables	4,8
	System	Run PUTSYS and PUTOVL & reset	
	Main board	Check main board	5
	Hard drive	Replace	8

Chapter 11

The Kaypro 16

Recently Kaypro entered the field of IBM PC-compatible computers with the Kaypro 16. Like other Kaypros, the 16 is a self-contained, portable computer. Other than this, the new model 16 is "another breed of animal" when compared to the rest of the Kaypro line.

It has four expansion slots inside to accept a variety of circuit boards. These carry out various functions. The idea is to make the computer as versatile as possible and adaptable to the individual needs of the owner.

At this time, three of the expansion slots are used up by the system, leaving one slot open for the user. It's very possible that the functions of the required boards will be combined, thus freeing up more expansion slots.

What looks like the main board is actually the memory and bus board. The CPU and related circuits are on a board that fits into one of the expansion slots. The video circuit board (which provides color graphics to an external monitor if desired) takes up another slot. A third slot is taken up by a floppy controller card. This circuit board also has the serial and parallel ports (both IBM compatible) and sockets for additional memory chips to bring the total on-board memory to 640K.

Unfortunately, this upgrade requires swapping some other chips that are not easily available to the end user. This means that you may have to visit the shop if you want the full 640K. You can easily load the computer to 512K, by simply plugging memory chips into the sockets on the memory board (that big one). Information on how to do this (and how to add expansion boards) is given later in this chapter.



FIG. 11-1 The Kaypro 16.

BASIC DIAGNOSIS

Tracking down a malfunction is essentially the same no matter which computer you're working on. It is a simple, step-by-step process of elimination. By observing the symptoms you can usually eliminate at least half of the possible causes immediately. From there simple tests can point out the single cause.

If you bought this book just for the Kaypro 16, don't confine yourself to reading this chapter alone. The material in the other chap-

TABLE 11-1. Kaypro 16 Specifications

CPU	8088
Memory	256K standard; user expandable to 512K; shop expandable to 640K
Drives	1 DSDD (360K) floppy; 1 10-megabyte hard drive
Video	Internal green phosphor; RGB and composite outputs for external color monitor
Ports	1 serial; 1 parallel
Expansion slots	4 expansion slots available; generally 3 are used by the system, leaving 1 open to the user
Other	85 watt switching power supply; reset switch; IBM PC- and XT-compatible in all respects

ters may not be exactly what you need, but that information will serve as an excellent guide. At the very least, read through chapters 1, 2, 3, and 7.

THE OBVIOUS

It can hardly be stressed enough to begin *all* diagnostics with a search for the obvious. Any technician who has worked around consumer electronic equipment for any period of time can tell you that a fair portion of all "malfunctions" aren't malfunctions at all—they are due to something silly.

Is the computer plugged in? And plugged into a good outlet? It takes just a few seconds to be sure. Don't just look at the plug—give it a push to make sure that it's in all the way. If nothing else is plugged into that same outlet, either plug something into it as a test (a lamp or whatever), or test the outlet with a meter.

Are the two fuses good? (There are two fuses—one mounted to the back of the chassis, and a second inside the computer on the power supply board.)

Is the power switch on? *All* the way on?

Is there any sign of power at all? (Is the fan running?)

Inside the Kaypro 16 are switch blocks to set the computer's memory, drives, and ports. Has anyone fiddled with these? Has anything new been added that would require new switch settings? Once again comes the important question, "Has it ever worked?"

The failure of the disk drives to load a program could be due to something as simple as the disk being inserted incorrectly, or using the wrong diskette. Again, it takes just a second to check.

Get a backup copy of the program you are trying to load, or of the data you are trying to retrieve and try again. (You *do* have at least two backup copies, right?)

The serial and video ports are identical in appearance, and are even located in the same relative position. Do you have the printer plugged into the video port, or vice versa? (It's easy to tell them apart, since both serial and parallel ports will be in one slot. The slot that carries the video port will also carry the composite color plug, which looks like a standard RCA jack.) Not only will the devices refuse to function if plugged into the wrong ports, you could damage the device, the board, or the computer by making such a mistake.

If you're used to a standard Kaypro, the parallel port could be confusing. It looks exactly like the serial port of other Kaypros (and

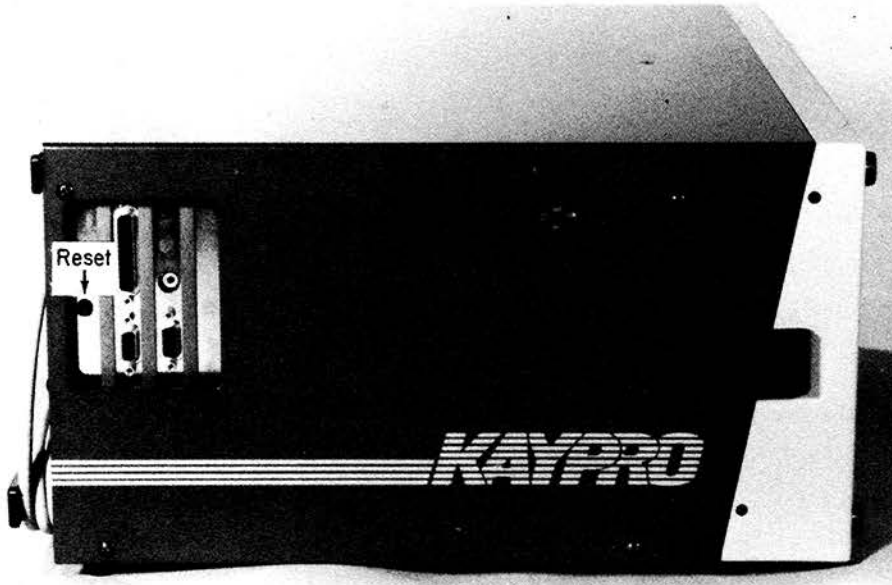


FIG. 11-2 The expansion ports. It's important to have the external devices connected correctly. Note the reset button.

most other computers). To help lessen the confusion, all you have to keep in mind is that the parallel port is the larger one.

PROCESS OF ELIMINATION

With the power off, remove all externally connected devices and try again. If everything operates again, the problem is in one of these external devices, or in the circuit board that holds the connecting port.

With this done, take the computer, plug it in, and flip the power switch. Nothing happens. You already know that the outlet is good, and so immediately eliminate that as the problem. With the case removed, and the power off, check all the connectors to be sure that they are making proper contact and are clean. Push all the socketed chips you can reach to make certain that they are seated correctly. (Removal is the same as with all other Kaypros—two screws on top and four on each side.)

The next thing to check is the internal fuse. This is done visually (for now). The power supply board is located next to the hard drive and beneath the large memory board. You can see the fuse by either looking into the computer from the side or from the top.

With the power off, disconnect everything that plugs in. Examine each connector visually and clean the connectors before attaching them again.

Get out the multimeter, set to read 12 volts DC. The power supply board is tucked down inside. You can't get to it without disassembly, but that isn't important. You can still test the power supply output.

TESTING THE POWER SUPPLY

The memory board is mounted with the chips facing down into the machine. The power supply feeds it through a six-pin connector on the component side of the circuit board. The pins can be accessed and tested from the top of the board.

Pin 6 is toward the back of the computer, with an obvious ground next to it (pin 5). The black probe goes to pin 5, and the red probe is touched to pin 6. The reading should be 12 volts.

Now it gets more complicated (but is still easy). Follow the readings in Table 11-2. You won't do any damage if you don't, but you'll get strange readings. For example, if you test between pin 4 and ground (pin 5), you'll get a reading of 24 volts. This is a false reading, and is actually the difference between the +12 VDC and the -12

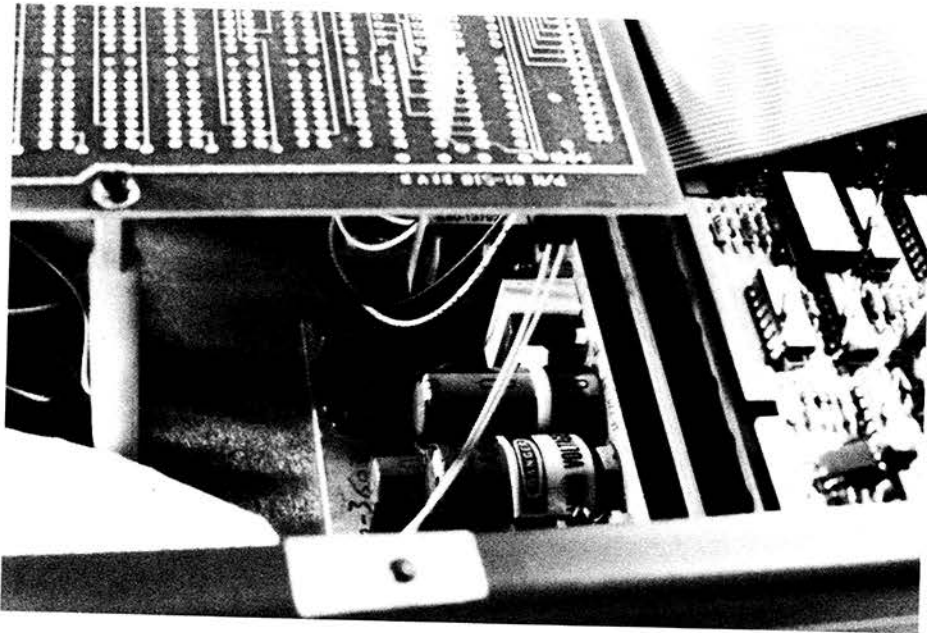


FIG. 11-3 Getting at the power supply is difficult.

TABLE 11-2.
Power to the Memory Board

<i>Black to pin number</i>	<i>Red to pin number</i>	<i>Reading</i>
5	6	+12 VDC
3	4	-12 VDC
3	1	+5 VDC

VCD outputs. Between that ground pin and pin 1 you'll read 17 volts—another false reading which is the difference between the +5 VDC and the -12 VDC. Neither reading is of any value, so don't waste your time looking for them. But, do keep in mind that if you suddenly get a meter reading of 25 volts, the only thing wrong is that you're probing the wrong pair of pins.

You can also quickly test the power flowing to the hard drive circuit board. This connector is located at the rear left of the board. You should read +5 volts between the white and black wires. A reading of -5 volts should be available across the other two pins.

If the readings you get in the above tests are good, the power supply is probably doing its job. If you have any doubts, shut the power down, reach beneath the memory circuit board, and unplug

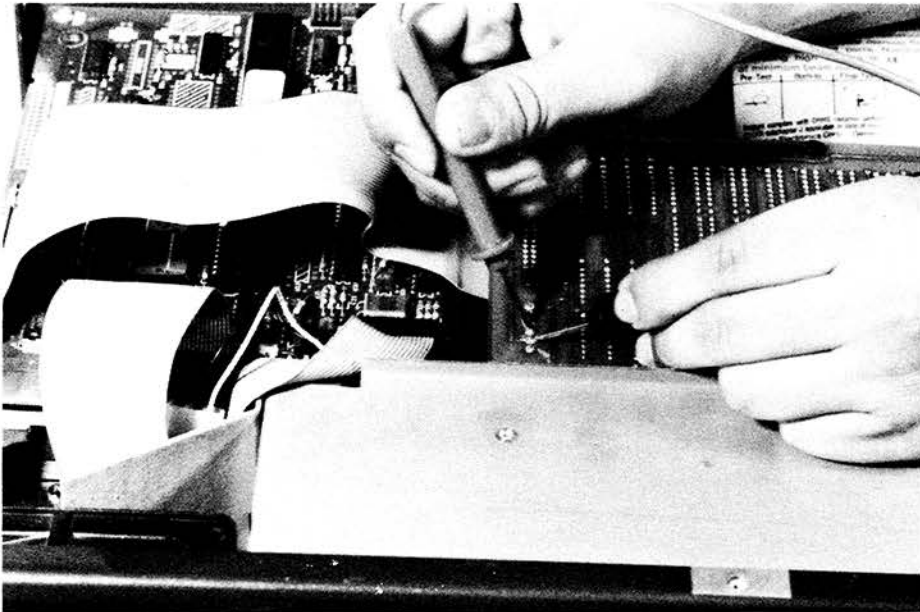


FIG. 11-4 Location of power testing points.

the power connector to test the power supply directly. If the readings are now correct but weren't before, the problem is definitely not the power supply.

At this point you've eliminated everything from the main board to the wall outlet. You've also avoided (hopefully) the common mistake of thinking that a zero voltage reading with the power supply connected means a dead power supply. Something farther in is causing the power supply to drag down and shut off. The power supply is probably just fine.

OVERHEATING

As with the Kaypro 10, overheating is a bit of a problem with the Kaypro 16. (The Kaypro 16 even uses the same case as does the Kaypro 10.) Air from the fan is circulated through the computer. When everything is working as it should be, this design is just fine.

The most common cause of overheating is simple and easy to take care of. On the back of the cabinet is a plastic holder and a spongy air filter. It doesn't take long for this filter to become clogged with dust. It also doesn't take long to clean it.

Some people seem to have the idea that the entire fan has to be removed. Out come the screws, and down go the tiny nuts into the inside of the cabinet. There's no need for this. The filter is held in place by the snap-on plastic cover. It comes off easily with your fingers (see Chapter 7, Figures 7-1 and 7-2). All you have to do then is to wash the filter in clean water (no soap!). Once it's dry again, just put it back in place and snap on the plastic cover.

EXPANDING THE SYSTEM

The Model 16 is made to be versatile and expandable. It comes from the factory with 256K installed. You can add more memory—up to 640K. Although three of the expansion slots are used up, you still have one for your own use. Almost any board that works in an IBM PC or XT will work in this slot. It's possible that as the computer becomes more popular, combination boards will be available that combine the functions of the existing boards and thus another slot will be opened up for your use. Rumor has it that a multi-CPU board will be available.

Making an addition to the Kaypro 16 isn't quite as simple as it is with the IBM computers, but it's still easy enough for you to handle. It just requires a partial disassembly.

DISASSEMBLY OF THE KAYPRO 16

The cabinet is held on with ten screws—two on top and four on each side. Shut off the power and unplug the computer. Then remove these screws and lift off the cabinet (Figure 11-5).

The main memory board is held in place with four screws through the back of the cabinet (Figure 11-6) and one screw down through the front of the board. Remove these. Then carefully label and remove all connectors that you can reach, including the ribbon cable going to the hard drive (Figure 11-8). (Unplug the LED wires from the board, not from the LED.)

The entire center section of the computer—the memory board and the box that contains the expansion slots—will lift out (Figure 11-9). It's a tight fit. Pulling forward and up will make it easier for you. If the movement isn't free, stop and double check to see if you've forgotten a screw or connector.

With this section partially removed, you'll be able to reach the few remaining connectors. Again, be sure to label them *before* you disconnect.

Four screws hold the case around the expansion slots. If you have to get at the boards inside, remove these (Figure 11-11). The boards

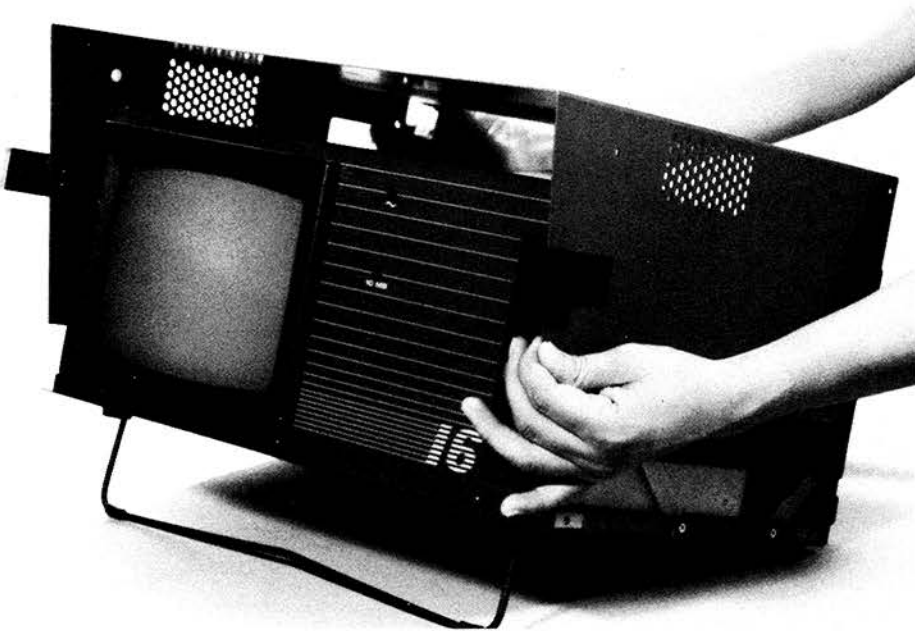


FIG. 11-5 Removing the cabinet.



FIG. 11-6 Removing the main memory board.

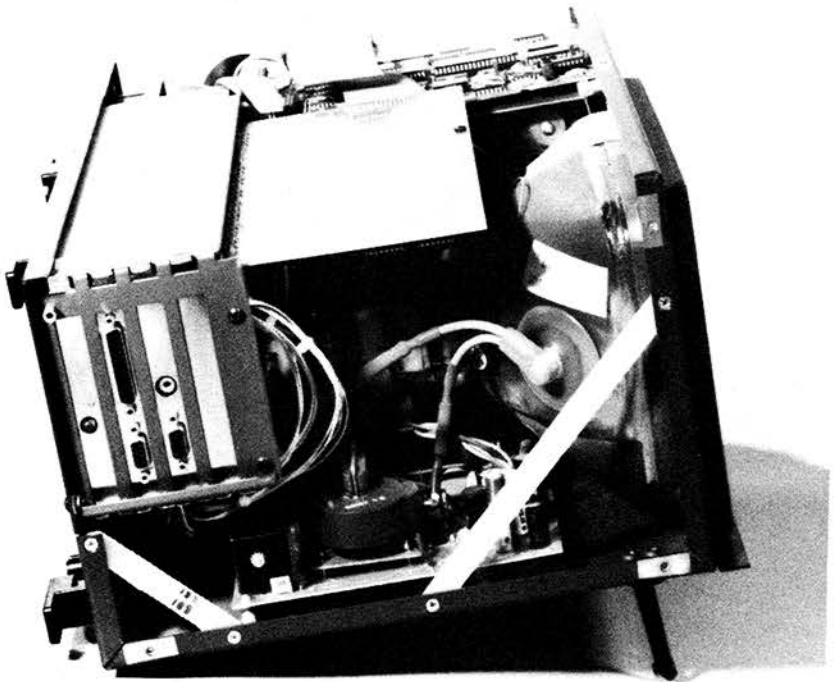


FIG. 11-7 Inside the computer.

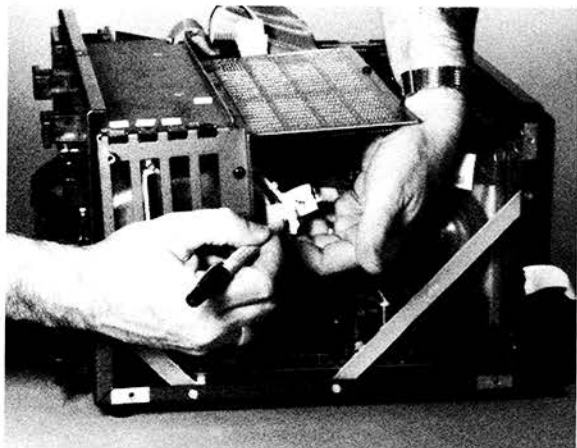


FIG. 11-8 Label all wires and cables *before* you disconnect them.

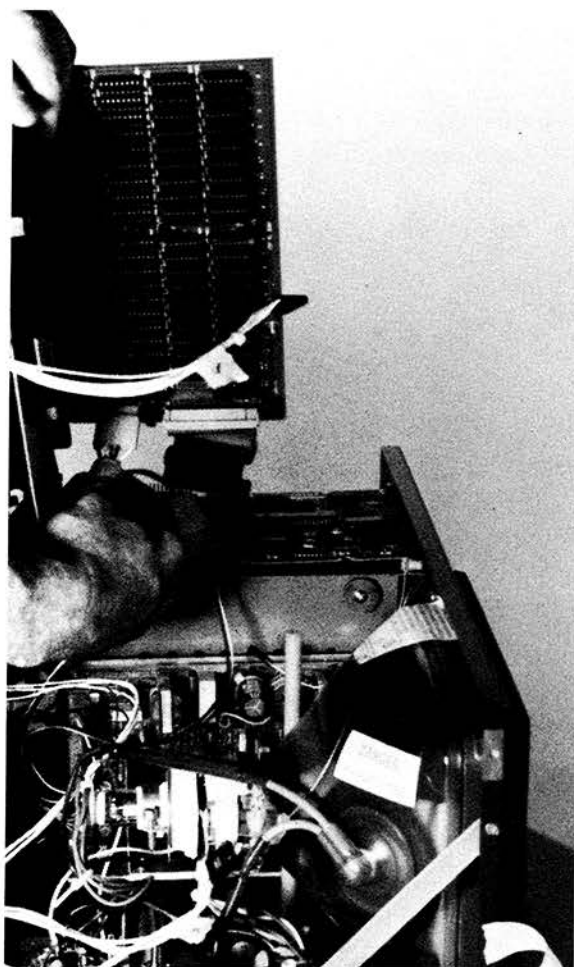


FIG. 11-9 Lift out the main section carefully.

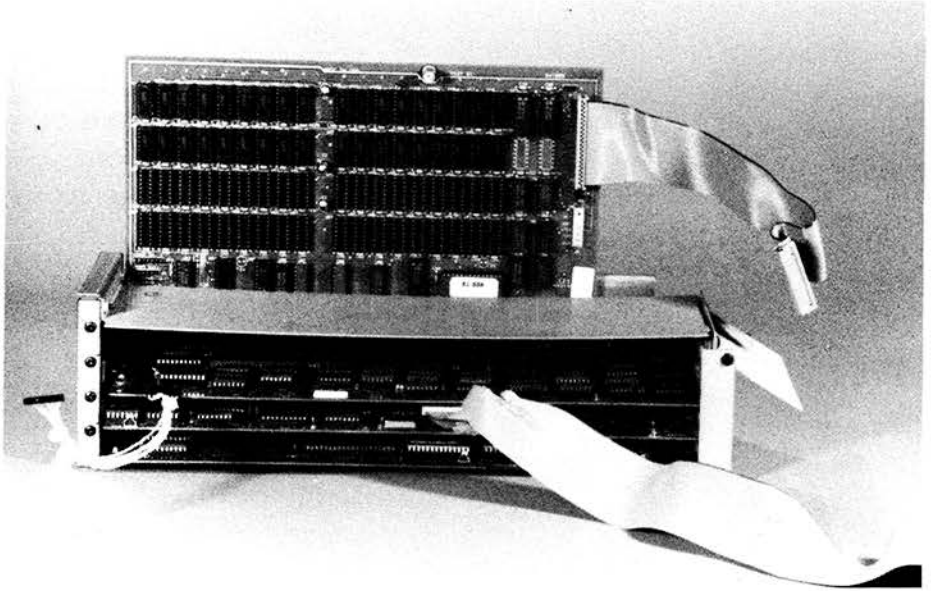


FIG. 11-10 The memory and expansion boards sections of the Kaypro 16.

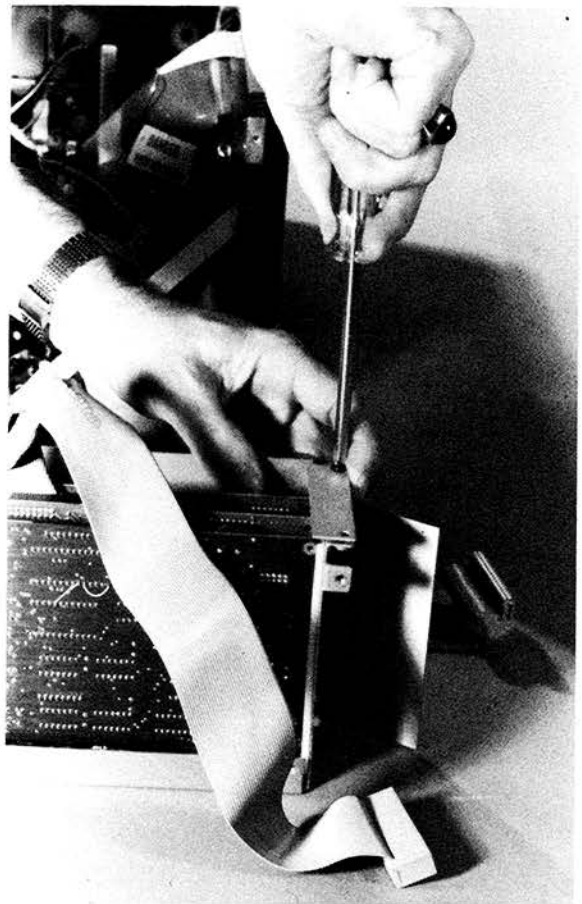


FIG. 11-11 Getting inside the expansion board case.

themselves are interlocked. To get out one, you have to remove the holding screws from all the boards.

The boards are supposed to be held firmly in the expansion slots. It might require a bit of a tug to get the board loose, but it won't require a lot of strength (Figure 11-12). If the board doesn't come out right away, look to be sure that you haven't left in one of the holding screws.

Reassembly of the computer is just the opposite; follow the above steps in reverse.

ADDING MEMORY

The most common memory chip is the 64K bit IC such as the 4164. A set of eight chips (one for each of the eight bits per byte) is needed for each 64K memory bank you wish to add. The memory board will hold four additional banks of memory, bringing the total on-board to 512K. The cost per bank of 64K can be anything from about \$10 to \$150, depending on the store you buy them from. A higher cost doesn't necessarily mean higher quality.

To install the chips, you'll have to disassemble the computer to the point of lifting out the main section. On the underside of the large board are a number of sockets set out in rows. Each complete row is a bank of 64K. If you're careful, you can install the chips with your

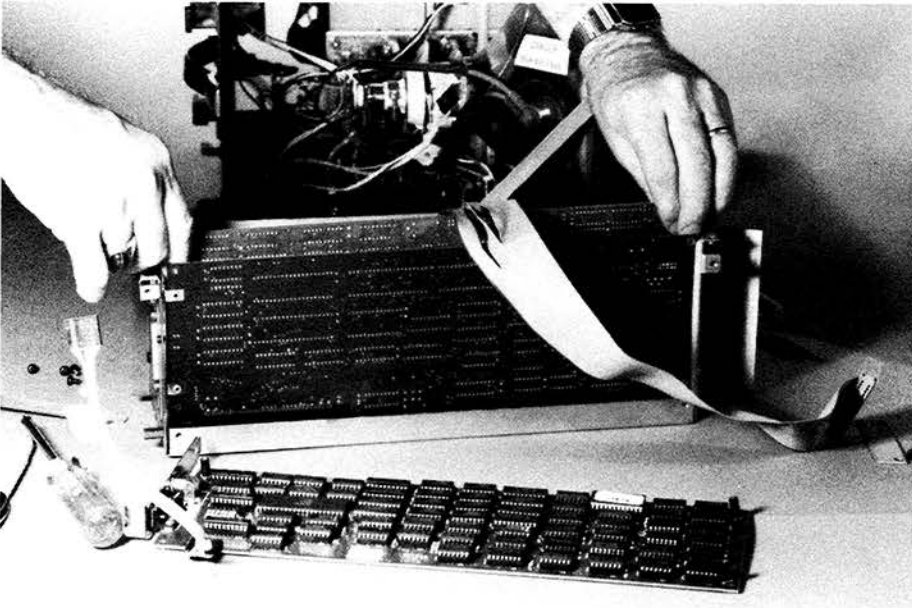


FIG. 11-12 To remove an expansion board, grasp firmly and pull. Don't force it!

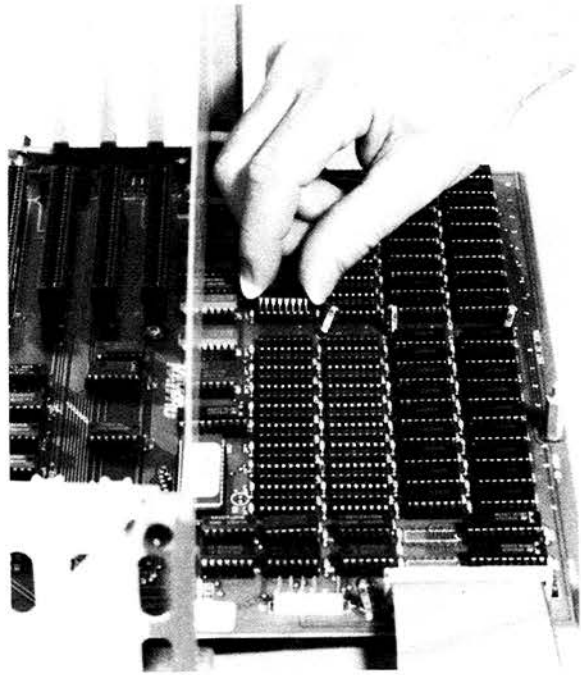


FIG. 11-13 Installing additional memory.

fingers. Better is to use an IC installer; either way, proceed carefully. The chips are sensitive to static. Even more common is for the installer to ruin the chip by damaging one of the pins.

To bring the computer to more than 512K, you have to get at the floppy drive controller board inside the expansion case. On this board are two more rows of sockets for RAM chips. Normally, the job of adding this final 128K is best left to the shop. (At present, the shop simply swaps your floppy controller board with another from Kaypro—one that has all the RAM and other chips in place and fully tested.)

Two additional chips are required—a 74LS409 has to be inserted in the U28 socket and a 74LS280 goes into the U54 socket. It will be fairly difficult to find these two chips, and you may have no choice but to turn the job over to an authorized dealer.

There is an eight-position DIP switch block on the board (the larger of the two). No changes are needed. The first four switches give the starting address of the RAM on the floppy controller board. Normally you'll want switch 1 off and switches 2, 3 and 4 on.

Switches 5, 6, and 7 on this same block tell the computer what kind of chips are being used. You'll want to have 5 and 7 on, and 6 off. The eighth chip is the on-off toggle for parity checking. The standard is to leave it on, although more than a few computer buffs prefer

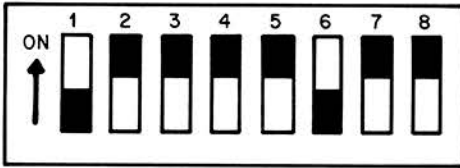


FIG. 11-14 Normal setting of the eight-position DIP switch on the floppy controller board is to have 1 and 6 off, and the rest on.

to have parity checking off. This is because a parity checking error will often lock up the computer, and cause a subsequent loss of all work done to that point that hasn't been saved to disk. The better solution is to save your work to diskette *often!*

OTHER SWITCHES

Also on the floppy drive controller board is a four-position DIP switch block. This is to control the serial and parallel ports. Switches 1 and 2 control the serial port. Normally you'll have both switches in the on position. This makes the serial port COM1, which is standard. With both switches off, the serial port is disabled. With switch 1 on and 2 off, the serial port will act as COM2.

Switches 3 and 4 control the parallel port. Normally you'll have switch 3 on and switch 4 off. This causes the parallel port to be addressed at 378 hex. To change the address of the port to 278 hex, 3 is off and 4 is on. With both switches on the port takes on the hex address of 3BC.

You don't usually have to worry about these switches, since they are set correctly at the factory. If someone has been fiddling around inside the computer, you may want to check the switch settings to be sure that they are as they should be (on, on, on, off).

MS-DOS

Most of the Kaypro line uses CP/M as an operating system. The Model 16 makes use of the same operating system as does the IBM PC—namely MS-DOS. This operating system is similar to CP/M in certain respects, but is quite different in others.

If you're a new computer owner, and the Kaypro 16 is your first computer, this won't present much of a problem. The DOS reference manual that came with the computer will guide you along.

However, if you've "upgraded" to the Kaypro 16 from a CP/M based computer, some of the commands might be a bit confusing at first. It's like learning how to speak two foreign languages.

The MS-DOS manual that comes with the computer will serve as a guide for you.

COMPATIBILITY

The Kaypro 16 is designed to be compatible with the IBM PC and XT. As with all other compatibles, there are bound to be a few programs that won't work quite right, and maybe one or two that won't work at all. Extensive testing was done by Kaypro, however, and all indications are that anything that will work with the IBM computers will work with the Kaypro 16.

However, the possibility exists that you *might* stumble across a program that doesn't function as it should. Obviously, any program provided by Kaypro has been thoroughly tested. If you experience an operational problem with one of these programs, either the diskette or the computer is at fault. The problem could also be a program that has a protection scheme that won't let the program load properly onto the hard drive.

The compatibility problem is more important when it comes to the plug-in expansion boards. Some boards simply will not function in the 16. Most notable are the multifunction boards that contain memory. The Kaypro 16 has already allocated the memory space all the way up to the 640K limit. An AST memory board, for example, can only cause problems.

It's too early to tell which other boards will function as they should, and which ones will cause a conflict in the operation of the computer. Information on this will come in and will be constantly revised over the next few years as more Kaypro 16s get into the market.

Meanwhile, your best route is to trust only those expansion boards that are proven to work, or ones that offer an unconditional guarantee.

The "Has it ever worked?" question will take care of most problems. If the computer has been operating just fine, but suddenly fails as you're trying a new program or device, chances are good that the fault is not with the computer at all.

With possible software problems, the easiest check is to try another program. If everything functions perfectly with the other programs you have, you'll know immediately that the diskette is bad, or you have a compatibility or protection scheme problem. (You can eliminate the software as the possible source if you have access to either another Model 16 or an IBM.)

A new expansion board that causes operational problems can be

checked by simply removing that board and trying to operate the system as it was before.

SUMMARY

Diagnosis of problems in the 16 is the same as with other Kaypro models. Begin with the obvious. This is probably the source of the malfunction. After this, it's a process of elimination.

If power is getting to the computer, but no power is getting to the main memory and bus board, the problem is either with the power supply or with something deeper inside the computer. By testing the power connector to the board you'll know right away. (If it shows power while unplugged, and no power when plugged in, the computer is at fault, not the power supply.)

Both the Kaypro 10 and the new 16 have a slight overheating problem. Occasional and random BIOS errors are an indicator that it's past time that you cleaned the filter. Keeping this filter clean is usually all that is needed to keep the overheating problem under control.

The Kaypro 16 is made to be expandable. You can add memory up to 640K. The first 256K is standard when you buy the computer. You can quickly and easily add an additional 256K to bring the computer to 512K total RAM.

The final 128K mounts on the floppy drive controller card (inside the expansion case). Along with the RAM chips you'll need two others (74LS409 and 74LS280), along with plenty of patience and care. Most of the time this upgrade from 512K to 640K is handled by the shop.

One problem that owners of the Kaypro 16 may run into is that of incompatibility. Although the computer is designed to be as close to 100% compatible with the IBM PC and XT as possible, there are bound to be some cases where a particular program won't run. The easiest way to avoid this problem is to check it out ahead of time. You can also test the program by running it in another 16, or in an IBM.

More important than program compatibility is the compatibility of expansion boards. Although most will function, some will not. Others will require modifications. A graphics board, for example, will conflict with the existing video circuits. A memory expansion board won't work at all. Again the easiest solution is to check it out before you buy the board.

Helpful Tables

Diskette Specification Standards

Tracks per inch	48 TPI
Tracks (number)	40 per side
Track width	.0108-.0128
Track density	6000 bits per inch
Temperature (operation)	50 to 112 F 10 to 44 C
Temperature (storage)	-40 to 140 F -40 to 60 C
Humidity (operation)	20% to 80%
(storage)	5% to 95%
Disk speed	300 rpm

Floppy Drive Configuration

Manufacturer	For Drive A	For Drive B
Epson	Install jumper across "0" position	Install jumper across "1" position
Hi-Tech	Install jumper across "DSO" position	Install jumper across "DS1" position
Shugart	Install jumper across "1" position; also jumper left and center pins of "MX"	Install jumper across "2" position; also jumper left and center pins of "MX"
Tandon (full-height)	Install jumpers across pins 1 and 14, and pins 2 and 13	Install jumpers across pins 1 and 14, and pins 3 and 12
Tokyo Electric	Install jumper across "DSO" position	Install jumper across "DS1" position
Toshiba	Install jumpers across "LD," "HM," and "1" positions	Install jumpers across "LD," "HM," and "2" positions

Power Supply Connector to Main Board

Pin	Value	Pin	Value
1	Not used	4	Ground
2	-12 VDC	5	Key
3	+12 VDC	6	+5 VDC

Main Board Resistance Check

Power Connector		Video Connector	
Pin	Ohms	Pin	Ohms
1	Infinite	1	@ 270
2	Infinite	3	@ 210
3	@ 300	4	@ 270
6	@ 90		

Note: For these readings the meter is set to the $\times 10$ range. The black probe is to be connected to pin 4 on the main board power connector.

Power Supply Specifications

Input Power	(@ 100 to 130 volts AC [120 nom]	@60 Hz; 2.5 amps)
DC output (65 watts)	+5 VDC \pm 3%	5 amps
	+12 VDC \pm 6%	3.5 amps
	-12 VDC \pm 10%	.25 amps
Maximum Case Temperature	130F (55C)	

Power Supply Pin Allocations

Pin	Use	Pin	Use
1	AC (input)	6	+12 VDC
2	AC (input)	7	Ground
3	Chassis ground	8	Ground
4	No connection	9	+5 VDC
5	-12 VDC	10	+5 VDC

Keyboard Pins

Pin	Wire Color	Use
1	Yellow	+5 VDC
2	Green	Data to computer
3	Red	Ground
4	Black	Data from computer

Main Board Video Connector Pin Allocations

Pin	Signal	Pin	Signal
1	Horizontal synch	3	Video
2	No connection (key)	4	Vertical synch

Parallel Pin Allocations

<i>Pin</i>	<i>Use</i>	<i>Pin</i>	<i>Use</i>
1	Strobe	10	Not used
2	Data bit 0	11	Busy
3	Data bit 1	12–15	Not used
4	Data bit 2	16–17	Ground
5	Data bit 3	18	Not used
6	Data bit 4	19–30	Ground
7	Data bit 5	31–32	Not used
8	Data bit 6	33	Ground
9	Data bit 7	34–36	Not used

Serial (RS-232) Pin Allocations

<i>Pin</i>	<i>Use</i>	<i>Pin</i>	<i>Use</i>
1	Ground	6	Data set ready (+5 V on Kaypro 10)
2	Transmit data	7	Signal ground
3	Receive data	8	Data carrier detect
4	Request to send	9–19	Not used
5	Clear to send	20	Data terminal ready

**Power to the Kaypro 16
Memory Board**

<i>Black to Pin Number</i>	<i>Red to Pin Number</i>	<i>Reading</i>
5	6	+12 VDC
3	4	-12 VDC
3	1	+5 VDC

Glossary

AC: Alternating current measured in cycles per second (cps) or hertz. The standard value coming through the wall outlet is 120 volts at 60 hertz. This voltage passes through a fuse or circuit breaker that can handle about 15 amps (check for yourself to know). The Kaypro can tolerate an AC value of between 107 volts and 132 volts. The power supply changes this to the proper DC levels required by the computer.

access: A fancy term for “to get at.”

acoustic: Having to do with sound waves. For example, an acoustic modem sends and receives data as a series of audible beeps. (A direct connected modem is better since it is not prone to interference or false signals due to room noise.)

address: Where a particular piece of data or other information is found in the computer. See Chapter 5. Can also refer to the location of a set of instructions in a program.

ASCII: This acronym stands for American Standard Code for Information Interchange. This code assigns binary (on/off) values to the 7-bit capability of the computer. The 8th bit signals the end of the character or functions as a parity bit to check for errors. ASCII is the standard code used to send data and other binary information, such as through a telephone modem.

asynchronous: Often abbreviated “asynch;” generally applied to electronic communications. Each character is balanced individually, such as with a stop bit. Communication occurs in only one direction at a time.

audio: A signal that can be heard, such as through a speaker.

- backup:** A copy of a program or data diskette. Make them often to protect yourself.
- bank:** The collection of memory modules that make up a block of RAM (usually eight ICs).
- BASIC:** One of the most common first computer languages learned.
- baud:** Used to describe the speed of transmission. The signal is split into a certain number of parts per second. Thus 300 baud will send 300 units per second. Generally each unit is a bit, so 300 baud basically means that 300 bits per second are being sent.
- bit:** A single pulse (on/off) of information used in binary code. The word "bit" is actually the abbreviation for "binary digit."
- boot:** To load a program into the computer. The term comes from "bootstrap" or "lifting oneself by one's own bootstraps." It means that the computer is loading itself and is setting up to operate, without other operator intervention.
- buffer:** A segment of memory used to store data temporarily while the data is being transferred from one device to another. A common example is a printer buffer. This device stores the incoming data at full computer speed and sends it to the printer at a speed the printer can use (such as 40 characters per second or about 300 baud).
- bug:** An error in a program.
- byte:** A collection of bits that makes up a character or other designation. Generally a byte is eight data bits, the binary representation of a character.
- carrier:** The reference signal used for the transmission or reception of data. The most common use with computers involves modem communications over phone lines. The modem monitors this signal to tell if the data is coming through. Generally, if the carrier isn't getting through, neither is the data.
- catalog:** See "directory."
- chip:** Another name for an IC, or integrated circuit.
- circuit:** A complete electronic path.
- circuit board:** The collection of circuits gathered together on a sheet of phenolic plastic, usually with all contacts made through a strip of pins. The circuit board is usually made by chemically etching metal-coated phenolic plastic.
- common:** The ground or return path used to make measurements with the multimeter. The black probe.
- CP/M:** Control Program for Microcomputers. The main operating protocol for the Kaypro computer.
- CPU:** Central Processing Unit. In the Kaypro this is a Z80 type.

- CRT:** Abbreviation for cathode ray tube; basically a fancy name for a television or monitor screen tube.
- crystal:** A small device located on various boards which vibrates at a particular frequency. One use is as a reference frequency for timing circuits.
- data:** Information.
- DC:** Direct current, such as that provided by the power supply. (Also found in batteries.)
- debug:** To rid a program of errors.
- default:** An assumption the computer makes when no other parameters are specified. For example, if you type "DIR" without specifying the drive to search, the computer automatically goes to the "default" drive (normally drive A) and assumes that this is what you want. The term is used in software to describe any action the computer or program takes on its own with imbedded values.
- density:** The amount of information that can be packed into a given area on a diskette. Diskettes used for the Kaypro are "double density" (and either single sided or double sided, depending on the drives being used).
- directory:** The allocation track of a diskette. Stores the titles given to the files saved on the diskette and tells the computer and drives how to get to those files. The directory serves as a table of contents for the files, identifying them by name, by size, by the kind of file stored (i.e., text file, binary file), the date the file was created, and the data that the computer needs to find that file on the diskette.
- diskette:** The flat magnetically coated media used in computers for the storage of data.
- DOS:** Disk Operating System.
- drive:** The device used to read and write on diskettes. With the Kaypro 2 and 4, the primary drive is A, with the secondary drive being B. The drive may also be a "fixed" drive, as in the Kaypro 10, which is commonly called a "hard drive" or "Winchester drive." The drive can also be electronic, using RAM instead of the magnetic media.
- DSDD:** Double sided, double density. Describes the diskettes used in a double sided drive.
- emulate:** A fancy word for "pretend to be." Often used to describe a device which is designed to make the computer function like another computer or terminal.
- edit:** To make a change or modification in data.
- execute:** To start a program or instruction set.

- FAT:** Files Allocation Table. An area on the diskette used to allocate space for files. The information included in the table indicates which sectors on the diskette are free and which are used.
- FCC:** Federal Communications Commission. Regulates the kind and amount of radio frequencies that can be emitted by computers and computer devices.
- ferric oxide:** An iron oxide (Fe_2O_3) used as the magnetic medium on diskettes. Essentially it is nothing more than rusted iron.
- firmware:** The ROM of the computer.
- file:** Any collection of information saved on a diskette. The file can be data, a program to run, or both.
- flippy:** A diskette with notches and index holes cut into both sides, allowing the diskette to be used on both sides by a single-sided drive (by flipping the diskette over).
- font:** A style of lettering. Many matrix printers are capable of using a variety of print styles, changeable through software.
- format:** A command within the CP/M "COPY" that assigns various tracks and sectors to new diskettes. Also, a particular manner in which something is laid out, such as in a program.
- ground:** The common or return side of a circuit. See "common."
- hardware:** The computer and computer devices.
- head:** The read/write head of the disk drive.
- hertz (Hz):** A measure of frequency. One cycle per second (cps). Frequency is also measured in units such as kilohertz (KHz or thousands of cycles per second) and megahertz (MHz or millions of cycles per second).
- hub ring:** A plastic reinforcing ring applied to the spindle access hole of a diskette. This ring adds strength and improves centering.
- IC:** Abbreviation for integrated circuit. This is a package of electronics, often encased in black plastic, with pins coming from the bottom. Pin 1 is the first pin on the right on the side with the notch or other marking.
- index hole:** Small holes on the diskettes near the hub access hole, used by some computers to find the beginning of a sector.
- interface:** A fancy term to say "connect." Used to describe any connection from hardware to hardware, from hardware to software, or even from hardware and/or software to user.
- K:** With computers, usually used to describe an amount of memory. Normally "K" denotes 1000 (such as in kilohertz above). Due to the electronics involved, 1K of memory is actually 1024 bytes; 64K is actually 65,536 bytes.
- keyboard:** Primary means of manual input to a computer.

- LED:** Light-emitting diode, such as those used in the drives to indicate that the spindle is turning.
- light pen:** An instrument used to read areas on the screen by pointing at them. Used to input data to the computer in addition to or instead of a keyboard. See also "mouse."
- matrix:** A pattern of dots, used to make up letters, numbers, and other symbols in computer printers.
- minifloppy:** Still another name for a diskette. Describes a 5¼ inch floppy.
- modem:** A device for transmitting data over telephone lines. The name means "modulate-demodulate."
- monitor:** A television-like device to display characters and other symbols. Also called a display, CRT, or VDU.
- mouse:** A handheld device rolled across the surface of a CRT. Used to input data to the computer by moving quickly from one spot on the screen to another. It is small, has a tail-like cable, and two buttons like eyes.
- multimeter:** A device to measure volts and ohms across a variety of ranges. Often called a VOM.
- ohm:** Unit of measurement of resistance.
- operating system:** CP/M or one of its parts (BDOS, BIOS, etc.)
- parallel:** A means of data transfer with the information being sent a byte at a time. See also "serial."
- parity:** A means of error checking in electronic communications. Parity checking can be even, odd, or none. Even parity checking means that the number of 1 bits (on) must be even in the byte which was sent over the phone lines. Odd parity means that the number of 1 bits in a byte must be odd. No parity means no parity checking is done.
- p.e.t.:** Polyethylene terephthalate, the generic name of the material used to make diskettes. Common trademark name is "Mylar" (owned by Dupont).
- platen:** The rubber roller of the printer.
- port:** A place where cables are connected to the computer or other device. Sometimes called an interface.
- program:** A set of instructions the computer can understand and act upon to perform some task.
- prompt:** A symbol on the screen indicating a state of readiness in the computer, such as A>. It's waiting for you to do something.
- sector:** An area on the track of the diskette assigned to hold a certain amount of information. In the Kaypro there are 10 sectors for each of the 40 tracks per side, or 400 sectors per side.

- serial:** A means of data transfer in which information is handled a bit (or pulse) at a time, with each bit following the others.
- soft sector:** A method of setting up a diskette (through the format command) so that data is written first to a sector whose position is determined by a code stored on disk.
- software:** Computer programs, usually on diskette or cassette.
- source:** Where a signal originates. See also "target."
- spindle:** The device in the disk drives that is inserted into the center hole and causes the diskette to spin.
- SSDD:** Single sided, double density. Describes diskettes used in single-sided drives.
- stepper motor:** Used to move the read/write heads across the surface of the diskette.
- system board:** The main circuit board of the Kaypro. More correctly called the "main board." It is sometimes called the "mother board" (a term that actually applies only to Apple computers).
- target:** Where a signal is to terminate. For example, if you are copying a file, the target is the diskette on which the file is to be copied.
- terminal:** In a computer system, a device through which data can be entered or retrieved. Can also be the end point of an electrical connection. Sometimes used to describe a monitor (i.e., "video terminal").
- TPI:** Tracks per inch. Standard with the Kaypro is 48 TPI, with 40 tracks being used.
- track:** One of the concentric rings on a diskette. The Kaypro uses 40 tracks, each holding 10 sectors. See also "sector."
- TVI:** Television interference. Computers and some computer devices emit radio frequencies that can interfere with normal television operation.
- VOM:** Volt-ohm-milliammeter. Commonly called a multimeter.
- write/protect:** The notch cut into the diskette allows a switch in the drive to activate the recording head. With this notch covered the recording head is disabled, making recording onto the diskette impossible.

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