BUILD A MACINTOSH-COMPATIBLE COMPUTER

CHARLES COLBY*

At last, a Mac-compatible computer for people on a budget—and it can be cheaper and more powerful than the new Classic Mac from Apple!

HAS THE HIGH COST OF OFF-THE-SHELF MACS kept you restricted to the confined world of MS-DOS computers? Well, you can stop feeling confined because, for about $400.00 and a few hours work, plus the cost of any 128K through SE-30 Mac logic board, you can build your own Mac! And that price includes the case, power supply, 800K floppy drive, special power/video board, video driver module, and a 14-inch Mac-compatible monitor.

The unit is 100% compatible with all Mac software, since it uses the real Apple Macintosh main logic board or motherboard. Even the earliest motherboards can be the start of a powerful machine. For example, with third party add-ons, you can increase the RAM of a Mac 128K through Mac SE to 1, 2.5, or 4 megabytes; you can increase the RAM on an SE-30 to 4, 8, 16, or 32 megabytes! There are accelerators available to let the unit run with a clock speed as high as 50 MHz even with a Mac 128K. With add-on boards, you can use a 19- or 21-inch 1024 × 768 pixel high-resolution monitor.

If you don't already have a Mac, any version of our Macintosh "clone" is a good starter machine. If you already have a Mac, you can put together a good second or third machine. If you are in any Mac-related service business, you'll especially appreciate how much easier it is to install or swap an internal component. That's because the case we use makes it easier to install or remove a board or drive as compared to a standard Mac case.

*Charles Colby is the president of Colby Systems Corporation, a company specializing in portable computers, terminals, Macintosh-compatible computers, and accessories.

Technical description

As shown in the block diagram of Fig. 1, the desktop Mac contains a real Apple Macintosh motherboard. The Mac motherboard is a very cleverly designed self-contained computer—it contains all of the essential components. The CPU in the Mac 128K, 512K, 512KE, Mac Plus, and Mac SE is a Motorola 68000 16-bit processor running at 8 MHz; a 16-MHz Motorola 68030 32-bit processor is found in the Mac SE-30. The motherboard also contains bios ROM's, RAM, various glue-logic chips, a keyboard- and mouse-input processing IC, and a custom Sony sound processor. There are two serial output ports: one for a modem and one for a printer—there are no parallel printer output ports. A small computer system interface (SCSI) port is found on a Mac Plus, SE, and SE-30, although SCSI adapters are available for other versions.

Also on the motherboard are the video chips that generate the Mac's 512 × 342 pixel, 22.5-kHz horizontal rate video. There are many third-party accelerators and big-screen video boards available for Macs; the Mac SE and SE-30 have expansion ports on the motherboard to accommodate them, and there are special expansion devices available that clip over the 68000 chip in the 128K, 512K, 512KE and Mac Plus boards eliminating the need for the expansion ports.

The motherboard is the most important part of this or any other Mac-compatible project. They can cost anywhere from 50 to 1500 dollars, depending on which model you want.

All that is needed to make the motherboard operate is a power supply, a video/sync adapter to drive an external monitor, a Mac-compatible floppy drive, an SCSI hard drive (optional), and a case in which to put them. The power supply is an IBM-PC clone type, so it is low in cost.

We'll show you where to get everything you need, and how to put it all together. We'll even show you how to build the interface that makes this project possible.

There are some external accessories required to make a complete operating computer, and one of them is a mouse or trackball. There are two basic types of Mac mice and trackballs. The original type is for the Mac 128K, 512K, 512KE, and the Mac Plus. Those all have a male 9-pin "D" connector. The newer type used with the SE and the SE-30 has a 4-pin male mini-DIN connector. They are known as ADB-type, which stands for Apple Desktop Bus which uses a proprietary Apple serial protocol. An IBM-PC type mouse or trackball will not work on a Mac.

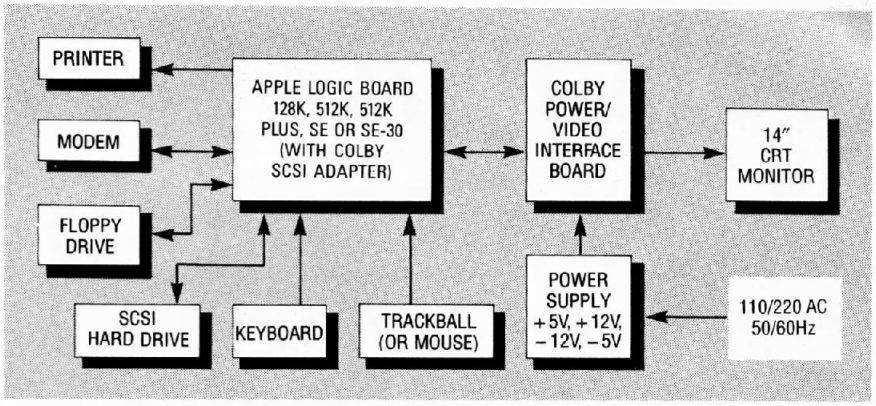


FIG. 1—YOU CAN SEE FROM THE BLOCK DIAGRAM, that the Colby Mac contains a real Apple motherboard.

A keyboard is also required. The original keyboard for the Mac 128K, 512K, and Mac Plus uses a 4-pin modular jack like the one on the handset of a telephone. However, the wiring in a telephone cable is different than a Mac keyboard cable.

Our desktop Mac uses a special 14-inch monitor. With a horizontal frequency of 22.5 kHz, it will not work with an IBM-PC or clone. It is available in either amber or paper-white phosphor versions. The monitor will work with all Macintosh computers with a proper Colby interface.

The one thing that sets our Mac apart from true Apple Macs is the power/video interface board that allows an IBM-PC style power supply, the monitor, and an Apple motherboard (logic board) to be connected together in one system. The interface board can either be built or purchased fully assembled. If you wish to build the board, PC foil patterns are provided, or you can buy a ready-made bare board.

Where to buy parts

Before building the interface board, let's discuss all of the other necessary components, where you can get them, and how much they cost. As mentioned earlier, you need an Apple 128K, 512K, 512KE, Plus, SE or SE/30 motherboard ($50.00 to $1400.00), a modified IBM-PC clone case ($89.00), a power supply ($69.00), a keyboard ($89.00–$129.00), a mouse or trackball ($49.00–$79.00), a monitor ($189.00), a floppy drive ($189.00), and perhaps an optional 40-MB hard drive ($299.00–$399.00). You'll also need the interface adapter board described in this article; it'll run you $59.00 in the assembled form (not including a $30 video/sync processor module), or you can build it yourself.

The most difficult part to find is the Apple motherboard. The

PARTS LIST—128K THROUGH MAC PLUS

1. Any Apple motherboard, 128K, 512K, 512KE or Mac Plus
2. PC case (Gettys Electronics)
3. 200-watt power supply (must fit in Gettys case)
4. 800K Mac-compatible internal floppy drive (must fit in Gettys case)
5. Modular-plug type Mac keyboard
6. 9-pin D-type trackball or
7. 9-pin D-type mouse
8. 14-inch Mac-compatible monitor (optional adapter for regular Mac)
9. Power/video adapter board
10. 20-pin floppy cable
11. 10-conductor power cable
12. 9-conductor video output cable
13. Internal modular keyboard cable w/bracket
13. Cermagraph 74OS video/sync processing module
14. 3.6V lithium battery for CPU real-time clock

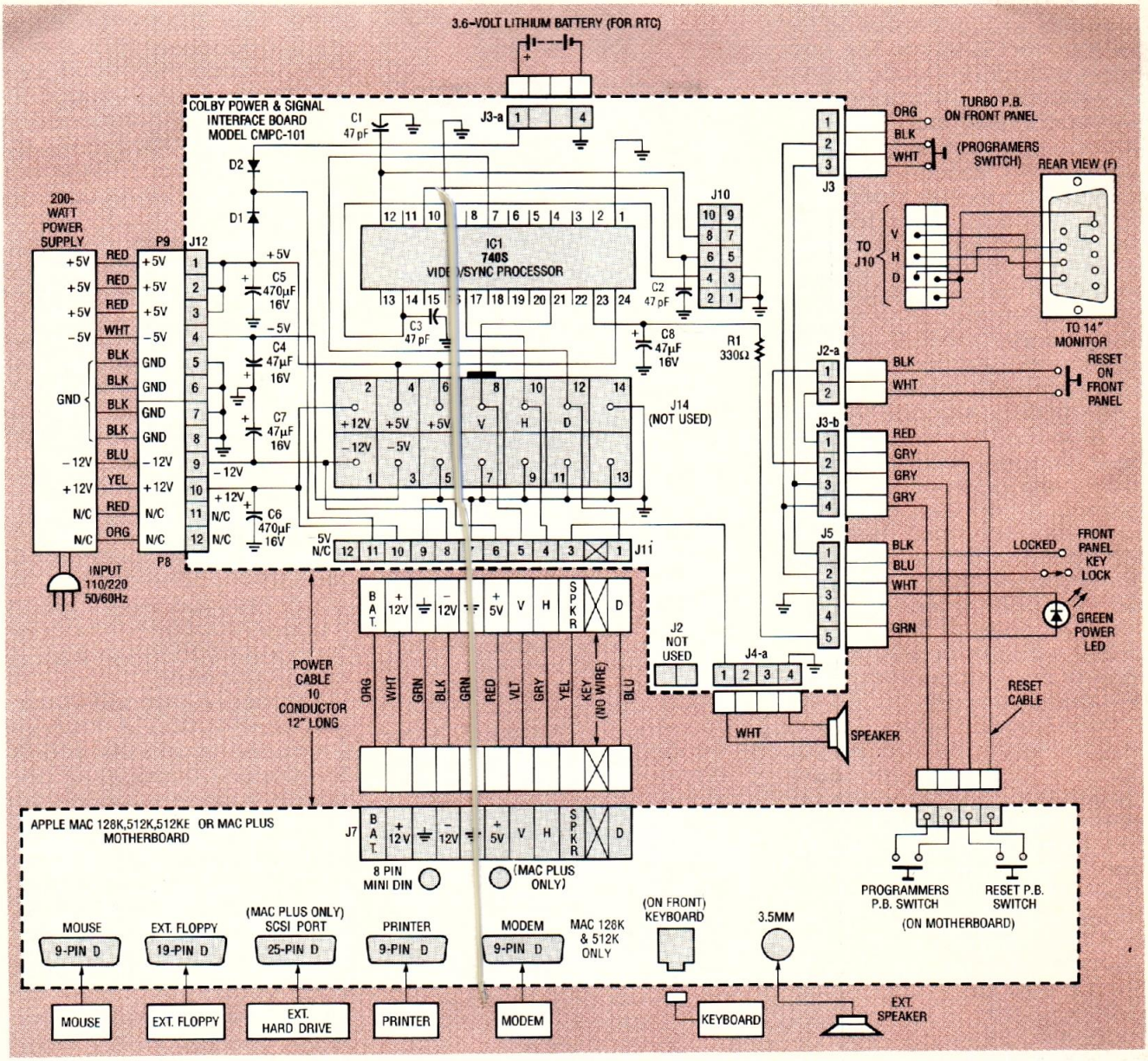


FIG. 2—SCHEMATIC FOR THE 128K, 512K, 512KE, and Mac Plus versions.

first Mac board, the 128K, sells for $50–$100, but the 128K RAM & old ROM's limit the software that you can use. Although the 512K version ($199–$299) has more capacity, it, too, is limited to older versions of software. However, there are RAM-upgrade kits available for both models. The 512KE version ($299–$399) has enhanced ROM's. It works with later software and the RAM can be expanded.

The Mac PLUS, $399–$499, is the workhorse of the Mac line—more of them are in use than any other type. It has later ROM's, and can hold 4 MB of RAM. It runs most current Mac software and, although it has no expansion slot, its speed can be increased with an add-on accelerator board. The Mac SE, $499–$599, has an expansion slot, a 68000 16-bit processor running at 8 MHz, and 4 MB of RAM. It runs all current Mac software and can be accelerated to 50-MHz operation. The SE/30 model, $1200–$1500, is very fast at 16 MHz, and has a 68030 32-bit processor with a math co-processor and an expansion slot. It runs all current Mac software and can also be accelerated to 50-MHz operation.

There are many Apple dealers who sell parts and motherboards, other than those mentioned in our sidebar; check your local phone book. There are also hundreds of local computer dealers (not just specifically Apple) who stock Apple parts and various motherboards.

While there must be over one hundred IBM-PC clone cases available, there is only one model we have found to be suitable for use with a Mac motherboard. The unit has been modified by a company called Gettys Electronics. They put a long horizontal slot at the back along the bottom of the rear panel, which allows the connectors on a Mac motherboard to protrude through the opening and eliminates the need to cut and file heavy sheet steel. The case will work with any of the Mac motherboards. All of the necessary mounting holes have also been

added, as well as provisions for the Mac reset function. The case comes with a bag of all the screws and standoffs you will need to mount the Mac motherboard, power supply, and floppy drives. It also comes with the cables required to connect the power supply to the adapter board, hook up the key switch, connect the green power LED, the reset button, the hard-drive access LED, and the Mac programmer's switch (mislabeled "turbo" on the front panel of the case). All of that adds up to a big savings in assembly time.

Not included with the case are the logic-board-to-power-adapter cable, video-output cable, hard-drive cable, and the mounting brackets for 3½-inch hard drives. (A 5¼-inch hard drive will mount easily without adapter brackets.) The power supply for the case, which provides +5, −5, +12, and −12 volts is rated at 200 watts; quite a bit higher than is required, so the system will always run cool.

There are some cables that are required inside the case, but not included, to connect the major components. One of them is the power signal cable from the interface board to the Mac motherboard, and there are two types. Type 1, a 10-conductor cable, is for use with 128K, 512K, 512KE and Mac Plus motherboards. Type 2, a 12-conductor cable, is for use with the SE and SE-30 motherboards. The required motherboard-to-floppy-drive cable provides both power and signals in one 20-pin flat cable. The video/sync output cable goes from the power/video interface board to the rear panel of the unit. It is a 10-pin-to-9-pin cable. The optional 50-to-50 pin SCSI hard-drive signal cable goes from the Mac motherboard to the hard drive. All cables must be built or purchased from one of the sources mentioned.

Add-on video boards

Most add-on boards for the Mac 128K through Mac SE will work in the Colby Desktop Mac. Although Apple has never manufactured big-screen boards for the early Macs, many aftermarket companies do. One problem with some add-on video boards is that they are designed to plug into Apple SE-30 motherboards at a right angle. These boards will not work with the case we described because they are too high. We do know that boards from E-Machines, Inc., Lapis Technology, Sigma Designs, Nutmeg, Moniterm, and Colby Systems will work in the Colby Mac. Of course, if you use a bigger case, you can use whatever size boards you like.

Colby Systems Corporation manufactures 640×480 monochrome, gray scale, 8- or 24-bit color, and 1024×768 monochrome boards for 19- and or 21-inch monitors that mount parallel with the motherboard. Colby also makes right-angle adapter board (SE-30 RAB, $49.99) that adapts most SE-30 boards to work with the case we used.

Accelerator boards

Two of the best companies, in terms of technical support, price, variety of products, and state-of-the-art offering, that make add-on accelerator boards for Macs are Dove Computer and Total Systems Incorporated (TSI). You can purchase their products through dealers, mail-order, and Colby Systems, as well.

Dove Computer has a line of medium- to high-end accelerators that enable you to add a 33-MHz 68030 processor to a Mac 128K! They also have a low-cost ($500.00) 68030 accelerator for a Mac SE-30 that doubles the speed to 33 MHz.

TSI has two lines called Gemini and Gemini II. The lower-cost Gemini series consists of 16- and 20-MHz 68020 and 68030 accelerators with versions available for Mac 128K through Mac SE-30. The Gemini II series is available in speeds from 33 to 50 MHz. The big advantage of accelerators is that the older motherboards may be brought up to speeds comparable with the latest Macs.

One problem that plagued early Macs was the power supply, which could deliver only about 35 watts—barely enough to run the standard motherboard, a 9-inch CRT, a floppy drive, and a keyboard. Once you started adding accelerators and hard drives, many power supplies went up in smoke. Apple has since redesigned the power supply in the Mac SE and SE-30 to output 60 watts. But because of the early problems, most reputable accelerator manufacturers have a separate 110 VAC-to-5 VDC power supply available to run the accelerator to prevent overloading the Mac's power supply. If you use a hefty enough power supply, you can save some money when you buy an accelerator. For example, all Dove and TSI accelerators are available without the additional power supply at a correspondingly lower price.

MAC VS IBM-PC

The Apple Macintosh was introduced January 1, 1984 with the now-famous TV commercial shown during the Superbowl football game where the girl in jogging shorts throws a sledgehammer into a movie screen amid an audience of "followers" with shaved heads, all dressed alike, bowing to a uniformed "leader." The "leader" was intended to be representative of IBM. Apple's message was 1984 won't be like 1984. Did it work?

Apple's challenge to the IBM dominance of the personal-computer market has produced sales of five or six million computers, vs IBM and clones of 40 to 50 million units. Who won? Both did, and are continuing to win, as the need for small computer systems accelerates worldwide. The clear advantage of the Mac's easy-to-learn, easy-to-use graphical interface and operating system makes it possible to do productive work on a Mac in one tenth to one fiftieth of the time required to become proficient at some MS-DOS based programs on an IBM-PC or clone.

Time will tell what effect Windows™ 3.0 will have in the race between the IBM world and the Mac world. Many people think the Mac will triumph. Yet the absence of true Mac clones (Apple will not let it happen) has kept the cost of the Macs very high in relationship to the relatively low prices found in the IBM-PC and clone arena.

The Mac 128K was a true major innovation in it's day, and innovations continue. For example, system 7.0, due out anytime now, promises to add many new features.

The Mac paved the way to desktop publishing by providing the first small computer with bit-mapped graphics, WYSIWYG text, and an innovative easy-to-use operating system that changed the face of personal computing. Even six years later, the 128K Mac is still a useful machine and can do simple word processing and drawing functions almost as well as the latest $11,000.00 Mac FX.

Apple isn't known for low prices, but it is one of the few companies ever to go from two guys building computers in a garage to a multi-billion dollar yearly sales organization with six or seven thousand employees and a billion dollars in the bank...all in a span of 12 years. **R-E**

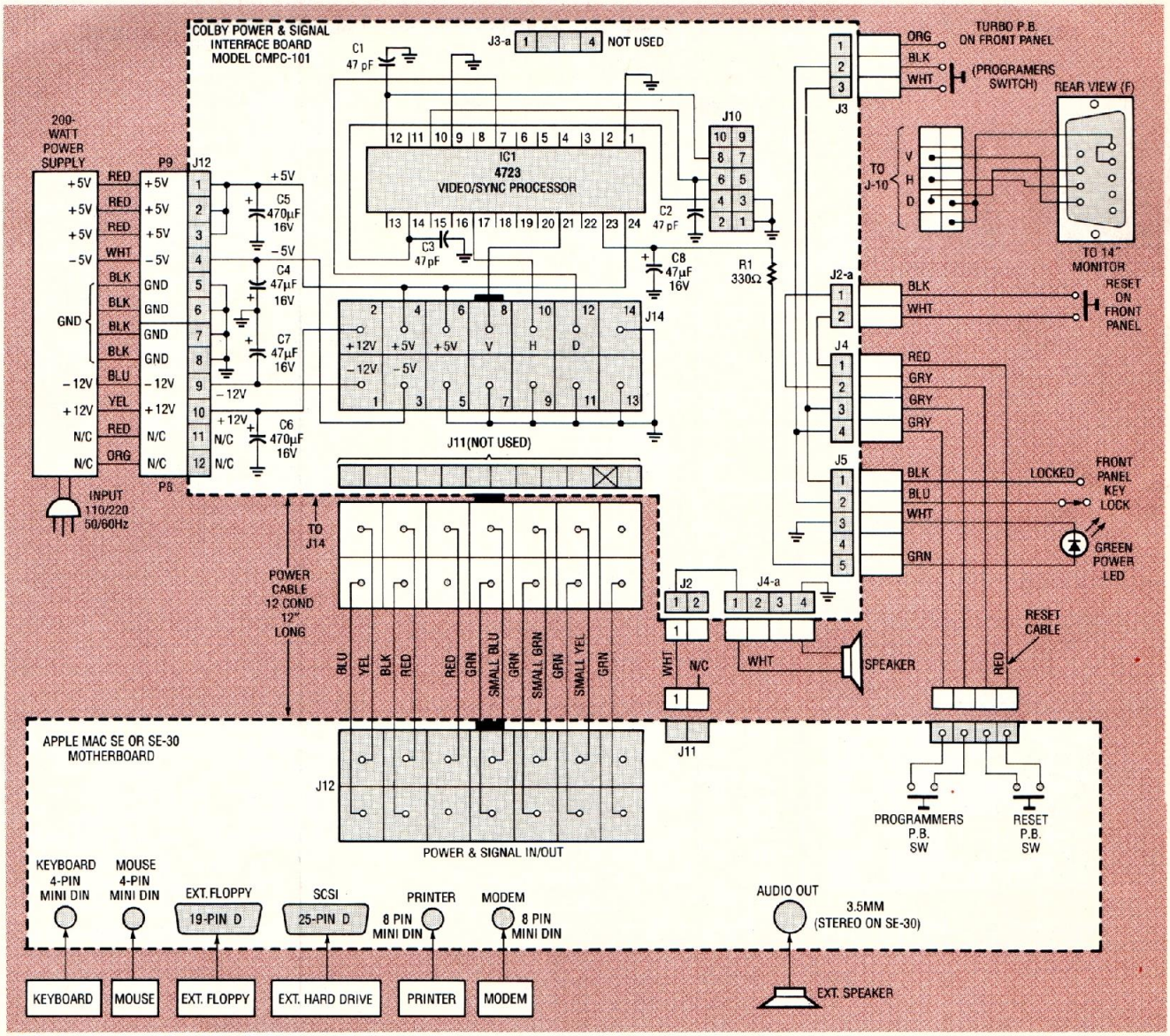


FIG. 3—SCHEMATIC FOR THE Mac SE and SE-30.

Building the Mac

Let's go over, step-by-step, the procedures necessary to get your Macintosh-compatible computer up and running. A wiring schematic for the 128K, 512K, 512KE, and Mac Plus versions is shown in Fig. 2, and one for the Mac SE and SE-30 is shown in Fig. 3. Regardless of which version you're going to build, you will need the power/video interface board. Should you decide to build the board yourself, a parts-placement diagram is shown in Fig. 4. A photograph of the completed board is shown in Fig. 5.

The first step is to make sure that the motherboard will fit in your case. There is a vertical metal tab, 2-inches high by 1-inch wide, near the two PC-mounted pushbuttons at the rear of all Mac motherboards. You will probably have to bend the metal tab parallel with the motherboard to clear the new case. The tab on the opposite side of the board must also be bent down, but not as low as the other tab.

PARTS LIST FOR MAC SE & SE-30

1. Apple SE or SE-30 motherboard
2. PC case (Gettys Electronics)
3. 200-watt power supply (must fit in Gettys case)
4. 800K Mac-compatible internal floppy drive (must fit in Gettys case) Colby FDD-800K
5. ADB-type Mac keyboard
6. ADB-type trackball or mouse
7. 14-inch Mac-compatible monitor
8. Power/video adapter
9. 20-pin floppy cable
10. 14-conductor power cable
11. 9-conductor video output cable
12. Cermagraph 4723N video/sync processing module

The only difference between a Mac 512K and a 512KE motherboard is that the 512KE has enhanced 128K ROM's (versus the older 64K ROM's). The later ROM's are available as upgrades. Do not attempt to copy Apple ROM's, as doing so would be a copyright infringement, and Apple has prosecuted many people who have copied their ROM's. If you obtain a motherboard without ROM's, they are installed in two 28-pin sockets on the motherboard, one marked ROM LO and one marked ROM HI.

The Apple ROM marked 342-0342-A, B, or C goes in the ROM LO socket and the ROM

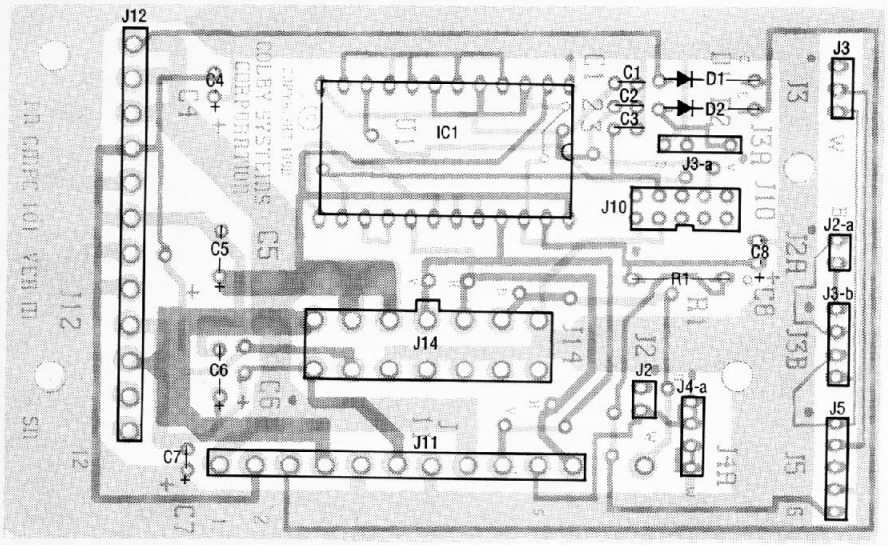


FIG. 4—PARTS-PLACEMENT DIAGRAM for the power/video interface board.

marked 342-0341-A, B, or C goes in the ROM HI socket. Those numbers are for 128K ROM's. The early 64K ROM's for pre-Mac 512KE motherboards are marked 342-022-A for ROM LO and 342-0220-A for ROM HI; they should be used only with 128K and 512K motherboards running very early Mac software, 400K single-sided floppies, and no hard drive. Mac SE ROM's are marked 342-0353A for ROM LO and 342-0352A for ROM HI. Mac SE-30 ROM's are on a single SIMM-type (single inline memory module) PC board, and not in 28-pin sockets. The latest ROM for an SE-30 is marked 638-4339.

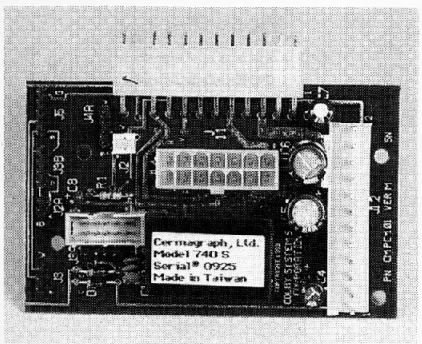


FIG. 5—THE COMPLETED POWER/VIDEO INTERFACE BOARD. It is the key to building your own Mac.

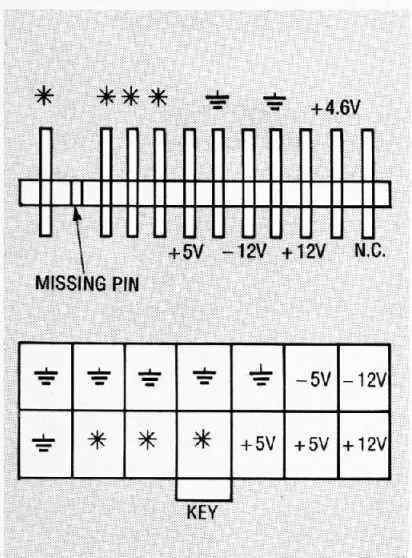


FIG. 6—MEASURE THESE VOLTAGES on the two connectors on the power/video interface board. The pins that are marked with an asterisk should have no more than 2 volts on them when not connected to the motherboard.

Plug in the two cables from the power supply, P8 and P9, into J12 on the power/video interface board. Measure the voltages on J11 and J14, on the power/video interface board as shown in Fig. 6. An 8-ohm, 20-watt resistor must be used as a dummy load on the +5-volt line to obtain proper readings. In a Mac 128K through Mac Plus, plug in the 10-conductor cable from J11 on the power/video interface board to J7 on the Apple motherboard. Plug in the 1-conductor cable from J11 on the Apple motherboard to J2 on the power/video interface board. Plug in the 2-conductor cable from the speaker to J4-a on the power/video interface board.

In a Mac SE or SE-30, plug in the 14-conductor cable from J14 on the power/video adapter board to J12 on the Apple motherboard. Plug in the 1-conductor cable from J11 on the Apple motherboard to J2 on the power/video interface board. Plug in the 2-conductor cable from the speaker to J4-a on the power/video interface board. The inside of a medium-cost SE version is shown in Fig. 7 and the inside of an SE-30 is shown in Fig. 8. The extra boards you see inside the SE-30 are for the Colby voice navigator ($499), which allows you to perform certain tasks using voice commands rather than a mouse or trackball. The voice navigator is shown in Fig. 9.

Turn on the power and, within 2 seconds, you should hear the familiar Mac "boing" sound on Macs 128K through SE and the multi-note 0.5-second chime on the SE-30. Those sounds indicate that the Mac motherboard has run through and successfully completed its on-board self-diagnosis routines. If you do

PARTS LIST—POWER/VIDEO ADAPTER

R1—330 ohms, ¼-watt
C5, C6—470 µF, 16 volts, electrolytic
C1–C3—47 pF, ceramic disc
C4, C7—47 µF, 16 volts, electrolytic
D1, D2—1N4001 rectifier diode
IC1—Cermagraph video/sync processing module (740S or 4723N)
J11—12-position right-angle Molex connector with key
J12—12-position Molex connector without key
J14—14-position connector with key
J10—10-position video & sync connector
J2, J2-a—2-pin header
J3—3-pin header
J3-a, J3-b, J4-a—4-pin headers
J5—5-pin header
Miscellaneous: PC board, 24-pin IC socket, solder, etc..

Note: The following items for the power/video interface are available from Maus Electronics: A bare PC board (#CMP-101), $19.99; a PC board and all parts except the video/sync module (#CKP-128), $36.99; an assembled and tested power/video interface (#CAT-128), $59.99. BE AWARE that the cables and the video/sync module are not included in any of the kits. The modules are available for $29.99. A step-by-step build-it-yourself video is available from Colby Systems Corporation for $19.99 plus $3.99 postage and handling (#PS-800K). A new book, "Building your own Colby Mac Desktop and Colby Mac Portable," will also be available from Colby Systems. Call, write, or fax for more information.

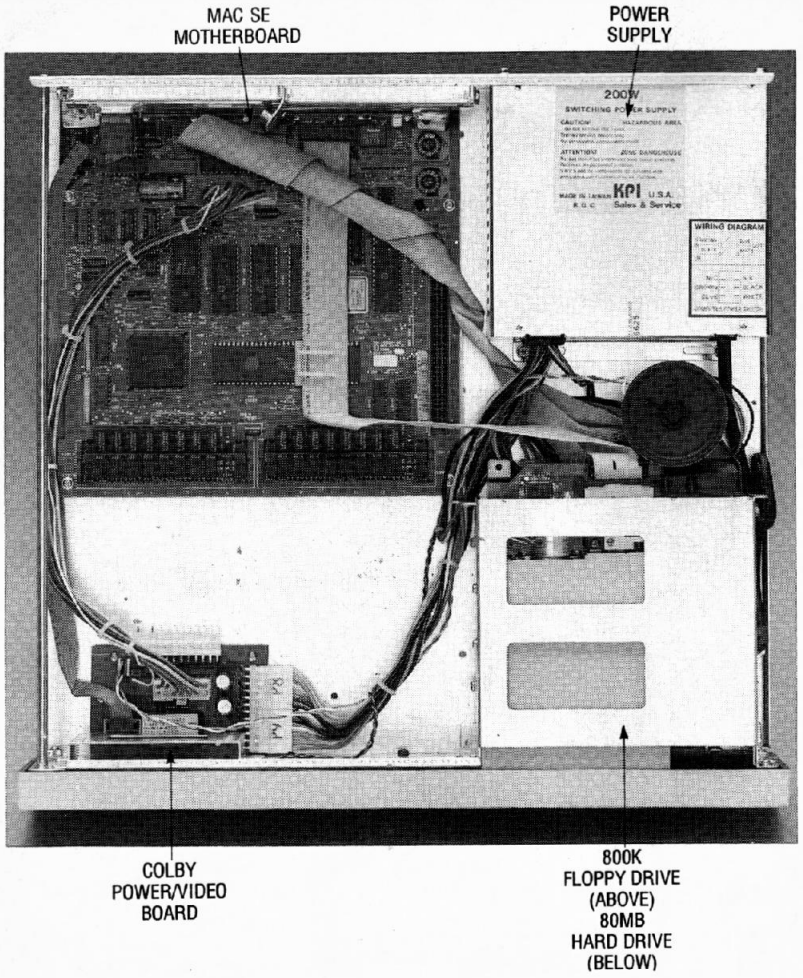
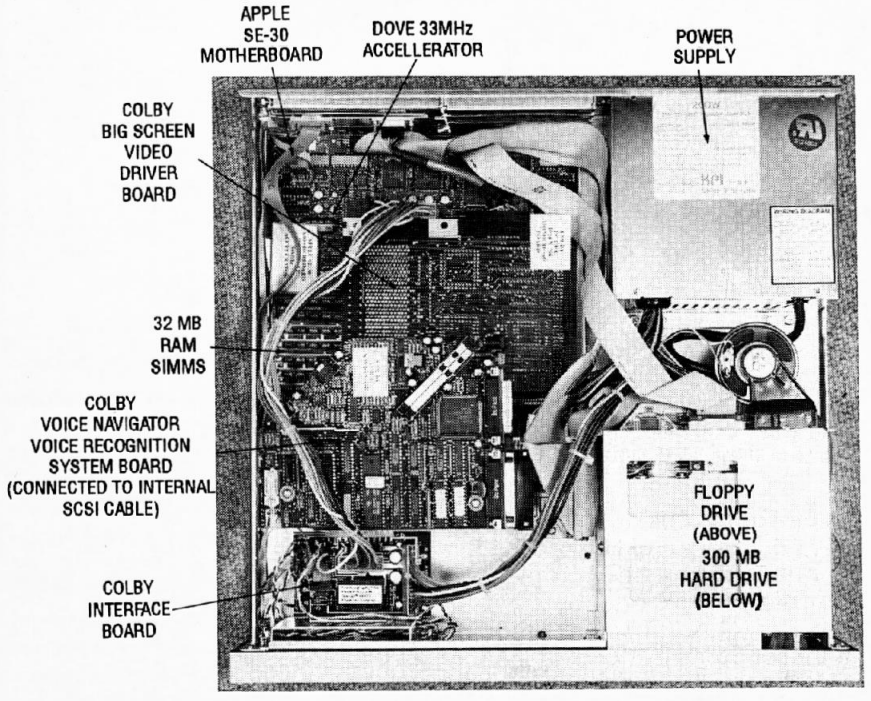


FIG. 7—THE INSIDE OF THE MEDIUM-COST SE VERSION.



8—THE INSIDE OF THE SE-30 VERSION. The extra boards you see are for the Colby voice navigator and big-screen driver board.

not get either of those sounds, or you get a brash sound or none at all on a Mac 128K through Mac Plus, or a multi-note chime that lasts for about 1½ seconds, then there is a problem on the motherboard. If that's the case, recheck the voltages at J7 or J12 on the motherboard. Recheck the ROM's to be sure they are in the correct sockets, that they are seated correctly, and that there are no pins folded under. Recheck the RAM; be sure it is seated correctly and that R8 and the jumpers are set correctly. If you have access to a Mac that you know is working properly, you can test the RAM SIMM's in that unit to verify that they are good.

Plug in the following cables one by one, and turn on the power after plugging each cable in to verify that you hear the correct boing or chime each time. By doing so, if there is a shorted or misplaced cable, you will know which cable is the suspect as you plug it in. All J numbers referred to are on the power/video interface board. Plug the 10-position video-output cable into J10. Plug the 9-pin "D" cable and verify that you have a raster on the CRT. There should be about a 1-inch black area between the edge of all sides of the raster and the plastic case bezel.

Plug one end of the 4-conductor reset cable into J4; the other end with the 1 × ½-inch PC board adapter plugs onto the 4 contacts on the top of the two black plastic pushbutton switches on the left rear of the Apple motherboard. Bend the pushbutton contacts so they are vertical and plug the adapter PCB on so the 4-conductor wire comes off toward the center of the motherboard.

Plug the 5-connector cable from the power-on LED and keylock switch into J5. With the keylock switch in the "on" (unlocked) position, verify the boot boing or chime. Then turn the key lock switch to the locked position and make sure you don't get the boing or chime. That essentially shorts the contacts on the programmer's switch and keeps the motherboard from booting.

Plug the connector with the orange, black, and white wires from the "turbo" pushbutton onto J3. Test the switch by turn-

ing on the power, waiting for the Mac raster to appear; then press the switch and a dialogue box should appear in the center of the screen. Note that it is not actually a turbo switch; it is used for activating the Mac function known as "programmer's switch" (see an Apple manual for a complete explanation). Also, the pushbutton switch is not exactly the right type for a programmer's switch; it is a push-push alternate action type where it actually should be a momentary pushbutton.

If you like, you can unsolder the switch from the PCB next to the key lock and replace it with the correct type of switch, or just remember to push it twice if you use it. Unless you plan to do any programming, you will not need to use it. The switch can also function as a simple "lock" for your computer. If you press it once and lock the button in, the computer will not boot.

Now plug in the 2-conductor black and white cable that goes to the front panel "reset" pushbutton. Test it by turning on the power and waiting for the boing or chime. When you press the button, the computer should reset; that is, it should boing or chime after each press.

Plug in the 20-conductor ribbon cable from J6 on 128K through Mac Plus boards or J8 on SE or SE-30 boards to the floppy drive. The cable is keyed so it cannot be inserted incorrectly. It also has several internally cut wires to make it work correctly with the Mac motherboards.

Plug in a mouse (or trackball) and a keyboard at the rear of the motherboard. Add an internal or external hard drive as desired. Insert an Apple system disk in the floppy and boot the computer so you get the Mac desktop. Table 1 shows the various combinations of system versions that work with different Mac motherboards. Note that motherboards with 64K ROM's use System 4.1, up to 6.0. Mac Plus motherboards (128K ROM's) use System 6.1 to 6.04. System 6.04 is the most bug-free, but is too large for use without a hard drive. If there is no hard drive, system 6.03 is recommended. System 6.05 is not recommended for the Plus or SE series; use it on the Mac FX IIci, etc..

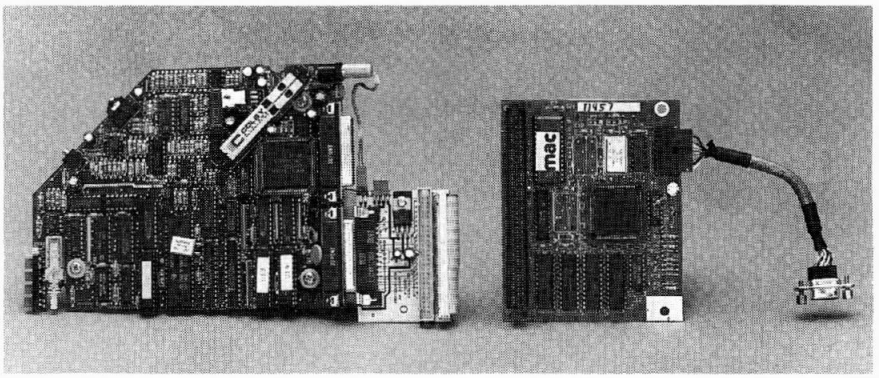


FIG. 9—THE VOICE NAVIGATOR allows you to perform certain tasks using voice commands rather than using a mouse or trackball.

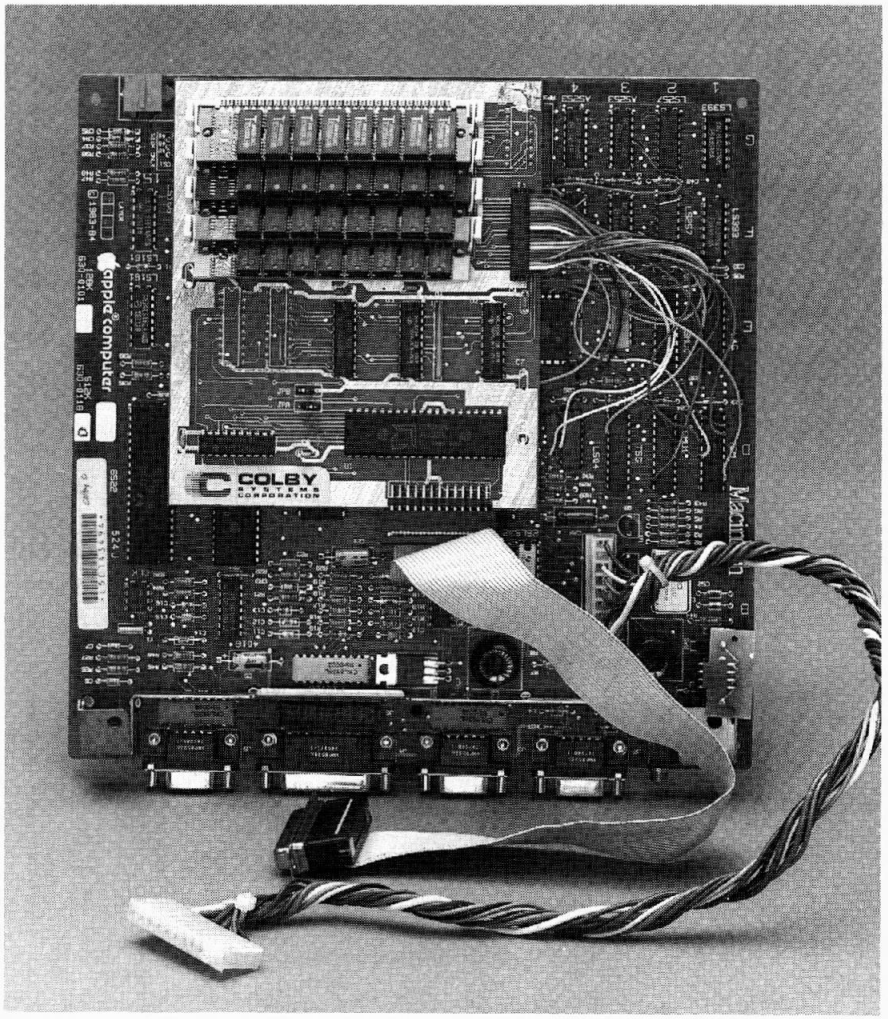


FIG. 10—THE COLBY SIMM ADAPTER BOARD requires that 2 DIP's be removed and about 22 wires and a daughter board to be soldered onto the motherboard. It allows you to use standard 256K or 1-MB SIMM's.

Memory upgrades

With the advent of Hypercard™ and many other later applications that require one megabyte or more of RAM, it becomes more and more important to add RAM to run the latest software. Simply install each SIMM module with chips to the right of the SIMM by pressing the SIMM module firmly in the socket at a 45-degree angle and gently rolling it back until it snaps into place.

Originally, the only way to upgrade memory on a Mac 128K, 512K or 512KE was to unsolder the old RAM chips and solder in newer, higher-capacity chips. More often than not, that resulted in damaging the fine

SOURCES OF MAC PARTS

MEMORY AND ROM UPGRADES
- Colby Systems Corp.
- Dove Computer
- Total Systems Inc.

MAC MOTHERBOARDS
- Your local computer or Apple dealer
- Mac Heaven
- Pre-Owned Electronics, Inc.
- Shreve Systems

MAC-COMPATIBLE KEYBOARDS AND MOUSE OR TRACKBALL
- Abaton Technology
- Any Apple dealer
- DataDesk Int'l.
- Colby Systems Corp.

SPECIAL CASE AND POWER SUPPLY
- Gettys Electronics

HARD DRIVES (20 to 300 MB)
- Any Apple dealer
- Colby Systems Corp.
- SuperMac Technology

HARD DRIVE BRACKETS, CABLES, AND FORMATTING SOFTWARE
- Maus Electronics
- Colby Systems Corp

MACK-COMPATIBLE INTERNAL FLOPPY DRIVES
(you must use the Colby FDD-800K in the case we used)
- Colby Systems Corp.

MAC-COMPATIBLE EXTERNAL FLOPPY DRIVES
- Any Apple dealer
- Colby Systems Corp.
- Appied Engineering

POWER & VIDEO CABLES AND VIDEO PROCESSOR MODULE
- Maus Electronics

MAC II COMPATIBLE 14" MONITOR
- Colby Systems Corp.
- Nuvotech

APPLE MACINTOSH OPERATING SYSTEM SOFTWARE
- Any Apple dealer

ADDRESSES

- Abaton Technology
48431 Milmont Dr.
Fremont, CA 94538
Phone: 415-683-2226
- Applied Engineering
PO Box 5100
Carrollton, TX 75011
Phone: 214-241-6060
- Colby Systems Corp.
2991 Alexis Drive
Palo Alto, CA 94304
Phone: 415-941-9090
Fax: 415-949-1019
- DataDesk Int'l.
7651 Haskell Ave.
Van Nuys, CA 91406
Phone: 800-826-5398
(in CA: 800-592-9602)
- Dove Computer
Phone: 919-763-7918
- Gettys Electronics
22018 Frontier Rd.
Clovis, CA 93618
Phone: 209-299-7828
- Mac Heaven
14101 Park Long Court
Chantilly, VA 22021
Phone: 703-263-2567
- Maus Innovations
121 S. Corona
Denver, Co 80209
Phone: 303-744-9512
- Nuvotech
2015 Bridgeway Ste 204
Sausalito, CA 94965
Phone 415-331-7815
- Pre-Owned Electronics, Inc.
30 Clematis Ave
Waltham, MA 02154
Phone: 617-891-6851
Fax: 617-891-3556
- Shreve Systems
2421 Malcom St.
Shreveport, LA 71108
Phone: 318-635-1121
Fax: 318-865-2006
- SuperMac Technology
485 Potrero Ave.
Sunnyvale, CA 94086
Phone: 408-245-2202
- Total Systems Inc.
Phone: 503-345-7395

traces of the motherboard. Also, the fact that the board is a four- or six-layer board makes desoldering very difficult. There is now an easier way to upgrade 128K and 512K motherboards without desoldering all the old RAM chips one-by-one.

TABLE 1

Version	System	Finder
Mac 128K	4.1	5.5
Mac 512K	4.1	5.5
Mac 512KE	6.0 to 6.04	6.1–6.1.4
Mac Plus	6.0 to 6.04	6.1–6.1.4
Mac SE	6.0 to 6.04	6.1–6.1.4
Mac SE-30	6.0 to 6.04	6.1–6.1.4

The Colby SIMM adapter board requires only 2 DIP's to be removed and about 22 wires and a daughter board to be soldered onto the motherboard, as shown in Fig. 10. That will save you about 3–4 hours of work, is much less likely to damage your motherboard, and allows you to use standard 256K or 1-MB SIMM's instead of discrete RAM chips. It also has a built-in SCSI port to enable you to operate a hard drive on a Mac 128K or 512K (128K ROM's are required).

The Mac Plus motherboard was the first Mac to use SIMM RAM. Unlike IBM-PC clones, the Mac uses only eight chips per SIMM instead of nine, because there is no provision for parity checking. There are two types of SIMM's that will work on this unit; 256K and 1-MB types. In general, they can be identified by inspecting the individual RAM IC's. The 256K chips have leads on all four sides, whereas the 1-MB chips have leads on only two sides.

The Mac Plus can be configured with 1 MB consisting of four 256K SIMM's, 2 MB consisting of two 1-MB SIMM's, 2.5 MB consisting of two 256K SIMM's and two 1-MB SIMM's, or 4 MB consisting of four 1-MB SIMM's.

One megabyte of memory (four 256K SIMM's) is normally present in the Mac Plus. It is located on four SIMM's at an angle of about 45 degrees to the main board in front of the 68000 processor. Remove all four of the SIMM's currently installed in your Mac Plus. Use your fingernail or small screwdriver to gently bend the plastic locking tabs out to the left and right to release the SIMM. CAUTION: The plastic retaining tabs will break very easily if you are not careful. Push them only enough so they clear the edge of the SIMM.

Locate resistor R8 in the corner of the motherboard nearest the printer port; clip it on one end and bend it aside to prevent contact. Do not remove it, so that if you want to reconfigure your Mac Plus back to one megabyte, you can do so easily.

Starting with the SIMM slot in the rear nearest the 68000 processor (row 1), install a 1-MB SIMM module in the rear socket on the Mac Plus motherboard by pressing it firmly into the socket at a 45-degree angle and gently rolling it back until the locking tabs snap into place. For 2.5 MB, two of the original Mac Plus 256K SIMM's go in the third and fourth sockets and two 1-MB SIMM's go in the first and second. For 4 MB, all four sockets must be filled with 1-MB SIMM's.

Replace the keyboard, mouse, and other attachments and power-up your Mac Plus. To test the memory installation, pull down "About the Finder" under the Apple DA menu for the registered amount of RAM. Note that with memory configurations

larger than 1 MB, the Macintosh will take an extra 15–30 seconds to boot up.

Like the Mac Plus, the Mac SE motherboard has 4 SIMM sockets and can be configured with 1 MB, 2 MB, 2.5 MB, or 4 MB of RAM. There are two versions of the SE motherboard and the placement of the SIMM's and jumper differs, so you must determine your logic board type. Type 1 has resistors and no jumper, and type 2 has a jumper on the header. Adhere to the instructions pertaining to your particular motherboard.

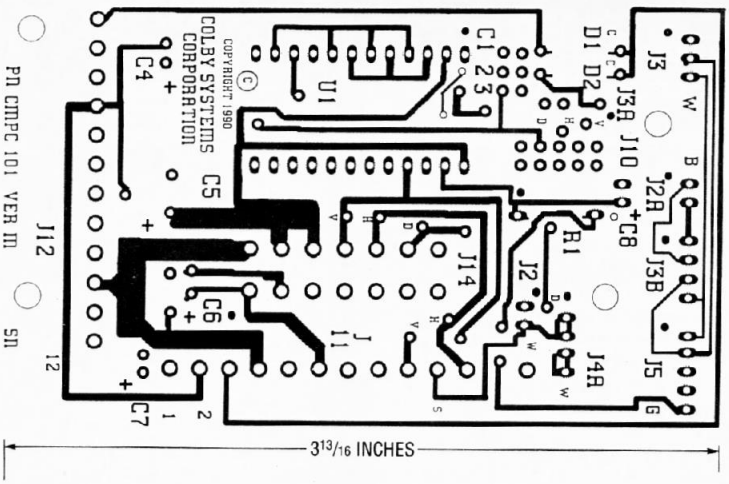
One megabyte of memory is typically installed in most SE motherboards with four 256K SIMM's filling the four memory SIMM slots. Remove all four original SIMM's, working from the front to the rear on both sides. If your SE has a resistor, clip the R35 resistor on one end and bend it aside to prevent contact. Do not remove it, as you may want to reconfigure to 1 MB later on.

The SE memory requirements with resistor R35 are as follows: For 2 MB, install two 1-MB SIMM's in SIMM sockets 1 and 2 (second row). For 2.5 MB, install two 1-MB SIMM's in position 1 and 2 (first row). Place two of the Apple 256K SIMM modules in positions 3 & 4 (second row), and completely remove the jumper. For 4 MB, install four 1-MB SIMM's in all four positions and completely remove the jumper

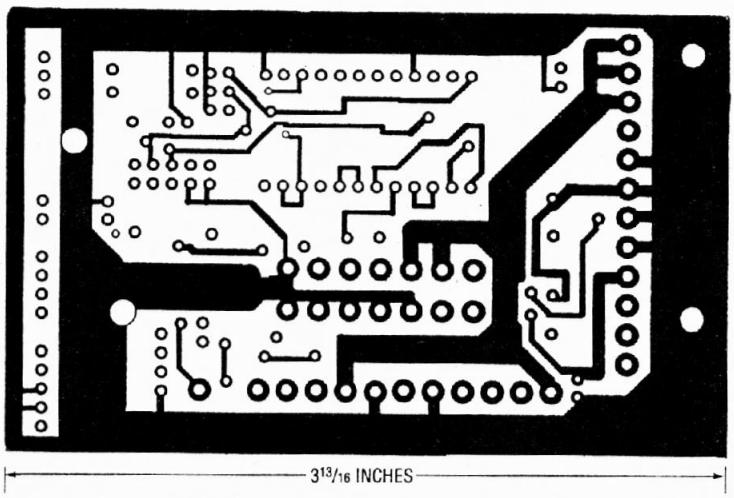
The three-pin jumper tells the SE what type of SIMM's are in use. The standard configuration is 1 MB of memory consisting of four 256K SIMM's installed in both rows. The jumper will be installed on the jumper block terminals labeled "1M."

The memory requirements for the SE version with a jumper are as follows: For 2 MB, install two 1-MB SIMM's in sockets 3 and 4 (second row). Move the jumper to the jumper block terminals labeled "2/4 MB." For 2.5 MB, put two of the Apple 256K SIMM modules in positions 1 and 2 (first row). Install two 1-MB SIMM's in positions 3 and 4 (second row), and completely remove the jumper. For 4 MB, install four 1-MB SIMM's in all four positions and completely remove the jumper.

Replace the keyboard, mouse, and other attachments and power-up your Mac Plus. To test your memory installation, pull down "About the Finder" under the Apple DA menu for the registered amount of RAM. The Mac SE-30 can be configured as follows: 1 MB with four 256K SIMM's in bank A, 2 MB with four 256K SIMM's in bank A and four 256K SIMM's in bank B, 4 MB with four 1-MB SIMM's in bank A, 5 MB with four 1-MB SIMM's in bank A and four 256K SIMM's in bank B, 8 MB with four 1-MB SIMM's in bank A and four 1 MB SIMM's in bank B, 16 MB with four 4-MB SIMM's in bank A, and 32 MB with four 4-MB SIMM's in bank A and four 4-MB SIMM's in bank B. Note: Since the Mac SE-30 runs at 16 MHz, it is recommended that 80 ns RAM be used (denoted by a -8 or -80 suffix on the part number on the individual chips on the SIMM).



THE COMPONENT SIDE of the power/video interface board.



THE SOLDER SIDE of the power/video interface board.

You must remove the original SIMM's found on your SE-30 motherboard if you are installing 1-MB SIMM modules. Note: This step is not necessary if you are installing 2 MB. Gently bend the plastic locking tabs out to the right and left to release the SIMM module. Rotate the SIMM forward to clear the locking tabs and remove all four SIMM's. Place the SIMM's on a non-static surface, such as the anti-static bags and pink foam supplied with your new SIMM's. Repeat this same procedure until all of the original SIMM's are removed.

Install each SIMM module with chips to the right of the SIMM by pressing the module firmly in the socket at a 45-degree angle and gently rolling it back until it snaps into place. 256K SIMM's are about $24.99, 1-MB SIMM's are about $49.99, and 4-MB SIMM's are about $299.99. **R-E**

MAC-HACK ATTACK

Thank you for the information on hacking a Macintosh ("Build Your Own Macintosh-Compatible Computer," **Radio-Electronics**, January 1990). I've been doing that kind of idiocy for a while, but believe me, it's not worth it. Add it up:

Clone case	$ 90.00
Fujitsu 800K floppy drive	104.00
Mouse (Samurai)	50.00
Monitor	50.00
Video/sync processor	59.00

Assorted cables	30.00
Fan	8.00
Memory/SCSI board	150.00
New ROM's	100.00
Motherboard	50.00
Used keyboard	50.00
Power supply	13.00
AC filter	3.00
Power cord	1.00
Battery	4.50
2 Meg RAM	80.00
Your time (10 hours at least)	250.00
TOTAL	$1092.50

You might as well go out and buy a packaged Mac from a dealer, because the above expenditures give you a bare-bones 8-MHz unit with a dinky screen and no hard disk!

ALEX FUNK
Durham, NC

MORE ON MACINTOSH BUILDING

I read with interest the article "Build A Macintosh-Compatible Computer" (**Radio-Electronics**, January 1991). Having purchased a Mac 128K in 1984 and upgrading the 128K motherboard (I'm still using it) to its current 2-MB RAM, 128K ROM, and SCSI drives, I noticed a few critical points that were overlooked. I hope this letter will help clear up some issues that could cause problems for your readers.

First, not every Mac is compatible with all software! Software written for the Mac II (68020 CPU) will not run on a Mac 128K, 512K, Plus, etc. There are a lot of programs that are written for System 6.0.x and these programs will *not* run on a Mac with the older 64K ROM. It is very difficult to find *any* software that will run on a 128K Mac today! You really must have the 128K ROM and 512K of RAM to use most Mac software.

Second, there is a significant difference between a 128K and 512K motherboards that have the 128K ROM's added along with more RAM and the Mac Plus motherboard. Those early motherboards had 20 bytes of Parameter RAM (battery backed). From the Mac Plus on, Apple used 256 bytes of parameter RAM called XPRAM. Under System 6.0.x, the sound and Map Control Panel programs will not work unless you have the 256 bytes of XPRAM. The term "512KE" is often used to identify 512K, 64K ROM motherboards that have been upgraded with 128K ROM, which is not correct. Apple issued 512KE motherboards that had 128K ROM and 256 bytes of parameter RAM, and those are the true "512KE" motherboards.

I have found a simple solution to the XPRAM problem. My motherboard has only 20 bytes of parameter RAM but I am using a System 6.0.x with no problems. I am using Scott Armitage's XPRAM INIT software that uses disk space to replace XPRAM memory. Best of all, the software is free (you can download it from GEnie) and it works great!

Finally, on page 36 of the article it said that with 64K ROM you can use only 400K floppy drives, yet the parts list on page 32 states that you can use an 800K floppy with a 128K or a 512K motherboard. That is confusing, but there is a solution. You *can* use an 800K floppy-disk drive with a motherboard that has 64K ROM *only* if you have Apple's Hard Drive 20 system file in the system folder. That file was intended for Apple's original hard drive that plugged into the floppy-disk-drive port and worked with the 512K machines. It also lets you use 800K floppies. The file is available on GEnie.

In case your readers don't have access to GEnie, for $5 and a formatted blank disk, I will send them the XPRAM and Hard Drive 20 files ($7 without a disk). (No phone calls after 9:30 PM CST, please.)

There are a number of vendors out there with products for making your own Macintosh and upgrading older 128K and 512K motherboards that were omitted from your article. Less Hall (P.O. Box 5732, Raleigh, NC 27650) supplies Macintosh parts and information; Atlanta Technical Specialists (3550 Clarkston Ind. Blvd., Suite F, Clarkston, GA 30021) sells cases, video cards, and kits; motherboard upgrades, SIMMS and SCSI, can be obtained from both Computer Care (Ford Center, Suite 1180, 420 North Fifth Street, Minneapolis, MN 55401) and Newbridge Microsystems, 603 March Rd., Kanata, Ontario, Canada K2K 2M5); Soft Solutions (907 River Road, Suite #98, Eugene, OR 97404) provides Macintosh parts and repairs; and Maya Computer (1-800-541-2318) offers Macintosh motherboards and all kinds of parts.

ANTHONY J. ORESTEEN
452 Orion Road
Batavia, IL 60510
(708) 879-5608