 Apple Lisa Computer
Technical Information

Apple Lisa Computer: Lisa Repair Information (Larry Pina 1990)

Lisa Computer: 1983 - 1985

Macintosh® Repair
& Upgrade Secrets

1990

Larry Pina

 Apple Lisa Computer
Repair Information

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Irving Freeman, Chairman of the Science and Computer Department at Worcester Academy, contributed to the Lisa Chapter. In fact, it's Irving's hands that are shown working on the Widget hard drive in Figures 13-25 and 13-26. I took the pictures.

Thanks also goes to Ralph Jannini of Rajan Technology. Ralph is credited as the original source for the Widget fix that I learned from Irving.

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CHAPTER

13

Lisa/Macintosh XL Repair Secrets

Many people believe that Lisas and Macintosh XL's are exactly the same computer. In truth, Lisas and XL's only look the same. There are three different models in the series. The Macintosh XL (a.k.a. Lisa 2/10) is simply the newest model. Since there are major differences between the models, it's important to determine which Lisa/Mac XL you own before beginning any upgrade or repair work.

Identifying the Models

This section lists the official hardware configurations. Hardware means a specific combination of drives, boards, and so on. By identifying what hardware is inside the box, you can easily determine which model of the Lisa you own. Table 13-1 provides a checklist. The next section provides illustrated disassembly instructions so that you can match your particular hardware configuration against the list.

> **Lisa 1:** The Lisa 1 has two DS 5.25-inch disk drives but no internal hard drive. There are two 5.25-inch disk drive openings in the front panel. The Lisa 1 is easy to spot. If you have 5.25-inch floppy disks and two disk drive openings in the front panel, yours is definitely a Lisa 1.
>
> **Lisa 2:** The Lisa 2 has one 3.5-inch 400K disk drive, different disk drive controller circuitry, and a redesigned front panel to accommodate the

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single 3.5-inch drive opening. A 400K floppy controller, labeled the "Lisa Lite Adapter," is mounted inside the disk drive cage. The System I/O board is socketed for an AMD 9512 arithmetic processor. It has nickel-cadmium battery backup for the real time clock. One 512K memory board is standard. The mother board has a mouse connector, two serial connectors, and an external parallel connector. The power supply is rated 1.2 A. The required operating system is called Lisa OS. The official disks generally have violet labels. If you have 3.5-inch disks and one floppy drive opening, yours is at least a Lisa 2.

Lisa 2/5: The Lisa 2/5 was bundled with a 5MB external hard drive or at dealer option, a 10MB external hard drive. Otherwise, it's a Lisa 2, bundled with Lisa OS, exactly the same as above. If you have one or more external hard drives, but no internal hard drive, yours is probably a Lisa 2/5, even if your external drives are 10MB models.

Lisa 2/10: The Lisa 2/10 has a completely different mother board. The mouse connector is different. There's no external parallel connector on the back of the computer. Instead, there's an internal parallel connector and a 10MB internal hard drive. An interrupt switch has been added. The system I/O board is also different. There's no socket for the AMD 9512 coprocessor. There's no nickel-cadmium battery backup for the real time clock. The disk drive controller is different. An extra chip on the I/O board replaces the Lisa Lite Adapter which was formerly located in the drive cage. The disk drive cabling is different. The wiring harness is different. The power supply is different. One megabyte of RAM is standard. If you have Lisa OS disks, a 10MB internal hard drive, no Lisa Lite card, no external parallel connector, and a 1.8-A 110/220-V power supply, yours is at least a Lisa 2/10.

Macintosh XL: The Macintosh XL is exactly the same as a Lisa 2/10. Only the sticker on the box, the operating system, and the instruction manuals are different. Instead of Lisa OS, the bundled OS is Macintosh System software and MacWorks XL, a Lisa program which allows 64K Macintosh ROM emulation. If you have MacWorks XL instead of Lisa OS disks, a 10MB internal hard drive, no Lisa Lite card, and a 1.8-A power supply, yours is probably a Macintosh XL.

Regardless of which model you own, all three Lisa/XL's are easily repaired. The next two sections show how to get a dead Lisa going again. The section after that shows how to turn it into a super deluxe, big-screen Macintosh Plus.

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Table 13-1 Hardware Configuration Checklist

This sample table reflects a fully upgraded Lisa 2/5

Item	Check	Model#/Notes
400K internal floppy		
800K internal floppy	✓	Sony# MPF-51W
Lite adapter	✓	Apple# 620-149
Internal hard drive	✓	Miniscribe/Sun 20MB
1.2-A power supply		
1.8-A power supply	✓	Jumpered for 110 V AC
System I/O board	✓	Apple# 620-0117 (Lisa 2/5)
CPU board	✓	Apple# 620-0119
Memory 1 board	✓	Apple# 620-0112 (512K)
Memory 2 board	✓	Apple# 620-0112 (512K)
Screen kit transformer	✓	Properly installed
ROM version	✓	3A/A8 (XL screen kit)

Lisa/XL Disassembly Procedure

All Lisa/XL models are built on the same chassis and come apart the same way, without tools. Before beginning, shut down the Lisa (if it's on) and physically disconnect the power cord from the back of the computer. To remove the front panel place your hands along the bottom edge, feel for the two finger grips, and push up gently as shown in Figure 13-1. Pushing up disengages two plastic tabs, swings the front panel forward, and opens a safety switch in the upper left corner of the chassis. If the computer is on, removing the front panel will immediately turn it off. Since this is not the recommended way to power down, always remember to *Save* your work and *Shut Down* before removing the panel.

The disk-drive assembly is held in place by a spring-loaded knurled nut as shown in Figure 13-2. To remove the entire disk-drive cage, loosen the nut until it springs free and then pull straight back. The cage slips out easily. Normally, the wiring harness is just long enough to allow you to set the assembly down in front of the computer. Take care not to snag or overextend the drive cables. As shown in Figure 13-3, there's not much slack!
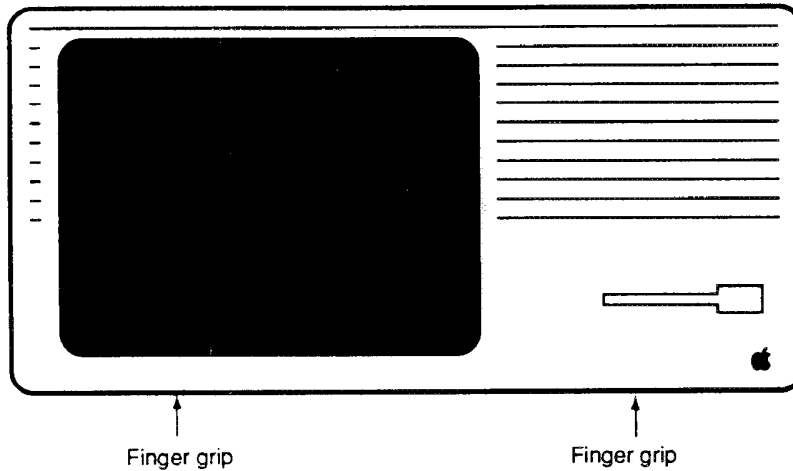
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Finger grip   Finger grip

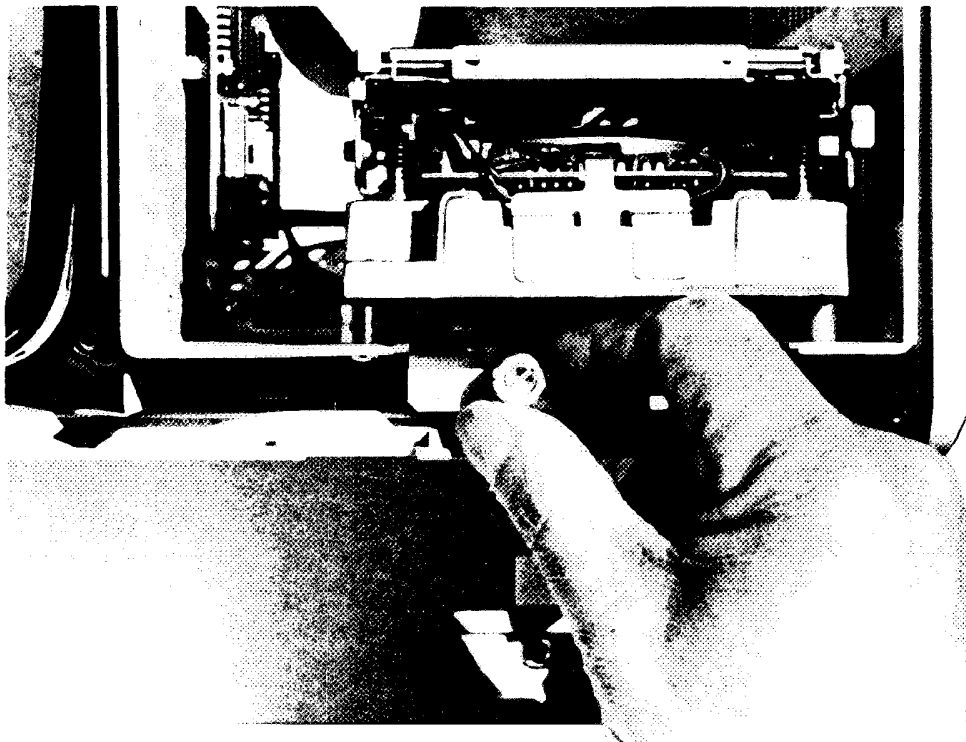**Figure 13-1** To remove the front panel, feel for the finger grips at the bottom edge and push up gently.

Figure 13-2 To remove the entire disk drive cage, loosen this retaining nut until it springs free and then pull straight back.
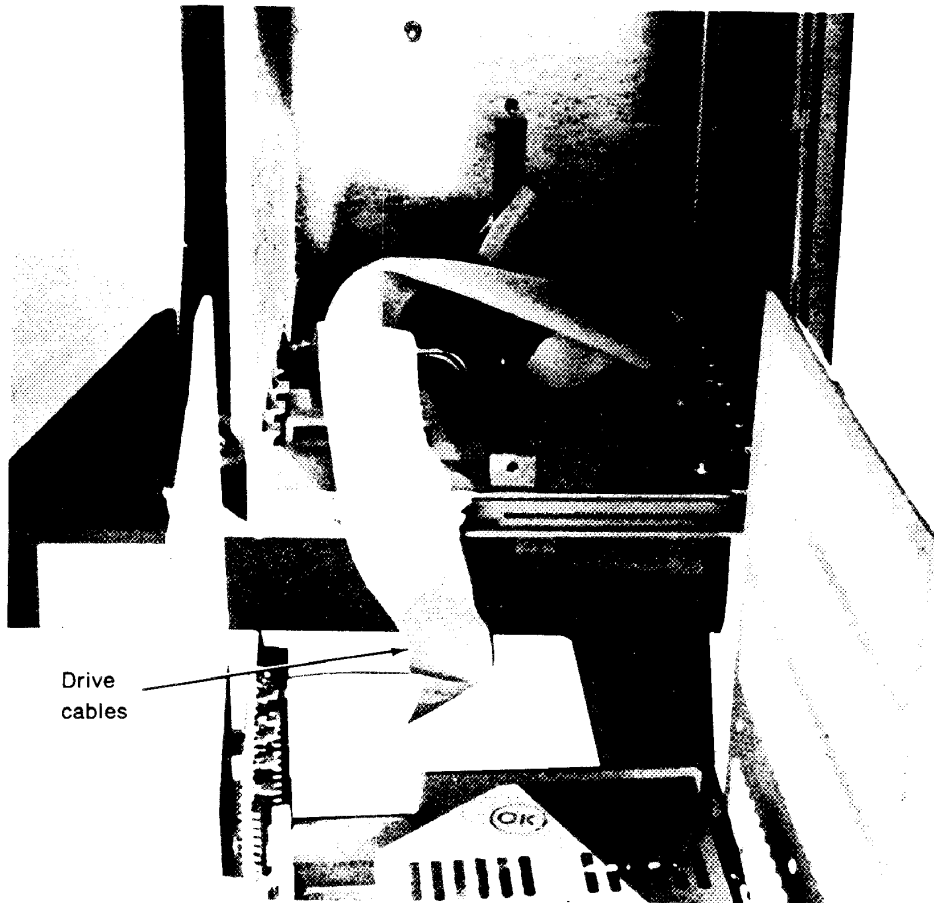
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Figure 13-3 When removing the disk drive assembly take care not to snag or
overextend the drive cables. There's not much slack!

Once the drive cage is out, note whether the floppy drive ribbon cable
is routed to a connector at the back of the cage or whether it's connected to a
Lisa Lite Adapter as in Figure 13-3. A Lite Adapter indicates that the
computer is either a Lisa 2 or a Lisa 2/5. Direct connection suggests a Lisa 2/
10 or a Mac XL.

You can remove the internal disk drive by tilting the drive cage forward
and loosening four screws at the bottom. Hard drives, when present, are held
by five or six screws along the side.

400K Sony drives are identified by part numbers beginning with OA-
D34V. 800K Sony drives are identified by part numbers beginning with MPF-
51W. You might also find an 800K Chinnon drive in a Lisa. These will clearly
be marked "Chinnon."

Original 10MB Widget drives are marked "Apple computer." Other
internal hard drives might be marked "Fujitsu," "Kalok," "Miniscribe," or
"Seagate." For reference, write down the make and model numbers of
whatever drives you find.

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The rear panel is held on by two thumbscrews. Turning the thumbscrew counterclockwise disengages a metal retaining tab. Note that it's not necessary to remove the thumbscrews. With a little loosening, you can pull the rear panel back and lift it away. This procedure is shown in Figure 13-4.
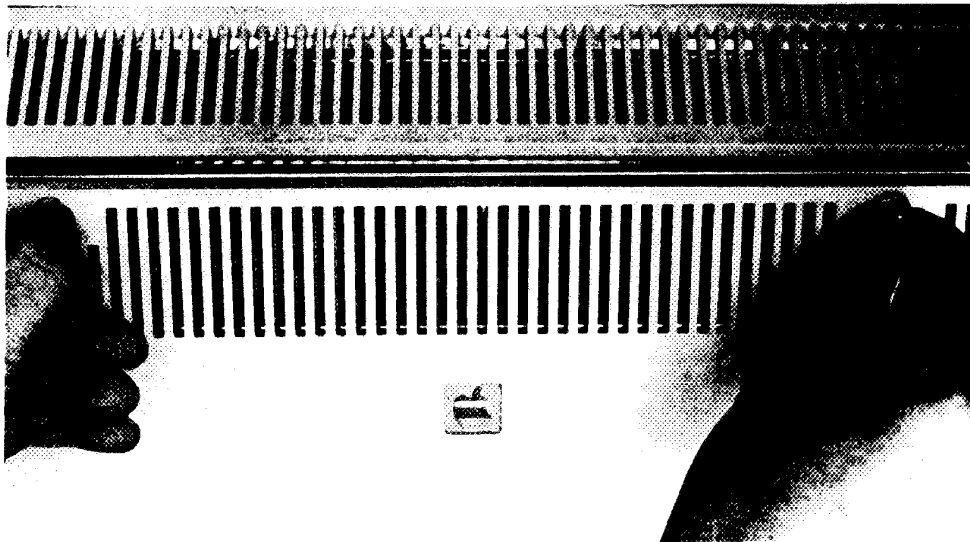

Figure 13-4 To remove the rear panel, first disconnect the power cord and all peripheral cables, then turn the thumbscrews counterclockwise, pull slightly, and lift at an angle.

Removing the rear panel opens a second safety switch in the upper right-hand corner of the chassis. If the computer is on, removing the rear panel also turns it off. Safety switches protect the computer as well as the operator. It's possible to defeat safety switches (the cap of a ball point pen works well) but be careful. Removing cards without turning the power off first is a surefire way to destroy them.

Note that pressing the on/off switch or removing the covers (engaging the safety switches) does not remove all power to the computer. The only way power can be completely removed is by unplugging the line cord.

The power supply is attached by a second spring-loaded, knurled nut as shown in Figure 13-5. Once you loosen the nut it may take considerable force to remove the supply. Because of a tight-fitting tongue and socket connector, that's normal. If the connector fits loosely, the operating voltages might fluctuate and the computer would be subject to intermittent operation.

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Fortunately, it's very well made. When you need to remove the power supply, loosen the finger nut (until it springs free) and pull straight back. When you need to replace the power supply, push it in ¼ inch past the resistance point, until the center of the nut is located approximately ½ inch from the edge of the chassis.

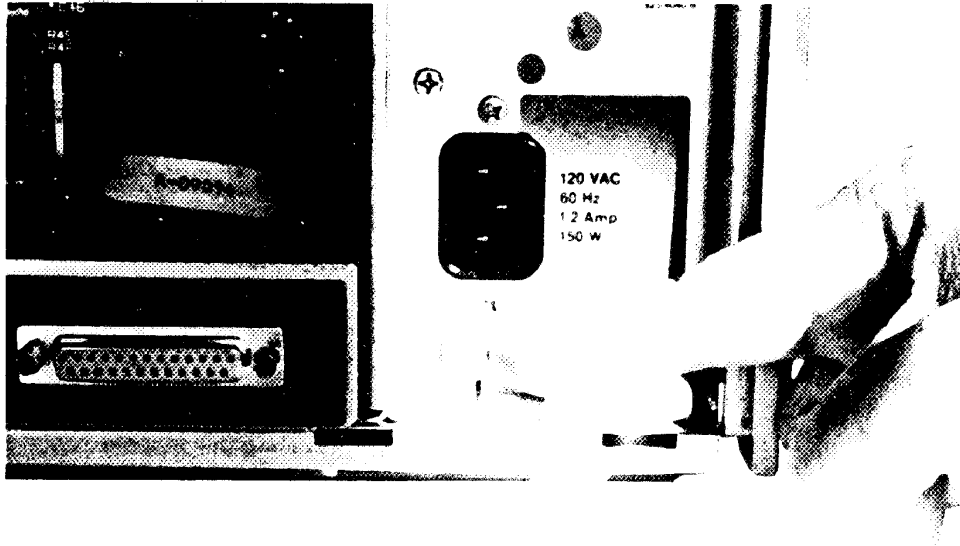**Figure 13-5** To remove the power supply, loosen the finger nut and pull straight back. Note that the nut is located approximately ½ inch from the edge of the chassis.

As shown in Figure 13-6 to 13-7, 1.8-A (ampere) power supplies are identified by part number 699-0189. 1.2-A power supplies are identified by part number 620-6103. Both supplies are marked "120 V AC 150 W," but the 1.8-A model is actually a dual voltage (110/220-V AC) model, and it's also 50% stronger!

Here are the figures: Power = Voltage × Current. Substituting Lisa 2/10 to Mac XL power supply values: 120 V AC × 1.8 A = 216 W (44% over specification). Substituting Lisa 2/5 power supply values: 120 V AC × 1.2 A = 144 W (4% under specification).

So how can both models be marked 150 W? The acceptable input voltage specified in the Lisa 2 literature is 90 V AC to 130 V AC. Substituting 90 V AC (the low limit) into the Lisa 2/10 to Mac XL supply's formula (90 V AC × 1.8 A) lowers its relatively high rating to 162 W. Substituting 130 V AC (the high limit) into the Lisa supply's formula (130 V AC × 1.2 A) raises its relatively low rating to 156 W. Since both figures exceed 150 W, that presumably explains the identical ratings. Nevertheless, the Lisa 2/10 to Mac XL supply is notably superior.
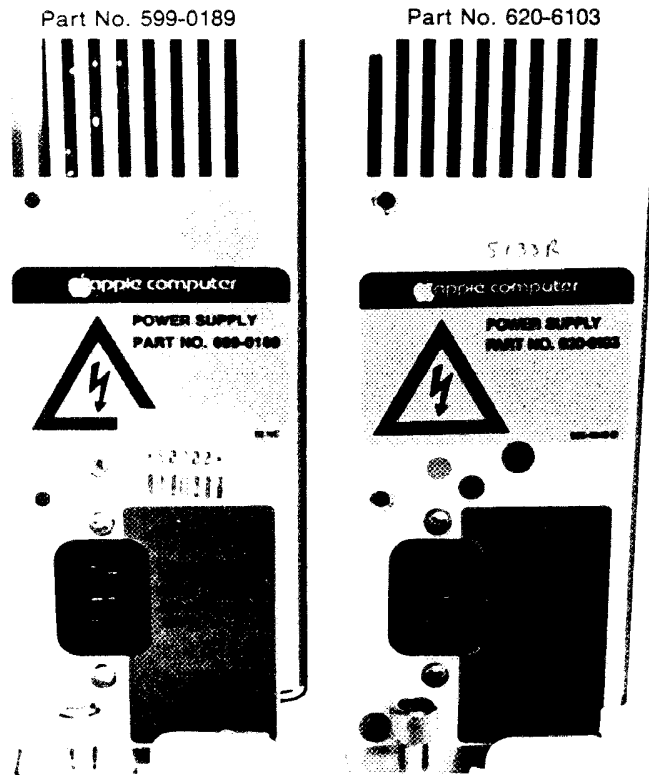
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Part No. 599-0189   Part No. 620-6103

Figure 13-6 Lisa/Mac XL power supplies—external views. 1.8-A Lisa 2/10 to Mac XL power supply (left), and 1.2-A Lisa 2/5 power supply (right) are both marked "150W," but the 1.8-A model is actually a dual voltage model, and it's 50% stronger!

When the original 1.2-A Lisa 2/5 supply is used with an internal hard drive and a Macintosh XL Screen Kit (described at the end of this chapter), audible transformer ringing results, horizontal retrace lines become noticeable, and a slight screen flicker is introduced. Installing the 1.8-A Lisa 2/10 to Mac XL supply eliminates all of that.

The 1.8-A Lisa 2/10 to Mac XL supply is also a dual voltage model. 110- to 220-V AC conversion is made by moving two jumpers at the bottom of the board, as shown in Figure 13-8.

These differences make a very important point. If you only remember one thing from this book, it should be this: Always confirm specifications by making your own calculations.
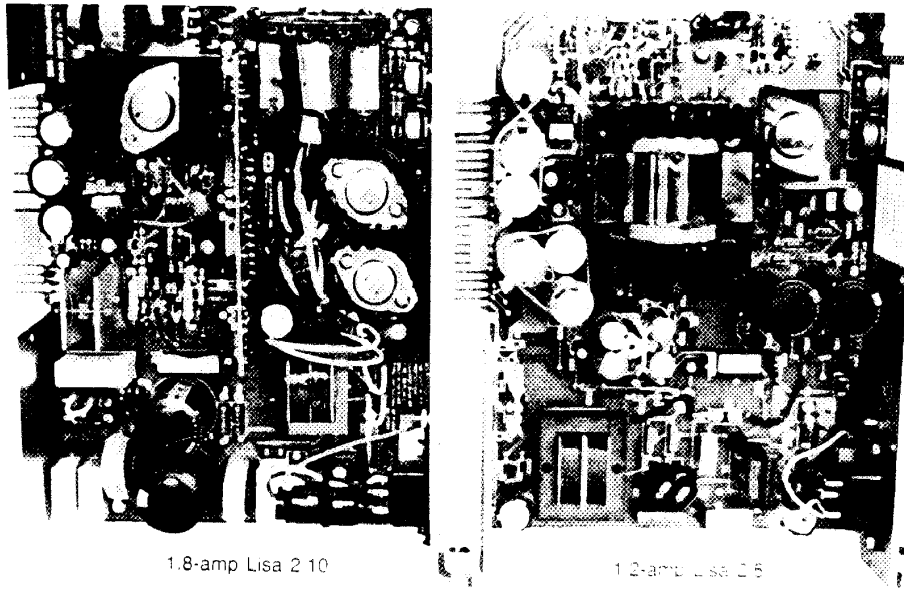
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1.8-amp Lisa 2 10   1.2-amp Lisa 2 5

Figure 13-7 Lisa/Mac XL power supplies—internal views. 1.8-A Lisa 2/10 to Mac XL power supply is shown on the left. 1.2-A Lisa 2/5 power supply is shown on the right. Note the three power transistors and the extra large filter caps in the Lisa 2/10 to Mac XL model.
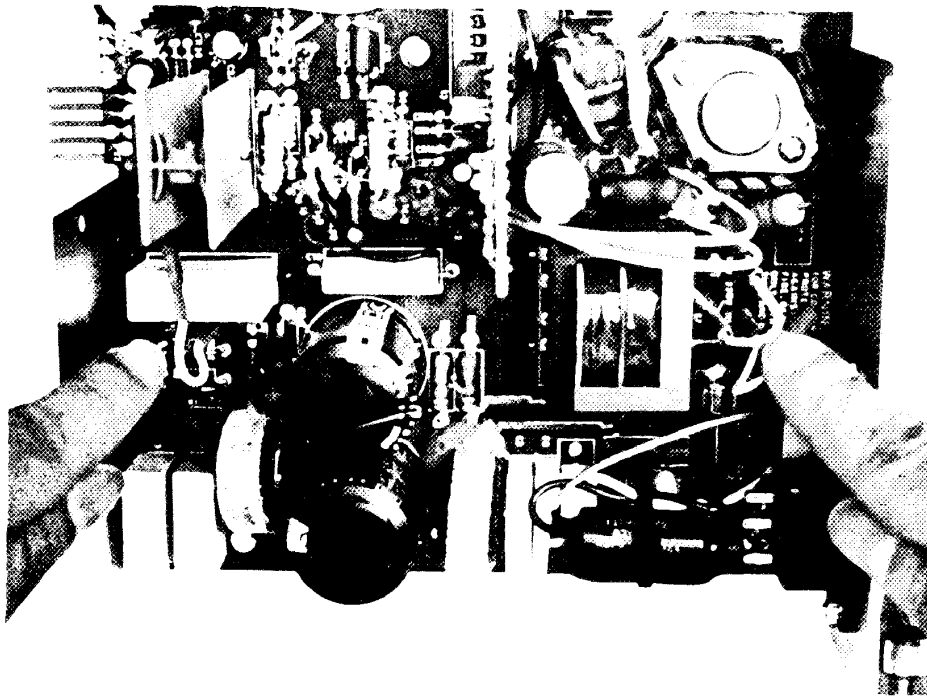

Figure 13-8 Lisa 2/10 to Mac XL power supply—110- to 220-V AC conversion (1.8-A model, only) is made by moving two jumpers at the bottom of the circuit board.

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The card cage is a removable rack for the Lisa's circuit cards. It's also held by tight-fitting tongue and socket connectors. To remove it, disconnect all peripheral cables from the back of the computer, brace your thumbs underneath and pull straight back as shown in Figure 13-9.
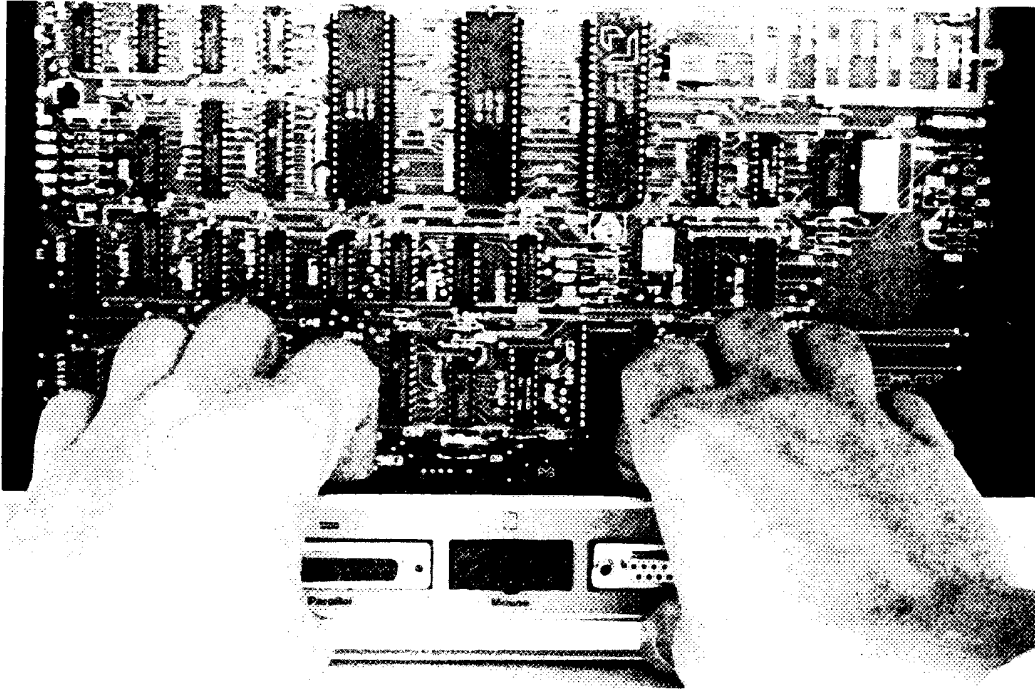

Figure 13-9 To remove the card cage, brace your thumbs and pull straight back.

The mother board is fixed to the bottom of the cage and there may be three or four removable cards (depending on how much memory you have) arranged vertically, from back to front, as shown in Table 13-2.

Table 13-2 Replaceable circuit cards

Card	Lisa Part#	XL Part#	Color Code
System I/O	620-0117	620-142	Red & brown
CPU	620-0119	620-0119	Blue & brown
Memory 1	620-0112	620-0112	Yellow & brown
Memory 2	620-0112	620-0112	Yellow & brown

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Note that part numbers beginning with 620 refer to a complete circuit card (defined as a plug-in circuit board with all the parts on it), not an empty board, which is always referred to by another number beginning with 820. All four cards fit into tongue and socket connectors on the mother board. To remove a card, loosen the color coded bails and pull straight up. The four cards slip in and out easily, and the design makes it impossible to reinstall them backwards; although, it's very easy to get confused. Note that the CPU card faces backward, while the System I/O card faces forward. If the CPU card offers the least bit resistance when you try to put it in, it means you're holding it wrong. Don't force anything! Check the color codes as illustrated in Figure 13-10.
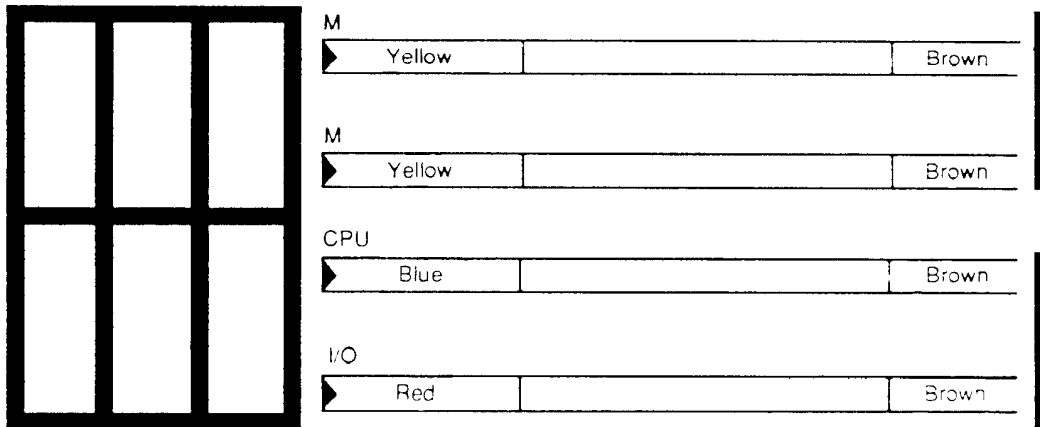

Figure 13-10 Top view of the Lisa/XL card cage.
Bail colors indicate proper orientation.

The Memory cards and the CPU card on Lisas and Mac XL's are interchangeable. The System I/O cards are not. Physically, they fit, but electrically there are problems with disk-drive control. If you just bought a used Lisa, or if you're restoring a Lisa and can't seem to get it going, it's important to check for the correct System I/O card. The differences are shown in Figures 13-11 and 13-12.

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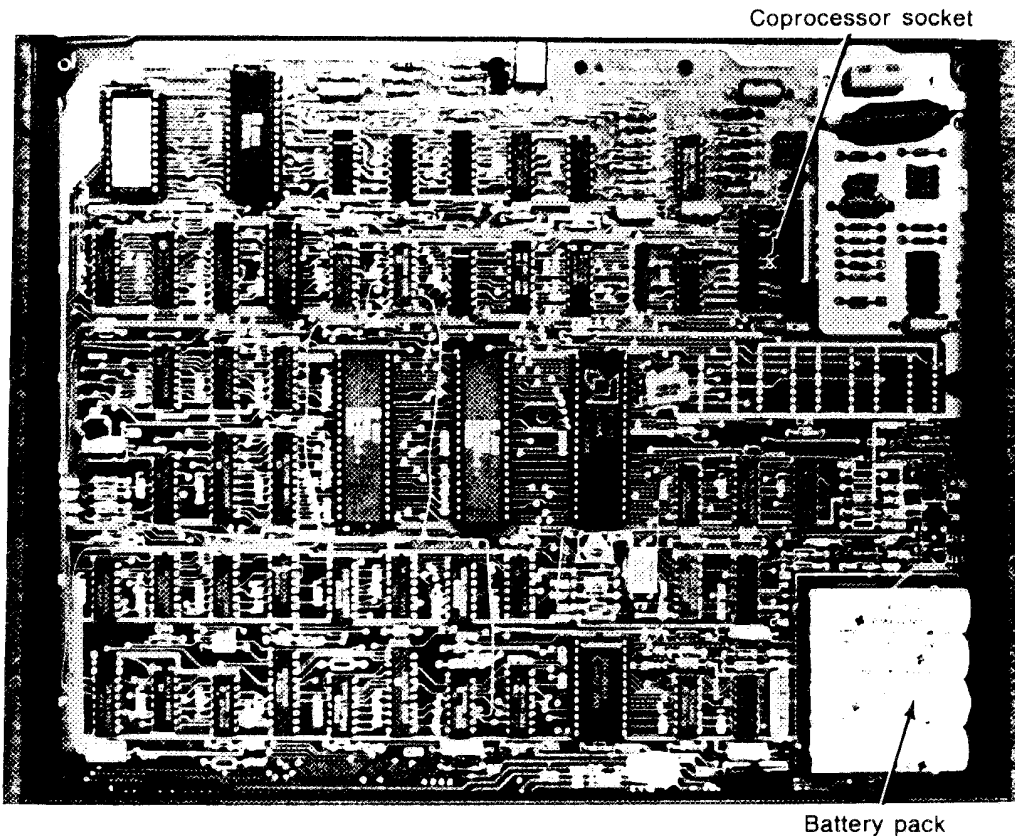
Coprocessor socket

Battery pack

Figure 13-11 The Lisa I/O card. Note the battery pack (lower right) and the AMD
9512 coprocessor socket (upper right).

While the card cage is out, peek inside the chamber and find the two
hidden screw holes on the underside of the top cover as shown in Figure 13-
13. When you need to remove the top cover, use a #2 Phillips-head screwdriver
to loosen the screws until they dangle, then slide the cover forward and lift
straight up. Both screws are permanently attached to the chassis. You don't
have to worry about them falling out.

Once you've determined that the hardware configuration is correct, the
Lisa's automatic startup tests will tell you if everything is working OK. It's
important to verify the hardware setup before proceeding, because if the
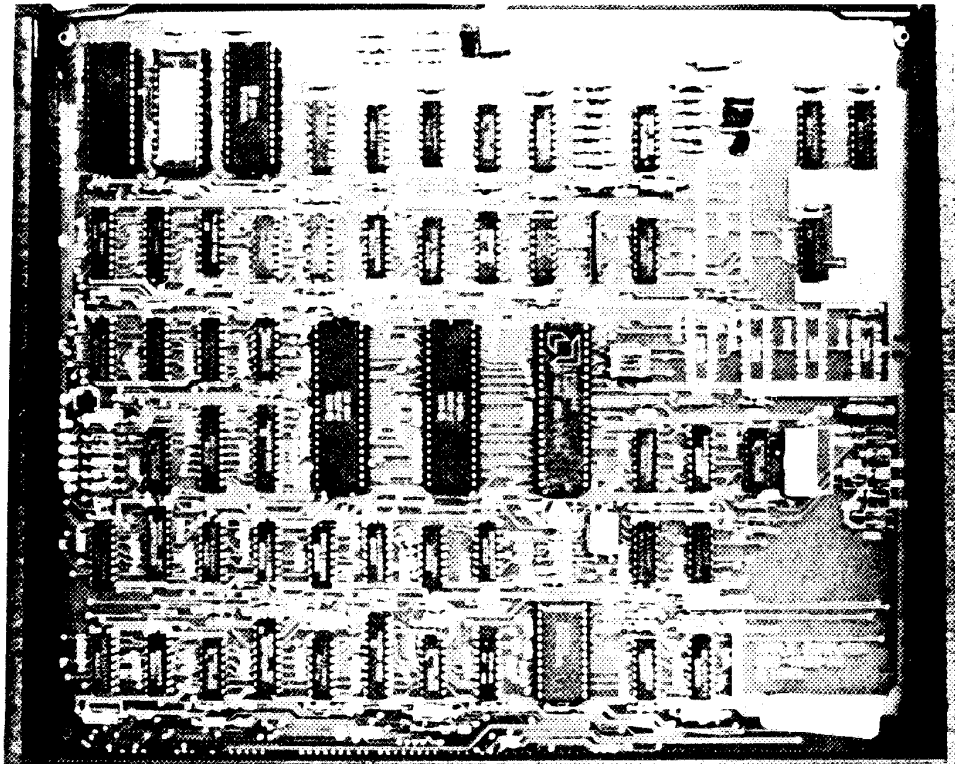wrong boards are in your machine, the test results may be invalid.

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Figure 13-12 The Mac XL I/O card. There's no battery pack (lower right) and no socket for the AMD 9512 coprocessor (upper right)!

Automatic Startup Tests

Every time you turn on the Lisa, it runs an exhaustive series of tests in the following sequence:

ROM Checksum

If the ROM Checksum fails, the computer hangs. When the CRT warms up, the screen may appear blank or it may display random patterns. These symptoms indicate a problem with the ROM chips, which are on the CPU board at locations D13 and D14. There are several things to check before ordering new ROMs:

1. Make sure the chips are oriented correctly. The notches should be pointing up. There were several ROM versions. Someone could have tried to install new ROMs, put them in backwards, and given up at that point.
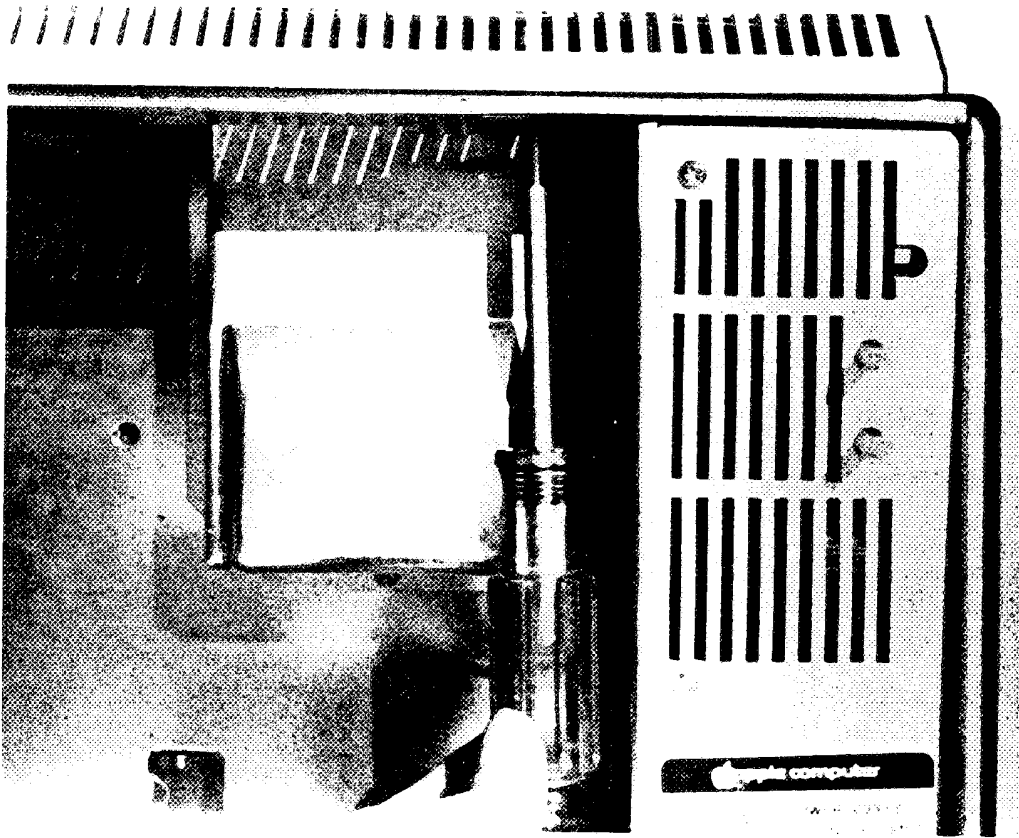
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Figure 13-13 The top cover is removed by loosening two hidden screws attached to the roof of the chamber. Both screws are permanently attached to the chassis. They won't fall out!

2. Make sure they're in the right sockets. If you have a stock Lisa with "H" ROMs, part number 341-0176-H should be in the socket at D14, part number 341-0175-H should be in the socket at D13. If you have a modified Lisa with "3A" ROMs, part number 341-0346 should be in the socket at D14, part number 341-0347 should be in the socket at D13. Any other part numbers indicate old (buggy) ROMs. Replace these on principle. It's usually not necessary to buy ROMs separately. The latest 3A ROMs are included with the XL Screen Kit, a video upgrade described later in this chapter.

3. Make sure there are no bent pins on the ROMs.

4. Make sure both chips are fully seated.

If you find any one of the above problems, pull the chips, replace them, reorient them, and/or straighten the pins as necessary.

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MMU Register Test

An initial failure of the MMU Register Test causes an endless loop. When the CRT warms up, it'll be blank. Other failures display error code 40 and show a cross over the CPU board icon. (Refer to Table 13-3.) Both symptoms indicate a problem in the memory management unit, which is made up of various static RAM chips. Each of these components is soldered in place which makes substitution very difficult.

When the MMU Register Test fails, make sure the CPU board is seated firmly, check for any obvious bad solder joints, and if that doesn't turn up anything, replace the board.

Memory Sizing

This test counts the installed memory. Errors are pretty much ignored, but if the memory can't be accessed at all, say both cards are missing, the speaker beeps, and the computer hangs with a series of alternating black and white stripes. The pattern is shown in Figure 13-14.
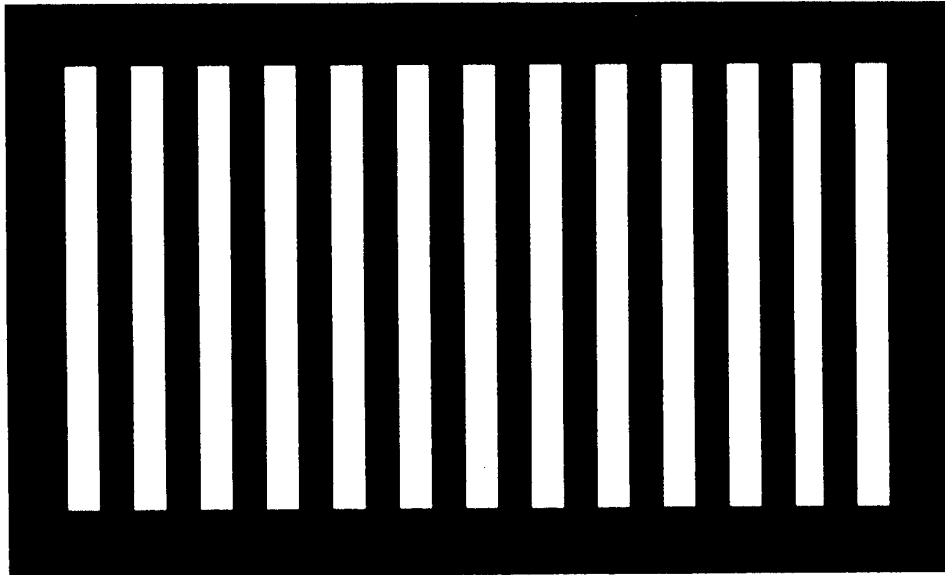

Figure 13-14 This pattern indicates total RAM failure. On the Lisa, Mac XL, Mac Plus, and Mac SE it generally means the cards and/or SIMMs are missing. On the 128K to 512Ke with certain memory upgrades, it generally indicates a problem with the 68000 clip.

The fix is to install or reset the cards. If necessary, clean the contacts with a pencil eraser. They're gold plated so they should be nice and shiny. Try not to touch the contacts with your fingers. It's best to keep them oil-free.

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Preliminary Memory Test

The startup ROM uses the first 2K of memory. If there's a problem with the first 2K, the speaker beeps twice and the computer hangs with a random display on the screen. This indicates a problem with the memory card in slot 1, the slot closest to the middle of the card cage. Verify by removing the card and trying again. So long as there's a second card in slot 2, the slot closest to the edge of the card cage, the computer will still boot, and, assuming that card's OK, testing will continue.

VIA Test

VIA is an acronym for Versatile Interface Adapter. The Lisa uses two 40-pin 6522A chips, the same chip used on other Macs. The chip at D7 (marked "keyboard") provides keyboard logic, a real time clock, and mouse control; the chip at D5 (marked "parallel port") controls the parallel port. Both chips are labeled and socketed.

If this test fails with a cross over the I/O board icon and error code 50 (keyboard VIA problem) or error code 51 (parallel port VIA problem), here's what to do:

1. Make sure the suspect VIA chip is installed. On a used or surplus Lisa, someone might have pulled it!
2. Make sure it's oriented correctly. The notch should be pointing up.
3. Make sure there are no bent pins on the chip.
4. Make sure the chip is fully seated.
5. If that doesn't turn up anything, it's worth trying a new VIA chip before scrapping the board.

The VIA test may also fail with a cross over the I/O board icon and error code 58, indicating an I/O access problem or with a cross over the I/O board icon and error code 41, indicating an I/O decode problem. In either case:

1. Make sure the CPU board is seated firmly.
2. Check for any obvious bad solder joints.
3. Make sure the 68000 is oriented correctly. The notch should be pointing up.
4. Make sure there are no bent pins on the 68000.
5. Make sure it's fully seated.
6. Make sure it's an 8-MHz 68000. Someone may have tried substituting a faster CPU. The OEM part is marked MC68000G8.

If that doesn't turn up anything, it's worth trying a new 68000 before scrapping the board.

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I/O Board Tests

I/O is an acronym for Input/Output. If both input devices (the keyboard and mouse) are connected, the speaker emits a single click. Otherwise, you're alerted (by an icon and a series of tones) that they're not connected. The click or the input device alert completes the kernel tests. Up to this point, only two or three seconds will have passed since the power button was pushed. Next, the Lisa runs module tests. When the screen warms up, you'll see a Startup Module Test Display as shown in Figure 13-15.

Testing...

Figure 13-15 The Startup Module Test Display.

As each module passes, it's marked with a check mark. Errors result in a cross over the module with an error code underneath. A complete list of error codes is given in Table 13-3.

Table 13-3 Startup Error Codes

Code	Icon	Symptom	Solution
N/A	Drive opening	No diskette	Insert disk
23	Diskette	Unreadable diskette	Reformat disk
38	Diskette	No startup file on diskette	Install system
39	Diskette	Drive ROM can't keep up	Wrong drive ROM?
40	CPU card	Memory management problem	
41	CPU card	Selection logic problem	CPU card missing?
42	CPU card	Video circuit problem	
43	CPU card	Parity circuit problem	
44	Lisa	Unexpected NMI interrupt	
45	Lisa	Bus error	
46	Lisa	Address error	
47	Lisa	Unexpected exception	
48	Lisa	Illegal instruction	
49	Lisa	Line 1010 or 1111 trap	
50	I/O board	Keyboard VIA error	6522A chip?
51	I/O board	Parallel VIA error	6522A chip?

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Table 13-3 (cont.)

Code	Icon	Symptom	Solution
52	I/O board	I/O COPS error	COPS chip?
53	I/O board	Keyboard COPS error	COPS chip?
54	I/O board	Clock error	
55	I/O board	Serial port A problem	Z 8530 chip?
56	I/O board	Serial port B problem	Z 8530 chip?
57	I/O board	Disk controller problem	Lite Adapter?
58	I/O board	I/O board access error	
59	I/O board	I/O COPS error	
60	I/O board	I/O or keyboard error	
70	Memory board	Read/write error	
71	Memory board	Parity error	
75	Internal HD	System files are damaged	Reinstall System
75	External HD	System files are damaged	Reinstall System
75	Floppy disk	System files are damaged	Reinstall System
75	Expansion card	System files are damaged	Reinstall System
80	Internal HD	Drive cable is disconnected	Check cable
80	External HD	Drive cable is disconnected	Check cable
81	Internal HD	No response from drive	Adjust solenoid?
81	External HD	No response from drive	
82	Internal HD	Drive doesn't answer	
82	External HD	Drive doesn't answer	
83	Internal HD	Other drive problem	
83	External HD	Other drive problem	
84	Internal HD	Boot blocks are damaged	Low level format?
84	External HD	Boot blocks are damaged	Low level format?
85	Internal HD	Drive can't keep up	
85	External HD	Drive can't keep up	
90	Expansion card	No card in that slot	
91	Expansion card	Can't start from that card	
92	Expansion card	Problem with the card ROM	
93	Expansion card	Other card problem	

ROM Identification

Another function of the startup module test is to identify which versions of the ROMs are installed. The version numbers appear in the upper right corner of the screen. The letters and numbers to the left of the divisor refer to the boot

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ROM. The letters and numbers to the right of the divisor refer to the drive ROM. A list of what you should see is given in Table 13-4.

Table 13-4 Acceptable Lisa/XL ROM Versions

Version	Computer	Meaning
H/A8	Lisa 2; 2/5	Stock screen—90 × 60 dpi
3A/A8	Lisa 2; 2/5	Modified screen—72 × 72 dpi
H/88	Lisa 2/10; XL	Stock screen—90 × 60 dpi
3A/88	Lisa 2/10; XL	Modified screen—72 × 72 dpi

H/A8 indicates a stock Lisa 2. 3A/A8 notes the presence of an XL screen kit, indicating a modified Lisa 2. H/88 indicates a stock Lisa 2/10 or a Mac XL. 3A/88 indicates the presence of an XL screen kit, indicating a modified Lisa 2/10 or a Modified Mac XL. Watching the ROM codes is the easiest way to determine whether an XL screen kit is installed. For reference, write down whatever codes are displayed.

Booting the Operating System

The next step is to boot an operating system (OS). One of the biggest problems veteran Mac owners have with Lisas and Mac XL's is understanding (conceptually) why this step is necessary. On the Macintosh, half of the OS is loaded transparently from ROM, and the other half loads from a startup disk, defined as any disk containing System and Finder files. It's simple.

The Lisa/Mac XL boot procedure is more complicated, because Lisas were designed to run multiple operating systems (Lisa Office System, Lisa Pascal Workshop, MacWorks XL, MacWorks Plus, etc.). That capability precludes putting half of any particular operating system in ROM. Instead, 100% of whatever OS you choose to run has to be loaded from disk. In practice, the allowable operating systems are permanently installed on one of seven partitioned hard disks, where they load automatically, according to modifiable startup preferences, upon completion of the module tests.

If there's no hard disk connected, or if it's powered down, two buttons appear on the Lisa/XL screen instead. To load MacWorks from a floppy (as might be necessary on the repair bench), click the "Startup From..." button, insert a MacWorks 3.0, MacWorks XL, or MacWorks Plus disk, then click the disk drive icon. If you boot MacWorks 3.0 or MacWorks XL, 64K ROM emulation will load into RAM. If you boot MacWorks Plus, 128K ROM emulation will load into RAM. Upon completion, the MacWorks disk kicks out, and the familiar blinking 3.5-inch floppy disk icon appears. From that point forward, the machine will operate just like any other Macintosh.

One Caveat: Following through with inappropriate versions of the System and Finder will crash the machine. Acceptable System/Finder

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combinations for use with MacWorks 3.0 and MacWorks XL include 2.0/4.1 and 3.2/5.3. These are the exact same limitations that 512K Macs have. Additionally, you must load the System and Finder from an MFS (Macintosh File System) disk. HFS (Hierarchical File System) disks are not recognizable on any Mac under the 64K ROMs.

MacWorks Plus requires at least System/Finder 4.2/6.0. In this case, previous versions of the System and Finder result in a crash. The important thing to remember is that system crashes of this nature have nothing to do with the hardware. Once you get to the blinking floppy disk icon, you can assume that the machine is OK.

Built-in Service Mode

In addition to the automatic startup tests, the Lisa has built-in service mode. The built-in service mode is top secret. Very few people know it exists. No one I've spoken to, not even the most knowledgeable Lisa owners and technical support people, has ever seen the documentation. Whether the documentation was lost, or whether it was ever written, remains a mystery. Still, some tests are easy to figure out. Adjust Video, for example, puts up a ½-inch reverse video crosshatch.

Here's how to enter the built-in service mode:

1. If the computer is on, turn it off. Wait a few seconds, then without inserting a startup floppy disk, turn the computer on again.

2. At the end of the kernel test (when you hear the first click), hit any key except Caps Lock. Hitting a key interrupts the normal startup procedure and turns on the Startup From mode.

3. At the end of the module test (when you hear the second click), hold down the Apple key and press the 2 key.

4. Since there's no floppy disk in the disk drive, the Lisa beeps three times and presents you with an error box. Ignore it!

5. Hold down the Apple key and press the s key. S presumably stands for service. Case is irrelevant. Pressing S, or s, will engage the service mode as shown in Figure 13-16.

Note that the numerical shortcut keys for the menu items don't require pressing the Apple key. If you'd rather not use the mouse, just press the numerical keys (all by themselves) to engage the tests. Press and, if necessary, hold down the Return key to return to the main menu. Press 7, not Apple Q, to Quit. Press the Reset button at the back of the computer to exit an endless loop.

Without more information, I can only speculate as to the purpose of these tests. My best guess is that they were used on the assembly line for quality control.
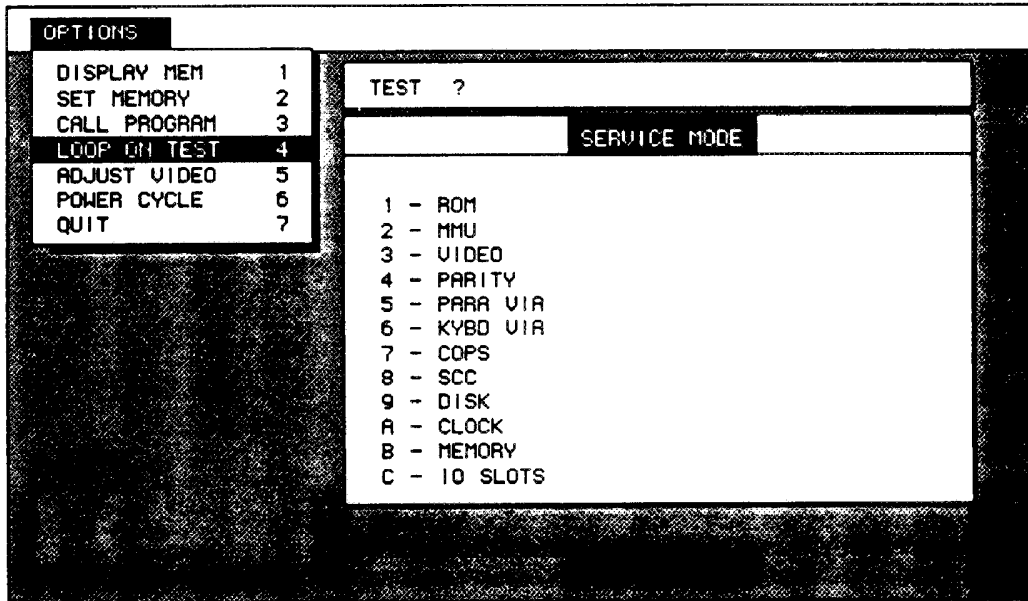
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```
OPTIONS
 DISPLAY MEM      1
 SET MEMORY       2           TEST   ?
 CALL PROGRAM     3
 LOOP ON TEST     4                  SERVICE MODE
 ADJUST VIDEO     5
 POWER CYCLE      6
 QUIT             7        1 - ROM
                          2 - MMU
                          3 - VIDEO
                          4 - PARITY
                          5 - PARA VIA
                          6 - KYBD VIA
                          7 - COPS
                          8 - SCC
                          9 - DISK
                          A - CLOCK
                          B - MEMORY
                          C - IO SLOTS
```

Figure 13-16 The Lisa's built-in service mode. Use with caution!

Warning! The Power Cycle & Loop On Tests presume a stock hardware configuration. They should not be used with a modified Lisa 2 or a Macintosh XL. Running the Power Cycle test with an 800K disk drive upgrade will cause the disk drive test to fail. Running the Power Cycle test on a Lisa 2/5 with an internal hard drive upgrade could wipe out the boot blocks on the hard disk. On startup, you'll get a cross over the hard disk icon with error code 84. You'll still be able to boot from a floppy, and the hard disk will mount, but in order to boot from the hard drive again, you may have to remove it, and send it out for a low level format. Use with extreme caution!

Summary of the Diagnostics Routines

The Lisa's built-in diagnostic routines display various icons accompanied by error codes pointing to particular electronic components. In practice, electronic failures are seldom seen. The most common problems result from mechanical failures, especially with the disk drives. The next section tells how to deal with them.

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Mechanical Problems with the 3.5-Inch Disk Drive

Just like its Macintosh counterpart, the Lisa's 400K 3.5-inch disk drive is subject to the following failures:

1. Eject mechanism makes eject noises but disks don't come out.
2. Eject mechanism fails to operate (doesn't make any eject noises at all) when rebooting after a System crash.
3. Grinding noises get louder and louder. Disks become unreadable.

The first failure indicates a lubrication problem. The second failure indicates the presence of an OEM 400K Mac drive. The third failure indicates a dirty stepper cam, a dirty head, and/or a clogged pressure pad.

Drive Makes Eject Noises but Disks Fail to Eject

When the drive makes eject noises but the disks don't come out it usually means that the grease on the eject mechanism has solidified. To fix it, all you have to do is disassemble the eject mechanism and change the grease. Here's the complete procedure:

1. Disconnect the computer's power cord from the wall outlet.
2. Remove the disk drive cage as shown in Figures 13-1 to 13-3.
3. Disconnect all data and power cables from the installed drives.
4. Remove the internal disk drive by tilting the drive cage forward and loosening four Phillips-head screws at the bottom. Use a #1 Phillips-head screwdriver. Support the drive with one hand as shown in Figure 13-17.
5. Use a small ⅛-inch slotted screwdriver to remove the C-ring shown in Figure 13-18.
6. Rotate the drive such that the disk opening is facing down and the eject motor is facing up. Use a small ⅛-inch slotted screwdriver to remove a single black flat-head screw behind the eject motor. Remove the top cover.
7. Rotate the drive such that the circuit board is facing up. As shown in Figure 13-19, use a small ⅛-inch slotted screwdriver to remove four gold-colored flat-head screws mounted *beneath* the circuit board.
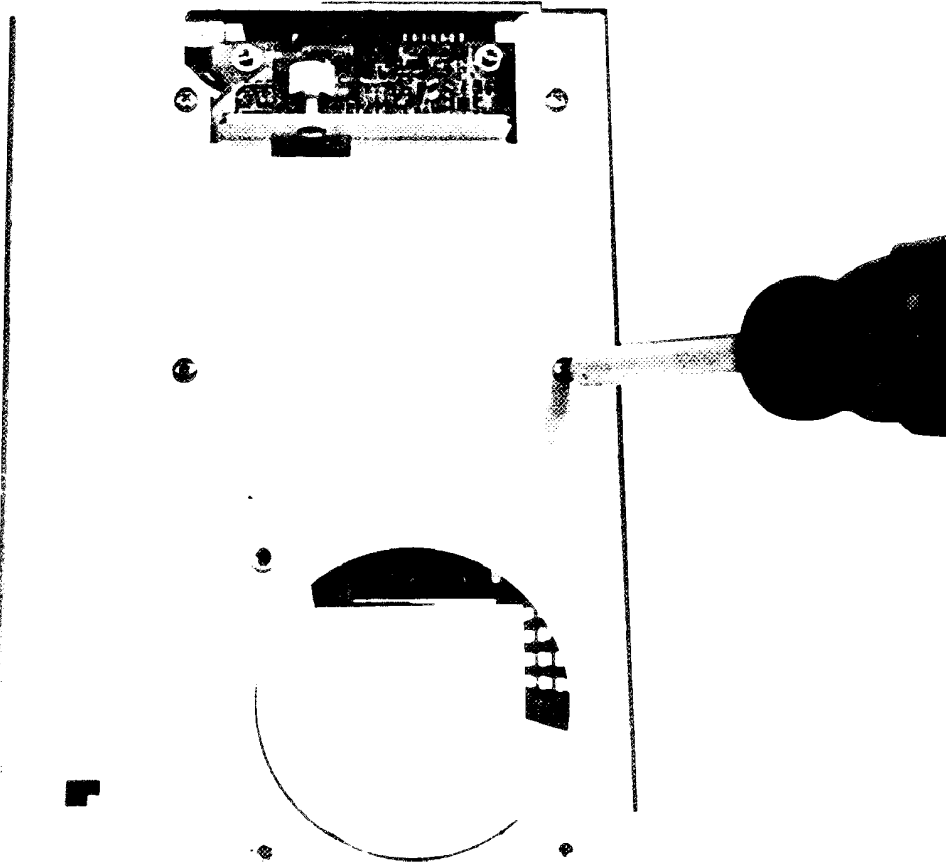
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Figure 13-17 Lisa disk drive removal.

Figure 13-18 C-ring removal.

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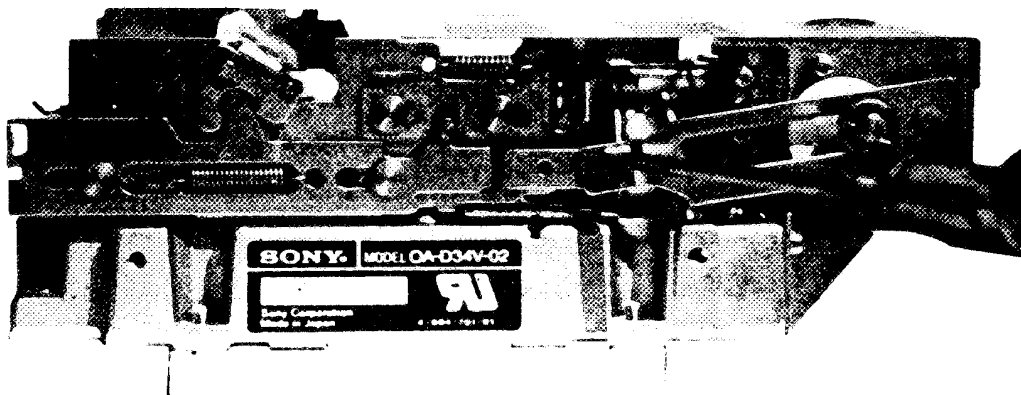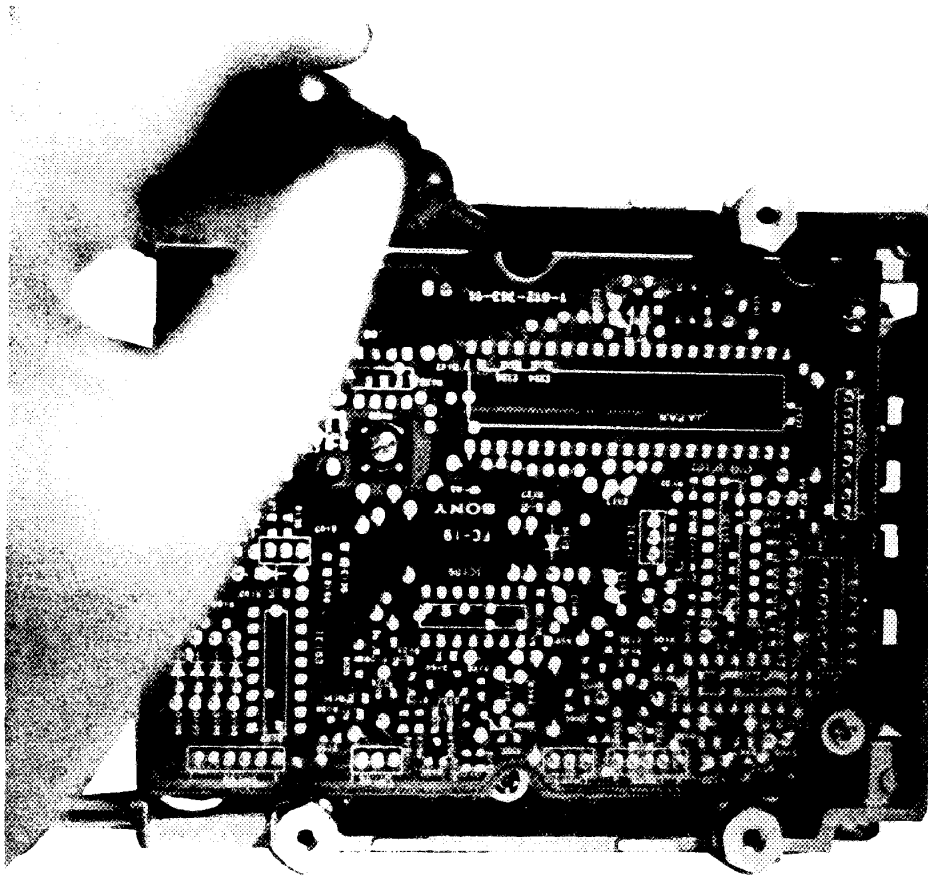

Figure 13-19 Carrier mechanism screw locations.

> **Note that three additional gold-colored screws on top of the circuit board do not have to be removed.**

8. As shown in Figure 13-20, disengage the disk carrier mechanism from the chassis.

9. With clean paper towels, wipe up as much of the old sticky grease as you can. The more you wipe up now, the less you'll have to dissolve later.

10. Set up a disposable aluminum tray as shown in Figure 13-21. Hold the eject mechanism over the tray and spray the remaining grease away with WD-40.

11. Work the levers back and forth as shown in Figure 13-22. Thumbs are shown on the release points. Work these points back and forth and respray as necessary until all of the old grease is gone.

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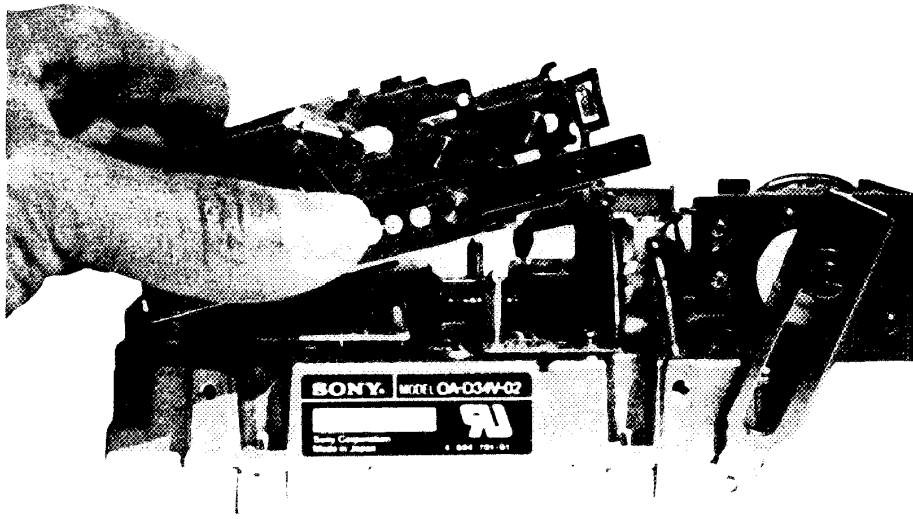
Figure 13-20 Carrier mechanism removal.

Figure 13-21 Spray away the old grease with WD-40.

12. WD-40 both removes the old grease and relubricates the drive. No additional lubrication is necessary. Reverse steps 8 through 1 to reassemble the repaired disk drive.

Relubricated carrier mechanisms work as good as new. Repairs last indefinitely because, unlike grease, WD-40 can't solidify.
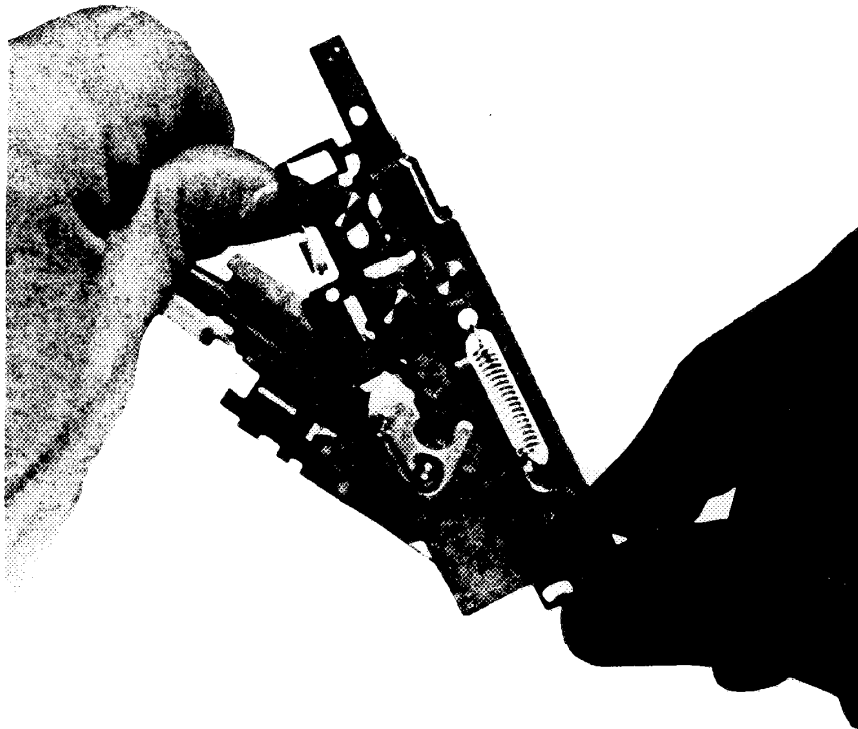
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Figure 13-22 Work the sliders back and forth until all of the old grease is gone.

This same procedure works for 400K Macintosh disk drives as well. The lubrication principles also apply to 800K Mac drives. Unless you operate in a hermetically sealed environment, all auto-eject drives eventually develop problems with the carrier mechanism. Tiny eject motors don't have nearly the same strength as a human finger on a push button. Periodic relubrication is (or at least it should be) part of routine maintenance.

Drive Does Not Make Eject Noises and Disks Get Stuck

Occasional eject failures which are not accompanied by eject noises indicate that the OEM Lisa drive has been replaced with an OEM Mac drive. Despite the mechanical similarity between 400K drives (right down to the part numbers!), the OEM Lisa model has a different eject mechanism. It's always triggered on shutdown, whether there's a disk in the drive or not. The OEM Mac model is not triggered, unless there *is* a disk in the drive. Since the Lisa can't do a disk check after a System crash, Mac drives fail to eject them when you restart the computer. Inserted disks remain in the drive, and the Lisa's boot ROM doesn't know what to make of them. There are three possible fixes.

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One is to drill a ⅟₁₆-inch hole to the right of the drive opening (just like small Macs) and use a straightened heavy-duty paper clip to eject the disks. The second is to repair and reinstall the original Lisa drive. The third is to install MacWorks Plus version 1.0.6 or later. Because MacWorks Plus includes 800K drive support, and since the only difference between a 800K Lisa drive and an 800K Mac drive is the mounting hardware, this problem was (and had to be) taken care of, or the 800K Lisa disk drive would malfunction exactly the same way. MacWorks Plus cures many long-standing Lisa problems. We'll be taking a very close look at it at the end of this chapter.

Grinding Noises

Grinding from the disk drive indicates a dirty stepper cam, a dirty head, and/ or a clogged pressure pad. Clean the cam shaft with cotton swabs and WD-40, but don't loosen the cam retaining screw. Dirty heads should be cleaned the same as tape recorder heads. For easier access, pull back the pressure pad assembly as shown in Figure 13-23. Use a cotton swab moistened with tape head cleaner.
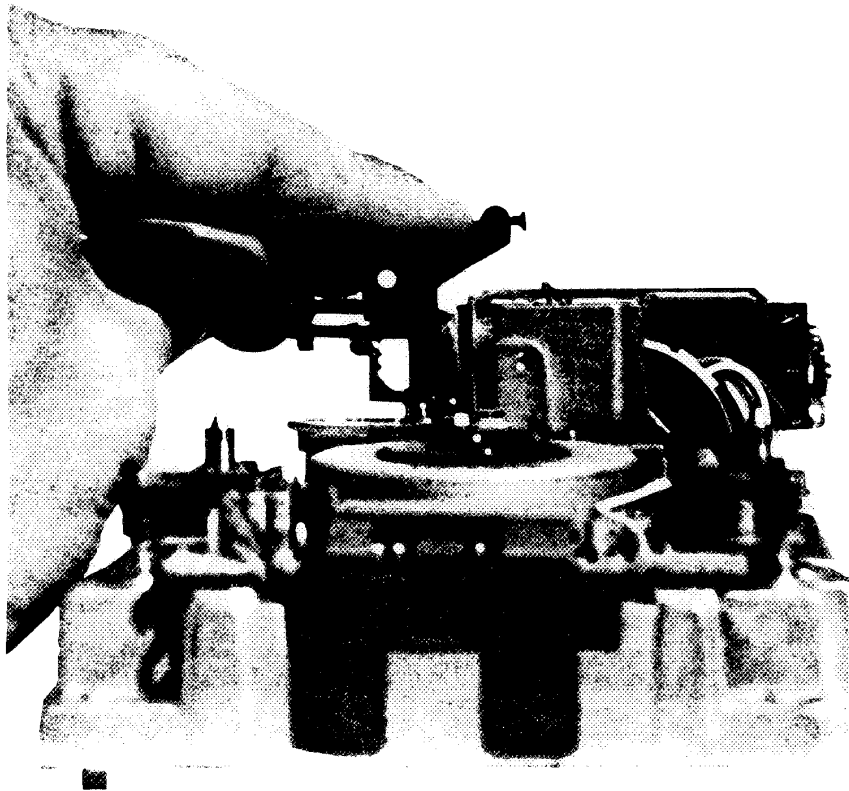

Figure 13-23 For easy access to the 400K drive head, pull back the pressure pad assembly.

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The pressure pad is made of a cotton-like material. Brush it clean with a small lint brush. If none is available, flick the surface with your fingernail. Depending on the age and condition of the drive, be prepared for a surprising amount of disk dust! Cleaning fluids should be avoided; they tend to be absorbed.

Hard Drive Repairs

The Lisa's OEM parallel hard drives (external Profile drives and internal Widget drives) are subject to three common problems:

1. Startup error code 81—pertains to 10MB Widget drive.
2. Startup error code 84—pertains to all Lisa hard drives.
3. Sad Mac error code 0F0064—pertains to all Lisa hard drives formatted under MacWorks 3.0 or MacWorks XL.

Startup Error 81

Startup error code 81 pertains primarily to the Lisa 2/10 and the Macintosh XL. Both models have a 10MB internal hard drive equipped with an electric brake. On startup, immediately after completion of the module tests, the electric brake makes a distinct clunk. If there's no clunk, it means the brake froze (didn't release). If the brake freezes, the hard disk can't spin; the result is a cross over the internal drive icon with error code 81 as shown in Figure 13-24.
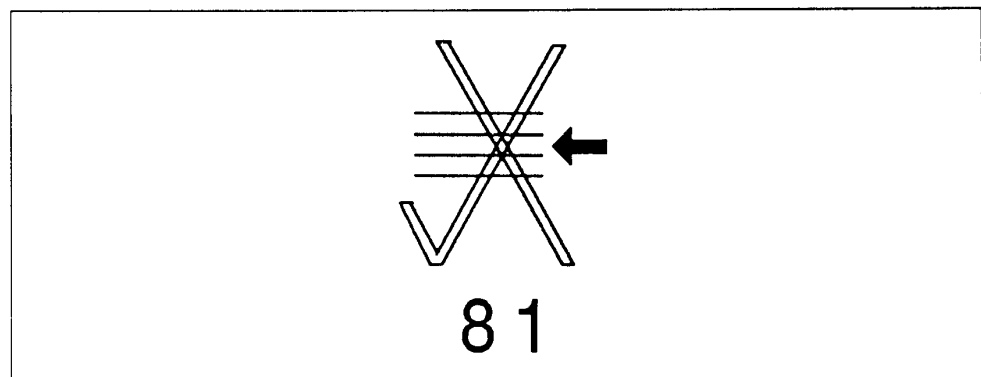

8 1

Figure 13-24 Error code 81 indicates a problem with the brake solenoid.

Without further information, many people assume that they need a whole new hard drive. Rather than spend the money, they shelve the computer. Well, it's time to dust them off! Error code 81 simply means the

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brake is out of adjustment. You can fix it, easily, in under an hour, with a #1 Phillips-head screwdriver and a .012-inch feeler gauge. Here's the complete procedure:

1. Disconnect the computer's power cord from the wall outlet.
2. Remove the disk-drive cage as shown in Figures 13-1 to 13-3.
3. Disconnect all data and power cables from the installed drives.
4. Turn the cage upside down. This puts the relatively light disk drive on top and the relatively heavy hard drive on the bottom.
5. Use a #1 Phillips-head screwdriver to remove six screws (three on each side of the cage) which hold the hard drive in place.
6. Lift the drive cage straight up. This leaves the hard drive upside down on the table.
7. Use a #2 Phillips-head screwdriver to remove four screws from the sheet metal support bracket as shown in Figure 13-25. Lift the bracket away and put it aside.
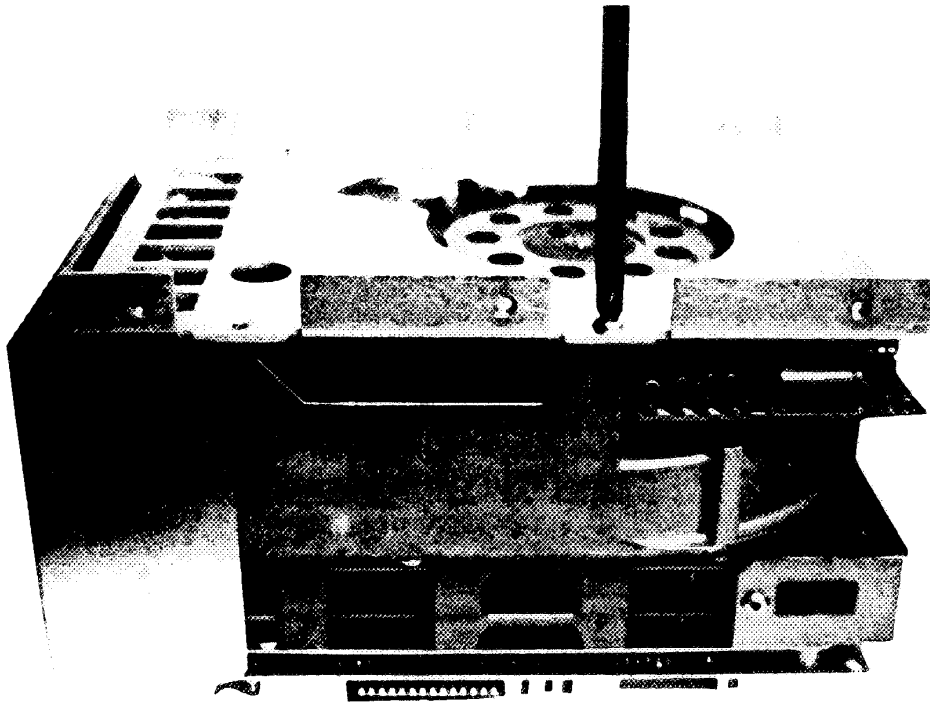

Figure 13-25 Four screws hold the sheet metal support bracket.

8. Locate the solenoid marked "Inertia Dynamics, Collinsville, CT USA." Insert a 0.012-inch feeler gauge as shown in Figure 13-26.
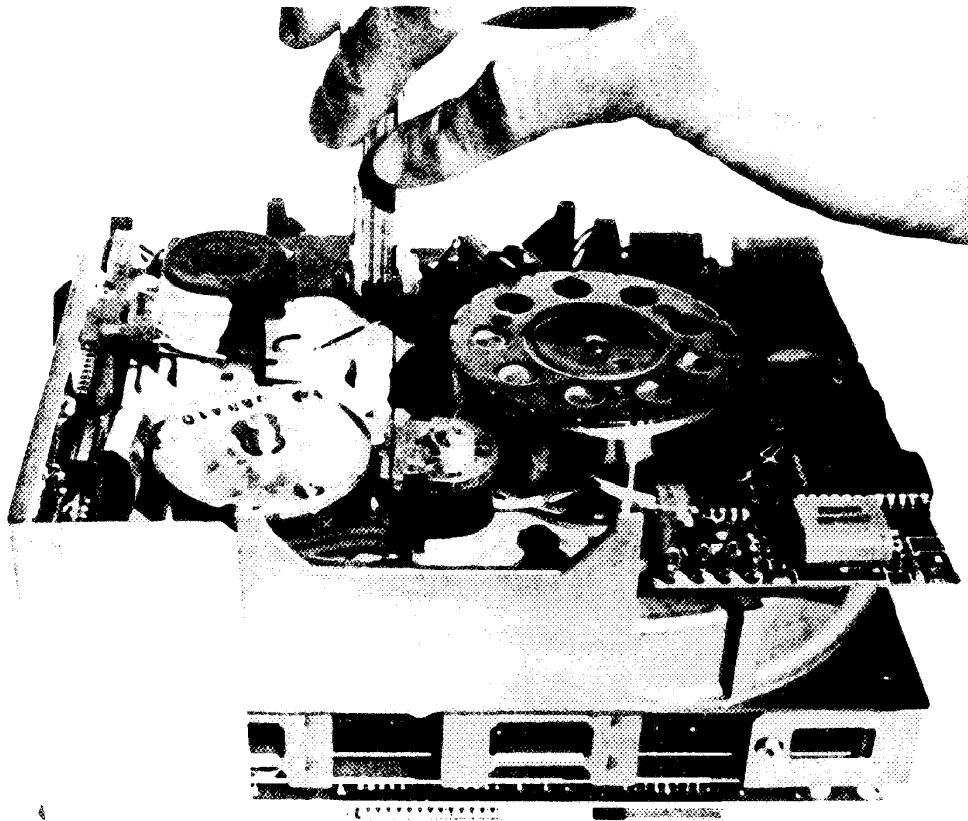
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Figure 13-26 Adjust the brake with a 0.012-inch feeler gauge.

9. At the time of failure, clearance might be as much as 0.075 inch. Loosen the solenoid holding screw and adjust for 0.012-inch clearance.

Tighten the screw, reverse steps 7 through 1, and everything should be OK! If not, repeat steps 1 through 9, allowing a little more or a little less clearance, until you get the brake working again.

Startup Error 84

Startup error code 84 pertains to Profile and Widget drives. It means the boot blocks are damaged. There are three possible fixes.

Fix one involves double-reformatting the drive—first under Lisa OS, then under MacWorks XL. Double-reformatting the drive is time-consuming and it only applies to unmodified computers. You can't use this method with a Macintosh XL Screen Modification Kit unless you pull the 3A ROMs and reinstall the old ROMs. Also, double-reformatting doesn't *always* work. In fact, it's never worked for me! Still, other people I respect have been successful with this method so, for what it's worth, I'm mentioning it here.

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Fix two involves reformatting the drive with MacWorks Plus version 1.0.14 or later. Holding down the Apple and the left Option keys while double clicking the MW_Install icon opens the program in the expert mode. Expert mode recognizes most unmountable drives and gives the option to you to reinitialize them. Afterwards, the drive may or not be bootable.

Fix three involves sending your drive to Sun Remarketing. Using a special machine, Sun technicians can do a low level format, which rewrites the boot blocks, then a high level format, which installs the latest version of whatever operating system you've been using (Lisa OS, MacWorks XL, or MacWorks Plus). This method always works and it's a lot less painful than having to buy a whole new drive.

Sad Mac Error Code 0F0064

Sad Mac error code 0F0064 pertains to any Lisa hard drive formatted under MacWorks 3.0 or MacWorks XL. At the time the original MacWorks was written, other Macs weren't equipped with hard drives. The old System software, written to 400K floppy disk specifications, has trouble dealing with big disk directories. If over 100 files accumulate, everything slows down and eventually fails. Error code 0F0064 generally indicates an irreparable problem with the System & Finder. There are three possible fixes. The first fix involves rebooting from the hard drive while holding down the Option key. If MacWorks itself is OK, you'll get a floppy disk icon with a blinking question mark. At that point, insert the MacWorks System disk. It'll load, you'll get the standard "Welcome to Macintosh" sign-on message, and, shortly thereafter, both disk icons (the floppy disk icon and the hard disk icon) should appear. Now all you have to do is replace the System files. To do that, open the System folder on the MacWorks System disk, select the System & Finder and drag them to the hard disk. A dialog box asking whether to "Replace items with the same names with the selected items?" will appear. Click OK and that's all there is to it.

The second fix applies when the hard drive icon doesn't appear. In that event, you need a special disk called Hard Disk Mount. Here's the complete repair procedure:

1. If the computer is on, reach around the back with your right hand and press the reset button. If the computer is off, turn it on.

2. Immediately after hearing the first click, tap any key but Caps Lock.

3. When the STARTUP FROM menu appears, insert the HD Mount disk and click the disk drive icon or hold down the Apple key and press the 2 key (the one on the keyboard, not the one on the keypad) to proceed.

4. When the HD Mount disk ejects, you'll see a floppy disk icon with a blinking question mark. "Hard Disk Mount" will be written under it.

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From here on, the repair is the same as above. Insert the MacWorks System disk, and shortly thereafter, both the floppy disk icon and the hard disk icon will appear. Replace the System files and that's all there is to it.

> **Note: Hard Disk Mount is for repair purposes only. It's not an upgrade! Replacing regular MacWorks with Hard Disk Mount (using the Hard Disk Install utility) is not recommended.**

The third fix is to replace MacWorks XL with MacWorks Plus. MacWorks Plus provides full 128K ROM emulation, including the HFS file system, support for hard drives, support for SCSI drives, and it lets you use later versions of the Macintosh System and Finder. Install MacWorks Plus and you'll never see error code 0F0064 again.

MacWorks Plus

MacWorks Plus was developed by Sun Remarketing in full cooperation with Apple Computer. It's an official upgrade, supplied on disk, either 400K or 800K (you have to specify which) so you can use it with both the old and the new style 3.5-inch disk drives. As of version 1.0.6, the hard disk installer program required a megabyte of standard RAM (two 512K cards). If you have a memory upgrade, the upgraded card has to be in slot 2, and a stock 512K card has to be inserted in slot 1, or the installer won't run. The important point is, you need 1Mb of memory and at least one 512K card to run the MacWorks Plus Installer program. So if you're planning to buy a memory upgrade, make sure you hang on to at least one of the original 512K cards!

What It Does

Other Macs contain two ROM (read only memory) chips packed with unique operating code. The Lisa doesn't. As soon as you turn on other Macs, portions of that code are read into RAM (random access memory). All Macintosh programs, including the System and Finder, rely on that code and presume it's going to be there. If it's not there, programs can't execute.

The MacWorks Plus Install program creates a file containing complete 128K ROM emulation on a read only portion of your hard drive. Immediately after the automatic startup tests, that code is read into RAM by the Lisa's boot ROM. From that point forward, the Lisa is, for all intents and purposes, a big-screen Macintosh Plus.

The initial installation of MacWorks Plus takes several hours. This summary will give you an idea of what's involved:

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MacWorks Plus Hard Drive Installation

1. Since the installer program reformats (erases) the hard drive, an important preliminary step is to back up all important files. Skip old system files. MW+ 1.0.6 requires new Macintosh System software (System 4.2 or later), so backing up System files is needless. After the backup, shut down normally and wait for the power light to go out.

2. Once the power light is out, wait 15 seconds or so for the internal hard drive to wind down (if appropriate) and turn on the Lisa. At the first click, tap any key but Caps Lock. Tapping a key will engage the Startup From menu as soon as the startup tests are done.

3. When the Startup From menu appears, insert the MW+ Boot disk and press Apple 2 to proceed.

4. As MacWorks Plus loads, a horizontal bar indicates progress. At the end, there's a beep followed by an icon of a floppy disk with a blinking question mark.

5. Assuming you have an icon of a floppy disk with a blinking question mark on the screen, insert the MW+ 400K System disk.

6. Once the desktop appears, eject the 400K System disk by choosing Eject from the File menu or by pressing Apple Shift 1.

7. Insert the MW+ Installer disk and wait for the disk icon to appear. Open the disk icon (if necessary) and then double click the MW+ installer icon. Swap disks as necessary until the program loads.

8. Follow the on-screen instructions to install MacWorks Plus onto your hard disk.

9. Reinsert the MW+ System disk. Drag the supplied System Folder to your hard disk.

10. Choose Shutdown from the Special menu.

11. Reboot. After the self-test finishes, you should see the Loading... indicator, then a MacWorks Plus sign on message. Next you'll be in the Finder.

12. Restore the hard disk. Be sure not to restore old System Files! MacWorks Plus 1.0.6, HyperCard 1.1, and MultiFinder 1.0 all require at least System 4.2 and Finder 6.0. Later versions may require even newer System software. The correct version was transferred in step nine. It's already been installed.

13. Select the Chooser desk accessory from the DA menu. Select the correct printer and reset the printer port.

14. Select the Control Panel desk accessory to reset the time, mouse, and keyboard settings. Choose SunTrol to set contrast, screen dimming, and startup device.

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Miscellaneous MacWorks Plus Information

Once installed, MacWorks Plus loads itself from the hard drive, then it usually boots the hard drive, but sometimes it shows you a floppy disk icon with a blinking question mark instead. When that happens, the Lisa is waiting for you to insert a Macintosh System/Finder disk. If you meant to start from the hard drive, press the right option key to proceed.

To reboot from a startup disk, hold down the Apple key and push the power switch. If you keep the Apple key down, you'll see the floppy disk icon with a blinking question mark. Insert a startup floppy disk, then let the Apple key up. The System file on the floppy disk (assuming it's version 4.2 or later) will now be in control of the computer. Once you get to the desktop, the floppy disk icon will be on top. The hard drive icon will be underneath.

Upgrading to MacWorks Plus may be all you need to do to bring an old Lisa/Mac XL up to the newest specifications. It's part of the 800K disk drive upgrade. It comes with internal hard drive upgrades, and it's available separately.

800K Disk Drive Upgrade

The 800K disk drive upgrade includes a new 800K disk drive, exactly the same drive that comes in every other Mac, a new disk drive ROM chip, the latest Macintosh System software, and the latest version of MacWorks Plus. All you need is a #1 Phillips-head screwdriver to install the drive and a small flat-head screwdriver to install the ROM. Figure 13-27 shows an 800K drive installed in a Lisa 2/5.

Here's the step by step 800K disk drive installation procedure:

1. Disconnect the computer's power cord from the wall outlet.
2. Remove the disk drive cage as shown in Figures 13-1 to 13-3.
3. Disconnect all data and power cables from the installed drives.
4. Remove the internal disk drive by tilting the drive cage forward and loosening four Phillips-head screws at the bottom. Use a #1 Phillips-head screwdriver. Support the drive with one hand as shown in Figure 13-17.
5. Swap drives. Support the new drive the same way. Screw it into the exact same holes.
6. Reconnect the data cables. Replace the drive cage. Reattach the front cover.
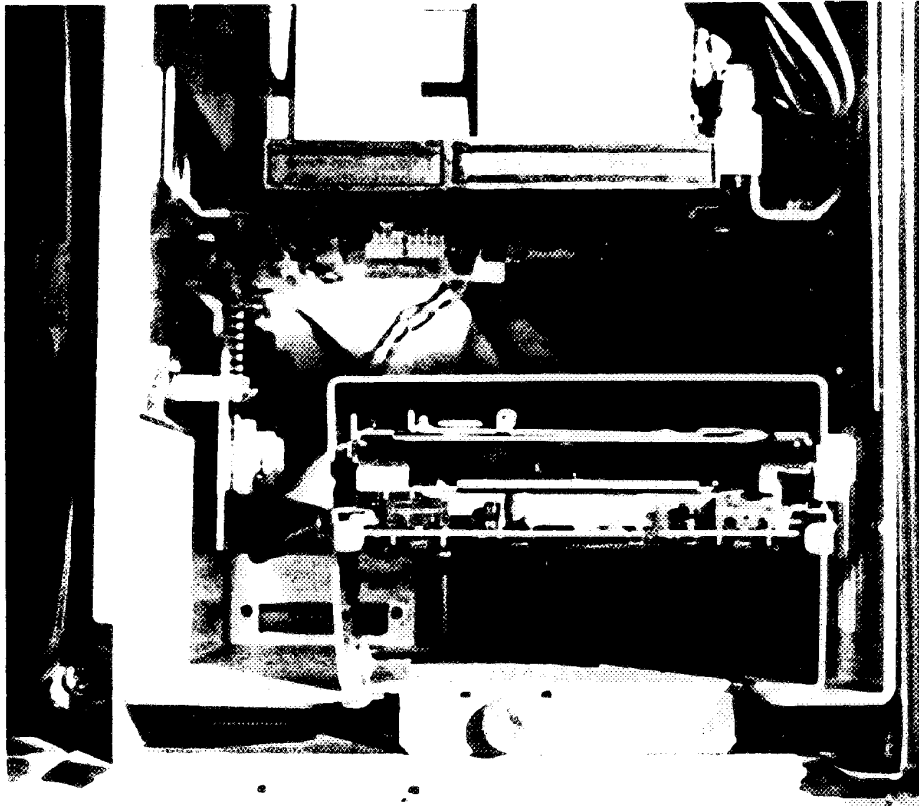7. Remove the rear panel as shown in Figure 13-4.

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Figure 13-27 Apple-brand 800K disk drive shown here in a Lisa 2/5
is the same model used in every other Mac. 20Mb Miniscribe is the
same OEM hard drive used in the Macintosh SE.

8. Refer to Figures 13-11 and 13-12. The disk drive controller circuit is on
   the upper left corner of the board. The disk drive ROM chips are marked
   with white stickers. On a Lisa, the ROM to pull is part# 341-0290 at
   position A1. On an XL, it's part# 341-0281D at position A2. Carefully
   pry both ends of the chip with a small flat-head screwdriver. Be sure to
   work from both ends. If you work from just one end, you'll bend and
   possibly break the pins.

9. Orient the new chip so that the notch is pointing upward. Plug it into the
   socket. On a Lisa, the chip fits the socket perfectly. On a Macintosh XL,
   the socket is larger than the chip. Start from the bottom of the socket. The
   top of the socket is not used.

10. Replace the rear cover, reattach the power cord, and that's it.

    Lisa 1's can also be fitted with an 800K disk drive upgrade. You'll need
to replace the front cover; otherwise, the procedure is identical.

Internal Hard Drive Upgrades

Internal hard drive upgrades vary, but if you specify, you can buy the exact same OEM drives that come in a Macintosh SE. Here's the step by step internal hard drive installation procedure:

1. Disconnect the computer's power cord from the wall outlet.
2. Remove the disk-drive cage as shown in Figures 13-1 to 13-3.
3. Disconnect all data and power cables from the installed drives.
4. If there is an existing hard drive, turn the cage upside down. This puts the relatively light disk drive on top and the relatively heavy hard drive on the bottom. Use a #1 Phillips-head screwdriver to remove six screws (three on each side of the cage) which hold the hard drive in place. Support the drive as necessary. Lift the drive cage straight up. This leaves the hard drive in your hand or upside down on the table.
5. Swap drives. Support the new drive the same way. Screw it into the exact same holes.
6. Reconnect the cables. Replace the drive cage. Reattach the front cover.

Figure 13-27 shows a 20MB Miniscribe, the same OEM model that comes in a Macintosh SE, installed in a Lisa 2/5. Since there's no internal hard drive connector on a Lisa 2/5, the data cable is plugged into an external connector as shown in Figure 13-28.
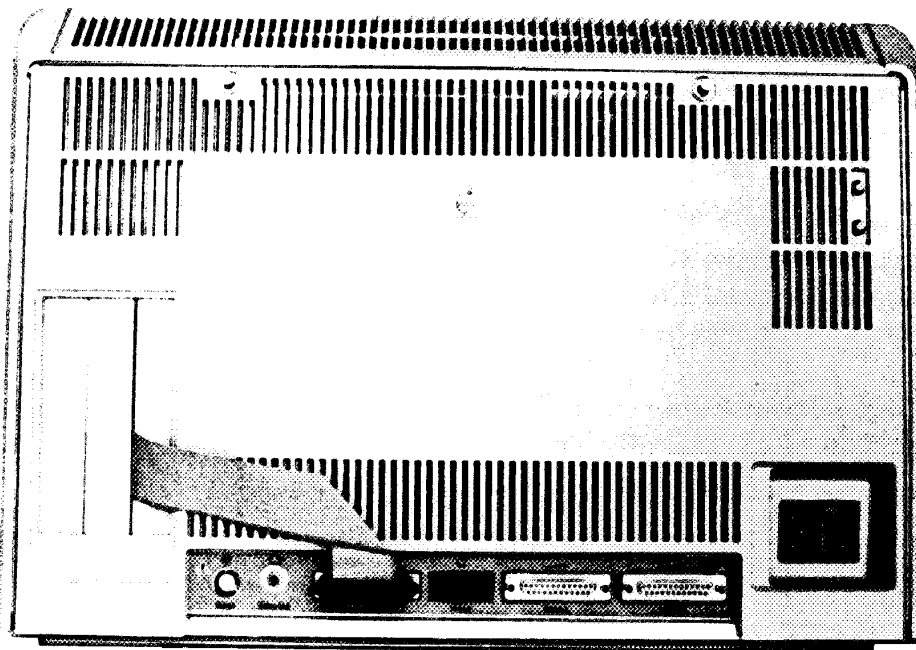
Figure 13-28 On the Lisa 2/5, internal hard drive upgrades
plug into an external connector.

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Noisy Hard Drives

Some hard drives tend to be intermittently noisy, like an annoyingly loud refrigerator. This problem isn't unique to Lisa/Mac XL internal hard drives, it occurs with other Mac hard drives as well. The fix is to remove the drive and check for a static discharge button. Intermittent strange noises often mean the discharge piece is too close to the media. Bend it back with a soldering aid as shown in Figure 13-29 and the noise will be gone. Be careful when you're doing this, but don't be overly concerned about bending it back too far. Some vendors advise removing the static button altogether. Generally, all you have to do is bend it back a little.
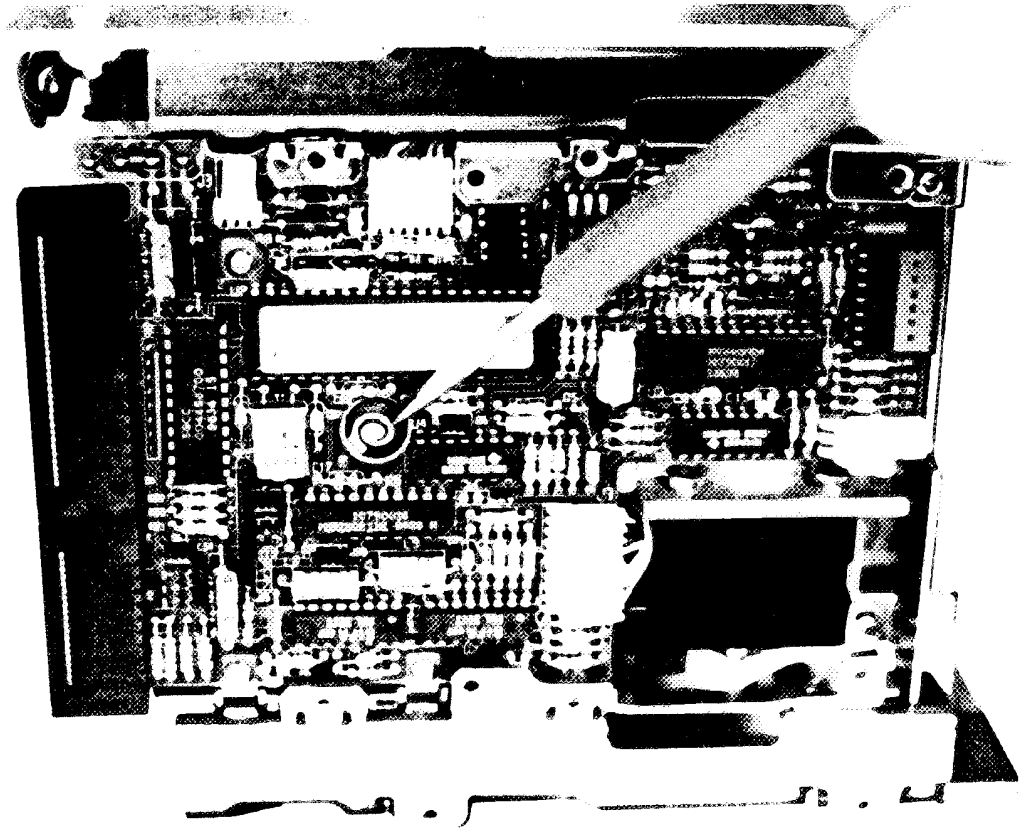
Figure 13-29 Intermittent strange noises often mean the discharge piece is too close to the media.

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Expansion Card Upgrades

As shown in Figure 13-28, the Lisa has three PC-like expansion slots to the left of the rear panel. Recently developed expansion cards that simply plug into these slots include the multivoice sound processor (with audio output jack) shown in Figure 13-30 and the external SCSI port shown in Figure 13-31. Together with an 800K disk drive upgrade, these cards essentially turn any 1Mb Lisa/XL into a big-screen Macintosh Plus.
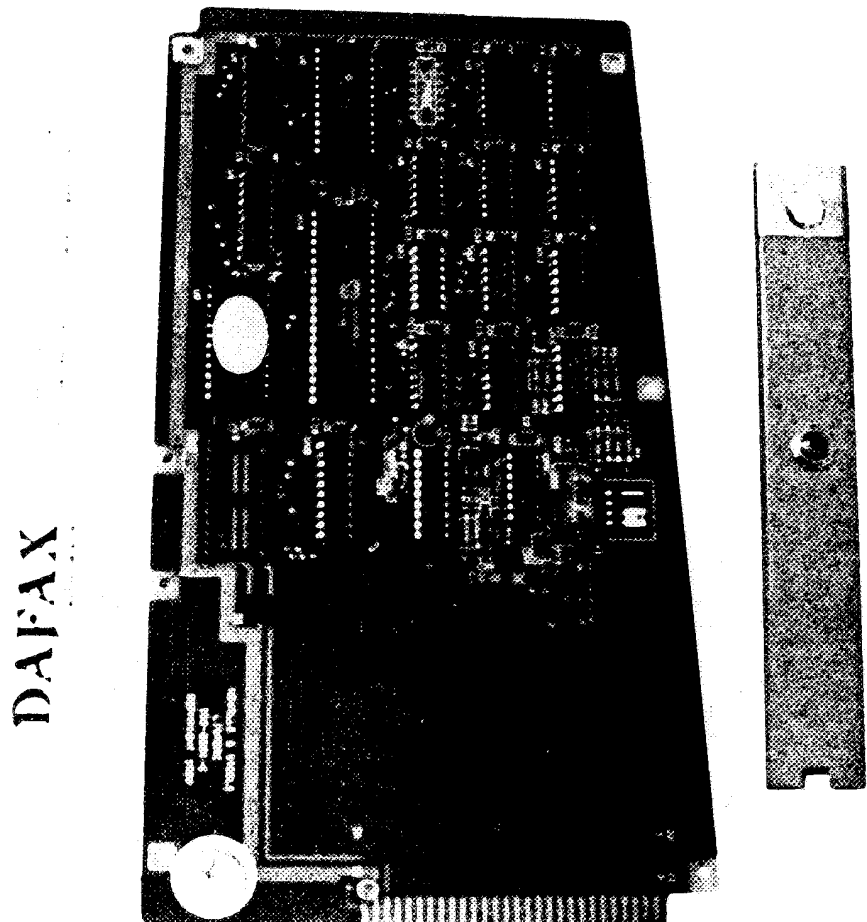
Figure 13-30 Multivoice sound card for the Lisa/Mac XL.

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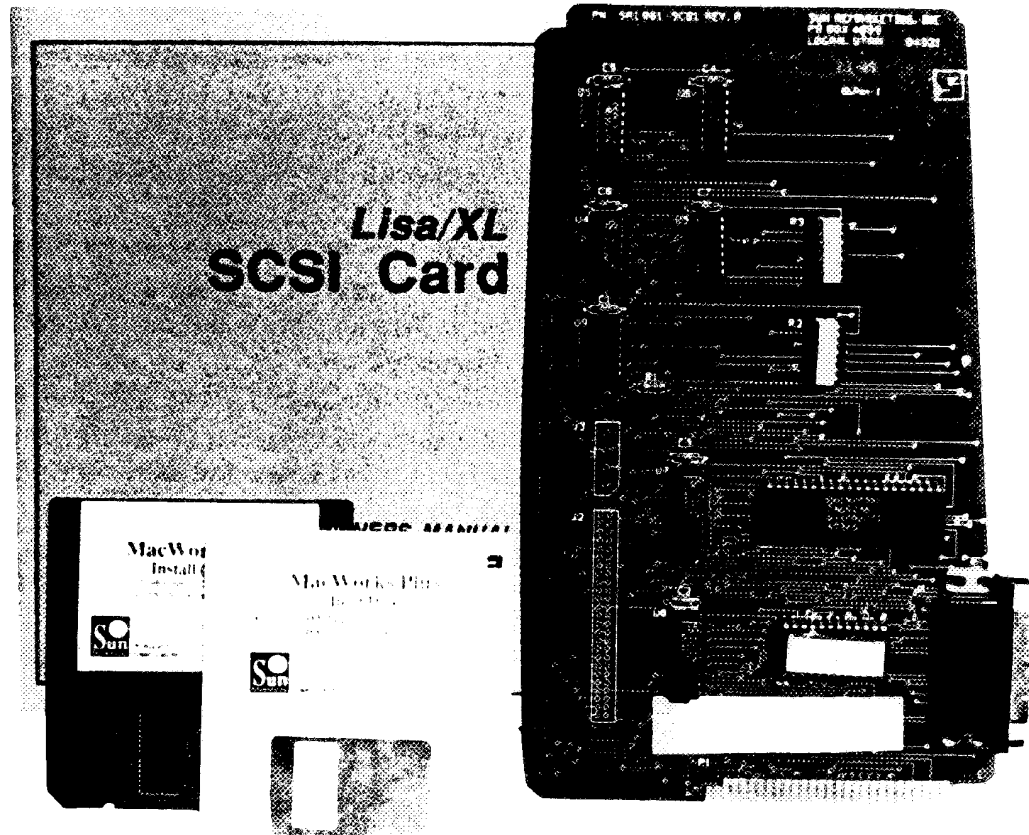
Figure 13-31 SCSI card for the Lisa/Mac XL.

Memory Upgrades

Early AST Ramstack upgrades (long since discontinued) took the Lisa/XL to 1.5Mb or 2.0Mb. RAM cards recently developed for the Lisa/XL use PC-style 256K×9 single inline memory modules (SIMMS). Upgrading beyond 2Mb requires CPU board modifications as well. Although the MC68000G8 processor can logically address 16 Mb, the original design of the Lisa/XL CPU board contains only enough physical address lines for 2Mb. By contrast, the 128K to 512K Mac CPU board contains just 0.5Mb of physical address lines, and the Mac Plus CPU board contains physical address lines for 4Mb. The necessary CPU board modifications add extra memory addresses, allowing you to populate the Lisa SIMM card all the way to 4Mb.

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Video Upgrades—External Monitors

All Lisa/Mac XL computers are equipped with a composite video out connector. As shown in Figure 13-28, the video connector is a standard RCA jack located just to the right of the reset button, at the rear of the computer. This connector accepts ordinary RCA phono cables, defined as shielded 2-conductor wire with an RCA phono plug on each end. Unlike the Macintosh 128K to Macintosh II, it's not necessary to buy or build an add-on video card to use an external monitor on the Lisa/Mac XL. All you need is an external monitor with *autosynchronous multiscanning capability* and a matching *composite video in* connector.

One inexpensive multiscanning monitor that works very well on the Lisa/Mac XL (and just about every other computer, including Apple II's, Mac SE's, Mac II's, and PC compatibles) is the Princeton Max 15. Since the Max 15 is an autosynchronous multiscanning monitor with both composite video and TTL connectors, all you have to do to use it on a Lisa/Mac XL is plug it in via the composite video connector. By comparison, inexpensive TTL monitors designed for PC compatible computers don't work at all on the Lisa/XL; nor do NTSC compatible composite monitors designed for Apple II's and Apple III's.

Video Upgrades—Internal Monitor—Macintosh XL Screen Kit

No recently restored Lisa/Mac XL is complete without a Macintosh XL Screen Kit. Unlike the standard 9-inch Macintosh which has square pixels, the stock Lisa/XL has rectangular pixels. With rectangular pixels, circles look like footballs, squares look like spaghetti boxes. The purpose of the Macintosh XL Screen Kit is to square up the pixels. Proportions become exactly the same as on other Macs (1 to 1), but the overall display area (608 pixels × 432 pixels) is made roughly the same as a 12-inch Macintosh II WYSIWYG monitor (640 × 480). Standard 9-inch Macs only display 512 × 342 pixels.

The complete screen modification kit includes new 3A boot ROMs, a new video ROM, a new yoke transformer, MacPaint 1.5, Macintosh System Software Update 2.0 and MacWorks XL version 3.0, just about everything you need to run early Macintosh software on a Lisa. (Newer software requires System Update 5.0 and MacWorks Plus as well.) Conscientious installation of the complete screen kit requires one to two hours. This summary will give you an idea of everything that's involved:

1. If the set is on, power down normally and switch off the power.
2. Physically disconnect the power cord from the wall outlet. If you're the least bit hesitant about discharging the CRT, leave the set disconnected overnight. By the next morning, most, if not all, of the high-voltage charge will have dissipated.

3. Disconnect all peripheral cables, and remove the rear cover from the back of the computer. Refer to Figure 11-4.

4. Remove the card cage and the CPU board. Refer to Figures 13-9 to 13-10.

5. Remove the existing 20-pin video ROM from location C6 on the CPU board. Replace it with part number 341-0348.

6. Remove the 28-pin boot ROM from location D12 on the CPU board. Replace it with part number 341-0347.

7. Remove the boot ROM from location D14. Replace it with part number 342-0346.

8. Replace the CPU board and put the card cage aside. Don't reinstall it just yet.

9. Remove the top cover. Refer to Figure 13-13.

10. Remove all rings, watches, and jewelry. Put on safety goggles.

11. With one hand behind your back, discharge the CRT through a 10-meg resistor as suggested in Figures 1-13 to 1-15.

12. Unplug the green and yellow CRT (yoke) to P2 cable from the video board. As illustrated in Figure 13-32, P2 is located approximately halfway down the left side of the board.
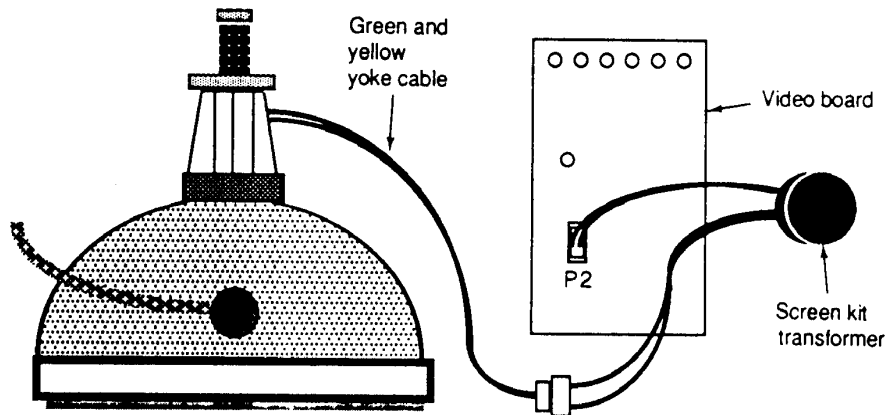
Figure 13-32 XL screen kit wiring details.

13. Plug the yoke cable into the new screen kit transformer. Plug the new transformer into P2.

14. The new transformer attaches to the outer wall of the disk-drive chamber with double-sided tape. Clean the area, and attach the transformer as shown in Figure 13-33.

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Figure 13-33 The new transformer attaches to the outer wall of the disk-drive chamber with double-sided tape.

15. Locate the six adjustment potentiometers labeled "CONT.," "HOR. PHASE," "HEIGHT," "V. HOLD," "WIDTH," and "V. LIN" which are at the top of the video board. As shown in Figure 13-34, these adjustments have been sealed at the factory and will have to be unsealed and readjusted for use with the screen kit.

16. With a sharp razor knife, carefully remove all of the sealant. The key word here is *all*. It's not enough just to break the sealant. Any glob that remains may artificially limit the adjustment, making it impossible to properly realign the screen. For best results, every glob of sealant must be removed!

17. Refer to Figure 13-9. Slide the card cage back into the Lisa, and reconnect the power cord. Turn on the Lisa/XL.

18. Adjust an accurate VOM meter to the lowest DC volt scale capable of measuring 5.0 V DC. Attach the black probe to the Lisa chassis. Locate the HOR. PHASE potentiometer, labeled R34, which is second from the left as you face the front of the video board. Turn around and face the rear of the video board. Find the point where R34 is soldered to the printed circuit. Insulate the red VOM probe with a piece of shrink tubing. Carefully touch the tip of the insulated, red probe to the rightmost of the potentiometer's three solder joints. (Note: if you do this while leaning over the front of the computer, the 5.0-V joint will be on your left.) Be careful not to short uninsulated probe tips to the steel card

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cage. Observe the meter. It should read 4.95 to 5.0 volts. If the reading is out of range, go on to step 19. If it's in range, skip to step 21.
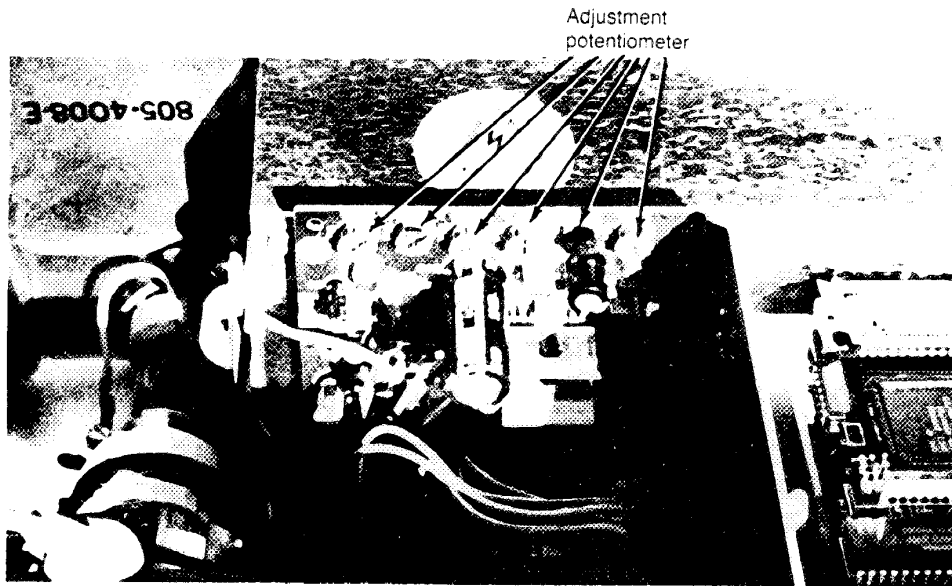

Figure 13-34 The CONT., HOR. PHASE, HEIGHT, V. HOLD, WIDTH, and V. LIN adjustments are at the top of the video board.

19. Refer to Figure 13-5. Turn off the Lisa/XL. Face the rear of the computer and unplug the power cord from the power supply. Unscrew the knurled knob and remove the supply by pulling straight back. New units may offer some resistance. Pull straight back.

20. As shown in Figure 13-35, find the access hole on the left side of the power supply. With a long-handled ⅛-inch slotted screwdriver, tweak the +5.00-V adjustment pot (R11) clockwise ¹⁄₁₆ of a turn. Reinsert the supply and measure again (repeating step 18). If the meter still doesn't read +5.00 volts, repeat steps 18 through 20 until it does.

21. The Macintosh XL Screen Kit generally causes horizontal foldover which manifests itself as an annoying ⅛-inch to ¼-inch white bar at the left edge of the screen. Turn the horizontal phasing control (at the top of the video board) counterclockwise until it's gone. Properly adjusted, the pointer on the HOR. PHASE pot will typically indicate eleven o'clock. If you can't adjust the HOR. PHASE pointer past twelve o'clock, check for excess sealant and remove it as noted in step 16. If the pointer turns fully counterclockwise and you still have a foldover problem, check the +5.00 voltage adjustment as noted in steps 18-20.
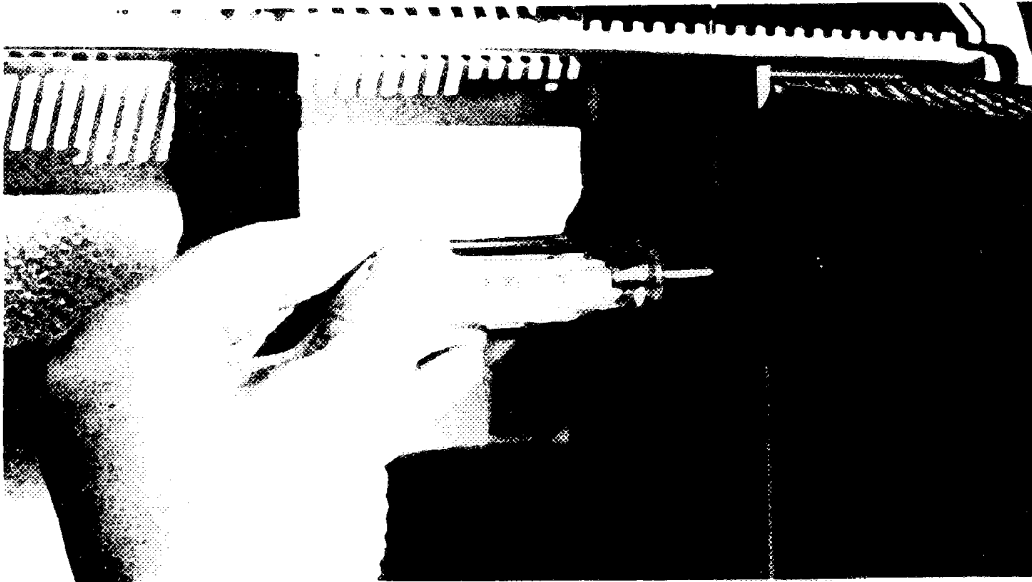
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Figure 13-35 The +5.00-V adjustment can be reached through this
access hole on the left side of the power supply.

The next step requires accuracy and involves the use of a soft cloth ruler (also
known as a dressmaker's ruler). Use a good one. Because the edge protectors on
cheap rulers are only haphazardly cemented to the tape, the first and last inches
could be off by as much as ⅛ inch! Attempting the final alignment procedure
with an inaccurate ruler will prove futile. Choose a quality cloth ruler. Check it
carefully for accuracy before proceeding.

22. Boot MacWorks or MacWorks Plus, and run 512K-TPG. Select 12-inch
    XL Screen Kit from the Screen Sizes menu, then choose Crosshatch from
    the Test Patterns menu. Hold a soft cloth ruler up against the screen.
    Measure the grid blocks. Typically, you'll find that the first few grid
    blocks will measure somewhat less than 1 inch and the last few grid
    blocks will measure substantially more than 1 inch. Adjust the HEIGHT
    and WIDTH controls on the video board until the grid blocks become
    squares, measuring exactly 1 inch × 1 inch. Don't be surprised if you
    have to turn both controls fully counterclockwise (to approximately 8
    o'clock). The final raster should measure exactly 8.44 inches in width

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and 5.99 inches in height. If it's substantially larger than that, shut down the Lisa/XL and remove the power cord. Pull the card cage, observe the metal chassis and find the L3 (coarse width) access hole. As shown in Figure 13-36, L3 is located below the alignment pots and has to be tuned from the back side of the board. Insert a plastic hexagonal alignment tool through the access hole and turn L3 counterclockwise (in), one full turn. That should do it. Reinstall the card cage, reboot, and repeat the HEIGHT and WIDTH adjustments for best linearity.

23. Hold down the left Option key and select Balance Test from the Test Patterns menu. Stand back and evaluate the screen. The five test patterns should be nice and round, not egg-shaped. The grid blocks should be square, not rectangular. The display should also be square to the frame, not tilted. If the screen displays any of these problems, go to step 24. If not, skip to step 28.

24. If the raster is intolerably off-center or tilted, shut down the Lisa/XL and remove the power cord. Remove jewelry, put on goggles, etc., and discharge the picture tube again.

25. Refer to Figure 3-12. Remove the sealant from the purity rings at the neck of the CRT until both rings move freely.

26. Refer to Figure 9-2. In the event the raster was also tilted, loosen the yoke retainer as well.

27. Plug in the Lisa and, while exercising all precautions, adjust the purity rings using just one hand, until the raster is centered on the screen. Next, adjust the yoke, if necessary, until the raster is square to the screen. With one hand still behind your back, carefully snug the yoke.

28. Complete the installation by relocking the adjustments to the PC board with fresh sealant.

29. Replace the top and the back cover. You now have a big-screen WYSIWYG Macintosh display.

One final note, as mentioned earlier in this chapter, when the XL Screen Kit is used with the Lisa's light duty 1.2-A power supply (Apple Part# 620-6103), audible transformer ringing may result, horizontal retrace lines may become noticeable, and a slight screen flicker may be introduced. The fix is to install the Lisa's heavy-duty 1.8-A power supply (Apple Part# 699-0189).
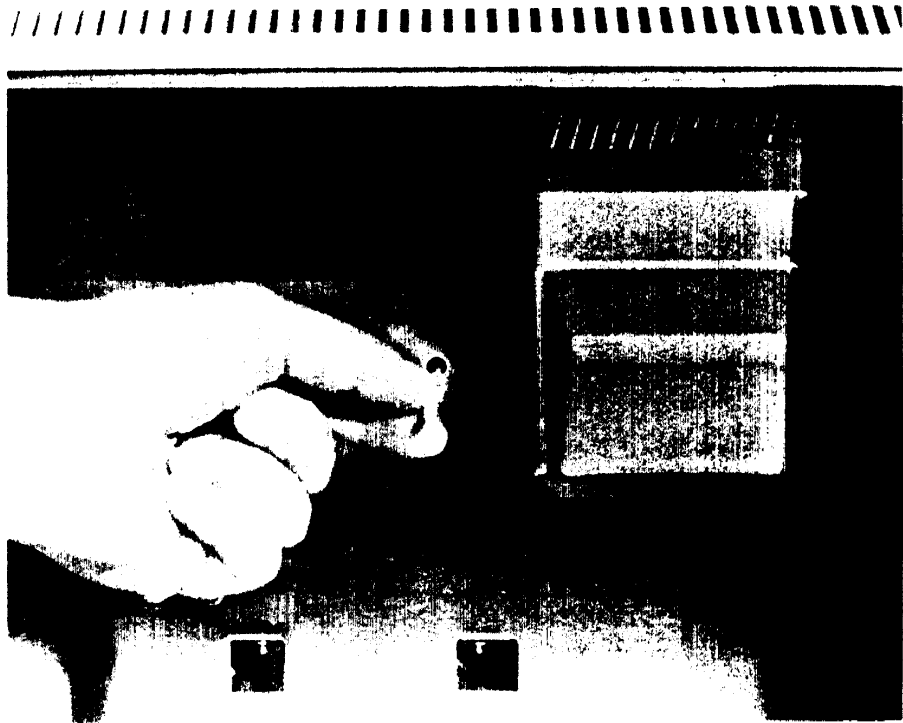
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Figure 13-36 L3, the coarse width control, is located below the alignment pots and has to be tuned from the back side of the board.

Summary

Despite the implication, an XL Screen Kit is not something you buy to turn a Lisa into a Mac XL. It's something you buy to turn Lisas and Mac XL's into WYSIWYG big-screen Macintoshes. Combined with an 800K disk drive upgrade, the result is a big-screen 1024K Macintosh. Combined with SCSI and multivoice sound cards, the result is a big-screen Macintosh Plus. Combined with an internal hard drive, the result is a big-screen Macintosh SE. Add on an accelerator card, and what you've got is somewhere between a Macintosh SE and the Macintosh II.

Consider the similarities: All three computers have detachable, dual voltage, heavy-duty power supplies. All three computers accept internal hard drives. All three have built-in expansion slots. All three have internal boxer fans. All three have heavy-duty keyboards with integral numerical keypads. The Macintosh II is regularly matched to a 12-inch monochome display. The Lisa/Mac XL is permanently matched to a 12-inch monochrome display. You could almost say that the philosophy has come full circle. We'll see how far it's come around when we look at the Macintosh SE in Chapter 14.
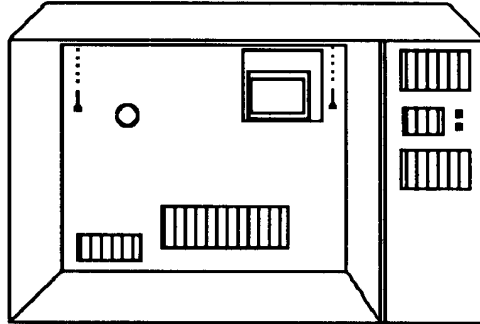
FINIS

Lisa/Macintosh XL Take-apart

Getting at the Lisa video board requires that you remove the back panel and pull the card cage. The top cover is held on by two screws located deep inside the chamber.
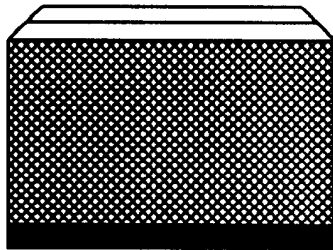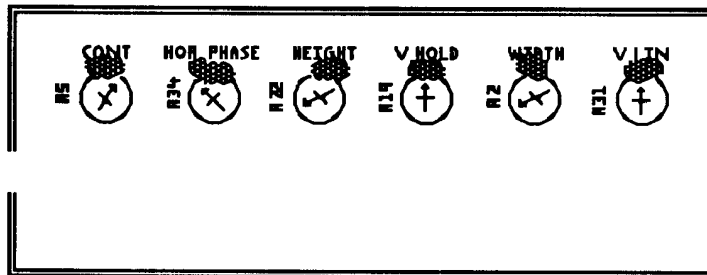

Card Cage   Rear View

☞ **Included for educational purposes only.**
Refer servicing to qualified personnel.

Lisa/Macintosh XL Alignment

The HOR PHASE, HEIGHT, V. HOLD, WIDTH, and V. LIN potentiometers are all on the Lisa video board. Each will have to be readjusted for use with an XL Screen Kit.
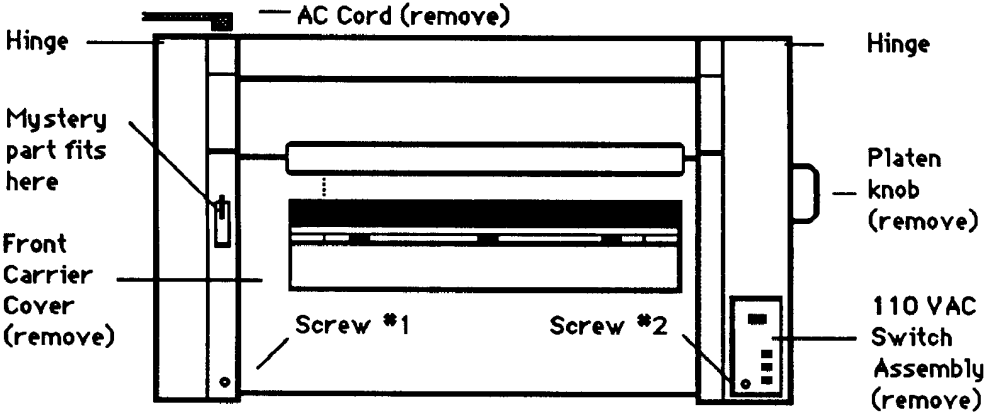

The potentiometers have been factory sealed with globs of paint. Readjusting the screen requires removing as much sealant as possible. Any globs that remain may impede rotation and artificially limit the adjustment range.

☞ **Included for educational purposes only.**
Refer servicing to qualified personnel.

ImageWriter Take-apart

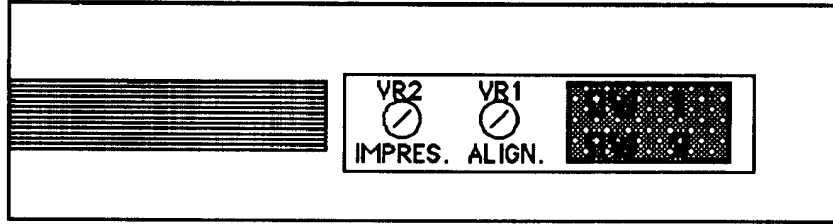The ImageWriter is held together by two hidden screws and rear plastic hinges.

AC Cord (remove)

Hinge

Hinge

Mystery part fits here

Platen knob (remove)

Front Carrier Cover (remove)

Screw #1

Screw #2

110 VAC Switch Assembly (remove)

☞ **Included for educational purposes only. Refer servicing to qualified personnel.**

ImageWriter Alignment

The ImageWriter alignment potentiometer (VR1) is readily accessible below the drive cabling near the dip switches under the front carrier cover.

VR2 ⊘ IMPRES.

VR1 ⊘ ALIGN.

☞ **Included for educational purposes only. Refer servicing to qualified personnel.**

APPENDIX

B

Dealer/Manufacturer Addresses

Altex Electronics
(2-pin shorting blocks, 4-position/
4-contact handset plug crimpers, 4-
position/4-contact handset plugs,
IDC connectors, mini DIN 8 plugs)
300 Breesport
San Antonio, Texas 78216
(800) 531-5369

Central Products
(Macintosh take-apart tools)
2211 Norfolk, Suite 518
Houston, Texas 77098
(713) 529-1080

Computer Service Experts
(amber, green, and OEM CRT's)
3484 The Alameda
Santa Clara, California 95050
(408) 984-5091

Dafax Processing Corp.
(Lisa/Mac XL parts and upgrades,
Lisa/Mac XL sound cards)
14 North Drive
Malba, New York 11357
(800) 323-1751

Digi-Key
(2 ⅜-inch 12-V DC boxer fans, 3.9-
mfd 100-V DC NP metalized
polyester caps, 4-position/4-
contact handset plugs, HF
Panasonic caps, microswitches,
SIMM sockets—call for a catalog)
701 Brooks Avenue South
Post Office Box 677
Thief River Falls, Minnesota 56701-
0677
(800) 344-4539

Dove Computer Corporation
(Install-it-yourself SCSI upgrades
for the 512Ke, install-it-yourself
SIMM upgrades for the Macintosh
Plus, Macintosh take-apart tools—
call for nearest dealer)
1200 North 23rd Street
Wilmington, North Carolina 28405
(800) 622-7627

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Edmund Scientific
(2 ⅜-inch 12-V DC boxer fans, 120/
240-V AC piezoelectric fans—call
for a catalog)
101 East Gloucester Pike
Barrington, New Jersey 08007-1380
(609) 573-6250

Howard W. Sams & Co.
(*Microcomputer Troubleshooting &
Repair* computer books, and basic
electronics/repair books)
Post Office Box 775
Carmel, Indiana 46032

Jacques Ebert Associates
(2 ⅜-inch 12-V DC boxer fans, 3.9-
mfd NP 100-V HF radial caps, 4-
mfd NP 25-V HF axial caps—call
for nearest dealer)
44 School Street
Glen Cove, New York 11542
(800) 645-2666

Jameco Electronics
(41-256 RAM chips, handset cables,
miscellaneous OEM parts,
replacement mice, soldering
equipment, 8-pin DIP 220/330
dual terminators, test equipment—
call for a catalog)
1355 Shoreway Road
Belmont, California 94002
(415) 592-8097

JDR Microdevices
(DB19 connectors, miscellaneous
OEM parts, soldering equipment,
test equipment—call for a catalog)
2233 Branham Lane
San Jose, California 95124
(408) 559-1200

MCM Electronics
(41-256 RAM chips, 4-position/4-
contact handset plug crimpers, 4-
position/4-contact handset plugs,
handset cables, flyback
transformers, miscellaneous OEM
parts, soldering equipment, test
equipment—call for a catalog)
650 East Congress Park Drive
Centerville, Ohio 45459-4072
(800) 543-4330

MicroSolutions
(400/800K Mac disk-drive
controller cards for XT and AT
compatible computers)
132 West Lincoln Highway
DeKalb, Illinois 60115
(815) 756-3411

MicroStore
(Teflon surfaced mouse feet)
Post Office Box 33
LeSueur, Minnesota 56058
(800) 962-8885

Micro Systems Design
(Lisa/Mac XL schematics)
Post Office Box 1187
Loomis, California 95650
(916) 652-5665

**Mobius Technologies,
Incorporated**
(MultiScreen video card for the
Macintosh SE, Multiscanning
monitors for the Lisa/ Mac XL and
the Macintosh SE)
6020 Adeline Street
Oakland, California 94608
(415) 654-0556

Philips ECG
(Replacement semiconductors—
call for nearest dealer)
1025 Westminster Drive
Post Office Box 3277
Williamsport, Pennsylvania 17701
(717) 323-4691

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Radio Shack
(Microswitches, miscellaneous
OEM parts, soldering equipment,
test equipment)
over 700 stores coast to coast
listed in the phone book under:
"Electronic Equipment &
Supplies"

R&D Electronic Surplus
(Nickel-cadmium batteries,
surplus keyboard assemblies—call
for a catalog)
1224 Prospect Avenue
Cleveland, Ohio 44115
(216) 621-1121

Sears Roebuck and Co.
(#1 screwdrivers, 1-inch spring
clamps, WD-40)
hundreds of stores coast to coast
listed in the phone book under:
"Sears Roebuck and Co"

Sher-Mark Products Inc.
(Antiglare magnification screens)
521 East 83rd Street—Suite 2R
New York, New York 10028
(800) 323-1776 Extension 71

Shreve Systems
(Analog boards, disk drives, logic
boards, OEM memory upgrades,
ROM chips, used parts)
2421 Malcolm Street
Shreveport, Louisiana 71108
(318) 635-1121

Soft Solutions
(2⅜-inch 120-V AC boxer fans, 3.9-
mfd NP 100-V HF radial caps, 18-
gauge power supply harnesses,
BU-406 transistors, component
level repairs, flyback transformers,
heavy-duty power supply upgrade
kits, J1 connectors, L2 coils,
Macintosh schematics, OEM
power supply components,
stabilant chemical for electrical
connectors)
907 River Road, Suite 98
Eugene, Oregon 97404
(503) 461-1136

Sophisticated Circuits ✔
(41-256 RAM chips, do-it-yourself
128K to 512K memory upgrade
kits, do-it-yourself 512K to 2048K
memory upgrade kits, install-it-
yourself SCSI upgrades for the
512Ke, install-it-yourself SIMM
upgrades for the Mac Plus and the
Mac SE)
19017 120th Avenue North East,
Suite 106
Bothell, Washington 98011
(206) 547-4779

Sun Remarketing
(Lisa/Mac XL parts and
upgrades—call for a catalog)
Post Office Box 4059
Logan, Utah 84321
(800) 821-3221

**Systems Control, a Division of
M.J. Electric**
(Dual-outlet surge suppressor with
integral antistatic touch pad)
Post Office Box 788E
Iron Mountain, Michigan 49801
(800) 451-6866

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Technology Works
(Do-it-yourself internal and
external hard drive kits, OEM hard
drives, SIMM upgrades for the
Mac Plus and the Mac SE)
4030 Braker Lane West, Suite 350
Austin, Texas 78759
(800) 622-2210

True Value Hardware
(¼-inch ratchet sets, ¼-inch T-15
insert bits, ⅜-inch outside diameter
¼-inch bit holders, 1-inch spring
clamps, WD-40)
Hundreds of stores coast to coast
listed in the phone book under:
"Hardware-Retail"

Larry P.'s Guide to Mail-order Sanity:

1. If there's no address and/or no phone number in a magazine advertisement, it means the company positively does not want to talk to you. Don't waste your time. Shop elsewhere!

2. Avoid ordering from any catalog with a misplaced index. Locating misplaced indexes is a hassle. If management misplaced their own index, imagine what they're going to do with your order!

3. Avoid ordering from any catalog printed on high glare paper. If the printed presentation glares, you can bet the personal service will glare even more.

4. Don't discuss. Don't ask. Know what you want before you pick up the phone.

5. Observing these failure avoidance strategies will steer you away from incompetent mail-order firms, but you could still receive unsatisfactory goods. In that case, please call the company that filled your order. This address list is not an endorsement. The author cannot guarantee your satisfaction.