Macintosh® Computers

Service Guide

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Apple Service Guide
Macintosh Computers—Introduction

Introduction

The *Apple Service Guide for Macintosh Computers* is the first volume in a series of booklets being developed to help Apple-certified technicians troubleshoot and repair Apple products at their customers' sites. The second release, *Apple Service Guide for Laserwriter Printers*, will be available in April 1991. Subsequent releases will cover networking and communications and Macintosh peripherals.

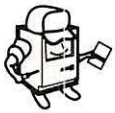
The *Apple Service Guide for Macintosh Computers* does not replace the *Apple Service Technical Procedures*. The *Apple Service Guide* condenses information found in the *Technical Procedures* and other Service publications, and presents this information in a booklet format that is easy to use and easy to carry. The guide includes *only* information that experienced technicians absolutely need to quickly and reliably service Macintosh computers at the customer's site.

This March 1991 update to the *Apple Service Guide for Macintosh Computers* replaces the original version of the guide (released in August 1990). For this update we made the following additions and revisions:

- Added new software and hardware troubleshooting information, and relocated this information to a new tab (On-Site Troubleshooting) at the front of the guide.
- Added information covering Apple's newest Macintosh computers—the Classic, LC, and IIsi **(see Using the Guide on the next page)**.
- Revised information in the Portable tab to cover the new backlit display.
- Located Apple Desktop Bus (ADB) input devices and part numbers in the General Information tab, and added other helpful information to this tab.

Key Features

- Portability—At 5-1/2 by 8 inches and 160 pages, the guide is easy to handle and carry. Just slip the guide into your toolbox or briefcase.
- Ease of use—The plastic spiral binding is tough and enables you to lay the guide open on any available surface. The paper is durable, and its matte finish prevents glare from overhead lighting. The booklet uses tabs, subject/product icons, and color highlighting to help you locate information quickly.
- Presentation of information—Information has been condensed to the extent possible while type size has been kept easily readable. Extensive charts, tables, and graphics present information clearly and concisely.
- No updating required—**This guide will be updated only as necessitated by product changes or new product introductions. Updated versions of the guide, such as this March 1991 release, replace previous versions.**
- Professional appearance—This guide is a high-quality publication that employs the new Apple Service design and uses color to emphasize important information. The cover has a protective coating to resist stains, and the high-resolution printing process enhances the guide's professional appearance and readability.



Guide Contents

Using the Guide

IMPORTANT: When ordering a replacement module or spare part, be sure to check the part number given in the guide against the current price pages in the* Apple Service Programs *manual. Remember that the* Apple Service Guide *is not updated on a regular basis.

Safety Procedures and Practices: You should be completely familiar with all safety procedures and practices before using this guide. Please read this section.

Tab 1 – On-Site Troubleshooting: This tab section contains generic troubleshooting information that you might find immediately helpful when you encounter a problem at your customer's site. This information includes:

- Software troubleshooting information, including on-site quick checks, a system crash checklist, and desktop procedures and practices
- Guide to system failures with system failure codes and explanations
- Generic hardware troubleshooting guide and flowchart
- System software installation and system-software compatiblity guide

Tabs 2-7: The six Macintosh computer tab sections contain information specific to particular models of the Macintosh computer. The types of information included are:

- Exploded-view drawings of the Macintosh systems
- Alphabetical parts lists (keyed to the exploded view drawings) with part numbers*
- Symptom/cure troubleshooting charts addressing system-specific problems
- System specifications, adjustments, and upgrade procedures

Tab 8 – General Information: This tab section contains information that applies to more than one of the Macintosh computers. In this section you can find:

- Internal disk drive information
- 1 MB and 256K SIMM identification tables
- MacTest™ hookups and procedures
- ADB input devices and part numbers
- An index to the special tools required to repair Macintosh computers

Tab 9 – Ports and Cables: This tab section includes a table of peripheral cables, Macintosh external connectors, tables of peripheral cable pin-outs, and pinfaces.

Safety

Warnings

WARNING: The compact Macintosh computers contain high voltage and a high-vacuum picture tube. To prevent serious personal injury and property damage, make sure you read and understand the safety precautions on the following pages.

WARNING: Voltage and video adjustments are performed with the power on. Review the following cathode-ray tube (CRT) safety and live adjustment rules before performing these adjustments.

WARNING: Failure to follow the rules for safe CRT discharge could result in serious injury or property damage. For compact Macintoshes, the CRT must be discharged to the ground lug to prevent damage to the logic board.

WARNING: Make sure that you are *not* grounded when:

- You are working on plugged-in equipment
- You are discharging a CRT
- You are working on an unplugged CRT that has not yet been discharged
- You are performing live adjustments

WARNING: Electrostatic discharge (ESD) can cause severe damage to sensitive microcircuits. Macintosh circuit boards contain CMOS components, among the most sensitive chips in use today. CMOS chips, ROMs, and SIMMs are very susceptible to ESD and skin acid damage. To prevent damage to these components, handle them only by the edges.

WARNING: Pulling a disk forcefully from a drive may damage the mechanism. If a disk does not fully eject, refer to "Disk Ejection Problems" in the General Information section.

WARNING: A "dead" lithium battery is considered hazardous waste and has some potential for explosion if improperly handled. Mark the battery "Dead," place it in a zip-lock wrapper and the packaging used to ship the replacement battery, and return the dead battery to Apple, where it will be disposed of following EPA guidelines. Exception: If the battery is physically damaged, do not return it to Apple; dispose of the battery locally according to local ordinances.

Ten Rules to CRT Safety

1. **Do not work on a monitor alone.** In case of an accident, having someone nearby—and having someone trained in CPR—could save your life.

2. **Remove all jewelry before performing repairs on a CRT.** Removing these conductors reduces the possibility of electric shock.

3. **Never use a grounding wriststrap or heelstrap or work on a grounded workbench mat when discharging a monitor or when performing live adjustments.** Grounding straps and mats are used to protect sensitive components from ESD damage and should be used only when working on "dead" (uncharged) equipment.

4. **Wear safety goggles when working with a CRT.** The CRT contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself). To protect your eyes, always wear safety goggles.

5. **Before working inside a monitor, turn off the power and disconnect the AC power cord.** Certain parts of a monitor chassis are hot (electrified) when the monitor is under power. Never work on a monitor under power except when making live adjustments.

6. **Keep one hand in your pocket or behind your back when working on a live monitor.** This reduces the risk of current passing through your body, should you accidentally contact high voltage.

7. **Always discharge the anode before touching anything inside the monitor.** High voltage (up to 12,000 volts DC) can be present on the anode **(see Figure)** and other components—even when power is off.

8. **Never touch the anode connector or the anode aperture.** When a CRT is replaced, the anode connector is removed, exposing the anode. The anode can retain a charge of several thousand volts even when power is off and can regain some charge even after being discharged.

9. **Do not pick up or handle a CRT by its neck (see Figure).** To prevent an implosion, take every precaution against breaking the tube. Be especially careful with the neck, where the tube is thinnest.

10. **In addition, never touch the following components (see Figure) when adjusting a live Macintosh CRT:**

    - The back of the power switch
    - The yoke wires
    - The anode connector
    - The anode wire
    - The flyback transformer

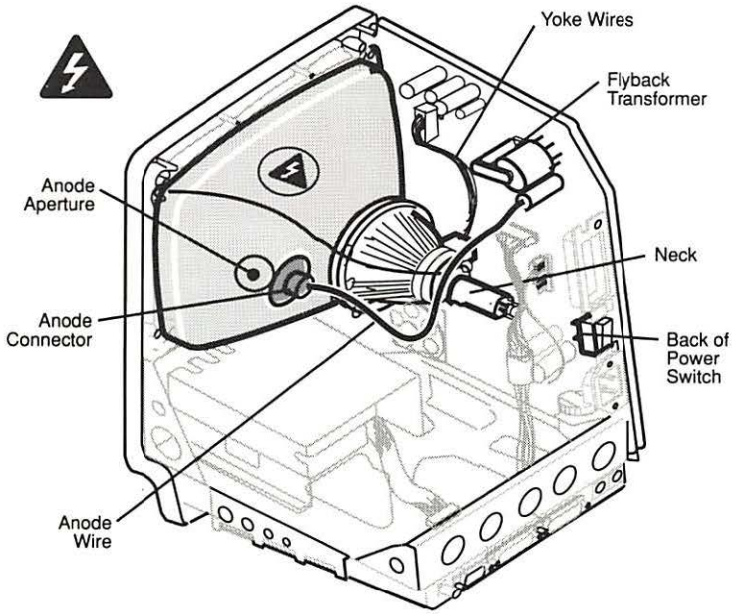


Figure: CRT High-Voltage Areas

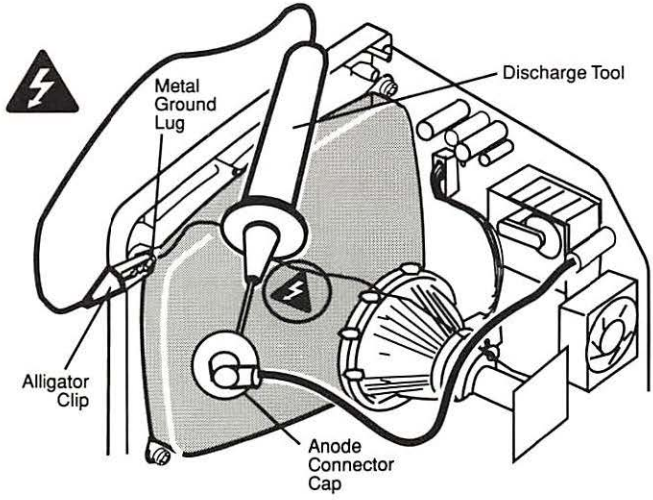


Figure: Discharging the CRT

Discharging & Devacuuming the CRT

Use the following procedure to discharge high voltage (12,000 volts) from the picture tube of a compact Macintosh. This procedure and the CRT discharge tool **(see "Special Tools Index" in the General Information section)** can be used to discharge any Macintosh monitor.

WARNING: Discharge the anode to the metal ground lug (see Figure on the previous page). Failure to do so will damage the logic board.

Discharge Procedure

1. Remove your grounding wriststrap and jewelry, and put on safety goggles.
2. Attach the alligator clip on the CRT discharge tool to the metal part of the ground lug **(see Figure on the previous page)**.
3. Put one hand in your pocket or behind your back. With your other hand, insert the tip of the CRT discharge tool under the anode cap **(see Figure on the previous page)** until it touches the anode ring.
4. Remove the CRT discharge tool. To be sure the CRT is discharged, repeat the discharge procedure (you may want to repeat the procedure using a flat-blade screwdriver with an insulated handle).

Note: *The anode can build up voltage over time. To drain off any residual charges, establish an ongoing ground. Fasten one end of an alligator lead to the ground lug and the other end to the anode aperture.*

Disposing of the Cathode-Ray Tube (CRT)

To prevent serious injury, follow the procedure described in this section whenever discarding a CRT.

WARNING: To properly dispose of a defective CRT, you must first devacuum the cathode-ray tube. Discarded CRTs that have not been devacuumed may become cracked and implode, injuring anyone who happens to be near.

Materials Required

Thick cardboard box large enough to conceal the CRT
Large, sharp diagonal cutters
Large pliers and duct tape
Safety goggles and gardening gloves
12" x 12" piece of cloth or heavy paper

Devacuuming Procedure

1. Put on safety goggles.
2. In the side of the box, about six inches from the bottom, cut a hole just large enough to insert the tip of the CRT neck.
3. Place the CRT inside the box with the tip of the neck protruding through the hole, and tape the box flaps down with the duct tape **(see Figure on the next page)**.

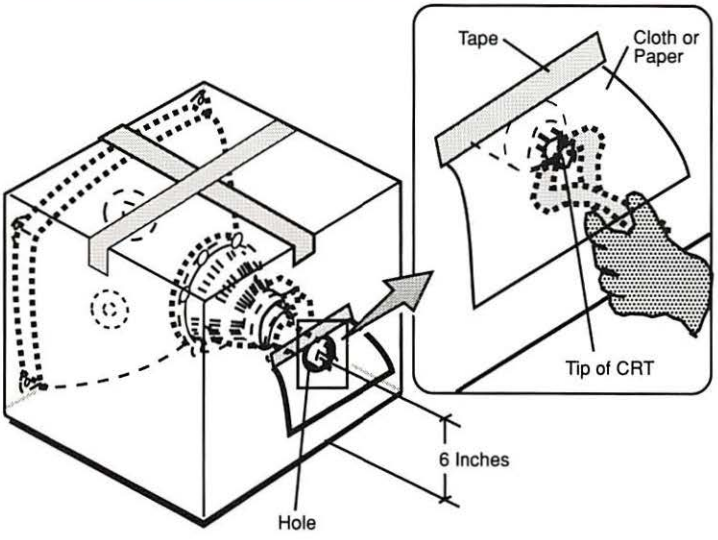


Figure: Devacuuming the CRT

WARNING: Only the very tip of the CRT neck should be protruding through the hole in the box, and the box must not have any other opening.

4. Put on the gloves and, using the diagonal cutters, carefully clip off the connector pins on the end of the CRT neck **(see Figure)**.
5. Tape the piece of cloth or paper onto the box so that it forms a veil over the opening, but allows access to the tip of the CRT **(see Figure)**. The veil's purpose is to catch bits of glass that may fly during the next step.
6. Make sure no one is standing nearby. Then stand to one side, reach under the veil, and with the large pliers grasp the exposed tip of the CRT. **Look away while you snip off the tip of the CRT.**

Note: *You will probably hear a rush of air entering the CRT when the CRT vacuum breaks—but even if you don't, the procedure is complete if the tip of the CRT is clearly broken off.*

ESD Prevention

Electrostatic discharge (ESD) can irreparably damage the sensitive CMOS chips and printed circuitry of modern electronic components. Plastic utensils, styrofoam cups, polyester clothing, even the ungrounded touch of your hand carry sufficient electrostatic charges to damage electronic components. Follow the ESD prevention rules and procedure on the next page to prevent ESD damage.

ESD Prevention Rules

1. **Before working on a device containing a printed circuit, ground yourself and your equipment.** Use a grounded conductive workbench mat and a grounding wriststrap, and ground your equipment to the mat. However:

WARNING: Make sure that you are *not grounded* when:
- You work on plugged-in equipment
- You discharge a cathode-ray tube (CRT)
- You work on an unplugged CRT that has not yet been discharged

2. **Do not touch anybody who is working on integrated circuits.** You could "zap" the equipment through the technician—even if the technician is grounded.
3. **Use static-shielding bags for boards and chips during storage, transportation, and handling.** Leave all Apple service exchange components in their ESD-safe packaging until you need them.
4. **Handle all ICs by the body, not the leads.** Also, do not touch the edge connectors or exposed circuitry on boards or cards.
5. **Do not wear polyester clothing or bring plastic, vinyl, or styrofoam into the work environment.** The electrostatic field around these nonconductors cannot be removed.
6. **Never place components on any metal surface.** Use antistatic, conductive, or foam rubber mats.
7. **If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator.** Charge levels are reduced (but not eliminated) in high-humidity environments and in areas with ion generators.
8. If an ESD pad/workstation (see below) is not available, touch bare metal on the power supply to discharge electrostatic charges.

Setting Up an ESD-Safe Workstation

Materials Required
Conductive workbench mat with ground cord
Wriststrap with built-in 1-megohm resistor and ground cord
Equipment ground cord with alligator clips
Ground/polarity tester

Setup and Procedure

1. **Remove all ESD hazards from the area.** Nonconductive materials (see rule #5 above) cannot be grounded and retain charges for hours and even days.
2. **Use a ground/polarity tester to verify proper grounding of the power outlet.** If the outlet is wired incorrectly, most testers show a light pattern that matches a code given on the tester. If the tester does not verify proper grounding, move to another outlet that is safe.
3. **Connect the ground cord of the workbench mat to ground.**
4. **Use a wriststrap ground cord. Fasten it to the workbench mat and to the wriststrap.** The wriststrap should touch your skin.
5. **Finally, ground the equipment you are working on.** Use alligator clips and a grounding cord to attach any metal part of the device you are working on to the grounded workbench mat.

On-Site Troubleshooting

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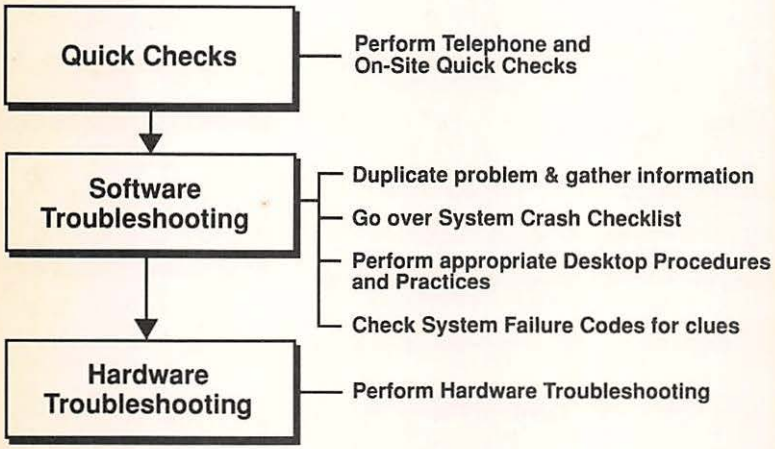
On-Site Troubleshooting—Overall Approach



Telephone and On-Site Quick Checks

- ✓ Check the power source and power connection.
- ✓ Check all cables and cable connections.
- ✓ Check the adjustment of all user controls.
- ✓ Check that not more than one system file is on the startup device/disk.
- ✓ Check that the computer system and the system software are compatible **(see the System-Software Configurations table in this section)**.
- ✓ Open the computer and verify that all circuit boards, fuses, and chips are secure, clean, and undamaged.

Information Gathering

When quick checks do not identify the problem, try duplicating the problem (or have your customer duplicate the problem) and gather as much information about the problem as possible.

Note the following:

- Operating condition of the system when the problem occurs (application and version being run; under Finder or Multifinder; system software and version installed; whether networked; system configuration and attached peripherals; INITs, CDEVs, and DAs installed; etc.)
- *Exactly*, what your customer is doing when the problem occurs
- What happens to the system (freezes, crashes, displays error message)
- What your customer has tried to do to fix the problem, and with what results
- If the problem appeared recently, note what your customer recently changed or added to the system

Using this information, perform appropriate solutions from the following System Crash Checklist. If this systematic approach does not fix the problem, your customer probably has a hardware problem **(refer to Hardware Troubleshooting later in this section).**

System Crash Checklist

✓ **Check whether the problem is peculiar to one application (try replicating the problem using another application). If the application is at fault, try the following:**

Possible Problem	Solutions
Program incompatible with MultiFinder	1. Try booting offending program first. 2. Switch to Finder.
Program incompatible with system software	1. Revert to older version of system software. 2. Remove program from system. 3. Contact vendor about program update.
Program corrupted	1. System crashes can corrupt the program and the system software. Remove the program. 2. Reinstall the program and system software from original disks.
Insufficient memory to run program	1. If under MultiFinder, close other applications and restart program. (You may have to restart the system). 2. If under MultiFinder, switch to Finder. 3. Allocate more memory to application. (Select application, select Get Info from menu bar, and increase allocated memory in the dialogue box.)

The message "Application is busy or missing" displays	1. Make sure application is on drive. 2. Launch application rather than document. If application launches, it is not corrupted. Rebuild your desktop **(see Desktop Procedures and Practices)**.
Programs (especially DAs, INITs, and CDEVs) conflict	1. If program was added just prior to problem, remove offending program. 2. Remove all DAs, INITs, and CDEVs, and replace one at a time until offender is found **(see Desktop Procedures and Practices)**.

✓ **Check whether problem is with system software (try booting from a floppy) or with multiple system folders (use Find File under the Apple menu).**

Problem	Solution
Multiple system folders	– Remove all system folders except folder with the Macintosh icon on it **(see Desktop Procedures and Practices).**
Corrupted system software	– Replace system software. Use Installer on original system software disks.

Important: *When replacing corrupted system software, avoid introducing new problems—always use Installer on the original system software disks. If you remove the System file before running Installer, you will need to replace the fonts and desk accessories on your customer's system. Make copies of your customer's fonts and desk accessories before running Installer. For more information, refer to "Replacing the System File" under Desktop Procedures and Practices later in this tab.*

Desktop Procedures and Practices

Identifying and remedying problems that may be software related requires familiarity with basic desktop management procedures and practices. An inappropriately managed desktop could cause the following problems.

Multiple System Folder Problems

Symptoms:	System crashes, unusual error messages, font and DA lists change unexpectedly.
Occurs:	When disks containing system folders are dragged onto system, or system software is loaded without using Installer
Remedy:	Locate and remove all system folders without the Macintosh icon on the folder; also remove any extra System or Finder files.
Procedure:	Boot from known-good system disk, use Find File DA to locate and remove multiple system folders, and reboot computer.

INIT and CDEV Conflicts

Symptoms:	System crashes and myriad other problems
Occurs:	When INIT or CDEV conflicts with an application on system
Remedy:	Locate and remove all INITs and CDEVs, and then replace them one at a time until the conflict returns.
Procedure:	Place all INITs and CDEVs in a separate folder within system folder (this prevents them from loading when booting system), and return each INIT and CDEV to system folder one at a time. (Renaming an INIT, such as prefixing it with a "Z" so it loads last, sometimes remedies conflict.)

RAM Cache Out-of-Memory Problems

The RAM cache is a Control Panel feature that speeds up the operation of the system. The RAM cache acts as a special RAM buffer between applications and disk drives. From 32K to 768K of the most frequently used blocks of data can be stored in the RAM cache, which can significantly increase speed within an application and will cause applications to launch from and return to the Finder more quickly. Memory problems can occur when the RAM cache is set too high.

Symptoms:	Insufficient memory problems, applications won't run, degraded system performance, ID=28 system bombs in systems configured with 1 MB or less of memory
Occurs:	When RAM cache is set too high (available system memory is insufficient to run program)
Remedy:	Switch off RAM cache, or reduce amount of memory allocated to RAM cache.
Procedure:	Open Control Panel and set RAM cache down as desired, and then reboot system.

Rebuilding the Desktop / Slow Finder

Symptoms:	Finder cannot locate applications that are on disk drive, or Finder is slow.
Occurs:	When disk is overloaded with applications and icons, or applications contain excessive number of file comments
Remedy:	Rebuild desktop file (which erases comments from Get Info comment box of all applications on drive).
Procedure:	Hold down <Option> and <Command> keys while booting, or while quitting application if operating in Finder. Click **Yes** in resulting dialog box (to rebuild the desktop).

Resetting Corrupted Parameter RAM

When an application crashes it sometimes executes code that corrupts parameter RAM on Macintosh II systems running system software prior to release 5.0. PRAM contains information (a default value) required by the Macintosh operating system (OS) to start up from an internal SCSI drive, as well as other OS information.

Symptoms:	Macintosh II will not boot from internal SCSI drive.
Remedy:	Reset parameter RAM to its default values.
Procedure:	Hold down <Shift>, <Option>, and <Command> keys while open-

ing Control Panel DA. Click **Yes** in resulting dialog box to zap PRAM, which resets some user options to their default values.

Restoring Damaged Boot Blocks

Symptoms: System does not recognize or boot from hard disk drive.
Occurs: When startup instructions (boot blocks) on the hard drive are damaged, or the hard disk driver is damaged
Remedy: Replace the hard disk driver.
Procedure: Boot the computer from a startup disk that contains an appropriate hard disk setup program. (For Apple HDAs, use the Apple HDSC Setup program found on a Macintosh System Utilities disk.) Install or update the hard disk driver on the hard drive.

Replacing the System File

Symptoms: Minor, intermittent problems accessing disks, printing, system startup, or launching programs
Occurs: When System file or related files are damaged, often from disk writing errors
Remedy: Replace the System file using the Installer. To ensure that the problem is corrected, you should remove the entire System Folder before using the Installer.
Procedure: Copy all **non-Apple** system folder files from the System Folder to another folder on the desktop (**see below**). Then drag the System Folder into the Trash and start up the Installer program from the original system software disk. Place the non-Apple files in the new System Folder. **(For information about using the Installer, refer to Replacing/Installing System Software later in this section.)**

Apple Files:	Access Privileges	Key Layout	MultiFinder	Finder
(System Folder)	Backgrounder	AppleShare	Keyboard	Mouse
	Clipboard File	DA Handler	Responder	Color
	Startup Device	Easy Access	Monitors	System
	Scrapbook File	Finder Startup	General	Sound

Removing and Preventing Viruses

Symptoms: Unexplained system crashes; corrupted or disappearing files
Occurs: By using a disk or program that is infected by a virus; often contracted from shareware found on electronic bulletin boards
Remedy: Use an anitvirus program to eradicate the virus, and practice virus prevention in the future.
Procedure: Boot the computer from a startup disk that contains an anitvirus application and launch the eradication program. There are several effective antivirus programs, including Disinfectant by John Norstad, Interferon and Virex by Robert Woodhead, and SAM from Symantec.
Prevention: Many of the antivirus applications include programs for screening inserted disks for known viruses—use them! Also, master disks should be locked; applications can be protected by locking them using the Get Info box.

System Failures—Introduction

You are experiencing a serious system failure if your screen fills with dots, strange patterns, or garbage characters, or your Mac emits sounds similar to muted gunfire. Other system failures, often called crashes, can result in a hung system (for instance, your cursor is frozen in place on the screen) or a system bomb with an error message and ID number. Often your only alternative is to hit the reset button on the programmer's switch or restart the computer. However, if you do encounter an alert box containing an error message and code, you should note the error code and check it against one of the tables on the following pages.

You can encounter three types of Macintosh system failure codes: **boot ("Sad Mac") failures**, **system failures**, and **application failures**. Explanations of these error codes can be found in the following tables. Whenever possible, these explanations include suggestions that may help isolate the problem. Further suggestions are given below on this page.

If these suggestions do not help and you have tried the software troubleshooting recommendations on the previous pages of this section, refer to Startup Problems—Flowcharts later in this section. You probably have a hardware problem.

About Sad Mac, System, and Application Error Codes

These codes and explanations (called *Meanings* in the table) can help lead you to the source of the problem. If the Meaning given in the Error Code tables does not recommend a solution, or the solution does not fix the problem, keep in mind that serious system failures can be caused by:

- Software problems (damaged program or system files; incompatible INIT files)
- Data problems (damaged or incomplete data files; corrupted PRAM)
- Damaged boot blocks
- Hardware problems

Possible Solutions:

To rectify system problems, try rebuilding the desktop and restarting your system. If this does not rectify the problem, use another startup disk and try:

1. Removing INITs from your system (especially INITs added recently)
2. Checking the disk for a virus
3. Replacing the System file and Finder using Installer
4. Replacing the application with a fresh copy from the master disk
5. Resetting the parameter RAM
6. Restoring the boot blocks

For instructions on performing these procedures, refer to "Desktop Procedures and Practices" earlier in this section.

Sad Mac Error Codes

If a Macintosh Plus fails at startup, you will see a "Sad Mac" icon **(see Figure)** and a six-digit error code. If a Macintosh SE fails at startup, the problem is usually bad RAM and you will see a 16-digit SIMM error code **(see the Macintosh SE tab)**. If other Macintoshes fail at startup, you will hear a series of error chords **(see Startup Problems—Flowchart 2)**.

Sad Mac error codes can mean that the computer has failed the internal diagnostic tests and you have a hardware problem. Sad Mac codes can also have less serious causes, outlined below.

Other Sad Mac possibilities:

1. A non-System disk in the default drive.
2. A bad boot disk.
3. An incompatible system file on the boot disk.
4. No Finder on the boot disk.
5. The programmer's switch is stuck.

Sad Mac Error Codes

Code	Meaning	Code	Meaning
01____	ROM test failure	0F0006	Overflow trap - TRAPV instruction [2]
02____	RAM test failure (bus subtest) [1]	0F0007	Privilege violation [2]
03____	RAM test failure (byte write) [1]	0F0008	Trace trap [2]
04____	RAM test failure (mod3 test) [1]	0F0009	Trap dispatcher error [2]
05____	RAM failure (address uniqueness) [1]	0F000A	Line 1111 trap [2]
0F0001	Bus error [2]	0F000B	Other trap [2]
0F0002	Address error [2]	0F000C	Unimplemented trap executed [2]
0F0003	Illegal instruction [2]	0F000D	Interrupt button, programmer's switch [2,3]
0F0004	Zero divide [2]	0F0064	Bad System file [2,4]
0F0005	Check trap - CHK instruction [2]	0F0065	Bad Finder [2]

[1] The first two digits indicate a RAM failure; the last four digits identify (in hexadecimal) the suspected bad chip. Try removing the SIMMs, rubbing the connection area with a pencil eraser to improve the connection, and replacing the SIMMs. If this doesn't help, isolate the bad SIMM **(refer to Flowchart 3, SIMM Verification)**.

[2] "0F" indicates a software error—the startup device was spinning before the failure occurred. Try: (1) Restarting the Macintosh with the <Option> and <Command> keys held down (rebuilding the desktop); or (2) Replacing the System file.

[3] Check the interrupt button—it could be stuck.

[4] The startup disk may be missing the System file.

System Error Codes

The two-digit system error code is located in the lower-right corner of the dialog box that informs you "A Serious System Error Has Occurred." **Refer to the System** and **Application Error Codes tables** that follow for a list of these codes and an explanation of their meaning.

System Error Codes

Code	Type	Meaning
01	Bus error	Program attempts to access an invalid memory location. Often caused by corrupt application. Replace application with known-good copy or upgraded version. If replacing software does not help, then probably a hardware problem.
02	Address error	A corrupt application has placed program information in an odd vs. even address location. Install a known-good copy or upgraded version of the application.
03	Illegal instruction	Processor receives an instruction that does not match its internal list of instructions.
04	Zero divide	Programmer told processor to divide by 0 (mathematically impossible).
05	Range check error	Index out of range (for example, programmer declares an array of five elements and searches for the sixth).
06	Overflow	Computer attempts to store a number that is too large for the allotted space.
07	Privilege violation	68000 is running in "user" mode and attempts to execute a command that requires "supervisor" mode.
08	Trace mode error	68000 chip can trace itself for debugging; can interfere with normal execution.
09	Line 1010 trap	Processor cannot execute a ROM call accessed via a trap with a hexadecimal "A" code. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
10	Line 1111 trap	An incorrect ROM call.
11	Exception error	A miscellaneous hardware error not covered elsewhere.
12	Unimplemented core routine	Occurs when program attempts to execute a ROM call via an undefined trap.
13	Uninstalled interrupt	Needed routines are not available or the interrupt switch is pressed when a runtime debugger is not present.
14	I/O core error	Error in the file system or the device manager system.

System Failure Codes

System Error Codes

Code	Type	Meaning
15	Segment loader error	System could not load needed segment from disk into RAM memory. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
16	Foating point error	A mathematical error.
17-24	Packages not present (0-7)	System tries/fails to read special sections of the system file called packages; System file may be damaged.
25	Memory full	Program requests a chunk of memory, but the system couldn't find enough.
26	Bad program launch	Attempt to load program without a CODE resource of 0; program is not a real program. Often caused by a corrupt application. Replace application with a known-good copy or upgraded version.
27	File system map damaged	Something is wrong with information on the disk. Try rebuilding the desktop.
28	Stack ran into heap	Two competing areas of memory, the stack and heap, have collided. You're out of memory or memory is not being managed properly.
30	Disk insertion error	
31	No disk insertion	
41	Finder error	Attempt to boot with startup disk that does not contain the Finder. Create new startup disk.
32-56	Memory mgr errors	
100	Mount volume error	Bad system file.

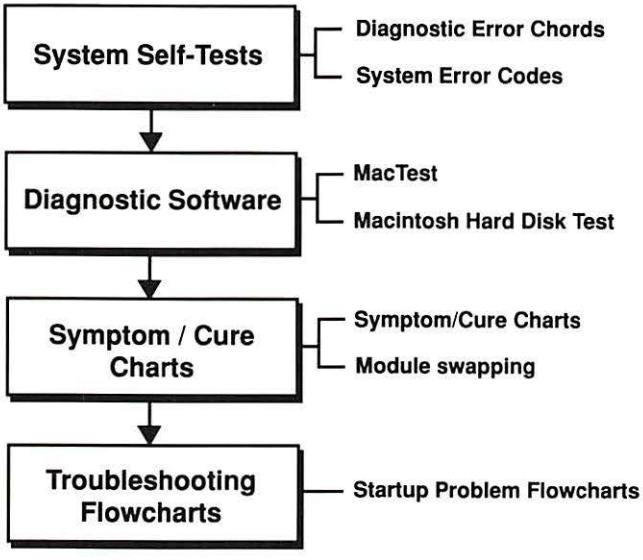
Application Error Codes

Rather than receive an error message such as "The disk is locked," you may receive a negative value error code such as -44 (see below). Refer to the Application Error Codes table below for these codes and their meanings.

Application Error Codes

Code	Meaning	Code	Meaning
-33	File directory full; folder cannot hold any more files.	-48	File with specified name/version number already exists.
-34	Volume/disk is full.	-49	Attempt to open two paths to the same file for writing.
-35	Specified volume does not exist.	-50	Parameter block error.
-36	I/O error.	-51	File reference number does not exist.
-37	Bad file or volume name.	-53	Specified volume (disk) is not present in any drive.
-38	Attempt to read or write an unopened file.	-54	Attempt to open a locked file for writing.
-39	Logical end-of-file reached during read operation.	-55	Volume already mounted.
-40	Attempt to move before start of file.	-56	No such device.
-41	Memory full.	-57	Not a Macintosh disk; volume lacks Macintosh format directory.
-42	Attempt to open too many files.	-59	Attempt to rename a file failed.
-43	File not found or file is corrupted and cannot be saved to. Save the file with another name and trash the original file.	-60	Bad master directory; must reinitialize volume (disk).
-44	Volume is locked by a hardware setting; the disk is write-protected.	-61	Tried writing to a read-only file.
-45	File is "locked."		
-46	Volume/disk is locked by a software flag.	-64	Drive isn't connected or error in updating the boot blocks. Try repairing the boot blocks with Disk First Aid or another hard disk utility, or replace the hard disk driver without erasing/reformatting disk.
-47	File is busy; one or more files are open.	-192 to -199	Resource manager errors. Often Installer cannot find/open one of system files it needs to install. Use a different copy of Installer disk.

Isolating a Hardware Problem



- **System Self-Tests**—Start up the customer's system, listen for diagnostic error chords **(see Startup Problems—Flowchart 2, in this section)**, and look for system error codes **(refer to System Failure Codes in this section)**.

- **Diagnostic Software**—If the system passes the self tests but the problem persists, try running the appropriate *MacTest* program **(refer to the General Information tab for MacTest versions, hookups, and procedures)**. If you suspect a hard disk problem, you should also run the *Macintosh Hard Disk Test* program.

- **Symptom Charts/Module Swapping**—If the customer's system (or *MacTest*) will not boot or *MacTest* fails to find the problem, **refer to Symptom/Cure Charts in the system tab that covers your customer's Macintosh**. If you think you recognize the problem and you have the necessary replacement module with you, try module swapping.

- **Troubleshooting Flowcharts**—If the customer's system (or *MacTest*) will not boot or *MacTest* fails to find the problem and the problem is not clearly defined or not listed in the Symptom/Cure Charts, **refer to the Startup Problems—Flowcharts at the end of this section**. These flowcharts present a step-by-step procedure for isolating the problem.

Hardware Troubleshooting Guidelines

1. Use only known-good test equipment and diagnostic programs.

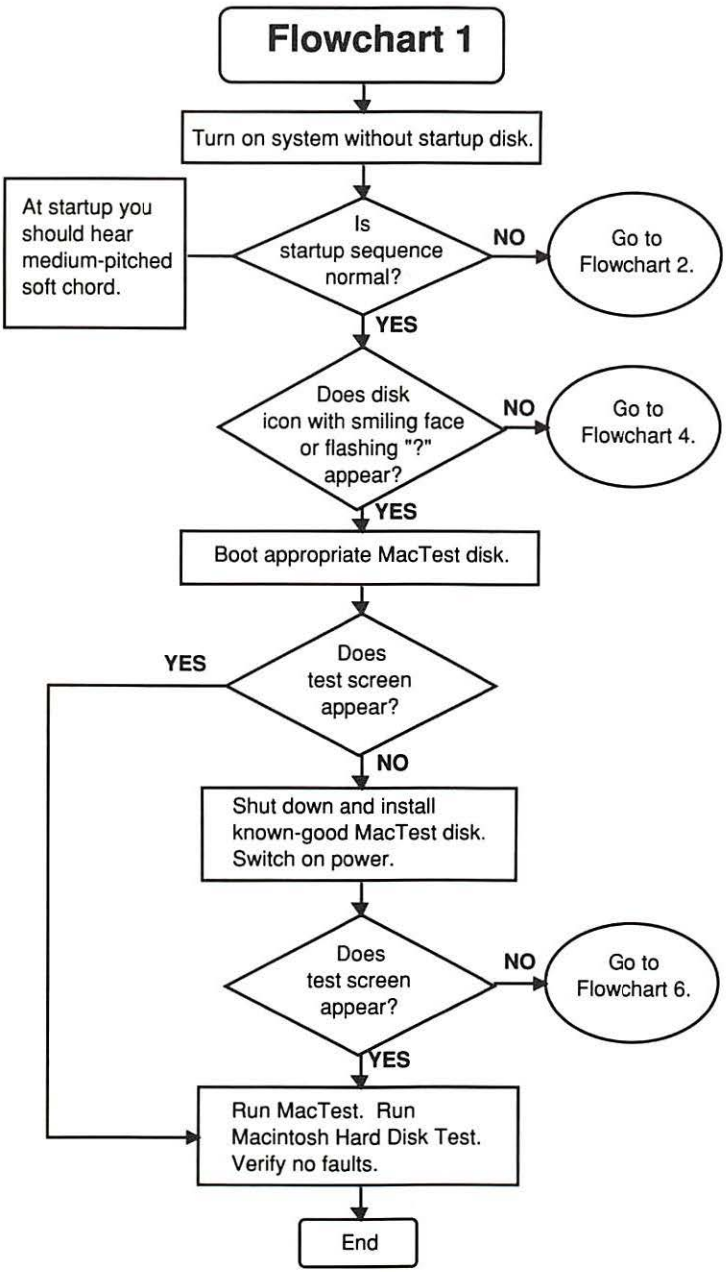
2. The troubleshooting tools are designed to test a system in its minimum configuration. Disconnect external peripherals and remove all NuBus cards. After verifying that the computer is fully operational, reinstall/reconnect and test each expansion card and external device one at a time.

3. When using the Symptom/Cure Charts, always try the solutions one at a time, in sequence, until you fix the problem. If the problem remains, reinstall the original module before trying the next solution.

4. The hardware troubleshooting flowcharts verify each repair action by looping back to the start (Flowchart 1). If a repair does not fix the problem, reinstall the original module, return to the flowblock of origin, and perform the next repair action on the list.

5. When instructed to replace the **logic board only**, place the customer's SIMMs on the replacement logic board. Be sure to use the SIMM removal tool **(see Special Tools Index under General Information).** To test the customer's SIMMs, **refer to Flowchart 3, SIMM Verification, in this section.**

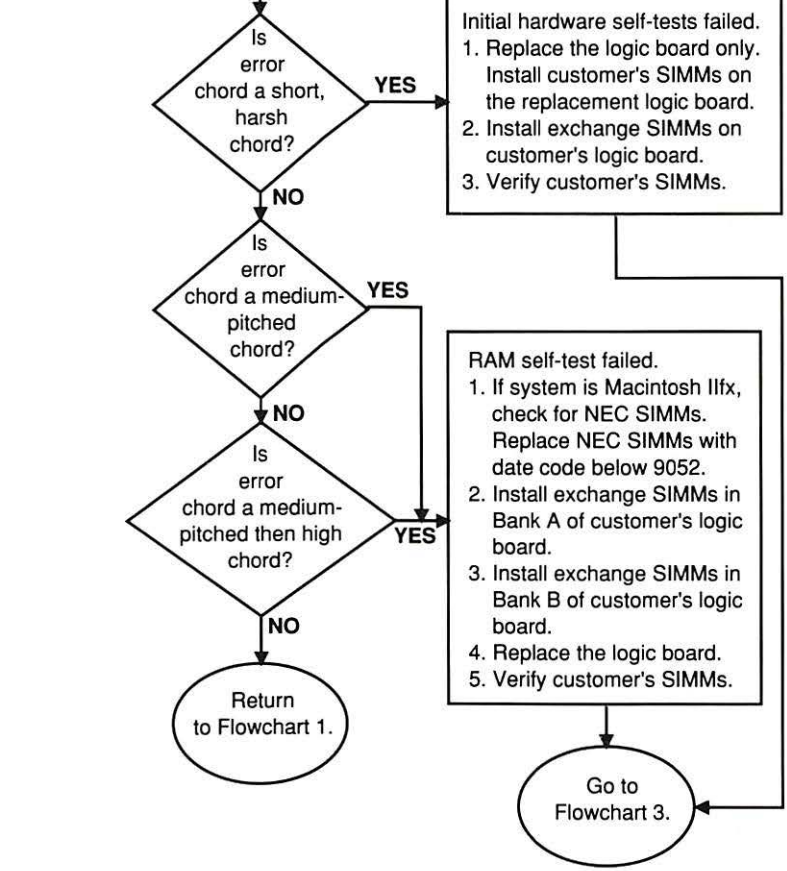
6. Always verify that the original problem has been fixed. To verify that the original problem is fixed, duplicate the conditions under which it appeared. To verify that there are no additional faults, run *MacTest*.

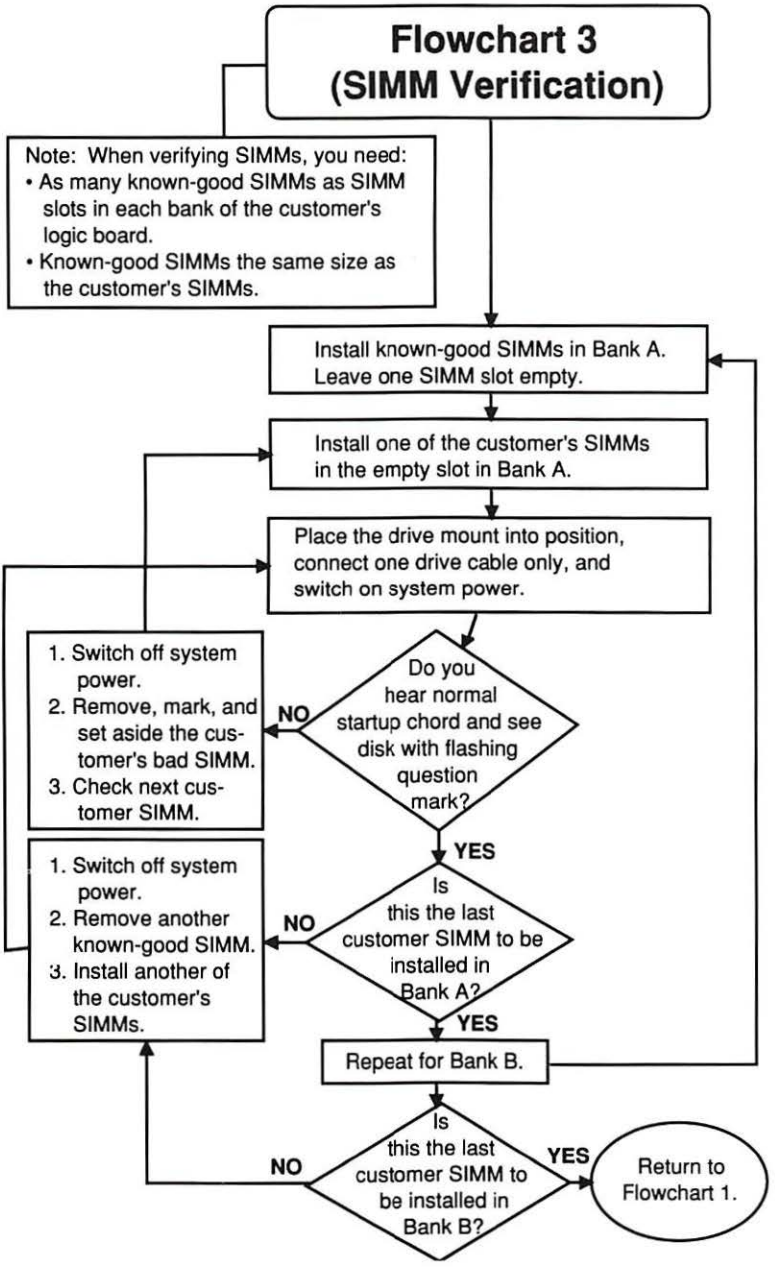

Flowchart 1
Turn on system without startup disk.
At startup you should hear medium-pitched soft chord.
Is startup sequence normal?
NO
Go to Flowchart 2.
YES
Does disk icon with smiling face or flashing "?" appear?
NO
Go to Flowchart 4.
YES
Boot appropriate MacTest disk.
YES
Does test screen appear?
NO
Shut down and install known-good MacTest disk. Switch on power.
Does test screen appear?
NO
Go to Flowchart 6.
YES
Run MacTest. Run Macintosh Hard Disk Test. Verify no faults.
End

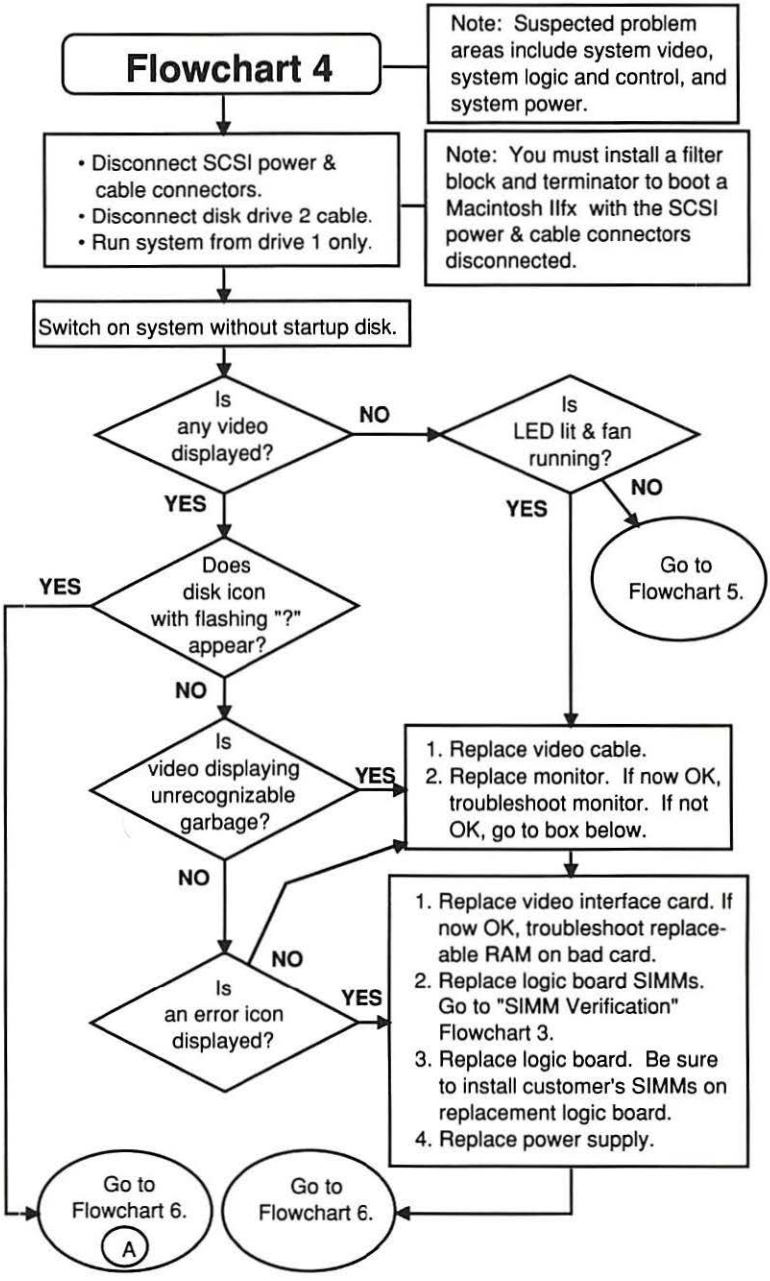
Flowchart 2 (Startup & Error Chords)

If an error is encountered at startup you will hear:
- First, a medium pitched, soft startup chord (normal)
- Second, an error chord (not normal)
- Third, a test monitor chord (4 chords, low to high)

Pay close attention to the error (second) chord.




Flowchart 3
(SIMM Verification)
Note: When verifying SIMMs, you need:
• As many known-good SIMMs as SIMM slots in each bank of the customer's logic board.
• Known-good SIMMs the same size as the customer's SIMMs.
Install known-good SIMMs in Bank A. Leave one SIMM slot empty.
Install one of the customer's SIMMs in the empty slot in Bank A.
Place the drive mount into position, connect one drive cable only, and switch on system power.
Do you hear normal startup chord and see disk with flashing question mark?
NO
1. Switch off system power.
2. Remove, mark, and set aside the customer's bad SIMM.
3. Check next customer SIMM.
YES
Is this the last customer SIMM to be installed in Bank A?
NO
1. Switch off system power.
2. Remove another known-good SIMM.
3. Install another of the customer's SIMMs.
YES
Repeat for Bank B.
Is this the last customer SIMM to be installed in Bank B?
NO
YES
Return to Flowchart 1.


Flowchart 4
Note: Suspected problem areas include system video, system logic and control, and system power.
• Disconnect SCSI power & cable connectors.
• Disconnect disk drive 2 cable.
• Run system from drive 1 only.
Note: You must install a filter block and terminator to boot a Macintosh IIfx with the SCSI power & cable connectors disconnected.
Switch on system without startup disk.
Is any video displayed?
NO
Is LED lit & fan running?
YES
NO
Go to Flowchart 5.
YES
Does disk icon with flashing "?" appear?
YES
NO
Is video displaying unrecognizable garbage?
YES
1. Replace video cable.
2. Replace monitor. If now OK, troubleshoot monitor. If not OK, go to box below.
NO
1. Replace video interface card. If now OK, troubleshoot replaceable RAM on bad card.
2. Replace logic board SIMMs. Go to "SIMM Verification" Flowchart 3.
3. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.
4. Replace power supply.
NO
Is an error icon displayed?
YES
Go to Flowchart 6.
A
Go to Flowchart 6.

Flowchart 5

Note: Suspected problem areas include system power, system logic and control, and system video.

Turn off system power, remove the top cover, and check the lithium batteries with a voltmeter. The batteries must read :

- 2.8V or higher - Macintosh Classic, SE & SE/30, LC, IIsi, IIcx, and IIci
- 3.2V or higher - Macintosh II/IIx/IIfx

Are batteries OK?

YES

1. Replace power supply.
2. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.

Go to Flowchart 7.

NO

Replace bad batteries and continue procedure.

Is LED lit & fan running?

NO

YES

Does disk icon with smiling face or flashing "?" appear?

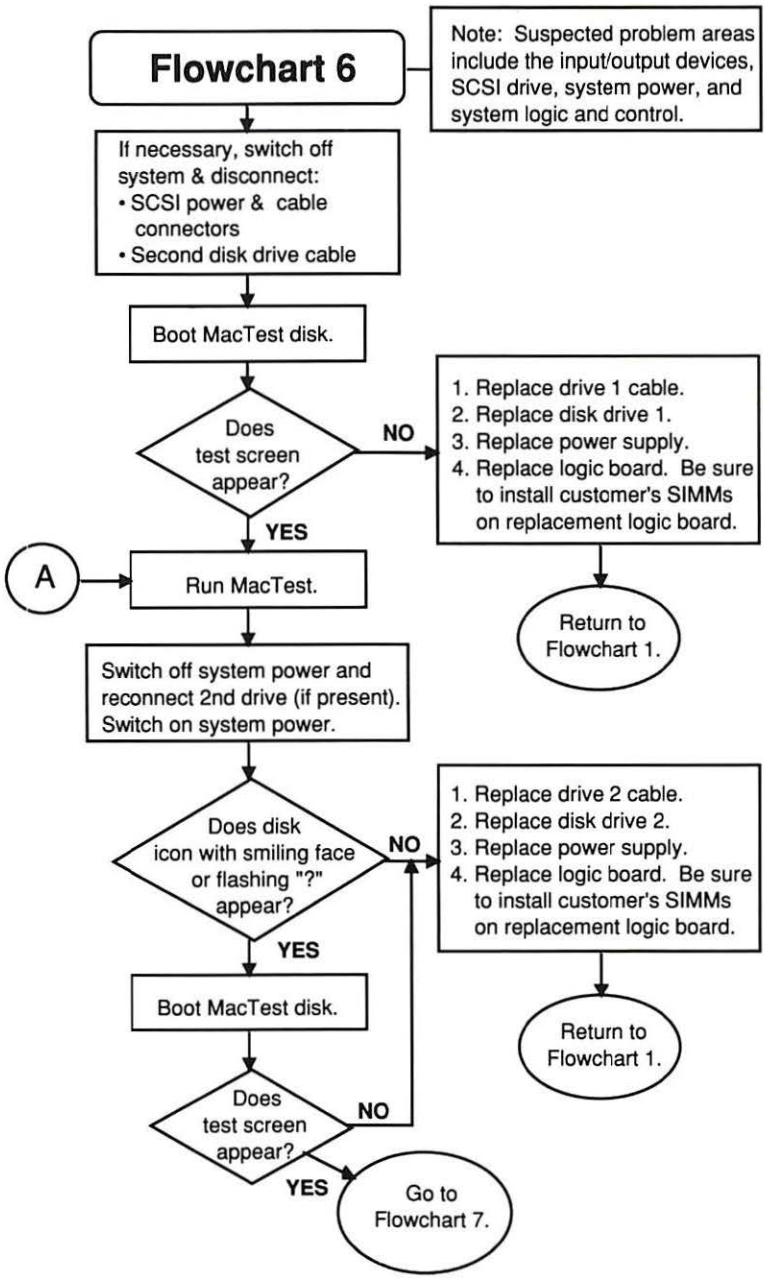
NO

1. Replace video cable.
2. Replace monitor. If now OK, troubleshoot monitor.
3. Replace video interface card. If now OK, troubleshoot replaceable RAM on bad card.
4. Replace logic board SIMMs. Go to "SIMM Verification" Flowchart 3.
5. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.
6. Replace power supply.

Return to Flowchart 1.

YES

Go to Flowchart 7.


Flowchart 6
Note: Suspected problem areas include the input/output devices, SCSI drive, system power, and system logic and control.
If necessary, switch off system & disconnect:
• SCSI power & cable connectors
• Second disk drive cable
Boot MacTest disk.
Does test screen appear?
NO
1. Replace drive 1 cable.
2. Replace disk drive 1.
3. Replace power supply.
4. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.
Return to Flowchart 1.
YES
A
Run MacTest.
Switch off system power and reconnect 2nd drive (if present). Switch on system power.
Does disk icon with smiling face or flashing "?" appear?
NO
1. Replace drive 2 cable.
2. Replace disk drive 2.
3. Replace power supply.
4. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.
Return to Flowchart 1.
YES
Boot MacTest disk.
Does test screen appear?
NO
YES
Go to Flowchart 7.

Flowchart 7

Note: Suspected problem areas include the SCSI drive, system power, and system logic & control.

Run MacTest.

Switch off system power and reconnect SCSI power and cable connectors. Switch on system power.

Does disk icon with smiling face or flashing "?" appear?

NO

1. Replace SCSI power and connector cables.
2. Replace SCSI drives.
3. Replace power supply.
4. Replace logic board. Be sure to install customer's SIMMs on replacement logic board.

Return to Flowchart 1.

YES

Boot MacTest disk.

Does test screen appear?

NO

YES

Run MacTest. Run Macintosh Hard Disk Test. Verify absence of faults.

END

Replacing/Installing System Software

You may need to install system software at the customer's site. Some systems—currently those with 80 or 160 MB internal SCSI drives—are shipped with the operating system already installed on the hard drive. Replacing these SCSI drives requires reinstalling system software.

Installing System Software Versions 6.0.2 to 6.0.4

Requirements

- System Software (ver. 6.0.2, 6.0.3, or 6.0.4)
  (System & Printing Tools, Utilities 1 & 2)

Installation

1. Insert the System Tools disk in a floppy drive, and switch on the computer.
2. Double-click on the System Tools disk icon, the Setup Folder, and Installer.
3. Select the disk on which you want to install system software. Click **Drive** until you see this disk.
4. Select your computer type and click **Install**.
5. When finished, quit the Installer and reboot.

Installing System Software Version 6.0.5 or Later

The Installer has Easy Install and Customize options. Easy Install automatically installs system and printer software that is appropriate for the destination disk and your computer. **You must use the Customize option to install AppleShare® workstation software.** The Customize option can also be used to create a boot disk with the minimal software required for any Macintosh system.

Requirements

- System Software (ver. 6.0.5 or later)
  (System & Printing Tools, Utilities 1 & 2, & HyperCard®)

Installation

1. Insert the System Tools disk in a floppy drive and switch on the computer.
2. Double-click on the System Tools disk icon and on the Installer.
3. When the welcome screen appears, click **OK**.
4. Select the disk on which you want to install system software. Click **Switch Disk** until you see this disk.

Easy Install

5. Click **Install**. The appropriate software is automatically installed.
6. When finished, quit the Installer and reboot.

Customize

5. Click **Customize**. Then select (click or shift-click) the software you wish to install from the options listed in the scrollable window.
6. Click **Install**. The selected software is then installed.
7. When finished, quit the Installer and reboot.

System-Software Configurations

Macintosh Model	Recommended Versions	Acceptable Versions
128K	System 2.0/Finder 4.1	
512K	System 3.2/Finder 5.3	
512Ke	System 3.2/Finder 5.3 System 3.3/Finder 5.4 System 3.4/Finder 5.4	System 4.0/Finder 5.4 System 4.1/Finder 5.5
Plus	System 6.0.2/Finder 6.1 System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	System 3.2/Finder 5.3 System 3.3/Finder 5.4 System 4.0/Finder 5.4 System 4.1/Finder 5.5 System 4.2/Finder 6.0
SE	System 6.0.2/Finder 6.1 System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	System 4.0/Finder 5.4 System 4.1/Finder 5.5 System 4.2/Finder 6.0
II	System 6.0.2/Finder 6.1 System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	System 4.1/Finder 5.5 System 4.2/Finder 6.0
SE/30 IIx, IIcx	System 6.0.3/Finder 6.1 System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	
IIci	System 6.0.4/Finder 6.1 System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	
Portable	System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	System 6.0.4/Finder 6.1
IIfx	System 6.0.5/Finder 6.1 System 6.0.7/Finder 6.1	
Classic, LC, IIsi	System 6.0.7/Finder 6.1	

Macintosh and Macintosh Plus

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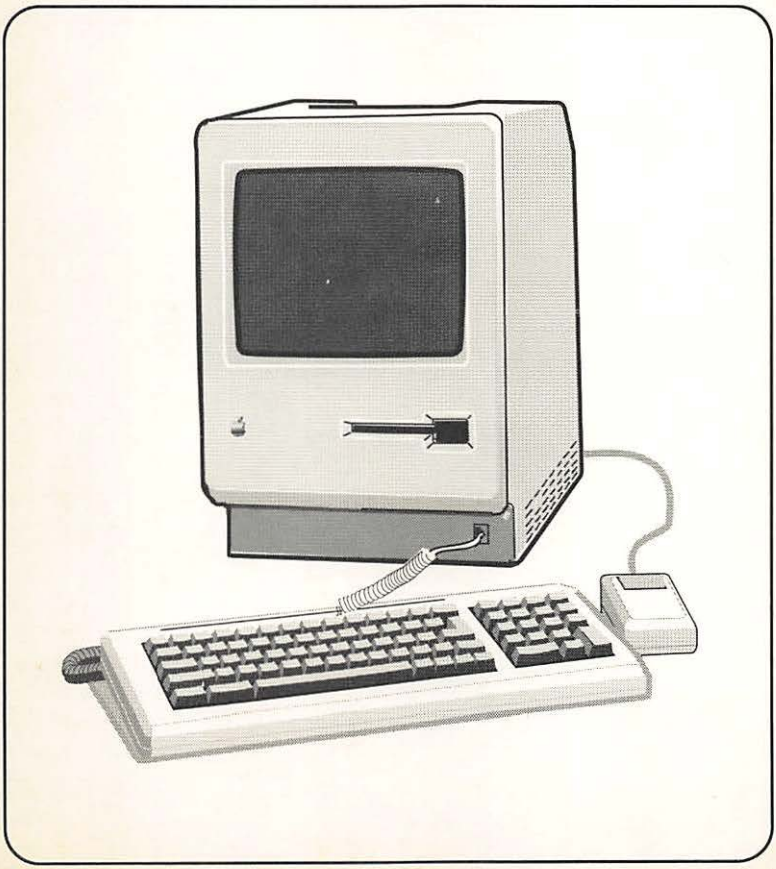
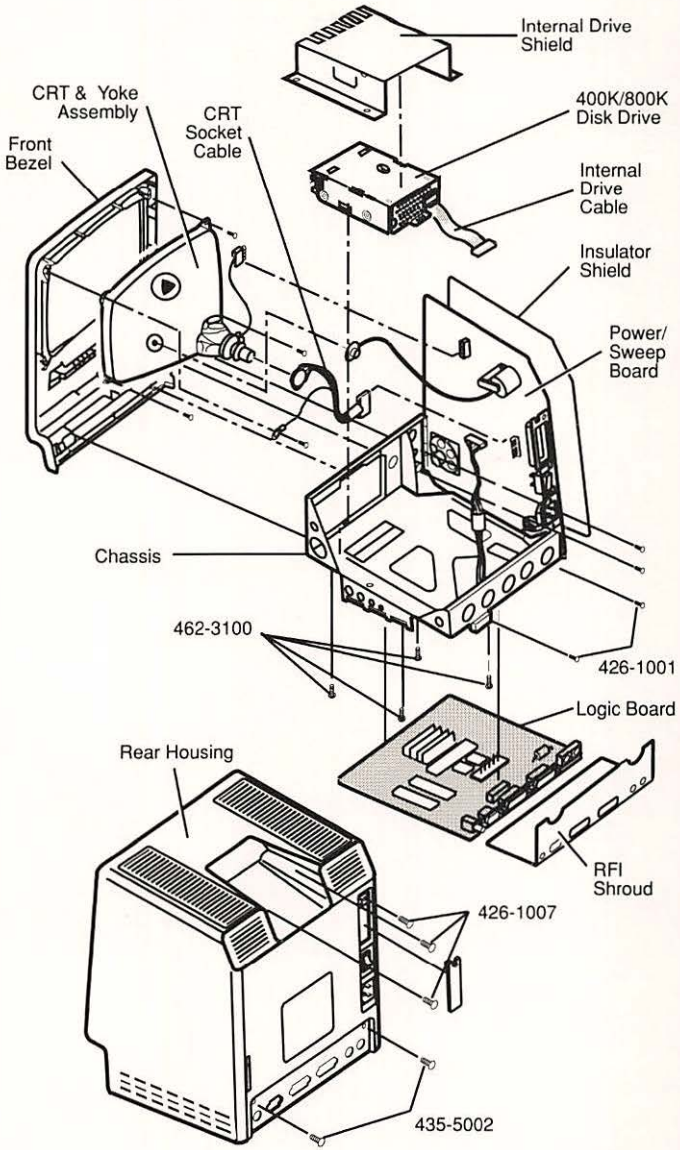


Macintosh and Macintosh Plus
Exploded View



Macintosh and Macintosh Plus

Parts List

Macintosh only

Disk Drive, Apple 3.5, 400K Mechanism	661-76156
Internal Drive Cable, 3-1/2" (red stripe – also 800K Mechanism)*	590-0167
Internal Drive Shield	805-0765
Front Bezel, Macintosh, Beige	810-0373
Logo Label (Bezel)	825-0547
Keyboard Parts (for obsolete Keyboard 661-9654):	
Keyboard Bottom Case	815-0754
Keyboard Top Case	815-0728
Keycap Set	658-7039
Logic Board, 128K Main	661-96152
Logic Board, 512K Main	661-96236
Battery, Alkaline, 4.5 V	742-0003
RFI Shroud, Macintosh	805-0577
ROM, High, Rev. B, Macintosh with 400K Floppy Disk Drive	661-0220
ROM, Low, Rev. B, Macintosh with 400K Floppy Disk Drive	661-0221
ROM, High, Macintosh with 800K Floppy Drive	661-0632
ROM, Low, Macintosh with 800K Floppy Drive	661-0633
Rear Housing with Label	630-5139
Agency Approval Label	825-4018
Agency Approval Label, 512K	825-1014
Logo Label (Housing)	825-0613
Macintosh Battery Door, Beige	815-0938
Macintosh Foot, Platinum (beige foot not available)	865-0051
Macintosh Label	825-0742
Macintosh Signature 128K Label	825-1064
Macintosh Signature 512K Label	825-1065

Macintosh Plus only

Cable, Peripheral Adapter, Smoke	699-0430
Front Bezel, Macintosh Plus, Beige	810-0379
Front Bezel, Macintosh Plus, Platinum	810-0385
Ground Clip, Macintosh Plus	805-0910
Logo Label (Bezel)	825-0547
Keyboard, Platinum (with cable)	661-0416
Keyboard, Platinum, French	F661-0416
Keyboard, Platinum, French Canadian	C661-0416
Keyboard, Platinum, German	D661-0416
Keyboard, Platinum, Italian	T661-0416
Keyboard, Platinum, Spanish	E661-0416
Keyboard Parts (for Keyboard 661-0416):	
Bottom Cover, Platinum	815-0984
Cable, Keyboard/Keypad, Smoke	590-0170
Keycap Set, Smoke	658-5190
Keyswitch, Alps Alpha Lock	705-0077
Keyswitch, Alps Long-Stem	705-0070
Keyswitch, Mitsumi	705-0104
Keyswitch, Mitsumi Locking	705-0044
Top Cover, Platinum	815-0983

***Refer to "Internal Drive Cables" in General Information.**

continued...

Logic Board (w/o RAM; replaces 661-0321)	661-0525
Battery, Alkaline, 4.5 V	742-0003
Resistor, 150 Ohms, 1/4 W, ±5%	101-4151
RFI Shroud, Macintosh Plus	805-5047
ROM, High	661-0632
ROM, Low	661-0633
SIMM, 256K, 120 ns	661-0402
SIMM, 256K, DIP, 120 ns	661-0494
SIMM, 1 MB, 120 ns	661-0403
Mouse, Apple, Platinum	661-0400
Rear Housing, Beige	630-5211
Agency Approval Label, Beige	825-1254
Battery Door, Beige	815-0938
Reset/Interrupt Switch, Beige	815-0737
Rear Housing, Platinum	630-5235
Agency Approval Label, Platinum	825-1345
Battery Door, Platinum	815-0971
Reset/Interrupt Switch, Smoke	815-0763
Rear Housing, Beige and Platinum—Parts for Both:	
Ground Clip, Upper	805-0575
Macintosh Foot, Platinum (beige foot not available)	865-0051
Screw, Tap, 8-32 x .625, Torx, Blk Zinc Oxide (main case bottom)	435-5002
Screw, Tap, M 4.22 x 1.41 x 16, Torx, Zinc (main case top)	426-1007

Macintosh & Macintosh Plus

Chassis	805-0766
Screw, M 3 x .5 x 6	462-3100
Screw, Tap, 6-32 x .375, Chassis Grounding	490-0002
CRT and Yoke Assembly	076-0103
CRT Socket Cable	590-0160
Mylar Washer	725-0018
Screw, Tap, M 4.22 x 1.41 x 13 (CRT & Chassis)	426-1001
Disk Drive, Apple 3.5, 800K Mechanism (512K Enhanced and Plus)	661-0345
Internal Drive Cable, 3-1/2" (yellow stripe)	590-0437
Internal Drive Shield (512K Enhanced and Plus)	805-0217
Packing Disk, 2-sided (for transporting)	003-0003
Keyboard, Beige (replacing 661-96154)	661-0322
Bottom Cover, Beige	815-0937
Cable, Keyboard/Keypad, Beige	590-0144
Keycap Set, Beige	658-5186
Keyswitch, Alps Alpha Lock	705-0077
Keyswitch, Alps Long-Stem	705-0070
Keyswitch, Mitsumi	705-0104
Keyswitch, Mitsumi Locking	705-0044
Screw, Tap 2.20 x 6.25 (Keyboard Case)	430-1025
Top Cover, Beige	815-0936
Mouse, Macintosh, Beige	661-96155
Mouseball Retainer	815-0409
Rubber-Coated Mouseball	699-8001
Power Cable, Beige	590-0138
Power Cable, Smoke	590-0131
Power Supply, 110 V, Beige	661-0461

Power Supply, 110 V, Platinum	661-0462
Power/Sweep Board, 220 V	661-76214
Brightness Knob, Smoke	865-0029
Cable, Power Supply to Logic	590-0511
Fuse, Power Supply, Int'l, 1.6 A 250 V	740-0060
Fuse, Power Supply, U.S., 2.5 A 250 V	740-0300
Ground Clip, Lower	805-0576
Insulator Shield (Back of Power Supply)	725-0011
Screw, M 2.9 x 10	470-2101
Service Packaging, 800K/1.4 MB Drives	602-0210

Power/Sweep Voltage Adjustment

You must verify correct voltages whenever the logic board or power/sweep board is replaced. If the voltages are outside specified tolerances, perform the voltage and video adjustments.

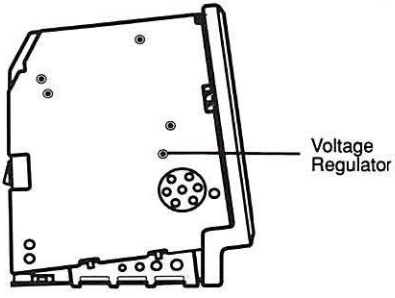


Figure: Voltage Adjustment Control

WARNING: Voltage adjustments are performed with the power on. Review the CRT safety and live adjustment rules before performing this procedure.

WARNING: When using the voltmeter, make sure the banana plug test probes do not short to one another, which will damage the Macintosh. Pull the insulating rubber hoods over the test probes.

Voltage Adjustment Procedure

1. Switch off power, disconnect the power cord, and disconnect any peripheral devices.

2. Connect the **voltage test cable** to the **external disk drive port** at the rear of the computer.

3. Use the voltmeter and **orange** test cable as follows:
   a. Connect the **black** voltmeter lead between the ground terminal of the voltmeter and the computer chassis.
   b. Connect the **orange** test cable lead (12-volt lead) to the voltage input terminal on the voltmeter.

continued...

c. Connect the power cord and switch on the computer. The voltage reading must be from **11.90 to 12.75 volts**.
d. If not within tolerance, use the plastic alignment tool to adjust the voltage regulator on the power/sweep board **(see Figure on previous page)**.

4. Switch off computer power and disconnect the orange lead.

5. Connect the **red** test cable lead (5-volt lead) to the voltage input terminal and switch on computer. If the voltage reading is not **5 volts (±.15V)**, adjust the voltage regulator **(see Figure on previous page)**.

6. Repeat steps to verify correct voltages. Replace the power/sweep board if correct voltages cannot be attained.

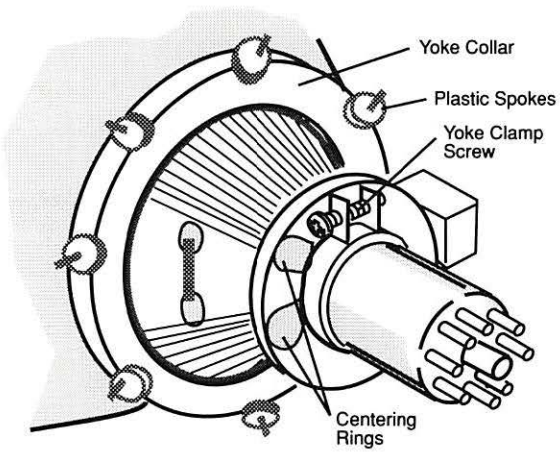


Figure: CRT Adjustment Controls

WARNING: Video adjustments are performed with the power on. Review the CRT safety rules before performing these procedures.

Tilt Adjustment Procedure

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you, and place a mirror in front of the CRT screen.

2. Loosen the **yoke clamp screw** two or three turns **(see Figure)**.

3. Connect the power cord and switch the power on.

4. Place one hand behind your back, and with your other hand grasp only the plastic spokes of the **yoke collar (see Figure).** Rotate the **yoke collar** until the top and bottom edges of the picture appear parallel with the top and bottom edges of the bezel. **(Do not move the magnets, which are preset by the manufacturer and should not be adjusted.)**

5. Switch the power off, unplug the computer, and discharge the CRT.

6. Hold the **yoke collar** in position and tighten the **yoke clamp screw** so that the **yoke collar** will not slip **(see Figure).** Don't overtighten.

7. Connect the power cord and switch the power on to verify that the adjustment is still correct.

8. Replace the cover.

Centering Ring Adjustment Procedure

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you, and place a mirror in front of the CRT screen.

2. Locate the two **centering rings** on the yoke assembly **(see Figure on previous page).** If a bonding material is holding the rings in place, use a small matte knife to break the bonding.

3. Connect the power cord and switch the power on.

4. Rotate each ring about half a turn and observe the effect on the screen. The adjustment of the **centering rings** determines whether the picture is centered or offset to one side.

5. Center the picture by first holding the **front ring** steady and moving the **rear ring**, then holding the **rear ring** steady and moving the **front ring**.

6. When the screen is properly centered, switch the power off, unplug the computer, and replace the cover.

Perform the video adjustments whenever the CRT or power/sweep board is replaced.

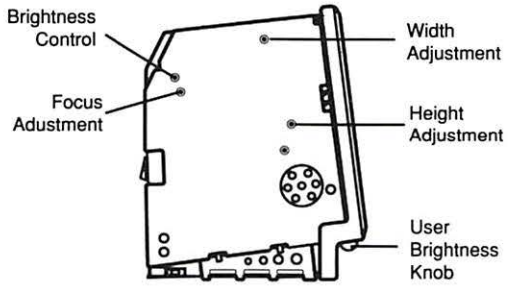


Figure: Video Adjustment Controls

WARNING: Video adjustments are performed with the power on. Review the CRT safety rules before performing these procedures.

Brightness and Contrast Adjustment Procedure

1. Remove the cover and discharge the CRT. Turn the computer so that the back is facing you and place a mirror in front of the CRT screen.
2. Connect the power cord and switch the power on.
3. Turn the **user brightness knob (see Figure)** fully clockwise.
4. Using the alignment tool, turn the **brightness control (see Figure)** fully counterclockwise so that white lines are visible on the screen. Then turn the **brightness control** clockwise until the white lines just disappear.
5. Turn the **user brightness knob** slightly counterclockwise to achieve the ideal brightness and contrast adjustment.

Size Adjustment Procedure

1. Use the plastic alignment tool to adjust the **width adjustment (see Figure)** until the raster is approximately 7 inches wide.
2. Use the alignment tool to adjust the **height adjustment (see Figure)** until the raster is approximately 4.7 inches high.

Focus Adjustment Procedure

1. Launch any application or document to fill the screen with information.
2. Turn the **focus adjustment (see Figure)** fully clockwise. Then turn the **focus adjustment** back (counterclockwise) one-eighth of a turn and adjust for best overall focus.
3. Close the application, switch off computer power, and replace the cover.

Macintosh and Macintosh Plus
Symptom/Cure Chart

Video Problems	Solutions
No video, but audio tone is present and drive operates	1. Turn contrast control fully clockwise. 2. Check video cable. 3. Replace neck cable. 4. Replace power/sweep board. 5. Replace logic board.
Screen is bright and audio is present, but no video information is present	1. Replace power/sweep board. 2. Replace logic board.

Drive Problems	Solutions
Disk ejects; display shows disk icon with blinking "X"	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace disk drive. 4. Replace logic board.
Unable to insert disk all the way	1. Power off the system and hold mouse button down while switching power back on to ensure eject cycle has been completed. 2. Replace disk drive.
Drive will not eject disk	1. Hold down <Shift> and <Command> keys and press 1 (for the internal drive) or 2 (for external drive). 2. Pull down File menu and select **Eject**. Attempt this two or three times. 3. Eject disk manually by pushing opened paper clip into hole beside drive slot. 4. Replace disk drive.
Will not read disks on internal or external drive	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace Mylar RFI shield. 4. Replace disk drive. 5. Verify ROMs on logic board. 6. Replace logic board.
Audio tone sounds at power on, video is present, but drive does not operate	1. Replace disk drive cable. 2. Replace disk drive. 3. Replace logic board.
Drive continually ejects disk	1. Check disk drive cable. **See the compatibility table under Disk Drives—Internal Drive Cables in General Information.** 2. Replace disk drive.

continued...

Drive Problems (continued)	Solutions
Disk drive runs continuously	1. Replace bad disk. 2. Replace disk drive cable. 3. Replace disk drive. 4. Replace logic board.
400K drive will not boot	1. If logic board has Rev. A ROMs and drive stepper motor is serial number F518 or higher, upgrade to Rev. B ROMs. 2. Replace disk drive.

Peripheral Problems	Solutions
Cursor does not move	1. Connect mouse. 2. Replace mouse. 3. Replace logic board.
Cursor moves but clicking mouse produces no response	1. Replace mouse. 2. Replace logic board.
No response to any key on the keyboard	1. Replace keyboard cable. 2. Replace keyboard. 3. Replace logic board.
No response from a particular key	1. Replace keyswitch. 2. Replace keyboard. 3. Replace logic board.
Known-good ImageWriter, or ImageWriter II will not print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Replace printer interface cable. 4. Replace logic board.
Known-good LaserWriter will not print	1. Make sure Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Refer to *Networks* tab in *Apple Service Technical Procedures.*

Miscellaneous Problems	Solutions
When turned on, Macintosh Plus continuously beeps and tries to power up	1. Check power/sweep voltage. 2. Replace power/sweep board, logic board, and internal drive; then turn on Macintosh Plus. **Replacing only the power/sweep board may damage the new power/sweep board.**
Clicking or chirping sound	1. Connect logic board cable. 2. Perform voltage adjustment. 3. Replace power/sweep board. 4. Replace logic board.
Smoke/odor issues from computer	– Replace power/sweep board.
No video, no audio tone, and no drive operation	1. Connect power cord. 2. Turn power on. 3. Replace power cord. 4. Check fuse. 5. Replace power/sweep board. 6. Replace logic board.
MacTest displays 128K/512K when 1 MB Macintosh Plus is tested	– Replace Macintosh Plus logic board.
When developer's switch is installed, Macintosh Plus resets intermittently	– Remove switch and file the end 1/16 of an inch.
Macintosh Plus hangs on startup	– Check ROMs. If ROMs 342-0341-A or B (ROM HI) and 342-0342-A (ROM LO) are installed on logic board and peripheral device is connected to SCSI port, turn on peripheral device before switching on computer.
Macintosh 512K enhanced has two RFI shrouds	– Some machines have two RFI shrouds installed. Replace two RFI shrouds with one RFI shroud.

Macintosh/Macintosh Plus Specifications

Microprocessor	MC68000; 32-bit internal data bus 7.83 MHz clock speed
Memory	128K, 512K Plus: 1 MB, expandable to 4 MB 128K ROM standard
Video Display	9-inch (diagonal) screen; 512-by-342-pixel bit-mapped display
Interfaces	Two RS-232/RS-422 serial ports (DB-9 on the Macintosh 128K/512K; Mini DIN-8 on the Macintosh Plus) One SCSI parallel port (Macintosh Plus only) One DB-19 external disk drive port One sound port
Internal Storage	Built-in 3.5-inch 400K drive for 128K and 512K Built-in 3.5-inch 800K drive for 512K enhanced and Plus (uses 3.5-inch hard-case floppy disks—either double-sided with 800K capacity, or single-sided with 400K capacity)
Sound	Four-voice sound with 8-bit digital/analog conversion using 22 KHz sampling rate
Clock/Calendar	CMOS custom chip with 4.5-volt user-replaceable battery backup (includes 256 bytes of memory that remembers system parameters even with the machine turned off)
Electrical	Line voltage: 105 to 125 volts AC Frequency: 50 to 60 Hz Maximum power: 60 watts

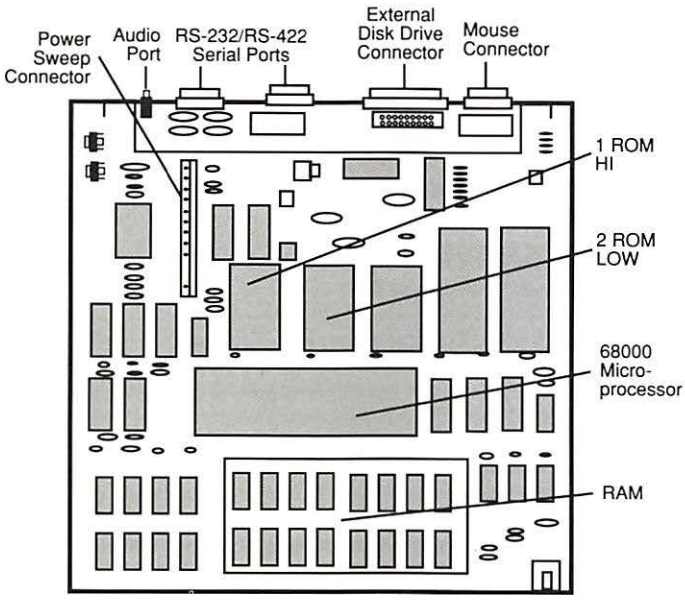


Figure: Macintosh 128K/512K Logic Board

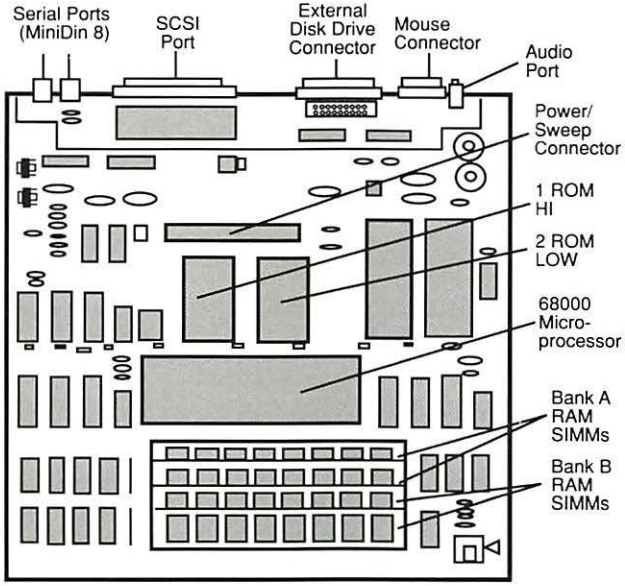


Figure: Macintosh Plus 1 MB Logic Board

Things to Remember

1. Before working inside the Macintosh, discharge the CRT to the metal ground lug. Failure to do so can result in damage to the logic and power/sweep boards **(see Discharging and Disposing of the CRT under Safety)**. Use the CRT discharge tool **(see Special Tools Index under General Information)**.

2. After installing the Disk Drive Kit, return the old ROMs and the 400K disk drive to Apple.

3. After installing the Logic Board Kit, return the 128/512K logic board, the old RFI shield, and the old cover to Apple.

800K Disk Drive Kit Installation Procedure

1. Remove the cover and the RFI shield, and discharge the CRT to the metal ground lug.

2. Remove the logic board. Using an IC extractor, remove the two ROMs installed at locations D5 and D8.

3. Install the two **new** ROMs in the appropriate locations on the logic board. The notch at the end of each ROM should face the front of the machine.

ROM	P/N	Location
HI	342-0341	D5
LOW	342-0342	D8

4. Remove the internal disk drive.

5. Install the logic board and the new 800K internal disk drive.

6. Install the RFI shield and the cover.

Logic Board Kit Installation Procedure

1. Remove the cover and the RFI shield, and discharge the CRT to the metal ground lug.

2. Remove the **128K/512K** logic board. Using an IC extractor, remove the two ROMS installed at locations D5 and D8.

3. Install the ROMs in the appropriate locations on the new **1 MB** logic board. The notch at the end of each ROM should face the front of the machine.

ROM	P/N	Location
HI	342-0341	D5
LOW	342-0342	D8

4. Install the new **1 MB** logic board, the new RFI shield, and the new cover.

Macintosh and Macintosh Plus

Macintosh Plus Memory Upgrade

The Macintosh and Macintosh Plus require 150-ns (or faster) SIMMs. RAM speed is indicated by the -xx number after the manufacturer's part number (-15 indicates a 150-ns SIMM). SIMMs are available in 256K and 1 MB RAM sizes. Adding memory to a Macintosh and Macintosh Plus requires that you configure the logic board as shown in the Figure and chart below.

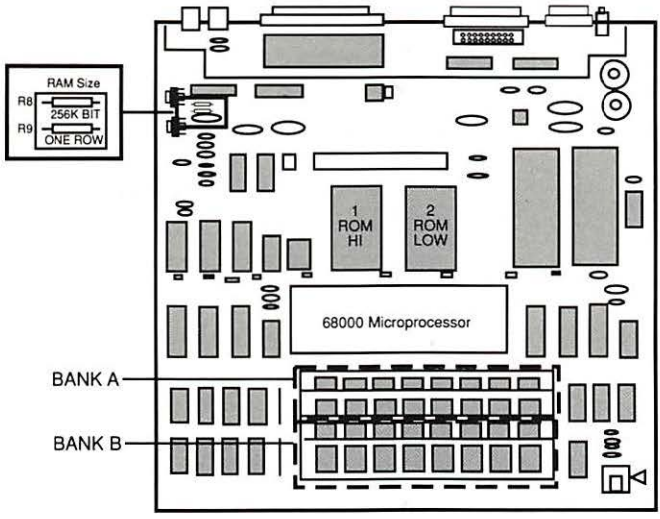


Figure: Macintosh Plus 1 MB Logic Board

Upgrade Procedure

1. Clip or install the needed resistor (see chart below).
2. Remove/install the SIMMs as indicated in the chart below. Use the SIMM removal tool **(see Special Tools Index under General Information)**.

RAM	Resistors	SIMMs
1 MB	R8 installed R9 removed	2—256K SIMMs (Bank A) 2—256K SIMMs (Bank B)
2.5 MB	R8 removed R9 removed	2—1 MB SIMMs (Bank A) 2—256K SIMMs (Bank B)
4 MB	R8 removed R9 removed	2—1 MB SIMMs (Bank A) 2—1 MB SIMMs (Bank B)

Macintosh and Macintosh Plus
ROM Upgrade & ROM Compatibility

To be compatible with the current 400K disk drive stepper motor, the 128K/512K Macintosh should have ROM HI 342-0220-B at location D5, and ROM LOW 342-0221-B at location D8. If these ROMs are not installed, upgrade the logic board by replacing the boot ROMs as shown below.

ROM Upgrade Procedure

1. Power off the Macintosh, remove the power cord and cover, and discharge the CRT. Use the CRT discharge tool **(see Special Tools Index under General Information)**.

WARNING: Failure to follow the rules for safe CRT discharge could result in serious injury or property damage. The Macintosh CRT must be discharged to the ground lug to prevent damage to the logic board.

2. Put on your grounding wriststrap and place the Macintosh on a grounded workbench pad.

3. Remove the logic board and verify that old ROMs are installed.

4. Using an IC extractor, remove the old ROMs.

5. Install the new ROMs in the appropriate location—ROM HI (P/N 342-0220-B) at location D5, ROM LOW (P/N 342-0221-B) at location D8. The notch at the end of each ROM should face the front of the machine on installation.

6. Replace the Macintosh logic board and the cover.

7. Run *MacTest* to verify correct operation.

ROM Compatibility for 800K Drives

The 512K logic board (P/N 661-96236) is shipped with a high-boot ROM (P/N 342-0220) and a low-boot ROM (P/N 342-0221) that support only the 400K disk drive. When the 512K logic board is used to replace a defective 512K enhanced logic board or a defective 512K logic board with a 800K disk drive, you must replace the ROMs on the replacement 512K logic board with ROMs from the customer's logic board. The customer's ROMs, which support 800K disk drive systems, will have part numbers 342-0341 (high-boot ROM) and 342-0342 (low-boot ROM).

Also, newer Macintosh 512K enhanced and Macintosh Plus systems and the 800K disk drive upgrade kit have revised high-boot and low-boot ROMs that correct the SCSI device problems of older ROMs. The newer ROMs are compatible with 512K systems, but you cannot mix old and new ROMs. This list gives the part number and the version letter of the old and new ROMs:

	Old ROMs	New ROMs
High Boot:	342-0341-A 342-0341-B	342-0341-C
Low Boot:	342-0342-A	342-0342-B

Macintosh SE, SE/30, and Classic

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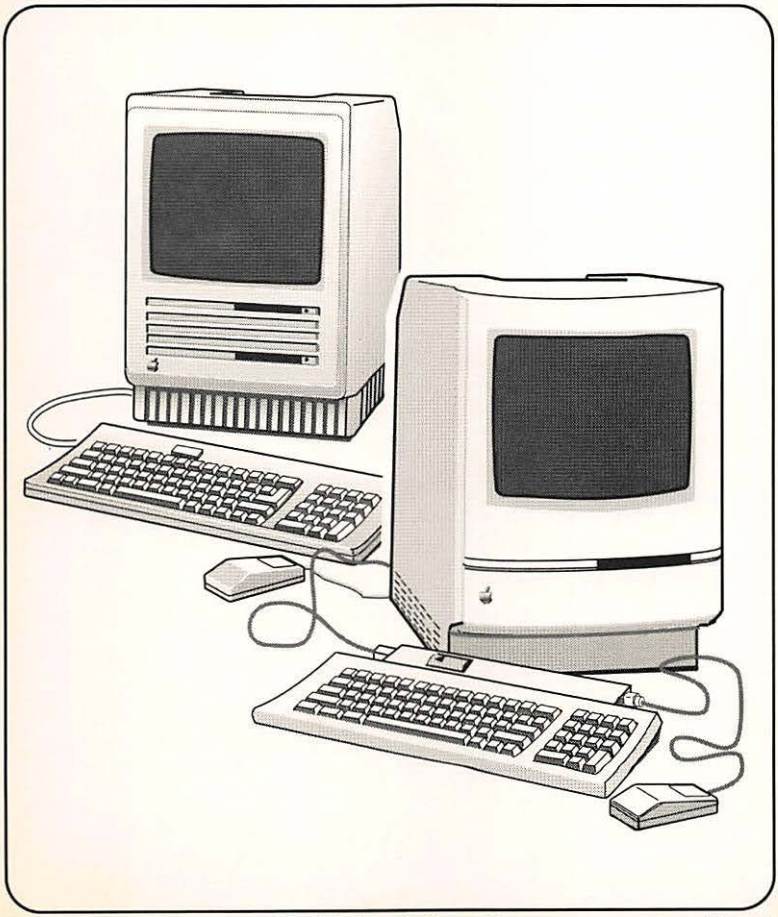
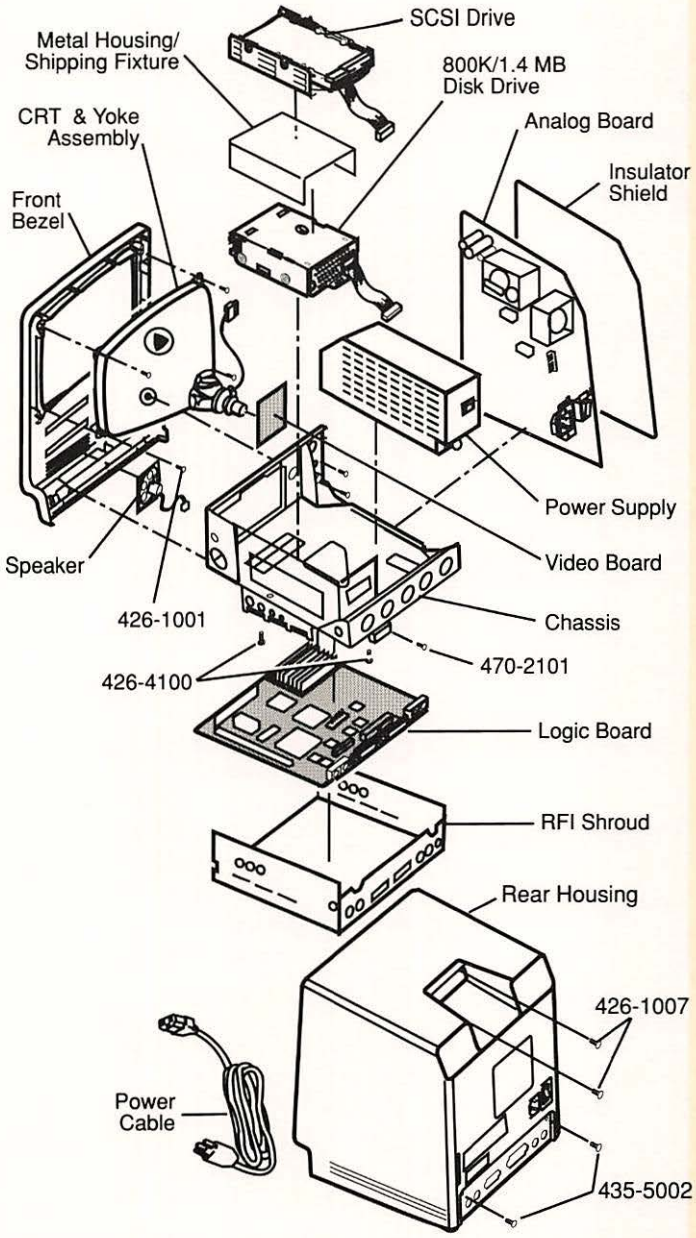
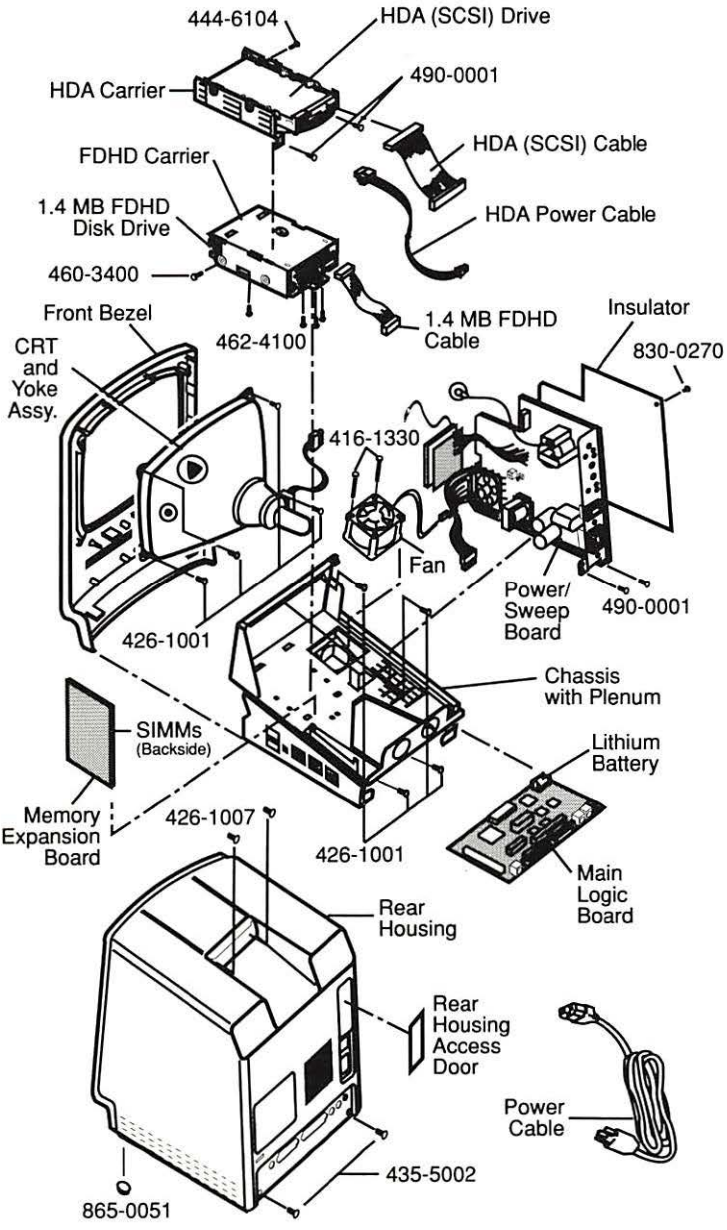


Exploded View—Macintosh SE and SE/30



Exploded View—Macintosh Classic



Analog Board, Macintosh SE & SE/30	661-0371
Brightness Knob	865-0047
Fan Kit	076-0311
Fastener, Snap-in Plastic	830-0240
Insulator, Analog Board	725-0020
Lower Ground Clip	805-0576
Screw, M 2.9 x 10	470-2101
Screw, M 3 x .5 x 6	462-3100
Screw, M 3 x .5 x 10 PN CR, Zinc	416-1310
Washer, Lock, Internal Tooth	860-0282
Cable, Power AC	590-0380
Chassis with Plenum, Macintosh Classic	805-0985
Screw, Tap, M 4.22 x 1.41 x 13, Torx, Zinc (chassis to bezel)	426-1001
Chassis, Macintosh SE and Macintosh SE/30	805-0938
Chassis—Accessories, Macintosh SE and SE/30	
Bracket	805-0939
Screw, M 2.9 x 10	470-2101
Screw, Tap, M 4.22 x 1.41 x 13, Torx, Zinc (chassis to bezel)	426-1001
CRT and Yoke Assembly	076-0103
Screw, Tap, M 4.22 x 1.41 x 13, Pan, Torx, Zinc (CRT to Chassis)	426-1001
Disk Drive, Apple 3.5," 800K (Macintosh SE only)	661-0345
Disk Drive, Apple 3.5," 1.4 MB FDHD/SuperDrive	661-0474
Disk Drive—Accessories	
Back Plate, Drive 2 (Macintosh SE only)	805-0914
Cable, 800K 3.5" Internal Drive (red or yellow stripe)	590-0188
Cable, 800K or 1.4MB 3.5" Internal Drive (yellow stripe)	590-0437
Cable, 1.4 MB FDHD, Internal (Macintosh Classic only)	590-0167
Disk Drive Carrier, 800K or 1.4MB	805-5050
Packing Disk, 2-sided (for transporting)	003-0003
Screw, M 3 x 0.5 x 6 (drive carrier to drive) (Macintosh Classic only)	460-3400
Screw, M 3.5 x .6 x 8, PNCRS Rec (drive carrier to chassis)	462-4100
Service Packaging, 800K and 1.4 MB FDHD Drives	602-0210
Fan, Macintosh Classic	982-0055
Screw, M 3 x 0.5 x 30 mm (fan to plenum)	416-1330
Front Bezel with Speaker, Slot Cover, Macintosh SE (800K)	810-0399
Front Bezel with Speaker, Slot Cover, Macintosh SE (FDHD)	810-0422
Front Bezel with Speaker, Macintosh SE/30 (800K)	630-5499
Front Bezel, Macintosh Classic	630-5825
Front Bezel—Accessories, Macintosh SE and SE/30	
Speaker	600-0393
Apple Logo Plate Label	825-1256
Slot Cover Bezel (Macintosh SE only)	630-5330
Slot Cover Retainer (Macintosh SE only)	805-0908
HDA, 20 MB, Internal 3.5 SCSI, Rev. A (Macintosh SE only)	661-0373
HDA, 20 MB, Internal 3.5 SCSI, Rev. B (Macintosh SE only)	661-0612
HDA, 40 MB, Internal 3.5 SCSI (Macintosh SE and SE/30)	661-0464
HDA, 80 MB, Internal 3.5 SCSI (Macintosh SE /30 only)	661-0600
HDA—Accessories, Macintosh SE and SE/30	
Cable, HDA I/O	590-0211
Cable, HDA LED (amber)	590-0506
Cable, HDA LED (red)	590-0237
Cable, Internal Power, HDA	590-0505
Frame, HDA, Internal, 3.5 SCSI	805-0066

Service Packaging, 3.5 HDA	602-0164
HDA, 1" Internal, 40 MB, 3.5" SCSI (Macintosh Classic only)	661-0614
Cable, HDA, Internal (SCSI connector cable)	590-0211
Cable, HDA, Power	590-0521
HDA Carrier	805-0950
Screw, 6 - 32 x 0.250 (HDA carrier to HDA)	444-6104
Screw (HDA carrier to FDHD carrier)	490-0001
Service Packaging, 3.5" HDA	602-0164
Keyboard, Apple*	661-0383
Main Logic Board, Macintosh SE 800K (w/o RAM)	661-0526
Cable, Logic Board Power Interconnect	590-0392
Connector, Jumper (Set of 10)	517-0546
IC, SWIM	344-0062
Lithium Battery (with Leads)	742-0009
Lithium Battery (w/o Leads)	742-0011
Resistor, 150 Ohms, .25 W, ± 5%	101-4151
ROM, High, Macintosh SE FDHD Upgrade	661-0701
ROM, Low, Macintosh SE FDHD Upgrade	661-0702
Shroud, RFI, Macintosh SE	805-5060
Main Logic Board, Macintosh SE (FDHD) (w/o RAM)	661-0536
Battery Holder Cover	520-0344
Cable, Logic Board Power Interconnect	590-0392
Lithium Battery (w/o Leads)	742-0011
Shroud, RFI, Macintosh SE	805-5060
Main Logic Board, Macintosh SE/30 (w/o RAM)	661-0527
Battery Holder Cover	520-0344
Cable, Logic Board Power Interconnect	590-0392
Lithium Battery (without Leads)	742-0011
Shroud, RFI, Macintosh SE/30	805-0969
Main Logic Board, Macintosh Classic	661-0596
Internal SCSI Terminator	630-0408
Lithium Battery (w/o leads)	742-0011
Memory Expansion Board (without SIMMs), Macintosh Classic	661-0598
Mouse, ADB*	661-0479
Power Supply, Macintosh SE and SE/30	661-0370
Power/Sweep Board 110 V, Macintosh Classic	661-0597
Power/Sweep Board 220 V, Macintosh Classic	661-0599
Power/Sweep Board—Accessories, Macintosh Classic	
Insulator, Power/Sweep Board	815-1216
Rivet, Nylon Snap-In, Black	830-0270
Screw (power/sweep to chassis)	490-0001
Rear Housing Assembly with Door and Feet, Macintosh SE and SE/30	630-5271
Agency Approval Label, Macintosh SE	825-2021
Agency Approval Label, Macintosh SE/30	825-2043
Rear Housing Assembly with Feet, Macintosh Classic	630-5812
Platinum Foot	865-0051
Rear Housing Access Door	815-1195
Screw, Tap, 8-32 x .625, Fill, Torx, Black Zinc Oxide (Main Case)	435-5002
Screw, Tap, M 4.22 x 1.41 x 16, Pan, Torx, Zinc (Main Case)	426-1007

***For additional ADB input devices and part numbers, see General Information.**

Audio Extension Cable	590-0612
Foot, Platinum	865-0051
Rear Housing Door	815-0986
Reset/Interrupt Switch	815-1008
Screw, Tap, 8-32 x .625, Fill, Torx, Black Zinc Oxide (Main Case)	435-5002
Screw, Tap, M 4.22 x 1.41 x 16, Pan, Torx, Zinc (Main Case)	426-1007
Upper Ground Clip	805-0575
SIMMs—Macintosh SE, SE/30, and Classic	
SIMM, 256K, 120 ns	661-0402
SIMM, 1 MB, 120 ns	661-0403
SIMM, DIP, 256K	661-0494
SIMM, DIP, 1 MB	661-0410
Video Board, Macintosh SE & SE/30	982-0024
Ferrite Bead, Clamp-on	159-0061

Macintosh SE and SE/30 Video Adjustments

Although the exact location of the adjustment controls differs slightly, the procedures for performing yoke and video adjustments are the same on the Macintosh SE and SE/30 as on the Macintosh and Macintosh Plus. **Refer to the Macintosh and Macintosh Plus tab for these adjustments.**

Macintosh Classic Video Adjustments

All Macintosh Classic video adjustments except the tilt adjustment are made from the service panel at the back of the computer under the service panel door. (For the Tilt Adjustment Procedure, refer to the **Macintosh and Macintosh Plus** tab.)

> You must use the *MacTest CL* Brightness and Video test patterns to adjust the Macintosh Classic correctly. Before performing the following adjustments, make sure the computer has been on for at least 30 minutes.

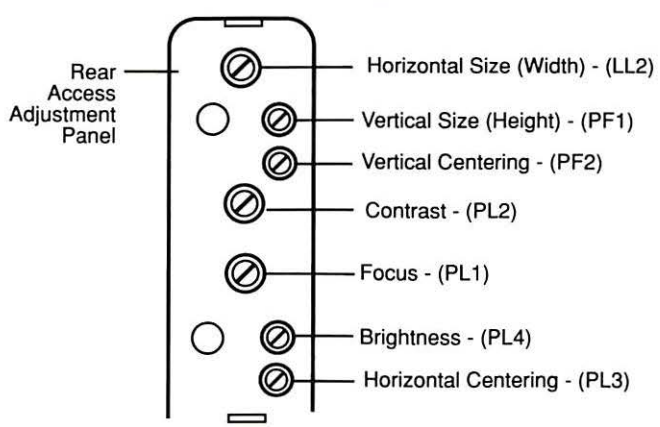


Figure: Macintosh Classic Service Panel Adjustments

Macintosh Classic Video Adjustments

Brightness and Contrast

1. Turn the computer so that the back is toward you, and place a mirror in front of the CRT screen. Remove the service panel door.

2. Boot *MacTest CL* and select **Brightness** from the MacTest CL Adjustments menu. Click the mouse button once to advance to the first brightness level.

3. Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10-to-18 range.

4. Using a plastic flat-blade tweaker, adjust contrast pot PL2 (**see Figure on previous page**) so that the luminance at the center of the screen reads at the high end of the black area between 10 and 11 on the light meter.

5. Click the mouse button to go to the next brightness level.

6. Set the light meter for the 2-to-10 range. Using a plastic hex alignment tool, adjust brightness pot PL4 (**see Figure on previous page**) so that the luminance at the center of the screen reads at the top end of 7 on the light meter.

7. Click the mouse button again to go to the next brightness level.

8. Reset the light meter for the 10-to-18 range and be sure the luminance at the center of the screen reads at the high end of the black area between 10 and 11 on the light meter. If it does not, repeat steps 2 through 8.

To generate the test patterns for the following adjustments, select **Video** from the *MacTest CL* Adjustments menu and click to advance to the pattern you need.

Centering Adjustments

1. Select the all-white or crosshatch pattern (with white background). Using a plastic hex alignment tool, adjust horizontal centering pot PL3 to center the display horizontally within the bezel.

2. Using a plastic hex alignment tool, adjust vertical centering pot PF2 to center the picture vertically within the bezel.

Size Adjustments

1. Select the all-white or crosshatch display (with white background). Using a plastic hex alignment tool, adjust horizontal size pot LL2 until the picture is approximately 7 inches wide.

2. Using a plastic hex alignment tool, adjust vertical size pot PF1 until the picture is approximately 4.7 inches high.

Focus Adjustment

– Select the focus display (with % signs). Using a plastic flat-blade tweaker, adjust focus pot PL1 for the best overall focus.

Macintosh SE, SE/30, and Classic
Symptom/Cure Chart

Video Problems	Solutions
Screen is dark; audio and drive operate	1. Readjust brightness. 2. Readjust cutoff (Macintosh Classic only). 3. Check yoke cable connection. 4. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 5. Replace video board (Macintosh SE and SE/30). 6. Replace main logic board. 7. Replace CRT.
Screen is bright and audio is present but no video informaton is visible	1. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 2. Replace video board (Macintosh SE and SE/30). 3. Replace main logic board.
Screen is completely dark and fan is not running	1. Replace power supply (Macintosh SE and SE/30). 2. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30).
A single vertical/ horizontal line is displayed	1. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 2. Replace video board (Macintosh SE and SE/30). 3. Replace main logic board. 4. Replace CRT.
Vertical/horizontal bars or stripes are displayed	1. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 2. Replace main logic board.
A white dot appears in center of screen	1. Check yoke cable connection. 2. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 3. Replace CRT.
Screen jitters	1. Move the computer away from adjacent electrical equipment that may cause interference. 2. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30).

Peripheral Problems	Solutions
Cursor does not move	1. Check mouse connection. 2. If mouse was connected to a keyboard, connect it to a rear ADB port. If mouse works, replace keyboard. 3. If mouse does not work in any ADB port, replace mouse. 4. Replace main logic board.
Cursor moves, but clicking the mouse button has no effect	1. Replace mouse. 2. Replace main logic board.

Macintosh SE, SE/30, and Classic

Symptom/Cure Chart

No response to any key on the keyboard	1. Check keyboard connection to rear ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace main logic board.
Cannot double-click to open a disk, application, or server	1. Remove extra system files on hard disk. 2. Clear parameter RAM. Hold down <Shift> <Option> <Command> keys and select **Control Panel** from Apple menu. Reset mouse controls. 3. If mouse was connected to a keyboard, connect it to a rear ADB port. If mouse works, replace keyboard. 4. If mouse fails in any ADB port, replace mouse. 5. Replace main logic board.
Known-good ImageWriter will not print	1. Make sure the Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Replace printer interface cable. 4. Replace main logic board. 5. Replace power/sweep board.
Known-good LaserWriter will not print	1. Make sure the Chooser and Control Panel are set correctly. 2. Replace software with known-good software. 3. Refer to the Networks tab in the *Apple Service Technical Procedures*.

Drive Problems	**Solutions**
Audio and video are present, but one internal drive does not operate	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace main logic board.
Audio and video are present, but neither internal drive operates	1. Replace bad disk. 2. Replace main logic board.
External drive does not operate	1. Replace bad disk. 2. Be sure external drive is on the right side of the Macintosh. 3. Replace external drive. 4. Replace main logic board.
Will not eject disk	1. Eject disk manually by pushing an opened paper clip into hole beside drive. 2. Power off system and hold mouse button down while powering back on (to complete eject cycle). 3. Replace disk drive.

continued...

Drive Problems (continued)	Solutions
Disk ejects; display shows icon with blinking "X"	1. Replace disk with known-good system disk. 2. Replace disk drive. 3. Replace main logic board.
Unable to insert disk all the way	1. Eject disk manually by pushing an opened paper clip into hole beside the drive. 2. Switch off system power and hold mouse button down while switching power back on (to complete eject cycle). 3. Replace disk drive.
Internal disk drive runs continuously	1. Replace bad disk. 2. Replace disk drive. 3. Replace main logic board. 4. Replace disk drive cable.

SCSI Problems	Solutions
Internal or external hard disk will not operate	1. Verify that SCSI loopback card is not attached. 2. Replace hard disk drive cable. 3. Replace hard disk drive. 4. Replace main logic board.
Works with internal or external SCSI device but will not work with both	1. Verify that SCSI device ID switch setting on external device is higher than 0. Also verify that ID switch setting on external SCSI device does not duplicate ID switch setting on any other attached SCSI device. 2. Replace terminator on the external device. 3. Verify that terminator is installed on the internal SCSI drive. 4. Replace SCSI device select cable.

Miscellaneous Problems	Solutions
Clicking, chirping, or thumping sound	1. Verify that main logic board power cable is connected at J12 on main logic board. 2. Replace power supply (Macintosh SE and SE/30). 3. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 4. Replace main logic board.
No video, no audio, and no drive operation	1. Connect power cord and switch power on. 2. Replace power cord. 3. Replace power supply (Macintosh SE and SE/30). 4. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30). 5. Replace main logic board.

Smoke/odor	1. Replace power supply (Macintosh SE and SE/30). 2. Replace power/sweep board (Macintosh Classic) or analog board (Macintosh SE and SE/30).
Sad Macintosh icon	1. Replace bad floppy disk. 2. Replace SIMM(s) if code matches any of those on SIMM Error Codes chart in this tab section (Macintosh SE and SE/30). 3. Verify that three-pin jumper on logic board is configured correctly for system RAM (Macintosh SE only). 4. Verify that jumper on memory expansion board is configured correctly for "SIMMs" or "No SIMMs" (Macintosh Classic). 5. Replace memory expansion board (Macintosh Classic). 6. Replace main logic board.
Sad Macintosh icon and black lines are displayed; screeching sound	1. Verify that three-pin jumper on logic board is configured correctly for system RAM (Macintosh SE only). 2. Verify that jumper on memory expansion board is configured correctly for "SIMMs" or "No SIMMs" (Macintosh Classic). 3. Replace memory expansion board (Macintosh Classic). 4. Replace main logic board.

Macintosh SE Specifications

Microprocessor	MC68000 32-bit internal architecture 7.83 MHz clock frequency
Memory	1 or 2 MB of RAM, expandable to 4 MB 256K of ROM 256 bytes of parameter memory
Video Display	Built-in 9-inch diagonal, high-resolution, 512-by-342-pixel, bit-mapped display
Interfaces	Two Apple Desktop Bus™ (ADB) ports Two RS-232/RS-422 serial ports SCSI interface One DB-19 external disk drive port Macintosh SE internal expansion slot One sound port
Internal Storage	One 1.4 MB FDHD™ SuperDrive™ (800K drive in older versions of the SE) Optional second FDHD SuperDrive (800K drive in older versions of the SE) Optional internal Hard Disk 20SC, 40SC
Sound	Four-voice sound with 8-bit digital/analog conversion using 22-KHz sampling rate
Clock/Calendar	CMOS custom chip with seven-year battery
Electrical	Line voltage: 120 to 240 VAC, RMS automatically configured Frequency: 48 to 62 Hz Maximum power: 75 watts

Macintosh SE/30 Specifications

Microprocessor	MC68030 32-bit internal architecture 15.667 MHz clock frequency Built-in paged memory management unit (PMMU) 256-byte instruction and data caches
Coprocessor	MC68882 floating-point unit
Memory	1 or 4 MB of RAM, expandable to 8 MB 256K of ROM 256 bytes of user-set-parameter memory
Video Display	Built-in 9-inch diagonal, high-resolution, 512-by-342-pixel, bit-mapped display Color QuickDraw™ in ROM provides support for grayscale and color video cards installed in the 030 Direct Slot
Interfaces	Two Apple Desktop Bus (ADB) ports Two RS-232/RS-422 serial ports SCSI interface 030 direct slot supporting full 32-bit address and data lines through 120-pin Euro-DIN connector Stereo sound port for external audio amplifier One DB-19 external disk drive port
Internal Storage	One 1.4 MB FDHD SuperDrive Optional internal Hard Disk 40SC, 80SC
Sound	Apple sound chip including four-voice, wavetable synthesis and stereo sampling generator Mixed stereo monophonic sound output through internal speaker
Clock/Calendar	CMOS custom chip with long-life battery
Electrical	Line voltage: 120 to 240 VAC, RMS automatically configured Frequency: 48 to 62 Hz, single phase Maximum power: 75 watts

Macintosh Classic Specifications

Microprocessor	MC68000 32-bit internal architecture 8.3336 MHz clock frequency 256-byte instruction and data caches
Memory	1 MB of RAM, expandable to 4 MB (120 ns or faster SIMMs) 256K of ROM 256 bytes of user-set-parameter memory
Video Display	Built-in 9-inch diagonal, high-resolution, 512-by-342-pixel, bit-mapped monochrome display
Interfaces	One Apple Desktop Bus (ADB) port Two mini DIN-8 RS-232/RS-422 serial ports Internal and external SCSI interface ports 44-pin memory expansion connector Sound port for external amplifier or headphones One DB-19 external disk drive port
Internal Storage	One 1.4 MB FDHD SuperDrive Optional internal Hard Disk 40SC
Sound	Four-voice sound with 8-bit digital/analog conversion using 22-KHz sampling rate
Clock/Calendar	CMOS custom chip with seven-year battery
Electrical	Line voltage: 100 to 120 VAC Frequency: 50 to 60 Hz, single phase Maximum power: 100 watts

Macintosh SE SIMM Error Codes

When the Macintosh SE is switched on, the ROM runs a series of logic board tests. If any of the tests fails, a Sad Macintosh icon and a two-row, eight-digit error code appears. Error codes indicating SIMM failures are shown in the table below. Identify the SIMM socket number for the type of logic board in the customer's computer and replace the bad SIMM.

Note: Paired XXs in the error codes indicate any number except 0. If the error code is unreadable, press the reset switch and watch carefully—the error code will appear briefly. If the error code is still unreadable, try replacing SIMMs.

Macintosh SE SIMM Error Codes

Error Code	SIMM # Solder Type [1]	SIMM # Jumper Type [2]	Error Code	SIMM # Solder Type [1]	SIMM # Jumper Type [2]
0000000E 000000XX	1	3	00000003 0000XX00	2	4
0000000E 00XX00XX	1	3	00000003 XX00XX00	2	4
0000000E 0000XX00	2	4	00000004 000000XX	3	1
0000000E XX00XX00	2	4	00000004 00XX00XX	3	1
00000002 000000XX	1	3	00000004 0000XX00	4	2
00000002 00XX00XX	1	3	00000004 XX00XX00	4	2
00000002 0000XX00	2	4	00000005 000000XX	3	1
00000002 XX00XX00	2	4	00000005 00XX00XX	3	1
00000003 000000XX	1	3	00000005 0000XX00	4	2
00000003 00XX00XX	1	3	00000005 XX00XX00	4	2

[1] The Macintosh SE uses both solder-type and jumper-type logic boards. To correctly locate the SIMM socket with the faulty SIMM, first identify the type of logic board in your customer's computer. This column refers to solder-type boards.

[2] This column refers to Macintosh SE computers with jumper-type logic boards.

Two logic boards are available for the Macintosh SE. The original logic board uses solder-type resistors to identify system memory configurations; the revised logic board uses a jumper to identify system memory. Also note that memory configurations requiring only two SIMMs use SIMM slots 1 and 2 on the original board, but use slots 3 and 4 on the revised board. The Macintosh SE requires 150 ns (or faster) SIMMs (indicated by the -xx number after the manufacturer's part number).

Upgrade Procedure (Solder-Type Resistors)

1. Clip or install the needed resistor (see the chart and figure below).
2. Install the SIMMs as indicated in the chart below.

RAM	Resistors	SIMMs
1 MB	R35 installed R36 removed	4—256K SIMMs
2 MB	R35 removed R36 installed	2—1 MB SIMMs (slots 1 & 2)
2.5 MB	No resistors	2—1 MB SIMMs (slots 1 & 2) 2—256K SIMMs (slots 3 & 4)
4 MB	No resistors	4—1 MB SIMMs

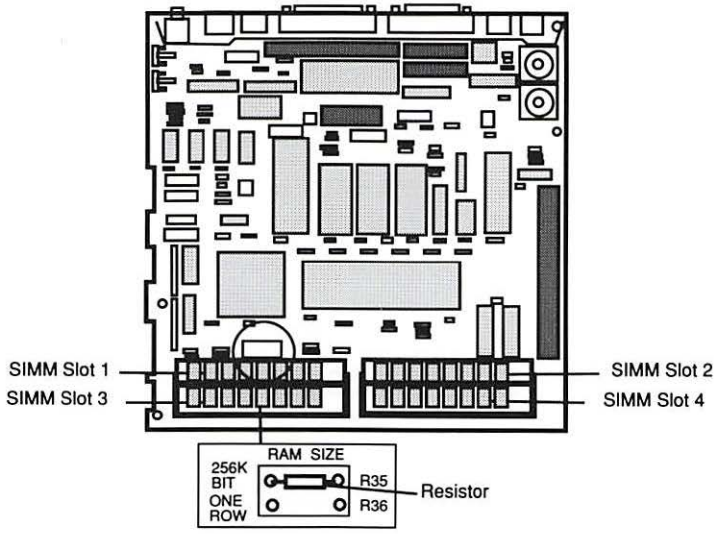
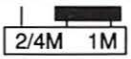
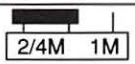
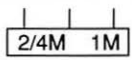
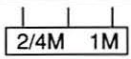


Figure: Macintosh SE Solder-Type Logic Board

Upgrade Procedure (Jumper-Type Resistors)

1. Move the jumper to the appropriate pins, or remove it altogether **(refer to the chart and figure below)**.
2. Install the SIMMs as shown below.

RAM	Jumpers	SIMMs
1 MB		4—256K SIMMs
2 MB		2—1 MB SIMMs (slots 3 & 4)
2.5 MB		2—1 MB SIMMs (slots 3 & 4) 2—256K SIMMs (slots 1 & 2)
4 MB		4—1 MB SIMMs

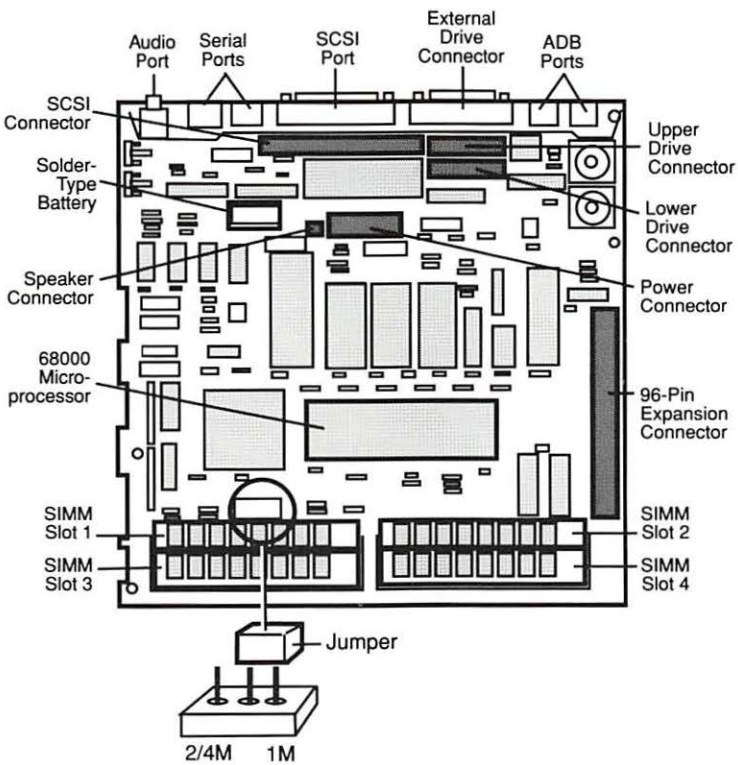


Figure: Macintosh SE Jumper-Type Logic Board

Macintosh SE/30 Memory Upgrade

The Macintosh SE/30 requires 120 ns (or faster) SIMMs. Using 150 ns SIMMs will cause serious timing problems. Oversized 256K and 1 MB DIP SIMMs should be installed in Bank A only. All SIMMs in each bank must be the same memory size.

SIZE	BANK A	BANK B
2 MB	4—256K SIMMs	4—256K SIMMs
4 MB	4—1 MB SIMMs	
5 MB	4—1 MB SIMMs	4—256K SIMMs
8 MB	4—1 MB SIMMs	4—1 MB SIMMs

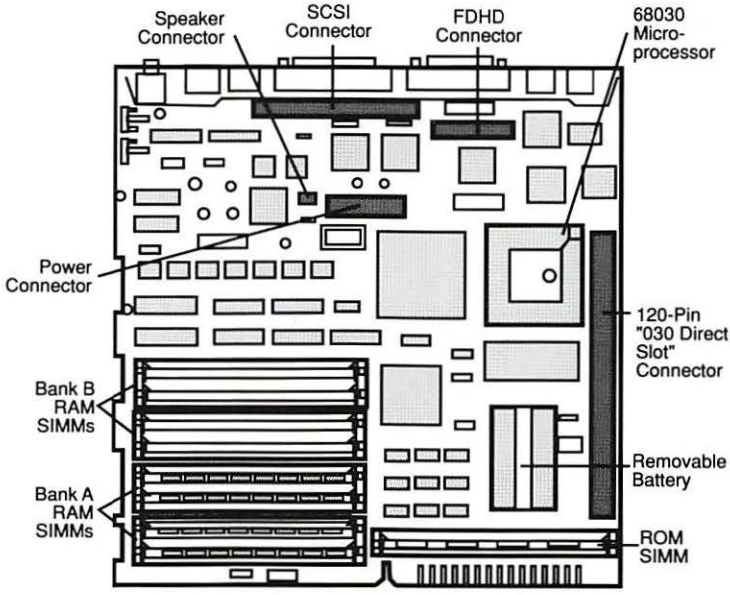


Figure: Macintosh SE/30 Logic Board

Macintosh SE FDHD Upgrade

Using the FDHD SuperDrive in the Macintosh SE requires using System software version 6.0.3 or higher. If the software is lower than 6.0.2, the SuperDrive will be recognized as an 800K mechanism.

Macintosh SE FDHD Upgrade

1. Remove the cover and discharge the CRT.
2. Place the Macintosh SE on the grounded workbench pad and put on your grounding wriststrap.
3. Remove the video board, the SCSI hard disk drive or upper 800K disk drive, the main logic board, and the lower 800K disk drive.
4. Using the IC extractor, remove the IWM chip at location D8 and the two ROM chips at locations D6 and D7 on the main logic board.
5. Install the SWIM chip and the two new ROMs as indicated in the following chart. The notch at the end of the SWIM chip and each ROM should face the front of the logic board (toward the SIMMs).

ROM	P/N	Location
SWIM	344-0062	D8
HI	342-0701	D6
LO	342-0702	D7

6. Install the FDHD SuperDrive in the lower internal drive.
7. Replace the main logic board; the SCSI hard disk, upper 800K disk drive, or second FDHD SuperDrive; the video board; and the cover.
8. Place the appropriate 1.4 MB and 800K labels in the grooves next to the upper and lower disk drive slots on the front bezel of the Macintosh SE.

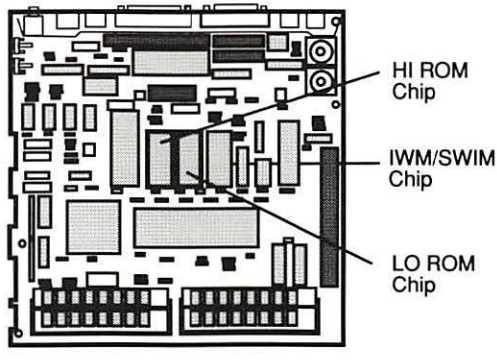


Figure: Macintosh SE Logic Board

Macintosh Classic Memory Upgrade

The Macintosh Classic main logic board has 1 MB of soldered random-access memory (RAM). A 1 MB Macintosh Classic may be upgraded by adding the optional memory expansion board, which contains an additional 1 MB of soldered DRAM plus one pair of SIMM slots. The system may then be upgraded further by adding two 256K or two 1MB SIMMs to the memory expansion board.

The two SIMM slots must contain two SIMMs of like memory capacity (two 256K SIMMS, or two 1 MB SIMMS), or both slots must be left empty. You must use 120 ns (or faster) SIMMs in the Macintosh Classic. **(Refer to "SIMM Identification" under the General Information tab.)**

Upgrade Procedure

The memory expansion board connects at a right angle to the main logic board and is supported by the side of the chassis **(see top Figure)**. The jumper on the memory expansion board must be set correctly for the presence or absence of SIMMs. For the board to operate properly when SIMMs are installed, the jumper must be over the first and second pins from the outside edge; for board operation without SIMMs, the jumper must be over the second and third pins **(see bottom Figure)**.

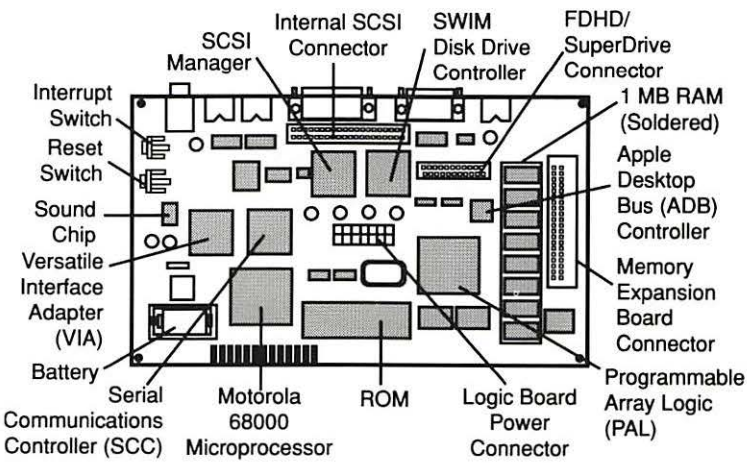


Figure: Classic Main Logic Board

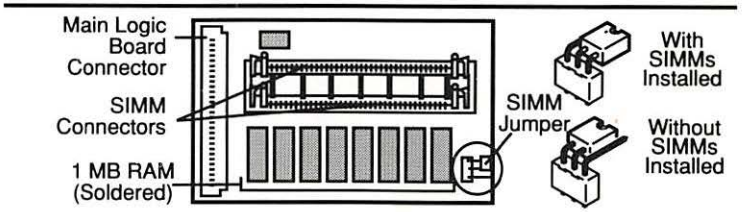


Figure: Classic Memory Expansion Board

Macintosh Portable

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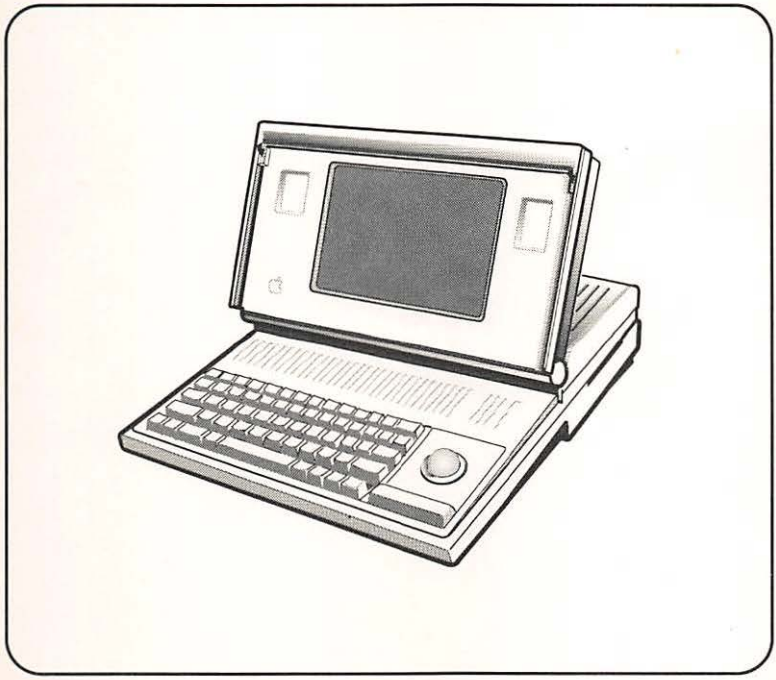
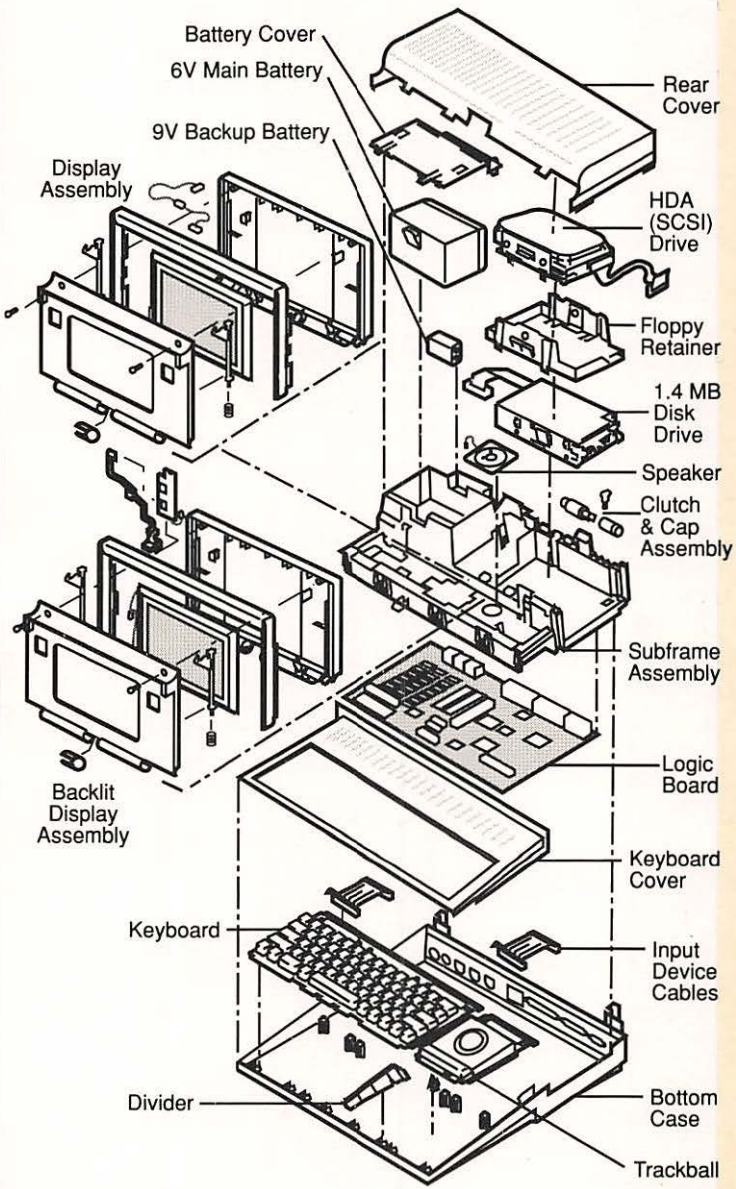


Macintosh Portable
Exploded View



Macintosh Portable

Parts List

Battery Insulator	865-0068
Battery Pack (6V)	076-0376
Packaging, Battery (6 V)	602-0208
Battery Recharger	630-6386
Bottom Case	630-5418
Corner Foot	865-0060
Flat Foot	865-0054
Keyboard Spacer	815-1093
Modem Cap	815-1111
RFI Foam Gasket	805-0973
Carrying Case	630-5574
Carrying Case Strap	699-0508
Luggage Tag	699-0142
Disk Drive, Apple 3.5", 1.4 MB FDHD/SuperDrive	661-0474
Cable, 1.4 MB FDHD Internal	590-0501
Floppy Bezel	815-1092
Floppy Retainer	815-1110
Packaging, 800K & FDHD/SuperDrive	602-0210
Screw, FDHD/SuperDrive	844-0018
Shield, FDHD/SuperDrive	805-0961
Shipping Fixture, 1.4 MB Mechanism	805-5050
Display Assembly (Backlit & Nonbacklit)	
Case Handle	630-5071
Center Pivot Cover	815-1108
Clutch Cover	815-1098
Clutch Mechanism	699-5070
Clutch Retainer	815-1109
Latch Spring	805-1120
Machine Screw, Platinum	450-0505
Display Assembly, Nonbacklit	
Display Cable	590-0502
Display Housing Assembly	652-0604
LCD Display, Nonbacklit	661-0473
Display Assembly, Backlit	
Display Cable	630-6280
Display Housing Assembly	652-0605
Inverter PCA	699-0515
LCD Display, Backlit	661-0647
External Modem/Data Access Arrangement (DAA)	
Australia, Intl. XP 2400™	X077-0235
Austria, Intl. XP 2400	AU077-0235
Belgium, Intl. XP 2400	FN077-0235
Denmark, Intl. XP 2400	DK077-0235
Finland, Intl. XP 2400	K077-0235
France, Intl. XP 2400	F077-0235
Germany, Intl. XP 2400	D077-0235
Holland, Intl. XP 2400	N077-0235
Ireland, Intl. XP 2400	ER077-0235
Italy, Intl. XP 2400	T077-0235
Luxembourg, Intl. XP 2400	LX077-0235
Norway, Intl. XP 2400	H077-0235
Spain, Intl. XP 2400	Y077-0235

continued...

- Sweden, Intl. XP 2400 ..... S077-0235
- Switzerland, Intl. XP 2400 ..... SD077-0235
- United Kingdom, Intl. XP 2400 ..... B077-0235

External Modem/DAA Cables

- Australia X076-8369
- Austria AU076-8369
- Belgium FN076-8369
- Denmark DK076-8369
- Finland K076-8369
- France F076-8369
- Germany D076-8369
- Holland N076-8369
- Ireland ER076-8369
- Italy T076-8369
- Luxembourg LX076-8369
- Norway H076-8369
- Spain Y076-8369
- Sweden/Iceland S076-8369
- Switzerland SF076-8369
- United Kingdom B076-8369

HDA, 3.5-inch, 40 MB, SCSI 661-0540

Internal Modem (Cards)

- Data Modem 2400 661-0468
- Intl. XP 2400 Modem* 661-0465
- Intl. XP 2400 Modem, Germany* D661-0465
- MNP Board, Intl. XP 2400 Modem* 661-0588

Keyboard, Lightweight 661-1612

- British Keyboard B661-1612
- French Keyboard F661-1612
- French Canadian Keyboard C661-1612
- German Keyboard D661-1612
- Italian Keyboard T661-1612
- Spanish Keyboard E661-1612
- Swedish Keyboard S661-1612

Keyboard, Original 661-0476

- British Keyboard B661-0476
- French Keyboard F661-0476
- French Canadian Keyboard C661-0476
- German Keyboard D661-0476
- Italian Keyboard T661-0476
- Spanish Keyboard E661-0476
- Swedish Keyboard S661-0476

Keyboard Parts

- Keyboard Cover 815-1059
- Keycap Set 658-7136
- Keyswitch Set (10/pk), Original Keyboard 076-0226
- Keyswitch Set (10/pk), Lightweight Keyboard 076-0387
- Locking Keyswitch 815-1132

Keyboard/Trackball Cable 590-0507
Logic Board, Static RAM 661-0470
Logic Board, Pseudostatic RAM 661-1610

***Not available in the United States.**

Mouse, Low-Power	661-0585
Ferrite Bead	612-5019
Mouse Ball (21.9 mm)	699-8038
Retainer, ADB Mouse Ball (38 mm)	076-0231
Numeric Keypad, Lightweight	661-1611
Numeric Keypad, Intl. PA Version	PA661-1611
Numeric Keypad, Intl. Z Version	Z661-1611
Numeric Keypad, Original	661-0477
Numeric Keypad, Intl. PA Version	PA661-0477
Numeric Keypad, Intl. Z Version	Z661-0477
Power Adapter/Charger	699-0505
Power Adapter/Charger, UK	B699-0505
Power Adapter/Charger, Japan	JA699-0505
Power Adapter/Charger, Australia	X699-0505
Power Adapter/Charger, Europe, 220V	Z699-0505
RAM Card, Pseudostatic, 1 MB	661-0614
RAM Card, Pseudostatic, 3 MB	661-0613
RAM Card, Static, 1 MB	661-0480
Rear Cover	630-5687
Standard Bezel	810-1096
Speaker	600-0406
Subframe Assembly	630-5684
Battery Connector	805-0970
Battery Cover	630-5723
Modem RFI Gasket	805-0976
Telephone Cable, U.S.	590-0590
Trackball Assembly	661-0475
Trackball Ball	815-1133
Trackball Retainer	815-1134
Wire Harness Assembly	600-0425

Macintosh Portable
Specifications

Macintosh Portable Specifications

Microprocessor	CMOS 68000 16 MHz clock speed
Memory	1 MB of low-power static RAM, expandable to 9 MB (on the original Macintosh Portable) 1, 2, or 4 MB of pseudostatic RAM, expandable to 8 MB (on the new Macintosh Portable) 256K of ROM, expandable to 4 MB
Screen	Active-matrix liquid crystal display, backlit on new units Full-page width 640 by 400 pixels
Input Devices	Built-in keyboard with standard Macintosh layout Low-power ADB mouse 1.3-inch diameter trackball pointing device 18-key numeric keypad (can be installed as an alternative to the trackball)
Internal Storage	One 1.4 MB FDHD SuperDrive Internal Hard Disk 40SC (optional on original Portable)
Interfaces	One external disk drive port One SCSI interface: uses a 50-pin internal connector and a DB-25 external connector One Apple Desktop Bus port allows daisy-chaining of peripheral devices One stereo sound port One power adapter port Two RS-232/RS-422 serial ports One video output port
Expansion Connectors	Three expansion slots for optional RAM, ROM, or 2400 bps modem 96-pin processor-direct slot
Sound	Apple custom digital sound chip
Electrical	Line voltage: 85 to 270 volts AC, 48 to 62 Hz Power: 15 watts maximum

Summary of Warnings and Cautions

The following warnings and cautions should be observed whenever you repair the Macintosh Portable computer. If you have not done so recently, take the time to review this important information.

CAUTION: Before replacing any modules within the Portable, always unplug the power adapter, remove the main battery, and replace the battery cover.

CAUTION: Failure to replace the battery cover could damage the computer. Replacing the battery cover disconnects the Portable from the 9-volt backup battery. Failure to do so leaves power connected to the logic board and could damage the modules removed.

WARNING: The 6 volt sealed lead-acid battery contains toxic chemicals and is considered toxic waste. If a bad battery is *not* physically damaged, return the battery to Apple—do not dispose with other trash. Return the battery in the same packaging used for new batteries. If a bad battery *is* physically damaged, do not return the battery to Apple. Dispose of such batteries according to local ordinances.

WARNING: Sulfuric acid in the main battery can cause severe burns to the skin and eyes. If you touch a damaged main battery, immediately wash your hands and any other contacted skin with water for at least five minutes.

CAUTION: The Macintosh Portable makes extensive use of low-power complementary metal oxide semiconductor (CMOS) devices. These devices are very susceptible to damage from electrostatic discharge (ESD). Observe appropriate ESD precautions.

CAUTION: The LCD display is extremely susceptible to ESD damage. As with all sensitive electronics, use a grounded workstation pad and grounding wriststrap when handling the display—and handle it ONLY by the edges. Do not remove the protective tape on the component side of the LCD display.

CAUTION: The bottom case and subframe of the Portable are coated to reduce electromagnetic interference. This protective coating can be damaged by skin oils. Avoid excessive handling of these modules.

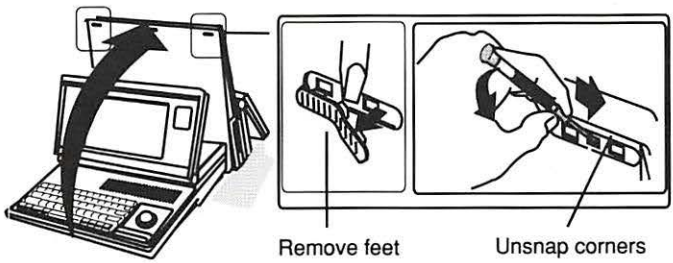


Figure: Removing the Keyboard Cover

Figure: Removing the Backup Battery

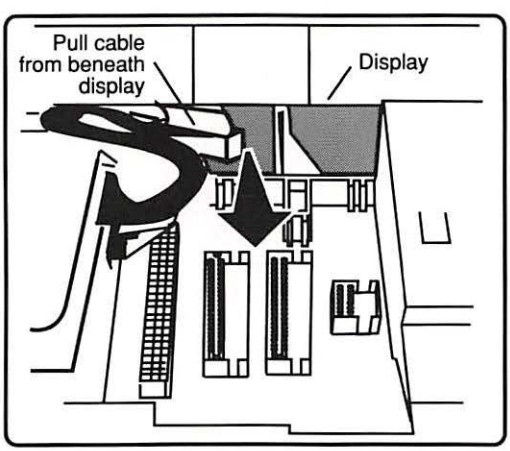


Figure: Removing the SCSI Drive

Summary of Module Removal Steps

Rear Cover

1. Place the computer on a grounded workstation mat.
2. Depress the two rear latches and lift off the rear cover.

Keyboard Cover

1. Open the display.
2. Using a jeweler's screwdriver, pop off the two feet beneath the keyboard **(see Figure on previous page)**. Insert the screwdriver through the center holes, and push down and out to unsnap the corners.
3. Unsnap and remove the keyboard cover.

Main Battery

1. Remove the rear cover.
2. Slide off the battery cover.
3. Lift out the battery. If you are removing another module, replace the battery cover.

Backup Battery

Note: *Removing the backup battery will erase parameter RAM. Before doing so, note all Control Panel settings so you can restore them later.*

1. Access the main battery.
2. Use a jeweler's screwdriver to pry up the backup battery **(see Figure on previous page)**.
3. Remove the battery and disconnect its cable.

Option Cards

1. Remove the rear cover and the main battery.
2. Replace the battery cover before removing any cards.

SCSI Drive

1. Remove the rear cover, main battery, and keyboard cover. Replace the battery cover.
2. Remove all option cards.
3. Disconnect the display and disk drive cables from connectors J19 and J18.
4. Close the display and slide out the disk drive cable **(see Figure on previous page)**.
5. Unsnap the two plastic latches and remove the drive.

CAUTION: When replacing the drive cable beneath the display assembly, make sure the cable is not caught under the disk drive shield.

6. After installing the new SCSI drive, run *Macintosh Hard Disk Test* to verify correct operation. If you are using version 1.0 of *Macintosh Hard Disk Test*, be sure to operate the computer with the power adapter connected; do not use **Loop on selected tests**.

Upper Floppy

1. Remove the rear cover, main battery, and any option cards. Replace the battery cover.
2. Disconnect the drive cable from the drive.
3. Unsnap the two plastic latches and remove the drive.
4. Depress two metal tabs and remove the mechanism.

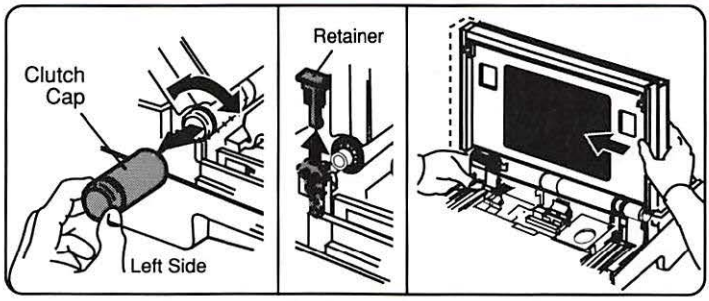


Figure: Removing the Display Assembly

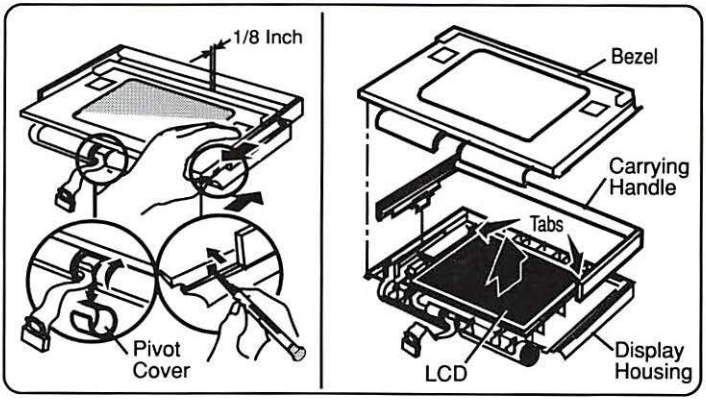


Figure: Removing the LCD Display

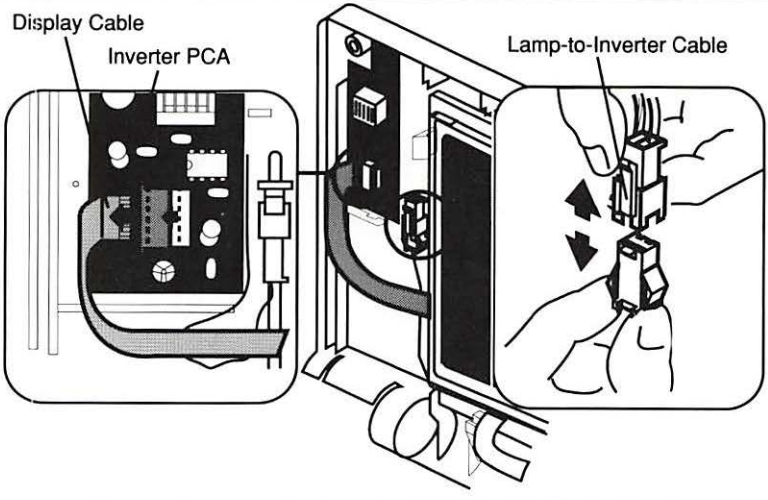


Figure: Removing the Inverter PCA (Backlit Display Only)

Lower Floppy

1. First remove the upper floppy or SCSI drive.
2. Disconnect the disk drive cable from the drive.
3. Lift the disk drive out of the subframe.

Trackball/ Numeric Keypad

1. Remove the rear cover, main battery, and keyboard cover. Replace the battery cover.
2. Disconnect the flat cable from the device(s) to be moved.
3. Unsnap and remove the device(s) from the case.

Speaker

1. Remove the rear cover, main battery, and keyboard cover. Replace the battery cover.
2. Disconnect the speaker cable from connector J16.
3. Depress the two plastic tabs and remove the speaker.

Display Assembly

1. Remove the rear cover, main battery, and keyboard cover. Replace the battery cover.
2. Disconnect the display cable from connector J19.
3. Gently twist back and forth, and remove the left clutch cap **(see Figure on previous page)**.
4. Pull off the left clutch retainer **(see Figure on previous page)**.
5. Push the display left as shown in the figure, and remove the left clutch mechanism.
6. Slide the display off the right clutch mechanism.

LCD Display (Nonbacklit)

1. Remove the rear cover, main battery, and display assembly. Replace the battery cover.
2. Pull out the carrying handle and remove the two Phillips screws (if present) from the upper right and upper-left corners of the display bezel.
3. Rotate and remove the center pivot cover **(see Figure on previous page)**.
4. Using a jeweler's screwdriver, release the plastic bezel from the display housing and pull down on the bezel to remove it **(see Figure on previous page)**. Repeat on both sides.
5. Remove the bezel and carrying handle.
6. Release the two plastic tabs at the upper-right and -left corners and remove the display **(see Figure on previous page)**.
7. Disconnect the display cable.

LCD Display (Backlit only)

8. Depress the tab and disconnect the ccfl-lamp-to-inverter PCA cable **(see Figure on previous page)**.
9. Disconnect the ribbon cable from the inverter PCA **(see Figure on previous page)**.
10. To remove the inverter PCA, use a jeweler's screwdriver to gently pry it from the display housing.

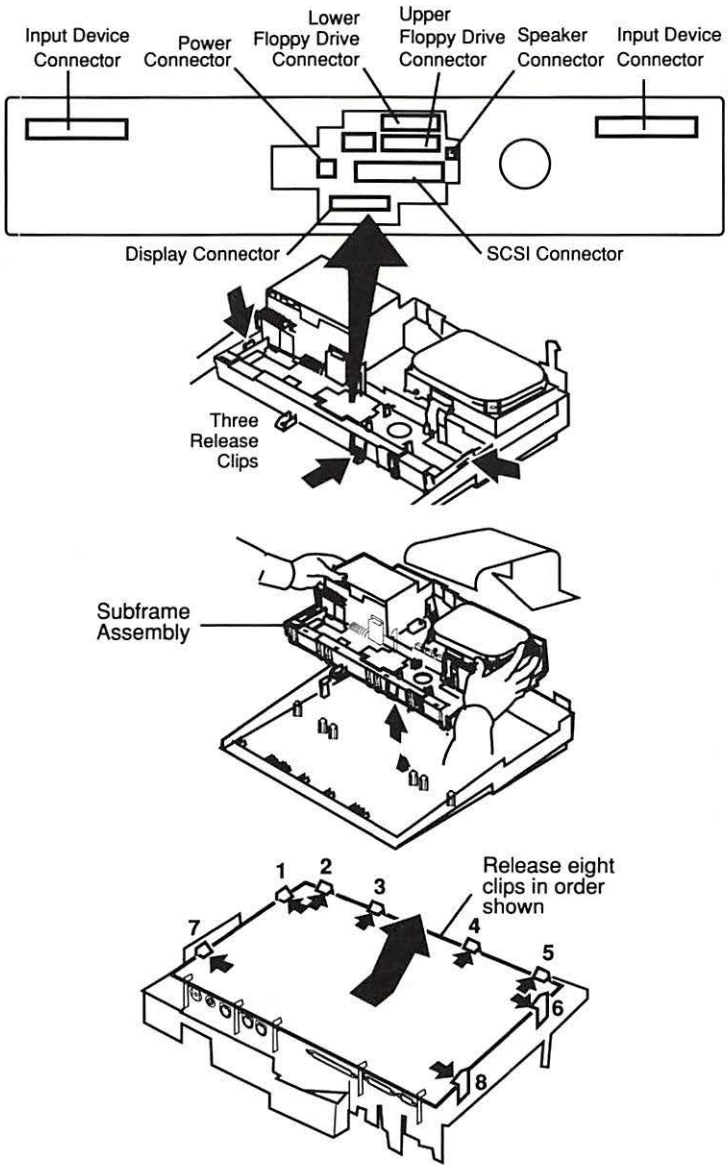


Figure: Removing the Logic Board

Logic Board

1. Remove the rear cover, main battery, keyboard cover, keyboard/trackball/keypad, display assembly, and option cards. Replace the battery cover.
2. Disconnect all cables (if present, J13-J18 and J20) from the logic board connectors **(see Figure on previous page)**.
3. Using a jeweler's screwdriver, release the clips at the left, front center, and right sides of the subframe **(see Figure on previous page)**. Lift the subframe slightly after releasing each clip, and then remove the subframe.

CAUTION: When releasing the subframe assembly from the bottom case, be careful not to lift the subframe too far. Lifting the subframe too far could damage the subframe or the logic board.

4. Release the eight plastic clips on the bottom of the subframe **in the order shown**, and separate the logic board from the subframe.

Troubleshooting—Introduction

Before trying other troubleshooting aids, determine whether the Portable is receiving enough power. Perform the battery troubleshooting procedure below.

If the problem is not resolved by the suggestions in battery basics (below), continue troubleshooting by starting up the system and listening for the diagnostic error chords. The diagnostic error chords will indicate major problems with the logic board or battery. If this does not identify all problems, run *MacTest* if the system will boot or run *AppleCAT*® if the system will not boot. **(Note: *MacTest Portable* does not run on Portables with pseudostatic RAM logic boards.)** These diagnostic programs perform identical tests. If the system still doesn't function properly or will not boot, refer to the Symptom/Cure Chart. If the symptom is not listed or is not clearly defined, refer to Troubleshooting—Startup Problems. These flowcharts provide step-by-step procedures for troubleshooting the complete Portable system.

Troubleshooting—Battery Basics

Note: *The power adapter by itself cannot provide enough power to operate the Macintosh Portable if the battery is not adequately charged.*

1. Connect the power adapter and and check the battery level. Even with the power adapter connected, the Portable must be more than 25% charged to operate properly.
2. Make sure the battery cover is completely closed. The Portable will not operate unless the battery cover is closed.
3. Press any key—you may merely have forgotten to wake the Portable up!
4. As a last resort, reset the power manager.
   - Unlock the interupt and reset switches **(see Figure)**.
   - Simultaneously press and hold the reset and interupt switches, and then release both of them.
   - Again, wake up the Portable by pressing any key.

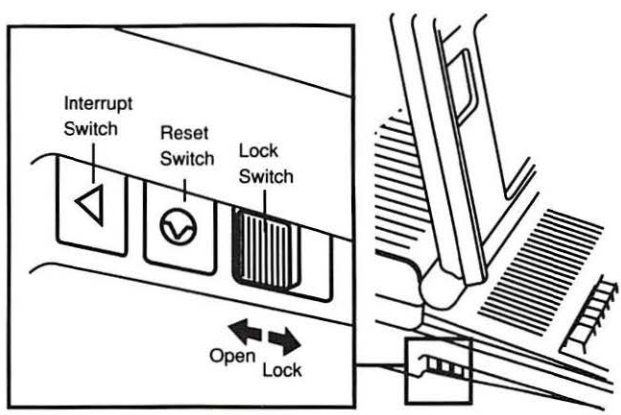


Figure: Resetting the Power Manager

Macintosh Portable
Symptom/Cure Chart

Power Problems	Solutions
Screen is blank; computer not responding	1. If computer is new, verify that plastic sheet has been removed from between battery and contacts. 2. Reset power manager. 3. Connect power adapter and try computer again in three or four minutes. 4. Try known-good, charged main battery. If computer now works, replace main battery. 5. Verify that keyboard cable is securely connected at both ends. 6. Replace keyboard. 7. Replace keyboard cable. 8. Replace logic board.
After main battery removal, some Control Panel settings are different	1. Was battery cover replaced when main battery was removed? If so, power to computer was interrupted and different settings are normal. Restore contents of Control Panel. 2. Replace backup battery.
Power adapter is plugged in and connected, but battery DA does not indicate charger is connected	1. Verify that charger is connected properly. 2. Try a different main battery. If battery now charges, replace main battery. 3. Replace power adapter. 4. Replace logic board.
A low-power warning is displayed soon after startup	1. Battery needs recharging. Attach power adapter. 2. Make sure peripherals being used display low-power icon. 3. Reduce use of floppy or hard disk, modem, sound, or other power-consuming devices, or connect power adapter.
Battery needs recharging after computer is unused for four or more days	– If system software is 6.0.4 and AppleTalk is active, using Shutdown command allows serial communications controller (SCC) to draw excess current. To prevent this, select **Sleep** from Special menu or deactivate AppleTalk using Chooser prior to **Shutdown**. Install system software 6.0.5.

Video Problems	Solutions
Some pixels never come on (blacken); no pattern	– A maximum number of five permanently OFF pixels (voids) is considered acceptable. If display contains six or more voids, replace LCD display.
Some pixels are always black; no pattern	– If any pixel remains on constantly, replace LCD display.
A row of pixels	1. Replace LCD display.

never blackens	2. Replace display cable. 3. Replace logic board.
A row of pixels is always black (black streaks)	1. Replace LCD display. 2. Replace display cable. 3. Replace logic board.
No display, but computer appears to be operating correctly	1. Verify that display cable is securely connected. 2. Replace LCD display. 3. Replace display cable. 4. Replace logic board.
Display looks blurred	1. Adjust angle of display. 2. Adjust screen contrast setting using Control Panel.
Display looks dark (nonbacklit display)	1. Not enough light is available. Locate computer closer to direct light or move light source closer to computer. 2. Adjust screen contrast setting using Control Panel. 3. Replace LCD display. 4. Replace logic board.
Display is too light (nonbacklit display)	1. Adjust angle of display. 2. Adjust screen contrast setting using Control Panel. 3. Replace LCD display.
Backlight level cannot be changed	– Verify that version 1.3 of the Portable CDEV is present. Earlier versions do not support the backlight feature. (To check the version of the CDEV, select the file named Portable in the system folder and select **Get Info** from the File menu.)
Backlight does not operate	1. Verify that version 1.3 of the Portable CDEV is present. Earlier versions do not support the backlight feature. (To check the version of the CDEV, select the file named Portable in the system folder and select **Get Info** from the File menu.) 2. Check inverter PCA connections. 3. Replace inverter PCA. 4. Replace LCD display. 5. Replace logic board.

Disk Drive Problems	**Solutions**
Audio and video present, but internal drive does not operate	1. Try different floppy disk. 2. Replace floppy disk drive. 3. Replace floppy disk drive cable. 4. Replace logic board.
Disk ejects while booting; display shows Mac icon with blinking "X"	1. Try known-good system disk. 2. Replace floppy disk drive. 3. Replace floppy disk drive cable. 4. Replace logic board.

continued...

Disk Drive Problems (continued)	Solutions
Disk will not eject	1. Shut down computer, press and hold down trackball or mouse button, and switch on computer. 2. Eject disk manually by pushing opened paper clip into bottom case hole located near disk drive. 3. Replace floppy disk drive. 4. Replace floppy disk drive cable. 5. Replace logic board.
Disk initialization fails	1. Verify that Apple-certified media are being used. 2. Try different disk. 3. Replace floppy disk drive. 4. Replace logic board.

SCSI Drive Problems	Solutions
Internal hard disk will not operate	1. Verify that external SCSI devices are switched on and SCSI hard drive cable is securely connected. 2. Use HD SC Setup to see if drive is visible. If it is, reinitialize drive. 3. Replace hard disk drive. 4. Replace logic board.

Peripheral Problems	Solutions
After connecting external SCSI device, computer no longer boots	1. Turn on external SCSI device before starting up computer. 2. Verify that proper cable termination is provided. 3. Verify that no two SCSI devices have same device address. 4. Replace logic board.
Cursor does not move when using trackball	1. Reset power manager. 2. Check cable connections between trackball and logic board. 3. Replace trackball cable. 4. Replace trackball. 5. Replace logic board.
Cursor does not move when using mouse	1. Check mouse connection to ADB port. 2. Reset power manager. 3. Clean mouse ball and inside mouse case. (Refer to You Oughta Know tab in *Apple Service Technical Procedures*.) 4. Replace mouse. 5. Replace logic board.
Cursor intermittently does not move or moves erratically	1. Clean trackball ball and internal rollers. 2. Replace trackball.

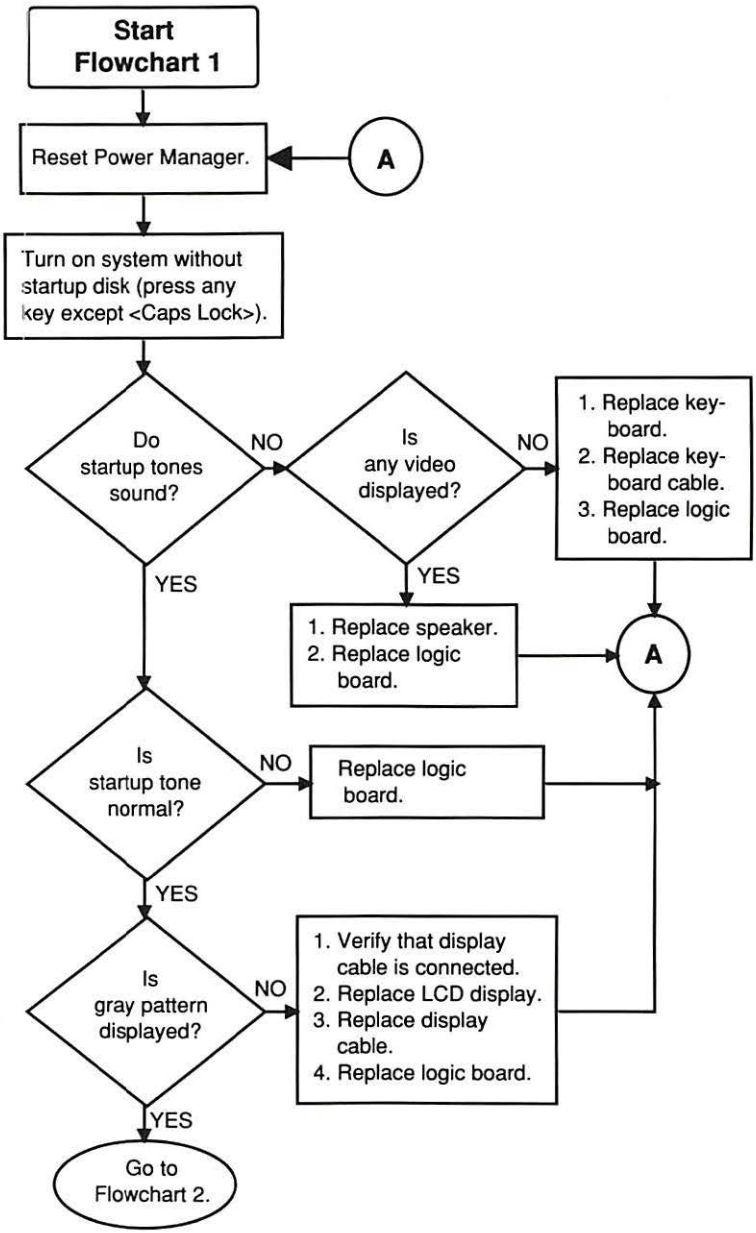
Device connected to modem port doesn't work	1. Verify that **External Modem** is selected in Portable CDEV. 2. If using System 6.0.4, upgrade to 6.0.5 or later. 3. Replace logic board.
Cursor moves, but clicking button has no effect	1. If trackball button is not working, replace trackball cable. If mouse button is not working, replace mouse. 2. Replace trackball. 3. Replace logic board.
No response to any key on keyboard	1. If screen is blank and you are trying to bring computer out of system sleep, try resetting power manager. 2. Check keyboard connection to logic board. 3. Replace keyboard. 4. Replace logic board.
Known-good ImageWriter, ImageWriter II, or LQ will not print	1. Make sure System 6.0.5 or later is being used. 2. Make sure Chooser is set correctly. 3. Replace printer cable. 4. Replace logic board.
Known-good LaserWriter will not print	1. Make sure System 6.0.5 or later is being used. 2. Make sure Chooser is set correctly. 3. Try another printer. If that printer works, computer is OK. Refer to *Networks* tab in *Apple Service Technical Procedures.* 4. Replace logic board.
Serial devices are unrecognized or garbage is transmitted and/or received	1. If System 6.0.4 is being used, be sure Macintosh Portable INIT 1.0 is installed in system folder. 2. Upgrade to System 6.0.5 or later.
When using external modem: After exiting communication program and putting Portable to sleep three or four times, computer locks up when coming out of system sleep	– If System 6.0.4 is being used, upgrade to System 6.0.5 or later.

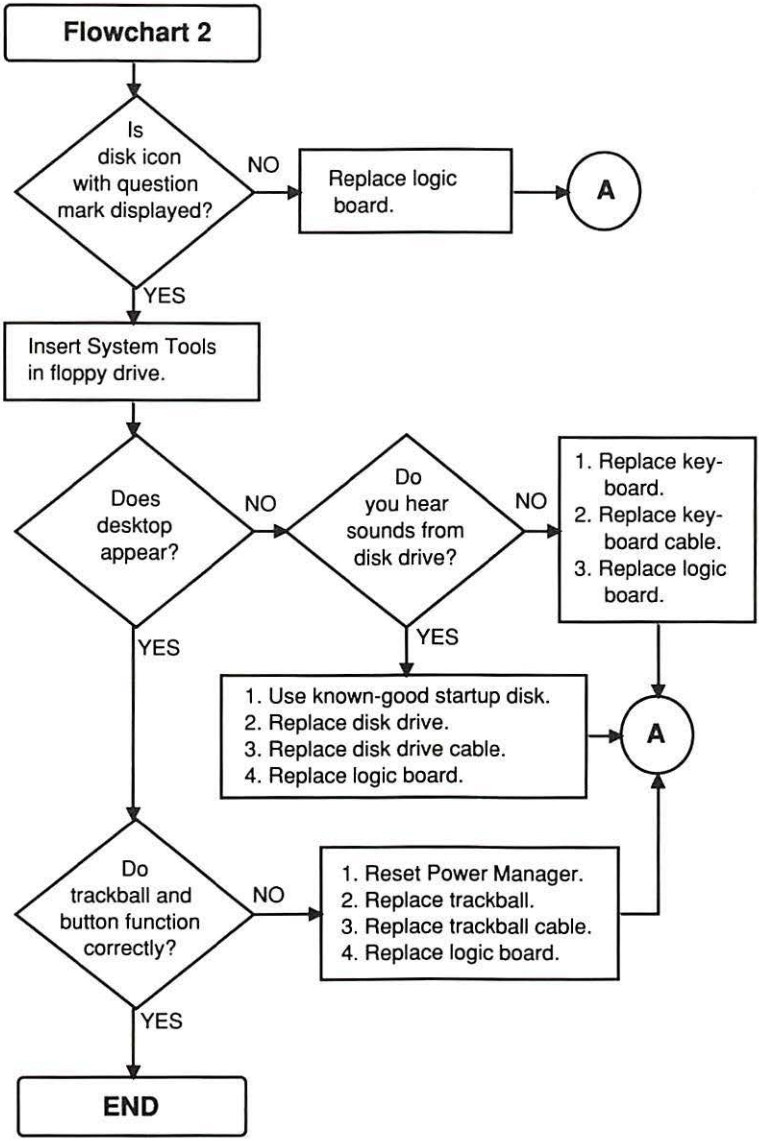
Internal Modem Problems	**Solutions**
Internal modem options do not appear in Portable CDEV when modem is installed	1. Try removing and reseating card. 2. Replace modem card. 3. Replace logic board.

continued...

Internal Modem Problems (cont'd)	Solutions
Modem interferes with system sound	1. Replace modem card. 2. Replace logic board.
Modem does not respond properly to AT command set instructions	1. Check baud rate and data format settings. Are they compatible with Portable Data Modem 2400 and remote modem? 2. Replace modem card.
Modem does not respond to incoming call	1. If system does not respond to incoming call during sleep mode, verify that **When Phone Rings** option in Automatic Wake-Up section of Portable CDEV is selected. 2. Replace modem card. 3. Replace logic board.
Modem has no sound output	– Replace modem card.

Miscellaneous Problems	Solutions
Screen goes blank and computer shuts down every few minutes	– Computer is going into system sleep to conserve battery power. Adjust sleep delays in Control Panel or connect power adapter.
Some applications seem to run slower after running for a few seconds	– Computer is switching to system rest. To disable system rest, open Control Panel, hold down <Option> key, and click **Minutes Until Automatic Sleep**. When dialog box appears, click **Don't Rest.**
Hard disk is slow to respond or screen goes blank too often	– The computer is powering down hard disk or going into system sleep to conserve battery power. Adjust sleep delays in Control Panel or connect power adapter.
No sound from speaker	1. Verify that volume setting in the Control Panel is 1 or above. 2. Check speaker connection to logic board. 3. Replace speaker. 4. Replace logic board.
Screen suddenly goes blank	– Computer has gone into system sleep to conserve battery power.


Start
Flowchart 1
Reset Power Manager.
A
Turn on system without startup disk (press any key except <Caps Lock>).
Do startup tones sound?
NO
Is any video displayed?
NO
1. Replace key-board.
2. Replace key-board cable.
3. Replace logic board.
YES
YES
1. Replace speaker.
2. Replace logic board.
A
Is startup tone normal?
NO
Replace logic board.
YES
Is gray pattern displayed?
NO
1. Verify that display cable is connected.
2. Replace LCD display.
3. Replace display cable.
4. Replace logic board.
YES
Go to Flowchart 2.


Flowchart 2
Is disk icon with question mark displayed?
NO
Replace logic board.
A
YES
Insert System Tools in floppy drive.
Does desktop appear?
NO
Do you hear sounds from disk drive?
NO
1. Replace keyboard.
2. Replace keyboard cable.
3. Replace logic board.
YES
YES
1. Use known-good startup disk.
2. Replace disk drive.
3. Replace disk drive cable.
4. Replace logic board.
A
Do trackball and button function correctly?
NO
1. Reset Power Manager.
2. Replace trackball.
3. Replace trackball cable.
4. Replace logic board.
YES
END

The logic board for the original Macintosh Portable (with static RAM) and the logic board for the new Portable (with pseudostatic RAM) *are not interchangeable*. The pseudostatic logic board has eight soldered RAM chips; the logic board with static RAM has thirty-two soldered chips.

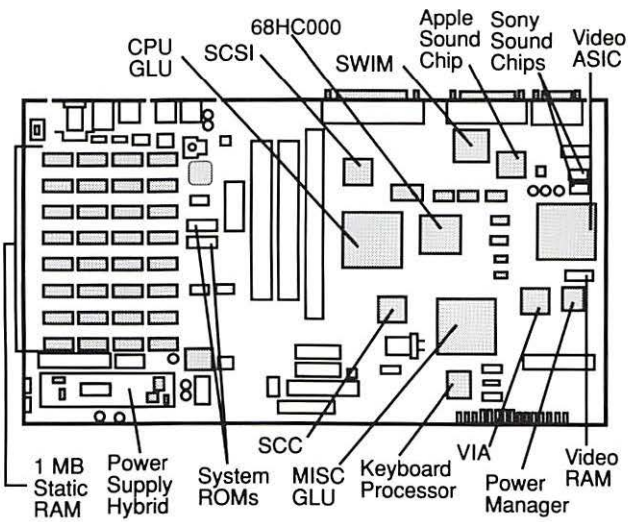


Figure: Logic Board Components (Original Logic Board Shown)

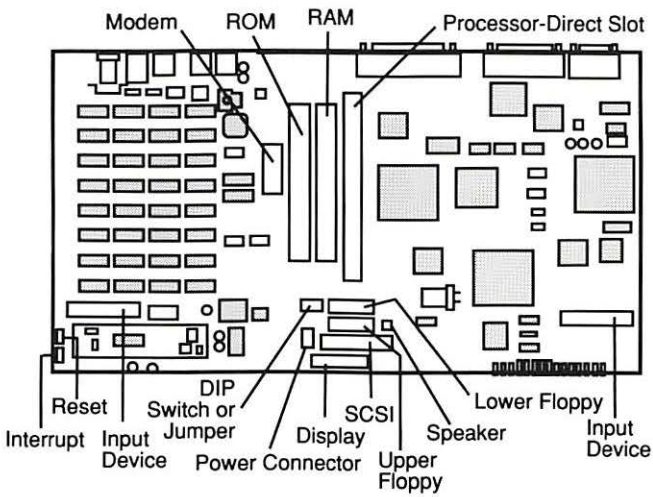


Figure: Internal Connectors and Switches

Installation and Verification Procedure

The following procedure covers the installation and verification of the internal, Macintosh Portable Data Modem 2400 and the Intl. XP 2400.

1. Unplug the power adapter, and remove the rear cover and main battery.
2. Remove the modem cap by pushing it through the rear of the computer.
3. Install the modem card in the modem connector. Make sure the modem card is on the right side of the modem gasket.
4. Replace the main battery and rear cover, and turn on the computer.
5. Use *ModemTest* to verify that the computer and modem are communicating, and AppleLink to verify operation of the modem with the telephone network. (For additional information, refer to Section 4, Diagnostics, under the Modems tab in *Apple Service Technical Procedures.*)

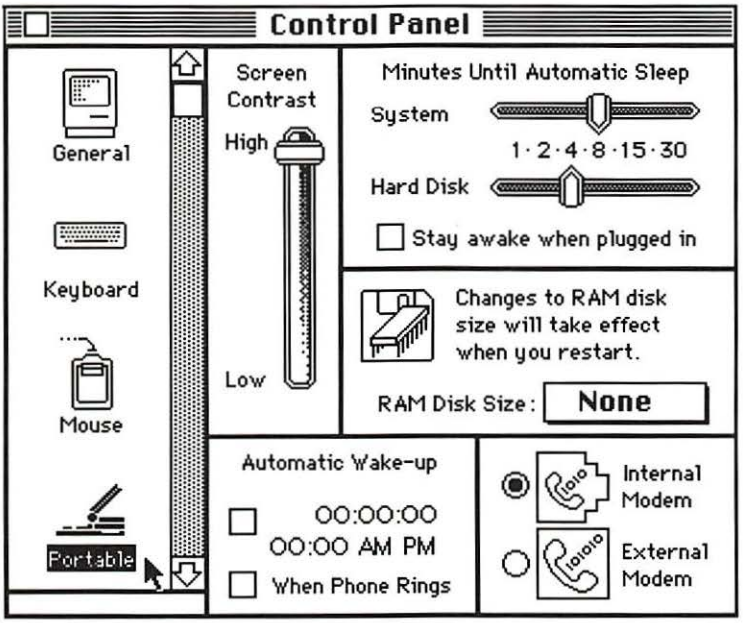


Figure: Verifying Correct Modem Installation

Installation Procedure

1. Place the Macintosh Portable on a grounded workstation mat and put on your grounding wriststrap.
2. Unplug the power adapter, and remove the rear cover and main battery.
3. Replace the main battery cover.

CAUTION: The 1 MB static RAM and the 1 MB and 3 MB pseudostatic RAM expansion cards *are not interchangeable.* Never install a static RAM card (unkeyed) on the new pseudostatic logic board (keyed connector).

4. Locate the RAM expansion connector **(see Figure D). If the connector is keyed, you must install a pseudostatic RAM expansion card (see the cards in Figures B and C below).**
5. Position the static (not keyed) or pseudostatic (keyed) expansion card over the connector and plug in the card **(see Figure D)**.
6. Remove the battery cover and replace the main battery.
7. Replace the rear cover.

Troubleshooting the Installation

1. Turn on the computer by pressing any key except <Caps Lock>.
2. Pull down the Apple menu and select **About the Finder™**.
3. Check that the amount of RAM indicated is 2048K (1 MB card) or 4096K (3 MB card). If the amount of RAM is not correct:
   - Check that correct card (static or pseudostatic) is installed.
   - If the card is correct but the amount of RAM is *not*, replace the card.
   - If the amount of RAM indicated is *still not* correct, replace the logic board.

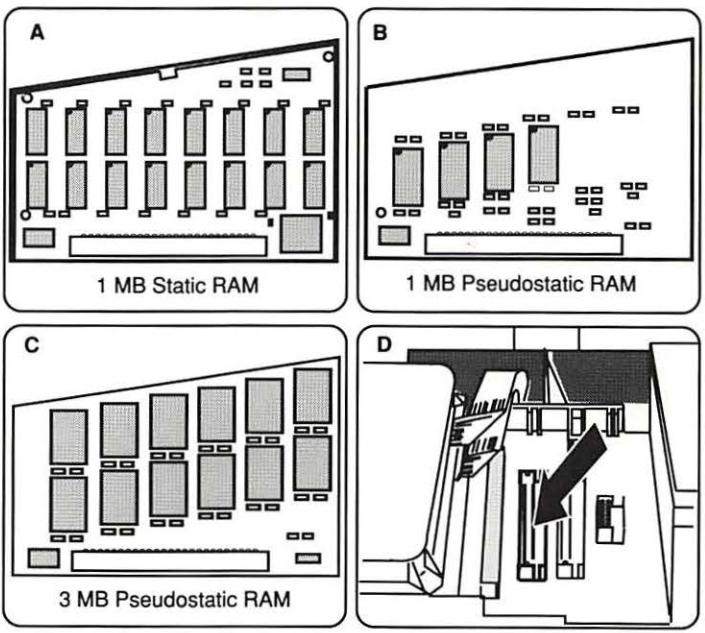


Figure: Installing Static or Pseudostatic RAM Expansion Cards

Macintosh LC

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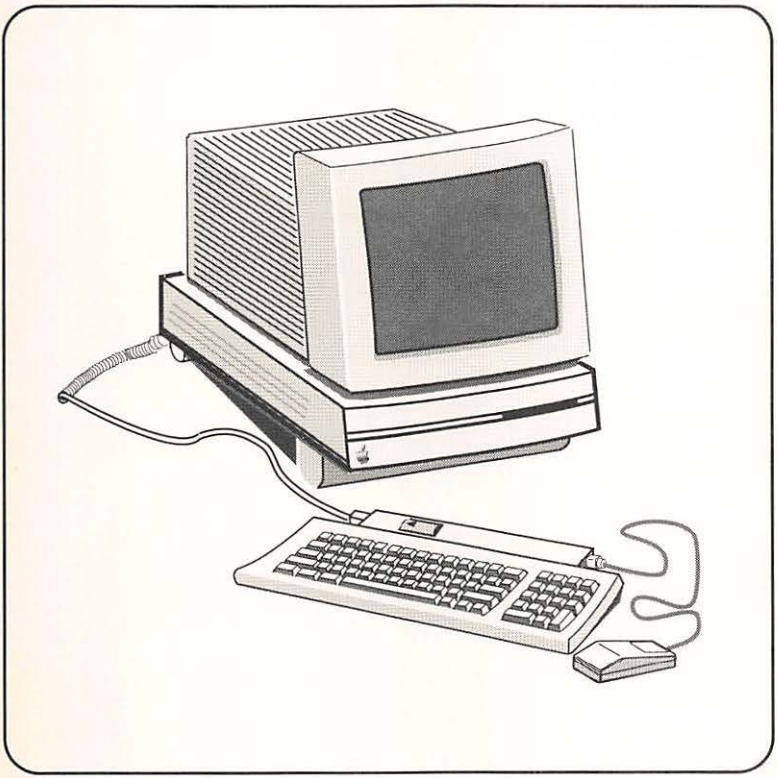
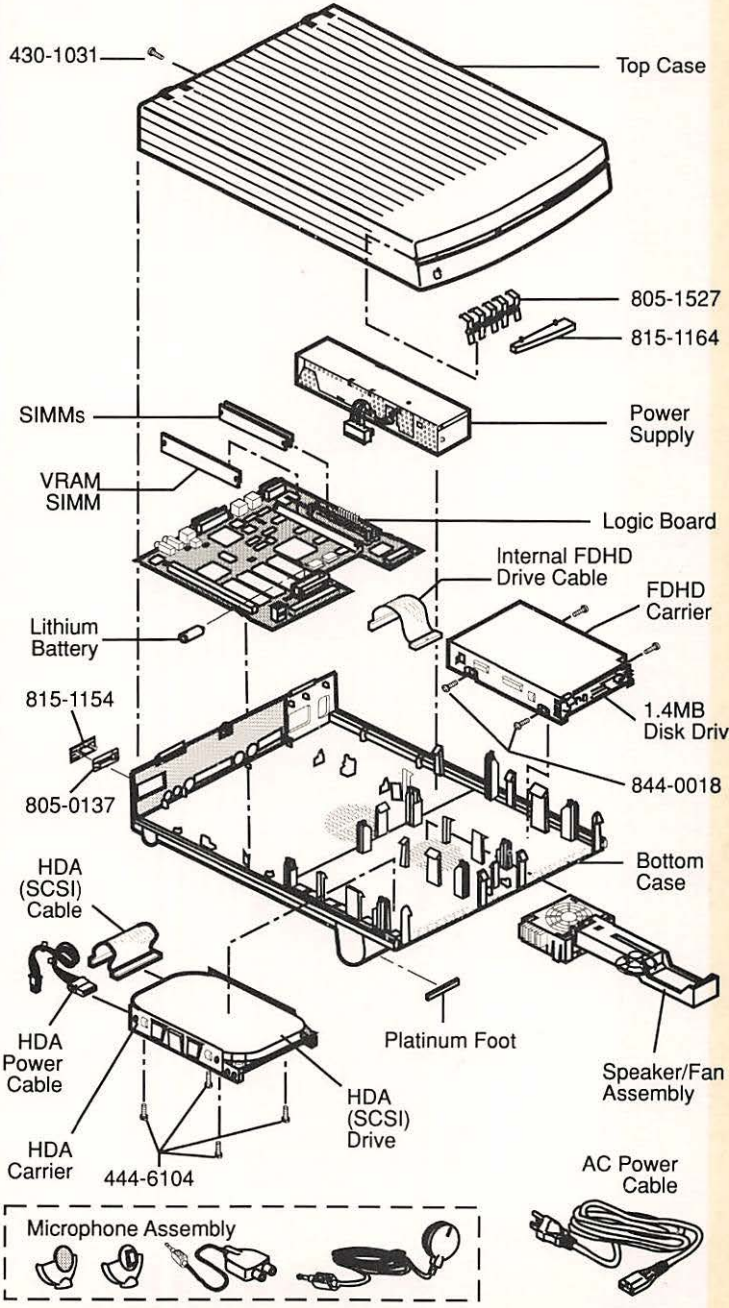


Macintosh LC
Exploded View



Bottom Case	630-0500
Access Cover	815-1154
Access Cover Shield	805-0137
Platinum Foot	865-0066
Cable, AC Power (smoke)	590-0380
Disk Drive, Apple 3.5, 1.4 MB FDHD/SuperDrive	661-0474
Cable, Internal FDHD Drive	590-0524
FDHD Carrier	805-5111
Screw, FDHD Carrier to FDHD	844-0018
HDA, 40 MB, 1" Internal 3.5 SCSI	661-0614
Cable, HDA Power	590-0303
Cable, Internal HDA (SCSI Connector Cable)	590-0228
HDA Carrier	805-0980
Screw, 6-32 x .250 (HDA to HDA Carrier)	444-6104
Keyboard II*	661-0603
Lithium Battery (without leads)	742-0011
Logic Board	661-0593
SIMM, 1 MB, 120 ns	661-0403
SIMM, DIP, 1 MB, 120 ns	661-0410
VRAM SIMM, 256K, 100 ns	661-0609
Microphone Assembly	699-5071
Mouse, Apple Desktop Bus*	661-0479
Power Supply	661-0594
Speaker/Fan Assembly	630-5058
Top Case	630-0505
Cover Screw	430-1031
Disk Drive Slot Cover	815-1164
Disk Drive Slot Cover Shield	805-1527

**For additional ADB devices and part numbers, see General Information.*

Symptom / Cure Chart

System Problems	Solutions
Does not power on—screen is black, fan is not running, and LED is not lit	1. Check cables. 2. Plug monitor directly into wall socket, and verify that monitor has power. 3. Replace power cord. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
System shuts down intermittently	1. Make sure air vents on top and sides of cover are clear. Thermal protection circuitry may shut down system. After 30-40 minutes, system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
Clicking, chirping, or thumping sound	1. Replace power supply. 2. Disconnect hard disk; replace if noise disappears. 3. Replace logic board. Retain customer's SIMMs.

continued...

System Problems (continued)	Solutions
System intermittently crashes or locks up	1. Make sure the System is version 6.0.7 or higher. 2. Make sure application software is known-good. 3. Replace system software. 4. Replace logic board. Retain customer's SIMMs. 5. Replace SIMMs. 6. Replace power supply.
System intermittently does not power on	1. Check cables. 2. Plug monitor directly to wall socket and verify that monitor has power. 3. Replace power cord. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
System seems to boot, then message "Finder is old version" displays	1. Clear parameter RAM. Hold down <Command> <Option> <p> <r> keys and reboot system. You will hear normal startup chords and about two seconds later you will hear another chord. This means parameter RAM has been cleared. 2. Replace logic board. Retain customer's SIMMs.

Video Problems	Solutions
Screen is completely dark, fan is not running, and LED is not lit	1. Plug monitor directly into wall socket, and verify that monitor has power. 2. Remove expansion card, if installed. 3. Remove any external peripherals, if attached. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.
Screen is dark, no audio, no drive, but fan is running and boot tone is normal	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace video RAM SIMM. 5. Replace SIMMs. 6. Replace logic board. Retain customer's SIMMs. 7. Replace power supply.
Vertical or horizontal lines or snow appear on screen, or screen is completely dark, and boot tone is normal	1. Replace monitor. 2. Replace video cable. 3. Replace video RAM SIMM. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.
Partial or whole screen is bright and audio is present, but no video information is visible	1. Replace monitor. 2. Replace video cable. 3. Replace logic board. Retain customer's SIMMs.

Screen is dark, audio and drive operate, fan is running, and LED is lit	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace SIMMs. 5. Replace logic board. 6. Replace power supply.

Note: *If replacing the monitor corrects the problem, refer to the apropriate Apple Service Technical Procedures to obtain monitor replacement information.*

Drive Problems	**Solutions**
Audio and video are present, but internal drive does not operate	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal disk drive cable. 4. Replace internal disk drive. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
Disk ejects; display shows icon with blinking "X"	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
Will not eject disk	1. Switch power off and hold mouse button down while switching power back on. 2. Eject disk manually by pushing opened paper clip into hole beside the drive slot. 3. Replace disk drive.
System attempts to eject disk but cannot	1. Try pushing disk completely back in. 2. Eject disk manually by pushing opened paper clip into hole beside the drive slot. 3. Replace disk drive.

SCSI Problems	**Solutions**
Internal hard drive runs continuously	1. Replace HDA cable. 2. Replace hard drive. 3. Replace logic board. Retain customer's SIMMs.
Internal hard drive will not operate	1. Replace HDA cable. 2. Replace HDA power cable. 3. Replace hard drive. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems	Solutions
Works with internal or external SCSI device but will not work with both	1. Check that switch setting of external SCSI device is different priority from that of internal device. 2. Replace terminator on external device. 3. Verify that terminator is installed on internal SCSI drive. 4. Replace SCSI device select cable.
Cursor does not move	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to a keyboard, connect it to the rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Cursor moves but clicking the mouse button has no effect	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
No response to any key on the keyboard	1. Make sure the System is version 6.0.7 or higher. 2. Check keyboard connection to ADB port. 3. Replace keyboard cable. 4. Replace keyboard. 5. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter or ImageWriter II will not print	1. Make sure that Chooser and Control Panel are set correctly. 2. Make sure the System is version 6.0.7 or higher. 3. Replace printer interface cable. 4. Replace logic board. Retain customer's SIMMs.
Known-good LaserWriter will not print	1. Make sure that Chooser and Control Panel are set correctly. 2. Make sure the System is version 6.0.7 or higher. 3. Refer to *Networks* tab in *Apple Service Technical Procedures* for more information.
Cannot double-click to open an application, disk, or server	1. Remove duplicate system files on hard disk. 2. Clear parameter RAM. Hold down <Shift> <Option> <Command> keys and select Control Panel from Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.

Miscellaneous Problems	Solutions
No sound from speaker	1. Verify that volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board. Retain customer's SIMMs.
Clock not running	1. Replace battery. 2. Replace logic board. Retain customer's SIMMs.

Macintosh LC Logic Board Components

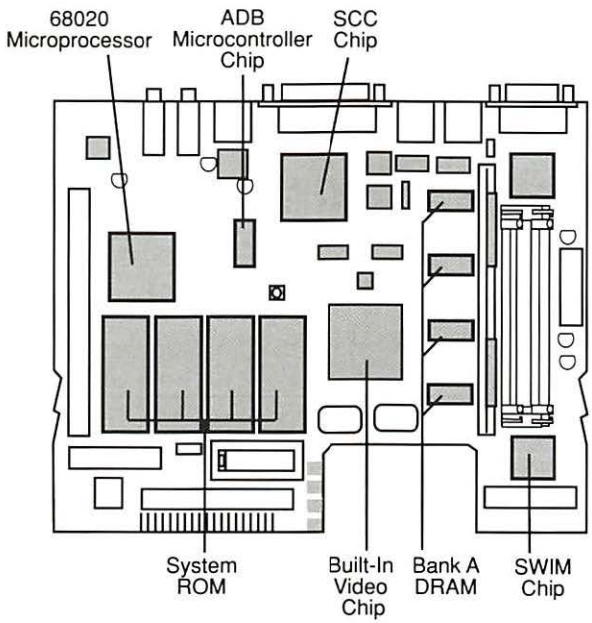


Figure: Macintosh LC Logic Board Components

Macintosh LC Specifications

Microprocessor	MC68020, 32-bit internal architecture 16 MHz clock speed Burst mode RAM access 256-byte instruction and data caches
Expansion Connector	96-pin processor-direct slot supporting 020 Direct Slot expansion card
Memory	2 MB expandable to 10 MB (100 ns or faster SIMMs) 512K ROM standard 256K VRAM (video RAM) SIMM, upgradeable to 512K VRAM SIMM
Built-in Video Support	Apple High-Resolution Monochrome Monitor AppleColor High-Resolution RGB Monitor Macintosh 12-Inch RGB Display Macintosh 12-Inch Monochrome Display
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) One Apple Desktop Bus (ADB) port One DB-15 monitor port for built-in video Monophonic sound-out port Sound input port for monaural sound input
Internal Storage	Built-in 1.4 MB FDHD SuperDrive Optional second FDHD SuperDrive Internal Hard Disk 40SC Optional internal Hard Disk 80SC
Sound	Monaural 8-bit sound input with Macintosh Audio Compression Expansion (MACE) sound utility supporting 3:1 or 6:1 compression Monophonic 8-bit sound generator supplying same signal to both channels of stereo equipment Omnidirectional electret microphone
Electrical	Line voltage: 100 to 240 volts AC, automatically configured Frequency: 50 to 60 Hz Maximum power: 50 watts, not including monitor

Macintosh LC
Memory Upgrade

The Macintosh LC comes with 2 megabytes of RAM soldered to the logic board in Bank A, and has two SIMM slots for expansion memory (**see Figure**). System memory can be expanded to 10 megabytes, but only 1 MB RAM SIMMs are currently available for the Macintosh LC (**the Macintosh LC does not support 256K SIMMs**). To expand system memory, both expansion slots must be filled with SIMMs of the same size. You can mix SIMMs of different speeds, as long as both SIMMs are 100 ns or faster.

Note: *Be sure to use the SIMM removal tool when removing SIMMs from the logic board. See the Special Tools Index in the General Information tab section.*

Upgrades

RAM	Bank A	SIMM Sockets
2 MB	2 MB soldered RAM	Empty
4 MB	2 MB soldered RAM	Two 1 MB SIMMs

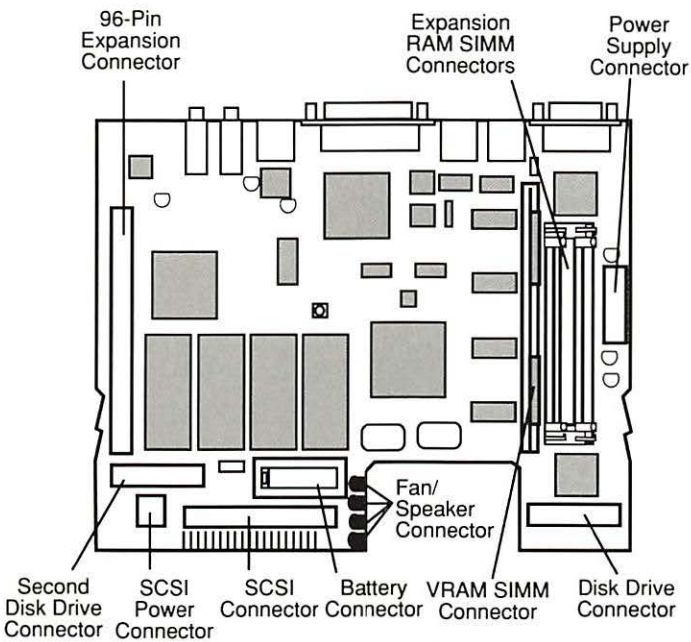


Figure: Macintosh LC Internal Connectors

Macintosh II, IIx, and IIfx

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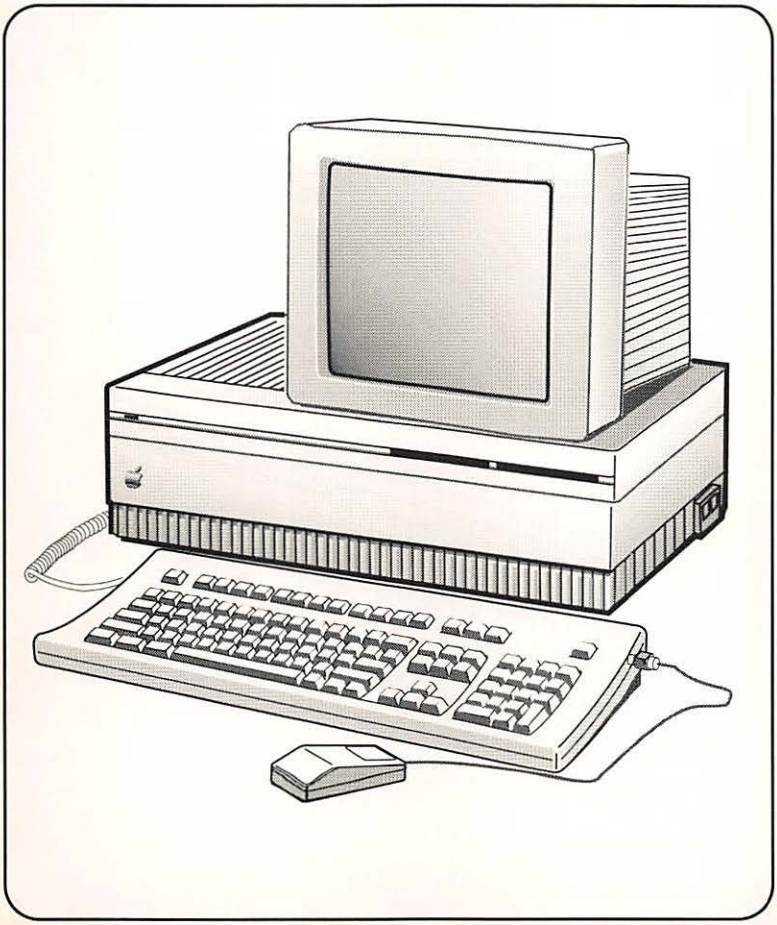
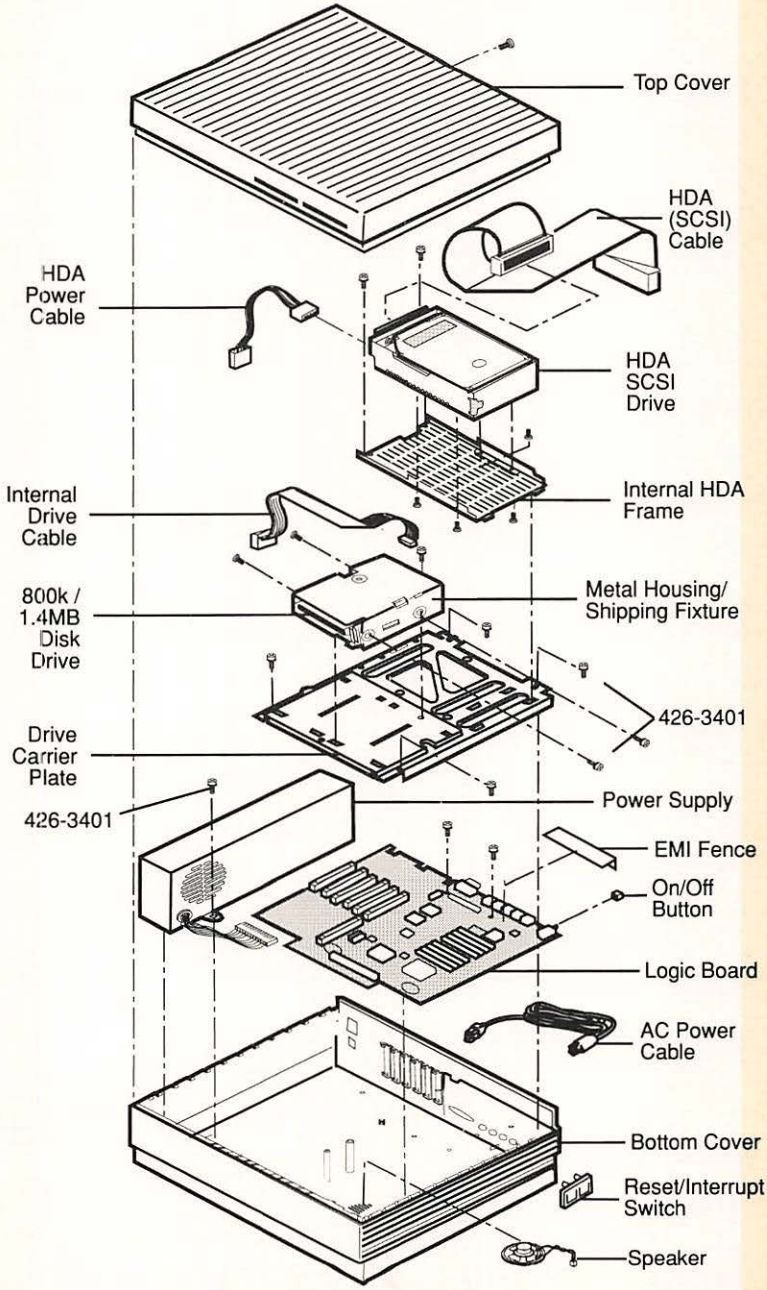


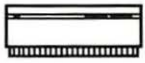
Macintosh II, IIx, and IIfx

Exploded View



Macintosh II, IIx, and IIfx

Parts List



Bottom Cover Assembly, Macintosh II	630-5227
Bottom Cover Assembly, Macintosh IIx	630-5494
Bottom Cover Assembly, Macintosh IIfx	630-5806
Reset/Interrupt Switch	815-6024
Speaker	630-5222
Cable, AC Power (smoke)	590-0380
Disk Drive, Apple 3.5, 800K Mechanism	661-0345
Disk Drive, Apple FDHD SuperDrive, 1.4 MB Mechanism	661-0474
Disk Drive Parts, 800K & 1.4 MB Drives	
Cable, 800K or 1.4 MB 3.5 Drives (red or yellow stripe)	590-0188
Internal Drive Shield, 800K (for transporting)	805-0217
Metal Housing/Shipping Fixture (for transporting)	805-5050
Packing Disk, 2-Sided (for transporting 800K Mechanisms)	003-0003
Screw, M 3 x 6, with two washers	462-3401
Drive Carrier Plate	805-5062
Extended Keyboard*	661-0384
HDA, 20 MB, Internal 3.5 SCSI, Rev. A	661-0373
HDA, 20 MB, Internal 3.5 SCSI, Rev. B	661-0612
HDA, 40 MB, Internal 3.5 SCSI	661-0464
HDA, 80 MB, Internal 3.5 SCSI	661-0600
HDA, 80 MB, Int. 3.5 SCSI with A/UX® v.1.1 (replaced by 661-0613)	661-0561
HDA, 80 MB, Internal 3.5 SCSI with A/UX, v.2.0	661-0613
HDA, 40 MB, Internal 5.25 SCSI	661-0391
HDA, 80 MB, Internal 5.25 SCSI	661-0411
HDA, 80 MB, Internal 5.25 SCSI with A/UX, v.1.0	661-0457
HDA, 160 MB, Internal 5.25 SCSI	661-0601
HDA Parts	
Cable, HDA Internal (SCSI Connector Cable)	590-0566
Cable, HDA Power, Macintosh II/IIx	590-0364
Cable, HDA Power (2 x 2 pin), Macintosh IIfx	590-0512
Internal HDA Frame, 3.5 Drive	805-5066
Internal HDA Frame, 5.25 Drive	805-5051
Screws, M 3.5 x .6 x 8, PNCRS Rec	462-4100
Keyboard, Regular Apple*	661-0383
Logic Board, Macintosh II (w/o RAM; replaces 661-0374)	661-0528
Battery Holder Board	600-0530
IC, IWM	344S0043
IC, SWIM	344S0062
IC, HMMU	343-0002
IC, PMMU	630-8221
ROM, Low, Macintosh II FDHD Upgrade	661-0642
ROM, Med Low, Macintosh II FDHD Upgrade	661-0641
ROM, Med High, Macintosh II FDHD Upgrade	661-0640
ROM, High, Macintosh II FDHD Upgrade	661-0639
SIMM, 256K, 120 ns	661-0402
SIMM, DIP, 256K, 120 ns	661-0494
SIMM, 1 MB, 120 ns	661-0403
SIMM, DIP, 1 MB, 120 ns	661-0410

***For additional ADB input devices and part numbers, see General Information.**

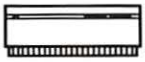
continued...

Logic Board, Macintosh IIx (w/o RAM; replaces 661-0463)	661-0529
Battery Holder Board	600-0530
SIMM, 256K, 120 ns	661-0402
SIMM, DIP, 256K, 120 ns	661-0494
SIMM, 1 MB, 120 ns	661-0403
SIMM, DIP, 1 MB, 120 ns	661-0410
Logic Board, Macintosh IIfx (w/o RAM)	661-0522
Battery Holder Cover	520-0344
Internal SCSI Termination Block	590-4515
Internal SCSI Filter	590-4516
SIMM, 1 MB, SOJ, 80 ns, 64-pin	661-0548
Logic Board, Parity, Macintosh IIfx (w/o RAM)	661-0592
Battery Holder Cover	520-0344
SIMM, 1 MB, SOJ, 60 ns, 64-pin, Parity	661-0549
Logic Board Parts	
EMI Fence	805-5070
Lithium Battery (w/o leads; replaces 742-0009)	742-0011
On/Off Button	815-6237
Screws (logic board mounting)	462-4100
Mouse, ADB (replaces 661-0338)*	661-0479
Power Supply, Macintosh II/IIx	661-0375
Power Supply, Macintosh IIfx	661-0542
Top Cover and Latch Assembly	630-5229
Disk Slot Plug Assembly	630-5302

***For additional ADB input devices and part numbers, see General Information.**

Symptom/Cure Chart

System Problems	Solutions
Does not power on, screen is black, fan is not running, and LED is not lit	1. Check cables. 2. Plug monitor directly into wall socket, and verify that monitor has power. 3. Replace power cord. 4. Check batteries. Replace both batteries if either battery is below 3.2 volts. 5. Replace power supply. 6. Replace logic board. Retain customer's SIMMs.
Clicking, chirping, or thumping sound	1. Replace power supply. 2. Replace logic board. Retain customer's SIMMs.
System intermittently crashes or locks up	1. Make sure system software is correct version. 2. Make sure all software is known-good. 3. Replace SIMMs. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.



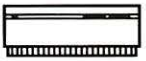
System shuts down intermittently	1. Check that air vents on sides and top of main unit are clear. Thermal protection circuitry may shut system down. After 30 to 40 minutes, system should be OK. 2. Replace power cord. 3. Check batteries. Replace both batteries if either battery is below 3.2 volts. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
System intermittently crashes or locks up	1. Make sure correct version of system software is being used. 2. Make sure all software is known-good. 3. Replace SIMMs. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.
System sounds error chords at startup (Macintosh IIfx only)	1. Check for Apple-labeled SIMMs manufactured by NEC. Replace any NEC SIMMs that have a date code of 9052 or lower. 2. See Startup Problems—Flowchart 2 in the On-Site Troubleshooting tab.
System does not boot (Macintosh IIfx only)	– Check for Apple-labeled SIMMs manufactured by NEC. Replace any NEC SIMMs that have a date code of 9052 or lower.

Video Problems	**Solutions**
Screen is black, audio and drive operate, fan is running, and LED is lit	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Move video card to different slot. 5. Replace video card. 6. Replace SIMMs. 7. Replace logic board. 8. Replace power supply.
Partial or whole screen is bright and audio is present, but no video information is visible	1. Replace monitor. 2. Replace video cable. 3. Move video card to different slot. 4. Replace video card. 5. Replace logic board. Retain customer's SIMMs.
Screen is black, audio and drive do not operate, but fan is running and LED is lit	1. Replace video cable. 2. Move video card to different slot. 3. Replace video card. 4. Replace SIMMs. 5. Replace logic board. 6. Replace power supply. 7. Replace monitor.

continued...

Video Problems (continued)	Solutions
Screen is completely dark, fan is not running, and LED is not lit	1. Plug monitor directly into wall socket and verify that monitor has power. 2. Check batteries. Replace both batteries if either battery is less than 3.2 volts. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
Video display exhibits "ghosting," or system boots and then loses video	– Check for Apple-labeled SIMMs manufactured by NEC. Replace any NEC SIMMs that have a date code of 9052 or below.

Disk Drive Problems	Solutions
Internal disk drive runs continuously	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
Audio and video are present, but one internal drive does not operate	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal disk drive cable. 4. Replace internal disk drive. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
Audio and video are present, but neither internal drive operates	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
Disk ejects; icon with blinking "X" displays	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
Will not eject disk	1. Switch power off and hold mouse button down while switching power back on. 2. Eject disk manually by pushing opened paper clip into hole beside drive slot. 3. Replace internal disk drive.
MS-DOS drive does not recognize disk formatted on 1.4 MB FDHD SuperDrive	– Reformat disk using MS-DOS™ drive.



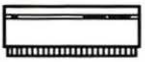
Attempts to eject disk but doesn't	1. Reinsert disk. 2. Reseat top cover so drive slots line up correctly. 3. Try ejecting disk manually by pushing opened paper clip into hole beside drive slot. 4. Replace internal disk drive.
SCSI Drive Problems	**Solutions**
Internal hard disk will not operate, LED does not light, drive does not spin	1. Replace SCSI signal cable. 2. Replace SCSI power cable. 3. Replace hard disk. 4. Replace logic board. Retain customer's SIMMs.
Drive does not appear on desktop	– If Macintosh IIfx, there may be a SCSI termination problem. **Refer to Macintosh IIfx—SCSI Termination** to verify that computer is properly terminated.
Works with internal or external SCSI device but will not work with both	1. Check SCSI device switch setting on external device. Make sure setting isn't 0 (internal hard drive address) or 7 (CPU address). 2. If Macintosh IIfx, there may be a SCSI termination problem. **Refer to Macintosh IIfx—SCSI Termination** to verify that computer is properly terminated. 3. Replace SCSI terminator on external device. 4. Verify that terminator is installed on internal SCSI drive. 5. Refer to *SCSI Hard Disk Drive Technical Procedures* for troubleshooting external drive.
Peripheral Problems	**Solutions**
No response to any key on keyboard	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board. Retain customer's SIMMs.
Cursor does not move	1. Check mouse connection. 2. Clean mouse, if necessary. 3. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Cursor moves, but clicking mouse button has no effect	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
Cannot double-click to open application, disk, or server	1. Remove any multiple system files on hard disk. 2. Clear parameter RAM. Hold down <Shift> <Option> <Command> keys and select Control Panel from Apple pull-down menu. Reset mouse controls.

continued...

Peripheral Problems (continued)	Solutions
Cannot double-click to open application, disk, or server	3. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter or ImageWriter II will not print	1. Make sure correct version of system software is being used. 2. Make sure that Chooser and Control Panel are set correctly. 3. Replace printer interface cable. 4. Replace logic board. Retain customer's SIMMs.
Known-good LaserWriter will not print	1. Make sure correct version of system software is being used. 2. Make sure that Chooser and Control Panel are set correctly. 3. Refer to *Networks* tab in *Apple Service Technical Procedures*.

Miscellaneous Problems	Solutions
No sound from speaker	1. Verify that volume setting in Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board. Retain customer's SIMMs.
HMMU socket does not allow PMMU installation	– Replace logic board. Verify that socket is 13 x 13 grid array package and that it contains 132 gold contacts inside socket. (Sockets containing 70 pins do not support PMMU.)
System hangs when first application is launched, or displays error code and locks up (Macintosh IIfx only)	– Check for Apple-labeled SIMMs manufactured by NEC. Replace any NEC SIMMs that have a date code of 9052 or lower.

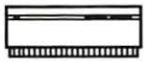
Macintosh II, IIx, and IIfx
Specifications



Macintosh II Specifications	
Microprocessor	MC68020, 32-bit internal architecture 15.6672 MHz clock speed
Coprocessor	MC68881 floating-point unit (FPU)
Memory	1 MB, expandable to 8 MB (120 ns or faster SIMMs) 256K ROM standard Optional 68851 paged memory management unit (PMMU)
Monitors	Apple High-Resolution Monochrome AppleColor™ High-Resolution RGB Apple Macintosh Portrait Display Apple Two-Page Monochrome
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) Two Apple Desktop Bus (ADB) ports Six NuBus™ internal slots supporting full 32-bit address and data buses One stereo sound port
Internal Storage	Built-in 3.5-inch, 800K disk drive Optional second 3.5-inch, 800K disk drive 1.4 MB, Apple FDHD SuperDrive upgrade Optional internal Hard Disk 20SC, 40SC, 80SC, 160SC
Sound	Apple custom digital sound chip (ASC), including four-voice wavetable synthesis, stereo sampling generator
Electrical	Line voltage: 90 to 140 volts; 170 to 270 volts, automatically configured Frequency: 48 to 62 Hz Maximum power: 220 watts, not including monitor power

Macintosh IIx Specifications

Microprocessor	MC68030, 32-bit internal architecture 15.6672 MHz clock speed 256-byte instruction and data caches Built-in paged memory management unit (PMMU)
Coprocessor	MC68882 floating-point unit (FPU) 15.6672 MHz clock speed
Memory	1 MB, expandable to 8 MB (100 ns or faster SIMMs) 256K ROM standard
Monitors	Apple High-Resolution Monochrome AppleColor High-Resolution RGB Apple Macintosh Portrait Display Apple Two-Page Monochrome
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) Two Apple Desktop Bus (ADB) ports Six NuBus internal slots supporting full 32-bit address and data buses One stereo sound port
Internal Storage	Built-in 1.4 MB FDHD SuperDrive Optional second FDHD SuperDrive Optional internal Hard Disk 40SC, 80SC, 160SC
Sound	Apple custom digital sound chip (ASC) provides 8-bit stereo sampling at 44.1 KHz and includes four-voice wavetable synthesis
Electrical	Line voltage: 100-240 VAC, automatically configured Frequency: 48 to 62 Hz Max power: 220 watts, not including monitor power



Macintosh IIfx Specifications

Microprocessor	MC68030, 32-bit internal architecture 40 MHz clock speed Built-in paged memory management unit (PMMU) Two 256-byte instruction and data caches
Coprocessor	MC68882 floating-point unit (FPU) 40 MHz clock speed
Static RAM Cache	Built-in zero-wait-state 32K static RAM cache memory architecture
Memory	4 MB of RAM, expandable to 8 MB 80 ns, fast-page mode, 64-pin SIMMs
Parity Support	Installation of optional parity-generating chip and parity DRAM (9-chip, 60 ns SIMM) provides parity error detection
Memory Subsystem	Supports overlapping reads from cache/ROM and writes to DRAM
Input/Output Processor Chips	SWIM chip manages the floppy disk drive(s) SCC chip manages the Apple Desktop Bus and serial ports
SCSI/DMA Controller	Standard cell implementation of 53C80 SCSI chip and DMA control logic (the SCSI/DMA chip manages the SCSI bus)
Interfaces	Two RS-232/RS-422 serial ports SCSI interface with direct memory access for faster transfers and compatibility with faster peripherals Processor-direct slot (PDS) provides high-speed, 32-bit access to the system bus Six NuBus internal slots supporting full 32-bit address and data buses Two Apple Desktop Bus (ADB) ports Stereo sound jack
Internal Storage	Two 1.4 MB FDHD SuperDrives Internal Hard Disk 40SC, 80SC, 160SC
Sound	Apple custom digital sound chip (ASC)
Electrical	Line voltage: 100 to 240 VAC Frequency: 48 to 62 Hz Maximum power: 230 watts, not including monitor power

Macintosh II and IIx Memory Upgrades

The Macintosh II and IIx require 120 ns (or faster) SIMMs. The 150-ns SIMMs will cause serious timing problems. All SIMMs in each bank must be the same size. Mitsubishi 1 MB SIMMs for the Macintosh IIx, which are labeled "For 030 Systems Only," should be used only in systems with 68030 microprocessors.

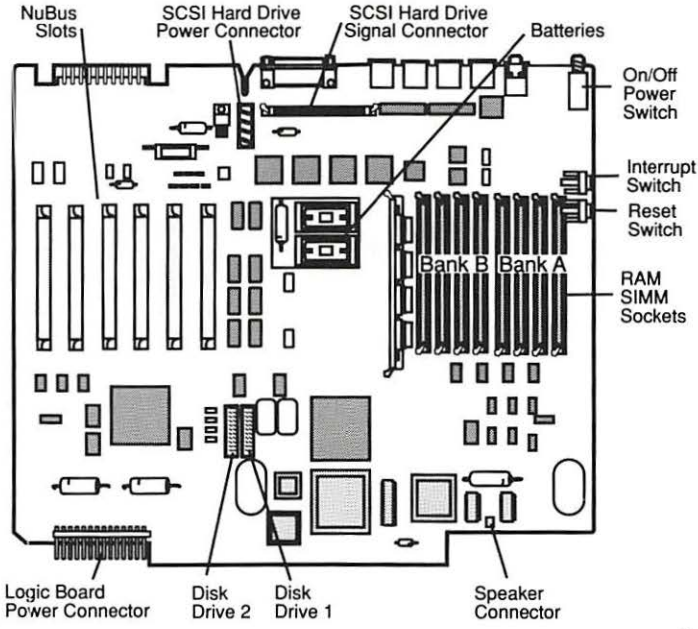


Figure: Macintosh II and IIx Logic Board

Size	Bank A	Bank B
1 MB	4—256K SIMMs	Empty
2 MB	4—256K SIMMs	4—256K SIMMs
4 MB	4—1 MB SIMMs	Empty
5 MB	4—1 MB SIMMs	4—256K SIMMs
8 MB	4—1 MB SIMMs	4—1 MB SIMMs

Macintosh IIfx Memory Upgrade

The Macintosh IIfx requires 80 ns (or faster) SIMMs in systems without the parity checking option, 60 ns (or faster) SIMMs in systems with parity checking. LaserWriter II SIMMs cannot be used in the Macintosh IIfx.

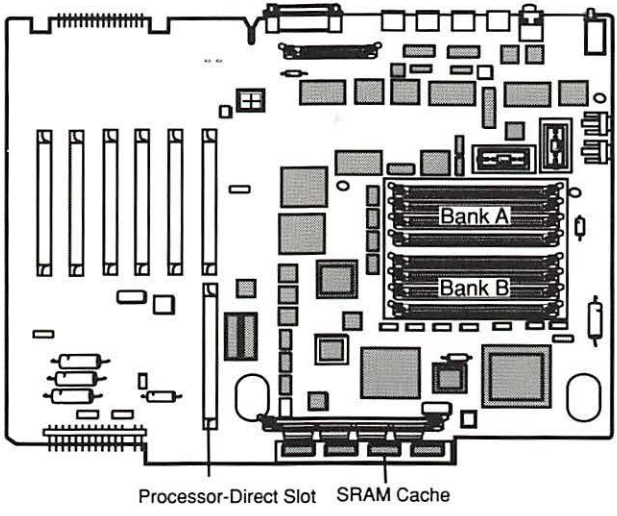


Figure: Macintosh IIfx Logic Board

Size	Bank A	Bank B
4 MB	4 — 1 MB SIMMs	Empty
8 MB	4 — 1 MB SIMMs	4 — 1 MB SIMMs

Macintosh II PMMU Upgrade Procedure

1. Remove the Macintosh II top cover and drive mount.
2. Locate the HMMU chip on the logic board (**see Figure on the next page**).
3. Using a small flat-blade screwdriver, gently pry up the sides of the chip to remove the HMMU from the socket.
4. Position the PMMU so that the line on its surface is pointing toward the speaker at the lower-right corner of the logic board.
5. Line up the pins in the socket and gently press the PMMU into the socket.
6. Replace the Macintosh II drive mount and top cover.

Macintosh II FDHD SuperDrive Upgrade

The system software must be version 6.0.2 or higher to use the 1.4 MB FDHD SuperDrive. If the software is lower than 6.0, the drive will be recognized as an 800K mechanism.

Upgrade Procedure

1. Place the Macintosh II on the grounded workbench pad and put on your grounding wriststrap.
2. Remove the top cover, video card (and any other cards installed), and the drive mount.
3. Using an IC extractor, remove the four ROMs at the logic board locations **shown in the Figure below**.
4. Using the following chart and the figure below, install the four revised 512K ROMs. The notch at the end of each ROM should face the front of the logic board.

ROM	P/N
HI	661-0639
MED HI	661-0640
MED LO	661-0641
LO	661-0642

5. Using the IWM/SWIM extractor **(see Special Tools Index in the General Information section)**, remove the IWM chip from the logic board **(see Figure)**.
6. Position the SWIM chip on the logic board socket **(see Figure)** so that the beveled edge of the chip (the edge with the dot) is facing the white dot on the logic board.
7. Line up the pins in the socket and gently press straight down on the SWIM chip until it is seated in the socket.
8. Install the 1.4 MB FDHD SuperDrive onto the drive mount on drive 1 or drive 2.
9. Replace the drive mount, the video card (and any other cards that you removed), and the top cover.
10. Place the 1.4 MB and 800K labels in the appropriate positions on the front of the Macintosh II.

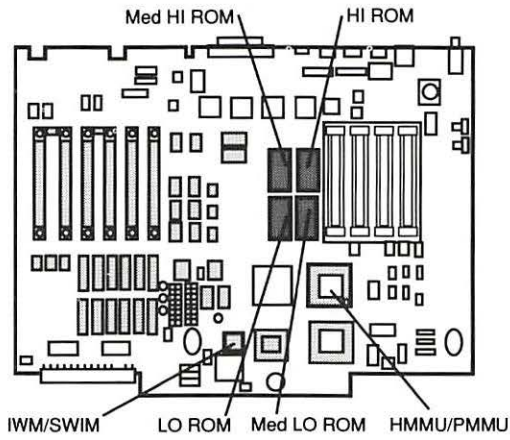


Figure: Macintosh II Logic Board

Macintosh IIfx—SCSI Termination

The Macintosh IIfx is able to transfer data to and from SCSI devices much faster than earlier Macintosh computers. This increased data transfer rate has made it necessary to modify the termination characteristics of the SCSI interface. Three new parts are used to implement these SCSI termination changes:

- Apple SCSI Cable Terminator II
- Internal SCSI Termination Block
- Internal SCSI Filter

Apple SCSI Cable Terminator II

SCSI Cable Terminator II must be installed to provide proper termination when one or more external SCSI devices is attached to a Macintosh IIfx. Rules for using and installing Terminator II are the same as those for the original SCSI terminator. To help you tell these devices apart, the plastic on the Terminator II is black, whereas the plastic on the original terminator is blue.

CAUTION: Never connect more than one Cable Terminator II on a SCSI daisy chain. Connecting more than one terminator can damage the Macintosh IIfx.

Internal SCSI Termination Block

The termination block must be installed to provide internal SCSI termination for systems **without** an internal SCSI hard drive. Apple installs this termination block (and the internal SCSI filter) at the logic board SCSI connector on all Macintosh IIfx systems shipped without internal SCSI drives **(see Figure)**. The termination block must be removed when an internal SCSI drive is added to the system.

Internal SCSI Filter

The SCSI filter must be installed to provide the proper termination capacitance for third-party drives and for Apple internal drives shipped before 3/19/90. When a SCSI drive is added to a Macintosh IIfx that has no SCSI drives installed, **the SCSI filter must be removed from the Macintosh IIfx logic board and connected to the drive.**

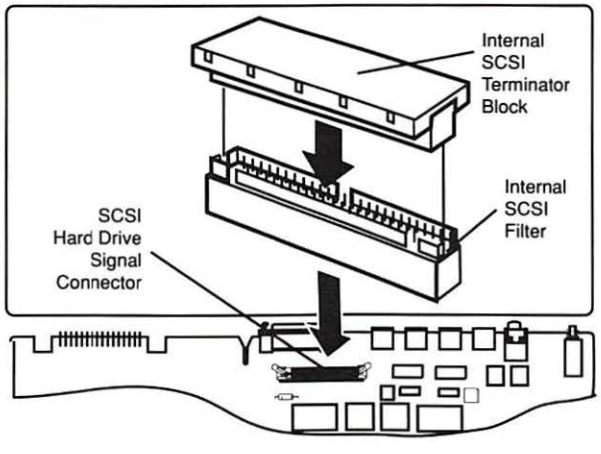


Figure: Macintosh IIfx Without Internal SCSI Drive

Defective Macintosh IIfx SIMMs

Some Macintosh IIfx systems and 4 MB expansion memory kits were manufactured with defective DRAM chips from NEC. Systems using these defective NEC SIMMs can experience a variety of failures, including:

- System does not boot
- System hangs on first application launch
- System boots but loses video (memory related)
- System sounds error chords
- Video display exhibits "ghosting"
- System displays an ID error and locks up

Macintosh IIfx systems with NEC SIMMs that have date code 9052 or lower can exhibit these failures and should be replaced. Locate the date code as shown below (**see Figure**).

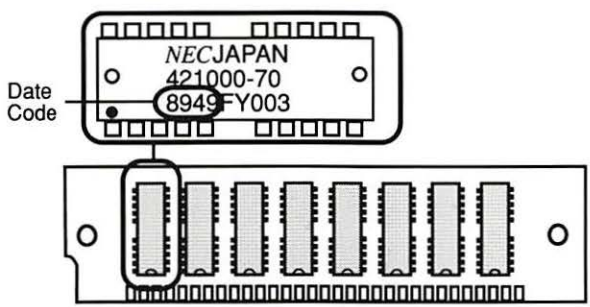


Figure: Location of Date Code on NEC SIMMs

Macintosh IIcx, IIci, & IIsi

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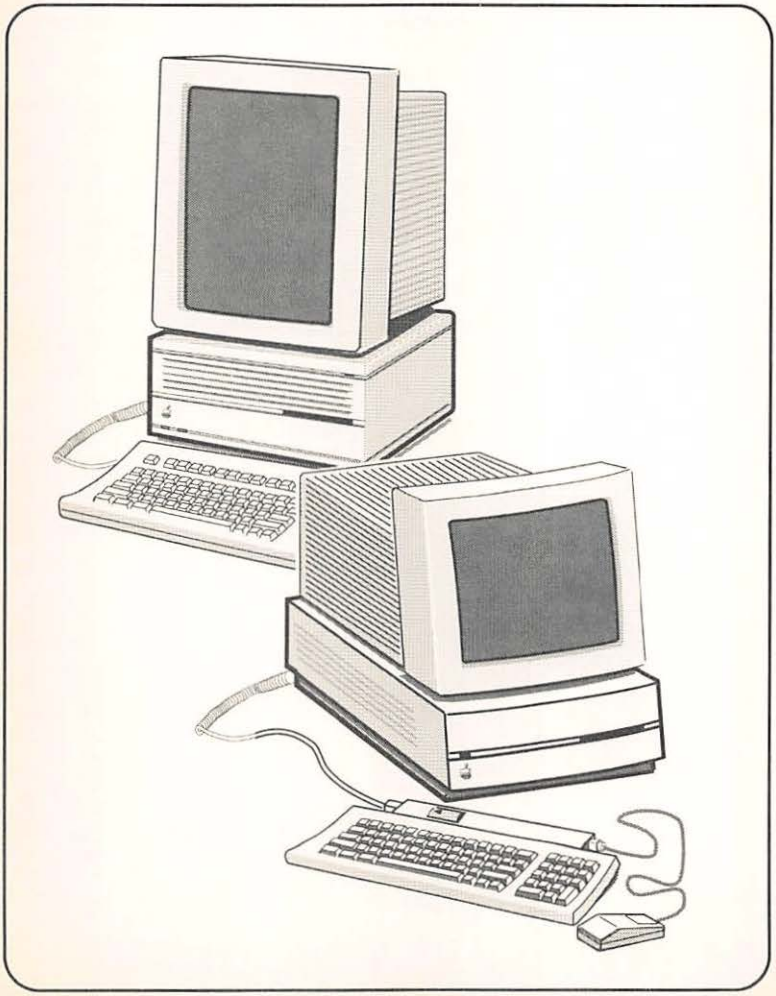
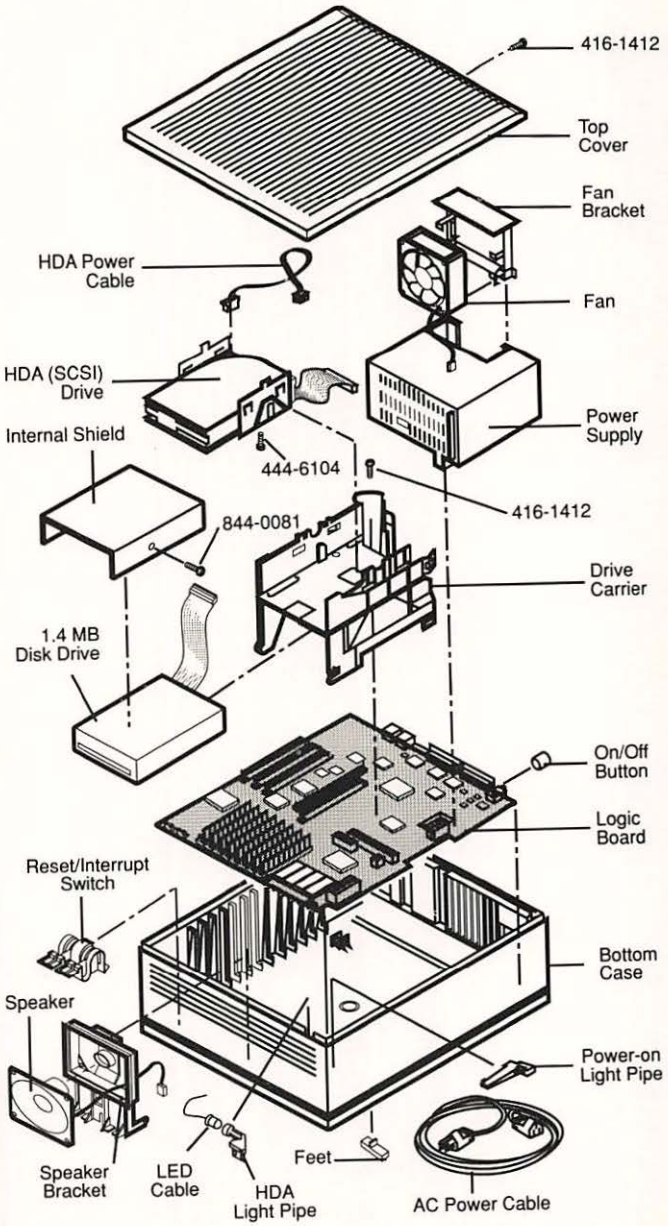
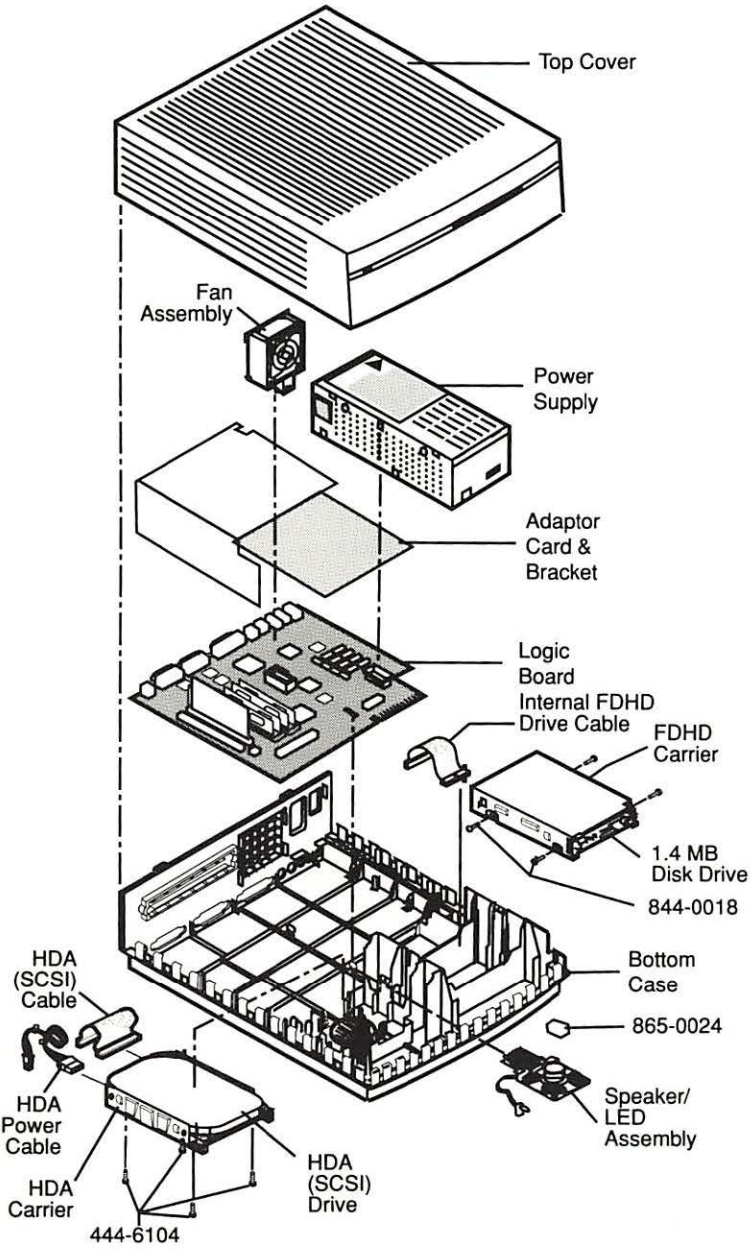


Exploded View—Macintosh IIcx & IIci



Exploded View—Macintosh IIsi



Macintosh IIcx & IIci

Bottom Case parts
- Cable, HDA LED (amber) . . . 590-0506
- Light Pipe, Power-On . . . 815-6032
- Light Pipe, HDA . . . 815-6036
- Rubber Feet . . . 865-0026

Cable, AC Power (smoke) (& Mac IIsi) . . . 590-0380
Disk Drive, Apple 3.5, 1.4 MB FDHD/SuperDrive . . . 661-0474
- Cable, Internal FDHD . . . 590-0607
- Internal Shield . . . 805-0961
- Screw, FDHD Shield/Carrier to FDHD . . . 844-0018

Drive Carrier . . . 815-6030
HDA, 20 MB, Internal 3.5 SCSI . . . 661-0373
HDA, 40 MB, Internal 3.5 SCSI . . . 661-0464
HDA, 80 MB, Internal 3.5 SCSI . . . 661-0600
HDA, 80 MB, Int. 3.5 SCSI with A/UX, v.1.1 (replaced by 661-0613) . . . 661-0561
HDA, 80 MB, Internal 3.5 SCSI with A/UX, v.2.0 . . . 661-0613
- Cable, HDA Power (Mac IIcx) . . . 590-0505
- Cable, HDA Power (2 x 2 Pin) . . . 590-0512
- Cable, Internal HDA (SCSI Connector Cable) . . . 590-0609
- HDA Mounting Bracket . . . 805-5078
- Screw, 6-32 x .250 (HDA to HDA Bracket) . . . 444-6104

Keyboard, Regular Apple* (& Mac IIsi) . . . 661-0383
Lithium Battery . . . 742-0011
- Battery Holder Cover . . . 520-0344

Mouse, ADB* (& Mac IIsi) . . . 661-0479
On-Off Button . . . 815-6033
Power Supply with Fan . . . 661-0467
- Bracket, Power Supply Fan . . . 815-5071
- Power Supply Fan . . . 982-0023

Reset/Interrupt Switch . . . 815-6034
Speaker . . . 630-5503
- Speaker Bracket . . . 815-6031

Top Cover . . . 810-6028
- Screw, M 3.5 x .6 x 8 (Top Cover; HDA Bracket/Bottom Case) . . . 416-1412

Macintosh IIcx

Bottom Case . . . 630-5502
Logic Board (w/o RAM; replaces 661-0459) . . . 661-0537
- SIMM, 256K, 120 ns . . . 661-0402
- SIMM, DIP, 256K, 120 ns . . . 661-0494
- SIMM, 1 MB, 120 ns . . . 661-0403
- SIMM, DIP, 1 MB, 120 ns . . . 661-0410

Macintosh IIci

Bottom Case . . . 630-5662
Logic Board (w/o RAM) . . . 661-0532
- SIMM, 256K x 4, 80 ns . . . 661-0519
- SIMM, 1 MB, 80 ns . . . 661-0520

Logic Board, Parity 661-0583
SIMM, 1 MB x 9, 80 ns, Parity 661-0546

Macintosh IIsi

Bottom Case 810-6032
Platinum Foot 865-0024
Disk Drive, Apple 3.5, 1.4 MB FDHD/SuperDrive 661-0474
Cable, Internal FDHD Drive 591-0025
FDHD Carrier/Shield 805-0961
Screw, FDHD Shield/Carrier to FDHD 844-0018
Fan Assembly 810-6030
HDA, 40 MB, 1", Internal 3.5 SCSI 661-0614
HDA, 80 MB, 1", Internal 3.5 SCSI 661-0624
Cable, Internal HDA (SCSI Connector Cable) 591-0026
Cable, HDA Power 591-0027
HDA Carrier 805-0980
Screw, 6-32 x .250 (HDA to HDA Bracket) 444-6104
Logic Board 661-1615
Bracket, plastic, 030 Adaptor Card 815-6246
Lithium Battery 742-0011
NuBus Adaptor Card 661-0645
030 Adaptor Card 661-0644
SIMM, SOJ, 256K, 80 ns 661-0519
SIMM, SOJ, 1 MB, 80 ns 661-0520
SIMM, SOJ, 1 MB, 80 ns, Parity 661-0546
Thumbscrew, NuBus Adaptor Card 450-0032
Microphone Assembly 699-5071
Power Supply 661-1616
Speaker/LED Assembly 810-6031
Top Cover 810-6034
Light Pipe, Power-On 815-6247

Note: For ADB input devices and part numbers, see General Information.

Symptom/Cure Chart

System Problems	Solutions
Does not power on—screen is black, fan is not running, and LED is not lit	1. Check cables. 2. Plug monitor directly into wall socket, and verify that monitor has power. 3. Replace power cord. 4. Check batteries. Voltage should be above 2.8. 5. Replace power supply. 6. Replace logic board. Retain customer's SIMMs.
System intermittently crashes or locks up	1. Make sure system software is correct version. 2. Make sure software is known-good. 3. Replace logic board. Retain customer's SIMMs. 4. Replace SIMMs. 5. Replace power supply. 6. If system has Macintosh IIci Cache Card with a serial number beginning with "CF," remove and return card to Apple. See *Apple Service Programs*.

System Problems (continued)	Solutions
Clicking, chirping, or thumping sound	1. Replace power supply. 2. Disconnect hard disk. Replace if noise disappears. 3. Replace logic board. Retain customer's SIMMs.
System shuts down intermittently	1. Make sure air vents on back side and top of main unit are not obstructed. Thermal protection circuitry may shut down system. After 30 to 40 minutes, system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
System intermittently does not power on	1. Check cables. 2. Plug monitor directly to wall socket and verify that monitor has power. 3. Try known-good keyboard and ADB cable. 4. Replace power cord. 5. Check batteries. Should be above 2.8 volts. 6. Unplug power cord from system for 5-10 minutes. Replace power cord and switch on system. If system starts normally, replace power supply. 7. Replace logic board. Retain customer's SIMMs.
System seems to boot, then message "Finder is old version" displays	1. Clear parameter RAM. Hold down <Command> <Option> <P> <R> keys and reboot system. You will hear normal startup chords and about two seconds later you will hear another chord. This means parameter RAM has been cleared. 2. Replace logic board. Retain customer's SIMMs.
System restarts itself (Mac IIsi)	– Set the locking power switch on the rear of the computer to the unlocked (horizontal) position.

Video Problems	Solutions
Screen is dark, no audio, but fan is running and LED is lit	1. Replace video cable. 2. Replace monitor. 3. Move video card (if installed) to a different slot. 4. Replace video card (if installed). 5. Remove NuBus cards (if installed). 6. Remove external peripheral (if installed). 7. Replace RAM SIMMs. 8. If computer is a Mac IIsi with a ROM SIMM, replace ROM SIMM. 9. Replace logic board. 10. Replace power supply.

Video Problems (continued)	Solutions
Screen is dark, audio and drive operate, fan is running, and LED is lit	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Move video card (if installed) to a different slot. 5. Replace video card (if installed). 6. Replace RAM SIMMs. 7. If computer is a Mac IIsi with a ROM SIMM, replace ROM SIMM. 8. Replace logic board. 9. Replace power supply.
Partial or whole screen is bright and audio is present, but no video information is visible	1. Replace video cable. 2. Replace monitor. 3. Move video card (if installed) to a different slot. 4. Replace video card (if installed). 5. Make sure ROM jumper is on logic board. 6. Replace logic board. Retain customer's SIMMs.
Screen is completely dark, fan is not running, and LED is not lit	1. Plug monitor directly into wall socket and verify that monitor has power. 2. Remove any installed NuBus cards. 3. Remove any external peripherals. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
Black and white video only	– Change monitor CDEV in Control Panel for additional shades of gray.

Note: *Systems with 1 MB of memory default to black-and-white video. You can allocate additional memory to video on 1 MB systems, but this leaves little free RAM for other applications.*

SCSI Problems	Solutions
Internal hard disk will not operate	1. Replace SCSI cable connector. 2. Replace SCSI power connector. 3. Replace hard disk. 4. Replace logic board. Retain customer's SIMMs.
Works with internal or external SCSI device but will not work with both	1. Check SCSI device switch setting on external device. 2. Replace terminator on external device. 3. Verify that terminator is installed on internal SCSI drive. 4. Replace SCSI device select cable.

Macintosh IIcx, IIci, & IIsi

Symptom/Cure Chart

Drive Problems	Solutions
Audio and video are present, but internal drive does not operate	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal disk drive cable. 4. Replace internal disk drive. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
Disk ejects; display shows icon with blinking "X"	1. Replace disk with known-good system disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
Will not eject disk	1. Switch power off and hold mouse button down while switching power back on. 2. Eject disk manually by pushing opened paper clip into hole beside the drive slot. 3. Replace disk drive.
System attempts to eject disk but cannot	1. Try pushing disk completely in. 2. Eject disk manually by pushing opened paper clip into hole beside the drive slot. 3. Replace disk drive.
Internal disk drive runs continuously	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems	Solutions
No response to any key on the keyboard	1. Check keyboard connection to ADB port. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board. Retain customer's SIMMs.
Cursor does not move	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to a keyboard, connect it to a rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Cursor moves, but clicking the mouse button has no effect	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.

Peripheral Problems (continued)	Solutions
Cannot double-click to open an application, disk, or server	1. Remove any multiple system files on hard disk. 2. Clear parameter RAM. Hold down <Shift> <Option> <Command> keys and select Control Panel from Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to rear ADB port. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board. Retain customer's SIMMs.
Known-good ImageWriter or ImageWriter II will not print	1. Make sure system software is correct version. 2. Make sure that Chooser and Control Panel are set correctly. 3. Check DIP switch settings. 4. Replace printer interface cable. 5. Replace logic board. Retain customer's SIMMs.
Known-good LaserWriter will not print	1. Make sure system software is correct version. 2. Make sure that Chooser and Control Panel are set correctly. 3. Refer to *Networks* tab in *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	Solutions
No sound from speaker	1. Verify that volume setting in the Control Panel is set to 1 or above. 2. Replace speaker. 3. Replace logic board. Retain customer's SIMMs.
Clock not running	1. Replace battery. 2. Replace logic board. Retain customer's SIMMs.
MacTest and AppleCAT crash on the Mac IIci	– Remove the Macintosh IIci Cache Card and rerun the diagnostic.

Macintosh IIcx Specifications

Microprocessor	MC68030, 32-bit internal architecture 15.6672 MHz clock speed Built-in paged memory management unit (PMMU) 256-byte instruction and data caches
Coprocessor	MC68882 floating-point unit (FPU)
Memory	1 MB expandable to 8 MB (120 ns or faster SIMMs) 256K ROM standard
Monitors	Apple High-Resolution Monochrome AppleColor HIgh-Resolution RGB Apple Macintosh Portrait Display Apple Two-Page Monochrome
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) Two Apple Desktop Bus (ADB) ports Three NuBus internal slots supporting full 32-bit address and data buses Stereo sound port One DB-19 serial (disk drive) port
Internal Storage	Built-in 1.4 MB FDHD SuperDrive Optional internal Hard Disk 40SC, 80SC
Sound	Apple custom digital sound chip (ASC), including four-voice wavetable synthesis and stereo sampling generator
Electrical	Line voltage: 100 to 240 volts AC, automatically configured Frequency: 50 to 60 Hz Maximum power: 90 watts, not including monitor

Macintosh IIci Specifications

Microprocessor	MC68030, 32-bit internal architecture 25 MHz clock speed Burst mode RAM access 256-byte instruction and data caches Built-in paged memory management unit (PMMU)
Coprocessor	MC68882 floating-point unit (FPU) 15.6672 MHz clock speed
Cache Connector	120-pin memory cache connector (for connection of optional high-speed memory cache card)
Memory	1 MB expandable to 8 MB (80 ns or faster SIMMs) 512K ROM standard
Parity Support	Purchase of optional parity board with parity generating chip and parity RAM converts the system to a parity system
Built-in Video Support	Apple High-Resolution Monochrome AppleColor High-Resolution RGB Apple Macintosh Portrait Display
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) One DB-19 serial (disk drive) port Two Apple Desktop Bus (ADB) ports Three NuBus internal slots supporting full 32-bit address and data buses One DB-15 video port for built-in video Stereo sound port
Internal Storage	Built-in 1.4 MB FDHD SuperDrive Optional internal Hard Disk 40SC, 80SC
Sound	Apple custom digital sound chip (ASC), including four-voice wavetable synthesis and stereo sampling generator
Electrical	Line voltage: 100 to 240 volts AC, automatically configured Frequency: 50 to 60 Hz Maximum power: 90 watts, not including monitor

Macintosh IIsi Specifications

Microprocessor	MC68030, 32-bit internal architecture 20 MHz clock speed Burst mode RAM access Two 256-byte instruction and data caches Built-in memory management unit (MMU) that supports the A/UX operating system
Coprocessor	Optional adapter card with 20 MHz MC68882 floating-point unit (FPU)
Expansion Connector	One expansion slot supporting NuBus (with adapter) or 030 Direct Slot expansion card
Memory	2 or 5 MB expandable to 17 MB (100 ns or faster SIMMs) 512K ROM standard
Built-in Video Support	Apple High-Resolution Monochrome Monitor AppleColor High-Resolution RGB Monitor Apple Macintosh Portrait Display Macintosh 12-Inch RGB Display Macintosh 12-Inch Monochrome Display
Interfaces	Two RS-232/RS-422 serial ports SCSI interface (50-pin internal connector and DB-25 external connector) One Apple Desktop Bus (ADB) port One external disk drive port One DB-15 video port for built-in video Stereo sound-out port Sound input port
Internal Storage	Built-in 1.4 MB FDHD SuperDrive Internal Hard Disk 40SC Optional internal Hard Disk 80SC
Sound	Apple custom digitial sound chip (ASC) Monaural 8-bit sound input supporting 3:1 or 6:1 compression Monophonic 8-bit sound generator Omnidirectional electret microphone
Electrical	Line voltage: 100 to 240 volts AC, automatically configured Frequency: 47 to 63 Hz Maximum power: 100 watts, not including monitor

Macintosh IIcx Memory Upgrade

The Macintosh IIcx requires 120 ns (or faster) SIMM modules. The 150 ns SIMMs will cause serious timing problems. All SIMMs in each bank must be the same size.

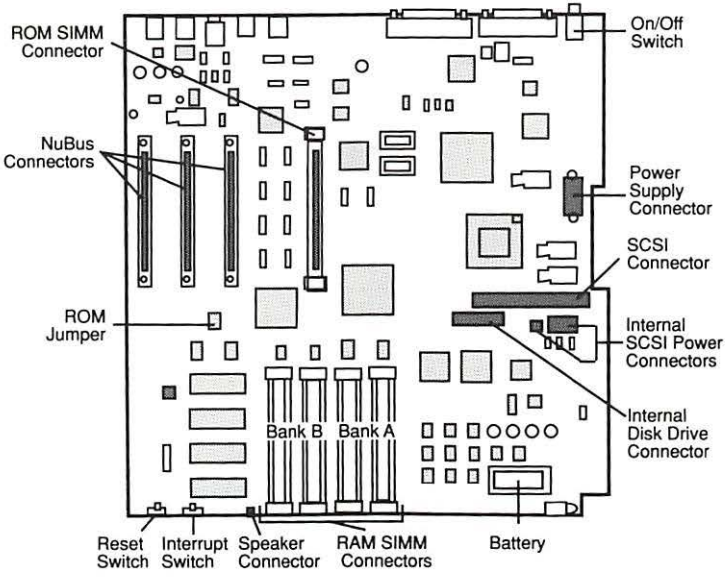


Figure: Macintosh IIcx Logic Board

Size	Bank A	Bank B
1 MB	4—256K SIMMs	Empty
2 MB	4—256K SIMMs	4—256K SIMMs
4 MB	4—1 MB SIMMs	Empty
5 MB	4—1 MB SIMMs	4—256K SIMMs
8 MB	4—1 MB SIMMs	4—1 MB SIMMs

Macintosh IIci Memory Upgrade

The Macintosh IIci requires 80 ns fast page mode SIMM modules. The 100, 120, and 150 ns SIMMs will cause serious timing problems. All SIMMs in a bank must be the same size. SIMMs must be installed in Bank A if built-in video mode is used. To upgrade a parity system, the 80 ns, 1 MB x 9-bit parity SIMMs must be used or the parity function will be disabled.

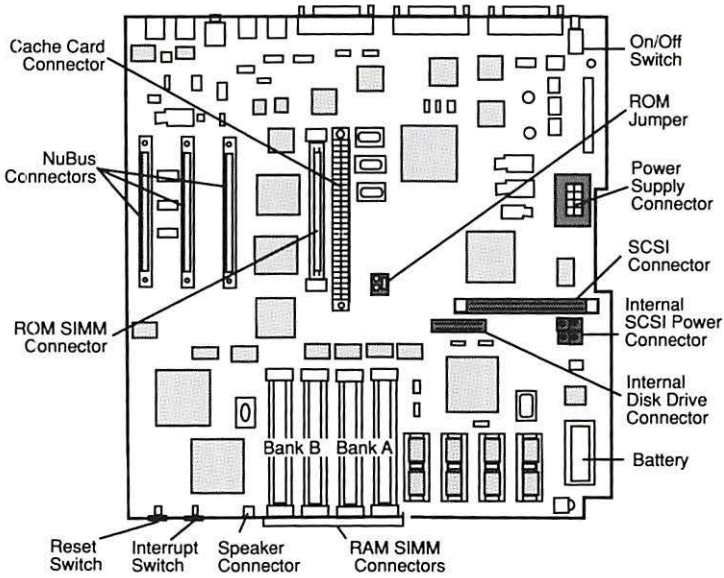


Figure: Macintosh IIci Logic Board

Size	Bank A	Bank B
1 MB	4—256K SIMMs Empty	Empty 4—256K SIMMs
2 MB	4—256K SIMMs	4—256K SIMMs
4 MB	4—1 MB SIMMs Empty	Empty 4—1 MB SIMMs
5 MB	4—1 MB SIMMs 4—256K SIMMs	4—256K SIMMs 4—1 MB SIMMs
8 MB	4—1 MB SIMMs	4—1 MB SIMMs
4 MB Parity	4—1 MB parity SIMMs Empty	Empty 4—1 MB parity SIMMs
8 MB Parity	4—1 MB parity SIMMs	4—1 MB parity SIMMs

Macintosh IIsi Memory Upgrade

The Macintosh IIsi requires 100 ns (or faster) SIMM modules. Slower SIMMs (e.g., 120 ns) will cause serious timing problems. All SIMMs must be the same size.

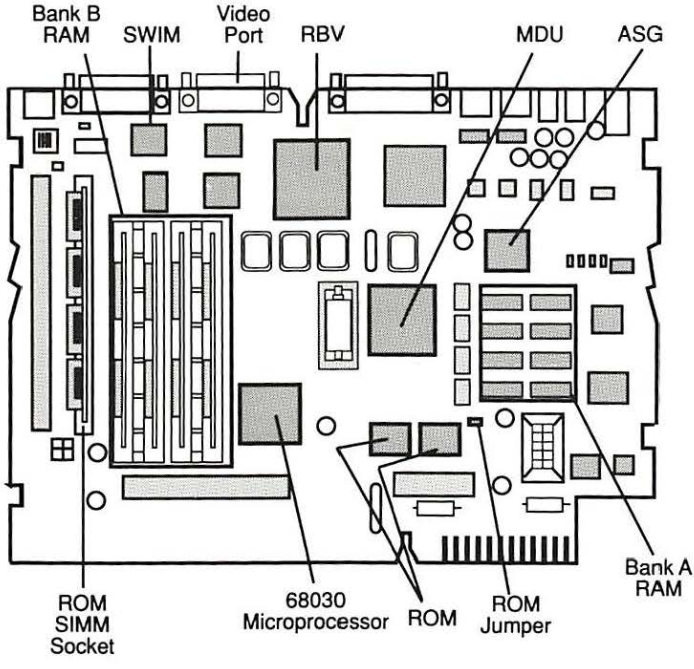


Figure: Macintosh IIsi Logic Board

Size	Bank A	Bank B
1 MB	1 MB on-board RAM	Empty
2 MB	1 MB on-board RAM	4—256K SIMMs
5 MB	1 MB on-board RAM	4—1 MB SIMMs

General Information

Table of Contents

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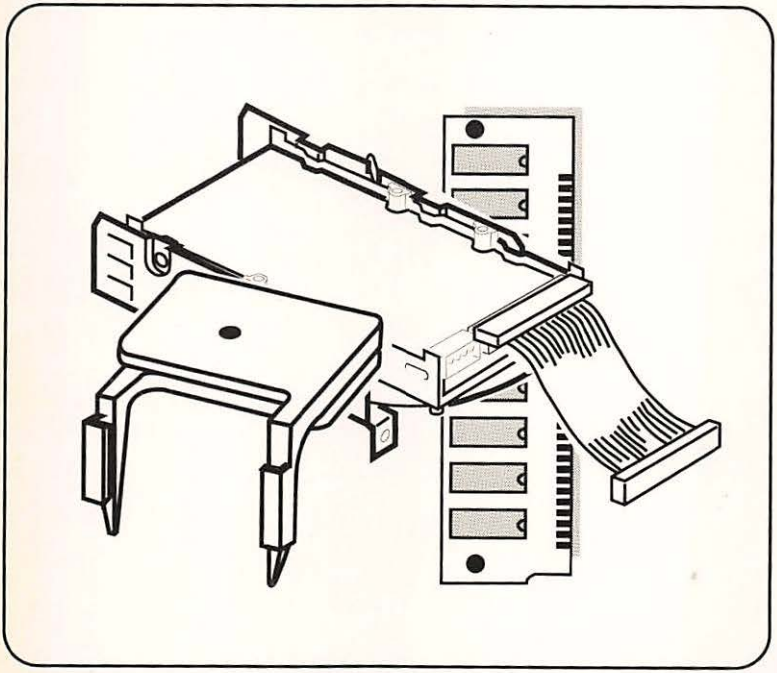
Note: *The General Information section contains repair procedures, compatibility and identification charts, diagnostics, and other information that apply to all of the Macintosh computers.*



Disk Drives—Disk Ejection Problems

To avoid disk ejection problems:

- Avoid placing more than two labels on a disk. Make sure another disk is not already in the drive, and press disks gently into the drive.
- During installation, make sure the disk opening of the drive mechanism is centered in the bezel. If the disk opening is not centered, binding or friction may cause disk ejection problems.
- Inspect the internal mounting bracket before installation. A warped or bent mounting bracket will not align properly with the bezel and can cause disk ejection problems.

CAUTION: Pulling a disk forcefully from a drive may damage the drive mechanism.

Removing Disks That Will Not Eject

1. Push the disk back in and try to eject it electronically by:
   a. Holding down the <Shift> and <Command> keys and pressing 1 (for an internal drive or drive 1) or 2 (for an external drive or drive 2).
   b. Pulling down the File menu and selecting **Eject**. (Repeat several times before giving up.)
2. If step 1 does not work, insert a straightened paper clip into the pin hole located to the right of the disk insertion slot.
3. If step 2 does not work, remove the disk drive and place the drive and RFI shield assembly upside down on a flat surface.
4. Remove the four screws that hold the drive mechanism to the RFI shield, and remove the drive mechanism.
5. Place the drive mechanism with the printed circuit board face down and the disk opening facing you. Press the eject lever at the right side of the disk drive **(see top figure below)**.
6. With the left side of the drive mechanism facing you, locate the small arm with a cylindrical cog at its end **(see bottom figure below)**. The cog will be caught in a half-moon depression.
7. Insert a small screwdriver as shown in the figure, and gently move the arm away from the disk until the disk pops forward slightly. Remove the disk from the disk drive.

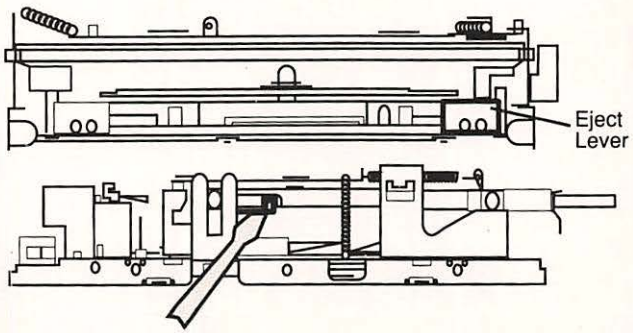


Figure: Removing Stuck Disk From Drive

Disk Drives—Internal Drive Cables

To identify the correct disk drive cable, refer to the part number stamped on the ribbon cable. Except for the red 400K drive cable (which does not have a stamped part number), do not rely upon cable color. Be sure to use only the cables listed in the compatibility table below.

Internal Disk Drive Cable Compatibility

Macintosh Computers	400K Drive 661-76156	800K Drive 661-0305 (MFD-51W or MFD- 51W-10)[1]	800K Drive 661-0345 (MFD-51W-03)	1.4 MB FDHD SuperDrive 661-0474
512K[2]	590-0167 Red (short)			
512K Enhanced[2]	590-0167 Red (short)	590-0167 Red (short)	590-0437 Yellow (short)	
Plus[2]		590-0167 Red (short)	590-0437 Yellow (short)	
SE[3]			590-0437 (bottom drive) 590-0188 Red or Yellow (long cable; top)	590-0437 (bottom) 590-0188 (top)
SE/30			590-0437 (bottom) 590-0188 (top)	590-0437 (bottom) 590-0188 (top)
Classic				590-0167
LC				590-0524
II[3]/IIx/IIfx			590-0188	590-0188
IIcx/IIci				590-0607
IIsi				591-0025
Portable				590-0501

1 Drive 661-0305 (obsolete) was replaced by drive 661-0345.

2 When replacing or upgrading to an 800K drive in the Macintosh 512K, 512K enhanced, or Macintosh Plus, be sure to use disk drive cable 590-0437 (yellow). **The red drive cable (590-0167) used with 400K and obsolete 800K drives (661-0305) is not interchangeable with cable 590-0437.**

3 Using an FDHD in the Macintosh SE and Macintosh II requires upgrading the logic board **(refer to the FDHD upgrade procedures for those computers)**

The FDHD SuperDrive is a high-density (1.4 MB), 3.5-inch drive for 030 Macintosh systems, upgraded Macintosh SE and Macintosh II systems **(see FDHD Upgrade in those sections)**, and the Macintosh Classic and LC. The FDHD SuperDrive is compatible with Apple's 400K and 800K data formats and provides data exchangeability between Apple systems (GCR data format) and MS-DOS or OS/2™ systems (MFM data formats).

Identifying an Internal Disk Drive

To identify an unlabeled internal drive, you can remove the computer cover and count the number of microswitches on the drive mechanism **(see Figure)**. FDHD SuperDrives have three microswitches, 800K drives have two, and 400K drives one.

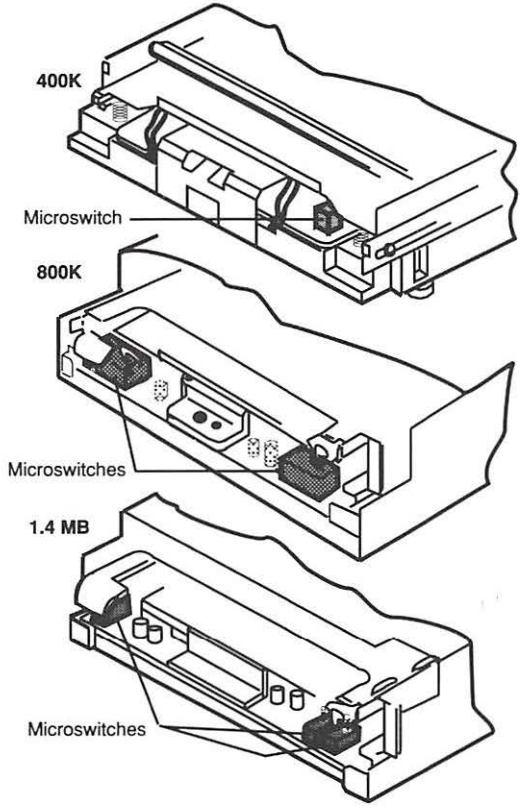


Figure: Macintosh Internal Disk Drives

High-Density Media

Special high-density, 3.5-inch disks are required to take full advantage of the increased storage capacity of the FDHD. These disks can be identified by the **HD** on the label, and by their two write-protect windows. Because HD disks are structurally different from other media, media/drive compatibility problems can occur. To avoid such problems, refer to the matrix below.

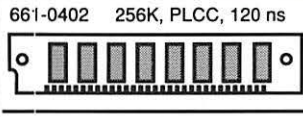
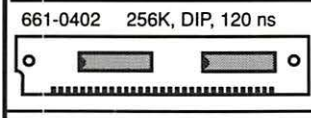
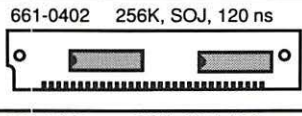
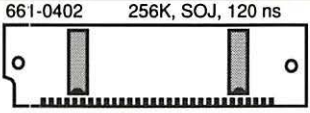
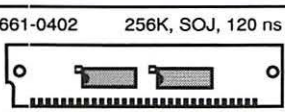
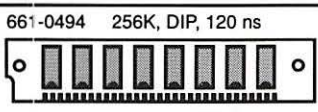
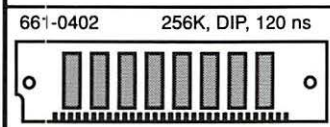
CAUTION: Apple does not recommend using high-density disks in 400K or 800K disk drives. Data saved to high-density disks using 400K or 800K drives is unreliable and could be lost.

Media and Drive Compatibility Matrix

		Media Formats			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
Single-Sided Disks	400K Drive	Yes	No	No	No
	800K Drive	Yes	NR	No	No
	FDHD Drive	Yes	NR	No	No
Double-Sided Disks	400K Drive	Yes	No	No	No
	800K Drive	Yes	Yes	No	No
	FDHD Drive	Yes	Yes	Yes	No
High-Density Disks	400K Drive	NR	No	No	No
	800K Drive	NR	NR	No	No
	FDHD Drive	No	No	No	Yes

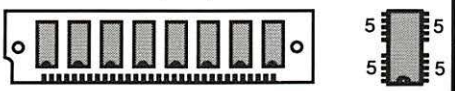
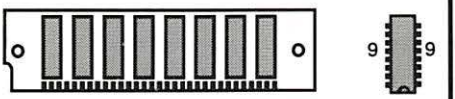
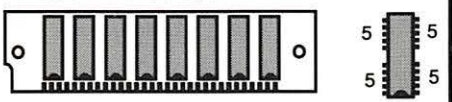
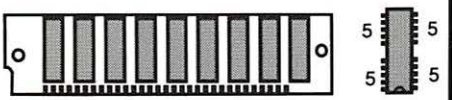
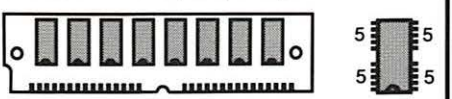
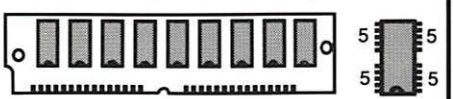
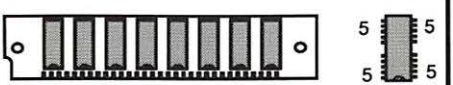
Legend:
Yes—The selected disk and drive can read and write this media format.
No—The selected disk cannot be used with the selected drive to read or write this media format.
NR—Apple does not recommend formatting the selected disk to this media format with the selected drive.

SIMM Identification—256K SIMMs

Service Exchange Modules	Macintosh										
	Plus	Classic	SE	SE/30	LC	II	IIx	IIfx	IIsi	IIcx	IIci
661-0402 256K, PLCC, 120 ns 	●	●	●	●		●	●			●	
661-0402 256K, DIP, 120 ns 	●	●	●	●		●	●			●	
661-0402 256K, SOJ, 120 ns 	●	●	●	●		●	●			●	
661-0402 256K, SOJ, 120 ns 	●	●	●	●		●	●			●	
661-0402 256K, SOJ, 120 ns 	●	●	●	●		●	●			●	
661-0494 256K, DIP, 120 ns 	●	●	1	2		●	●			●	
661-0402 256K, DIP, 120 ns 	●		1								
661-0519 256K, SOJ, 80 ns 	●	●	●	●		●	●		●	●	●

1 Can be installed in SIMM positions 3 and 4 only because of space constraints.
2 Can be installed in SIMM Bank A only because of space constraints.
3 Available from finished goods only—you will not receive this SIMM as a service exchange module. Apple ships a compatible service exchange module when receiving a finished-goods SIMM.

SIMM Identification—1 MB SIMMs

Service Exchange Modules	Macintosh										
	Plus	Classic	SE	SE/30	LC	II	IIx	IIfx	IIsi	IIcx	IIci
661-0403 1 MB, SOJ, 120 ns 	●	●	●	●		●	●			●	
661-0410 1 MB, DIP, 120 ns 		●	[1]	[2]		●	●			●	
661-0520 1 MB, SOJ, 80 ns 	●	●	●	●	●	●	●		●	●	●
661-0546 1 MB, SOJ, 80 ns Parity 	●	●	●	●	●	●	●		●	●	●
661-0548 1 MB, SOJ, 80 ns, 64-Pin 								●			
661-0549 1 MB, SOJ, 60 ns, Parity, 64-Pin 								●			
661-0403 1 MB, SOJ, 120ns [3] 				●			●			●	

When used as stand-alone tests, the *MacTest* diagnostic programs perform pass/fail functional tests of the Macintosh computer systems. The procedures for using all *MacTest* programs are similar, but not identical. **Be sure to use the *MacTest* program for the system you want to test.** The information on the following pages summarizes how to hook up test equipment and run the *MacTest* programs. For more detailed information, see the *Apple Service Technical Procedures.*

Things to Remember

1. Use the Finder to make a backup copy of the *MacTest* disk. (If using a Macintosh or Macintosh Plus, use the appropriate disk copy program on the *MacTest* disk.) Do not write-protect your working disk.

2. Do not replace the System and Finder files on the *MacTest* disk.

3. Before running *MacTest*, close all Desk Accessories. Also note that most versions of *MacTest* are not compatible with MultiFinder™.

4. *MacTest* cannot test an internal SCSI hard drive or an external drive connected to a Hard Disk 20.

5. If you cannot boot the *MacTest* disk:
   a. Check the power cable and internal cable connections.
   b. Refer to the Symptom/Cure Chart, and replace the module(s) specified for your problem.

6. **(Macintosh / Macintosh Plus only)** If you receive an **error code** while attempting to run *MacTest*, **refer to Macintosh/Macintosh Plus *MacTest* Error Codes** (on the next page) to correct the problem.

7. **(Macintosh Portable only)** The power adapter must be connected to the Macintosh Portable for the *AppleCat/MacTest* diagnostic to operate.

8. If the desktop appears instead of the *MacTest* window, open the *MacTest* disk icon and highlight the *MacTest* file icon, select **Set Startup** from the Special menu, and reboot with the *MacTest* disk.

9. Loopbacks are not needed to run *MacTest*, but are necessary to thoroughly test the system. **Switch off the system when you connect a SCSI loopback card.**

10. If a logic board test is selected but the loopbacks are not installed, click **OK** in the dialog box that appears. Then deselect the logic board test, or **switch off power to the system** and install the loopback equipment.

11. Do not press the reset or interrupt switch while the RAM test is running. Pushing reset causes the RAM test to fail, and pressing interrupt could damage the *MacTest* disk.

12. After completing the repair, always run *MacTest* to verify that there are no other faults.

Running MacTest

1. **(Portable only)** Plug in the power adapter and connect it to the Portable.
2. Connect the following loopback equipment **(see Figures on next page)**:
   - DB-9 serial port plugs (2) to serial ports **(Macintosh 128K/512K only)**, or serial loopback cable (Mini DIN-8 cable) between serial ports.
   - SCSI loopback test card to SCSI port. (The Macintosh 128K/512K does not have SCSI circuitry, and the Portable does not require using the SCSI loopback test card.)
3. **(Portable only)** Reset the power manager by simultaneously depressing and then releasing the reset and interrupt switches.
4. Boot the *MacTest* disk.
5. Select tests from the Test Selections menu.
6. To loop on selected tests, select **Auto Run Selected** from the Options menu **(Macintosh/Macintosh Plus only)** or **Loop on selected tests** from the Test Selections window.
7. Click **Start**.

Macintosh / Macintosh Plus MacTest Error Codes

Before using this chart, verify that you are using a known-good *MacTest* disk. X's in the codes can represent any number.

Error Code	Corrective Checks and Actions
100xx.xxxx	1. Check that keyboard is connected. 2. Replace keyboard cable. 3. Replace keyboard. 4. Replace logic board.
200xx.xxxx 300xx.xxxx	1. Check that loopback connectors are installed. 2. Check that cables are connected. 3. Check that loopback connectors are good. 4. Replace logic board.
400xx.xxxx	1. Check that *MacTest* disk is unlocked. 2. Replace internal disk drive.
500xx.xxxx	1. Check that blank, formatted 400K disk is in external disk drive before running test. 2. Check that blank disk is unlocked. 3. Replace external disk drive.
600xx.xxxx	Replace logic board.
800xx.xxxx (Mac Plus only)	1. Check that SCSI loopback test card is connected. 2. Check that cables are connected. 3. Check that SCSI loopback card is good. 4. Replace logic board.

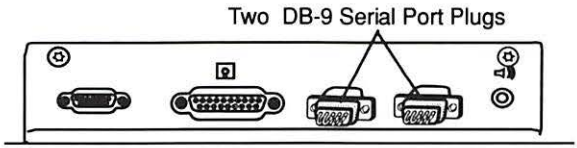


Figure: Macintosh 128K/512K *MacTest* Hookup

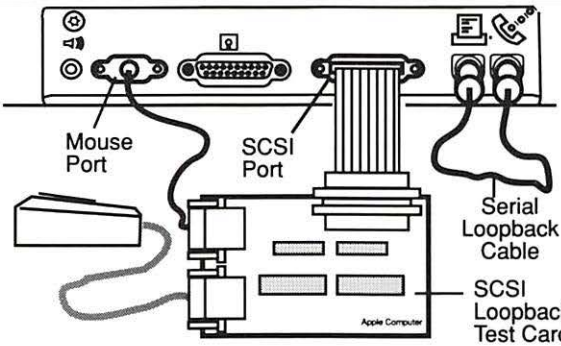


Figure: Macintosh Plus *MacTest* Hookup

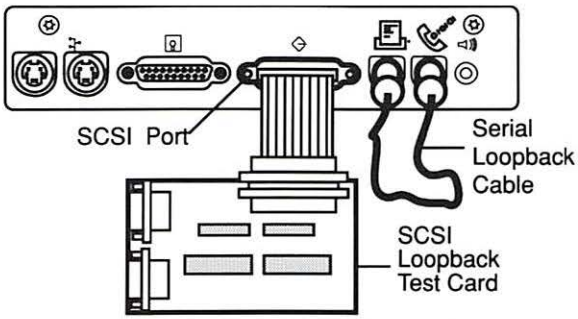


Figure: Macintosh SE & SE/30 *MacTest* Hookup

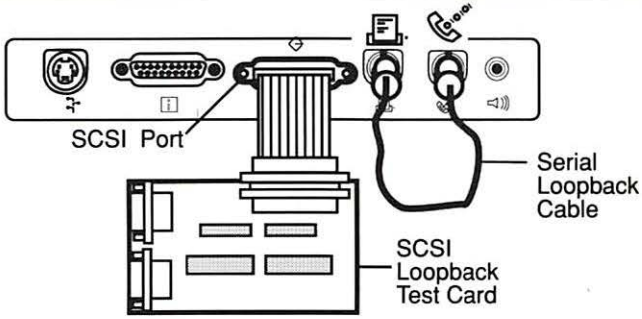


Figure: Macintosh Classic *MacTest* Hookup

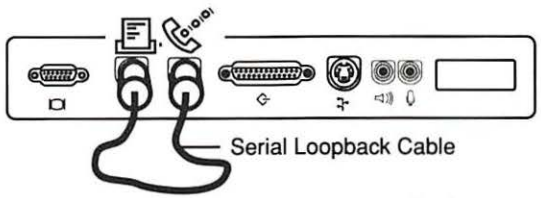


Figure: Macintosh LC *MacTest* Hookup

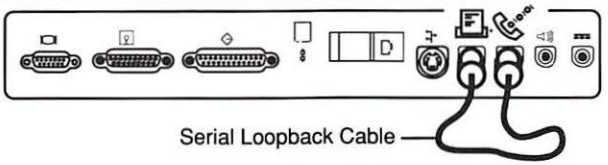


Figure: Macintosh Portable *MacTest* Hookup

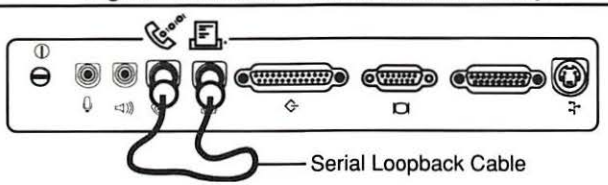


Figure: Macintosh IIsi *MacTest* Hookup

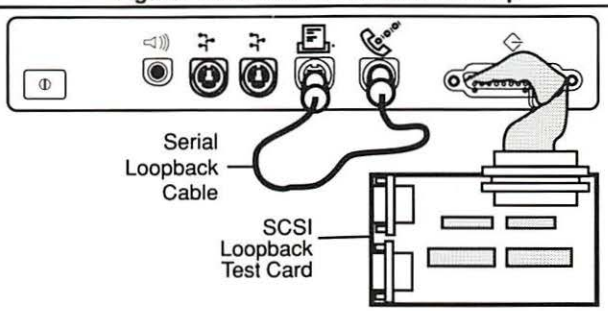


Figure: Macintosh II/IIx/IIfx *MacTest* Hookup

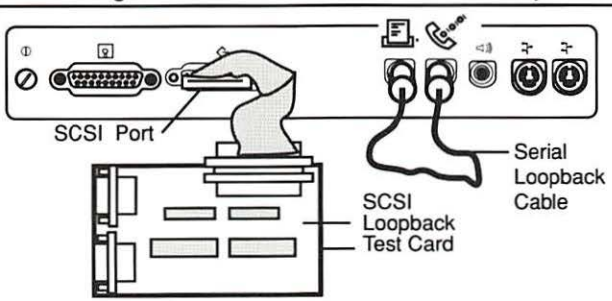


Figure: Macintosh IIcx/IIci *MacTest* Hookup

MacTest – Macintosh Hardware Diagnostic Matrix

MacTest Products (across) (latest version beneath)		Original MacTest (7.0)	S E (3.0)	SE/30 (1.0)	C L (1.0)	Portable (1.0)	II / IIx (3.1)	IIcx / IIci (2.0)	M P (1.1)
Computers	Mac 512K & 512K enhanced	●							
	Mac Plus	●							
	S E		●						
	SE/30			●					
	Classic				●				
	Portable (nonbacklit)					●			
	Portable (backlit)								
	L C								●
	II / IIx						●		
	IIsi								●
	IIcx / IIci							●	
	IIfx								●
Monitors	Apple High-Res Monochrome						●	●	●
	AppleColor High-Res RGB						●	●	●
	Apple Two-Page Monochrome						●	●	●
	Apple Macintosh Portrait Display						●	●	●
	Portrait Display Series B						●	●	●
	Mac 12-inch Monochrome Disp.						●	●	●
	Mac 12-inch RGB Display								●
Video Cards	Mac II Video Card						●	●	●
	Mac II Two-Page Monochrome V.C.						●	●	●
	Mac II Monochrome Video Card							●	●
	Mac II Portrait Video Card						●	●	●
	Mac II High-Res Display V.C.							●	●
	Mac II Extended High-Res Display Card							●	●
	Mac Display Card 4-8								●
	Mac Display Card 8-24								●
	Mac Display Card 8-24GC								●

MacTest Diagnostics Matrix

MacTest – Macintosh Hardware Diagnostic Matrix

MacTest Products (across) (latest version beneath		Original MacTest (7.0)	SE (3.0)	SE/30 (1.0)	CL (1.0)	Portable (1.0)	II / IIx (3.1)	IIcx / IIci (2.0)	MP (1.1)
Drives	Apple 3.5 (external)		●	●	●	●		●	LC IIsi
	Apple PC 5.25		●				●		
	400K (internal)	●							
	800K (internal)	●	●	●	●	●	●	●	●
	FDHD/SuperDrive (int/ext)		●	●	●	●	●	●	●
	SCSI Hard Drives	Use Macintosh Hard Disk Test 2.1							
	Apple HD20 (non-SCSI)								
	Apple CD-ROM	Use Apple CD Test 1.1 on Macintosh Peripherals Test disk							
Drive Cards	Mac II PC Card						●	IIcx	
	Mac SE-Bus PC Card		●						
Misc. Peripheral Devices	AppleFax Modem	Use FaxTest 1.2 on Macintosh Peripherals Test disk							
	AppleScanner	Use ScanTest 2.0 on Macintosh Peripherals Test disk							
	LaserWriter NT/NTX	Use NT/NTX ROM & SIMM Test 1.0							
	ImageWriter LQ	Use PrintTest LQ 1.3 on Macintosh Peripherals Test disk							
Modems	Apple Data Modem 2400	Use ModemTest 1.0 on Macintosh Peripherals Test disk							
	Apple Portable Data Modem 2400								
	Int'l XP 2400								
Network Cards	EtherTalk Interface Card						●	1.0	
	EtherTalk NB Card						●	1.0	1.2
	Apple Token-Talk NB Card	Use ConnectTest 1.0 on Macintosh Peripherals Test disk							
	Apple Coax/ Twinax Card								
	Apple Serial NB Card								
	LC Ethernet Card								1.2
Input Devices	Keyboard Communication		●	●			●	●	
	Mouse Communication		●	●			●	●	●
	ADB Communication		●	●		●	●	●	●

The SCSI loopback card must be jumpered between J1 pin 25 and RP1 pin 14 in order to be used with *MacTest*. New loopback cards have the jumper etched into the card circuitry. Older versions of the card need the jumper installed.

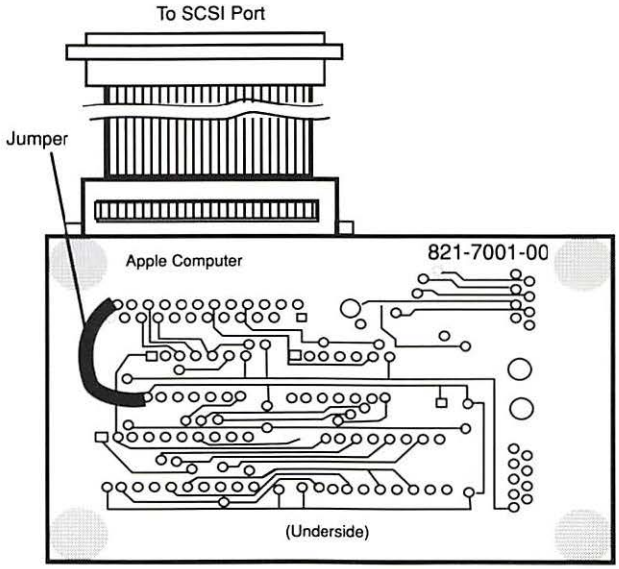


Figure: Older SCSI Loopback Card with Jumper

Determining If a Jumper Is Needed

1. Look at the part number on the back of the SCSI loopback card.
2. If the part number ends with the letter **A**, the jumper is included in the card circuitry.
3. If the part number ends with double zeros **(00)**, check to see if the card has an external jumper installed from J1 pin 25 to RP1 pin 14. If there is no external jumper, install one.

Installing the Jumper

1. Locate J1 pin 25 and RP1 pin 14 on the SCSI loopback card (**see Figure**). J1 pin 25 is the pin closest to the upper-left corner of the card; RP1 pin 14 is in the middle line of pins and closest to the left edge of the card.
2. Solder a wire connection between J1 pin 25 and RP1 pin 14 on the SCSI loopback card.

Installation—HDA Drive Carrier

As a result of Apple's new carrierless drive strategy for the Macintosh Classic, Macintosh IIsi, and Macintosh LC, you may need to install drive carriers on replacement HDA drive mechanisms. Proper installation requires using a torque driver (**P/N 076-0390**) to mount the carrier to the replacement drive, and following the procedure outlined below.

Installing the HDA Drive Carrier

1. Align the mounting carrier on the bottom of the new drive mechanism as shown in the figure below.

2. With the four lockwashers and Phillips screws removed from the faulty drive, loosely fasten the carrier to the drive . For the Macintosh IIsi, use the screw hole marked **A**; for the Macintosh LC, use the screw hole marked **B** (**see Figure**).

CAUTION: Be sure to use the Phillips screws that you removed from the customer's faulty drive. Also be careful not to overtorque the screws and follow the torque sequence shown in the figure below. Failure to do so could damage the replacement drive.

3. **Following the sequences shown in the Figure below**, torque the four Phillips screws to **8.0 in-lbs**.

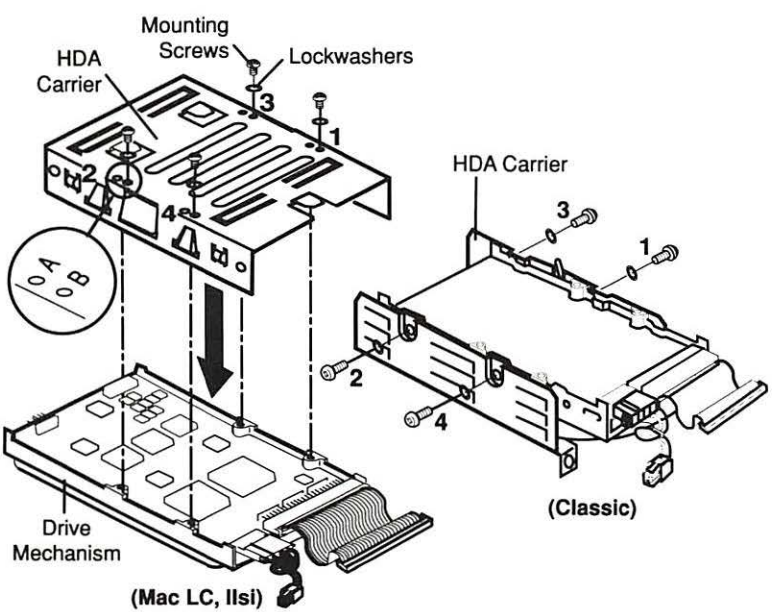


Figure: Installing the HDA Drive Carrier

Macintosh ADB Input Devices

This list includes all ADB input devices for the Macintosh SE, SE/30, II, IIx, IIcx, IIci, IIfx, IIsi, Classic, and LC computers, along with their part numbers.

Apple Keyboard 661-0383
Apple Keyboard, French Canadian C661-0383
Apple Keyboard, Spanish E661-0383
Apple Keyboard Parts
- Alps Locking Keyswitch 970-1263
- Bottom Case 815-1017
- Key Cap Set 658-7011
- Keyboard Cable, 1 meter 590-0361
- Keyboard Cable, 2 meter 590-0152
- Keyswitch Set, ADB Kybd, Tan Plunger (Set of 10) 076-0209
- Keyswitch Set, ADB Kybd, White Plunger (Set of 10) 076-0387
- Top Case 815-1016

Apple Keyboard II 661-0603
Apple Keyboard II, Arabic* AB661-0603
Apple Keyboard II, British* B661-0603
Apple Keyboard II, Danish* DK661-0603
Apple Keyboard II, French* F661-0603
Apple Keyboard II, French Canadian C661-0603
Apple Keyboard II, German* D661-0603
Apple Keyboard II, Greek* GR661-0603
Apple Keyboard II, Hebrew* HB661-0603
Apple Keyboard II, Icelandic* SK661-0603
Apple Keyboard II, International* Z661-0603
Apple Keyboard II, Italian* T661-0603
Apple Keyboard II, Japanese JA661-0603
Apple Keyboard II, Korean KH661-0603
Apple Keyboard II, Norwegian* H661-0603
Apple Keyboard II, Portugese* PO661-0603
Apple Keyboard II, Persian* PS661-0603
Apple Keyboard II, Spanish* Y661-0603
Apple Keyboard II, Swedish* S661-0603
Apple Keyboard II, Swiss* SF661-0603
Apple Keyboard II, Taiwanese TA661-0603
Apple Keyboard II, Turkish* TU661-0603
Apple Keyboard II, Western Spanish E661-0603
Apple Keyboard II, Yugoslavian* YU661-0603

***These keyboards are not available in the United States.**

Apple Extended Keyboard 661-0384
Apple Extended Keyboard, French F661-0384
Apple Extended Keyboard, French Canadian C661-0384
Apple Extended Keyboard, German D661-0384
Apple Extended Keyboard, Italian T661-0384
Apple Extended Keyboard, Spanish E661-0384
Apple Extended Keyboard Parts
- Bottom Case 815-1019
- Key Cap Set 658-7010
- Keyboard Cable, 1 meter 590-0361
- Keyswitch, Alps Locking 970-1263
- Keyswitch Set, ADB Kybd, Tan Plunger (Set of 10) 076-0209

continued...

- Keyswitch Set, ADB Kybd, White Plunger (Set of 10) 076-0387
- Top Case 815-1018

Apple Extended Keyboard II 661-0543
Apple Extended Keyboard II, ISO, French EF661-0544
Apple Extended Keyboard II, ISO, French Canadian EC661-0544
Apple Extended Keyboard II, ISO, German ED661-0544
Apple Extended Keyboard II, ISO, Italian ET661-0544
Apple Extended Keyboard II, ISO, Spanish EE661-0544
Apple Extended Keyboard II Parts

- Bottom Case 658-5211
- Foot, Front 865-0057
- Foot, Rear, Adjustable 865-1139
- Foot Pad, Rear 865-0067
- Key Cap Set 658-7010
- Keyboard Cable, 1 meter 590-0361
- Keyswitch, Alps Locking 970-1263
- Keyswitch Set, ADB Kybd, Tan Plunger (Set of 10) 076-0209
- Keyswitch Set, ADB Kybd, White Plunger (Set of 10) 076-0387
- Spring, Foot Return 870-0030
- Template 001-0017
- Top Case 658-5210

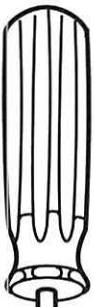
Apple ISO Keyboard, French F661-0454
Apple ISO Keyboard, German D661-0454
Apple ISO Keyboard, Italian T661-0454

Mouse, ADB (replaced by 661-0479) 661-0338

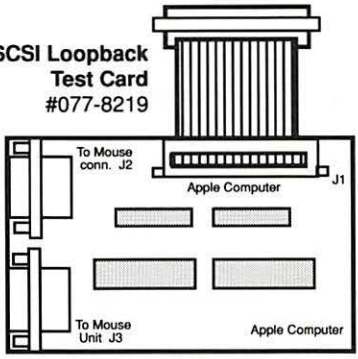
- Mouse Ball (25.4 mm dia), gray 699-8001
- Mouse Ball (21.9 mm dia), black 699-8038
- Retainer, ADB Mouse (38 mm dia) 076-0231
- Retainer, ADB Mouse (34 mm dia) 815-0816

Mouse, ADB (replacing part number 661-0338) 661-0479

- Mouse Ball 815-1135
- Retainer, ADB Mouse 815-1136

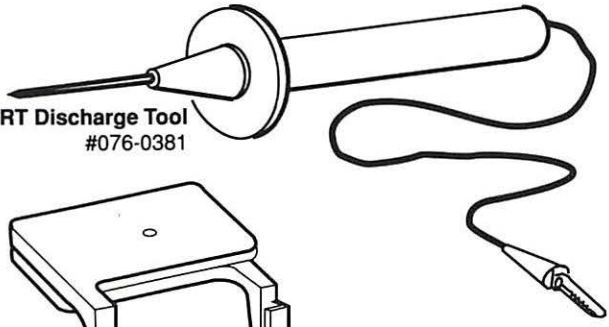


Torx Driver
#076-8053



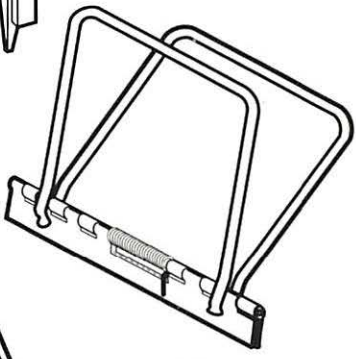
SCSI Loopback Test Card
#077-8219

DB9 Serial Port Plug
(Set of 2) #077-8129



CRT Discharge Tool
#076-0381

SIMM Removal Tool
#076-8354



Pull-Apart Tool
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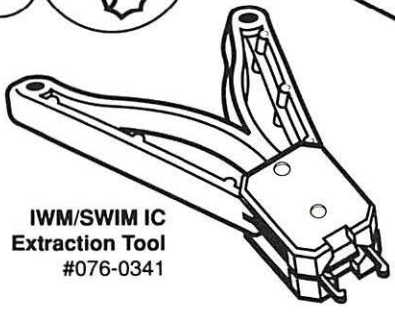

IWM/SWIM IC Extraction Tool
#076-0341

Ports and Cables

Table of Contents/Cable Connectors

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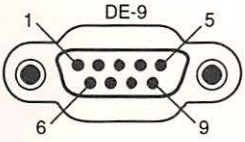
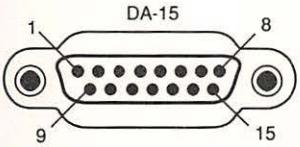
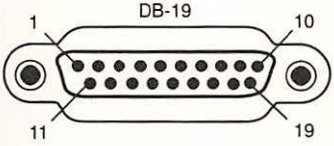
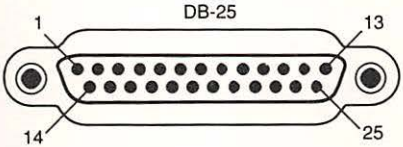
Cable Connectors

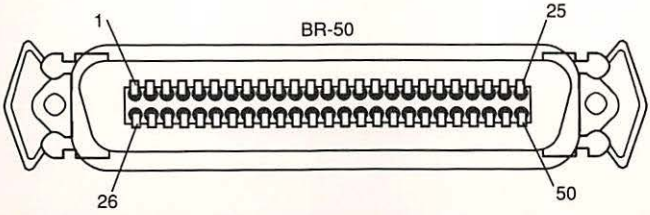
The pin numbers shown below are for the connectors attached to the ends of the Macintosh peripheral cables, as viewed from the front of the connector.

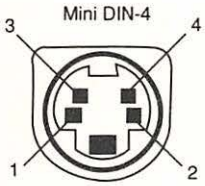


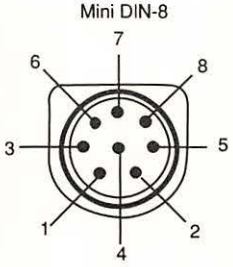




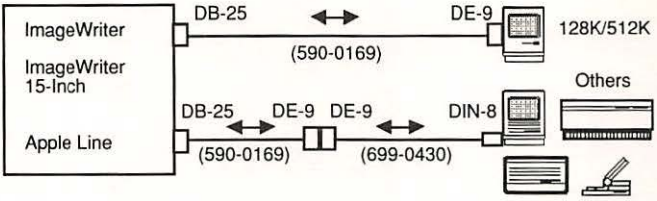


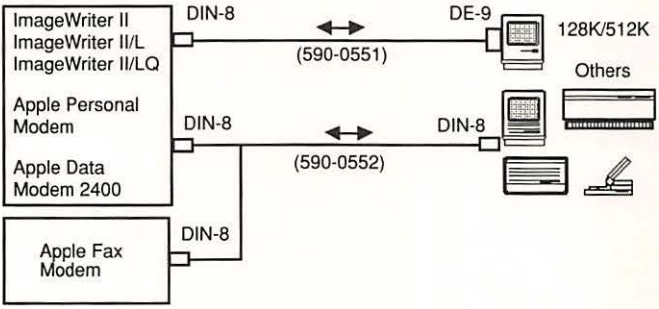


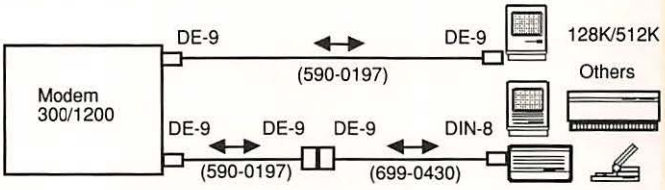




Peripheral Cables







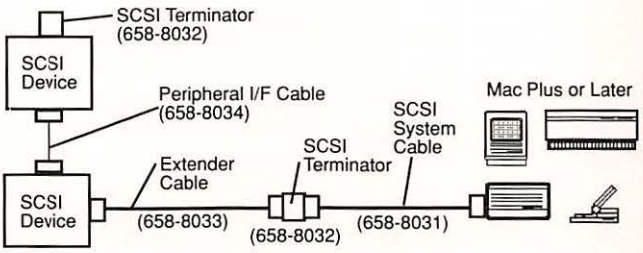
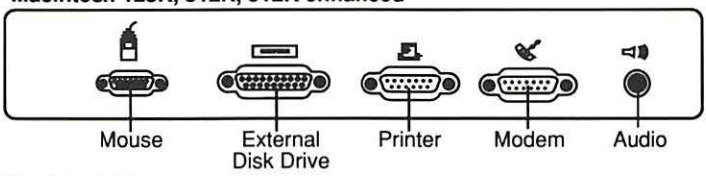


Table of Peripheral Cables

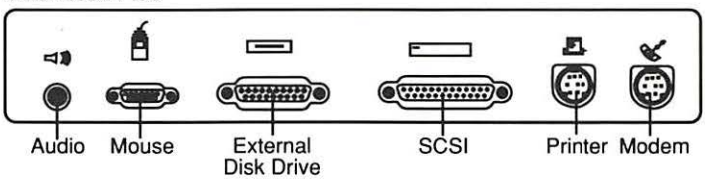
	Service Part #		Cable Information		
	Macintosh 128K/512K	Macintosh Plus and Later	Model #	Color	Type
ImageWriter®, ImageWriter 15-Inch, AppleLine™, Cluster Controller	590-0169	590-0169 and 699-0430 590-0553 or 590-0341	M0150 M0199 M0189	Medium Brown Smoke Beige	DE-9 to DB-25 Male to Male Mini DIN-8 to Mini DE-9 Male to Female (adapter cable)
ImageWriter II, II/L, & II/LQ; Apple Personal Modem & Apple Data Modem 2400	590-0551 or 590-0332	 590-0552 or 590-0340	M0196 M0185 M0197	Smoke Beige Smoke Beige	Mini DIN-8 to DE-9 Male to Male Mini DIN-8 to Mini DIN-8 Male to Male
AppleFax™ Modem		590-0552 or 590-0340	M0197	Smoke Beige	Mini DIN-8 to Mini DIN-8 Male to Male
Modem 300/1200	590-0197	590-0197 and 699-0430 590-0553 or 590-0341	M0170 M0199 M0189	Medium Brown Smoke Beige	DE-9 to DE-9 Male to Male Mini DIN-8 to Mini DE-9 Male to Female (adapter cable)
SCSI Devices (system cable)		658-8031 590-0305 or 590-0345	M0206	Smoke Beige	BR-50 to DB-25 Male to Male
SCSI Devices (terminator)		658-8032 590-0304 or 590-0344	M0209	Smoke Beige	BR-50
SCSI Devices (cable extender)		658-8033 590-0307 or 590-0347	M0208	Smoke Beige	BR-50 Male to Female
SCSI Devices (peripheral I/F cable)		658-8034 590-0306 or 590-0346	M0207	Smoke Beige	BR-50 Male to Male

Computer Port Locations

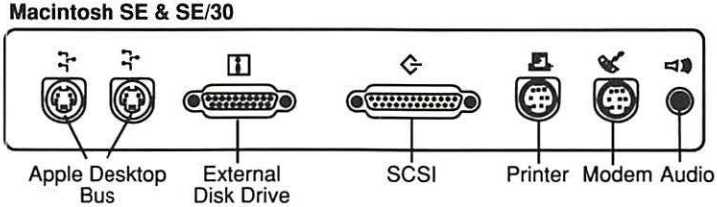
Macintosh 128K, 512K, 512K enhanced



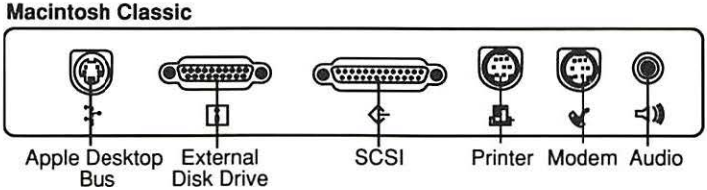
Macintosh Plus



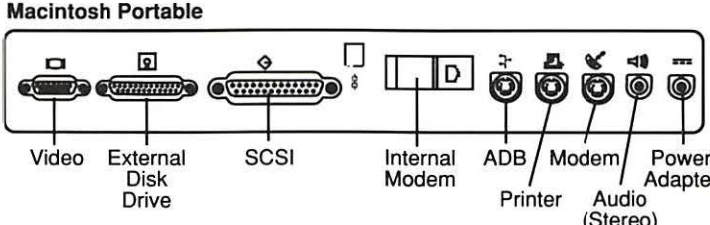
Macintosh SE & SE/30



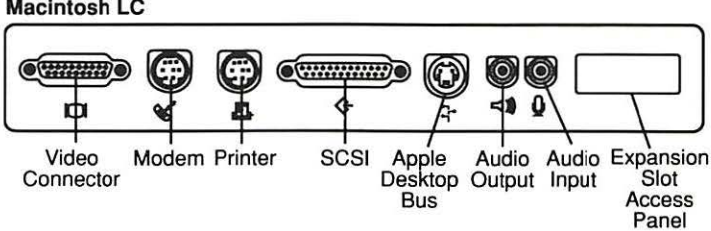
Macintosh Classic



Macintosh Portable

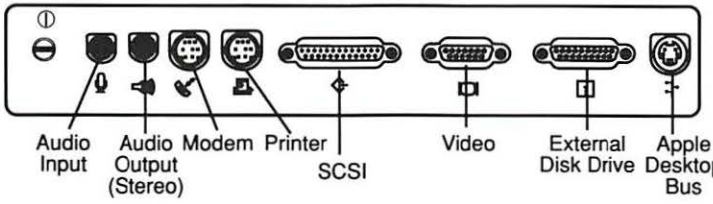


Macintosh LC

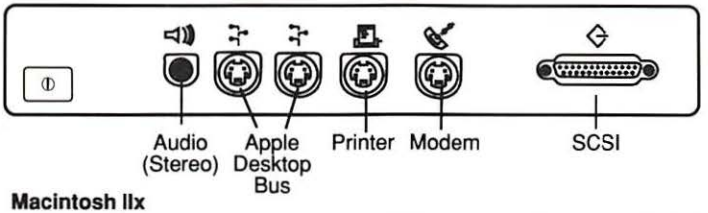


Computer Port Locations

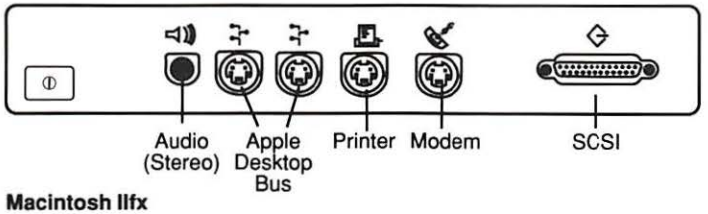
Macintosh IIsi



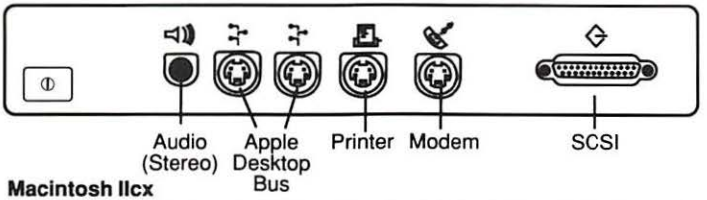
Macintosh II



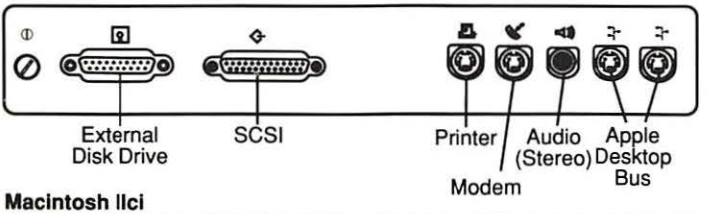
Macintosh IIx



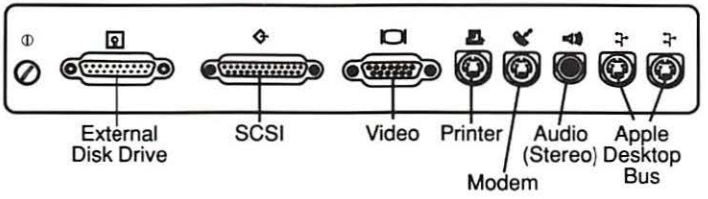
Macintosh IIfx



Macintosh IIcx



Macintosh IIci



This section contains the specifications for all the built-in interfaces and interface card connectors for the Macintosh family of computers. Built-in interfaces are covered first, followed by interface cards. Illustrations on the previous two pages show the locations of the built-in interface connectors.

Note: *The connector specified is for the cable end, not the computer port. A slash (/) after the signal name indicates that the signal is valid when the signal is low.*

Keyboard Connector

Pin	Signal	Signal Description
1	GND	Ground
2	CLOCK	Keyboard clock (input to VIA)
3	DATA	Serial data line
4	+5V	+5 volts

This RJ-11 connector is present on the Macintosh 128K/512K/512K enhanced, and Plus.

Mouse Connector

Pin	Signal	Signal Description
1	GND	Signal ground
2	+5V	+5 volts
3	GND	Signal ground
4	X2	Left-to-right motion indicator
5	X1	Interrupt line (left-to-right motion)
6	NC	No connection
7	SW	Mouse button
8	Y2	Up-down motion indicator
9	Y1	Interrupt line (up-down motion)

This male DE-9 connector is present on the Macintosh 128K, 512K, 512K enhanced, and Plus.

Apple Desktop Bus Connector

Pin	Signal	Signal Description
1	Data	Bidirectional data bus
2*	Power On/	Signal momentarily grounded to pin 4 to begin power-up sequence in CPU
3	Power	+5 volts
4	Ground	Signal ground

The ADB connector (Mini DIN-4 male) is present on the entire Macintosh family of computers except the Macintosh 128K, 512K, 512K enhanced, and Plus.

* Pin 2 is used on Macintosh II family computers only.

External Disk Drive Connector

Pin	Signal	Signal Description
1	GND	Signal ground
2	GND	Signal ground
3	GND	Signal ground
4	GND	Signal ground
5	-12V	-12 volts DC
6	+5V	+5 volts DC
7	+12V	+12 volts DC
8	+12V	+12 volts DC
9	NC	No connection
10	PWM	Motor speed control
11	PH0	Command control line
12	PH1	Command control line
13	PH2	Command control line
14	PH3	Command control line
15	WRREQ/	Write request
16	HDSEL	Head select
17	ENBL2/	Read line enable
18	RD	Read data
19	WR	Write data

This male DB-19 connector is present on all Macintosh computers except the Macintosh II, IIx, IIfx, and LC. The external disk drive connects the following:

- 400K external drive to Macintosh 128K, 512K, 512K enhanced, Plus, SE, and Portable
- 800K/Apple 3.5 Drive to Macintosh 512K enhanced, Plus, SE, SE/30, Classic, IIcx, IIci, IIsi, and Portable
- FDHD SuperDrive to Classic, SE/30, IIcx, IIci, IIsi, Portable, and upgraded Macintosh SE
- Apple Hard Disk 20 to Macintosh 512K, 512K enhanced, Plus, and SE.

Modem/Printer Connectors (DE-9)

Signal Name RS-422		
Pin	**Signal**	**Signal Description**
1	GND	Signal ground
2	+5V	+5 volts
3	GND	Signal ground
4	TxD+	Transmit Data +
5	TxD-	Transmit Data -
6	+12V	+12 volts
7	HSKi	Handshake Input
8	RxD+	Receive Data +
9	RxD-	Receive Data -

This male DE-9 connector is present on the Macintosh 128K, 512K, and 512K enhanced.

Modem/Printer Connectors (DE-9)

Signal Name RS-232		
Pin	**Signal**	**Signal Description**
1	FG	Frame ground
2	NC	No connection
3	SG	Signal ground
4	NC	No connection
5	TxD	Transmit Data
6	NC	No connection
7	DSR	Data Set Ready
8	NC	No connection
9	RxD	Receive Data

This male DE-9 connector is present on the Macintosh 128K, 512K, and 512K enhanced.

Modem/Printer Connectors (DIN-8)

Pin	Signal	Signal Description
1	HSKo	Handshake output; connected to SCC Data Terminal Ready
2	HSKi	Handshake input; connected to SCC Clear To Send and Transmit/Receive Clock
3	TxD-	Transmit Data (inverted); connected to SCC Transmit Data; tri-stated when Request To Send is deasserted
4	SG	Signal ground; connected to logic and chassis ground
5	RxD-	Receive Data; connected to SCC Receive Data
6	TxD+	Transmit Data; connected to SCC Transmit Data; tri-stated when Request To Send is deasserted
7	GPi	General-Purpose input; connected to SCC Data Carrier Detect (or to Receive/Transmit Clock if the VIA1 SYNC signal is high). Not connected on the Macintosh Plus, Classic, LC, or IIsi.
8	RxD+	Receive Data; connected to the SCC Receive Data

These Mini DIN-8 (male) connectors are present on all Macintosh computers except the Macintosh 128K/512K/512K enhanced. To connect DE-9 cables to the Mini DIN-8 port, use adapter cable 590-0341 (beige) or 590-0553/699-0430 (smoke).

Audio Input Connector

Pin	Signal	Signal Description
(Sleeve)	GND	Signal ground
(Tip)	+8V	+8 volts for powering electret microphone
(Ring)	Right	Audio input with a maximum amplitude of 20 MV at 600 ohms impedance

This stereo, miniature phono plug is present on the Macintosh LC and IIsi.

Audio Output Connector—Monaural

Pin	Signal	Signal Description
(Sleeve)	GND	Signal ground
(Tip)	AUDIO	.5-volt peak-to-peak audio signal

This monaural, miniature phono plug is present on the Macintosh 128K/512K/512K enhanced, Plus, and SE. The internal speaker is disabled when this connector is being used.

Audio Output Connector—Stereo

Pin	Signal	Signal Description
(Sleeve)	GND	Signal ground
(Tip)	Left	1-volt peak-to-peak audio signal with an impedance of 47 ohms*; left channel
(Ring)	Right	1-volt peak-to-peak audio signal with an impedance of 47 ohms*; right channel

This stereo, miniature phono plug is present on all Macintosh computers except the Macintosh 128K/512K/512K enhanced, Plus, and SE. The internal speaker is disabled when this connector is being used.

* The Macintosh Portable produces a 0.75-volt peak-to-peak signal.

Ports and Cables

Pin-Outs—Computer Ports

CAUTION: The SCSI interface uses the same type of connector as a standard RS-232 serial interface, but is electrically very different. DO NOT connect any RS-232 device or cable to this connector. Doing so can result in damage to both the device and the computer.

SCSI Connector

Pin	Signal	Signal Description
1	REQ/	Request
2	MSG/	Message
3	I/O/	Input/output
4	RST/	Reset
5	ACK/	Acknowledge
6	BUSY/	Busy
7	GND	Signal ground
8	Data0/	Data bit 0
9	GND	Signal ground
10	Data3/	Data bit 3
11	Data5/	Data bit 5
12	Data6/	Data bit 6
13	Data7/	Data bit 7
14	GND	Signal ground
15	C/D/	Control/data
16	GND	Signal ground
17	ATN/	Attention
18	GND	Signal ground
19	SEL/	Select
20	PARITY/	Data parity
21	Data1/	Data bit 1
22	Data2/	Data bit 2
23	Data4/	Data bit 4
24	GND	Signal ground
25	TERMPRW	+5 volts (terminator power) *

This male DB-25 connector is on all Macintosh computers except the Macintosh 128K, 512K, and 512K enhanced.
* Terminator power is not provided on the Macintosh Plus.

External Video Connector

Pin	Signal	Signal Description
1	RED.GND	Red video ground
2	RED.VID	Red video
3	CSYNC/	Composite sync
4	MON.ID1	Monitor ID, bit 1
5	GRN.VID	Green video
6	GRN.GND	Green video ground
7	MON.ID2	Monitor ID, bit 2
8	NC	No connection
9	BLU.VID	Blue video
10	MON.ID3	Monitor ID, bit 3
11	C&VSYNC GND	Composite & vertical sync ground
12	VSYNC/	Vertical sync
13	BLU.GND	Blue video ground
14	HSYNC.GND	Horizontal sync ground
15	HSYNC/	Horizontal sync
Shell	CHASSIS GND	Chassis ground

This DA-15 connector is present on the Macintosh LC, IIci, and IIsi. This video connector supports all Apple Macintosh monitors except the Two-Page Display.

External Video Connector—Portable

Pin	Signal	Signal Description
1	FPDATA(0)	Flat panel display data bus (bit 0)
2	FPDATA(1)	Flat panel display data bus (bit 1)
3	+5V	+5 volts DC
4	FPDATA(2)	Flat panel display data bus (bit 2)
5	FPDATA(3)	Flat panel display data bus (bit 3)
6	FPDATA(4)	Flat panel display data bus (bit 4)
7	GND	Ground
8	+5V	+5 volts DC
9	GND	Ground
10	FPDATA(5)	Flat panel display data bus (bit 5)
11	FPDATA(6)	Flat panel display data bus (bit 6)
12	FPDATA(7)	Flat panel display data bus (bit 7)
13	BATT_VOLTAGE	Direct connect to main battery
14	FLM	Flat panel new frame sync
15	CL2/	Flat panel display data clock

The external video connector for the Macintosh Portable is a male DA-15 connector. This connector does not support monitors directly; an interface adaptor is required to connect an external monitor to this video port on the Macintosh Portable.

Service Guide—Macintosh® Computers

March 1991

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408-879-0220

Customer Service Administration
408-559-6444

Apple Service Account # (Filled in by service provider)

☐☐-☐☐☐☐☐☐-☐☐

Send your Comments and Suggestions to:
Applelink: ASG

This Apple® manual was written, edited, and composed on Apple Macintosh® computers. Proof pages were created on Apple LaserWriter® printers. Final pages were created on the Varityper® 4300P. The following software programs were used in the creation of the Apple Service Guide: Aldus® FreeHand™, Aldus PageMaker®, Macreations™ Tycho™, MetaDesign™, and Microsoft® Word.

The ***Apple Service Guide for Macintosh Computers*** is a product of the Service Technical Publications Department. The ASG development team includes the following persons:

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Graphic Designer: Steve Rancourt
Production: Laura Ashby

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