Apple Service Technical Procedures Macintosh Family Volume Two

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Volume Two

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Apple Technical Procedures

Macintosh Family
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Macintosh LC and LC II

Technical Procedures

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Macintosh LC and LC II

Section 1 – Basics

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❑ PRODUCT DESCRIPTIONS

The Macintosh® LC and LC II are low-cost Macintosh computers that offer many of the high-performance, open-architecture characteristics of earlier Macintosh computers.

Macintosh LC Features

The Macintosh LC includes the following features:

- 68020 microprocessor
- 16 MHz clock frequency
- 512K of ROM
- 2 MB RAM, upgradeable to 10 MB
- Eight-bit built-in video support
- 256K video RAM, upgradeable to 512K
- Sound input and output capabilities
- A 96-pin processor-direct slot (PDS) for system expansion

Macintosh LC Configurations

The Macintosh LC comes in three configurations:

- 2 MB of RAM, one Apple® 1.4 MB SuperDrive™, and one 40 MB SCSI hard drive

- 2 MB of RAM, one Apple 1.4 MB SuperDrive, and one 80 MB SCSI hard drive

- 2 MB of RAM and two Apple 1.4 MB SuperDrives

Enhancements

In addition to the standard features of the Macintosh LC, you can add the following enhancements:

- Up to seven external SCSI devices (up to six external devices for systems with an internal SCSI drive)

- 2, 4, or 8 MB of expansion RAM on SIMM boards

- 512K video RAM SIMM (replaces 256K video RAM SIMM)

Macintosh LC II Features

The Macintosh LC II includes the following features:

- 68030 microprocessor
- 16 MHz clock frequency
- 512K of ROM
- 4 MB RAM, upgradeable to 10 MB
- Eight-bit built-in video support
- 256K video RAM, upgradeable to 512K
- Sound input and output capabilities
- A 96-pin processor-direct slot (PDS) for system expansion

Macintosh LC II Configurations

The Macintosh LC II comes in two configurations:

- 4 MB of RAM, one Apple 1.4 MB SuperDrive, and one 40 MB SCSI hard drive

- 4 MB of RAM, one Apple 1.4 MB SuperDrive, and one 80 MB SCSI hard drive

Enhancements

The following enhancements can be added:

- Up to seven external SCSI devices (up to six external devices for systems with an internal SCSI drive)

- 6, 8, or 10 MB of expansion RAM on SIMM boards (however, the maximum usable RAM on a Macintosh LC II is 10 MB)

- 512K video RAM SIMM (replaces 256K video RAM SIMM)

❑ MODULE IDENTIFICATION

The Macintosh LC and LC II include the modules and replacement parts in **Figure 1-1.**

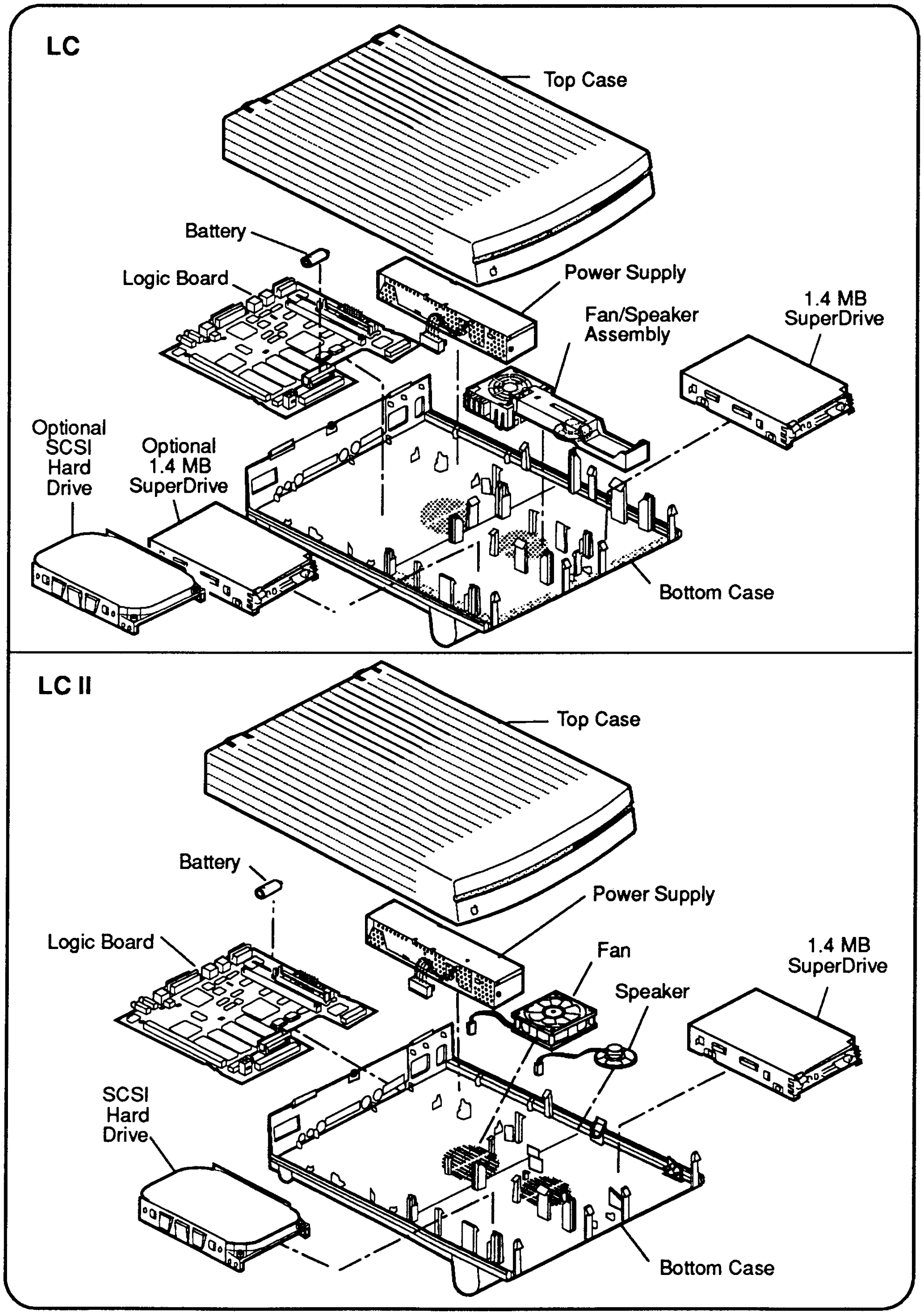


Figure 1-1 Modules and Replacement Parts

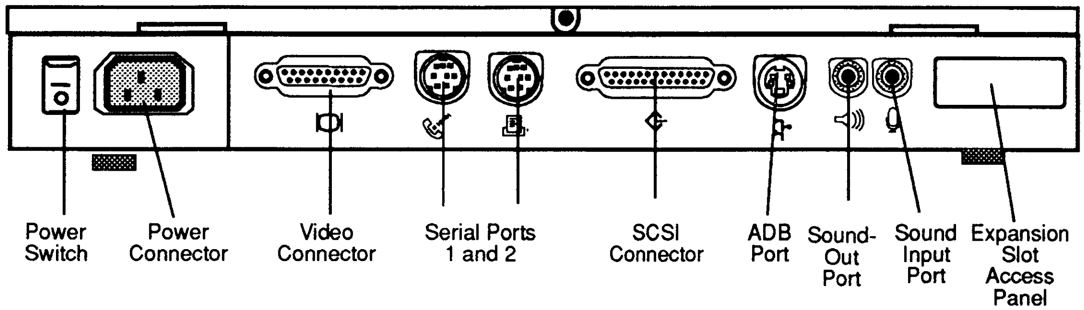


Figure 1-2 Back Panel

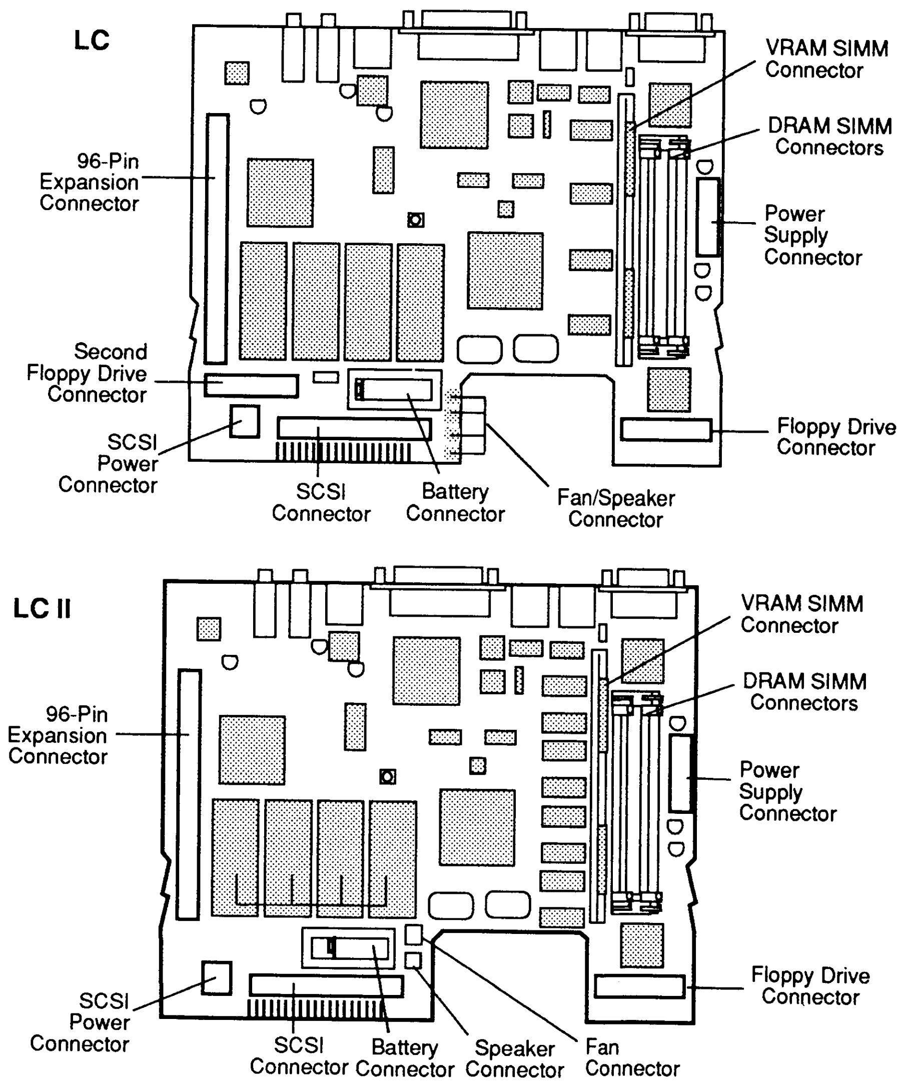


Figure 1-3 Internal Connectors

❑ CONNECTOR IDENTIFICATION

Back Panel

Figure 1-2. The Macintosh LC and LC II have the same built-in ports and connectors on their back panels.

- Power switch
- AC power connector
- Video connector
- Serial port 1
- Serial port 2
- SCSI connector
- Apple Desktop Bus™ port
- Sound-out port
- Sound input port
- Expansion slot access panel

Internal Connectors

Figure 1-3. The internal connectors on the Macintosh LC and LC II logic boards differ slightly.

Macintosh LC

The Macintosh LC internal connectors include:

- Video RAM SIMM connector
- Two DRAM SIMM connectors
- Power supply connector
- Internal 1.4 MB SuperDrive connector
- Fan/speaker connector
- Battery connector
- Internal SCSI hard drive connector
- Power connector for internal SCSI hard drive
- Second internal 1.4 MB SuperDrive connector
- 96-pin processor-direct slot (PDS) expansion connector

Macintosh LC II

The Macintosh LC II internal connectors include:

- Video RAM SIMM connector
- Two DRAM SIMM connectors
- Power supply connector
- Internal 1.4 MB SuperDrive connector
- Fan connector
- Speaker connector
- Battery connector
- Internal SCSI hard drive connector
- Power connector for internal SCSI hard drive
- 96-pin processor-direct slot (PDS) expansion connector

❑ MACINTOSH LC and LC II SYSTEM FEATURES

The Macintosh LC and LC II logic boards include the following components:

- MC68020 (LC) or MC68030 (LC II) microprocessor running at 16 MHz
- 512K of ROM
- Built-in video chip (with optional VRAM)
- Serial communications controller (SCC) chip
- ADB microcontroller chip
- SWIM disk controller chip

Logic Board

Figure 1-4. The Macintosh LC uses the **Motorola 68020 microprocessor**. The Macintosh LC II uses the **Motorola 68030 microprocessor**. These high-performance microprocessors run at 16 MHz and support both 24- and 32-bit processing modes. You can also enhance the performance of the 68020 microprocessor by taking advantage of separate video RAM, which eliminates system delay for video updates.

The Macintosh LC and LC II logic boards include four 32-pin **ROM chips**. The ROM includes code that supports the built-in video and 32-bit QuickDraw™. The code also supports future upgrades to the Macintosh operating system.

The **built-in video chip** controls all system timing, video generation, memory mapping, sound, and clock generation. The system can have 0, 256K, or 512K of Video RAM (VRAM), which is installed in a 68-pin SIMM socket. This SIMM socket uses the same pinouts as the VRAM expansion sockets on the Macintosh Display Card 8•24.

When VRAM is installed (256K or 512K SIMM), video data refreshes from the VRAM, leaving all cycles available to the CPU. When VRAM is not installed, the chip refreshes video from main memory. Video data passes from the CLUT (color lookup table) to the DB-15 video port.

The **serial communications controller (SCC)**, an 8-MHz AMD 85C80 chip, is also known as the combo chip because it combines the functions of the SCC and the SCSI controller into a single device. The SCC portion of the chip controls the two RS-422 serial ports that connect the Macintosh LC and LC II to networks, printers, and modems. The SCSI (small computer system interface) controller portion of the combo chip controls the high-speed parallel port that connects as many as seven external SCSI devices. The SCSI circuit includes the 50-pin internal connector on the logic board and the DB-25 external connector.

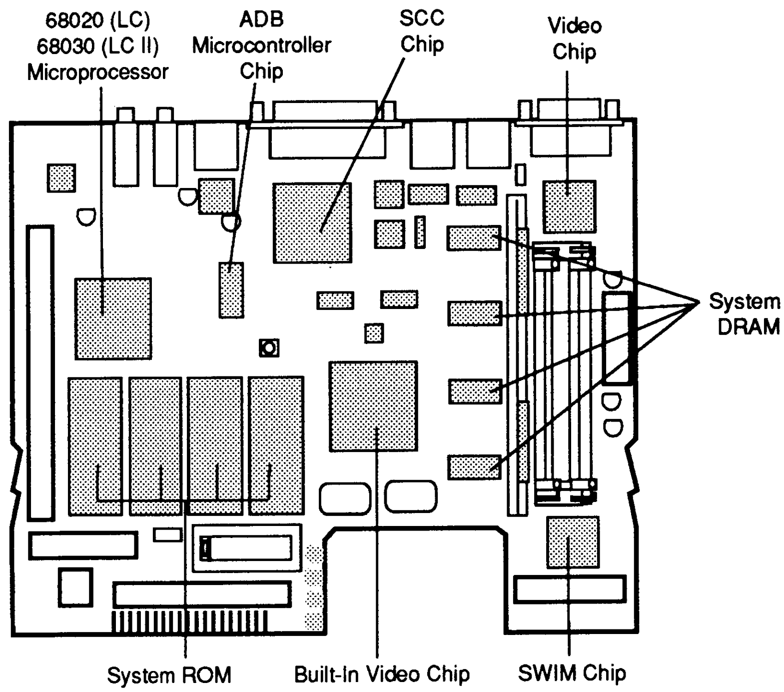


Figure 1-4 Logic Board

The **ADB 68HC05 microcontroller chip** performs keyboard scanning and ADB (Apple desktop bus) interface functions, and stores 256 bytes of parameter RAM (PRAM). The ADB chip also supplies control signals to the DFAC (Digital Filter Audio Chip) analog sound chip. When system power is off, the 68HC05 receives power from the backup battery and operates as the real-time clock.

The **SWIM disk controller chip** enables the 1.4 MB Apple SuperDrive to read and write GCR (group-coded recording) and MFM (modified frequency modulation) data formats. Refer to the following section, "Apple 1.4 MB SuperDrive," for more information.

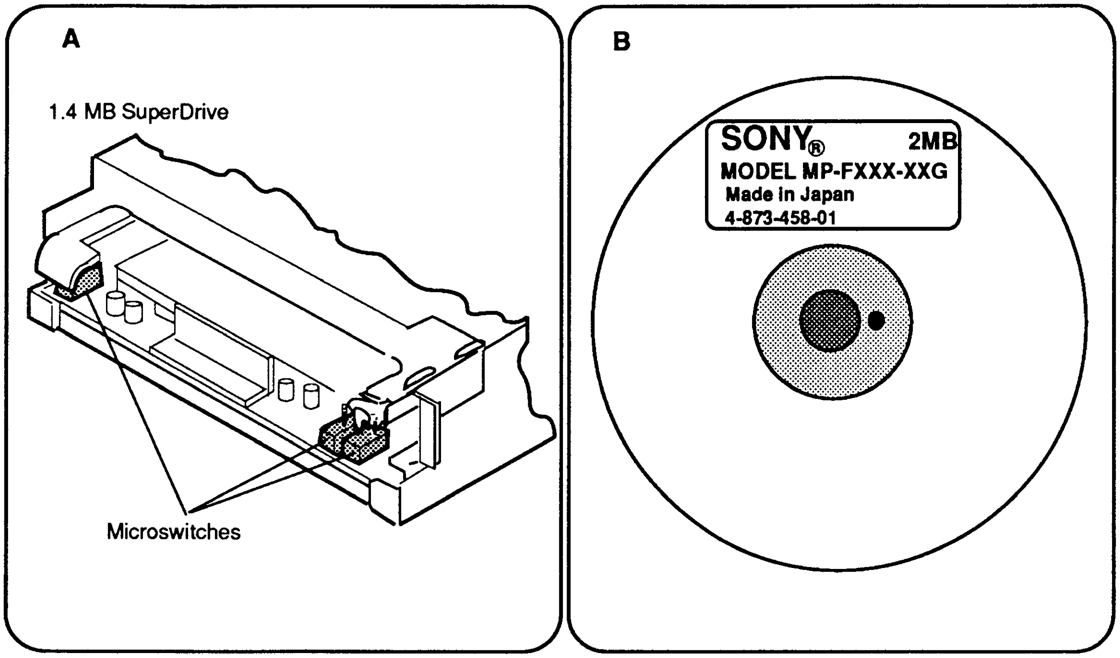


Figure 1-5 Identifying the Apple 1.4 MB SuperDrive

DRIVE	MEDIA	MEDIA FORMAT			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
1.4 MB	Single-Sided	R/W/F	NR	X	X
1.4 MB	Double-Sided	R/W/F	R/W/F	R/W/F	X
1.4 MB	High-Density	X	X	X	R/W/F

NR = Not Recommended
R = Read
W = Write
F = Format
X = Not Allowed

Figure 1-6 Drive/Media Compatibility Matrix

Apple 1.4 MB SuperDrive

The Apple 1.4 MB SuperDrive is a high-density 3.5-inch floppy drive. In addition to high-capacity data storage, the SuperDrive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The Apple SuperDrive is also backward-compatible with the 800K disk format.

Identification

Figure 1-5A. The Macintosh LC and LC II support 800K drives and the Apple 1.4 MB SuperDrive, but ship with SuperDrives only. To differentiate between 800K and 1.4 MB drives, remove the top case and locate the microswitches at the front of the drive. The Apple 1.4 MB SuperDrive has three microswitches; the 800K drive has only two microswitches.

Figure 1-5B. You can also identify an Apple SuperDrive by removing it from the computer and checking the manufacturer's label on the bottom of the drive: all high-density drives have *2MB* on the label.

Drive/Media Compatibility

Figure 1-6. Special 1.4 MB data disks take full advantage of the increased data storage capacity of the Apple 1.4 MB SuperDrive. Apple does not recommend using 1.4 MB media in 800K disk drives, however. Data saved to high-density media using 800K drives is unreliable and could be lost.

CAUTION: *High-density media (1.4 MB) are more susceptible to problems than are low-density media (400K/800K). To avoid media problems, use only known-good media or high-density media bearing the Apple label.*

The 800K drives can read, write, and format single- and double-sided media. The Apple SuperDrive can read, write, and format single-sided (400K), double-sided (800K), and high-density media. In addition, the SuperDrive can read, write, and format 720K and 1.4 MB double-sided MFM-format media.

Note: To help understand drive and media format compatibility, think in terms of the drive/media of lowest capacity. If your Macintosh LC system has an internal 800K drive and an Apple SuperDrive, you must always use 800K media (the drive and media of lowest capacity) to ensure media compatibility between the two drives.

❑ SPECIFICATIONS

Processor	Macintosh LC: MC68020 processor: 32-bit architecture with 256-byte instruction caches Macintosh LC II: MC68030 processor: 32-bit architecture with 256-byte data and instruction caches supporting burst reads
Clock Frequency	16 MHz
Addressing	32-bit internal registers 16-bit address bus
Coprocessor	None
Memory	512K on a ROM SIMM 256 bytes of parameter memory 256K of video RAM, expandable to 512K Macintosh LC: 2 MB RAM, expandable to 10 MB Macintosh LC II: 4 MB RAM, expandable to 10 MB
Slot Expansion	96-pin processor-direct slot (PDS)
Sound System	Built-in speaker External stereo headphone jack that plays in mono Subset of Apple sound chip that enables sound recording, playback, and playthrough (mixing)
Disk Drives	Internal SCSI hard drive (optional on Macintosh LC) Up to seven external SCSI drives (if no internal SCSI drive is installed) Internal Apple 1.4 MB SuperDrive Macintosh LC: Optional second Apple 1.4 MB SuperDrive
SCSI Port	One external SCSI port (DB-25) One internal 50-pin SCSI connector

Serial Ports	Two RS-422/RS-232/AppleTalk® serial ports (mini DIN-8)
Video Display	Built-in video with external video port supports: Macintosh 12-Inch RGB Display at 8 bits/pixel with 256K VRAM (or 16 bits/pixel with 512K VRAM); Apple High-Resolution Monochrome Monitor, AppleColor™ High-Resolution RGB Monitor, and Macintosh 12-Inch Monochrome Display at 4 bits/pixel with 256K VRAM or 8 bits/pixel with 512K VRAM
Keyboard	Apple Keyboard, Apple Keyboard II, or Apple Extended Keyboard II connected through Apple Desktop Bus ports (Mini DIN-4)
Mouse	Apple Desktop Bus mouse (Mini DIN-4)
Input Power	100 to 240 volts AC RMS automatically configured 50–60 Hz single-phase 130 watts maximum
Output Power	DC power: 30 watts maximum
Clock/Calendar	CMOS custom chip with long-life lithium battery
Operating Temperature	10° C to 40° C (50° F to 104° F)
Storage Temperature	-40° C to 47° C (-40° F to 116.6° F)
Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 ft)

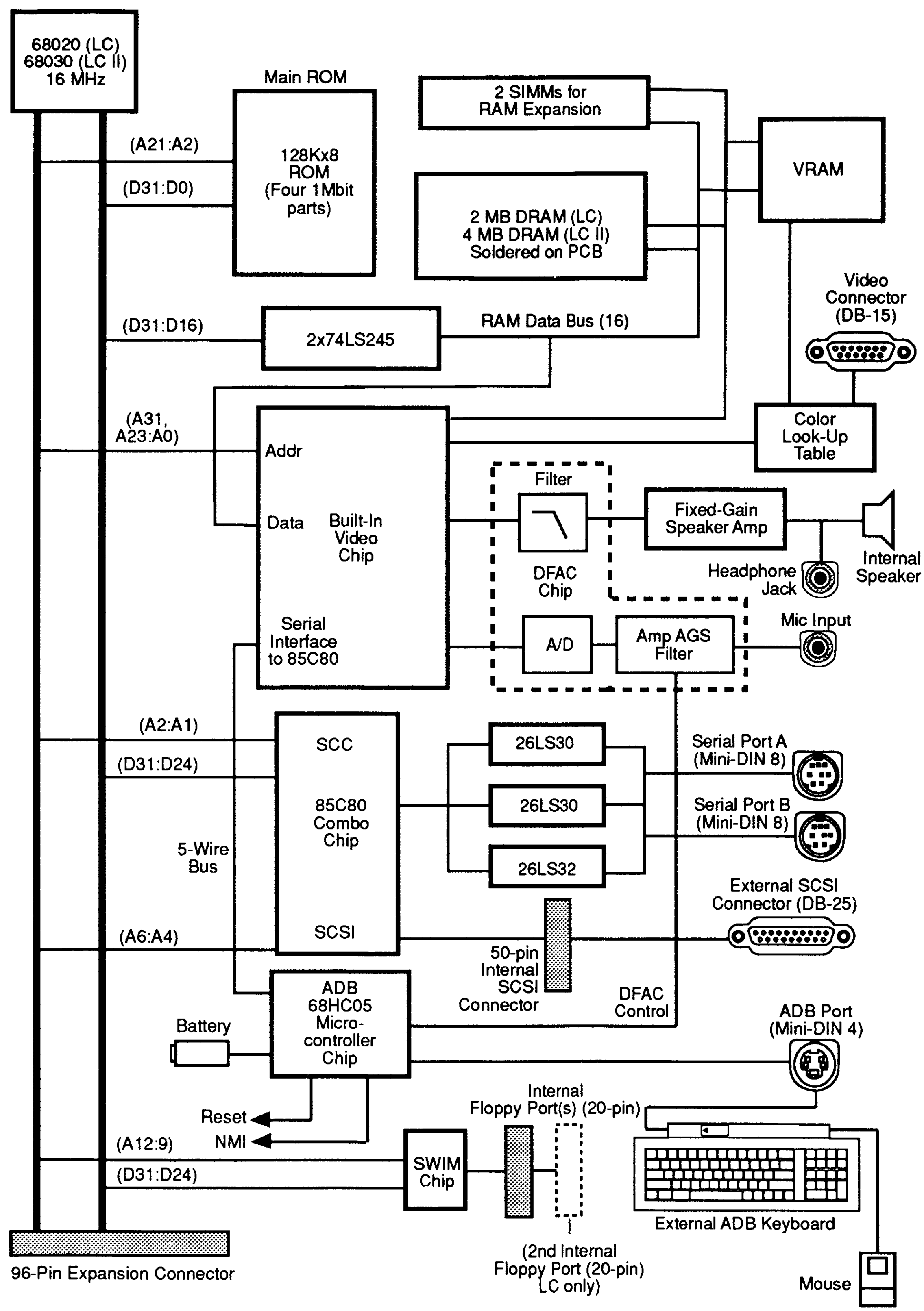


Figure 1-7 Macintosh LC and LC II Block Diagram

❑ THEORY OF OPERATION

Introduction

The Macintosh LC and LC II computers have three basic modules: the logic board, the power supply, and the disk drive(s). The Macintosh LC can have one or two internal floppy drives; the Macintosh LC II supports only one internal floppy drive. Both computers can have one internal SCSI hard disk drive and up to six external SCSI devices (drives, scanners, etc.).

The information in this section will assist you in performing logical troubleshooting on the LC and LC II computers. **Figure 1-7** shows a block diagram of the Macintosh LC and LC II computers.

System Startup

When you switch on the computer, the system begins a carefully synchronized sequence of events. First the system software performs a memory test to determine how much RAM is present and whether the RAM is good.

The system then compiles separate 24-bit and 32-bit memory maps describing the current memory configuration. The 24-bit memory map allows existing Macintosh software to use a 24-bit address mode; the 32-bit memory map enables new software to use the full 32-bit address space.

The memory management unit (MMU) is then programmed, based on the 24- and 32-bit memory maps, to provide contiguous logical memory from the potentially noncontiguous physical segments in bank A (bank B is empty) and the RAM SIMM expansion slots.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive(s)
2. Startup device set in the control panel
3. SCSI devices in declining order of device ID (from 6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are destroyed, the setup device defaults to the device with ID=0.

The system then finds a readable disk, reads the disk, and completes the system startup process.

Logic Board

The logic board is the module that processes all information. Below is a list of the major components of the Macintosh LC and LC II logic boards and the functions they perform.

By using the block diagram in **Figure 1-7** as you read through the various sections, you will get a clearer understanding of how the logic boards work.

Microprocessor

Macintosh LC: contains a Motorola 68020 microprocessor running at 16 MHz. The MC68020 is a true 32-bit processor but also supports 24- and 16-bit processing modes. When running in the 24-bit addressing mode, the Macintosh LC is compatible with the majority of existing Macintosh applications.

Macintosh LC II: contains a Motorola 68030 microprocessor running at 16 MHz. The MC68030 is a true 32-bit processor but also supports 24- and 16-bit processing modes. When running in the 24-bit addressing mode, the Macintosh LC II is compatible with the majority of existing Macintosh applications.

DRAM

The random-access memory (RAM) interface on the logic board supports up to 10 MB of DRAM. The first 10 megabytes of space available in main memory are reserved for RAM.

On the Macintosh LC, the first two megabytes of DRAM are soldered onto the logic board in bank A. The Macintosh LC II ships with 4 MB of DRAM soldered onto the logic board.

Two single in-line memory module (SIMM) sockets provide memory expansion on the Macintosh LC and LC II. These expansion RAM sockets can be empty or can contain two SIMMs of the same density (two 1 MB SIMMs, for instance).

RAM bank A and the two SIMM sockets do not occupy contiguous address space, as they do on most previous Macintosh products. The 68020 on-chip MMU joins the noncontiguous blocks of physical memory to contiguous logical memory for application software.

VRAM

If the VRAM (video RAM) SIMM does not contain VRAM (the SIMM contains two transparent latches only), then on-board video operates out of main memory. Video data resides in a video frame buffer that is in the topmost megabyte of soldered RAM, thereby allowing the video address to be independent of memory size.

If VRAM (256K or 512K) is installed on the VRAM SIMM, the video frame buffer is in the VRAM, and video accesses do not affect memory access. Video data can be fetched from VRAM without interrupting CPU access to main memory or to I/O devices.

ROM

The Macintosh LC and LC II contain 512K of nonvolatile read-only memory. The system ROMs contain the Macintosh Toolbox, operating system support, and self-tests. The ROMs are implemented with four 32-pin, 128K x 8 ROM chips.

Built-in Video Chip

The built-in video chip provides support for VRAM and for the Ariel color lookup table (CLUT). The video chip also includes a full-function VIA1 (versatile interface adapter) chip and VIA2 registers similar to those implemented in the Apple Sound Chip.

If VRAM is not installed on the VRAM SIMM, the video chip uses data stored in a buffer frame in bank A of RAM to refresh screen video. The video chip requests this video data as needed and refreshes video in 32-bit bursts. If a video burst is in progress, CPU access to RAM bank A is delayed, which slows the CPU. The RAM SIMM expansion slots are not affected by video refresh; the CPU has full access to these slots at all times (the expansion slots are connected directly to the CPU data bus).

When a monitor is connected to the built-in video port, the monitor will ground certain pins on the connector. The grounding pattern allows the video chip to identify the type of monitor connected. The video chip automatically selects the appropriate pixel clock and sync timing parameters. If an unknown monitor is plugged in or no monitor is plugged in, built-in video output halts.

The video monitor connects to the computer through a DB-15 female connector on the back of the CPU. **Table 1** shows the pinouts for this connector.

Pin	Signal	Description	Pin	Signal	Description
1	R.GND	Red video ground	9	B.V.	Blue video
2	R.V.	Red video	10	ID3	Monitor ID bit 3
3	CSYNC	Composite H and V sync	11	GND	CSYNC ground
4	ID1	Monitor ID bit 1	12	VSYNC	Vertical sync
5	G.V.	Green video	13	B.GND	Blue video ground
6	G.GND	Green video ground	14	GND	HSYNC return
7	ID2	Monitor ID bit 2	15	HSYNC	Horiz sync (VGA only, CSYNC otherwise)
8	-	Not used	Shell	S.GND	Shield ground

Table 1 External Video Connector Pinouts

Macintosh LC and LC II built-in video supports the following monitors: the Macintosh 12-Inch RGB Display (512 x 384 screen); the Macintosh 12-Inch Monochrome Display, AppleColor Hi-Res RGB Monitor, and Apple Hi-Res Monochrome Monitor (640 x 480 screens); and VGA monitors (512 x 384 screen).

When using a video SIMM without VRAM, the built-in video chip supports 640 x 480 screens only, at 1 bit/pixel. With 256K of VRAM, the Macintosh LC and LC II can drive 640 x 480 and 560 x 384 screens at 4 bits/pixel, and 512 x 384 screens at 8 bits/pixel. With 512K of VRAM, these CPUs can drive 640 x 480 and 560 x 384 screens at 8 bits/pixel, and 512 x 384 screens at 16 bits/pixel.

The video signals generated by the built-in video chip pass through a CLUT (color lookup table) chip. The lookup table has 256 three-byte entries (one byte each for red, green, and blue). In monochrome mode, the same signal drives red, green, and blue.

Input/Output Interfaces

The input/output interfaces of the system include the serial ports, the SCSI port, the internal floppy disk, the ADB port, the sound system, and the expansion port. The following chips control these ports and their devices.

SCC Chip

The SCC (serial communications controller) chip, an 8-MHz AMD 85C80, controls communications with the serial ports. This chip is also known as the combo chip because it combines the functions of the SCC and the SCSI controller into a single device. The 85C80 is transparent to operating software.

The SCC portion of the 85C80 has two independent ports for serial communication. Each port can be independently programmed for asynchronous, synchronous, and AppleTalk protocols. The serial ports conform to EIA standard RS-422. These ports are used mainly for (though not limited to) connecting the CPU to networks, printers, and modems.

To use the serial ports with RS-232 single-ended devices, use the RS-422 TxD- for the RS-232 TxD, RS-422 RxD- for the RS-232 RxD, and ground RxD+ to the SG pin (see **Figure 1-8**).

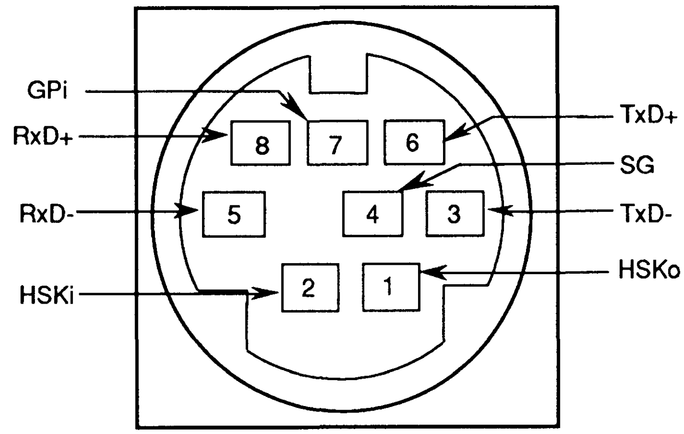


Figure 1-8 Mini DIN-8 Connector

The second portion of the 85C80 combo chip is the small computer system interface (SCSI) controller. The SCSI portion of the 85C80 supports the SCSI as defined by the American National Standards Institute (ANSI) X3T9.2 Committee. This part of the device is compatible with the 53C80 controller in the Macintosh II family. The rest of the SCSI interface consists of an internal 50-pin connector for connecting an internal SCSI drive, and an external DB-25 connector.

The combo chip connects directly to the internal 50-pin connector and the external DB-25 connector, and the chip controls the high-speed parallel port for communicating with up to seven SCSI peripherals. (If you have an internal SCSI drive, you can have only six external SCSI devices.) The combo chip supports arbitration of the SCSI bus, including reselection.

The 85C80 does not provide the internal SCSI disk drive with termination power; the drive provides the termination power.

SWIM Chip

The SWIM chip (Sanders-Woz integrated machine) controls the internal 3.5-inch floppy drive—the Apple 1.4 MB SuperDrive. The SWIM chip incorporates the functionality of the IWM chip (integrated Woz machine), and enables the high-capacity SuperDrive to read, write, and format in GCR and MFM data formats.

The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (Apple 400K/800K) or MFM (MS-DOS 720K and 1.4 MB, and Apple 1.4 MB) data formats. This arrangement enables the Apple SuperDrive to exchange data between Apple and MS-DOS® systems. For specific compatibilities between drives and media, see **Figure 1-6**.

To translate the formatted data for use within an application program, use an application-specific translator within the Apple File Exchange utility program or a third-party translator.

ADB Microcontroller Chip

A custom Motorola 68HC05 microcontroller chip drives the external ADB bus and reads the status of the selected device. The Macintosh LC and LC II interface with the microcontroller chip via an improved, extended-handshake protocol with the VIA1 register in the built-in video chip.

The ADB is a serial communication bus that connects keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The system microprocessor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the microcontroller. The microcontroller drives the external bus and reads the status of the selected device.

All Apple Desktop Bus devices have a microprocessor that makes the devices intelligent. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device on the Apple Desktop Bus.

There are three Macintosh Apple ADB keyboards—the Apple Keyboard, Apple Keyboard II, and Apple Extended Keyboard II. The keyboards connect to the Apple Desktop Bus port on the rear of the CPU. The keyboards have their own microprocessors, called keyboard microcontrollers. The keyboards operate asynchronously, issue commands on the ADB, and transmit and receive data to and from the ADB devices.

The ADB microcontroller chip includes other functions that used to be provided by extra devices on the logic board. The microcontroller includes a real-time clock and parameter RAM, control bits for the soft power control circuit, power-on reset capabilities, and keyboard-controlled NMI functions. Each of these functions is described below.

Sound System

The sound system includes an input jack, a built-in speaker, and a stereo headphone jack that plays in mono. The system can record sounds digitally and includes a playthrough feature that permits the user to mix an external audio source with computer-generated sound and to play the result through the speaker or headphone jack.

The Macintosh LC and LC II use main memory for the sound buffer. Sound data is written to memory and played back using a first-in, first-out (FIFO) storage method incorporated into the built-in video chip. The FIFO address is a byte wide, and the sound buffer in main memory is 1022 bytes long. A DFAC chip (digital filter audio chip) controls all analog processing functions. Control bits for the DFAC are in a shift register loaded from the ADB microcontroller chip.

The sound input circuit consists of an input jack; a preamplifier; a switched capacitor filter to provide input filtering; an analog-to-digital converter; a first-in, first-out memory to store the digitized data; and control logic that allows software to control the circuitry. Software uses sound control registers to control the storage of data and the generation of interrupts. The sound input control register controls the sample rate, the record/play bit, and write/diagnostic address to the FIFO memory. Sound samples can be made at 11 or 22 KHz with 8-bit resolution.

Sound input sources can be a microphone or an audio line, either of which plugs into the sound input jack on the rear of the computer. The input source should provide a 20-mV amplitude and a 600-Ω input impedance. A line input (1 volt, peak to peak) source—such as a CD player, VCR, or tape player—provides a higher voltage input level. Use an attenuating adapter plug to decrease the level of these devices so they are compatible with Macintosh LC and LC II input.

Apple provides an electret microphone that digitizes voice inputs. Electret microphones require a bias voltage. The Macintosh LC powers the electret via a bias voltage at the second tip of the input connector. This connection provides eight volts DC at up to 1 mA. This bias voltage has no effect on input devices with monophonic or stereo input plugs. However, plugging some types of amplifiers into the sound input jack instead of the sound output jack could damage the amplifier.

CAUTION: *The user must take care to ensure that the connections to the rear of the computer are correct. Incorrect connections could damage the computer or external equipment.*

The sound output circuit consists of the DFAC chip, which filters the pulse-width-modulated (PWM) signal and drives the internal speaker and headphone jack, and a separate amplifier that mixes the right and left channels before output.

Expansion Slot

The Macintosh LC and LC II each have one expansion slot that accepts compatible expansion cards.

The expansion bus connector is a 96-pin DIN three-row connector. The connector provides the 32-bit CPU data and address buses, DMA control signals, other CPU control signals, interrupt inputs, and status signals for future expansion. Additionally, the slot outputs +5 V, +12 V, and -12 V DC, and 4 watts of DC power. The expansion card is installed horizontally, parallel to the main logic board. There is sufficient clearance for cooling air to flow between the boards.

Power Supply

The power supply operates on standard line voltage and outputs +5 V, +12 V, and -12 V DC voltages, which are used by the logic board, the internal devices, and the slots.

***CAUTION:** It is extremely important that you do not exceed the ratings of the power supply. Exceeding the ratings will damage the power supply and the logic board. For maximum system ratings, see the specifications in this section.*

Power Control

You cannot switch the Macintosh LC or LC II on or off from the keyboard. You must use the on/off power switch on the rear panel.

You can lock the rear-panel power switch in an ON position, which allows the computer to restart as soon as it detects AC power. If a power failure shuts off the computer, it will start up as soon as power is reinstated.

The Shut Down command in the Finder™ puts the power-off function under software control. This soft-off allows the computer to complete pending activity. When the soft-off routine finishes, the monitor screen displays the dialog box "You may now shut down your Macintosh safely." Use the rear panel power switch to switch off power.

Real-Time Clock

The ADB 68HC05 microcontroller chip incorporates the real-time clock. The microcontroller chip contains 256 bytes of RAM that a battery powers when external power is off. These RAM bytes are called parameter RAM (PRAM). Parameter RAM stores the configuration of ports, the clock setting, and other data that must be preserved even when system power is not available.

The user accesses PRAM information through a new pseudo device command protocol for the 68HC05. This protocol is different from the protocols of previous Macintosh computers. Software can use the driver routines to access the clock and PRAM; however, software that attempts to access these hardware devices directly must be modified.

Interrupt/ Reset Circuit

The Macintosh LC and LC II provide a keyboard-initiated nonmasked interrupt (NMI) and reset. To produce a NMI, press <Command> and the power button at the same time; to reset, press <Command>, <Control>, and the power button at the same time.

Debugging software uses the NMI to stop an application and change to a debugger for low-level software and hardware testing. The NMI signal has an enable flag in the PRAM of the 68HC05. When the 68HC05 initially powers up, the flag resets and the keyboard cannot generate the NMI. To use the debugging function, debugging software must set the enable flag in the PRAM so that the keyboard can generate the NMI.

The NMI reset is a hard reset, identical to the power-on reset. All RAM contents are lost and the computer behaves as if you just switched it on.

Macintosh LC and LC II

Section 2 – Take-Apart

❑ CONTENTS

Note: Detailed instructions for underlined steps are elsewhere in this section.

❑ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh LC and LC II contain ROM and RAM memory (which is installed on small separate boards called SIMMs—single in-line memory modules) and CMOS components. The CMOS components and the SIMMs are very susceptible to damage from electrostatic discharge (ESD).

You must take preventive measures to avoid ESD damage. When you unwrap, install, or replace modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

If the proper ESD procedures are not available, then do the following: switch off power and disconnect the power cord. After removing the cover and before going near the logic board, touch the metal of the power supply case.

❑ TOP CASE

Materials Required

Medium Phillips screwdriver

Remove

1. Switch off power. Disconnect the power cord and all cables from the rear of the computer.
2. If necessary, remove the case screw (**Figure 2-1**).
3. Lift the tabs at the back of the lid (**Figure 2-1**). Lift the top case straight up and off the bottom case.

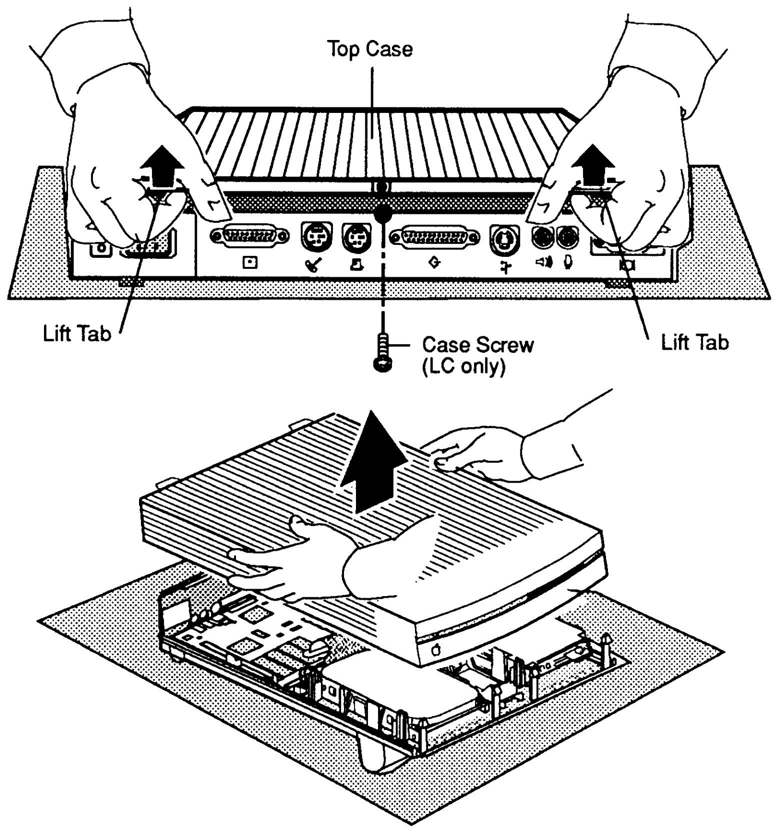


Figure 2-1 Removing the Top Case

Replace

1. Replace the front end of the top case on the front end of the bottom case, and swing the lid down toward the back of the unit. Press down on the back of the top case until you hear it click into place on the bottom case.
2. Replace the case screw, if present (**Figure 2-1**).

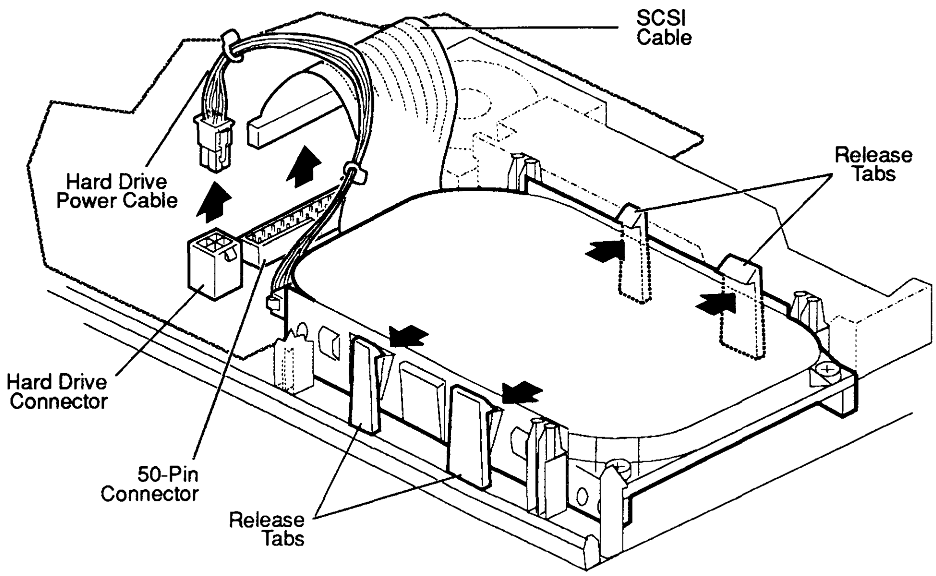


Figure 2-2 Removing the Hard Drive

Note:
Drive carrier
configuration
may vary
between LC
and LC II,
but the screw
placement
sequence is
the same.

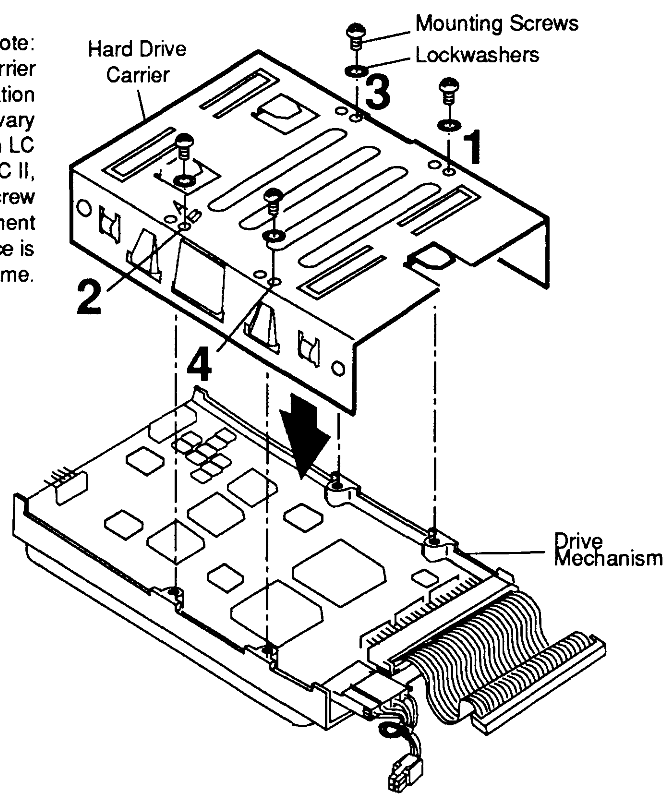


Figure 2-3 Installing the Drive Carrier

❑ HARD DRIVE

Note: If you are replacing the hard drive, you will need a torque driver. Most hardware and automotive supply stores carry torque drivers.

Materials Required

Medium Phillips screwdriver
Torque driver

Remove

1. Remove the top case.

2. **Figure 2-2.** Disconnect the HDA (hard disk assembly) power cable from the HDA power connector on the logic board. To remove this cable, you must release the locking tab on the side of the connector.

3. **Figure 2-2.** Disconnect the SCSI cable from the 50-pin SCSI connector on the logic board.

4. **Figure 2-2.** Release the two plastic tabs on one side of the hard drive, and lift the drive slightly. Repeat on the other side of the hard drive and remove the drive (with its carrier) from the computer.

CAUTION: *DO NOT loosen or remove any of the torx screws that secure the black cover to the drive mechanism. Loosening or removing these screws can cause irreparable damage to the hard drive.*

---

5. **Figure 2-3.** If you are replacing the hard drive, turn the drive over and remove the four Phillips screws and lockwashers that secure the defective drive mechanism to its carrier. You will need to use this carrier when installing a new hard drive.

   Note: If you are replacing the hard drive, detach and retain the HDA power cable and the SCSI cable from the bad drive. You will need these cables to connect the new drive.

Replace

If you are replacing a defective hard drive, begin with step 1. If you are simply reinstalling the same drive (which is already attached to the silver-colored carrier), begin with step 5.

1. **Figure 2-3**. Using the screw hole marked **B**, align the carrier on the bottom of the new drive mechanism. **Loosely** fasten the carrier to the drive with the four lockwashers and Phillips screws.

2. **Figure 2-3**. Using the torque driver and following the sequence in **Figure 2-3**, torque the four Phillips screws to 8.0 in-lbs.

CAUTION: *Be sure to use the Phillips screws that you removed in step 5 above and follow the installation sequence in Figure 2-3. Failure to do so can damage the drive.*

---

3. Connect one end of the SCSI cable to the hard drive.

4. Connect the rectangular end of the HDA power cable to the hard drive.

5. **Figure 2-2**. Position the hard drive so the metal tabs on the carrier align with the four plastic release tabs on the bottom case. Push the drive into the bottom case until the drive snaps into place.

6. **Figure 2-2**. Connect the SCSI cable to the 50-pin SCSI connector on the logic board.

7. **Figure 2-2**. Connect the square end of the power cable to the HDA power connector on the logic board. Be sure that the cable locks into place.

8. <u>Replace the top case</u>.

❑ FAN/SPEAKER ASSEMBLY (MACINTOSH LC ONLY)

Remove

1. Remove the top case.
2. Release the plastic tab (**Figure 2-4**) on one end of the fan/speaker assembly, and lift the assembly slightly. Release the other plastic tab and remove the fan/speaker assembly from the bottom case.

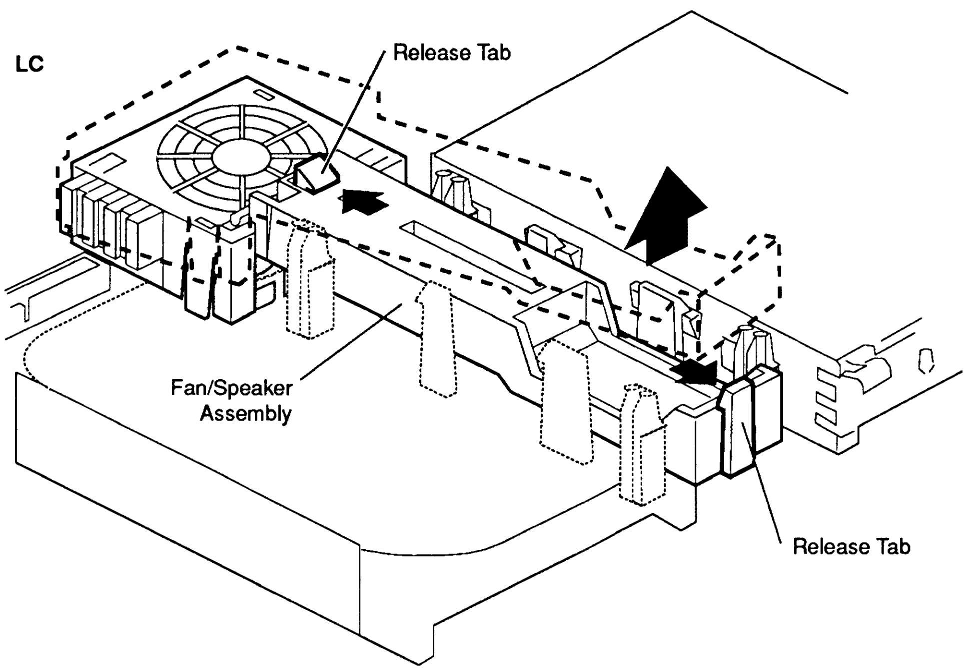


Figure 2-4 Removing and Installing the Fan/Speaker Assembly

Replace

1. Insert the two tabs on the fan end of the fan/speaker assembly (**Figure 2-4**) under the logic board. Push the assembly down until you hear it snap into place.
2. Replace the top case.

❑ FAN (MACINTOSH LC II ONLY)

Remove

1. Remove the top case.

2. Disconnect the fan cable from the fan connector (J24) on the logic board (**Figure 2-5**).

3. Release the plastic tabs on the sides of the fan (**Figure 2-5**) and lift the fan to remove it.

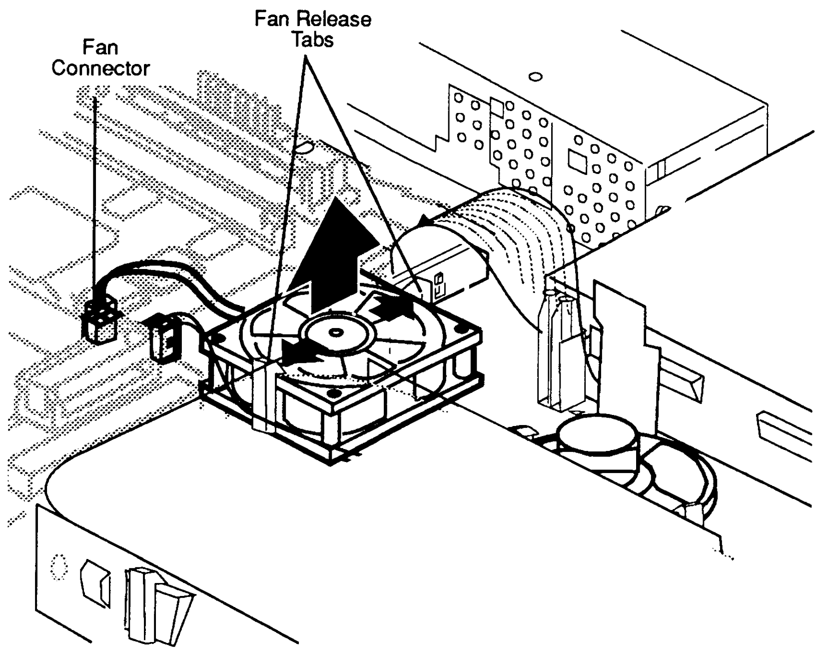


Figure 2-5 Removing and Installing the Fan

Replace

1. Position the fan (logo side down) so that its cable reaches the fan connector (J24) (**Figure 2-5**).

IMPORTANT: *You must install the fan with the logo side down, or the fan may damage the computer.*

2. Gently push down on the fan until you hear it snap into place.

3. Connect the fan cable to the fan connector (J24) on the logic board.

4. Replace the top case.

❑ SPEAKER (MACINTOSH LC II ONLY)

Remove

1. Remove the top case.
2. Remove the hard drive.
3. Disconnect the speaker cable from the speaker connector (J25) on the logic board (**Figure 2-6**).
4. Release the plastic tabs on the sides of the speaker (**Figure 2-6**) and lift the speaker to remove it.

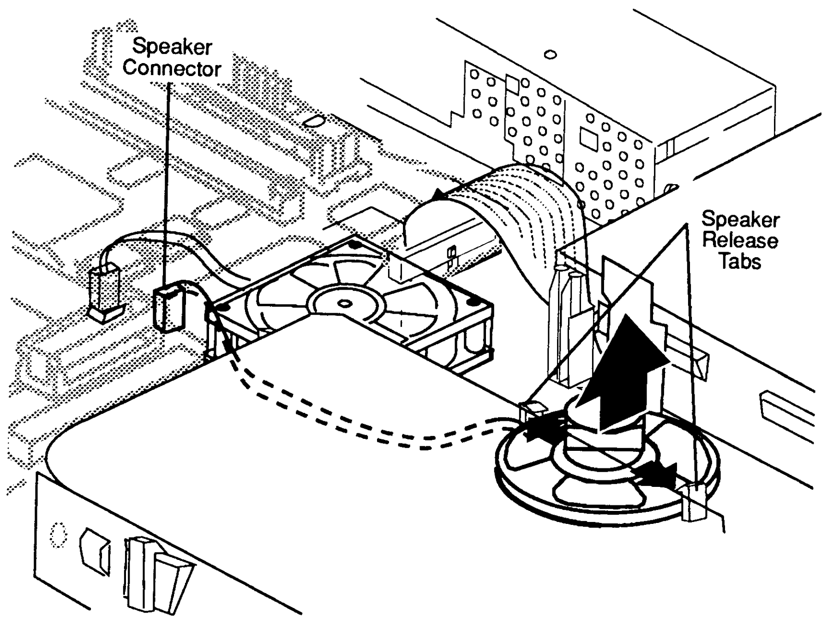


Figure 2-6 Removing and Installing the Speaker

Replace

1. Slide the speaker under the front plastic tab that holds the speaker in place; pull back on the bottom tab (**Figure 2-6**). Push down on the speaker until it snaps into place.
2. Thread the speaker cable through the top two plastic brackets that hold the hard drive in place, and connect the speaker cable to the speaker connector (J25) on the logic board.
3. Replace the hard drive.
4. Replace the top case.

❑ FLOPPY DRIVE (MACINTOSH LC ONLY)

Remove

1. Remove the top case.

2. Disconnect the floppy drive cable from the floppy drive connector (J13) on the logic board (**Figure 2-7**).

3. Release the plastic tabs (**Figure 2-7**) on one side of the floppy drive, and lift the drive slightly. Repeat on the other side and remove the drive.

Note: If you are replacing a bad drive, detach and keep the floppy drive cable for use with the new drive.

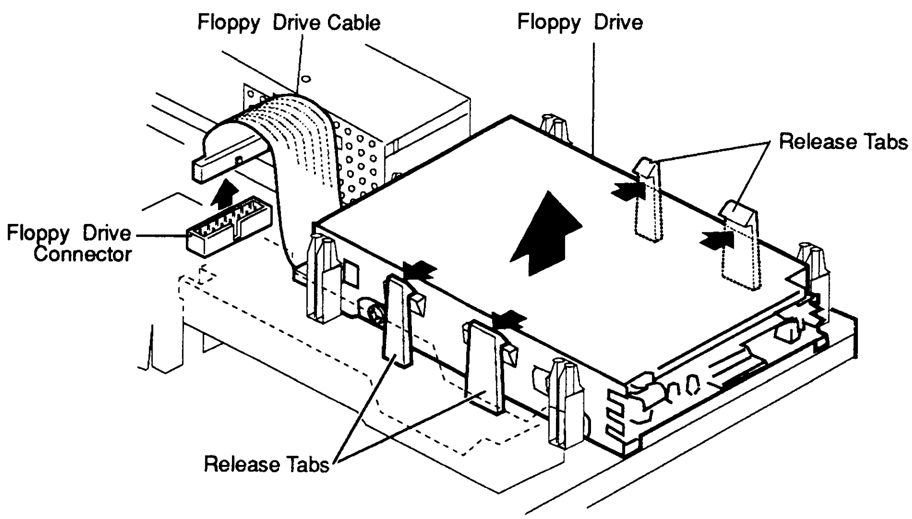


Figure 2-7 Removing the Floppy Drive (Macintosh LC Only)

Replace

IMPORTANT: *Before you install a replacement 1.4 MB floppy drive in a Macintosh LC, you* ***must*** *remove the dust shield from the replacement drive.*

1. Position the floppy drive so that the metal tabs on the drive carrier align with the plastic release tabs (**Figure 2-7**). Push the drive into the bottom case until the drive snaps into place.

2. Connect the floppy drive cable to the drive (if necessary) and to connector J13 (**Figure 2-7**) on the logic board.

3. Replace the top case.

❑ FLOPPY DRIVE (MACINTOSH LC II ONLY)

Remove

1. Remove the top case.

2. Disconnect the floppy drive cable from the floppy drive connector (J2) on the logic board (**Figure 2-8**).

3. Release the two plastic tabs at the rear of the floppy drive (**Figure 2-8**), and lift the drive up and out.

Note: If you are replacing a bad drive, detach and keep the floppy drive cable for use with the new drive.

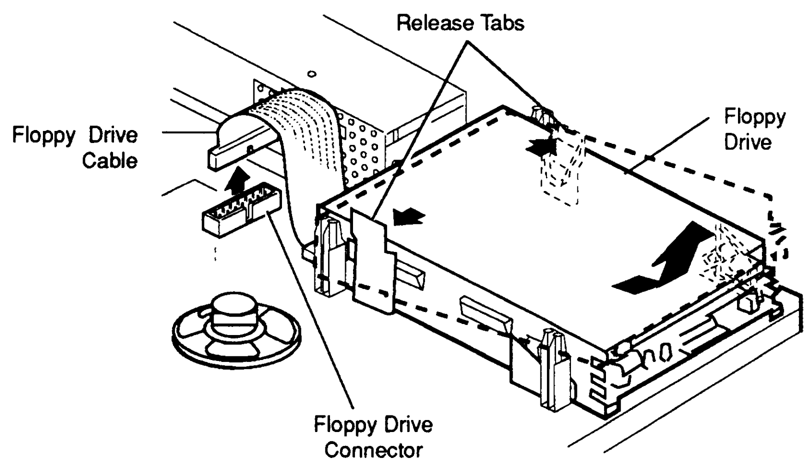


Figure 2-8 Removing the Floppy Drive (Macintosh LC II Only)

Replace

IMPORTANT: *Before you install a replacement 1.4 MB floppy drive in a Macintosh LC II, you* ***must*** *remove the dust shield from the replacement drive.*

1. Insert the metal locating screws on the front of the drive carrier into the grooves on the plastic brackets that hold the front of the drive (**Figure 2-8**). Push down on the back of the drive until the drive snaps into place.

2. Connect the floppy drive cable to the drive (if necessary) and to connector J2 (**Figure 2-8**) on the logic board.

3. Replace the top case.

❑ POWER SUPPLY

Remove

1. Remove the top case.

2. Disconnect the power supply cable from the power supply connector (**Figure 2-9**) on the logic board.

3. Release the two plastic tabs (**Figure 2-9**) that secure the front end of the power supply to the bottom case, and at the same time lift the power supply up and out of the case.

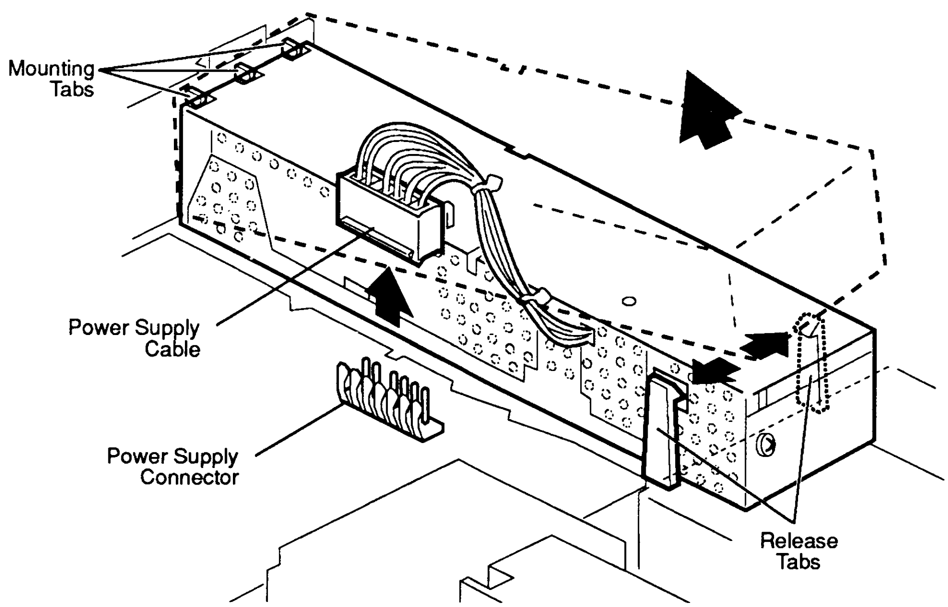


Figure 2-9 Removing and Installing the Power Supply

Replace

1. Slide the back end of the power supply over the three plastic mounting tabs (**Figure 2-9**) at the rear of the bottom case.

2. Push down on the power supply until it snaps into place.

3. Connect the power supply cable to the power supply connector (**Figure 2-9**) on the logic board.

4. Replace the the top case.

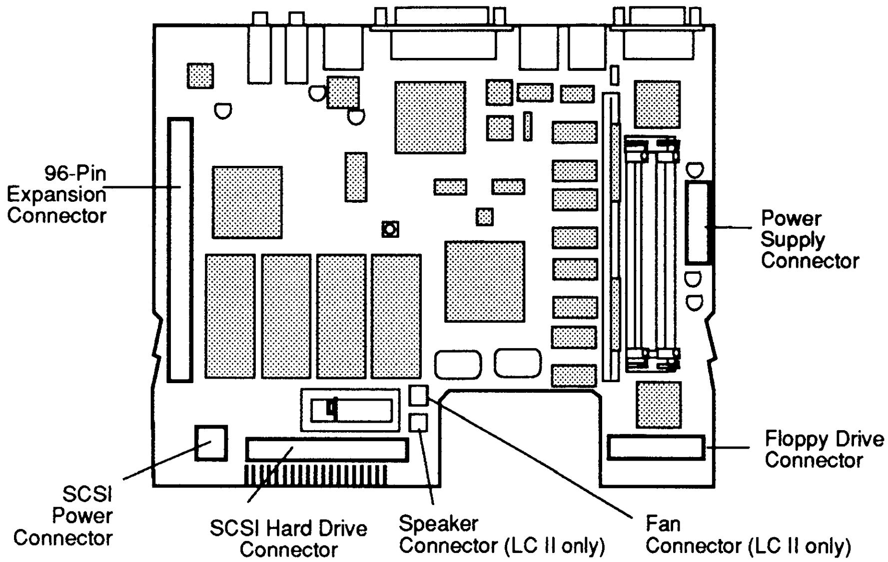


Figure 2-10 Disconnecting Connectors from the Main Logic Board

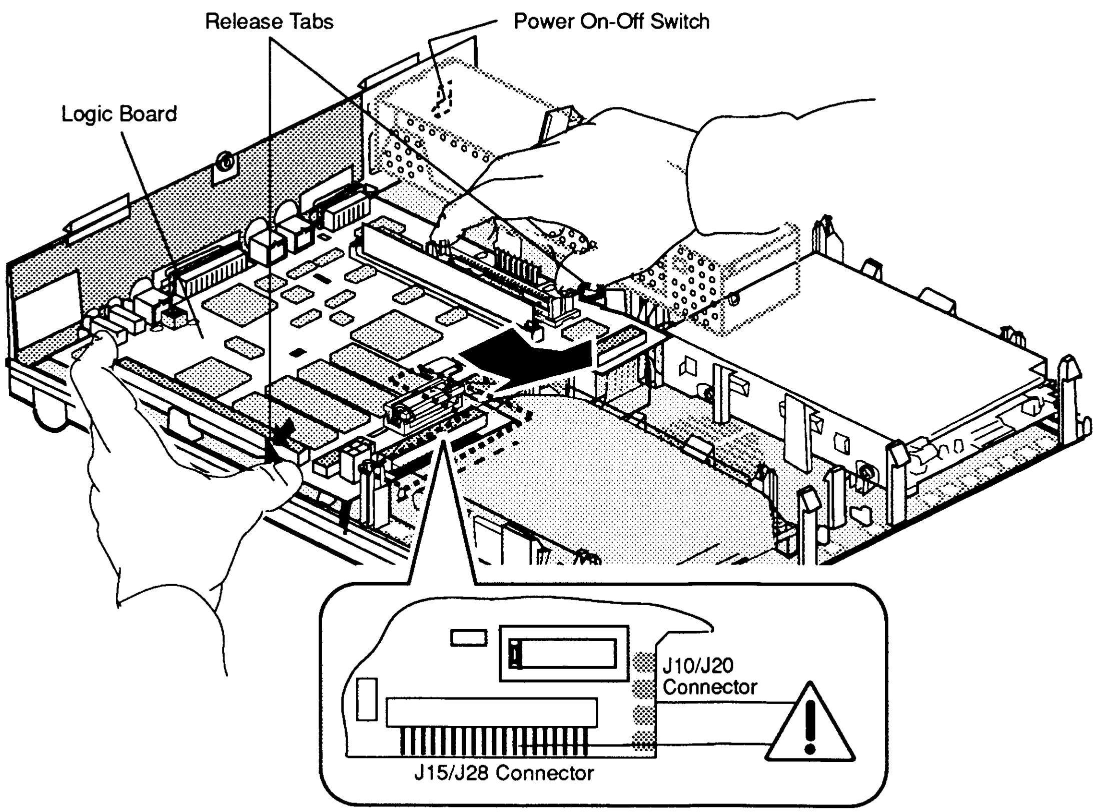


Figure 2-11 Removing the Main Logic Board

❑ MAIN LOGIC BOARD

Materials Required

SIMM removal tool

Remove

1. Remove the top cover.

2. Remove the fan/speaker assembly (Macintosh LC only).

3. **Figure 2-10**. Disconnect the following connectors from the logic board:

   - Power supply connector
   - Internal floppy drive connector
   - Fan connector (Macintosh LC II only)
   - Speaker connector (Macintosh LC II only)
   - 50-pin SCSI connector
   - HDA power connector
   - Expansion card (if installed) from the 96-pin processor-direct slot

4. **Figure 2-11**. Use your thumbs to spread the two plastic tabs that secure the logic board to the bottom case. At the same time, use your forefingers to slide the logic board toward the front of the case. (Use the 96-pin expansion connector and the power supply connector to push back the logic board.)

CAUTION: *Be sure the power on/off button clears the rear panel before you lift the logic board out of the case.*

CAUTION: *Because the oil from your skin can be harmful, do not touch the "fingers" of the J28 or J29 connectors on the Macintosh LC* ***(Figure 2-11).***

5. Gently lift the board completely out of the case.

6. Use the SIMM removal tool (see the instructions in "SIMM Removal Tool" under the *You Oughta Know* tab) to remove all DRAM SIMMs and VRAM SIMMs from the logic board. You must install the customer's DRAM SIMMs and VRAM SIMMs on the new logic board. Note the size and number of SIMMs to ensure that the customer receives the same DRAM and VRAM SIMM configuration that he or she brought in.

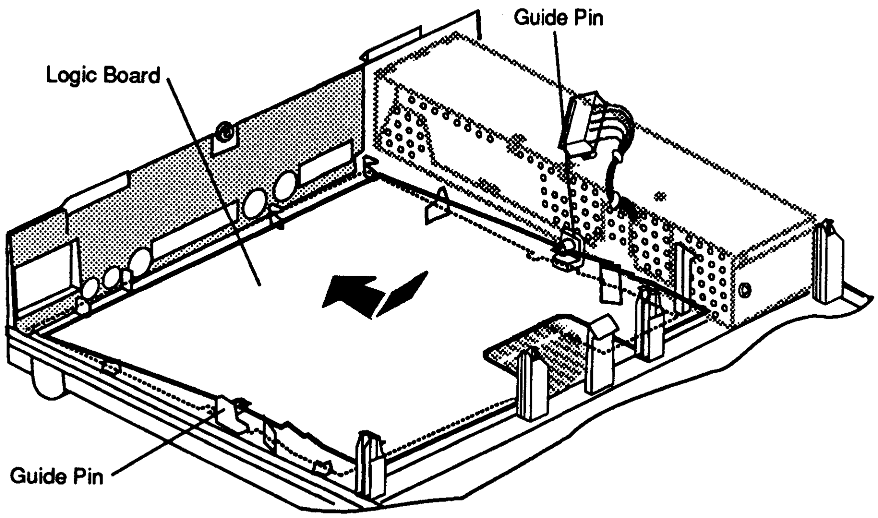


Figure 2-12 Installing the Main Logic Board

Replace

1. Install the customer's DRAM SIMMs and VRAM SIMM onto the replacement logic board.

2. **Figure 2-12**. Insert the logic board into the bottom case so that the round slots in the logic board fit over the plastic guide pins on the bottom of the case.

3. Slide the logic board toward the rear of the case as far as it will go. The board will click into place.

4. **Figure 2-12**. Connect the following connectors to the logic board:

   - Power supply connector
   - Internal floppy drive connector
   - Fan connector (Macintosh LC II only)
   - Speaker connector (Macintosh LC II only)
   - 50-pin SCSI connector
   - HDA power connector
   - Expansion card (if removed) from the 96-pin processor-direct slot

5. Replace the fan/speaker assembly (Macintosh LC only).

6. Replace the top cover.

Macintosh LC and LC II

Section 3 – Diagnostics

❑ CONTENTS

Because the Macintosh IIfx, Macintosh IIsi, and Macintosh LC computers use the same diagnostics application (*MacTest MP*), diagnostics procedures for these products are in the *Macintosh Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures.*

Note: There are no diagnostics currently available for the Macintosh LC II.

Apple Technical Procedures

Macintosh LC and LC II

Section 4 – Troubleshooting

❑ CONTENTS

❑ INTRODUCTION

General Information

The following two disks test modules of the Macintosh LC and/or Macintosh LC II:

- *MacTest MP*, version 1.1 or later (Macintosh LC computer only)
- *Macintosh Hard Disk Test* (test hard disks on the Macintosh LC or LC II computers)

Use this section to troubleshoot the Macintosh LC and LC II. If you are troubleshooting the Macintosh LC and are unable to boot the *MacTest MP* disk or if the disk is unable to detect a module failure, use this section instead of *MacTest MP*. After you repair a Macintosh LC system, run *MacTest MP* again to verify system operation.

Before You Start

Read the subsections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "DRAM SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information in these subsections to troubleshoot the CPU effectively.

Error Chords

When you switch on the Macintosh LC or LC II, the unit executes a ROM-based self-test. If any part of the self-test fails, a sequence of chords follows the initial startup chord. To interpret this sequence of chords, refer to "Startup and Error Chords."

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you go to the next action.

If the symptoms displayed by the Macintosh LC or LC II are not in the symptom chart, or if the system does not have a clearly defined problem, refer to "Troubleshooting Flowcharts."

Note: When using the AppleColor High-Res RGB Monitor with the Macintosh LC or LC II, the width of the raster/image area shrinks 3/16 inch from each side of the screen. To correct this problem, adjust the horizontal size of the monitor (see the *High-Res RGB Monitor Technical Procedures*).

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh LC. Only Flowcharts 1 and 3 pertain to the Macintosh LC II, however. Begin with Flowchart 1 and continue until you complete Flowchart 5. Reference notes on the opposite page provide additional instructions or referrals to other procedures.

Follow each flowchart from top to bottom. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go to the next action.**

❑ THINGS TO REMEMBER

1. When working on the CPU, follow all electrostatic discharge (ESD) precautions. For additional information refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

2. If available, use a known-good monitor and monitor cable to isolate the problem to the CPU, internal drive, keyboard, or mouse.

3. Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

4. Before you begin troubleshooting, remove the expansion card (if installed) and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

After the CPU has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding other devices. Repeat the install-and-test process until all devices have been installed and tested.

5. When troubleshooting the Macintosh LC, use a known-good copy of the *MacTest MP* disk.

6. Perform the following quick checks:

   - Check the power source and power connection.
   - Check all cables and cable connections.
   - Check the adjustment of all user controls.
   - Check that no more than one system file is on the startup device/disk.
   - Check that the computer system and the system software are compatible.
   - Open the computer and verify that all circuit boards, fuses, and chips are secure, clean, and undamaged.

7. During a normal startup sequence, a medium-pitched soft chord sounds. If you do not hear the chord, refer to "Startup and Error Chords" for additional information.

8. To ensure that customers receive the same system configurations they bring in, record:

   - Type and number of floppy drives
   - Size of SCSI drive (if present)
   - Number and size of DRAM SIMMs
   - Amount of video RAM
   - Type and serial number of expansion card

9. Verify that Macintosh LC customers are using system software version 6.0.7 and Finder 6.1 or later and that Macintosh LC II customers are using system software version 7.01 and Finder 7.0 or later. Using earlier versions may destroy data or prevent the CPU from booting.

❑ MODULE EXCHANGE INFORMATION

Logic Board Configuration

Apple ships the Macintosh LC logic board service exchange module without DRAM SIMMs and without the video RAM (VRAM) SIMM. To make sure that customers always receive the same logic board configurations they brought in, be sure to record the amount of memory installed and the size of the DRAM SIMMs, and record the amount of VRAM on the VRAM SIMM if installed.

All Macintosh LC and LC II logic boards ship with ROM memory. This memory is soldered onto the board at the locations marked **UB2/LL**, **UC2/ML**, **UD2/MH**, and **UE2/HH** (between the 96-pin expansion connector and the SIMM slots). When you return a defective logic board, return it with the ROM, but without the DRAM and VRAM SIMMs.

Internal SCSI Hard Drive

Internal SCSI hard drive service modules do not include SCSI cables or SCSI power cables. These cables are sold as separate replacement parts.

You must detach the SCSI cable and the SCSI power cable from the customer's defective drive and install them on the replacement drive. Be sure to keep these cables with the customer's system.

❑ STARTUP AND ERROR CHORDS

Introduction

When the computer is switched on, the ROM executes a self-test. If any part of the self-test fails, a special sequence of chords will sound, as explained below.

If you are unable to interpret the chords using the following explanation, see "Macintosh LC Flowcharts" and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is the only sound emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord **and** additional chords sound, a failure occurred during the initial hardware self-tests.

Macintosh LC: After the startup chord you will hear a short, harsh error chord, followed closely by the test monitor chord sequence (four chords, from low to high). Following these chords, a blank gray screen usually appears (see DRAM SIMM Failure).

Macintosh LC II: After the startup chord you will hear a multi-tone error chord. Depending upon the type of failure, this chord will be either an eight-tone chord (see DRAM SIMM Failure) or a four-tone chord (see Hardware Failure).

DRAM SIMM Failure

To correct a DRAM SIMM failure:

1. Exchange the DRAM SIMMs. (Refer to "DRAM SIMM Verification" in this section for complete instructions.)

2. If DRAM SIMM exchanges do not work, exchange the logic board. (Install the customer's DRAM SIMMs on the exchange board.)

3. If the system still does not work, you will need to perform the DRAM SIMM verification with the exchange logic board.

Hardware Failure

To correct a hardware failure:

1. Disconnect the SCSI hard drive power and cable connectors, and reboot the system. If the startup sequence is normal, run *Macintosh Hard Disk Test* and replace the hard drive if necessary.

2. If the error chord(s) still sound at system startup, disconnect the floppy drive cable connector and reboot the system. If the startup sequence is normal, replace the floppy drive.

3. If you still hear the error chord(s) at system startup, exchange the logic board. (Install the customer's DRAM and VRAM SIMMs on the exchange logic board.)

❑ SYMPTOM CHART

Built-In Video Problems	**Solutions**
• *Screen is dark, but audio and at least one drive operate, fan runs, LED is lit, and boot tone is normal*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace existing video RAM SIMM, or if none is present, install a video RAM SIMM. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
• *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Remove expansion cards. 2. Remove all external peripherals. 3. Replace DRAM SIMMs (refer to "DRAM SIMM Verification" in this section). 4. Replace logic board. 5. 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. Make sure a video RAM SIMM is installed. 4. Replace logic board. Retain customer's SIMMs.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. Remove expansion card. 3. Remove all external peripherals. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
• *Vertical or horizontal lines or snow appear on screen, or screen is completely dark, and boot tone is normal*	1. Replace video cable. 2. Replace monitor. 3. Replace existing video RAM SIMM, or if none is present, install a video RAM SIMM. 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply. **Note:** If replacing the monitor corrects the problem, refer to the appropriate *Apple Service Technical Procedures* to obtain monitor replacement information.

Floppy Drive Problems	Solutions
• *Audio and video present, but floppy drive does not operate*	1. Replace floppy drive cable. 2. Replace floppy drive. 3. Replace logic board. Retain customer's SIMMs.
• *Disk ejects; display shows Mac icon with blinking "X"*	1. Replace disk with known-good disk. 2. Replace floppy drive cable. 3. Replace floppy drive. 4. Replace mouse. 5. Replace logic board. Retain customer's SIMMs.
• *Disk will not eject*	1. Switch off system and hold mouse button down while switching on. 2. Try ejecting disk manually with paper clip. 3. Replace floppy drive cable. 4. Replace floppy drive.
• *Drive attempts to eject disk, but doesn't*	1. Try pushing disk completely in. 2. Try ejecting disk manually with paper clip. 3. Check that front lid of case is completely on. 4. Replace floppy drive.

SCSI Problems	Solutions
• *Internal hard drive is continuously active*	1. Make sure system software is version 6.0.7 (or later) for Macintosh LC computer or version 7.01 (or later) for Macintosh LC II computer. 2. Replace internal SCSI cable. 3. Replace internal hard drive. 4. Replace logic board. Retain customer's SIMMs.
• *Internal hard drive will not operate*	1. Replace internal SCSI cable. 2. Replace internal HDA power cable. 3. Replace internal hard drive. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems	**Solutions**
• *Peripheral works with internal or external SCSI device but will not work with both*	1. Verify that SCSI select-level switch on external device is set to a different priority from that of internal device. 2. Verify that both ends of SCSI chain are terminated. 3. Replace terminator on the external device. 4. Verify that terminator is installed on the internal SCSI drive. 5. Replace SCSI device select cable.
• *Cursor does not move*	1. Reboot system. 2. Check mouse connection. 3. If mouse was connected to keyboard, connect the mouse to the rear ADB port instead and disconnect the keyboard. 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.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
• *Cannot double-click to open an application, disk, or server*	1. Remove extra system files on the hard disk. 2. Hold down <Option> <Command> <R> <P> keys at power on. Release keys after second startup chord sounds. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to the rear ADB port instead. 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.
• *No response to any key on the keyboard*	1. Make sure system software is version 6.0.7 (or later) for Macintosh LC computer or version 7.01 (or later) for Macintosh LC II computer. 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 Chooser and Control Panel are set correctly. 2. Make sure system software is version 6.0.7 (or later) for Macintosh LC computer or version 7.01 (or later) for Macintosh LC II computer. 3. Check printer DIP switches. 4. Replace printer interface cable. 5. Replace logic board. Retain customer's SIMMs.
• *Known-good LaserWriter will not print*	1. Make sure Chooser and Control Panel are set correctly. 2. Make sure system software is version 6.0.7 (or later) for Macintosh LC computer or version 7.01 (or later) for Macintosh LC II computer. 3. Refer to the *Networks* tab in the *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *System shuts down intermittently*	1. Make sure air vents on top and sides of top cover are unobstructed. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace SIMMs (refer to "DRAM SIMM Verification" in this section). 5. Replace logic board. Retain customer's SIMMs.
• *System intermittently crashes or locks up*	1. Make sure system software is version 6.0.7 (or later) for Macintosh LC computer, or version 7.01 (or later) for Macintosh LC II. 2. Make sure to use known-good application software. 3. Replace logic board. Retain customer's SIMMs. 4. Replace SIMMs (refer to "DRAM SIMM Verification" in this section). 5. Replace power supply.

• *System intermittently doesn't power on*	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.
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Disconnect hard drive; replace if noise disappears. 3. Replace logic board. Retain customer's SIMMs.
• *No sound from speaker*	1. Verify that volume setting in Control Panel is set to 1 or above. 2. Reseat speaker connector (Macintosh LC II only). 3. Replace speaker. 4. Replace logic board. Retain customer's SIMMs.
• *Clock not running*	1. Replace battery (see "Battery Verification" in this section). 2. Replace logic board. Retain customer's SIMMs.
• *System seems to boot; then message "Finder is old version" displays*	1. Clear parameter RAM by holding down <Command> <Option> <p> <r> keys and restarting the system. Continue holding down these keys. You will hear the normal startup chords and about two seconds later you will hear another chord. This second chord means the parameter RAM has been cleared. 2. Replace logic board. Retain customer's SIMMs.
• *Monitor raster width too narrow*	– If connected monitor is AppleColor High-Res RGB (revision A only), perform width adjustments for the monitor (see *High-Res RGB Monitor Technical Procedures*).
• *System does not recognize more than 10 MB of RAM*	– Refer to "Logic Board RAM Identification and Upgrades" for more information. Note that although you can install 12 MB of RAM in a Macintosh LC II, 10 MB is the maximum amount of RAM the system recognizes.

❑ TROUBLESHOOTING FLOWCHARTS

Introduction

Flowcharts 1 through 5 on the following pages will help you troubleshoot the Macintosh LC; only Flowcharts 1 and 3 apply to the Macintosh LC II. Reference notes on the opposite page provide additional instructions or referrals to other procedures.

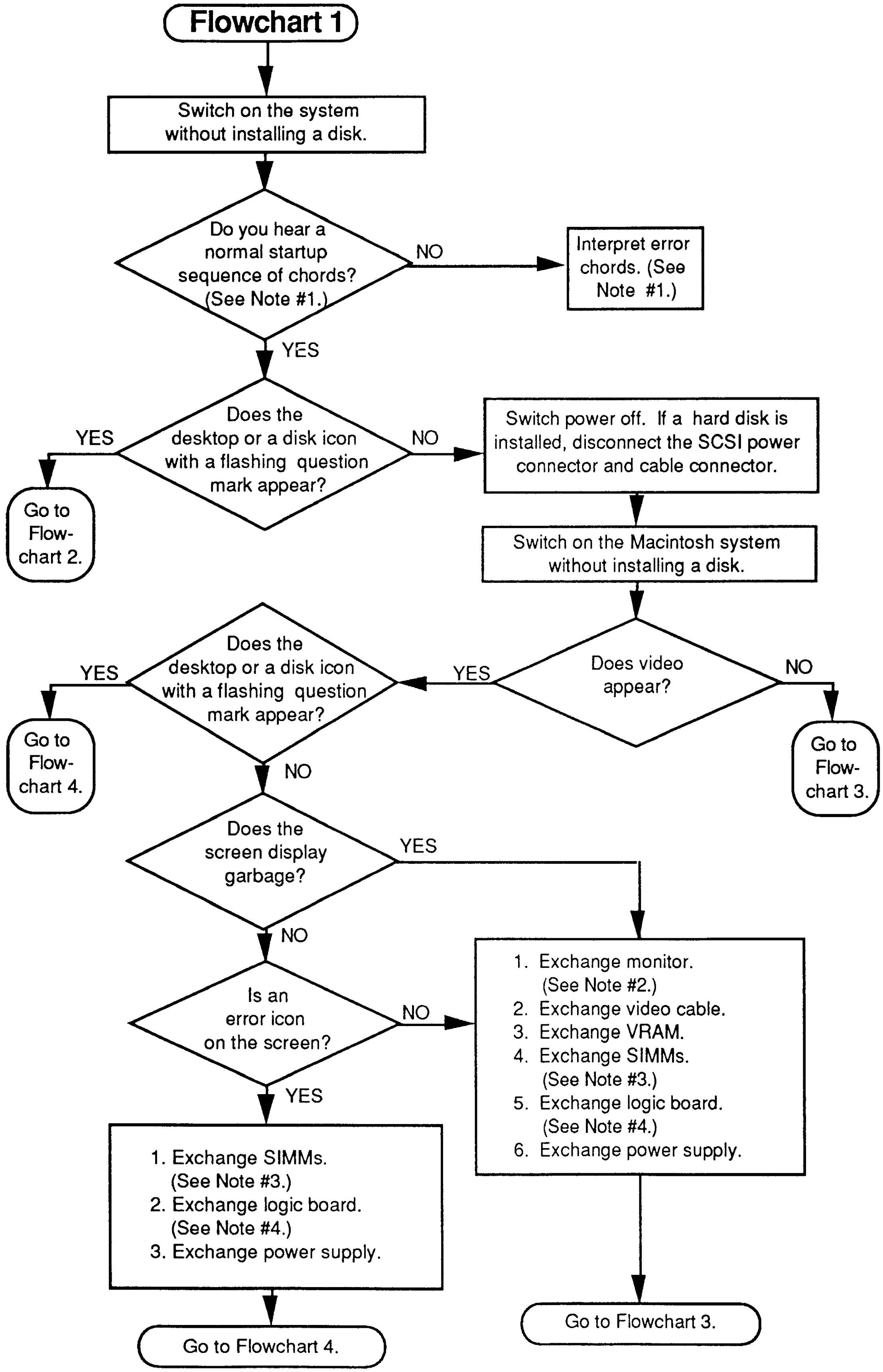
Flowchart 1 Notes (LC or LC II)

1. During a normal startup sequence, you hear a medium-pitched soft chord. If you do not hear this startup chord, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor corrects the problem, refer to the appropriate monitor technical procedures to isolate the monitor problem to the module level.

3. Refer to "DRAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

4. If known-good SIMMs do not correct the problem, install the customer's SIMMs on the replacement logic board.

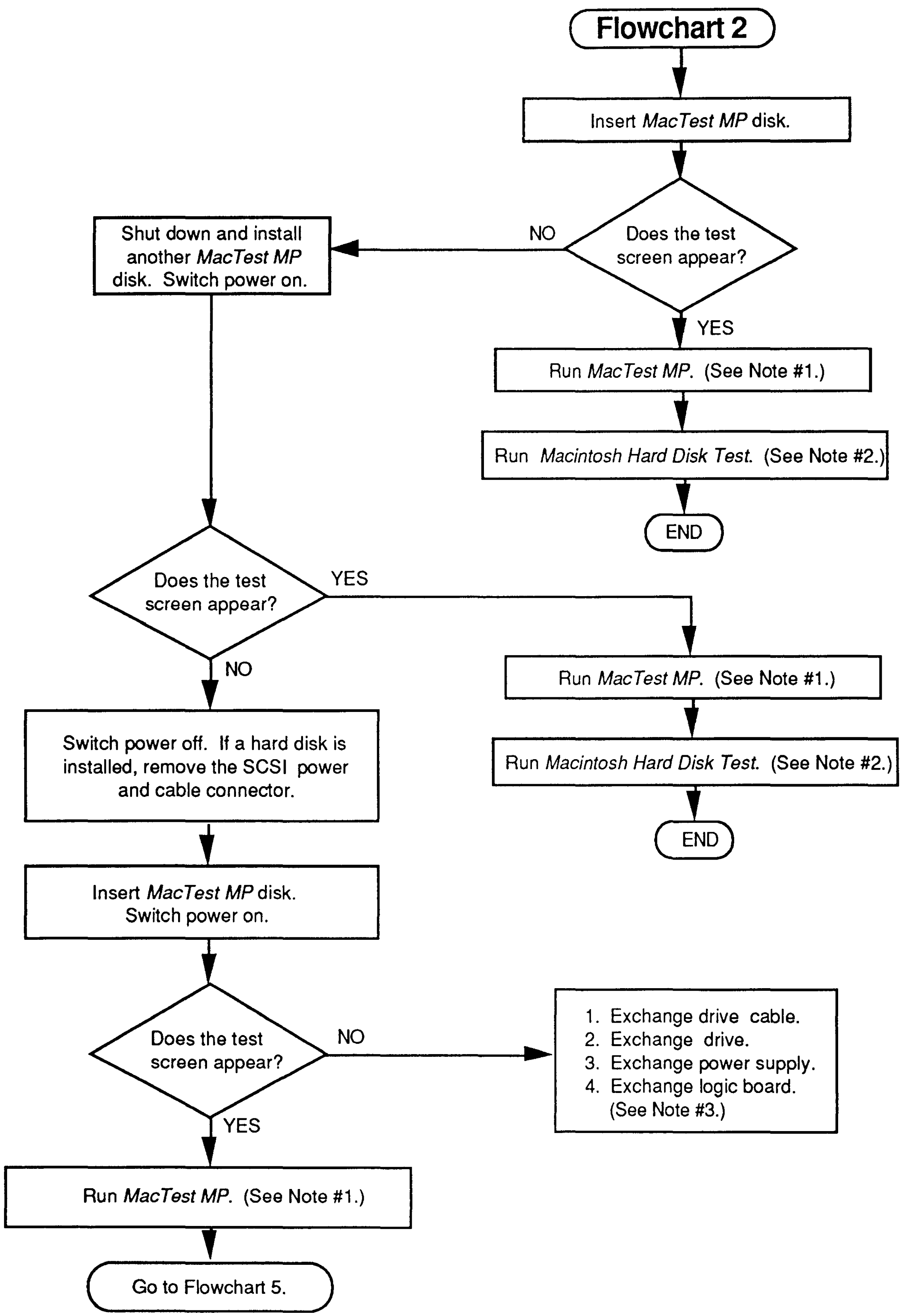

Flowchart 1
Switch on the system without installing a disk.
Do you hear a normal startup sequence of chords? (See Note #1.)
NO
Interpret error chords. (See Note #1.)
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 2.
NO
Switch power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Switch on the Macintosh system without installing a disk.
Does video appear?
NO
Go to Flow-chart 3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 4.
NO
Does the screen display garbage?
YES
NO
Is an error icon on the screen?
NO
1. Exchange monitor. (See Note #2.)
2. Exchange video cable.
3. Exchange VRAM.
4. Exchange SIMMs. (See Note #3.)
5. Exchange logic board. (See Note #4.)
6. Exchange power supply.
Go to Flowchart 3.
YES
1. Exchange SIMMs. (See Note #3.)
2. Exchange logic board. (See Note #4.)
3. Exchange power supply.
Go to Flowchart 4.

Flowchart 2 Notes (LC Only)

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

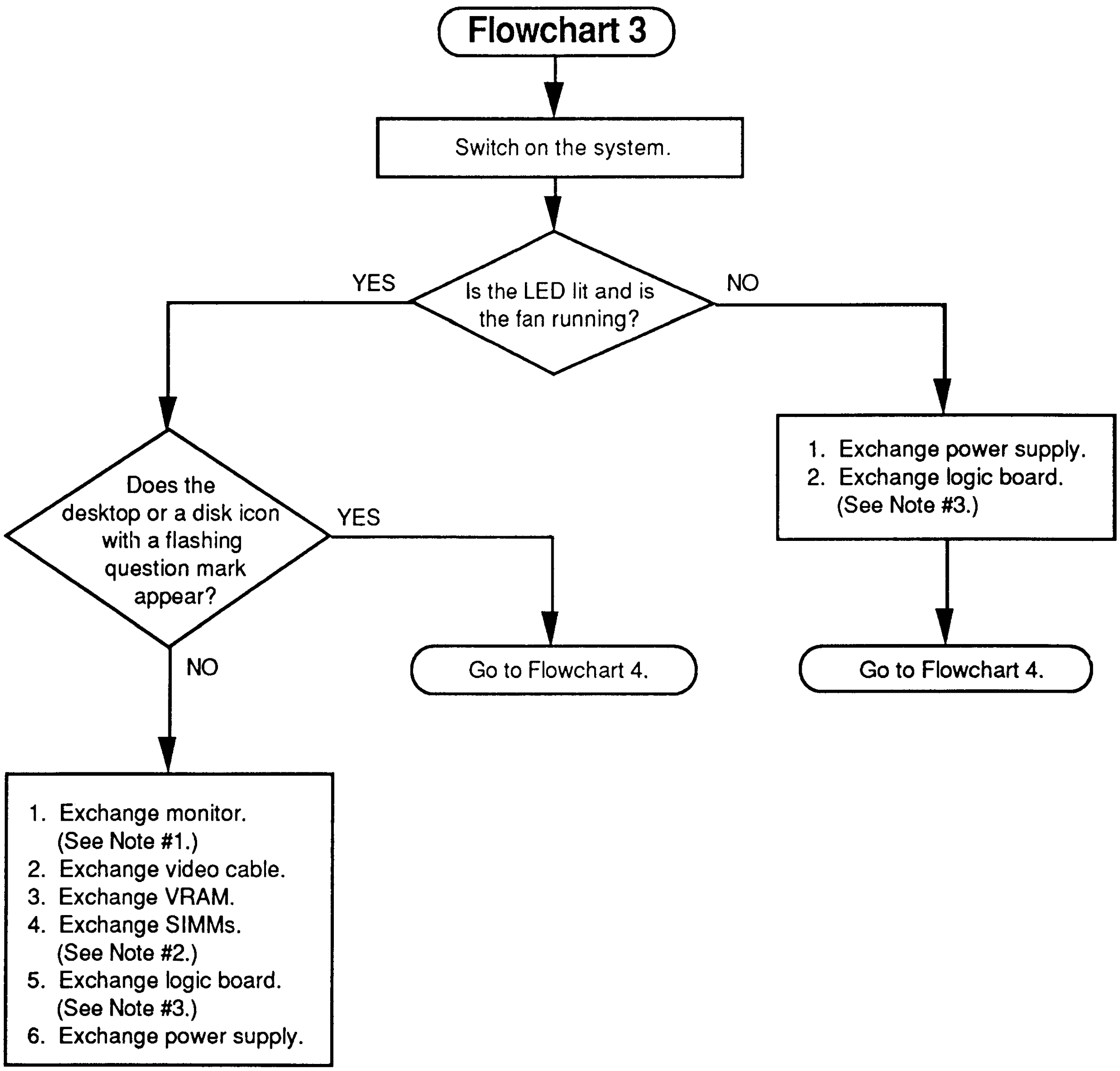

Flowchart 2
Insert MacTest MP disk.
Does the test screen appear?
NO
Shut down and install another MacTest MP disk. Switch power on.
YES
Run MacTest MP. (See Note #1.)
Run Macintosh Hard Disk Test. (See Note #2.)
END
Does the test screen appear?
YES
Run MacTest MP. (See Note #1.)
Run Macintosh Hard Disk Test. (See Note #2.)
END
NO
Switch power off. If a hard disk is installed, remove the SCSI power and cable connector.
Insert MacTest MP disk. Switch power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Run MacTest MP. (See Note #1.)
Go to Flowchart 5.

Flowchart 3 Notes (LC or LC II)

1. If exchanging the monitor corrects the problem, refer to the appropriate monitor technical procedures to isolate the monitor problem to the module level.

2. Refer to "DRAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

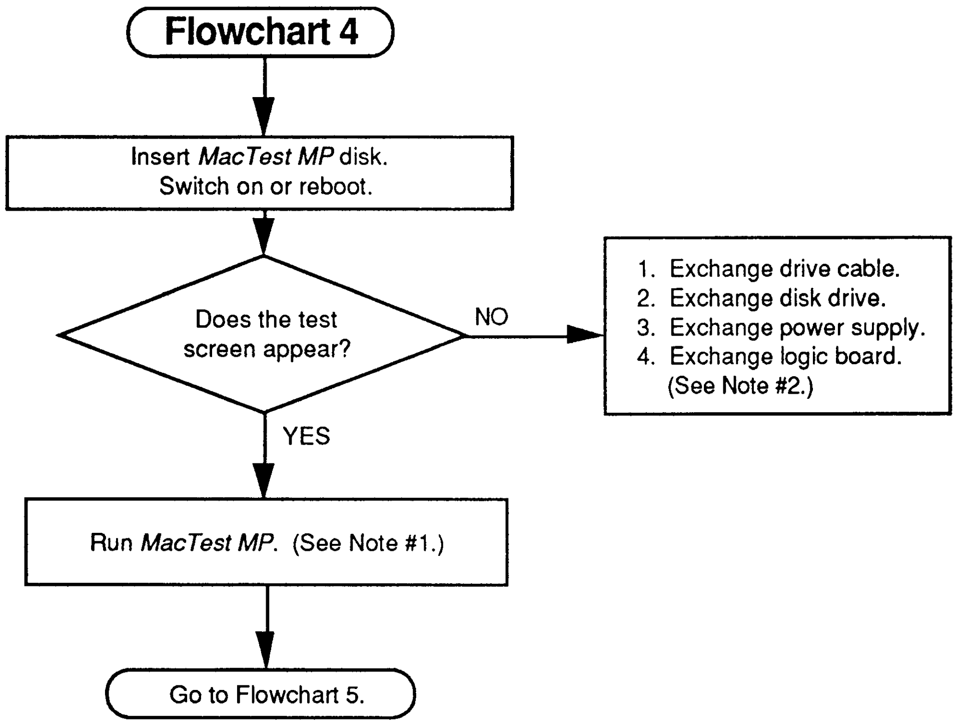
3. Install the customer's SIMMs on the replacement logic board.



Flowchart 4 Notes (LC Only)

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Install the customer's SIMMs on the replacement logic board.



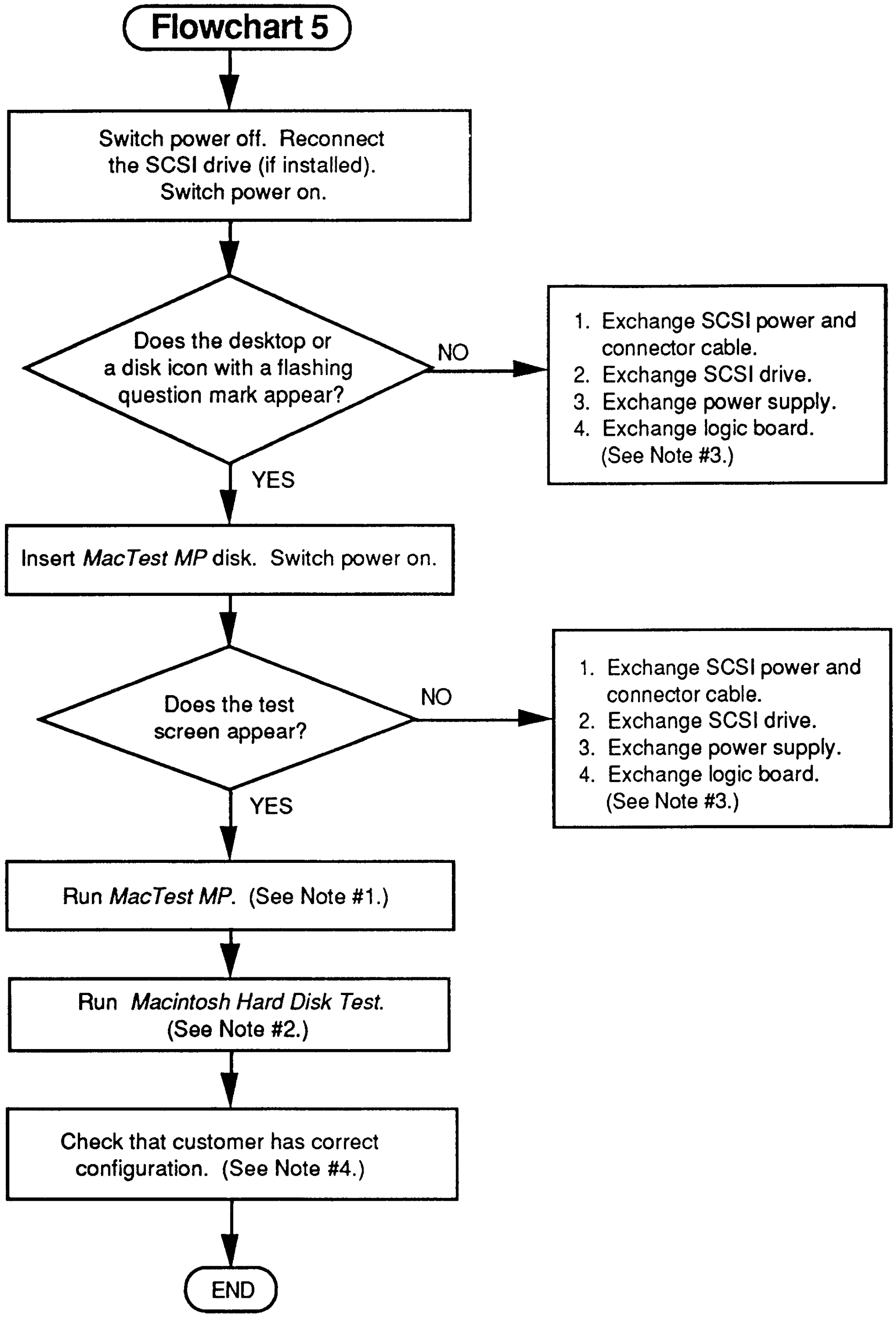
Flowchart 5 Notes (LC Only)

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information" in this section.


Flowchart 5
Switch power off. Reconnect the SCSI drive (if installed). Switch power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Insert *MacTest MP* disk. Switch power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board. (See Note #3.)
YES
Run *MacTest MP*. (See Note #1.)
Run *Macintosh Hard Disk Test.* (See Note #2.)
Check that customer has correct configuration. (See Note #4.)
END

❑ DRAM SIMM VERIFICATION

Introduction

The service exchange logic board ships without DRAM SIMMs.

The DRAM SIMMs on the customer's logic board may be defective. To verify a defective SIMM, remove all the customer's DRAM SIMMs and install known-good SIMMs. Mark each known-good DRAM SIMM with a dot of white correction fluid or a small sticker that will not come off during testing.

Materials Required

Two known-good SIMMs the same size as those on the customer's logic board
SIMM removal tool

Verification Procedure

1. Remove the top case.

CAUTION: *Before removing the SIMMs, be sure to use proper ESD procedures to prevent damage to the logic board. If an ESD pad is not available, touch bare metal on the power supply before proceeding.*

2. Remove the customer's DRAM SIMMs by using the SIMM removal tool. See the *You Oughta Know* tab for SIMM tool use.

3. Install two known-good DRAM SIMMs.

   Note: Use only DRAM SIMMs with 100 ns (or faster) fast-page-mode DRAM chips.

4. Switch on the system. If you hear the normal startup sequence, the system works properly; you can proceed to test the customer's DRAM SIMMs.

5. Switch the system off, remove one of the known-good SIMMs, and install one of the customer's SIMMs.

6. Switch on the system. If you hear the normal startup sequence, the customer's DRAM SIMM is good.

7. Repeat steps 5 and 6 to test the other DRAM SIMMs. Be sure to set defective SIMMs where you will not mix them with good ones.

❑ BATTERY VERIFICATION

Introduction

The Macintosh LC and LC II logic boards each contain one lithium thionyl chloride battery. This battery maintains the clock and PRAM while the unit is switched off.

***WARNING:** Lithium batteries, the type in the Macintosh LC and LC II, have a potential for explosion if improperly handled. Follow the verification procedure exactly.*

Materials Required

Voltmeter

Verification Procedure

1. Be sure power is off. Remove the top case.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (**Figure 4-1**).

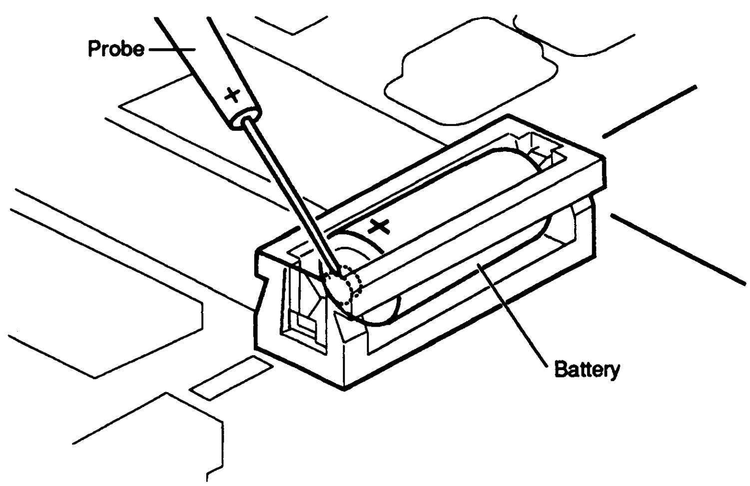


Figure 4-1 Verifying Battery Voltage

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.
5. The reading for a good battery should be **above 3.0 volts**. If the reading falls below 3.0 volts, replace the battery. Refer to Section 5, Additional Procedures, for replacement instructions.

 Apple Technical Procedures

Macintosh LC and LC II

Section 5 – Additional Procedures

❑ CONTENTS

Note: Instructions for underlined steps are in Section 2, Take-Apart.

❑ BATTERY REPLACEMENT

Introduction

Lithium thionyl chloride batteries, the type in the Macintosh LC and LC II, have a potential for explosion or overheating if improperly handled. Take the following precautions when storing, handling, or disposing of lithium batteries:

- Store lithium batteries in a designated, well-marked area with limited access.
- Apple's lithium batteries are sealed in individual air-tight wrappers. Upon receipt, inspect the wrappers for integrity. Store batteries in the same packaging in which they were received or in a similar closed, heavy plastic bag.
- Lithium batteries cannot be recharged. Do not attempt to recharge the battery. Attempts at recharging may cause the battery to overheat or explode.
- Do not allow the leads or terminals to short-circuit. A short-circuited battery may overheat or explode.
- Replace the battery with the correct Apple replacement battery only. Using an incorrect battery or a non-Apple battery may cause the battery to overheat or explode.
- When installing the battery, verify the correct polarity. The polarity markings on the battery must match those on the battery holder or circuit board. Failure to observe correct polarity may cause the battery to overheat or explode.
- If the battery holder has a cover, be sure to replace the cover.
- If the dead battery has leads, remove them before disposing of the battery.
- Do not dispose of the battery in a fire or incinerator—the battery may explode. Instead, follow the disposal instructions on the next page.

- In addition to its explosive potential, lithium is water-reactive and must be disposed of as a hazardous waste, as follows:

  Place the dead battery into the air-tight wrapper and packaging from which you took the replacement battery. Mark the battery package *DEAD* and return it to Apple for proper disposal. Exception: If the battery is physically damaged (for example, it is leaking), do not return it to Apple; dispose of the battery locally according to your local ordinances.

The long-life lithium battery in the Macintosh LC and LC II should serve many years. Refer to Section 4, Troubleshooting, to check the condition of the battery. If the battery fails, replace it according to the following procedure.

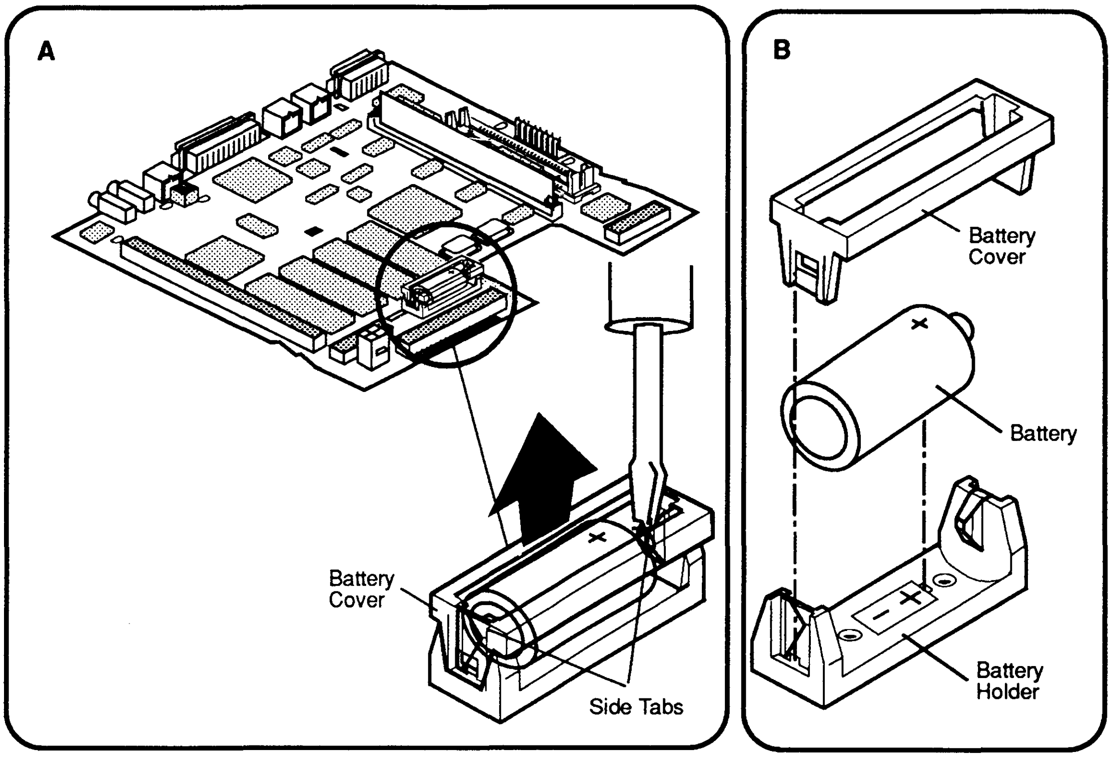


Figure 5-1 Replacing the Battery

Materials Required

Grounded workbench and wriststrap
Small, flat-blade screwdriver

CAUTION: *Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the top cover.
2. **Figure 5-1A**. Locate the battery holder and battery at the center of the logic board.
3. **Figure 5-1A**. On one side of the battery holder, insert a small flat-blade screwdriver into the top of the holder and gently push the screwdriver down until the side tab pushes out. The battery holder cover will come loose; do the same on the other end and remove the cover from the holder.
4. **Figure 5-1B**. Grasp the battery between your thumb and forefinger and lift the battery from the holder.

Replace

1. **Figure 5-1B**. Insert the new battery so the positive side of the battery is in the positive-marked side of the holder.

CAUTION: *Be sure the positive side of the battery is in the correct location (see **Figure 5-1**). An incorrectly placed battery can damage the logic board.*

2. Replace the holder cover.
3. Replace the top cover.
4. Use the Control Panel to set the clock.

Note: On early models of the Macintosh LC, replacing the battery may corrupt the system parameter RAM. To reset the PRAM on these systems, press the red button on the logic board.

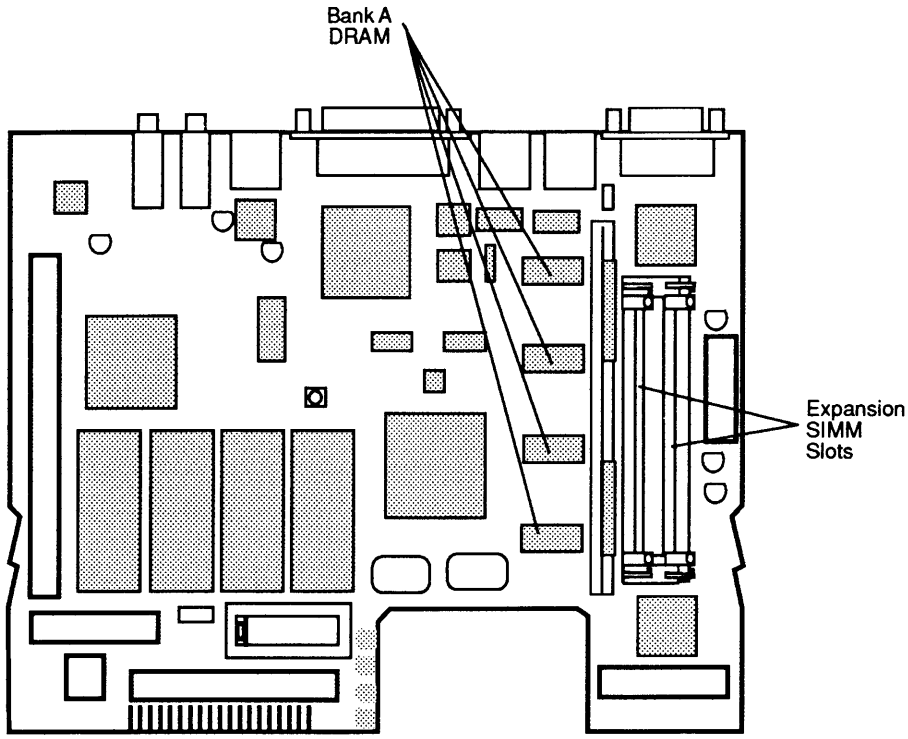


Figure 5-2 DRAM Locations

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

The Macintosh LC contains 2 MB and the Macintosh LC II 4 MB of DRAM soldered on the logic board in bank A (**Figure 5-2**). You can install additional RAM in packages known as single in-line memory modules (SIMMs). A SIMM is a small circuit board with DRAM chips that may be surface-mounted or mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board. The Macintosh LC and LC II each have two SIMM sockets.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Identification

The Macintosh LC and LC II do not support 256K SIMMs; both units require 100 ns (or faster) SIMMs. You can mix SIMMs of different speeds, as long as neither of the SIMMs is slower than 100 ns. Slower SIMMs (120 ns, etc.) will cause serious timing problems. The RAM speed is usually indicated by the -**xx** number after the manufacturer's part number. For example, -8 indicates 80 ns SIMMs.

Note: When you remove SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are under the *You Oughta Know* tab.

Upgrades

The following chart summarizes the memory configurations that the Macintosh LC and LC II support:

LC	LC II	Bank A	SIMM Sockets	Total RAM
✓		2 MB soldered RAM	Empty	2 MB
✓		2 MB soldered RAM	Two 1 MB SIMMs	4 MB
✓		2 MB soldered RAM	Two 2 MB SIMMs	6 MB
✓		2 MB soldered RAM	Two 4 MB SIMMs	10 MB
	✓	4 MB soldered RAM	Empty	4 MB
	✓	4 MB soldered RAM	Two 1 MB SIMMs	6 MB
	✓	4 MB soldered RAM	Two 2 MB SIMMs	8 MB
	✓	4 MB soldered RAM	Two 4 MB SIMMs	10 MB*

*The maximum amount of DRAM that the Macintosh LC II can utilize is 10 MB.

CAUTION: *Other configurations, such as a single SIMM or a pair of different-size SIMMs, will not function correctly.*

❑ VIDEO RAM (VRAM) UPGRADE

Introduction

Figure 5-3. The Macintosh LC and LC II computers are available in 256K or 512K VRAM (video RAM) configurations. Customers with 256K of VRAM can upgrade their computers to 512K of VRAM (see the chart below). Perform this upgrade by swapping VRAM SIMM boards in the 68-pin SIMM socket on the logic board.

Monitor	Display	VRAM	Depth	Shades Colors
12-Inch Monochrome	640x480	256K 512K	4 bits/pixel 8 bits/pixel	16 256
Hi-Res Monochrome	640x480	256K 512K	4 bits/pixel 8 bits/pixel	16 256
Hi-Res RGB	640x480	256K 512K	4 bits/pixel 8 bits/pixel	16 256
12-Inch RGB	512x384	256K 512K	8 bits/pixel 16 bits/pixel	256 32,768

***CAUTION:** SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Upgrades

Note: Use the SIMM removal tool to remove VRAM SIMMs from the logic board. Instructions for using this tool are in the *You Oughta Know* tab.

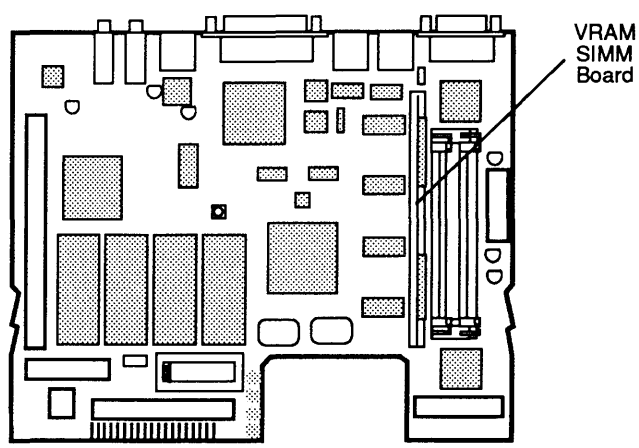


Figure 5-3 Location of VRAM SIMM

❑ MACINTOSH LC II UPGRADE

Introduction

Use a Macintosh LC II upgrade kit to upgrade a Macintosh LC to a Macintosh LC II. The upgrade kit includes the following items:

- Macintosh LC II logic board
- Macintosh LC II top case

Upgrade Procedure

To upgrade a Macintosh LC, remove the LC fan/speaker assembly and logic board. Install the LC II logic board, and replace the fan/speaker assembly. Replace the Macintosh LC top case with the LC II top case.

Refer to Section 2, Take-Apart, for instructions on how to replace the main logic board and fan/speaker assembly.

CAUTION: *Take care that the connections to the sound-out and sound input ports are correct. Inserting equipment into the wrong port could damage the computer or equipment.*

Apple Technical Procedures

Macintosh LC and LC II

Illustrated Parts List

❑ CONTENTS

Note: The figures and lists in this section include all piece parts available from Apple for the Macintosh LC and LC II computers, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

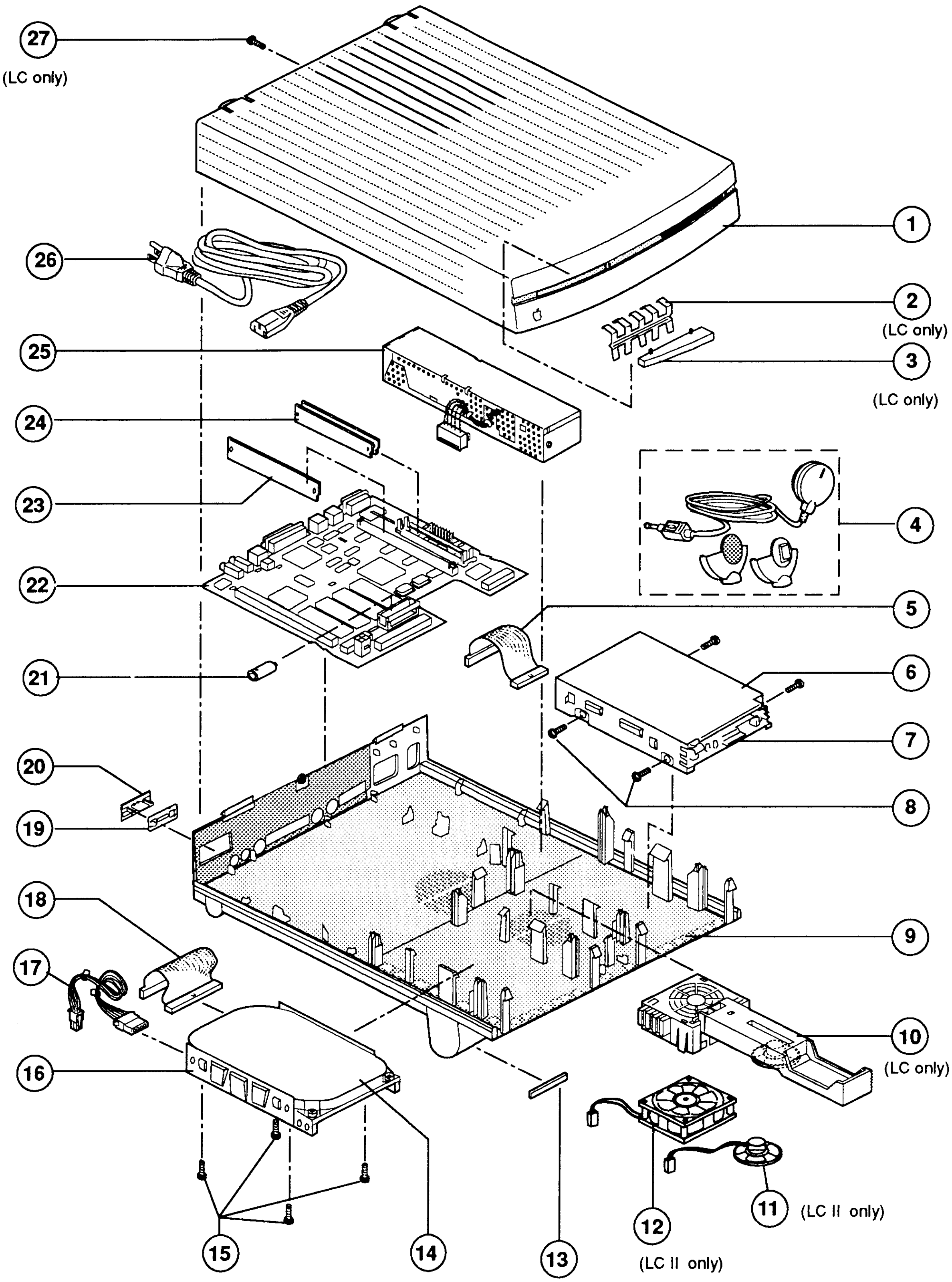


Figure 1 Macintosh LC and LC II – System Exploded View

❑ MACINTOSH LC and LC II – SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
–	602-0164	Service Packaging, HDA, 3.5-inch, half-height (replaced by 602-0282 or 602-0308)
–	602-0308	Service Packaging, HDA, 3.5-inch, 1-inch-height, without carrier (also used for 19 mm floppy drive)
1	630-0505	Top Case (Macintosh LC)
	630-0507	Top Case (Macintosh LC or LC II)
2	805-1527	Disk Drive Slot Cover Shield (Macintosh LC)
3	815-1164	Disk Drive Slot Cover (Macintosh LC)
4	699-5071	Microphone Assembly
5	590-0524	Cable, Internal Floppy Drive
6	805-5111	Carrier, Internal Floppy Drive (Macintosh LC)
	805-0961	Carrier, Internal Floppy Drive (Macintosh LC II)
7	661-0474	1.4 MB Mechanism, Apple SuperDrive
8	844-0018	Screw, SuperDrive Carrier to SuperDrive
9	630-0500	Bottom Case (Macintosh LC)
	630-0501	Bottom Case (Macintosh LC II)
10	630-5058	Speaker/Fan Assembly (Macintosh LC)
11	609-0003	Speaker (Macintosh LC II)
12	600-0193	Fan (Macintosh LC II)
13	865-0066	Platinum Foot
14	661-0614	HDA, Internal 3.5-inch SCSI, 1-inch-height, 40 MB
15	444-6104	Screw, 6-32 x .250 (HDA carrier to HDA)
16	805-0980	Carrier, HDA, Internal 3.5-inch SCSI
17	590-0303	Cable, Internal HDA Power
18	590-0228	Cable, Internal HDA
19	805-0137	Rear Case Access Cover Shield
20	815-1154	Rear Case Access Cover
21	742-0011	Lithium Battery (without leads)
22	661-0593	Logic Board, 2 MB RAM (Macintosh LC)
	661-0729	Logic Board, 4 MB RAM (Macintosh LC II)
23	661-0609	VRAM SIMM, 256K, 100 ns
	661-0649	VRAM SIMM, 512K, 100 ns
24	661-0520	DRAM SIMM, 1 MB, SOJ, 80 ns
	661-0643	DRAM SIMM, 2 MB, SOJ, 80 ns
	661-0719	DRAM SIMM, 1 MB, SOJ, 80 ns
25	661-0594	Power Supply
26	590-0380	Cable, AC Power, 110 V (smoke)
27	430-1031	Screw, Cover (Macintosh LC)

 Apple Technical Procedures

Macintosh IIsi

Technical Procedures

❑ TABLE OF CONTENTS

Section 3 – Diagnostics

Refer to the MacTest MP section under the*Macintosh Multiple-Product Diagnostics* tab in the Macintosh Family *Apple Service Technical Procedures.*

Section 4 – Troubleshooting

Section 5 – Additional Procedures

Illustrated Parts List

Apple Technical Procedures

Macintosh IIsi

Section 1 – Basics

❏ CONTENTS

❑ PRODUCT DESCRIPTION

Features

The Macintosh® IIsi is a high-performance, open-architecture Macintosh computer with the following features:

- 68030 microprocessor
- Runs at 20 MHz
- Built-in video support (up to eight-bit)
- 512K of ROM
- 2 MB RAM, upgradeable to 17 MB
- Sound input and output capabilities
- A unique expansion slot that can be configured as either a NuBus™ slot or an 030 Direct Slot
- An optional floating-point math coprocessor
- A locking power switch

Macintosh IIsi Configurations

The Macintosh IIsi comes in two configurations:

- 2 MB of RAM, one Apple® FDHD™/SuperDrive™, and one 40 MB hard drive

- 5 MB of RAM, one Apple FDHD/SuperDrive, and one 80 MB hard drive

Enhancements

The following enhancements can be added:

- Up to six external SCSI drives and either the 800K, 3.5-inch disk drive or the 1.4 MB FDHD/SuperDrive (The Macintosh IIsi does not support 400K drives and requires the HD20 driver to support the HD20.)

- Apple® low-profile, 3.5-inch internal SCSI hard disk drive with 40 or 80 MB

❑ CONNECTOR IDENTIFICATION

Back Panel

The back panel of the Macintosh IIsi has the following built-in ports and connectors (see **Figure 1-1**).

- AC power connector
- Switched (courtesy) monitor connector
- Expansion slot for either a NuBus card or an 030 Direct Slot card
- Apple Desktop Bus™
- External disk drive port
- Video port
- SCSI port
- Serial port 1
- Serial port 2
- Stereo sound-out port
- Sound input port
- Locking power switch
- Security lock

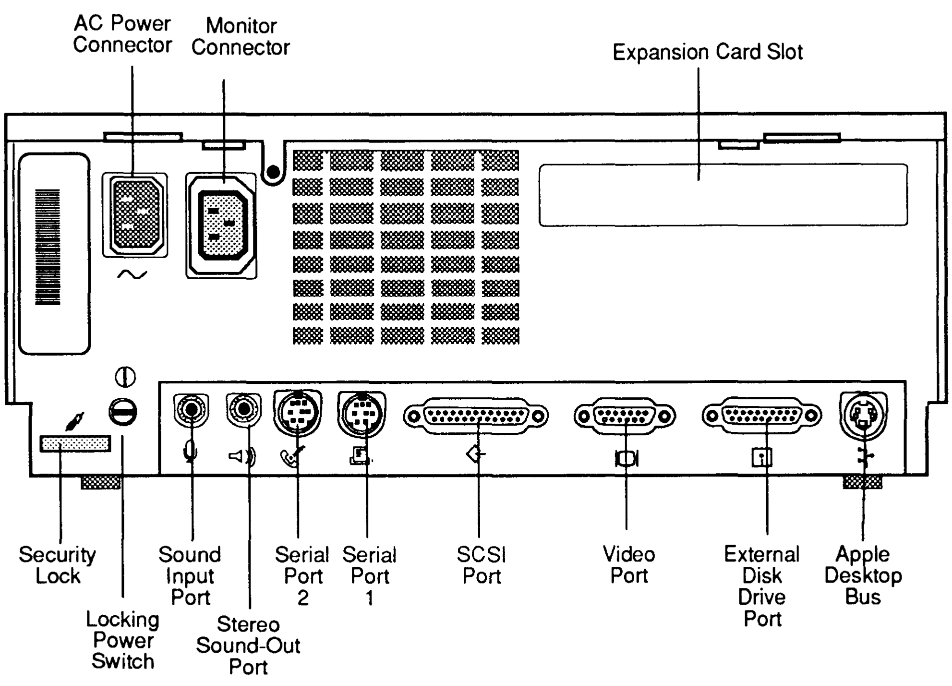


Figure 1-1 Back Panel

Internal Connectors

The Macintosh IIsi logic board has the following connectors and jumpers (see **Figure 1-2**):

- Expansion slot connector
- ROM SIMM connector
- Four RAM SIMM connectors
- Battery
- Fan connector
- Power supply connector for the logic board
- ROM jumper
- Internal disk drive connector
- Internal SCSI connector
- Speaker/LED connector
- Power connector for internal SCSI hard drive

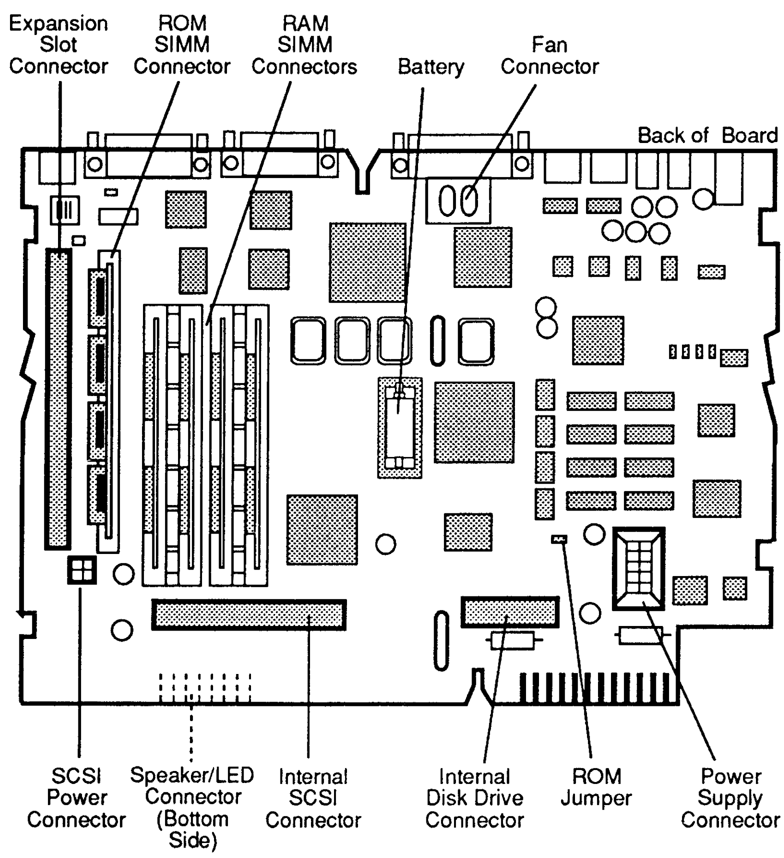


Figure 1-2 Logic Board

❑ MODULE IDENTIFICATION

Figure 1-3 shows the major modules of the Macintosh IIsi.

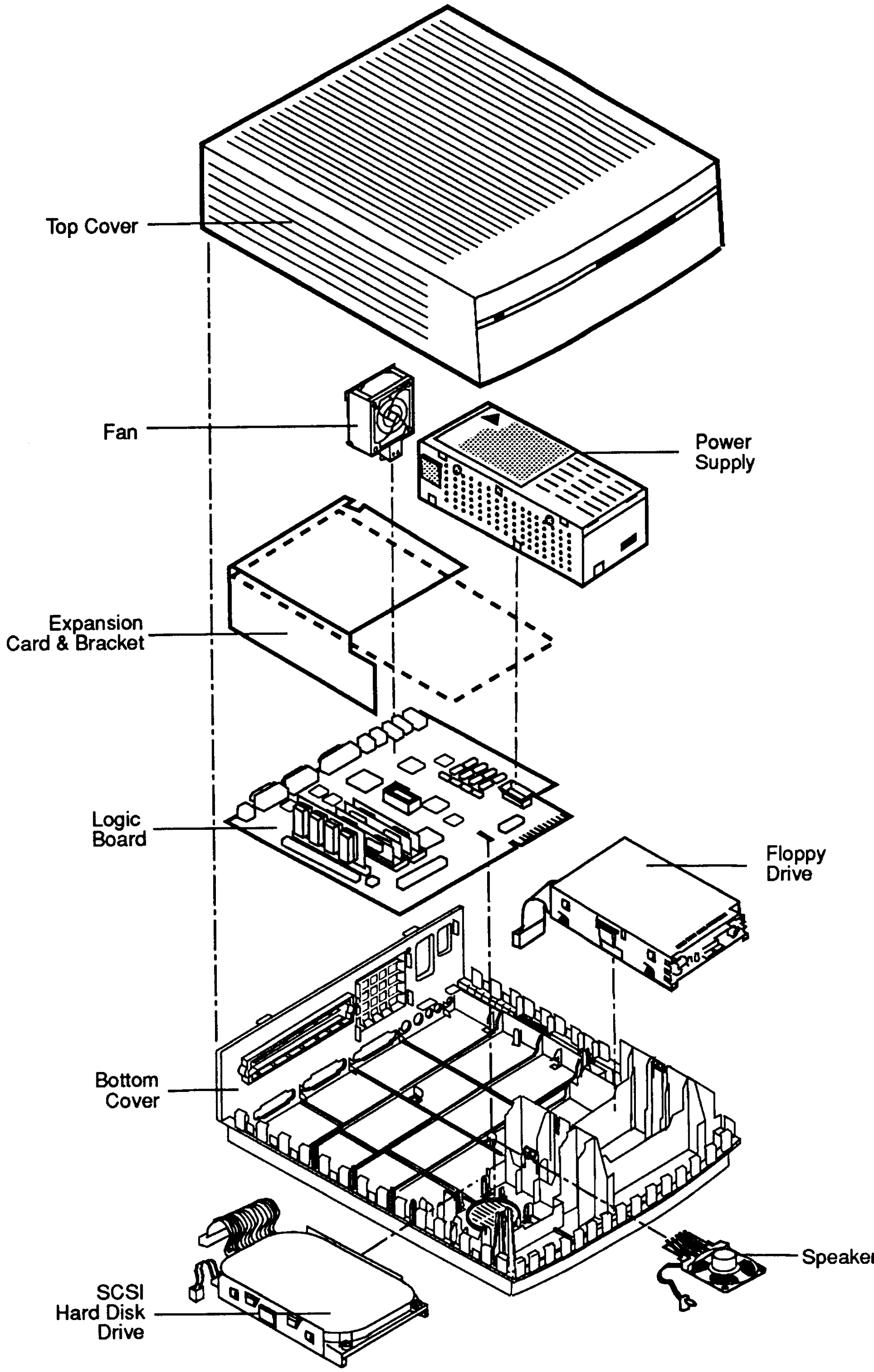


Figure 1-3 Modules

❑ MACINTOSH IIsi SYSTEM FEATURES

The Macintosh IIsi includes the following components:

- Motorola 68030 microprocessor running at 20 MHz
- 512K of ROM
- RBV (RAM-based video chip)
- MDU (memory decode unit)
- An optional adapter card for installing a NuBus card or an 030 Direct Slot card

Macintosh IIsi Logic Board

At the heart of the Macintosh IIsi is the Motorola 68030 microprocessor (**Figure 1-4**). The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 16- and 24-bit Macintosh microprocessors. This high-performance microprocessor runs at 20 MHz and is designed to handle paged memory management, thereby eliminating the HMMU (or PMMU). With this increased speed, and by taking advantage of the 68030 burst access capability (which enables the CPU to read groups of instructions or data in fewer clock cycles than in normal access mode), the Macintosh IIsi is a very high performance system.

The ROM on the Macintosh IIsi logic board includes code that supports the built-in video, parity, virtual memory (used on A/UX® systems), and 32-bit QuickDraw™. The code supports future upgrades to the Macintosh operating system.

The Macintosh IIsi has two possible locations for the ROM—two ROM chips that are soldered to the logic board or a ROM SIMM in a connector on the logic board (**Figure 1-4**). If a ROM jumper is not installed, the computer uses the ROM on the two soldered chips; if a ROM jumper is installed, the computer uses the ROM on the ROM SIMM. (However, if a ROM jumper is installed and no ROM SIMM is present, the computer defaults back to the ROM on the two chips.)

Having the RBV (RAM-based video) chip on the logic board enables the Macintosh IIsi to drive a 640 x 480 screen at up to 8 bits/pixel and a 640 x 870 screen at up to 4 bits/pixel without the need for a video card. The chip uses a section of the RAM as a screen frame and retrieves the video data, which is then converted for display by a video DAC (digital-to-analog converter) and sent out through the DB-15 video port.

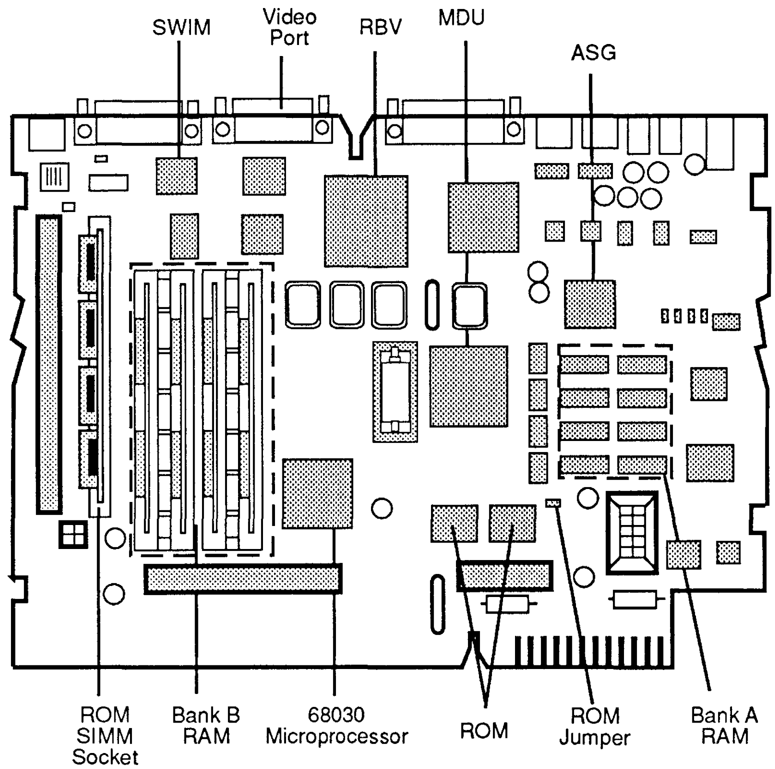


Figure 1-4 Logic Board

The MDU (memory decode unit) decodes device selection for the physical address map, and addresses both banks of RAM memory. This chip allows larger amounts of memory to be installed in bank B.

The SWIM chip enables the Apple FDHD drive to read and write GCR (group-coded recording) and MFM (modified frequency modulation) data formats.

Apple FDHD/ SuperDrive

The Apple FDHD/SuperDrive is a high-density (1.4 MB), 3.5-inch disk drive. In addition to high-capacity data storage, the Apple FDHD/SuperDrive provides data exchangeability between Apple (GCR data format) and MS-DOS (MFM data format) systems. The Apple FDHD/SuperDrive is also fully backward-compatible with the current 800K disk format.

Identification

The Apple FDHD/SuperDrive is the only internal drive supported by the Macintosh IIsi. If you suspect that an 800K drive has been installed internally, you can tell by removing the top lid and locating the microswitches (**Figure 1-5**) at the front of the drive. The Apple FDHD/SuperDrive has three microswitches; the 800K drive has only two microswitches.

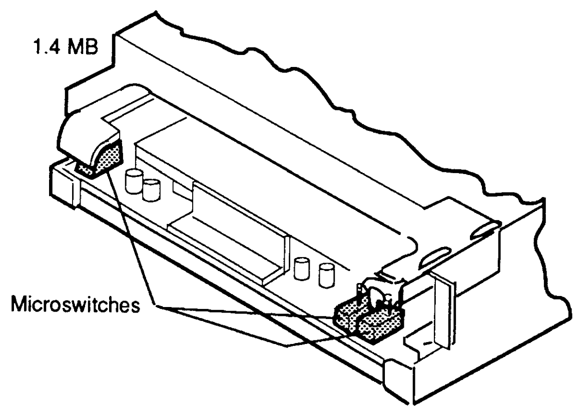


Figure 1-5 Floppy Drive Identification

You can also identify an Apple FDHD/SuperDrive by removing it from the Macintosh IIsi and checking the manufacturer's label (**Figure 1-6**) on the bottom of the drive: all high-density drives have the note *2MB* on the label.

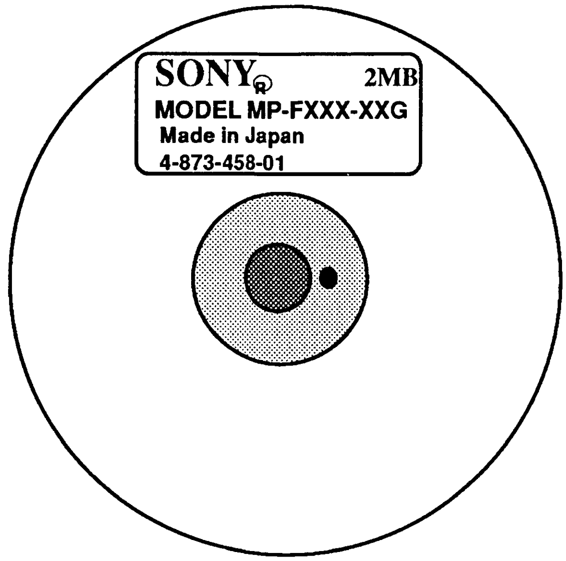


Figure 1-6 FDHD/SuperDrive Label

High-Density

The Apple FDHD/SuperDrive can read, write, and format 800K media data disks. However, special high-density, 3.5-inch disks that take full advantage of the increased capacity of the Apple FDHD/SuperDrive are also available.

***CAUTION:** High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

As shown in the drive-and-media compatibility matrix (**Figure 1-7**), 800K drives can read, write, and format single- and double-sided media. However, Apple does not recommend using high-density media in 800K disk drives. Data saved to high-density media using 800K drives is unreliable and could be lost later. The Apple FDHD/SuperDrive can read, write, and format single-sided, double-sided, and high-density media. In addition, Apple FDHD/SuperDrives can read, write, and format 720K and 1.4 MB double-sided MFM-format media.

DRIVE	MEDIA	MEDIA FORMAT			
		400K (GCR)	800K (GCR)	720K (MFM)	1.4 MB (MFM)
800K	Single-Sided	R/W/F	NR	X	X
800K	Double-Sided	R/W/F	R/W/F	X	X
800K	High-Density	NR	NR	X	X
FDHD	Single-Sided	R/W/F	NR	X	X
FDHD	Double-Sided	R/W/F	R/W/F	R/W/F	X
FDHD	High-Density	X	X	X	R/W/F

NR = Not Recommended
R = Read
W = Write
F = Format
X = Not Allowed

Figure 1-7 Drive/Media Compatibility Matrix

Note: To help understand drive and media format compatibility, think in terms of the drive/media of lowest capacity. For example, if your system has both an external 800K drive and an Apple FDHD/SuperDrive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

❑ SPECIFICATIONS

Processor	MC68030 processor: 32-bit architecture with 256K data and instructional caches supporting burst reads
Clock Frequency	20 MHz
Addressing	32-bit internal registers 32-bit address bus Supports paged memory management
Coprocessor	20 MHz MC68882 floating-point unit (FPU) included on the optional adapter card
Memory	512K on a ROM SIMM 2 MB RAM, expandable to 17 MB 256 bytes of parameter memory
Slot Expansion	One slot for either a NuBus or an 030 Direct Slot card Power available (15 watts maximum) +5 V 2.000 Amp +12 V .175 Amp -12 V .150 Amp
Sound	Apple Sound Chip (ASC), including: • Four-voice wave table synthesis • Stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment • Sound input capability
Disk Drives	Internal SCSI hard disk Internal Apple 1.4 MB, FDHD/SuperDrive Up to six external SCSI drives One external floppy drive (800K drive or FDHD/SuperDrive; does not support 400K drive)

SCSI	One external SCSI port (DB-25)
Serial Ports	Two RS-422/RS-232/AppleTalk® serial ports (mini DIN-8)
Video Display	Built-in video support with external video port to support Macintosh 12-Inch RGB Display, Apple High-Resolution Monochrome Monitor, AppleColor™ High-Resolution RGB Monitor, Macintosh Portrait Display, and Macintosh 12-Inch Monochrome Display
Keyboard	Apple Keyboard, Apple Keyboard II, or Apple Extended Keyboard connected through Apple Desktop Bus ports (Mini DIN-4)
Mouse	Apple Desktop Bus mouse (Mini DIN-4)
Input Power	100 to 240 volts AC RMS automatically configured 50–60 Hz single phase 130 watts maximum, not including monitor convenience power connector load
System Output Power	Output receptacle: 100-240 volts AC, RMS (determined by actual input voltage) DC power: 47 watts maximum
Clock/Calendar	CMOS custom chip with long-life lithium battery
Operating Temperature	10° C to 40° C 50° F to 104° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 ft)

❑ THEORY OF OPERATION

Introduction

The Macintosh IIsi computer is made up of three basic modules: the logic board, the power supply, and the disk drives. The computer can have one internal floppy disk drive, one internal SCSI hard disk drive, up to six external SCSI devices (drives, scanners, etc.), and one external floppy disk drive.

The information here will give you an understanding of how the Macintosh IIsi works. This understanding, in turn, will assist you in performing logical troubleshooting on this system.

Figure 1-8 shows a block diagram of the Macintosh IIsi.

System Startup

When the computer is turned on, the system begins a carefully synchronized sequence of events. The software determines the memory size and compiles a table describing the current memory configuration. The memory management unit (MMU) is then programmed, based on this table, to provide contiguous logical memory from the potentially noncontiguous physical segments in banks A and B. The 24/32-bit memory map allows existing Macintosh software to use a 24-bit address mode; new software can use the full 32-bit address space. The mapping is implemented simply and directly.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive
2. External floppy disk drive
3. Setup device set in the control panel
4. SCSI devices in declining order of device ID (from 6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are destroyed, the setup device defaults to the device with ID=0.

The system finds a readable disk, reads the disk, and completes the disk startup process.

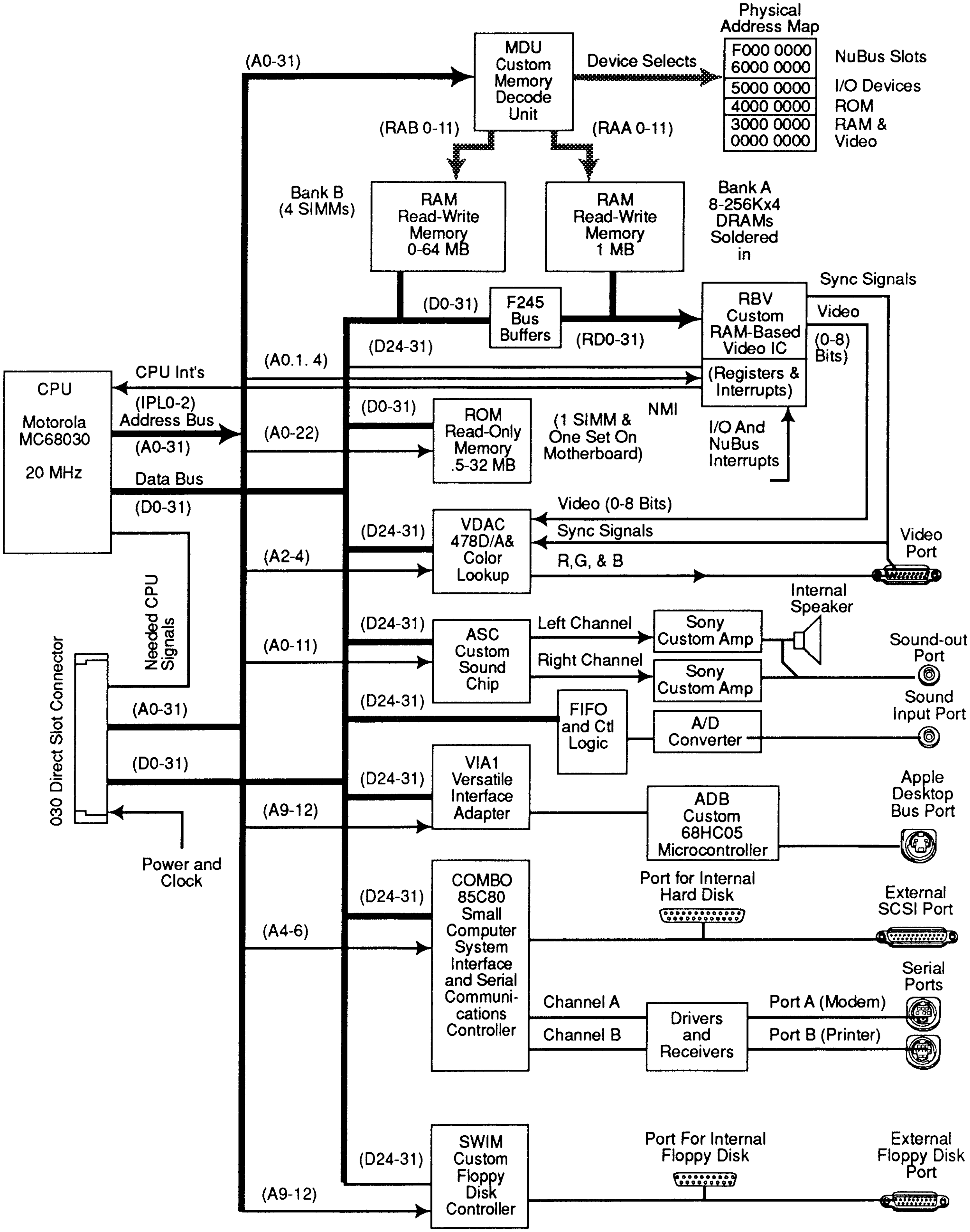


Figure 1-8 Block Diagram

Logic Board

The logic board is the heart of the system, the place where all processing of information takes place. Below is a list of the major components of the Macintosh IIsi logic board and the functions they perform.

By using the block diagram in Figure 1-8 as you read through the various sections, you will get a clearer understanding of how the logic board works.

Microprocessors

The Macintosh IIsi contains a 68030 microprocessor, which is a true 32-bit processor but also supports 24- and 16-bit processing modes. The microprocessor runs at 20 MHz for high performance. When running in the 24-bit addressing mode, the Macintosh IIsi is compatible with the majority of existing Macintosh applications.

When working in A/UX (Apple UNIX®), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for an HMMU or PMMU (as found in the Macintosh II). When the 68030 seeks data from a memory location that isn't in the RAM, the 68030 swaps the page containing the data from the disk to the RAM.

RAM

The random-access memory (RAM) interface on the logic board is designed to support from 1 MB to 65 MB of RAM. The interface supports burst mode, which allows a five-clock initial access followed by 3 two-clock accesses. The first MB of RAM is found in eight 256K x 4 fast-page-mode DRAMs that are soldered onto the logic board. This RAM is called bank A. Bank A RAM cannot be changed by technicians, but the logic board can be manufactured with 4-Mbit parts to provide a 4 MB base memory configuration.

Four single in-line memory module (SIMM) sockets are provided for memory expansion. This expansion RAM is called bank B. Bank B can be empty or it can contain four same-sized SIMMs. Table 1 shows the various possible RAM configurations.

RAM banks A and B do not occupy contiguous address space, as they do on most previous Macintosh products. The 68030 on-chip MMU is used to join the noncontiguous blocks of physical memory to current contiguous logical memory for application software.

Bank A	Bank B	RAM
1 MB on-board DRAM	Empty	1 MB
1 MB on-board DRAM	Four 256K SIMMs	2 MB
1 MB on-board DRAM	Four 512K SIMMS	3 MB
1 MB on-board DRAM	Four 1 MB SIMMs	5 MB
1 MB on-board DRAM	Four 2 MB SIMMs	9 MB
1 MB on-board DRAM	Four 4 MB SIMMs	17 MB

Table 1 RAM Configurations

On-board video operates out of bank A, which is used as the frame buffer. The RAM-based video (RBV) frame buffer varies in size, depending on the currently selected bit depth and on the size of the video monitor plugged into the on-board video port. The RBV requires only enough memory to hold the contents of the screen; it does not require any additional memory for the frame buffer. Software determines the maximum video bit depth available at startup and sets aside the needed memory.

Every time the Macintosh IIsi is switched on, the system software performs a memory test to determine how much RAM is present and whether the RAM is good.

Video accesses affect only bank A memory access because the data bus between the RAM banks can be disconnected by a bus buffer (**Figure 1-9**). This access allows the RBV to fetch data from bank A without interrupting CPU access to bank B or I/O devices. Each bank of RAM is accessed independently by the memory decode unit (MDU), so the MDU can decode addresses for the CPU and the RBV at the same time without interference.

ROM

The ROMs are the system's nonvolatile read-only memory. The earliest Macintosh IIsi computers contain a ROM SIMM; later units contain two 4-Mbit ROM chips soldered on the logic board. These chips are 256K x 16 devices in a 44-pin quad flat pack.

The 64-pin ROM SIMM socket will allow the Macintosh IIsi to use new ROM SIMMs when they are available, thus providing a simple method to upgrade the machine.

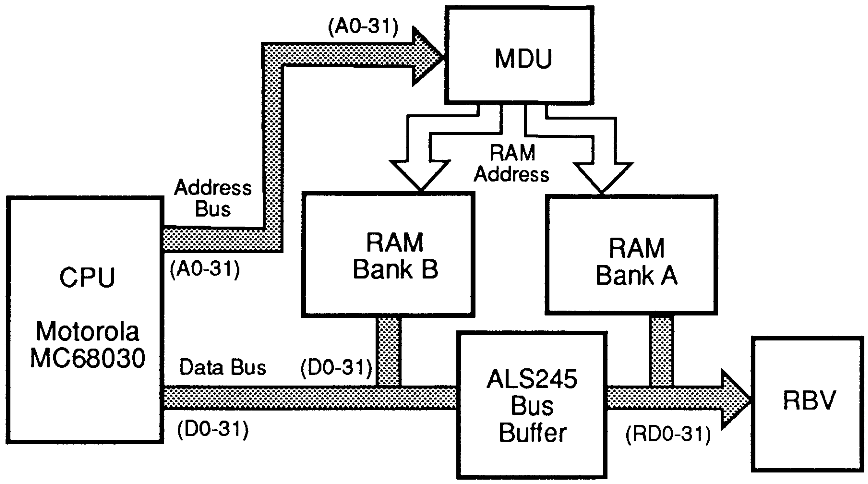


Figure 1-9 RAM/Video Diagram

Built-in Video RBV Chip

The RBV (RAM-based video) consists of two functional parts, the video interface and the VIA2. The video portion of the RBV and bank A of RAM share a separated RAM data bus, which can be connected to or disconnected from the CPU data bus by bus buffers. The RBV uses data stored in bank A of RAM to feed a constant stream of video data to the display monitor during the live video portion of each horizontal screen line. The RBV asks the MDU (memory decode unit) for data as needed. The MDU responds by disconnecting the bank A RAM data bus from the CPU data bus and performing a DMA burst read from bank A RAM while clocking the read data into the RBV.

If a video burst is in progress, CPU access to RAM bank A is delayed, effectively slowing the CPU. This effect is more pronounced for the larger monitors and for video configurations using more bits per pixel. Only access to RAM bank A is affected by video. The optional bank B of RAM connects directly to the CPU data bus, and the CPU has full access to this bank at all times, as it does to ROM and the I/O devices.

The video signals generated by the RBV chip are driven through a CLUT/VDAC (color lookup table/video digital-to-analog converter) chip. The lookup table has 256 three-byte entries (one byte each for red, green, and blue), and triple 8-bit video D/A converters.

When a monitor is connected to the built-in video ports, the monitor will ground certain pins on the connector. The grounding pattern allows the RBV to identify the type of monitor connected. The RBV automatically selects the appropriate pixel clock and sync timing parameters. If an unknown monitor is plugged in or no monitor is plugged in, built-in video output is halted. The MON. ID bits can specify eight possible combinations, as shown in Table 2.

MON. ID 3	2	1	Monitor Selected	Screen Size	Bit Depths Supported	Refresh Rate
0	0	0	Unsupported monitor			
0	0	1	15" Portrait Display (B/W)	640 x 870	1, 2, 4	75 Hz
0	1	0	Mac 12-Inch RGB Display	512 x 384	1, 2, 4, 8	60.15 Hz
0	1	1	Unsupported monitor			
1	0	0	Unsupported monitor			
1	0	1	Unsupported monitor			
1	1	0	Mac 12" B/W, 13" RGB, and Apple High Res B/W	640 x 480	1, 2, 4, 8	66.67 Hz
1	1	1	No external monitor			

Table 2 RAM-Based Video Monitors Supported

The VIA2 portion contains eight 8-bit registers for miscellaneous inputs and outputs, video control, RBV chip-testing modes, and interrupt handling. The CPU communicates with these registers over an 8-bit bidirectional data bus that is separate from the 32-bit RAM data bus used by the video portion.

Input / Output Interface

The input/output interfaces of the system are the serial ports, the floppy disk, the SCSI port, the ADB port, and the sound subsystem. The optional numeric coprocessor, the VIA chip, the VIA2 (which is part of the RBV chip), and associated circuitry are, to some extent, considered input/output devices; however, one should recognize that these components provide input/output to the processor. They do not have external ports as the system-level input/output circuitry does. Each of these interfaces is designed to be backwards compatible, when possible, with existing Macintosh systems.

Serial Communications Controller

The serial communications controller (SCC) is an 8-MHz AMD 85C30. This device, also known as the combo chip, combines the functions of the SCC and the SCSI controller into a single device. The 85C80 is designed to be transparent to operating software. The SCC portion of the 85C80 has two independent ports for serial communication. Each port can be independently programmed for asynchronous, synchronous, and AppleTalk protocols. The serial ports conform to EIA standard RS-422. These ports are used mainly for (though not limited to) connecting the Macintosh IIsi to networks, printers, and modems.

To use the serial ports with RS-232 single-ended devices, use the RS-422 TxD- for the RS-232 TxD, RS-422 RxD- for the RS-232 RxD, and ground RxD+ to the SG pin (**Figure 1-10**).

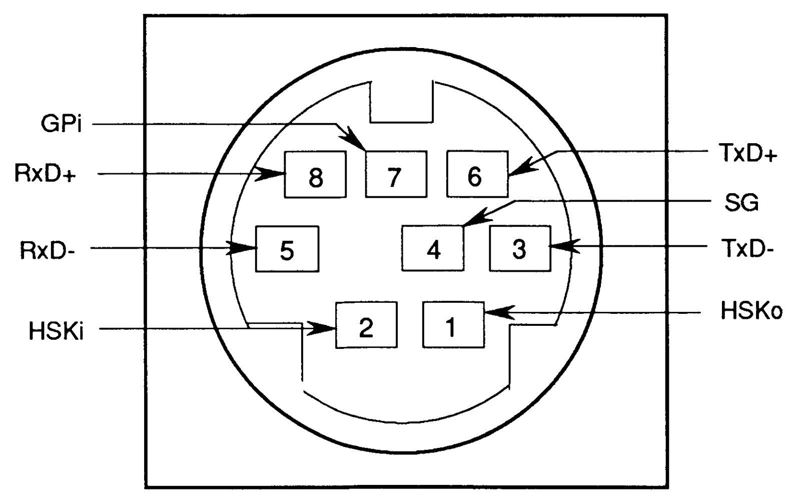


Figure 1-10 Mini DIN-8 Connector

Small Computer System Interface

The second portion of the 85C80 is the small computer system interface (SCSI) controller. The SCSI portion of the 85C80 supports the SCSI as defined by the American National Standards Institute (ANSI) X3T9.2 Committee. This part of the device is compatible with the 53C80 controller used in the Macintosh II family. The rest of the SCSI interface consists of an internal 50-pin connector and an external DB-25 connector.

The chip is connected directly to the internal 50-pin connector and the external DB-25 connector, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. (If you have an internal SCSI drive, you can have only six external SCSI peripherals.) This device supports arbitration of the SCSI bus, including reselection. The chip is controlled through a set of memory-mapped read-and-write registers.

The 85C80 does not provide the internal SCSI disk drive with termination power; the drive provides the termination power.

SWIM Chip

The Sanders-Woz Integrated Machine (SWIM) interface is the single chip that controls the internal 3.5-inch floppy disk drive and the optional external 3.5-inch drive. The SWIM incorporates the functionality of the integrated Woz machine (IWM) and provides the capability to read, write, and format in both GCR (Apple) and MFM (MS-DOS and Apple high-density) data formats. The SWIM chip controls the one internal floppy disk drive and the one external floppy drive.

Sound Subsystem

The sound subsystem offers new levels of functionality not offered as standard features on previous Macintosh computers. The sound input portion consists of discrete logic and memory components.

Sound Output

The sound output circuit consists of the Apple Sound Chip (ASC) and two Sony sound chips that filter the pulse-width-modulated (PWM) signal and drive the internal speaker or external stereo miniphone jack. The speaker drive circuit utilizes a separate amplifier that mixes the right and left channels to drive the internal speaker.

Sound Input

The sound input portion consists of an input jack; a preamplifier; a switched capacitor filter to provide input filtering; an analog-to-digital converter; a first-in, first-out (FIFO) memory to store the digitized data; and control logic that allows software to control the circuitry. Sound control registers are used by software to control the storage of data and the generation of interrupts. The sound input control register controls the sample rate, the record/play bit, and write/ diagnostic address to the FIFO. Sound samples can be made at 11 or 22 KHz with 8-bit resolution.

Sound input sources can be either a microphone or an audio line, either of which can be plugged into the sound input jack on the rear of the computer. The sound subsystem accommodates stereo output and monaural input. If a stereo signal is fed into the sound input section, the two sides will be summed (or mixed) before being digitized.

Input devices can be connected to the microphone input connector on the rear of the computer. The input source should provide a 20-mV amplitude and a 600 Ω input impedance. A line input source—such as a CD player, VCR, or tape player—provides a higher input level. Apple provides an attenuating adapter plug to decrease the level of these devices so that they are compatible with the Macintosh IIsi input. Apple also provides an electret microphone for users to digitize voice inputs.

Electret microphones require a bias voltage. Most external electret microphones provide a battery within the microphone body to power the element. The Apple electret is powered by the computer system with a bias voltage provided at the second tip of the input connector. This connection provides eight volts DC at up to 1 mA. This voltage has no effect on input devices that have a monophonic or stereo input plug.

***CAUTION:** If the user inadvertently plugs some types of amplifiers into the sound input jack instead of the sound output jack, the DC voltage goes to the amplifier inputs. Damage to the amplifier could result. Care must be taken to ensure that the connections to the rear of the computer are made correctly.*

Apple Desktop Bus

The Apple Desktop Bus (ADB) interface in the Macintosh IIsi is implemented differently from the ADB on previous Macintosh computers. An 8-bit custom microcontroller is the heart of the design. This microcontroller is a custom Motorola 68HC05 that drives the external ADB bus and reads the status of the selected device. The system interfaces with this new custom device with an improved, extended handshake protocol with the VIA chip.

The ADB controller also includes other functions that used to be provided by extra devices on the logic board. The controller includes a real-time clock and parameter RAM, along with control bits for the soft power control circuit, power-on reset, and keyboard-controlled reset and NMI functions. Each of these functions is described below.

The ADB is a serial communication bus used to connect keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the ADB controller. This is a 4-bit microprocessor that actually drives the external bus and reads the status of the selected device. The mini-DIN 4-pin ADB connectors (**Figure 1-11**) connect the devices to the Macintosh IIsi.

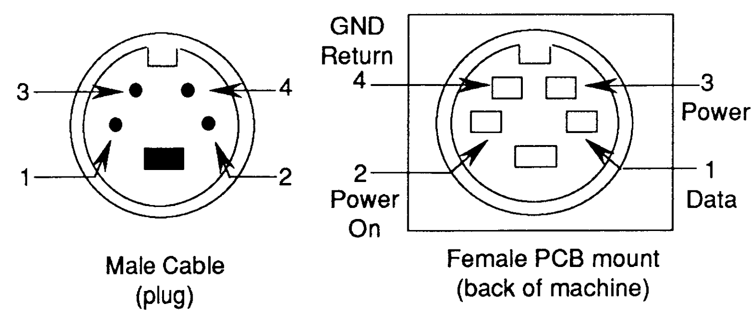


Figure 1-11 ADB Connector

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the Apple Desktop Bus.

There are three Macintosh Apple ADB keyboards—the Apple Keyboard, Apple Keyboard II, and Apple Extended Keyboard. The keyboards connect to the Apple Desktop Bus port on the rear of the Macintosh IIsi. The keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issue commands on the ADB, and transmit and receive data to and from the ADB devices.

Real-Time Clock

The Macintosh IIsi real-time clock is a custom chip. It contains 256 bytes of RAM that are powered by a battery when external power is off. These RAM bytes are called parameter RAM (PRAM). Parameter RAM stores the configuration of ports, the clock setting, and other data that must be preserved even when system power is not available.

Access to PRAM information is accomplished using a new pseudo device command protocol for use with the 68HC05. This protocol is different from the protocols of previous Macintosh computers. Software can use the driver routines to access the clock and PRAM; however, software that attempts to access these hardware devices directly must be modified.

Power Control

The Macintosh IIsi has a soft-off/hard-on circuit to control the power supply. The circuit is designed to control the power supply through the power fail warning (PFW) signal to the power supply and the expansion slot interface.

When either the keyboard on/off switch or the rear-panel power switch is pressed, the PFW signal is pulled high and the power supply turns the power on within 1.5 seconds.

The rear-panel power switch can be locked in an ON position, which allows the unit to restart itself as soon as AC power is detected. In effect, when this switch is locked in the ON position and a power failure causes the unit to shut off, the unit will start up as soon as the power is reinstated. Also, when the switch is locked in the ON position, using the Shut Down command in the Finder™ causes the unit to restart. This feature is most valuable when using the unit as a file server.

The Macintosh IIsi provides two new power-up capabilities:

- A programmable file server flag in PRAM provides the same functionality as the lockable power switch.
- The PRAM can be programmed to turn the system on at a specified time.

The power-off function is under software control when the Shut Down command in the Finder is used. This soft-off allows the computer to clean up any pending activity before switching off. In contrast, the power on/off switch generates a hard off that turns off the computer after 2 ms without going through software.

The Macintosh IIsi also provides a keyboard-initiated nonmasked interrupt (NMI) and reset. To produce a NMI, press <Command> and the power button at the same time; to reset, press <Command>, <Control>, and the power button at the same time.

The NMI is used by debugging software to stop an application and change to a debugger for low-level software and hardware testing. The NMI signal has an enable flag in the PRAM of the 68HC05. When the 68HC05 is initially powered up, the flag is reset and the NMI cannot be generated by the keyboard. Software that wishes to use this function needs to set the enable flag in the PRAM so that the keyboard NMI can be generated.

The reset is a hard reset, identical to the power-on reset. All RAM contents are lost and the computer behaves as if it were just switched on.

Power Supply

The power supply operates on standard line voltage and outputs +5 V, +12 V, and -12 V DC voltages, which are used by the logic board, the internal devices, and the slots.

***CAUTION:** It is extremely important that the ratings of the power supply not be exceeded. Exceeding the ratings will result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Fuses

The logic board has three fuses that protect the external connectors, SCSI, floppy disk drive, and ADB. These fuses are resettable polyfuses and require about four seconds to reset once blown by an overload.

Internal Floppy Disk Drives

The internal disk drive connects to the main logic board through an internal connector. The flow of data between the logic board and the disk drives is channeled through the SWIM disk controller. The SWIM controls reading and writing operations.

FDHD Drive

The SWIM disk controller enables the Apple FDHD/SuperDrive to exchange data between Apple and MS-DOS® systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (Apple) or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM). For specific compatibilities between drives and media, see **Figure 1-7**.

An application-specific translator within the Apple File Exchange utility program, or provided by third parties, must be used to translate the formatted data for use within an application program.

Internal Hard Disk SCSI

The hard disk connects to the logic board through the internal SCSI connector. Other SCSI devices may be daisy-chained to the external SCSI port.

Expansion Slot

The Macintosh IIsi has one expansion slot that can accept a NuBus card or an 030 Direct Slot card.

The expansion bus connector is a 120-pin DIN-style three-row connector. The connector provides the 32-bit CPU data and address buses, DMA control signals, other CPU control signals, interrupt inputs, and status signals for future expansion. Additionally, +5 V, +12 V, and -12 V power is provided. An adapter card allows the expansion card to be installed horizontally, parallel to the main logic board. There is sufficient clearance provided by the adapter card for cooling air to flow between the boards.

The installation process for a NuBus card is quite different from the installation process for an 030 Direct Slot card. When installing either card, be sure to follow the directions that come with the adapter card.

Numeric Coprocessor

The numeric coprocessor is located on the optional adapter cards. The numeric coprocessor is an MC68882 device that provides a high degree of precision and speed for numeric computations.

Note: Some software applications require that the numeric coprocessor be on the logic board. Such applications require special adaptations to run on the Macintosh IIsi.

NuBus Card

The NuBus interface is based on the Apple NuBus specification. This interface adds the NMRQ~ to the IEEE NuBus definition of NuBus slots. The NMRQ~ line from the slot is wired to a pin of the RBV to allow the immediate determination of interrupt source rather than a polling of all possible interrupt sources.

Note: To guarantee that the Macintosh IIsi meets all specifications regardless of the operation conditions, the power dissipation should not exceed 15 watts.

The NuBus interface supports the following features for the Macintosh IIsi:

- **Geographic Addressing** Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other means to uniquely address each card.

- **Distributed Arbitration** There is no central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requestors receive equal access to the bus over time.

- **Synchronous Transaction** All bus transactions are timed relative to a single asymmetric 10-MHz clock.

- **32-bit Address/Data** The NuBus supports 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 supports all these data types through the use of dynamic bus sizing. Dynamic bus sizing means word and long-word operations do not have to be aligned but instead cause multiple NuBus transactions to perform the proper alignment. The data bus from the 68030 to NuBus is byte reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address implies.

- **Bus Time-out** The absence of a card on the NuBus will not hang the bus by waiting for a reply. A system resource errors-out any transaction taking longer than 25.6 µs.

- **Simple Interrupts** Each card has the ability to generate simple open-collector interrupts that allow inexpensive cards to gain system attention without having to become bus master.

The NuBus has three major states of communication with the Macintosh IIsi system:

- Processor-to-NuBus, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

- NuBus-to-Processor Bus, which is for access to RAM and ROM and for I/O to and from NuBus. Two control functions are performed for this process. One tracks the changes on NuBus, and the other lets the 68030 tell NuBus what to do next.

- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

Direct Slot Card

The internal expansion connector can be used as an 030 Direct Slot. This enables Apple and third-party expansion cards to directly access the 32-bit address and data bus of the 68030 microprocessor. This slot architecture delivers the improved performance of the 32-bit bus and has other benefits for expansion card developers. However, the greater pin demands of the 32-bit bus require using a 120-pin connector. As a result, most accelerator and video expansion cards designed to utilize a 16-bit data bus cannot be used.

Apple Technical Procedures

Macintosh IIsi

Section 2 – Take-Apart

❏ CONTENTS

Note: If a step is underlined, detailed instructions for that step can be found elsewhere in the section.

❑ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh IIsi contains ROM and RAM memory (which is installed on small separate boards called SIMMs—single in-line memory modules) and CMOS components. The CMOS components and the SIMMs are very susceptible to damage from electrostatic discharge (ESD).

Preventive measures must be taken to avoid ESD damage. When you unwrap, install, or replace modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

If the proper ESD procedures are not available, then do the following:

Turn off the power and disconnect the power cord. After removing the cover and before going near the logic board, touch the metal of the power supply case.

❑ TOP COVER

Remove

1. Remove all cables that are attached to the rear of the computer.

2. Push up on the tabs on the back of the cover (**Figure 2-1**) and lift up the lid. The cover may make a loud snap.

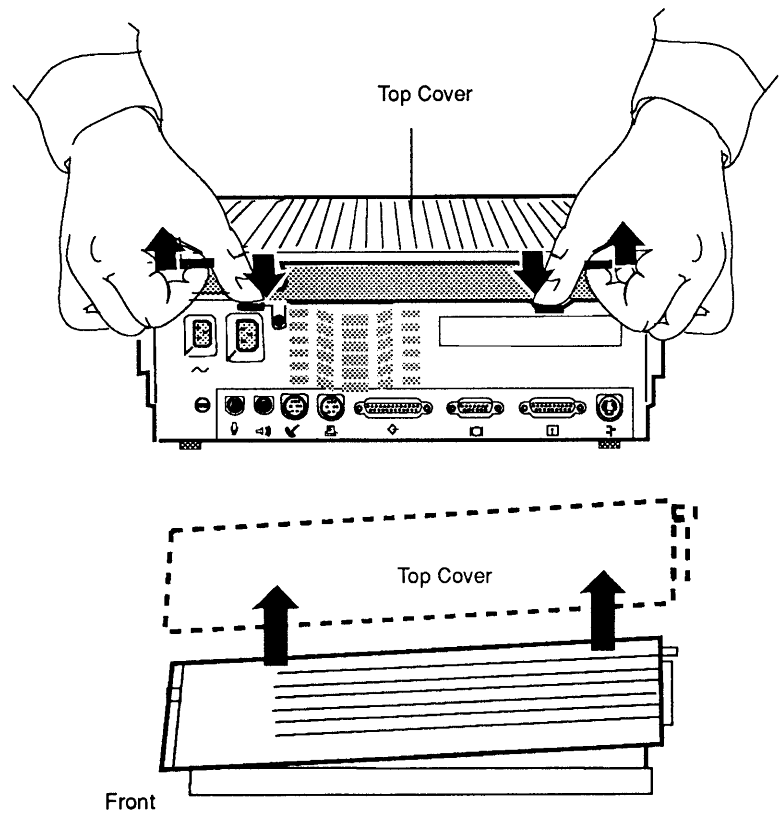


Figure 2-1 Top Cover

Replace

1. Insert the front end of the cover onto the front end of the unit, making sure that the tabs on the cover fit into the receptacles on the unit.

2. Swing the cover down toward the back of the unit, pressing down on the back until you hear the case click into place.

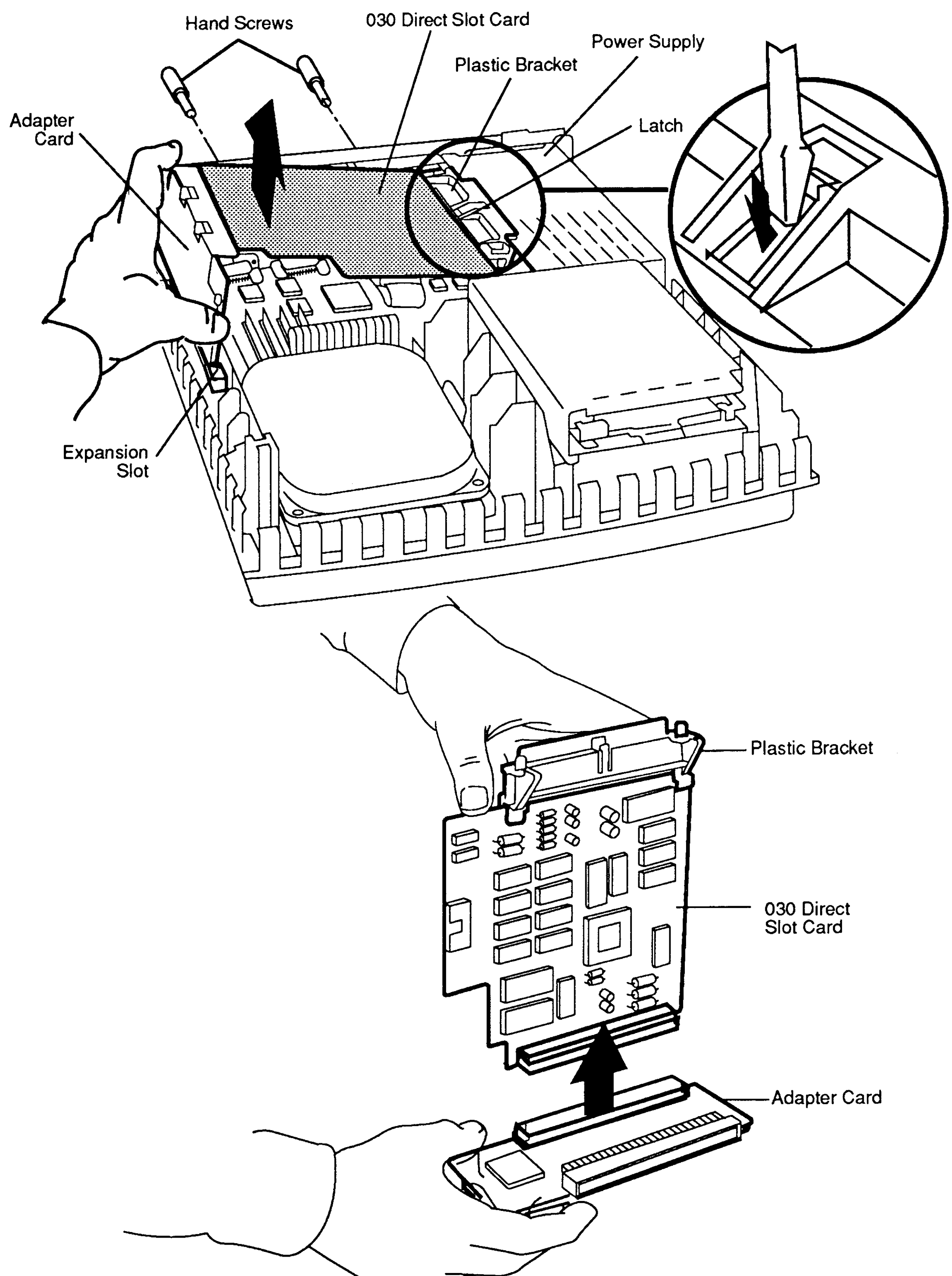


Figure 2-2 The 030 Direct Slot Card

❑ ADAPTER CARD AND 030 DIRECT SLOT CARD

CAUTION: *Adapter and expansion cards are sensitive to electrostatic discharge. To avoid damaging these cards, follow all ESD safety procedures. For complete ESD prevention information, refer to the You Oughta Know tab in the* Apple Service Technical Procedures.

Remove

1. Remove the top cover.
2. Remove the screws that secure the 030 Direct Slot card to the access port.
3. With a screwdriver, press down on the latch (**Figure 2-2**) that secures the plastic bracket to the power supply. Remove the plastic bracket from the power supply carefully so that you do not flex the 030 Direct Slot card.
4. Carefully, and without flexing either card, pull the 030 card out of the connector on the adapter card.
5. If you are replacing the adapter card, remove the adapter card from the logic board by pulling straight up on the adapter card.

Note: If you are replacing the 030 Direct Slot card, detach the plastic bracket and keep it to use with the replacement 030 Direct Slot card.

Replace

1. Attach the plastic bracket to the 030 Direct Slot card. The bracket snaps into place on the side of the Direct Slot card that is opposite the connector.
2. Attach the 030 Direct Slot card to the adapter card.
3. Attach the plastic bracket to the power supply.
4. Press the adapter card into the expansion slot on the logic board.
5. Secure the external connector of the 030 Direct Slot card to the access port.
6. Replace the top cover.

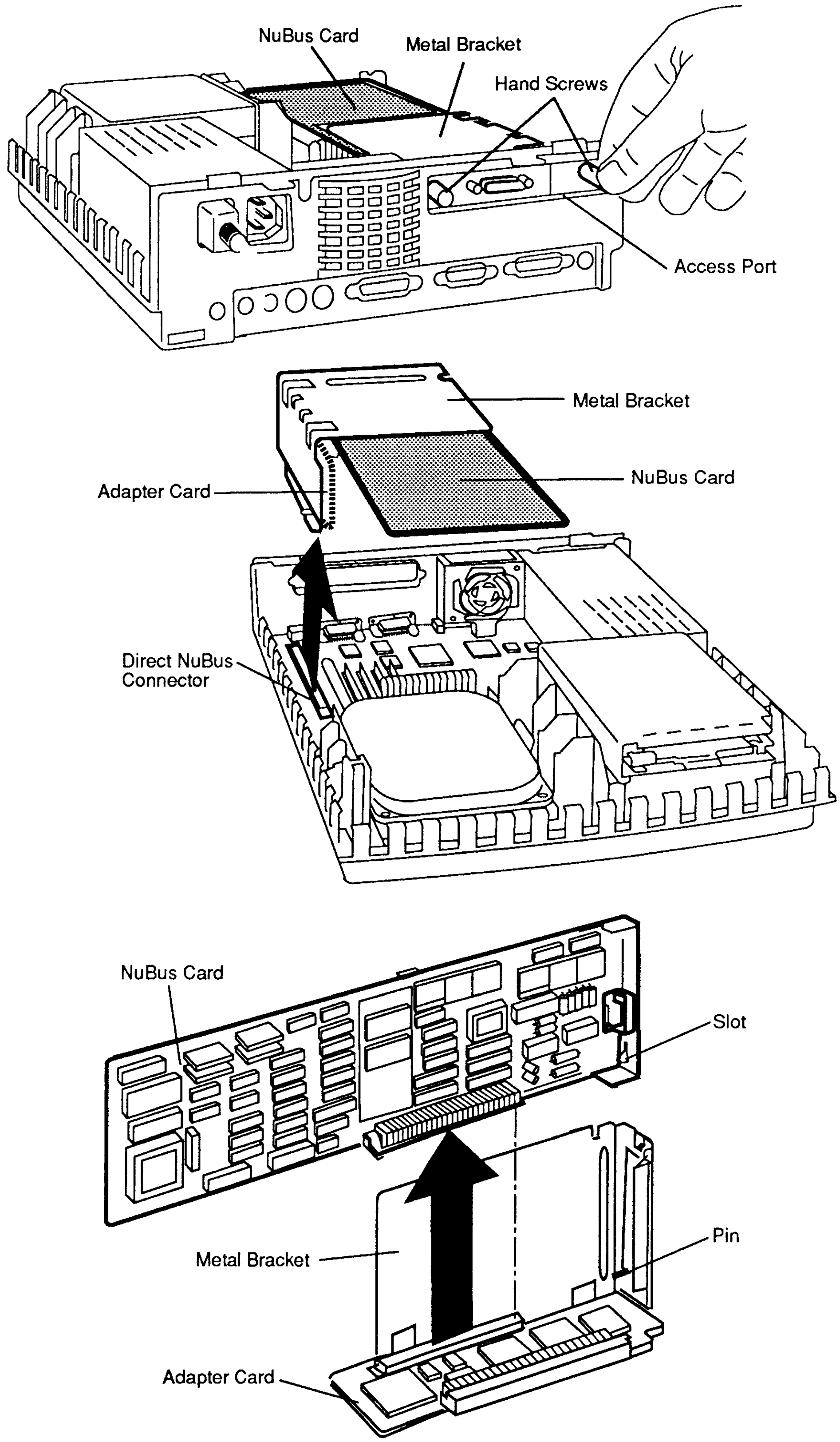


Figure 2-3 Adapter Card, Bracket, and NuBus Card

❑ ADAPTER CARD, BRACKET, AND NUBUS CARD

CAUTION: Adapter and expansion cards are sensitive to electrostatic discharge. To avoid damaging these cards, follow all ESD safety procedures. For complete ESD prevention information, refer to the You Oughta Know tab in the Apple Service Technical Procedures.

Remove

1. Remove the top cover.
2. Loosen the two screws that fasten the NuBus card to the access port on the rear of the computer (**Figure 2-3**).
3. Pull straight up on the metal bracket to remove the bracket, NuBus card, and adapter card from the computer.
4. If you are replacing the NuBus card, rest the adapter card on a flat surface, with the metal bracket and NuBus card perpendicular, and carefully pull the NuBus card out of the connector on the adapter card.

Replace

If the NuBus card is already attached to the adapter card and bracket, begin with step 2.

1. Attach the NuBus card to the adapter card assembly.
   - Rest the adapter card on a flat surface, with the metal bracket perpendicular, and slide the NuBus card into the bracket, making sure that the pin on the bracket aligns with the slot on the NuBus card.
   - Press the NuBus card into the connector on the adapter card.
2. Line up the connector on the adapter card with the expansion slot on the logic board. Press down gently but firmly on the adapter card until the connector is fully inserted.
3. Replace the two screws that fasten the NuBus card to the access port on the rear of the computer.
4. Replace the top cover.

❑ FAN

Remove

1. Remove the top cover and remove the 030 Direct Slot card, if one is installed.

2. With the front of the computer facing you, place your thumbs under the fan (**Figure 2-4**) and pull straight up. The fan will snap free. (You may need to use moderate pressure to snap the fan free.)

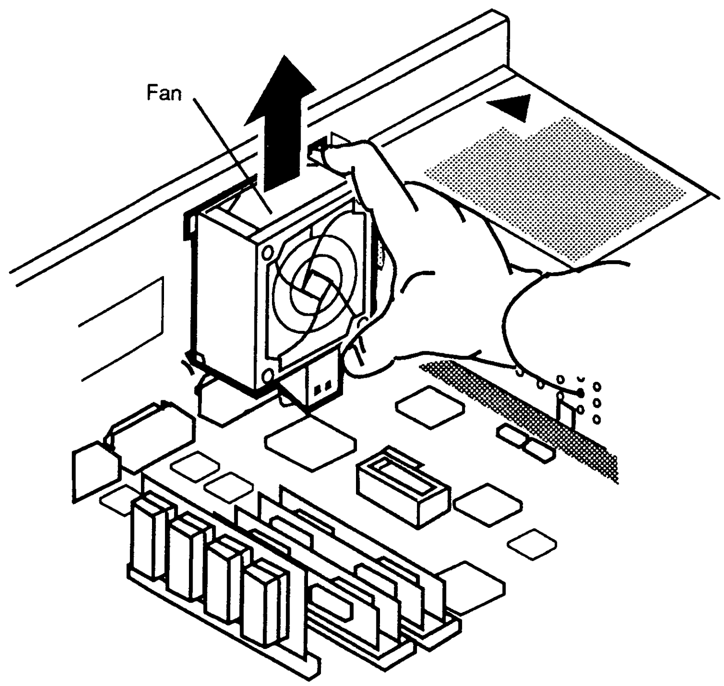


Figure 2-4 Removing the Fan

Replace

1. Align the fan so that the plastic notches of the fan assembly go into the plastic guides on the rear of the case.

2. Push the fan all the way down until you hear the fan snap into place. The fan must rest securely against the logic board.

3. Replace the 030 Direct Slot card (if one was installed) and the top cover.

❑ POWER SUPPLY

Remove

1. Remove the top cover, the 030 Direct Slot card (if one is installed), and the fan.

2. Near the rear end of the power supply, locate the two metal tabs shown in **Figure 2-5**. Press in on the tabs and lift the rear end of the power supply about 1/2 inch.

3. On the front end of the power supply (near the floppy drive), locate the large plastic tab (**Figure 2-5**) that latches the power supply to the bottom case. Using a finger, push the tab toward the front of the case and at the same time lift the power supply up and out of the case.

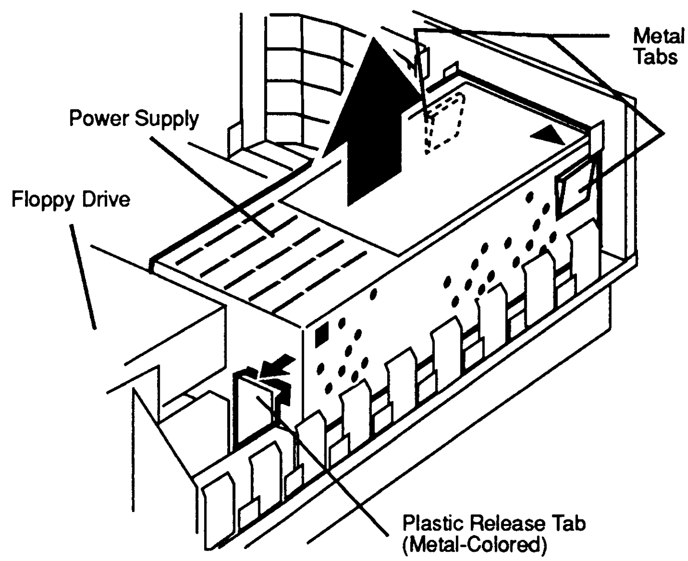


Figure 2-5 Power Supply

Replace

1. Position the power supply so that the white connector on the power supply fits into the white connector on the logic board.

2. Slide the power supply into the case until the two metal tabs near the rear of the computer and the large plastic tab near the floppy drive hold the power supply in place.

3. Replace the fan, the 030 Direct Slot card (if one was installed), and the top cover.

❑ HARD DISK DRIVE

Note: If you are replacing the hard disk drive, you will need a torque driver. Torque drivers are readily available at most hardware or automotive supply stores.

Remove

1. Remove the top cover.
2. Disconnect the power cable from connector J14 on the logic board (**Figure 2-6**). This connector has a locking tab that you must release in order to remove the cable.
3. Disconnect the 50-pin connector from the logic board (**Figure 2-6**). You may have to gently rock the cable from side to side to release the cable.

   Note: If you are replacing the hard disk drive, detach and retain the power cable and the 50-pin connector cable from the drive. You will need them to install the new drive.

4. Release the two metal-colored tabs (**Figure 2-6**), one on each side of the hard disk drive, and lift the drive (with its carrier) out of the computer.

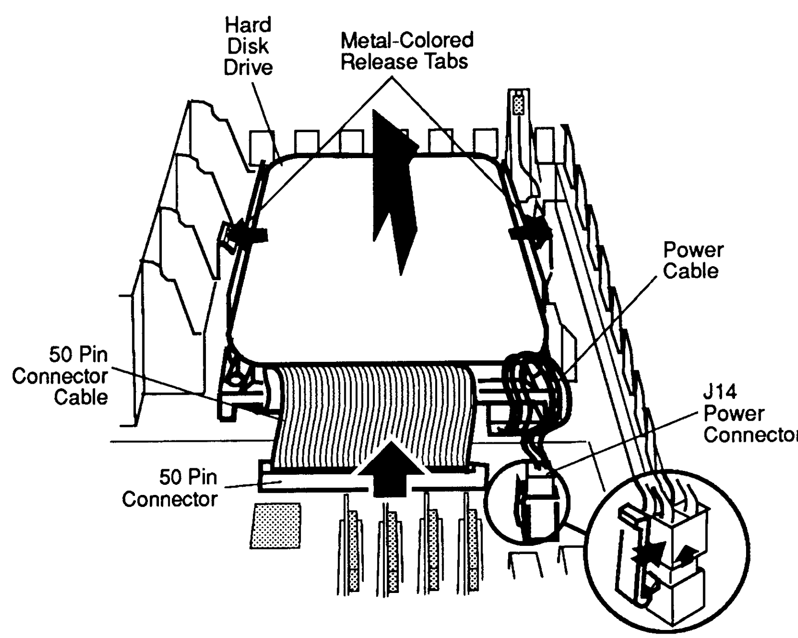


Figure 2-6 Hard Disk Drive

CAUTION: *DO NOT loosen or remove any of the four torx screws that secure the black cover to the drive. Loosening or removing these screws can cause irreparable damage to the hard drive.*

5. If you are replacing the hard disk drive, remove the defective hard disk drive from its silver-colored carrier by removing the four Phillips screws and lockwashers from the carrier.

Replace

If you are replacing a defective hard disk drive, begin with step 1. If you are simply reinstalling the same drive (which is already attached to the silver-colored carrier), begin with step 3.

1. Align the carrier screw hole marked **A** on the replacement hard disk drive as shown in **Figure 2-7**. Use the four lockwashers and Phillips screws to **loosely** fasten the carrier to the drive.

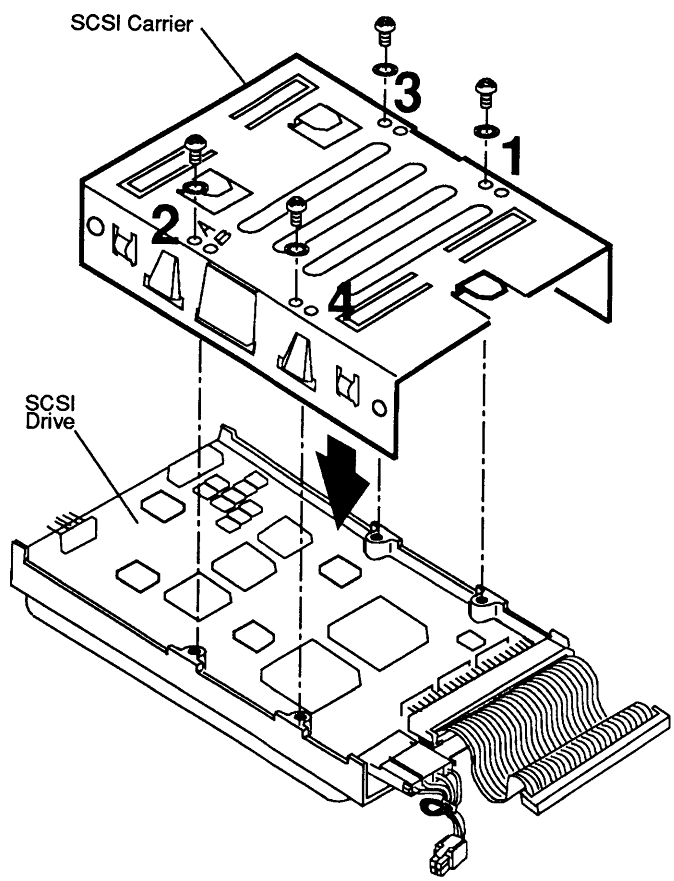


Figure 2-7 Hard Disk Drive Carrier

2. Using the torque driver and following the sequence shown in **Figure 2-7**, torque the four Phillips screws to 8.0 in-lbs.

***CAUTION:** Be sure to use the Phillips screws that you removed in step 5 above and follow the installation sequence shown in **Figure 2-7.** Failure to do so can damage the drive.*

3. The hard drive goes over the speaker, with the carrier side down and the connectors facing the rear of the computer. Position the hard disk drive so that the metal tabs on the carrier align with the plastic release tabs on the bottom case (**Figure 2-6**).

4. Push the carrier and drive down into the bottom case until the hard disk drive snaps into place.

5. Connect one end of the 50-pin cable to the hard drive and the other end to connector J17 on the logic board. (Note that the cable has a small tab in the center of the connector at each end of the cable. Align this tab with the slot in the connectors on the logic board and on the hard disk drive.)

6. Connect the rectangular end of the the power cable to the hard drive.

7. Connect the square end of the power cable to connector J14 on the logic board. Be sure that the cable locks into place.

8. <u>Replace the top cover</u>.

❑ FLOPPY DISK DRIVE

Remove

1. Remove the top cover.

2. Disconnect the 20-pin connector (J18) from the logic board (**Figure 2-8**).

3. Release the two metal-colored tabs (**Figure 2-8**), and lift the drive straight up and out of the computer. Retain the 20-pin cable for the drive replacement.

IMPORTANT: *Apple advises you to install dust shields on 1.4 MB floppy drives in all Macintosh IIsi computers. You **must** clean the drive before you slip on the dust shield. See "Cleaning the Drive" in the Basic section of the FDHD/SuperDrive tab of the* Apple Technical Procedures.

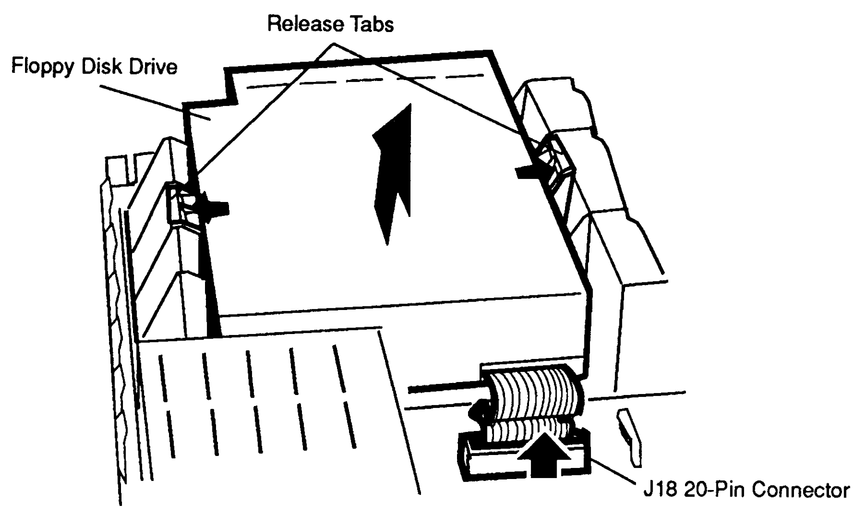


Figure 2-8 Floppy Disk Drive

Replace

1. Connect the 20-pin cable to the new drive.

2. Position the drive so that the two plastic tabs of the case align with the metal tabs of the drive. Push the drive down until the tabs of the case snap into position over the tabs of the drive.

3. Connect the 20-pin floppy cable to connector J18 on the logic board.

4. Replace the top cover.

❑ MAIN LOGIC BOARD

Remove

1. Remove the top cover, adapter card (if installed), fan, and power supply.
2. Disconnect connector J18 (the floppy disk drive) and connectors J17 and J14 (the hard disk drive).
3. Use your forefingers to release the two tabs (**Figure 2-9**) that secure the logic board in place.

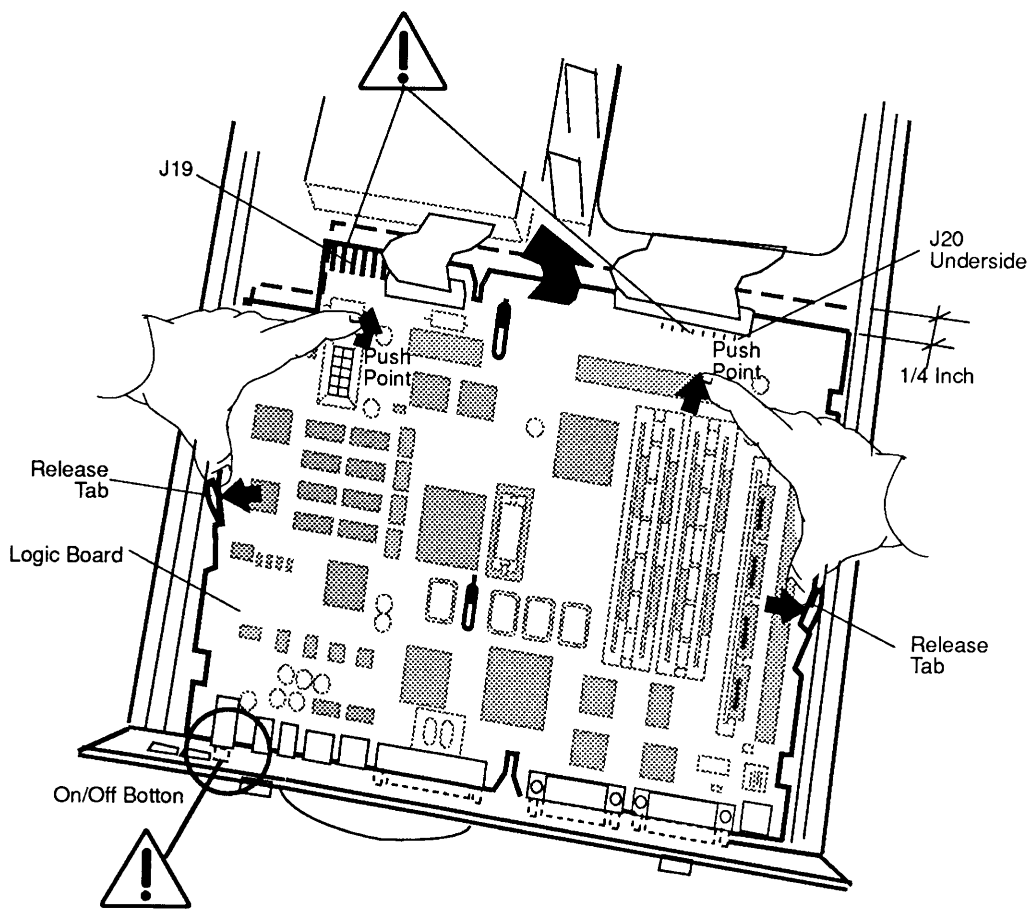


Figure 2-9 Main Logic Board

4. Use your right thumb to push on the black 120-pin connector and slide the logic board toward the front of the case until the board stops.

***CAUTION:** Be sure the power on/off button clears the rear panel before you lift the logic board out of the case.*

5. Gently lift the board completely out of the case.

CAUTION: *Because the oil from your skin can be harmful to the connectors, do not touch the connector "fingers" of the speaker/LED (J20—located on the bottom side of the logic board) or connector J19.*

---

6. Use the SIMM removal tool (see the instructions in "SIMM Removal Tool" under the *You Oughta Know* tab) to remove the RAM SIMMs from the logic board. You will need to install these SIMMs on the new logic board.

   Note the size and number of the customer's RAM SIMMs. The customer must receive the same RAM SIMM configuration as was brought in.

Replace

1. Install the customer's RAM SIMMs onto the replacement logic board.
2. Insert the logic board into the case so that the connectors align with the openings in the back panel. The slots in the logic board fit over the tabs on the bottom of the case.
3. With a slight downward pressure, slide the logic board toward the rear of the case as far as it will go. The board will click into place.
4. Reconnect connector J18 (the floppy disk drive) and connectors J17 and J14 (the hard disk drive).
5. Replace the power supply, fan, adapter card (if you removed one), and top cover.

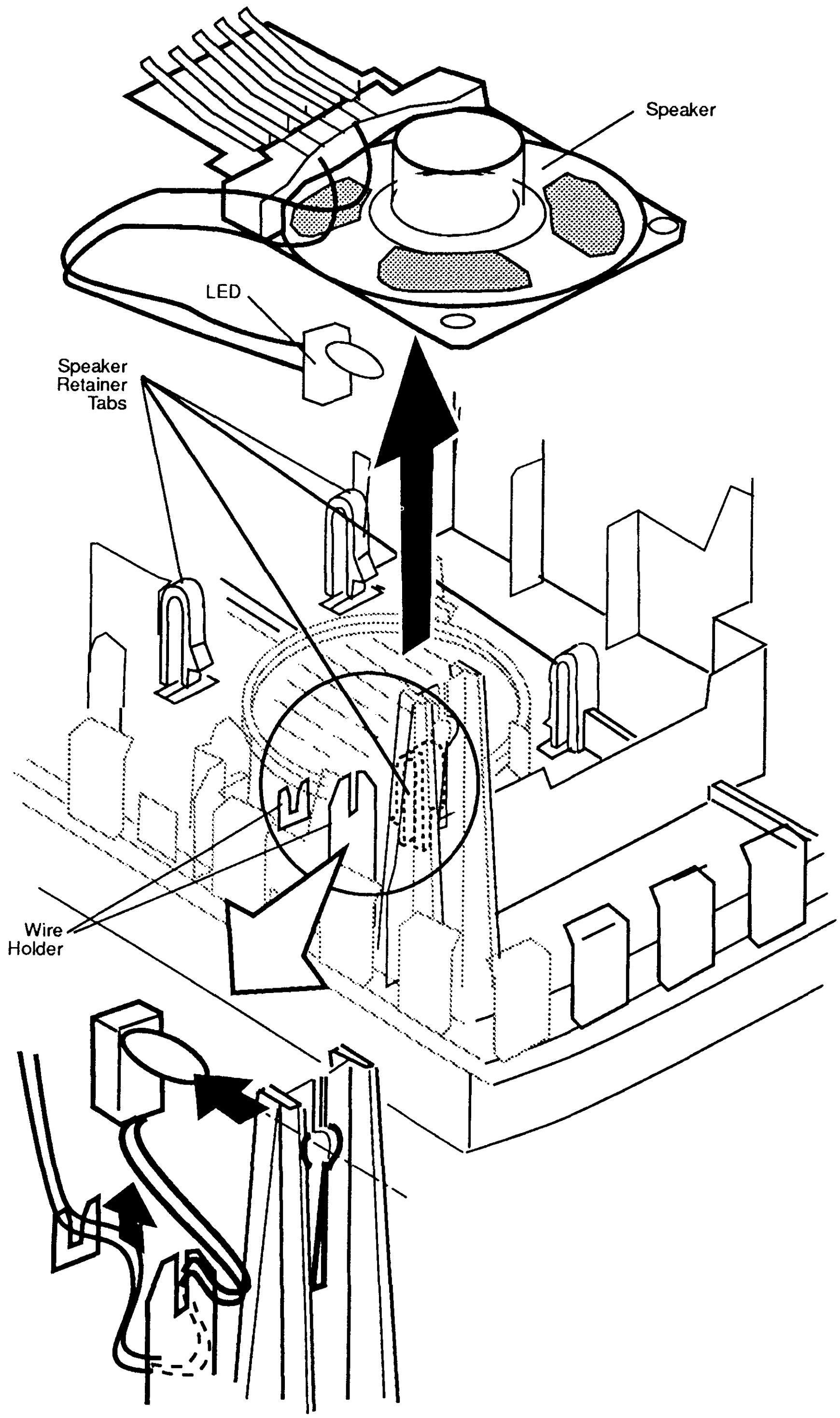


Figure 2-10 Speaker

❏ SPEAKER

Remove

1. Remove the top cover, adapter card (if installed), fan, power supply, and hard disk drive.

2. Disconnect the floppy disk drive cable from connector J18 on the logic board.

3. Remove the logic board.

4. Remove the diode power light on the front of the case by pushing the bulb back and pulling the diode (**Figure 2-10**) from the holder. Carefully remove the diode cables from the two cable holders.

5. Release the four clips that hold the speaker to the bottom case (**Figure 2-10**). Lift the speaker out of the bottom case.

Replace

1. Place the speaker face-down in the bottom case. Push each of the four corners of the speaker firmly down until the four clips snap into position over the speaker. You may have to push back on the clips to snap them over the speaker edges.

2. Replace the diode power light in its holder, and place the diode cables in the two cable holders (**Figure 2-10**).

3. Replace the logic board, making sure that the metal connector fingers of the speaker contact the metal fingers on the underside of the logic board.

4. Reconnect the floppy disk drive cable to connector J18 on the logic board.

5. Replace the hard disk drive, power supply, fan, adapter card (if you removed one), and top cover.

Macintosh IIsi

Section 3 – Diagnostics

❑ CONTENTS

Refer to the MacTest MP section under the *Macintosh Multiple-Product Diagnostics* tab in the Macintosh Family *Apple Service Technical Procedures.*

Macintosh IIsi

Section 4 – Troubleshooting

❑ CONTENTS

❑ INTRODUCTION

General Information

The following two disks may be used to test portions of the Macintosh IIsi system:

- *MacTest MP*
- *Macintosh Hard Disk Test* (version 1.0 or higher)

Use this troubleshooting section if you are unable to boot *MacTest MP* or if *MacTest MP* is unable to detect a module failure. After you repair the system, run *MacTest MP* to verify system operation.

Note: See MacTest MP under the *Macintosh Multiple-Product Diagnostic* tab in the *Macintosh Family Technical Procedures* for instructions on using *MacTest MP*. See Macintosh Hard Disk Drive Diagnostic under the *SCSI Hard Disk Drives* tab of *Cross Family Peripherals Technical Procedures* for instructions on using *Macintosh Hard Disk Test*.

Before You Start

Read the subsections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "RAM SIMM Verification," and "Battery Verification" before you begin troubleshooting. You need the information provided in these subsections to troubleshoot the Macintosh IIsi effectively.

Error Chords

When switched on, the Macintosh IIsi executes a ROM-based self-test. If any part of the self-test fails, a sequence of chords will sound. To hear a sample of each sequence of chords, listen to the Diagnostic Sound Sampler on the *MacTest MP* disk. (Refer to Section 3, Diagnostics, for more information.)

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.

If the symptoms displayed by the Macintosh IIsi are not listed in the symptom chart, or if the system is not displaying a clearly defined problem, use the flowchart subsection.

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh IIsi. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes that are above the flowchart or on the opposite page. These notes provide additional instructions or referrals to other procedures.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

❑ THINGS TO REMEMBER

ESD

1. Follow all electrostatic discharge (ESD) precautions when working on the Macintosh IIsi. Refer to the *You Oughta Know* tab in the *Apple Service Technical Procedures* for additional information.

Troubleshooting Hints

2. If available, use a known-good monitor and monitor cable. Using them will isolate the problem to the CPU, internal drive, keyboard, or mouse.

3. Before you begin troubleshooting, remove the expansion and adaptor cards and disconnect any external devices (printers, SCSI devices, and/or ADB devices other than the keyboard and mouse).

   After the Macintosh IIsi has passed the diagnostic tests, each expansion card or peripheral must be installed and tested. Install one device and test the system before adding other devices. Repeat the install-and-test process until all devices have been installed and tested.

4. Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

5. Use a known-good copy of *MacTest MP*.

Normal Startup Tone

6. During a normal startup sequence, a medium-pitched soft chord sounds. If you do not hear the chord, refer to "Startup and Error Chords" for additional information.

System Configuration

7. To ensure that customers get back the same system configurations that they bring in, record the following information:

   - The size of the SCSI hard disk (40 MB or 80 MB) if one is installed
   - SIMM sizes
   - Type and serial number of expansion card
   - Whether a ROM SIMM is installed

System Software

8. Verify that the customer is using System 6.0.7 or higher. Using earlier versions may destroy data or prevent the computer from booting.

❑ MODULE EXCHANGE INFORMATION

Logic Board Configuration

The Macintosh IIsi logic board service exchange module is shipped without RAM SIMMs. To make sure that customers always get back the same logic board configurations that they brought in, be sure to record the amount of memory installed and the size of the RAM SIMMs.

All Macintosh IIsi logic boards are shipped with ROM memory. This memory may be on a ROM SIMM or it may be soldered onto the board at the locations marked **ROM 4MBIT** (near the floppy disk cable connector, J18). When you return a defective Macintosh IIsi logic board, return it with the ROM, but without RAM SIMMs.

Internal Hard Disk SCSI

The internal 40 MB and 80 MB SCSI hard disk service modules are shipped without the SCSI cable connected. Be sure to keep the SCSI cable with the customer's Macintosh IIsi system. The SCSI cable is sold as a separate replacement part and is not part of a module.

The SCSI power cable is not included with the internal SCSI drive modules. You must detach the power cable from the old drive and install it on the replacement drive.

❑ STARTUP AND ERROR CHORDS

Introduction

When the Macintosh IIsi is switched on, the ROM executes a self-test. If any part of the self-test fails, a sequence of chords will sound.

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord and additional chords sound, a blank gray screen will usually be all one sees. Three sequences play whenever an error is encountered during startup: startup chord first; then the short, harsh error chord; followed closely by the test monitor sequence (four chords, from low to high).

Initial Failure

If you hear the above sequence, a failure has occurred during the initial hardware self-tests. To correct the problem:

1. Exchange the RAM SIMMs. (Refer to "RAM SIMM Verification" in this section for complete instructions.)

2. If RAM SIMM exchanges do not work, exchange the logic board. (Install the customer's RAM SIMMs on the exchange board.)

3. If the system still does not work, you will need to perform the RAM SIMM verification with the exchange logic board. (Refer to "RAM SIMM Verification" in this section.)

❑ SYMPTOM CHART

Built-In Video Problems	**Solutions**
• *Screen is dark, audio and at least one drive operate, fan is running, and LED is lit*	1. Adjust brightness on monitor. 2. Replace monitor. 3. Replace video cable. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
• *Screen dark, no audio, no drive, but fan is running and LED is lit*	1. Replace video cable. 2. Replace monitor. 3. Remove any NuBus cards. 4. Remove all external peripherals. 5. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 6. Replace logic board. Retain customer's SIMMs. 7. 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. Replace logic board. Retain customer's SIMMs.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. NuBus card is drawing too much power. Remove the NuBus card and switch on power again. 3. Remove all external peripherals. 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.

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

Floppy Drive Problems	Solutions
• *Audio and video present, but internal floppy drive does not operate*	1. Replace internal floppy disk drive cable. 2. Replace internal floppy disk drive. 3. Replace logic board. Retain customer's SIMMs.
• *Disk ejects; display shows Mac icon with blinking "X"*	1. Replace floppy disk with known-good disk. 2. Replace internal disk drive cable. 3. Replace internal disk drive. 4. Replace logic board. Retain customer's SIMMs.
• *Disk will not eject*	1. Switch off system and hold mouse button down while switching on. 2. Try ejecting disk manually with paper clip. 3. Replace disk drive.
• *Drive attempts to eject disk, but doesn't*	1. Try pushing disk completely in. 2. Try ejecting disk manually with paper clip. 3. Replace disk drive.

SCSI Problems	Solutions
• *Internal disk drive runs continuously*	1. Replace internal SCSI drive cable. 2. Replace internal hard drive. 3. Replace logic board. Retain customer's SIMMs.
• *Internal hard disk will not operate*	1. Replace SCSI cable. 2. Replace SCSI 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. Verify that SCSI select-level switch on external device is set to a different priority from internal. 2. Replace terminator on the external device. 3. Verify that terminator is installed on the 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 keyboard, connect the mouse to the rear ADB port instead and disconnect the keyboard. 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.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board. Retain customer's SIMMs.
• *Cannot double-click to open an application, disk, or server*	1. Remove extra system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift> <Option> <Command> keys and select **Control Panel** from the Apple menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to the rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in the ADB port, replace the mouse. 5. Replace logic board. Retain customer's SIMMs.
• *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.

• *Known-good ImageWriter or ImageWriter II will not print*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Check the printer DIP switches. 4. Replace printer interface cable. 5. Replace logic board. Retain customer's SIMMs.
• *Known-good LaserWriter will not print*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Refer to the *Networks* tab in the *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**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 the back and top of the main unit are clear. Thermal protection circuitry may shut down the system. After 30 to 40 minutes, the system should be OK. 2. Replace power cable. 3. Replace power supply. 4. Replace logic board. Retain customer's SIMMs.
• *System intermittently crashes or locks up*	1. Make sure the System is version 6.0.7 (or higher). 2. Make sure software is known-good. 3. Replace logic board. Retain customer's SIMMs. 4. Replace SIMMs (refer to "RAM SIMM Verification" in this section). 5. Replace power supply.
• *No sound from speaker*	1. Verify that the 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 (see "Battery Verification" in this section). 2. Replace logic board. Retain customer's SIMMs.

- *Systems seems to boot, then message "Finder is old version" displays*

  1. Clear parameter RAM by holding down the <Command> <Option> <P> <R> keys and restarting the system. Continue to hold these keys down. You will hear the normal startup chords and about two seconds later you will hear another chord. This second chord means the parameter RAM has been cleared.
  2. Replace logic board. Retain customer's SIMMs.

- *System restarts itself*

  – Set the locking power switch on the rear of the unit to the unlocked (horizontal) position.

❑ MACINTOSH IIsi FLOWCHARTS

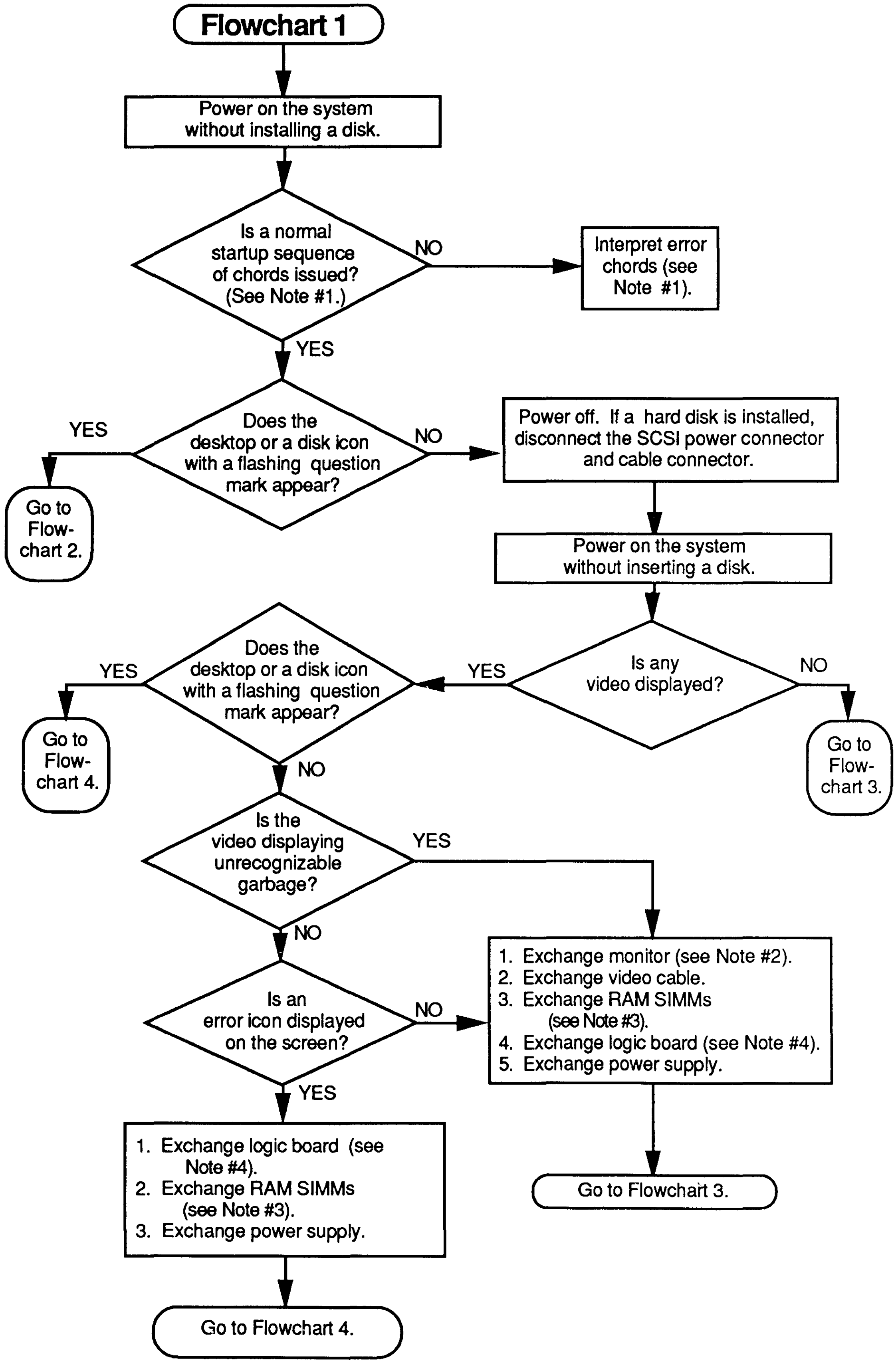
Flowchart 1 Notes

1. During a normal startup sequence, a medium pitched soft chord is emitted. If this does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor will correct the problem, refer to the appropriate *Technical Procedures* to isolate the monitor problem to the module level.

3. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

4. If the known-good SIMMs did not correct the problem, install the customer's SIMMs on the replacement logic board.

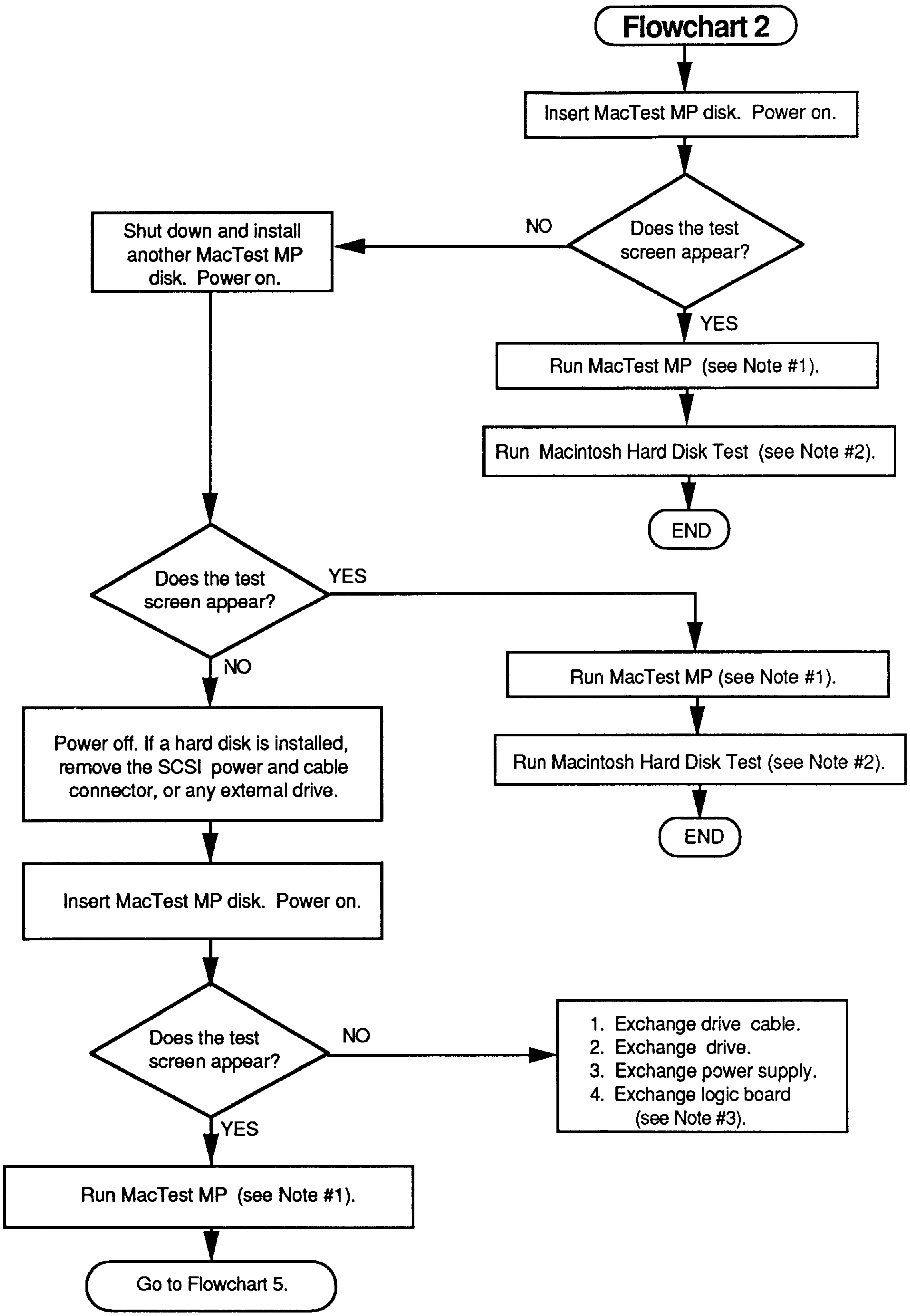

Flowchart 1
Power on the system without installing a disk.
Is a normal startup sequence of chords issued? (See Note #1.)
NO
Interpret error chords (see Note #1).
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 2.
NO
Power off. If a hard disk is installed, disconnect the SCSI power connector and cable connector.
Power on the system without inserting a disk.
Is any video displayed?
NO
Go to Flow-chart 3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flow-chart 4.
NO
Is the video displaying unrecognizable garbage?
YES
NO
1. Exchange monitor (see Note #2).
2. Exchange video cable.
3. Exchange RAM SIMMs (see Note #3).
4. Exchange logic board (see Note #4).
5. Exchange power supply.
Go to Flowchart 3.
Is an error icon displayed on the screen?
NO
YES
1. Exchange logic board (see Note #4).
2. Exchange RAM SIMMs (see Note #3).
3. Exchange power supply.
Go to Flowchart 4.

Flowchart 2 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Refer to the *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

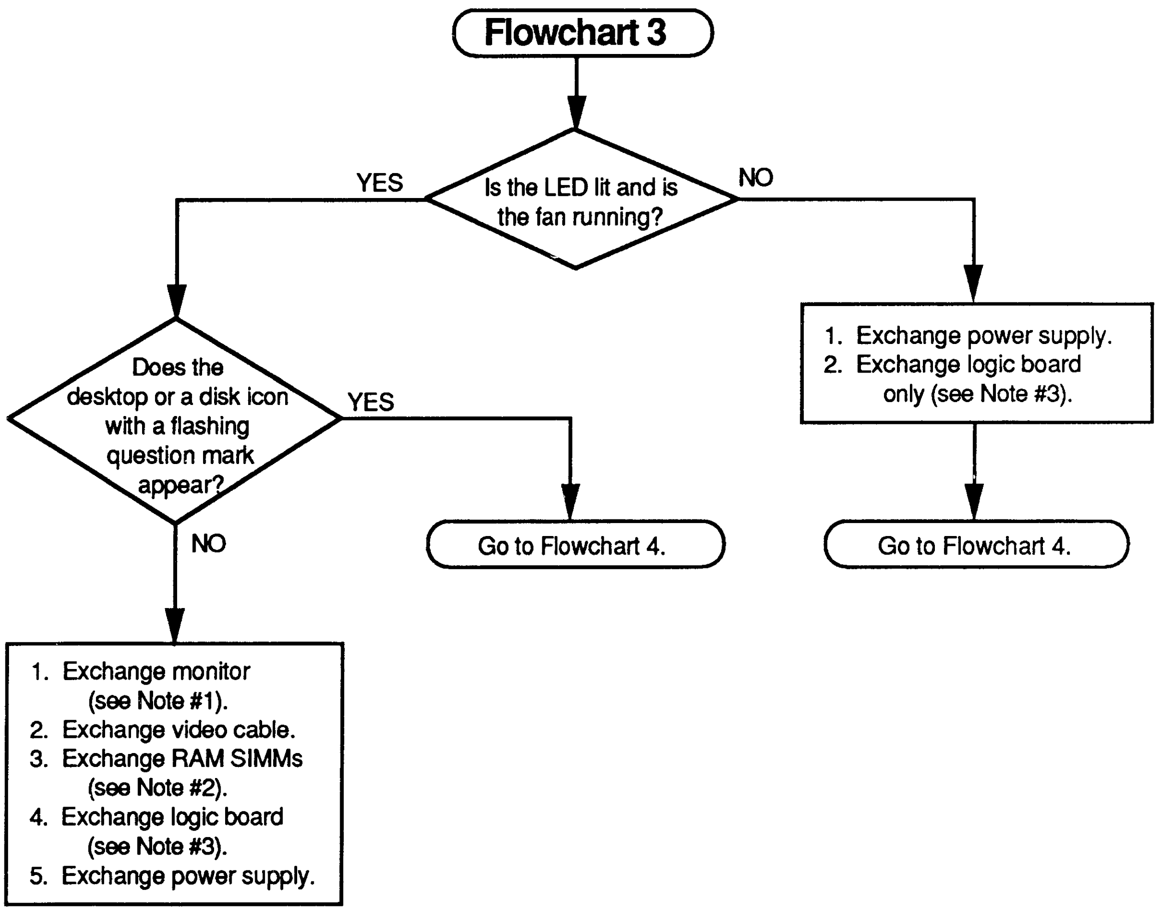

Flowchart 2
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
Shut down and install another MacTest MP disk. Power on.
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #2).
END
Does the test screen appear?
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #2).
END
NO
Power off. If a hard disk is installed, remove the SCSI power and cable connector, or any external drive.
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board (see Note #3).
YES
Run MacTest MP (see Note #1).
Go to Flowchart 5.

Flowchart 3 Notes

1. If exchanging the monitor will correct the problem, refer to the appropriate *Technical Procedures* to isolate the monitor problem to the module level.

2. Refer to "RAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

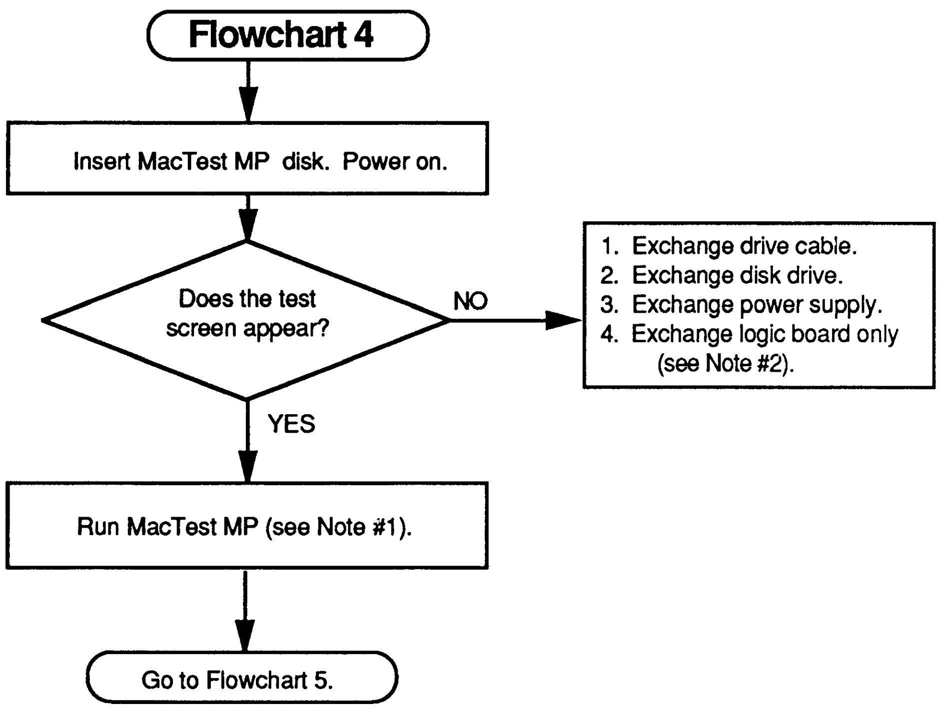
3. Install the customer's SIMMs on the replacement logic board.



Flowchart 4 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Install the customer's SIMMs on the replacement logic board.



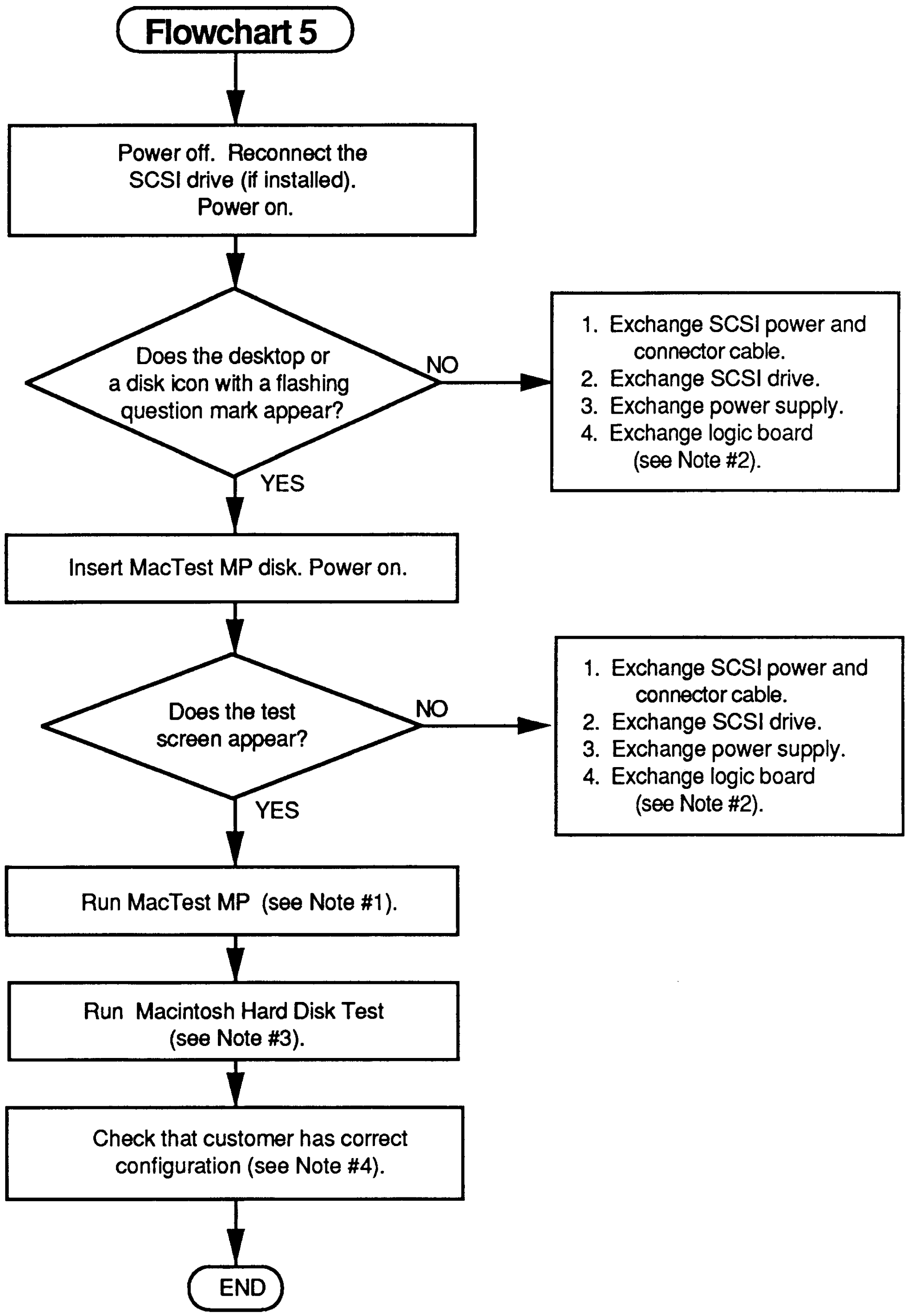
Flowchart 5 Notes

1. Refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures* for complete information.

2. Install the customer's SIMMs on the replacement logic board.

3. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

4. Customers must always get back the same system configurations they bring in. Refer to "Module Exchange Information" in this section.


Flowchart 5
Power off. Reconnect the SCSI drive (if installed). Power on.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board (see Note #2).
YES
Insert MacTest MP disk. Power on.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cable.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board (see Note #2).
YES
Run MacTest MP (see Note #1).
Run Macintosh Hard Disk Test (see Note #3).
Check that customer has correct configuration (see Note #4).
END

❑ RAM SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The RAM SIMMs installed on the customer's logic board may be defective. To verify a defective RAM SIMM, you must remove all the customer's RAM SIMMs and install known-good RAM SIMMs. Mark each known-good RAM SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Materials Required

SIMM removal tool
Four known-good SIMMs that are the same size (e.g., 512K or 1 MB) as the SIMMs you are verifying

Verification

1. Remove the top cover.

CAUTION: *Before removing the SIMMs, be sure to use proper ESD procedures. If an ESD pad is not available, touch bare metal on the power supply before proceeding. Failure to use proper ESD procedures can damage the logic board.*

2. Remove the customer's RAM SIMMs by using the SIMM removal tool. See the *You Oughta Know* tab for SIMM tool use.

   Note: Record the number and the sizes of the RAM SIMMs. The customer should receive the same number and sizes back!

3. Install four known-good RAM SIMMs.

   Note: Use only RAM SIMMs with 100 ns (or faster) fast-page-mode DRAMs. Do not use RAM SIMMs with 120 or 150 ns DRAMs.

4. Switch on the system. If you hear the normal startup sequence, the system is working properly and you can proceed to test the customer's RAM SIMMs.

5. Switch the system off, remove one of the known-good SIMMs, and install one of the customer's SIMMs.

6. Switch on the system. If you hear the normal startup sequence, the customer's RAM SIMM is good.

7. Repeat steps 5 and 6 to test each of the RAM SIMMs. Be sure to set defective RAM SIMMs where they will not be mixed up with good ones.

❑ BATTERY VERIFICATION

Introduction

The Macintosh IIsi logic board contains one lithium battery. This battery maintains the clock and PRAM while the unit is powered off.

WARNING: *Lithium batteries, the type used in the Macintosh IIsi, have a potential for explosion if improperly handled. Follow the verification procedure exactly.*

Materials Required

Voltmeter

Verification Procedure

1. Be sure power is off. Remove the top lid.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery (**Figure 4-1**).

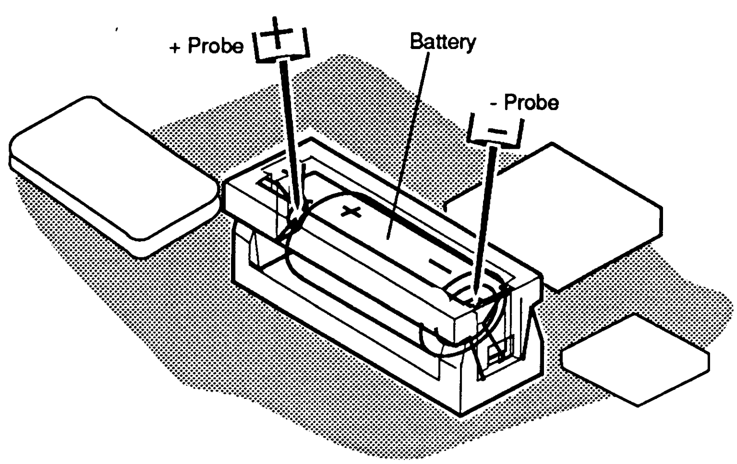


Figure 4-1 Verifying Battery Voltage

4. Touch and hold the ground probe of the voltmeter to the negative side of the battery.
5. The reading for a good battery should be **above 3.0 volts**. If the reading falls below 3.0 volts, replace the battery. Refer to Section 5, Additional Procedures, for replacement instructions.

Macintosh IIsi

Section 5 – Additional Procedures

❑ CONTENTS

Note: If a step is underlined, instructions for that step can be found in Section 2, Take-Apart.

❑ BATTERY REPLACEMENT

Introduction

Lithium thionyl chloride batteries, the type used in the Macintosh Classic, have some potential for explosion or overheating if improperly handled. The following precautions should be taken when storing, handling, or disposing of lithium batteries:

- Store lithium batteries in a designated, well-marked area with limited access.

- Apple's lithium batteries are sealed in individual zip-lock wrappers. Upon receipt, inspect the batteries for integrity of their wrappers, and store them in the same packaging in which they were received or in a similar closed, heavy plastic bag.

- Lithium batteries cannot be recharged. Do not attempt to recharge the battery. Doing so may cause the battery to overheat or explode.

- Do not allow the leads or terminals to short-circuit. A short-circuited battery may overheat or explode.

- Replace the battery with the correct Apple replacement battery only. Using an incorrect battery or a non-Apple battery may cause the battery to overheat or explode.

- When installing the battery, ensure the correct polarity. The polarity markings on the battery must match those on the battery holder or circuit board. Failure to observe correct polarity may cause the battery to overheat or explode.

- If the battery holder was provided with a cover, be sure to replace it.

- If the dead battery has leads, remove them before disposing of the battery.

- Do not dispose of the battery in a fire or incinerator. Doing so may cause the battery to explode.

- In addition to its explosive potential, lithium is water-reactive and must be disposed of as a hazardous waste, as follows:

  Place the dead battery into the zip-lock wrapper and packaging from which you took the replacement battery. Mark the battery package *DEAD* and return it to Apple for proper disposal. Exception: If the battery is physically damaged (for example, leaking), do not return it to Apple; dispose of the battery locally according to your local ordinances.

The long-life lithium battery in the Macintosh IIsi should serve many years. Refer to Section 4, Troubleshooting, to check the condition of the battery. If the battery should fail for some reason, replace it according to the following procedure.

Materials Required

Grounded workbench and wriststrap

CAUTION: *Use ESD precautions before removing or replacing the battery. Failure to do so may result in logic board failure.*

Remove

1. Remove the top cover and NuBus card, if one is installed.

2. Locate the battery holder and battery (**Figure 5-1**) toward the center of the logic board.

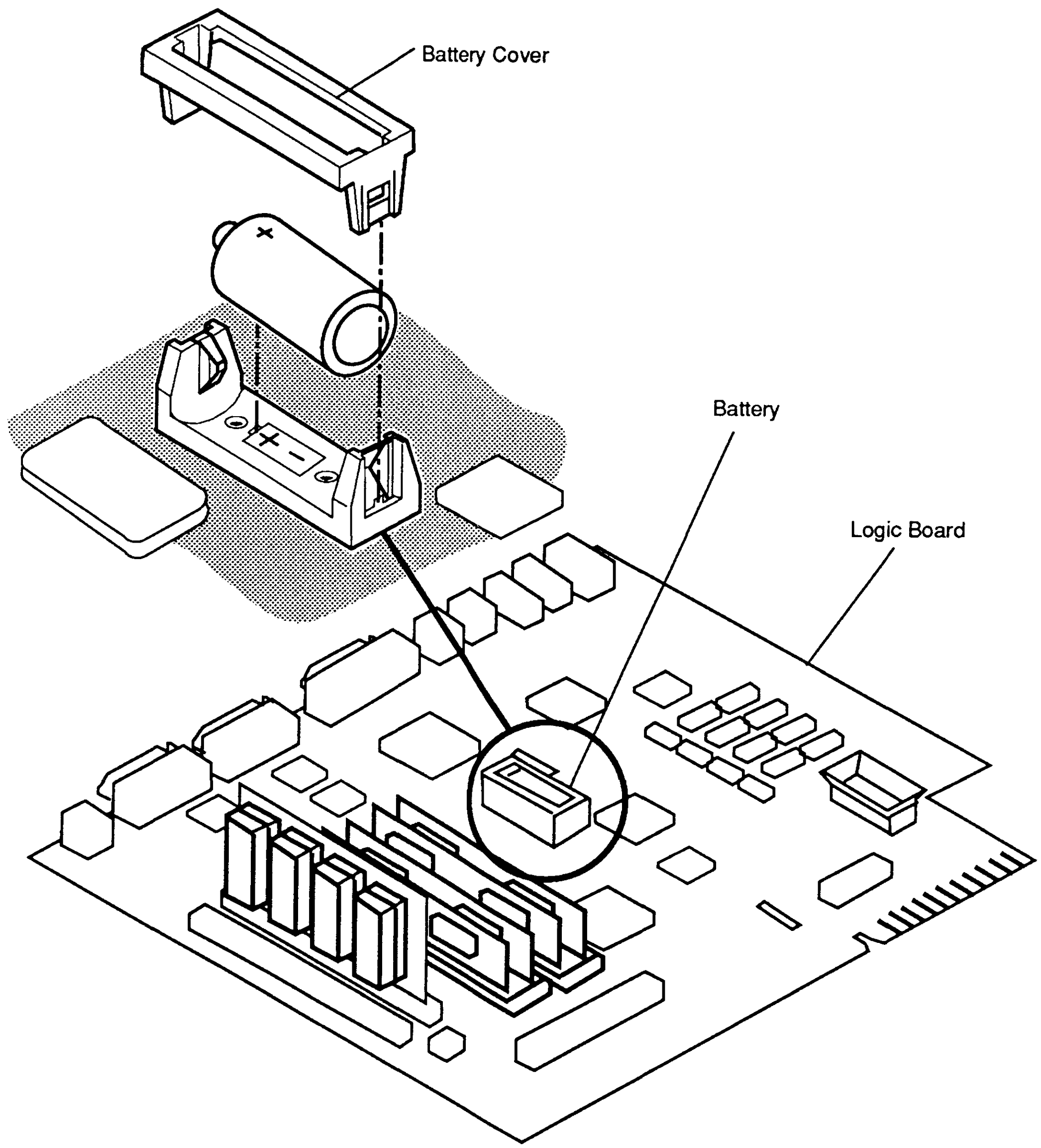


Figure 5-1 Battery

3. On one side of the battery holder, insert a small flat-blade screwdriver into the top and gently push the screwdriver down until the side tab pushes out. The battery holder cover will come loose; do the same on the other end and remove the cover from the holder.

4. Grasp the battery between your thumb and forefinger and lift out the battery.

Replace

1. Insert the new battery so the positive side of the battery is inserted into the positive-marked side of the holder (**Figure 5-1**).

CAUTION: *Be sure the positive side of the battery is in the correct location (see* ***Figure 5-1****). An incorrectly placed battery can damage the logic board.*

---

2. Replace the holder cover.

3. Replace the NuBus card, if one was installed, and the top cover.

4. Set the clock using the Control Panel.

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

The Macintosh IIsi contains 1 MB of RAM soldered on the logic board (bank A). Additional RAM is available in packages known as single in-line memory modules (SIMMs). A SIMM is a small circuit board with memory chips. The memory chips may be surface-mounted, or they may be mounted through the board. Each SIMM board has contacts on one edge that fit into the sockets of bank B on the logic board.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Identification

SIMMs are available with various amounts of RAM and various speeds.

The four SIMM sockets (bank B) must be empty or be filled with four same-sized SIMMs (e.g., 256K). You cannot combine different-sized SIMMs.

IMPORTANT: *A single SIMM or a pair of different-size SIMMs will not function correctly.*

You must use 100 ns (or faster) SIMMs on the Macintosh IIsi. Slower SIMMs (e.g., 120 ns) will cause serious timing problems. The RAM speed is usually indicated by the *-xx* number after the manufacturer's part number. For example, *-8* indicates 80 ns SIMMs and *-12* indicates 120 ns SIMMs.

Note: When you are removing SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are located in *You Oughta Know.*

Upgrades

The following chart summarizes the configurations that the Macintosh IIsi supports:

RAM	Bank A	Bank B
1 MB	1 MB on-board RAM	Empty
2 MB	1 MB on-board RAM	Four 256K SIMMs
3 MB	1 MB on-board RAM	Four 512K SIMMs
5 MB	1 MB on-board RAM	Four 1 MB SIMMs
9 MB	1 MB on-board RAM	Four 2 MB SIMMs
17 MB	1 MB on-board RAM	Four 4 MB SIMMs

Macintosh IIsi

Illustrated Parts List

❑ CONTENTS

The figures and lists in this section include all piece parts that can be purchased separately from Apple for the Macintosh IIsi, along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

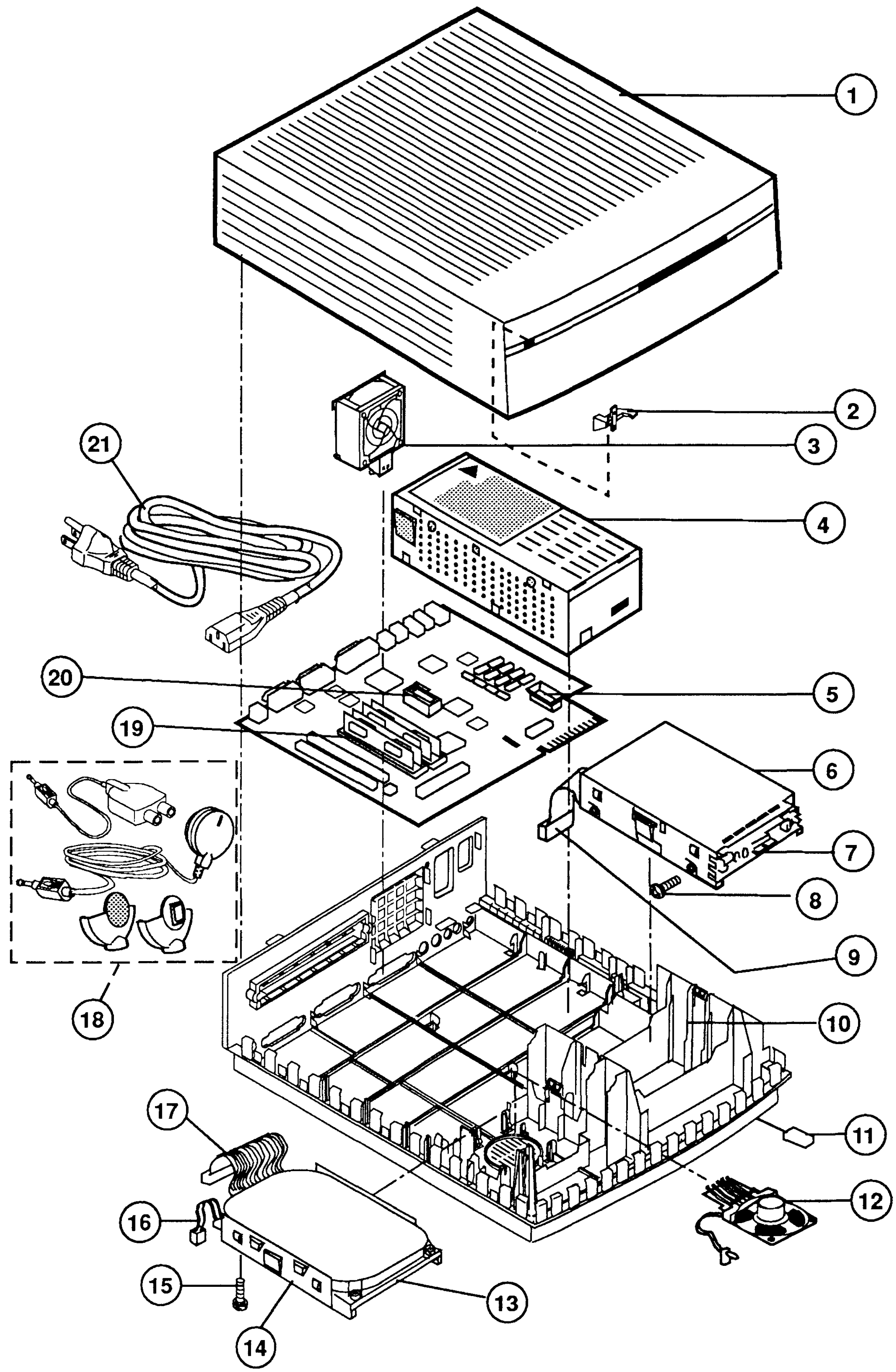


FIGURE 1

❑ MACINTOSH IIsi – SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
–	602-0164	Service Packaging, HDA, 3.5-Inch, Half-Height (replaced by 602-0282 or 602-0308)
–	602-0308	Service Packaging, HDA, 3.5-Inch, 1-Inch-Height, without carrier (also used for 19 mm floppy drive)
–	076-0439	Dust Shield, 1.44 MB Apple SuperDrive, Package of 5
1	630-5804	Top Case
2	815-6247	Light Pipe, Power Indicator
3	810-6030	Fan Assembly
4	661-1616	Power Supply
5	661-1615	Logic Board
6	805-0961	SuperDrive Carrier
7	661-0474	1.4 MB SuperDrive Mechanism
8	844-0018	Screw, SuperDrive Carrier to SuperDrive
9	591-0025	Cable, 1.4 MB SuperDrive, Internal
10	630-5803	Bottom Case
11	865-0024	Platinum Foot
12	810-6031	Speaker/LED Assembly
13	661-0614	HDA, 40 MB, 3.5-Inch, 1-Inch-Height, SCSI
	661-0624	HDA, 80 MB, 3.5-Inch, 1-Inch-Height, SCSI
14	805-0980	Carrier, HDA, Internal, 3.5-Inch, SCSI
15	444-6104	Screw, 6 - 32 x 0.250 (HDA carrier to HDA)
16	591-0027	Cable, HDA, Power
17	591-0026	Cable, HDA, Internal
18	699-5071	Microphone Assembly
19	661-0519	SIMM, 256K, SOJ, 80 ns
	661-0646	SIMM, 512K, SOJ, 80 ns
	661-0520	SIMM, 1 MB, SOJ, 80 ns
	661-0546	SIMM, 1 MB, SOJ, 80 ns, Parity
	661-0643	SIMM, 2 MB, SOJ, 80 ns
	661-0719	SIMM, 1 MB, SOJ, 80 ns
20	742-0011	Lithium Battery (without leads)
21	590-0380	Cable, AC Power, 110 V, Smoke

IMPORTANT: *Refer to the* Quick Reference: SIMM Compatibility *chart for SIMM compatibility. Follow this chart carefully! Some SIMMs that may appear to be interchangeable with others are not.*

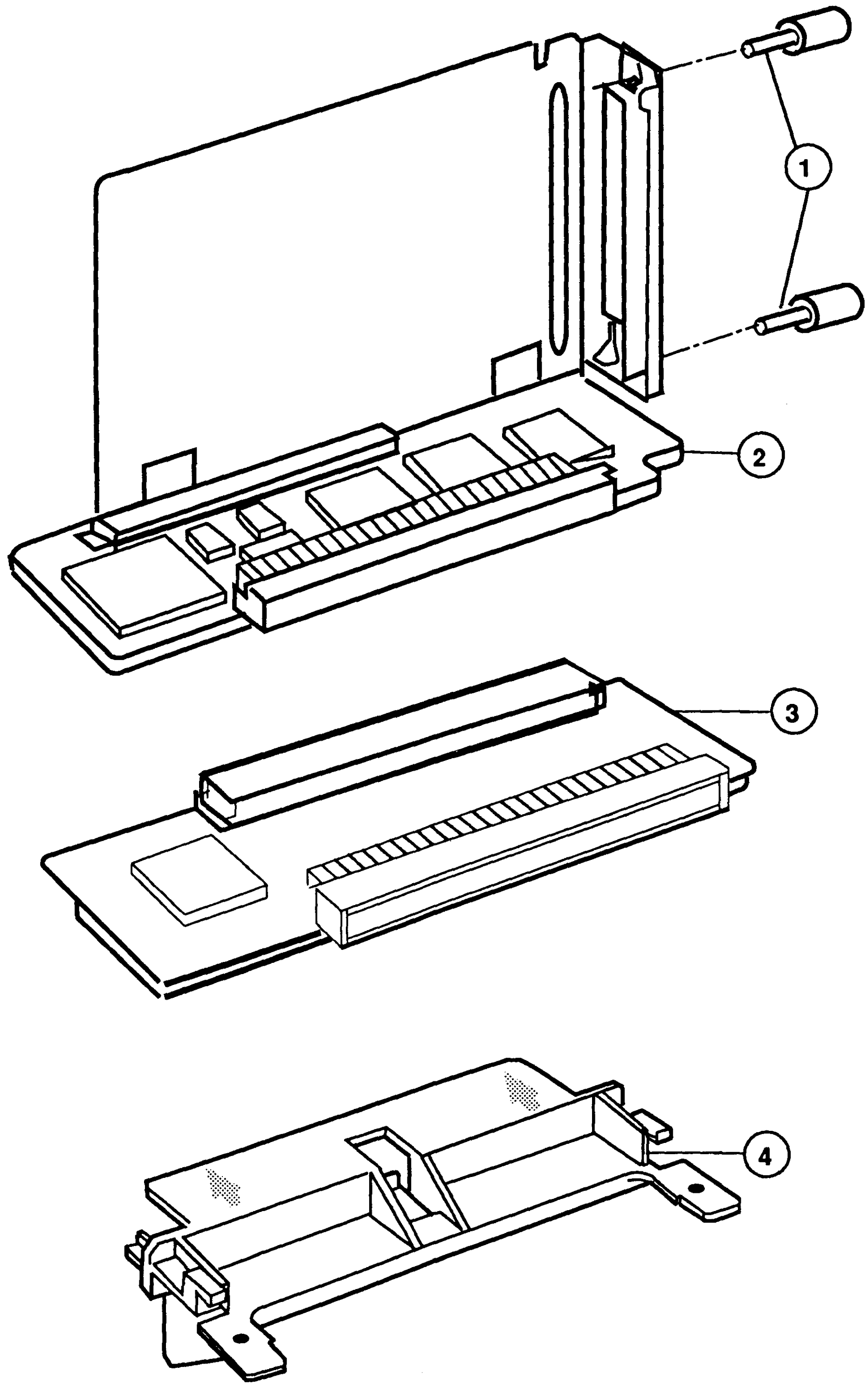


FIGURE 2

❑ ADAPTER CARDS (Figure 2)

Item	Part No.	Description
1	450-0032	Thumbscrew, NuBus Adapter Card
2	661-0645	NuBus Adaptor Card
3	661-0644	030 Adaptor Card
4	815-6246	Plastic Bracket, 030 Adapter Card

Apple Technical Procedures

Macintosh II/IIx/IIfx

Technical Procedures

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Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 1 – Basics

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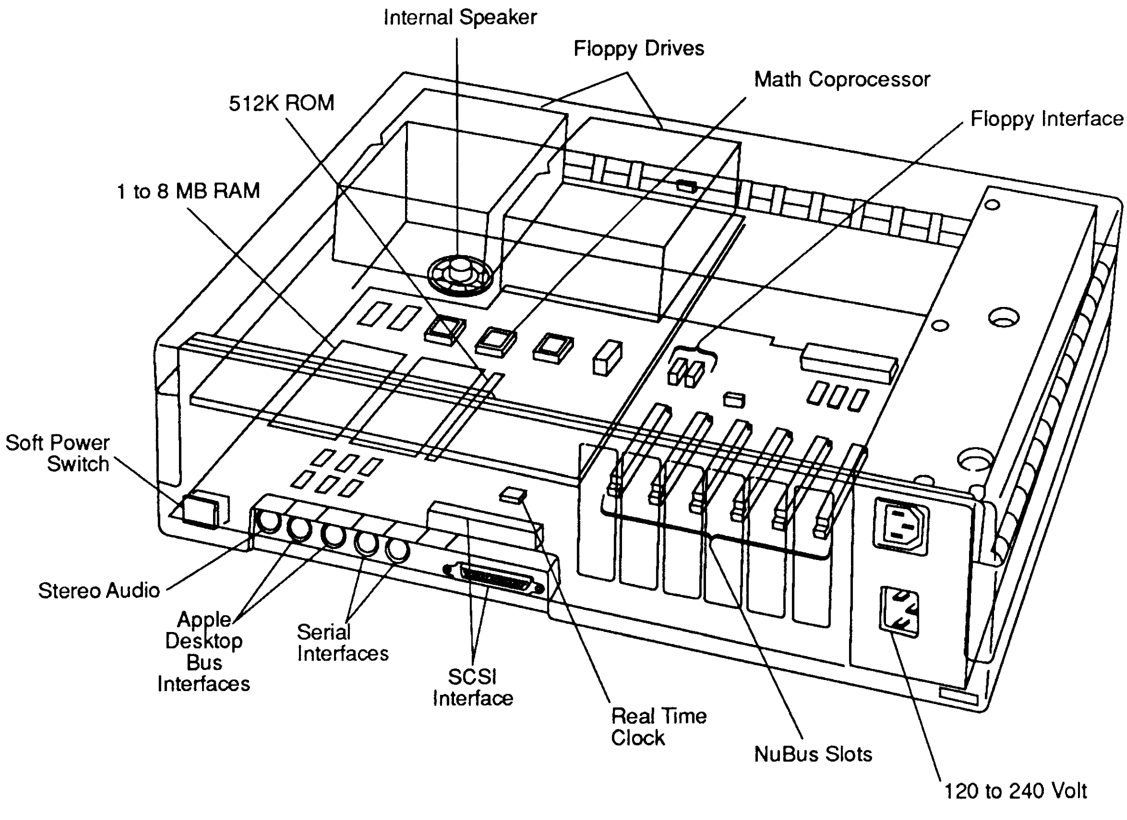

Internal Speaker
Floppy Drives
Math Coprocessor
Floppy Interface
512K ROM
1 to 8 MB RAM
Soft Power Switch
Stereo Audio
Apple Desktop Bus Interfaces
Serial Interfaces
SCSI Interface
Real Time Clock
NuBus Slots
120 to 240 Volt

Figure 1-1

❑ PRODUCT DESCRIPTION

The Macintosh® II, IIx, and IIfx are high-performance, open-architecture Macintosh computers. As the high-end computers of the Macintosh line, they were designed to run existing software while providing the power, flexibility, and expandability necessary for future applications.

Features

Figure 1-1. Features are divided into two categories—those common to the Macintosh II, IIx, and IIfx and features specific to each model. Features common to each computer include:

- Two RS-422 serial interfaces
- SCSI interface with internal and external connectors
- Floppy interface supporting a maximum of two drives
- Stereo audio with internal speaker and a connector for attaching external speakers
- Two Apple Desktop Bus™ interfaces
- Battery backed-up real time clock chip
- Random-access memory packaged as single in-line memory modules (SIMMs)
- Floating-point math coprocessor
- Supports a maximum of two floppy drives and one half-height SCSI hard disk drive
- Six NuBus™ expansion slots
- "Soft" power switch
- 120 volt to 240 volt universal power supply
- 512K of ROM

Macintosh II

The Macintosh II has these additional features:

- Motorola® MC68020 microprocessor operating at 16 MHz
- Motorola MC68881 math coprocessor
- Address management unit (AMU)
- Optional paged memory management unit (PMMU) to support multitasking operating systems such as Apple A/UX®
- 1 megabyte 120-nsec RAM, expandable to 8 megabyte
- One 800K 3.5-inch disk drive (second drive optional)
- 200 percent faster than a Macintosh SE
- Macintosh system software version 6.0.2 or later

Macintosh IIx

The Macintosh IIx has these additional features:

- Motorola MC68030 microprocessor operating at 16 MHz
- MC68030 has an on-chip paged memory management unit (PMMU) and a 256-byte data and instruction cache
- Motorola MC68882 math coprocessor
- 4 megabytes of 100-nsec RAM, expandable to 8 megabytes
- One 1.4 MB Apple SuperDrive™ (second drive optional)
- 15 percent faster than Macintosh II
- Macintosh system software version 6.0.2 or later

Macintosh IIfx

The Macintosh IIfx has these additional features:

- Motorola MC68030 microprocessor operating at 40 MHz
- MC68030 has on-chip paged memory management unit (PMMU) and a 256-byte data and instruction cache
- Motorola MC68882 math coprocessor
- 4 MB of 80-nsec RAM, expandable to 8 MB
- Two 1.4 MB SuperDrive floppy disk drives
- 120-pin processor-direct slot for high-speed interfacing to the microprocessor
- SCSI interface supports direct memory access (DMA) for faster transfers and compatibility with new, higher-speed peripherals
- I/O processors for the two serial ports, two Apple Desktop Bus ports, and SCSI port
- 32K of 25-nsec static RAM (data cache)
- 30 to 80 percent faster than Macintosh IIci
- 130 to 300 percent faster than Macintosh IIx
- NuBus slots that implement 32-bit address and data paths
- Macintosh system software version 6.0.5 or later

Configurations

The Macintosh II, IIx, and IIfx are available from Apple in various configurations. These configurations are described below.

Macintosh II

- Single 800K 3.5-inch floppy disk drive
- Single 800K 3.5-inch floppy disk drive and 40 MB hard disk

Macintosh IIx

- Single FDHD SuperDrive
- Single FDHD SuperDrive and 80 MB hard disk

Macintosh IIfx

- Dual FDHD SuperDrives
- Dual FDHD SuperDrives and 80 MB hard disk
- Dual FDHD SuperDrives and 160 MB hard disk
- Dual FDHD SuperDrives and 80 MB hard disk with Apple A/UX
- Dual FDHD SuperDrives, 80 MB hard disk, and parity memory

These are not the only possible configurations. Apple offers a number of options to enhance the operation and performance of these systems. These options are described later in this section. Also, third-party manufacturers offer a wide variety of products which can be installed. You may see systems with different amounts of RAM, different sizes and capacities of hard disk drives, NuBus cards, and external peripherals.

Options and Upgrades

The following options and upgrades are available from Apple:

- Second internal 800K floppy drive or Apple SuperDrive
- 1.4 MB Apple SuperDrive upgrade for the Macintosh II
- 20-, 40-, 80-, and 160-megabyte internal and external SCSI hard disk drives
- 68851 paged memory management unit (PMMU) for the Macintosh II (required to run Apple A/UX)
- 1-, 2-, and 4-megabyte memory expansion kits
- Macintosh IIx logic board upgrade for the Macintosh II
- Macintosh IIfx logic board upgrade for the Macintosh II and IIx

Revised Macintosh II Logic Board

A revised logic board with upgraded ROMs is available for the Macintosh II. This logic board has four revision "B" ROMs. The revised logic board with upgraded ROMs for the Macintosh II is not necessary unless you are using a NuBus card that requires more than 1 MB of address space.

A/UX Users

To maintain system functionality, A/UX customers planning to use the Macintosh IIx or IIfx and/or Apple SuperDrive must upgrade A/UX software to version 1.0.1.

Module Identification

An exploded view of the system unit with field serviceable modules is shown in **Figure 1-2**. Additional module identification is available in the *Apple Service Technical Procedures Module Identification* manual. Information in the *Module Identification* manual supersedes the information available in this manual.

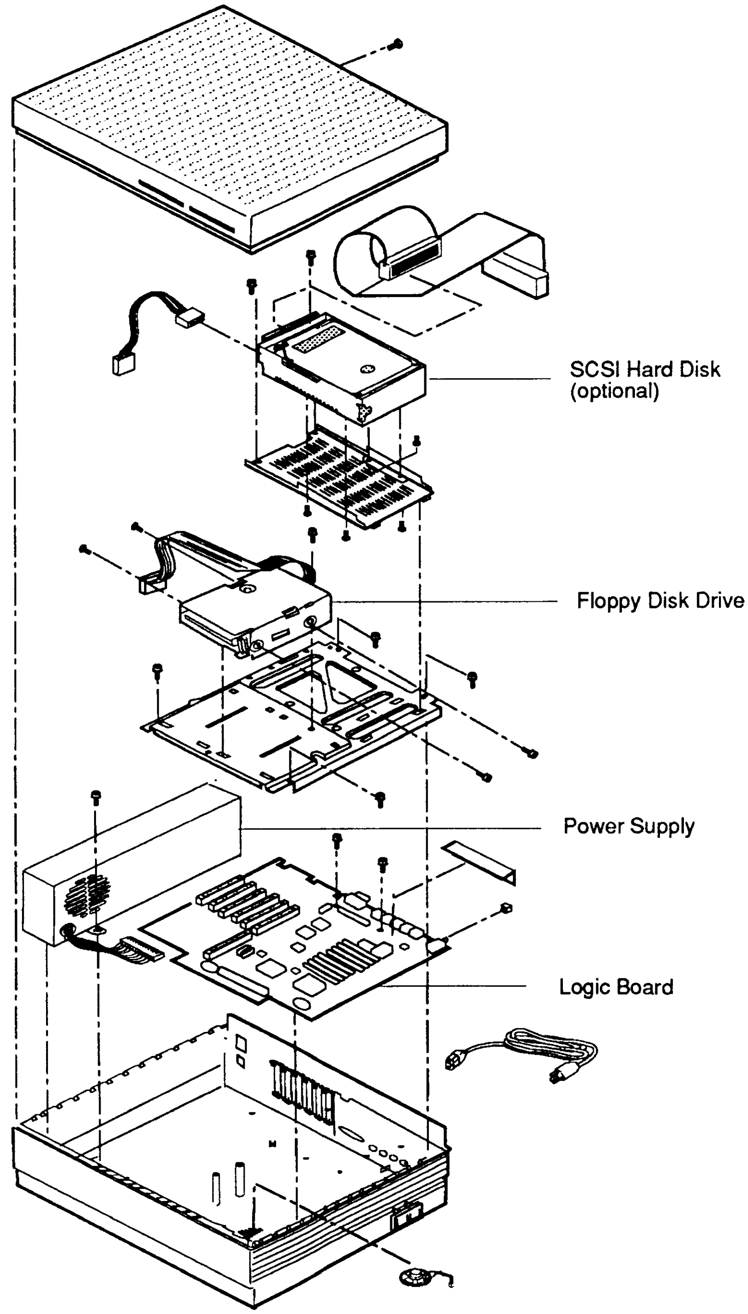
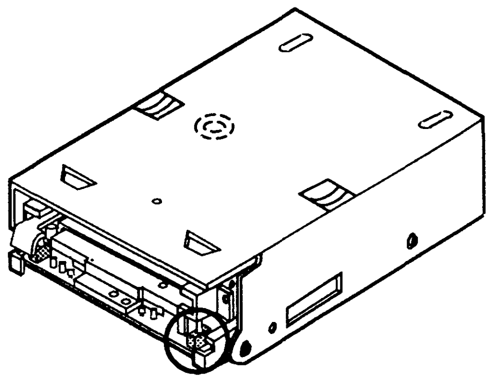


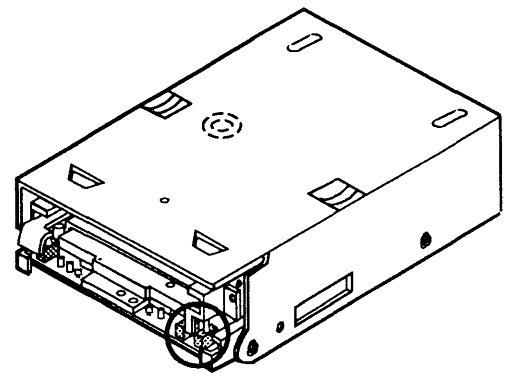
Figure 1-2

FDHD and 800K Drive Identification

Figure 1-3. The FDHD disk drive cannot be distinguished from the 800K format disk drive without first removing the computer's cover (see Section 2, Take-Apart). With the cover removed, locate the microswitches at the front of the drive. The FDHD has three microswitches; the 800K drive has only two microswitches.



800K Drive



1.4 MB Drive

Figure 1-3

Figure 1-4. You can also identify a FDHD drive by checking the manufacturer's label on the bottom of the drive; **2MB** has been added to the label on all high-density drives.

SONY® 2MB
MODEL MP-FXXX-XXG
Made in Japan
4-873-458-01

Figure 1-4

Connector and Switch Identification

Figure 1-5. The Macintosh II, IIx, and IIfx have six interface connectors, two power connectors, six NuBus card openings, and a power switch on their rear panels. The programmer's switch is located at the right rear of the computer. Pin-outs and signal descriptions for the interface connectors can be found in the *Apple Service Technical Procedures Peripheral Interface Guide.*

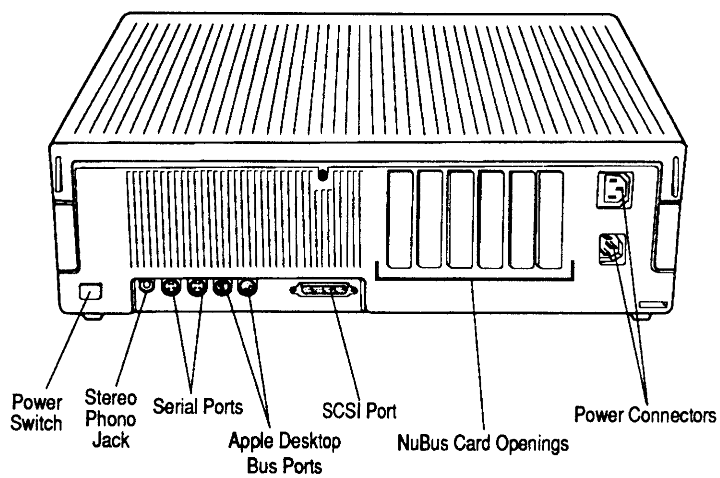
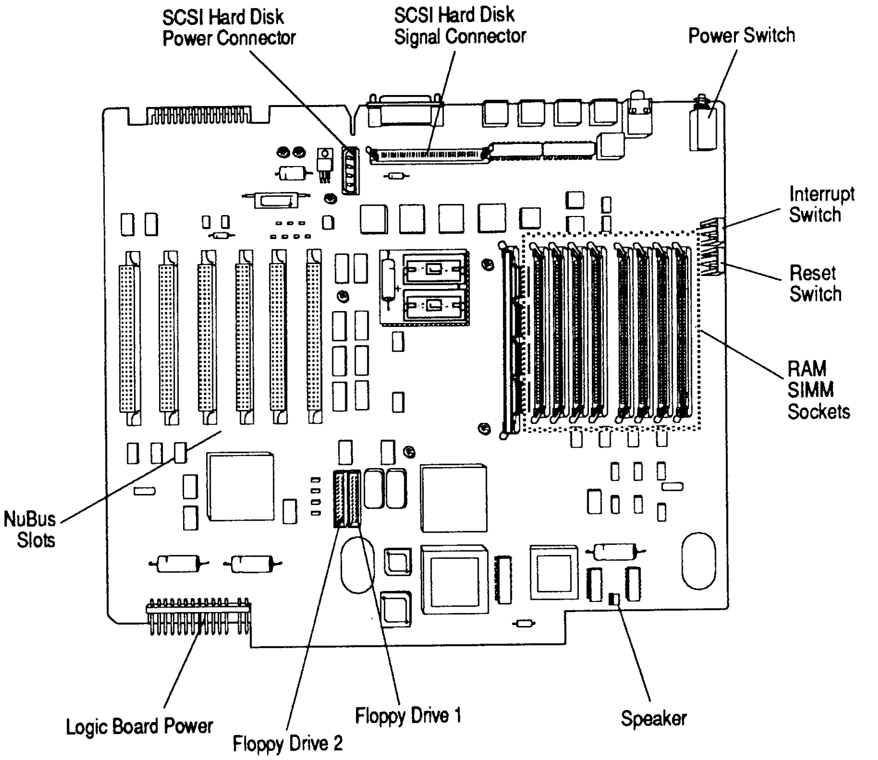


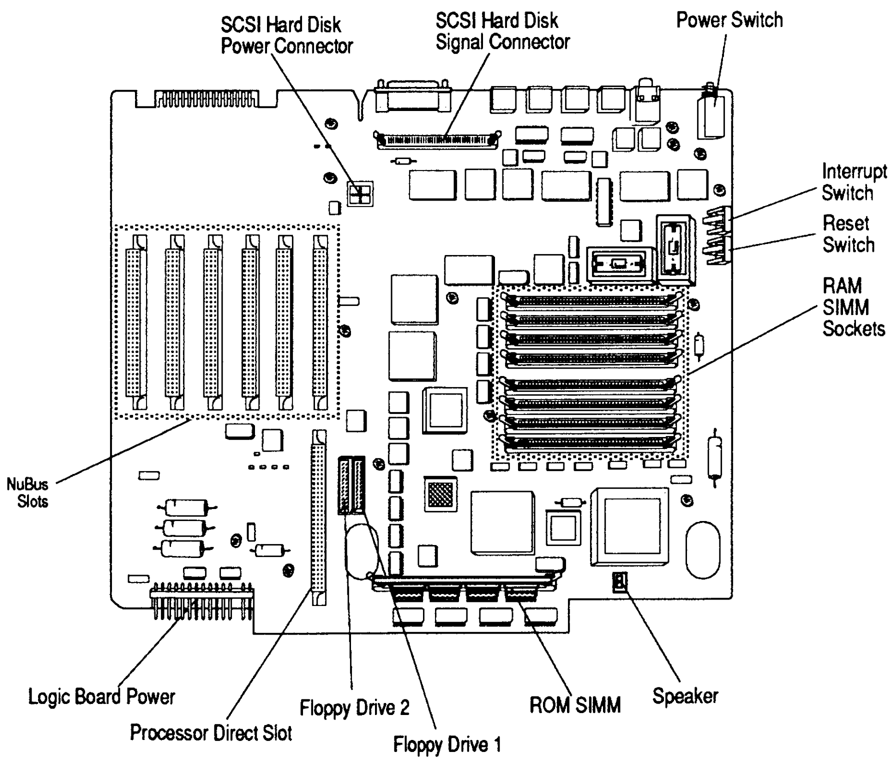
Figure 1-5

Figure 1-6. The Macintosh IIfx has six NuBus slots, a 120-pin processor-direct slot; one ROM and eight DRAM SIMM sockets; and connectors for power, two floppy drives, the internal speaker, the SCSI hard disk signal, and the SCSI hard disk power cable.

The Macintosh II and IIx have the same connectors with two exceptions: The Macintosh II does not have a ROM SIMM socket, and neither the Macintosh II or IIx have the 120-pin processor-direct slot.



Macintosh II/IIx



Macintosh IIfx

Figure 1-6

Two other items concerning the internal connectors should be noted:

- The SCSI hard disk power connector on the Macintosh IIfx is a 2-pin x 2-pin square connector, while the Macintosh II and IIx use a 4-pin x 1-pin rectangular connector. Be sure you have the correct cable when exchanging SCSI hard disks.

- While the Macintosh IIfx PDS connector is physically the same as the cache memory card slot in the Macintosh IIci, these slots are electrically different and cards designed for one computer cannot be used in the other.

CAUTION: *If a Macintosh IIci cache card is installed in the Macintosh IIfx expansion slot, or vice-versa, damage to the card and logic board are likely.*

❑ THEORY OF OPERATION

Introduction

The Macintosh II, IIx, and IIfx are made up of three modules: the logic board, power supply, and FDHD SuperDrive (Macintosh IIx/IIfx) or 800K disk drive (Macintosh II). This section presents an overview of each of these modules and a functional description of the system as a whole. The main logic boards for the Macintosh II and IIx are similar and are described together with differences noted where appropriate. The Macintosh IIfx logic board is different and is described separately. The power supplies and floppy disk drives used in all three computers are the same and are described after the logic boards.

The information here will give you an understanding of how each module of the computer works, as well as how the system functions. This will assist you in performing logical troubleshooting of the Macintosh II, IIx, and IIfx computers.

Macintosh II and IIx Logic Boards

The design and operation of the Macintosh II and IIx logic boards is very similar. Differences between them are noted where appropriate. **Figure 1-7** is a simplified block diagram. **Figure 1-8** shows the major logic board components.

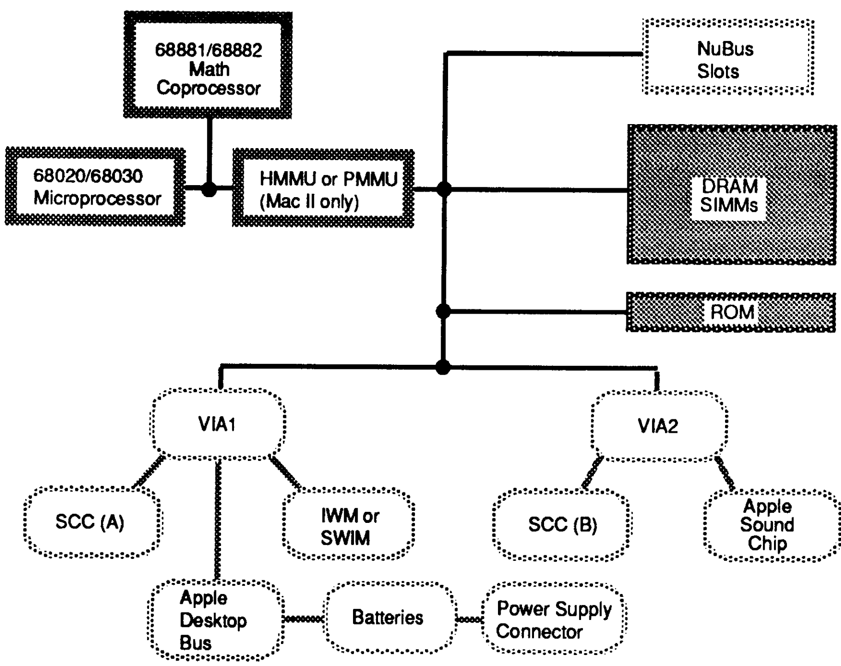
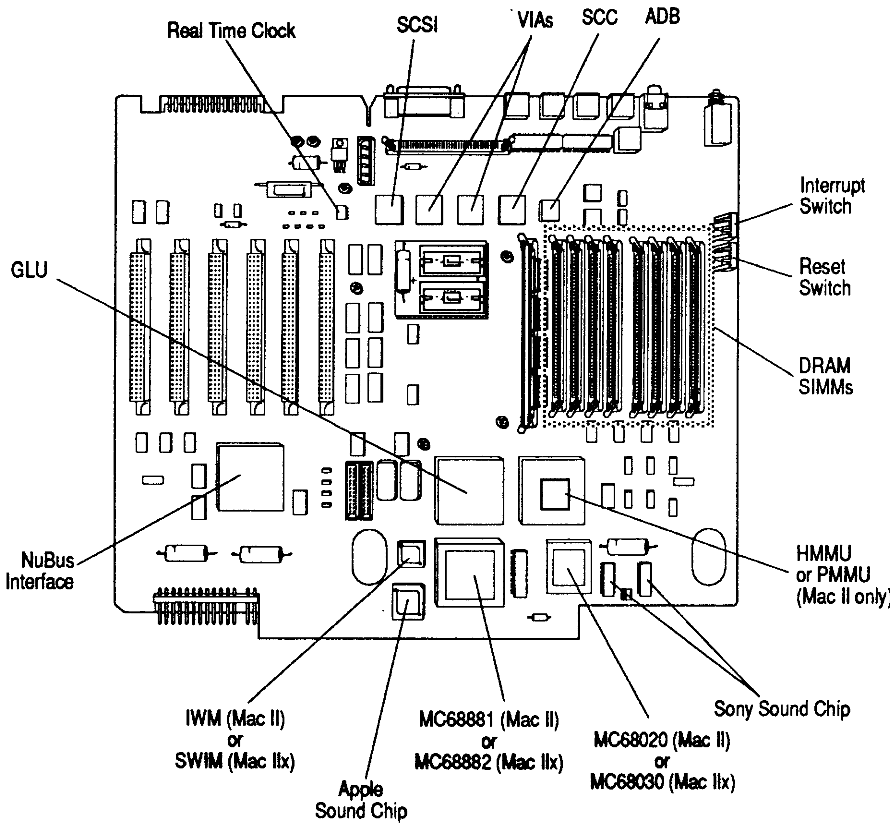


Figure 1-7



Macintosh II and IIx

Figure 1-8

Microprocessor

The Macintosh II contains a 68020 microprocessor that supports both 24- and 32-bit processing modes. The 68030 microprocessor in the Macintosh IIx is a true 32-bit processor, yet it also supports 24- and 32-bit processing modes. Both microprocessors run at 15.6672 MHz for high performance. When running in the 24-bit processing mode, the Macintosh II and Macintosh IIx are compatible with the majority of existing Macintosh applications.

The 68030 is an enhanced version of the 68020. In addition to the features of the 68020, the 68030 also includes an integrated paged memory management unit (PMMU) to support multitasking operating systems such as Apple A/UX. The 68030 also features a 256-byte data cache to provide fast access to commonly used instructions. This data cache results in approximately a 15 percent increase in performance over the 68020.

Math Coprocessor

The 68881 math coprocessor in the Macintosh II and the 68882 coprocessor in the Macintosh IIx are IEEE P754 standard floating-point ICs. Each provides a high degree of precision and speed for Macintosh programs.

Address Management Unit (Macintosh II only)

The address management unit (AMU) is in the Macintosh II only. The AMU, also called the Hochsprung memory management unit (HMMU), allows the Macintosh II to run Macintosh software in the 24-bit address mode of 68000-based Macintoshes, and run Macintosh II software in the 32-bit address mode.

Paged Memory Management Unit

The 68851 paged memory management unit (PMMU) is available as an option to replace the HMMU in the Macintosh II. In the Macintosh IIx, the PMMU is an integral part of the 68030 microprocessor. The PMMU, in addition to providing 24- to 32-bit address translation, also provides memory management capabilities to support multitasking capabilities such as virtual, protected, and shared memory. These features allow the use of the UNIX® operating system in the form of Apple A/UX in addition to the Macintosh operating system and compatibility with older applications.

GLU Chip

The general logic unit (GLU) IC is an Apple-designed custom gate array that performs a variety of support functions for the microprocessor. The GLU chip provides address decoding and chip select; RAM refresh; CPU, SCC, and VIA clock signal generation; and NuBus, VIA, SCC, power, and NMI switch interrupt handling.

RAM

Random-access memory (RAM) is provided in packages known as single in-line memory modules (SIMMs). Each SIMM consists of a small printed circuit board with various configurations of surface-mounted dynamic RAM (DRAM) chips. On one edge of each SIMM is a contact that fits into the SIMM sockets located on the logic board.

The amount of RAM on the logic board can be changed by installing the same size SIMMs in either Bank A or B, with the larger RAM size in Bank A (the first four rows closest to the edge of the board).

Various RAM configurations are possible, depending on how many SIMMs are used and on the size of the DRAM chips.

Every time the Macintosh II or IIx is powered on, the system ROMs performs a memory test to determine how much RAM is present in the machine.

ROM–
Macintosh II

The Macintosh II has 256K of nonvolatile read-only memory. Four 512K x 8-bit dual-in line (DIP) devices are used. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox, operating system support, diagnostics, and self-tests.

ROM replacement and upgrades are performed by replacing one or more ROMs. The Macintosh II logic board is designed to also accept 1 megabit (128K x 8-bit) devices providing a maximum of 512K of ROM.

*ROM–
Macintosh IIx*

The Macintosh IIx has 256K of nonvolatile read-only memory. Four 512K x 8-bit surface-mount devices are used. These four ROMs are then attached to a small printed circuit board for installation in the ROM SIMM socket provided. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox, operating system support, diagnostics, and self-tests. These ROM chips also include code supporting the FDHD disk drive and SWIM disk controller chip.

ROM replacement and upgrades are performed by replacing the entire ROM SIMM. The Macintosh IIx logic board is designed to also accept 1 megabit (128K x 8-bit) devices providing a maximum of 512K of ROM.

*Versatile
Interface
Adapters*

The Macintosh II and Macintosh IIx contain two SY6522A versatile interface adapters (VIAs). These chips, known as VIA1 and VIA2, provide maximum compatibility with existing Macintosh software.

VIA1 provides the system with most of the signals from the 68000-based Macintosh configuration. It also provides access to new features, including an Apple Desktop Bus interrupt and a synchronous modem signal.

VIA2 controls the HMMU (Macintosh II only); decodes the NuBus slot interrupts, a SCSI interrupt, and the Apple sound chip interrupt; powers the unit off; blocks NuBus accesses to RAM; and determines errors that occur in NuBus transactions.

*Real-Time
Clock*

The real-time clock is an Apple-custom chip. It contains 256 bytes of RAM that is powered by two lithium batteries when external power is turned off. These RAM bytes are called parameter RAM. They store the configuration of ports, the clock setting, and other data that need to be preserved even when external AC power is not available.

Input / Output Interfaces

The Macintosh II and IIx, like all Macintosh computers, contain a number of input/output interfaces:

- Two RS-422 serial ports – The serial ports include support for a synchronous modem and are controlled by the serial communications controller (SCC) circuitry.

- Two Apple Desktop Bus ports – This is a low-speed serial interface that provides communication between the CPU and input devices.

- Floppy disk interface – The Macintosh IIx floppy interface can support two internal FDHD disk drives and is controlled by the SWIM chip. The Macintosh II floppy interface can support two internal 800K disk drives and is controlled by the IWM chip.

- SCSI interface – Supports an optional internal SCSI hard drive and up to six additional external SCSI devices. This interface is controlled by the 53C80 SCSI controller circuitry.

- Stereo sound port – The Macintosh II and IIx have stereo sound capability. Sound is controlled by the Apple and Sony™ Sound Chip circuitry.

- NuBus expansion interface – The Macintosh II and IIx have six NuBus expansion slots. NuBus is a 32-bit bus designed by Texas Instruments for system expansion.

RS-422 Serial Interfaces

The two serial ports are controlled by an 8530 serial communications controller (SCC). Port 1, the modem port, can be programmed for asynchronous or synchronous protocols. Port 2, the printer port, can be programmed for asynchronous or AppleTalk® operation. The serial ports conform to the EIA RS-422 standard. These ports are used mainly for (though not limited to) connecting the Macintosh II and IIx to AppleTalk networks, serial printers, and modems.

The Macintosh II and IIx use two mini DIN-8 connectors for the two ports. These are the same connectors found on all Macintosh computers since the Macintosh Plus. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K enhanced serial ports.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a low-speed serial communication bus used to connect input devices to the computer. ADB can be used to connect devices such as keyboards and pointing devices. ADB devices connect to the computer via a mini DIN-4 connector on the rear panel.

All devices that are made for the Apple Desktop Bus have some kind of microprocessor that makes them intelligent devices. All external ADB devices, except the mouse, have a second ADB connector for connecting to other ADB devices. Because it has no connector, the mouse must be the last device attached to the Apple Desktop Bus.

Floppy Interface – Macintosh II

The Macintosh II is capable of supporting two internal 800K 3.5-inch drives. The disk interface uses the Apple custom "Integrated Woz Machine" (IWM) chip to control the drives. Together with the VIA, the IWM generates all the signals needed to read, write, format, and eject disks. The disk interface on the Macintosh II supports up to two internal drives and no external drives.

The IWM is clocked at 15.6672 MHz, which is twice the frequency used in previous Macintosh systems. An internal "divide by two" circuit is used to access 400K or 800K drives.

An upgrade is available that allows the Macintosh II to use the 1.4 MB FDHD SuperDrive. The upgrade replaces the IWM with a SWIM disk controller and includes new system ROMs with extensions to support the new disk controller and high-density drive.

Floppy Interface – Macintosh IIx

The SWIM chip in the Macintosh IIx is a complete multimode floppy disk interface on a single IC. The SWIM is an enhanced version of its predecessor, the IWM, found in the Macintosh, Macintosh Plus, SE, and II. The SWIM chip incorporates the features of the IWM and provides the additional capability to read, write, and format in both group coded recording (GCR) and modified frequency modulation (MFM) data formats. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR (variable rotational speed) or MFM (constant rotational speed) format. This arrangement provides the capability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM). The disk interface on the Macintosh IIx supports up to two internal drives and no external drives.

Small Computer System Interface (SCSI)

The Small Computer System Interface (SCSI) consists of the 53C80 SCSI controller IC, an internal 50-pin connector to connect an optional internal SCSI hard disk, and an external DB-25 connector to attach up to six additional external SCSI devices. The SCSI controller is connected directly to both connectors, and it controls the high-speed parallel port for communicating with up to seven SCSI peripherals. Each SCSI device has a unique address. This address is used to direct information between devices. The Macintosh computer is always address 7. The optional internal hard disk is address 0. External SCSI devices can be addressed from 0 to 6. (If an internal hard disk is installed, address 0 cannot be used.)

The Apple SCSI interface differs from the industry SCSI standard in two ways:

- A DB-25 connector is used instead of the standard 50-pin "D" connector to attach external SCSI devices. The *Apple SCSI System Cable* is available to convert the connector to the standard.

- Power for termination resistors is not provided. If the attached SCSI device does not have the required terminator resistor, the external device must either include a built-in terminator or provide power for an external terminator.

Stereo Sound Port

The Apple sound chip generates a stereo audio signal. This signal is buffered by two Sony audio chips that filter the pulse-width-modulated (PWM) signal and drive the internal speaker (mono) or external audio port (stereo).

NuBus Interface

The Macintosh II and Macintosh IIx have six expansion slots to support Apple standard peripherals and increase RAM size. Each expansion slot is a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are a few of the cards that will go into the NuBus slots:

- Video cards
- Coprocessor cards
- RAM cards
- Ethernet™, Token Ring, and other network interface cards
- Data acquisition cards

The NuBus has three major states of communication with the Macintosh II and Macintosh IIx systems:

- **Processor Bus to NuBus**, which is activated whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

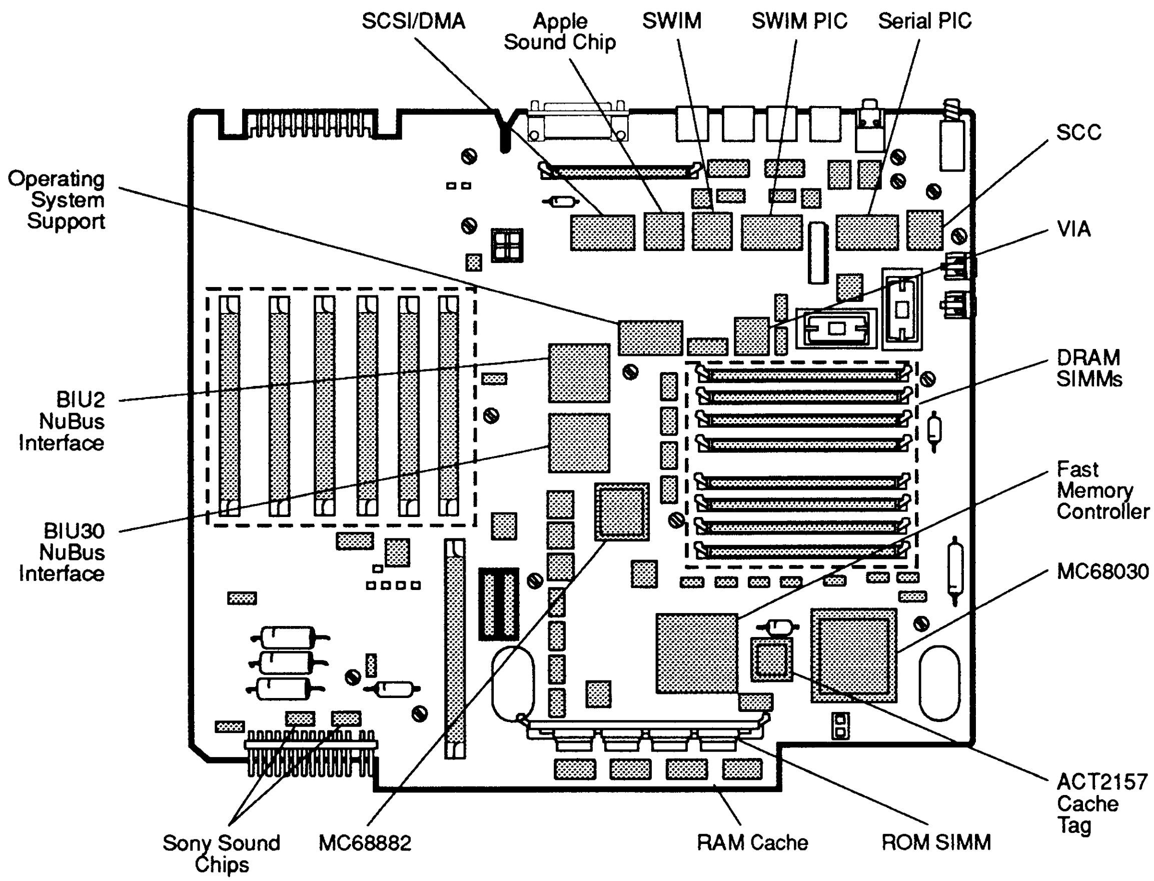
- **NuBus to Processor Bus**, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are being performed for this process. One tracks the changes on NuBus, and the other lets the 68020/68030 tell NuBus what to do next.

- **NuBus timeout**, which is required to prevent access to empty slots. Accessing empty slots would hang the system.

Every NuBus card should contain a ROM that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Macintosh IIfx Logic Board

There are two versions of the Macintosh IIfx logic board—one with the parity generator chip (PGC) and one without. The logic boards are identical in all other respects. **Figure 1-9** shows the major logic board components. **Figure 1-10** is a simplified block diagram.



Macintosh IIfx

Figure 1-9

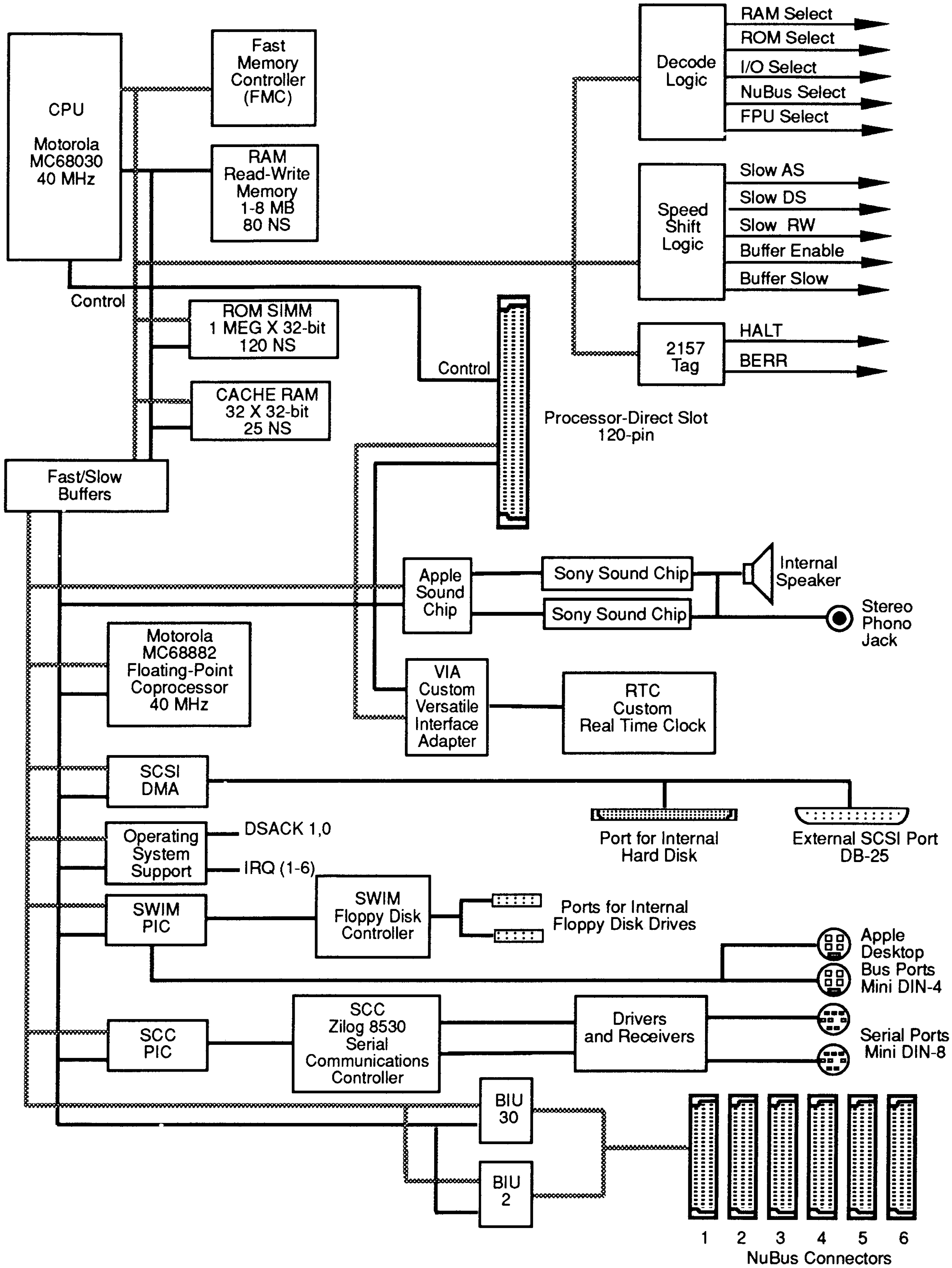

CPU
Motorola
MC68030
40 MHz
Fast
Memory
Controller
(FMC)
RAM
Read-Write
Memory
1-8 MB
80 NS
Control
ROM SIMM
1 MEG X 32-bit
120 NS
CACHE RAM
32 X 32-bit
25 NS
Fast/Slow
Buffers
Decode
Logic
RAM Select
ROM Select
I/O Select
NuBus Select
FPU Select
Speed
Shift
Logic
Slow AS
Slow DS
Slow RW
Buffer Enable
Buffer Slow
2157
Tag
HALT
BERR
Control
Processor-Direct Slot
120-pin
Apple
Sound
Chip
Sony Sound Chip
Sony Sound Chip
Internal
Speaker
Stereo
Phono
Jack
Motorola
MC68882
Floating-Point
Coprocessor
40 MHz
VIA
Custom
Versatile
Interface
Adapter
RTC
Custom
Real Time Clock
SCSI
DMA
Port for Internal
Hard Disk
External SCSI Port
DB-25
Operating
System
Support
DSACK 1,0
IRQ (1-6)
SWIM
PIC
SWIM
Floppy Disk
Controller
Ports for Internal
Floppy Disk Drives
Apple
Desktop
Bus Ports
Mini DIN-4
SCC
PIC
SCC
Zilog 8530
Serial
Communications
Controller
Drivers
and Receivers
Serial Ports
Mini DIN-8
BIU
30
BIU
2
1 2 3 4 5 6
NuBus Connectors

Figure 1-10

Microprocessor

The Macintosh IIfx contains a Motorola MC68030 16-bit microprocessor operating at 33 MHz. This processor is completely software compatible with all versions of the 68000, 68020, and 68030 used in other computers in the Macintosh family. The Macintosh IIfx will run most existing Macintosh applications without modification.

Another feature of the 68030 is burst-mode memory access. This method of accessing memory allows the processor to read and write groups of instructions or data in less time than reading and writing individually. When the instruction or data to be fetched isn't in either the internal 256-byte or the external 32K cache, the processor performs a burst-mode access and fetches four long-words (32-bit words) from memory. Data latches are also used to improve throughput during memory writes.

Math Coprocessor

The 68882 math coprocessor in the Macintosh IIfx is an IEEE P754 standard floating-point IC. The 68882 provides a high degree of precision and speed for Macintosh programs.

Operating System Support (OSS) ASIC

The operating system support (OSS) IC performs a variety of support functions for the system. The OSS includes elements of the 65C22 VIA, I/O device decoding and timing, interrupt prioritization and masking, a 56-bit system counter, bus timeout logic, interface support for the real time clock chip, and DSACK generation.

RAM

Random-access memory for the Macintosh IIfx is provided using the same SIMM technology that is used in the Macintosh II and IIx. However, the manner in which the microprocessor accesses this memory is different. In the Macintosh II and IIx, the 68020/68030 reads and writes memory via the same data bus. In the Macintosh IIfx, memory reads and writes occur on separate data buses. This separation allows memory to be read and written simultaneously.

The amount of RAM on the logic board can be changed by installing the same size SIMMs in either Bank A or B, with the larger RAM size in Bank A (the four sockets nearest the rear of the computer). Although the rules for configuring memory are the same for the Macintosh IIfx as for the Macintosh II and IIx, the possible memory configurations are different. This is because the Macintosh IIfx cannot use 256K SIMMs. Therefore, it is not possible to have 1-, 2-, or 5-megabyte systems.

Every time the Macintosh IIfx is powered on, the system software performs a memory test to determine how much RAM is present in the machine.

RAM Cache

The Macintosh IIfx has a 32K RAM cache for storing the most frequently used data and instructions. This cache is an extension of the 68030's internal 256-byte cache. The RAM cache is made up of four 8K x 8-bit static RAMs and an ACT2157 cache tag. The cache tag serves as a pointer for the CPU to locate information stored in the RAM cache. This RAM cache can be accessed by the CPU in 25 nsec (vs. 60 or 80 nsec for SIMM RAM accesses) with no wait states.

Fast Memory Controller (FMC)

The Fast (Fitch) Memory Controller (FMC) is an integrated dynamic RAM and cache memory controller. It supports the MC68030 microprocessor's burst mode to access memory. The FMC supports two banks of 1-, 4-, or 16-megabit DRAMs and caches up to 128K.

The FMC also requires several other support ICs—the tag RAM, four static RAMs (cache memory), and four data latches.

Parity Generator Chip (PGC)

The Macintosh IIfx can be ordered with a parity checking option. Parity is generated by the parity generator chip (PGC). If the parity chip is installed and parity checking is required, then the system must use 9-bit DRAM SIMMs. If parity checking is not needed, then 8-bit DRAMs can be used and parity checking will not take place.

If the PGC is present, the parity bit is always written. If the bit is not physically present (not using 9-bit SIMMs), it is ignored. If 9-bit SIMMs are being used when a read takes place in the RAM address space, the PGC generates an internal parity bit from each byte of the data bus, and compares it to the bit read from the SIMM's parity bit. If the two parity bits do not agree and parity is enabled, the PGC generates two outputs: one that interrupts the processor and the other that indicates a parity error. If a parity error occurs, the system will have to be reset.

ROM

The Macintosh IIfx has 256K of nonvolatile read-only memory. Four 512K x 8-bit surface-mount ROMs are used. These four ROMs are then attached to a small printed circuit board for installation in the ROM SIMM socket. All four ROMs are read simultaneously, providing a 32-bit data word. These ROMs contain the Macintosh ToolBox; operating system support; 32-bit QuickDraw™; support for 32-bit addressing, the peripheral interface controllers, and SCSI DMA; FDHD SuperDrive extensions; diagnostics; and self-tests.

ROM replacement and upgrades are performed by replacing the entire ROM SIMM. The Macintosh IIfx logic board is designed to accept 1-megabit (128K x 8-bit) devices providing 512K of ROM.

Peripheral Interface Controllers

The Macintosh IIfx is the first Macintosh computer to include dedicated I/O processors. An input/output processor (IOP) is a processor dedicated to a specific task or tasks that are normally performed by the main CPU. In all previous Macintosh computers, low-level communications with external devices were handled by the main processor. This resulted in reduced performance since each time a peripheral required attention, the main processor was diverted from its primary function—running applications. IOPs provide the ability to off-load some of the support required by the peripheral device interfaces. A total of three IOPs are utilized in the Macintosh IIfx. Two IOPs are implemented as stand-alone peripheral interface controllers (PICs). One PIC supports the 8530 serial communications controller (SCC); the other supports the SWIM disk controller and Apple Desktop Bus interface.

The third IOP is included in the same IC as the 5380 SCSI controller. This chip is described later in this section.

Each PIC includes a 65CX02 microprocessor operating at 2 MHz, a 16-bit timer, two DMA controllers, two digital phase-locked loops (DPLLs), and a RAM expansion bus to support an external 43256 32K x 8-bit static RAM. The PIC communicates with the host 68030 via this RAM.

Real-Time Clock

The real-time clock is the same custom Apple chip as in the Macintosh II and IIx. Refer to the Macintosh II/IIx logic board theory of operation for information on the real-time clock.

Input / Output Interfaces

The Macintosh IIfx has the same input/output interfaces as the Macintosh II and IIx. However, each interface—except the stereo sound port—has been enhanced to improve performance.

- Two RS-422 serial ports – The serial ports include support for a synchronous modem and are controlled by the Serial Communications Controller (SCC), Peripheral Interface Controller (PIC), and associated circuitry.

- Floppy disk interface – The Macintosh IIfx floppy interface can support two internal FDHD disk drives and is controlled by the SWIM and a second PIC chip.

- SCSI interface – The Macintosh IIfx SCSI interface supports an optional internal SCSI hard drive and up to six additional external SCSI devices. This interface is controlled by the SCSI/DMA controller chip.

- Apple Desktop Bus – This is a low-speed serial interface used to provide communication between the CPU and input devices.

- Stereo sound port – The Macintosh IIfx has stereo sound capability. Sound is controlled by the Apple and Sony Sound Chip circuitry.

- 120-pin processor direct slot – This expansion slot provides direct access to the MC68030 microprocessor bus and allows high-speed interaction.

- NuBus expansion interface – The Macintosh IIfx uses the same NuBus expansion interface as on the Macintosh II and IIx. The IIfx implementation supports full 32-bit address and data paths. In addition, the processor-to-NuBus interface has several new custom chips that have replaced discrete components.

RS-422 Serial Interfaces

The two RS-422 serial interfaces are the same as those on the Macintosh II and IIx with one exception—to improve throughput on the IIfx, an input/output processor has been added. Refer to the Macintosh II/IIx logic board theory of operation for information on the RS-422 interfaces. Information on the serial IOP can be found in "Peripheral Interface Controllers" earlier in this section.

Apple Desktop Bus Interface

The Apple Desktop Bus interface on the Macintosh IIfx functions identically to the ADB interface on the Macintosh II and IIx. However, ADB functions are included in the SWIM/ADB IOP. Refer to the Macintosh II/IIx logic board theory of operation for information on the Apple Desktop Bus interface. Information on the SWIM/ADB IOP can be found in "Peripheral Interface Controllers" earlier in this section.

Floppy Interface

The floppy interface used in the Macintosh IIfx uses the same SWIM disk controller chip used in the Macintosh IIx. Improved performance is provided by the SWIM/ADB IOP. Refer to the Macintosh II/IIx logic board theory of operation for information on the floppy interface. Information on the SWIM/ADB IOP can be found in "Peripheral Interface Controllers" earlier in this section.

SCSI DMA

A custom version of the NCR 53C80 SCSI controller is provided in the Macintosh IIfx. This Apple-designed ASIC includes the circuitry of the 53C80 plus direct memory access (DMA) support and a peripheral interface controller. This combination provides a high speed interface between the Small Computer Systems Interface (SCSI) and the 68030 bus. Data transfers and bus arbitration are handled independently from the MC68030. This new SCSI/DMA chip is fully compatible with all features of and software written for the 53C80 SCSI chip. SCSI transfer times can be increased by up to 400 percent. The SCSI/DMA chip also supports greater bandwidth to support the future generation of higher-speed SCSI devices.

Stereo Sound Port

The Apple and Sony Sound Chips used in the Macintosh IIfx are the same as in the Macintosh II and IIx. Refer to the Macintosh II/IIx logic board theory of operation for information on the sound chips.

Processor Direct Slot

The processor direct slot provides direct access to the MC68030 microprocessor bus. Providing direct access to the CPU bus rather than going through NuBus results in increased throughput for the device. This slot is similar to the PDS slot in the Macintosh SE/30 except they operate at different clock speeds.
Note that this slot is not electrically compatible with the IIci cache card slot—cards cannot be interchanged between systems. Logic board damage can occur if a Macintosh IIcx cache card is installed in a Macintosh IIfx or vice-versa.

To prevent the installation of all six NuBus cards plus a PDS-type card, the PDS slot has been aligned with NuBus slot E. This allows only a PDS-type card and five NuBus cards or six NuBus cards to be installed.

NuBus Interface

The six NuBus slots on the Macintosh IIfx function the same as the slots in the Macintosh II and IIx. However, a number of discrete components used to implement the NuBus interface have been combined into three new parts.

NuBus Bus Interface Units (BIUs)

NuBus interface support is provided by two ASICs—BIU30 and BIU2. These two ICs provide the interface between NuBus and the 68030. BIU30 contains the control circuitry and latches for part of the address and data bus. BIU2 contains the latches for the balance of the address and data bus.

NuBus Clock Generator

The NuBus clock generator generates the 10 MHz NuBus clock signal and monitors the NuBus control signals.

Power Supply

The power supply is a self-configuring switching-type supply that operates on AC line voltages from and 90 to 140 VAC and 170 to 270 VAC. The supply outputs +5V, +12V, and -12V DC voltages, which are used by the logic board, fan, internal disk drives, peripheral ports, and NuBus slots.

Floppy Disk Drives

Floppy disk drives for the Macintosh II, IIx, and IIfx are available in two capacities—800K and 1.4 MB. The Macintosh II is shipped to support the 800K drive. An upgrade that supports the 1.4 MB drive is available. The Macintosh IIx and Macintosh IIfx are shipped with 1.4 MB drives and can use either 1.4 MB or 800K drives.

Each internal floppy disk drive connects to the logic board through a 20-pin connector. The flow of data between the logic board and the disk drives is channeled through the IWM or SWIM disk controller. The IWM/SWIM controls reading and writing operations.

SCSI Hard Disk Drives

The Macintosh II, IIx, and IIfx can be equipped with a single, internal 3.5- or 5.25-inch half-height SCSI hard disk drive. For information on SCSI hard disk drives, refer to *Apple Technical Procedures*, "*SCSI Hard Disk Drives.*"

Functional Overview

The following section describes the operation of the power control circuitry and the events that occur during system startup.

Power Control

The Macintosh II, IIx, and IIfx have a hardware-on/software-off circuit to control the power supply.

There are two power switches on the system: one on the rear of the Macintosh II (power *on* and *off*), and a second (power *on* only) on the Apple Desktop Bus keyboard.

The computer can be powered on by either pressing the power switch at the rear of the computer or the switch on the Apple Desktop Bus keyboard.

The computer can be turned off by either selecting **Shut Down** from the Finder™'s Special menu or by pressing the power switch at the rear of the computer. Occasionally, severe software crashes can cause both of these methods to be inoperative. If the system crashes and cannot be powered-off using one of these methods, the computer should be unplugged. However, it is recommended that the system always be turned off by using the Shut Down command. Using **Shut Down** enables the computer to save valuable file and folder information before finishing.

The power supply is designed to protect itself and the computer by shutting down if excessive heat, a short circuit, or an excessive power drain is experienced. After allowing the system to cool down, removing the short circuit, or removing some of the load, the system can be turned on again.

System Startup

An elaborate series of events occurs inside a Macintosh II, IIx, or IIfx when the system is first turned. Understanding what happens during this process can be useful in quickly pinpointing the source of problems that occur during system startup.

When the computer is turned on, the system begins a carefully synchronized sequence of events. First, the processor is held in a wait state while a series of circuits puts the system in a known state in preparation for operation. During this time, the versatile interface adapter and the SWIM chip are initialized, and the mapping of RAM and ROM is altered temporarily in order to test the system.

The software contained in the system ROMs then performs a RAM test to determine how much RAM is present and to verify the proper operation of that RAM. Several other system tests are then performed. When the system is fully tested and initialized, system RAM is mapped for normal operation.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drives—right drive first, followed by the left drive

2. Startup device set in the control panel

3. SCSI devices—starting with internal drive, then in declining order of device ID (6 to 0)

Note: The startup device will default to the device with SCSI address 0 if the lithium batteries are exhausted.

Once a readable disk containing boot tracks and a System Folder are found, the disk is read and the disk startup process is completed.

❑ SYSTEM SOFTWARE

System Software 6.0.2

The Macintosh II and IIx operate using Macintosh Operating System version 6.0.2 or later. Installation procedures for version 6.0.2 are provided here for reference.

Installation

Before beginning to install system software, be sure to make backup copies of the system software disks and use the copies to perform the installation.

Materials Required

Macintosh System Software (version 6.0.2 or later)
System Tools, Printing Tools, Utilities 1, and Utilities 2

Procedure

1. Insert the *System Tools* disk in any available floppy disk drive.
2. Turn on the computer by pressing the power switch.
3. When the desktop appears, double-click on the System Tools disk to open it.
4. Double-click on the Setup Folder to open it.
5. Double-click on the Installer to launch it.
6. Select the disk you want to install system software onto. The name of the currently selected disk appears above the buttons on the right side. If it's not the disk you want, click **Drive** until you see the name of the disk you want.
7. Select the type of computer you are installing system software on.
8. Click **Install**. The installer will place a complete set of system software for the computer on the selected disk.
9. When the **Installation was successful** message appears, click **Quit**.
10. Choose **Restart** from the Special menu. The computer reboots.

System Software 6.0.5

Macintosh IIfx systems require Macintosh Operating System version 6.0.5 or later. Systems ordered with either the 80- or 160-MB internal SCSI hard disk drive factory-installed will have the operating system and HyperCard® installed. If replacement of the hard drive becomes necessary, you should follow these procedures to install the operating system and HyperCard on the replacement drive.

Installation

Before beginning to install system software, be sure to make backup copies of the system software disks and use the copies to perform the installation.

Materials Required

Macintosh System Software (version 6.0.5 or later)
System Tools, Printing Tools, Utilities 1, and Utilities 2
HyperCard software

Procedure

1. Insert the *System Tools* disk in any available floppy disk drive.
2. Turn on the computer by pressing the power switch.
3. When the desktop appears, double-click on the System Tools disk to open it.
4. Double-click on the Installer to launch it.
5. When the welcome screen appears, click **OK**.
6. Select the disk you want to install system software onto. The name of the currently selected disk appears next to the disk icon. If it's not the disk you want, click **Switch Disk** until you see the name of the disk you want.
7. Click **Install**. The installer will place a complete set of system software for the computer and printer software for all Apple printers on the selected disk.
8. When the **Installation was successful** message appears, click **Quit**.
9. Choose **Restart** from the Special menu. The computer reboots.

10. When the desktop appears, create a new folder on the hard disk. Name the folder HyperCard.

11. Copy the four HyperCard floppy disks to the hard disk.

    System software and HyperCard installation is complete.

❑ OTHER INFORMATION

High-Density Media

The FDHD SuperDrive can read, write, and format 400K and 800K disks. However, special high-density, 3.5-inch disks that take full advantage of the increased capacity of the FDHD SuperDrive are also available. To avoid media-related problems when using the FDHD SuperDrive disk drive, Apple advises using high-density media bearing the Apple label.

DRIVE AND MEDIA COMPATIBILITY MATRIX			
	Media		
Drive/Format	Single-Sided	Double-Sided	High-Density
400K (GCR)	R/W/F	R/W/F (400K format only)	N R
800K (GCR)	R/W/F	R/W/F	N R
1.4 MB (MFM)	R/W/F	R/W/F	R/W/F
1.4 MB (MFM)	X	R/W (720K Media)	X

LEGEND: R = Read
W = Write
F = Format
X = Not Allowed
N R = Not Recommended
GC R = Apple Data Format
M F M= IBM Data Format

Figure 1-11

Figure 1-11. As shown in the drive and media compatibility matrix, **400K drives** can read, write, and format single-sided media and double-sided media (in 400K format only). The **800K drives** can also read, write, and format single- and double-sided media. However, **Apple does not recommend using high-density media in either 400K or 800K disk drives.** Data saved to high-density media using 400K or 800K drives is unreliable and could be lost later. The **1.4 MB drives** can read, write, and format single-sided, double-sided, and high-density media. In addition, 1.4 MB drives can read and write 720K, double-sided MFM format media (MS-DOS and OS/2).

CAUTION: *High-density media are more likely to have problems than low-density media. To avoid media-related problems, use only known-good media or high-density media bearing the Apple label.*

Note: To help understand drive and media format compatibility, try thinking in terms of the drive/media of lowest capacity. For example, if your system has both an 800K drive and an FDHD SuperDrive, to ensure media format compatibility between the two drives you must use 800K media (the drive and media of lowest capacity).

Programmer's Switch

Figure 1-12. The programmer's switch can be used to reset the computer, place the computer in test monitor mode, or generate a nonmaskable interrupt (NMI) to the microprocessor for software and hardware development.

- Reset switch – Pressing the reset switch resets the microprocessor and reboots the computer. Doing so causes any information in system RAM to be lost.

- Interrupt switch – Pressing the interrupt switch generates a nonmaskable interrupt. If the interrupt switch is pressed while the computer is booting, the self-test monitor will be entered. The self-test monitor is a program in system ROM that allows another computer to communicate directly with the Macintosh II, IIx, and IIfx hardware to run diagnostics.

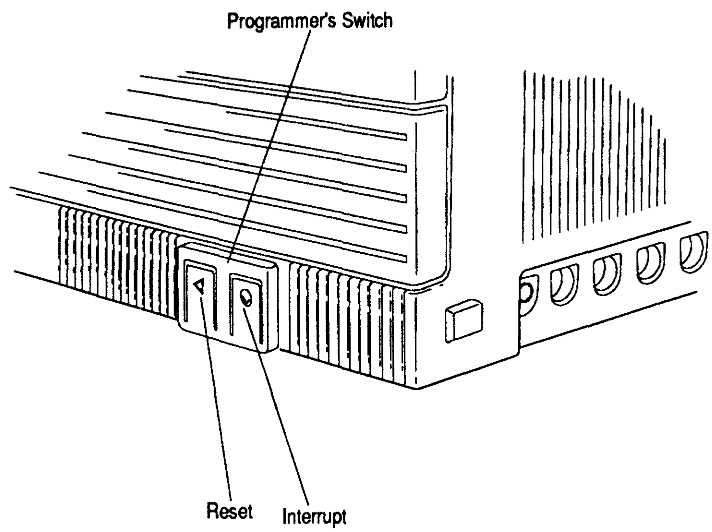


Figure 1-12

Materials Required to Service the Macintosh II/IIx/IIfx

A minimum of tools are required to maintain and repair the Macintosh II, IIx, and IIfx.

- #2 Phillips screwdriver
- Flat-blade screwdriver
- Grounded workstation pad
- Grounding wriststrap
- MacTest™ and AppleCAT® II/IIx (Macintosh II and IIx)
- MacTest IIfx (Macintosh IIfx)

Certain procedures require other items such as software or manuals. These items will be indicated where required.

❑ SPECIFICATIONS

	Macintosh II	Macintosh IIx	Macintosh IIfx
Processor			
Type	MC68020	MC68030	MC68030
Addressing	32-bit registers 32-bit address bus 32-bit data bus	32-bit registers 32-bit address bus 32-bit data bus	32-bit registers 32-bit address bus 32-bit data bus
Clock Rate	15.6772 MHz	15.6772 MHz	40 MHz
Memory			
RAM	1 MB standard Four 256K SIMMs; expandable to 8 MB	1 MB standard Four 256K SIMMs; expandable to 8 MB	4 MB standard Four 1 MB SIMMs; expandable to 8 MB
	256-byte parameter RAM	256-byte parameter RAM	256-byte parameter RAM
			32K RAM cache Four 8K x 8-bit static RAMs
ROM	256K Four 512K x 8-bit DIP devices	256K Four 512K x 8-bit SOJ devices on a ROM SIMM	256K Four 512K x 8-bit SOJ devices on a ROM SIMM
I/O Interfaces			
Floppy Disk Interface	Apple IWM chip GCR modes	Apple SWIM chip MFM/GCR modes Support 800K and 1.4 MB drives	Apple SWIM chip MFM/GCR modes Support 800K and 1.4 MB drives
Expansion Interface			120-pin processor direct slot
SCSI Interface	7.5 MB/second transfer rate	7.5 MB/second transfer rate	3 MB/second transfer rate

SCSI Interface (continued)	Supports a maximum of 8 devices (The computer is always device 7. Optional internal SCSI hard disk drive is device 0.)
Apple Desktop Bus	Low-speed, synchronous serial interface
Serial Interfaces	Two RS-232/RS-422 230.4K baud maximum 0.920 Mbit/second if external clock source is provided (modem interface only) Asynchronous, synchronous (modem only), and AppleTalk (printer only) protocols supported
Stereo Audio	Stereo compatible Output impedance of 8 to 600 ohms Short-circuit protected Disables internal speaker when in use 4-voice wave-table synthesis and stereo sampling generator

Floppy Disk Drive

800K Disk Drive	512 bytes per sector 9 sectors per track 368.64K/side 737.28K/disk
FDHD SuperDrive	512 bytes per sector 18 sectors per track 737.28K/side 1474.56K/disk

Electrical

Line voltage	90 to 140 VAC and 170 to 270 VAC, self-configuring power supply
Line Frequency	48 to 62 Hz
Power	230 watts (maximum), not including monitor
Altitude	0 to 10,000 feet

Environmental

Operating Temperature	10° C to 35° C 50° F to 95° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	5% to 95% noncondensing
Altitude	0 to 10,000 feet 0 to 3048 m

Physical

Dimensions	Width	18.66 in (474 mm)
	Height	5.51 in (140 mm)
	Depth	14.37 in (365 mm)

Weight

24 to 26 lbs. (10.9 to 11.8 kg)
Weight varies depending on configuration of RAM, floppy drives, and hard drives. Does not include any NuBus expansion cards.

Apple Technical Procedures

Macintosh II/IIx/IIfx

Section 2 – Take-Apart

❑ CONTENTS

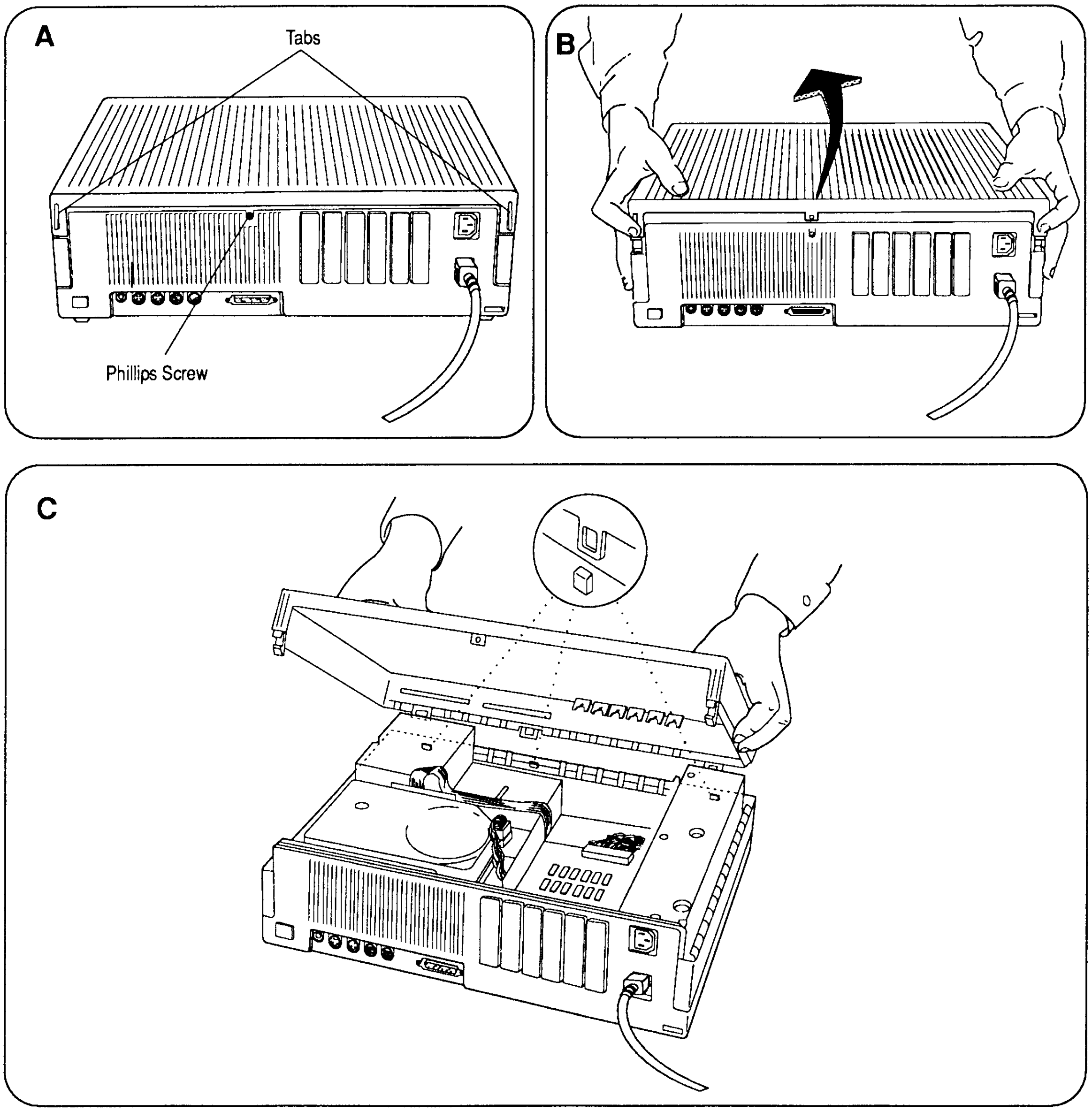


Figure 2-1

❑ TOP COVER

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Turn off the computer, and disconnect all cables except the power cord from the rear of the computer.

2. **Figure 2-1A**. Remove the Phillips screw located at the center-rear of the top cover.

3. **Figure 2-1A**. Locate the two tabs at the rear of the computer that secure the top cover to the case, one on each side.

4. **Figure 2-1B**. Simultaneously push the tabs in with your index fingers and lift the top cover, back first, from the computer. No force is necessary. (Do not push down on the top of the computer with your thumbs.)

CAUTION:* *Do not* *rotate the rear of the top cover more than 45 degrees. Rotating the cover more than 45 degrees will cause damage to the floppy disk drives.

Replace

1. **Figure 2-1C**. Position the top cover on the case, front first. Be sure to align the three notches on the front of the cover with the three tabs on the case.

CAUTION:* *Sheet metal tabs on the inside of the top cover can be bent out of place easily and can damage the floppy disk drives. Before replacing the top cover, make sure none of the sheet metal tabs are bent inward, toward the center of the cover.

2. Lower the top cover until the rear tabs snap into position.

3. Replace the top cover screw.

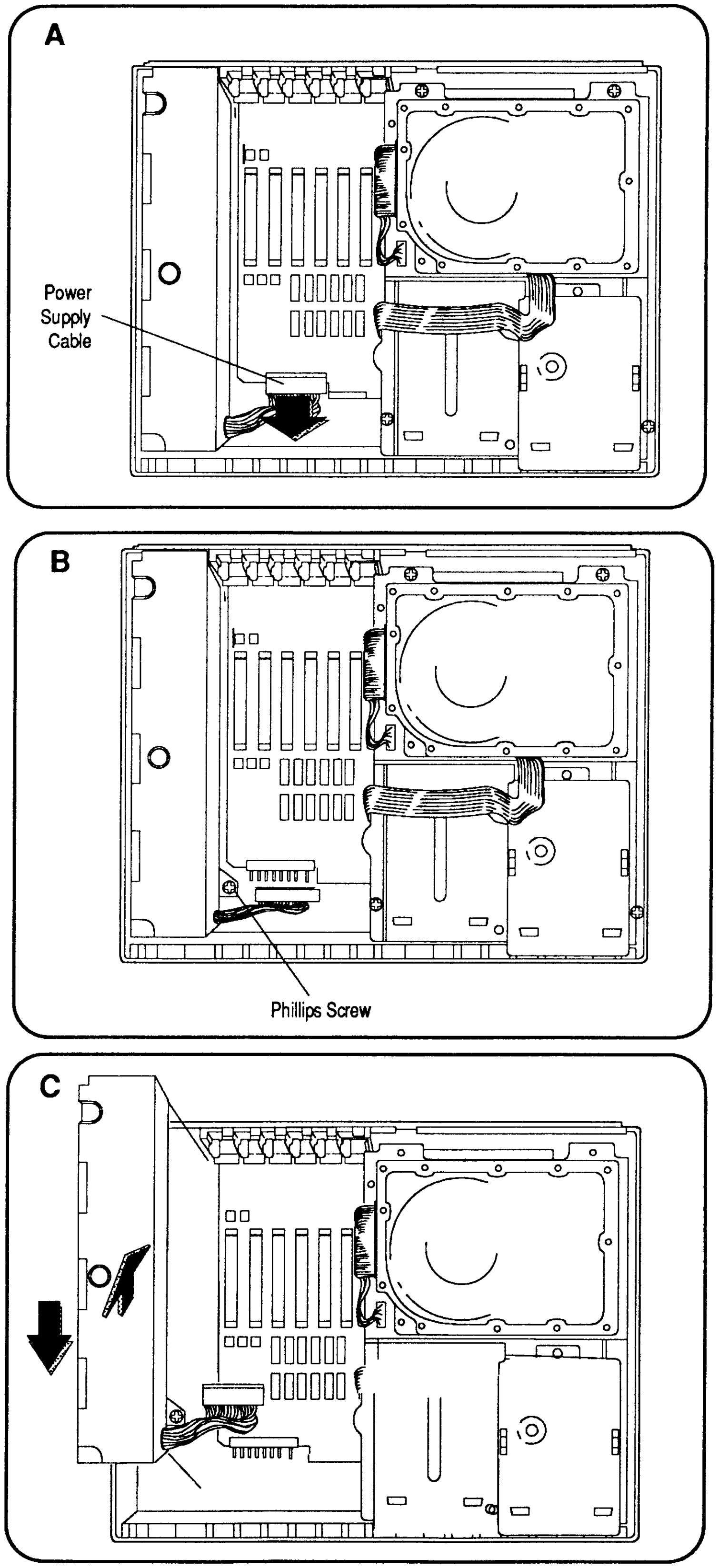


Figure 2-2

❑ POWER SUPPLY

Materials Required

Grounded workstation pad and wriststrap
#2 Phillips screwdriver
Small, flat-blade screwdriver

Remove

1. Remove the top cover.
2. Verify that the power is off and disconnect the power cord.
3. **Figure 2-2A**. Disconnect the power supply cable from the logic board. If necessary, use a small flat-blade screwdriver to pry the cable loose.
4. **Figure 2-2B**. Remove the Phillips screw that holds the power supply in place.
5. **Figure 2-2C**. Slide the power supply toward the front of the case, and lift the power supply, front first, from the case.

Replace

1. Lower the power supply into the case, so that the AC connectors align with the holes in the back panel. Press down and slide the power supply toward the back panel until the screw tab on the power supply aligns with the screw hole on the case.
2. Replace the Phillips screw that holds the power supply in place.
3. Connect the power supply cable to the logic board.
4. Replace the top cover.

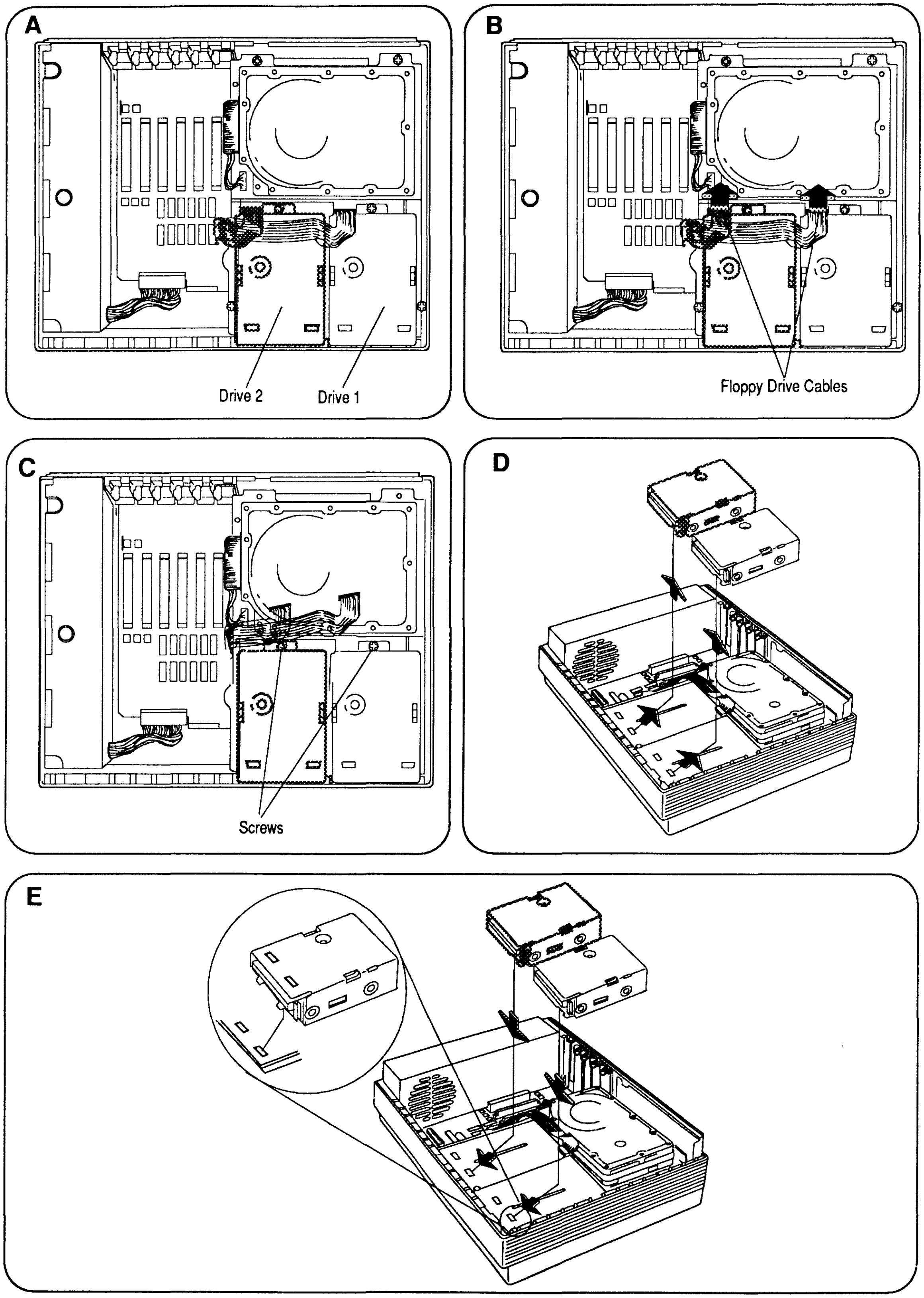


Figure 2-3

❑ FLOPPY DISK DRIVES

The Macintosh II, IIx, and IIfx can have two internal floppy disk drives. Drive 1 is located on the right side of the drive mount; its cable is connected to the right 20-pin connector (farthest from the power supply). Drive 2 is located on the left side of the drive mount; its cable is connected to the left 20-pin connector (nearest the power supply). The disk drives and cables are shown in **Figure 2-3A**. The procedure for removing the internal floppy disk drives, whether 800K or 1.4 MB, is the same.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Remove the top cover.
2. **Figure 2-3B**. Disconnect the cable from the floppy disk drive to be removed.
3. **Figure 2-3C**. Remove the screw holding the drive to be removed.
4. **Figure 2-3D**. Lift the rear of the drive, slide it back, and lift it off the drive mount.

Replace

IMPORTANT: *Apple strongly advises the use of dust shields on 1.4 MB floppy drives in all Macintosh II/IIx/IIfx computers. All 1.4 MB replacement drives ship with the dust shield already installed. If you plan to install a dust shield on a current drive, however, you* ***must*** *clean the drive first. Follow the procedure in "Cleaning the Drive" in the Basics section of the FDHD/SuperDrive tab of the* Apple Service Technical Procedures.

1. **Figure 2-3E**. Position the front of the drive so that the two tabs on the drive case slide into the two holes on the drive mount. Lower the drive into position, making sure that the screw holes line up.
2. Replace the screw that holds the drive in place.
3. Connect the cable to the drive.
4. Replace the top cover.

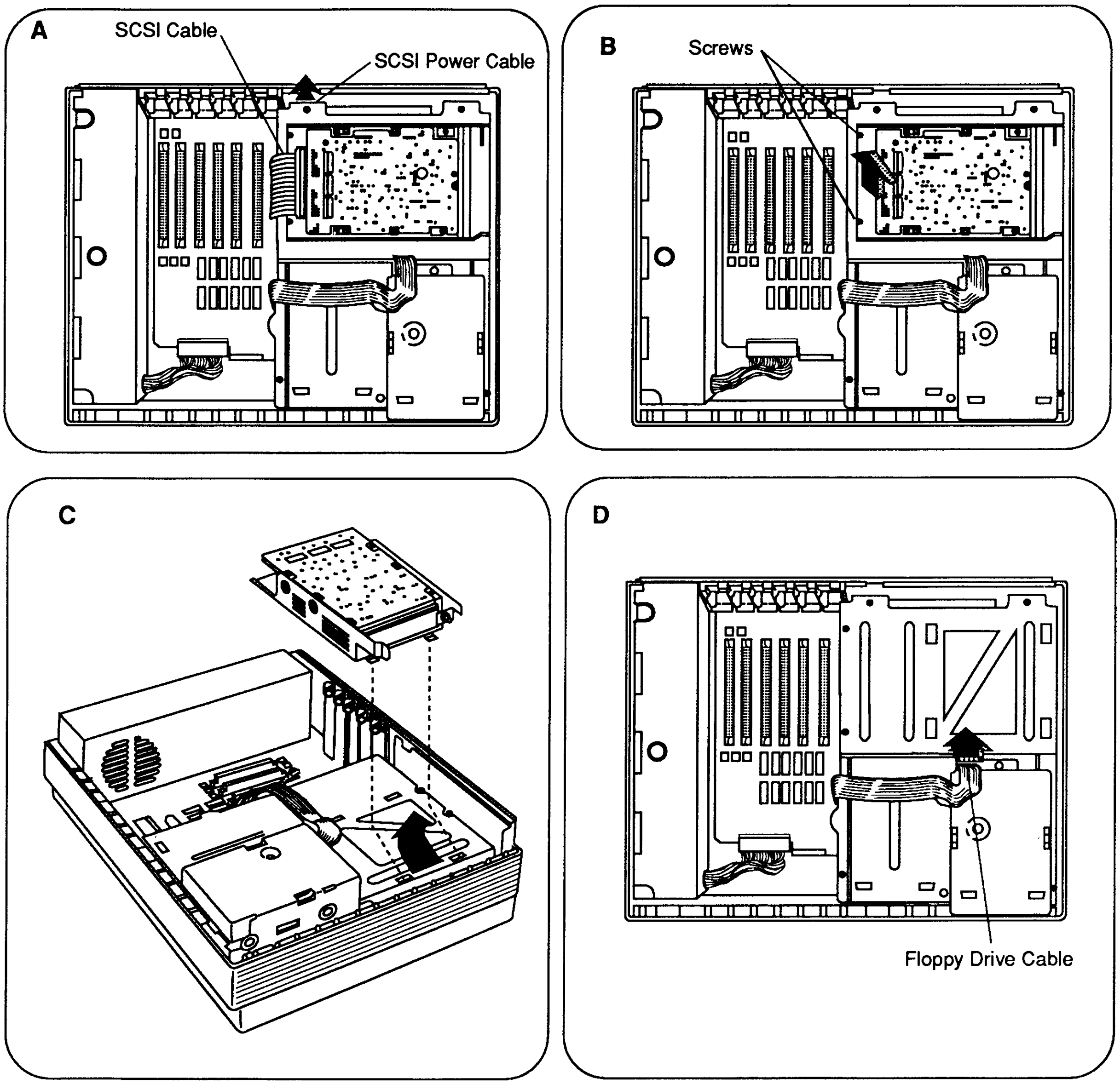


Figure 2-4

❑ SCSI HARD DISK DRIVE

The Macintosh II, IIx, and IIfx can be configured with a 3.5-inch half-height, a 5.25-inch half-height, or a 3.5-inch 1-inch-height SCSI hard disk drive. The procedure for removing all Apple internal SCSI drives is the same.

Certain drives are oriented PCB-side down in their carriers; thus, when removing the drive, the SCSI power cable will be opposite its location in **Figure 2-4A**.

Apple currently ships two versions of the internal Hard Disk 20SC. To the customer, the Hard Disk 20SC Revision A drive and the Hard Disk 20SC Revision B drive are identical, but **these drives must be replaced like-for-like.** To differentiate between the drives, refer to "Identifying 20SC Revision A and B Drives." For part numbers, refer to the Illustrated Parts List or your *Apple Service Programs* binder.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver
Torque driver (for 1-inch-height drives)

Remove

1. Remove the top cover.

2. **Figure 2-4A**. Disconnect the power and SCSI cables from the hard disk drive.

   Note: If the computer is a Macintosh IIfx, be sure to also remove the SCSI filter, if present.

3. **Figure 2-4B**. Remove the two Phillips screws that hold the hard disk in position.

4. **Figure 2-4C**. Lift the hard disk from the side with the cable connectors, slide the drive toward the power supply, and lift it off the drive mount.

5. To remove the SCSI cable:
   a) **Figure 2-4D**. Disconnect the floppy drive(s).

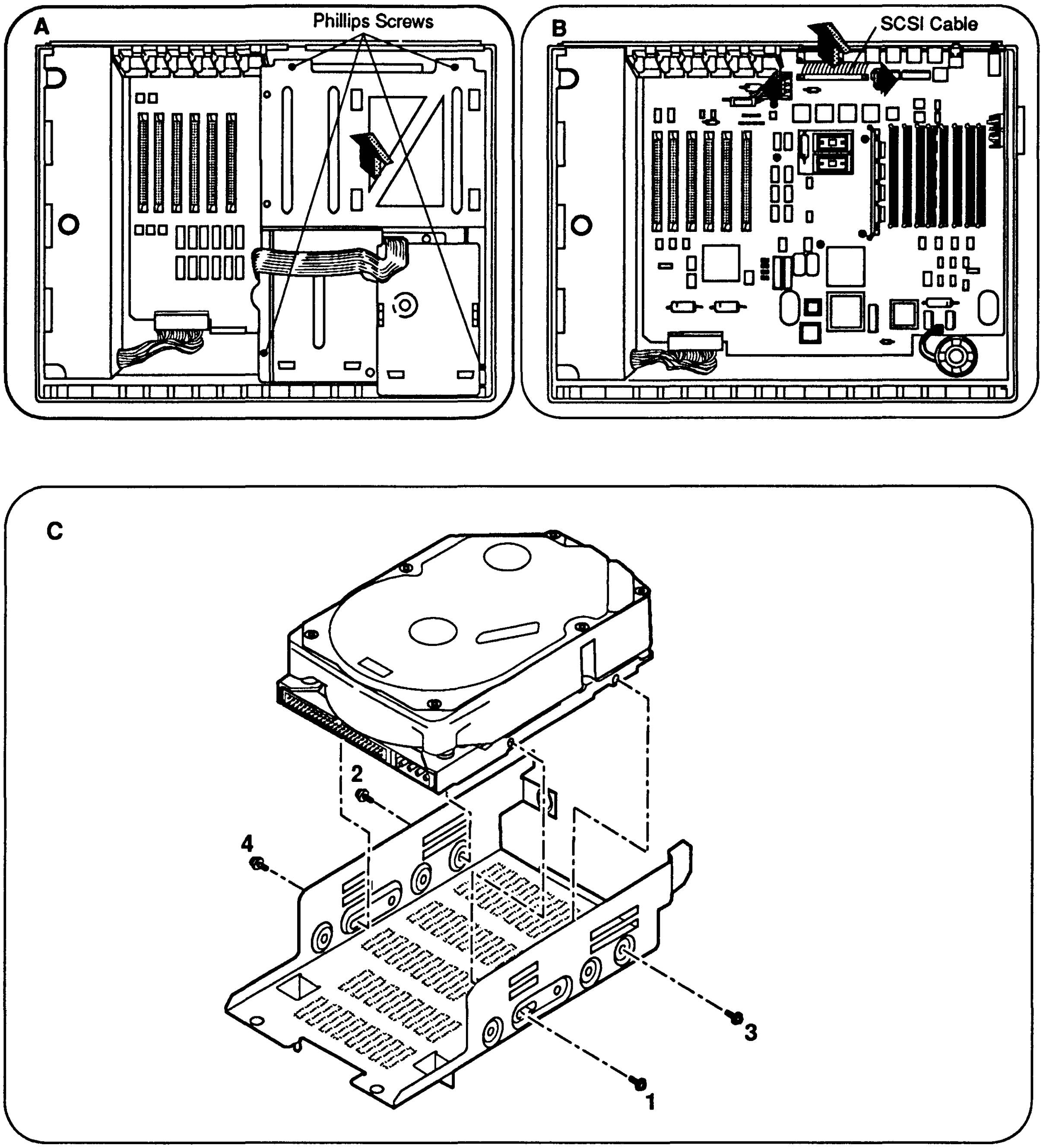


Figure 2-5

b) **Figure 2-5A**. Remove the four drive mount screws and lift out the drive mount.

c) **Figure 2-5B**. Press outward on the two ejector tabs on the SCSI connector (located on the main logic board) and unplug the cable.

Note: There are a number of ways in which damaged hard drives must be returned to Apple. For information on the appropriate return configuration for your drive, see *SCSI Hard Disk Drives Technical Procedures.*

Removing the Drive From Its Carrier

To remove the drive from its carrier:

1. **Figure 2-5C**. Remove the four Phillips screws on the lower sides of the carrier.

2. Lift the drive out of the carrier.

Replacing the Drive In Its Carrier

Most drives can be replaced in a carrier by reversing the steps above. Because of the compact nature of 1-inch-height drives, special steps are required when tightening the drives into their carriers. Use the following steps to assure the proper functioning and longevity of these drives.

1. Using the Phillips screws that you removed in step 1, loosely secure the drive to its carrier.

2. Tighten the screws in the sequence shown in Figure 2-5C, and torque the four screws to 8.0 in-lbs.

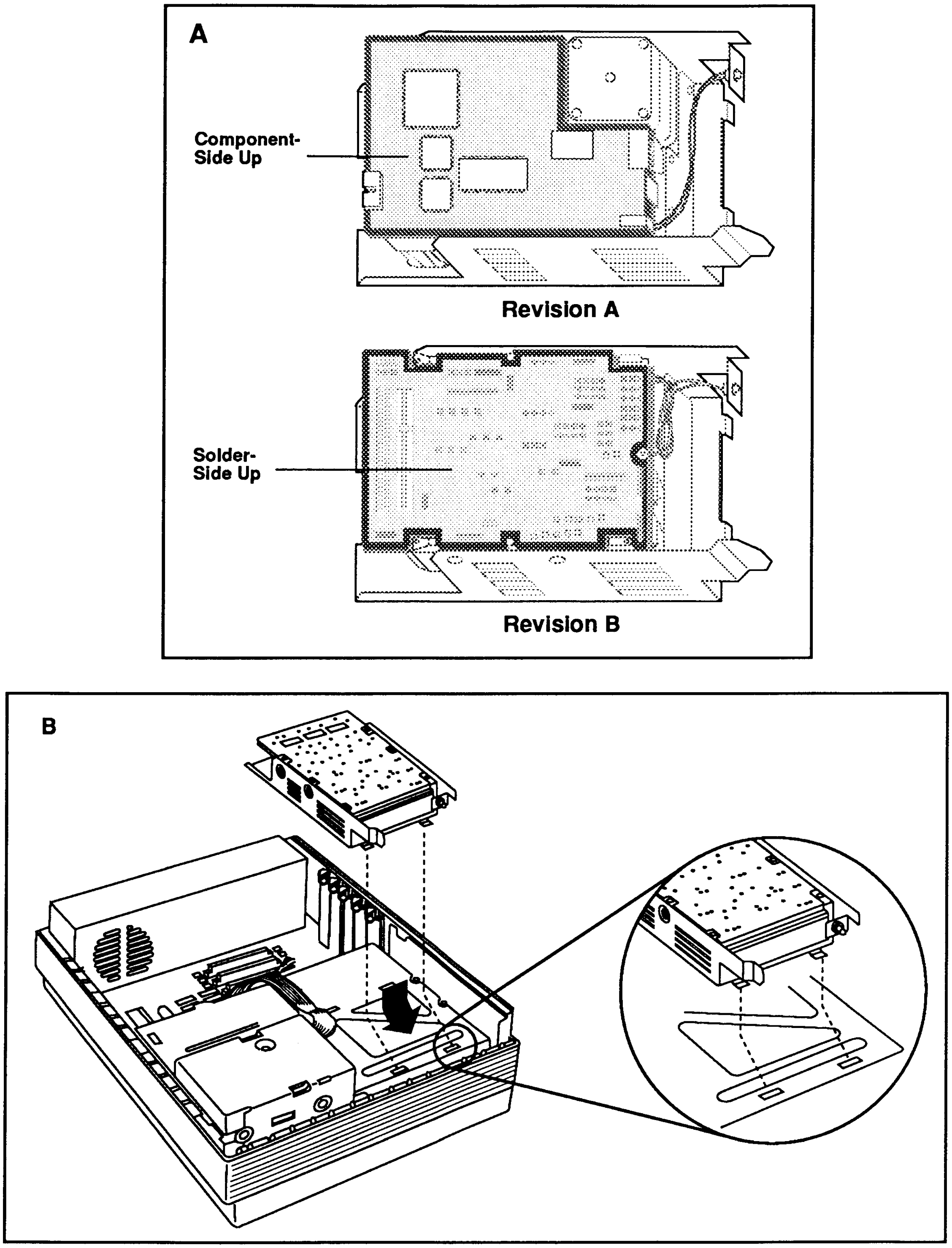


Figure 2-6

Identifying 20SC Revision A and B Drives

Revision A and Revision B Hard Disk 20SC drives must be replaced like-for-like. To differentiate between drive versions, compare their circuit boards to the drive installed in an internal carrier. For Revision A drives **(Figure 2-6A)** the component side of the board is up; for Revision B boards the solder side is up.

Replace

1. For the 3.5-Inch 160 MB drive, place the drive into its carrier and replace the four screws on the lower sides of the carrier.
2. If the SCSI cable was removed (step 5), connect the SCSI cable to the SCSI connector on the main logic board, replace the drive mount and its four Phillips screws, and reconnect the floppy drive(s).
3. **Figure 2-6B**. Position the front of the hard disk so that the two tabs on the hard disk case slide into the two holes on the drive mount. Lower the hard disk into position.
4. Replace the two hard disk screws.
5. Connect the SCSI and power cables to the hard disk.

   Note: If the computer is a Macintosh IIfx, you may have to install a SCSI filter. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for information.

6. Replace the top cover.

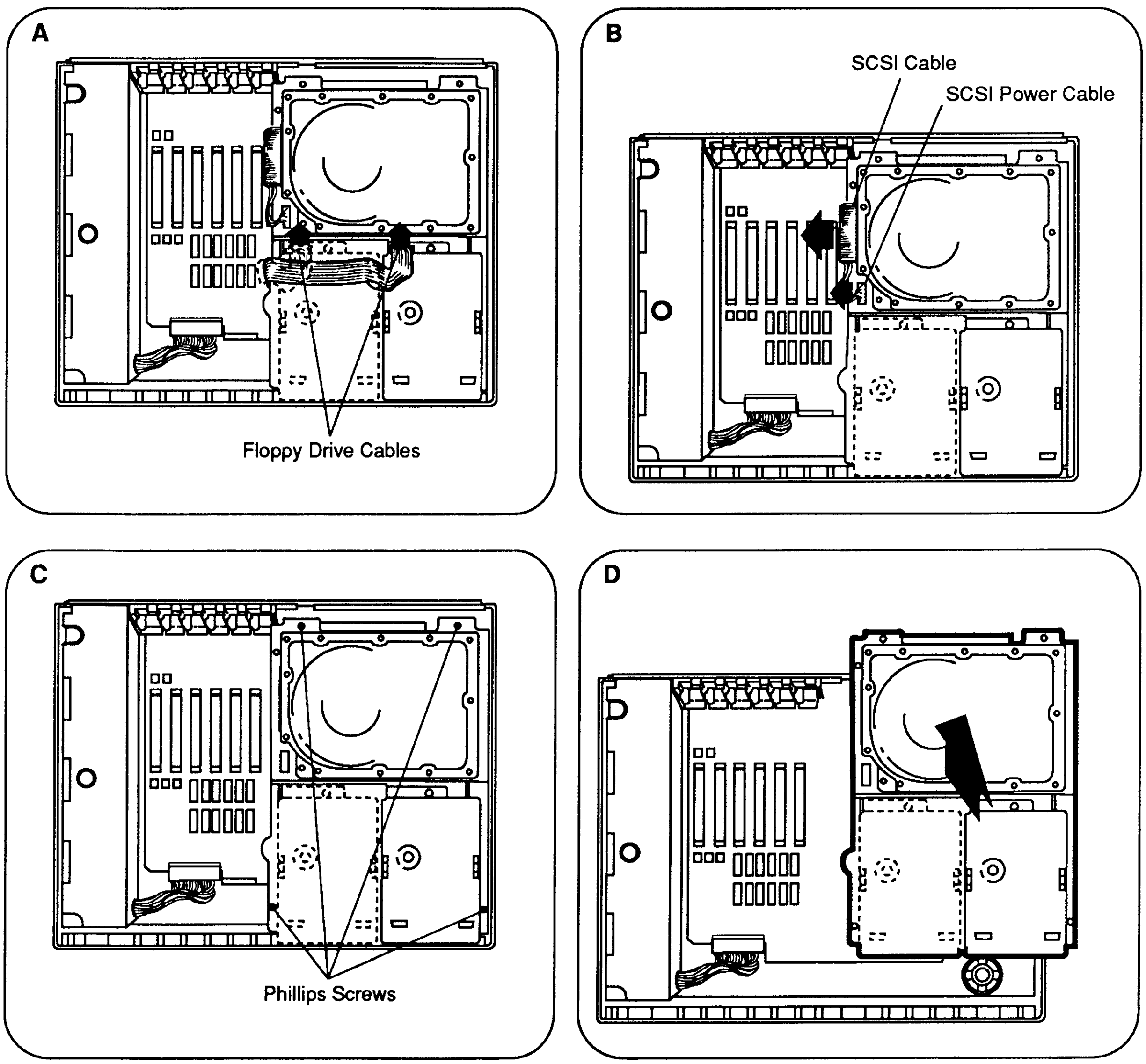

A
Floppy Drive Cables
B
SCSI Cable
SCSI Power Cable
C
Phillips Screws
D

Figure 2-7

❑ DRIVE MOUNT

The drive mount is a metal frame that holds the floppy and hard disk drives. The drive mount installs in the case.

The internal drives vary with the customer's configuration. Disregard the instructions that do not apply to the system you are working on.

Materials Required

Grounded workbench pad and wriststrap
#2 Phillips screwdriver

Remove

1. Remove the top cover.
2. **Figure 2-7A**. Disconnect the cables from floppy disk drive 1 and drive 2 (if installed).
3. **Figure 2-7B**. Disconnect the power and SCSI cables from the SCSI hard disk, if installed.
4. **Figure 2-7C**. Remove the four Phillips screws that hold the drive mount in position.
5. **Figure 2-7D**. Remove the drive mount.

Replace

1. Position the drive mount so that the screw holes align with the holes on the support posts.
2. Replace the four Phillips screws that hold the drive mount in place.
3. Connect the power and SCSI cables to the hard disk.
4. Connect the cables to floppy disk drive 1 and drive 2 (if installed).
5. Replace the top cover.

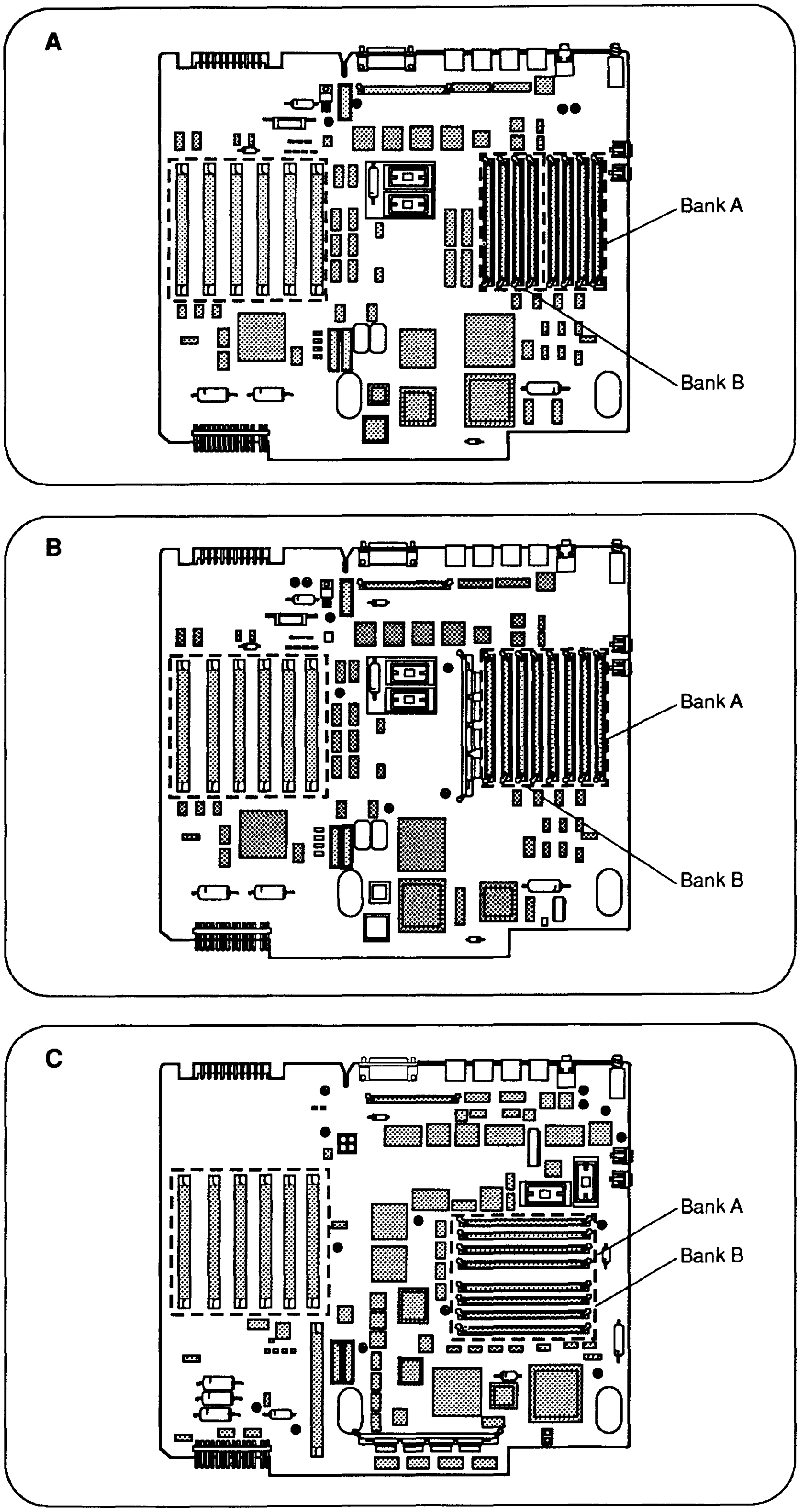


Figure 2-8

❑ SIMMS

RAM memory in the Macintosh II, IIx, and IIfx is packaged in Single In-line Memory Modules (SIMMs). SIMMs for the Macintosh II and IIx can be either 256K or 1 megabyte and must be 120 nanoseconds or faster. For the Macintosh IIfx, use only 1-megabyte SIMMs with a speed of 80 nanoseconds or faster (nonparity systems) or 60 nanoseconds or faster (parity systems).

The Macintosh II logic board is shown in **Figure 2-8A**; the Macintosh IIx logic board in **Figure 2-8B**; the Macintosh IIfx logic board in **Figure 2-8C**.

Two banks of SIMM sockets are located on each of the logic boards. For all logic boards, the banks are labeled Bank A and Bank B. Each bank contains four slots. When installing SIMMs, use either Bank A alone, or Bank A and Bank B. Fill all four slots of each bank with like-sized SIMMs. The following chart illustrates the configurations each computer supports.

	Macintosh II and IIx		**Macintosh IIfx**	
RAM	**Bank A**	**Bank B**	**Bank A**	**Bank B**
1 MB	Four 256K	Empty	NA	NA
2 MB	Four 256K	Four 256K	NA	NA
4 MB	Four 1 MB	Empty	Four 1 MB	Empty
5 MB	Four 1 MB	Four 256K	NA	NA
8 MB	Four 1 MB	Four 1 MB	Four 1 MB	Four 1 MB

For additional information on RAM identification and upgrades, refer to Section 5, Additional Procedures.

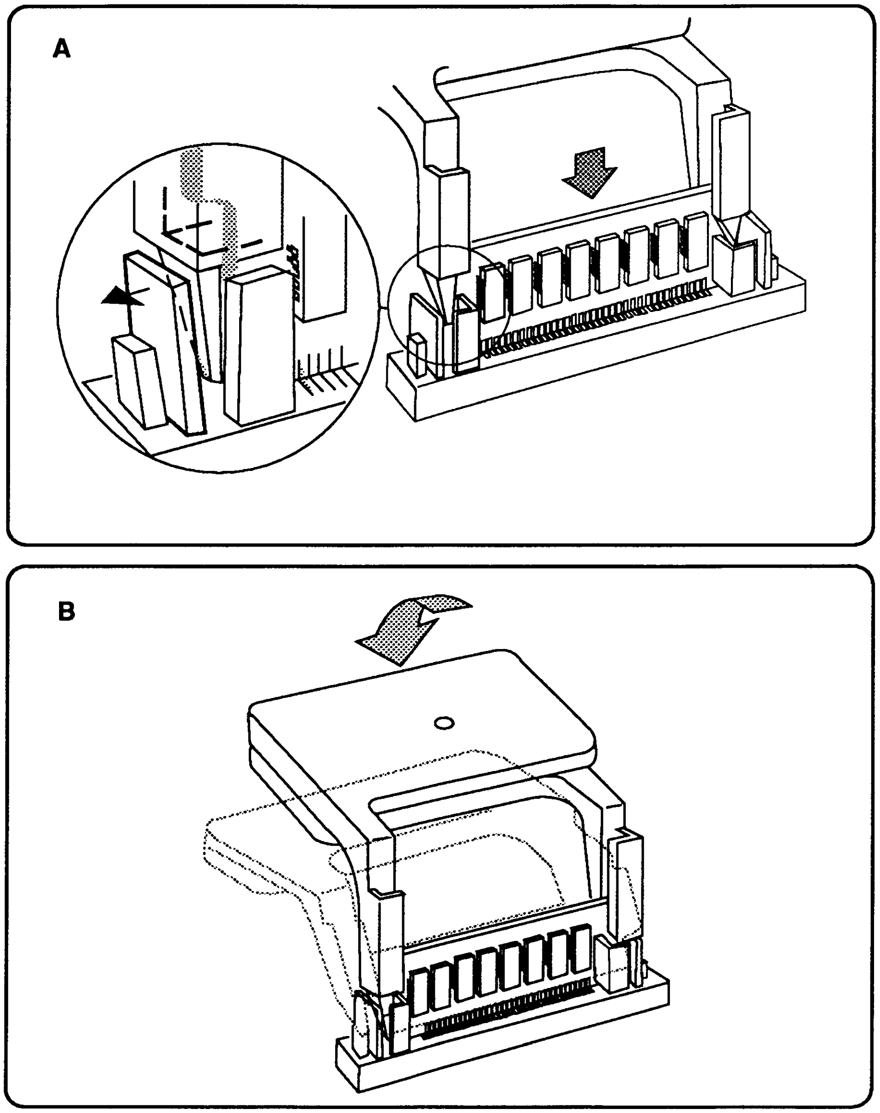


Figure 2-9

Materials Required

Grounded workbench pad and wriststrap
SIMM removal tool

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Remove

1. Place the computer on the grounded workbench pad and put on your grounding wriststrap.

2. Remove the top cover and drive mount.

3. **Figures 2-9A and 2-9B**. To remove a SIMM you must release the plastic tabs on the ends of the socket. The correct tool is the SIMM removal tool. For instructions see the *You Oughta Know* tab in *Apple Service Technical Procedures, Cross Family Peripherals.*

Replace

1. With the contacts on the SIMM pointing down, set the SIMM into the connector at an angle. Push back on the top corners of the SIMM. You will hear a click when the SIMM snaps into place.

2. Replace the drive mount and top cover.

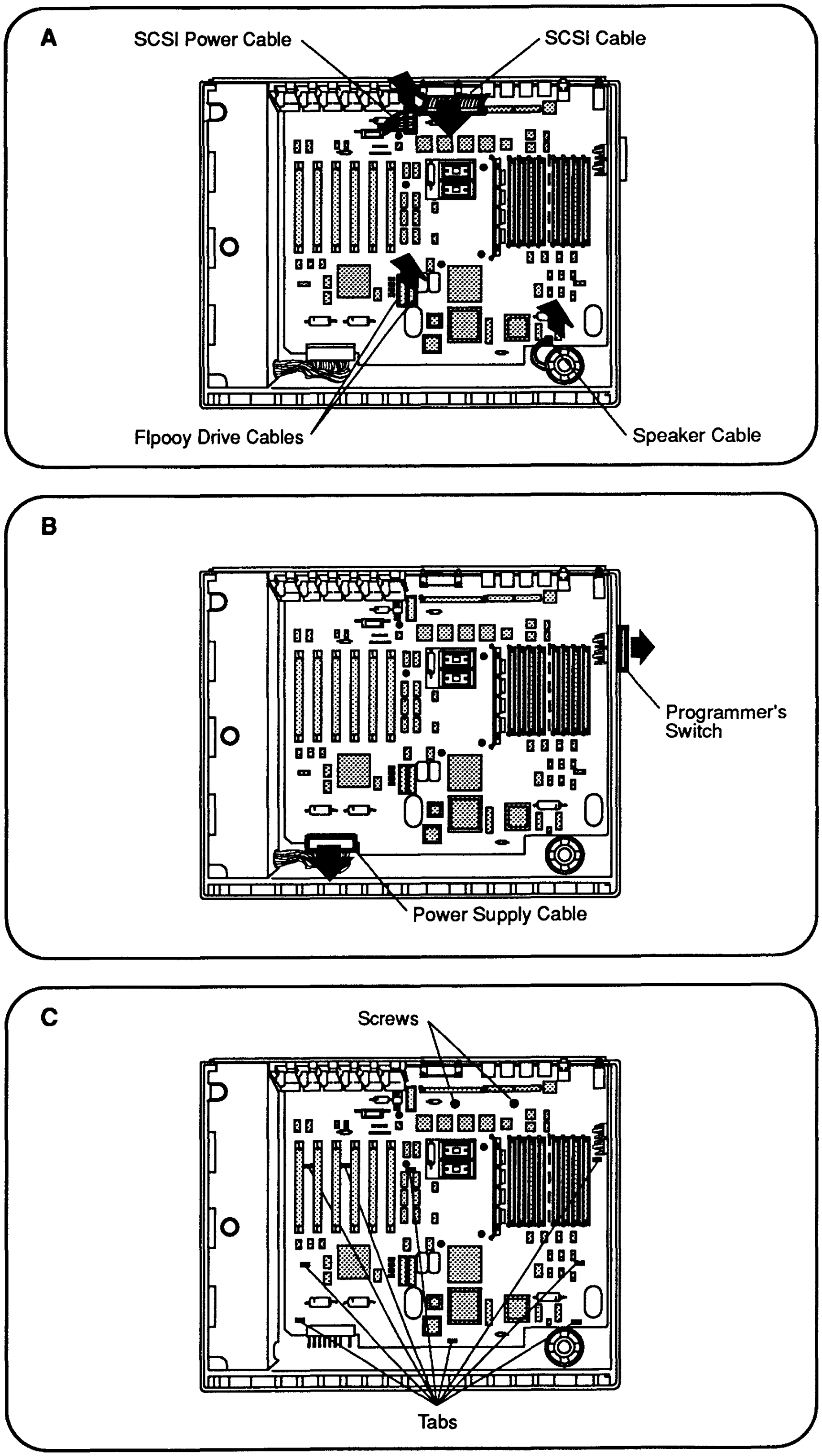

A
SCSI Power Cable
SCSI Cable
Flpooy Drive Cables
Speaker Cable
B
Programmer's
Switch
Power Supply Cable
C
Screws
Tabs

Figure 2-10

❑ LOGIC BOARD

Macintosh II and IIx computers ship with various revisions of main logic boards that vary slightly in appearance but have no functional differences and can be used interchangeably. Be sure to remove any SIMMs installed on the old logic board and install them on the new logic board. Refer to Section 5, Troubleshooting, for further module exchange information.

CAUTION: *The logic board contains components that are very susceptible to ESD damage. Handle the board only by its edges, and follow the precautions outlined for ESD prevention in* ***You Oughta Know.***

Materials Required

#2 Phillips screwdriver
Grounded workbench pad and wriststrap
Small, flat-blade screwdriver

Remove

1. Remove the top cover and drive mount.
2. **Figure 2-10A**. Disconnect the floppy drive cables, the SCSI hard drive cables, and the speaker cable from the logic board.
3. **Figure 2-10B**. Disconnect the power supply cable from the logic board. Use the flat-blade screwdriver if necessary.
4. **Figure 2-10B**. Remove the programmer's switch, if installed.
5. **Figure 2-10C**. Remove the two screws that hold the logic board in place.
6. **Figure 2-10C**. Starting at the front of the logic board, gently lift the board as you push in each of the nine tabs, one at a time.

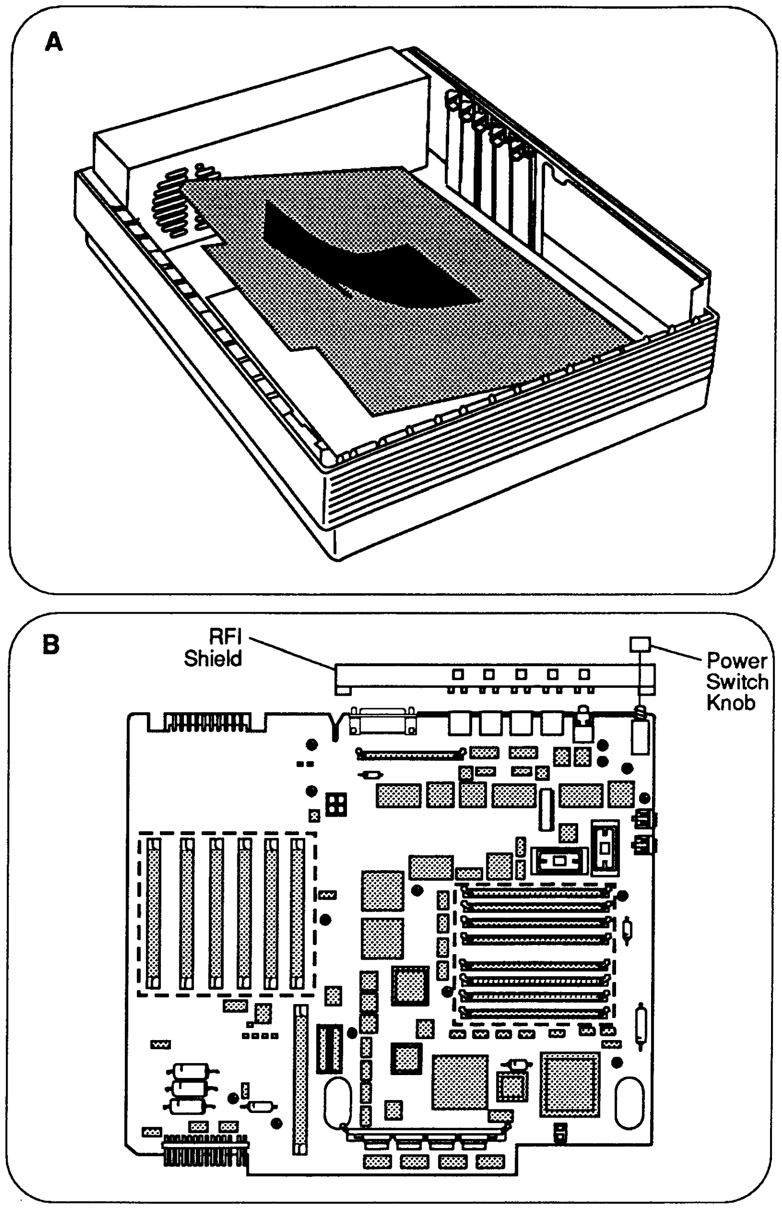


Figure 2-11

7. **Figure 2-11A**. Slide the logic board toward you and lift it from the case.

8. **Figure 2-11B**. Remove the power switch knob and RFI shield.

Replace

1. Replace the power switch knob and RFI shield.

2. Position the logic board so that the port connectors align with the rear of the case. Gently lower the board into the case and press the board onto the tabs.

3. Replace the two logic board screws.

4. Connect the floppy drive cables, power supply cable, SCSI hard drive cables, and speaker cable to the logic board.

   Note: If the computer is a Macintosh IIfx, you may have to install a SCSI filter and/or terminator. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for information.

5. Replace the programmer's switch, if removed.

6. Replace the drive mount and top cover.

Macintosh II/IIx/IIfx

Section 3 – Diagnostics

❑ CONTENTS

Note: These procedures cover the operation of **MacTest II/IIx only**. Refer to the MacTest MP section of the *Mac Multiple-Product Diagnostics* tab in Volume II of the *Macintosh Family Technical Procedures* for instructions on using **MacTest MP** on the Macintosh **IIfx**.

❑ INTRODUCTION TO MACTEST II/IIX

The *MacTest™ II/IIx* diagnostic disk (version 3.0 or higher) is part of the *AppleCAT® II/IIx* diagnostic set, but may also be used as a standalone functional test of your Macintosh II or Macintosh IIx system. The *MacTest II/IIx* disk includes the *MacTest II/IIx* program and the Diagnostic Sound Sampler. The Diagnostic Sound Sampler lets you listen to the various musical chord sequences that are generated during a power-on failure.

MacTest II/IIx is a pass/fail functional test. As the test progresses, messages on the screen indicate the tests being performed and the test results. As soon as a failure is detected, the test stops and the screen indicates which module must be replaced before the test can be completed. MacTest then terminates and returns to the Finder (desktop).

The *MacTest II/IIx* program identifies the ROM version of the system and tests the

- Main logic board
- Internal disk drives
- Video interface card
- SCSI bus
- HMMU/PMMU (Macintosh II only)
- Apple PC 5.25 Drive and Macintosh II PC Card
- Apple EtherTalk™ Card

MacTest II/IIx also provides test patterns for use in adjusting the high-resolution monitors.

***MacTest II/IIx* does not test the internal SCSI hard disk.** To test the hard disk, use the *Macintosh Hard Disk Drive Diagnostic* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures*).

MacTest II/IIx tests an internal expansion slot only when an Apple expansion card is installed. To test an expansion slot, install an EtherTalk Card or a Macintosh II PC Card (with an Apple PC 5.25 Drive) in the slot and select the appropriate test from the Test Selections window.

Copying MacTest II/IIx Disk

Use Finder to make a backup disk before you begin! When testing a defective Macintosh II or Macintosh IIx, it is possible to damage or erase a section of the *MacTest II/IIx* disk.

Using Your Backup Disk

Take the following precautions when using your *MacTest II/IIx* disk copy:

- **Do not write-protect your working copy of the *MacTest II/IIx* disk.** The program will not run correctly if you do.

- **Do not change the name of the diagnostic program on the disk.** During logic board testing, the machine reboots, looks for, and restarts the diagnostic named *MacTest II/IIx*. If the name has been changed, the startup routine will not be able to locate it, and the system will stay on the desktop.

  Therefore, if the *MacTest II/IIx* window does not reappear after a logic board test, check the name of the diagnostic icon on the desktop. Correct it to *MacTest II/IIx*, then select **Set Startup** from the desktop **Special** menu. When you are asked if you wish to change the name of the startup application to *MacTest II/IIx*, click **OK**. Then double-click on the corrected *MacTest II/IIx* icon to return to the test program.

❑ RUNNING MACTEST II/IIX

Materials Required

MacTest II/IIx diagnostic disk (backup)
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback test card (modified with jumper—see "SCSI Loopback Jumper Procedure")
Blank, 800K disk for drive test
Blank, 1.4 MB disk for high-density drive test

Starting MacTest II/IIx

You can use *MacTest II/IIx* to perform a functional test of the entire Macintosh II or Macintosh IIx system, or you can use it to test a single component in a known-good system. Follow the start-up steps below for the testing you wish to perform.

Testing Complete System or Logic Board

1. If you are testing a complete Macintosh II or Macintosh IIx system, or if you intend to run the logic tests, turn the power off and remove all expansion cards except the Macintosh II Video Card.

2. Install the loopback connectors as described under "Installing the Loopbacks," later in this section.

3. Insert the *MacTest II/IIx* disk into the right internal drive, and power on the system. *MacTest II/IIx* will display the *MacTest II/IIx* **Status**, or **Start**, window. From the **Status** window you can click on **Start** to run the tests.

Testing Single Component

1. If you are testing a single component in a known-good system, insert the *MacTest II/IIx* disk into the right internal drive, and power on the system.

2. *MacTest II/IIx* will display a window that tells you to turn off the power and connect the SCSI loopback board. Click **OK** to get to the *MacTest II/IIx* **Status**, or **Start**, window.

3. From the **Status** window you can use the *MacTest II/IIx* menus. Go to the **Options** menu and use the **Test Selections** submenu to select the tests you want to run. Then click on **Start**. For more specific information on the tests, see "Using the *MacTest II/IIx* Menus" and "Running the Tests," later in this section.

Helpful Startup Information

1. If any of the following problems are encountered, refer to Section 4, Troubleshooting, for additional information.

   - The known-good *MacTest II/IIx* disk will not boot.
   - The **Configuration** window indicates there is no interface card installed in any slot, and there is.
   - The **Configuration** window indicates there are no disk drives installed, and there are.
   - The Macintosh II/Macintosh IIx system intermittently locks up during the logic test.
   - The **Configuration** window indicates the wrong amount of RAM installed.

2. If you do not know whether the system you are testing is good:

   a) Run the *MacTest II/IIx* logic, drive, and video card tests. (See "Using the *MacTest II/IIx* Menus" and "Running the Tests," later in this section.) Complete any needed repairs before you continue.

   b) If you removed a Macintosh II PC Card, run the Apple PC 5.25 Drive test as described in Section 3, Diagnostics, of the *Apple PC 5.25 Drive Technical Procedures*.

   c) If you removed an EtherTalk Interface Card, run the EtherTalk Interface Card test as described in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

   d) If you removed any non-Apple expansion cards, install them one at a time, and run the *MacTest II/IIx* logic, drive, and monitor tests after each card is installed. Repeat the install-and-test process until all expansion cards are installed and the Macintosh II/Macintosh IIx passes all tests.

Installing the Loopbacks

Before beginning *MacTest II/IIx*, and **with the power off,** connect the serial loopback cable, the SCSI loopback card, the keyboard, the mouse, the video interface card, and the monitor.

***CAUTION:** Always power off the system when you connect or disconnect the SCSI loopback card.*

The SCSI loopback card cable (Figure 3-1, #1) must be connected to the SCSI port (Figure 3-1, #2) on the back of the Macintosh II/Macintosh IIx. (No other connections between the card and the Macintosh II/Macintosh IIx are necessary.) To protect the SCSI circuitry, you must have the power off when you connect the SCSI card. The loopback cable (Figure 3-1, #3) with the mini DIN-8 connectors must be installed between the modem and printer ports (Figure 3-1, #4) on the rear of the machine.

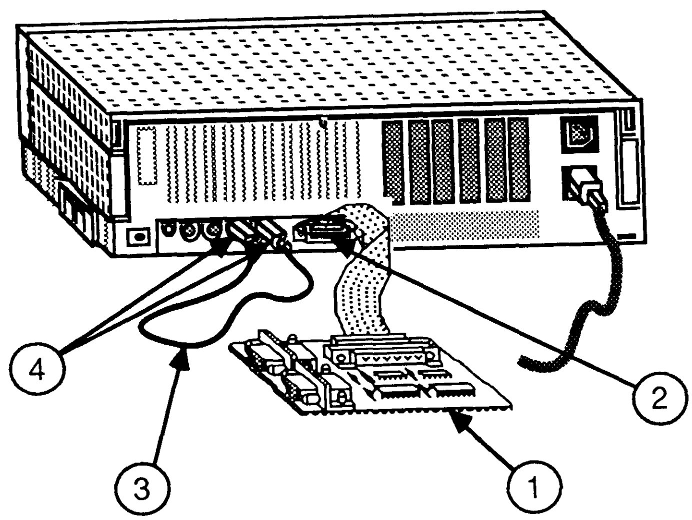


Figure 3-1

Using the MacTest II/IIx Menus

Before you start *MacTest II/IIx*, you may use the *MacTest II/IIx* menus to select the tests you want to run or to select other features of the diagnostic. **You cannot use the menus when the tests are running.**

Options Menu

The **Options** menu contains the **Test Selections** and **Configuration** submenus.

1. **Test Selections:** The following window (Figure 3-2) appears when **Test Selections** is chosen:

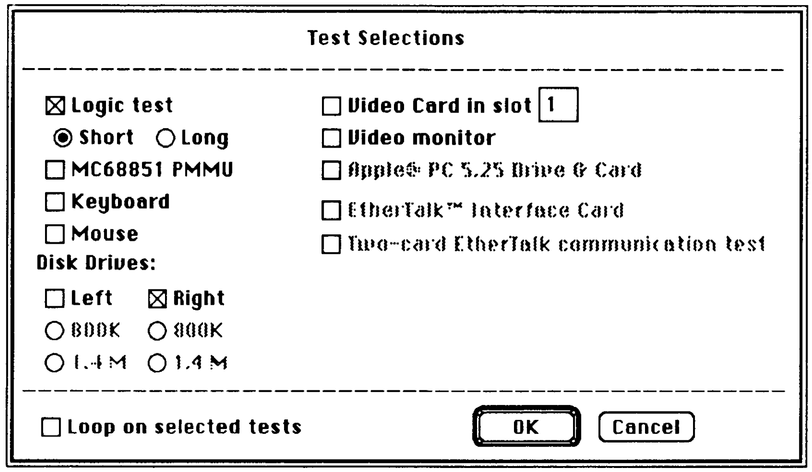


Figure 3-2

Test Selections allows you to select the tests you wish to run, and identifies the slot number in which each expansion card is installed. If an EtherTalk Card or a Macintosh II PC Card is not installed in an expansion slot, the selection for that test will be dimmed.

To select a test, click in the box next to the name of the item to be tested. The box will display an X. To deselect the test, click again in the box to remove the X. When you have selected all the tests you wish, click in the **OK** box. You will be returned to the *MacTest II/IIx* **Status** window.

Test Selections includes the following tests:

a) **Logic:** This test will verify the correct functioning of the following circuitry on the logic board:

- VIA (Versatile Interface Adaptor)
- FPU (Floating Point Unit)
- Serial ports
- Clock
- SCSI bus
- RAM

You may select a short or long logic test. The running time of the test will vary depending on how much memory is installed. At the beginning of the RAM test, *MacTest II/IIx* will indicate the maximum running time of the test.

b) **MC68851 PMMU:** This selection tests the circuitry and basic functions of the Paged Memory Management Unit on the main logic board of the Macintosh II only.

c) **Keyboard:** This selection activates the keyboard self-tests that verify the functioning of the keyboard.

d) **Mouse:** This selection activates the mouse self-tests that verify the functioning of the mouse.

e) **Disk Drives:** This test verifies the proper functioning of the right and left disk drives, or whichever drive (right or left) is present. It also tests both 800K and 1.4 MB disk drives.

f) **Video Card in slot:** This selection tests a Macintosh II Video Card installed in one of the expansion slots on the Macintosh II or Macintosh IIx. If more than one video card is installed, you must tell *MacTest II/IIx* which video card to test. Enter the slot number of the video card you want to test in the box after **Video Card in slot.** Use the keyboard to type in the correct slot number, or use the space bar to space to the correct slot number.

g) **Video monitor:** This selection displays test patterns that are used to adjust the video picture on the high-resolution monitors. **Video monitor** displays test patterns on the main (default) monitor only. If you are adjusting a second monitor, select **Monitors** in the **Control Panel**, drag the menu bar at the top of the monitor icon into the icon of the second monitor, and reboot.

Note: Refer to *Apple High-Res Monochrome Monitor Technical Procedures* or *Apple High-Res RGB Monitor Technical Procedures* for information about any necessary adjustments.

h) **EtherTalk Interface Card:** This selection tests the EtherTalk Interface Card and the expansion slot. To set up for this test, follow the instructions in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

i) **Two-card EtherTalk communication test:** This selection tests the communication between a known-good EtherTalk card and a suspect EtherTalk card. To set up for this test, follow the instructions in Section 2, Diagnostics, of the *EtherTalk Interface Card Technical Procedures.*

j) **Apple PC 5.25 Drive and Card:** This test verifies the correct functioning of the drive, the Macintosh II PC Card, and the expansion slot. To set up for this test, follow the instructions in Section 3, Diagnostics, of the *Apple PC 5.25 Drive Technical Procedures.*

Note: The Apple PC 5.25 Drive test cannot always determine which module caused a test to fail. If the test reports that the drive and/or card is bad, replace one module at a time as described in Section 4, Troubleshooting, of the *Apple PC 5.25 Drive Technical Procedures.*

k) **Loop on all tests:** This selection provides continuous running (in sequence) of all selected tests except the **Video monitor**. To stop the looping, click the **Stop** box between tests (when the screen displays an arrow and not a wristwatch).

Note: You cannot loop on both the logic board and drive tests at the same time.

2. **Configuration:** The following window (Figure 3-3) will appear when **Configuration** is selected.

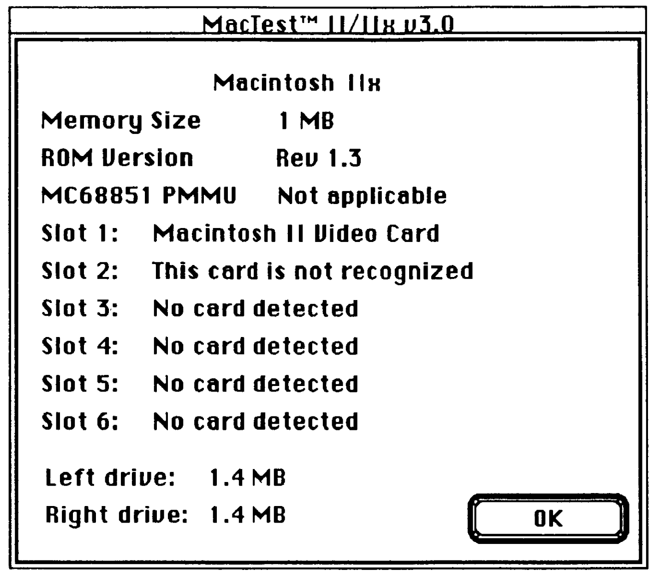


Figure 3-3

This window displays the amount of memory, the version number of the ROMs, the cards installed in expansion slots 1 through 6 of the Macintosh II or Macintosh IIx, and the current disk drive configuration.

File Menu

The **File** menu displays the following items. **Open**, **Close**, and **Stop** are dimmed.

•**Open...**	[Command-O]
•**Close**	(Dimmed unless a desk accessory is open)
•**Save Test Selections**	[Command-S]
•**Stop**	[Command-.]
•**Quit**	[Command-Q]

1. **Save Test Selections:** Allows you to customize your *MacTest II/IIx* disk by saving your selection of tests for the next time you use *MacTest II/IIx*.

2. **Stop:** Select **Stop** to end the diagnostic and return to the *MacTest II/IIx* **Status** window.

3. **Quit:** Returns you to the desktop.

Apple Menu

The Apple () menu contains the following three selections:

1. **About MacTest II/IIx:** When selected, a dialog box displays the diagnostic name, version number, date of release, and a copy-protect statement.

2. **Control Panel:** This option allows you to set preferences for speaker volume, monitor status, desktop pattern, or mouse tracking.

3. **Key Caps:** When selected, **Key Caps** displays a window with a keyboard. Press each key on the keyboard and verify that the display block for the key is highlighted. If the key is not highlighted, the keyswitch is bad and should be replaced. If numerous keys are not highlighted, exchange the keyboard.

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *MacTest II/IIx*. Click on the **Start** box in the *MacTest II/IIx* **Status** window. Please note the following:

- The **Status** line at the bottom of the *MacTest II/IIx* window will keep you informed of the tests being performed and the test results.

- While running, all tests display a wristwatch. There is no other moving or flashing indicator that tells you the test is in progress.

- If the SCSI loopback card is missing or improperly installed, you will be instructed at once to turn off the power, disconnect all external SCSI drives, and connect the SCSI loopback card.

- If the serial loopback cable is missing or improperly installed, the testing will begin, but the serial ports test will fail. You will be instructed to make sure the serial loopback cable is connected, then to click on **Continue** to retry the failed test. (You can connect the serial loopback cable without powering off the system.)

- When testing the disk drives, you will be prompted to insert and remove blank 800K and high-density disks. Perform the disk swaps as directed on the screen, and then click on **OK**.

  Note: It is important to insert the requested low- or high-density disk. If the wrong disk is inserted, *MacTest II/IIx* will indicate that the disk drive is malfunctioning when it may not be.

CAUTION: *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 may damage the MacTest II/IIx disk.*

- You may halt the testing by clicking on **Stop** or **Pause** any time between tests:

  - Choose **Stop** to halt the testing and to return to the *MacTest II/IIx* **Status** window. Choose **Start** when you wish to begin the testing sequence again.

  - Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption.

Replace any module that the test indicates is faulty (see Section 2, Take-Apart). Before replacing the module, use *AppleCAT II/IIx* or refer to Section 4, Troubleshooting, to verify the diagnosis. If the system is still not operating properly, turn to Section 4, Troubleshooting, for more information.

If all tests pass, the Macintosh II/Macintosh IIx will return to the *MacTest II/IIx* **Status** window. The message **All selected tests have passed** will be displayed on the **Status** line.

❑ DIAGNOSTIC SOUND SAMPLER

Introduction

The Diagnostic Sound Sampler enables you to listen and become familiar with the Macintosh II and Macintosh IIx error chords. Error chords are brief, musical tones that indicate whether the system is functioning correctly or if there is a hardware problem.

Refer to Section 4, Troubleshooting, for complete information on startup and error chords.

Materials Required

Known-good Macintosh II or Macintosh IIx system
MacTest II/IIx disk (backup)

Procedure

1. Set up the Macintosh II/Macintosh IIx system.
2. Insert the *MacTest II/IIx* backup disk. A window will appear telling you to connect a SCSI loopback card.
3. Click **OK**. The desktop will appear.
4. Open the Diagnostic Sound Sampler. A window listing the various chords and chord sequences will be displayed. Select the ones you wish to hear.
5. On completion, click **Quit**.

❑ INTRODUCTION TO APPLECAT II/IIX

AppleCAT II/IIx is a diagnostic tool that uses a known-good Macintosh to diagnose module failures in a defective Macintosh II or Macintosh IIx. The known-good Macintosh (test station) and defective Macintosh II/IIx (unit under test, or UUT) are connected through their communication ports. The test station performs the following functions:

- Establishes communications with the UUT
- Calls tests in the UUT ROM
- Downloads tests to the faulty machine
- Calls tests for MacTest in the UUT disk drive
- Displays test results on the test station screen
- Identifies the failing module
- Prompts the technician for information
- Recommends a repair procedure
- Issues a repair confirmation code (RCC)

With *AppleCAT II/IIx*, the machine being tested does not have to be fully operational. By using an independent, working computer to do the diagnosis, *AppleCAT II/IIx* depends very little on the unit under test (UUT), and is more reliable and thorough than traditional diagnostic methods.

Standard windows guide the technician through each stage of the diagnostic. When the UUT fails a test or indicates a problem, an *AppleCAT II/IIx* screen will ask for more information or recommend a repair.

After each module replacement or adjustment, *AppleCAT II/IIx* reruns the failed test to verify that the problem has been fixed. If the UUT successfully completes a final system verification, *AppleCAT II/IIx* issues a repair confirmation code (RCC).

❑ RUNNING APPLECAT II/IIX

Materials Required

Macintosh II or Macintosh IIx (unit under test, or UUT)
Known-good Macintosh Plus, SE, II, or IIx (test station)
AppleCAT II/IIx diagnostic disk
MacTest II/IIx disk
Blank, 800K disk
Blank, 1.4 Megabyte disk
Programmer's switch for the UUT
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback card
Mini DIN-8 serial loopback plug
NuBus™ master card (installed in slot 2)
Digital multimeter or volt/ohmmeter
#2 Phillips screwdriver

Setting Up Test Station and UUT

1. Connect the test station to a wall socket with an AC power cord.

2. Place the Macintosh II/Macintosh IIx (UUT) next to the test station.

3. Connect the UUT to a wall socket with an AC power cord.

4. Connect the SCSI loopback card to the SCSI port (Figure 3-4, #1) on the UUT.

5. Connect the serial loopback plug to the printer port (Figure 3-4, #2) on the UUT.

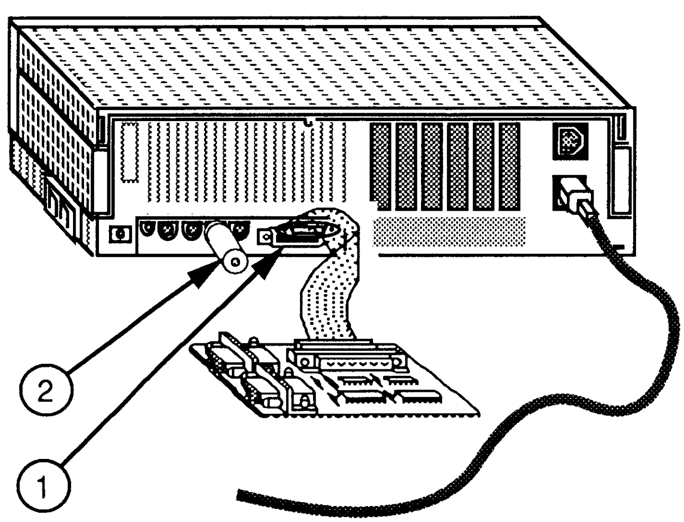


Figure 3-4

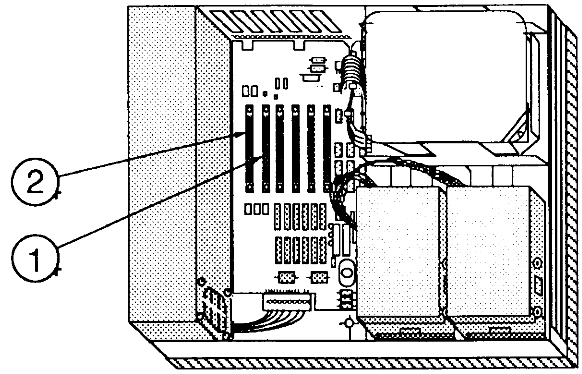


Figure 3-5

6. Install the NuBus master card in the second slot (Figure 3-5, #1) from the power supply of the UUT. The card **must be** installed in slot 2 to work correctly. The video card should be in slot 1 (Figure 3-5, #2).

7. Connect one end of the serial port cable (Figure 3-6, #1) to the modem port (Figure 3-6, #2) on the UUT.

8. Connect the other end to the modem port (Figure 3-6, #3) on the test station.

9. Connect a keyboard or mouse (Figure 3-6, #4) to the UUT.

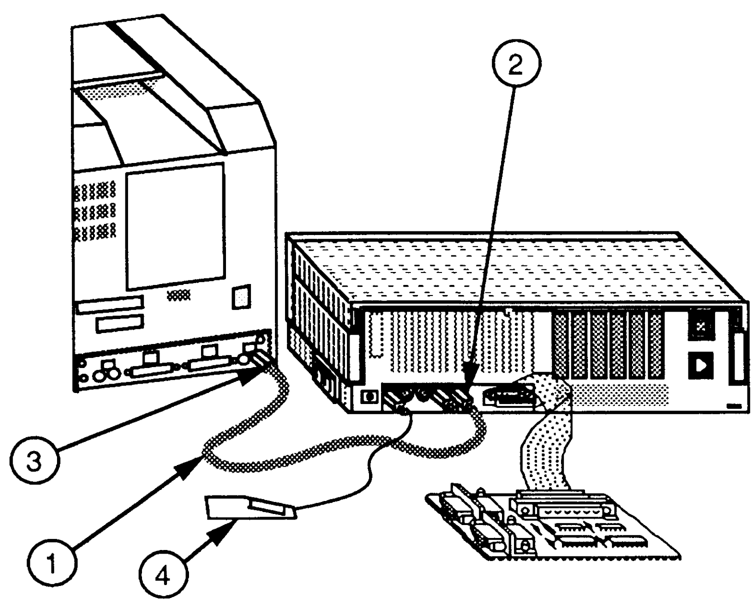


Figure 3-6

10. Verify that the programmer's switch (Figure 3-7) is installed. With the front of the Macintosh II or Macintosh IIx (UUT) facing you, insert the two long tabs of the programmer's switch into the 2nd and 5th **open** slots from the back, along the right side of the UUT. Push the switch until it snaps into place or you are certain it is secure.

    The programmer's switch has two parts. The front part of the switch is a reset switch. Pressing it is just like turning the power switch *off* and back *on*. The back part of the switch is an interrupt switch. Pressing the interrupt switch places the UUT in interrupt mode.

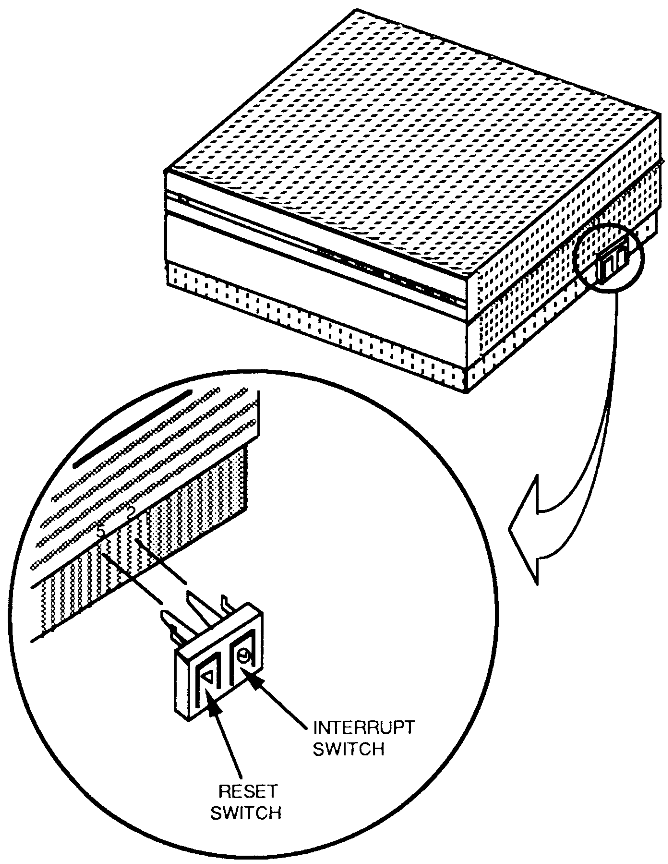


Figure 3-7

Establishing Communication

1. Insert the *AppleCAT II/IIx* disk into the test station, and power on the test station.

2. Open the disk icon and then the *AppleCAT II/IIx* icon. The *AppleCAT II/IIx* **Start** window (Figure 3-8) will appear on the test station screen.

3. Make sure that all disks are ejected from the UUT.

4. Power on the UUT. If you hear **only** the boot tone (a single chord), you are **not** in interrupt mode. To get into interrupt mode, wait until an arrow appears in the upper left corner of the UUT screen (about 4 seconds per megabyte of installed memory), and then press the interrupt switch (see Figure 3-7). When in interrupt mode, or test mode, the UUT can respond to information received over the communication port.

IMPORTANT: *If you hear any additional chords after the single boot tone, you are already in interrupt/test mode.* ***Do not*** *hit the interrupt switch. The Macintosh II/IIx will automatically go into interrupt mode if an error is detected at power on.*

> ***Note:*** If a *MacTest II/IIx* disk was left in the UUT disk drive during power on, the *MacTest II/IIx* disk may boot before you can press the interrupt switch on the UUT. If this happens, eject the *MacTest II/IIx* disk, power off the UUT, and start over at step 4.

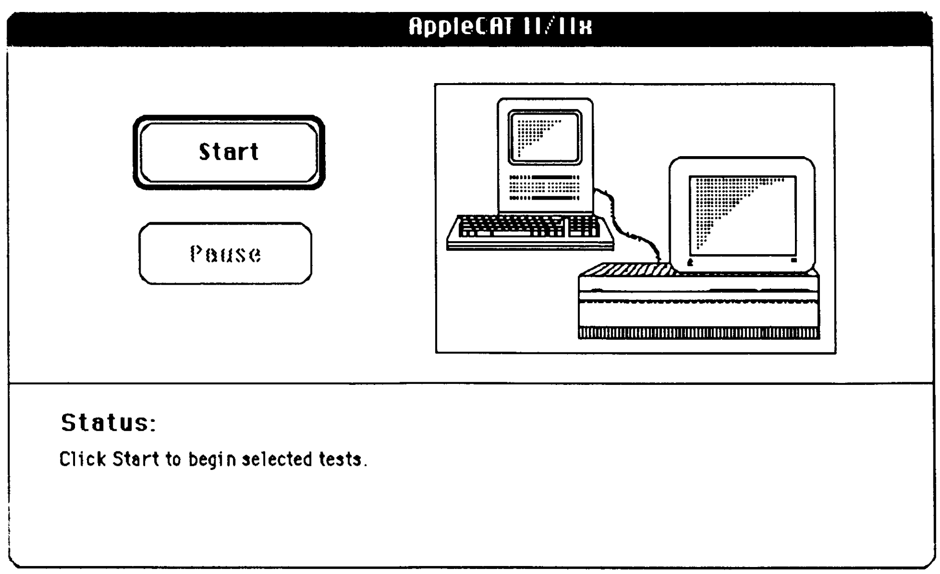


Figure 3-8

Using the AppleCAT II/IIx Menus

Before you start *AppleCAT II/IIx*, you may use the *AppleCAT II/IIx* menus to select the tests you want to run or to select other features of the diagnostic.

> ***Note:*** You must make your test selections before you start *AppleCAT II/IIx*. Changes to the test selections cannot be made while *AppleCAT II/IIx* is running. If you do not use the **Test Selections** menu, the **default test selection** will include the following tests:
>
> - Logic Board
> - Right Hand Internal Drive

IMPORTANT: *Selecting specific tests shortens the AppleCAT II/IIx test, but cannot find all faulty modules. Only the default test selections will ensure a complete system check.*

Options Menu

The **Options** menu contains the **Test Selections** submenu (Figure 3-9). When Test Selections is chosen, the following window appears:

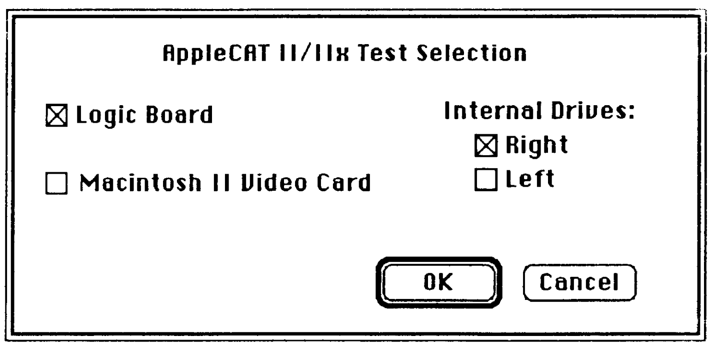


Figure 3-9

Test Selections allows you to select and run certain tests individually. To select a test, click in the box next to the name of the item to be tested. The box will display an X. To deselect the test, click again in the box to remove the X. When you have selected all the tests you wish, click the **OK** button. You will be returned to the *AppleCAT II/IIx* **Start** window.

> ***Note:*** Test Selections will remain unchanged until you change them or you reboot AppleCAT II/IIx.

1. **Logic Board:** This test verifies the correct functioning of the following circuitry on the Macintosh II and Macintosh IIx logic boards:

   - ROM
   - Memory Size
   - CPU Data Bus and Address Bus
   - Memory (RAM)
   - VIA (Versatile Interface Adaptor)
   - Internal Clock
   - Parameter RAM
   - Serial Ports (SCC)
   - SCSI Bus
   - NuBus Control Circuitry
   - IWM/SWIM (Disk Controller IC)
   - FPU (Floating Point Unit)
   - Apple Desktop Bus
   - Sound Chip

   Note: Although *AppleCAT II/IIx* tests the SCSI circuitry on the logic board, it does not test the internal SCSI hard disk. To test the hard disk, use the *Macintosh Hard Disk Drive Diagnostic* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures).*

2. **Macintosh II Video Card:** This test checks the video RAM on the Macintosh II Video Card (for the Macintosh II and Macintosh IIx), and the video DAC (digital-to-analog converter). The Macintosh II Video Card must be installed in Slot 1 before running this test. (The NuBus master card should be in slot 2.)

3. **Internal Drives:** This test will verify the proper functioning of both the right and left drives.

   Note: Testing the internal, 3.5-inch drives will require swapping blank disks in the UUT. Refer to "Running the Tests" (step 5), for more information.

File Menu

The **File** menu displays the following items. All are dimmed except **Stop** and **Quit.**

• **Open...**	[Command-O]
• **Close**	(Dimmed unless a desk accessory is open)
• **Save Test Selections**	(Option not available)
• **Stop**	[Command-.]
• **Quit**	[Command-Q]

1. **Stop:** Select **Stop** to end the diagnostic and return to the *AppleCAT II/IIx* **Start** window.

2. **Quit:** Select **Quit** to exit the program and return to the desktop.

Apple Menu

The Apple () menu contains the following three choices:

1. **About Diagnostic:** When selected, a dialog box displays the diagnostic name, version number, date of release, serial number, and a copy-protect statement.

2. **Control Panel:** With this option you can set preferences for things such as speaker volume, mouse tracking, whether or not AppleTalk is connected, and the desktop pattern.

3. **Key Caps:** When selected, **Key Caps** displays a window with a keyboard.

Help

The **Help** menu will be available with a later release of *AppleCAT II/IIx*. Until the help screens are implemented, the **Help** menu will remain dimmed. **Help** will contain the following items:

- What is *AppleCAT II/IIx?*
- Configuration of Unit Under Test
- Special Tools
- Setup
- Establishing Communication

Running the Tests

After selecting the tests you wish to run using **Test Selections**, you are ready to start *AppleCAT II/IIx*. Click on the **Start** button in the *AppleCAT II/IIx* window. Please note the following:

1. The **Status** line at the bottom of the *AppleCAT II/IIx* window will keep you informed of the tests being performed and their results.

   Note: If the message **Could not establish communication** appears on the **Status** line, you may have inserted the *MacTest II/IIx* disk in the UUT disk drive before powering on. If this message appears, follow the instructions given in the *AppleCAT II/IIx* window.

2. *AppleCAT II/IIx* will interact with you throughout each stage of the testing. When performing internal drive tests, you will be required to perform setup steps (see step 5). When the UUT fails a test or indicates a problem, *AppleCAT II/IIx* will prompt you for more information or recommend a repair.

3. *AppleCAT II/IIx* will ask you for information that it cannot obtain electronically. The screen will display a choice of answers. Select the most appropriate answer in each situation. After selecting a response, click **OK** to continue.

CAUTION: *Do not click the OK button until you've completed every instruction given on the screen. Failure to complete the instructions may misdirect the diagnostic.*

4. If the UUT is turned off to replace or reinstall a module:

   a) Verify that all cables and test fixtures are reattached before powering on.

   b) Eject all disks from the UUT before powering on.

   c) If you do not hear the test mode chimes, wait until an arrow appears onscreen (about 4 seconds per megabyte of RAM), and then press the interrupt switch to get into the test mode.

   d) Click **Start** at the test station to restart the test.

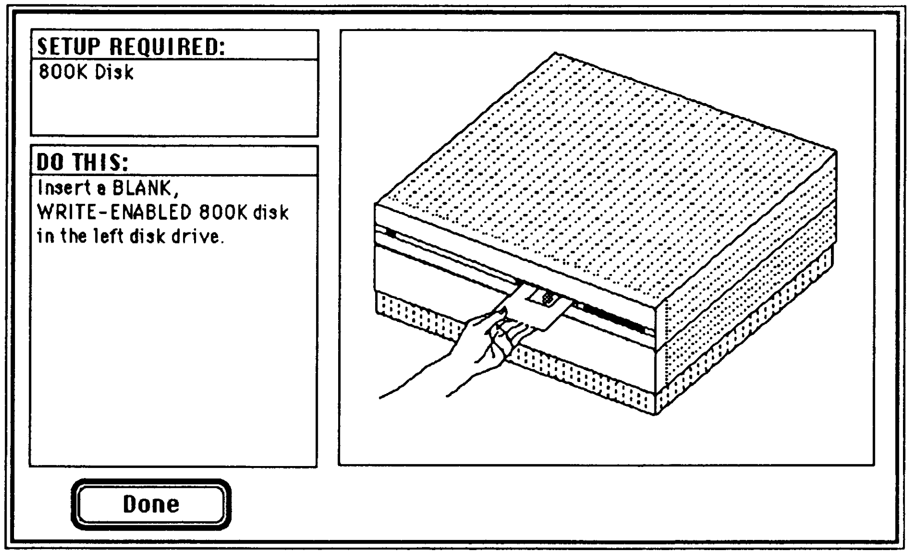


Figure 3-10

5. *AppleCAT II/IIx* will also ask you to perform setup steps. When the **Setup Required** window (Figure 3-10) appears, insert the requested disk. *AppleCAT II/IIx* will specify which drive to use. After inserting the disk, click **Done** to continue the test. *AppleCAT II/IIx* will request the following disks:

   - 800K Disk (blank and write-enabled)
   - High Density Disk (blank and write-enabled; for FDHD drive testing only)
   - Write-protected, *MacTest II/IIx* Disk

6. You may halt the testing by clicking on **Stop** or **Pause** any time during the tests:

   a) Choose **Stop** to halt the testing and to return to the *AppleCAT II/IIx* window. Choose **Start** when you wish to begin the testing sequence again from the beginning.

   b) Choose **Pause** if you wish to discontinue testing temporarily. Choose **Continue** to resume testing from the point of interruption.

IMPORTANT: *Please read all messages and instructions carefully. Do only what AppleCAT II/IIx specifically instructs you to do.*

Repair Confirmation Code (RCC)

When the UUT passes its final test, *AppleCAT II/IIx* issues a repair confirmation code (RCC). The RCC is an eight-digit information record that contains the diagnostic name, the diagnostic version number, the replaced module name, and the repair sequence the program followed. This RCC should be entered on the SRO form that accompanies the returned module.

If *AppleCAT II/IIx* finds no problems, one of the following RCC codes will be displayed:

- All selected tests passed 20ZZ-019G
- All selected tests passed 0MZZ-019G

If *AppleCAT II/IIx* is unable to identify the problem with the UUT, *AppleCAT II/IIx* will issue an RCC beginning with one of these four-digit prefixes:

- **20ZZ**-xxxx . . . . for the Macintosh II
- **0MZZ**-xxxx . . . . for the Macintosh IIx

Helpful Suggestions

If you receive an RCC with one of the prefixes shown above, refer to Section 4, Troubleshooting, for information that can help you isolate the problem. Also keep in mind that AppleCAT II/IIx is unable to identify a system failure if any of the following is true:

- The bad module is failing intermittently.

- The system configuration changes during the test (memory is removed or added, or system power is removed).

- Selected modules are tested; only the default tests perform a complete system check.

- The replacement module itself is bad.

- You provide inaccurate input to AppleCAT II/IIx, or set up the test station incorrectly.

❑ SCSI LOOPBACK JUMPER PROCEDURE

To Determine If a Jumper Is Needed

To be used with *MacTest II/IIx* and *AppleCAT II/IIx,* the SCSI loopback card must be jumpered between Pin 25 of J1 and Pin 14 of RP1. On new SCSI loopback cards, the jumper has been etched into the printed circuit. Only cards with the old PCB artwork need the jumper procedure.

> ***Note:*** This modification does not interfere with the card's use on other Macintosh or Apple II family systems, except that to work on Apple II systems the card must be connected to a notched mouse cable. (For further information on the notched cable, refer to *SCSI Hard Disk Drives Technical Procedures*, Section 5, "SCSI Interface Card.")

To Identify a New Card

To determine if you have a new card, which will not need to be jumpered, look at the back of the card. If the jumper is included in the artwork, there will be an **A** instead of double zeros (**00**) at the end of the part number, which is located under the words "APPLE COMPUTER" (Figure 3-11, #1). **These new cards do not have to be jumpered.**

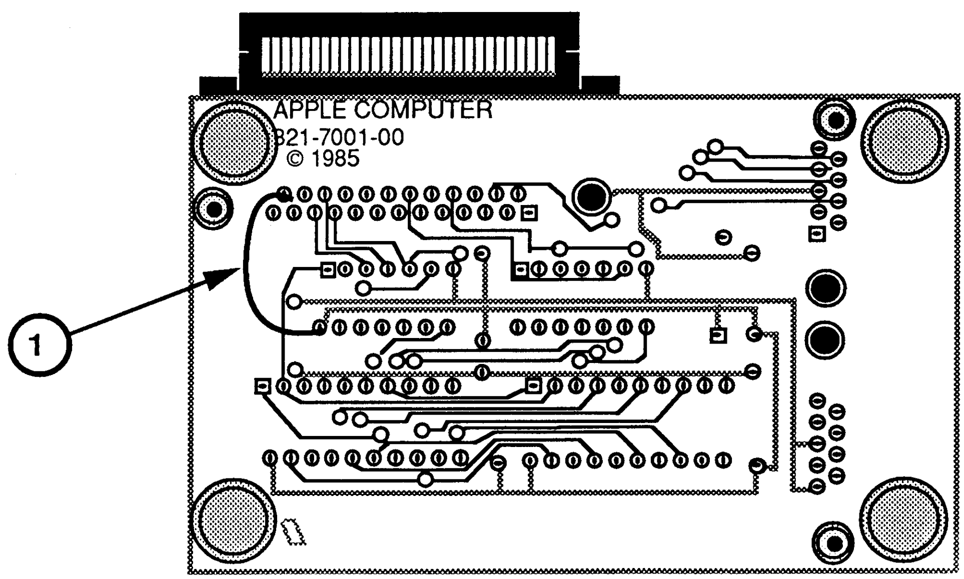
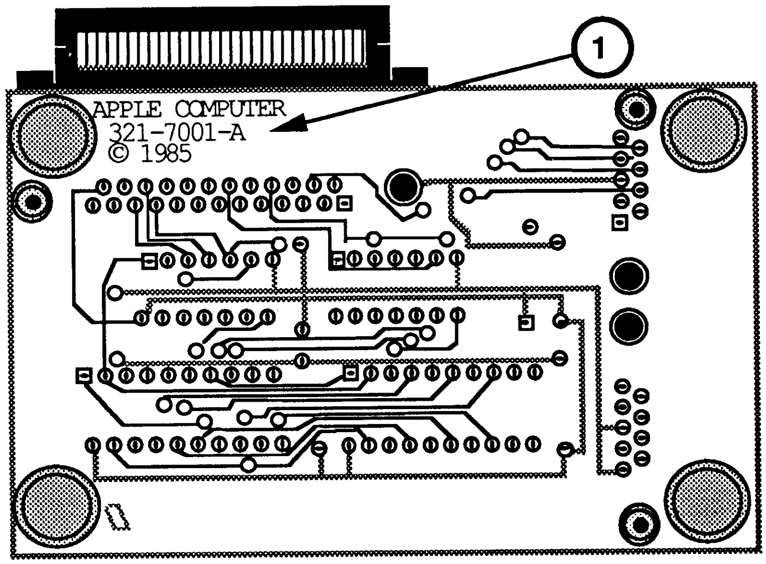


Figure 3-11

External Jumpers on Old Cards

Some cards with the **00** part number and the old artwork were modified with an external jumper during the manufacturing process. Therefore, if your card has a **00** part number, check to see if it has an external jumper from Pin 25 of J1 to Pin 14 of RP1 (Figure 3-12, #1). If it has no external jumper, you must install one yourself.



Fligure 3-12

Summary

To summarize:

If # on back ends with:	Do this:
A	Nothing (Jumper is present in artwork.)
00	Check to see if external jumper is present. If not, install jumper.

To Install the Jumper

If you find that the card must be jumpered, solder a wire connection between Pin 25 of J1 and Pin 14 of RP1, as shown in Figure 12. (The pins are not numbered on the board. In the orientation shown in Figure 12, Pin 25 is the pin closest to the upper left corner of the card, and Pin 14 is in the middle line of pins, and closest to the left edge of the card.)

Macintosh II/IIx/IIfx

Section 4 – Troubleshooting

❑ CONTENTS

Note: If a step is underlined, detailed procedures for that step can be found in Section 2, Take-Apart.

❑ INTRODUCTION

Use this troubleshooting section if you are unable to boot the *MacTest II/IIx* (Macintosh II or IIx) or *MacTest MP* (Macintosh IIfx) disk, or if the diagnostic is unable to detect a module failure. After you repair the system, run the test disk again to verify system operation.

Before You Start

Read the articles and subarticles titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "SIMM Verification," and "Battery Verification" before you begin troubleshooting. **You need the information provided in these sections to troubleshoot the Macintosh II, IIx, and IIfx effectively.**

How to Use the Symptom Chart

To use the symptom chart, first find the symptom that most nearly describes the problem; then perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. **If you replace a module and find that the problem remains, reinstall the original module before you go on to the next action.**

If the symptoms displayed by the system are not listed in the symptom chart or if the system is not displaying a clearly defined problem, use the troubleshooting flowcharts.

How to Use the Troubleshooting Flowcharts

There are five numbered troubleshooting flowcharts for the Macintosh II, IIx, and IIfx computers. These flowcharts are useful in troubleshooting startup-related problems.

The troubleshooting flowcharts are designed to verify operation of the computer in its minimum configuration. Therefore, before using the troubleshooting flowcharts, remove any options installed and disconnect any external peripherals.

Starting at the top of Flowchart 1, answer the questions and proceed down the chart. When you arrive at a rectangular box containing a list of actions, perform the actions in the sequence listed. On completion, return to the preceding diamond box. **If the problem remains, reinstall the original module before you go on to the next action.**

Each of the flowcharts includes references to notes on the opposite page. These notes provide additional instructions or referrals to other procedures.

Things to Remember

- Be sure to follow all electrostatic discharge precautions when working on the computer. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for additional information.

- If available, use a known-good monitor and video interface card. Thus you will isolate the problem to the CPU, internal drives, keyboard, and mouse.

- To ensure that customers receive the same computer configurations that they bring in, record the following information before beginning:

  - Type and serial number of NuBus expansion cards

  - Size and capacity of internal SCSI hard disk, or type (800K or 1.4 MB) of second floppy disk drive, if installed

  - Number and types of SIMMs installed

  - Macintosh II only
    - Whether an IWM or SWIM disk controller chip is installed
    - Version of ROM installed
    - Whether an HMMU or PMMU is installed

  - Macintosh IIfx only
    - Whether a SCSI filter and/or terminator is installed

  At the end of this section is a form you can use to record the customer's system configuration.

- Before you begin troubleshooting, remove all NuBus expansion cards and disconnect all external serial, SCSI, and ADB devices (except the keyboard and mouse).

After the computer is fully operational, each option card or peripheral should be installed and tested. Install one device and test the system before adding any others. Repeat the install-and-test process until all devices have been installed and tested.

- Mark each known-good SIMM module on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

- Use a known-good copy of the diagnostic disk.

- During a normal startup sequence, a medium-pitched soft chord is emitted. If you do not hear a medium-pitched soft chord, refer to "Startup and Error Chords" for additional information.

- The Macintosh II and IIx require system software 6.0.2 or later. The Macintosh IIfx requires version 6.0.5 or later. If an earlier version of the system is installed, install the correct version and reverify the failure before beginning troubleshooting. Many times problems that appear hardware related are actually caused by software. System software installation procedures are included in Section 1, Basics.

- When instructed to replace the **logic board only**, place the **customer's SIMMs** on the **replacement logic board**.

  Note: If you are removing SIMMs from the logic board, use the SIMM removal tool. See *You Oughta Know* for instructions.

Macintosh II Only

When instructed to replace the **logic board only** on a system with a **1.4 MB Apple FDHD disk drive**, remove the ROMs and SWIM chip included with the replacement logic board, and install the **customer's SIMMs, ROMs, and SWIM chip** on the **replacement logic board**. If a PMMU upgrade is installed, swap the **customer's PMMU** for the **HMMU** on the **replacement logic board**.

Macintosh IIfx Only

- Make sure an internal SCSI terminator is installed on any system that does not have an internal SCSI hard disk installed.

- Systems containing an Apple internal SCSI hard disk manufactured before March 19, 1990 may require the use of an internal SCSI filter. See Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for additional information.

- If an internal Apple SCSI hard disk drive is being replaced, an internal SCSI filter may be required. See Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for additional information.

❑ MODULE EXCHANGE INFORMATION

At the end of this section is a form you can use to record the customer's system configuration. Feel free to copy it for your own use.

Logic Board

To make sure the customer always receives the same logic board configuration that he or she brought in, **be sure to record the following information before you exchange any modules:**

- The type of logic board exchanged: Macintosh II, IIx, or IIfx

- The amount of memory installed

- For the Macintosh II:

  - ROM version

  - Whether an IWM or SWIM is installed

  - Type of memory management unit that is installed: the HMMU (standard) or the PMMU (a 68851 IC upgrade)

- For the Macintosh IIfx:
  - SCSI filter and/or terminator

Internal SCSI Hard Disk Drives

Internal SCSI hard disks ship without the SCSI cable connected. **Be sure to keep the SCSI cable with the customer's system.** The cable sells as a separate replacement part and is not part of any module.

The SCSI power cable is included with all internal SCSI drive modules.

Macintosh IIfx 1 MB 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. These failures include:

- System doesn't 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 codes up to and including 9052 will exhibit these failures. Figure 4-1 shows the location of the date code. Replace SIMMs that have date codes of 9052 and below.

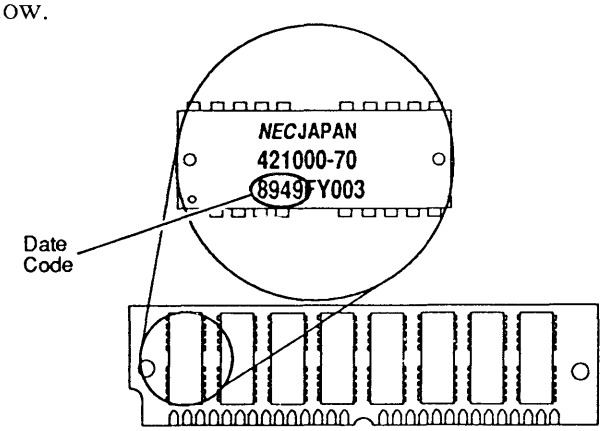


Figure 4-1

❑ STARTUP AND ERROR CHORDS

Introduction

When the computer is powered on, a series of self-tests are performed. If any part of the self-test fails, a sequence of chords will sound.

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Startup Chord

During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

If a startup chord and additional chords sound, a blank gray screen usually appears. There will always be three chords played when an error is encountered during startup: startup chord, error chord, and test monitor chord.

Refer to the list of failure areas below. The list includes a description of each error chord, the problem it indicates, and what to do to correct the problem.

Initial Failure

A short, harsh chord indicates a failure during the initial hardware self-tests. To correct the problem:

1. Exchange the logic board. (Install the customer's SIMM modules on the exchange board. Be sure you mark the known-good SIMMs that you remove from the exchange logic board.)

2. If exchanging the logic board doesn't work, use the customer's logic board and exchange the SIMMs only. (Refer to "SIMM Verification" in this section for complete instructions.)

   If the system still does not work, you will need to verify the customer's SIMMs on the exchange logic board. (Refer to "SIMM Verification" in this section for complete instructions.)

RAM 1 and 2 Failure

A long, medium-pitched chord (RAM 1) or a medium-then-high pitched then high chord (RAM 2) indicates a RAM self-test failure. To correct the problem:

1. If the failure occurs on a Macintosh IIfx, refer to "Macintosh IIfx 1 MB SIMMs" under *Module Exchange Information.*

2. Exchange only the SIMMs in Bank A. (Refer to "SIMM Verification" in this section for complete instructions.)

3. Exchange only the SIMMs in Bank B. (Refer to "SIMM Verification" in this section for complete instructions.)

4. If these exchanges do not work, exchange the logic board. (Install the customer's SIMM modules on the exchange board.)

5. If the system still does not work, you must do the SIMM verification with the exchange logic board.

Test Monitor

Four chords (from low to high) indicate that the system has entered the test monitor.

Summary

The following chart summarizes all the preceding information on error chords. The left column lists the chords, and the right column lists the actions to be taken.

Chord Sequences	Actions
• *Startup, Initial, Test Monitor*	1. Replace logic board only. 2. Perform SIMM verification on customer's logic board.
• *Startup, RAM 1, Test Monitor*	1. If the failure occurs on a Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information." 2. Perform SIMM verification of Bank A, then of Bank B on customer's logic board. 3. Replace logic board only. 4. Perform SIMM verification on replacement logic board.
• *Startup, RAM 2, Test Monitor*	1. If the failure occurs on a Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information." 2. Perform SIMM verification of Bank A, then of Bank B on customer's logic board. 3. Replace logic board only. 4. Perform SIMM verification on replacement logic board.

❑ SYMPTOM 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 the monitor directly into the wall socket, and verify that the monitor has power. 3. Replace power cord. 4. Check batteries (refer to "Battery Verification"). 5. Replace power supply. 6. Replace logic board only.
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Replace logic board only.
• *System shuts down intermittently*	1. Make sure air vents on the sides and top of the system unit are kept clear. Thermal protection circuitry may shut the system down. After 30 to 40 minutes the system should be OK. 2. Replace power cord. 3. Check batteries (refer to "Battery Verification"). 4. Replace power supply. 5. Replace logic board only.
• *System intermittently crashes or locks up*	1. Make sure the correct version of system software is being used. 2. Make sure software is known-good. 3. Replace logic board only. 4. Replace SIMMs (refer to "SIMM Verification"). 5. Replace power supply.
• *System doesn't boot (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.

System Problems (continued)	Solutions
• *System sounds error chords at startup (Macintosh IIfx only)*	1. Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information. 2. See "Startup and Error Chords" in this section.

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 interface card to a different slot. 5. Replace video interface card. 6. Replace SIMMs (refer to "SIMM Verification"). 7. Replace logic board. 8. Replace power supply.
• *Screen is black, audio and drive do not operate, but fan is running and LED is lit*	1. Replace video cable. 2. Move video interface card to a different slot. 3. Replace video interface card (refer to Section 5, Additional Procedures). 4. Replace SIMMs (refer to "SIMM Verification"). 5. Replace logic board. 6. Replace power supply. 7. Replace monitor.
• *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 interface card to a different slot. 4. Replace video interface card. 5. Replace logic board only.
• *Screen is completely dark, fan is not running, and LED is not lit*	1. Plug the monitor directly into the wall socket, and verify that the monitor has power. 2. Check batteries (refer to "Battery Verification"). 3. Replace power supply. 4. Replace logic board only.

Video Problems (continued) **Solutions**

• *Video display exhibits "ghosting" (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.
• *System boots and then loses video (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.

Note: If replacing the monitor corrects the problem, refer to the appropriate monitor *Technical Procedures* for monitor troubleshooting information.

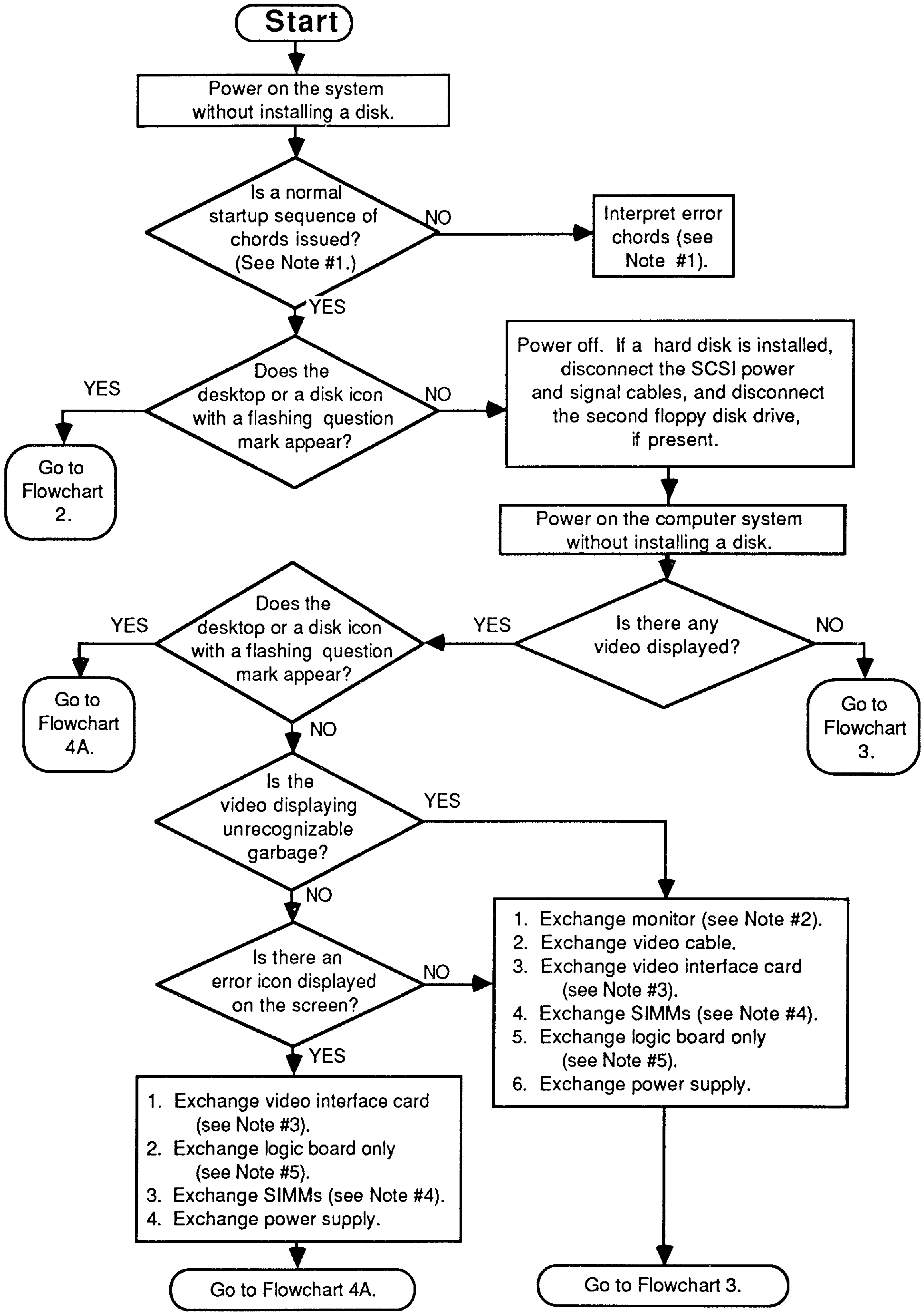
Floppy Disk Drive Problems	Solutions
• *Internal disk drive runs continuously*	1. Replace bad disk. 2. Replace internal disk drive cable. 3. Replace internal floppy disk drive. 4. Replace logic board only.
• *Audio and video are present, but one internal floppy drive does not operate*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal floppy drive cable. 4. Replace internal floppy drive. 5. Replace logic board only. 6. Replace power supply.
• *Audio and video are present, but neither internal floppy drive operates*	1. Replace bad disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace power supply. 4. Replace logic board only.
• *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 floppy disk drive. 4. Replace logic board only.
• *Will not eject disk*	1. Switch power off and hold mouse button down while switching power back on. 2. Replace floppy disk drive.
• *Attempts to eject disk but doesn't*	1. Reinsert disk. 2. Reseat top cover so drive slots line up correctly.
• *MS-DOS® drive does not recognize a disk formatted on a 1.4 MB FDHD drive*	– If compatibility in reading and writing files with the 1.4 MB FDHD is desired, format all disks with the MS-DOS drive first.

SCSI Hard Disk Drive Problems	Solutions
• *Internal hard disk will not operate; LED doesn't light; drive doesn't spin-up*	1. Replace SCSI signal cable. 2. Replace SCSI power cable. 3. <u>Replace hard disk</u>. 4. <u>Replace logic board only</u>.
• *Drive does not appear on the desktop*	– If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used.
• *Data is lost or corrupted*	– If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used.
• *Works with internal or external SCSI device but will not work with both*	1. Check the SCSI device switch setting on the external device and make sure it isn't **0** (the address of the internal hard disk) or **7** (the computer's address). 2. If the computer is a Macintosh IIfx, there may be a SCSI termination problem. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" to verify that proper SCSI termination is being used. 3. Replace the SCSI terminator on the external device. 4. Verify that a terminator is installed on the internal SCSI drive. 5. Refer to *SCSI Hard Disk Drive Technical Procedures* for troubleshooting the external drive.

Peripheral Problems	Solutions
• *Cursor does not move*	1. Check mouse connection. 2. Inspect the inside of the mouse for a buildup of dirt and other contaminants. Clean the mouse if necessary. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board only.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace mouse. 2. Replace logic board only.
• *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 only.
• *Cannot double-click to open an application, disk, or server*	1. Remove any multiple system files on the hard disk. 2. Clear parameter RAM. Hold down the <Shift> <Option><Command> keys and select **Control Panel** from the Apple pull-down menu. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board.

Peripheral Problems (continued)	**Solutions**
• *Known-good ImageWriter® or ImageWriter II will not print*	1. Make sure the correct version of system software is being used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Replace printer interface cable. 4. <u>Replace logic board only</u>.
• *Known-good LaserWriter® will not print*	1. Make sure the correct version of system software is being used. 2. Make sure that the Chooser and the Control Panel are set correctly. 3. Refer to the Networks tab in *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *No sound from speaker*	1. Verify that the volume setting in the Control Panel is set to one or above. 2. Replace speaker. 3. <u>Replace logic board only</u>.
• *HMMU socket does not allow PMMU installation (Macintosh II only)*	– <u>Replace logic board</u>. Verify that the socket is a 13 x 13-pin grid array package and that it contains 132 gold contacts inside the socket. (Sockets containing only 70 pins do not support the PMMU.)
• *System hangs when the first application is launched (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.
• *System displays an ID error and then locks up (Macintosh IIfx only)*	– Check whether Apple-labeled SIMMs manufactured by NEC have a date code of 9052 or below. If any NEC SIMMs have a date code of 9052 or below, replace them. Refer to "Module Exchange Information" for further information.



Flowchart 4-1

❑ TROUBLESHOOTING FLOWCHARTS

Flowchart 4-1 Notes

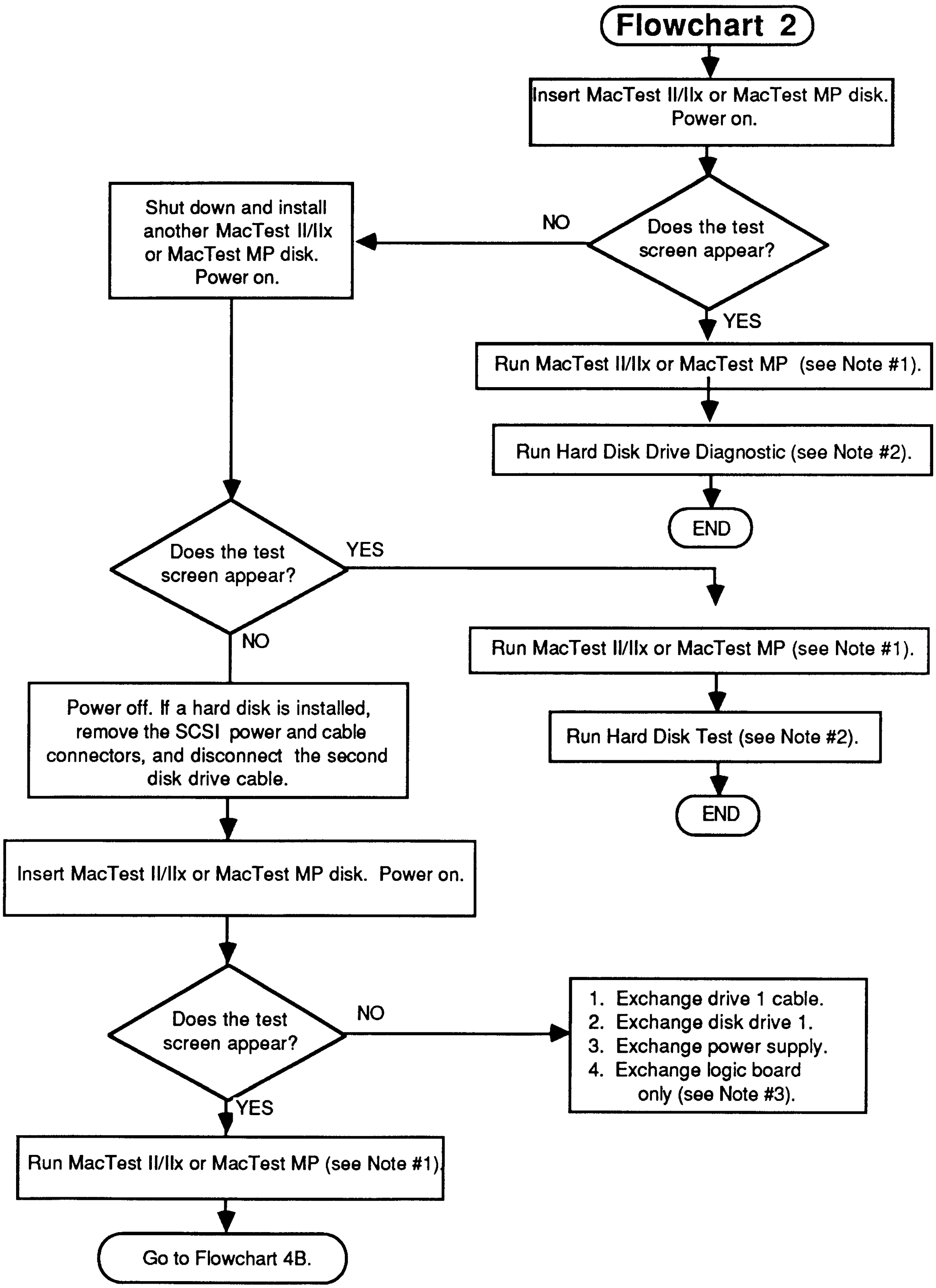
1. During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found). If either of these things does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor corrects the problem, refer to the *Technical Procedures* for the monitor to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, and if the customer's card has the video expansion kit installed, refer to *Macintosh Family Cards Technical Procedures—Macintosh II Video Cards*, for information on troubleshooting the eight replaceable RAMs.

4. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

5. If the known-good SIMMs did not correct the problem, install the **customer's SIMMs** on the **replacement logic board**.



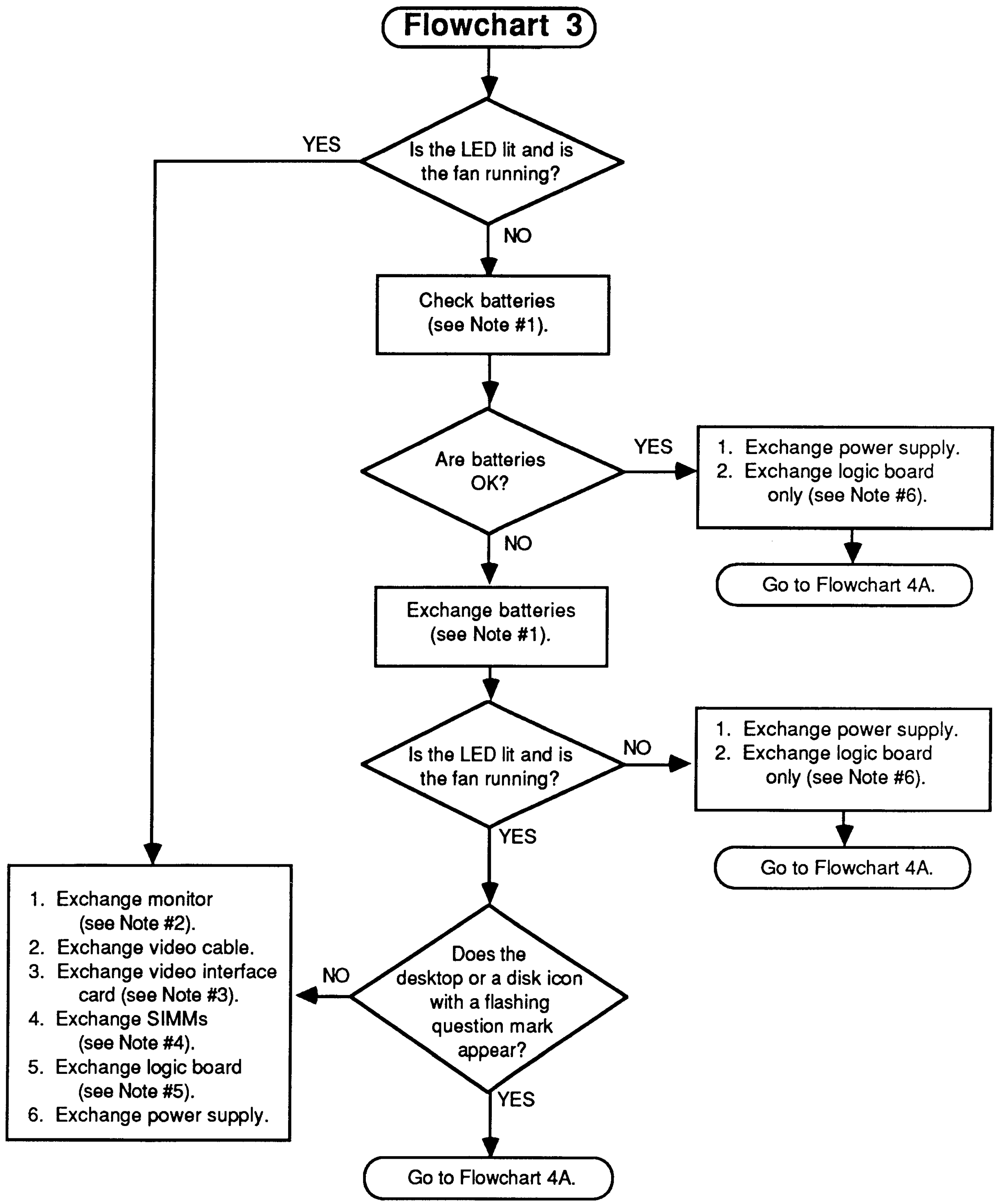
Flowchart 4-2

Flowchart 4-2 Notes

1. For *MacTest II/IIx*, refer to Section 3, Diagnostics, for complete information. For *MacTest MP*, refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the **customer's SIMMs** on the **replacement logic board**.



Flowchart 4-3

Flowchart 4-3 Notes

1. Refer to "Battery Verification" for complete instructions on checking the lithium batteries.

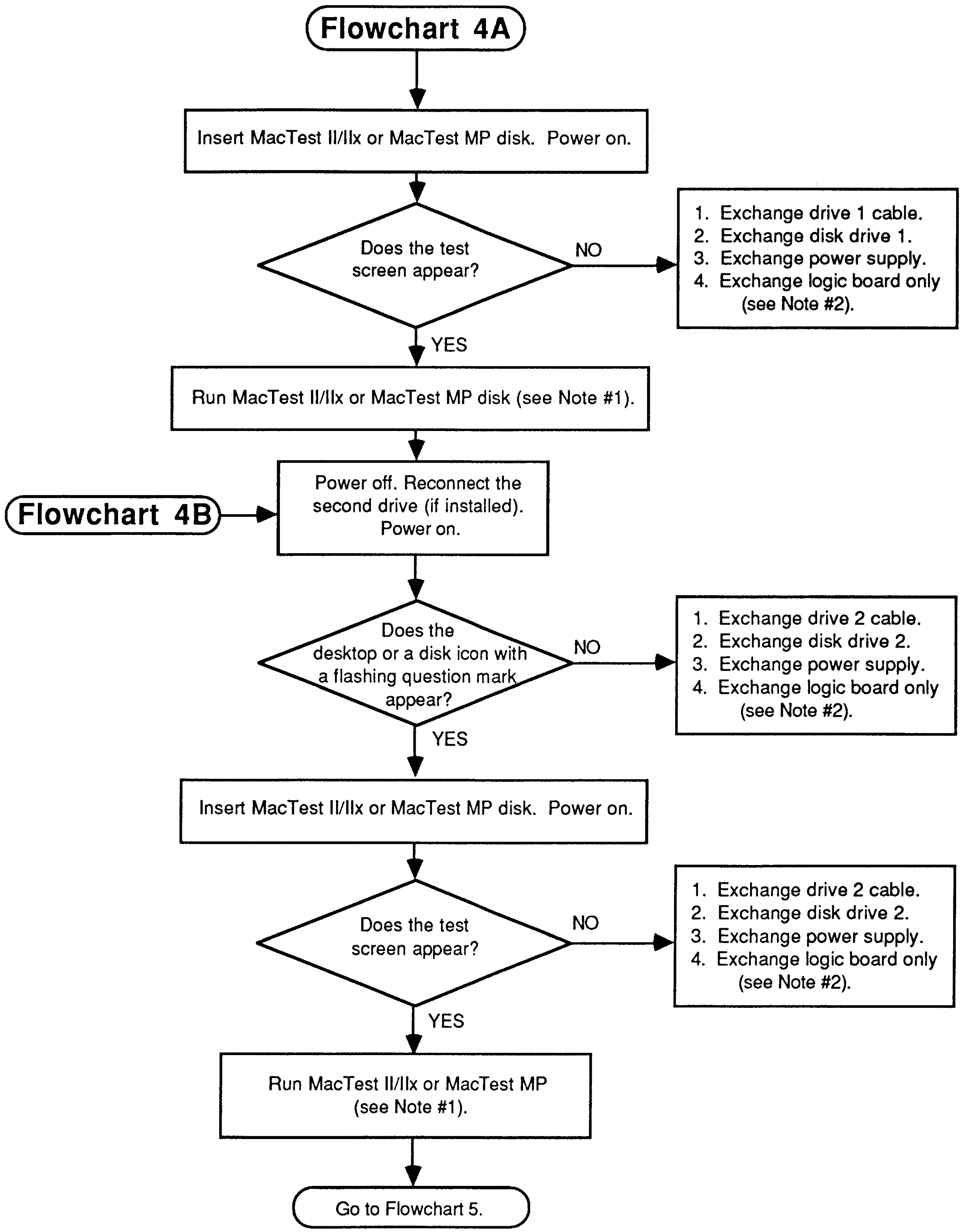
2. If exchanging the monitor corrects the problem, refer to the Technical Procedures for the monitor to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, and if the customer's card has the video expansion kit installed, refer to *Macintosh Family Cards Technical Procedures—Macintosh II Video Cards*, for information on troubleshooting the eight replaceable RAMs.

4. There are two steps to perform when exchanging the SIMM modules. Refer to "SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

5. If the known-good SIMMs did not correct the problem, install the **customer's SIMMs** on the **replacement logic board**.

6. Exchange only the logic board by installing the **customer's SIMMs** on the **replacement logic board**.

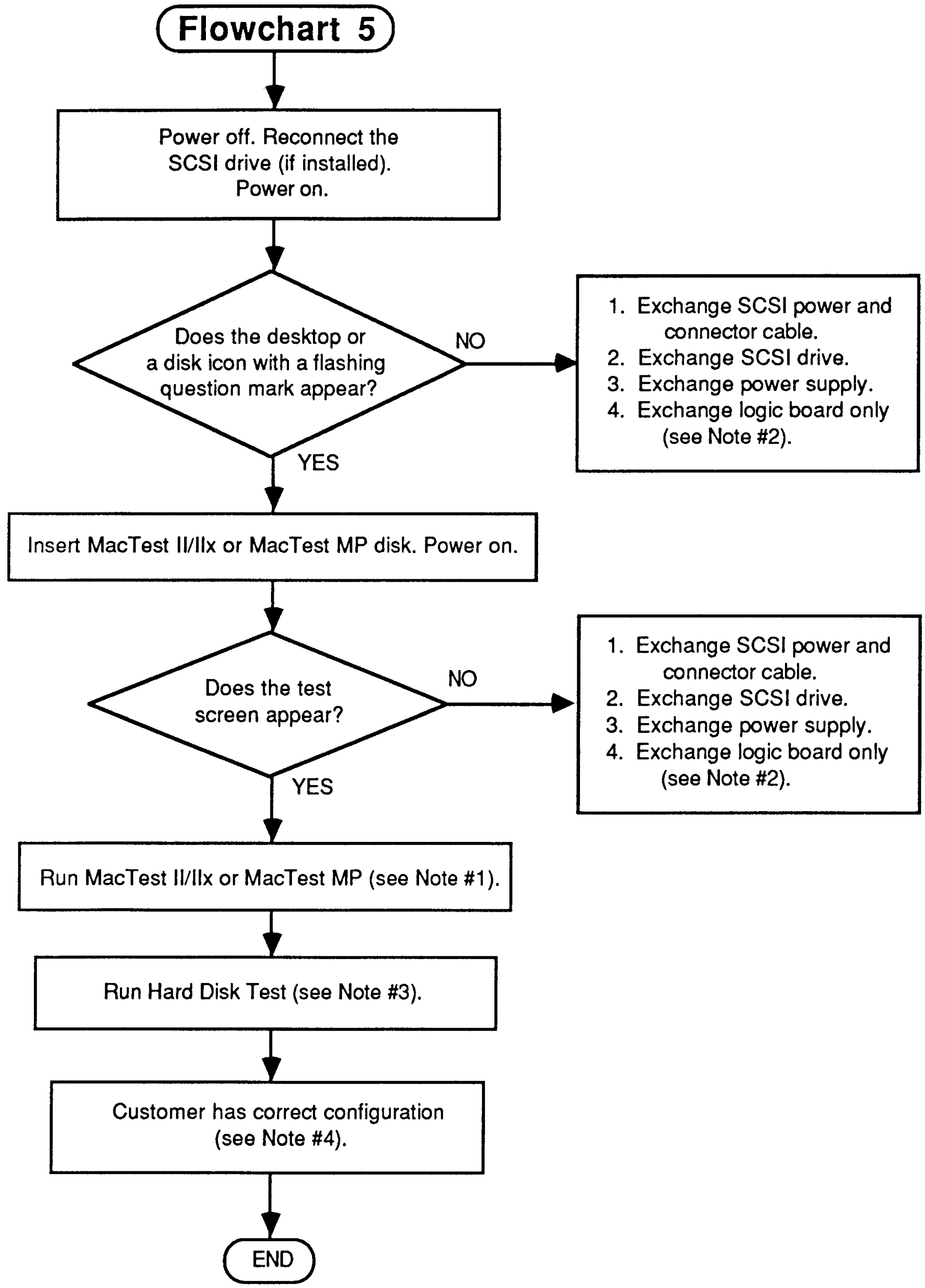


Flowchart 4-4

Flowchart 4-4 Notes

1. For *MacTest II/IIx*, refer to Section 3, Diagnostics for complete information. For *MacTest MP*, refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*

2. Install the **customer's SIMMs** on the **replacement logic board**.



Flowchart 4-5

Flowchart 4-5 Notes

1. For *MacTest II/IIx,* refer to Section 3, Diagnostics for complete information. For *MacTest MP,* refer to the MacTest MP section of the *Macintosh Multiple-Product Diagnostics* tab in the *Macintosh Family Technical Procedures.*

2. Install the **customer's SIMMs** on the **replacement logic board**.

3. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

4. The customer must always receive the same system configuration he or she brings in. Refer to "Module Exchange Information."

❑ SIMM VERIFICATION

Introduction

The service exchange logic board comes without RAM SIMMs.

The SIMMs installed on the customer's logic board may be defective. To check for defective SIMMs, remove all of the customer's SIMMs and install known-good SIMMs. Mark each known-good SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Note: If the system is Macintosh IIfx, refer to Macintosh IIfx 1 MB SIMMs under "Module Exchange Information."

Isolating a Defective SIMM

1. Remove the top cover and drive mount.

2. Remove the customer's SIMMs using the SIMM removal tool. See *You Oughta Know* for instructions on how to use this tool.

   Note: Using the configuration chart located at the end of this section, record the number and the sizes of the SIMMs. The customer should get back the same number and sizes. Refer to the *Apple Technical Procedures SIMMs Quick Reference Chart* for information on identifying the SIMMs.

3. **Figure 4-2**. Install the four known-good SIMMs in Bank A.

4. Place the drive mount into position, and connect floppy disk drive 1 only.

5. Power on the system.

6. Insert the *MacTest II/IIx* (Macintosh II and IIx) or *MacTest MP* (Macintosh IIfx) disk in floppy disk drive 1.

   If the test boots, run it. Then continue with the appropriate verification procedure.

   If the test does not boot, return to the appropriate flowchart.

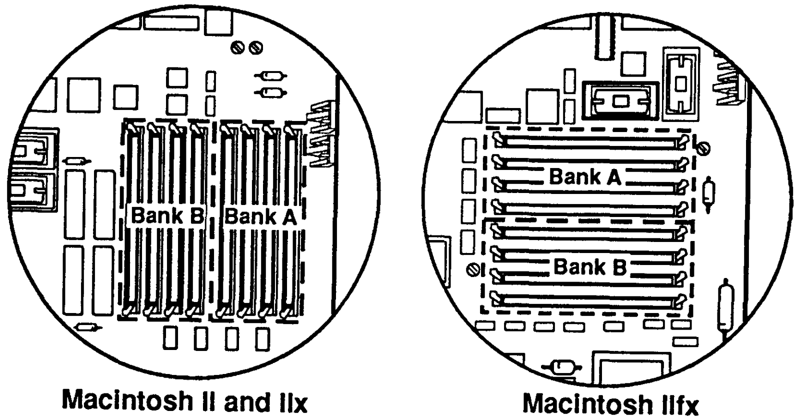


Figure 4-2

Verification

If the customer has 256K SIMMs or 1 MB SIMMs installed, you must verify all SIMMs. Use Flowchart 4-6 and the verification flowchart notes.

Materials Required

If you are verifying 256K SIMMs (Macintosh II and IIx only), you will need four 256K known-good SIMMs.

If you are verifying 1 MB SIMMs, you will need four 1 MB known-good SIMMs of the correct speed (60, 80, or 120 nanoseconds) and type (parity or nonparity).

Verification Flowchart Notes

1. **Figure 4-3**. Locate Bank A on the logic board and install three known-good SIMMs.

2. During a normal startup sequence, you hear a medium-pitched chord; then a disk icon appears on the screen. The disk icon will have a flashing question mark if the computer cannot find a startup disk, or a smiling face if the computer finds a startup disk. Refer to "Startup and Error Chords" for additional information.

3. Be sure to label the defective SIMM so you will not confuse it with other SIMMs.

4. **Figure 4-3**. Return to the beginning of the flowchart and perform the same procedure for the SIMMs in Bank B.

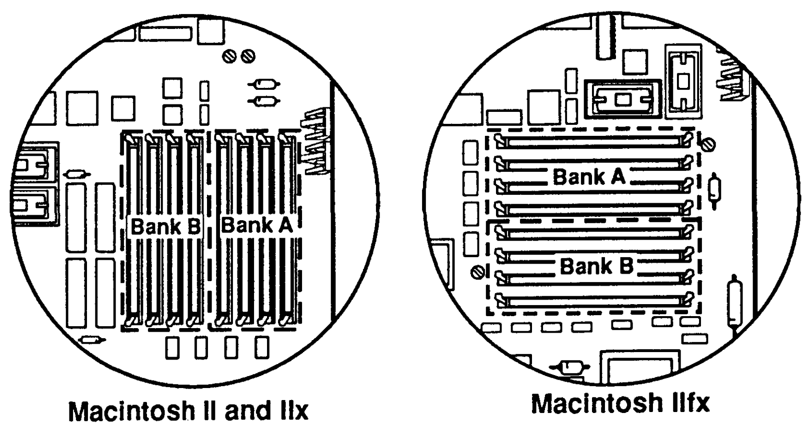
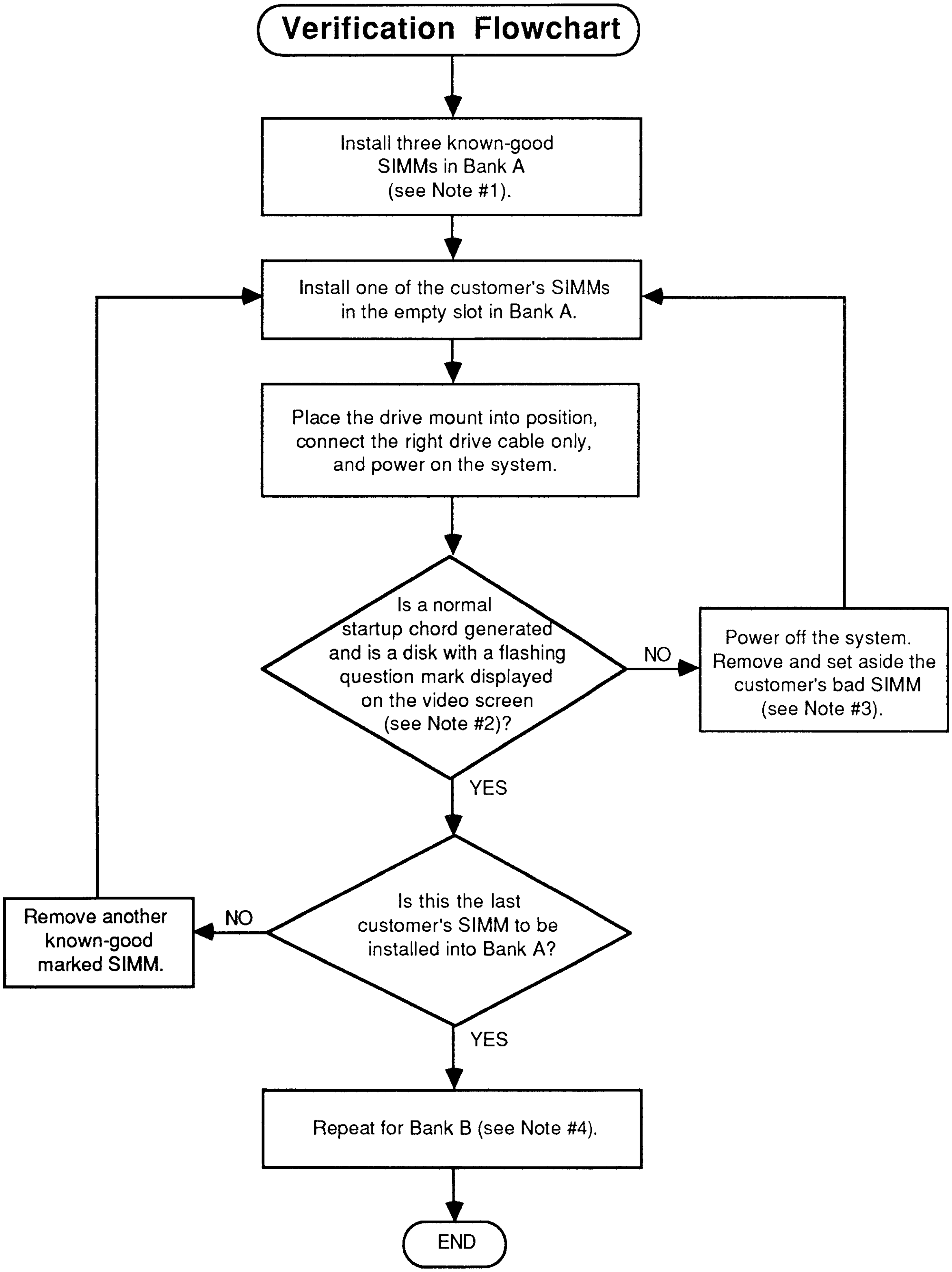


Figure 4-3



Flowchart 4-6

❑ BATTERY VERIFICATION

Introduction

There are two lithium batteries on the main logic board. These batteries are part of the power-on circuit. If either battery falls below specifications, **both** must be removed and replaced.

WARNING: *Lithium batteries, the type used in the Macintosh II/IIx/IIfx, have some potential for explosion if improperly handled. Follow the procedure below exactly as written.*

Materials Required

Voltmeter

Verification Procedure

Figure 4-4. To check the lithium batteries with a voltmeter:

1. Be sure power is off. Then remove the top cover.
2. Set the voltmeter range to measure 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **positive side** of one of the batteries.
4. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the same battery.
5. The reading for a good battery should be **3.2 volts or higher**.
6. Repeat steps 3, 4, and 5 for the other battery.

If either battery falls below 3.2 volts, replace both batteries. Refer to Section 5, Additional Procedures, for replacement instructions.

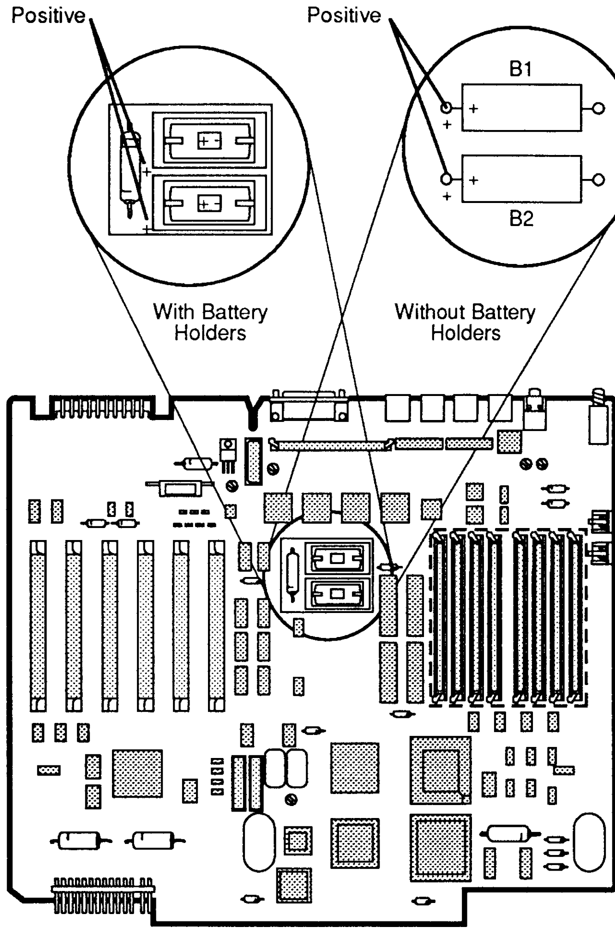

Positive
Positive
B1
B2
With Battery Holders
Without Battery Holders

Figure 4-4

❑ CUSTOMER'S CONFIGURATION CHART

The chart below can be copied and used to keep track of a customer's system configuration. Once the chart has been filled out, attach it to the system. The chart will help you make absolutely sure that the customer receives the same configuration that he or she brought in.

Customer ______________________

Model ______________________

Serial Number ______________________

Internal SCSI Hard Disk Drives

Storage Capacity ☐ 20 MB ☐ 40 MB ☐ 80 MB ☐ 160 MB ☐ Other: __________

Disk Size ☐ 3.5 Inch ☐ 5.25 Inch

Internal Floppy Drives

Left Drive ☐ 800 K ☐ 1.4 MB

Right Drive ☐ 800 K ☐ 1.4 MB

NuBus Cards

	Type	Serial Number
Slot 1	__________	______________
Slot 2	__________	______________
Slot 3	__________	______________
Slot 4	__________	______________
Slot 5	__________	______________
Slot 6	__________	______________

SIMMs

Bank A ☐ 256 K ☐ 1 MB

Bank B ☐ 256 K ☐ 1 MB

Macintosh II Only

Memory Management Unit ☐ HMMU ☐ PMMU

Floppy Controller ☐ IWM ☐ SWIM

ROM Rev ☐ Rev A ☐ Rev B

Macintosh IIfx Only

SCSI Filter Installed ☐ Yes ☐ No

SCSI Terminator Installed ☐ Yes ☐ No

Macintosh II/IIx/IIfx

Section 5 – Additional Procedures

❑ CONTENTS

Note: If a step is underlined, detailed procedures for that step can be found in Section 2, Take-Apart.

❑ BATTERIES

Introduction

Lithium thionyl chloride batteries, the type used in the Macintosh II, IIx, and IIfx have some potential for explosion if improperly handled. The following precautions should be taken when storing, handling, or disposing of lithium batteries:

- Lithium batteries should be stored in a designated, well-marked area with limited access.

- Apple's lithium batteries are sealed in individual zip-lock wrappers. Upon receipt, inspect the integrity of the wrappers, and store the batteries in the same packaging in which they were received.

- Lithium batteries cannot be recharged and, therefore, require disposal when exhausted. In addition to its explosive potential, lithium is water-reactive and must be disposed of as hazardous waste. Therefore, Apple recommends the following course of action:

  After removing an exhausted battery from the board, clip off the lead wires (necessary for soldered batteries) and place the battery into the zip-lock wrapper and packaging from which the replacement battery was taken. Mark the battery *DEAD* and return it to Apple, where it will be disposed of following EPA guidelines.

Overview

You can use a voltmeter to check the condition of the two long-life lithium batteries in the Macintosh II, IIx, and IIfx. Refer to “Battery Verification,” in Section 4, Troubleshooting, for directions.

On a Macintosh II or IIx that does not have a battery holder board, the batteries are either soldered directly to the logic board or encased in battery holders that are soldered to the logic board. In either case, follow the procedures in "Battery Holder Board Installation."

On a Macintosh II or IIx that has a battery holder board already installed or on a Macintosh IIfx, follow the procedure in "Battery Replacement."

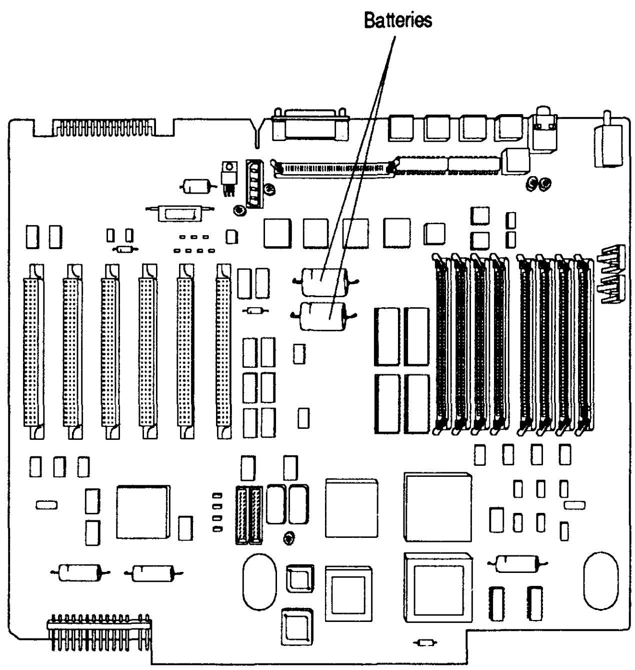


Figure 5-1

Battery Holder Board Installation

To use the battery holder board, you must remove the batteries (and battery holders, if present) from the logic board, solder the battery holder board to the logic board, and install the batteries and battery covers on the battery holder board.

Materials Required

Soldering iron (50-watt maximum)
Desoldering tool
60/40 resin-core solder
Battery holder board
Small wire cutters
Grounded workbench and wriststrap
Two lithium batteries

Installation

Follow the steps below to remove the batteries from the logic board, solder the battery holder board to the logic board, and install the batteries in the battery holders:

1. Remove the logic board.

2. **Figure 5-1**. Locate the two batteries or the two battery holders on the front of the logic board.

   Note: Be sure to leave the lead wire long enough so that you can pull it out of the logic board when you melt the solder that holds the lead wire in place.

3. If the batteries are soldered to the logic board, cut the lead wires that hold the batteries. Then follow the battery disposal procedures explained in the introduction to this section.

CAUTION: *Use a 50-watt (or less) soldering iron. Excessive heat may cause damage to the logic board.*

4. Turn the logic board over. Locate the four soldered leads that held the batteries or battery holders in place.

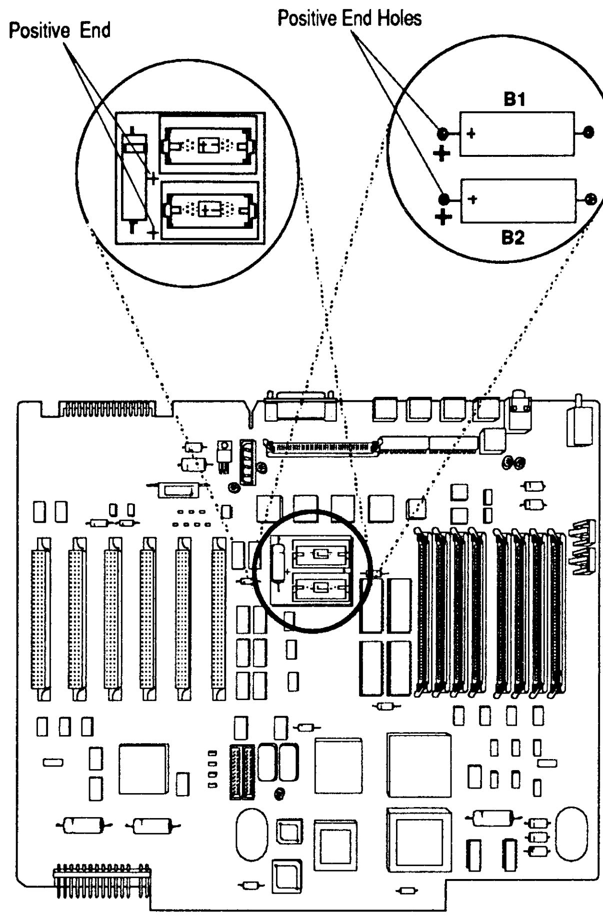


Figure 5-2

5. Desolder the four connections. If the batteries were soldered to the logic board, be sure to remove the wire from each hole and clear the hole of any solder.

CAUTION: *Do not force the connections free or you may remove the traces from the board. Repeat step 5 if necessary.*

6. **Figure 5-2**. Insert the battery holder board so its positive-marked end is inserted into the two positive-marked holes on the logic board, and so the battery holder board is flush with the logic board.

CAUTION: *Be sure the positive side of the battery holder board is in the correct location. Failure to do so can result in damage to the logic board.*

7. Solder the battery holder board into place.

8. Install the batteries and the battery covers on the battery holder board. If necessary, refer to "Battery Replacement."

9. Replace the logic board.

10. Use the Control Panel to reset the clock, mouse, desktop pattern, and volume control settings.

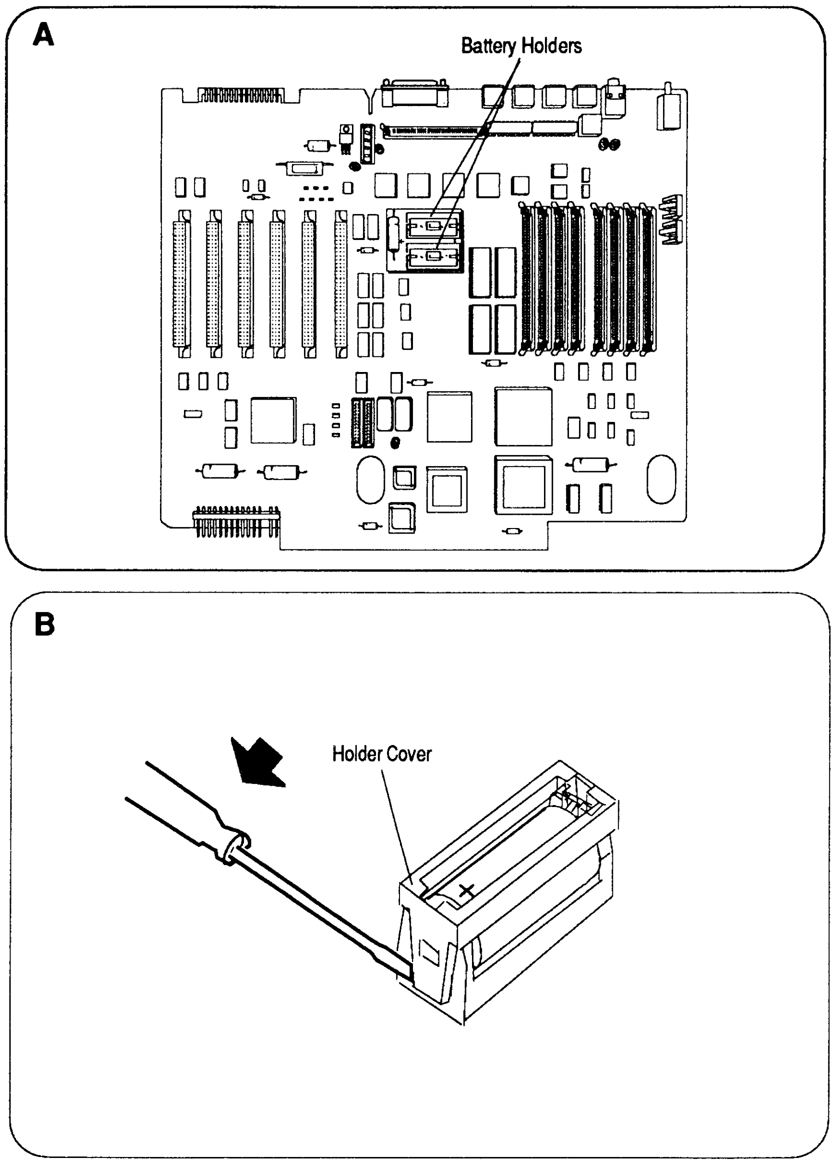


Figure 5-3

Battery Replacement

The following procedure covers the removal and replacement of batteries installed in battery holders. If you are changing batteries in a Macintosh II or IIx and there is no battery holder board installed, refer to "Battery Holder Board Installation."

Materials Required

Small flat-blade screwdriver
Two batteries

Remove

To remove the batteries from the plastic battery holder, follow these steps:

1. **Figure 5-3A**. Remove the top cover from the computer and locate the battery holders.

2. **Figure 5-3B**. If there is a cover on the battery holder, remove it by inserting a small flat-blade screwdriver between the cover latch and the battery holder and gently prying the latch away from the holder. The plastic cover will lift off.

3. Use your fingers to remove the batteries from the battery holders.

Replace

To replace the batteries in the battery holder, follow these steps:

1. Orient the new battery so that the end marked "+" matches the "+" on the main logic board. Insert the battery in the battery holder, and, if applicable, replace the plastic cover.

2. Replace the top cover.

3. Use the Control Panel to reset the clock, mouse, desktop pattern, and volume control settings.

4. Package and label the old batteries as directed in the introduction to this section, and return them to Apple for proper disposal.

❑ LOGIC BOARD RAM IDENTIFICATION AND UPGRADES

Introduction

RAM for the Macintosh II, IIx, and IIfx is provided in packages known as Single In-line Memory Modules (SIMMs). A SIMM is a small, rectangular-shaped circuit board, with two or eight memory chips. The memory chips may be surface mounted, or mounted through the board. Each SIMM board has contacts on one edge that fit into sockets on the logic board.

Note: When you remove SIMMs, use the SIMM removal tool. See the *You Oughta Know* tab for instructions on using the removal tool.

Identification

The SIMMs are available with two sizes of RAM (256K and 1 MB) and come in several configurations. Consult the *Quick Reference Chart: SIMM Compatibility* to obtain current SIMM identification information.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle SIMMs only by the edges!*

Speed

You must use 120 ns (or faster) SIMMs on the Macintosh II and Macintosh IIx. The Macintosh IIfx uses 80 ns (or faster) SIMMs. SIMMs with a slower rating will cause serious timing problems and cause system crashes. The RAM speed is usually indicated by the -xx number after the manufacturer's part number. For example, -12 indicates 120 ns SIMMs, -10 indicates 100 ns SIMMs, -8 indicates 80 ns, and -6 indicates 60 ns.

CAUTION: *Use Mitsubishi 1 MB SIMMs for the Macintosh IIx, which are labeled "For 030 Systems Only," only in systems with 68030 microprocessors. Therefore, do not use the Mitsubishi 1 MB SIMM modules in the Macintosh II. Do not use LaserWriter II SIMMs in the Macintosh IIfx. Although electrically interchangeable, Macintosh IIfx SIMMs are 80 ns; LaserWriter II SIMMs are 120 ns.*

Upgrades

Various RAM upgrades are possible on the Macintosh II, IIx, and IIfx depending on the number and size of the SIMMs that you install on the logic board.

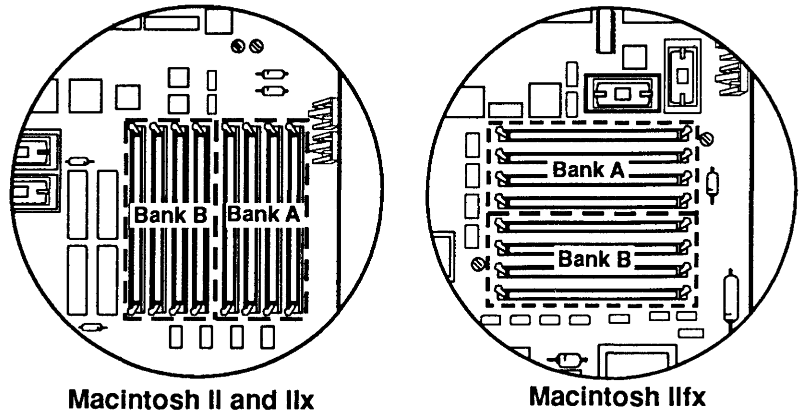


Figure 5-4

Figure 5-4. Two banks of SIMM sockets are located on the logic board and are labeled Bank A and Bank B. Each bank contains four slots. When installing SIMMs, the following rules apply:

- All four slots within a bank must be filled with SIMMs of the same RAM size.
- A bank cannot be partially filled; all four slots of a bank must be filled or left empty.
- If different size SIMMs are being used, the larger SIMMs must be in Bank A.
- Bank A must be filled before Bank B.

The following chart summarizes the configurations that the Macintosh II, IIx, and IIfx support:

	Macintosh II and IIx		Macintosh IIfx	
RAM	Bank A	Bank B	Bank A	Bank B
1 MB	Four 256K	Empty	NA	NA
2 MB	Four 256K	Four 256K	NA	NA
4 MB	Four 1 MB	Empty	Four 1 MB	Empty
5 MB	Four 1 MB	Four 256K	NA	NA
8 MB	Four 1 MB	Four 1 MB	Four 1 MB	Four 1 MB

CAUTION: *Other configurations, such as a single SIMM or a pair of differently sized SIMMs, will not function correctly.*

❑ LOGIC BOARD UPGRADES

The Macintosh IIx and Macintosh IIfx Logic Board Upgrade Kits are available to Macintosh II and Macintosh IIx owners. These upgrade kits convert a Macintosh II to a Macintosh IIx or a Macintosh II or IIx to a Macintosh IIfx, respectively. In addition to a new logic board, the kits also include an identification decal that should be affixed to the bottom cover of the upgraded system. Refer to Section 2, Take-Apart, to replace the logic board.

Macintosh IIx Logic Board Upgrade

The Macintosh IIx Logic Board Upgrade Kit converts a Macintosh II to a Macintosh IIx.

Materials Required

Macintosh IIx Logic Board Upgrade Kit
#2 Phillips screwdriver

Procedure

1. Remove the Macintosh II logic board.

   Note: Instructions for returning the Macintosh II logic board are included in the upgrade kit.

2. Install the Macintosh IIx logic board.

3. Refer to Section 5, Additional Procedures, "Logic Board RAM Identification and Upgrades" for RAM SIMM installation procedures.

4. Install the identification decal on the bottom cover as shown in **Figure 5-5**.

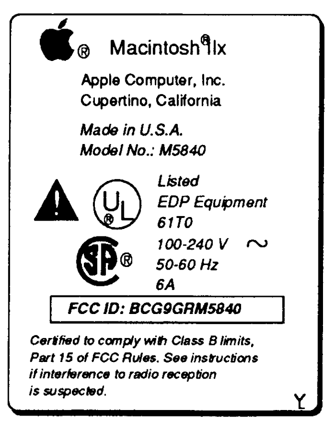


Figure 5-5

Macintosh IIfx Logic Board Upgrade

The Macintosh IIfx Logic Board Upgrade Kit converts a Macintosh II or IIx to a Macintosh IIfx.

Materials Required

Macintosh Macintosh IIfx Logic Board Upgrade Kit
#2 Phillips screwdriver

Procedure

1. Remove the Macintosh II or IIx logic board.

   Note: Instructions for returning the old logic board are included in the upgrade kit.

2. If an upgrade is being performed on a system with an internal SCSI hard disk, remove the power cable connected to the hard disk and replace it with the one provided in the upgrade kit.

3. Install the Macintosh IIfx logic board.

4. Refer to Section 5, Additional Procedures, "Macintosh IIfx—SCSI Termination" for SCSI termination options.

5. Refer to Section 5, Additional Procedures, "Logic Board RAM Identification and Upgrades" for RAM SIMM installation procedures.

6. Refer to Section 1, Basics, "System Software" for Macintosh system software 6.0.5 installation procedures.

7. Install the identification decal on the bottom cover as shown in **Figure 5-6**.

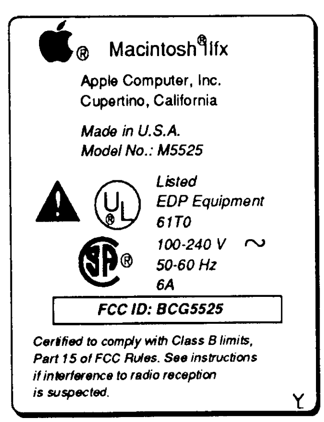


Figure 5-6

Paged Memory Management Unit Upgrade

The 68851 Paged Memory Management Unit (PMMU) replaces the HMMU on the Macintosh II logic board. This upgrade is required to run Apple A/UX. The PMMU supports both 32-bit and 24-bit address modes and can run both Apple A/UX and the Macintosh operating system.

Materials Required

Grounded workbench and wriststrap
Small flat-blade screwdriver
Phillips screwdriver

Installation

1. Remove the top cover and the drive mount from the Macintosh II.

2. **Figure 5-7**. Locate the HMMU. Use the small flat-blade screwdriver to pry gently along the sides of the chip to remove the HMMU from the socket.

CAUTION: *Before pressing the new memory management unit into the socket, verify that the IC is positioned correctly!*

3. **Figure 5-7**. With the front of the Macintosh II facing you, position the PMMU so that the line on its surface is facing the lower-right corner of the board.

4. Line up the pins in the socket and gently press the PMMU into the socket.

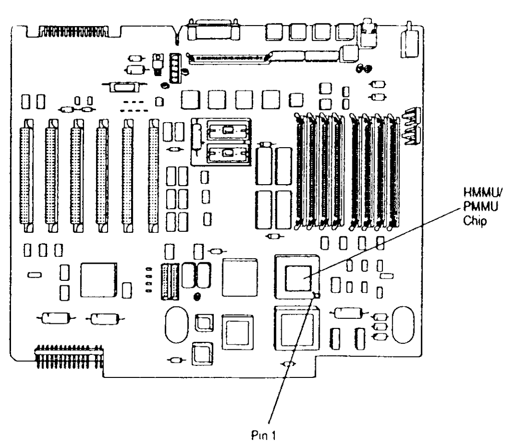


Figure 5-7

FDHD SuperDrive Upgrade

The FDHD SuperDrive is available to Macintosh II owners. To upgrade a Macintosh II so it can support the FDHD drive, you must install a Macintosh II Apple FDHD Upgrade Kit.

The upgrade involves replacing the original four ROMs with the revised 512K ROMs, and the IWM chip with the SWIM chip. The 800K disk drive remains in the system as drive 1 or 2, and the FDHD drive mechanism is added.

IMPORTANT: *The FDHD SuperDrive requires that system software must be version 6.0.2 or higher. If the software is lower than 6.0, the drive will be recognized as an 800K drive. To correct this problem, run the System Installer (version 6.0.2 or higher) to upgrade the system software.*

Materials Required

Grounded workbench and wriststrap
Macintosh II Apple FDHD Upgrade Kit
#2 Phillips screwdriver
IWM/SWIM extraction tool
IC extractor

Installation

1. Place the Macintosh II on the grounded workbench pad and put on your grounding wriststrap.

2. <u>Remove the Macintosh II drive mount</u>.

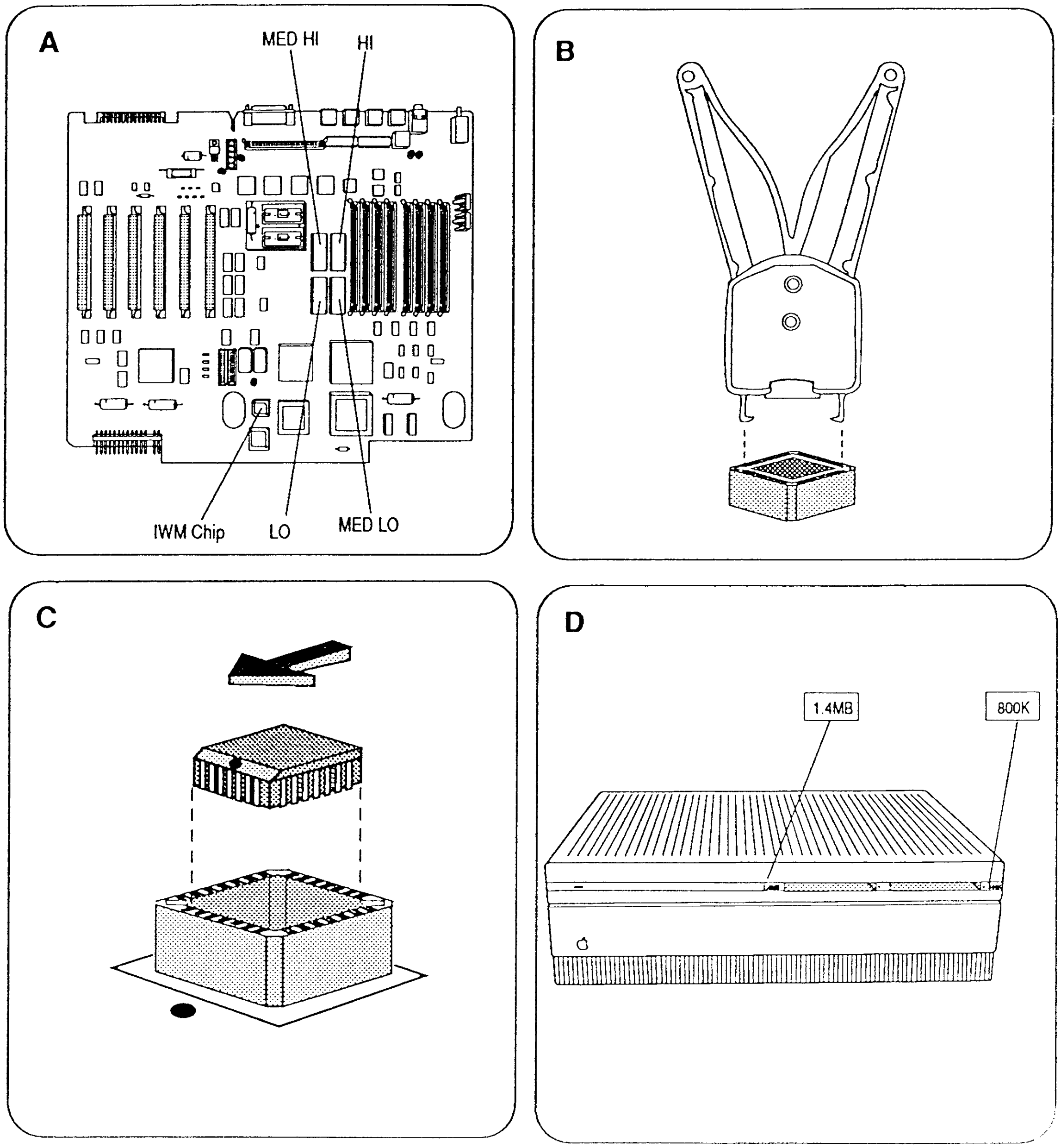


Figure 5-8

3. **Figure 5-8A**. Locate the four ROMs. Using the IC extractor, remove the ROMs from the logic board.

4. **Figure 5-8A**. Use the following chart to install the four revised 512K ROMs:

ROM	Part Number	Location
HI	342-0639	C13
MED HI	342-0640	C12
MED LO	342-0641	E13
LO	342-0642	E12

Note: The notch at the end of each ROM should face the front of the logic board.

5. **Figure 5-8A and B**. Locate the IWM chip. Insert the two notched edges of the IWM/SWIM extractor into the small openings on two corners of the chip. Squeeze the handles and pull the IWM chip straight up.

CAUTION: *Before pressing the new SWIM chip into the socket, verify that the chip is positioned correctly!*

6. **Figure 5-8C**. With the computer facing you, position the SWIM chip so that the beveled edge with the dot is facing the power supply (or align the beveled edge of the SWIM chip with the white dot on the logic board beside the socket). Align the pins in the socket and gently press straight down on the SWIM chip until it is seated in the socket.

7. Install the FDHD SuperDrive onto the drive mount as drive 1 or drive 2.

8. Install the drive mount and replace the top cover.

9. Place the 1.4 MB label and 800K label in the appropriate positions on the front of the Macintosh II cover. If the 1.4 MB drive is in the left-drive position, and the 800K drive is in the right-drive position, place the labels as shown in **Figure 5-8D**.

10. Be sure the system software is version 6.0.2 or later.

11. Run *MacTest II/IIx* to ensure that the upgrade is installed and functioning correctly. Refer to Section 3, Diagnostics, for further information.

❑ MACINTOSH IIfx

SCSI Termination

A feature of the Macintosh IIfx is the ability to transfer data to and from SCSI devices faster than earlier Macintosh computers. As a result of this increased transfer rate, Apple has found it necessary to modify the termination characteristics of the SCSI interface. These termination changes are implemented utilizing three new parts:

Apple SCSI Cable Terminator II – This is a revised version of the present external SCSI cable terminator. Using a SCSI Cable Terminator II provides the proper termination required for external SCSI devices attached to a Macintosh IIfx. Rules for where and when to install the terminator are identical to the original SCSI terminator. The terminators can be distinguished from each other by looking at the plastic around the connector contacts. On the new terminator the plastic, is black. On the original terminator, the plastic is blue.

CAUTION: *Never connect more than one Cable Terminator or Cable Terminator II on a SCSI daisy-chain. Connecting more than one terminator can cause damage to the computer.*

Internal SCSI Termination Block – Provides internal SCSI termination for systems **without** an internal SCSI hard disk. All finished-goods Macintosh IIfx computers shipped without internal SCSI hard drives have the filter attached to the logic board SCSI connector. This termination block is removed when an internal SCSI hard disk is present.

Internal SCSI Filter – Provides the proper termination capacitance required for third-party drives and Apple internal hard drives that shipped from Apple before March 19, 1990. The SCSI filter is connected between the SCSI signal cable and the mating connector on the hard drive. All finished goods Macintosh IIfx computers shipped without internal SCSI hard drives have the filter attached to the logic board SCSI connector.

Note: The SCSI filter **must be** connected to the drive to function correctly. Connecting the filter at the logic board will cause SCSI failures.

Macintosh II/IIx/IIfx

Illustrated Parts List

❑ CONTENTS

Note: The figures and lists in this section include all piece parts that Apple sells separately for the Macintosh II, IIx, and IIfx computers. This list also shows part numbers. All ADB input devices for these computers now have their own section. Please refer to *Macintosh Family, Volume Four*, for these parts. Refer to your *Apple Service Programs* manual for prices.

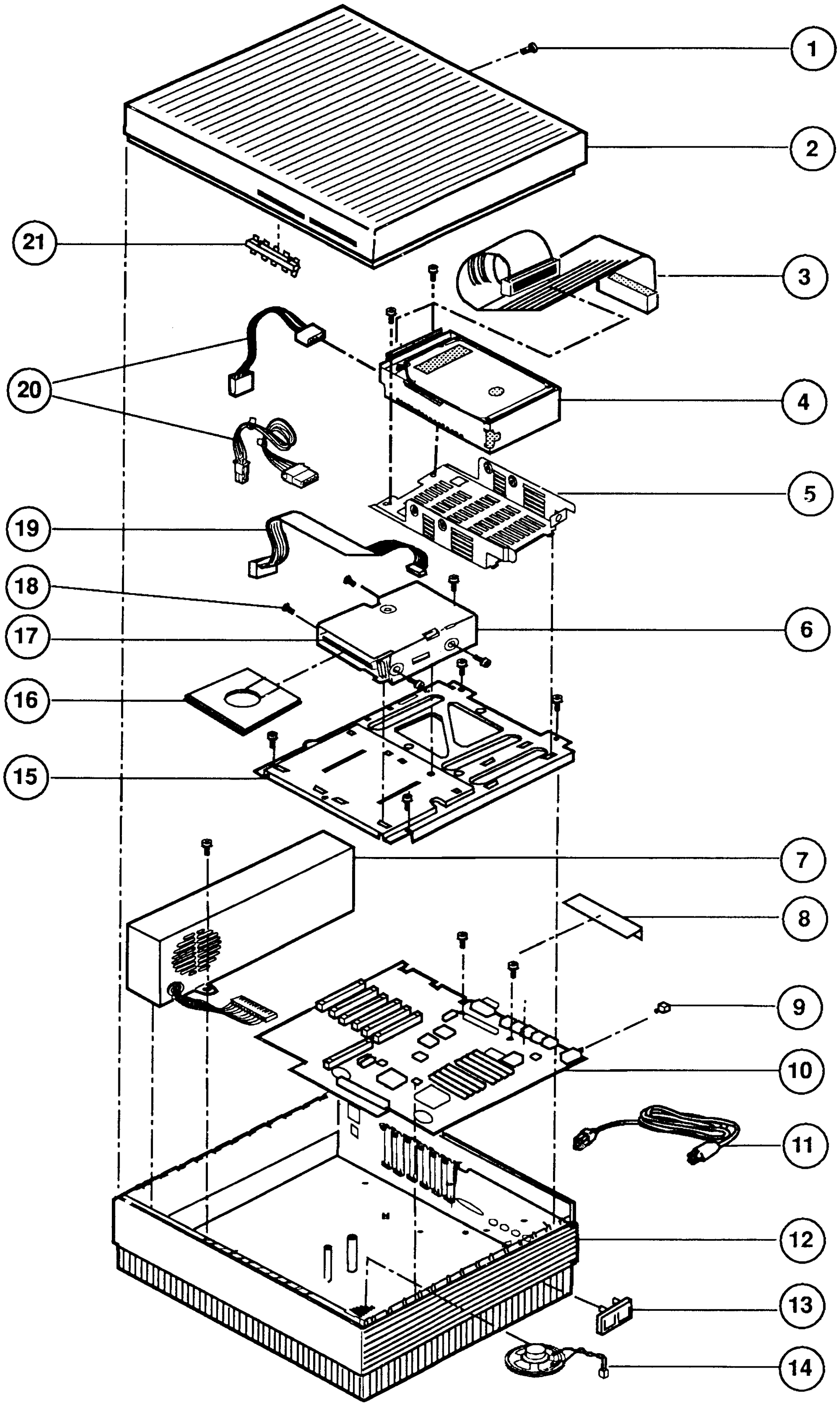


Figure 1

❑ MACINTOSH II/IIx/IIfx – SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
–	590-0705	Apple SCSI Cable Terminator II, Mac IIfx, Black
–	076-0439	Dust Shield, 1.4 MB Apple SuperDrive, Package of 5
1	462-4100	Screws, M 3.5 x .6 x 8, PNCRS Rec
2	630-5229	Top Cover and Latch Assembly
3	590-0566	Cable, Internal Hard Disk
4	–	Drives for the Macintosh II/IIx/IIfx are listed under "Macintosh II/IIx/IIfx – Drives"
5	805-5051	Carrier, HDA, 5.25, SCSI
	805-5066	Carrier, HDA, Internal, 3.5, SCSI, High Side-Mounting Holes
	805-0952	Carrier, HDA, Internal, 3.5, SCSI, Low Side-Mounting Holes*
6	805-5050	Metal Housing/Shipping Fixture, 800K/Apple SuperDrive (for transporting)
7	661-0375	Power Supply, Macintosh II/IIx
	661-0542	Power Supply, Macintosh IIfx
8	805-5070	EMI Fence
9	815-6237	On/Off Button
10	661-0528	Logic Board, Macintosh II (without RAM; replaces part number 661-0374)
	661-0529	Logic Board, Macintosh IIx (without RAM; replaces part number 661-0463)
	661-0522	Logic Board, Macintosh IIfx (without RAM) ‖
11	590-0380	Cable, Power AC (smoke)
12	630-5227	Macintosh II Bottom Cover Assembly
	630-5494	Macintosh IIx Bottom Cover Assembly
	630-5806	Macintosh IIfx Bottom Cover Assembly
13	815-6024	Reset/Interrupt Switch
14	630-5222	Speaker
15	805-5062	Drive Mount
16	003-0003	Packing Disk, 2-Sided (for transporting 800K mechanisms)
17	661-0345	800K Mechanism, Apple 3.5 Drive
	661-0474	Apple SuperDrive
18	462-3401	Screw, M 3 x 6, with two washers
19	590-0188	Cable, 3.5 Internal Drive (red or yellow stripe)
20	590-0505	Cable, Internal Hard Disk Power, Macintosh II/IIx
	590-0512	Cable, Internal Hard Disk Power (2 x 2 pin), Macintosh IIfx
21	630-5302	Assembly, Disk Slot Plug

* The drive carrier with low side-mounting holes (805-0952) fits the 3.5-inch 160 MB (661-0625) and 1-inch height drives (661-1629) exclusively.

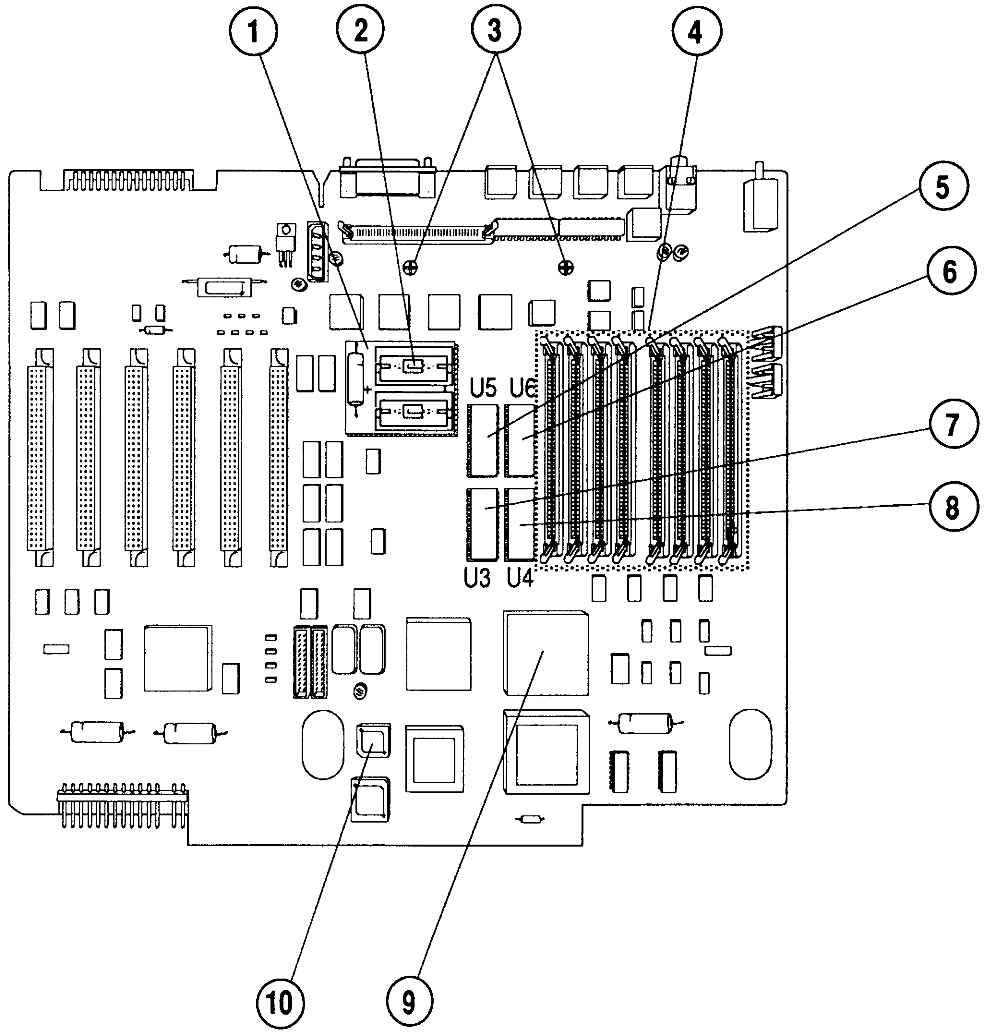


FIGURE 2

❑ MACINTOSH II – LOGIC BOARD (Figure 2)

Item	Part No.	Description
–	661-0528	Logic Board
1	600-0530	Battery Holder Board
2	742-0011	Lithium Battery (without leads) (replaces part number 742-0009)
3	462-4100	Screws
4	661-0402	SIMM, 256K, 120 ns
	661-0403	SIMM, SOJ, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0519	SIMM, SOJ, 256K, 80 ns
	661-0520	SIMM, SOJ, 1 MB, 80 ns
	661-0546	SIMM, SOJ, 1 MB, 80 ns, Parity
5	661-0640	ROM, Med High, Macintosh II FDHD Upgrade
	342-0106	IC, ROM, 512K, Med High
6	661-0639	ROM, High, Macintosh II FDHD Upgrade
	342-0105	IC, ROM, 512K, High
7	661-0642	ROM, Low, Macintosh II FDHD Upgrade
	342-0108	IC, ROM, 512K, Low
8	661-0641	ROM, Med Low, Macintosh II FDHD Upgrade
	342-0107	IC, ROM, 512K, Med Low
9	343-0002	IC, HMMU
	630-8221	IC, PMMU*
10	344S0043	IC, IWM
	344S0062	IC, SWIM

*Included in the PMMU Upgrade

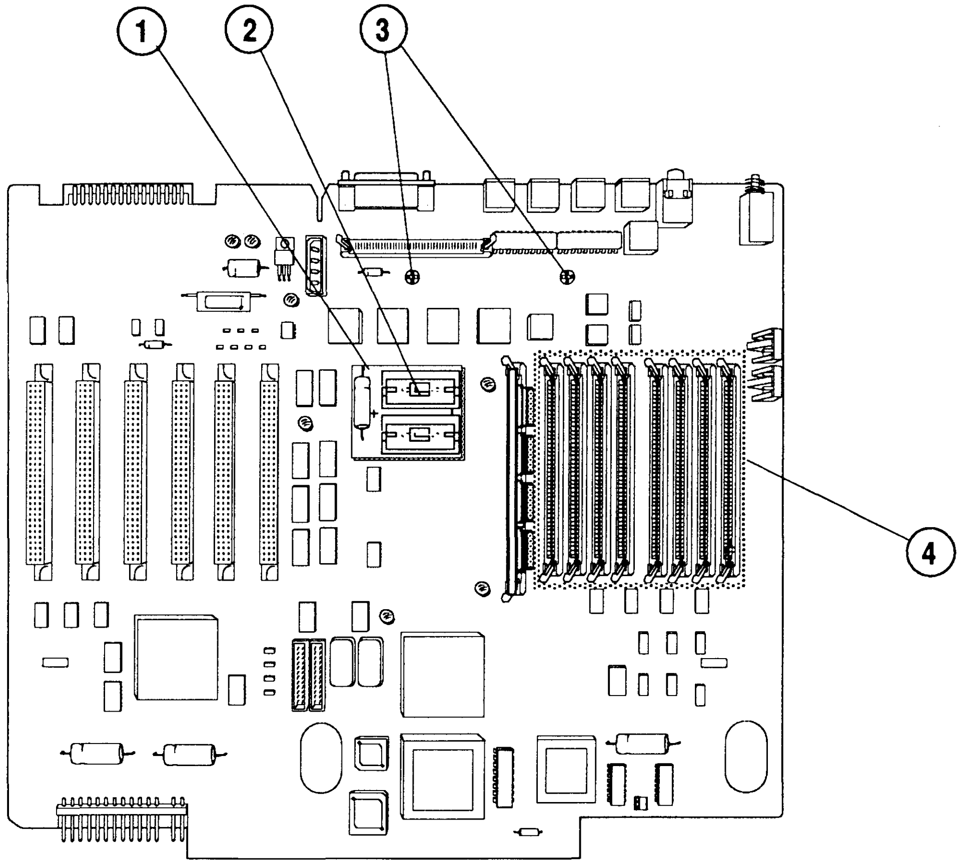


FIGURE 3

❑ MACINTOSH IIx – LOGIC BOARD (Figure 3)

Item	Part No.	Description
–	661-0529	Logic Board
1	600-0530	Battery Holder Board
2	742-0011	Lithium Battery (without leads) (replacing part number 742-0009)
3	462-4100	Screws
4	661-0402	SIMM, 256K, 120 ns
	661-0403	SIMM, SOJ, 1 MB, 120 ns
	661-0410	SIMM, DIP, 1 MB, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0519	SIMM, SOJ, 256K, 80 ns
	661-0520	SIMM, SOJ, 1 MB, 80 ns
	661-0546	SIMM, SOJ, 1 MB, 80 ns, Parity

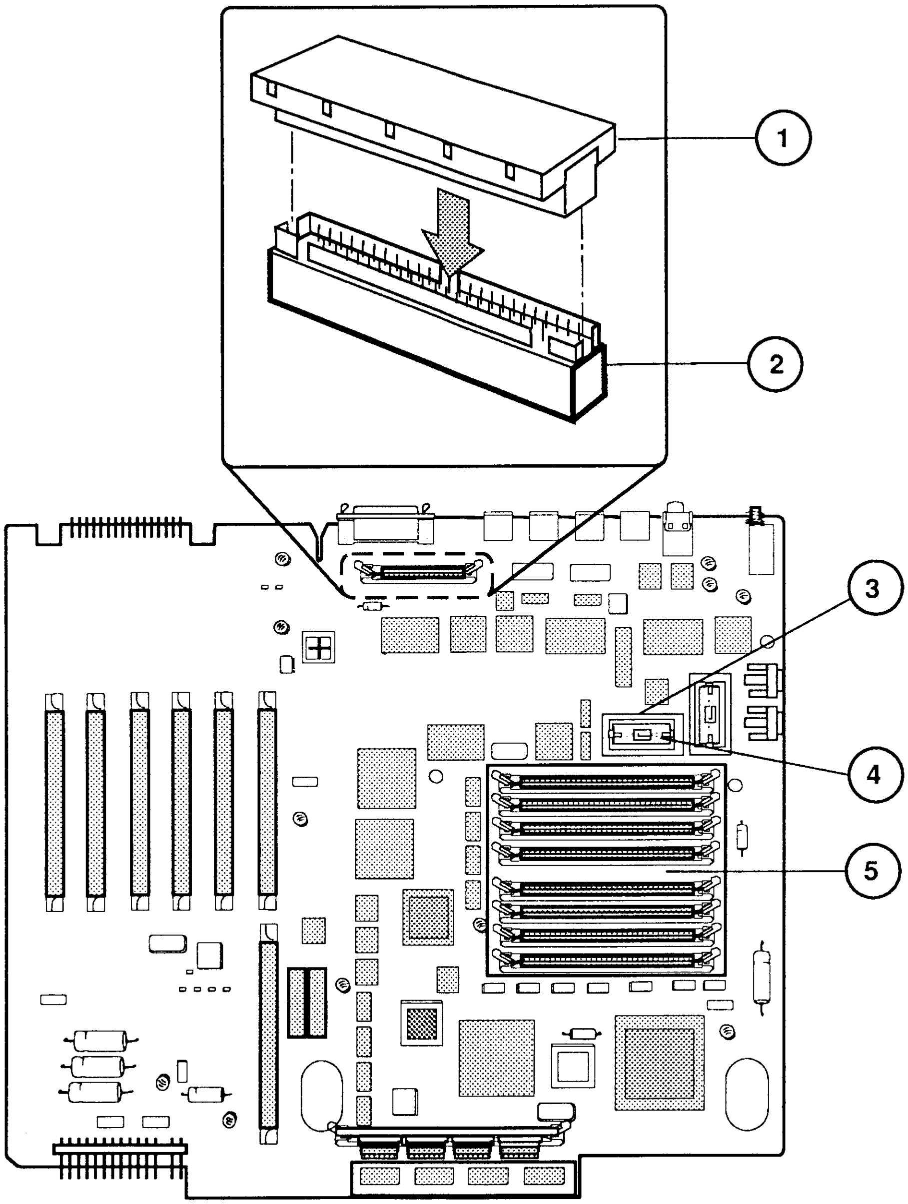


FIGURE 4

❑ MACINTOSH IIfx—LOGIC BOARD (Figure 4)

Item	Part No.	Description
–	661-0522	Logic Board
1	590-4515	Internal SCSI Termination Block
2	590-4516	Internal SCSI Filter
3	520-0344	Battery Holder Cover
4	742-0011	Lithium Battery (without leads)
5	661-0548	SIMM, 1 MB, SOJ, 80 ns, 64 pin
	661-0549	SIMM, 1 MB, SOJ, 60 ns, 64 pin, Parity

Note: Items 1 and 2 ship only with Macintosh IIfx systems without hard drives.

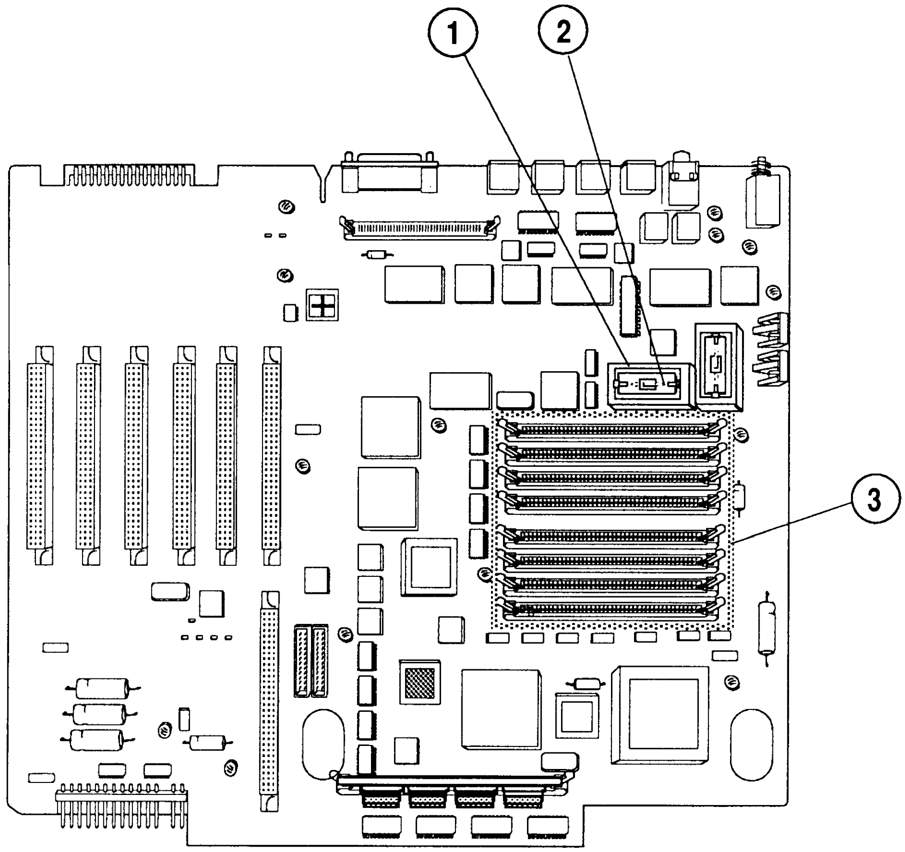


FIGURE 5

❑ MACINTOSH IIfx—LOGIC BOARD WITH PARITY (Figure 5)

Item	Part No.	Description
–	661-0592	Logic Board with Parity
1	520-0344	Battery Holder Cover
2	742-0011	Lithium Battery (without leads)
3	661-0549	SIMM, 1 MB, SOJ, 60 ns, 64 pin, Parity

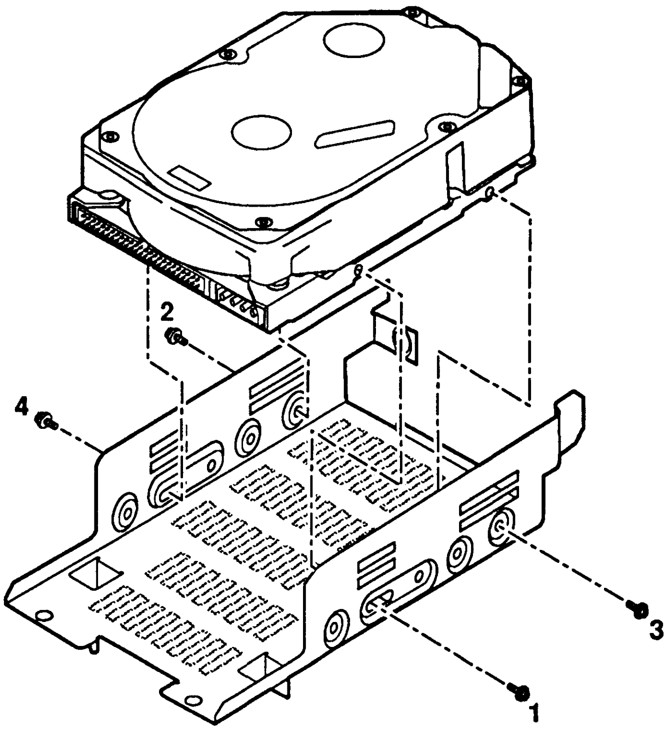


FIGURE 6

❑ MACINTOSH II/IIx/IIfx – DRIVES (Figure 5)

Item	Part No.	Description
–	661-0373	HDA, 3.5-Inch, 20 MB, SCSI, Rev. A
	661-0612	HDA, 3.5-Inch, 20 MB, SCSI, Rev. B
	661-0391	HDA, 5.25-Inch, 40 MB, SCSI
	661-0464	HDA, 3.5-Inch, 40 MB, SCSI
	661-1629	HDA, 3.5-Inch, 1-Inch-Height, 40 MB, SCSI*
	661-0457	HDA, 5.25-Inch, 80 MB, SCSI with A/UX, v.1.0
	661-0561	HDA, 3.5-Inch, 80 MB, SCSI with A/UX, v.1.1 (replaced by 661-0613)
	661-0613	HDA, 3.5-Inch, 80 MB, SCSI with A/UX, v.2.0
	661-0411	HDA, 5.25-Inch, 80 MB, SCSI
	661-0600	HDA, 3.5-Inch, 80 MB, SCSI
	661-0601	HDA, 5.25-Inch, 160 MB, SCSI
	661-0625	HDA, 3.5-Inch, 160 MB, SCSI*
	602-0164	Service Packaging, HDA, 3.5-Inch, Half-Height (replaced by 602-0282 or 602-0308)
	602-0282	Service Packaging, HDA, 3.5-Inch, Half-Height; and 3.5-Inch, 1-Inch-Height, with Carrier
	602-0148	Service Packaging, HDA, 5.25-Inch

* Use the drive carrier with low side-mounting holes (805-0952) with these drives.

Apple Technical Procedures

Macintosh IIcx/IIci/Quadra 700

Technical Procedures

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Section 1 – Basics

Section 3 – Diagnostics

Macintosh IIcx/IIci/Quadra 700

Section 1 – Basics

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❑ PRODUCT DESCRIPTIONS

The Apple® Macintosh® IIcx, Macintosh IIci, and Macintosh Quadra™ 700 computers are high-performance, open-architecture personal computers. All three machines run existing Macintosh software.

Macintosh IIcx: The Macintosh IIcx is a 68030-based machine that runs at 16 MHz. It offers paged memory management and floating-point coprocessing for calculation-intensive operations. The Macintosh IIcx uses the NuBus™ interface (three slots) and DRAM SIMMs for system expansion. The minimum memory configuration on the Macintosh IIcx is 1 MB of DRAM installed in DRAM SIMM sockets (expandable to 32 MB). The system ROM (256K) is soldered on the logic board; the logic board also features a ROM SIMM socket. The Macintosh IIcx supports 32-bit QuickDraw™, stereo sound, and an external floppy drive.

Macintosh IIci: The Macintosh IIci is a 68030-based machine that runs at 25 MHz. In addition to the features offered by the Macintosh IIcx, the Macintosh IIci offers built-in video, burst access mode, support for parity RAM, and a RAM cache connector to enhance performance. The Macintosh IIci comes standard with 5 MB of DRAM installed in DRAM SIMM sockets (expandable to 32 MB). The system ROM (512K) is soldered on the logic board; the logic board also features a ROM SIMM socket.

Macintosh Quadra 700: The Macintosh Quadra 700 is a 68040-based machine that runs at 25 MHz. Memory management, memory cache, and math coprocessing are built into the 68040 chip. The computer's modular design is very similar to that of the Macintosh IIcx and IIci but is intended to stand vertically rather than horizontally. The Macintosh Quadra 700 features VRAM-based on-board video, built-in Ethernet support, and improved SCSI and NuBus interfaces. In addition to two NuBus slots, the Macintosh Quadra 700 has an in-line 68040 processor-direct slot (PDS). The Macintosh Quadra 700 comes with 4 MB of DRAM soldered on the logic board and four DRAM SIMM sockets for memory expansion (up to 20 MB). The system ROM (1 MB) is soldered on the logic board; the logic board also features a ROM SIMM socket. The Macintosh Quadra 700 supports 32-bit QuickDraw and stereo sound.

Features

This table compares the features of the Macintosh IIcx, IIci, and Quadra 700 computers.

Feature	IIcx	IIci	Quadra 700
Processor	68030	68030	68040
Processor speed	16 MHz	25 MHz	25 MHz
On-board ROM	256K	512K	1 MB
Standard DRAM	1 MB	5 MB	4 MB
Maximum DRAM	32 MB	32 MB	20 MB
Built-in video support		✔	✔
Video monitor options (via NuBus)	✔	✔	✔
ROM SIMM connectors	✔	✔	✔
NuBus expansion slots	3	3	2
Built-in Ethernet port			✔
Processor-direct slot			✔
Cache card connector		✔	
Memory caching			Built in
Floating-point coprocessor	68882	68882	
Math coprocessing			Built in
Burst access support		✔	✔
Parity		✔**	
True 32-bit support		✔	✔
Internal Apple SuperDrive™	✔	✔	✔
Optional internal hard disk	40 or 80 MB	40, 80 or 160 MB	80 or 160 MB
External floppy drive connector	✔	✔	
RS-422 serial ports	2	2*	2*
Sound input port			✔
Locking power switch	✔	✔	✔
Compatiblity with other operating systems	✔	✔	✔

* RS-232 compatible   ** Optional feature

Configurations

The Macintosh IIcx, IIci, and Quadra 700 are available from Apple in a variety of configurations. (Other configurations beyond those offered by Apple are also possible.) The chart below shows the configurations and enhancements available from Apple for the Macintosh IIcx, IIci, and Quadra 700 computers.

Note: You may see units with DRAM configurations not shown below and with third-party internal SCSI hard disk drives.

DRAM	Internal Hard Disk
Macintosh IIcx	
1 MB	None
1 MB	40 MB
4 MB	80 MB
4 MB	80 MB with A/UX® installed
Macintosh IIci	
5 MB	None
5 MB	40 MB
5 MB	80 MB
5 MB	80 MB with A/UX installed
5 MB	160 MB
Macintosh Quadra 700	
4 MB	None
4 MB	80 MB
4 MB	160 MB

Note: All systems include one internal Apple SuperDrive.

IMPORTANT: *A/UX customers must use the appropriate A/UX version for their system(s). Refer to A/UX specifications in the Product Info Library on AppleLink, or the A/UX data sheet for specific version requirements.*

❑ CONNECTOR IDENTIFICATION

Back Panel

Figure 1-1 indicates the back panel ports, connectors, and switches on the Macintosh IIcx, IIci, and Quadra 700 computers.

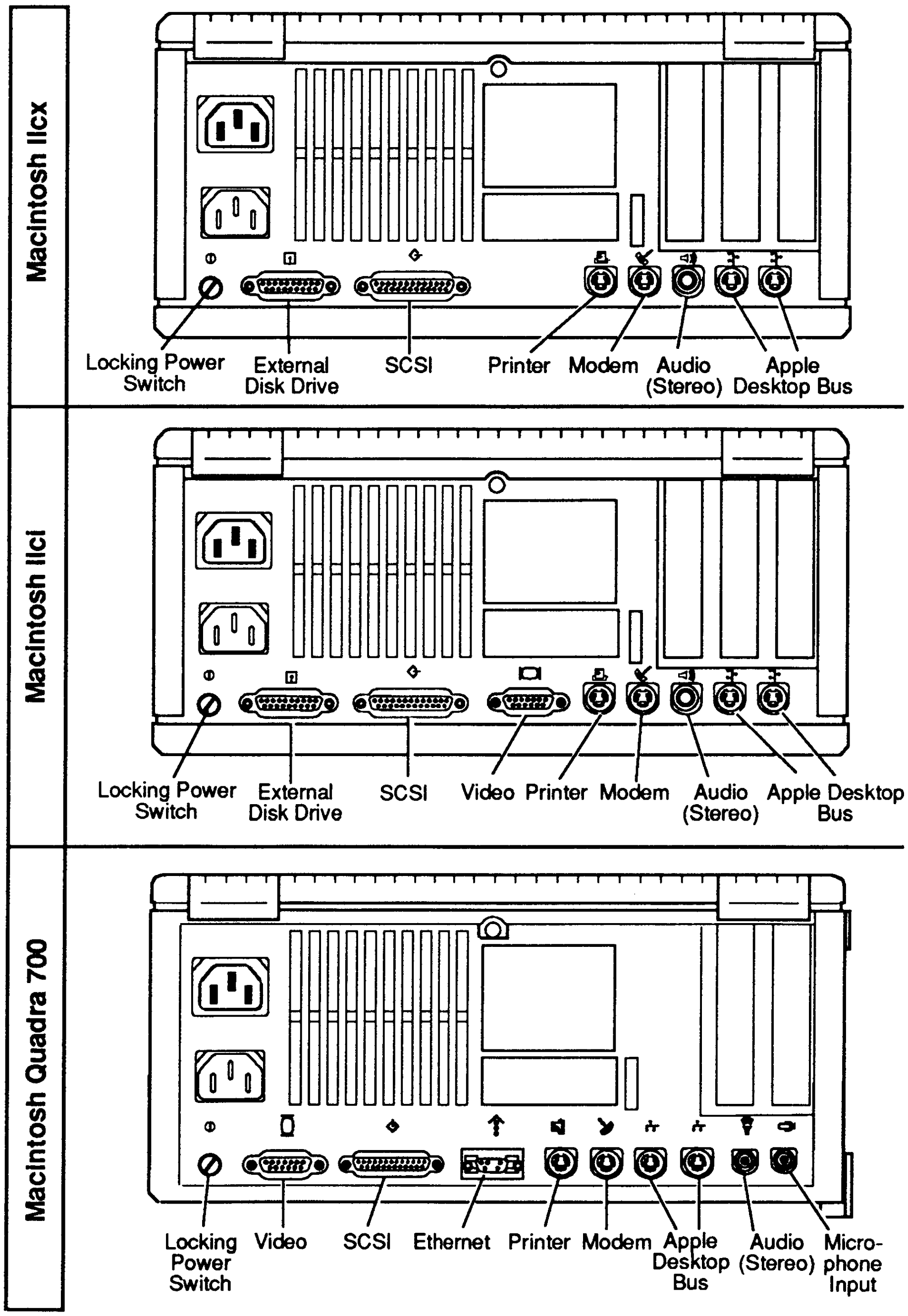


Figure 1-1 Back Panel Connectors

Internal Connectors

Figure 1-2 indicates the internal connectors on the Macintosh IIcx, IIci, and Quadra 700 logic boards.

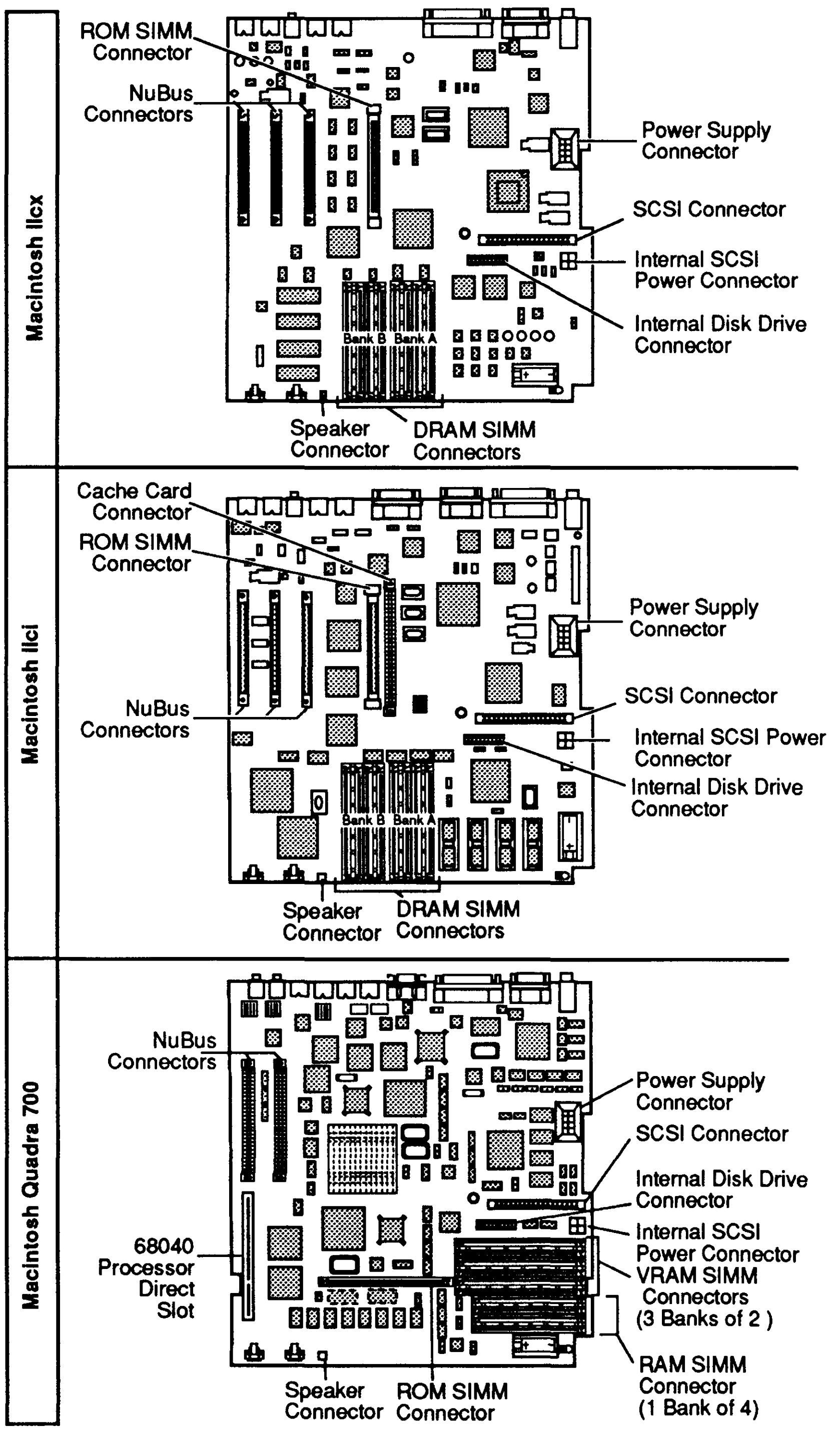


Figure 1-2 Internal Connectors

❑ MODULE IDENTIFICATION

Exploded View

Figure 1-3 shows the modular components that make up the Macintosh IIcx, IIci, and Quadra 700 computers.

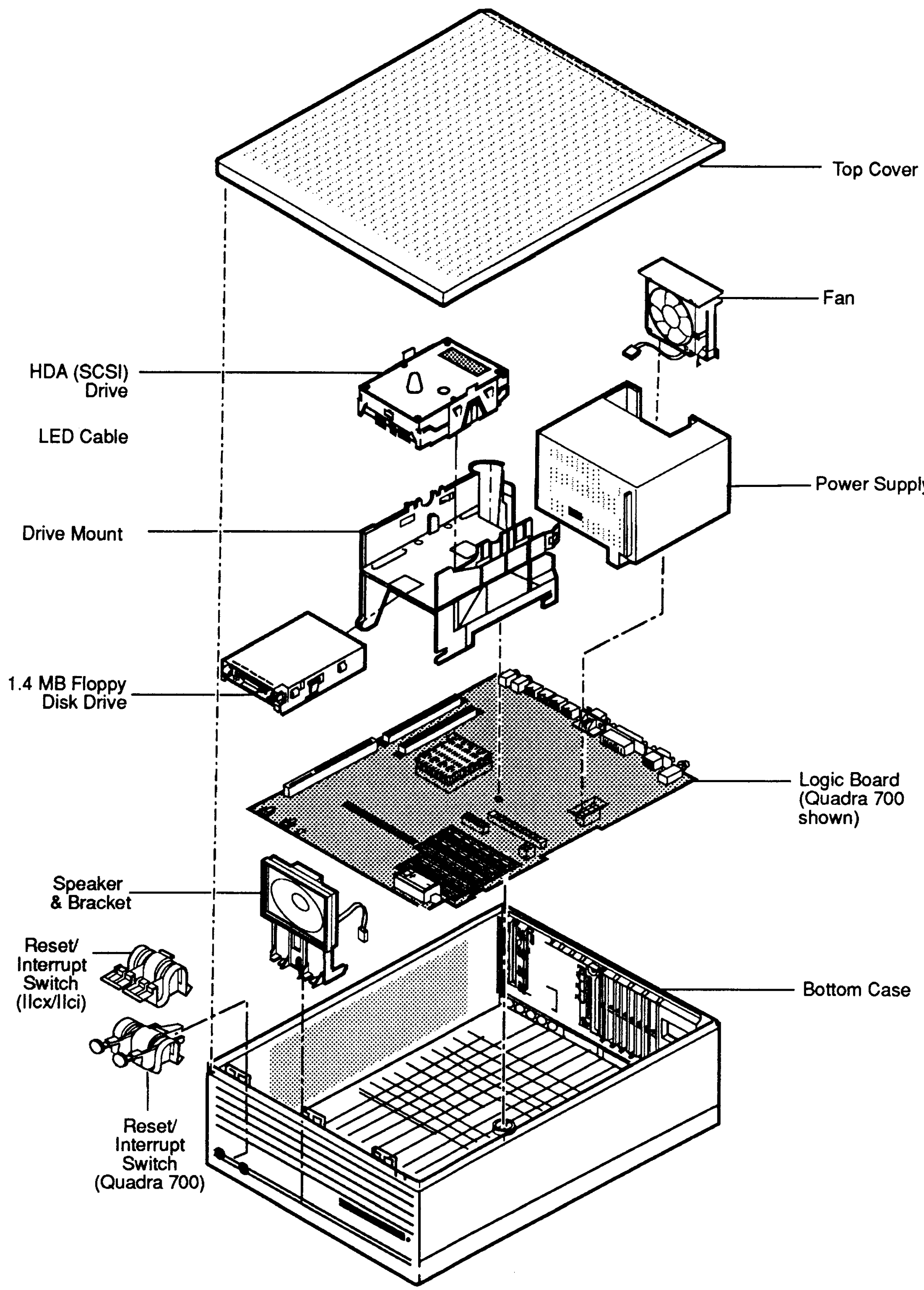


Figure 1-3 Module Identification

❑ LOGIC BOARD FEATURES

This section details the logic board features for the Macintosh IIcx, IIci, and Quadra 700 computers. Refer to **Figures 1-4**, **1-5**, and **1-6** to locate components.

Macintosh IIcx

The Macintosh IIcx CPU is a Motorola 68030 microprocessor. The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 68000 series Macintosh computers. The Macintosh IIcx 68030 runs at 16 MHz and includes paged memory management, thereby eliminating the paged memory management unit (PMMU) necessary in some earlier Macintosh computers.

The Macintosh IIcx logic board has four 28-pin soldered ROM chips (total ROM size is 256K). The ROM chips include code that supports the Apple SuperDrive and the SWIM (Sanders-Wozniak integrated machine) disk controller chip. The SWIM chip enables the Apple SuperDrive to read and write both GCR (group-coded recording) and MFM (modified frequency modulation) data formats.

The logic board has a 64-pin ROM SIMM (single in-line memory module) connector. When you install a ROM SIMM, the existing ROM remains on the board. The Macintosh IIcx recognizes the new ROM after you remove the ROM jumper on the logic board.

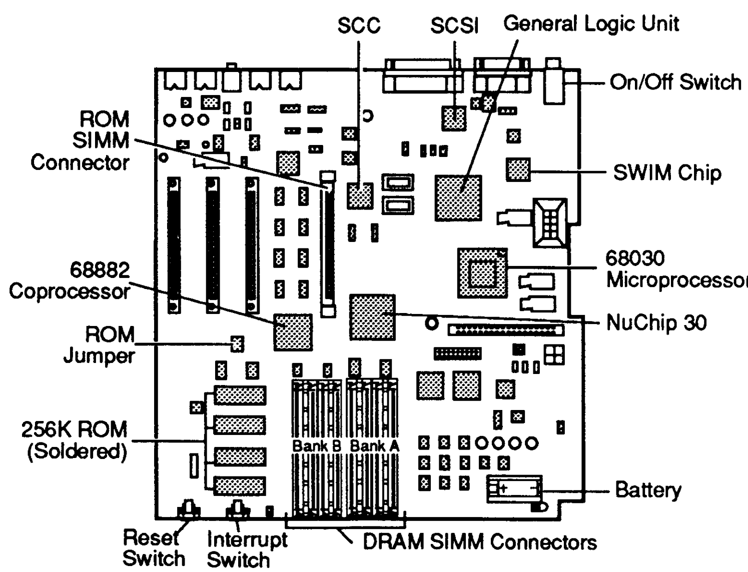


Figure 1-4 Macintosh IIcx Logic Board Features

Macintosh IIci

The Macintosh IIci CPU is a Motorola 68030 microprocessor. The 68030 is a true 32-bit microprocessor that is fully compatible with earlier 68000 series Macintosh computers. The Macintosh IIci 68030 runs at 25 MHz and includes paged memory management, thereby eliminating the PMMU necessary in some earlier Macintosh computers. The 68030 processor in the Macintosh IIci also features burst access capability, which enables the CPU to read groups of instructions or data in fewer clock cycles than in normal access mode.

The Macintosh IIci logic board has four 128K x 8-bit 32-pin DIP soldered ROM chips (total ROM size is 512K). The ROM chips include code that supports built-in video, optional parity checking, virtual memory (used on A/UX systems), and 32-bit QuickDraw routines.

The logic board has a 64-pin ROM SIMM connector. When you install a ROM SIMM, the existing ROM remains on the board. The Macintosh IIci recognizes the new ROM after you remove the ROM jumper on the logic board.

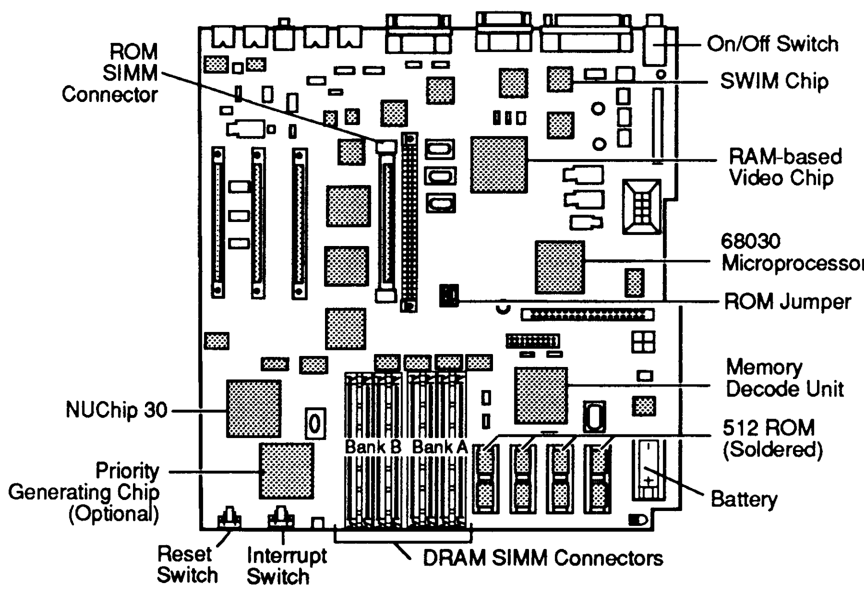


Figure 1-5 Macintosh IIci Logic Board Features

Macintosh Quadra 700

The Macintosh Quadra 700 uses a Motorola 68040 processor that runs at 25 MHz. Memory management, memory cache (8K), and math coprocessing are all built into the 68040 chip. The 68040 is compatible with earlier 68000 series Macintosh computers.

The Macintosh Quadra 700 logic board has two 4-Mbit soldered ROM chips (total ROM size is 1 MB) running at 150 ns. Each ROM chip is a 256K x 16 device.

The logic board has a 64-pin ROM SIMM connector. When you install a ROM SIMM, the existing ROM remains on the board. The Macintosh Quadra 700 recognizes the new ROM automatically; there is no ROM jumper on the Quadra 700 logic board.

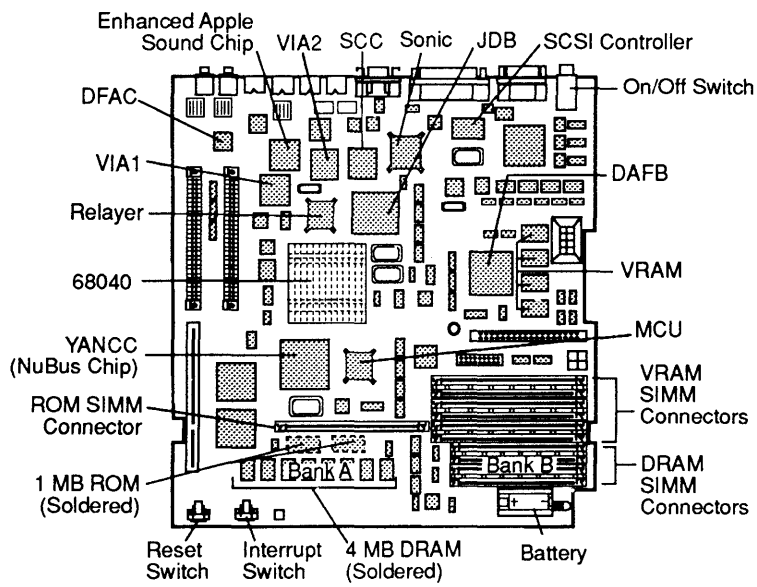


Figure 1-6 Macintosh Quadra 700 Logic Board Features

❑ SPECIFICATIONS – Macintosh IIcx

Processor	MC68030 running at 16 MHz 32-bit address bus; 32-bit registers Built-in paged memory management unit (PMMU)
Coprocessor	MC68882 floating-point unit (FPU) on the logic board Supports coprocessor expansion through NuBus
ROM	256K soldered on the logic board ROM SIMM socket
DRAM	1, 2, or 4 MB standard—expandable to 5 or 8 MB using 256K or 1 MB DRAM SIMMs (80 to 120 ns) (DRAM configurations greater than 8 MB require DRAM SIMMs from third-party manufacturers and Mode 32 software) Additional memory expansion through NuBus slots
Interfaces	Two ADB connectors (mini DIN-4) for keyboard, mouse, and low-speed input devices Three NuBus slots (96-pin Euro-DIN connector) Two RS-422 serial ports (mini-8), 230.4 Kbaud maximum SCSI interface (DB-25) Stereo sound port
Disk Drives	One internal Apple SuperDrive External 3.5-inch floppy disk drive connector (800K or 1.4 MB) Internal 3.5-inch SCSI hard disk (40 or 80 MB)
Video Display	Supports multiple external color and monochrome monitors via NuBus video cards
Sound	Apple sound chip (ASC), including four-voice wave-table synthesis and stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment Mixed stereo monophonic output—internal speaker
Keyboards	Apple Keyboard, Apple Extended Keyboard, Apple Keyboard II, or Apple Extended Keyboard II
Mouse	ADB mouse (mini DIN-4)

Input Power

100 to 240 volts AC (rms), automatically configured
50–60 Hz single phase
130 watts maximum (not including monitor power connector load), 90 watts maximum continuous

Output Power

Output receptacle: 100-240 volts AC (rms) (determined by actual input voltage)

DC output: 90 watts maximum

+5 volts	12.0 amps	(60 watts)
+12 volts	1.5 amps	(18 watts)
–12 volts	1.0 amps	(12 watts)

Power Supply Ratings

Input voltage range: 85-135 volts (rms) and 170-270 volts (rms)
Input surge range: 300 volts (rms) for 100 ms
Input line transient immunity: 0-6 kilovolts with no component failures
Peak inrush current: 40 amps for all load and line conditions
Input line frequency: 47-63 Hz, single phase
Line dropout immunity: 20 ms minimum, for 85 volts (rms); 50 Hz input and maximum load
Input/Output power efficiency: 70% minimum for all line conditions and maximum load

Clock/Calendar

CMOS custom chip with long-life lithium battery
256 bytes of parameter memory

Operating Temperature

50° F to 104° F (10° C to 40° C)

Storage Temperature

-40° F to 116.6° F (-40° C to 47° C)

Relative Humidity

5% to 95% (noncondensing)

Altitude

0 to 3048 m (0 to 10,000 feet)

Physical Dimensions

Height:	5.5 inches (140 millimeters)
Width:	11.9 inches (312 millimeters)
Depth:	14.4 inches (365 millimeters)
Weight:	13 pounds, 10 ounces (6.2 kilograms)

❑ SPECIFICATIONS – Macintosh IIci

Processor	MC68030 running at 25.0 MHz 32-bit address bus; 32-bit registers Built-in paged memory management unit (PMMU) Supports burst access mode and parity error checking
Coprocessor	25 MHz MC68882 floating-point unit on the logic board Supports coprocessor expansion through NuBus
ROM	512K soldered on the logic board ROM SIMM socket
DRAM	5 MB standard—expandable to 8, 9, 10, or 16 MB using 256K, 512K, 1 MB, or 2 MB DRAM SIMMs (80 ns fast-page mode) (DRAM configurations greater than 16 MB require DRAM SIMMs from third-party manufacturers) Parity error detection DRAM optional Additional memory expansion through NuBus slots
Interfaces	Two ADB connectors (mini DIN-4) for keyboard, mouse, and low-speed input devices Three NuBus slots (96-pin Euro-DIN connector) Two RS-422 (RS-232 compatible) serial ports (mini-8), 230.4 Kbaud maximum Cache connector (120-pin Euro-DIN) Built-in video (DB-15) SCSI interface (DB-25) Stereo sound port
Disk Drives	One internal Apple SuperDrive External 3.5-inch floppy disk drive connector (800K or 1.4 MB) Internal 3.5-inch SCSI hard disk (40, 80, or 160 MB)
Video Display	Built-in video with external port to support the Macintosh 12-inch Monochrome Display, Macintosh 12-inch RGB Display, Apple High-Resolution Monochrome Monitor, AppleColor High-Resolution RGB Monitor, and the Apple Portrait Display System supports multiple external color and monochrome monitors via NuBus cards
Sound	Apple sound chip (ASC), including four-voice wave-table synthesis and stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment Mixed stereo monophonic output—internal speaker

Keyboards	Apple Keyboard, Apple Extended Keyboard, Apple Keyboard II, or Apple Extended Keyboard II
Mouse	ADB mouse (mini DIN-4)
Input Power	100 to 240 volts AC (rms), automatically configured 50–60 Hz single phase 130 watts maximum (not including monitor power connector load), 90 watts maximum continuous
Output Power	**Output receptacle:** 100-240 volts AC (rms) (determined by actual input voltage) **DC output:** 90 watts maximum +5 volts 12.0 amps (60 watts) +12 volts 1.5 amps (18 watts) –12 volts 1.0 amps (12 watts)
Power Supply Ratings	**Input voltage range:** 85-135 volts (rms) and 170-270 volts (rms) **Input surge range:** 300 volts (rms) for 100 ms **Input line transient immunity:** 0-6 kilovolts with no component failures **Peak inrush current:** 40 amps for all load and line conditions **Input line frequency:** 47-63 Hz, single phase **Line dropout immunity:** 20 ms minimum, for 85 volts (rms); 50 Hz input and maximum load **Input/Output power efficiency:** 70% minimum for all line conditions and maximum load
Clock/Calendar	CMOS custom chip with long-life lithium battery 256 bytes of parameter memory
Operating Temperature	50° F to 104° F (10° C to 40° C)
Storage Temperature	-40° F to 116.6° F (-40° C to 47° C)
Relative Humidity	5% to 95% (noncondensing)
Altitude	0 to 3048 m (0 to 10,000 feet)
Physical Dimensions	Height: 5.5 inches (140 millimeters) Width: 11.9 inches (312 millimeters) Depth: 14.4 inches (365 millimeters) Weight: 13 pounds, 10 ounces (6.2 kilograms)

❑ SPECIFICATIONS – Macintosh Quadra 700

Processor	MC68040 running at 25.0 MHz 32-bit address bus; 32-bit registers Built-in paged memory management unit (PMMU), math coprocessor, and 8K cache architecture
ROM	1 MB soldered on the logic board ROM SIMM socket
DRAM	4 MB standard—expandable to 8 or 20 MB using 1 MB or 4 MB DRAM SIMMs (80 ns fast-page mode) (DRAM configurations of 20 MB or greater require DRAM SIMMs from third-party manufacturers) Additional memory expansion through NuBus slots
Video RAM	512K standard—expandable to 1 or 2 MB using 512K VRAM SIMMs (100 ns)
Interfaces	Two ADB connectors (mini DIN-4) for keyboard, mouse, and low-speed input devices Two NuBus slots (96-pin Euro-DIN connector) One 68040 processor-direct slot (PDS) Two RS-422 (RS-232-compatible) serial ports (mini-8), 230.4 Kbaud maximum Built-in video (DB-15) Built-in Ethernet connector (AUI-15) SCSI interface (DB-25) Stereo sound output port Sound input port
Disk Drives	Internal Apple SuperDrive Internal 3.5-inch SCSI hard disk (80 or 160 MB)
Video Display	Built-in VRAM video support for all Apple monitors; six VRAM expansion slots (three banks) Multiple external color and monochrome monitors through NuBus expansion slots
Sound	Enhanced Apple sound chip (EASC), including four-voice wave-table synthesis and stereo sampling generator capable of driving stereo mini phone jack headphones or stereo equipment Mixed stereo monophonic output—internal speaker Sound input—omnidirectional microphone (output voltage is 4 millivolts, peak to peak, at normal speaking volume)

Keyboard — Apple Keyboard, Apple Extended Keyboard, Apple Keyboard II, or Apple Extended Keyboard II

Mouse — ADB mouse (mini DIN-4)

Input Power

100 to 240 volts AC (rms), automatically configured
50–60 Hz single phase
130 watts maximum (not including monitor power connector load), 90 watts maximum continuous

Output Power

Output receptacle: 100-240 volts AC (rms) (determined by actual input voltage)

DC output: 90 watts maximum

+5	volts	12.0 amps	(60 watts)
+12	volts	1.5 amps	(18 watts)
–12	volts	1.0 amps	(12 watts)

Power Supply Ratings

Input voltage range: 85-135 volts (rms) and 170-270 volts (rms)
Input surge range: 300 volts (rms) for 100 ms
Input line transient immunity: 0-6 kilovolts with no component failures
Peak inrush current: 40 amps for all load and line conditions
Input line frequency: 47-63 Hz, single phase
Line dropout immunity: 20 ms minimum, for 85 volts (rms); 50 Hz input and maximum load
Input/Output power efficiency: 70% minimum for all line conditions and maximum load

Clock/Calendar

CMOS custom chip with long-life lithium battery
256 bytes of parameter memory

Operating Temperature — 50° F to 104° F (10° C to 40° C)

Storage Temperature — -40° F to 116.6° F (-40° C to 47° C)

Relative Humidity — 20% to 80% (noncondensing)

Altitude — 0 to 3048 m (0 to 10,000 feet)

Physical Specifications

Height:	5.5 inches (140 millimeters)
Width:	11.9 inches (312 millimeters)
Depth:	14.4 inches (365 millimeters)
Weight:	13 pounds, 10 ounces (6.2 kilograms)

❑ THEORY OF OPERATION – Introduction

The Theory of Operation sections explain how the Macintosh IIcx, IIci, and Quadra 700 computers work. There is a separate section for each of the three computers. The information in these sections will help you in troubleshooting the systems.

The Macintosh IIcx, IIci, and Quadra 700 computers consist of three basic modules: the logic board, the power supply, and the disk drive mount. The addition of a video interface card (required for the Macintosh IIcx) constitutes a fourth module. All three computers support one internal floppy disk drive and one internal SCSI hard disk.

The primary differences among the three computers are in the main logic boards—the power supplies and disk drives are the same in all three computers. For easier reference, the information on power supplies and disk drives is repeated for each computer.

❑ THEORY OF OPERATION – Macintosh IIcx

Introduction

The Macintosh IIcx computer system consists of four basic modules: the logic board, the power supply, the disk drive mount, and the video interface card. The Macintosh IIcx supports one internal floppy disk drive and one internal SCSI hard disk.

System Startup

When you switch on the computer, the system begins a synchronized sequence of events. First, the processor waits while a series of circuits puts the system in a known state in preparation for operation.

The initial startup sequence initializes the VIAs (versatile interface adapters) and the SWIM chip and temporarily alters the mapping of RAM and ROM in order to test the system.

The firmware in ROM performs a DRAM test to determine how much DRAM is present and to verify its proper operation. This information is then stored in a global variable, and several other system tests are performed. When the system is fully tested and initialized, system DRAM is mapped for normal operation.

After the initial startup sequence, the system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive
2. External floppy disk drive
3. Setup device set in the control panel
4. SCSI devices in declining order of device ID (6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are wiped out, the setup device defaults to the device with ID=0.

Once the system finds a readable disk, the system reads the disk and completes the disk startup process.

Logic Board

The logic board is where all processing of information takes place. This section describes the major logic board components and the functions they perform.

Microprocessor

The Macintosh IIcx uses a Motorola 68030 microprocessor that runs at 16 MHz. The 68030 is a true 32-bit processor that also supports 16/32 processing mode.

When working in A/UX (the Apple UNIX® operating system), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for a PMMU (as found in the Macintosh II). When data is sought from a memory location that is not in RAM, the 68030 swaps the page containing the data from the disk to RAM.

Coprocessor

The Macintosh IIcx uses a Motorola 68882 floating-point coprocessor that performs computations in parallel with the microprocessor. The coprocessor chip is in a 64-pin grid array.

DRAM

The Macintosh IIcx contains DRAM in single in-line memory modules (SIMMs). A SIMM is a small printed circuit board with DRAM chips. On one edge of each SIMM is a contact that fits into the SIMM sockets on the logic board. There are two banks (A and B) of DRAM.

On the Macintosh IIcx, bank A consists of the four SIMM sockets closest to the disk drive mount (refer to **Figure 1-4**). Bank B consists of the remaining four SIMM sockets.

The RAM interface requires DRAM with CAS-before-RAS refresh. The Macintosh IIcx requires 120 ns or faster DRAM.

You can change the amount of DRAM on the logic board by installing four additional (or larger) SIMMs in bank A or bank B.

Note: SIMMs installed in an individual bank must be of the same size (256K, 1 MB, or 4 MB); however, the SIMMs in bank A can be of a different size than those in bank B.

The Macintosh IIcx requires that the larger DRAM SIMMs be in bank A.

ROM

Read-Only Memory (ROM) is the system's permanent memory. The ROM contains the routines for the operating system, the Toolbox, virtual memory (VM), 32-bit QuickDraw routines, and other necessary system routines. The ROM supports 32-bit addressing (that is, it can address up to 1.2 gigabytes of addressable memory).

The Macintosh IIcx has 256K of ROM. The ROM is contained in four 64K chips in 28-pin DIP packages (soldered). This configuration forms a 32-bit wide data bus.

The logic board also features a 64-pin ROM SIMM connector.

Input/Output Interface

The system input/output interfaces are:

- The serial ports, controlled by the serial communications controller (SCC) circuitry
- The floppy disk, controlled by the SWIM circuitry
- The SCSI devices, controlled by the small computer system interface (SCSI) circuitry
- The stereo sound port, controlled by Apple sound chip (ASC) circuitry

The floating-point coprocessor and the VIA chips and associated circuitry are, to some extent, input/output devices; however, they provide input/output to the processor only. They do not have external ports as the system level input/output circuitry does.

VIAs

The Macintosh IIcx contains two versatile interface adapters (VIAs). These chips, VIA1 and VIA2, provide maximum compatibility with existing Macintosh software.

The Macintosh IIcx VIA1 provides the system with most of the signals designed into the 68000-based Macintosh systems. It also provides access to additional features, including an Apple Desktop Bus (ADB) interrupt and a synchronous modem signal.

The Macintosh IIcx VIA2 does the following:

- Controls the fake memory mapping unit
- Decodes the NuBus slot, SCSI, and the digital sound chip interrupts
- Disables the 68030 instruction and data cache
- Switches the unit off
- Blocks NuBus accesses to DRAM
- Decodes errors that occur in NuBus transactions

The access time between the two VIA chips and the 68030 is 500 ns. The internal frequency of the VIA is 783.36 KHz.

SWIM Chip

The SWIM chip incorporates the functionality of the IWM (from the original Macintosh II). It provides the capability to read, write, and format in GCR (Apple), MFM (MS-DOS and Apple high-density), and ProDOS data formats. The SWIM chip controls the one internal floppy disk drive internal to the unit and the one external floppy drive, if connected. The SWIM chip uses a 15.667-MHz clock when accessing the Apple SuperDrive and uses a divide-by-two circuit when accessing an 800K drive.

SCSI

The small computer system interface (SCSI) consists of a SCSI chip (53C80 CMOS version), an internal 50-pin connector, and an external DB-25 connector. The chip maps directly to both connectors and controls the high-speed parallel port for communicating with up to seven SCSI peripherals. This device supports arbitration of the SCSI bus, including reselection. A set of memory-mapped read-and-write registers controls the chip.

The external SCSI port differs from the industry SCSI standard in two ways:

1. It uses a DB-25 connector instead of the standard 50-pin connector. (An adapter is available to convert the connector to the standard.)

2. It provides power for termination resistors. If an attached SCSI device does not have the required terminator resistor, you must install a terminator block on the last device.

Serial Communications Controller

The serial communications controller (SCC) controls the two serial ports. The serial ports conform to EIA standard RS-422. These ports are primarily for connecting the computer to networks, printers, and modems.

In the Macintosh IIcx, you can program the printer port for asynchronous, synchronous, or AppleTalk® protocols, and the modem port for asynchronous operation only.

The two serial ports use Mini-DIN 8 connectors. Both connectors interface with the SCC through serial driver chips. Each signal pin passes through an RC filter network. The ports provide an output handshake but do not provide the +5 and +12 volts from the serial ports on the Macintosh 128K, 512K, and 512K enhanced.

Apple Sound Chip

The Apple sound chip in the Macintosh IIcx generates a stereo/audio signal. This signal is buffered by two additional chips that filter the PWM (pulse width modulated) signal and drive the internal speaker or external stereo mini phone jack. When an external stereo mini phone jack is not plugged into the connector, channel A drives the internal speaker.

The sound generation system supports previous Macintosh modes; it also offers a complete set of new ROM tools in the software Sound Manager™ for performing sound generation.

Real-Time Clock

The real-time clock in the Macintosh IIcx is a custom chip. It contains 256 bytes of RAM that receives power from a battery when external power is off. These RAM bytes are called parameter RAM (or PRAM). They store the configuration of ports, the clock setting, and other data that must be preserved even when the system power is not available.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a serial communication bus for connecting keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the ADB modem chip. A 4-bit microprocessor drives the external bus and reads the status of the selected device.

The microprocessor normally samples the state of each device by using the control lines in VIA1 to read or write to the Apple Desktop Bus modem chip.

Except for the mouse, all ADB devices have some kind of microprocessor that makes them intelligent devices. The mini 4-pin ADB connector connects the devices to the computer. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the bus.

Apple keyboards connect to the ADB port on the back of the computer. The keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issuing commands on the ADB and transmitting and receiving data to and from the ADB devices.

NuBus Interface

The Macintosh IIcx uses the NuBus architecture for system expansion. The Macintosh IIcx has three NuBus slots. These slots can be used to support Apple standard peripherals and to increase DRAM size. Each expansion slot has a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are some of the types of cards that will go into the NuBus slots:

- Video cards
- RAM expansion cards
- Network interface cards
- Add-on SCSI port cards

The NuBus interface supports the following features:

- **Geographic Addressing** – Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other devices to address each card uniquely.

- **Distributed Arbitration** – The computer does not have a central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requesters will receive equal access to the bus over time.

- **Synchronous Transaction** – All bus transactions are timed relative to a single asymmetric 10-MHz clock.

- **32-bit Address/Data** – The NuBus interface supports up to 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 processor supports all these data types through the use of dynamic bus sizing. As a result, word and long-word operations do not have to be aligned but instead cause NuBus transactions that complete the alignment. The data bus from the processor to NuBus is byte-reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address would imply.

- **Bus Timeout** – The absence of a card on the NuBus will not cause the processor to hang the bus by waiting for a reply. A system resource will delete any transaction taking longer than 25.6 μs.

- **Simple Interrupts** – Each card has the ability to generate simple, open-collector interrupts that allow cards to gain system attention without having to become the bus master.

The NuBus interface has three major states of communication:

- Processor to NuBus, which happens whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

- NuBus to processor bus, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are performed for this process—one tracks the changes on NuBus, and the other lets the processor tell NuBus what to do next.

- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

Every NuBus card should contain a ROM declaration that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Power Control

The Macintosh IIcx uses a switch-and-shut-down circuit circuit to control the power supply. The circuit controls the power supply through the power failure warning signal on the NuBus interface.

The circuit attempts to switch on the power supply when the power switch is pressed and for two seconds afterward. ADB keyboards have a secondary power switch. Pressing either power switch discharges a capacitor (through a resistor) that activates the power-on circuitry. The capacitor receives its charge through a soft-power circuit that is active even when the computer is off. As long as the computer is plugged in, the power supply will switch on the computer within two to four seconds.

This circuit works in conjunction with the locking power switch on the rear of the computer. This switch can be locked in an *on* position, which allows the computer to restart as soon as it detects AC power. In effect, if there is a power failure and the computer shuts off, it will restart as soon as power is restored. If this switch is in the *off* position, the computer will not turn on automatically. This feature is most valuable when using the computer as a file server.

The **power-off** function is under software control. In the Finder™, the **Shut Down** command from the Special menu activates the power-off function. This software control allows the computer to finish pending activity before switching off. On the other hand, the **power-down** switch generates a signal that turns off the computer after two milliseconds without going through software.

Power Supply

The power supply operates on 100-240 line input voltage and puts out +5V, +12V, and -12V DC voltages, which are used by the logic board, the internal devices, and the slots (respectively).

CAUTION: *It is extremely important not to exceed the ratings of the power supply. Exceeding the ratings could result in damage to the power supply and the logic board. (See the specifications in this section for maximum ratings for the system.) Take precautions against power surges. For locations outside the U.S., check local power ratings.*

Fuses

The logic board has three fuses that protect the external SCSI drive, floppy disk drive, and ADB connectors. These are resettable fuses that require about four seconds to reset.

Internal Floppy Disk Drive

The flow of data between the logic board and the disk drives is through the SWIM disk controller chip. The SWIM chip controls reading and writing operations.

The SWIM chip enables the Apple SuperDrive to exchange data between Apple and MS-DOS systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR or ProDOS (Apple), or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K disks (GCR and ProDOS), MS-DOS 720K disks (MFM), and Apple or MS-DOS high-density (1.4 MB) disks (MFM).

Translating data from one format to another for use in an application requires an application-specific translator within the Apple File Exchange utility, or a third-party translator.

Internal SCSI Hard Disk

The internal hard disk connects to the logic board through the internal SCSI connector. You can daisy-chain up to six additional SCSI devices (a total of seven SCSI devices, including the internal hard disk) through the external SCSI port.

❑ THEORY OF OPERATION – Macintosh IIci

Introduction

The Macintosh IIci computer consists of three basic modules: the logic board, the power supply, and the disk drive mount. A video interface card (optional for the Macintosh IIci) constitutes a fourth module. The Macintosh IIci supports an internal floppy disk drive and one internal SCSI hard disk.

System Startup

When you switch on the computer, the system begins a synchronized sequence. First, the processor waits while a series of circuits puts the system in a known state in preparation for operation.

During system startup, the memory decode unit (MDU) maps the ROM and enables the 68030 to recognize the starting address. After the first access to the true ROM address space, the MDU imposes the normal memory map. The power-up map selects ROM for low addresses, whereas the normal map selects RAM for low addresses.

The software determines the memory size and compiles a table describing the current memory configuration. The processor then programs the MMU (memory management unit), based on this table, to provide contiguous logical memory from the potentially noncontiguous physical segments in memory banks A and B. The 24/32-bit memory map allows software to use 24-bit or 32-bit address mode.

After the initial startup sequence, the system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive
2. External floppy disk drive
3. Setup device set in the control panel
4. SCSI devices in declining order of device ID (6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are wiped out, the setup device defaults to the device with ID=0.

Once the system finds a readable disk, the system reads the disk and completes the disk startup process.

Logic Board

The logic board is where all processing of information takes place. This section describes the major logic board components and the functions they perform.

Microprocessor

The Macintosh IIci uses a Motorola 68030 microprocessor that runs at 25.0 MHz. The 68030 is a true 32-bit processor that also supports 16/32 processing mode.

When working in A/UX (the Apple UNIX operating system), the 68030 microprocessor incorporates instruction sets for handling paged memory management, thereby eliminating the need for a PMMU (as found in the Macintosh II). When the computer seeks data from a memory location that is not in RAM, the 68030 swaps the page containing the data from the disk to RAM.

Coprocessor

The Macintosh IIci uses a Motorola 68882 floating-point coprocessor that performs computations in parallel with the microprocessor. The coprocessor chip in the Macintosh IIci is a surface mount quad-flat-pack.

DRAM

The Macintosh IIci contains DRAM in single in-line memory modules (SIMMs). A SIMM is a small printed circuit board with DRAM chips. On one edge of each SIMM is a contact that fits into the SIMM sockets on the logic board. There are two banks (A and B) of memory.

On the Macintosh IIci, bank A consists of the four SIMM sockets closest to the disk drive (refer to **Figure 1-5**). Bank B consists of the remaining four SIMM sockets.

The RAM interface requires DRAM with CAS-before-RAS refresh. The Macintosh IIci requires 80 ns or faster fast-page mode DRAM.

You can change the amount of DRAM on the logic board by installing four additional (or larger) SIMMs in bank A or bank B. If both bank A and bank B contain DRAM SIMMs, the Macintosh IIci will operate more efficiently with the larger DRAM SIMMs in bank B.

Note: SIMMs installed in an individual bank must be of the same size (256K, 512K, 1 MB, 2 MB, or 4 MB); however, the SIMMs in bank A can be a different size than those in bank B.

MMU

The two banks of DRAM in the Macintosh IIci do not occupy contiguous address space. The 68030 memory management unit (MMU) joins the discontiguous blocks of physical memory to current contiguous logical memory for application software.

RAM-Based Video

The built-in video on the Macintosh IIci is a RAM-based video (RBV) system. The use of built-in video affects how you configure the system and how the system performs.

To use the built-in video feature on the Macintosh IIci, you must have DRAM in bank A. The operating system decides at startup how much of bank A to devote to video and how much to map to the system/application RAM address space. The RBV buffer requires only enough memory to hold the contents of the screen. The RBV frame buffer varies in size, depending on the selected bit depth and the size of the video monitor.

Video accesses affect only bank A because a bus buffer can disconnect the data bus between the DRAM banks. Disconnection allows the RBV to fetch data from bank A without interrupting CPU access to bank B or the I/O devices. Because the MDU accesses each bank of DRAM independently, the MDU can decode addresses for the CPU and the RBV at the same time without interference.

Cache Connector

The cache connector is a 120-pin EuroDIN connector that enables installation of a cache card to boost performance. The main idea of adding a cache card is to increase the effective speed of main memory by providing the CPU with a copy of the most frequently used data more quickly. The cache stores the most recently accessed data and instructions in a small (≤64K) bank of high-speed memory. This storage is especially useful in accessing looping routines. A cache card should operate transparently to the user programs.

***CAUTION:** Even though the cache connector is the same connector used in the SE/30, the SE/30 cards are not compatible with the cache connector. The pinouts are different. Using an SE/30 card in the cache connector will damage the computer and the card.*

Parity

Parity is generated by the parity generator chip (PGC), which is optional on the Macintosh IIci. The parity feature requires 9-bit parity DRAM SIMMs.

Note: A Macintosh IIci with a PGC can still use 8-bit DRAM SIMMs, but parity checking will not take place. Under these circumstances, a warning message appears at startup to indicate that parity is not functioning.

If the PGC is present, the processor always writes the parity bit. If the bit is not physically present (that is, if 9-bit DRAM SIMMs are not installed), the processor simply ignores the parity bit. If 9-bit DRAM SIMMs are in use when a read takes place in the RAM address space, the PGC generates an internal parity bit from each byte of the data bus and compares it to the bit read from the DRAM SIMM's parity bit. If the two parity bits do not agree, the PGC generates two outputs: one that interrupts the processor and one that indicates a parity error. A dialog appears on the screen, states that a parity error has occurred, and offers the choice to continue or restart.

ROM

Read-only memory (ROM) is the system's permanent memory. The ROM contains the routines for the operating system, the Toolbox, virtual memory (VM), 32-bit QuickDraw routines, and other necessary system routines. The ROM supports 32-bit addressing (that is, it can address up to 4 gigabytes of addressable memory). The Macintosh IIci ROM contains the routines for built-in video and parity.

The Macintosh IIci has 512K of ROM contained in four 128K x 8-bit ROM chips in 32-pin DIP packages. This configuration forms a 32-bit-wide data bus.

The logic board also has a 64-pin ROM SIMM connector.

Input/Output Interface

The system input/output interfaces are:

- The serial ports, controlled by the SCC circuitry
- The floppy disk, controlled by the SWIM circuitry
- The SCSI devices, controlled by the SCSI circuitry
- The stereo sound port, controlled by the ASC circuitry
- Mono sound-in

The floating-point coprocessor and the VIA chips and associated circuitry are, to some extent, input/output devices; however, they provide input/output to the processor only. They do not have external ports as the system level input/output circuitry does.

VIAs

The Macintosh IIci contains two versatile interface adapters (VIAs). These chips, VIA1 and VIA2, provide maximum compatibility with existing Macintosh software.

VIA1 provides the system with most of the signals designed into the 68000-based Macintosh systems. The VIA1 appears to the software as the VIA chip in 68000-based Macintosh computers. VIA1 also provides access to features such as an Apple Desktop Bus interrupt and a synchronous modem signal.

The Macintosh IIci VIA2 does the following:

- Decodes the NuBus slot, SCSI, and the Apple sound chip interrupts
- Detects the external speaker or amplifier
- Disables the 68030 instruction and data cache
- Flushes and disables a cache card
- Tests the parity circuit
- Powers the unit off
- Blocks NuBus accesses to RAM
- Decodes errors that occur in NuBus transactions

SWIM Chip

The SWIM chip incorporates the functionality of the IWM (from the original Macintosh II). It provides the capability to read, write, and format in GCR (Apple), MFM (MS-DOS and Apple high-density), and ProDOS data formats. The SWIM chip controls the one internal floppy disk drive internal to the unit and the one external floppy drive, if connected. The SWIM chip uses a 15.667-MHz clock when accessing the Apple SuperDrive and uses a divide-by-two circuit when accessing an 800K drive.

SCSI

The small computer system interface (SCSI) consists of a SCSI chip (53C80 CMOS version), an internal 50-pin connector, and an external DB-25 connector. The chip maps directly to both connectors and controls the high-speed parallel port for communicating with up to seven SCSI peripherals. This device supports arbitration of the SCSI bus, including reselection. A set of memory-mapped, read-and-write registers controls the chip.

The external SCSI port differs from the industry SCSI standard in two ways:

1. It uses a DB-25 connector instead of the standard 50-pin connector. (An adapter is available to convert the connector to the standard.)

2. It provides power for termination resistors. If an attached SCSI device does not have the required terminator resistor, a terminator block must be installed on the last device.

Serial Communications Controller

The serial communications controller (SCC) controls the two serial ports. The serial ports conform to EIA standard RS-422 and are also RS-232 compatible. These ports are primarily for connecting the computer to networks, printers, and modems.

In the Macintosh IIci, you can program each serial port independently for asynchronous or synchronous protocols. You can program the printer port for AppleTalk protocols.

The two serial ports use Mini-DIN 8 connectors. Both connectors interface with the SCC through serial driver chips. Each signal pin passes through an RC filter network. The ports provide an output handshake but do not provide the +5 and +12 volts from the serial ports on the Macintosh 128K, 512K, and 512K enhanced.

Apple Sound Chip

The Apple sound chip in the Macintosh IIci generates a stereo/audio signal. This signal is buffered by two additional chips that filter the pulse width modulated (PWM) signal and drive the internal speaker or external stereo mini phone jack. If an external stereo mini phone jack is not plugged into the connector, then channel A sound output drives the internal speaker.

The sound generation system supports previous Macintosh modes; it also offers a complete set of new ROM tools in the software Sound Manager for performing sound generation.

Real-Time Clock

The real-time clock in the Macintosh IIci is a custom chip. It contains 256 bytes of RAM that is powered by a battery when external power is off. These RAM bytes are called parameter RAM (or PRAM). They store the configuration of ports, the clock setting, and other data that must be preserved even when system power is not available.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a serial communication bus for connecting keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the ADB modem chip. A 4-bit microprocessor drives the external bus and reads the status of the selected device.

The microprocessor normally samples the state of each device by using the control lines in VIA1 to read or write to the Apple Desktop Bus modem chip.

Except for the mouse, all ADB devices have some kind of microprocessor that makes them intelligent devices. The mini 4-pin ADB connector connects the devices to the computer. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the bus.

Apple keyboards connect to the ADB port on the back of the computer. The keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issuing commands on the ADB and transmitting and receiving data to and from the ADB devices.

NuBus Interface

The Macintosh IIci uses the NuBus architecture for system expansion. The Macintosh IIci has three NuBus slots. These slots can be used to support Apple standard peripherals and to increase DRAM size. Each expansion slot has a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are some of the types of cards that will go into the NuBus slots:

- Video cards
- RAM expansion cards
- Network interface cards
- Add-on SCSI port cards

The NuBus interface supports the following features:

- **Geographic Addressing** – Each of the three slots has a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other devices to address each card uniquely.

- **Distributed Arbitration** – The computer does not have a central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requesters will receive equal access to the bus over time.

- **Synchronous Transaction** – All bus transactions are timed relative to a single asymmetric 10-MHz clock.

- **32-bit Address/Data** – The NuBus interface supports up to 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68030 processor supports all these data types through the use of dynamic bus sizing. As a result, word and long-word operations do not have to be aligned but instead cause NuBus transactions that complete the alignment. The data bus from the processor to NuBus is byte-reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address would imply.

- **Bus Timeout** – The absence of a card on the NuBus will not cause the processor to hang the bus by waiting for a reply. A system resource will delete any transaction taking longer than 25.6 μs.

- **Simple Interrupts** – Each card has the ability to generate simple, open-collector interrupts that allow cards to gain system attention without having to become the bus master.

The NuBus interface has three major states of communication:

- **Processor to NuBus**, which happens whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.

- **NuBus to processor bus**, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are performed for this process—one tracks the changes on NuBus, and the other lets the processor tell NuBus what to do next.

- **NuBus time-out**, which is required to prevent access to empty slots. Such access would hang the system.

The NuBus interface in the Macintosh IIci allows direct communications from one NuBus card to a second NuBus card.

Every NuBus card should contain a ROM declaration that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Power Control

The Macintosh IIci uses a switch-and-shut-down circuit to control the power supply. The circuit controls the power supply through the power failure warning signal on the NuBus interface.

The circuit attempts to switch on the power supply when the power switch is pressed and for two seconds afterward. ADB keyboards have a secondary power switch. Pressing either power switch discharges a capacitor (through a resistor) that activates the power-on circuitry. The capacitor receives its charge through a soft-power circuit that is active even when the computer is off. As long as the computer is plugged in, the power supply will switch on the computer within two to four seconds.

This circuit works in conjunction with the locking power switch on the rear of the computer. This switch can be locked in an *on* position, which allows the computer to restart as soon as it detects AC power. In effect, if there is a power failure and the computer shuts off, it will restart as soon as power is restored. If this switch is in the *off* position, the computer will not turn on automatically. This feature is most valuable when using the computer as a file server.

The **power-off** function is under software control. In the Finder, the **Shut Down** command from the Special menu activates the power-off function. This software control allows the computer to finish pending activity before switching off. On the other hand, the **power-down** switch generates a signal that turns off the computer after two milliseconds without going through software.

Power Supply

The power supply operates on 100-240 line input voltage and puts out +5V, +12V, and -12V DC voltages, which are used by the logic board, the internal devices, and the slots (respectively).

CAUTION: *It is extremely important not to exceed the ratings of the power supply. Exceeding the ratings could result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Fuses

The logic board has three fuses that protect the external SCSI, floppy disk drive, and ADB connectors. The three are resettable fuses that require about four seconds to reset automatically.

Internal Floppy Disk Drive

The flow of data between the logic board and the disk drives is through the SWIM disk controller chip. The SWIM chip controls reading and writing operations.

The SWIM chip enables the Apple SuperDrive to exchange data between Apple and MS-DOS systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for either GCR or ProDOS (Apple), or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K disks (GCR and ProDOS), MS-DOS 720K disks (MFM), and Apple or MS-DOS high-density (1.4 MB) disks (MFM).

Translating data from one format to another for use in an application requires an application-specific translator within the Apple File Exchange utility, or a third-party translator.

Internal SCSI Hard Disk

The internal hard disk connects to the logic board through the internal SCSI connector. You can daisy-chain up to six additional SCSI devices (a total of seven SCSI devices, including the internal hard disk) through the external SCSI port.

❑ THEORY OF OPERATION – Macintosh Quadra 700

Introduction

The Macintosh Quadra 700 computer consists of three basic modules: the logic board, the power supply, and the disk drive mount. A video interface card (optional on the Macintosh Quadra 700) constitutes a fourth module. The Macintosh Quadra 700 supports one internal floppy disk drive and one internal SCSI hard disk.

System Startup

When you switch on the computer, the system begins a synchronized sequence. First, the processor waits while a series of circuits prepare the system for operation.

During system startup, the memory control unit (MCU) maps the ROM and enables the 68040 to recognize the starting address. After the first access to the true ROM address space, the MCU imposes the normal memory map. The only change from one map to the other is that the power-up map selects ROM for low addresses, whereas the normal map selects RAM for the low address space.

The firmware in ROM performs a test to determine how much DRAM is present and to verify the proper operation of the DRAM. The system stores this information in a global variable and performs several other system tests. When the system is fully tested and initialized, it maps system DRAM for normal operation.

After the initial startup sequence, the system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive
2. Setup device set in the control panel
3. SCSI devices in declining order of device ID (6 to 0)

Note: If the battery is removed or the contents of the parameter RAM are wiped out, the setup device defaults to the device with ID=0.

Once the system finds a readable disk, the system reads the disk and completes the disk startup process.

Logic Board

The logic board handles all processing of information. This section describes the major logic board components and the functions they perform.

Microprocessor

The Macintosh Quadra 700 uses a Motorola 68040 microprocessor that runs at 25 MHz. The 68040 is a true 32-bit processor that also supports 16/32 processing mode. In addition to having memory management built into the processor, the 68040 has a math coprocessing unit and 8K of memory cache built in.

DRAM

The Macintosh Quadra 700 has 4 MB of DRAM soldered on the logic board. The logic board also has SIMM sockets for DRAM expansion. A SIMM is a small printed circuit board with DRAM chips. On one edge of each SIMM is a contact that fits into the SIMM sockets on the logic board.

The Macintosh Quadra 700 has two banks (A and B) of memory: bank A is the 4 MB of memory soldered on the logic board; bank B consists of the four DRAM SIMM sockets located under the drive mount.

The RAM interface requires DRAM with CAS-before-RAS refresh. The Macintosh Quadra 700 requires 80 ns or faster DRAM.

You can increase the amount of DRAM on the logic board by installing four DRAM SIMMs in bank B.

Note: SIMMs installed in bank B must be of the same size (1 MB or 4 MB).

VRAM-Based Video

The built-in video on the Macintosh Quadra 700 is a VRAM-based video system. A direct-access frame buffer (DAFB) chip controls the system, which supports all current Apple monitors as well as several non-Apple monitors (VGA) and broadcast standards (NTSC and PAL).

The Macintosh Quadra 700 ships with one bank of VRAM (512K) soldered on the logic board. The standard configuration supports an 8 bpp (bits per pixel) display on Apple's 12-inch monochrome and 13-inch RGB monitors and 4 bpp display on Apple's Portrait and Two-Page monitors.

The Macintosh Quadra 700 frame buffer supports up to four banks (2 MB) of VRAM. In addition to the one bank of soldered VRAM, three banks of VRAM SIMM sockets support expansion. When all expansion banks are populated, the Quadra 700 will support a display of up to 32 bpp, depending on the monitor.

ROM

Read-only memory (ROM) is the system's permanent memory. The ROM contains the routines for the operating system, the Toolbox, virtual memory (VM), 32-bit QuickDraw routines, and other necessary system routines. The ROM supports 32-bit addressing (that is, it can address up to 1.2 gigabytes of addressable memory).

The Macintosh Quadra 700 has 1 MB of ROM. The ROM is contained in two 4-MBit chips (soldered) that run at 150 ns; each ROM device is 256K x 16-bit. The Macintosh Quadra 700 ROM contains routines that support the following:

- Math coprocessing, memory management, and cache functions built into the 68040
- Sound capabilities and VRAM-based video
- Ethernet
- Support for a bootable RAM disk
- Higher performance SANE (standard Apple numerics environment) math coprocessing (separate from the math coprocessing built into the 68040)

The logic board also features a 64-pin ROM SIMM connector.

Input/Output Interface

The system input/output interfaces are:

- The serial ports, controlled by the SCC circuitry
- The floppy disk, controlled by the SWIM circuitry
- The SCSI devices, controlled by the SCSI circuitry
- The stereo sound port, controlled by the enhanced Apple sound chip (EASC) circuitry
- Mono sound-in
- Ethernet

VIAs

The Macintosh Quadra 700 contains two versatile interface adapters (VIAs). These chips, VIA1 and VIA2, provide maximum compatibility with existing Macintosh software.

The Macintosh Quadra 700 VIA1 performs almost identically to the VIA1 in the Macintosh IIci. However, the two bits supporting parity in the Macintosh IIci handle A/UX software and initialization in the Macintosh Quadra 700.

The Macintosh Quadra 700 VIA2 does the following:

- Decodes the NuBus slot, SCSI, the enhanced Apple sound chip (EASC), and the digitally filtered audio chip (DFAC) interrupts
- Detects the external speaker or amplifier
- Disables the 68040 instruction and data cache
- Flushes and disables the 68040 memory cache
- Controls the direct-access frame buffer (for built-in video) and built-in Ethernet support
- Powers the unit off
- Blocks NuBus accesses to RAM
- Decodes errors in NuBus transactions

SWIM Chip

The SWIM chip incorporates the functionality of the IWM (from the original Macintosh II). It provides the capability to read, write, and format in GCR (Apple), MFM (MS-DOS and Apple high-density), and ProDOS data formats. The SWIM chip controls the one internal floppy disk drive. The SWIM chip uses a 15.667 MHz clock when accessing the Apple SuperDrive.

SCSI

The small computer system interface (SCSI) consists of a SCSI chip (53C96), an internal 50-pin connector, and an external DB-25 connector. The chip maps directly to both connectors and controls the high-speed parallel port for communicating with up to seven SCSI peripherals. This device supports arbitration of the SCSI bus, including reselection. A set of memory-mapped, read-and-write registers controls the chip.

The external SCSI port differs from the industry SCSI standard in two ways:

1. It uses a DB-25 connector instead of the standard 50-pin connector. (An adapter converts the connector to the standard.)

2. It provides power for termination resistors. If an attached SCSI device does not have the required terminator resistor, install a terminator block on the last device.

Serial Communications Controller

The serial communications controller (SCC) controls the two serial ports. The serial ports conform to EIA standard RS-422 and are RS-232 compatible. These ports are primarily for connecting the computer to networks, printers, and modems.

In the Macintosh Quadra 700, you can program each serial port independently for asynchronous or synchronous protocols. You can program the printer port for AppleTalk protocols.

The two serial ports use Mini-DIN 8 connectors. Both connectors interface with the SCC through serial driver chips. Each signal pin passes through an RC filter network. The ports provide an output handshake but do not provide the +5 and +12 volts from the serial ports on the Macintosh 128K, 512K, and 512K enhanced.

Sound Chips

The sound technology in the Macintosh Quadra 700 incorporates three new sound chips:

- The enhanced Apple sound chip—an application-specific integrated circuit (ASIC) that enables sound input and an external digital/audio converter and buffers playback and sound input samples

  The enhanced Apple sound chip (EASC) supports these features:

  - ASC compatibility
  - 16-bit stereo output
  - 8-bit sound input
  - Low noise
  - Low distortion analog circuitry

- A digitally filtered audio chip (DFAC) that provides sound input functionality

- A custom analog chip (called "Sporty") that is part of the sound output path (this chip replaces two sound chips used in previous Macintosh computers)

Real-Time Clock

The real-time clock is a custom chip. It contains 256 bytes of RAM that is powered by a battery when external power is off. These RAM bytes are called parameter RAM (or PRAM). They store the configuration of ports, the clock setting, and other data that must be preserved even when the system power is not available.

Apple Desktop Bus

The Apple Desktop Bus (ADB) is a serial communication bus for connecting keyboards, mouse devices, graphic tablets, and other input devices to the system. It is a single-master, multiple-slave serial bus using an asynchronous protocol. The processor normally samples the state of each of the devices by using the control lines and shift register in VIA1 to read or write bytes over an internal serial link to the ADB modem chip. A 4-bit microprocessor drives the external bus and reads the status of the selected device.

The microprocessor normally samples the state of each device by using the control lines in VIA1 to read or write to the Apple Desktop Bus modem chip.

Except for the mouse, all ADB devices have some kind of microprocessor that makes them intelligent devices. The mini 4-pin ADB connector connects the devices to the computer. All ADB devices, except the mouse, have ports for connecting to other ADB devices. Because it has no port, the mouse must be the last device attached to the bus.

Apple keyboards connect to the ADB port on the back of the computer. The keyboards have their own microprocessors, which are called keyboard microcontrollers. The keyboards operate asynchronously, issuing commands on the ADB and transmitting and receiving data to and from the ADB devices.

NuBus Interface

The Macintosh Quadra 700 uses the NuBus architecture for system expansion. The machine has two NuBus slots. These slots can be used to support Apple standard peripherals and to increase DRAM size. Each expansion slot has a 96-pin DIN connector that uses the NuBus interface to communicate with the system. The following are some of the types of cards that will go into the NuBus slots:

- Video cards
- RAM expansion cards
- Network interface cards
- Add-on SCSI port cards

The NuBus interface supports the following features:

- **Geographic Addressing** – Both slots have a unique 4-bit value encoded into the slots, which eliminates the need for DIP switches or other devices to address each card uniquely.

- **Distributed Arbitration** – The computer does not have a central bus master or daisy chain to assign bus mastership. The bus mastership is performed with the geographic addresses, thus allowing a priority within a group of bus requesters but not an overriding control of the bus. In theory, all requesters will receive equal access to the bus over time.

- **Synchronous Transaction** – All bus transactions are timed relative to a single asymmetric 10-MHz clock.

- **32-bit Address/Data** – The NuBus interface supports up to 4 GB of address with justified 8-bit, 16-bit, and 32-bit data transactions. The 68040 processor supports all these data types. As a result, word and long-word operations do not have to be aligned but instead cause NuBus transactions that complete the alignment. The data bus from the processor to NuBus is byte-reversed to allow sequential byte addresses to appear on the NuBus data ports in the same order as the NuBus address would imply.

- **Bus Timeout** – The absence of a card on the NuBus will not cause the processor to hang the bus by waiting for a reply. A system resource will delete any transaction taking longer than 25.6 μs.

- **Simple Interrupts** – Each card has the ability to generate simple, open-collector interrupts that allow cards to gain system attention without having to become the bus master.

The NuBus interface has three major states of communication:

- Processor to NuBus, which happens whenever the microprocessor generates a physical slot address. If a device responds, the data is transferred.
- NuBus to processor bus, which is for access to RAM, ROM, and I/O to and from NuBus. Two control functions are performed for this process—one tracks the changes on NuBus, and the other lets the processor tell NuBus what to do next.
- NuBus time-out, which is required to prevent access to empty slots. Such access would hang the system.

The NuBus interface in the Macintosh Quadra 700 allows direct communications from one NuBus card to a second NuBus card.

All NuBus cards should contain a ROM declaration that provides information to the operating system at startup. The ROM information ensures that drivers are properly installed and that the card is initialized and recognized by the system.

Processor-Direct Slot

The Macintosh Quadra 700 features a 68040 processor-direct slot (PDS) that attaches to the pins of the 68040 without any buffers. The PDS feature allows for expansion of the 68040 processor's capabilities.

A typical PDS card works with the system software Slot Manager. Such a card must contain a NuBus declaration ROM and must notify the NuBus controller that it is using the NuBus space by sending a signal to the PDS connector.

Note: The location of the PDS connector on the logic board is directly in line with one of the NuBus connectors. Therefore, the use of the PDS slot reduces the number of available NuBus slots from two to one.

IMPORTANT: *Any PDS board used in the Macintosh Quadra 700 must be designed to work with the 68040 processor. PDS cards designed for use with 68020 or 68030 processors will not work in the Macintosh Quadra 700. Also, any PDS card intended for use in a Macintosh Quadra 700 can include a back-panel I/O connector and should have the same board outline as a NuBus card.*

Power Control

The Macintosh Quadra 700 uses a switch-and-shut-down circuit to control the power supply. The circuit controls the power supply through the power failure warning signal on the NuBus interface.

The circuit attempts to switch on the power supply when the power switch is pressed and for two seconds afterward. ADB keyboards have a secondary power switch. Pressing either power switch discharges a capacitor (through a resistor) that activates the power-on circuitry. The capacitor receives its charge through a soft-power circuit that is active even when the computer is off. As long as the computer is plugged in, the power supply will switch on the computer within two to four seconds.

This circuit works in conjunction with the locking power switch on the rear of the computer. This switch can be locked in an *on* position, which allows the computer to restart as soon as it detects AC power. In effect, if there is a power failure and the computer shuts off, it will restart as soon as power is restored. If this switch is in the *off* position, the computer will not turn on automatically. This feature is most valuable when using the computer as a file server.

The **power-off** function is under software control. In the Finder the **Shut Down** command from the Special menu activates the power-off function. This software control allows the computer to finish pending activity before switching off. On the other hand, the **power-down** switch generates a signal that turns off the computer after two milliseconds without going through software.

Power Supply

The power supply operates on 100-240 line input voltage and puts out +5 V, +12 V, and -12 V DC voltages, which are used by the logic board, the internal devices, and the slots (respectively).

CAUTION: *It is extremely important not to exceed the ratings of the power supply. Exceeding the ratings could result in damage to the power supply and the logic board. See the specifications in this section for maximum ratings for the system.*

Fuses

The logic board has three fuses that protect the external SCSI, Ethernet, and ADB connectors. The three are resettable fuses that require about four seconds to reset automatically.

Internal Floppy Disk Drive

The flow of data between the logic board and the disk drives is through the SWIM disk controller chip. The SWIM chip controls reading and writing operations.

The SWIM chip enables the Apple SuperDrive to exchange data between Apple and MS-DOS systems. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for GCR or ProDOS (both Apple) or MFM (MS-DOS and Apple high-density) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K disks (GCR and ProDOS), MS-DOS 720K disks (MFM), and Apple or MS-DOS high-density (1.4 MB) disks (MFM).

Translating data from one format to another for use in an application requires an application-specific translator within the Apple File Exchange utility, or a third-party translator.

Internal SCSI Hard Disk

The internal hard disk connects to the logic board through the internal SCSI connector. You can daisy-chain up to six additional SCSI devices (a total of seven SCSI devices in the system, including the internal hard disk) through the external SCSI port.

Macintosh IIcx/IIci/Quadra 700

Section 2 – Take-Apart

❑ CONTENTS

Note: Detailed instructions for underlined steps can be found elsewhere in this section.

❑ ELECTROSTATIC DISCHARGE PREVENTION

The Macintosh IIcx, IIci, and Quadra 700 contain CMOS components, and DRAM is installed in SIMMs. The CMOS components and the SIMM modules are very susceptible to damage from electrostatic discharge (ESD).

You must take preventive measures to avoid ESD damage. When you unwrap, install, or replace modules, observe the appropriate ESD precautions.

For complete ESD prevention information, refer to the *You Oughta Know tab* in *Cross Family Peripherals Technical Procedures.*

If the proper ESD equipment is not available, do the following:

1. Switch off the computer power.
2. Disconnect the power cord.
3. Remove the lid and touch the metal of the power supply case.

❑ LID

Materials Required

Phillips screwdriver

Remove

1. Remove the AC power cable.

2. Remove the rubber feet if they are the side-mount type (standard on the Macintosh Quadra 700).

2. Remove the security screw (if present) at the top of the back panel (see **Figure 2-1**).

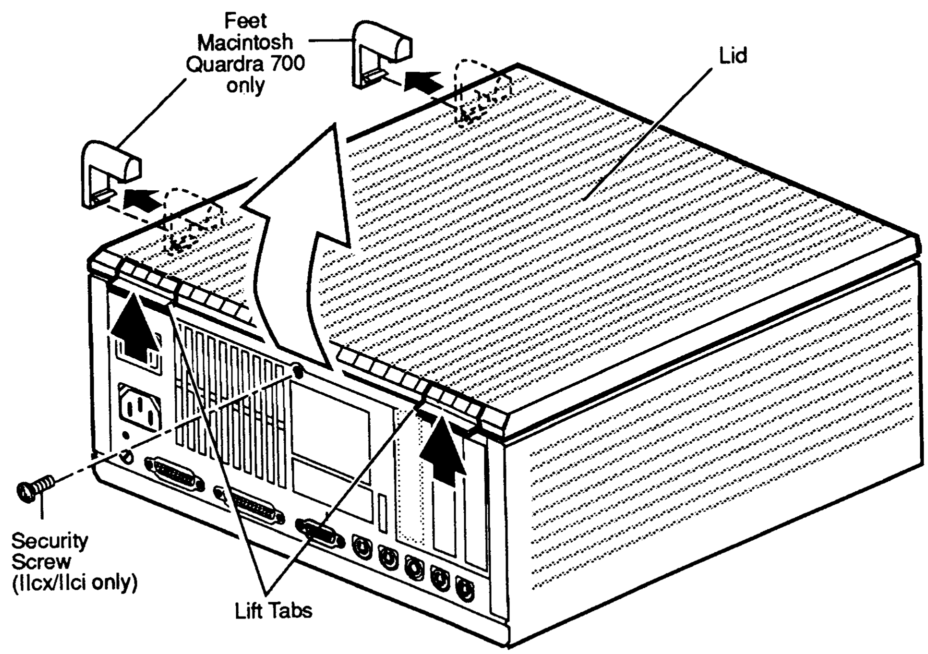


Figure 2-1 Lid

3. Pull up the tabs on the back of the lid (see **Figure 2-1**) and lift—back to front—until the lid is free of the front edge.

Replace

To replace the lid, simply reverse the above steps and make sure the small tabs on the front of the lid fit into their respective slots before you lower the lid.

❑ INTERFACE CARDS

Use the following procedure to remove or replace any interface or expansion card that is installed in the Macintosh IIcx, IIci, or Quadra 700.

Remove

1. Remove the lid.

2. Follow ESD precautions in the *You Oughta Know* tab. If you do not have ESD equipment, touch the metal on the power supply case inside the computer to discharge any static electricity that might be on your body or clothing.

3. Carefully grasp each end of the card and pull straight up to remove the card. Pull up evenly on both sides of the card to avoid bending the connector pins.

Replace

1. Position the card so the connector on the bottom of the card aligns with the expansion slot (that is, the NuBus, cache connector, or processor-direct slot). Align the card so the metal guides at the top and bottom of the rear slot opening fit through the metal shield attached to the card.

2. Place one hand on the card, directly over the connector area, and push down firmly until the connector is fully seated.

CAUTION: *Do not force the card. If the card does not seat properly, remove the card and try again.*

3. Replace the lid.

❑ SPEAKER BRACKET AND SPEAKER

The speaker is in a bracket that you must remove from the case before you can remove the speaker itself.

Remove

1. Remove the lid.

2. Locate the speaker and speaker bracket (see **Figure 2-2**) at the front of the unit and disconnect the speaker connector from the main logic board.

   Note: To simplify the replacement procedure, note how the speaker wire and speaker connector thread through the speaker bracket.

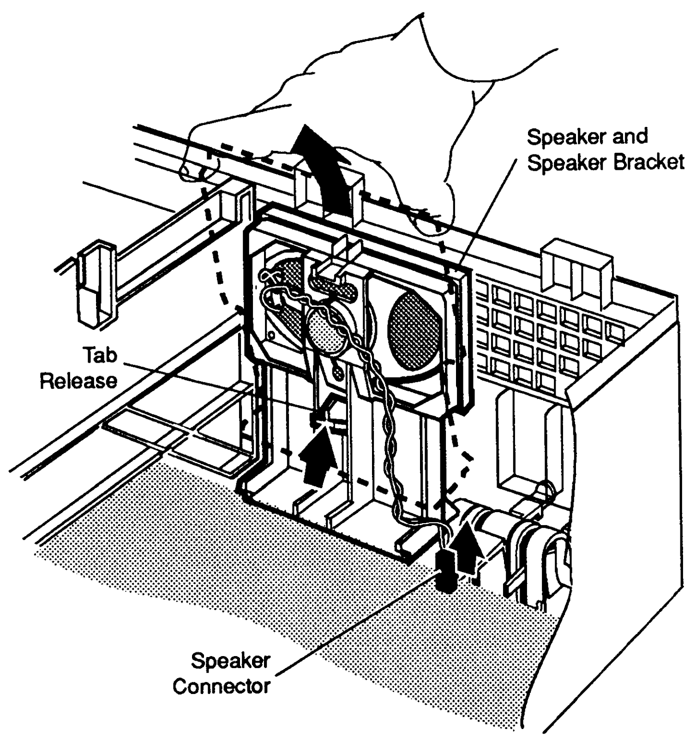


Figure 2-2 Speaker and Speaker Bracket

3. Gently lift the tab in the center of the speaker bracket (see **Figure 2-2**). Pull back on the top of the bracket until the bracket is free of the bottom panel.

__CAUTION:__ In the next step, do not push on the heavy paper portion of the speaker or you will damage the speaker.

4. Gently push the speaker away from the bracket by applying force to the back of the circular magnet at the rear of the speaker (see **Figure 2-3**).

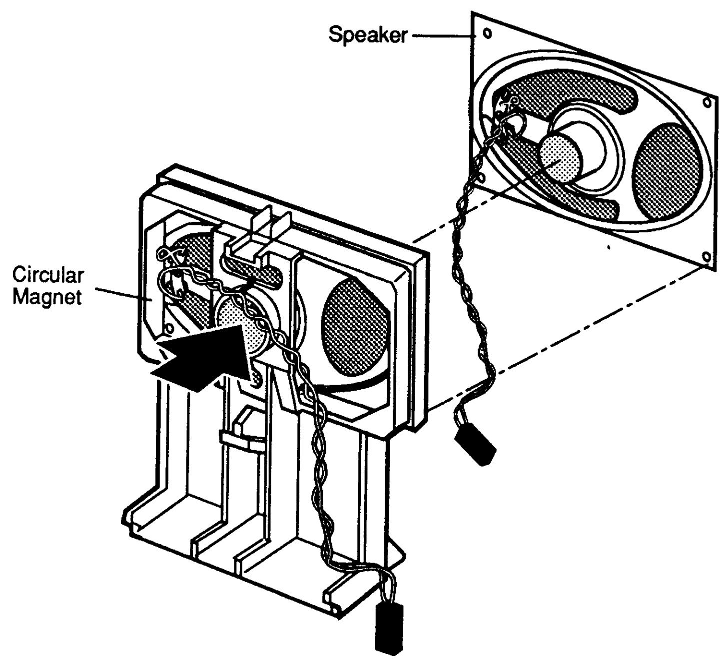


Figure 2-3 Speaker

Replace

To replace the speaker and speaker bracket, reverse the above steps. To be sure the bracket is secure, try pressing the top of the bracket forward. (The top should not move forward.)

❑ POWER SUPPLY

Materials Required

Flat-blade screwdriver

Remove

1. Remove the AC power cable.
2. Remove the lid.
3. While holding the underside of the power supply with your right hand, slide the screwdriver along the tab release (as shown in **Figure 2-4**). The screwdriver will release the tab that holds the power supply in place.

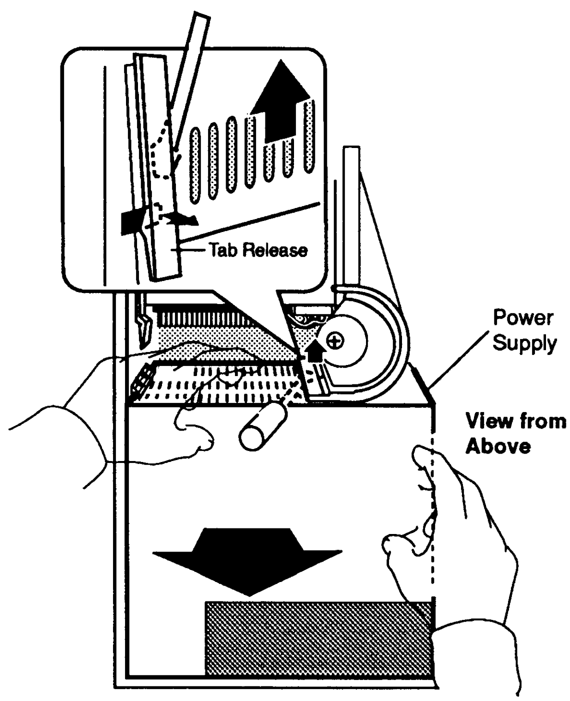


Figure 2-4 Power Supply

4. As the screwdriver releases the tab, lift the power supply. (You will have to use force to free the power supply from its connector.) If the power supply won't move, double-check the placement of the screwdriver to be sure you have released the tab.

   Once the power supply begins to move, it will come completely up and out of the case.

Replace

Replacing the power supply requires proper alignment of the guide posts and rails (as shown in **Figure 2-5**). (The tab will click into place on its own, so you don't need a screwdriver for the replacement.)

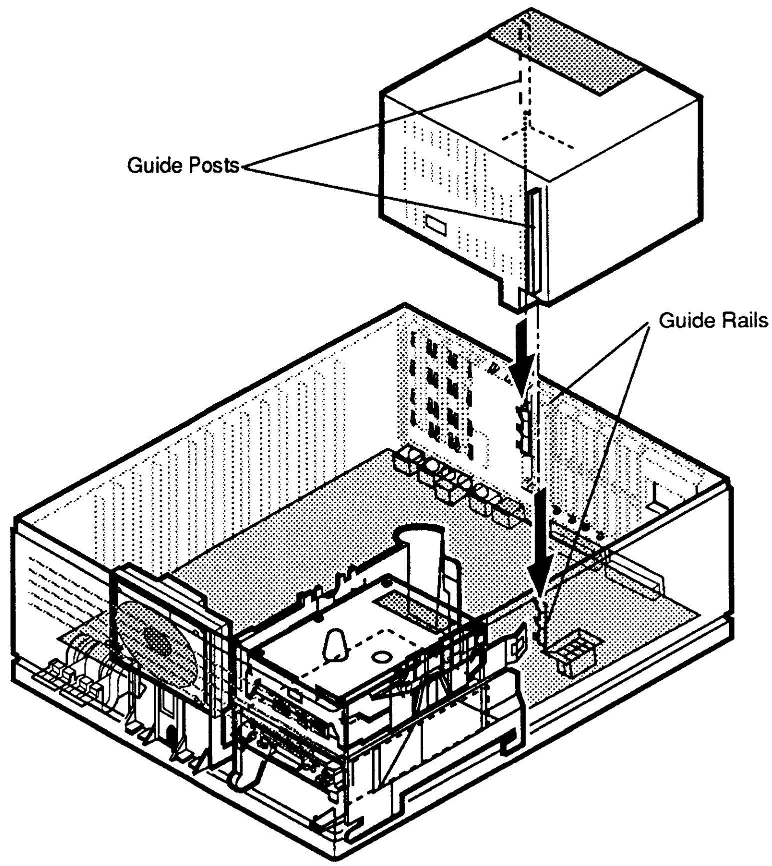


Figure 2-5 Replace Power Supply

Note: Don't worry about the connector on the bottom of the power supply. This is a self-aligning connector that will go automatically into the connector on the logic board if you have properly aligned the power supply.

❑ FAN BRACKET AND FAN

The fan and fan bracket are two separate units. To remove the fan, you must first remove the fan bracket.

Remove

1. Remove the power supply.

2. Unlatch the two bracket latches that protrude from the bottom of the power supply by gently squeezing them together (see **Figure 2-6**) until they clear the metal tabs. As the tabs release, push up so that the fan bracket separates from the power supply case.

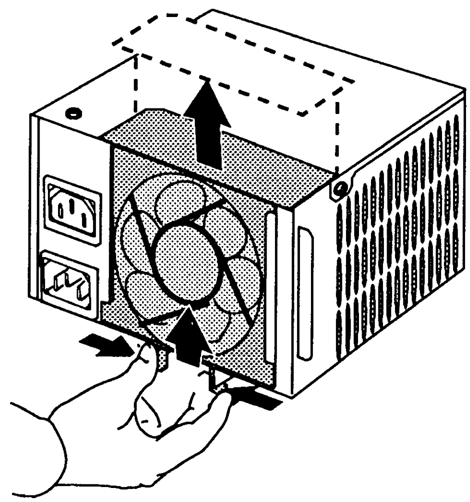


Figure 2-6 Fan and Fan Bracket

3. Remove the bracket.

4. Unplug the connector that attaches to the printed circuit board inside the power supply case (see **Figure 2-7A**).

5. On the fan side of the bracket (the side from which the wires exit), unlatch the two fan tabs (one on each side of the fan) and push the fan from the bracket (see **Figure 2-7B**).

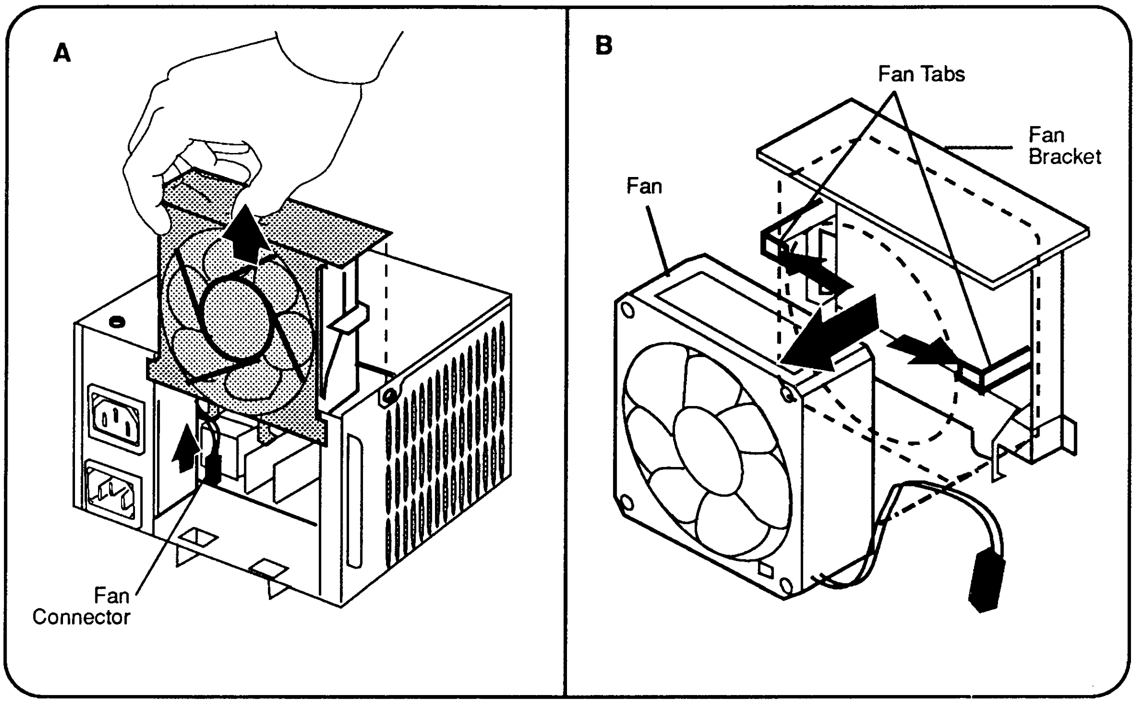


Figure 2-7 Fan and Fan Bracket

Replace

1. Reverse the removal steps.

   Note: Make sure you push the fan wire into the power supply to prevent the wire from contacting the blades.

2. Replace the power supply.

❑ HARD DISK DRIVE

The hard disk drive is on the top of the disk drive mount (see **Figure 2-8**). You can remove the hard disk drive with or without removing the drive mount. The following procedure describes how to remove the hard disk drive without removing the mount unit. (The procedure for removing the mount unit is explained later in these take-apart procedures.)

Note: If you are replacing the hard disk drive, you will need a torque driver.

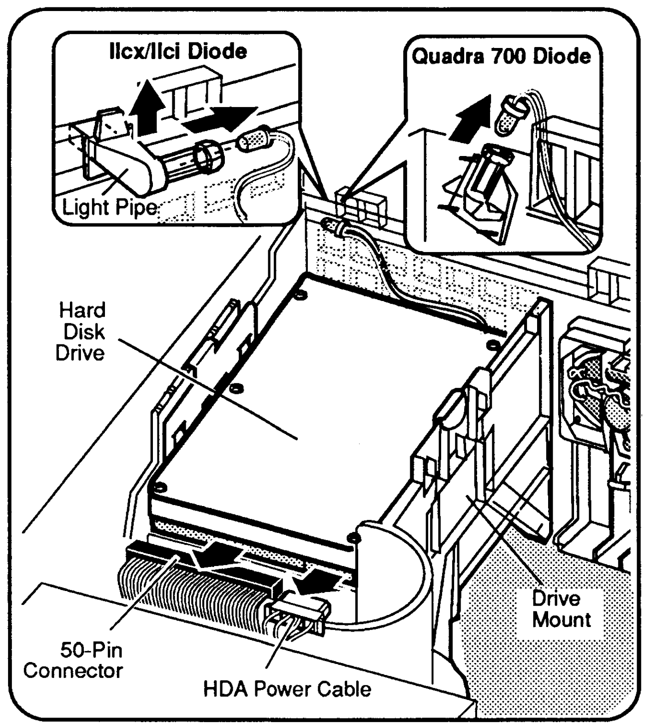


Figure 2-8 Hard Disk Drive/Diode/Mount

Remove

1. <u>Remove the lid</u>.
2. Gently remove the 50-pin connector from the back of the hard disk drive (**Figure 2-8**).
3. Disconnect the HDA power cable (**Figure 2-8**).
4. Remove the diode drive light on the front of the case by lifting the plastic holder and pulling the diode from the holder (see inset on **Figure 2-8**).

Note: If you are returning a defective HDA to Apple, detach the SCSI and power cables from the main logic board. Install the customer's HDA power cable on the replacement HDA. Return the replacement HDA cable to Apple with the failed HDA.

5. Grasp the two metals tabs (**Figure 2-9**) on the side of the hard disk drive carrier. Squeeze the tabs and gently pull up the carrier.

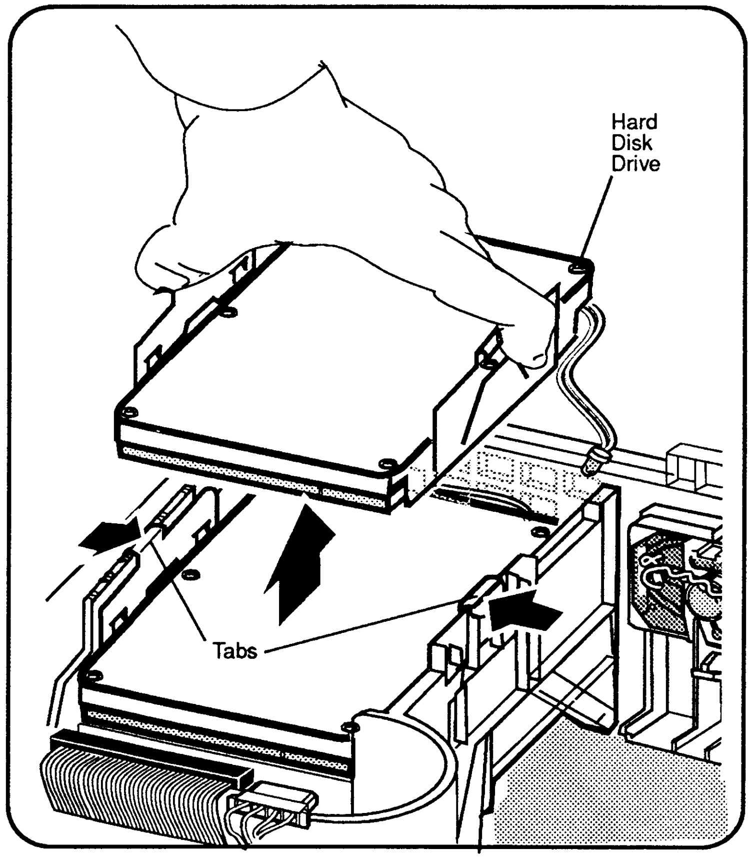


Figure 2-9 Hard Disk Drive Carrier

Note: On some hard disk drives, the power connector may be on the back of the hard disk drive, next to the 50-pin connector.

6. The hard disk drive (with its metal carrier) will start to separate from the large plastic drive mount. Remove the hard disk drive.

7. Remove the hard disk drive from its metal carrier by removing the four Phillips screws on the bottom of the carrier (**Figure 2-10**).

   You must remove the 3.5-inch 160 MB drive and the 1-inch height drives must be removed from their carriers before you return the drives to Apple; replacement drives do not have carriers.

   For drives other than the 3.5-inch 160 MB drive and the 1-inch height drives, you must return the defective HDA to Apple along with the metal carrier supplied with the replacement HDA.

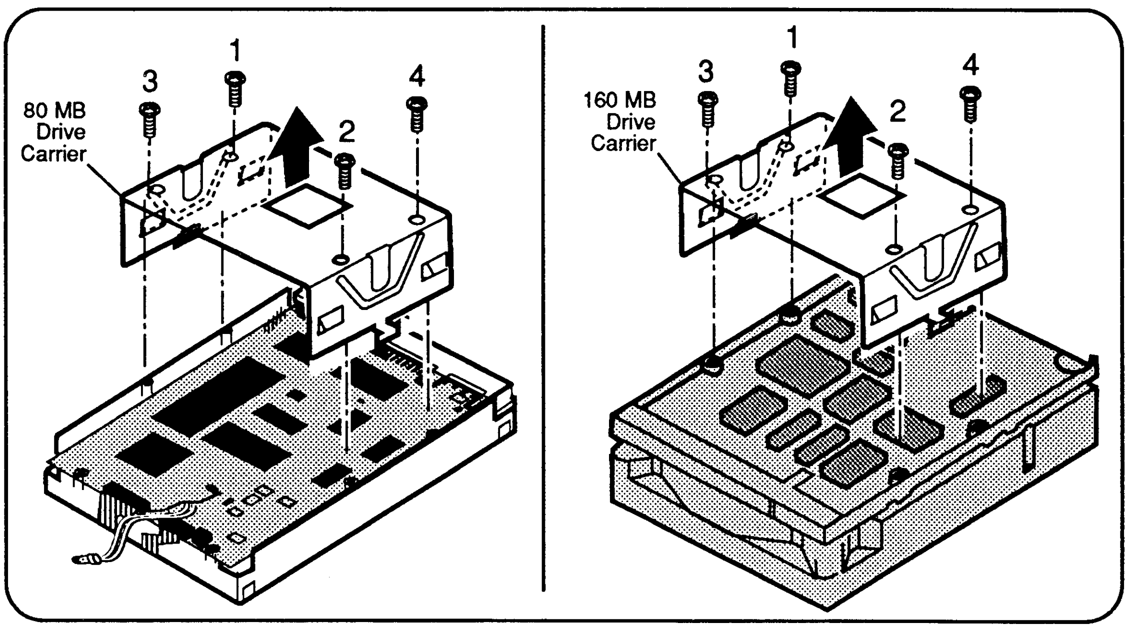


Figure 2-10 Hard Disk Assembly (HDA) and Carrier

8. **For the 3.5-inch 160 MB drive and the 1-inch height drives**, package the drive for return to Apple. Do not return the carrier or the LED. Skip steps 9-11.

9. **For drives other than the 3.5-inch 160 MB drive and the 1-inch height drives**, remove the metal carrier from the replacement hard disk drive by removing the four Phillips screws on the bottom of the carrier.

10. Position the customer's metal carrier on the replacement hard disk drive and secure the carrier with the four Phillips screws.

11. Position the replacement drive's metal carrier on the defective hard disk drive and secure the carrier with the four Phillips screws.

    Note: When you return a half-height drive and receive a 1-inch height drive as a replacement, the half-height drive will not fit in the replacement drive packaging. To make the half-height drive fit in the packaging, detach the carrier and LED before returning the drive to Apple.

Replace

Reverse the take-apart steps.

***CAUTION:** Screws that attach the 1-inch height drive to its carrier must be tightened in the order shown in **Figure 2-10** and torqued to 8.0 in-lbs.*

Note: If you are installing a hard disk in a Macintosh IIcx, IIci, or Quadra 700 that has not previously had one, you must remove the SCSI terminator on the main logic board SCSI connector *before* connecting the internal SCSI hard disk cable to the main logic board.

Note: If you are removing a hard disk from a Macintosh IIcx, IIci, or Quadra 700 and not replacing it, you must install a SCSI terminator on the main logic board SCSI connector. To insert the terminator correctly, align the white key icon on the terminator with the notch in the cable connector.

❑ DISK DRIVE MOUNT AND FLOPPY DISK DRIVE

Remove

To remove the floppy disk drive, you must remove the entire plastic disk drive mount (**Figure 2-11**) that holds the hard disk drive and the floppy disk drive.

1. Remove the lid.
2. Remove the power supply.
3. Remove the Phillips screw (**Figure 2-11**) from the disk drive mount.
4. Remove the diode from the lens (see **Figure 2-11**).

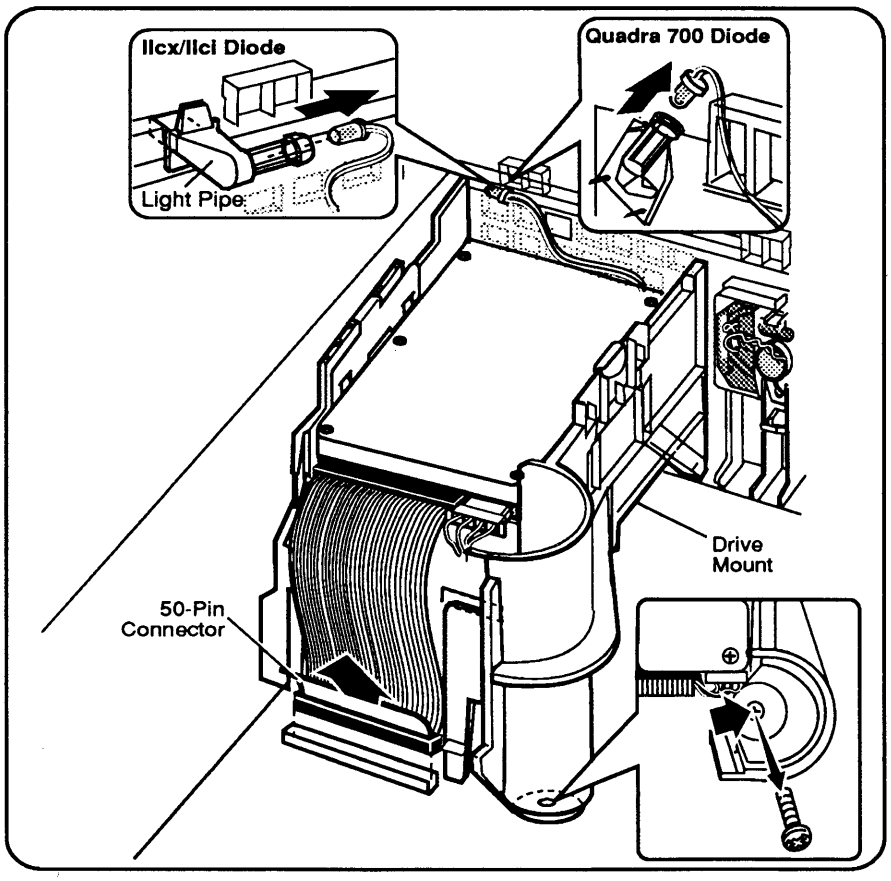


Figure 2-11 Disk Drive Mount

5. Pull up on the 50-pin connector tab (**Figure 2-11**) to disconnect the signal cable from the main logic board.

6. Disconnect the 20-pin connector (**Figure 2-12**) from the logic board.

7. Disconnect the power cable connector from the hard disk drive (**Figure 2-12**).

8. Unlatch the carrier (**Figure 2-12**) along the side of the disk drive mount. At the same time, pull the mount one half inch toward the rear of the case. Lift the mount to remove it from the case.

   Note: If you're removing the hard disk drive, follow the removal steps under "Hard Disk Drive," earlier in this section It doesn't matter whether the disk drive mount is in or out of the main case.

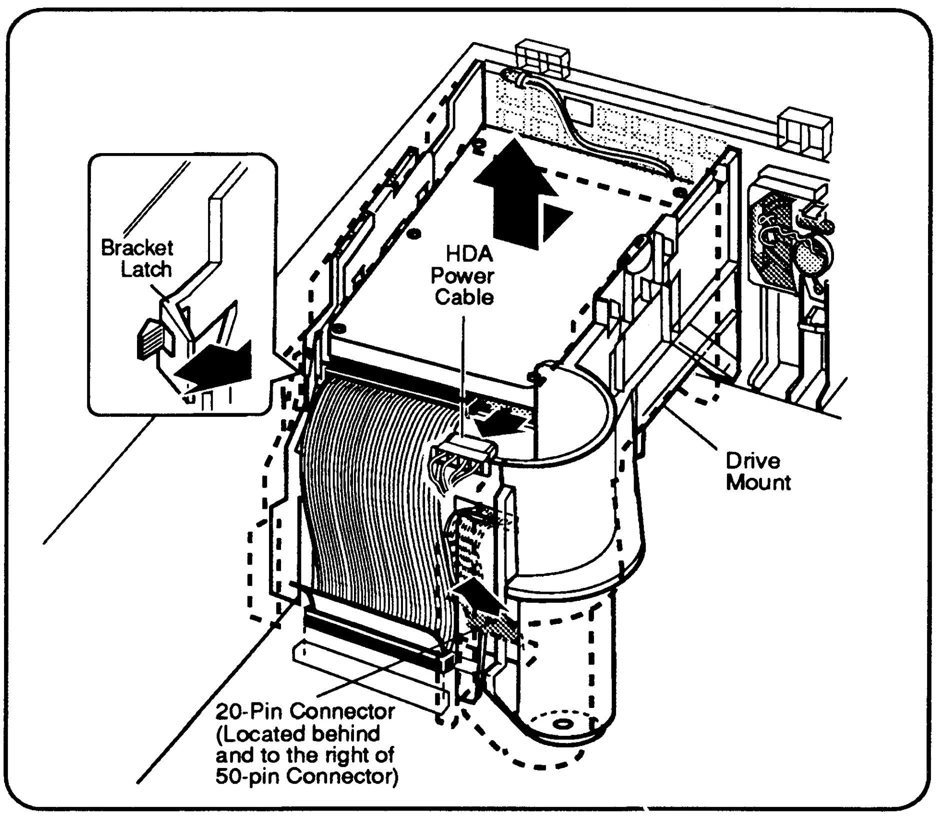


Figure 2-12 Removing the Disk Drive Mount

9. Turn over the disk drive mount and gently push down on the latch (**Figure 2-13**) that holds the front of the floppy disk drive.

10. Move the floppy disk drive toward the front of the mount one inch (see **Figure 2-13**). Pull the front of the floppy drive away from the mount; the rest of the drive will follow. Remove the drive.

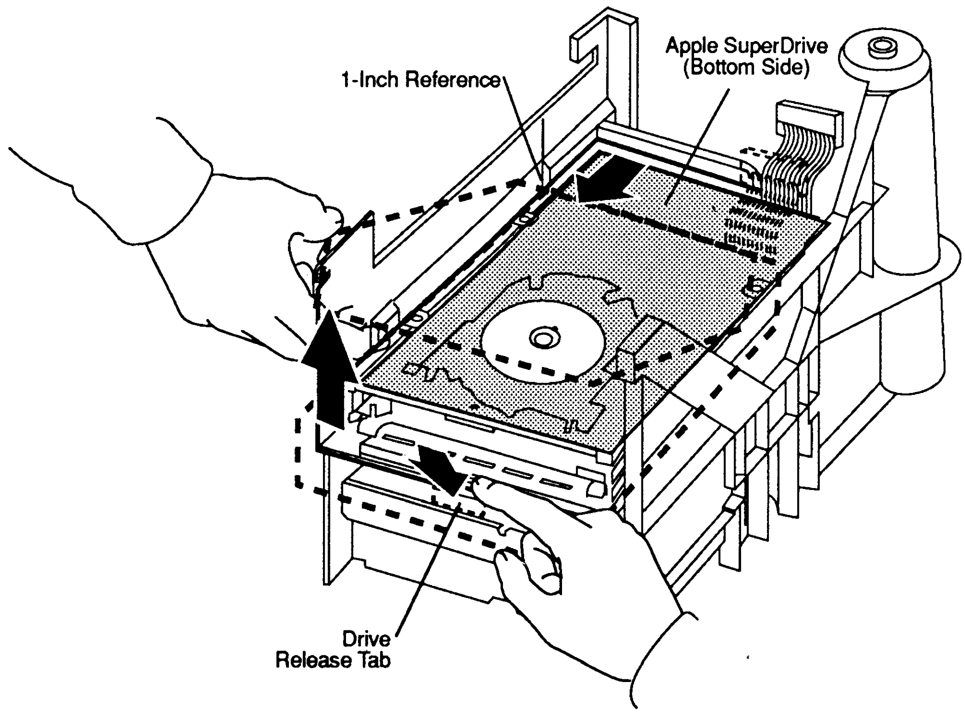


Figure 2-13 Floppy Disk Drive

Replace

1. Reverse the take-apart steps.

IMPORTANT: *Apple strongly advises the use of dust shields on 1.4 MB floppy drives in all Macintosh IIcx, IIci, and Quadra 700 computers. All 1.4 MB replacement drives ship with the dust shield already installed. If you plan to install a dust shield on the current drive, however, you* ***must*** *clean the drive first. Follow the "Cleaning the Drive" procedure in the Basics section of the FDHD/ SuperDrive tab of the* Apple Service Technical Procedures.

---

2. Replace the power supply.

3. Replace the lid.

❑ RESET / INTERRUPT SWITCH

If the reset/interrupt switch is installed, you must remove it before you can remove the main logic board.

Remove

1. Using one finger, lift up on the center tab of the switch (**Figure 2-14**). This action releases the switch from the logic board.

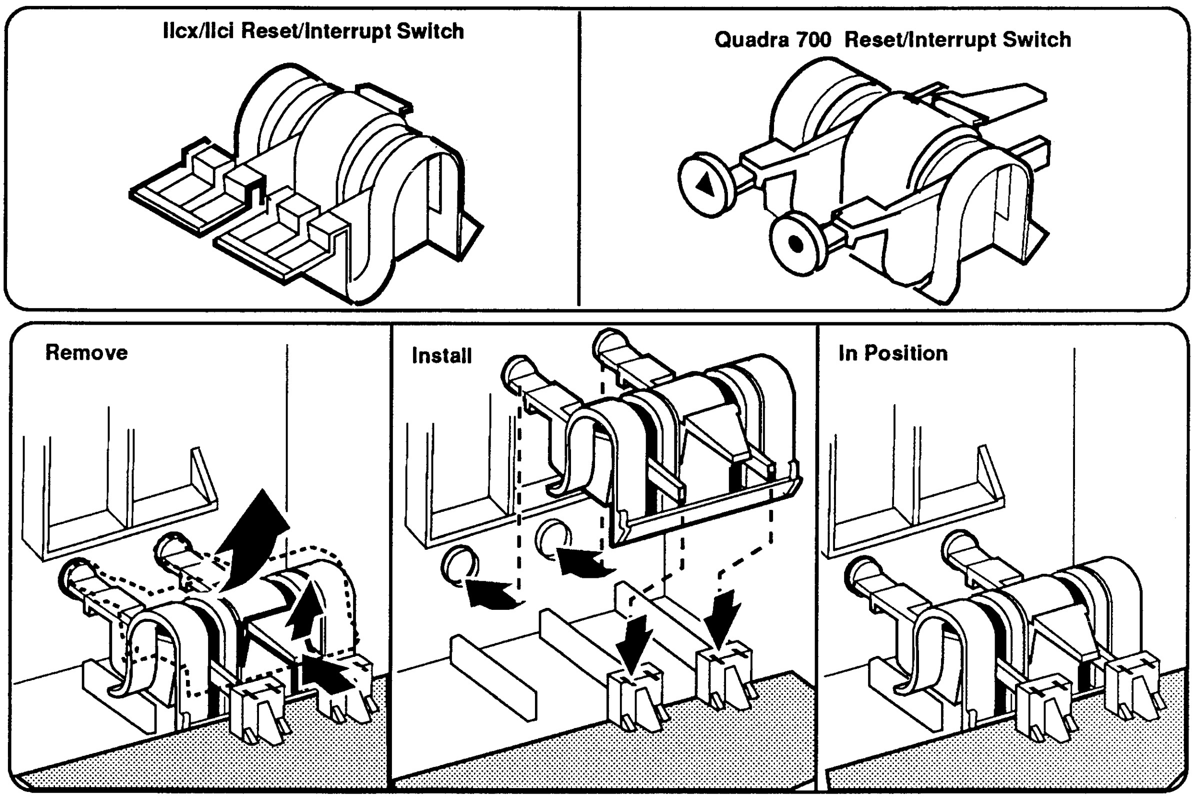


Figure 2-14 Reset/Interrupt Switch

2. Lift the rear of the loosened switch up and away from the front of the case. You may have to wiggle the switch to separate it from the case. Do not force the switch as it is fragile.

Replace

Insert the front of the switch (**Figure 2-14**) down and into the two slots at the right-front bottom of the case. As the tabs on the front of the switch go into the slots, push the rest of the switch down until it snaps under the edge of the main logic board.

❑ MAIN LOGIC BOARD

Before removing the main logic board, you must take preventive measures to avoid ESD damage. Observe the appropriate ESD precautions. (For complete ESD prevention information, refer to the *You Oughta Know* tab in *Cross Family Peripherals Technical Procedures.*)

If the proper ESD equipment is not available, do the following:

1. Switch off the computer power.
2. Disconnect the power cord.
3. Remove the lid and touch the metal of the power supply case.

Remove

1. Remove the lid.
2. Remove interface cards.

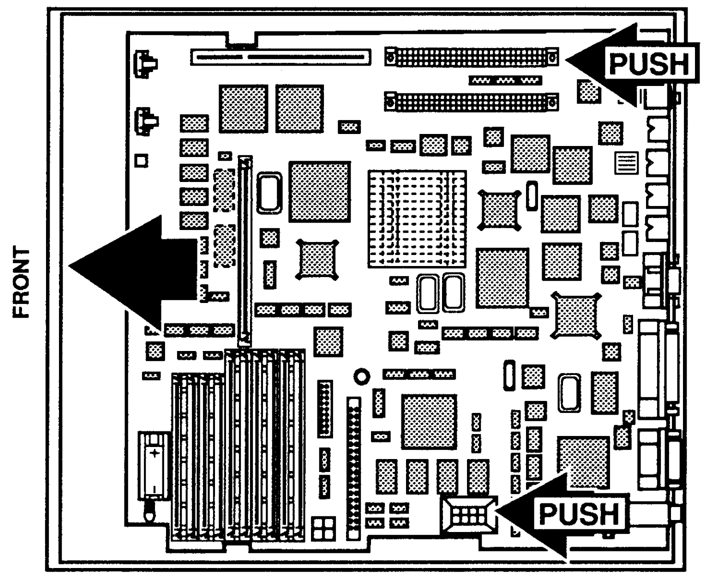
CAUTION: *If the computer has been on, let it cool for five minutes before touching the power supply.*

3. Remove the power supply.
4. Remove the disk drive mount.
5. Remove the reset/interrupt switch (if installed).
6. Remove the speaker bracket.

...Continued on next page

7. Slide the logic board toward the front of the case until it stops (**Figure 2-15**).

8. Gently begin lifting the rear of the logic board; the front will follow. Lift the board completely out of the case.



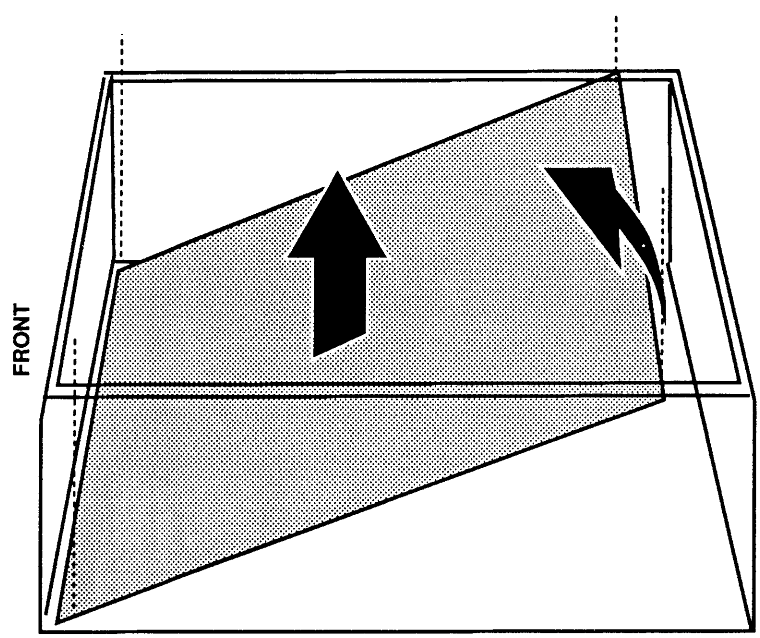


Figure 2-15 Removing the Logic Board

IMPORTANT: *Two versions of the Macintosh IIcx logic board exist under the same part number. One Macintosh IIcx logic board has a 1 x 4-pin internal SCSI power connector (**Figure 2-16A**), the other version has a 2 x 2-pin internal SCSI power connector (**Figure 2-16B**). If you replace one version of the logic board with the other version, you must also replace the hard drive power cable.*

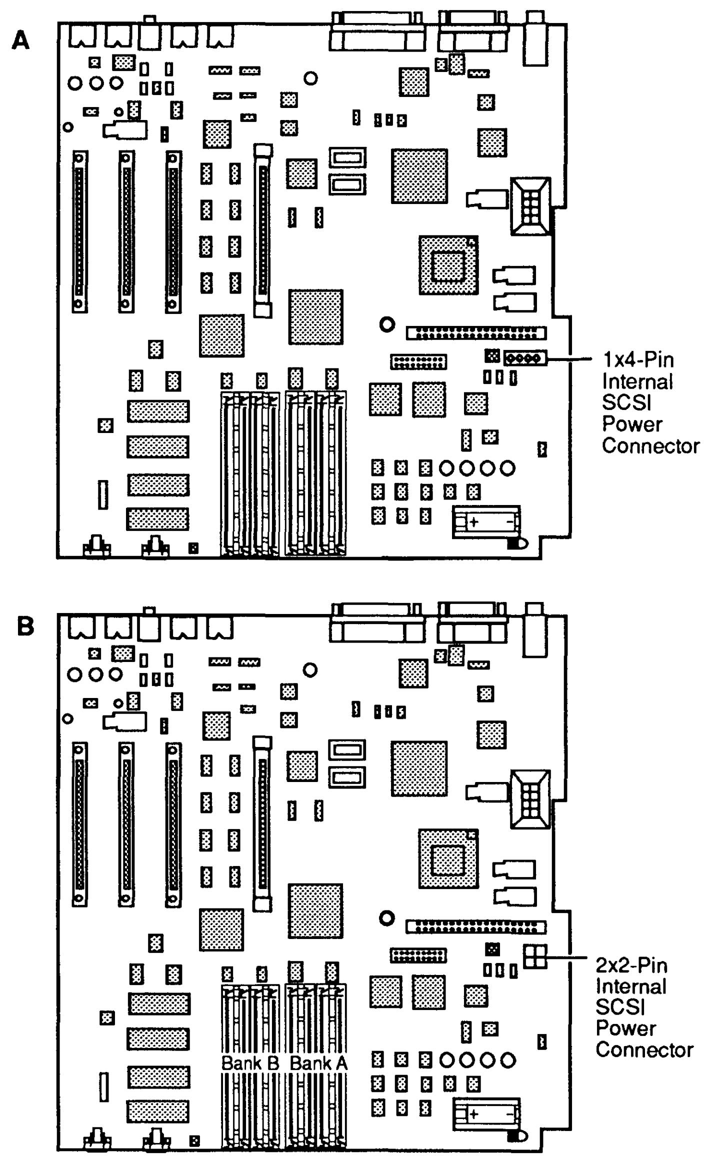


Figure 2-16 Macintosh IIcx Logic Board Versions

Replace

1. Insert the logic board into the case, back end first, so that its connectors align with the openings in the back of the bottom case (**Figure 2-17**).

2. Lay the board flat on the bottom. Make sure the slots in the logic board fit over the gray tabs on the bottom of the case (**Figure 2-17**).

   Note: Before sliding the logic board toward the rear of the case, make sure the metal grounding tabs surrounding the port holes on the rear of the case are not folded in front of the port holes. These metal tabs should press against the connectors at the rear of the logic board to form a common ground shield when the board is in place. If a tab is folded in front of the hole and you push the board against the tab, the tab could break off or block the port hole.

3. Slide the logic board toward the rear of the case as far as it will go. You should feel and hear a slight thump.

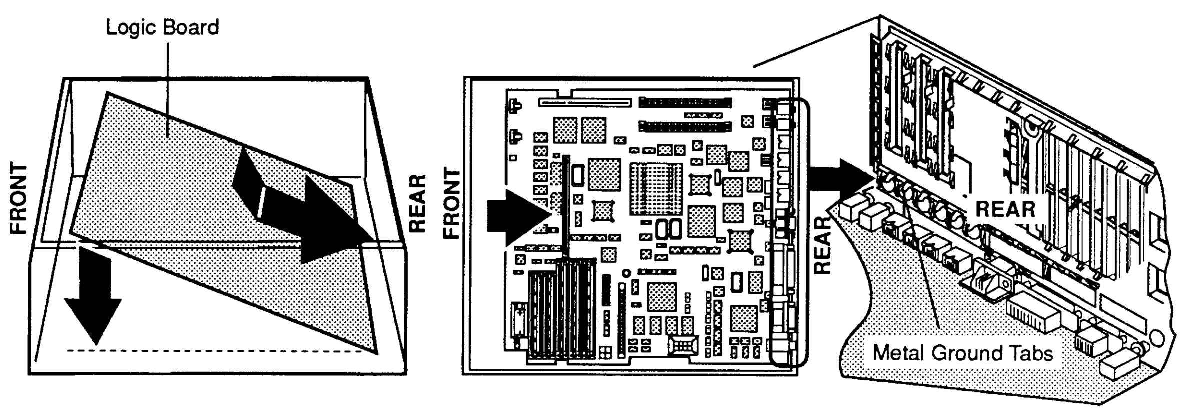


Figure 2-17 Replacing the Logic Board

4. Replace the reset/interrupt switch (if needed).

5. Replace the speaker and speaker bracket.

6. Replace the disk drive mount.

7. Replace the power supply.

8. Replace the interface cards (if removed).

9. Replace the lid.

 Apple Technical Procedures

Macintosh IIcx/IIci/Quadra 700

Section 3 – Diagnostics

❑ CONTENTS

Note: Currently, diagnostics for the Macintosh Quadra 700 are not available but will be included in a future *Technical Procedures* update.

Note: *MacTest IIcx/IIci* version 2.0 does not include test looping at this time. The looping feature will be added to a future version of the program.

❑ INTRODUCTION

This section contains diagnostic information for Macintosh IIcx and IIci computers. Diagnostic procedures for these systems make use of two software programs—*MacTest™ IIcx/IIci* and *AppleCAT® IIcx/IIci.*

Currently there are no diagnostics for the Macintosh Quadra 700.

❑ ABOUT MACTEST IIcx/IIci

The *MacTest IIcx/IIci* diagnostic disk (version 2.0 or higher) is part of the *AppleCAT IIcx/IIci* diagnostic set. *MacTest IIcx/IIci* is also usable as a stand-alone confidence test of Macintosh IIcx or IIci systems. The *MacTest IIcx/IIci* disk includes the system folder, the *MacTest IIcx/IIci* program, and the Diagnostic Sound Sampler. The Diagnostic Sound Sampler lets you listen to the various musical chord sequences generated during a startup failure.

MacTest IIcx/IIci is a pass/fail confidence test program. As the program progresses, messages on the screen indicate the specific test in progress and its results. As soon as the program detects a failure, the test stops and the screen indicates which module you must replace. When the test is complete, *MacTest IIcx/IIci* terminates and returns to the Finder.

The *MacTest IIcx/IIci* program identifies the ROM version of the system and tests the following items:

- Main logic board
- Internal disk drive
- External disk drive
- NuBus video cards for these monitor types:
  - High-resolution color
  - Color
  - Monochrome
  - Portrait
  - Two-Page
- Apple PC 5.25 drive and Macintosh II PC card

MacTest IIcx/IIci also provides test patterns for adjusting the high-resolution monitors.

***MacTest IIcx/IIci* does not test the internal or external SCSI hard disk.** To test the hard disk, use *Macintosh Hard Disk Test* (see Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures*).

MacTest IIcx/IIci tests an internal NuBus expansion slot only when an Apple expansion card is installed. To test a NuBus expansion slot, install a NuBus video card, an EtherTalk® card, or a Macintosh II PC card (with an Apple PC 5.25 drive) in the slot and select the appropriate test from the Test Selections window.

Copying the Disk

Make a backup disk before you begin! When testing a defective Macintosh IIcx or IIci, you may damage or erase a section of the *MacTest IIcx/IIci* disk.

Using Your Backup Disk

Take the following precautions when using your backup *MacTest IIcx/IIci* disk:

- **Do not write-protect your working copy of the *MacTest IIcx/IIci* disk.** The program will not run correctly if you do.

- **Do not change the name of the diagnostic program on the disk**. During logic board testing, the machine restarts, then looks for and restarts the diagnostic named *MacTest™ cx/ci* (notice that "II" is omitted from the CPU designations due to character string constraints). If the name has been changed, the startup routine will not be able to locate the program and the system will stay at the desktop.

If the *MacTest IIcx/IIci* window does not reappear after a logic board test, check the name of the diagnostic icon on the desktop. Correct it to *MacTest IIcx/IIci* and select **Set Startup** from the desktop Special menu. When the message **Upon Startup automatically open: MacTest™ IIcx/IIci** appears, click **OK**. Double-click the corrected *MacTest IIcx/IIci* icon when you return to the test program.

❑ RUNNING MACTEST IIcx/IIci

Materials Required

MacTest IIcx/IIci diagnostic disk (backup)
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback test card (modified with jumper—see "SCSI Loopback Jumper Procedure" in this section)
Blank, known-good 800K disk for drive test
Blank, known-good 1.4 MB disk for SuperDrive test
Macintosh IIcx or Macintosh IIci
Macintosh Display Card (required for Macintosh IIcx)

Starting MacTest IIcx/IIci

You can use *MacTest IIcx/IIci* to perform a confidence test of the entire system or to test a single component in a known-good system. Follow the start-up steps below for the testing you wish to perform.

Testing the Complete System or Logic Board

1. If you are testing a complete system, or if you intend to run the logic board tests, switch the power off.

   Note: The application ships with the default setting to run all tests.

2. Install the loopback connectors as described in "Installing the Loopbacks," later in this section.

3. Insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system. *MacTest IIcx/IIci* will display the Status window (**Figure 3-1**). Click **Start** to run the tests.

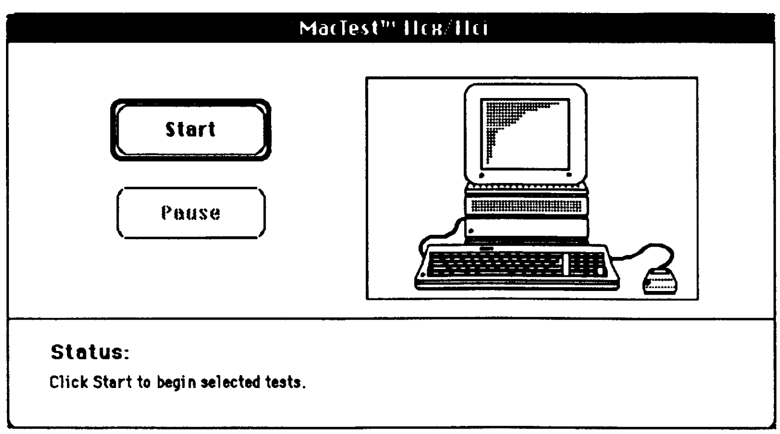


Figure 3-1 MacTest IIcx/IIci Status Window

Testing a Single Component

1. If you are testing a single component in a known-good system, insert the *MacTest IIcx/IIci* disk into the internal drive, and switch on the system.

2. If you selected the SCSI loopback test, *MacTest IIcx/IIci* displays a window that tells you to switch off the power and connect the SCSI loopback board. Click **OK** to display the *MacTest IIcx/IIci* Status window.

3. From the Status window you can use the *MacTest IIcx/IIci* menus. Go to the Options menu and use the Test Selections submenu to select the tests you want to run. Click **OK** to exit the Test Selections window.

4. From the Status window, click **Start**. For more specific information on the tests, see "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," in this section.

Helpful Startup Information

If you encounter any of the following problems, refer to Section 4, Troubleshooting, for additional information:

- The known-good *MacTest IIcx/IIci* disk will not start up.

- The Configuration window does not show the installed card(s).

- The Configuration window indicates that no disk drives are installed, or that fewer drives are installed than is the case.

- The Macintosh IIcx or IIci system intermittently locks up during the tests.

- The Configuration window indicates that the wrong amount of DRAM is installed.

If you do not know whether the system you are testing is good:

- Run the *MacTest IIcx/IIci* logic, drive, and video card tests. (See "Using the *MacTest IIcx/IIci* Menus" and "Running the Tests," in this section.) Complete any needed repairs before you continue.

- If you removed a Macintosh II PC card, run the Apple PC 5.25 drive test as described in Section 3, Diagnostics, of the *Apple PC 5.25 Drive Technical Procedures*.

- If you removed any expansion cards, install them one at a time, and run the *MacTest IIcx/IIci* logic, drive, and monitor tests after installing each card. Repeat the install-and-test process until all expansion cards are installed and the Macintosh IIcx or IIci passes all tests.

Installing the Loopbacks

If you are running the serial loopback test or the SCSI test, you must connect the serial loopback cable or the SCSI loopback card—along with the keyboard, mouse, and monitor.

CAUTION: *Always switch off the system when you connect or disconnect the SCSI loopback card.*

You must connect the SCSI loopback card cable to the SCSI port on the back of the computer (see **Figure 3-2**). (No other connections between the card and the computer are necessary.) To protect the SCSI circuitry, you must have the power off when you connect the SCSI card. You must also install the loopback cable with the mini DIN-8 connectors between the modem and printer ports on the rear of the machine (see **Figure 3-2**).

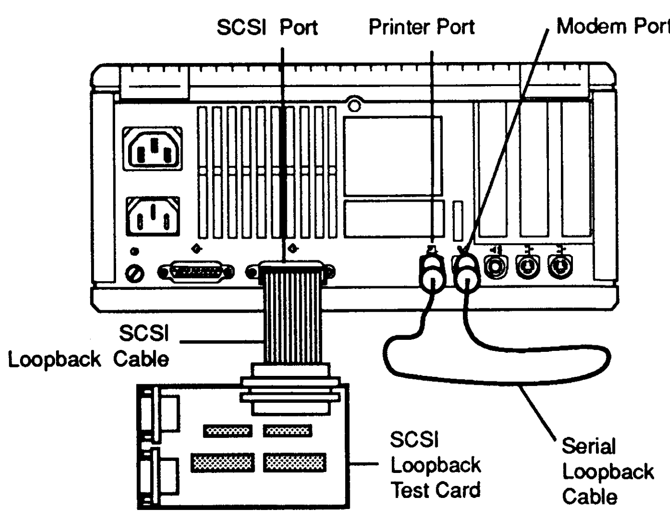


Figure 3-2 Loopback Cables

Using the MacTest IIcx/IIci Menus

Before you start *MacTest IIcx/IIci*, use the *MacTest IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic. **You cannot use the menus when the tests are running.**

Options Menu

The Options menu contains the Test Selections and Configuration submenus.

1. **Test Selections** – the following window (**Figure 3-3**) appears when you choose **Test Selections**:

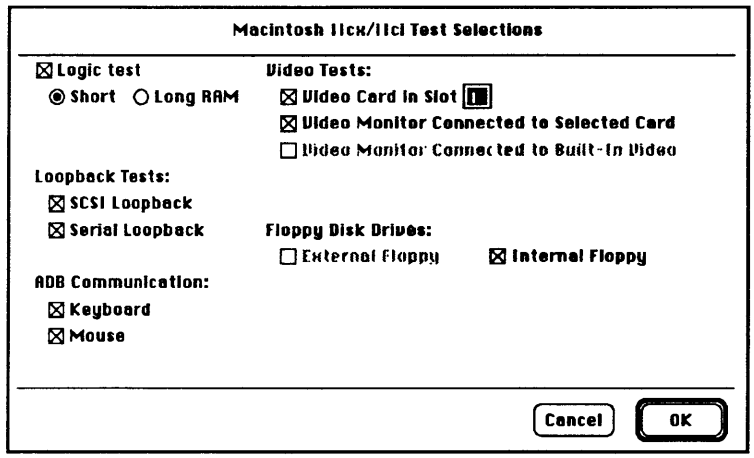


Figure 3-3 Test Selections Window

Test Selections allows you to select the tests you wish to run and indicates which slot contains the card to be tested. If an expansion slot does not contain an EtherTalk card, Macintosh II PC card, or a NuBus video card, the selection for that test appears dimmed.

To select a test, click the check box next to the name of the item you wish to test. To deselect the test, click the box again. When you have selected all the tests you wish, click **OK**. The Status window will appear.

Below are the tests you can select from the Test Selections window:

a) **Logic** verifies the correct functioning of the following circuitry on the logic board:

- VIAs (versatile interface adapters)
- Apple stereo sound chip
- Clock/PRAM
- FPU (floating-point unit)
- RAM

You can choose a short or a long RAM test when you select the logic test. The running time of the test depends on how much memory is installed. At the beginning of the RAM test, *MacTest IIcx/IIci* indicates the maximum running time of the test.

During the VIA and sound chip test, the logic board test generates a sound through sound channel A that plays through the internal speaker. (If necessary, use the Control Panel to modify the volume.)

Note: Once the RAM test begins, you cannot interrupt it.

b) **SCSI Loopback** tests the SCSI chip, the SCSI bus signals, and the external SCSI connector. You must have the SCSI loopback card connected to the external SCSI port when you run this test.

c) **Serial Loopback** tests the SCC (serial controller chip), serial communication signals, and the serial connectors. You must have the serial loopback cable connected when you run this test.

d) **Keyboard Communications** confirms that the logic board can communicate correctly with the ADB keyboard.

e) **Mouse Communications** confirms that the logic board can communicate correctly with the ADB mouse.

f) **Floppy Disk Drives** verifies the functioning of the 1.4 MB internal, 800K external, or 1.4 MB external disk drives and related circuitry on the logic board.

g) **Video card in slot** tests a Macintosh II video card installed in one of the expansion slots on the Macintosh IIcx or IIci. If more than one video card is installed, you must tell *MacTest IIcx/IIci* which video card to test. (If you do not specify which card to test, the software will default to the lowest slot number with a video card in it.) Use the keyboard to enter the slot number of the video card you want to test in the space next to the **Video card in slot** option.

h) **Video monitor connected to a selected card** displays test patterns used to adjust the video picture on the high-resolution monitors. This test displays test patterns on the monitor connected to the selected video card. If you are adjusting a second monitor, select the other card slot on the video test control.

Note: The tests for the Apple Macintosh Portrait Display and Two-Page Display monitors require extended memory to display the test patterns. These monitors must be connected when you start up the system.

Note: Refer to the appropriate Technical Procedures manual for your monitor for information about necessary monitor adjustments.

i) **Apple PC 5.25 Drive and Card** verifies that the drive, the Macintosh II PC card, and the expansion slot are functioning correctly. To set up for this test, follow the instructions in Section 3, Diagnostics, in *Apple PC 5.25 Drive Technical Procedures.*

Note: The Apple PC 5.25 drive test cannot always determine which module is at fault when a test fails. If the test reports that the drive and/or card is bad, replace one module at a time as described in Section 4, Troubleshooting, in the *Apple PC 5.25 Drive Technical Procedures.* Note that if you have two Apple PC 5.25 cards installed, you must select the slot holding the card to be tested.

2. **Configuration** – The following window (**Figure 3-4**) appears when you select **Configuration:**

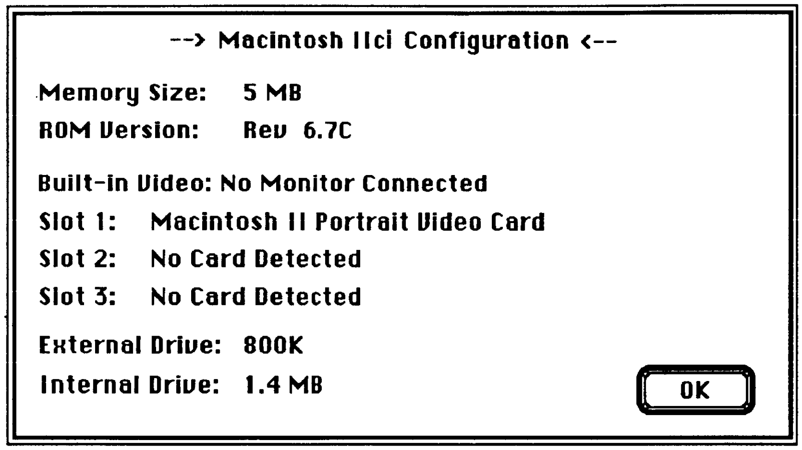


Figure 3-4 Configuration Window

The Configuration window displays the amount of memory, the ROM version number, the cards installed in expansion slots 1 through 3, and the current disk drive configuration.

File Menu

The list below shows the items in the File menu and their key equivalents, if applicable.

Open	(always dimmed)
Close	(always dimmed)
Save Test Selections	[Command-S]
Stop	[Command - . (period)]
Quit	[Command - Q]

Note: **Open** and **Close** are always dimmed; **Save** and **Stop** are sometimes dimmed.

Save Test Selections allows you to customize your *MacTest IIcx/IIci* disk by saving your selection of tests for the next time you use *MacTest IIcx/IIci*. **Save Test Selections** is dimmed if no changes have been made.

Stop ends the diagnostic and returns you to the *MacTest IIcx/IIci* Status window.

Quit returns you to the desktop.

Apple Menu

The Apple () menu contains the following three selections:

- **About MacTest IIcx/IIci**, which displays a dialog box with the diagnostic name, the version number, the date of release, and a copy-protect statement.
- **Control Panel**, which allows you to set preferences for speaker volume, monitor status, desktop pattern, and mouse tracking.
- **Key Caps**, which displays a window with a keyboard. Press each key on the keyboard and verify that the display block for each key highlights. If the key does not highlight, the keyswitch is bad and you must replace it. If numerous keys do not highlight, exchange the keyboard.

Running the Tests

After using **Test Selections** to select the tests you wish to run, you are ready to start *MacTest IIcx/IIci*. Click the Start box in the *MacTest IIcx/IIci* Status window. Please note the following:

- The Status line at the bottom of the *MacTest IIcx/IIci* window indicates the tests that are running and the test results.

- While running, all tests display a wristwatch. There is no other moving or flashing indicator that tells you the test is in progress.

- You cannot stop the diagnostic while the cursor is a wristwatch; you can stop the diagnostic only while the cursor is a pointer.

- If you select the SCSI test and the loopback card is either missing or improperly installed, instructions will tell you to switch off the power, disconnect all external SCSI drives, and connect the SCSI loopback card.

- If you select the serial test and the loopback cable is either missing or improperly installed, testing will begin but the serial ports test will fail. Instructions will tell you to make sure the serial loopback cable is connected and then to click **Continue** to retry the failed test.

  Note: You can connect the serial loopback cable without switching off the system.

- During the disk drives test, the program prompts you to insert and remove blank 800K and 1.4 MB disks. Perform the disk swaps as directed on the screen; then click **OK**.

  Note: It is important to insert the low- or high-density disk when requested. If you insert the wrong disk, *MacTest IIcx/IIci* will indicate that the disk drive is malfunctioning when it may not be.

CAUTION: *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 *may damage the MacTest IIcx/IIci disk.*

- To stop testing, click **Stop** or **Pause** anytime between tests while the cursor is a pointer.

  - Choose **Stop** to stop testing and return to the *MacTest IIcx/IIci* Status window. Choose **Start** to begin the testing sequence again.

  - Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume the tests from the point of interruption.

Replace any module that the test indicates is faulty (see Section 2, Take-Apart). Before replacing the module, use *AppleCAT IIcx/IIci* or refer to Section 4, Troubleshooting, to verify the diagnosis. If the system still does not operate properly, turn to Section 4, Troubleshooting, for more information.

If all tests pass, the system returns to the *MacTest IIcx/IIci* Status window. The message **All selected tests have passed** appears on the Status line.

When you choose **Loop on all selected tests**, a looping counter shows the number of completed loops.

❑ DIAGNOSTIC SOUND SAMPLER

Introduction

The Diagnostic Sound Sampler enables you to listen to and become familiar with the Macintosh IIcx and IIci error chords. Error chords are brief musical tones that indicate whether the system is functioning correctly.

Refer to Section 4, Troubleshooting, for complete information on startup and error chords.

Materials Required

Known-good Macintosh IIcx or IIci system
MacTest IIcx/IIci disk (backup)

Procedure

To listen to the various Macintosh IIcx or IIci error chords, follow these steps:

1. Set up the Macintosh IIcx or IIci system.
2. Insert the *MacTest IIcx/IIci* backup disk. A window appears.
3. Click **Quit** from the File menu. The desktop appears.
4. Open the disk or folder and then open the Diagnostic Sound Sampler. A window listing the various chords and chord sequences appears. Select the chords you wish to hear.
5. Upon completion, click **Quit**.

❑ INTRODUCTION TO APPLECAT IIcx/IIci

AppleCAT IIcx/IIci is a diagnostic tool that uses a known-good Macintosh to diagnose module failures in a defective Macintosh IIcx or IIci. The known-good Macintosh (test station) and defective Macintosh IIcx or IIci (unit under test, or UUT) are connected through their communication ports. The test station performs the following functions:

- Establishes communications with the UUT
- Calls tests in the ROM of the UUT
- Downloads tests to the faulty machine
- Calls *MacTest IIcx/IIci* tests in the UUT disk drive
- Displays test results on the test station screen
- Identifies the failing module
- Prompts the technician for information
- Recommends a repair procedure

With *AppleCAT IIcx/IIci*, the UUT does not have to be fully operational. By using an independent, working computer to do the diagnosis, *AppleCAT IIcx/IIci* depends very little on the UUT, making the test results more reliable and thorough than traditional diagnostic methods.

Standard windows guide the technician through each stage of the diagnostic. When the UUT fails a test or indicates a problem, an *AppleCAT IIcx/IIci* screen asks for more information or recommends a repair.

After each module replacement or adjustment, *AppleCAT IIcx/IIci* reruns all the prior tests to verify that the problem is fixed. If the UUT successfully completes a final system verification, an alert window reports **All selected tests passed, click start to begin.**

A looping mode allows users to check for intermittent RAM failures.

❑ RUNNING APPLECAT IIcx/IIci

Materials Required

Macintosh IIcx or IIci (unit under test, or UUT)
Known-good Macintosh (Macintosh Plus or later) as a test station
AppleCAT IIcx/IIci diagnostic disk
MacTest IIcx/IIci disk
Blank 800K disk
Blank 1.4 MB disk
Reset/Interrupt switch for the UUT
Mini-DIN-8-to-mini-DIN-8 serial port cable
SCSI loopback card
Mini DIN-8 serial loopback plug
Video card in slot 1
Digital multimeter or volt/ohmmeter
#2 Phillips screwdriver
Monitor
Known-good ADB keyboard for the UUT
Known-good ADB mouse for the keyboard

Setting Up the Test Station and UUT

1. Connect the test station to a wall socket with an AC power cord.

2. Place the UUT next to the test station and connect the UUT to a wall socket with an AC power cord.

3. Connect the SCSI loopback card cable to the SCSI port on the back of the UUT (**Figure 3-5**).

4. Connect the serial loopback plug to the printer port on the back of the UUT (**Figure 3-5**).

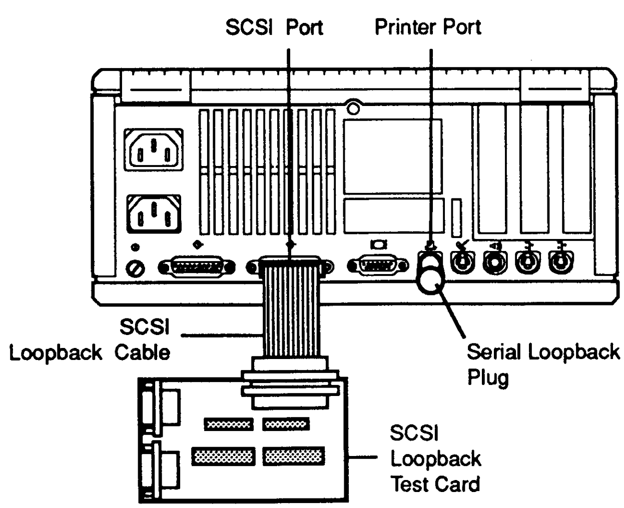


Figure 3-5 Loopback Cable and Plug

5. Connect one end of the serial port cable to the modem port on the UUT, and connect the other end to the modem port on the test station (**Figure 3-6**).

6. Connect a known-good keyboard to the ADB port on the UUT, and connect a known-good mouse to the other ADB port on the UUT (**Figure 3-6**).

   Note: You must connect a keyboard and a mouse in order to test either device.

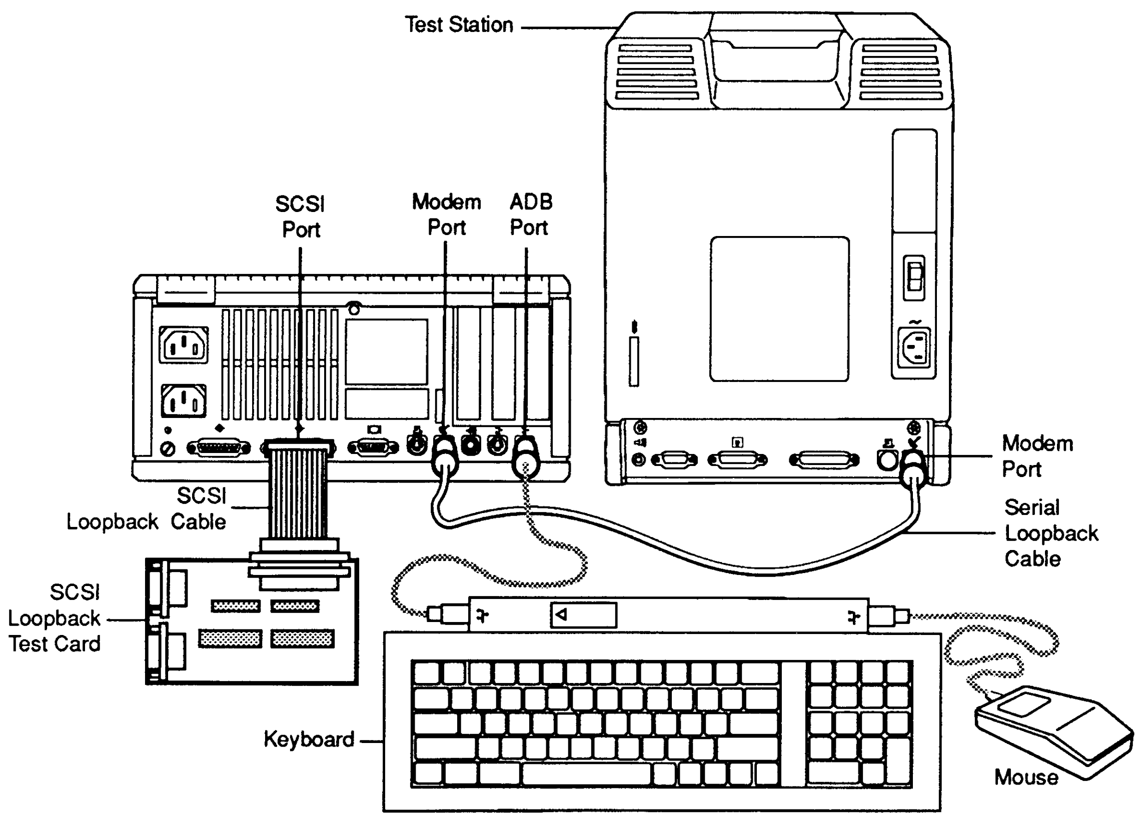


Figure 3-6 Modem and ADB Connections

7. Verify that the reset/interrupt switch (**Figure 3-7**) is installed. With the front of the UUT facing you, look at the lower-left corner where the two slots are, and see if the switch is installed (see **Figure 3-7**). If a switch is not installed, you must install one. Refer to Section 2, Take-Apart, for installation instructions.

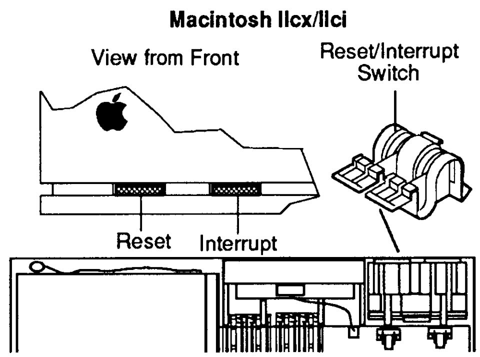


Figure 3-7 Reset/Interrupt Switches

The reset/interrupt switch has two switches—the reset switch and the interrupt switch (**Figure 3-7**). Pressing the reset switch is the same as switching the power off and back on. Pressing the interrupt switch places the UUT in interrupt mode.

Establishing Communication

1. Insert the *AppleCAT IIcx/IIci* disk into the test station, and switch on the test station.

2. Open the disk icon and then the *AppleCAT IIcx/IIci* icon. The *AppleCAT IIcx/IIci* Start window appears on the test station screen (**Figure 3-8**).

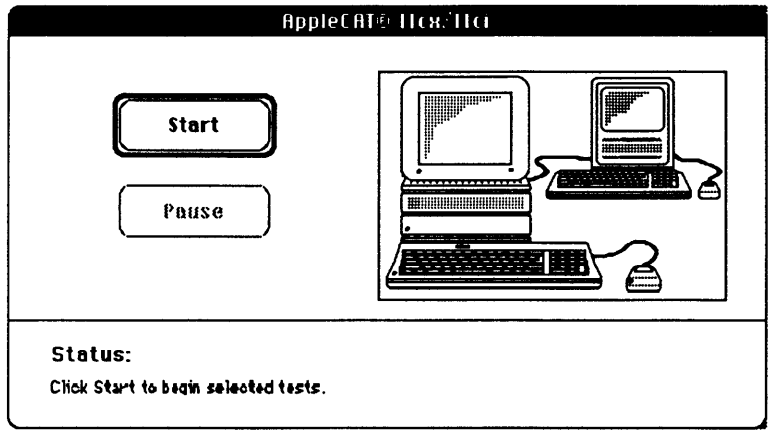


Figure 3-8 AppleCAT IIcx/IIci Start Window

3. Make sure that all disks are ejected from the UUT.

4. Switch on the UUT. A four-tone chord (following the startup chord) indicates that you are in test mode. If you hear **only** the startup tone (a single chord), you are **not** in test mode. To obtain test mode, wait about four seconds for each megabyte of installed memory, and then press the interrupt switch (refer to **Figure 3-7**). When in test mode, the UUT can respond to information it receives through the modem port.

IMPORTANT: *If you hear any additional chords after the single startup tone, you are already in interrupt/test mode.* ***Do not*** *press the interrupt switch. The Macintosh IIcx or IIci will automatically go into interrupt mode if it detects an error at power-on.*

Note: If the unit starts up with the hard disk or with any bootable disk that was left in the UUT disk drive during power-on, the window for pressing the interrupt switch on the UUT does not appear. If this situation occurs, press the reset switch on the UUT, and repeat steps 3 and 4.

Using the AppleCAT IIcx/IIci Menus

Before you start *AppleCAT IIcx/IIci*, use the *AppleCAT IIcx/IIci* menus to select the tests you want to run or to select other features of the diagnostic.

Note: You must make your test selections before you start *AppleCAT IIcx/IIci.* You cannot make changes to the test selections while *AppleCAT IIcx/IIci* is running. If you do not use the Test Selections submenu, the default test selection will include the following tests:

- Logic Board (which includes RAM testing)
- Internal Drive

IMPORTANT: *Selecting specific tests shortens the AppleCAT IIcx/IIci test, but you may not find all faulty modules. The default test selections will ensure a complete system check of all components except for the video card.*

Options Menu

The Options menu contains the Test Selections submenu. When you choose **Test Selections**, the window in **Figure 3-9** appears.

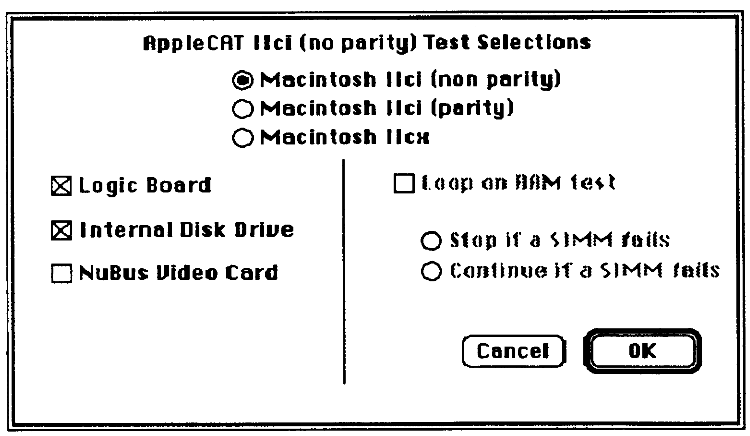


Figure 3-9 AppleCAT IIcx/IIci Test Selections Window

Test Selections allows you to select certain tests individually. To select a test, click the box next to the name of the item to be tested. To deselect the test, click the box again. When you have selected all the tests you wish to run, click **OK**. *AppleCAT* will return you to the *AppleCAT IIcx/IIci* Start window.

Note: Your test selections remain in effect until you change them or until you reboot *AppleCAT IIcx/IIci.*

- **UUT Selection** allows you to select one of the following:
  - IIcx
  - IIci (nonparity)
  - IIci (parity)

- **Logic Board** verifies correct functioning of the following circuitry on the Macintosh IIcx or IIci logic boards:
  - ROM
  - Memory size plus RAM testing
  - CPU data bus and address bus
  - VIAs (versatile interface adapters)
  - Internal clock
  - Parameter RAM
  - Serial ports (SCC)
  - External SCSI bus
  - NuBus control circuitry
  - SWIM (disk controller IC)
  - FPU (floating-point unit)
  - Apple stereo sound chip

  Note: Although *AppleCAT IIcx/IIci* tests the SCSI circuitry on the logic board, it does not test the internal SCSI hard disk. To test the hard disk, use the *Apple Hard Disk Test* disk (see Section 3, Diagnostics, in the *SCSI Hard Disk Drives Technical Procedures).*

- **NuBus Video Card** runs only if a video card is installed in slot 1. The test checks the video RAM on the video card and the video DAC (digital-to-analog converter).

- **Internal Drive** verifies the proper functioning of the drive, cable, and SWIM circuitry.

File Menu

The list below shows the items in the File menu and their key commands if applicable. All are dimmed except **Stop** and **Quit**.

Open	(always dimmed)
Close	(always dimmed)
Save Test Selections	(always dimmed)
Stop	[Command - . (period)]
Quit	[Command - Q]

Stop ends the diagnostic and returns you to the *AppleCAT IIcx/IIci* Start window.

Quit exits the program and returns you to the desktop.

Apple Menu

The Apple () menu contains the following three choices:

- **About Diagnostic** displays the diagnostic name, version number, date of release, serial number, and a copy-protect statement.
- **Control Panel** sets preferences for speaker volume, mouse tracking, whether or not AppleTalk is connected, the desktop pattern, and so on.
- **Key Caps** displays a window with a keyboard.

Running the Tests

After using **Test Selections** to select the tests you wish to run, you are ready to start *AppleCAT IIcx/IIci*. Click **Start** in the *AppleCAT IIcx/IIci* window. Please note the following:

- The Status line at the bottom of the *AppleCAT IIcx/IIci* window indicates which test is in progress and the test results.

  Note: If the message **Could not establish communication** appears on the Status line, you may have inserted a bootable disk in the UUT disk drive before switching the unit on. If this message appears, follow the instructions in the *AppleCAT IIcx/IIci* window.

- *AppleCAT IIcx/IIci* interacts with you throughout each stage of the testing. When the UUT fails a test or indicates a problem, *AppleCAT IIcx/IIci* prompts you for more information or recommends a repair.

- By displaying a choice of answers, *AppleCAT IIcx/IIci* asks you for information that it cannot obtain electronically. Select the most appropriate answer for each situation. After selecting a response, click **OK** to continue.

***CAUTION:** Do not click the OK button until you've completed every instruction on the screen. Failure to complete the instructions may misdirect the diagnostic.*

- If you turned off the UUT to replace or reinstall a module, do the following:

  a) Verify that all cables and test fixtures are reattached before switching on the UUT. Do not click the OK button until you've completed every instruction on the screen.

  b) Eject any disk from the UUT before switching on the UUT.

  c) If you do not hear the test mode chords, press reset and wait four seconds per megabyte of DRAM. Then press the interrupt switch to establish test mode.

  d) To restart the test, click **Start** at the test station.

- *AppleCAT IIcx/IIci* will also ask you to perform setup steps when checking drives, video cards, and the ADB. When the Setup Required window appears, insert the requested disk. *AppleCAT IIcx/IIci* will specify which drive to use. After inserting the disk, click **Done** to continue the test. *AppleCAT IIcx/IIci* will request the following disks:

  – 800K disk (blank and write-enabled)
  – High-density disk (blank and write-enabled)
  – Write-protected *MacTest IIcx/IIci* disk

- To stop testing, click **Stop** or **Pause** anytime during the tests:

  a) Choose **Stop** to stop testing and return to the **Status** window. Choose **Start** to start the testing sequence from the beginning.

  b) Choose **Pause** to discontinue testing temporarily. Choose **Continue** to resume testing from the point of interruption.

***IMPORTANT:** Please read all messages and instructions carefully. Do only what AppleCAT IIcx/IIci specifically instructs you to do.*

When the UUT passes its final test, an alert window displays the message **All selected tests passed, click start to begin.**

Helpful Suggestions

If the unit passes *AppleCAT IIcx/IIci* but is still not running correctly, refer to Section 4, Troubleshooting, for information that can help you isolate the problem. Keep in mind that *AppleCAT IIcx/IIci* is unable to identify a system failure if any of the following is true:

- The bad module fails intermittently.
- The system configuration changes during the test (memory is removed or added, or system power is removed).
- Selected modules are tested; except for the video card, only the default tests perform a complete system check.
- The replacement module itself is bad.
- You provided inaccurate input to *AppleCAT IIcx/IIci,* or set up the test station incorrectly.

❑ SCSI LOOPBACK JUMPER PROCEDURE

Determining Whether You Need a Jumper

In order to use the SCSI loopback card with *MacTest IIcx/IIci* and *AppleCAT IIci,* you must jumper the card between pin 25 of J1 and pin 14 of RP1. On some SCSI loopback cards, the jumper has been etched into the printed circuit. Only cards with the old PCB circuitry need the jumper procedure.

Note: This modification does not interfere with using the card on other Macintosh or Apple II family systems. For the card to work on Apple II systems, however, you must connect the card to a notched mouse cable. (For further information on the notched cable, refer to Section 5, SCSI Interface Card, in the *SCSI Hard Disk Drives Technical Procedures*.)

To determine whether you have a card that does not need to be jumpered, look at the back of the card. If the circuitry includes the jumper, an *A* instead of two zeros (00) appears at the end of the part number, which is located under the words *APPLE COMPUTER*. If the part number ends with an *A*, you do not need to jumper the card (see **Figure 3-10**).

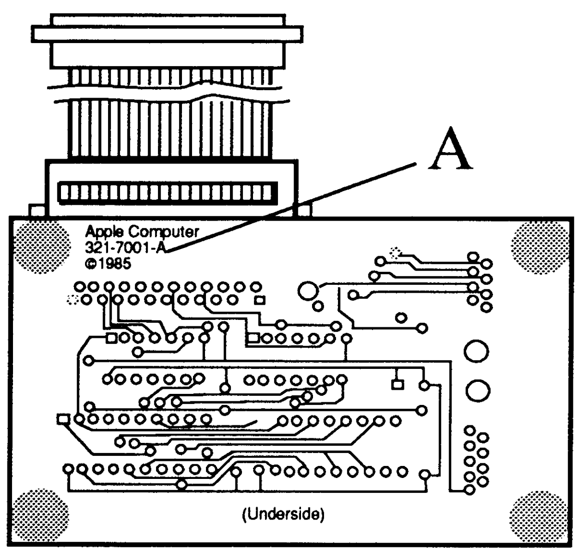


Figure 3-10 SCSI Loopback Card

External Jumpers

SCSI loopback cards with the **00** part number were modified with an external jumper during the manufacturing process. Therefore, if your card has a **00** part number, check for an external jumper from pin 25 of J1 to pin 14 of RP1 (**Figure 3-12**). If the card does not have an external jumper, you must install one.

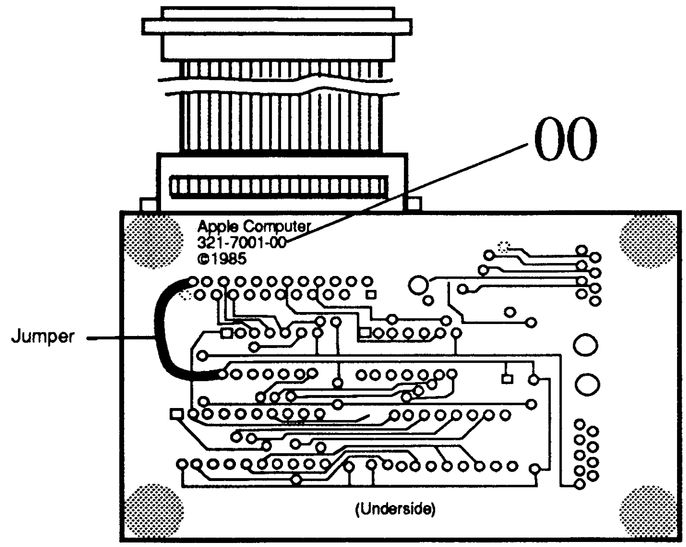


Figure 3-11 SCSI Loopback Card

Summary

To summarize:

If the number ends with:	Do this:
A	Nothing (Jumper is present on the card)
00	Check to see if an external jumper is present. If not, install a jumper.

Installing the Jumper

If you find that the card requires a jumper, solder a wire connection between pin 25 of J1 and pin 14 of RP1 (as shown in **Figure 3-11**). (The pins are not numbered on the board. In the orientation shown in **Figure 3-11**, pin 25 is the pin closest to the upper-left corner of the card; pin 14 is in the middle line of pins on the left end of the row.)

 Apple Technical Procedures

Macintosh IIcx/IIci/Quadra 700

Section 4 – Troubleshooting

❑ CONTENTS

❑ INTRODUCTION

General Information

This troubleshooting section provides two methods for detecting module failures on the Macintosh IIcx, IIci, and Quadra 700 computers: the symptom chart provides descriptions of common problems and solutions, and the troubleshooting flowcharts verify operation of the computer in its minimum configuration.

Use this troubleshooting section if you are unable to boot *MacTest IIcx/IIci* or *Macintosh Hard Disk Test*, or if the diagnostic is unable to detect a module failure.

Troubleshooting Procedure

To troubleshoot a Macintosh IIcx, IIci, or Quadra 700 computer, follow these steps:

1. Read the subsections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "DRAM SIMM Verification", and "Battery Verification" before you begin troubleshooting.

2. To troubleshoot the Macintosh IIcx and IIci computers, begin with the symptom chart. If the symptoms displayed by the Macintosh IIcx and IIci are not listed in the symptom chart, or if the system is not displaying a clearly defined problem, use the troubleshooting flowcharts.

   To troubleshoot the Macintosh Quadra 700 computer, use the the startup and error chords and the symptom chart. Troubleshooting flowcharts and diagnostics are not yet available for the Macintosh Quadra 700.

3. **If you replace a module or component and find that the problem remains**, reinstall the original module or component before proceeding.

4. After you repair a Macintosh IIcx or IIci computer, run *MacTest IIcx/IIci* to verify system operation.

How to Use the Symptom Chart

First, find the symptom that most nearly describes the problem; then, perform the first corrective action on the solution list. If that corrective action does not fix the problem, go to the next action. **If you replace a module and find that the problem remains, reinstall the original module before going on to the next action.**

How to Use the Troubleshooting Flowcharts

There are five numbered flowcharts for the Macintosh IIcx and IIci computers. On completion of Flowchart 1, you will be instructed to continue to the next flowchart. Continue until you complete Flowchart 5.

Each of the flowcharts includes references to notes on the opposite page. These notes provide additional instructions or refer you to other procedures.

Things to Remember

- Follow all electrostatic discharge (ESD) precautions when working on the computer. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for additional information.

- If available, use a known-good monitor and video interface card, if either of these is installed. Using these components, you can isolate the problem to the CPU, internal drives, keyboard, or mouse.

- During a normal startup sequence, the Macintosh IIcx and IIci computers emit a medium-pitched chord and the Macintosh Quadra 700 computer emits a single, soft chord. If you do not hear these startup chords, refer to "Startup and Error Chords" for additional information.

- Before you begin troubleshooting, remove all NuBus, cache, and processor direct slot cards and disconnect all external serial, SCSI, and ADB devices (except the keyboard and mouse). Also, disconnect any devices connected to the microphone, headphone, or line-in/out connectors.

  After the system is fully operational, you must install and test each card or peripheral. Install one device and test the system before adding any others. Repeat the install-and-test process until you have installed and tested all devices.

- To ensure that customers get back the same system configuration that they bring in, record the following information before beginning:

  - Type and serial number of any NuBus, cache, or processor direct slot cards

  - Size, type, and capacity of internal SCSI hard drive(s)

  - Number and sizes of installed DRAM SIMMs

  - Whether a VRAM upgrade is installed (available on the Macintosh Quadra 700 only)

- Mark each known-good DRAM and/or VRAM SIMM on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

- Use a known-good copy of the diagnostic disk.

- The Macintosh IIcx requires system software version 6.0.3 or later, the IIci requires version 6.0.4 or later, and the Quadra 700 requires version 7.0.1 or later. If you are using an earlier version of the system software, install a compatible version and reverify the failure before beginning the troubleshooting process. Many times problems that appear hardware related are actually caused by software.

- When instructed to replace the logic board only, install the customer's DRAM and VRAM SIMMs on the replacement logic board.

  Note: If you are removing DRAM or VRAM SIMMs from the logic board, use the SIMM removal tool. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for instructions.

❑ MODULE EXCHANGE INFORMATION

Macintosh IIcx/IIci Logic Boards

Apple ships the Macintosh IIcx and IIci logic board service exchange modules without DRAM SIMMs. To make sure the customer always receives the same logic board configuration that was brought in, be sure to record the amount of memory installed and the size of the DRAM SIMMs.

Macintosh Quadra 700 Logic Board

Apple ships the Macintosh Quadra 700 logic board service exchange modules without DRAM SIMMs or VRAM SIMMs. To make sure the customer always receives the same logic board configuration that was brought in, be sure to record the amount of memory and size of the DRAM and VRAM SIMMs.

Internal SCSI Hard Disk Drives

Apple ships internal SCSI hard disk drives without the SCSI or power cables. **Be sure to keep the SCSI and power cables with the customer's system.** They are sold as separate replacement parts and are not part of any module.

Macintosh IIci Cache Card

Macintosh IIci cache cards containing serial numbers with the "CF" prefix, e.g., CFXXXXXXX, can cause frequent system crashes. Return these cards to Apple. Refer to the *Apple Programs* icon on AppleLink for additional information.

The revised Macintosh IIci cache card has a serial number with an "AF" prefix, e.g., AFXXXXXXX. This revised card should function properly; if it fails, return it to Apple through standard service channels.

For diagnostic information on testing the revised Macintosh IIci cache card, see Section 1, MacTest MP, in the *Mac Multiple-Product Diagnostics* tab.

❑ STARTUP AND ERROR CHORDS

Introduction

When you switch on the computer, a series of self-tests are performed. If any part of the self-test fails, a sequence of chords will sound.

If you are unable to interpret the chords, use the flowcharts and ignore the question about the startup chord on Flowchart 1.

Macintosh IIcx/IIci Startup Chord

During normal system startup, a **short, medium-pitched chord** plays; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Macintosh IIcx/IIci Error Chords

Three chords play when an error is encountered during startup—a startup chord, an error chord (a short, harsh chord), and a test monitor chord (four tones, from low to high).

DRAM SIMM Failure

The above error sequence indicates a failure during the initial hardware self-tests. To correct the problem:

1. Exchange the DRAM SIMMs. (Refer to "DRAM SIMM Verification" in this section for complete instructions.)
2. If DRAM SIMM exchanges do not work, exchange the logic board. (Install the customer's DRAM SIMMs on the exchange board.)
3. If the system still does not work, perform the DRAM SIMM verification with the exchange logic board. (Refer to "DRAM SIMM Verification" in this section.)

Macintosh Quadra 700 Startup Chord

During normal system startup, a **single, soft chord** plays; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Macintosh Quadra 700 Error Chords

Two chords play when an error is encountered during startup—a startup chord and an error chord. Depending upon the type of failure, you will hear either a two-part error chord sequence (eight tones) or a shorter, one-part error chord sequence (four tones).

Refer to the list of failure areas below. The list includes a description of each error chord, the problem it indicates, and what to do to correct the problem.

DRAM SIMM Failure

When a DRAM SIMM failure occurs, you will hear a **two-part error chord sequence** (eight tones) after the startup chord. To correct the problem:

1. Exchange the DRAM SIMMs. (Refer to "DRAM SIMM Verification" in this section for complete instructions.)

2. If DRAM SIMM exchanges do not work, exchange the logic board. (Install the customer's DRAM and VRAM (if any) SIMMs on the exchange board.)

3. If the system still does not work, perform the DRAM SIMM verification with the exchange logic board. (Refer to "DRAM SIMM Verification" in this section.)

Hardware Failure

When a hardware failure occurs, you will hear **a startup chord and the one-part error chord sequence (four tones), with a brief pause between the two sequences**. To correct the problem:

1. Disconnect the SCSI hard disk drive power and cable connectors, and reboot the system. If the startup sequence is normal, run *Macintosh Hard Disk Test* and replace the hard drive, if necessary.

2. If the error chords still sound at system startup, disconnect the floppy drive cable connector and reboot the system. If the startup sequence is normal, replace the floppy drive.

3. If you still hear the error chords at system startup, exchange the logic board. (Install the customer's DRAM and VRAM SIMMs on the exchange logic board.)

❑ SYMPTOM 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.
• *Does not start up without monitor attached*	– Install Virtual Monitor Switch control panel. (Applies to Macintosh Quadra 700 only)
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Replace logic board. Retain customer's SIMMs.
• *System shuts down intermittently*	1. Be sure that air vents on the **sides and top** of case are unblocked. Thermal protection circuitry may shut the system down. After 30 to 40 minutes, the system should be OK. 2. Replace power cord. 3. Check battery (refer to "Battery Verification"). 4. Replace power supply. 5. Replace logic board. Retain customer's SIMMs.
• *System intermittently crashes or locks up*	1. Make sure you are using the correct version of system software. 2. Make sure you are using known-good software. 3. Identify and replace defective DRAM SIMMs (refer to "DRAM SIMM Verification"). 4. Replace logic board. Retain customer's SIMMs. 5. Replace power supply.

Video Problems | **Solutions**

Note: If replacing the monitor corrects the problem, refer to the appropriate monitor *Apple Service Technical Procedures* for troubleshooting information.

- *Screen is black, audio and drive operate, fan is running, and LED is lit*

1. Adjust brightness on monitor.
2. Replace video cable.
3. If a video interface card is installed, move card to a different slot.
4. Replace video interface card, if installed.
5. Replace VRAM SIMMS (Macintosh Quadra 700 only).
6. Replace defective DRAM SIMMs (refer to "DRAM SIMM Verification").
7. Replace monitor.
8. Replace logic board. Retain customer's SIMMs.
9. Replace power supply.

- *Screen is black, audio and drive do not operate, but fan is running and LED is lit*

1. Replace video cable.
2. If a video interface card is installed, move card to a different slot.
3. Replace video interface card, if installed.
4. Replace VRAM SIMMS (Macintosh Quadra 700 only.
5. Replace defective DRAM SIMMs (refer to "DRAM SIMM Verification").
6. Replace logic board. Retain customer's SIMMs.
7. Replace power supply.
8. Replace monitor.

- *Partial or whole screen is bright and audio is present, but no video information is visible*

1. Replace video cable.
2. If a video card is installed, move card to a different slot.
3. Replace video interface card, if installed.
4. Replace VRAM SIMMs (Macintosh Quadra 700 only).
5. Replace monitor.
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. Check battery (refer to "Battery Verification").
3. Replace power supply.
4. Replace logic board. Retain customer's SIMMs.

Apple SuperDrive Problems	Solutions
• *Internal floppy disk drive runs continuously*	1. Replace bad disk with known-good system disk. 2. Replace internal floppy disk drive cable. 3. Replace internal floppy disk drive. 4. Replace logic board. Retain customer's SIMMs.
• *Audio and video are present, but internal floppy drive does not operate*	1. Replace bad disk with known-good system disk. 2. Verify that all external SCSI devices are disconnected. 3. Replace internal floppy disk drive cable. 4. Replace internal floppy disk drive. 5. Replace logic board. Retain customer's SIMMs. 6. Replace power supply.
• *Disk ejects; display shows icon with blinking "X"*	1. Replace bad disk with known-good system disk. 2. Replace internal floppy disk drive cable. 3. Replace internal floppy 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. Replace internal floppy disk drive.
• *Attempts to eject disk but can't*	1. Reinsert disk and try to eject disk again. 2. Reseat floppy drive bezel and/or disk drive so the slot in the bezel lines up correctly with the disk drive.
• *MS-DOS® drive does not recognize a disk formatted on a 1.4 MB SuperDrive*	– To ensure read/write compatibility with the 1.4 MB SuperDrive, format all disks with the MS-DOS drive first.

SCSI Hard Disk Drive Problems	Solutions
• *Internal SCSI drive will not operate; drive doesn't spin up*	1. Replace internal SCSI drive cable. 2. Replace SCSI power cable. 3. Replace SCSI drive. 4. Replace logic board. Retain customer's SIMMS.
• *Drive does not appear on the desktop*	1. Verify there are no duplicate SCSI device addresses. 2. Drive may not be initialized. If drive has just been installed, initialize the drive with *HD SC Setup* and install system software.
• *Works with internal or external SCSI devices, but will not work with both*	1. Make sure SCSI device switch setting on external device(s) is not set to 7 (the computer's address) or the same as any internal SCSI device. 2. Replace external SCSI terminator. 3. Verify that SCSI termination is installed on internal SCSI drive. 4. Refer to appropriate *Apple Service Technical Procedures* to troubleshoot the external device.

Peripheral Problems	Solutions
• *Cursor does not move*	1. Check mouse connection. 2. Inspect inside of mouse for buildup of dirt or other contaminants. Clean mouse if necessary. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. 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.
• *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.
• *Cannot double-click to open an application, disk, or server*	1. Remove any multiple system files on the hard disk. 2. Clear parameter RAM. Hold down <Command><Option><R><P> keys while booting the system. Release the keys when the computer generates the startup chord a second time. Reset mouse controls. 3. If mouse was connected to keyboard, connect it to a rear ADB port instead. If mouse works, replace keyboard. If mouse does not work in any ADB port, replace mouse. 4. Replace logic board. Retain customer's SIMMs.

Peripheral Problems Continued

Solutions

- *Known-good serial printer will not print*

1. Make sure you are using the correct version of system software.
2. Make sure the Chooser and Control Panel are set correctly.
3. Replace printer interface cable.
4. Replace logic board. Retain customer's SIMMs.

- *Known-good LaserWriter on an AppleTalk network will not print*

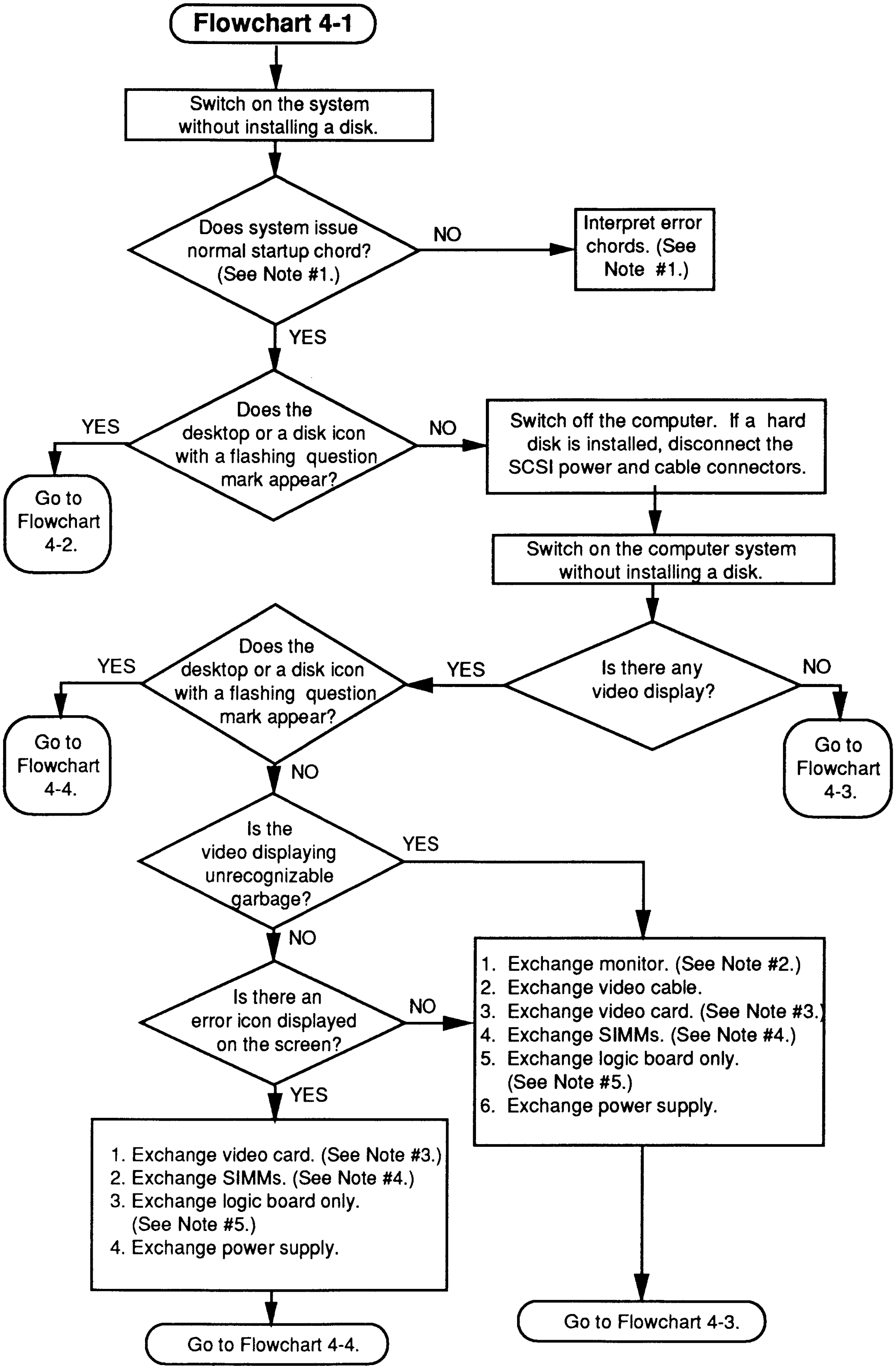
1. Make sure you are using the correct version of system software.
2. Make sure the Chooser and Control Panel are set correctly.
3. Refer to the Networks tab in *Apple Service Technical Procedures* for more information.

Miscellaneous Problems

Solutions

- *No sound from speaker*

1. Verify that volume setting in the Control Panel is set to one or above.
2. Replace speaker.
3. Replace logic board. Retain customer's SIMMs.



Flowchart 4-1
Switch on the system without installing a disk.
Does system issue normal startup chord? (See Note #1.)
NO
Interpret error chords. (See Note #1.)
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flowchart 4-2.
NO
Switch off the computer. If a hard disk is installed, disconnect the SCSI power and cable connectors.
Switch on the computer system without installing a disk.
Is there any video display?
NO
Go to Flowchart 4-3.
YES
Does the desktop or a disk icon with a flashing question mark appear?
YES
Go to Flowchart 4-4.
NO
Is the video displaying unrecognizable garbage?
YES
NO
Is there an error icon displayed on the screen?
NO
1. Exchange monitor. (See Note #2.)
2. Exchange video cable.
3. Exchange video card. (See Note #3.)
4. Exchange SIMMs. (See Note #4.)
5. Exchange logic board only. (See Note #5.)
6. Exchange power supply.
Go to Flowchart 4-3.
YES
1. Exchange video card. (See Note #3.)
2. Exchange SIMMs. (See Note #4.)
3. Exchange logic board only. (See Note #5.)
4. Exchange power supply.
Go to Flowchart 4-4.

❑ MACINTOSH IIcx/IIci FLOWCHARTS

Flowchart 4-1 Notes

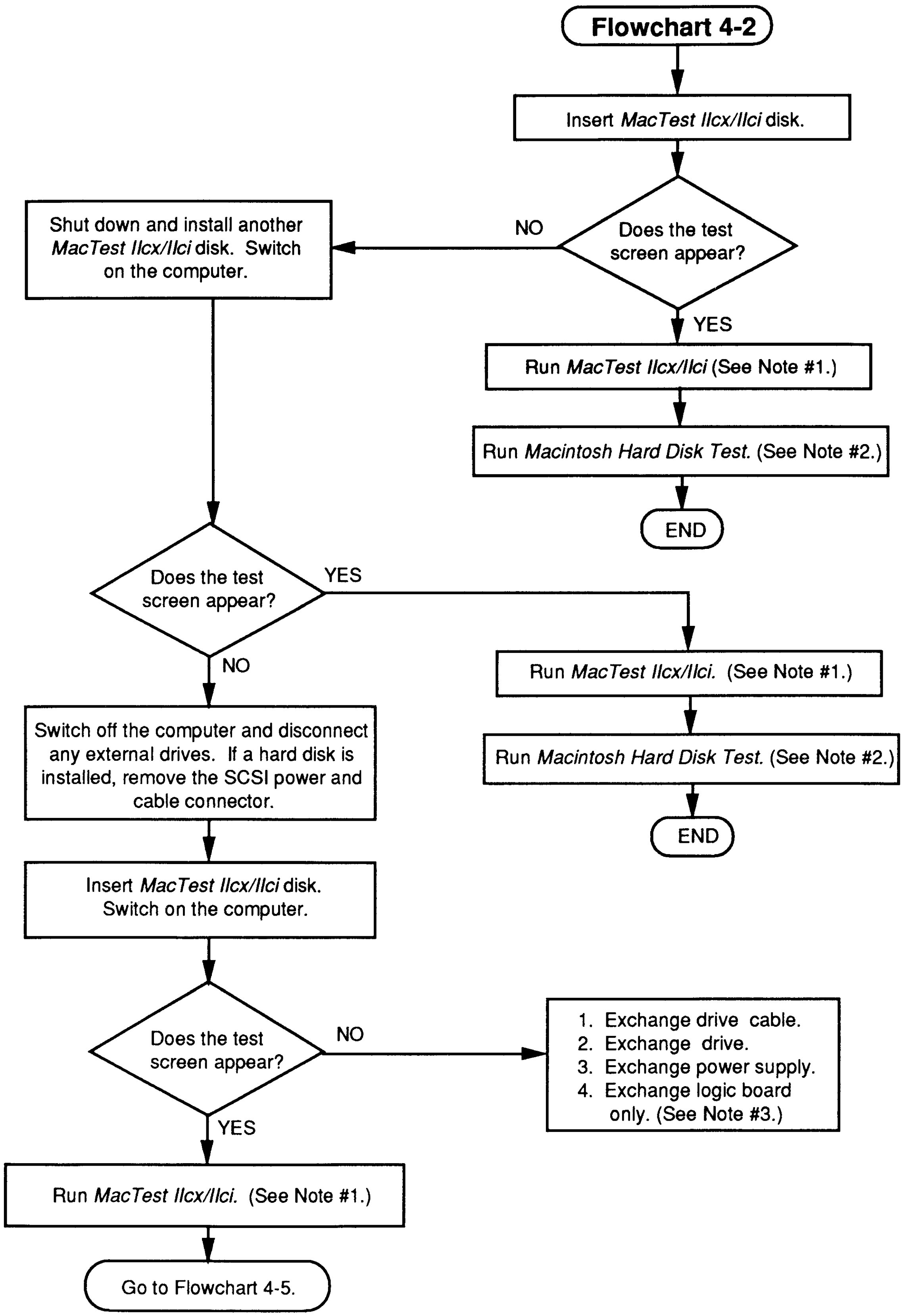
1. During a normal startup sequence, a medium-pitched chord is emitted; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found). If either of these things does not happen, refer to "Startup and Error Chords" for additional information. If you cannot interpret the chords, continue with the flowchart.

2. If exchanging the monitor corrects the problem, refer to the appropriate *Technical Procedures* manual to isolate the monitor problem to the module level.

3. If exchanging the video interface card corrects the problem, and if the customer's card has the video expansion kit installed, refer to Section 1, Macintosh II Video Cards, in the *Macintosh Video Cards* tab section, for information on troubleshooting the replaceable VRAMs.

4. Refer to "DRAM SIMM Verification" for complete instructions on verifying and troubleshooting the DRAM SIMMs.

5. If the known-good DRAM SIMMs did not correct the problem, install the customer's DRAM SIMMs on the replacement logic board.



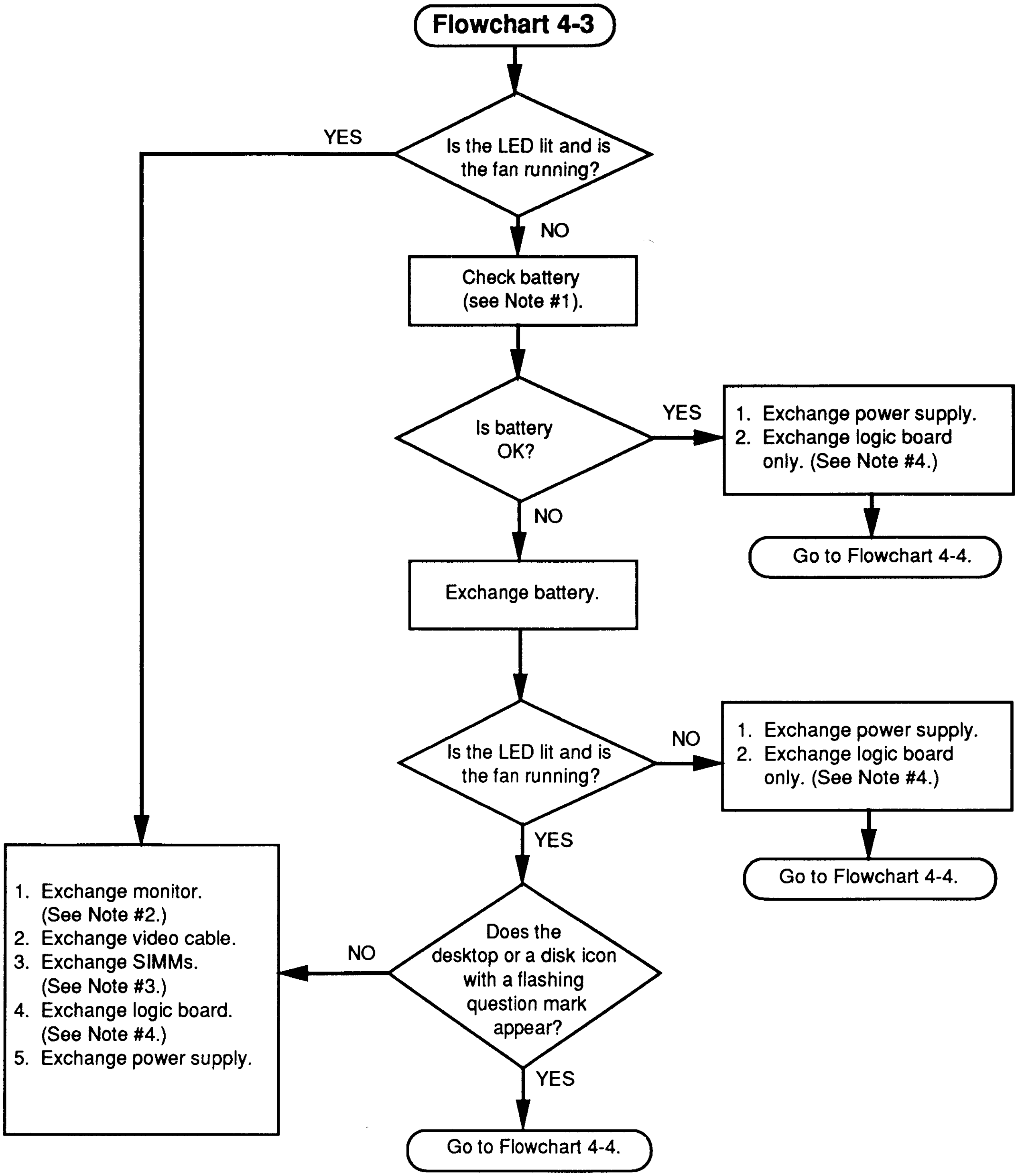
Flowchart 4-2
Insert *MacTest IIcx/IIci* disk.
Does the test screen appear?
NO
Shut down and install another *MacTest IIcx/IIci* disk. Switch on the computer.
YES
Run *MacTest IIcx/IIci* (See Note #1.)
Run *Macintosh Hard Disk Test.* (See Note #2.)
END
Does the test screen appear?
YES
Run *MacTest IIcx/IIci.* (See Note #1.)
Run *Macintosh Hard Disk Test.* (See Note #2.)
END
NO
Switch off the computer and disconnect any external drives. If a hard disk is installed, remove the SCSI power and cable connector.
Insert *MacTest IIcx/IIci* disk. Switch on the computer.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Run *MacTest IIcx/IIci.* (See Note #1.)
Go to Flowchart 4-5.

Flowchart 4-2 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.


Flowchart 4-3
Is the LED lit and is the fan running?
YES
NO
Check battery (see Note #1).
Is battery OK?
YES
1. Exchange power supply.
2. Exchange logic board only. (See Note #4.)
Go to Flowchart 4-4.
NO
Exchange battery.
Is the LED lit and is the fan running?
NO
1. Exchange power supply.
2. Exchange logic board only. (See Note #4.)
Go to Flowchart 4-4.
YES
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange monitor. (See Note #2.)
2. Exchange video cable.
3. Exchange SIMMs. (See Note #3.)
4. Exchange logic board. (See Note #4.)
5. Exchange power supply.
YES
Go to Flowchart 4-4.

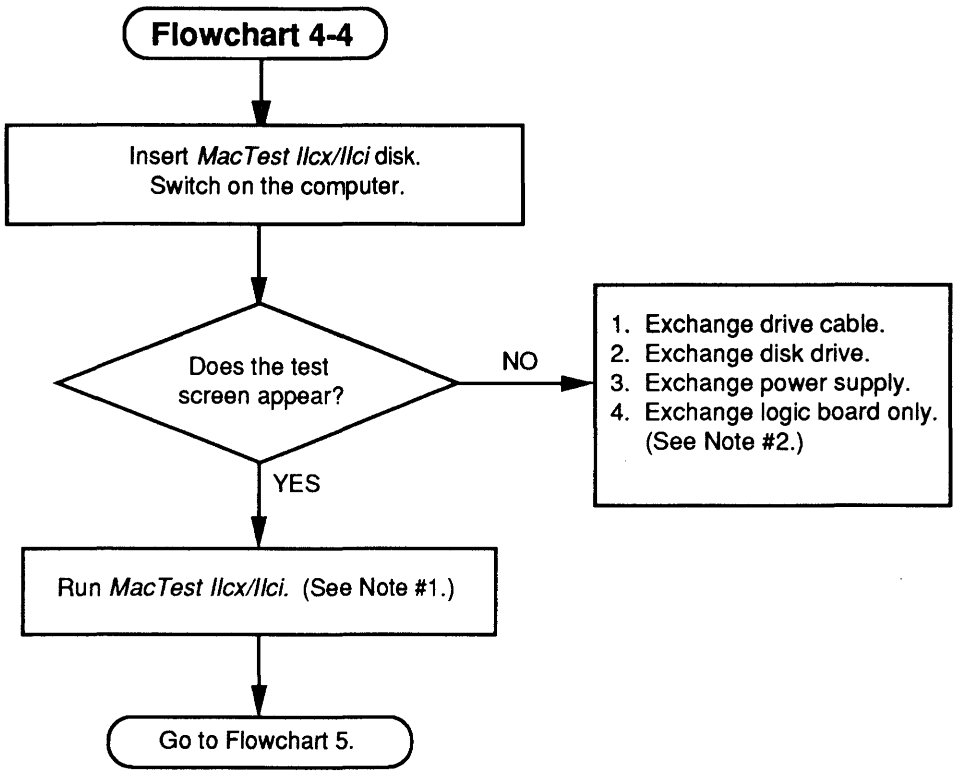
Flowchart 4-3 Notes

1. Refer to "Battery Verification" for complete instructions on checking the lithium battery.

2. If exchanging the monitor corrects the problem, refer to the appropriate *Technical Procedures* for the monitor to isolate the monitor problem to the module level.

3. There are two steps to perform when exchanging the SIMM modules. Refer to "DRAM SIMM Verification" for complete instructions on verifying and troubleshooting the SIMMs.

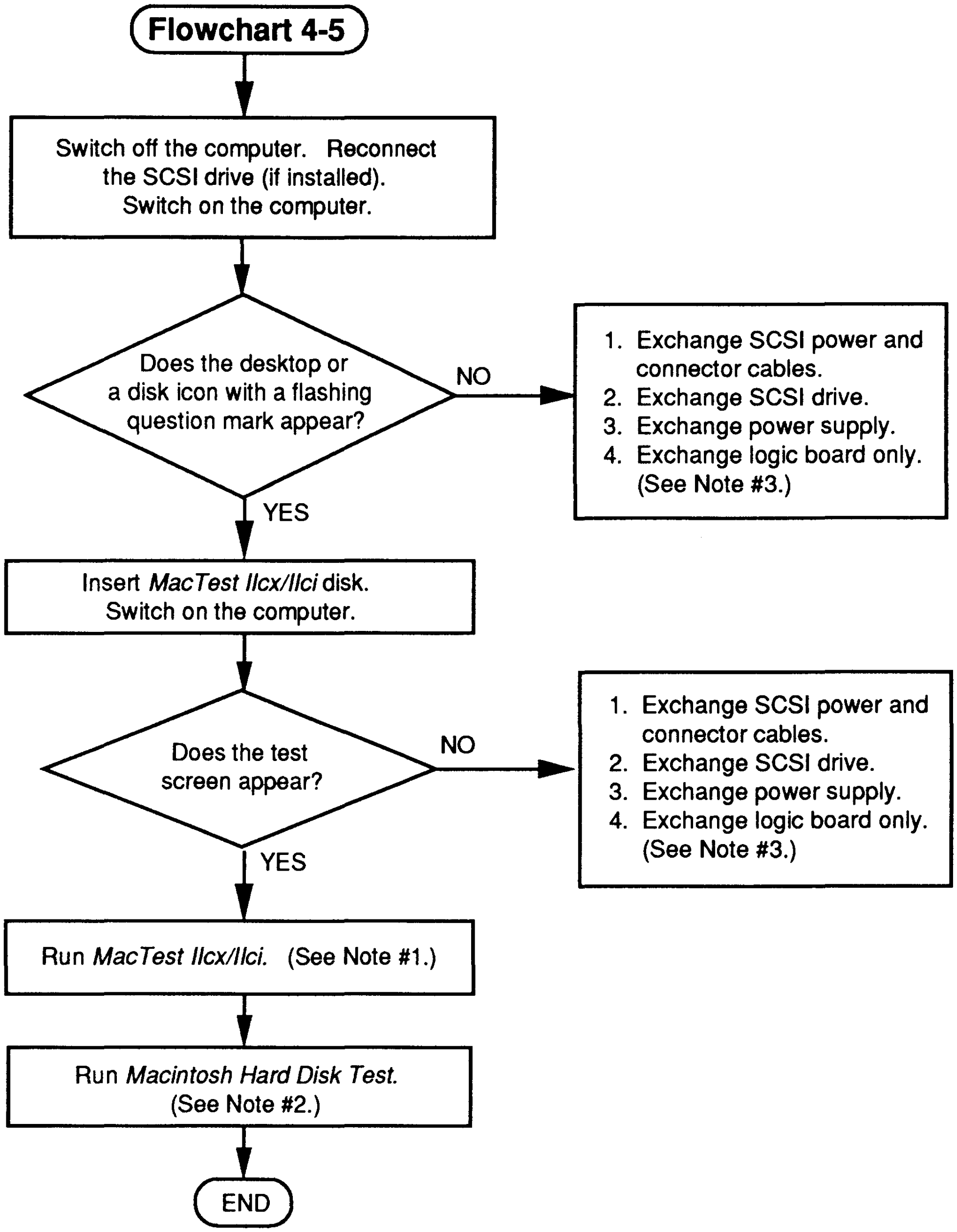
4. Install the customer's DRAM SIMMs on the replacement logic board.


Flowchart 4-4
Insert MacTest IIcx/IIci disk.
Switch on the computer.
Does the test screen appear?
NO
1. Exchange drive cable.
2. Exchange disk drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #2.)
YES
Run MacTest IIcx/IIci. (See Note #1.)
Go to Flowchart 5.

Flowchart 4-4 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Install the customer's SIMMs on the replacement logic board.


Flowchart 4-5
Switch off the computer. Reconnect the SCSI drive (if installed). Switch on the computer.
Does the desktop or a disk icon with a flashing question mark appear?
NO
1. Exchange SCSI power and connector cables.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Insert *MacTest IIcx/IIci* disk. Switch on the computer.
Does the test screen appear?
NO
1. Exchange SCSI power and connector cables.
2. Exchange SCSI drive.
3. Exchange power supply.
4. Exchange logic board only. (See Note #3.)
YES
Run *MacTest IIcx/IIci.* (See Note #1.)
Run *Macintosh Hard Disk Test.* (See Note #2.)
END

Flowchart 4-5 Notes

1. Refer to Section 3, Diagnostics, for complete information.

2. Refer to *SCSI Hard Disk Drives Technical Procedures* for complete instructions.

3. Install the customer's SIMMs on the replacement logic board.

❑ DRAM SIMM VERIFICATION

Introduction

Apple ships the service exchange logic board without DRAM SIMMs.

The DRAM SIMMs installed on the customer's logic board may be defective. To check for defective DRAM SIMMs, remove all of the customer's DRAM SIMMs and install known-good DRAM SIMMs. Mark each known-good DRAM SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Materials Required

SIMM removal tool
Four or eight known-good DRAM SIMMs that are the same size (e.g., 512K, 1 MB, or 4 MB) as the DRAM SIMMs you are verifying.

Verification

1. If the computer is a Macintosh IIcx or IIci, remove the top cover. If the computer is a Macintosh Quadra 700, remove the lid, the power supply, and the disk drive mount.

CAUTION: *Before removing the SIMMs, be sure to follow proper ESD procedures. If an ESD pad is not available, touch bare metal on the power supply before proceeding. Failure to use proper ESD procedures can damage the logic board.*

2. Remove the customer's DRAM SIMMs by using the SIMM removal tool. See the *You Oughta Know* tab for SIMM tool use.

   Note: Record the number and the sizes of the DRAM SIMMs. The customer should receive the same number and sizes back!

3. **Figure 4-1**. If the computer is a Macintosh IIcx or IIci, install four known-good DRAM SIMMs in Bank A. If the computer is a Macintosh Quadra 700, install four known-good DRAM SIMMs in Bank B.

   Note: You must use 120 ns (or faster) DRAM SIMMs on the Macintosh IIcx, and 80 ns (or faster) DRAM SIMMs on the Macintosh IIci and Quadra 700. Slower SIMMs will cause serious timing problems.

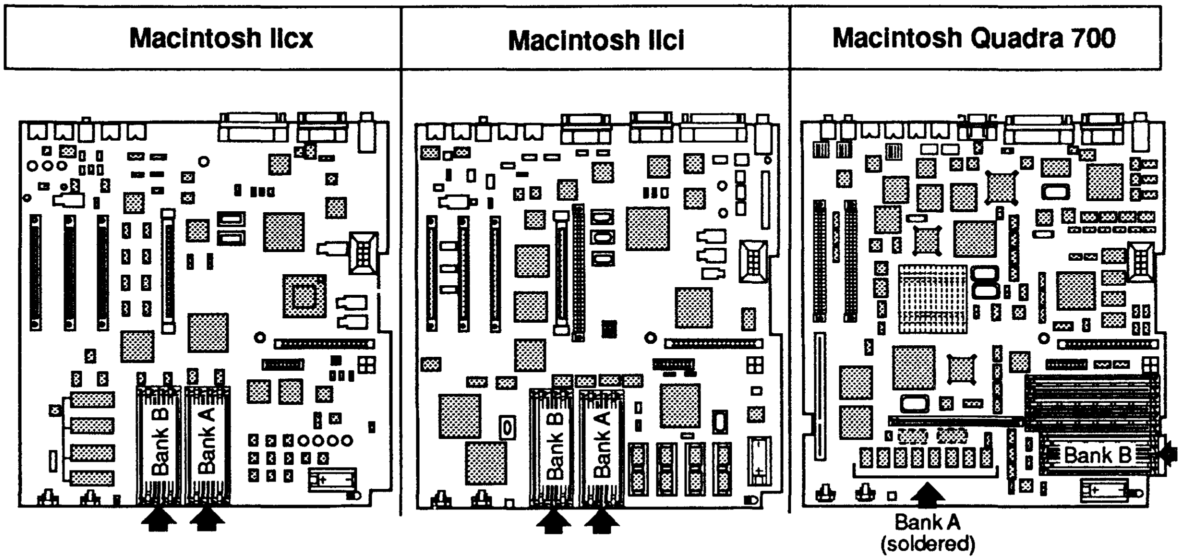


Figure 4-1 DRAM SIMM Verification

4. Switch on the system. If you hear the normal startup sequence, the system is working properly and you can proceed to test the customer's DRAM SIMMs.

5. Switch the system off, remove one of the known-good DRAM SIMMs, and install one of the customer's DRAM SIMMs.

6. Switch on the system. If you hear the normal startup sequence, the customer's DRAM SIMM is good.

7. Repeat steps 5 and 6 to test each of the DRAM SIMMs. Be sure not to mix defective DRAM SIMMs with the good ones.

8. **Figure 4-1**. To verify DRAM SIMMs installed in Bank B on the Macintosh IIcx and IIci, install four known-good DRAM SIMMs in Bank B and repeat the procedure described in steps 4 through 7.

❑ BATTERY VERIFICATION

Introduction

The lithium battery on the main logic board supplies power to the power-on circuit, real time clock, and parameter RAM. If the battery falls below specifications, you must replace it.

WARNING: *Lithium batteries have some potential for explosion if improperly handled. Follow the procedure below exactly as written.*

Materials Required

Voltmeter

Macintosh IIcx/IIci Battery Verification

1. Switch off the computer and remove the top cover.
2. Set the voltmeter to measure 10 volts DC.
3. **Figure 4-2.** Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery.
4. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the battery.
5. The reading for a good battery should be **2.8 volts or higher**. If the reading falls below 2.8 volts, replace the battery.

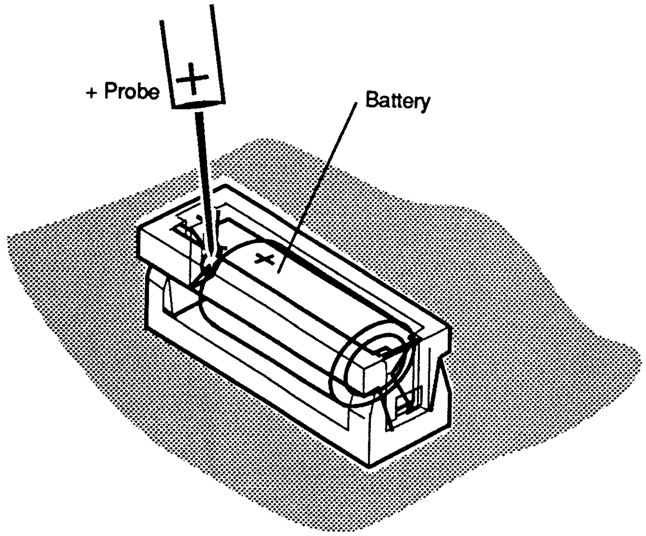


Figure 4-2 Battery Verification

Macintosh Quadra 700 Battery Verification

1. Switch off the computer. Remove the lid, the power supply, and the disk drive mount.

2. Set the voltmeter to measure 10 volts DC.

3. **Figure 4-2**. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery.

4. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the battery.

5. The reading for a good battery should be **3.2 volts or higher**. If the reading falls below 3.2 volts, replace the battery.

 Apple Technical Procedures

Macintosh IIcx/IIci/Quadra 700

Section 5 – Additional Procedures

❑ CONTENTS

Note: Detailed instructions for underlined steps can be found in Section 2, Take-Apart.

❑ BATTERY REPLACEMENT

***WARNING:** The type of lithium battery used in the Macintosh IIcx, IIci, and Quadra 700 computers could explode if improperly handled.*

Storage and Handling

Take the following precautions when storing and handling lithium batteries:

- A lithium battery from Apple is sealed in an individual zip-lock wrapper. When you receive it, check to make sure the wrapper is intact. If it is not, mend the wrapper with tape or replace it before you store the battery.

- Store the battery in the packaging in which it was shipped.

- Be certain that the storage area for lithium batteries is well-marked and that access to the area is restricted.

Disposal

A lithium battery is not rechargeable and requires proper disposal when it is "dead." Because lithium is water-reactive and potentially explosive, lithium batteries must be treated as hazardous waste.

***WARNING:** "Dead" lithium batteries are considered hazardous waste and must be returned to Apple in their original packaging for disposal according to Environmental Protection Agency (EPA) guidelines.*

Because of this hazard, Apple recommends the following course of action:

- After removing a "dead" lithium battery from a logic board, place the battery in the zip-lock wrapper and original packaging from the replacement battery. Mark the old battery *DEAD* and return it to Apple for disposal according to EPA guidelines.

***WARNING:** DO NOT ship a leaking battery to Apple. If the battery is leaking, dispose of it according to local hazardous waste disposal guidelines.*

- The long-life lithium battery should last about seven years. Refer to "Battery Verification" in Section 4, Troubleshooting, to check the condition of the battery. If the battery fails, replace it according to the following procedure.

Materials Required

Grounded workbench and wriststrap

CAUTION: *Use ESD precautions before removing or replacing the battery. Failure to do so may result in la ogic board failure.*

Remove

1. Remove the logic board.
2. Locate the battery holder and battery on the front of the logic board (**Figure 5-1**).

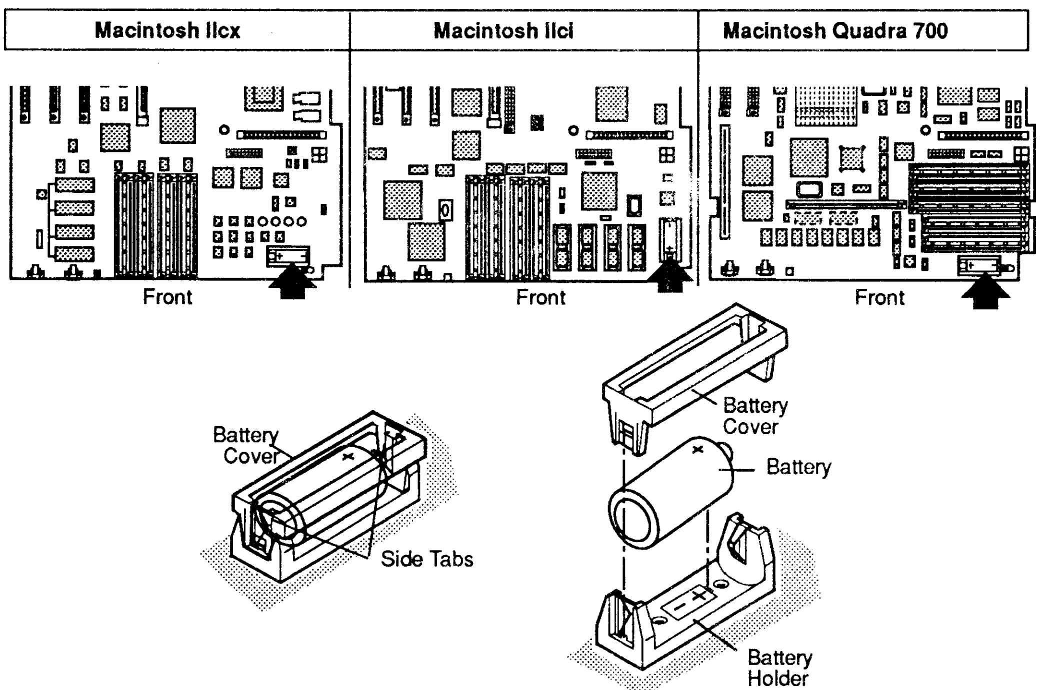


Figure 5-1 Battery Holder and Battery

3. Remove the cover from the holder by gently squeezing one end of the cover, then the other.
4. Grasp the battery between the thumb and fore-finger and remove it.

Replace

1. Insert the new battery with the positive side of the battery in the side of the holder marked positive (refer to **Figure 5-1**).

CAUTION: *Be sure the positive side of the battery is in the correct location (**Figure 5-1**). An incorrectly placed battery can damage the logic board.*

---

2. Replace the logic board.

3. After restarting the machine, set the clock using the Control Panel.

❑ MEMORY IDENTIFICATION AND UPGRADES

Note: This section covers memory upgrades by way of the DRAM SIMM sockets on the logic board. It does not address upgrading system memory by way of NuBus expansion slots.

Introduction

Changing the DRAM configuration on a Macintosh IIcx, IIci, or Quadra 700 involves the use of DRAM SIMMs. DRAM SIMMs have memory chips that are either surface mounted or mounted through the board. Each SIMM has a connector that fits into the SIMM sockets on the main logic board of the computer.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Identification

DRAM SIMMs are available in a number of sizes and speeds. Refer to the *SIMM Compatibility Chart* for a list of all the SIMMs available from Apple.

Size

The SIMM size indicates the amount of memory in the SIMM. Apple provides SIMMs in various sizes from 256K to 2 MB. Some third parties provide even larger-sized SIMMs.

Speed

You must follow the SIMM speed requirements for each machine. Slower SIMMs than those recommended will cause serious timing problems. On the SIMM itself, the "-x" or "-xx" number after the manufacturer's part number usually indicates RAM speed. For example, "-8" indicates 80 ns SIMMs and "-12" indicates 120 ns SIMMs.

Note: When you remove SIMMs from the logic board, use the SIMM removal tool. Instructions for using this tool are located under the *You Oughta Know* tab in the *Apple Service Technical Procedures.*

DRAM Upgrades - Macintosh IIcx/IIci

The Macintosh IIcx and IIci logic boards each have two banks of DRAM SIMM sockets labeled Bank A and Bank B, which consist of four slots each (**Figure 5-2**). Each bank, if populated, requires same-sized SIMMs in all four slots.

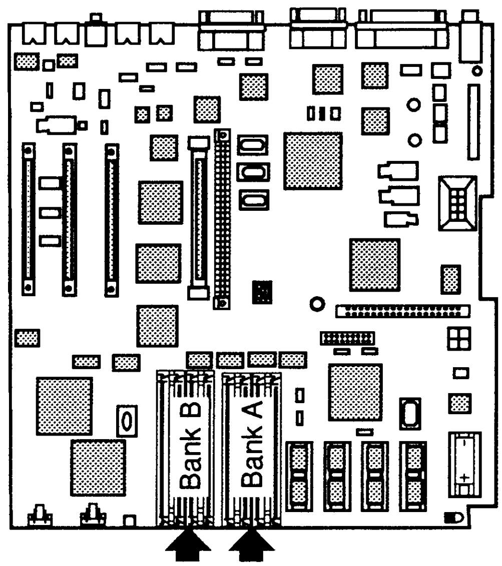


Figure 5-2 Macintosh IIcx/IIci Memory Banks

Macintosh IIcx

The following chart shows memory configurations and SIMM sizes that the Macintosh IIcx supports:

DRAM	Bank A	Bank B
1 MB	Four 256K SIMMs	Empty
2 MB	Four 256K SIMMs	Four 256K SIMMs
4 MB	Four 1 MB SIMMs	Empty
5 MB	Four 1 MB SIMMs	Four 256K SIMMs
8 MB	Four 1 MB SIMMs	Four 1 MB SIMMs

Note: DRAM configurations greater than 8 MB require DRAM SIMMs from third-party manufacturers and Mode 32 software.

IMPORTANT: *A bank cannot be partially filled (such as with a single SIMM); nor can a bank contain different-sized SIMMs.*

Macintosh IIci

The following chart shows memory configurations and SIMM sizes that the Macintosh IIci supports:

DRAM	Bank A	Bank B
1 MB	Four 256K SIMMs	Empty
2 MB	Four 256K SIMMs	Four 256K SIMMs
2 MB	Four 512K SIMMs	Empty
3 MB	Four 512K SIMMs	Four 256K SIMMs
4 MB	Four 512K SIMMs	Four 512K SIMMs
4 MB	Four 1 MB SIMMs	Empty
5 MB	Four 1 MB SIMMs	Four 256K SIMMs
6 MB	Four 1 MB SIMMs	Four 512K SIMMs
8 MB	Four 1 MB SIMMs	Four 1 MB SIMMs
8 MB	Four 2 MB SIMMs	Empty
9 MB	Four 2 MB SIMMs	Four 256K SIMMs
10 MB	Four 2 MB SIMMs	Four 512K SIMMs
16 MB	Four 2 MB SIMMs	Four 2 MB SIMMs

Note: DRAM configurations greater than 16 MB require DRAM SIMMs from third-party manufacturers.

IMPORTANT: *A bank cannot be partially filled (such as with a single SIMM), nor can a bank contain different-sized SIMMs.*

If you use built-in video on the Macintosh IIci, you must have SIMMs in bank A because the built-in video uses bank A for video framing. If you use a video card, then putting SIMMs in bank A is optional.

Note: On a Macintosh IIci that has different-sized SIMMs in banks A and B, built-in video works most efficiently with the larger SIMMs in bank B.

If the Macintosh IIci is a parity system, you must use parity SIMMs (1 MB x 9-bit SOJ SIMMs) to upgrade memory. Nonparity SIMMs disable the parity function.

DRAM Upgrades - Macintosh Quadra 700

Various DRAM configurations are possible on the Macintosh Quadra 700. The number and size of the DRAM SIMMs added to the logic board determine the total memory size.

The Macintosh Quadra 700 has two DRAM memory banks. Bank A consists of 4 MB of DRAM soldered on the logic board. Bank B consists of four SIMM sockets for DRAM expansion (see **Figure 5-3**). All four sockets within bank B must contain either no SIMMs or four same-sized SIMMs.

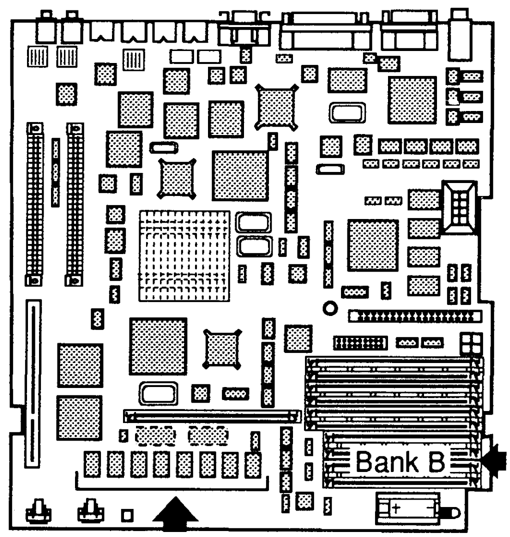


Figure 5-3 Macintosh Quadra 700 Memory Banks

The following chart shows memory configurations that the Macintosh Quadra 700 supports:

RAM	**Bank A (soldered)**	**Bank B**
4 MB	4 MB	Empty
8 MB	4 MB	Four 1 MB SIMMs
20 MB	4 MB	Four 4 MB SIMMs

Note: DRAM configurations of 20 MB or greater require DRAM SIMMs from third-party manufacturers.

VRAM Upgrades - Macintosh Quadra 700

Various VRAM configurations are possible on the Macintosh Quadra 700. The number and size of the DRAM SIMMs added to the logic board determines the total memory size.

The Macintosh Quadra 700 has four VRAM memory banks. Bank A consists of 512K of VRAM soldered on the logic board. In addition, banks B, C, and D consist of two VRAM SIMM sockets for VRAM expansion (see **Figure 5-4**). Both sockets within a bank must contain either no SIMMs or two same-sized SIMMs.

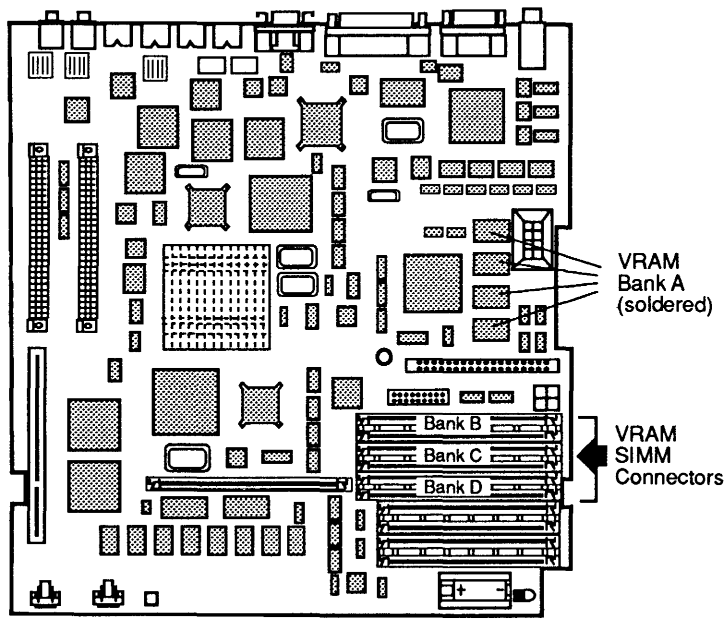


Figure 5-4 Macintosh Quadra 700 VRAM Memory Banks

The following chart shows VRAM configurations that the Macintosh Quadra 700 supports:

VRAM	Bank A (soldered)	Bank B	Bank C	Bank D
512K	512K	Empty	Empty	Empty
1 MB	512K	Two 256K SIMMs	Empty	Empty
2 MB	512K	Two 256K SIMMs	Two 256K SIMMs	Two 256K SIMMs

Note: The Macintosh Quadra 700 does not support a 1.5 MB VRAM configuration.

❑ MACINTOSH IIcx UPGRADE TO MACINTOSH IIci

Use this procedure to upgrade a Macintosh IIcx to a Macintosh IIci. The procedure involves changing the logic board, RAM SIMMs, bottom case, and the HDA power cable as explained below.

Materials Required

Phillips screwdriver
RAM SIMM removal tool
Macintosh IIci Upgrade Kit
Necessary DRAM SIMMs

Procedure

Upgrading a Macintosh IIcx to a Macintosh IIci requires the Macintosh IIci Upgrade Kit. The kit includes a Macintosh IIci logic board, a new bottom case, and a new HDA power cable. Use the procedures in Section 2, Take-Apart, to take apart the Macintosh IIcx and then rebuild the new Macintosh IIci unit. The major differences between the Macintosh IIcx and IIci are:

- The Macintosh IIci logic board has a different layout and one additional connector (video port).
- The Macintosh IIci requires different DRAM SIMMs than the Macintosh IIcx. Therefore, you cannot use the DRAM SIMMs from the Macintosh IIcx unless they are 80 ns fast-page mode DRAM SIMMs.
- A new HDA (hard disk assembly) power cable accommodates the new connector on the logic board.
- A new bottom case accommodates the new video port connector.

Take-Apart

1. Remove the Macintosh IIcx logic board.
2. Using the SIMM removal tool, remove the DRAM SIMMs from the logic board. If they are not the specific kind of DRAM SIMMs required for the Macintosh IIci (refer to the *SIMM Compatibility Chart*), give them to the customer.
3. Discard the bottom case. (You need not return the bottom case to Apple.)
4. Return the logic board (without SIMMs) to Apple.

Rebuild

1. Insert the Macintosh IIci logic board into the new bottom case.

2. Insert the necessary DRAM SIMMs into the Macintosh IIci logic board.

CAUTION: ***You cannot use the DRAM SIMMs from the Macintosh IIcx unless they are 80 ns fast-page mode DRAM SIMMs.***

Note: Unlike the Macintosh IIcx, the Macintosh IIci does not require that the larger DRAM SIMMs be in bank A. In fact, if the customer plans to use the built-in video feature, the system will function most efficiently with the larger SIMMs in bank B.

3. Install the speaker, disk drive(s), drive mount, power supply, and reset/interrupt switch. (Use the new disk drive power cable included in the upgrade kit.)

Note: If the computer contains a hard drive, transfer the hard drive light pipe from the old Macintosh IIcx case to the Macintosh IIci bottom case.

❑ MACINTOSH IIcx/IIci UPGRADE TO MACINTOSH QUADRA 700

Use this procedure to upgrade a Macintosh IIcx or IIci to a Macintosh Quadra 700. The procedure involves changing the logic board, bottom case, HDA power cable, and speaker and installing an internal SCSI terminator.

IMPORTANT: *The Macintosh Quadra 700 requires System software version 7.0.1 or greater. Instructions for installing system software are in the* Getting Started With Your Macintosh Quadra 700 *manual.*

Materials Required

Phillips screwdriver
DRAM SIMM removal tool
Macintosh Quadra 700 Upgrade Kit

Procedure

Upgrading a Macintosh IIcx or IIci to a Macintosh Quadra 700 requires the Macintosh Quadra 700 Upgrade Kit. The kit includes a Macintosh Quadra 700 logic board, a new bottom case, a new HDA power cable, a new speaker, and an internal SCSI terminator. Use the procedures in Section 2, Take-Apart, to take apart the Macintosh IIcx or IIci and to rebuild the new Macintosh Quadra 700 unit. The major differences between the Macintosh IIcx/IIci and the Macintosh Quadra 700 are:

- The Macintosh Quadra 700 logic board has a different layout and different connectors.

- The Macintosh Quadra 700 has 4 MB of DRAM soldered on the logic board and only one bank of DRAM SIMMs for expansion. It also requires different DRAM SIMMs than a Macintosh IIcx. Therefore, you cannot use the DRAM SIMMs from a Macintosh IIcx unless they are 80 ns fast-page mode DRAM SIMMs.

- The Macintosh Quadra 700 speaker provides higher output.

- The Macintosh Quadra 700 HDA (hard disk assembly) power cable accommodates the connector on the Macintosh Quadra 700 logic board.

- The Macintosh Quadra 700 bottom case accommodates the different port connectors.

Take Apart

1. Remove the Macintosh IIcx/IIci logic board.
2. Using the SIMM removal tool, remove the DRAM SIMMs from the logic board. If they are not useable in the Macintosh Quadra 700, give them to the customer.
3. Discard the bottom case. (You need not return the bottom case to Apple.)

Rebuild

1. Insert the Macintosh Quadra 700 logic board into the new bottom case.
2. If the DRAM SIMMs from the Macintosh IIcx/IIci are useable in the Macintosh Quadra 700, insert them into the Quadra 700 logic board.

CAUTION: *You cannot use the DRAM SIMMs from a Macintosh IIcx unless they are 80 ns (or faster) fast-page mode DRAM SIMMs.*

3. Install additional VRAM SIMMs in the Macintosh Quadra 700 logic board, if applicable.
4. Install the new speaker, disk drive(s), drive mount, power supply, and reset/interrupt switch. (Use the new disk drive power cable included in the upgrade kit.)

Rebuild Note: If you are not installing a hard disk in the upgraded system, you must install the SCSI terminator (included in the upgrade kit) on the main logic board SCSI connector. To insert the connector correctly, align the white key icon on the terminator with the notch in the cable connector.

Note: If you are upgrading a Macintosh IIci with a 160 MB hard disk to a Macintosh Quadra 700, you must run the *Quadra 700 Upgrade 160 MB Update* software application. The application is available on AppleLink on the Service and Support bulletin board in the Apple Support folder. If you do not have access to AppleLink, contact the Apple Assistance Center.

Macintosh IIcx/IIci/Quadra 700

Illustrated Parts List

❑ CONTENTS

Note: The figures and lists in this section include all piece parts that Apple sells for the Macintosh IIcx, IIci, and Quadra 700 along with their part numbers. These are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

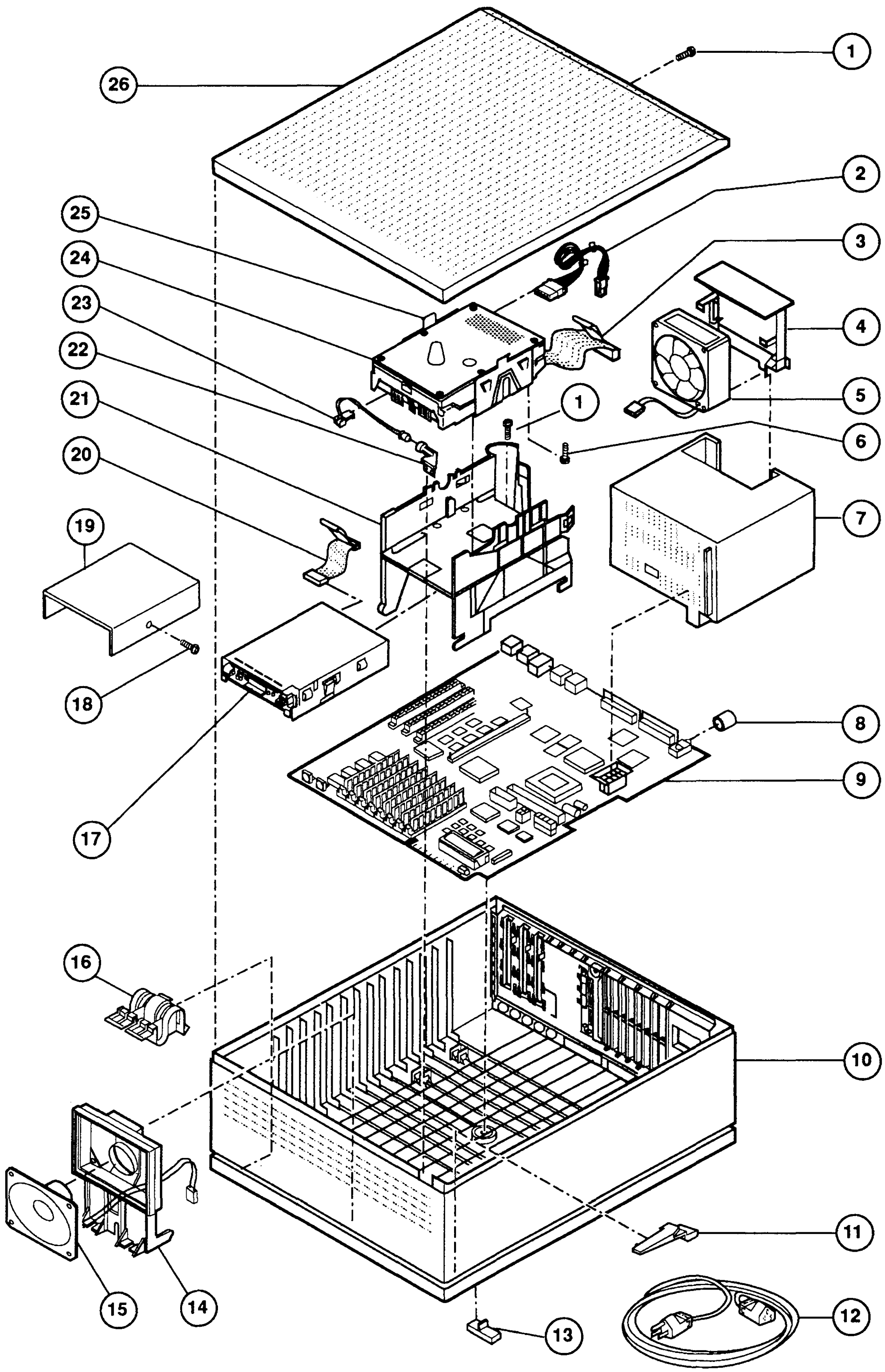


Figure 1 Macintosh IIcx – Exploded View

❑ MACINTOSH IIcx – EXPLODED VIEW (Figure 1)

Item	Part No.	Description
–	602-0164	Service Packaging, HDA, 3.5-Inch, Half-Height (replaced by 602-0282 or 602-0308)
–	602-0282	Service Packaging, HDA, 3.5-Inch, Half-Height; and 3.5-Inch, 1-Inch-Height, with Carrier
–	076-0439	Dust Shield, Package of 5
1	416-1412	Screw, M 3.5 x .6 x 8 (top cover, drive mount to bottom case)
2	590-0505	Cable, Internal HDA Power (1 x 4-pin)
	590-0512	Cable, Internal HDA Power (2 x 2-pin)
3	590-0609	Cable, Internal HDA
4	815-5071	Bracket, Power Supply Fan
5	982-0023	Power Supply Fan
6	444-6104	Screw, 6-32 x .250 (HDA to HDA bracket)
7	661-0467	Power Supply with Fan
8	815-6033	On-Off Button
9	661-0537	Logic Board (without RAM; replaces part number 661-0459)
10	630-5502	Bottom Case
11	815-6032	Light Pipe, Power On
12	590-0380	Cable, Power AC (smoke)
13	865-0026	Rubber Feet
14	815-6031	Speaker Bracket
15	630-5503	Speaker
16	815-6034	Reset/Interrupt Switch
17	661-0474	1.4 MB Mechanism, Apple SuperDrive
18	844-0018	Screw, Socket, Phillips (1.4 MB mechanism)
19	805-0961	Shield, Internal 1.4 MB Mechanism
20	590-0607	Cable, Internal Floppy Drive (yellow stripe)
21	815-6030	Drive Mount
22	815-6036	HDA Light Pipe
23	590-0506	Cable, HDA LED (amber)
	590-0527	Cable, HDA LED (fits 1-Inch-Height drives)
24	661-0373	HDA, Internal 3.5-Inch SCSI, 20 MB
	661-0464	HDA, Internal 3.5-Inch SCSI, 40 MB
	661-1629	HDA, Internal 3.5-Inch SCSI, 1-Inch-Height, 40 MB
	661-0561	HDA, Internal 3.5-Inch SCSI, 80 MB with A/UX, v. 1.1 (replaced by 661-0613)
	661-0600	HDA, Internal 3.5-Inch SCSI, 80 MB
	661-0613	HDA, Internal 3.5-Inch SCSI, 80 MB with A/UX, v. 2.0
25	805-5078	Carrier, HDA, Internal 3.5-Inch, SCSI
26	810-6028	Top Cover

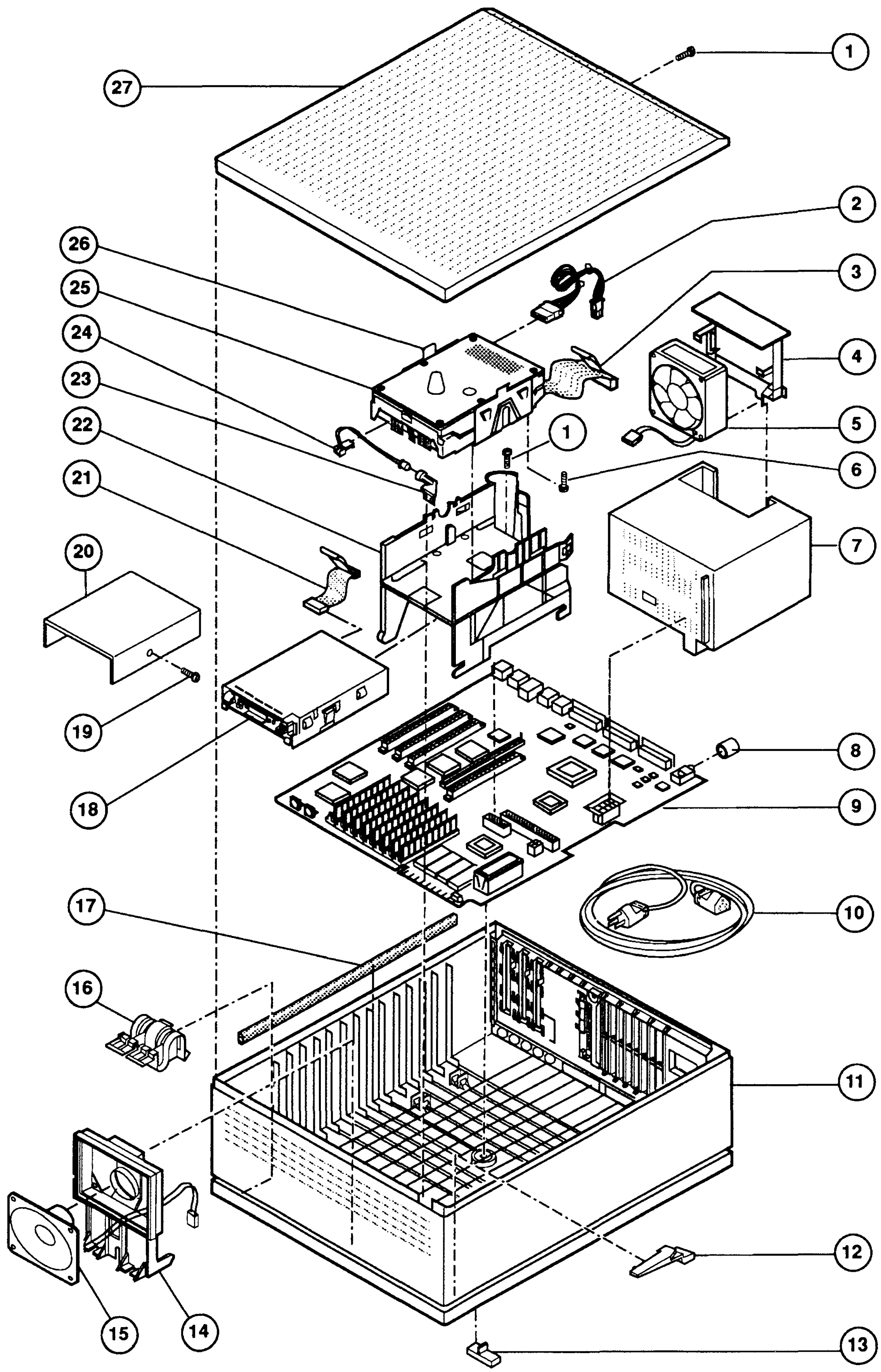


Figure 2 Macintosh IIci – Exploded View

❑ MACINTOSH IIci – EXPLODED VIEW (Figure 2)

Item	Part No.	Description
–	602-0164	Service Packaging, HDA, 3.5-Inch, Half-Height (replaced by 602-0282 or 602-0308)
–	602-0282	Service Packaging, HDA, 3.5-Inch, Half-Height; and 3.5-Inch, 1-Inch-Height, with carrier
–	076-0439	Dust Shield, Package of 5
1	416-1412	Screw, Metric, 3.5 x .6 x 8 (top cover, drive mount to bottom case)
2	590-0512	Cable, Internal HDA Power
3	590-0609	Cable, Internal HDA
4	815-5071	Bracket, Power Supply Fan
5	982-0023	Power Supply Fan
6	444-6104	Screw, 6-32 x .250 (HDA to HDA bracket)
7	661-0467	Power Supply with Fan
8	815-6033	On-Off Button
9	661-0532	Logic Board
	661-0583	Parity Logic Board
10	590-0380	Cable, AC Power (smoke)
11	630-5662	Bottom Case
12	815-6032	Light Pipe, Power On
13	865-0026	Rubber Feet
14	815-6031	Speaker Bracket
15	630-5503	Speaker
16	815-6034	Reset/Interrupt Switch
17	875-0110	EMI Gasket
18	661-0474	1.4 MB Mechanism, Apple SuperDrive
19	844-0018	Screw, Socket, Phillips (1.4 MB mechanism)
20	805-0961	Shield, Internal 1.4 MB Mechanism
21	590-0607	Cable, Internal Floppy Drive (yellow stripe)
22	815-6030	Drive Mount
23	815-6036	HDA Light Pipe
24	590-0506	Cable, HDA LED (amber)
	590-0527	Cable, HDA LED (fits 1-Inch-Height drives)
25	661-0373	HDA, Internal 3.5-Inch SCSI, 20 MB
	661-0464	HDA, Internal 3.5-Inch SCSI, 40 MB
	661-1629	HDA, Internal 3.5-Inch SCSI, 1-Inch-Height, 40 MB
	661-0561	HDA, Internal 3.5-Inch SCSI, 80 MB with A/UX v.1.1 (replaced by 661-0613)
	661-0600	HDA, Internal 3.5-Inch SCSI, 80 MB
	661-0624	HDA, Internal 3.5-Inch SCSI, 1-Inch-Height, 80 MB
	661-0613	HDA, Internal 3.5-Inch SCSI, 80 MB with A/UX v. 2.0
	661-0625	HDA, Internal 3.5-Inch SCSI, 160 MB (replaced by 661-1641)
	661-1639	HDA, Internal 3.5-Inch SCSI, 160 MB with A/UX v. 2.0.1
	661-1641	HDA, Internal 3.5-Inch SCSI, 160 MB
26	805-5078	Carrier, HDA, Internal 3.5-Inch, SCSI
27	810-6028	Top Cover

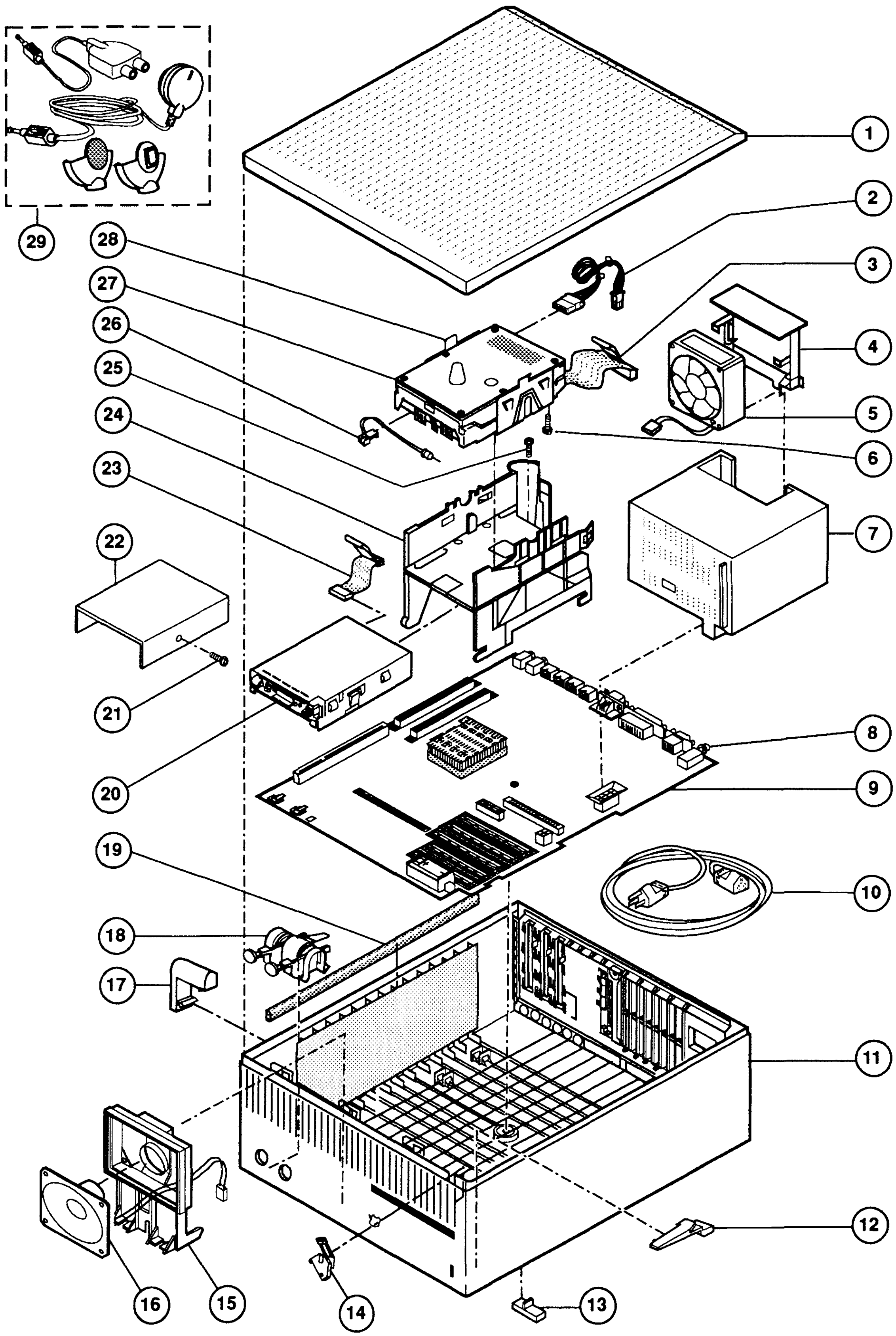


Figure 3 Macintosh Quadra 700 – Exploded View

❑ MACINTOSH QUADRA 700 – EXPLODED VIEW (Figure 3)

Item	Part No.	Description
–	602-0164	Service Packaging, HDA, 3.5-Inch, Half-Height (replaced by 602-0282 or 602-0308)
–	602-0282	Service Packaging, HDA, 3.5-Inch, Half-Height; and 3.5-Inch, 1-Inch-Height, with carrier
–	076-0439	Dust Shield, Package of 5
1	810-6038	Lid
2	590-0512	Cable, Internal HDA Power (2 x 2 pin)
3	590-0609	Cable, Internal HDA
4	815-5071	Bracket, Power Supply Fan
5	982-0023	Power Supply Fan
6	444-6104	Screw, 6-32 x .250 (HDA to HDA bracket)
7	661-0467	Power Supply with Fan
8	815-6033	On-Off Button
9	661-0666	Logic Board
10	590-0380	Cable, AC Power (smoke)
11	630-5992	Bottom Case
12	815-6272	Light Pipe, Power On
13	865-0026	Rubber Feet
14	815-6271	HDA Light Pipe
15	815-6031	Speaker Bracket
16	630-5999	Speaker
17	865-0800	Rubber Foot
18	815-6270	Reset/Interrupt Switch
19	875-0110	EMI Gasket
20	661-0474	1.4 MB Mechanism, Apple SuperDrive
21	844-0018	Screw, Socket, Phillips (1.4 MB mechanism)
22	805-0961	Shield, Internal 1.4 MB Mechanism
23	590-0607	Cable, Internal Floppy Drive (yellow stripe)
24	810-6040	Drive Mount
25	416-1412	Screw, Metric, 3.5 x .6 x 8 (drive mount to bottom case) ‖
26	590-0506	Cable, HDA LED (amber)
	590-0527	Cable, HDA LED (fits 1-Inch-Height drives)
	590-0248	Cable, HDA LED, 400 MB HDA
27	661-0624	HDA, Internal 3.5-Inch SCSI, 1-Inch-Height, 80 MB ‖
	661-1641	HDA, Internal 3.5-Inch SCSI, 160 MB
	661-1636	HDA, Internal 3.5-Inch SCSI, 400 MB
28	805-5078	Carrier, HDA, Internal 3.5-Inch, SCSI
29	699-5071	Microphone Assembly

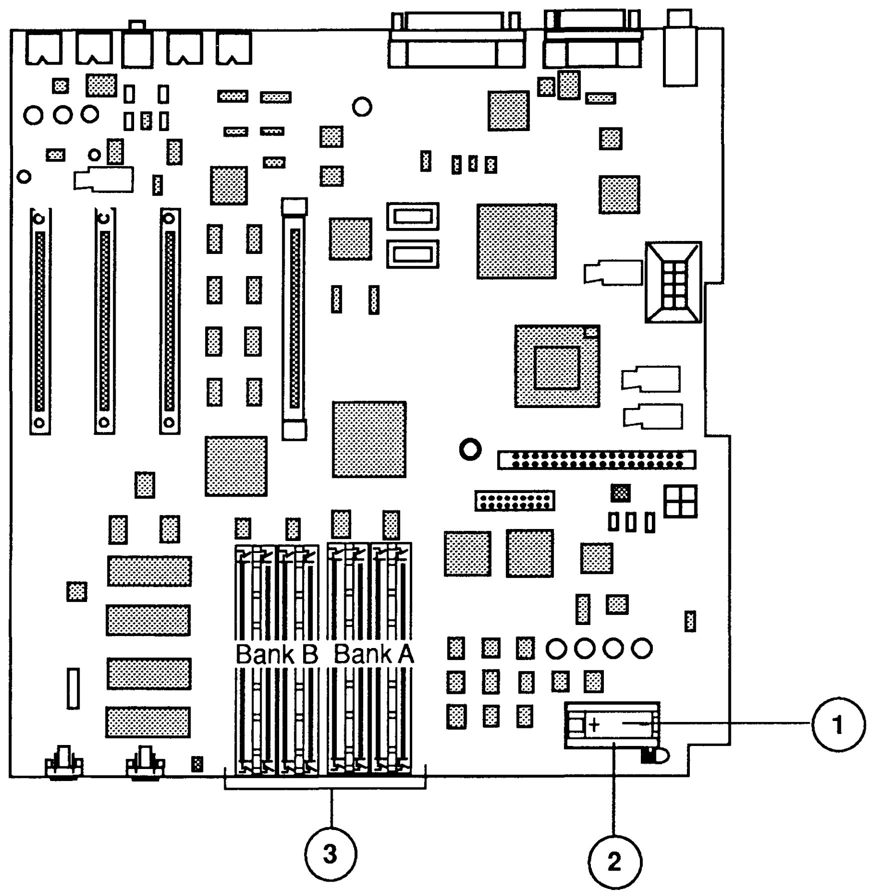


Figure 4 Macintosh IIcx – Logic Board

❑ MACINTOSH IIcx – LOGIC BOARD (Figure 4)

Item	Part No.	Description
–	661-0537	Logic Board
1	742-0011	Lithium Battery (without leads)
2	520-0344	Battery Holder Cover
3	661-0402	SIMM, 256K, SOJ, 120 ns
	661-0494	SIMM, DIP, 256K, 120 ns
	661-0403	SIMM, 1 MB, DIP, 120 ns
	661-0410	SIMM, 1 MB, DIP, 120 ns
	661-0520	SIMM, 1 MB, SOJ, 80 ns
	661-0719	SIMM, 1 MB, 80 ns

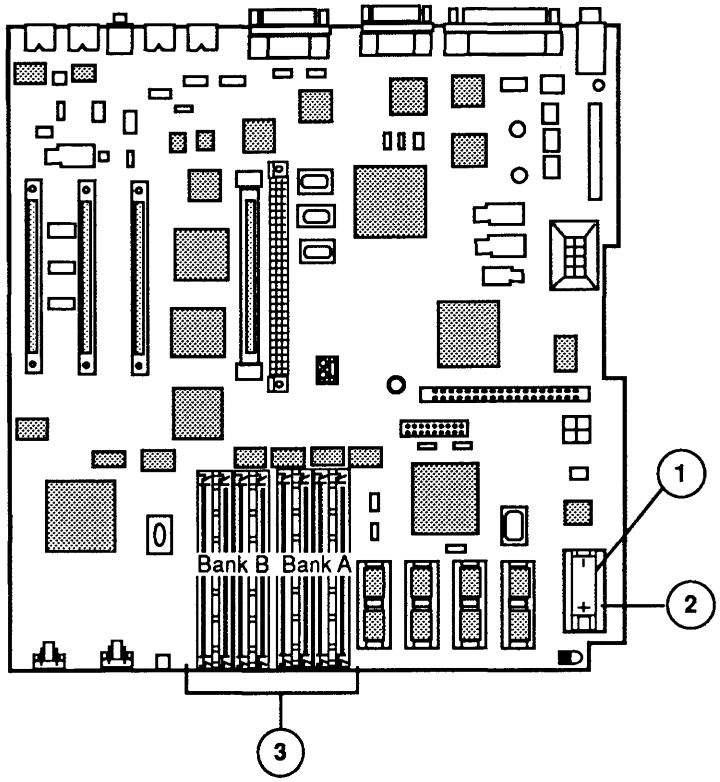


Figure 5 Macintosh IIci – Logic Board

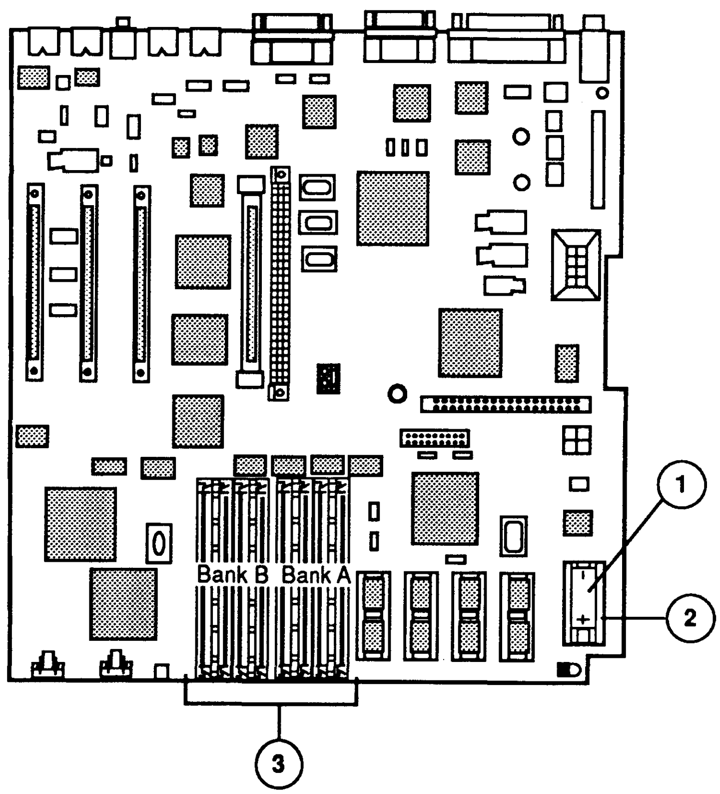


Figure 6 Macintosh IIci – Logic Board with Parity

❑ MACINTOSH IIci – LOGIC BOARD (Figure 5)

Item	Part No.	Description
–	661-0532	Logic Board
1	742-0011	Lithium Battery
2	520-0344	Battery Holder Cover
3	661-0519	SIMM, 256K, SOJ, 80 ns
	661-0646	SIMM, 512K, SOJ, 80 ns
	661-0520	SIMM, 1 MB, SOJ, 80 ns
	661-0546	SIMM, 1 MB, SOJ, 80 ns, Parity
	661-0643	SIMM, 2 MB, SOJ, 80 ns
	661-0719	SIMM, 1 MB, SOJ, 80 ns

IMPORTANT: *Refer to the* Quick Reference: SIMM Compatibility *chart for SIMM compatibility. Follow this chart carefully! Some SIMMs that may appear to be interchangeable with others are not.*

❑ MACINTOSH IIci – LOGIC BOARD WITH PARITY (Figure 6)

Item	Part No.	Description
–	661-0583	Parity Logic Board
1	742-0011	Lithium Battery
2	520-0344	Battery Holder Cover
3	661-0546	SIMM, 1 MB, SOJ, 80 ns, Parity

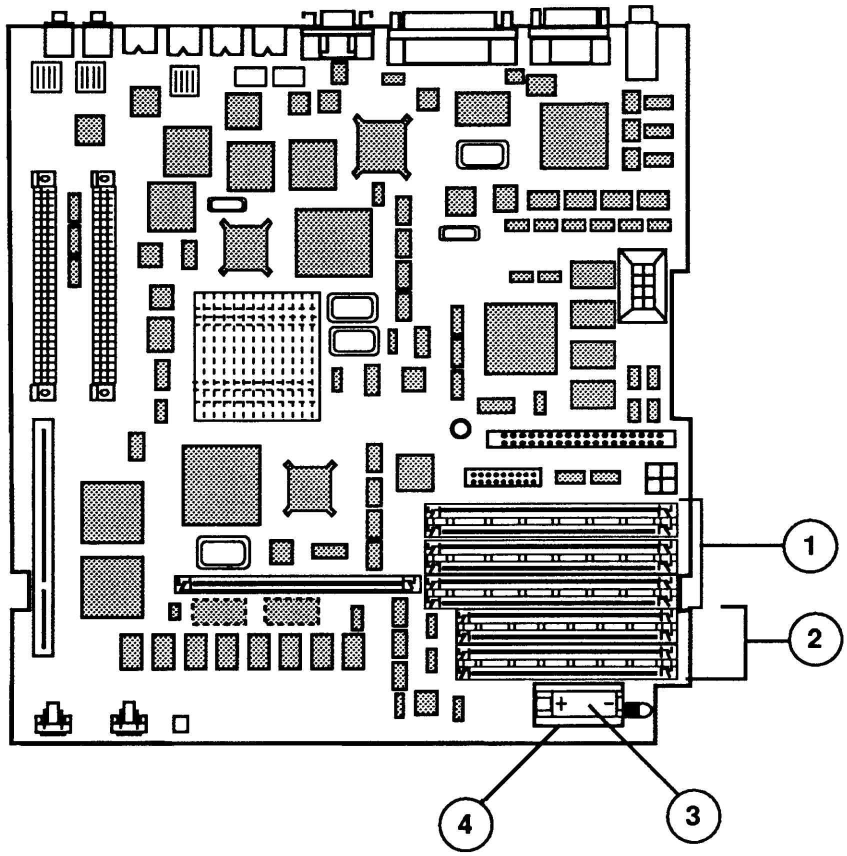


Figure 7 Macintosh Quadra 700 – Logic Board

❑ MACINTOSH QUADRA 700 – LOGIC BOARD (Figure 7)

Item	Part No.	Description
–	661-0666	Logic Board
1	661-0609	VRAM SIMM, 256K, 100 ns
	661-0722	VRAM SIMM, 256K, 80 ns
2	661-0520	DRAM SIMM, 1 MB, SOJ, 80 ns
	661-0719	DRAM SIMM, 1 MB, SOJ, 80 ns
3	742-0011	Lithium Battery
4	520-0344	Battery Holder Cover

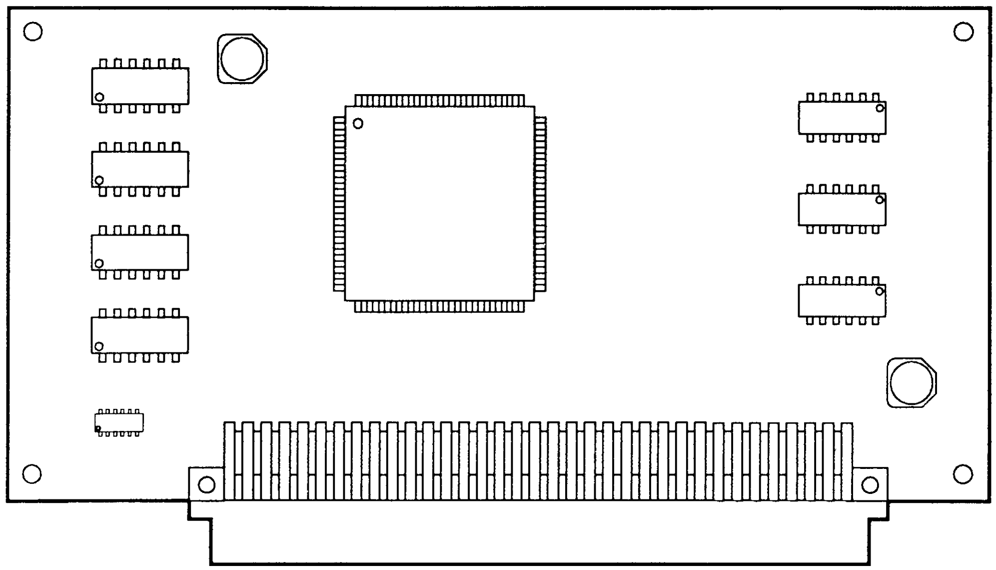


Figure 8 Macintosh IIci – Cache Card

❑ MACINTOSH IIci – CACHE CARD (Figure 8)

Item	Part No.	Description
–	661-1619	Macintosh IIci Cache Card, Revised

Note: The original Macintosh IIci cache card (661-1602) can cause frequent system crashes. This card has a "CF" serial number prefix—e.g., CF#######. Return these cards to Apple. Additional information is available on AppleLink under the *Apple Programs* icon.

The serial number on the revised Macintosh IIci cache card (661-1619) begins with an "AF" prefix—e.g., AF#######. This revised card should function properly; if it fails, return it to Apple through standard service channels.

Apple Technical Procedures

Macintosh Quadra 900

Technical Procedures

❑ TABLE OF CONTENTS

Section 1 – Basics

Section 2 – Take-Apart

Section 3 – Diagnostics

There are currently no diagnostics to test the Macintosh Quadra 900. When diagnostics are available, instructions will be in the *Macintosh Family Technical Procedures* under the *Macintosh Multiple-Product Diagnostics* tab.

 Apple Technical Procedures

Macintosh Quadra 900

Section 1 – Basics

❑ CONTENTS

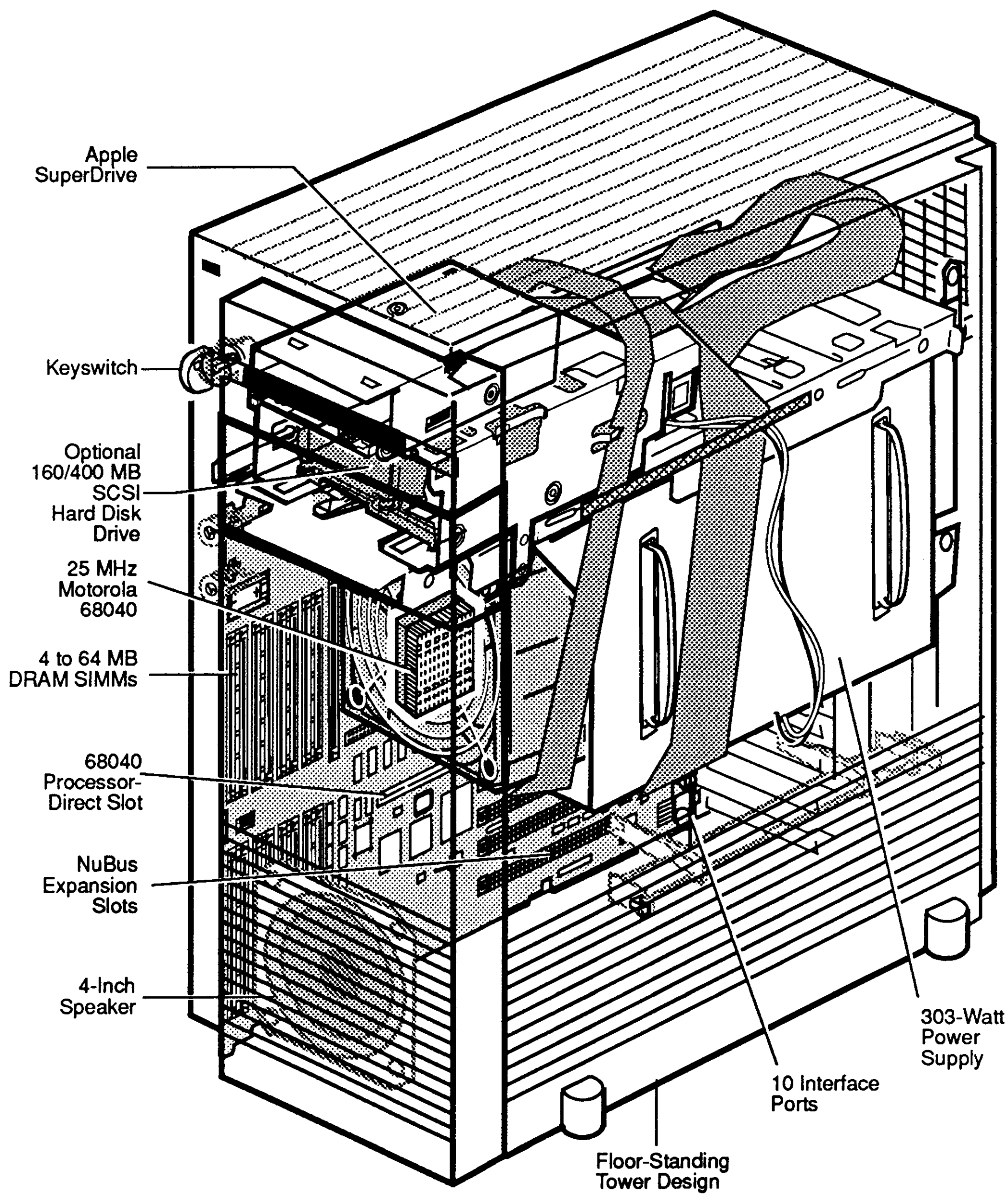


Figure 1-1 Apple Macintosh Quadra 900

❑ PRODUCT DESCRIPTION

The Apple® Macintosh® Quadra™ 900 is a high-performance Motorola® 68040-based Macintosh computer designed for maximum power, expansion, and flexibility. The system supports up to four internal mass storage devices—two can be removeable-media devices. All systems include an Apple SuperDrive™ 1.4 megabyte floppy disk drive. An additional removeable-media device (such as a DAT [digital audio tape], magneto-optical, or tape drive) can be installed below the Apple SuperDrive.

Features

The Macintosh Quadra 900 has the following features:

- Floor-standing tower design that supports up to four internal mass storage devices, including removeable-media, half-height, and full-height drives
- 303-watt power supply
- Two serial and one Apple Desktop Bus™ interfaces
- 1.4 MB Apple SuperDrive floppy disk drive
- Keylock security switch
- Motorola 68040 operating at 25 MHz with integral memory management, floating-point unit, and memory cache
- 68040 processor-direct slot (PDS)
- DRAM SIMM capacity from 4 to 64 MB using standard 80 nsec DRAM (4 MB standard)
- Five NuBus™ slots with improved performance and support for burst mode, processor write buffer, oversized boards, and NuBus '90 compatibility
- Built-in 8-bit (upgradeable to 24-bit) video circuitry with performance approaching that of the Apple 8•24 GC Display Card and support for all Apple monitors

- Dual-channel (one internal and one external) SCSI interface that supports high-speed SCSI transfers and implements a controlled impedance internal cable system

- Input/output processors for the Apple Desktop Bus, serial ports, and floppy disk interface

- Built-in Ethernet interface using the Apple Ethernet Cable System

- Improved sound capabilities—including a built-in 4-inch speaker, 8- and/or 16-bit stereo sound output, 8-bit monaural sound input with microphone and line-in connectors, and real-time decompression hardware

Configurations

The Macintosh Quadra 900 is available from Apple in three configurations:

- 4 MB RAM and an Apple SuperDrive

- 4 MB RAM, an Apple SuperDrive, and a 160 MB SCSI hard disk drive

- 4 MB RAM, an Apple SuperDrive, and a 400 MB SCSI hard disk drive.

These are not the only possible configurations. Apple offers a number of options to enhance the operation and performance of the Macintosh Quadra 900. These options are described later in this section. Also, third-party manufacturers offer a wide variety of products that can be installed. You may see systems with different amounts of RAM, different sizes and capacities of hard disk drives, NuBus cards, and external peripherals.

Internal Mass Storage

The Macintosh Quadra 900 offers a high degree of flexibility in the configuration of internal mass storage devices. The system has a total of four half-height mounting locations.

The two front locations accommodate removable-media devices, such as floppy drives, CD-ROM drives, or magneto-optical drives. The top front position contains an Apple SuperDrive. In systems with an optional Apple internal 160 or 400 megabyte SCSI hard disk drive, the hard drive is installed beneath the floppy drive.

The two rear locations accommodate two half-height or a single full-height drive.

Each of the four locations accommodates 3.5- or 5.25-inch devices.

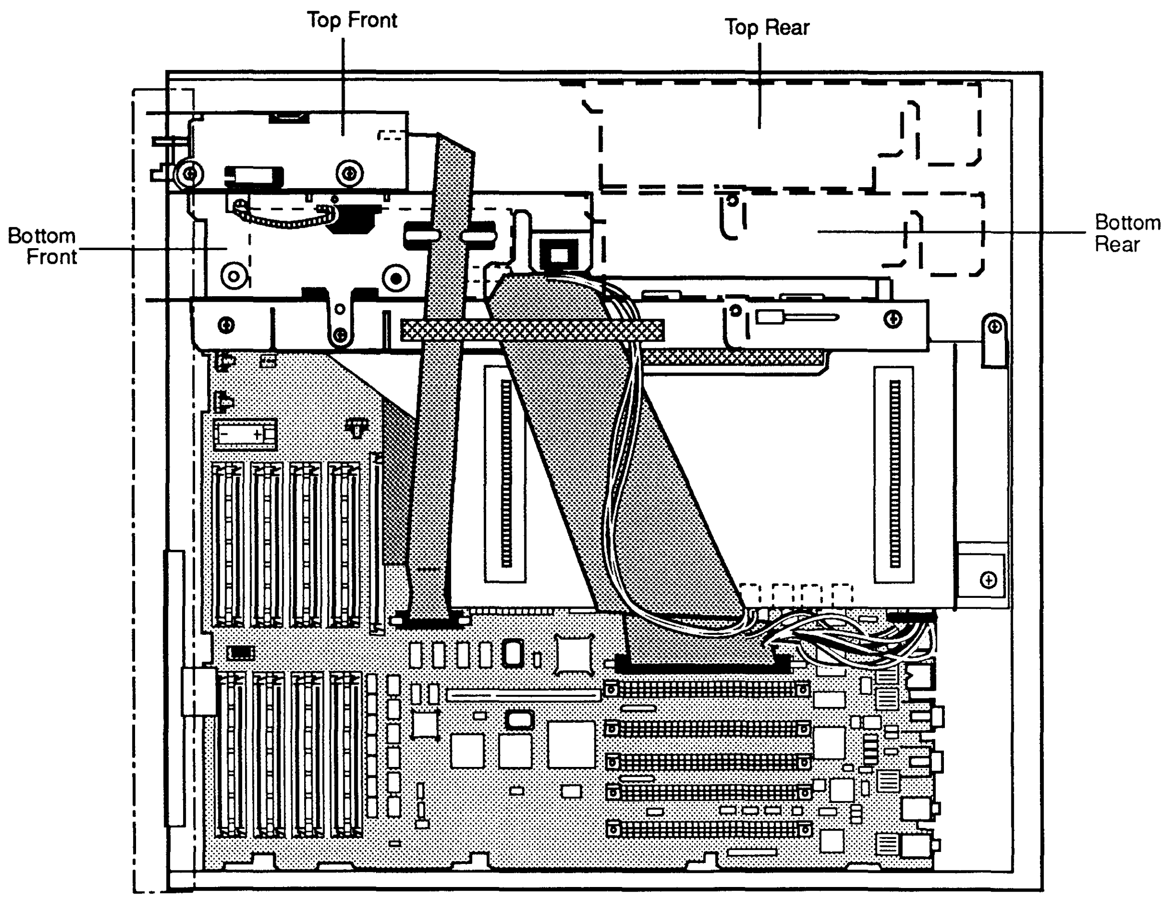


Figure 1-2 Internal Disk Drive Locations

Internal SCSI Bus Termination

To make installing SCSI devices as straightforward as possible and to reduce the potential for SCSI bus problems, the internal SCSI cable has built-in termination. Before installing a SCSI device, make sure the device does not have termination resistors installed. (SCSI hard drives ordered from Apple Service ship with termination resistor packs installed.) Refer to Section 2, Take-Apart for instructions on how to remove the built-in termination for the 160 and 400 MB hard drives.

WARNING: *Failure to remove the termination resistors can result in damage to the Macintosh Quadra 900 logic board.*

VRAM Upgrade

Apple provides VRAM upgrade kits that increase the video RAM from 1 to 2 MB. This additional VRAM increases the number of bits per pixel.

For instructions on installing the VRAM upgrade, see Section 5, Additional Procedures.

Module Identification

Figure 1-3 is an exploded view of the Macintosh Quadra 900 field-serviceable modules. Additional module identification is in the *Apple Service Technical Procedures Module Identification* manual. Information in the *Module Identification* manual supersedes the information available in this manual.

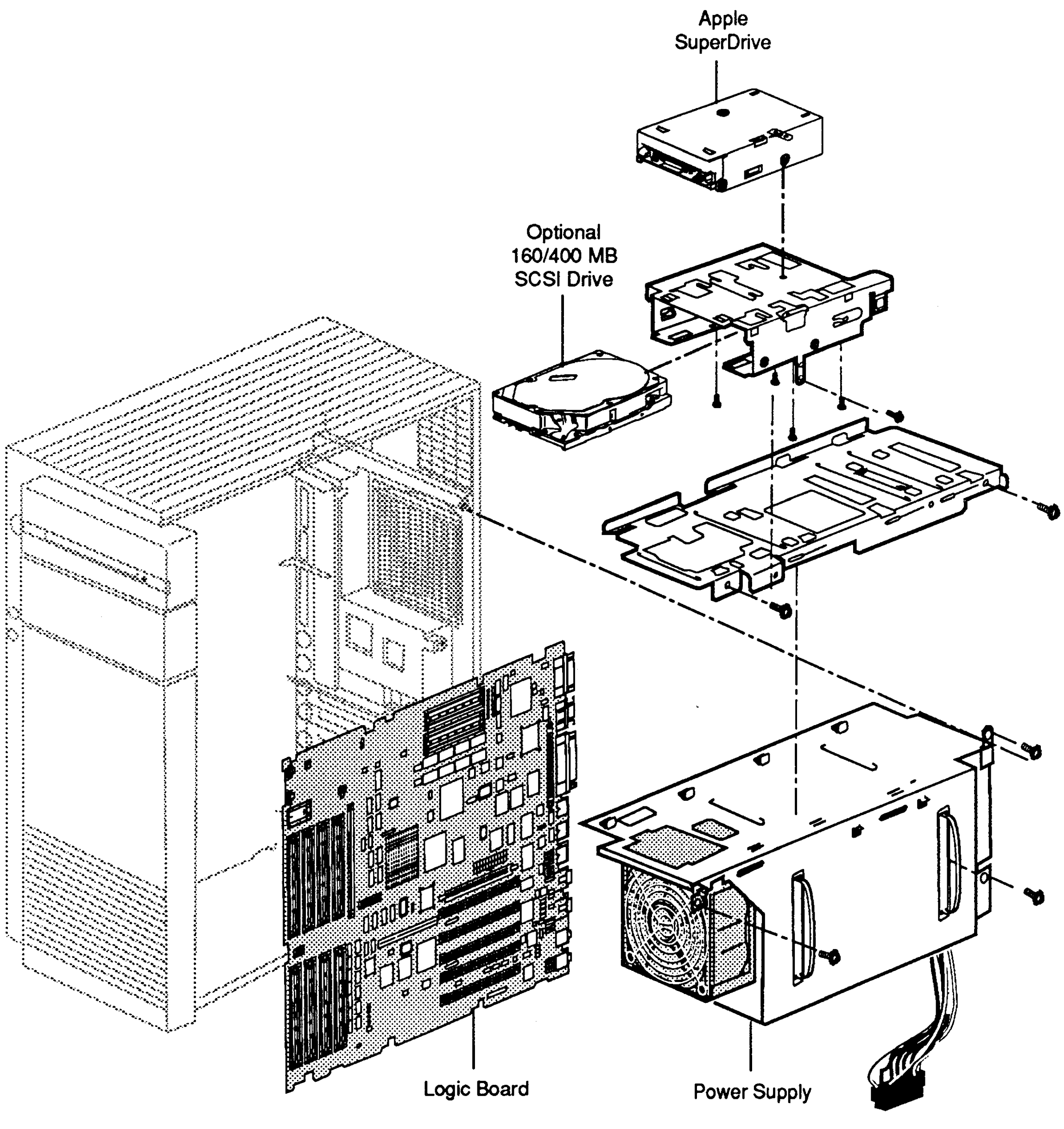


Figure 1-3 Modules

External Connectors

Figure 1-4. The Macintosh Quadra 900 has 10 interface connectors, two power connectors, and five NuBus card openings on the rear panel. The *Apple Service Technical Procedures Peripheral Interface Guide* contains pin-outs and signal descriptions for the interface connectors.

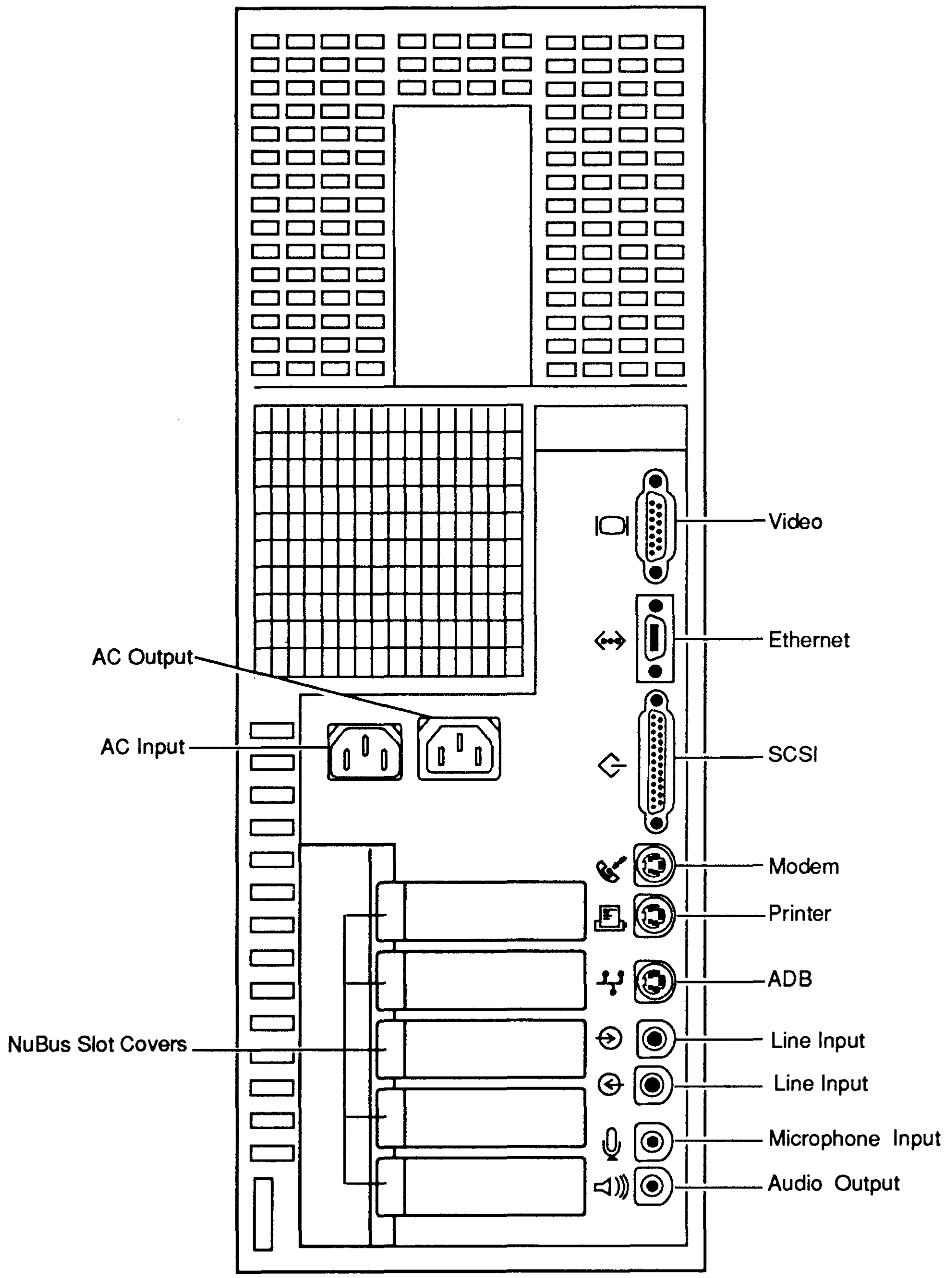


Figure 1-4 External Connectors

Internal Connectors

Figure 1-5. The Macintosh Quadra 900 has a variety of internal expansion connectors—including five NuBus slots, a 68040 processor-direct slot (PDS), sixteen DRAM SIMM connectors, a ROM SIMM connector, and four VRAM SIMM connectors. The logic board also has connectors for the SCSI drives, Apple SuperDrive, speaker, keyswitch, and power supply.

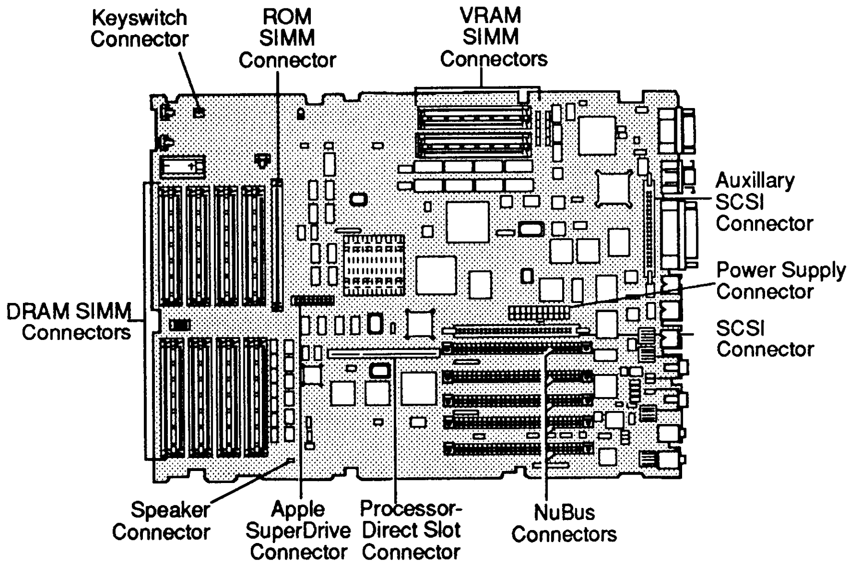


Figure 1-5 Internal Connectors

Keyswitch

Figure 1-5. The Macintosh Quadra 900 includes a keyswitch to limit access to the system. The keyswitch has three positions: *off*, *on*, and *secure*.

- **Off** – When the keyswitch is in the *off* position, the computer cannot be turned on. Turning the keyswitch from *on* or *secure* to *off* turns the computer off.

IMPORTANT: *Turning the keyswitch off when the computer is running turns the power off immediately. If you use the keyswitch to switch the computer off, you risk losing data in RAM and possibly corrupting files on the hard or floppy disk.*

- **On** – With the keyswitch in the *on* position, you may switch on the computer from the keyboard and switch it off from the Shut Down menu item of the Finder™.

- **Secure** – When the keyswitch is in the *secure* position, the ADB devices and the floppy disk are disabled. The computer automatically turns on when the keyswitch is set to *secure* and AC power is available. Note that the interrupt and reset switches remain active when the *secure* mode is selected.

In the event the keys are lost, the customer can contact the keyswitch manufacturer and order replacement keys. The *Apple Service Programs* manual contains ordering information. Alternately, you can replace the keyswitch assembly, or a locksmith can create a new key.

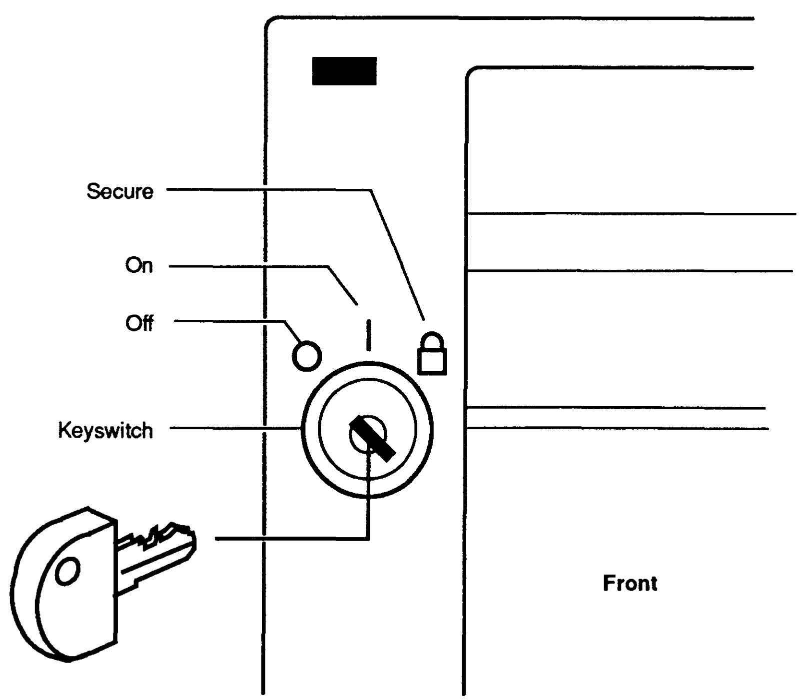


Figure 1-6 Keyswitch

Interrupt and Reset Switches

Figure 1-7. The reset and interrupt switches are on the front of the computer below the keyswitch. These switches reset the computer, place the computer in test monitor mode, or generate a nonmaskable interrupt (NMI) to the microprocessor for software and hardware development.

- **Reset switch** – Pressing the reset switch resets the microprocessor and reboots the computer. When you press the reset switch, data in system RAM disappears.

- **Interrupt switch** – Pressing the interrupt switch generates a nonmaskable interrupt. If you press the interrupt switch while the computer is booting, the computer enters the test monitor program—a program in system ROM that allows another computer to communicate directly with the Macintosh Quadra 900 hardware to run diagnostics.

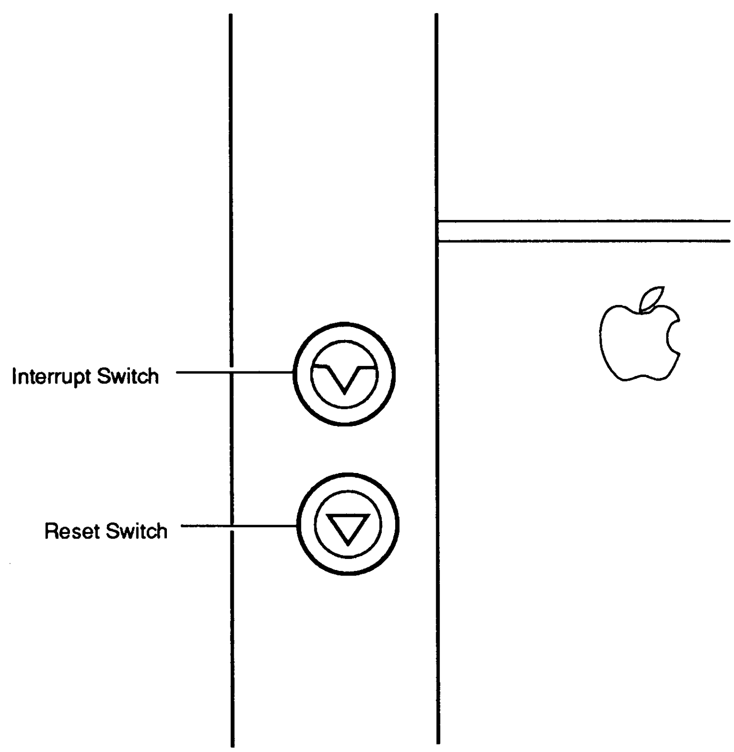


Figure 1-7 Reset and NMI Switches

❑ THEORY OF OPERATION

This section includes an overview of the major modules of the Macintosh Quadra 900: the logic board, power supply, Apple SuperDrive, and optional SCSI hard disk drive.

The information here will give you an understanding of how each module of the computer works, as well as how the system functions. This information will assist you in performing logical troubleshooting of the Macintosh Quadra 900 computer.

Logic Board

Figure 1-8 shows the Macintosh Quadra 900 logic board and its major components. **Figure 1-9** is a block diagram of the logic board.

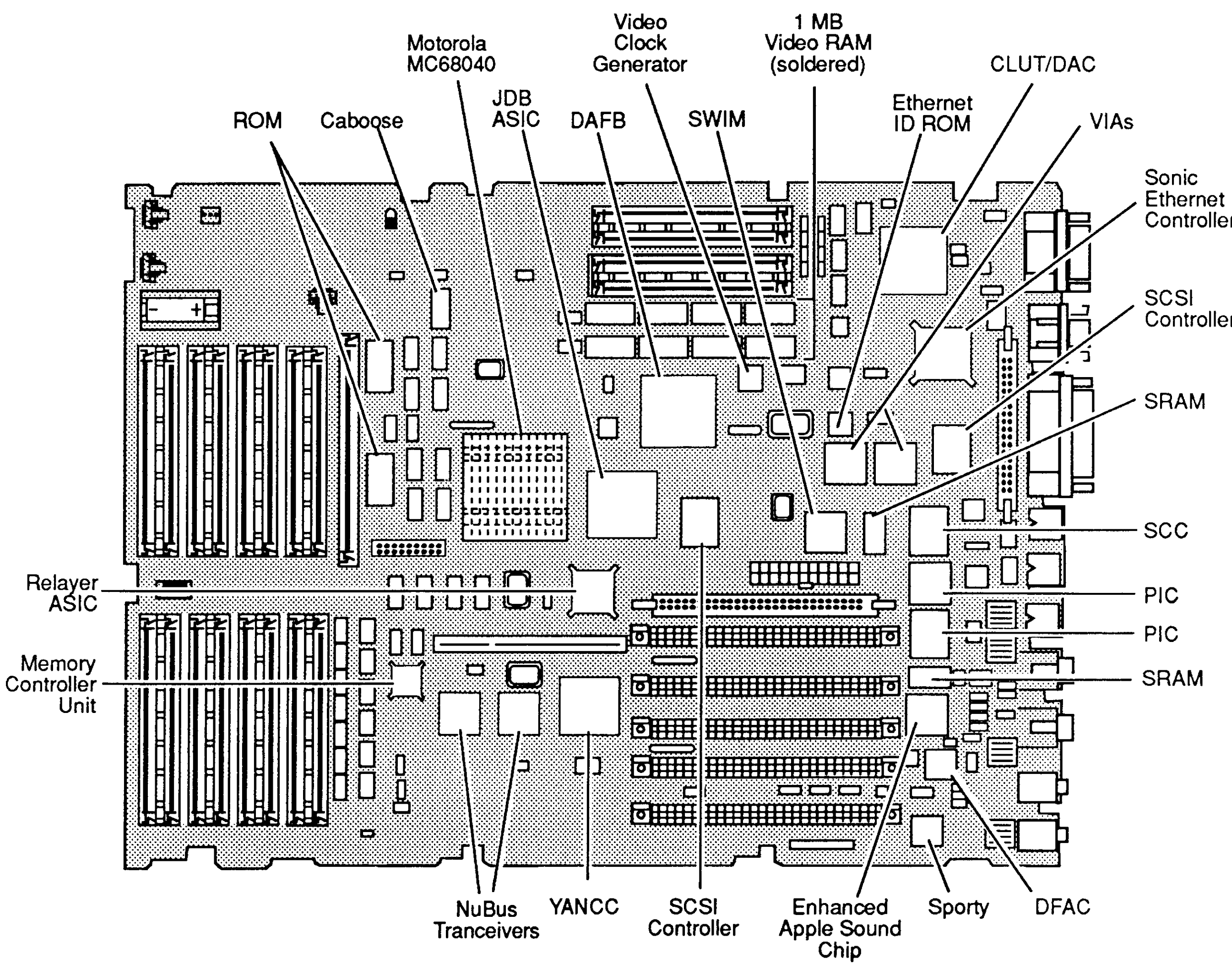


Figure 1-8 Logic Board Major Components

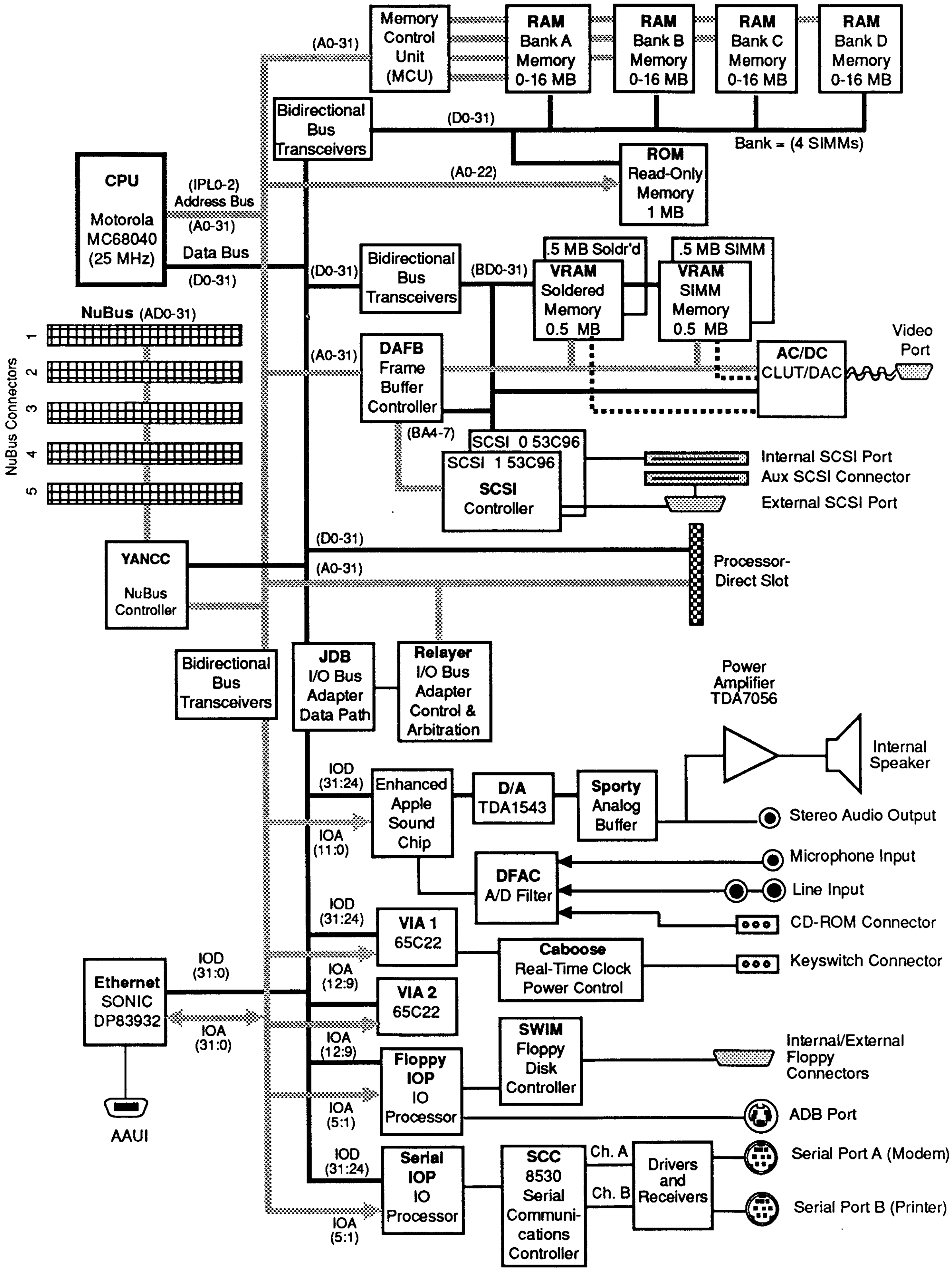


Figure 1-9 Logic Board Block Diagram

Microprocessor

The Macintosh Quadra 900 contains a Motorola MC68040 32-bit microprocessor operating at 25 MHz. This processor is completely software compatible with all 68000, 68020, and 68030 versions used in other Macintosh computers. The Macintosh Quadra 900 runs most Macintosh applications without modification. (However, programs with self-modifying code may be incompatible with the 68040 memory cache.) A list of compatible applications ships with every Macintosh Quadra 900. AppleLink® contains the most up-to-date list of compatible applications.

The 68040 microprocessor includes an integrated floating-point unit (FPU), a memory management unit (MMU), and 8K of instruction and data cache.

The integrated FPU eliminates the separate 68881/68882 math coprocessor in 68020/68030-based Macintosh computers. The optimized FPU in the 68040 executes the most commonly used subset of the 68882 instruction set and includes additional instruction formats for single- and double-precision rounding of results.

The integrated MMU eliminates the paged memory management unit in 68020-based Macintosh computers. The MMU provides support for System 7.0 virtual memory, A/UX® (Apple's implementation of UNIX®), and memory addressing of up to one gigabyte.

The built-in data and instruction cache of the 68040 eliminates the need for an external cache like that used in the Macintosh IIci and IIfx.

Bus Architecture

The Macintosh Quadra 900 uses three separate buses: the system bus, I/O bus, and NuBus.

The system bus is the native 68040 bus, which operates at the same clock rate as the 68040 (25 MHz). It is a high-performance synchronous bus connecting the 68040 to the memory control unit, the I/O bus (through the JDB and Relayer ASICs), and the processor-direct slot. The system can support up to four bus masters: three on the system bus and one on the I/O bus. The Relayer ASIC contains the bus arbitration circuitry.

The I/O bus is fully buffered from and is asynchronous with the system bus. The I/O bus connects the 68040 to the input/output processors for the serial, ADB, and floppy interfaces; the VIAs; and the Enhanced Apple Sound Chip. The bus operates at 15.6672 MHz. The I/O bus connects to the system bus via two ASICs—the Relayer and the JDB (junction data bus).

The system bus and I/O bus allow alternate bus masters to request the bus and to transfer data to and from main memory (DRAM SIMMs). Supporting alternate bus masters allows NuBus cards requiring fast memory transfers—such as graphics and network cards—to transfer data much faster than would be possible with CPU transfers.

The NuBus is the same expansion bus as in Macintosh II computers. The bus is fully buffered and connects to the system bus via the YANCC (Yet Another NuBus Controller Chip) chip and two bus transceivers.

RAM

Single in-line memory modules (SIMMs) provide system memory for the Macintosh Quadra 900. Each SIMM contains 1 or 4 MB of dynamic RAM (DRAM). Memory is in four groups, called banks, of four SIMM sockets each. A system can contain a maximum of 64 MB of system memory (sixteen 4 MB DRAM SIMMs). The system ships with four 1 MB DRAM SIMMs installed in Bank A. (These 1 MB DRAM SIMMs are the same as those in the Macintosh IIci and Quadra 700.)

When installing DRAM SIMMs, the following rules apply:

- Each DRAM SIMM must be 80 nsec or faster.
- All four slots within a bank must be empty or have four DRAM SIMMs of the same RAM size (1 MB or 4 MB).
- Do not partially fill a bank; fill all four slots of a bank or leave all four slots empty.

Every time you switch on the Macintosh Quadra 900, the system runs a memory test to determine how much RAM is present.

You can determine the amount of memory by visual inspection of the SIMMs or by using **About This Macintosh** under the Apple menu of the Finder.

ROM

The system has 1 MB of nonvolatile read-only memory in two 256K x 16-bit surface-mount ROMs. These ROMs contain the Macintosh ToolBox, operating system support, 32-bit QuickDraw™, support for 32-bit addressing and the peripheral interface controllers, Apple SuperDrive extensions, diagnostics, and self-tests.

You can replace or upgrade the ROM by installing a ROM SIMM card in the ROM SIMM slot.

Memory Controller

The memory controller unit (MCU) connects to the system bus and provides the control and timing signals for system ROM and RAM.

Real-Time Clock

Caboose, an application-specific integrated circuit (ASIC), replaces the real-time clock chip of earlier Macintosh computers. Caboose also includes parameter RAM, DFAC (digital filter audio chip) control, support for the keyswitch, and power control.

Input/Output Interfaces

The Macintosh Quadra 900 includes the standard set of Macintosh interfaces—two serial, one Apple Desktop Bus, one SCSI, and one stereo sound output. The system also provides a video interface, a microphone input, line inputs, and an Ethernet network interface.

Built-in Video

The built-in video port provides performance approaching that of the 8•24 GC card. The interface uses a video-RAM-based frame buffer supporting high-resolution graphics on all Apple monitors. The interface supports several non-Apple monitor types—including NTSC and PAL broadcast standards and VGA (used on IBM-compatible computers and monitors). To reduce flicker, convolution is an option for NTSC and PAL.

The standard 1 MB of video RAM supports up to 8 bits per pixel (BPP) on all Apple monitors. By adding an additional 1 MB of video RAM, the Macintosh Quadra 900 will support up to 32 BPP on all Apple monitors except the Apple Macintosh Portrait Display, Apple Two-Page Monochrome Monitor, and 21-Inch Color Display.

	Number of colors or shades of gray	
Monitor	**1 MB VRAM**	**2 MB VRAM**
Macintosh 12-Inch Monochrome	256	millions
Macintosh 12-Inch RGB	millions	millions
Apple High-Res RGB (13-Inch)	256	millions
Apple Macintosh Portrait Display	256	256
Apple Two-Page Monochrome	256	256
Macintosh 21-Inch Color	256	256
16-Inch Color	256	millions
VGA	256	millions
Super VGA	256	millions
NTSC	256	millions
NTSC with convolution	256	256
PAL	256	millions
PAL with convolution	256	millions

Table 1-1 Video RAM Configurations for Monitor Size and Pixel Depth

Table 1-2 indicates the amount of video RAM needed for various monitor sizes and pixel depth combinations.

Floppy Interface

The floppy disk controller chip in the Macintosh Quadra 900 is the SWIM chip of other Macintosh computers. The SWIM is a complete multimode floppy disk interface on a single IC that provides the capability to read, write, and format in group-coded recording (GCR) and modified frequency modulation (MFM) data formats. The SWIM chip interprets, converts, and outputs dual-disk (clock/time) and file (data) signals as appropriate for GCR (variable rotational speed) or MFM (constant rotational speed) formats. This arrangement provides the capability to read, write, and format Apple 400K and 800K data disks (GCR), MS-DOS® 720K data disks (MFM), and Apple or MS-DOS high-density (1.4 MB) data disks (MFM). The Macintosh Quadra 900 supports one internal floppy drive. The system does not support an external floppy drive.

SCSI

The Macintosh Quadra 900 features a dual SCSI controller architecture. One controller supports internal SCSI devices, and a second controller supports external SCSI devices. This design provides improved SCSI signal quality and greater reliability. Although the SCSI interface utilizes two channels, it still supports a maximum of eight devices. (The computer uses SCSI device address 7, leaving seven available addresses for other devices.)

The 53C96 SCSI controller chip is faster than the 53C80 of previous Macintosh computers. The 53C96 supports data transfer rates of up to 5 MB per second.

The internal SCSI bus is actively terminated and electrically isolated from the external bus. By isolating the two buses, changes in external devices, cabling, and termination do not impact the performance of the internal devices.

The external SCSI bus provides a more uniform impedance and cleaner signal termination than on previous Macintosh computers. The external SCSI bus also has a connector inside the computer. The internal SCSI connector supports third-party special applications such as mirrored disks (for fault tolerance) and disk arrays (for faster throughput). To prevent possible termination problems, do not use the internal auxillary SCSI connector and the external connector simultaneously.

Serial Interfaces

An 8530 serial communications controller (SCC) controls the two serial ports. You can program port 1, the modem port, for asynchronous or synchronous protocols. You can program port 2, the printer port, for asynchronous or AppleTalk® operation. The serial ports conform to the EIA RS-422 standard. These ports are used mainly for (though not limited to) connecting the Macintosh Quadra 900 to AppleTalk networks, serial printers, and modems.

The Macintosh Quadra 900 uses two mini DIN-8 connectors for the two ports. These are the same connectors as on all Macintosh computers since the Macintosh Plus. The ports provide an output handshake but do not provide the +5 and +12 volts found on the Macintosh 128K, 512K, and 512K enhanced serial ports.

Apple Desktop Bus Interface

The Apple Desktop Bus interface on the Macintosh Quadra 900 functions identically to the ADB interface on other Macintosh computers. However, ADB functions are included in the SWIM/ADB input/output processor. Information on the SWIM/ADB IOP is in Peripheral Interface Controllers later in this section.

Ethernet

A National Semiconductor DP83932 SONIC Ethernet controller chip implements the Ethernet network interface. The SONIC chip includes an IEEE 802.3 encoder/decoder (ENDEC); a media access control (MAC) unit; separate 32-byte send-and-receive, first-in-first-out (FIFO) buffers; and a direct memory access (DMA) controller. A separate ROM provides the Ethernet global address (which provides a unique 48-bit identity for each Ethernet device).

The interface connector is an Apple AAUI connector. This connector supports the Apple Ethernet Network Cable System which supports thicknet, thinnet, or 10BaseT cable systems. The *Ethernet Networks* tab in *Cross Family Service Technical Procedures* contains additional information on the Apple Ethernet Cable System.

Line Input Connectors

The line input connectors provide sampling of line input devices such as a CD player, VCR audio output, or tape deck. These inputs are mixed internally to form a monaural signal. This monaural signal is combined with the input from the microphone and connected to the 8-bit sound input circuit. Even though the system has two line-in connectors, the stereo channels combine into a single monaural input and the stereo information is lost. The two connectors are provided so that an external mixer is not required.

Microphone Input

The microphone input connector supports the connection of an electret microphone. The microphone is included with the Macintosh Quadra 900.

CAUTION: *The microphone input connector provides +8 volts on one of its pins. This is a nonstandard use for this pin. Do not plug any device into the microphone input except the microphone included with the Macintosh Quadra 900.*

Audio Output and Internal Speaker

The audio output connector provides for the attachment of external audio equipment such as headphones, powered speakers, or an amplifier. The connector is a 3.66 mm stereo miniature phone plug.

A four-inch internal speaker provides a built-in monaural source. This speaker is driven by a more powerful amplifier than on previous Macintosh computers. The higher power is required to drive the larger speaker. Because most Macintosh Quadra 900 computers will sit on the floor, they must produce higher sound levels to give users the same perceived sound as on a desktop system.

Peripheral Interface Controllers

The Macintosh Quadra 900 uses the same peripheral interface controllers (PICs) that were introduced in the Macintosh IIfx. The PICs are input/output processors that reduce the workload on the 68040. An input/output processor (IOP) is a processor dedicated to a specific task or tasks that are normally performed by the main CPU. In all previous Macintosh computers, low-level communications with external devices were handled by the main processor. This resulted in reduced performance because each time a peripheral required attention, the main processor was diverted from its primary function—running applications. IOPs provide the ability to off-load some of the support required by peripheral-device interfaces. The Macintosh Quadra 900 has two PICs—one supports the 8530 serial communications controller (SCC); the other supports the SWIM disk controller and Apple Desktop Bus interface.

Each PIC includes a 65CX02 microprocessor operating at 2 MHz, a 16-bit timer, two DMA controllers, two digital phase-locked loops (DPLLs), and a RAM expansion bus to support an external 32K x 8-bit static RAM chip. The PIC communicates with the host 68040 via this RAM.

NuBus and the Processor-Direct Slot

The Macintosh Quadra 900 has two types of system expansion slots:

- One 120-pin 68040 processor-direct slot (PDS)
- Five NuBus expansion slots

The processor-direct slot provides direct access to the 68040 microprocessor bus. Providing direct access to the CPU bus rather than going through NuBus results in increased throughput for the device.

To prevent the installation of all five NuBus cards plus a PDS-type card, the PDS slot has been aligned with NuBus slot E. By aligning the fifth NuBus slot and the processor-direct slot, only four NuBus cards and a PDS card—or five NuBus cards—can be installed. This design prevents too many cards from being installed and thus potentially overloading the power supply.

The NuBus expansion slots in the Macintosh Quadra 900 implement the same expansion bus in other Macintosh II computers. However, NuBus in the Macintosh Quadra 900 has a number of new features.

Macintosh Quadra 900 NuBus slots support standard or oversized cards. The oversized cards are approximately two-inches higher than earlier NuBus cards. Card guides installed on the side cover hold standard-sized cards in place. NuBus in the Macintosh Quadra 900 supports block transfers between NuBus cards at twice the speed of earlier systems.

The power supply in the Macintosh Quadra 900 provides power for two 25-watt cards and three 15-watt cards (a maximum of 95 watts).

The interface between the five NuBus slots and the system bus is provided by three chips: the YANCC and two 16-bit NuBus transceiver chips.

Power Supply

The power supply is a self-configuring switching supply that operates on AC line voltages from 90 to 140 VAC and 170 to 270 VAC. The supply outputs +5 VDC, +12 VDC, and -12 VDC voltages, which are used by the logic board, fan, internal disk drives, peripheral ports, and the NuBus and processor-direct slots. A switched convenience outlet provides power for a monitor.

The power supply also provides a +5 volt trickle voltage for the power-on circuit, NuBus standby power, a real-time clock, and parameter RAM. This voltage is supplied when the computer is off but still connected to an AC outlet. When AC power is not available, the parameter RAM and real-time clock receive power from a lithium battery on the logic board to retain their settings.

Apple SuperDrive

The system contains a single Apple SuperDrive 1.4 MB megabyte floppy disk drive.

The drive connects to the logic board through a 20-pin connector. The flow of data between the logic board and the disk drive is controlled by the SWIM (Sanders Wozniak Integrated Machine) disk controller chip. The SWIM controls reading and writing operations.

SCSI Hard Disk Drives

The Macintosh Quadra 900 can be equipped with up to three internal 3.5- or 5.25-inch half-height or full-height SCSI hard disk drives. For information on SCSI hard disk drives, refer to the *SCSI Hard Disk Drives Technical Procedures.*

Functional Overview

The following section describes the operation of the power control circuitry and the events that occur during system startup.

Power Control

The Macintosh Quadra 900, like other Macintosh II computers, has a hardware-on/software-off circuit to control the power supply.

There are two power switches: the keyswitch on the front (power *on* and *off*), and a second (power *on* only) on the Apple Desktop Bus keyboard.

The computer can be powered on by turning the keyswitch to the *on* position or pressing the soft power-on switch on the Apple Desktop Bus keyboard.

The computer can be turned off either by selecting **Shut Down** from the Special menu of the Finder or by turning the keyswitch to the *off* position. However, Apple recommends that you always use the Shut Down command. Using **Shut Down** enables the computer to save valuable file and folder information.

The power supply protects itself and the computer by shutting down in response to excessive heat, a short circuit, or an excessive power drain. To correct the problem, allow the computer to cool, remove the short circuit, or adjust the power load. After five to ten minutes, you can switch the system on again.

System Startup

Understanding what happens during system startup can be useful in quickly pinpointing the source of startup problems.

When you switch the computer on, the system begins a carefully synchronized sequence. First, the processor waits while a series of circuits initializes the system in preparation for operation. During this time, the versatile interface adapter and the SWIM chip initialize, and the mapping of RAM and ROM alters temporarily in order to test the system.

The software in the system ROMs then performs a RAM test to determine how much RAM is present and verify proper RAM operation. Several other system tests run. When the system is fully tested and initialized, system RAM maps for normal operation.

At this point the disk startup process begins. The system looks for a readable disk in the available disk drives in the following order:

1. Internal floppy disk drive

2. Startup device set in the control panel

3. SCSI devices—starting with internal drive; then in declining order of device ID (6 to 0)

Note: The startup device will default to the device with SCSI address 0 if a startup device is not selected or the SCSI device address is invalid.

If the Macintosh Quadra 900 finds a readable disk containing boot tracks and a System Folder, the disk is read and the disk startup process is completed.

❑ SPECIFICATIONS

Processor

Type	Motorola MC68040 with integral floating-point unit, memory management unit, 4K data cache, and 4K instruction cache
Addressing	32-bit registers 32-bit address bus 32-bit data bus
Clock Rate	25 MHz

Memory

DRAM SIMM	4 MB standard using four 1 MB, 80 nsec SIMMs; expandable to 64 MB (using 4 MB SIMMs)
Parameter RAM	256 bytes
Video RAM	1 MB; expandable to 2 MB
ROM	1 MB using two 150 nsec, 256K x 16-bit chips

I/O Interfaces

NuBus	5 slots support standard and oversize cards, burst mode transfers, a processor write buffer, and NuBus '90
Expansion Interface	140-pin 68040 processor-direct slot
Floppy Disk Interface	Supports 800K and 1.4 MB internal disk drives using GCR (group-coded recording) and MFM (modified frequency modulation—1.4 MB drive only) recording standards

SCSI Interface	Up to 5 MB/second transfer rate (asynchronous) Dual SCSI interface chips support internal and external SCSI buses Controlled-impedance internal cable system with active termination Supports a maximum of eight devices, including the computer, which is always device 7
Apple Desktop Bus	Low-speed, synchronous serial interface
Serial Interfaces	Two RS-232/RS-422 ports Mini DIN-8 connectors 230.4K baud maximum 0.920 Mbit/second if external clock source is provided (modem interface only) Asynchronous, synchronous (modem only), and AppleTalk (printer only) protocols supported
Video Interface	Supports all current Apple monitors (8-bit) Supports VGA monitors and NTSC and PAL video standards 1 MB video RAM (VRAM) standard, expandable to 2 MB (for increased pixel depth)
Ethernet	AUI-15 connector
Audio	8-bit stereo output via miniature phone plug connector 8-bit monaural input via miniature phone plug connector; supports supplied electret-type microphone 8-bit monaural input via two RCA connectors (left and right channels mix internally to yield a monaural signal) Built-in 4" speaker 4-voice wave-table synthesis Stereo sampling generator

Floppy Disk Drive

Apple SuperDrive	512 bytes per sector 18 sectors per track 737.28K/side 1474.56K/disk

Microphone

Type	Electret, omnidirectional
Output Voltage	4 millivolts, peak to peak, at normal speaking volume

Electrical

Line Voltage	85 to 270 VAC, RMS, self-configuring power supply
Line Frequency	50 to 60 Hz, single phase
Power	303 watts (maximum), not including monitor

Environmental

Operating Temperature	10° C to 40° C 50° F to 104° F
Storage Temperature	-40° C to 47° C -40° F to 116.6° F
Relative Humidity	20% to 80% noncondensing
Altitude	0 to 10,000 feet 0 to 3048 m

 Apple Technical Procedures

Macintosh Quadra 900

Section 2 – Take-Apart

❑ CONTENTS

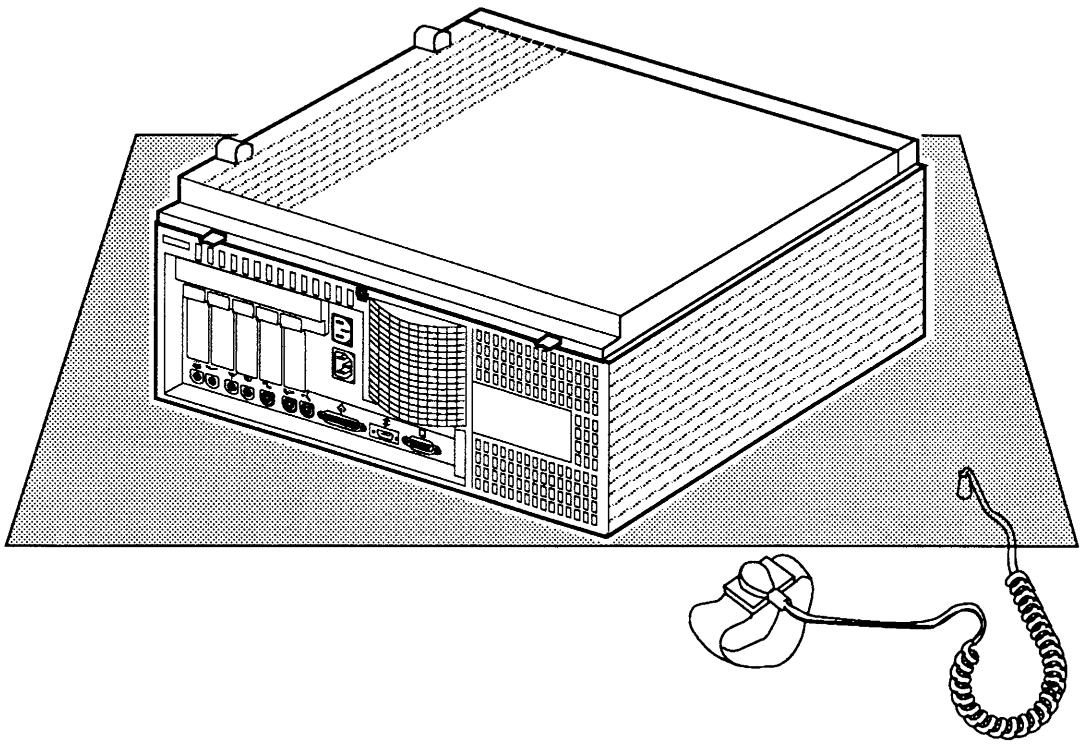


Figure 2-1 Take-Apart Orientation

❑ INTRODUCTION

The following items contain important information necessary to successfully disassemble and reassemble the Macintosh Quadra 900:

- If a step or part of a step is underlined, detailed procedures for that procedure are earlier in this section.
- Place the system on an antistatic mat with the left side on the mat, as shown in **Figure 2-1**. With the system on its side, you'll be able to work without the risk of tipping the system over.
- A DRAM SIMM configuration chart is in Section 5, Additional Procedures. Use the chart to determine the number and size of DRAM SIMMs for different memory sizes.

Materials Required

Grounded workbench pad and wriststrap
Flat-blade screwdriver
#2 Phillips screwdriver
SIMM removal tool

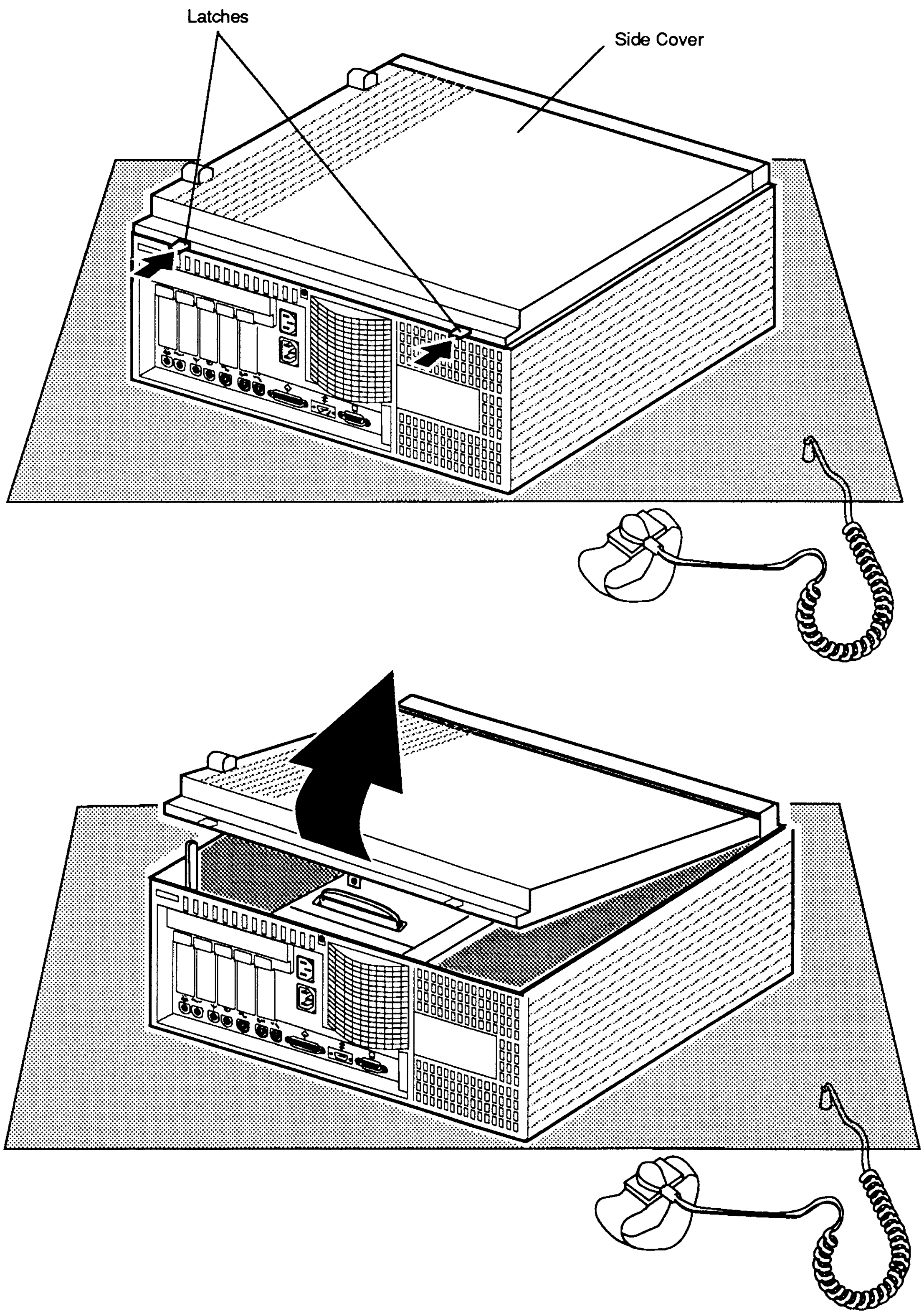


Figure 2-2 Removing the Side Cover

❑ SIDE COVER

To perform any of the take-apart procedures on the Macintosh Quadra 900, you must remove the side cover. This procedure is illustrated in **Figure 2-2**.

1. If the system is still set up, unplug all cables attached to the rear of the unit.

2. Place the computer, left side down, on the grounded workstation pad.

3. Press the two latches and lift the cover to remove it from the main housing.

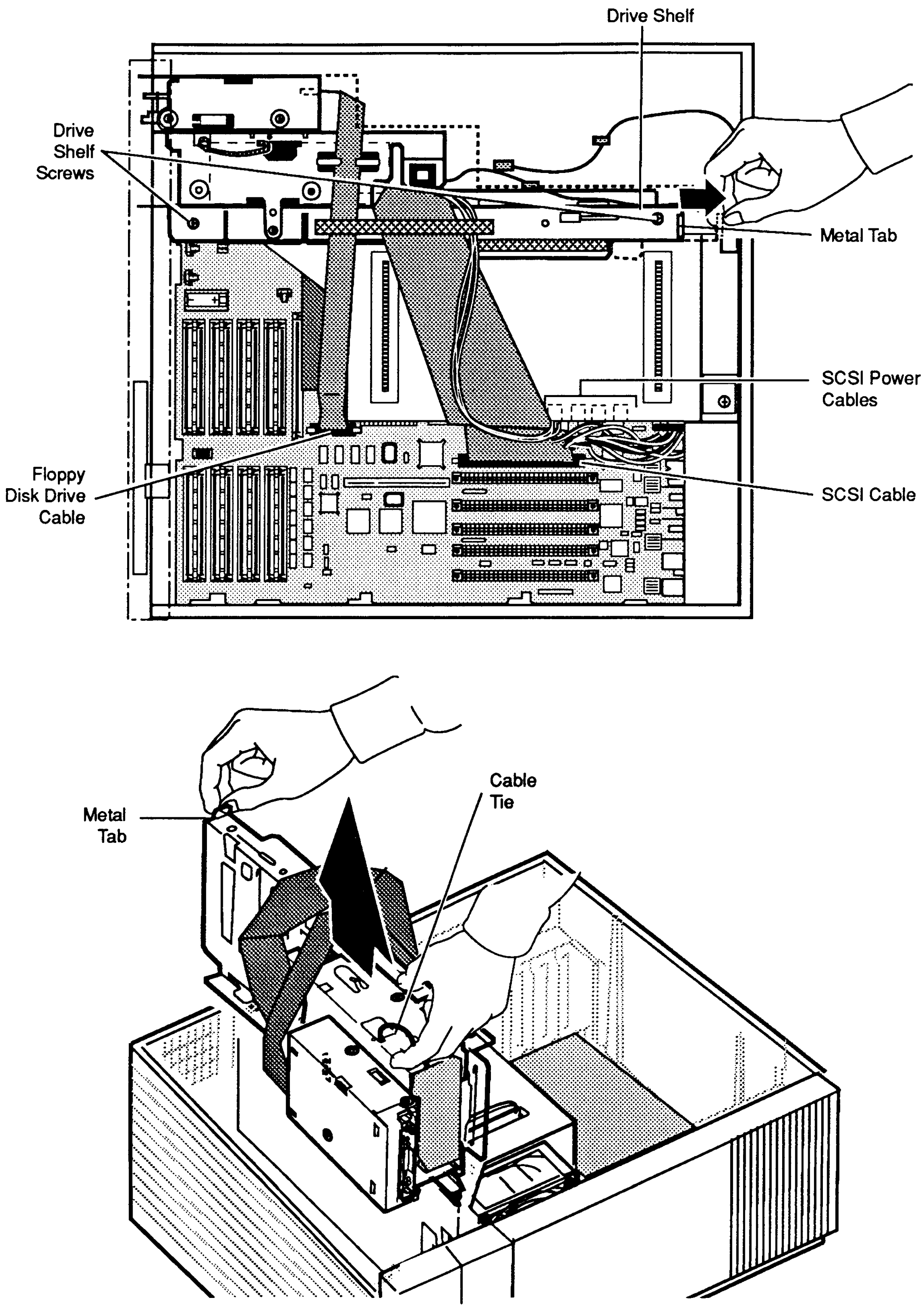


Figure 2-3 Removing the Drive Shelf

❑ DRIVE SHELF AND DISK DRIVES

To remove or install disk drives, you must remove the drive shelf. Also remove the drive shelf prior to removing the power supply. Removing the drive shelf is illustrated in **Figure 2-3**.

Drive Shelf

1. Disconnect the following cables:

    - Internal floppy disk drive cable from the logic board
    - SCSI cable from the logic board
    - SCSI power cable(s), if present, from the power supply

2. Remove the two drive shelf screws.

3. Slide the drive shelf toward the rear of the computer.

4. Grasp the cable tie on the lower-front drive carrier and the metal tab at the right of the drive shelf. Lift the drive shelf out of the case. Be careful that none of the cables catches on the case while you're removing the drive shelf.

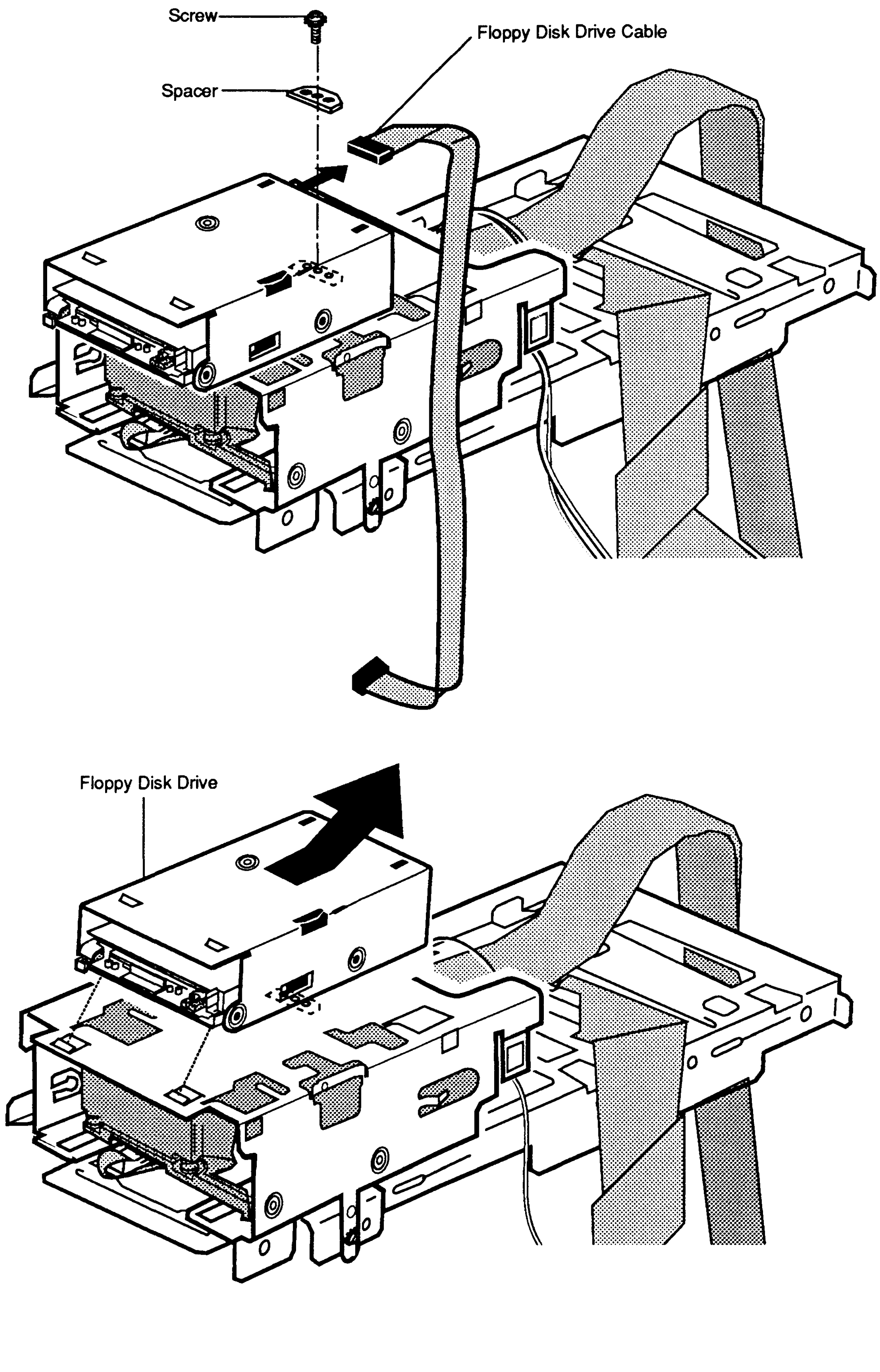


Figure 2-4 Removing the Apple SuperDrive

Apple SuperDrive

The removal of the Apple SuperDrive is illustrated in **Figure 2-4**.

1. Disconnect the internal floppy disk drive cable from the floppy disk drive.

2. Remove the screw and spacer that secure the drive.

3. Pull up the rear of the floppy drive and slide the drive toward the rear of the drive shelf. Remove the drive from the drive carrier.

IMPORTANT: *Apple strongly advises the use of dust shields on 1.4 MB floppy drives in all Macintosh Quadra 900 computers. All 1.4 MB replacement drives ship with the dust shield already installed. If you plan to install a dust shield on a current drive, however, you* ***must*** *clean the drive first. Follow the procedure in "Cleaning the Drive" in the Basics section of the FDHD/SuperDrive tab of the* Apple Service Technical Procedures.

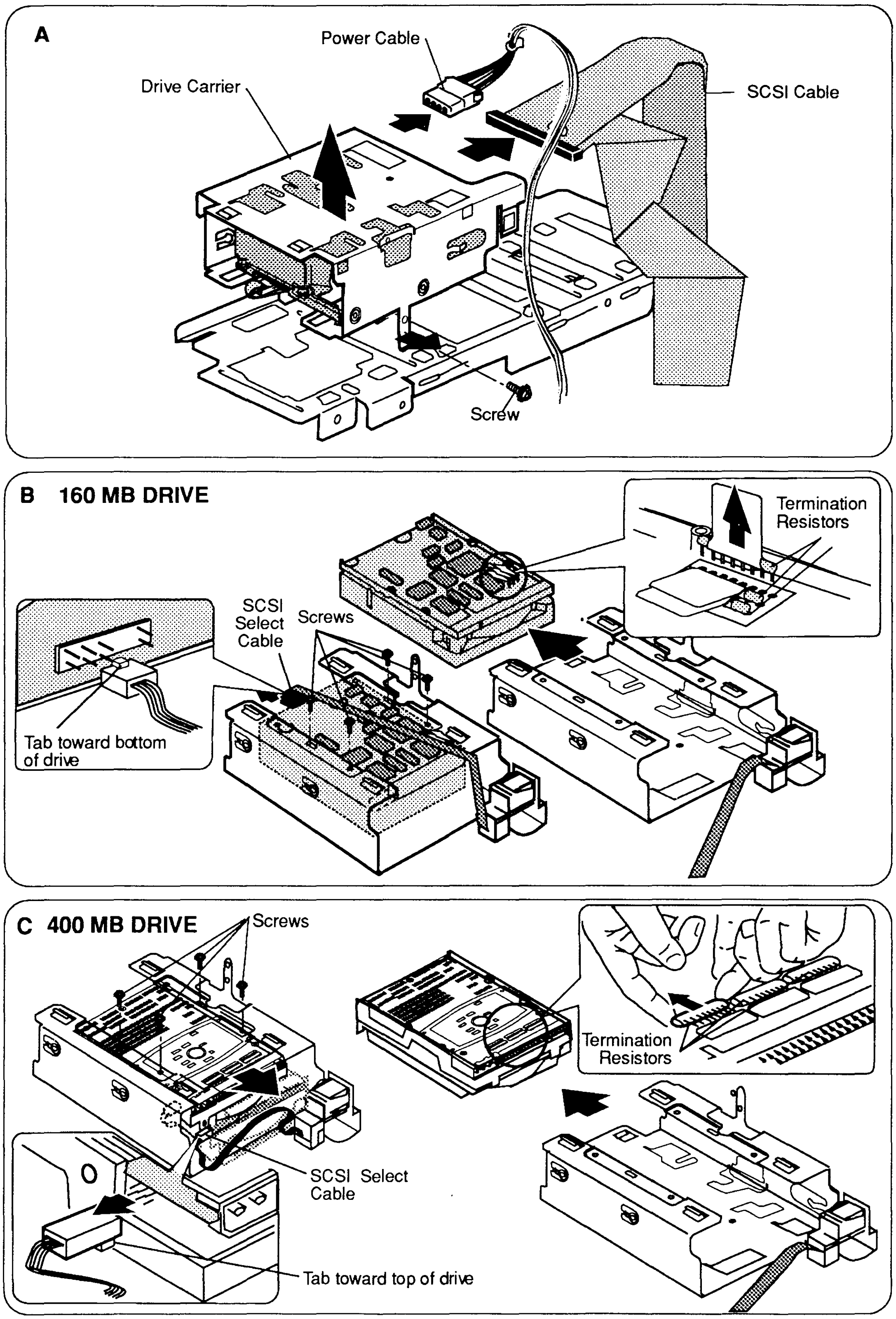


Figure 2-5 Removing the SCSI Disk Drive

SCSI Hard Disk Drive

Figure 2-5A illustrates removal of the drive carrier. This procedure assumes the disk drive is in the bottom-front drive position. The drive can also be in the top- or bottom-rear position; removal procedures are the same or analogous.

1. Remove the Apple SuperDrive.

2. Disconnect the SCSI cable and power cable from the hard disk drive.

3. Remove the Phillips screw that secures the drive carrier to the drive shelf and remove the drive carrier.

4. Gently place the drive carrier and hard disk drive upside down on the static mat.

Drive Carrier

Figures 2-5B and 2-5C illustrate removal of the 160 MB and 400 MB hard disk drives from the drive carrier.

1. Disconnect the SCSI select cable from the disk drive.

2. Remove the four Phillips screws that secure the drive to the drive carrier.

   - On 3.5-inch drives, the screws are on the bottom of the drive carrier.

   - On 5.25-inch drives, the screws are on the long sides of the drive carrier.

3. Slide the drive from the end of the drive carrier opposite the SCSI select switch.

Termination Notes

Before installing a replacement SCSI hard drive, remove the termination resistors. Apple ships all replacement SCSI hard drives with the termination resistors installed. Refer to **Figures 2-5B and 2-5C** to remove the resistors.

WARNING: *Failure to remove the termination resistors can result in damage to the Macintosh Quadra 900 logic board.*

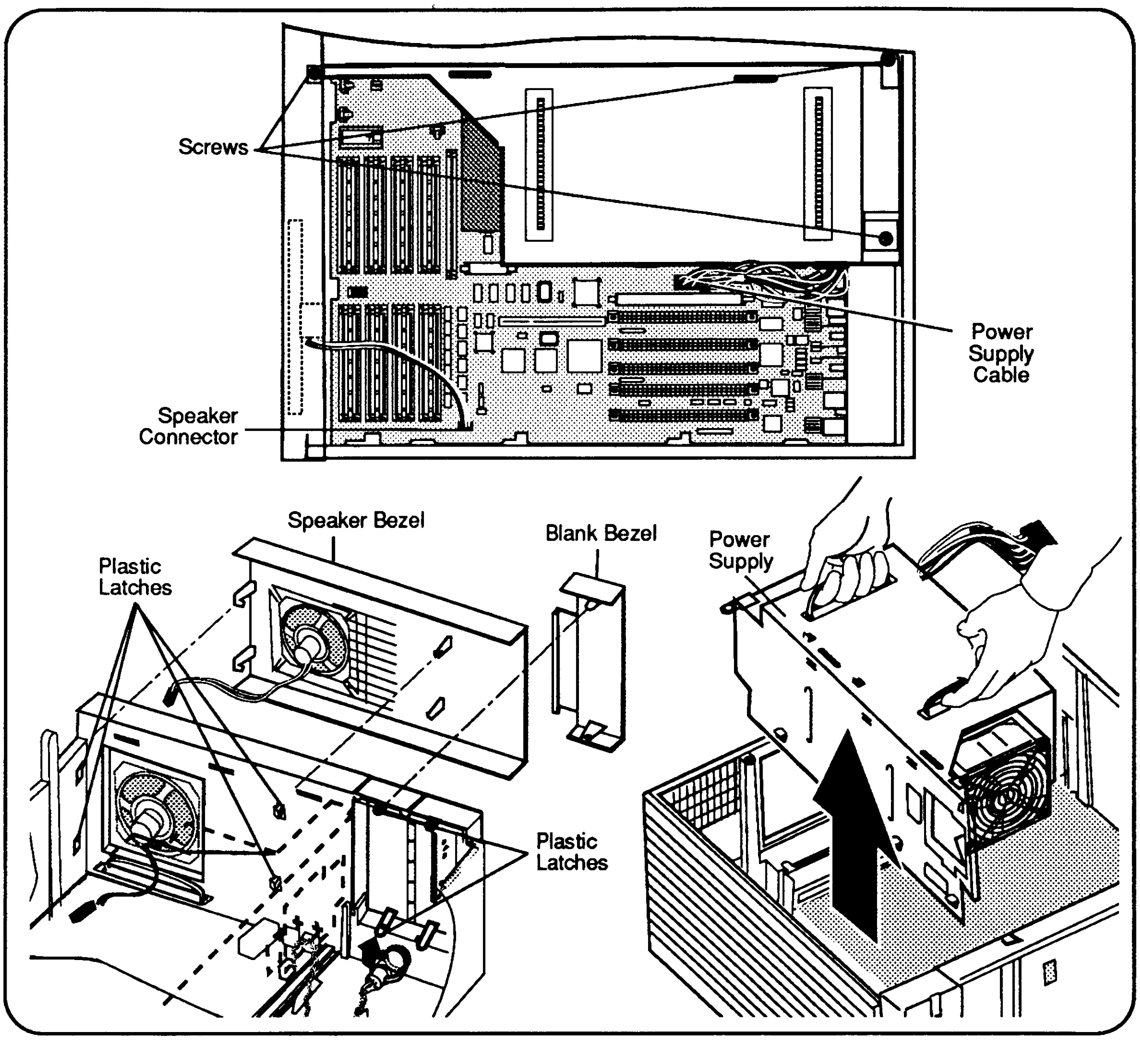


Figure 2-6 Removing the Power Supply

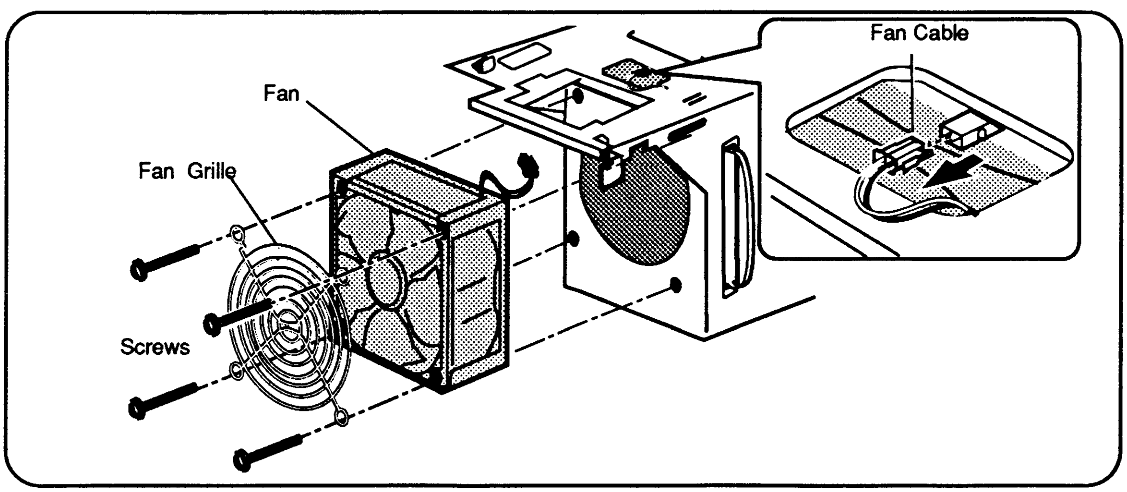


Figure 2-7 Removing the Fan

❑ POWER SUPPLY AND FAN

Power Supply

Figure 2-6 illustrates removal of the power supply.

1. Remove the drive shelf.
2. Remove the speaker bezel as follows:
   - Disconnect the speaker cable from the logic board.
   - Press up and out on the two plastic latches at the top of the speaker bezel.
   - Use a screwdriver to release the two latches at the bottom of the speaker bezel.
3. Disconnect the power supply cable from the logic board.
4. Remove the three screws that secure the power supply to the case.
5. Grasp the two plastic handles and pull the power supply from the case. To keep the power supply from binding, pull it evenly.

Fan

Figure 2-7 illustrates removal of the fan.

1. Press the fan connector latch and pull the connector from its mating socket.
2. Remove the four screws that secure the fan and fan grille. Remove the fan.

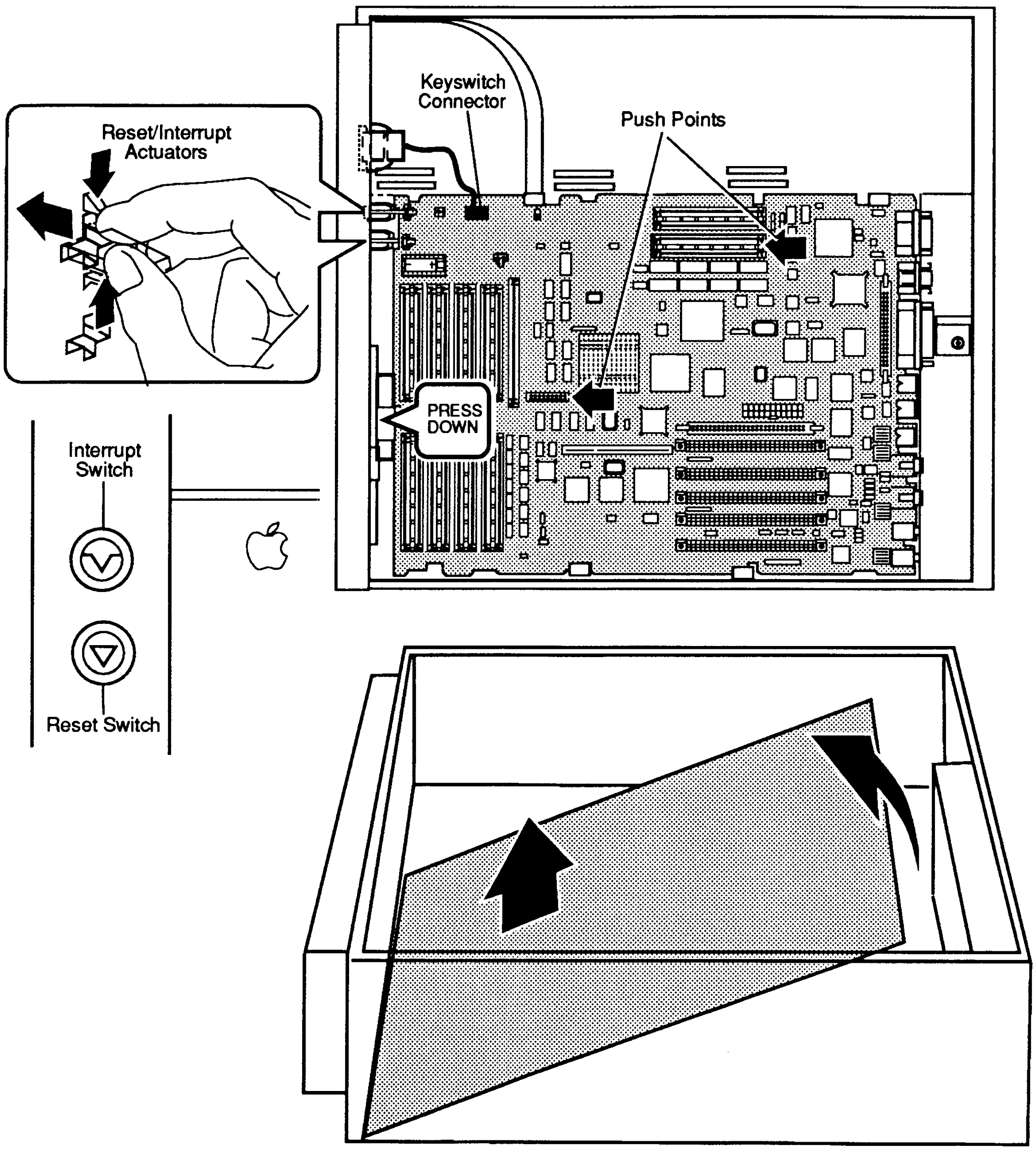


Figure 2-8 Removing the Logic Board

❑ LOGIC BOARD

Figure 2-8 illustrates removal of the logic board.

1. Remove the drive shelf and power supply.

2. Remove the *interrupt* and *reset* actuators by pressing the sides of the actuators and pushing the actuators away from the logic board and out of the case.

3. Disconnect the keyswitch cable from the logic board.

4. To remove the logic board

   - Press down on the latch that holds the logic board in place and slide the logic board toward the front of the case.

   - Raise the front of the logic board up and out of the case.

Macintosh Quadra 900

Section 3 – Diagnostics

❑ CONTENTS

There are currently no diagnostics available to test the Macintosh Quadra 900. When diagnostics are available, instructions will be provided in the *Macintosh Family Technical Procedures* under the *Macintosh Multiple-Product Diagnostics* tab.

Apple Technical Procedures

Macintosh Quadra 900

Section 4 – Troubleshooting

❑ CONTENTS

❑ INTRODUCTION

Before You Start

Before you begin troubleshooting, read the sections titled "Things to Remember," "Module Exchange Information," "Startup and Error Chords," "DRAM SIMM Verification," and "Battery Verification." You need the information provided in these sections to troubleshoot the Macintosh Quadra 900 effectively.

Things to Remember

- Follow all electrostatic discharge precautions when working on the Macintosh Quadra 900. Refer to the *You Oughta Know* tab in *Apple Service Technical Procedures* for additional information.

- Use a known-good monitor (if available) and connect it to the built-in video port. This strategy will isolate the problem to the CPU, internal drives, keyboard, and mouse.

- To ensure that customers get back the same configurations that they brought in, record the following information before beginning:

  - Type and serial number of NuBus or processor-direct slot cards

  - Size (3.5- or 5.25-inch) and capacity of internal SCSI drive(s)

  - Number (sets of four) and sizes (1 or 4 MB) of DRAM SIMMs installed

  - Whether a VRAM upgrade is installed

  At the end of this section is a form you can use to record the customer's system configuration.

- Before you begin troubleshooting, remove all NuBus and processor-direct slot cards and disconnect all external serial, Ethernet, SCSI, and ADB devices (except the keyboard and mouse). Detach the microphone and any devices connected to the audio output or line-input connectors.

  After the system is fully operational, install and test each option card or peripheral. Install one device and test the system before adding others. Repeat the install-and-test process until you install and test all devices.

- Mark each known-good DRAM SIMM on the exchange logic board with white correction fluid or a small sticker to prevent confusion during the troubleshooting procedure.

- During a normal startup sequence, a single, soft chord plays. If you do not hear a single, soft chord, refer to "Startup and Error Chords" for additional information.

- The Macintosh Quadra 900 requires system software 7.0.1 or later. If an earlier version of the system software is installed, install the correct version and reverify the failure before beginning troubleshooting. Many times, problems that appear hardware related are actually caused by software.

- When instructed to replace the **logic board**, install the **customer's DRAM and VRAM SIMMs** on the **replacement logic board**.

  Note: If you are removing DRAM or VRAM SIMMs from the logic board, use the SIMM removal tool. See the *You Oughta Know* tab for instructions.

❑ MODULE EXCHANGE INFORMATION

At the end of this section is a form you can use to record the customer's system configuration. Feel free to copy the form for your own use.

Procedures for removing and installing modules are in Section 2, Take-Apart.

Logic Board

To make sure the customer always receives the same logic board configuration that he or she brought in, be sure to record the following information before you exchange the logic board:

- The amount of DRAM SIMM memory
- Whether a VRAM upgrade is installed

Internal SCSI Hard Disk Drives

Apple ships some replacement SCSI hard disks without a power cable. If the replacement hard disk comes without a power cable, be sure to keep the power cable with the customer's system. For drives shipped without a power cable, the power cable sells as a separate replacement part and is not part of any module.

Return the defective module to Apple in the same packaging the replacement module arrives in. This packaging protects the module from damage during transit. Failure to properly package returned modules can result in additional charges.

Apple ships SCSI hard disks with the termination resistors installed. The termination resistors **must** be removed prior to installing the drive in the system. Procedures for removing the termination resistors are in Section 2, Take-Apart.

WARNING: *Failure to remove the termination resistors can result in damage to the Macintosh Quadra 900 logic board.*

Apple SuperDrive

Apple ships the Apple SuperDrive in a mounting bracket. To minimize possible damage, return drives to Apple with the mounting bracket attached.

Power Supply

The power supply module includes the fan. The fan and screws are also available as separate replacement parts.

❑ STARTUP AND ERROR CHORDS

Introduction

When you switch on the Macintosh Quadra 900, a sound resource stored in system ROM plays. This sound is called the startup chord and consists of a single, soft chord. After the startup chord plays, the computer runs a series of self-tests. If any part of the self-test fails, a sequence of error chords will sound.

Startup Chord

During a normal startup sequence, a single, soft chord plays; then a disk icon appears on the screen. The disk icon will have a flashing question mark (if a startup disk is not found) or a smiling face (if a startup disk is found).

Error Chords

One or two sets of chords play when an error occurs during startup. Depending upon the type of failure, you will hear either a two-part error chord (eight tones) or a shorter one-part error chord (four tones).

Refer to the list of failure areas below. The list includes a description of each error chord, the problem it indicates, and what to do to correct the problem.

Hardware Failure

When a hardware error occurs during the initial self-tests, the one-part error chord (four tones) plays after the startup chord. To correct the problem:

1. If the system boots from an internal SCSI disk drive, disconnect the SCSI cable from the logic board and restart the system. If the startup sequence is normal, try reinitializing the hard disk. If an error chord still sounds, replace the hard disk drive.

2. If the system boots from the internal floppy drive, disconnect the floppy drive cable and restart the system. If the startup sequence is normal, replace the floppy drive.

3. If you still hear the error chords at system startup, exchange the logic board. (Install the customer's DRAM and VRAM (if any) SIMMs on the exchange board.

DRAM SIMM Failure

When a DRAM SIMM failure occurs during the initial self-tests, a two-part error chord sequence, **with a pause between the two sequences**, plays after the startup chord. To correct the problem, refer to "DRAM SIMM Verification" later in this section.

❑ SYMPTOM CHART

How to Use the Symptom Chart

First find the symptom that most nearly describes the problem; then perform the first corrective action on the list. If the first corrective action does not fix the problem, go to the next action. If you replace a module and find that the problem remains, reinstall the original module before you procede.

Note: When instructed to replace the logic board, install the customer's DRAM and VRAM SIMMs on the exchange board.

System Problems	Solutions
• *Does not power on—screen is black, fan is not running, and LED is not lit*	1. Check the power cables. 2. Plug the monitor directly into the wall socket, and verify that the monitor has power. 3. Replace power cord. 4. Replace power supply. 5. Replace logic board.
• *Clicking, chirping, or thumping sound*	1. Replace power supply. 2. Replace logic board. 3. Replace floppy disk drive cable. 4. Replace floppy disk drive.
• *System shuts down intermittently*	1. Make sure that the air vents on the side cover and at the rear of the system unit are clear. Thermal protection circuitry may shut the system down. After 30 to 40 minutes the system should be OK. 2. Replace power cord. 3. Check the voltage of the lithium battery on the logic board. If the battery voltage is below 3.2 volts, replace the battery. 4. Replace power supply. 5. Replace logic board.
• *System intermittently crashes or hangs*	1. Make sure system software is version 7.0.1 or later. 2. Verify that the software (applications, INITs, CDEVs, RDEVs, etc.) is System 7 compatible. 3. Identify and replace defective DRAM SIMMs (refer to "DRAM SIMM Verification"). 4. Replace logic board. 5. Replace power supply.

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. If a video interface card is being used with the monitor, move the card to a different slot. 5. If a video interface card is being used with the monitor, replace card. 6. Identify and replace defective DRAM SIMMs (refer to "DRAM SIMM Verification"). 7. Replace logic board. 8. Replace power supply.
• *Screen is black, audio and drive do not operate, fan is running, and LED is lit*	1. Replace video cable. 2. Move video interface card (if installed) to a different slot. 3. Replace video interface card (if installed). 4. Identify and replace defective DRAM SIMMs (refer to "DRAM SIMM Verification"). 5. Replace logic board. 6. 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 interface card (if installed) to a different slot. 4. Replace video interface card (if installed). 5. Replace logic board.

Note: If replacing the monitor corrects the video problem, refer to the appropriate monitor *Technical Procedures* for monitor troubleshooting information.

Apple SuperDrive Problems	**Solutions**
• *Drive runs continuously*	1. Replace bad floppy disk. 2. Replace floppy disk drive cable. 3. <u>Replace floppy disk drive</u>. 4. <u>Replace logic board</u>.
• *Drive does not operate*	1. Verify that the keyswitch is not set to *secure*. 2. Replace bad floppy disk. 3. Replace floppy disk drive cable. 4. <u>Replace floppy disk drive</u>. 5. <u>Replace logic board</u>. 6. <u>Replace power supply</u>.
• *During system startup, disk ejects; display shows icon with blinking "X"*	1. Replace disk with known-good system disk. 2. Replace floppy disk drive cable. 3. <u>Replace floppy disk drive</u>. 4. <u>Replace logic board</u>.
• *Will not eject disk*	1. Verify that the keyswitch is not set to *secure*. 2. Switch power off and hold mouse button down while switching power back on. 3. <u>Replace floppy disk drive</u>. 4. Replace floppy disk drive cable. 5. <u>Replace logic board</u>.
• *Drive attempts to eject disk, but disk does not eject*	1. Reinsert disk and try to eject disk again. 2. Reseat floppy drive bezel and/or disk drive so the slot in the bezel aligns correctly with the disk drive. 3. Try ejecting disk manually with a paper clip.
• *MS-DOS drive does not recognize a disk formatted on an Apple SuperDrive*	– Format all disks with the MS-DOS drive first.

SCSI Hard Disk Drive Problems	**Solutions**
• *A single internal SCSI drive will not operate; drive doesn't spin*	1. Replace SCSI cable. 2. Replace SCSI power cable. 3. Replace SCSI drive.
• *No internal SCSI drives will operate*	1. Verify that each SCSI device has a unique SCSI device address. 2. Replace SCSI cable. 3. Replace power supply. 4. Replace logic board.
• *Drive does not appear on the desktop*	1. Verify that each SCSI device has a unique SCSI device address. 2. The drive may not be initialized. Use *HD SC Setup* to initialize the drive.
• *Works with internal or external SCSI devices but will not work with both*	1. Verify that each SCSI device has a unique SCSI device address. 2. Replace the external SCSI terminator. 3. Verify that the internal SCSI drives are not terminated. 4. Refer to the apropriate *Apple Service Technical Procedures* for troubleshooting the external device.

Peripheral Problems	Solutions
• *Cursor does not move*	1. Verify that the keyswitch is not set to *secure*. 2. Check mouse connection. 3. Inspect the inside of the mouse for a buildup of dirt and other contaminants. Clean the mouse if necessary. 4. If the mouse was connected to the keyboard, connect the mouse to the rear ADB port instead. If the mouse works, replace the keyboard. 5. If the mouse does not work in any ADB port, replace the mouse. 6. Replace logic board.
• *Cursor moves, but clicking the mouse button has no effect*	1. Replace the mouse. 2. Replace logic board.
• *No response to any key on the keyboard*	1. Verify that the keyswitch is not set to *secure*. 2. Verify the keyboard connection to the ADB port. 3. Replace keyboard cable. 4. Replace keyboard. 5. Replace logic board.
• *Cannot double-click to open an application, disk, or server*	1. Remove multiple system files on the hard disk. 2. Clear parameter RAM. Hold down the <Option> <Command><R> and <P> keys during system startup. Reset mouse controls. 3. If the mouse was connected to the keyboard, connect the mouse to a rear ADB port instead. If mouse works, replace keyboard. 4. If mouse does not work in any ADB port, replace mouse. 5. Replace logic board.

• *Known-good serial printer will not print*	1. Make sure the system software is version 7.0.1 or later. 2. Make sure that the Chooser settings are correct. 3. Replace printer interface cable. 4. Replace logic board.
• *Known-good printer on an AppleTalk network will not print*	1. Make sure the system software is version 7.0.1 or later. 2. Make sure that the Chooser settings are correct. 3. Refer to the *Networks* tab in *Apple Service Technical Procedures* for more information.

Miscellaneous Problems	**Solutions**
• *No sound from speaker*	1. Verify that the Speaker Volume setting in the Sound Control Panel is one or above. 2. Replace speaker. 3. Replace logic board.

❑ DRAM SIMM VERIFICATION

Introduction

The DRAM SIMMs installed on the customer's logic board may be defective. To check for defective DRAM SIMMs, remove all of the customer's DRAM SIMMs and install known-good DRAM SIMMs. Mark each known-good DRAM SIMM with a dot of white correction fluid or a small sticker. Whatever you use, be sure it will not come off while you are testing.

Materials Required

SIMM removal tool
Four known-good DRAM SIMMs (80 nsec or faster) that are the same size (1 or 4 megabyte) as the DRAM SIMMs you are verifying. If the system has both sizes of DRAM SIMMs, you'll need four of each size.

Isolating a Defective DRAM SIMM

1. Remove the side cover.

2. Remove all the customer's DRAM SIMMs.

   Note: Use the configuration chart at the end of this section to record the number and the sizes of the DRAM SIMMs. The customer should get back the same number and sizes. Refer to the *Apple Technical Procedures SIMM Quick Reference Chart* for information on identifying the DRAM SIMMs.

3. **Figure 4-1**. Install four known-good DRAM SIMMs in Bank A and switch on the system.

   If you hear the normal startup sound, the system is working properly and you can proceed to test the customer's DRAM SIMMs.

4. Switch the system off, remove one of the known-good DRAM SIMMs, and install one of the customer's DRAM SIMMs.

5. Switch on the system. If you hear the normal startup sound, the customer's DRAM SIMM is good.

6. Repeat steps 4 and 5 to test each DRAM SIMM. Be sure to set defective DRAM SIMMs where you will not mix them with good ones.

❑ BATTERY VERIFICATION

Introduction

The lithium battery on the main logic board supplies power to the real-time clock and parameter RAM. If the battery falls below specifications, you must remove and replace the battery.

WARNING: *Lithium batteries have a potential for explosion if improperly handled. Follow the procedure below exactly.*

Materials Required

Voltmeter

Verification Procedure

1. Remove the side cover.
2. Remove the battery cover.
3. Set the voltmeter range to 10 volts DC.
4. Touch and hold the **positive probe** of the voltmeter to the **positive side** of the battery.
5. Touch and hold the **ground probe** of the voltmeter to the **negative side** of the battery.
6. The reading for a good battery should be **3.2 volts or higher**. **If the battery measures below 3.2 volts, replace the battery.**

❑ CUSTOMER'S CONFIGURATION CHART

You may copy the chart on the following page and use it to keep track of a customer's system configuration. Attach the completed chart to the system. The chart will help you make absolutely sure that the customer receives the same configuration that he or she brought in.

CUSTOMER CONFIGURATION CHART

Customer ______________________

Model ______________________

Serial Number ______________________

Internal Disk Drives

Top Front

- ☐ Apple SuperDrive
- ☐ SCSI Hard Disk ______ MB
  - ☐ 3.5-Inch
  - ☐ 5.25-Inch
- ☐ Other ______________

Top Rear

- ☐ SCSI Hard Disk ______ MB
  - ☐ 3.5-Inch
  - ☐ 5.25-Inch
- ☐ Other ______________

Bottom Front

- ☐ SCSI Hard Disk ______ MB
  - ☐ 3.5-Inch
  - ☐ 5.25-Inch
- ☐ Other ______________

Rear Front

- ☐ SCSI Hard Disk ______ MB
  - ☐ 3.5-Inch
  - ☐ 5.25-Inch
- ☐ Other ______________

NuBus / PDS Cards

	Type	Serial Number
Slot 1		
Slot 2		
Slot 3		
Slot 4		
Slot 5		
Slot 6		
PDS Slot		

DRAM SIMMs

Bank A	Bank B	Bank C	Bank D
☐ 1 MB	☐ 1 MB	☐ 1 MB	☐ 1 MB
☐ 4 MB	☐ 4 MB	☐ 4 MB	☐ 4 MB

VRAM SIMMs Upgrade

☐ **Installed** ☐ **Not Installed**

Macintosh Quadra 900

Section 5 – Additional Procedures

❑ CONTENTS

❑ DRAM SIMM UPGRADES

Introduction

DRAM SIMMs for the Macintosh Quadra 900 are available with two sizes of RAM (1 MB and 4 MB) and come in several configurations that you can use interchangeably. Consult the *Apple Service Technical Procedures SIMM Quick Reference Chart* for current SIMM identification information.

You must use 80 ns (or faster) DRAM SIMMs on the Macintosh Quadra 900. DRAM SIMMs with a slower rating will cause serious timing problems and system crashes. The RAM speed is usually indicated by the *-xx* number after the manufacturer's part number. For example, *-12* indicates 120 ns DRAMs, *-10* indicates 100 ns DRAMs, *-8* indicates 80 ns, and *-6* indicates 60 ns.

Installation and Handling

Note: Use the SIMM removal tool to remove SIMMs. See the *You Oughta Know* tab for instructions on using the removal tool.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Configurations

Various DRAM SIMM configurations are possible, depending on the number and size of the DRAM SIMMs that you install on the logic board.

Figure 5-1. The logic board has four banks of DRAM SIMM sockets (Bank A, Bank B, Bank C, and Bank D). Each bank contains four slots.

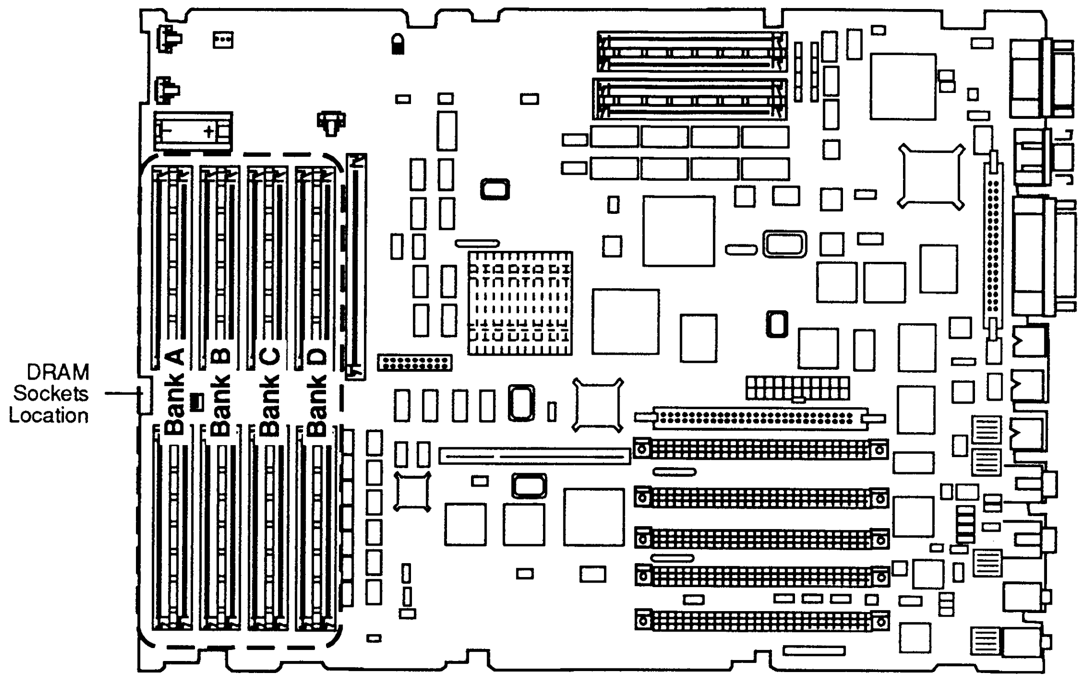


Figure 5-1 DRAM SIMM Socket Locations

When installing DRAM SIMMs, the following rules apply:

- All four slots within a bank must be empty or have four DRAM SIMMs of the same RAM size (1 MB or 4 MB).
- Do not partially fill a bank; fill all four slots of a bank or leave all four slots empty.

CAUTION: *Other configurations, such as a single SIMM or differently sized SIMMs in a bank, will not function correctly.*

❑ VRAM SIMM UPGRADES

Introduction

The Macintosh Quadra 900 ships with 1 megabyte of video RAM (VRAM) standard. You may increase video RAM to 2 megabytes by installing four VRAM SIMMs.

You must use 100 ns (or faster) VRAM SIMMs on the Macintosh Quadra 900. VRAM SIMMs with a slower rating will cause video timing problems.

Table 5-1 indicates the amount of video RAM needed for various monitor sizes and pixel depth combinations.

	Number of colors or shades of gray	
Monitor	**1 MB VRAM**	**2 MB VRAM**
Macintosh 12-Inch Monochrome	256	millions
Macintosh 12-Inch RGB	millions	millions
Apple High-Res RGB (13-Inch)	256	millions
Apple Macintosh Portrait Display	256	256
Apple Two-Page Monochrome	256	256
Macintosh 21-Inch Color	256	256
16-Inch Color	256	millions
VGA	256	millions
Super VGA	256	millions
NTSC	256	millions
NTSC with convolution	256	256
PAL	256	millions
PAL with convolution	256	millions

Table 5-1 Video RAM Configurations for Monitor Size and Pixel Depth

Installation and Handling

To install the VRAM SIMMs, you must first remove the drive shelf and power supply. Instructions are in Section 2, Take-Apart.

Note: Use the SIMM removal tool to remove VRAM SIMMs. See the *You Oughta Know* tab for instructions on using the removal tool.

CAUTION: *SIMMs are very susceptible to damage from ESD and skin acid. Handle only by the edges!*

Configurations

To upgrade the VRAM to 2 MB, you must install four VRAM SIMMs (one upgrade kit in socket J3 and one in socket J4). Refer to **Figure 5-2** for VRAM SIMM socket locations.

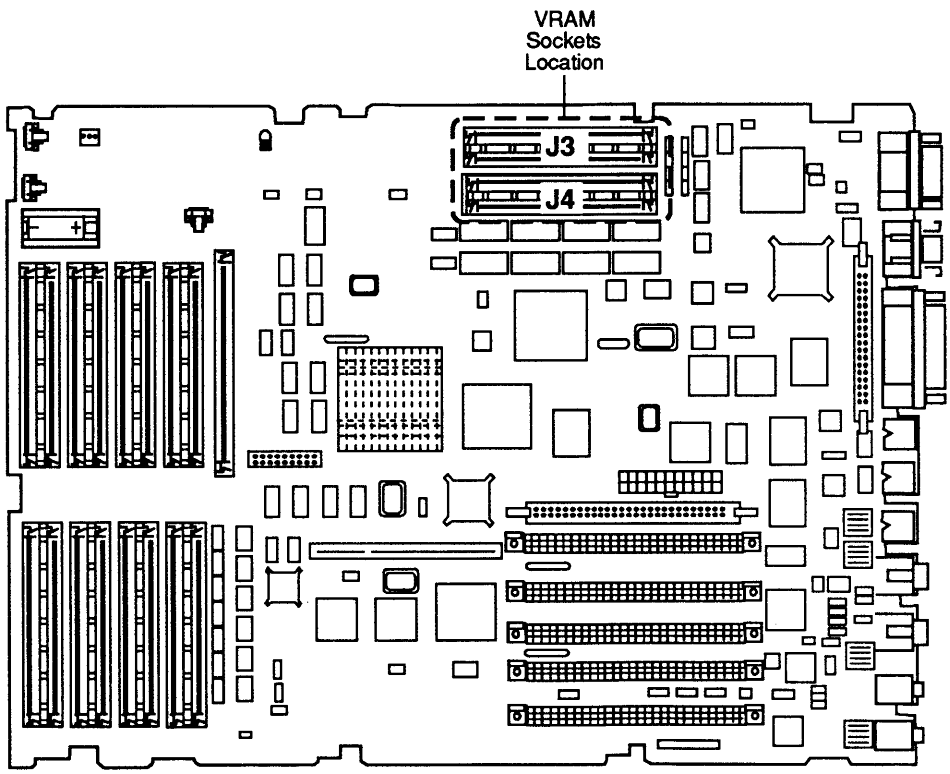


Figure 5-2 VRAM SIMM Socket Locations

 Apple Technical Procedures

Macintosh Quadra 900

Illustrated Parts List

❑ CONTENTS

Note: The figures and lists in this section include all piece parts that you can purchase separately from Apple for the Macintosh Quadra 900, along with their part numbers. ADB input devices for Macintosh computers now have their own tab section. Please refer to *Macintosh Family Technical Procedures* for ADB input devices. The items listed in this section are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

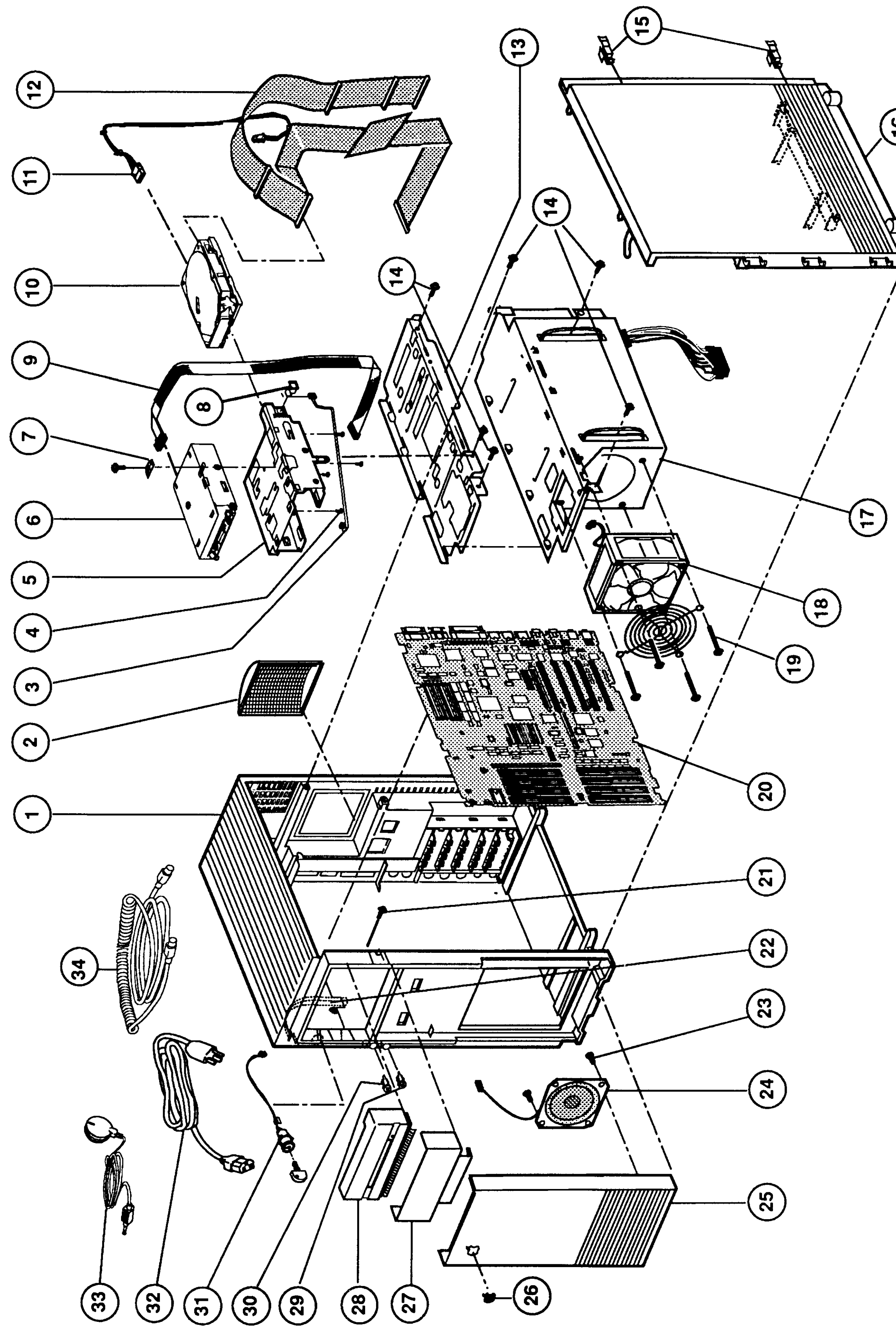


Figure 1 System Exploded View

❑ SYSTEM EXPLODED VIEW (Figure 1)

Item	Part No.	Description
1	076-0434	Main Housing Assembly (includes product label, NuBus slot covers, fan exhaust vent cover, and light pipe)
2	076-0432	Cover, Fan Exhaust Vent (also included with main housing)
3	590-0518	Cable, SCSI Device Select (for use with 661-1641)
	590-0790	Cable, SCSI Device Select (for use with 661-1636)
4	444-6104	Screw, 6-32 x .25
5	805-5106	Hard Drive Carrier (3.5- or 5.25-Inch)
6	661-0474	Apple SuperDrive (1.4 MB floppy drive)
7	805-5113	Apple SuperDrive Spacer (included in screw kit)
8	705-0045	Switch, SCSI Device Select
9	590-0515	Cable, Apple SuperDrive
10	661-1641	HDA, 160 MB, 3.5-Inch (without carrier)
	661-1636	HDA, 400 MB, 3.5-Inch (without carrier)
11	590-0517	Cable, HDA Power
12	590-0528	Cable, SCSI (with terminator)
13	630-6097	Drive Shelf Assembly (includes Velcro cable straps)
14	462-4100	Screw, Metric 3.5 x .6 x .8 PNCR Rec
15	815-6262	Side Cover Latch
16	076-0436	Side Cover Assembly (includes NuBus card guides)
17	661-0664	Power Supply (includes fan)
18	720-0518	Power Supply Fan
19	462-4400	Screw, Metric 3.5 x 45 SEM Machine (included in screw kit)
20	661-0665	Logic Board (without DRAM/VRAM SIMMs)
21	420-1001	Screw, Metric 3.5 x .610, Self-Tapping (included in screw kit)
22	815-6251	Light Pipe, Power LED (also included with main housing)
23	462-4101	Screw, Metric 3.5 x 6, Pan-Head Machine (included in screw kit)
24	630-6011	Speaker Assembly
25	076-0433	Speaker Bezel Assembly
26	825-1256	Apple Logo
27	076-0431	Blank Bezel Assembly
28	076-0437	Floppy Drive Bezel Assembly
29	815-6249	Reset Actuator
30	815-6250	Interrupt Actuator
31	705-0175	Keyswitch (with two keys)
32	590-0760	Cable, AC Power
33	699-5073	Microphone Assembly
34	590-0152	Cable, ADB, 2 Meter

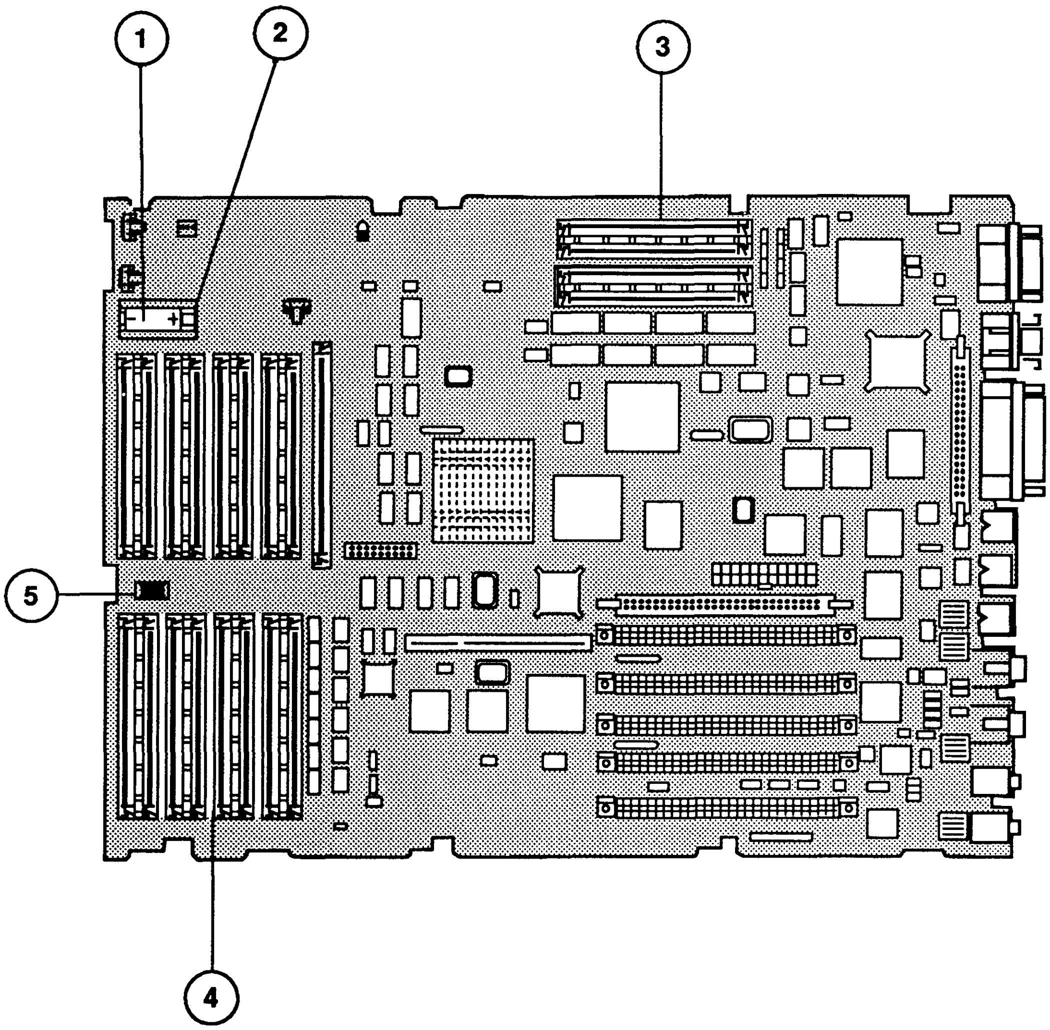


Figure 2 Logic Board Components

❑ LOGIC BOARD COMPONENTS (Figure 2)

Item	Part No.	Description
1	742-0011	Lithium Battery
2	520-0344	Battery Holder Cover
3	661-0609	VRAM SIMM, 256K, 100 ns
	661-0722	VRAM SIMM, 256K, 80 ns
4	661-0520	DRAM SIMM, 1 MB, 80 ns
	661-0719	DRAM SIMM, 1 MB, 80 ns
	661-0546	DRAM SIMM, 1 MB, 80 ns, Parity
5	517-0546	Jumper Connector (package of 10)

❑ MISCELLANEOUS ITEMS

Item	Part No.	Description
–	076-0439	Dust Shield, 1.4 MB Apple SuperDrive, Package of 5
–	602-0282	Service Packaging, HDA, 3.5-Inch, Half-Height
–	602-0210	Service Packaging, 3.5-Inch Floppy Drives
–	805-5050	Shipping Fixture, Apple SuperDrive
–	003-0003	Packing Disk, Apple SuperDrive
–	076-0435	Miscellaneous Screw Kit Includes:

420-1001	Screw, Metric 3.5 x .610, Self-Tapping
462-4101	Screw, Metric 3.5 x 6, Pan-Head Machine
462-4400	Screw, Metric 3.5 x 45, SEM Machine
805-5113	Apple SuperDrive Spacer

Macintosh Multiple-Product Diagnostics

Technical Procedures

❑ TABLE OF CONTENTS

Section 1 – MacTest MP

Illustrated Parts List – Apple TechStep

Macintosh Multiple-Product Diagnostics

Illustrated Parts List – Apple TechStep

❑ CONTENTS

Note: The figures and lists in this section include all piece parts that you can purchase separately from Apple for Apple TechStep, along with part numbers. The items in this section are the only parts available from Apple. Refer to your *Apple Service Programs* manual for prices.

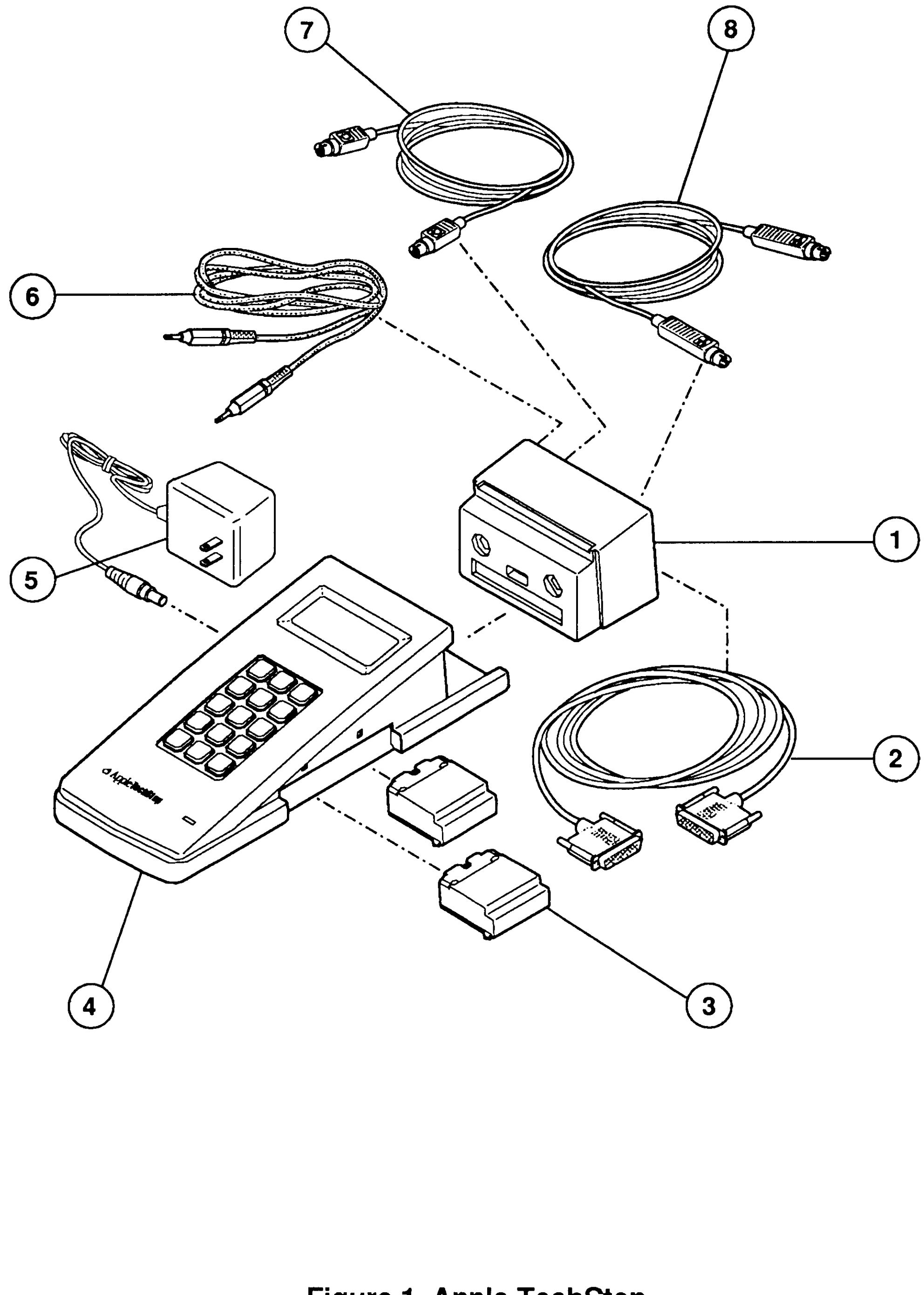


Figure 1 Apple TechStep

❑ Apple TechStep (Figure 1)

Item	Part No.	Description
–	699-0578	Carrying Case
1	076-0574	Port Pack
2	590-0623	Cable, SCSI
3	076-0572	ROM Pack, CPU Tests, Volume 1, v. 1.0
	076-0573	ROM Pack, SCSI HD Tests, v. 1.0
4	661-0703	Assembly, Apple TechStep (without port or ROM packs)
5	077-8668	Power Adapter, U.S.
	B077-8668	Power Adapter, U.K.
	JA077-8668	Power Adapter, Japan
	X077-8668	Power Adapter, Australia
	Z077-8668	Power Adapter, Europe
6	590-4512	Cable, Stereo
7	590-0552	Cable, Mini DIN-8, 2-meter
8	590-4501	Cable, ADB, 2-meter

Macintosh Multiple-Product Diagnostics

Section 1 – MacTest MP

❑ CONTENTS

❑ INTRODUCTION TO MACTEST MP

MacTest™ MP is a disk-based confidence program that isolates and identifies faults in malfunctioning **Macintosh IIfx, Macintosh IIsi, Macintosh LC, and Macintosh Classic® II** computers. After completing repairs, use the program to verify proper system operation.

In addition, use *MacTest MP* with **any** Macintosh II family computer to test the following Apple peripherals and monitors:

- Internal and external floppy disk drives
- Apple monitors (adjustment test patterns)
- Apple video cards

MacTest MP does not test hard disk drives. To test a hard disk drive, use the *Macintosh Hard Disk Test.* Procedures for using *Macintosh Hard Disk Test* are in Section 3, Diagnostics, in *SCSI Hard Disk Drives Technical Procedures.*

IMPORTANT: *If your customer's Macintosh IIfx or Macintosh IIsi contains a Macintosh Display Card 8•24GC, you must remove 8•24GC INITs from the System Folder before running* MacTest MP. *Failure to remove 8•24GC INITs from the System Folder will hang* MacTest MP.

Overview

The *MacTest MP* main window in **Figure 3-1** includes the following functions:

- Program controls
- System configuration information
- Logic board test selections
- Other test selections (floppy drive, ADB communications, Apple expansion and video cards, and Apple monitors)
- Testing status indicator
- Test log indicator

Note: The arrangement of items within the main window will depend on the size of the monitor and the system to which the monitor is connected.

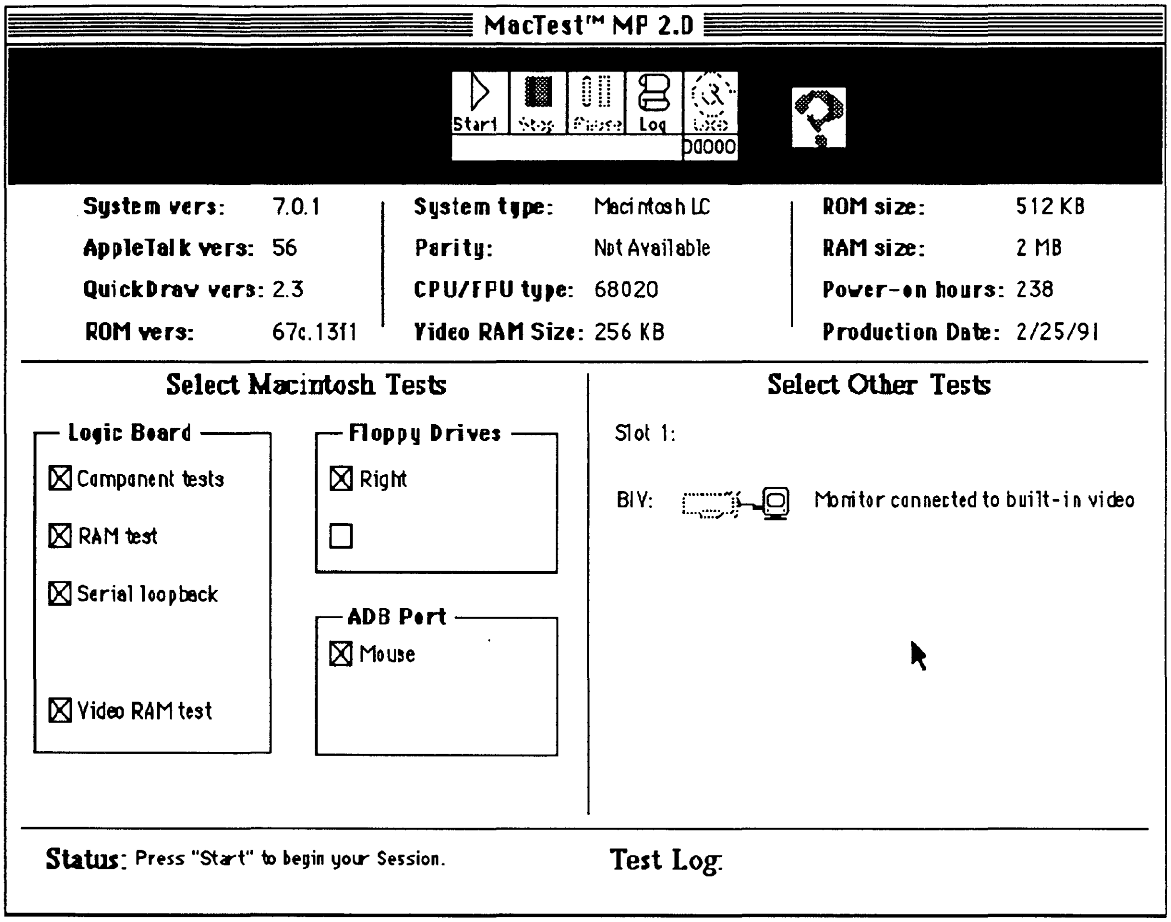


Figure 3-1 Main Window for 12-Inch Monitor with Macintosh LC

Each time a test sequence runs, *MacTest MP* stores the results temporarily in a test log. By selecting (highlighting) the Log icon, you can display a window containing the contents of the current test log. You can save, print, and customize the test log in this window to include the name and address of the customer and the service center (see Setting Preferences under "Operating MacTest MP"). You can also open, add to (if the system configuration and tests selected are the same), and print saved test logs.

Note: If you are unable to print an open Test Log, save the Test Log, reboot *MacTest MP*, and try printing the log again.

Features

Figure 3-2. *MacTest MP* has the following features:

- Easy-to-use program controls. The bar of icons along the top of the main window controls the operation of the diagnostic program (Start, Stop, and Pause) and includes three additional features:
  - A Log icon, which when selected (highlighted) displays a log of the test in progress or just completed. You can print test logs, save them, and customize them with service center and customer data.
  - A Looping icon, which when selected (highlighted) repeats the selected tests to find problems that occur intermittently or after a delay.
  - A Question Mark icon, which provides assistance for some test failures. The Question Mark icon is gray except when it contains additional service information.

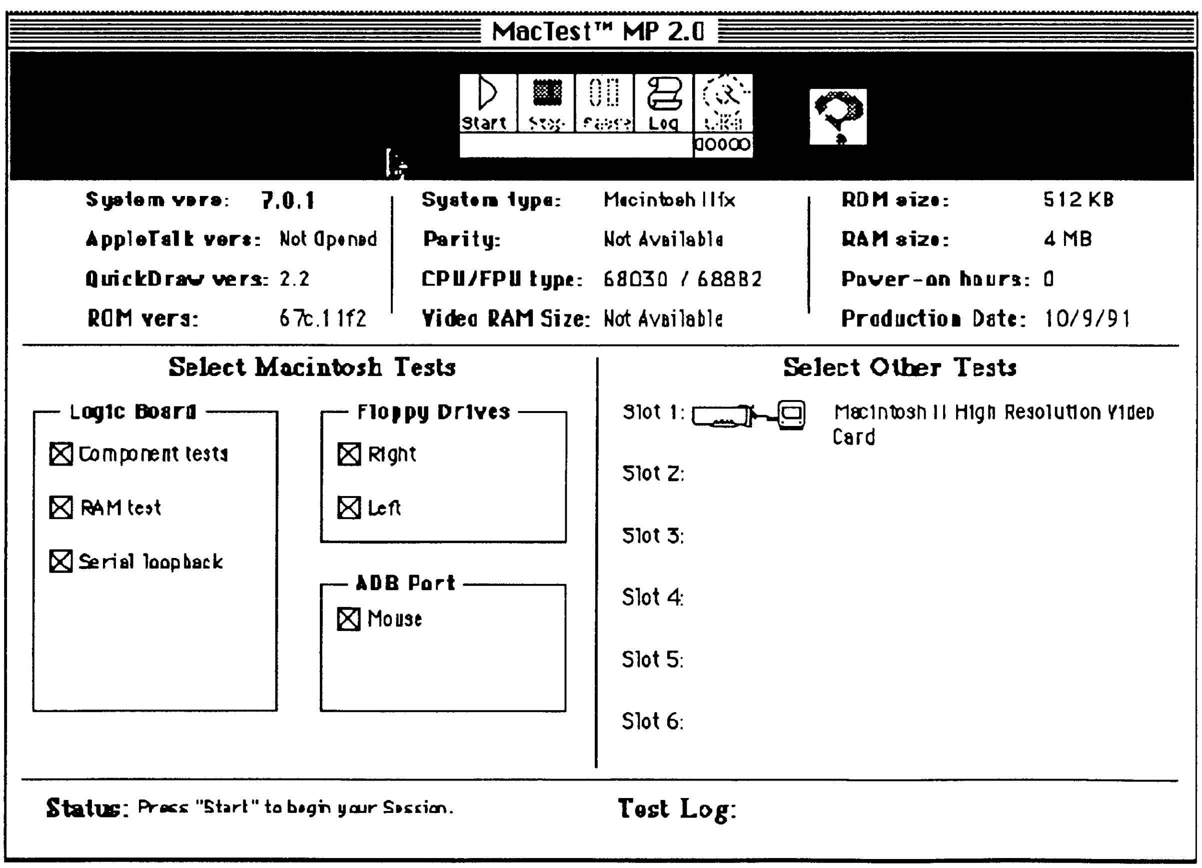


Figure 3-2 Main Window for 13-Inch Monitor with Macintosh IIfx

- System configuration information—including system software, AppleTalk, QuickDraw, and ROM versions; system and processor types; amount of system RAM and ROM; parity checking; amount of video RAM; date of manufacture; and the number of hours under power.

- Selectable logic board tests—for components, system RAM, serial loopback circuitry, and video RAM. The logic board component tests examine Macintosh computers as follows.

  Tested on the IIfx, IIsi, and LC:
  - ROM (read-only memory) chips
  - SCC (serial communications controller) chip
  - SWIM (Sanders-Woz Integrated Machine) disk drive controller chip
  - VIA (versatile interface adaptor) chip
  - SCSI registers

  Tested on the Macintosh IIfx:
  - FPU (floating-point unit) chip
  - ASC (Apple sound chip)
  - FMC (fast memory controller) chip
  - OSS (operating system support) chip

  Tested on the Macintosh IIsi:
  - RBV (RAM-based video) chip
  - FPU (floating-point unit)

  Tested on the Macintosh LC:
  - BIV (built-in video) chips
  - CLUT (color look-up table) chip

  Tested on the Macintosh Classic II:
  - VIA (versatile interface adaptor) chip
  - SCC (serial communications controller) chip
  - RBV (RAM-based video) chips
  - ADB communication

- Selectable tests of the internal and external floppy drives (external on the Macintosh IIcx, IIci, IIsi, and Classic II only) and of system-to-mouse Apple Desktop Bus (ADB) communications.

- Tests for Apple video cards in the NuBus slots. *MacTest MP* tests these Apple video cards:

  - Macintosh II Monochrome Video Card
  - Macintosh II Video Card
  - Macintosh II High-Resolution Display Video Card
  - Macintosh II Extended High-Resolution Display Video Card
  - Macintosh II Two-Page Monochrome Video Card
  - Macintosh Display Card 4•8
  - Macintosh Display Card 8•24
  - Macintosh Display Card 8•24GC (Before testing this card, be sure to remove 8•24GC INITs from the System Folder.)
  - Macintosh II Portrait Video Card (You must attach a monitor to the installed card. For the monitor test patterns to function, you must use a Video Card Expansion Kit (8 RAM chips) to upgrade the Macintosh Portrait Video Card.)

- Tests for other Apple cards:

  - Macintosh IIci Cache Card Revised
  - Apple IIe Card (Macintosh LC only)
  - EtherTalk® NB Card (test works on the Macintosh II, IIx, IIcx, and IIfx—but **not** on the IIci and IIsi)

- Test patterns for adjusting Macintosh monitors (select the Monitor icon and click **Start**). *MacTest MP* contains test patterns for adjusting the following Apple Macintosh monitors:

  - Apple High-Resolution Monochrome Monitor
  - AppleColor™ High-Resolution RGB Monitor
  - Apple Macintosh Portrait Display
  - Apple Two-Page Monochrome Monitor
  - Macintosh 12-Inch Monochrome Display
  - Macintosh 12-Inch RGB Display

❑ STARTING MACTEST MP

Materials Required

Macintosh IIfx, IIsi, LC, or Classic II (You can run *MacTest MP* on a Macintosh II, IIx, IIcx, or IIci to test cards and monitors, but *MacTest MP* will not test the II, IIx, IIcx, and IIci logic boards.)
Macintosh monitor and video cable
ADB keyboard and mouse
MacTest MP diagnostic disk (backup copy)
Peripheral-8 serial interface cable (required only for serial loopback test)
Blank 800K or 1.4 MB floppy disk (required only for floppy drive test)

Note: **Make a backup copy** of the *MacTest MP* diagnostic disk before you begin. When testing a defective system, you can damage or erase the disk.

Note: If you plan to test system RAM or loop on tests including the RAM test, **make *MacTest MP* the boot disk and application**. Select the *MacTest MP* Application icon, select **Set Startup** from the Special menu, and click **OK**. You must unlock (write-enable) your *MacTest* copy.

Test Setup

If you need more information, refer to the appropriate Macintosh Owner's Guide.

1. Connect AC power cords from an AC outlet to the computer, and from an outlet to the monitor. Connect the keyboard and mouse to the computer.

2. Connect the video cable to the monitor. Connect the the video cable to the Macintosh external video port or the connector on the Macintosh video card.

3. If you want to run the serial loopback test, connect the serial cable between the printer port and the modem port.

4. Insert a **copy** of the *MacTest MP* disk into the right or left internal (or external) drive and switch on system power.

5. Double-click the *MacTest MP* icon and the *MacTest MP* application. (If you followed the instructions in Materials Required to adjust **Set Startup**, skip this step.)

❑ OPERATING MACTEST MP

System Configuration Information

Figure 3-3. The main window area displays a variety of useful information concerning the hardware and software configuration of the system under test. Before running the tests, verify that the information is accurate.

System vers: The version of the system software in the System Folder on the startup disk.

AppleTalk vers: The version of AppleTalk (if the computer is connected to an AppleTalk network).

QuickDraw vers: The version of QuickDraw in the System Folder on the startup drive or in ROM.

ROM vers: The version of firmware in the system ROM chips.

System type: The type of Macintosh computer that is running *MacTest MP.*

Parity: Not available for *MacTest MP.*

CPU/FPU type: The type (68000, 68020, or 68030) of central processing unit (CPU), and the type of floating-point math coprocessor (FPU) (if installed).

Video RAM size: The amount of RAM in the video RAM banks. To obtain the video RAM size of video cards, double-click the Card icon.

ROM size: The amount of ROM in the computer.

RAM size: The amount of RAM in the main RAM banks. On the Macintosh IIsi and IIci, some RAM can be for video.

Power-on hours: The number of hours that the computer has been powered on since manufacture.

> ***Note:*** When you clear parameter RAM, the power-on hours revert to zero and the production date disappears. On the Macintosh II, power-on hours remain at zero.

Production Date: The computer's date of manufacture.

Macintosh Test Selections

Figure 3-3. Select Macintosh Tests allows you to select the tests you want to run. To select a test, click the box next to the name of the test. An **X** appears in the box. To deselect the test, click the box again and the **X** disappears. If a selection is dimmed, the test is not available. The following section explains each test and describes special requirements.

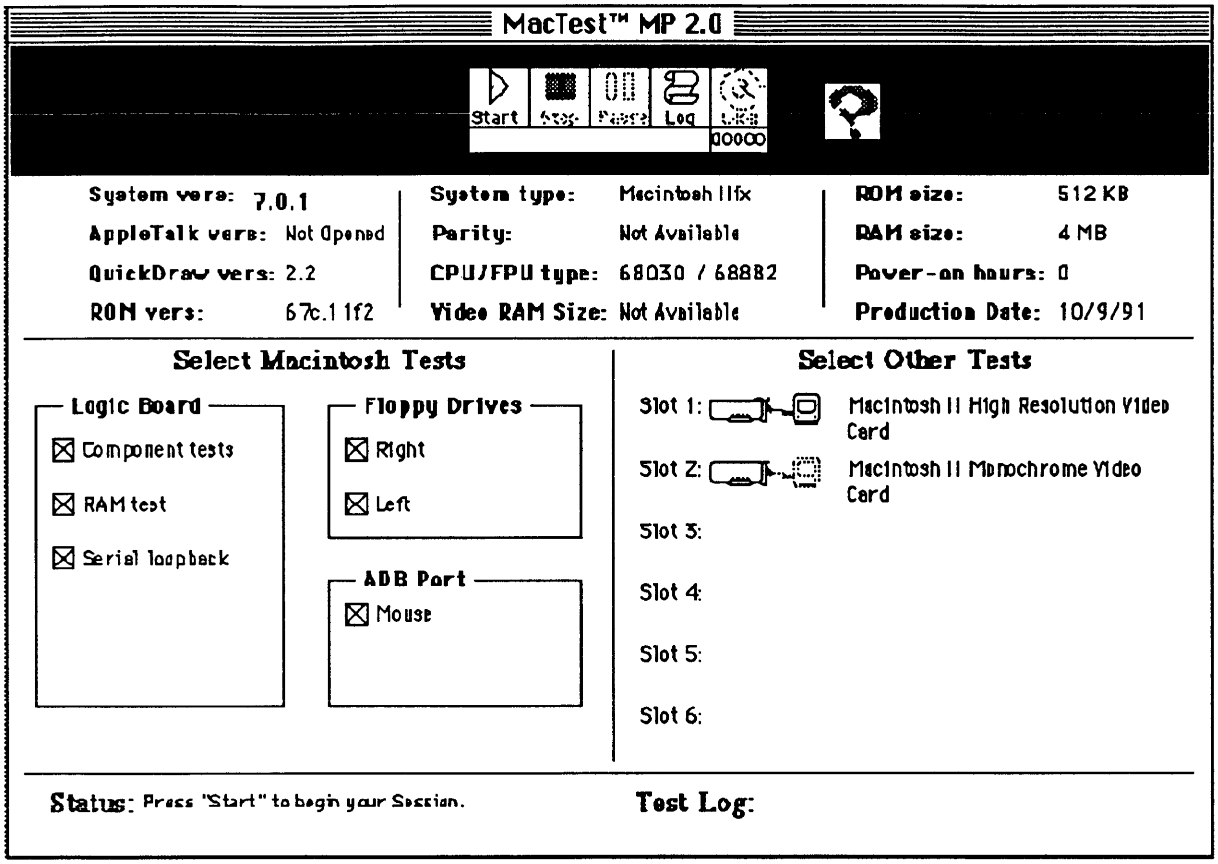


Figure 3-3 Main Window for 12-Inch Monitor with Macintosh IIfx

Logic Board

The logic board tests are divided into the following selections:

Component tests – Tests all logic board circuitry and most components. Refer to Features under "Introduction to *MacTest MP*" for a complete list of logic board components and circuits that *MacTest MP* tests.

You can separately select data transfer tests for the serial interfaces.

RAM test – Performs a test of the system memory indicated by **RAM size**. The test takes thirty seconds per megabyte and reboots the system afterward.

IMPORTANT: *To run the RAM test, you must unlock (write-enable) your copy of the* MacTest *disk.*

Video RAM test – Tests the VRAM (video RAM) chips on the 68-pin VRAM SIMM (Macintosh LC only) or on the video card. **Video RAM size** indicates the amount of VRAM memory tested. (This test is not applicable to the Macintosh Classic II.)

Serial loopback – Tests the two serial interfaces by performing a series of bidirectional data transfers between the modem and printer serial ports. This test requires a peripheral-8 serial cable between the modem and printer ports.

Screen patterns – Displays test patterns for the Macintosh **Classic II only**.

To display the monitor test patterns:

- Click the Screen Patterns box under Logic Board tests.
- Click **Start**.

To move forward through the test patterns:

- Press the Space bar.
- Press <Shift> <+>.
- Click the mouse.

To return to a previous test pattern:

- Press <Option> and click the mouse.
- Press <Hyphen>.

Note: In the backward direction you can loop through the five test patterns as many times as you wish. However, in the forward direction the main window appears after the fifth pattern.

Floppy Drives

Right/Internal and **Left/External** – Perform a write/read/verify test of the right and left (optional) internal 800K and 1.4 MB Apple SuperDrive disk drives. **Right/Internal** and **Left/External** examine floppy drives connected to the external disk drive port on the Macintosh IIsi. Use a formatted 1.4 MB floppy disk with at least 27K available.

ADB Port

Mouse – Tests the Apple Desktop Bus (ADB) circuitry by establishing communication with a **known-good** ADB keyboard and mouse. Note that this **is not** a test of the mouse itself. The mouse test checks only for communication between the mouse and computer.

Other Test Selections

Use **Select Other Tests** (see **Figure 3-3**) in the *MacTest MP* main window for the Macintosh IIfx, IIsi, and LC (the Macintosh Classic II main window has no **Select Other Tests**) to identify and test Apple video cards. If a card is in an expansion slot and *MacTest MP* recognizes the card, a Card icon and name appear next to the slot number. Otherwise the message **Unfamiliar Card** appears. If *MacTest MP* does not test the card, the Card icon dims. If a slot is empty, no icon or card name appears.

For additional information about a card, double-click on the slot number, Card icon, or card name.

Monitor Test Patterns (except Classic II)

To display test patterns for the Macintosh Classic II, see Screen Patterns under Logic Board (above). For the Macintosh IIfx, IIsi, or LC, the **Select Other Tests** area of the main window enables you to adjust monitors connected to the system's built-in video port (**BIV**) or to a video card. To display the test patterns, select the appropriate Monitor icon and click **Start**. You can access additional information about the selected monitor or the test patterns by double-clicking **BIV** or the Monitor icon.

To display the monitor test patterns:
- Select the Monitor icon.
- Click **Start**.

To move forward through the test patterns:
- Press the Space bar.
- Press <Shift> <+>.
- Click the mouse.

To return to a previous test pattern:
- Press <Option> and click the mouse.
- Press <Hyphen>.

Note: In the backward direction you can loop through the six test patterns as many times as you wish. However, in the forward direction the main window appears after the sixth test pattern.

Setting Looping Options

The looping options in *MacTest MP* allow you to test modules repeatedly. Use looping to isolate intermittent or nonimmediate failures. Looping provides two choices—setting a specific number of times to repeat the selected tests, or looping until you give a stop signal. **Setup Looping** is under the Options menu.

If you loop on the RAM test, you must unlock (write-enable) your copy of the *MacTest* floppy disk.

If you loop on the RAM test, *MacTest MP* automatically reboots the computer at the end of each pass. The *MacTest MP* program automatically reboots **if** *MacTest MP* is the startup disk and startup application (see the note under "Starting MacTest MP"). For several seconds, *MacTest MP* displays the test results. During this display you can stop the looping. If you do not stop the looping, *MacTest MP* runs another RAM test.

Note: When you run the RAM test, *MacTest MP* saves the current selections, and the previous selections disappear.

Setting Preferences

You can customize *MacTest MP* test logs to include service center and customer information, system configuration, and a time stamp. Customize test logs by selecting **Preferences** from the Log menu. However, the Log menu is deactivated (dimmed) unless a test log is open and selected (the log is the front window).

To begin a new test log, select **New** from the File menu. To select an existing test log, click the Log icon, use **Open** to select a saved test log from the File menu, or select an open log from the Windows menu. With the desired test log open on your screen, select **Preferences** from the Log menu. You can now enter the service center and customer information, and set test log options. **Figure 3-4** shows the Test Log Preferences dialog box.

Note: When you close the log, dealer information saves as a default, but customer information disappears.

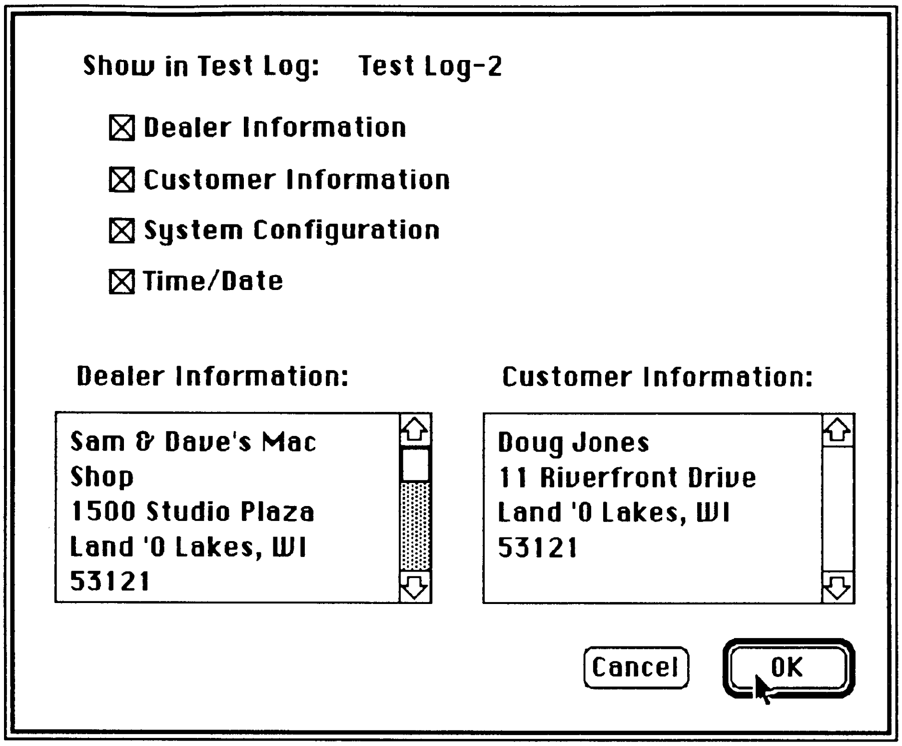


Figure 3-4 Test Log Preferences Dialog Box

Using the Controls

After selecting tests, setting preferences, and choosing looping options, you can start testing. Activate the following controls by clicking:

- **Start** – Runs the selected tests.
- **Stop** – Terminates the test(s) in process.
- **Pause** – Temporarily suspends the tests. Click **Pause** again to resume testing.
- **Log** – Turns the display of the test log window on or off. If no open log exists, a new log appears.
- **?** icon – Contains additional information about the test failure. When *MacTest MP* has no additional information, the icon is dimmed.
- **Loop** – Indicates whether looping is ON (the circular, Looping Arrow icon highlights) or OFF (the circular arrow is white/clear). A loop counter is beneath the icon.

As the Tests Are Running

The **Status line** at the lower-left corner of the main window indicates the progress of *MacTest MP.* You can temporarily suspend tests by clicking **Pause**. You can end tests by clicking **Stop** or typing ⌘ - <Period>.

Note: During the RAM test and video card tests, the mouse and keyboard do not operate. The RAM and video card tests must run to completion.

If *MacTest MP* finds no problems, it displays the message **All Tests Passed**.

If *MacTest MP* encounters a problem, the test stops and displays an error message on the Status line and in the test log. If *MacTest MP* has more information, the Question Mark icon highlights. Click the question mark for assistance. If information from *MacTest MP* doesn't correct the problem, refer to Section 4, Troubleshooting, of the *Apple Service Technical Procedures* for the Apple product you are testing.

❑ MACTEST MP REFERENCE

Quick Reference

To set up and run *MacTest MP*, follow the steps below. Detailed procedures are under "Operating MacTest MP." Remember to use a **copy** of *MacTest MP* and to use **Set Startup** to automatically open the *MacTest MP* application.

1. Set up the Macintosh IIfx, IIsi, LC, or Classic II. You will need a video monitor, video cable, keyboard, and mouse. You may need a video card.

2. Connect a serial loopback cable if you plan to run the Serial Loopback test.

3. Insert the *MacTest MP* disk in the right (or left) internal or external disk drive. Switch on the computer.

4. If the desktop appears, double-click the *MacTest MP* disk icon.

5. Double-click the *MacTest MP* application.

6. Verify that the system configuration information is correct.

7. Select the tests you wish to run.

8. If you desire, select **Setup Looping** under the Options menu.

9. Click **Start**.

10. Click **Stop** or **Pause**.

11. Print and save the test log. Use **Preferences** under the Log menu to enter service center and customer information.

12. If a test fails and the Question Mark icon highlights, click the icon for information.

Menus and Keyboard Equivalents

The *MacTest MP* menus and menu selections appear below. Keyboard equivalents are indicated.

Apple Menu

The Apple () menu contains the following selection:

About MacTest MP – Displays a dialog box that shows the diagnostic name and version number.

File Menu

The File menu contains the following selections:

New (⌘ - N) – Creates a test log that will be current until you close it, create a new log, or open another.

Open (⌘ - O) – Opens a saved test log. You can open a saved test log for display, printing, or appending.

Close (⌘ - W) – Closes the current test log. If you haven't saved the contents, a dialog box will appear.

Save (⌘ - S) – Displays a dialog box that asks you for a file name to save the test log contents.

Save As – Displays a dialog box that asks for a file name. *MacTest MP* saves the log under the new name.

Revert to Saved – Opens the most recently saved test log.

Save Selections – Saves the current test and looping selections.

Page Setup – Displays the printer Page Setup dialog box. See the *Macintosh System Software User's Guide.*

Print (⌘ - P) – Prints the active test log to the printer selected in the Chooser.

Quit (⌘ - Q) – Terminates the program and returns to the Finder™ (desktop).

Eject (⌘ - E) – Ejects the right floppy disk or internal floppy disk.

Eject Left (⌘ - 2) – Ejects disks from the left floppy drive or external floppy drive.

Controls Menu

The Controls menu contains the following selections:

Start (⌘ - G) – Runs the selected logic board and peripheral tests.

Stop (⌘ - <Period>) – Terminates the test(s) in process.

Pause (⌘ - <Apostrophe>) – Suspends (dark/highlighted button) the test in process. Click **Pause** again to resume testing (light button).

Log (⌘ - L) – Displays (dark/highlighted button) or hides (light button) the contents of the current test log.

Loop (⌘ - I) – Switches looping on (dark/highlighted button) or off (light button).

? icon (⌘ - Y) – When the icon is highlighted, *MacTest MP* has information about test failures; click the icon. When the icon is dimmed, *MacTest MP* has no information.

Options Menu

The Options menu contains the following selections:

Setup Looping – Displays the Looping Options dialog box shown in **Figure 3-5**. You can set the number of loops, or you can loop on the selected tests until you enter the stop command.

Brightness – (Macintosh **Classic II only**) Lets you adjust screen brightness. (Refer to Section 3, Adjustments, of the *Macintosh Classic and Classic II Technical Procedures.*) To advance to the next brightness adjustment screen, click the mouse or Space bar. After the third screen, you will return to the main window.

Shut Down – Quits *MacTest MP* and runs the safe shutdown sequence as if you had selected **Shut Down** from the Finder.

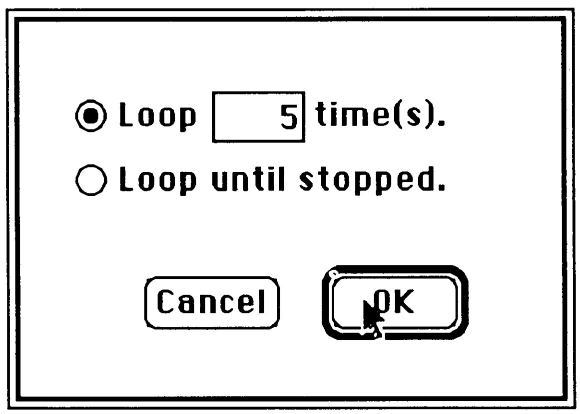


Figure 3-5 Looping Options Dialog Box

Windows Menu

The Windows menu contains the following selections:

Main Window (⌘ - M) – Brings the *MacTest MP* main window to the front and makes it the active window.

Test Log 1-x – If test logs are open, *MacTest MP* adds their names to the Windows menu. To bring a test log to the front (active window), select that test log entry from the menu.

Log Menu

The Log menu contains the following selection:

Preferences – Contains selections for including the service center, customer information, system configuration, time, and date in the test log.

Illustrations Menu

Unless memory limitations dictate otherwise, the Illustrations menu displays drawings of Macintosh modules and video cards.

Note: You must have 733K of available memory to run *MacTest MP 2.0.* This 733K provides enough memory to display the Macintosh LC, IIsi, or IIfx logic boards from the Illustrations menu; the other illustrations are not shown. If you increase the application memory size to 1200K, all illustrations will become available. To increase the available memory, select the *MacTest MP* icon and choose **Get Info** (⌘ - I) from the File menu. Under **Application Memory Size (K)**, type *1200.* Close the Get Info window.

System Software Compatibility

To run *MacTest MP*, you must use system software version 6.0.7 or later. The System Folder on the *MacTest MP* disk should not contain non-Apple startup or control panel documents, desk accessories, device drivers, or other system software modifications. Apple cannot guarantee the accuracy of test results for systems with third-party operating-system modifications.

MultiFinder Compatibility

MacTest MP is MultiFinder® compatible. In fact, System 7 computers run MultiFinder only.