

PowerBook 140/170

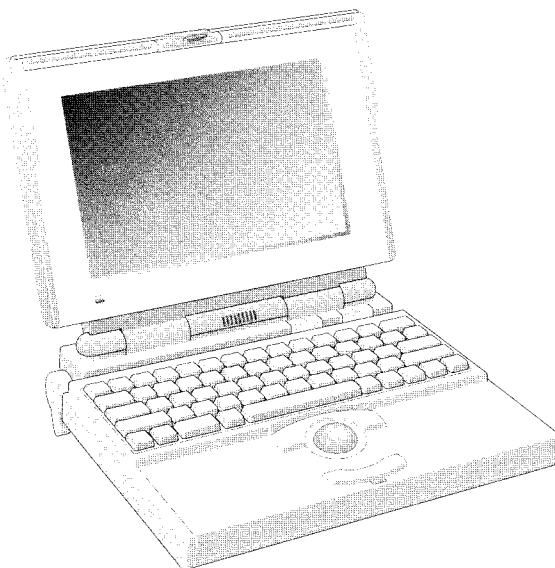
Table of Contents



Contents

Page

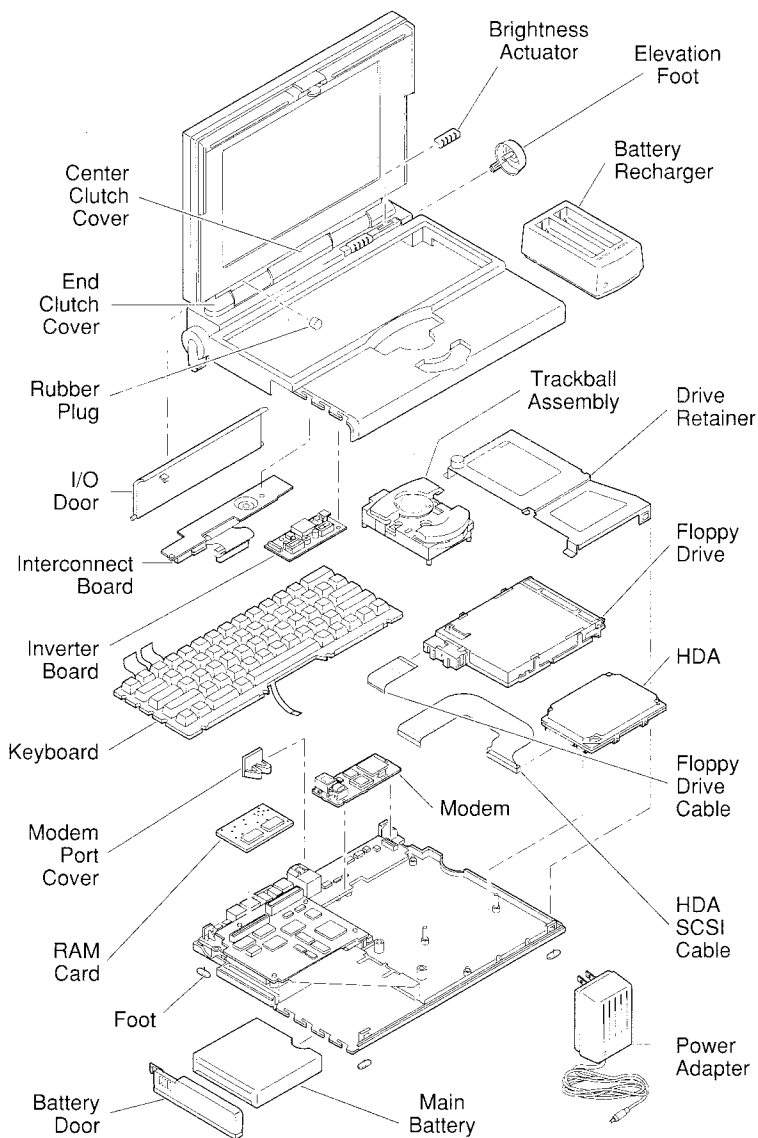
Exploded View	2
Parts List	3
Specifications	4-7
Reset, Interrupt, and Power Switches	8
Troubleshooting—Introduction	9
Troubleshooting—Power Systems	10
Troubleshooting—Symptom/Cure Chart	11-17
Troubleshooting—Startup Problems	18-19
Module Replacement	20-25
Logic Board Component Identification	26
Memory Upgrade	27
Fax/Data Modem	28





PowerBook 140/170

Exploded View—PowerBook 140/170



PowerBook 140/170

Parts List



Drive Retainer, 17-mm-High.....	805-0412
Drive Retainer, 19-mm-High.....	805-0414
Elevation Foot, Left.....	815-1278
Elevation Foot, Right.....	815-1237
Elevation Foot Spring Clip.....	805-0400
Elevation Foot Washer.....	815-1266
Foot.....	815-1236
Inverter Board, Active Matrix (green).....	699-0273
Inverter Board, FSTN (blue).....	699-0271
Inverter Board, FSTN (red).....	699-0272
Inverter Shield (PowerBook 140, pkg. of 5).....	076-0588
Inverter Shield (PowerBook 170, pkg. of 5).....	076-0587
Interconnect Board.....	661-0724
HDA, 2.5-Inch, 20 MB, HDI-30.....	661-1622
HDA, 2.5-Inch, 40 MB, HDI-30.....	661-1630
Internal HDA SCSI Cable.....	630-0534
HDI-30 SCSI System Cable.....	590-0717
Packaging, 2.5-Inch, SCSI HDA.....	602-0307
I/O Door.....	815-1233
Keyboard, Domestic.....	661-0712
Main Battery.....	661-0721
Battery Door.....	815-1240
Battery Recharger.....	076-0567
Microphone Assembly.....	658-0303
Modem Board, 2400 Baud, Domestic (optional on PowerBook 140).....	661-1621
Modem Port Cover.....	815-0578
Modem Screw Kit (PowerBook 140).....	076-0575
Power Adapter, Domestic.....	699-0517
RAM Card, 2 MB (Optional).....	661-0715
RAM Card, 4 MB (Optional).....	661-0714
Top Case, Misc. Parts.....	
Brightness Actuator (PowerBook 140).....	815-1248
Brightness Actuator (PowerBook 170).....	815-1305
Center Clutch Cover.....	815-1230
Contrast Actuator (PowerBook 140).....	815-1247
End Clutch Cover.....	815-1231
Rubber Plug.....	875-0112
Trackball Assembly.....	661-0710
Trackball Ball.....	949-0362
Trackball Retainer.....	949-0363



PowerBook 140/170

Specifications

Microprocessor	MC68030. 32-bit internal architecture Clock speed: PowerBook 140 – 16 MHz PowerBook 170 – 25 MHz
Memory	System RAM: PowerBook 140 – 2 MB, four 4-megabit 512K x 8-bit PSRAM chips (on daughterboard) PowerBook 170 – 4 MB, eight 4-megabit 512K x 8-bit PSRAM chips (2 MB on daughterboard, 2 MB on RAM expansion card) Other RAM: 256 bytes of system parameter memory 256 K of static video display memory ROM: 1 MB, two 256 K x 16-bit devices; 150 nsec access time (addressing supports up to 4 MB)
PowerBook 140 Display	Type: Film-compensated Supertwist Nematic (FSTN) backlight flat-panel display Speed: 250 ms Brightness: 50 nits minimum, user controllable Contrast: 12:1, user controllable Resolution: 640 x 400 pixels, 75 dpi Power: .45 W display, 3 W inverter
PowerBook 170 Display	Type: Transmissive, active-matrix liquid crystal backlight flat-panel display Speed: 50 ms Brightness: 60 nits minimum, user controllable Contrast: 15:1, factory set Resolution: 640 x 400 pixels, 75 dpi Power: .45 W display, 3 W inverter
Keyboard	Dimensions: 10.6" length; 3.5" width, .5" depth Pitch: .73" horizontal; .71" vertical Interface: Matrix
Trackball	Apple Desktop Bus interface

PowerBook 140/170

Specifications



Floppy Drive	19-mm-high, 1.4 MB high-density floppy disk drive 4.5 W startup power 1.25 W random operation 50 mW idle
20 MB Hard Drive	20 MB formatted capacity Apple SCSI interface 2.5-inch mechanism 5.0 W startup power 2.7 W random operation 1.5 W idle
40 MB Hard Drive	40 MB formatted capacity Apple SCSI interface 2.5-inch mechanism 5.0-5.55 W startup power 2.25-3.5 W random operation 1.3-2.0 W idle
Disk Interface	Apple SWIM chip MFM/GCR modes Supports Macintosh 1.4 MB floppy drive and Apple 800K floppy drive
SCSI Interface	HDI-30 SCSI connector HDI-30 SCSI system cable 1.5 MB/second transfer rate Supports a maximum of five external devices (The internal SCSI hard disk drive is device 0.) Termination power is not supplied. Terminate the SCSI chain as shown under Troubleshooting—Introduction. Use Apple's standard terminator (not the Macintosh IIx terminator)
Serial Interfaces	Two RS-422 ports 230.4 K baud maximum 0.920 Mbit/second if external clock source (modem interface only) Supports asynchronous, synchronous, and AppleTalk protocols Internal connector supports the Macintosh PowerBook Fax/Data Modem



PowerBook 140/170

Specifications

Main Battery	Type: NiCad (nickel cadmium) Size: 3.94" x 3.94" x .8" Weight: .83 lbs Voltage: 5.65–7.2 V (6.0 nominal) Capacity: 2.5–3 amp-hours (fully charged battery; actual time depends on system configuration and power management settings) Recharge Time: 3 hrs (CPU off) Power Cycles: 500
Parameter RAM Battery	3-volt lithium, rechargeable
Power Adapter	AC input voltage: 110–240 VAC Output voltages: 7–10 V (7.8 nominal) 2.0 amps
Battery Recharger (Optional)	Input voltage: 7.8 VDC Input current: 2.0 amps (max.)
Apple Desktop Bus	Low-speed serial interface Maximum current draw for all ADB devices is 200 mA
General Information	Dialog boxes: First Dialog 5.9 V Second Dialog 5.75 V 10 Sec. Warning 5.65 V Shutdown 5.55 V System Usage: Sleep 5–6 mA Shutdown 300 μ A Backlight max, HDA spin 940–960 mA Backlight min, HDA spin 690–720 mA Backlight max, HDA off 670–700 mA Backlight min, HDA off 430–450 mA

PowerBook 140/170

Specifications



Sound	Enhanced Apple Sound Chip 1 voice in mono and stereo with 8-bit digital-to-analog conversion using a 22 KHz sampling rate Filtered by the digitally filtered audio chip (DFAC) Stereo-compatible (monaural input, stereo output) Output impedance of 8 to 600 ohms Short-circuit protected Speaker: Size: .78" x .39" x .12" Impedance: 8 ohms at 1 KHz Maximum Power: .2 W Harmonic Frequency: 640 Hz Frequency Range: 640 Hz to 3 KHz Sound Power Level: 79 dB +3 dB
Modem	Operating Modes: Auto or manual dial Auto or manual answer Protocol: Serial binary and asynchronous Character Length: 7 or 8 bits; 1 or 2 stop bits Parity: Odd, even, mark, space, or no parity Data Transmission Mode: Full Duplex Asynchronous Transmission Rate: 110–300 bps Bell 103 1200 bps Bell 212A 1200 bps CCITT V.22 2400 bps CCITT V.22bis 110/300 bps CCITT V.21 1200/75 bps CCITT V.23 (Int.) Data Compression: MNP Class 5 CCITT V.42bis Error Control: MNP Class 4 CCITT V.42 Fax Compatibility: Group 3 Transmission Speeds: 2400 bps, 1200 bps, 300 bps Fax Transmission Mode: Half Duplex Fax Transmission Rate: 2400/4800 bps CCITT V.27ter 7200/9600 bps CCITT V.29



PowerBook 140/170

Reset, Interrupt, and Power Switches

Pressing the reset switch resets the power manager and the central processor and reboots the computer; information in system RAM disappears. Pressing the interrupt switch creates a system interrupt. Pressing the power button switches the computer on or wakes it from sleep. The table below summarizes the computer power states and the reset switch, interrupt switch, and power button functions.

Power States

Starting Power State	Action	Computer Response
Power off	Press power button	Boot
Power off	Press any key	Power off (no change)
Power off	Insert charger	Charging
Power on	Issue shutdown command	Data saved, power off
Power on	Press power button	Data lost, power off
Power on	Press power button twice	Data lost, reboot
Power on	Press reset switch	Data lost, reboot
Power on	Press interrupt switch	Test monitor mode
Power on	Press both reset & interrupt	Data lost, reboot
Power on	Issue sleep command	Sleep
Sleep	Press any key (except <Caps Lock>)	Power on
Sleep	Press power button	Power on
Sleep	Detect very low power	Data lost, power off
Sleep	Remove battery	Data lost, power off

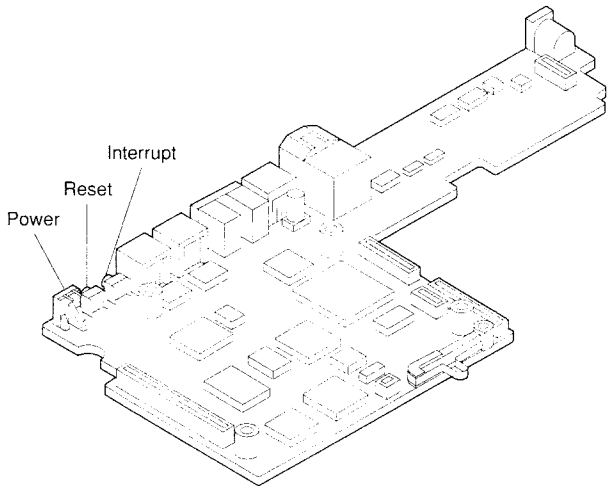


Figure: Reset Switch, Interrupt Switch, and Power Button

PowerBook 140/170

Troubleshooting—Introduction



Before You Start

- Check the battery and power adapter. Note that the parameter RAM battery does not support system RAM. Save RAM contents before removing the main battery.



CAUTION: The power adapters on the Macintosh Portable and the PowerBook computers are not interchangeable. You will damage the computer if you try to use the power adapters interchangeably.

- Check connections on internal and external cabling and on option cards.
- If the correct version of system software is not present, install it and verify the failure. Use system software 7.0.1 or later.
- Remove all option cards and disconnect external devices (printers, SCSI devices, additional ADB devices, and disk drives).
- Test the internal cables with known-good systems.

Things to Remember

- Install inverter shields on all PowerBook 140/170 computers.
- When running the *Hard Disk Test* diagnostic to test the hard disk, operate the computer from the power adapter and do not select looping.
- Follow all electrostatic discharge precautions when working on the PowerBook 140/170. The computers are **very sensitive to ESD**. Refer to Safety Information in *Service Source* for additional information.
- When you attach the power adapter to the computer but do not plug the computer into a power source, a low-power dialog box appears .
- The battery desk accessory is a general indicator of the battery charge. Use a voltmeter to determine the actual charge.
- The PowerBook computers do not provide termination power. Terminate the SCSI chain as shown in the table below.

	1 External SCSI Device	>1 External SCSI Device
PowerBook Without Internal Hard Drive	2 terminators, both on external device	1 terminator on first external device 1 terminator on last external device
PowerBook With Internal Hard Drive	1 terminator on external device	1 terminator on first external device 1 terminator on last external device



PowerBook 140/170

Troubleshooting—Power Systems

Battery Verification

1. Disconnect the power adapter. Note that the parameter RAM battery does not support system RAM. Save RAM contents before removing the main battery.



WARNING: Do not short the battery. The battery may become hot enough to burn you.

2. Remove the main battery.
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 **negative probe** of the voltmeter to the **negative side** of the battery.
6. The reading for a good battery should be **above 5.7 volts**. If the battery falls below 5.7 volts, recharge the battery. If the battery will not recharge, replace it.

Adapter Verification

1. Plug the power adapter into the wall source.
2. Set the voltmeter range to 10 volts DC.
3. Touch and hold the **positive probe** of the voltmeter to the **inside** of the adapter plug.
4. Touch and hold the **negative probe** of the voltmeter to the **outside** of the adapter plug.
5. The reading for a good adapter should be **7.5-7.9 volts**. If the voltage is not in this range, replace the adapter.



CAUTION: The power adapters on the Macintosh Portable and the PowerBook computers are not interchangeable. You will damage the computers if you try to use the power adapters interchangeably.

**Startup Problems****Solutions**

Computer gives startup chord followed by two-part (eight-tone) error chord sequence

1. Replace RAM expansion card.
2. Return computer to Apple.

Computer gives startup chord, pauses, and then plays four-tone error chord sequence

1. Disconnect hard drive SCSI cable and reboot. If startup chord is normal, replace hard drive.
2. Disconnect floppy drive cable and reboot. If startup chord is normal, replace floppy drive.
3. If error chords still sound, return computer to Apple.

Power Problems**Solutions**

Screen is blank; computer doesn't respond

1. Reset power manager.
2. Connect power adapter and try computer again in three or four minutes.
3. Try known-good, charged main battery. If computer now works, replace main battery.
4. Verify that interconnect board, daughterboard, and motherboard connections are secure.
5. If computer is in sleep mode, replace keyboard.
6. Replace interconnect board.
7. Return computer to Apple.

After removing main battery, some Control Panel settings are different

1. Replace interconnect board.
2. Return computer to Apple.

Computer runs when plugged into wall outlet, but does not function when draws from battery. Battery voltage is within tolerance.

- Return computer to Apple.

Power adapter is plugged in and connected, but battery DA does not indicate charger is connected

1. Verify that charger is connected properly.
2. Try known-good main battery. If battery now charges, replace main battery.
3. Try known-good adapter. If battery now charges, replace power adapter.
4. Verify that battery thermistor cable connection is secure.
5. Return computer to Apple.

continued...



PowerBook 140/170

Troubleshooting—Symptom/Cure Chart

Power Problems (continued)

Solutions

A low-power warning appears soon after starting to use computer

1. Battery needs recharging. Attach power adapter.
2. Make sure peripherals are low-power type.
3. Reduce use of floppy or hard disk, modem, sound, backlight, or other power-consuming devices, or connect power adapter.
4. Verify that battery is good.
5. Verify that power adapter is good.

Video Problems

Solutions

Pixel never comes on/is always on

- If more than five pixels do not come on or are always on, return computer to Apple.

A row of pixels never comes on

1. Replace interconnect board.
2. Return computer to Apple.

Slight white line is always in middle of screen

- This is normal for the FSTN screen in PowerBook 140. If screen is active-matrix (PowerBook 170), return computer to Apple.

Partial or complete row of pixels is always on

1. Replace interconnect board.
2. Return computer to Apple.

Screen flickers

- Return computer to Apple.

Display is very light or totally white

1. Adjust screen contrast setting (PowerBook 140).
2. Verify that display cable, inverter board, interconnect board, daughterboard, and motherboard connections are secure.
3. Replace inverter board.
4. Replace interconnect board.
5. Return computer to Apple.

No display, but computer appears to be operating correctly

1. Adjust screen contrast setting (PowerBook 140) and brightness setting.
2. Check inverter board, interconnect board, and daughterboard connections.
3. Replace inverter board.
4. Replace interconnect board.
5. Return computer to Apple.

Image on display is not uniform

- This effect is normal for the FSTN screen in PowerBook 140. Diminish the effect by adjusting contrast and brightness. If screen is active-matrix (PowerBook 170), return computer to Apple.



Display stopped working (or dimmed) but shows no problems now

- If temperature is under 5° C or over 40° C, such reaction is normal for FSTN screen in PowerBook 140.

Backlight doesn't operate

1. Check display cable, inverter board, interconnect board, and daughterboard connections; check that none of the cables is pinched or severed.
2. Replace inverter board.
3. Replace interconnect board.
4. Return computer to Apple.

Floppy Drive Problems

Solutions

Audio and video present, but internal drive does not operate

1. Try known-good floppy disk.
2. Check floppy drive cable connection. If it's secure, return computer to Apple.

Disk ejects while booting; display shows Mac icon with blinking "X"

1. Try known-good system disk.
2. Check that trackball or mouse button is working.
3. Check floppy drive cable connection. If it's secure, return computer to Apple.

Disk will not eject

1. Shut down computer, press and hold trackball or mouse button, and switch on computer.
2. Eject disk manually by pushing opened paper clip into hole under floppy drive slot.
3. Check floppy drive cable connection. If it's secure, return computer to Apple.

Disk initialization fails

1. Verify that you are using the proper type of media.
2. Try a known-good disk.
3. Install an inverter shield.
4. Check floppy drive cable connection. If it's secure, return computer to Apple.

SCSI Hard Drive Problems

Solutions

Internal hard drive will not operate

1. Disconnect all external SCSI devices.
2. Verify that internal SCSI hard drive cable is securely connected at both ends.
3. Use HD SC Setup to determine whether computer recognizes drive. If it does, try to reinitialize drive.
4. Replace internal SCSI hard drive cable.
5. Replace hard drive.
6. Return computer to Apple.



PowerBook 140/170

Troubleshooting—Symptom/Cure Chart

Peripheral Problems

Solutions

After connecting external SCSI device, computer no longer boots

1. Switch on external SCSI device before starting computer.
2. Verify that external device is connected properly.
3. Verify that SCSI cable is terminated properly.
4. Verify that no two SCSI devices have same device address.
5. Verify that internal hard drive is good.
6. Use a known-good device to verify external SCSI devices.
7. Return computer to Apple.

Cursor does not move when using trackball

1. Press reset switch.
2. Check cable connections between trackball and keyboard, keyboard and interconnect board, and interconnect board and daughterboard.
3. Connect a low-power mouse and try to move cursor. If cursor moves, try using trackball and keyboard.
4. If trackball does not move cursor, replace trackball.
5. If keyboard does not move cursor, replace keyboard.
6. Replace interconnect board.
7. Return computer to Apple.

Cursor intermittently does not move or moves erratically

1. Clean ball and internal rollers of trackball.
2. Replace trackball.
3. Replace keyboard.
4. Replace interconnect board.
5. Return computer to Apple.

Cursor moves, but clicking trackball button has no effect

1. Check cable connections between trackball and keyboard, keyboard and interconnect board, and interconnect board and daughterboard.
2. Replace trackball.
3. Replace keyboard.
4. Replace interconnect board.
5. Return computer to Apple.

Cursor does not move when using mouse

1. Check mouse connection to ADB port.
2. Press reset switch.
3. Clean mouse ball and inside of mouse.
4. Replace mouse.



No response to any key on the keyboard

1. Verify that computer is on.
2. If screen is blank and you are trying to bring computer out of system sleep, try resetting power manager.
3. Check keyboard connections to interconnect board and interconnect board connection to daughterboard.
4. Replace keyboard.
5. Replace interconnect board.
6. Return computer to Apple.

Known-good ImageWriter, ImageWriter II, or LQ does not print

1. Make sure system software is 7.0.1 or later.
2. Make sure that Chooser is set correctly.
3. Verify printer cable is securely attached.
4. Replace printer cable.
5. Return computer to Apple.

Known-good LaserWriter does not print

1. Make sure system software is 7.0.1 or later.
2. Make sure Chooser is set correctly.
3. Verify that all printer cabling is securely attached.
4. Replace printer cable.
5. Try another printer. If printer works, computer is OK. Refer to network information on *Service Source* for further assistance.
6. Return computer to Apple.

Device connected to external modem port doesn't work

1. Verify that **External Modem** is selected in CDEV.
2. Make sure system software is 7.0.1 or later.
3. Check that all cabling is correctly and securely attached.
4. Attach device to known-good computer.
5. Return computer to Apple.

I/O devices are unrecognized or garbage is transmitted and/or received

1. Make sure system software is 7.0.1 or later.
2. Verify that all cabling is correctly and securely attached.
3. If device is SCSI type, verify that it is properly terminated.
4. Verify that no two SCSI devices have same device address.
5. Attach device(s) to known-good computer.
6. Return computer to Apple.



Internal Fax/Data Modem Problems

Solutions

Internal modem options do not appear in CDEV when modem is installed

1. Reseat modem board.
2. Make sure system software is 7.0.1 or later.
3. Replace modem board.
4. Return computer to Apple.

Modem does not respond properly to AT command set instructions

1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
2. Verify that modem cord is securely attached and working properly.
3. Reseat modem board.
4. Make sure system software is 7.0.1 or later.
5. Replace modem board.
6. Return computer to Apple.

Strange mix of characters appears on screen

1. Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
2. Verify that modem cord is securely attached and working properly.
3. Reseat modem board.
4. Make sure system software is 7.0.1 or later.
5. Replace modem board.
6. Return computer to Apple.

Modem connects but does not communicate with remote modem

- Verify that remote modem needs error correction (this is internal modem's default). If remote modem does not need error correction, disable error correction by typing **&Q0** (see *Macintosh PowerBook Fax/Data Modem User's Guide*).

Modem does not respond to incoming call

1. If system doesn't respond to an incoming call during sleep mode, verify that **Wake on Ring** option in CDEV is selected.
2. Verify that modem cord is working properly.
3. Replace modem board.
4. Return computer to Apple.

Modem interferes with system sound

1. Reseat modem board.
2. Replace modem board.
3. Replace interconnect board.
4. Return computer to Apple.



Modem has no sound output

1. Verify that Control Panel volume indicator is set above 0.
2. Replace modem board.
3. Replace interconnect board.
4. Return computer to Apple.

Miscellaneous Problems

Solutions

Screen goes blank and computer shuts down every few minutes

- Computer is going into system sleep to conserve battery power. If computer is going into system sleep too often, adjust sleep delays in Control Panel or connect power adapter.

Some applications seem to run slower after a few seconds

- Computer is switching to system rest. If system rest is interfering with the operation of an application, connect power adapter.

Hard disk is slow to respond, or screen goes blank too often

- Computer is powering down hard drive or going into system sleep to conserve battery power. If hard drive is shutting down or system is going into system sleep too often, adjust sleep delays in Control Panel or connect power adapter.

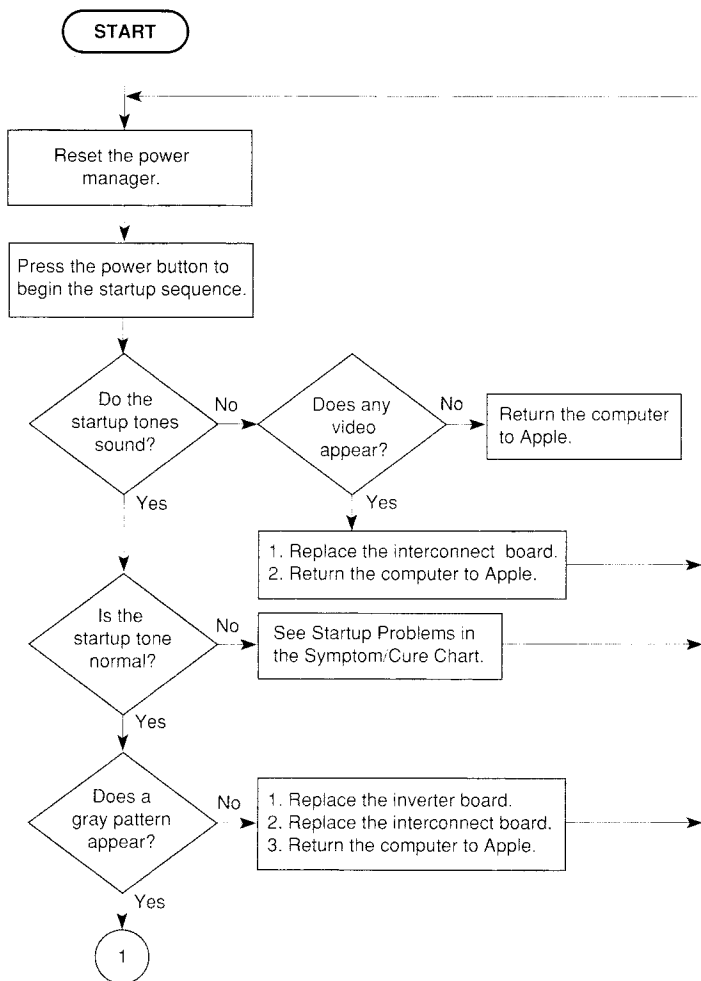
No sound from speaker

1. Verify that volume setting in Control Panel is 1 or above.
2. Check speaker connection to interconnect board, interconnect board connection to daughterboard, and daughterboard connection to motherboard.
3. Return computer to Apple.



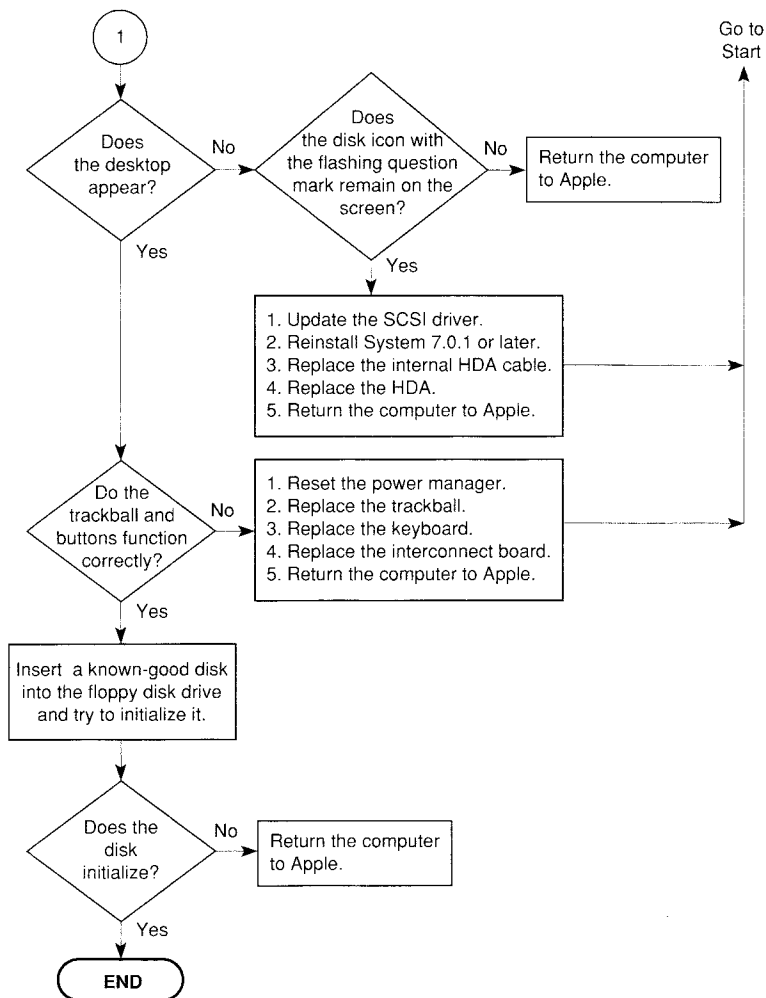
PowerBook 140/170

Troubleshooting—Startup Problems



PowerBook 140/170

Troubleshooting—Startup Problems





PowerBook 140/170

Module Replacement

BACK VIEW

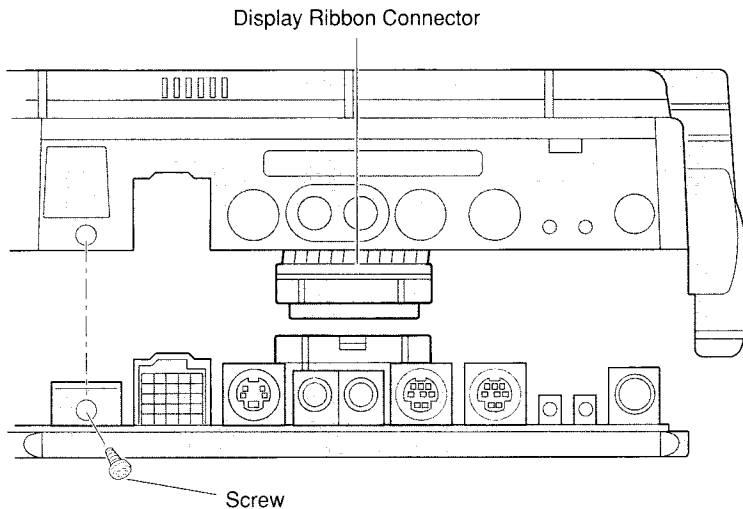


Figure: Removing the Top Case

SIDE VIEW

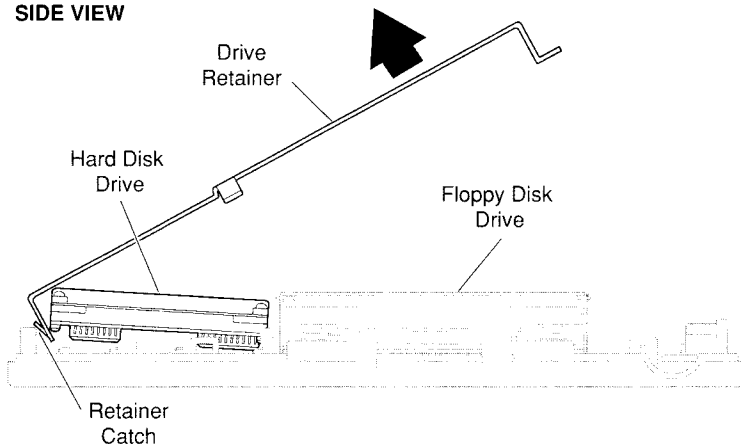


Figure: Removing the SCSI Hard Drive

PowerBook 140/170

Module Replacement



Things to Remember

- Prior to removing or replacing PowerBook 140/170 modules, you must unplug the power adapter and remove the main battery.

Note: Save RAM contents before removing the main battery. Otherwise, RAM contents will be lost.

- Avoid excessive handling of the inside of the case and, if possible, wash your hands prior to working with the case.



CAUTION: When you unwrap, install, or replace modules, follow the appropriate electrostatic discharge (ESD) precautions. The PowerBooks are very susceptible to damage from electrostatic discharge. For more ESD information, see ESD Prevention under Safety in this guide.

Top Case

1. Remove the main battery and the I/O door.
2. Remove the four bottom screws and the screw on the back panel (see **Figure on previous page**).
3. Lift the top of the case, and disconnect the display ribbon connector.
4. To unhook the front fasteners, lift the top of the case away from you. Remove the top case.

SCSI Hard Drive

1. Remove the main battery, I/O door, and top case.
2. Disconnect the hard drive SCSI cable from the motherboard. **Handle this cable carefully; it is fragile.**
3. Remove the five screws holding the drive retainer in place.
4. Lift the drive retainer, on the side near the display, until the hard drive lifts. Lift out the hard drive (see **Figure on previous page**).

Note: When replacing the drive retainer, position the hard drive SCSI cable so that it is above the drive retainer.

Note: The 17-mm-high drive retainer and the 19-mm-high drive retainers are not interchangeable. To tell which retainer you have, look at the center of the retainer. A 17-mm-high retainer will have a stair-step bend in the middle (see **Figure on previous page**). The 19-mm-high retainers have no bends in the middle.



PowerBook 140/170

Module Replacement

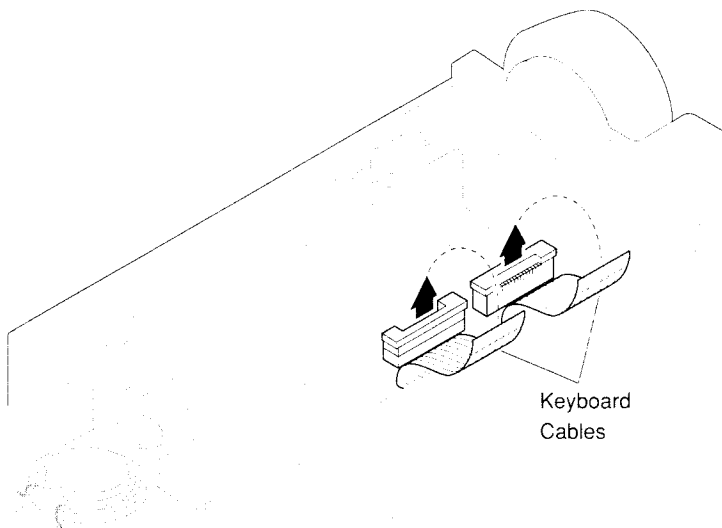


Figure: Removing the Keyboard

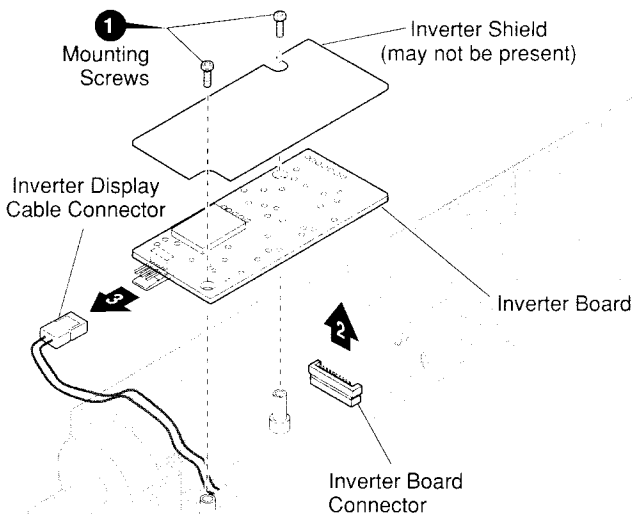


Figure: Removing the Inverter Board

PowerBook 140/170

Module Replacement



Trackball Assembly

1. Remove the main battery, I/O door, and top case.
2. Disconnect the trackball cable from its connector.
Handle the cable carefully; it is fragile.
3. Remove the two mounting screws.
4. Lift out the trackball assembly.

Keyboard Assembly

1. Remove the main battery, I/O door, top case, and trackball assembly.
2. Disconnect the keyboard cables from their connectors on the interconnect board (**see Figure on previous page**). **Handle these cables carefully; they are fragile.**
3. Remove the seven screws from the keyboard.
4. Lift the keyboard out of the top case.

Inverter Board

The PowerBook 140/170 computers have three discrete displays—one is active matrix and two are FSTN. Each display requires a matching inverter. When replacing a display or inverter board, make certain that the colored dot on the display cable matches the colored dot on the inverter. All of the inverter boards connect in the same manner.

1. Remove the main battery, I/O door, and top case.
2. Remove the two mounting screws from the inverter board (**see Figure on previous page**).

Note: Some systems have a silver-colored inverter shield attached to the inverter (**see Figure on previous page**). This inverter shield enhances the computer's operation; do not remove or modify the shield.

3. Remove the inverter shield (if present).
4. Disconnect the inverter board from the interconnect board by pulling the inverter board straight up.
5. Disconnect the three-pronged display inverter cable from the inverter board (**see Figure on previous page**).

Note: The brightness and contrast actuators are the most frequently forgotten parts when reassembling the computer. Make certain that you align the actuators correctly on the inverter pots when you replace the inverter board. It is easiest to align the actuator on the pot if both are set at the extreme outer positions. You may need to use cellophane tape to hold the actuators in place while you connect the inverter board.



PowerBook 140/170

Module Replacement

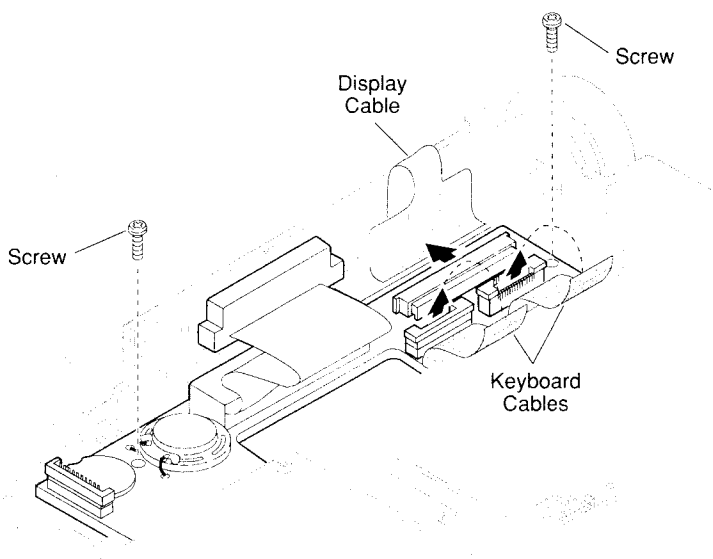


Figure: Removing the Interconnect Board

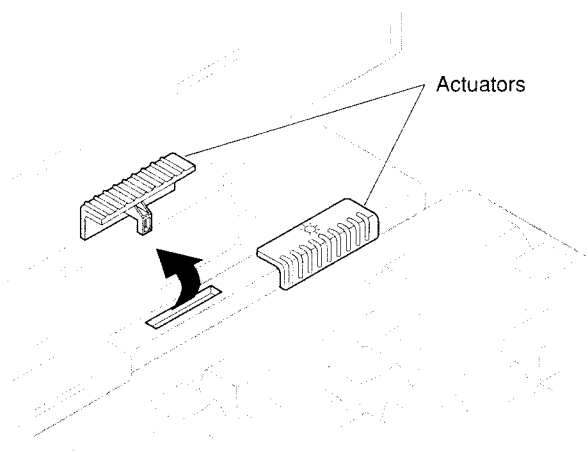


Figure: Removing the Brightness and Contrast Actuators



Interconnect Board

1. Remove the main battery, I/O door, top case, and inverter board.
2. Disconnect the keyboard and display cables from the interconnect card (**see Figure on previous page**). **Handle these cables carefully; they are fragile.**
3. Remove the two screws that hold the interconnect board in place.
4. Lift the interconnect board up and out of the top case.

Note: *Connect the display cable before you replace the interconnect board. It is very difficult to connect this cable after the interconnect board is in place.*



WARNING: The interconnect board contains hazardous materials. Return nonfunctional interconnect boards to Apple for proper disposal.

Brightness and Contrast Actuators

On the PowerBook 170, the contrast is preset, so **only a brightness actuator is on the front of the computer**. The PowerBook 140 (shown here) has both a contrast and a brightness actuator. The removal procedure for all actuators is the same.

1. Remove the main battery, I/O door, top case, and inverter board.
2. Pull up while rotating the actuator toward the display (**see Figure on previous page**).

Note: *The brightness and contrast actuators are the most frequently forgotten parts when reassembling the computer. Make certain that you align the actuators correctly on the inverter pots when you replace the inverter board. It is easiest to align the actuator on the pot if both are set at the extreme outer positions. You may need to use cellophane tape to hold the actuators in place while you connect the inverter board.*

Elevation Feet

1. Remove the main battery, I/O door, and top case.
2. Remove the screw that holds the elevation foot.
3. Lift the spring clip up, and the elevation foot will fall off.



PowerBook 140/170

Logic Board Component Identification

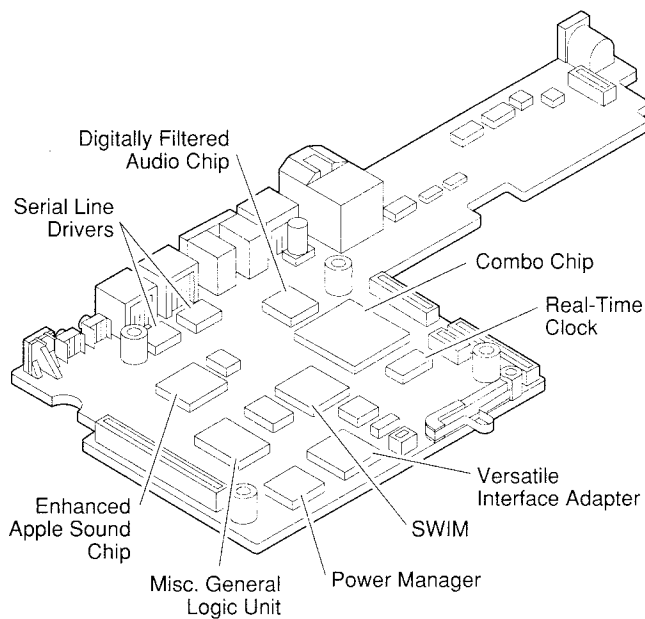


Figure: Motherboard Components

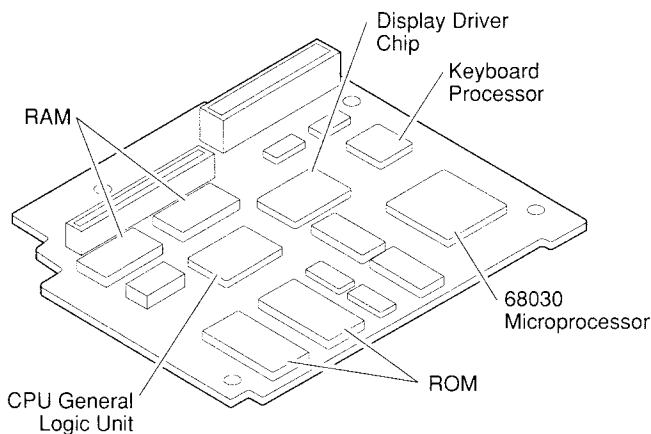


Figure: Daughterboard Components

PowerBook 140/170

Memory Upgrade



Installation

RAM	PowerBook	Upgrade Procedure (see Figure below)
2 MB	140	Standard configuration for computer
4 MB	140	Insert 2 MB RAM expansion card
6 MB	140	Replace 2 MB RAM expansion card with 4 MB RAM expansion card
8 MB	140	Replace 4 MB RAM expansion card with 6 MB RAM expansion card (3rd party only)
4 MB	170	Standard configuration for computer
6 MB	170	Replace 2 MB RAM expansion card with 4 MB RAM expansion card
8 MB	170	Replace 4 MB RAM expansion card with 6 MB RAM expansion card (3rd party only)

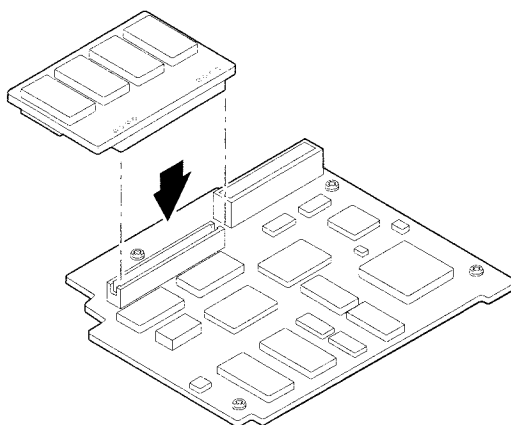


Figure: Inserting the RAM Expansion Card

Verification

Inserted RAM Expansion Card	Total Memory (inside Get Info—virtual memory off) Built-in Memory (inside Get Info—virtual memory on)
2 MB	4096 K
4 MB	6144 K
6 MB	8192 K

If the amount of RAM is not correct:

1. Replace the RAM expansion card.
2. If the amount of RAM indicated is still not correct, return the computer to Apple.



PowerBook 140/170

Fax/Data Modem

Fax/Data Modem Removal

The modem is a standard feature on the PowerBook 170; it is an option on the PowerBook 140.

1. Remove the main battery, I/O door, and top case.



CAUTION: The components on the modem are very sensitive to ESD. Follow ESD precautions with extra care when touching this board.

2. Remove the two screws holding the modem on the top of the motherboard hex nuts (see Figure below).
3. Disconnect the modem from the motherboard.

Note: For installation, the modem port cover must be removed to uncover the modem port. To remove the modem port cover, pinch the tabs together at their base and push the cover through the computer's back panel from inside to outside.

Note: When installing the modem, affix the FCC modem label and the DOC label to the inside of the I/O door. Position the FCC modem label so that it aligns with the modem port, and the DOC label so that it aligns with the HD-30 SCSI port.

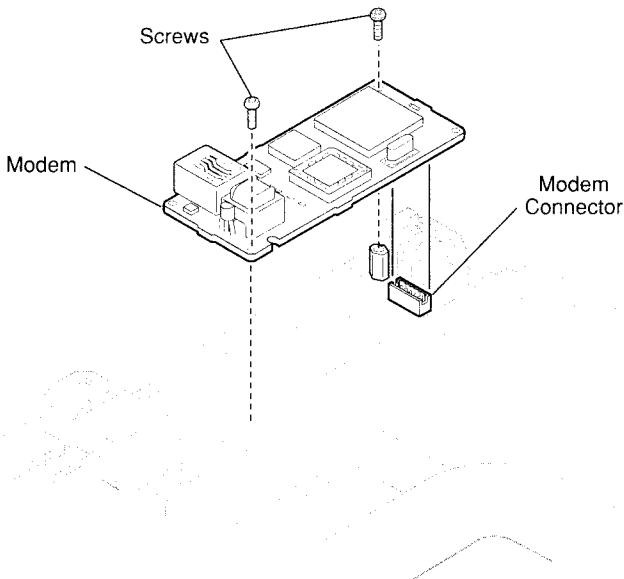


Figure: Removing the Fax/Data Modem