



PowerBook 140/145/ 145B/170

PowerBook 140, PowerBook 145,
PowerBook 145B, PowerBook 170





Basics

PowerBook 140/145/145B/170



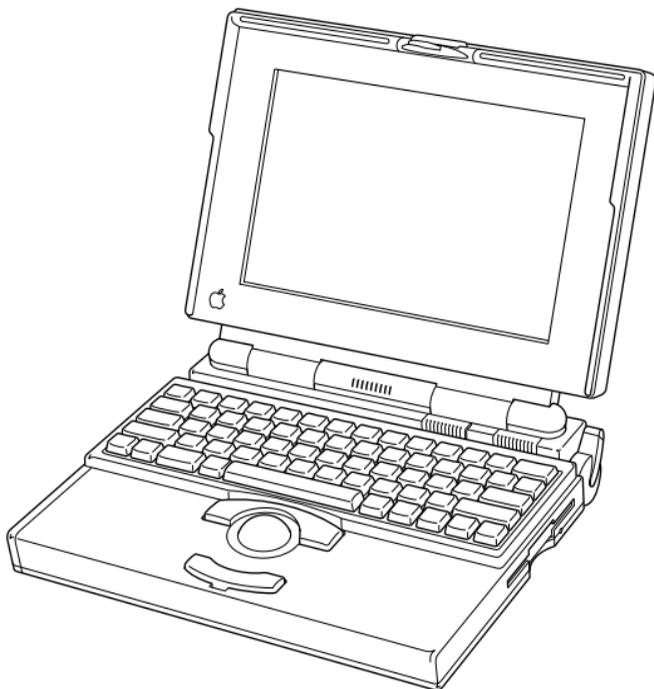


Figure: PowerBook 140, 145, 145B, 170

Overview

This manual includes complete repair procedures for the PowerBook 140, PowerBook 145 and 145B, and the PowerBook 170.





Display Compatibility Matrix

	Active Matrix PB 170 661-0711	FSTN, Rev. A PB 140/145 661-0706	FSTN, Rev. B PB 140/145 661-0681	FSTN, Rev. C PB 145/145B 661-0745
Inverter	699-0273	699-0271	699-0272	922-0025
Display Cable	630-6273	922-0820	630-6272	922-0820
Inverter Cable	936-0106	936-0106	936-0106	936-0106

Important: The PowerBook family includes four displays—an active matrix and three FSTN displays. Each of these displays requires a compatible inverter and display cable; the inverters, display cables, and displays are not interchangeable. Before ordering a replacement display, display cable, or inverter, refer to the display matrix.

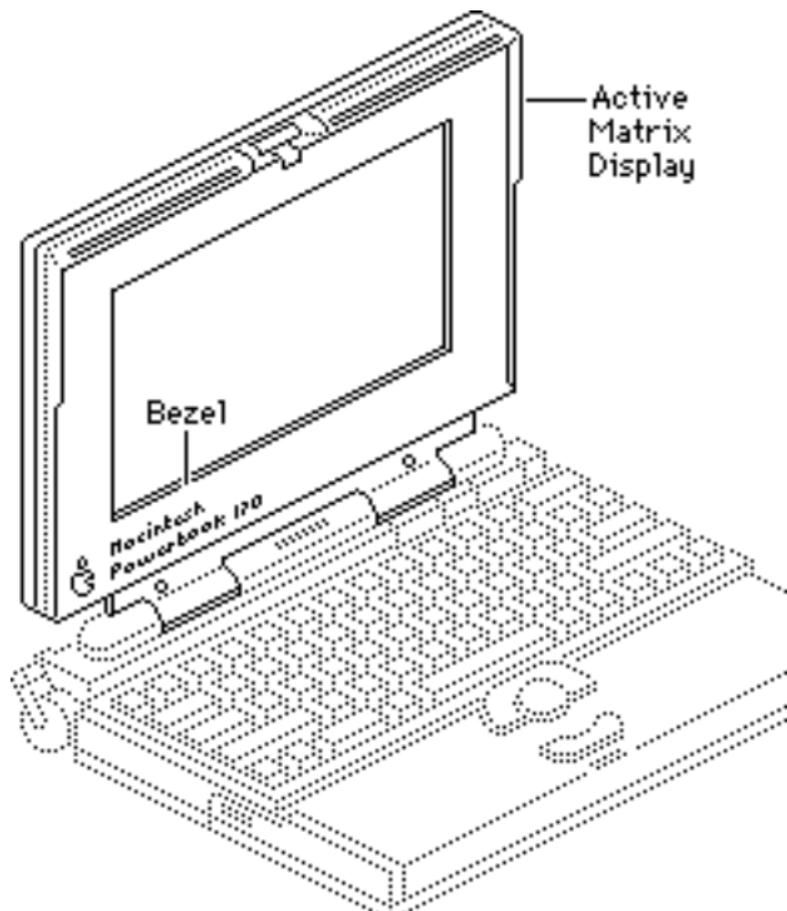




Displays

Each of the four displays requires a compatible inverter and display cable. Refer to the following pages to identify the displays.





Active-Matrix Display

The active-matrix display is available for the PowerBook 170 only. Use the following replacement parts with the PowerBook 170:

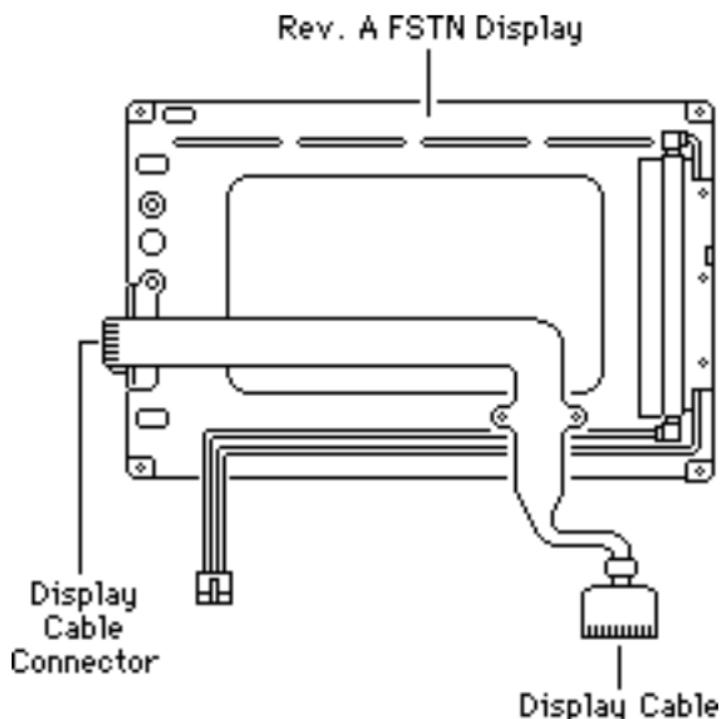
- Active Matrix Display
661-0711
- Inverter (green)
699-0273
- Display Cable
630-6273
- Inverter Cable
936-0106





FSTN Display, Rev. A

Rev. A, B, and C FSTN displays are available for the PowerBook 140/145/145B. The Rev. A display has a plastic rear cover, and the display cable connector is located along the outside edge of the printed circuit board.





If you are replacing the inverter, display cable, or Rev. A display in a PowerBook 140/145, use these replacement parts:

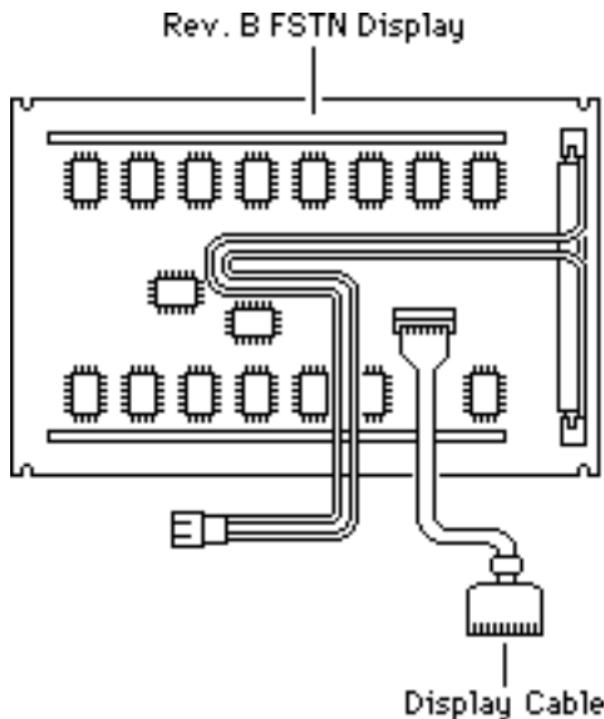
- FSTN Display, Rev. A
661-0706
- Inverter (blue)
699-0271
- Display Cable
922-0820
- Inverter Cable
936-0106





FSTN Display, Rev. B

Rev. A, B, and C FSTN displays are available for the PowerBook 140/145/145B. The printed circuit board is exposed at the rear of the Rev. B display, and the display cable connector is located near the center of the board.





If you are replacing the inverter, display cable, or Rev. B display in a PowerBook 140/145, use these replacement parts:

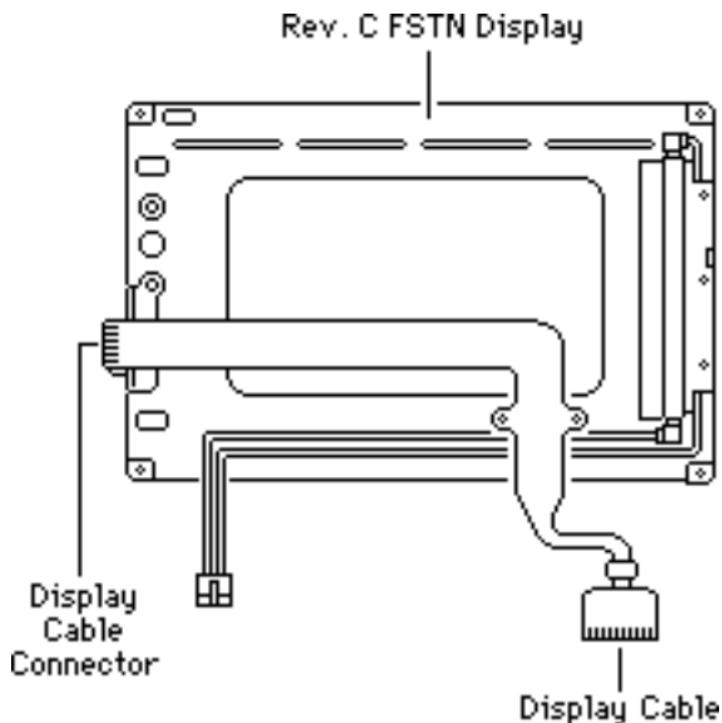
- FSTN Display, Rev. B
661-0681
- Inverter (red)
699-0272
- Display Cable
630-6272
- Inverter Cable
936-0106





FSTN Display, Rev. C

Rev. A, B, and C FSTN displays are available for the PowerBook 140/145/145B. The Rev. C display has a plastic rear cover, and the display cable connector is located along the outside edge of the printed circuit board.





If you are replacing the inverter, display cable, or Rev. C display in a PowerBook 145/145B, use these replacement parts:

- FSTN Display, Rev. C
661-0745
- Inverter (blue)
922-0025
- Display Cable
922-0820
- Inverter Cable
936-0106





Specifications

PowerBook 140/145/145B/170





Introduction

Specifications information for this product can be found in this chapter and also in the Spec Database, which you can access in one of three ways:

- Launch it directly by double-clicking the Apple Spec Database runtime alias at the top level of the Main Service Source CD.
- Select “Apple Spec Database” from the Service Source drop-down main menu.
- Click the Acrobat toolbar icon for the database, which is near the right end of the toolbar with the letters “SP.”





Processor

140 CPU

Motorola 68030 microprocessor
16 MHz

145/145B/170 CPU

Motorola 68030 microprocessor
25 MHz

Coprocessor (170 Only)

Motorola 68882 floating-point unit (FPU)
25 MHz

Addressing

32-bit internal registers
32-bit address bus
32-bit data bus





Memory

RAM	4 MB, 2 MB installed on the daughterboard and 2 MB on an expansion card Expandable to 6 MB by replacing 2 MB expansion card with 4 MB card
RAM 145B	4 MB pseudostatic RAM (PSRAM) installed on the daughterboard Expandable to 8 MB by installing 4 MB expansion card
ROM	1 MB, expandable to 4 MB
PRAM	256 bytes of parameter memory
VRAM	256K of static video display memory





Clock/Calendar

Custom chip with long-life lithium battery





Disk Storage

Floppy Drive

19 mm high, 1.4 MB Apple SuperDrive

Hard Drive

2.5 in., 40/80/120 MB hard drive





I/O Interfaces

SCSI	HDI-30 SCSI port with 1.5 MB/sec. transfer rate Supports up to five external SCSI devices Does not provide termination power
Apple Desktop Bus	Apple Desktop Bus (ADB) port (maximum of three ADB devices is recommended) 200 mA maximum current draw for all ADB devices
Serial	Two RS-422 serial ports; mini DIN-8 connectors
Sound	Monaural sound-in port Stereo sound-out headphone jack that plays CD audio tracks in stereo and computer-generated sounds in mono





I/O Devices

Keyboard

Built-in standard Apple keyboard
63 keys domestic; 64 keys ISO
Two-level tilt adjustment

Trackball

30 mm diameter, dual button
ADB interface

Microphone (140/ 145/170)

Electret, omnidirectional
Output voltage of 4 mV, peak to peak





Sound and Video

Video Display 140/ 145/145B

10 in. (254 mm) diagonal screen
Flat-panel, film-compensated supertwist nematic (FSTN) liquid
crystal display
CCFL on-demand backlight
640 by 400 pixels

Video Display 170

10 in. (254 mm) diagonal screen
Flat-panel, active-matrix liquid crystal display
CCFL on-demand backlight
640 by 400 pixels

Sound Generator

Apple sound chip provides 8-bit sound capable of driving stereo
headphones or other stereo equipment through the sound jack





Electrical

Main Battery

Nickel cadmium (NiCad), 2.5 Ah

Provides 2-3 hours of usage before recharging

Recharge time: 3 hours

500 power cycles capacity

PRAM Battery

3 V lithium

Power Adapter

110-240 VAC line voltage

50-60 Hz

US, Japanese, United Kingdom, Australian, and European versions





Physical

Dimensions

Height: 2.25 in. (5.7 cm)

Width: 11.25 in. (28.6 cm)

Depth: 9.3 in. (23.6 cm)

Weight

6.8 lb. (3.1 kg) with battery





Environmental

Operating Temperature	50-104° F (10-40° C)
Storage Temperature	50-140° F (10-60° C)
Relative Humidity	20-80% noncondensing
Altitude	0-15,000 ft. (0-4722 m)





Other

Fax/Data Modem

Internal 2400-baud modem with fax send at 9600 baud (includes fax send software)

300/1200/2400 bps transmission rates

Serial binary and asynchronous protocols

Fax communication: V.29

Error correction: V.42 and MNP 4

Data compression: V.42bis and MNP 5





Troubleshooting

PowerBook 140/145/145B/170





General

The Symptom Charts included in this chapter will help you diagnose specific symptoms related to your product. Because cures are listed on the charts in the order of most likely solution, try the first cure first. Verify whether or not the product continues to exhibit the symptom. If the symptom persists, try the next cure. (Note: If you have replaced a module, reinstall the original module before you proceed to the next cure.)

If you are not sure what the problem is, or if the Symptom Charts do not resolve the problem, refer to the Flowchart for the product family.

For additional assistance, contact Apple Technical Support.





Power Manager Reset

Reset the power manager if the battery and power adapter are proven good, but the computer will not power on. The computer will not reset after a system crash.

To reset the power manager in a PowerBook 140/145/145B/170,

- Remove the AC adapter and the battery.
- Let the unit sit without power hooked up for 3-5 minutes.
- Using two paper clips, simultaneously hold down the reset and interrupt buttons for 5-10 seconds.
- Reinstall the battery and, if necessary, reconnect the AC adapter.
- Turn on the computer.





Symptom Charts

Startup

RAM failure occurs
(eight-tone error
chord sequence
sounds after startup
chord)

- 1 Replace RAM expansion card.
- 2 Replace daughterboard.
- 3 Replace motherboard.

Hardware failure
occurs (four-tone
error chord sequence
sounds after startup
chord)

- 1 Disconnect hard drive data cable and reboot system. If startup sequence is normal, replace hard drive.
- 2 Disconnect floppy drive cable and reboot system. If startup sequence is normal, replace floppy drive.
- 3 Replace motherboard.





Startup (Continued)

Screen displays
checkerboard pattern;
no startup chime

- 1 Reseat RAM expansion card.
- 2 Replace RAM expansion card.
- 3 Replace daughterboard.
- 4 Reseat display cable.





Power

Screen is blank;
computer doesn't
respond

- 1 Press reset switch.
- 2 Connect power adapter and reboot computer in 3–4 minutes.
- 3 Try known-good, charged main battery.
- 4 Check all interconnect board, daughterboard, and motherboard connections.
- 5 Reset the power manager.
- 6 Replace keyboard.
- 7 Replace interconnect board.
- 8 Replace daughterboard.
- 9 Replace motherboard.





Power (Continued)

After removing main battery, some Control Panel settings are different

- 1 Replace interconnect board.
- 2 Replace daughterboard.
- 3 Replace motherboard.

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

- 1 Check battery charger connection.
- 2 Try known-good, charged main battery.
- 3 Try known-good power adapter.
- 4 Check battery thermistor cable connection.
- 5 Replace motherboard.





Power (Continued)

Low-power warning appears

- 1 Recharge battery or attach power adapter.
- 2 Verify that peripherals are low-power.
- 3 Reduce use of power-consuming devices or connect power adapter.
- 4 Try known-good, charged main battery.
- 5 Try known-good power adapter.
- 6 Replace motherboard.

Computer runs when plugged in to wall outlet but not on battery power; battery voltage is within tolerance

- 1 Reseat battery to make sure it is mating with contacts on motherboard.
- 2 If motherboard includes removeable fuse, replace fuse.
- 3 Replace motherboard.
- 4 Return computer to Apple.





Video

Pixel is always white

- 1 PowerBook 170, active matrix display only: If there are more than five voids (pixels that are always white), or two or more voids within one inch of each other, replace display (CPRC/international repairers only) or return computer to Apple.
- 2 PowerBooks 140, 145, and 145B, replace display.

Pixel is always black

- 1 PowerBook 170, active matrix display only: Replace display (CPRC/ international repairers only) or return computer to Apple.
- 2 PowerBooks 140, 145, and 145B, replace display.





Video (Continued)

Row or partial row of pixels never comes on or is always on

- 1 Add shim to display cable. Refer to Additional Procedures.
- 2 Replace display cable.
- 3 Replace FSTN display (all repairers) or replace active-matrix display (CPRC/ international repairers only).
- 4 Replace interconnect board.
- 5 Replace daughterboard.

Thin white line is always on at middle of screen

For FSTN screens (PowerBook 140/145/145B), a thin white line is normal. For active-matrix screens (PowerBook 170), return display (CPRC/ international repairers only) or return computer to Apple.





Video (Continued)

Display is very light
or totally white

- 1 Adjust screen contrast (PowerBook 140/145/145B only).
- 2 Check display cable, inverter board, interconnect board, daughterboard, and motherboard connections.
- 3 Replace inverter board.
- 4 Replace interconnect board.
- 5 Replace display cable.
- 6 Replace FSTN display (all repairers) or replace active-matrix display (CPRC/ international repairers only).
- 7 Replace daughterboard.
- 8 Replace motherboard.





Video (Continued)

No display, but computer appears to operate correctly

- 1 Adjust screen contrast.
- 2 Check display cable, inverter board, interconnect board, daughterboard, and motherboard connections.
- 3 Replace inverter board.
- 4 Replace interconnect board.
- 5 Add shim to display cable. Refer to Additional Procedures.
- 6 Replace power cable.
- 7 Replace display cable.
- 8 Replace FSTN display (all repairers) or replace active-matrix display (CPRC/ international repairers only).
- 9 Replace daughterboard.
- 10 Replace motherboard.





Video (Continued)

Rainbow colors visible from extreme viewing angles

Such colors are normal for FSTN screens (PowerBook 140/145/145B).

Image is not uniform

For FSTN screens (PowerBook 140/145/145B), irregularity in images is normal. Adjust contrast and brightness to diminish effect. For active-matrix screens (PowerBook 170), replace display (CPRC/ international repairers only) or return computer to Apple.

Display stopped working or dimmed but is fine now

If temperature is under 5 or over 40 degrees centigrade, this reaction is normal for FSTN screens (PowerBook 140/145/145B).





Video (Continued)

Backlight doesn't operate

- 1 Check cables.
- 2 Check display cable, inverter board, interconnect board, daughterboard, and motherboard connections.
- 3 Replace inverter board.
- 4 Replace inverter display cable.
- 5 Replace interconnect board.
- 6 Add shim to display cable. Refer to Additional Procedures.
- 7 Replace display cable.
- 8 Replace FSTN display (all repairers) or replace active-matrix display (CPRC/ international repairers only).
- 9 Replace daughterboard.
- 10 Replace motherboard.





Video (Continued)

Screen goes blank	<ol style="list-style-type: none">1 Press any key to wake computer from system sleep.2 Check display cable connection.
Two black horizontal lines appear; screen intermittently goes dark	Add shim to display cable. Refer to Additional Procedures.
Screen flickers	Add shim to display cable. Refer to Additional Procedures.





Floppy Drive

Audio and video present, but internal drive does not operate

- 1 Try known-good floppy disk.
- 2 Check floppy drive cable connection.
- 3 Replace floppy drive cable.
- 4 Replace floppy drive.
- 5 Replace daughterboard.
- 6 Replace motherboard.

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

- 1 Try known-good system disk.
- 2 Verify that trackball or mouse button is not stuck.
- 3 Check floppy drive cable connection.
- 4 Replace floppy drive cable.
- 5 Replace floppy drive.
- 6 Replace motherboard.





Floppy Drive (Continued)

Disk does not eject

- 1 Switch off system and hold mouse button down while you switch system on.
- 2 Insert opened paper clip into hole beside drive.
- 3 Check floppy drive cable connection.
- 4 Replace floppy drive cable.
- 5 Replace floppy drive.
- 6 Replace daughterboard.
- 7 Replace motherboard.

Disk initialization fails

- 1 Verify using correct media.
- 2 Try known-good floppy disk.
- 3 Install inverter shield.
- 4 Check floppy drive cable connection.
- 5 Replace floppy drive cable.
- 6 Replace floppy drive.





Floppy Drive (Continued)

Read/write/copy
error

- 1 Verify using correct media.
- 2 Try known-good floppy disk.
- 3 Install inverter shield.
- 4 Check floppy drive cable connection.
- 5 Replace floppy drive cable.
- 6 Replace floppy drive.





Hard Drive

Internal hard drive
does not operate

- 1 Disconnect external SCSI devices.
- 2 Check internal hard drive data cable connection.
- 3 Use HD SC Setup to reinitialize drive.
- 4 Replace internal hard drive data cable.
- 5 Replace internal hard drive.
- 6 Replace motherboard.





Peripherals

After connecting external SCSI device, computer doesn't boot

- 1 Switch on external SCSI device before starting computer.
- 2 Check cable connections.
- 3 Verify that standard Apple terminator terminates SCSI chain at beginning and end.
- 4 Verify that SCSI select switch setting on external device is unique.
- 5 Verify operation of internal hard drive.
- 6 Try known-good external SCSI device.
- 7 Replace motherboard.





Peripherals (Continued)

Cursor does not move when using trackball

- 1 Press reset switch.
- 2 Check interconnect board, daughterboard, and motherboard connections.
- 3 Try low-power mouse. If cursor moves, replace trackball or keyboard.
- 4 Replace interconnect board.
- 5 Replace daughterboard.
- 6 Replace motherboard.

Cursor intermittently does not move or moves erratically

- 1 Clean ball and rollers of trackball.
- 2 Replace trackball.
- 3 Replace keyboard.
- 4 Replace interconnect board.
- 5 Replace motherboard.





Peripherals (Continued)

Cursor moves, but clicking trackball button has no effect

- 1 Check interconnect board, daughterboard, and motherboard connections.
- 2 Replace trackball.
- 3 Replace keyboard.
- 4 Replace interconnect board.
- 5 Replace daughterboard.
- 6 Replace motherboard.

Cursor does not move when using mouse

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





Peripherals (Continued)

No response to any key on keyboard

- 1 Reset power manager.
- 2 Check connections of keyboard to interconnect board, and interconnect board to daughterboard.
- 3 Replace keyboard.
- 4 Replace interconnect board.
- 5 Replace daughterboard.

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

- 1 Verify that System is 7.0.1 or later.
- 2 Verify that Chooser and Control Panel settings are correct.
- 3 Check cables.
- 4 Replace printer interface cable.
- 5 Try known-good printer.
- 6 Replace daughterboard.
- 7 Replace motherboard.





Peripherals (Continued)

Known-good
LaserWriter does not
print

- 1 Verify that System is 7.0.1 or later.
- 2 Verify that Chooser and Control Panel settings are correct.
- 3 Check cables.
- 4 Replace printer interface cable.
- 5 Try known-good printer. If printer works, troubleshoot network. Refer to Networks and Communications manual.
- 6 Replace daughterboard.
- 7 Replace motherboard.

Device connected to
external modem port
doesn't work

- 1 Verify that External Modem is selected in CDEV.
- 2 Verify that System is 7.0.1 or later.
- 3 Check cables.
- 4 Attach device to known-good computer.
- 5 Replace daughterboard.
- 6 Replace motherboard.





Peripherals (Continued)

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

- 1 Verify that System is 7.0.1 or later.
- 2 Check cables.
- 3 Verify that SCSI device has standard Apple terminator.
- 4 Verify that SCSI select switch setting on external device is unique.
- 5 Attach device to known-good computer.
- 6 Replace daughterboard.
- 7 Replace motherboard.





Internal Modem

Internal modem options do not appear in CDEV

- 1 Remove and reseal modem card.
- 2 Verify that System is 7.0.1 or later.
- 3 Replace modem card.
- 4 Replace motherboard.

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 Check phone cord connection and operation.
- 3 Remove and reseal modem card.
- 4 Verify that System is 7.0.1 or later.
- 5 Replace modem card.





Internal Modem (Continued)

Strange mix of characters appears onscreen

- 1 Verify that baud rate and data format settings of communications application are compatible with internal modem and remote modem.
- 2 Check phone cord connection and operation.
- 3 Remove and reseal modem card.
- 4 Verify that System is 7.0.1 or later.
- 5 Replace modem card.
- 6 Replace daughterboard.
- 7 Replace motherboard.

Modem interferes with system sound

- 1 Remove and reseal modem card.
- 2 Replace modem board.
- 3 Replace interconnect card.
- 4 Replace motherboard.





Internal Modem (Continued)

Modem does not respond to incoming call

- 1 If computer is in sleep mode, verify that Wake On Ring option in CDEV is selected.
- 2 Check phone cord connection and operation.
- 3 Replace modem card.
- 4 Replace motherboard.

Modem has no sound output

- 1 Verify that Control Panel volume setting is above 0.
- 2 Replace modem card.
- 3 Replace interconnect card.
- 4 Replace motherboard.





Internal Modem (Continued)

Modem connects but does not communicate with remote modem

- 1 Verify that remote modem needs error correction (error correction is internal modem default).
- 2 Type &Q0 to disable error correction.





Miscellaneous

Screen goes blank and computer shuts down every few minutes

Adjust sleep delays in Control Panel or connect power adapter.

Application seems to run slower after few seconds

Connect power adapter.

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

Adjust sleep delays in Control Panel or connect power adapter.





Miscellaneous (Continued)

No sound from speaker

- 1 Verify that volume setting in Control Panel is 1 or above.
- 2 Check connections of speaker to interconnect board, interconnect board to daughterboard, and daughterboard to motherboard.
- 3 Replace interconnect board.
- 4 Replace daughterboard.
- 5 Replace motherboard.

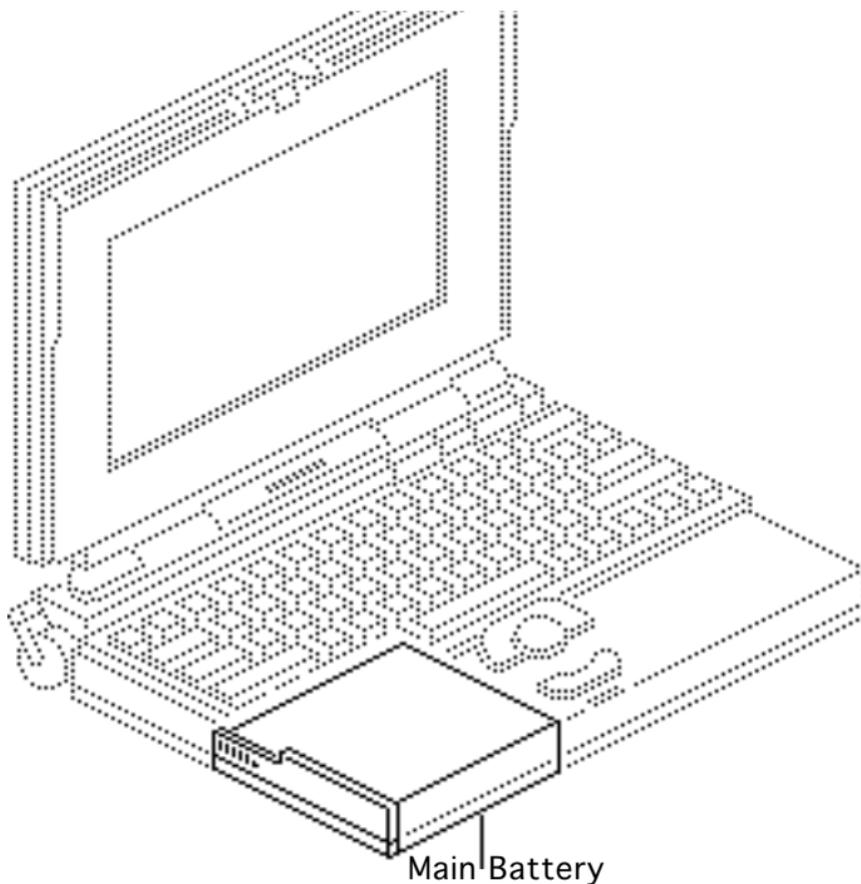




Take Apart

PowerBook 140/145/145B/170





Main Battery

Before you begin, disconnect the power adapter.

Note: This procedure also covers removal of the main battery door.

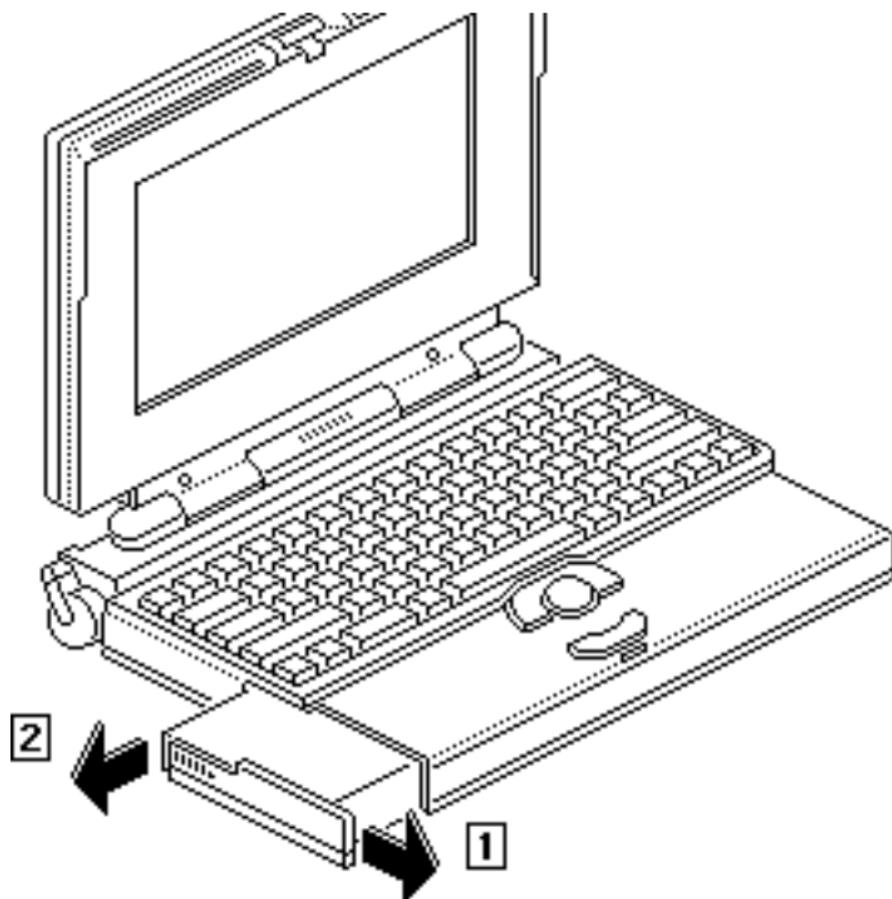
Important: Before removing the main battery, use the Macintosh Shut Down command. Otherwise, all RAM contents will be lost.





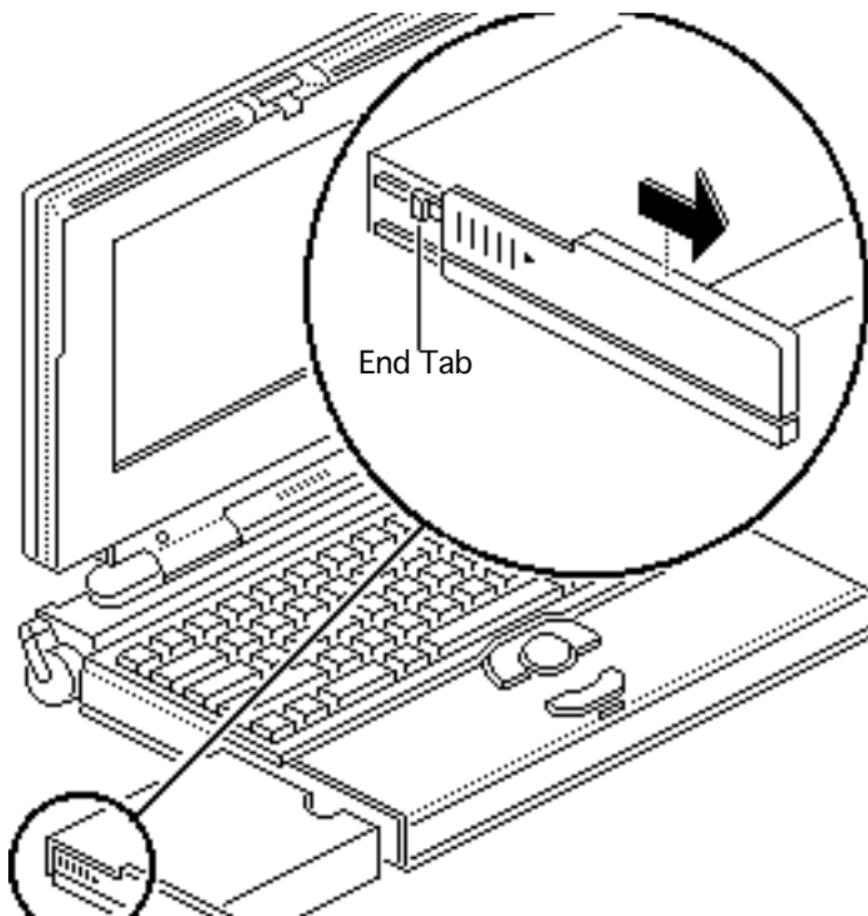
⚠ Warning: The main battery is a NICAD battery that contains toxic materials. Send undamaged, dead batteries to Apple for recycling—do not discard dead batteries with other waste. If the battery is damaged, do not return it to Apple. Dispose of damaged batteries according to local ordinances. Review battery handling and disposal instructions in Bulletins/ Safety.





- 1 Slide open the battery door.
- 2 Using the battery door as a handle, pull out the main battery.





- 3 Slide the battery door completely open.
- 4 Pull the end tab until it releases and remove the door from the battery.

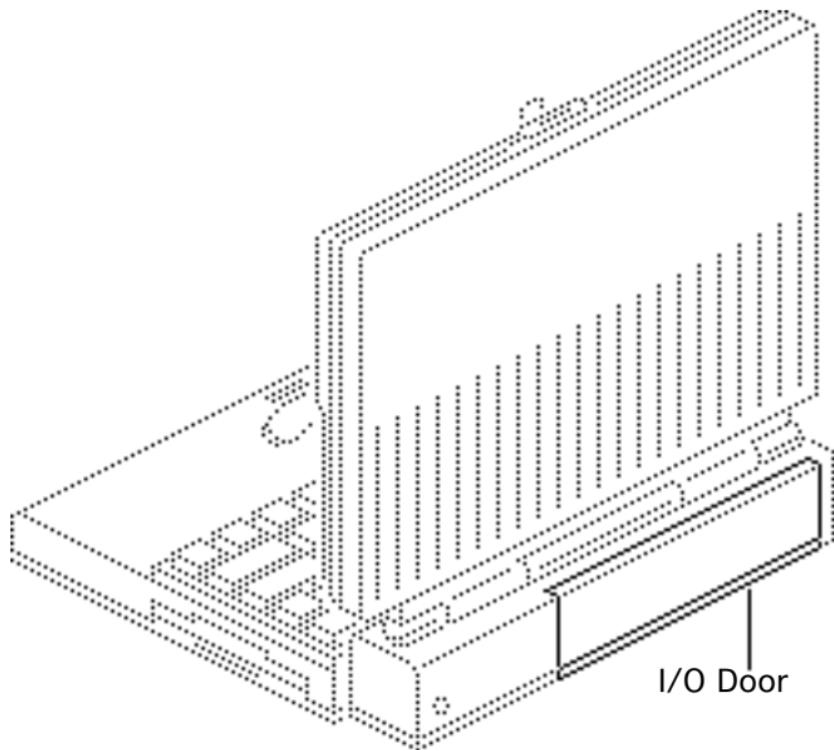


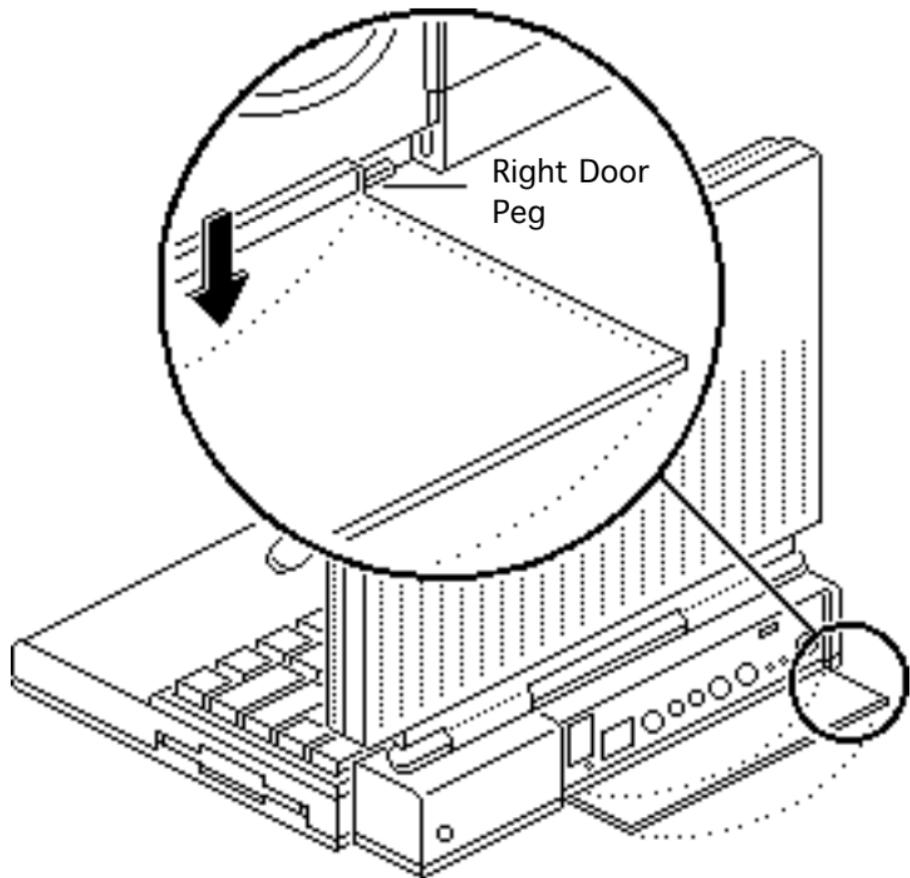


I/O Door

No preliminary steps are required before you begin this procedure.

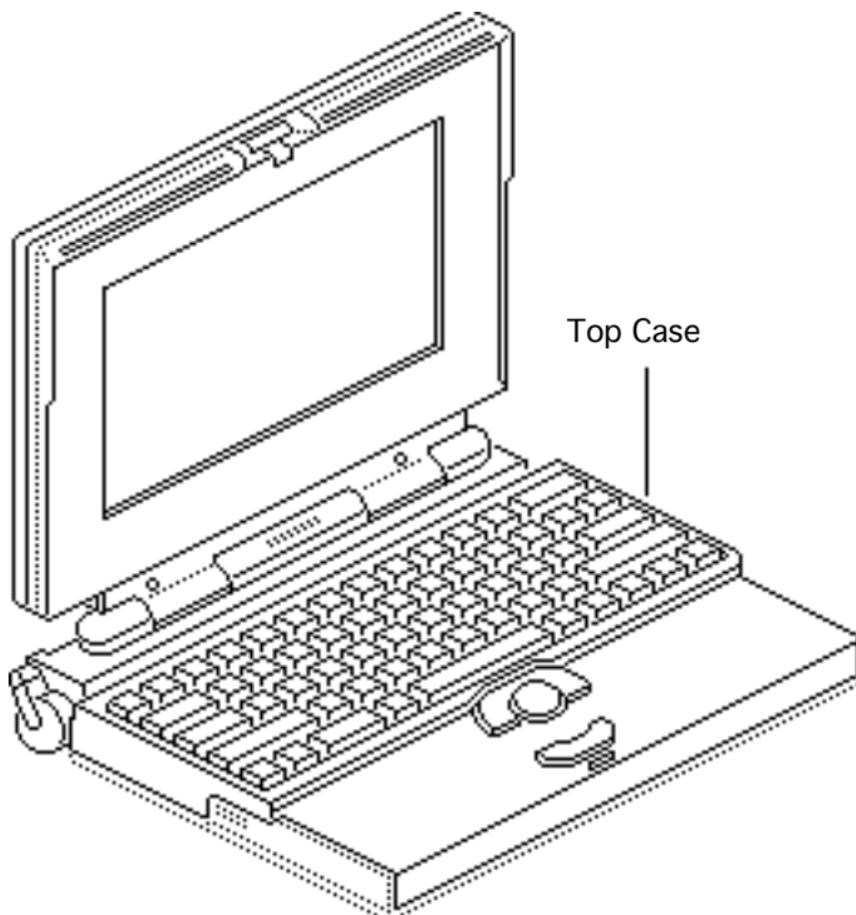
Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/ Safety.





- 1 Open the I/O door.
- 2 Carefully bend the door so that the middle bows outward and unhinge the two bottom door pegs.





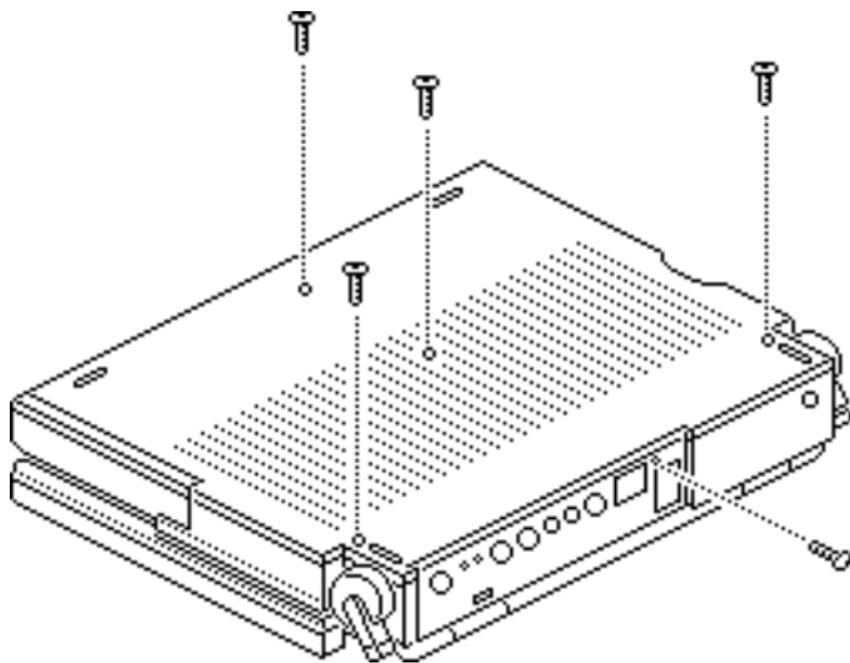
Top Case

Before you begin, remove the following:

- Main battery
- I/O door

Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/ Safety.

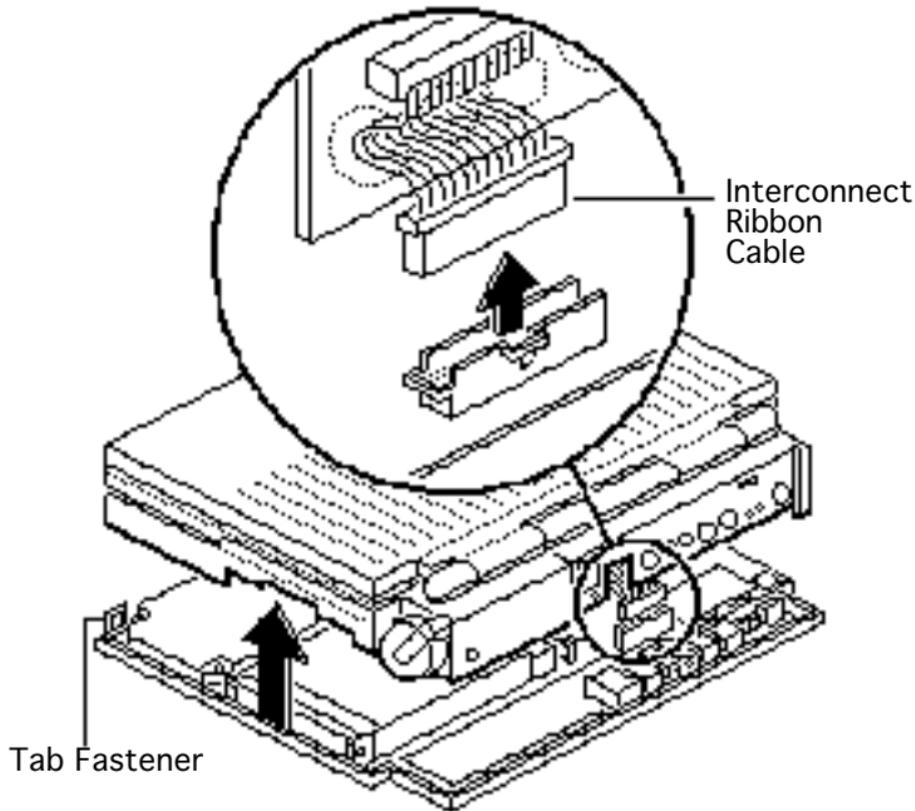




- 1 **Note:** Use a T-8 torx driver to remove the small screw from the rear connector panel and a T-10 torx driver to remove the other case screws.

Remove the five torx screws from the bottom case.





- 2 Lift up the top case and disconnect the interconnect cable.
- 3 Lift off the top case and unhook the two tab fasteners from the front of the bottom case.

Replacement Caution: When connecting the interconnect cable, fold the cable as shown. If it is not folded correctly, the cable could short.



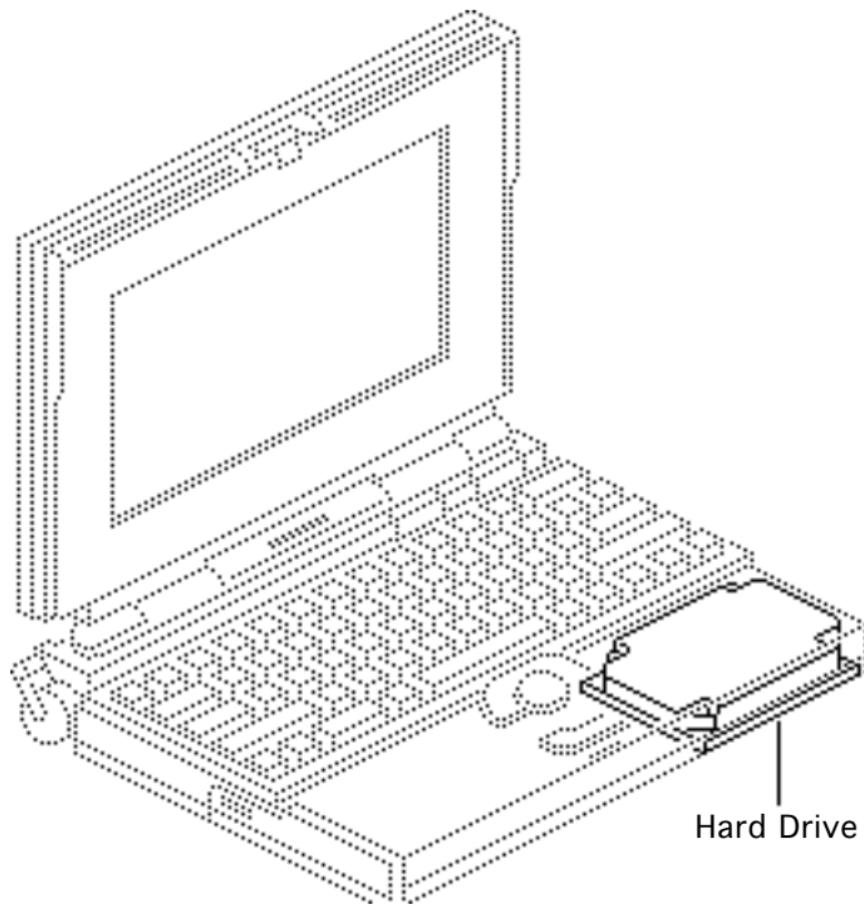


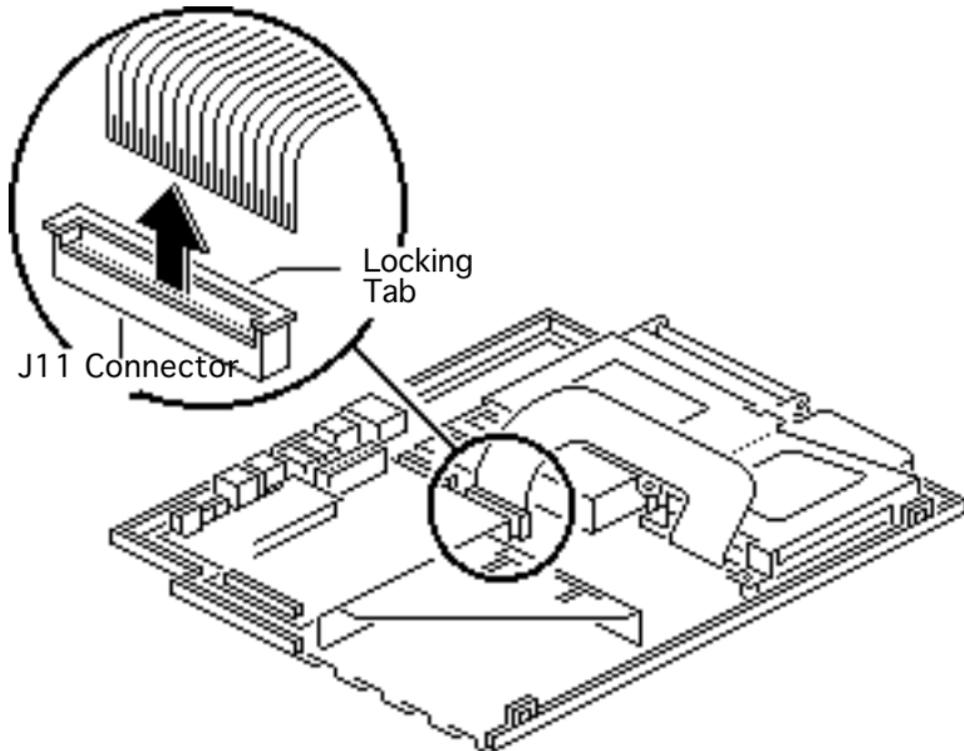
Hard Drive

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Modem card (if present)

Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

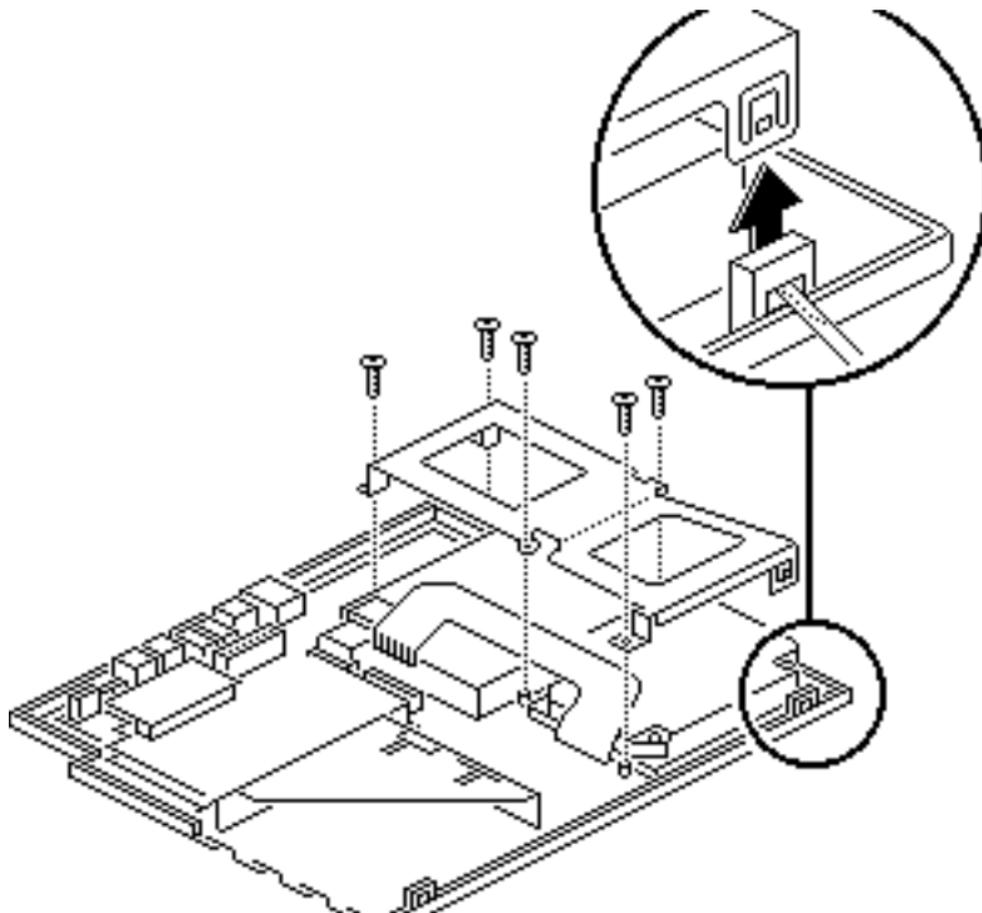




- 1 **Caution:** The hard drive ribbon cable is fragile. Handle it with care.

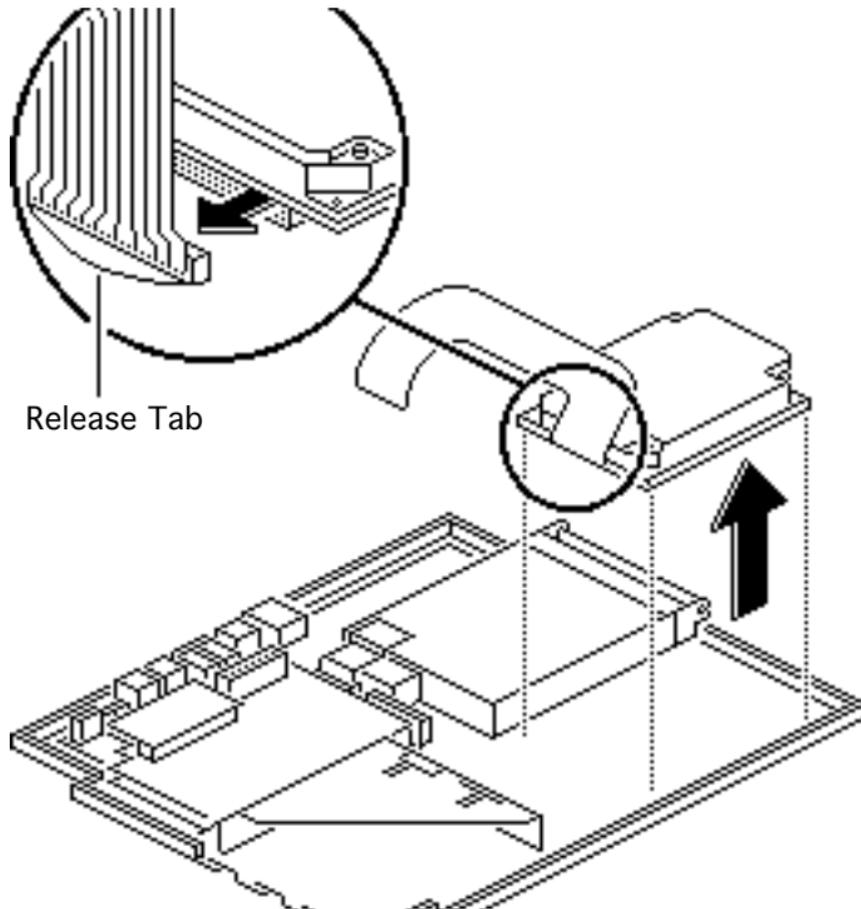
Lift the locking tab on connector J11 and remove the hard drive ribbon cable from the motherboard.





- 2 Using a T-8 torx driver, remove the five screws from the drive retainer.
- 3 Using a jeweler's screwdriver, release the drive retainer latch and remove the retainer.





- 4 Lift the hard drive out of the bottom case.
- 5 **Note:** If the hard drive does not have a release tab, carefully pry the cable from the drive with a screwdriver.

Pull the release tab and disconnect the hard drive cable.

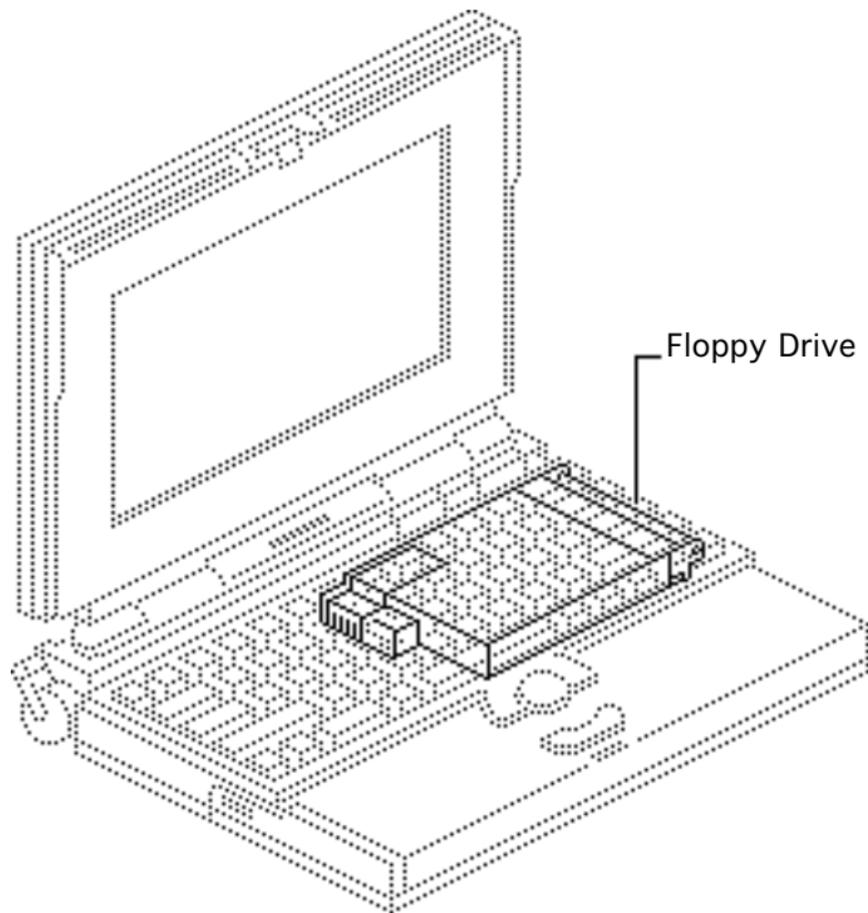




Replacement Note: Drive retainers for 17-mm-high and 19-mm-high hard drives are not interchangeable. Check the height of the replacement drive and use the appropriate drive retainer. For hard drive upgrades, refer to Upgrades.

Replacement Note: For information on returning drives, cables, and carriers to Apple, refer to Additional Procedures in the Hard Drives manual.





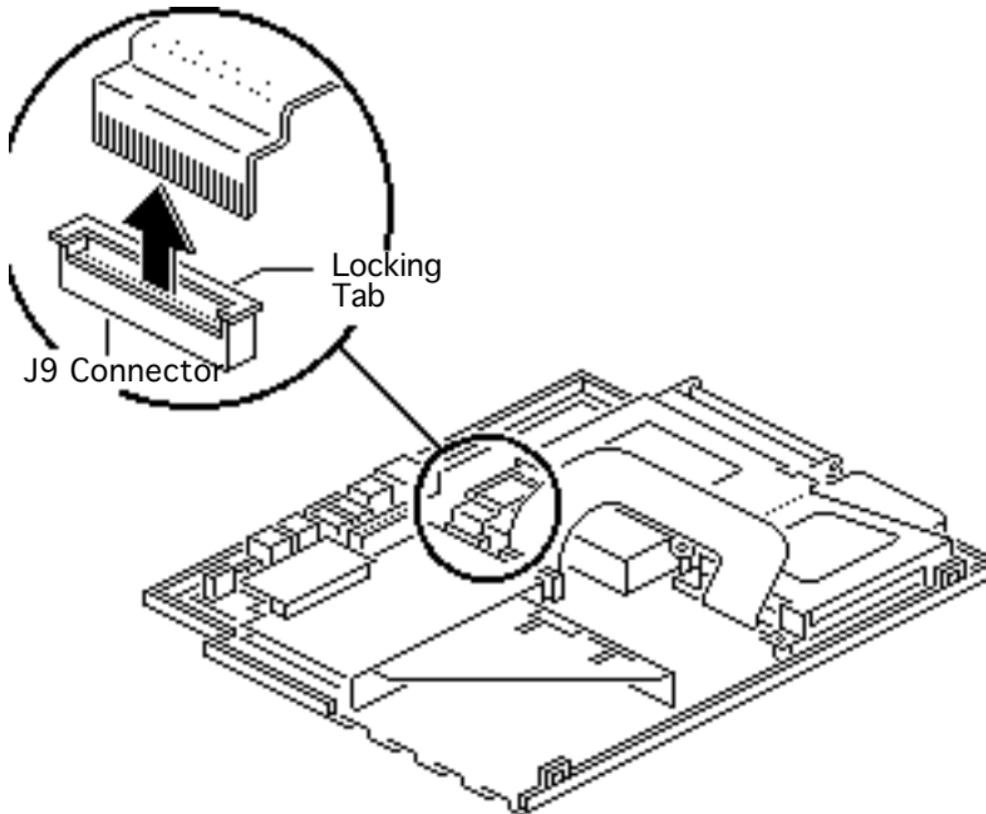
Floppy Drive

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Modem card (if present)

Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

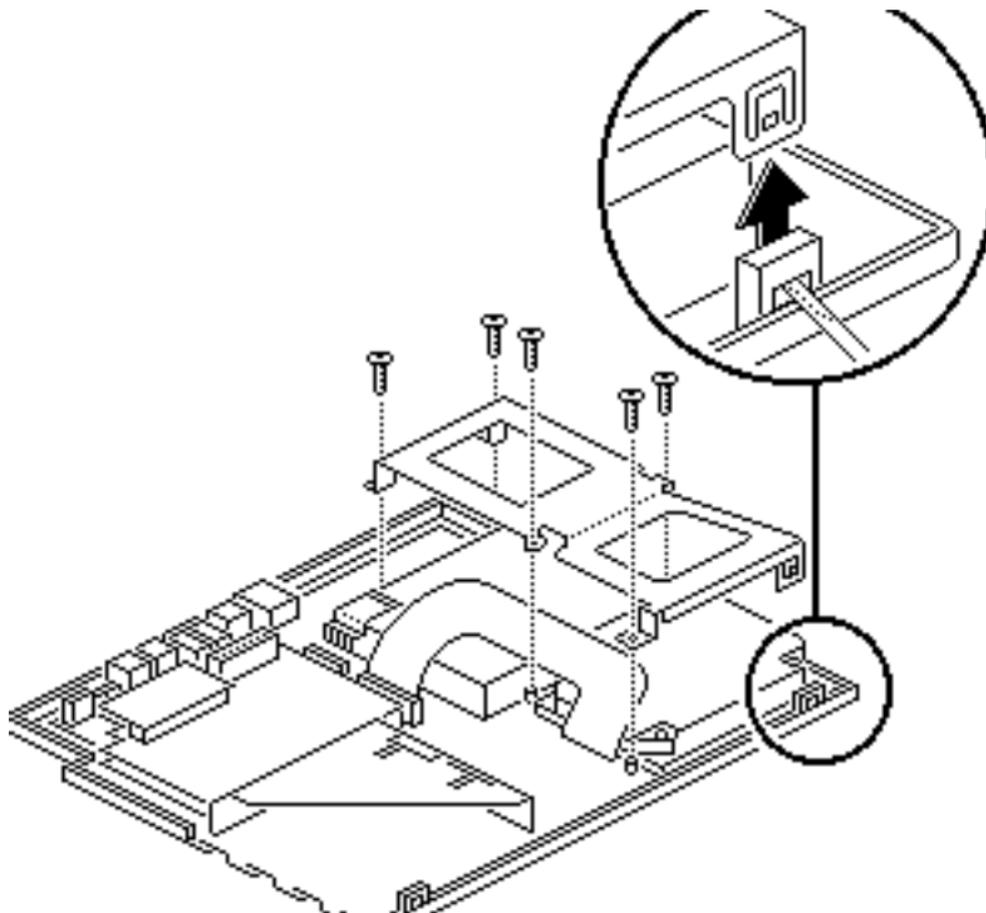




- 1 **Caution:** The floppy drive ribbon cable is fragile and should be handled with care.

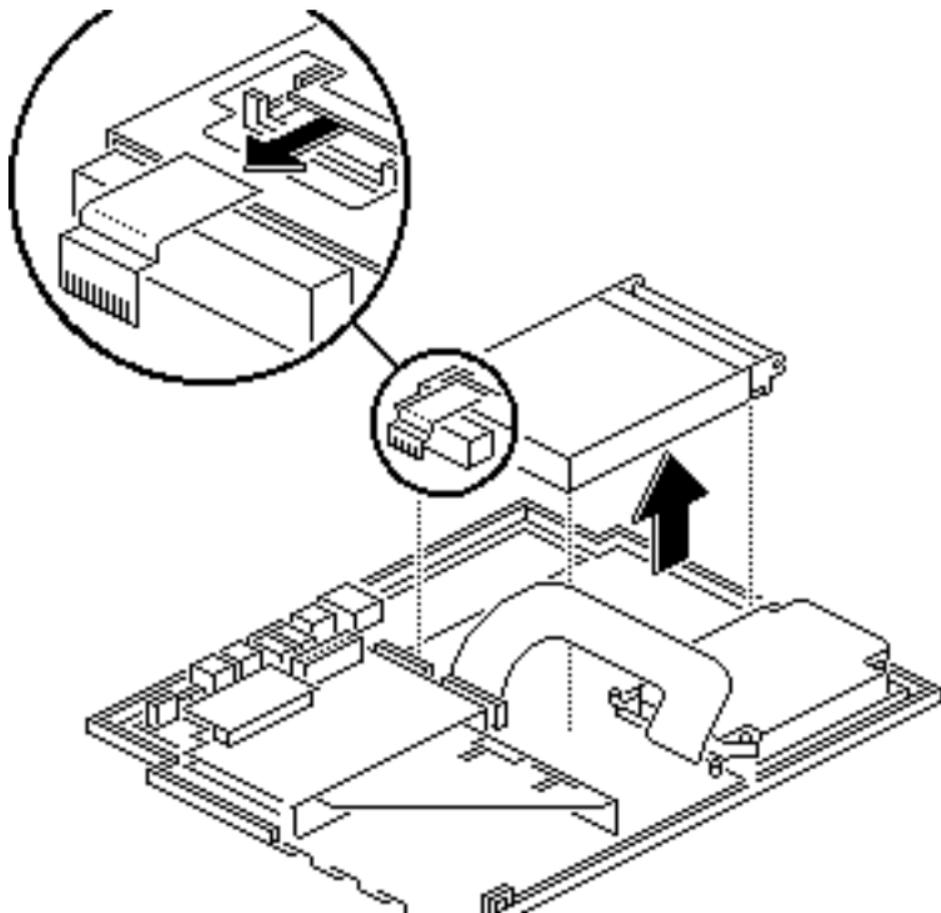
Lift the locking tab on connector J9 and remove the floppy drive ribbon cable from the motherboard.





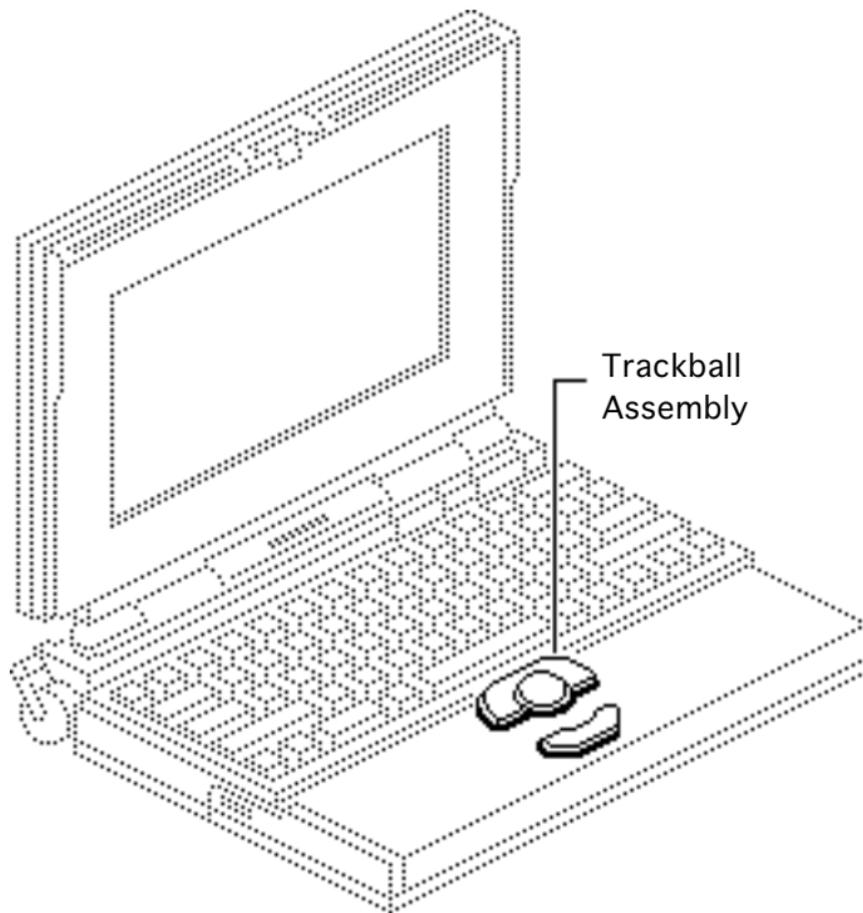
- 2 Using a T-8 torx driver, remove the five torx screws from the drive retainer.
- 3 Using a jeweler's screwdriver, release the drive retainer latch and remove the retainer.





- 4 Lift the floppy drive out of the bottom case.
- 5 Using a jeweler's screwdriver, push out the locking tab and remove the floppy drive ribbon cable from the drive.





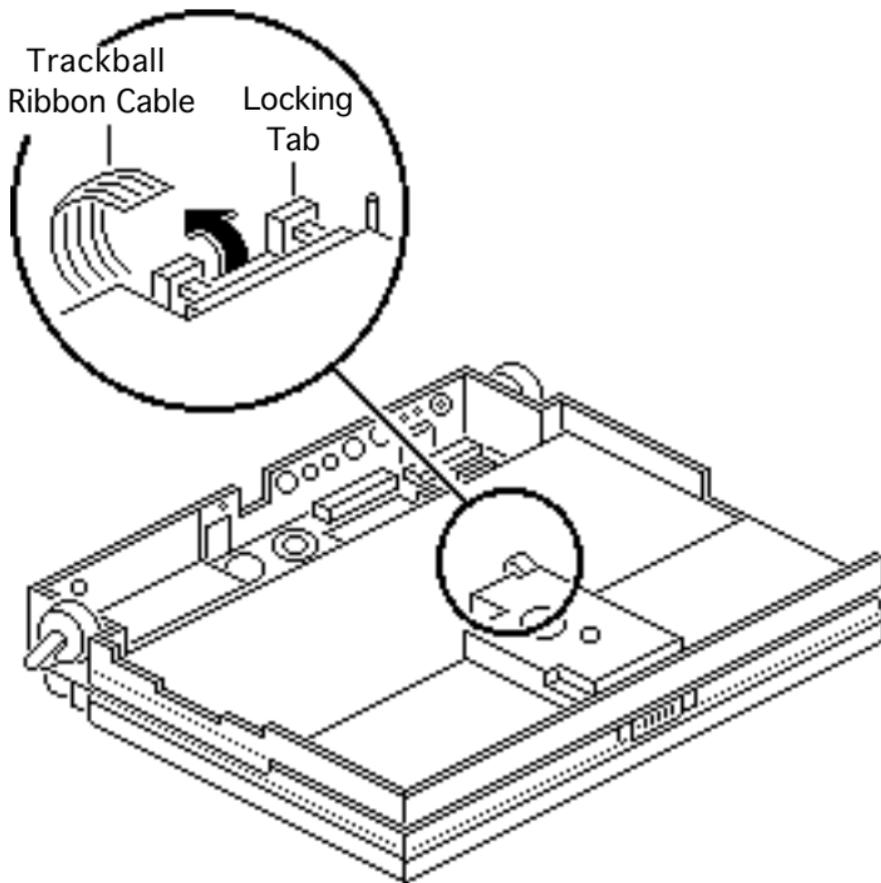
Trackball Assembly

Before you begin, remove the following:

- Main battery
- I/O door
- Top case

Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/ Safety.

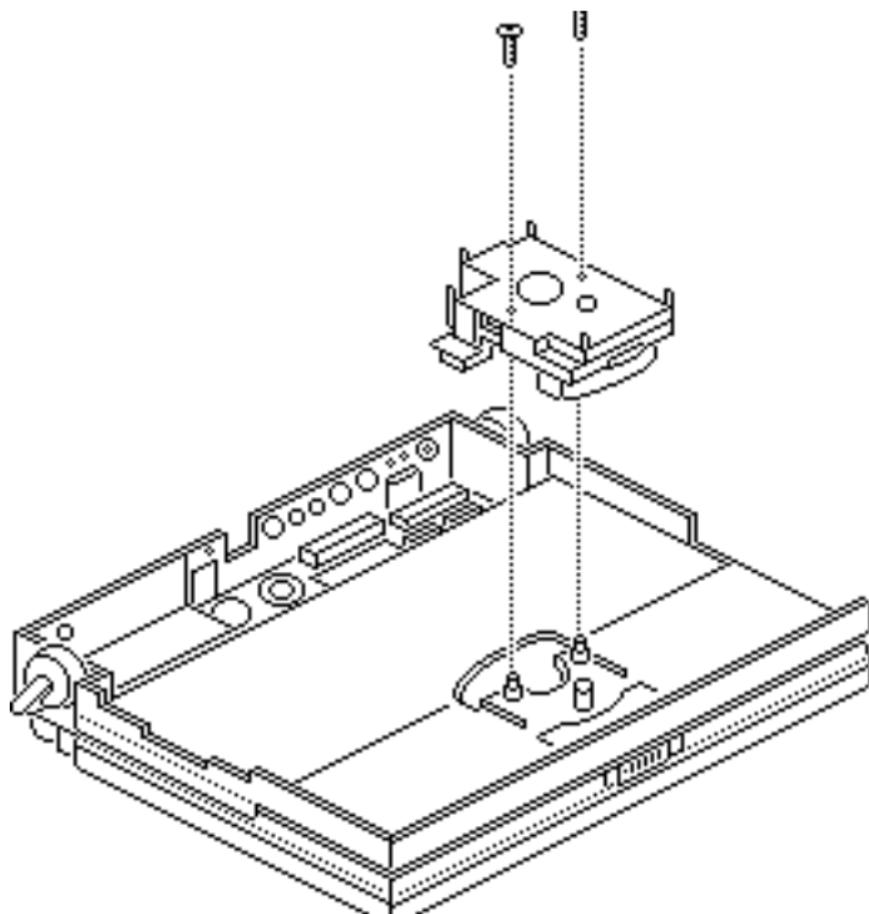




- 1 **Caution:** The trackball ribbon cable is fragile and should be handled with care.

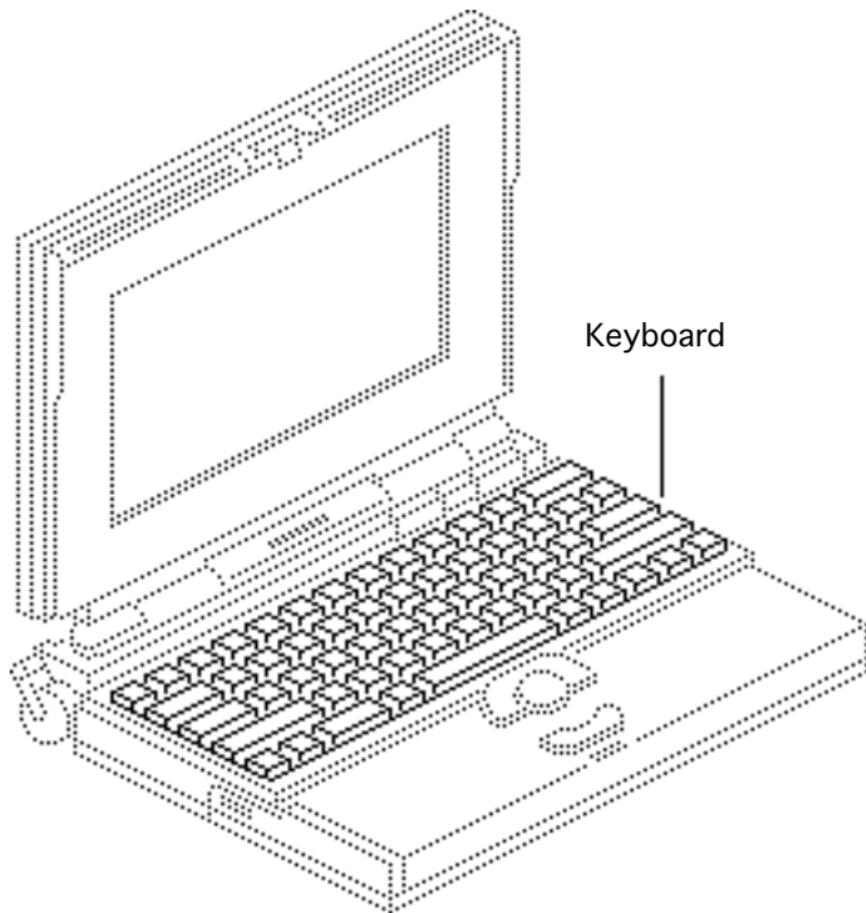
Pull out the locking tab on the trackball connector and remove the trackball ribbon cable.





- 2 Using a T-8 torx driver, remove the two mounting screws and lift the trackball assembly out of the top case.





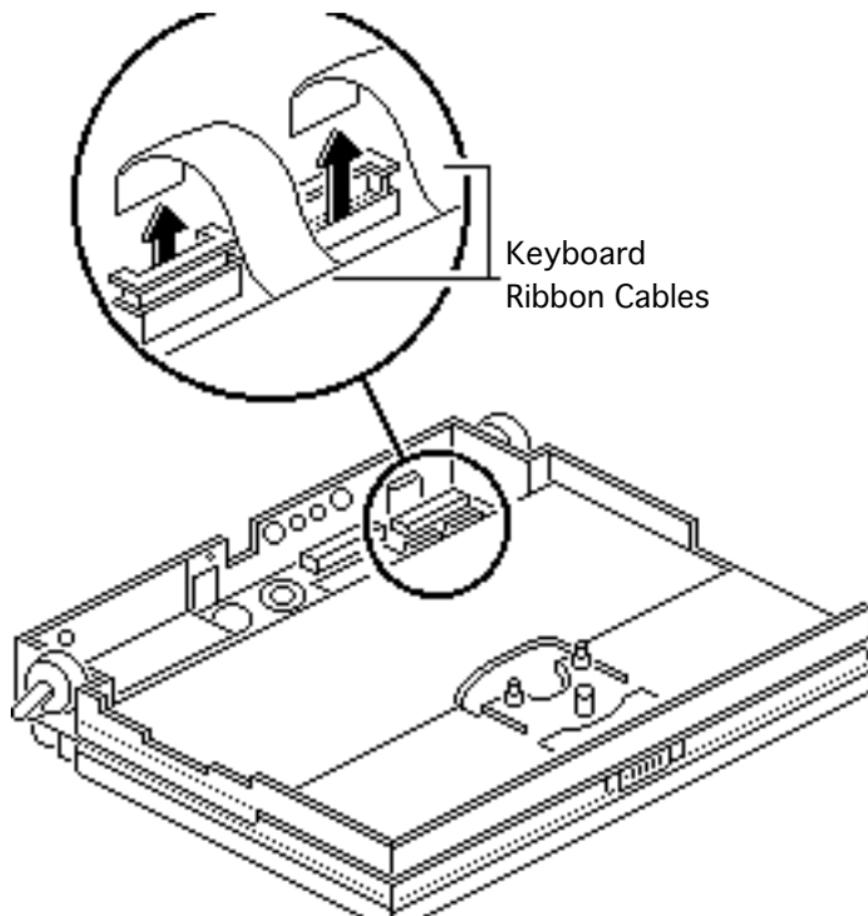
Keyboard

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Trackball assembly

Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

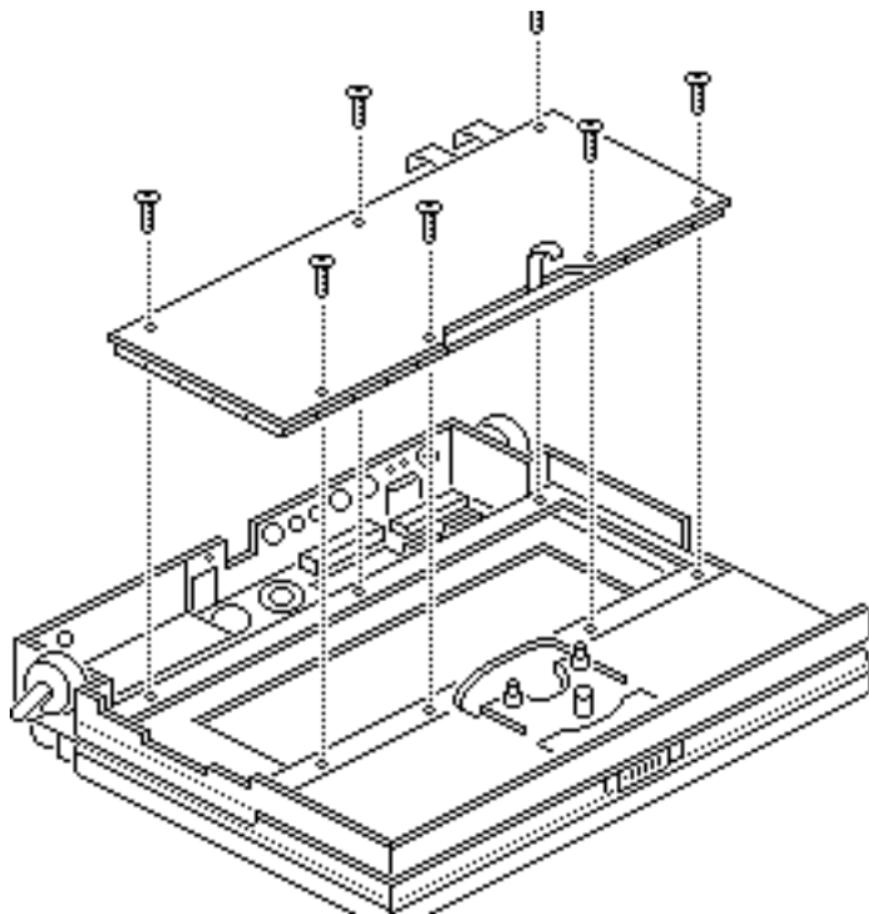




- 1 **Caution:** The keyboard ribbon cables are fragile and should be handled with care.

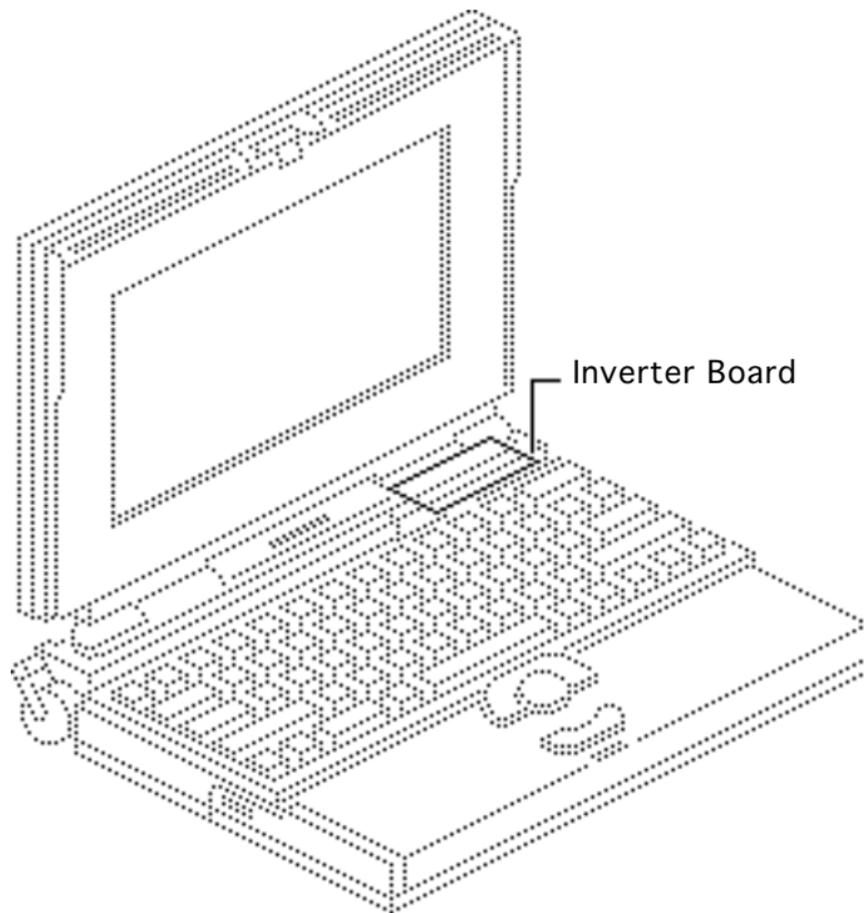
Lift up the locking tabs on the two keyboard connectors and remove the keyboard ribbon cables.





- 2 Using a T-8 torx driver, remove the seven mounting screws and lift the keyboard out of the top case.





Inverter Board

Before you begin, remove the following:

- Main battery
- I/O door
- Top case

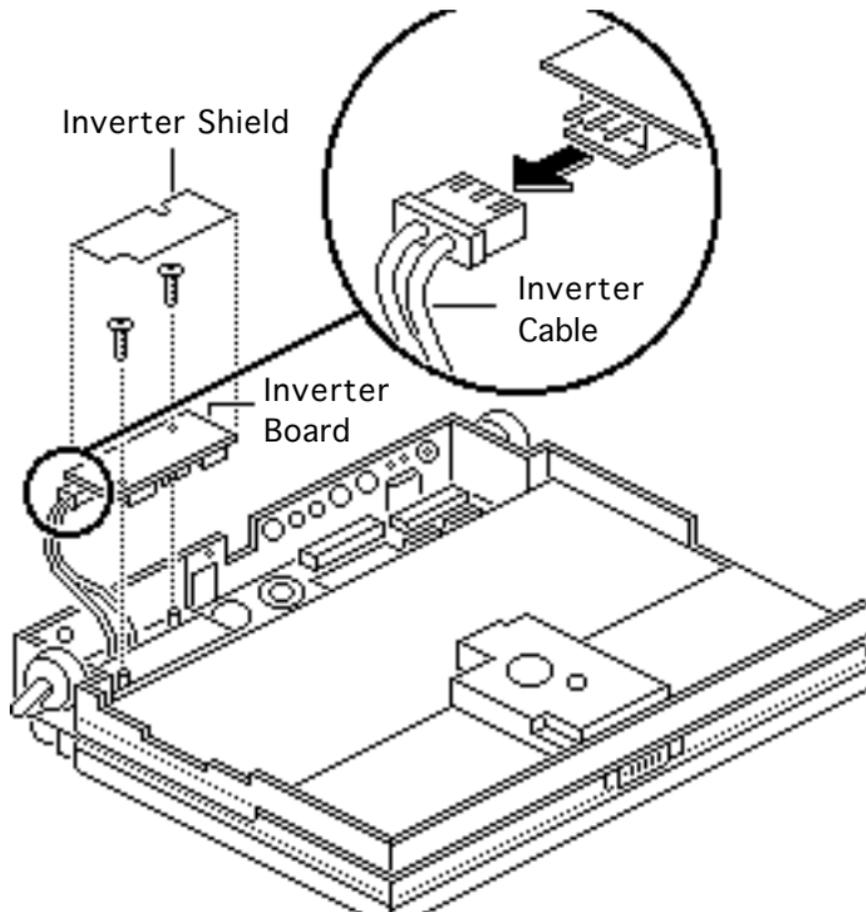
Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.





Important: One active-matrix and three FSTN displays are used with the PowerBook 140/145/170 computers. Each display requires a matching inverter. When replacing a display or inverter board, refer to the “Display Compatibility Matrix” in Basics and to Service Source parts database for the correct part number for each board.





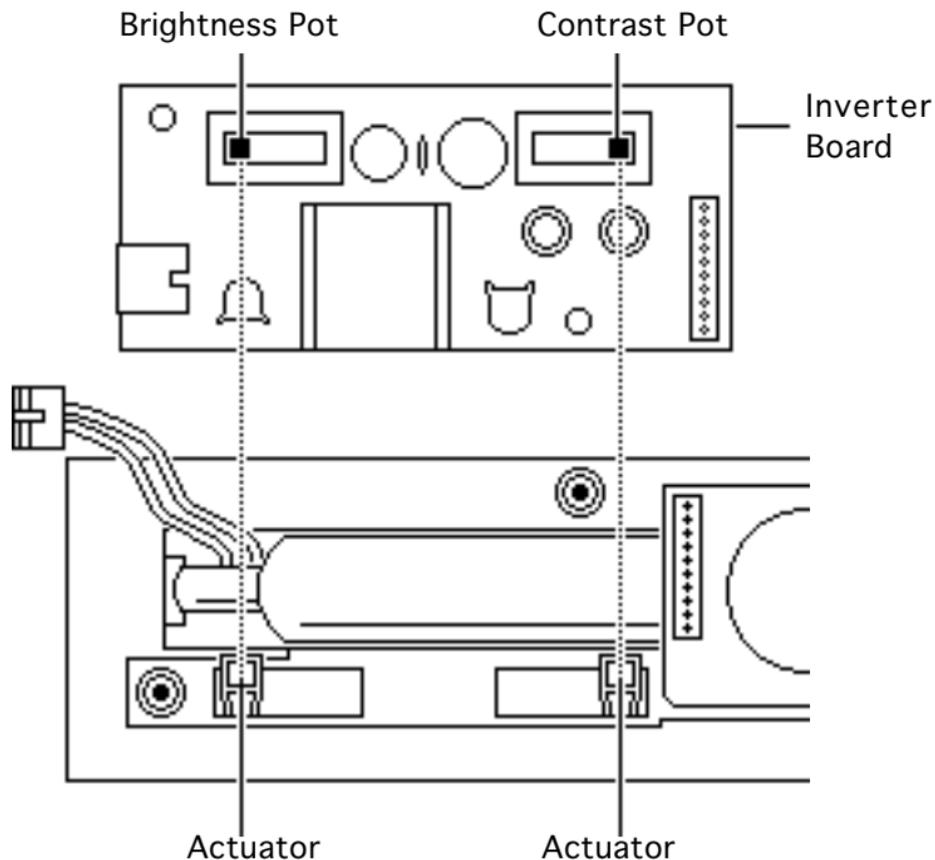
- 1 If present, remove the inverter shield.
- 2 Remove the two screws and pull the inverter board straight up to disconnect it from the interconnect board.
- 3 Disconnect the inverter cable.





Replacement Note: Install inverter shields on all PowerBook 140/145/170 computers. Inverter shields are available on the Price Pages. If you are replacing a defective inverter that has an inverter shield installed, order both the inverter board and the inverter shield. Do not reuse the original inverter shield.





Replacement Note: For systems with FSTN displays, be sure to align the brightness and contrast pots on the inverter board with the plastic actuators on the top case. It is easiest to align the pots and actuators if you set both to their extreme outer positions.





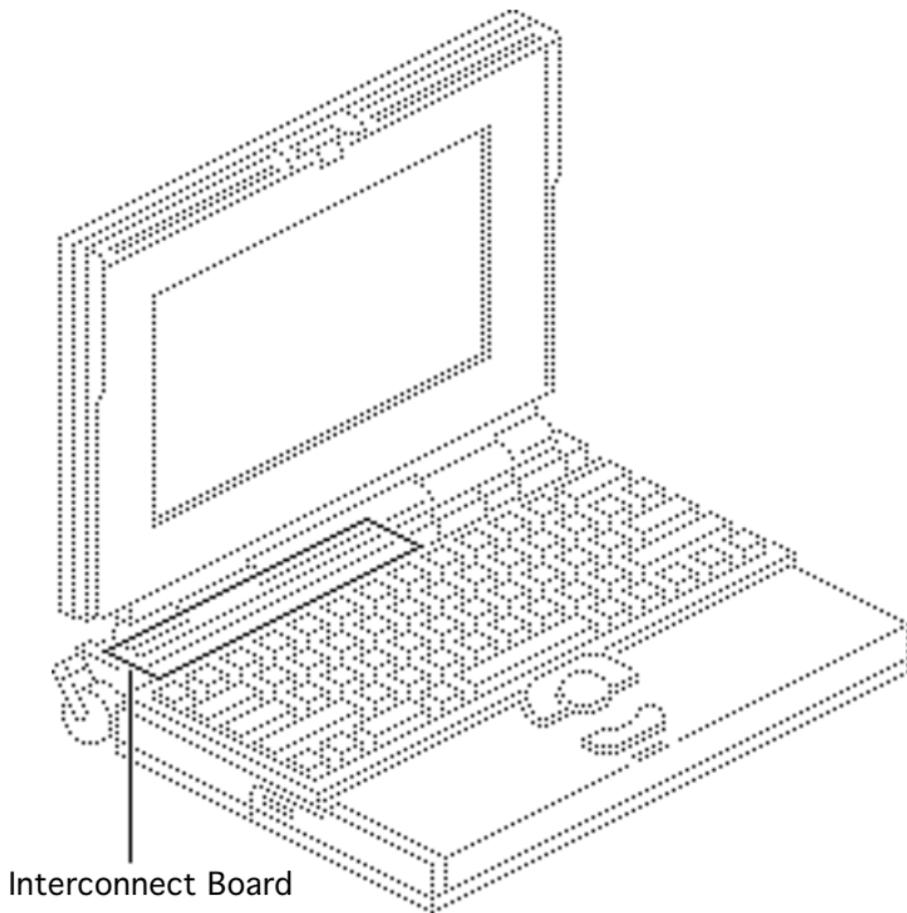
Interconnect Board

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Inverter board

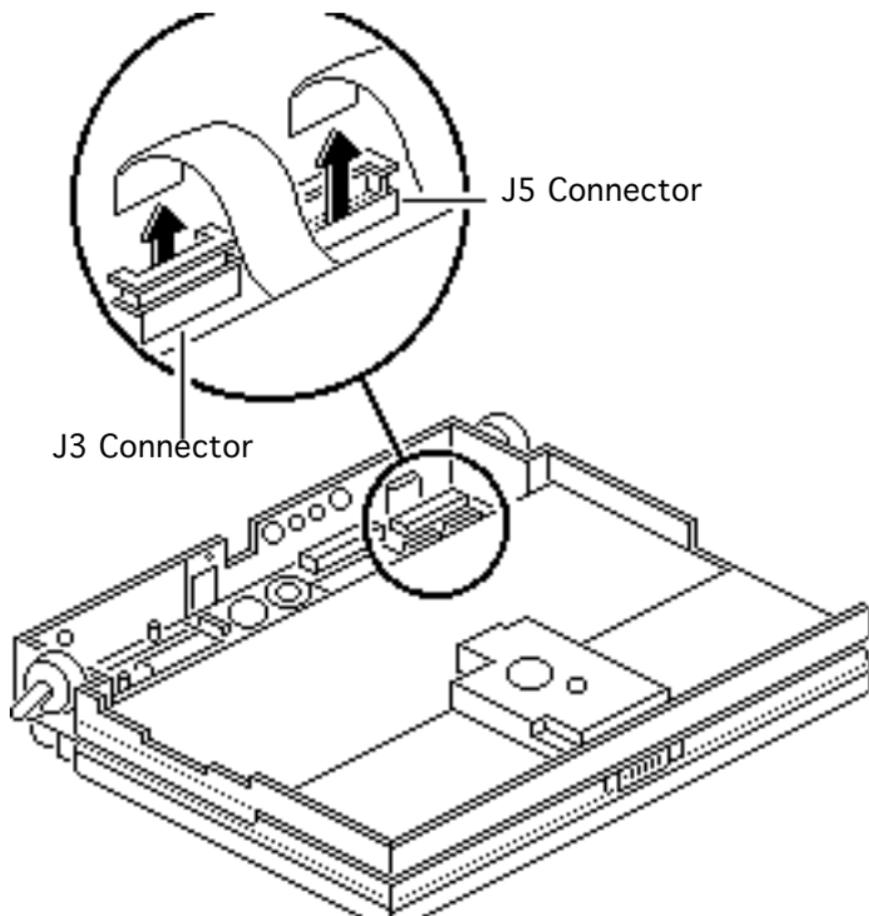
Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD

precautions in Bulletins/



Interconnect Board





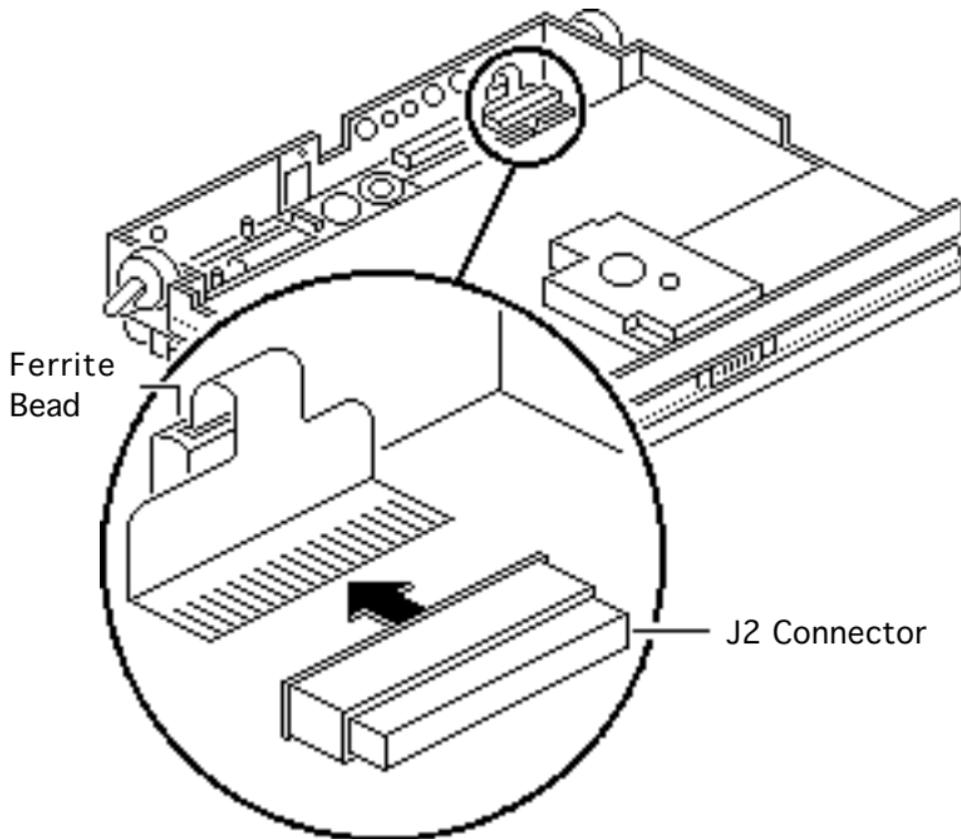
Safety.

⚠ Warning: The interconnect board contains hazardous materials. Return bad interconnect boards to Apple for proper disposal.

- 1 **Caution:** The keyboard and display ribbon cables are fragile. Handle these cables with care.

Lift up the locking tabs on connectors J5 and J3 and remove the keyboard ribbon cables.



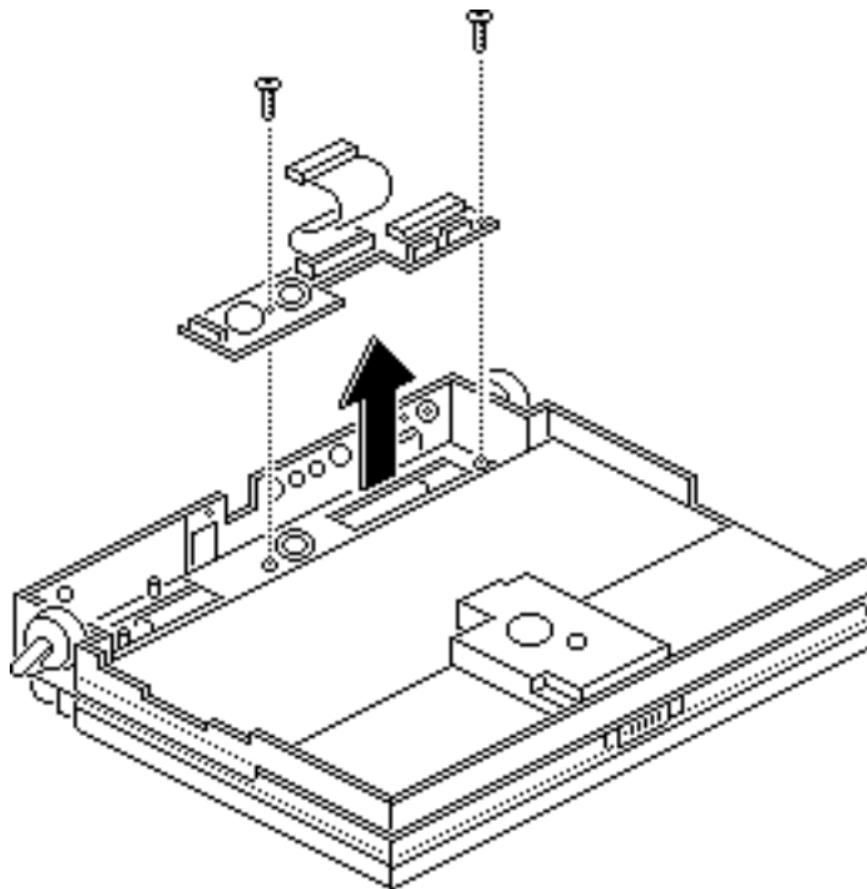


- 2 Pull out the locking tab on connector J2 and remove the display cable.

Note: If you also plan to remove the display or the display cable, separate the display cable ferrite bead from the top case. You may need to use a small flat-blade screwdriver to pry off the ferrite bead.

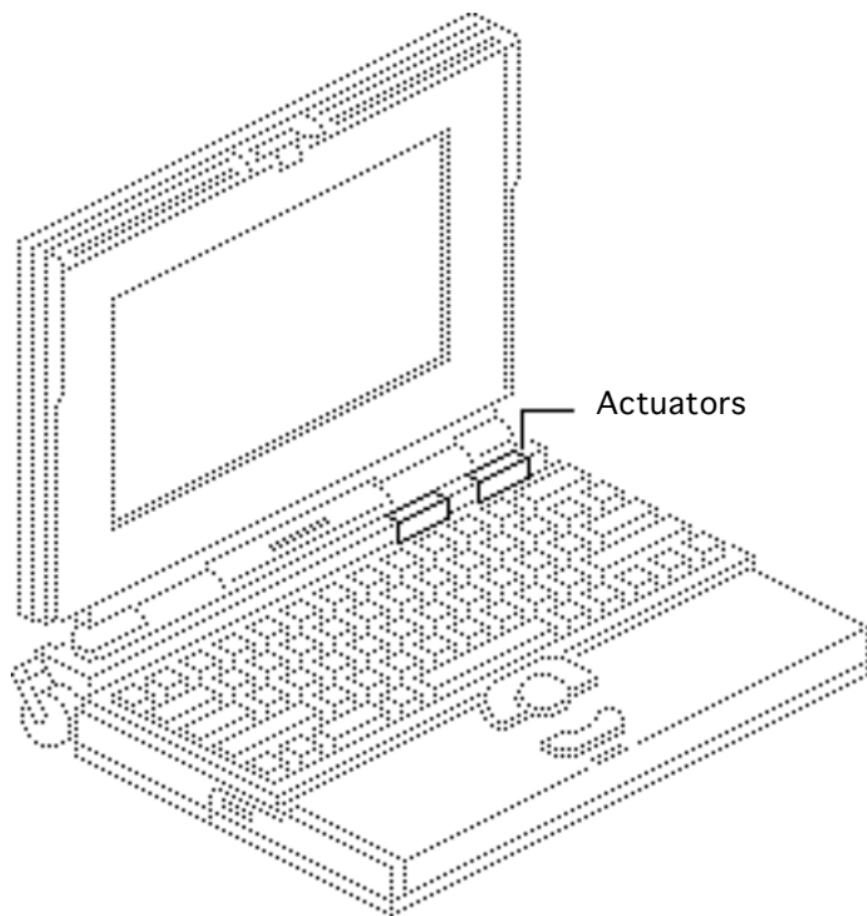
Replacement Note: Connect the display cable before replacing the interconnect board.





- 3 Using a T-8 torx driver, remove the two mounting screws and lift the interconnect board from the top case.





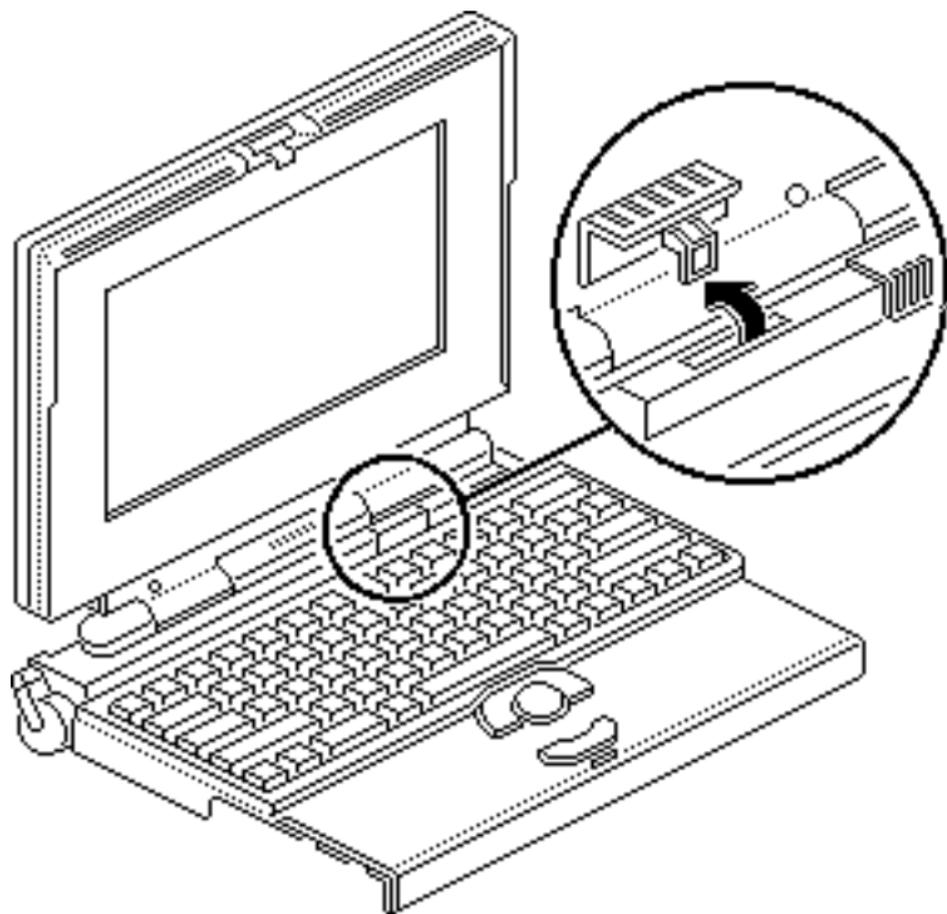
Actuators

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Inverter board

Caution: The PowerBook140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.





Note: The PowerBook 170 has a brightness actuator only (contrast is preset). The PowerBook 140 has

both contrast and brightness actuators.

Pull up and rotate the actuator toward the display to remove it from the top case.



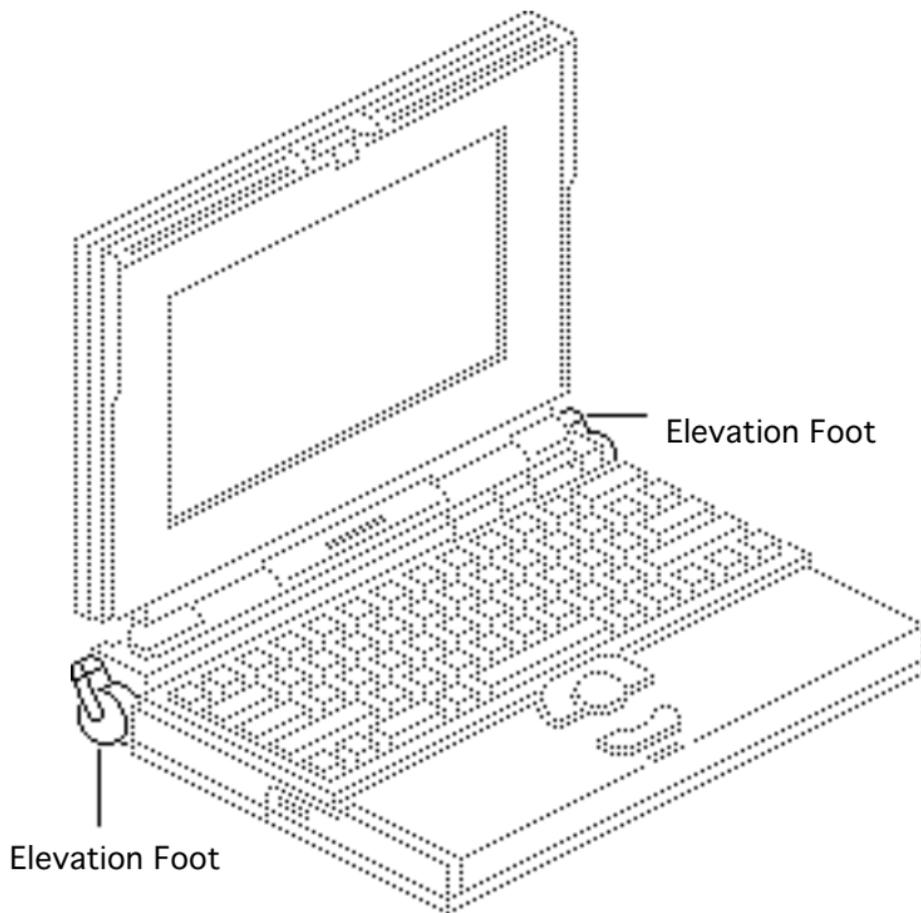


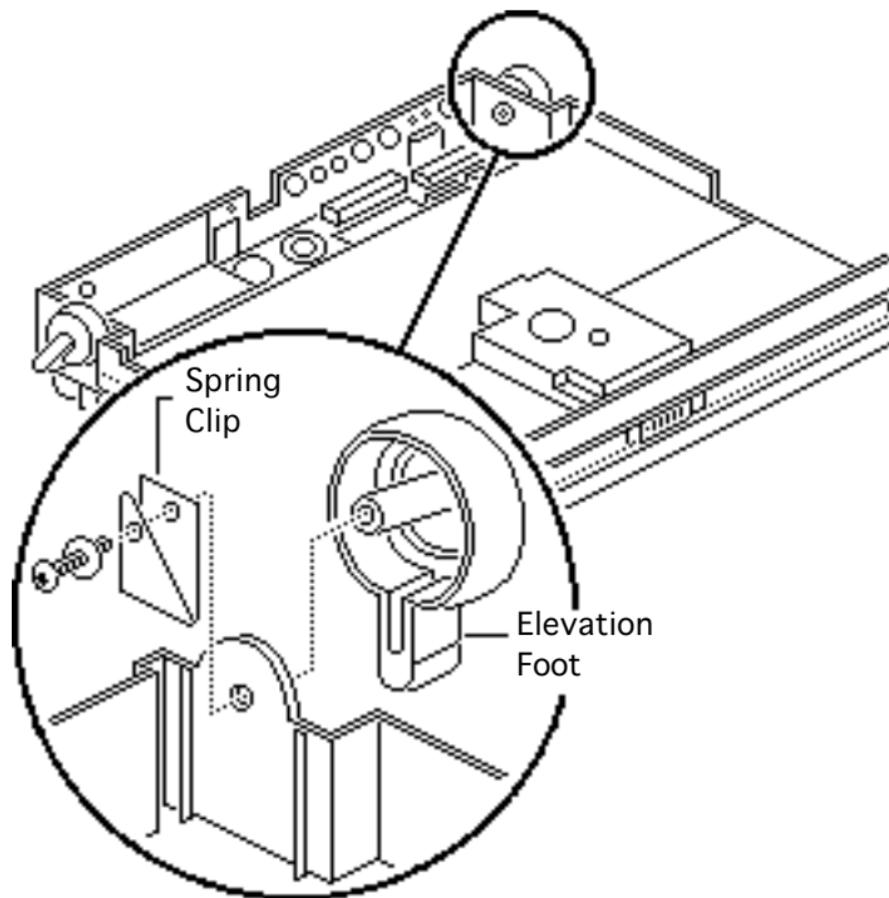
Elevation Feet

Before you begin, remove the following:

- Main battery
- I/O door
- Top case

Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.





- 1 Using a T-8 torx driver, remove the torx screw and washer and the spring clip from the inside of the elevation foot.
- 2 Pull off the elevation foot.

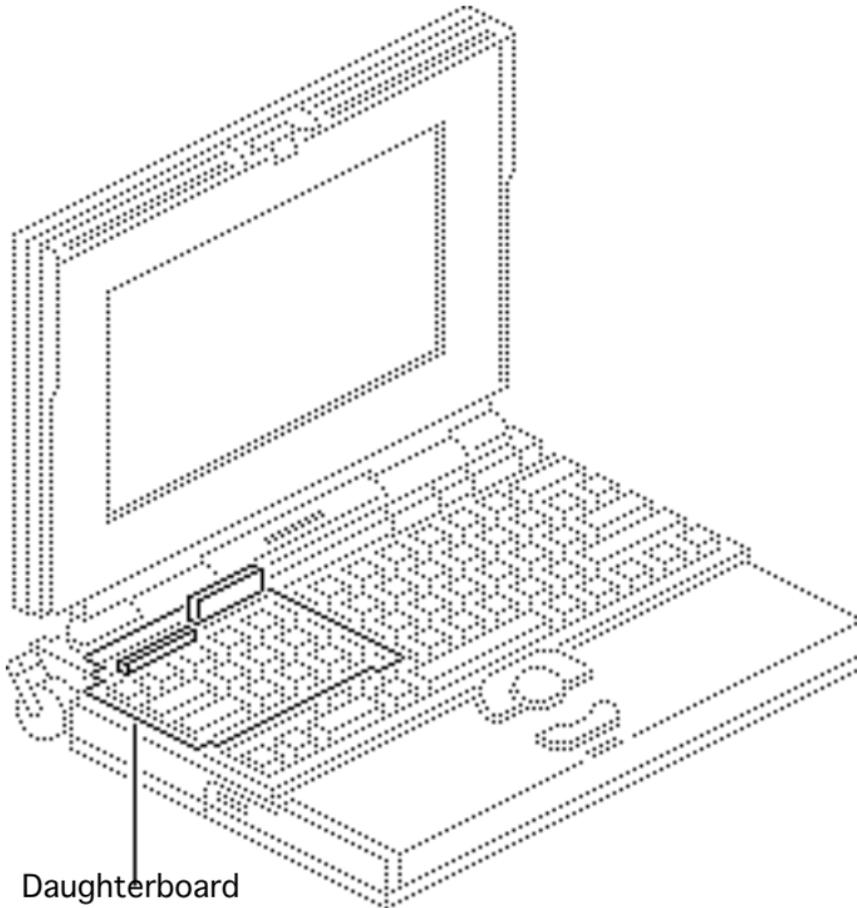




Daughterboard

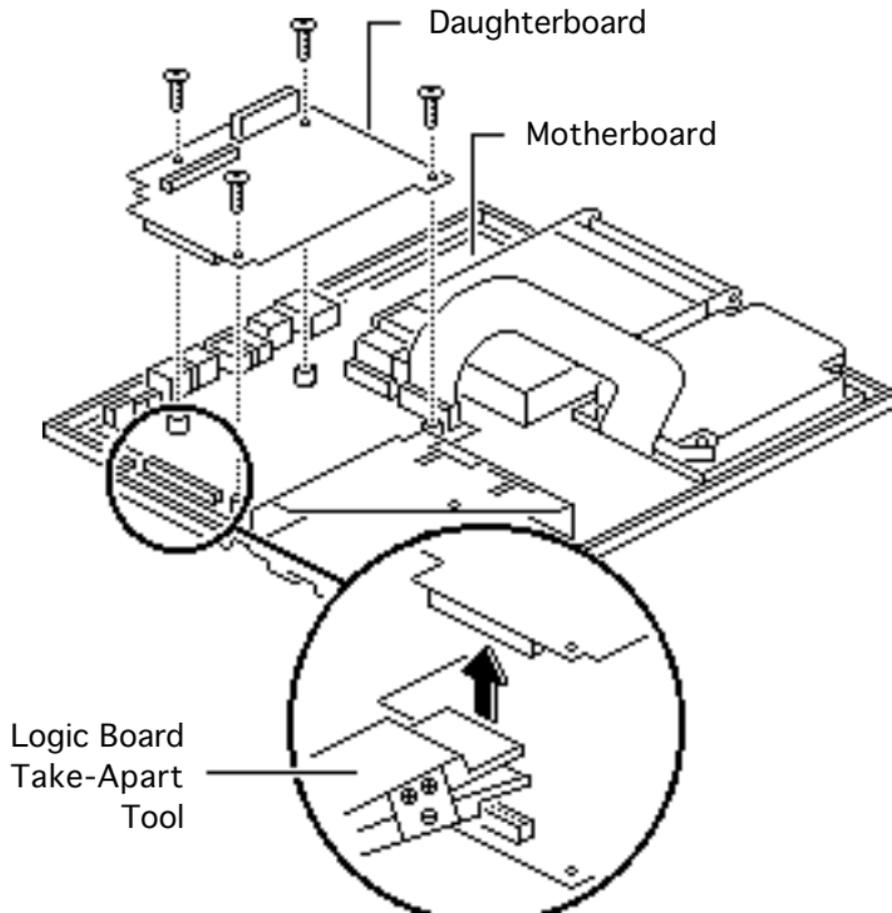
Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- RAM expansion card (if present)



Daughterboard





Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

- 1 Using a T-8 torx driver, remove the four daughterboard mounting screws.

Caution: Always use the logic board take-apart tool to separate the daughterboard connector from the motherboard





connector. Trying to disconnect the daughterboard from the motherboard by rocking or peeling the boards apart damages the connectors.

- 2 Using the logic board take-apart tool, disconnect the daughterboard from the motherboard.

Note: For tools ordering information, refer to “Special Tools” in Bulletins/Service Notices.

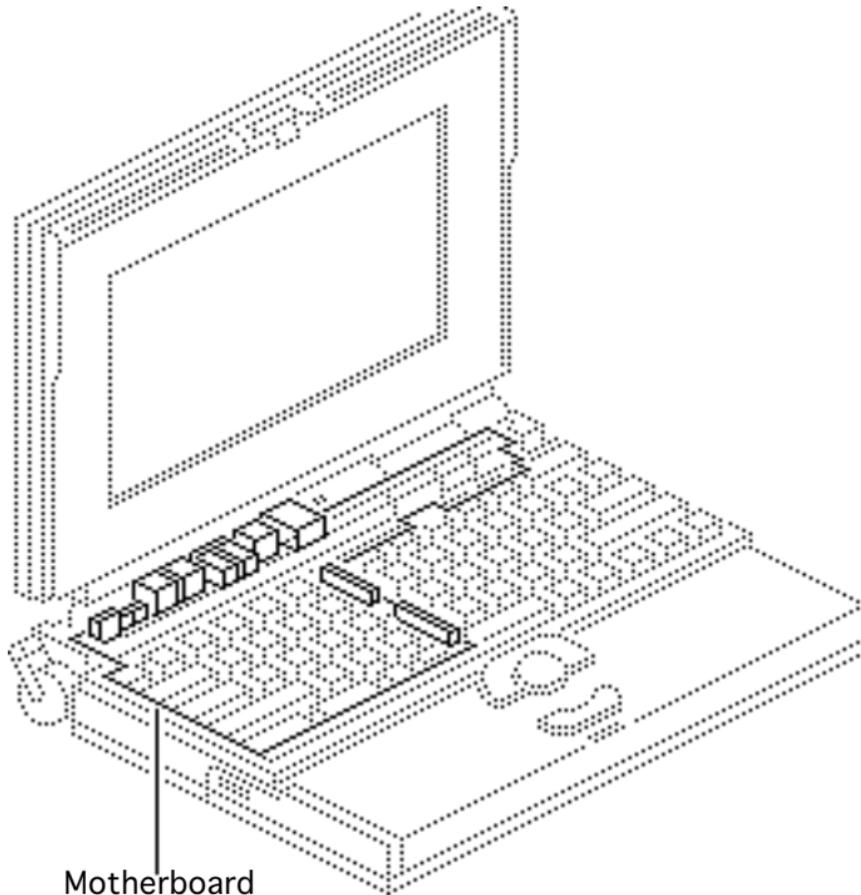




Motherboard

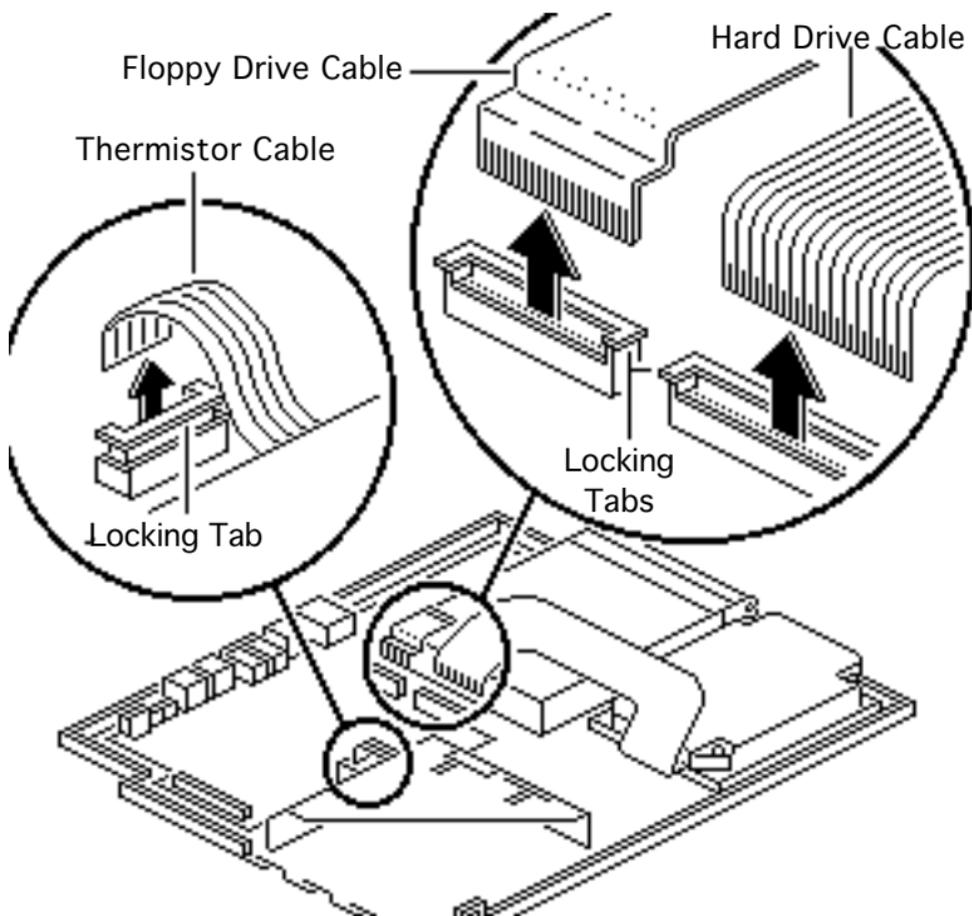
Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- RAM expansion card (if present)
- Daughterboard
- Modem board (if present)



Motherboard



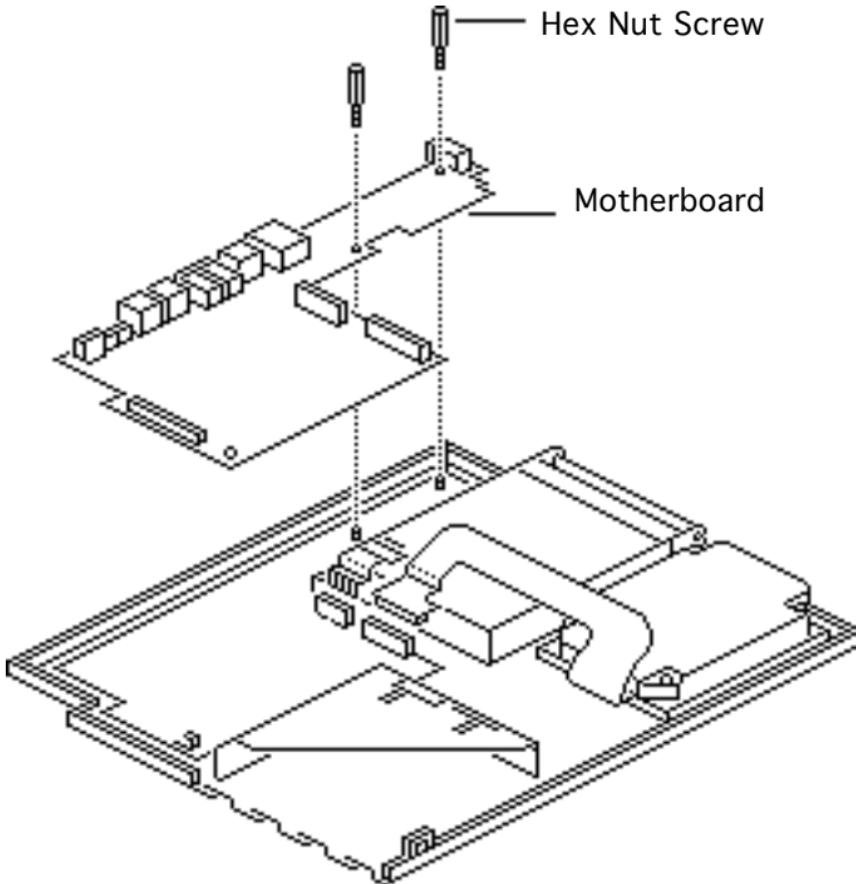


Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

- 1 **Caution:** The hard drive, floppy drive, and thermistor cables are fragile. Handle them with care.

Lift up the locking tabs and remove the hard drive, floppy drive, and





battery thermistor cables.

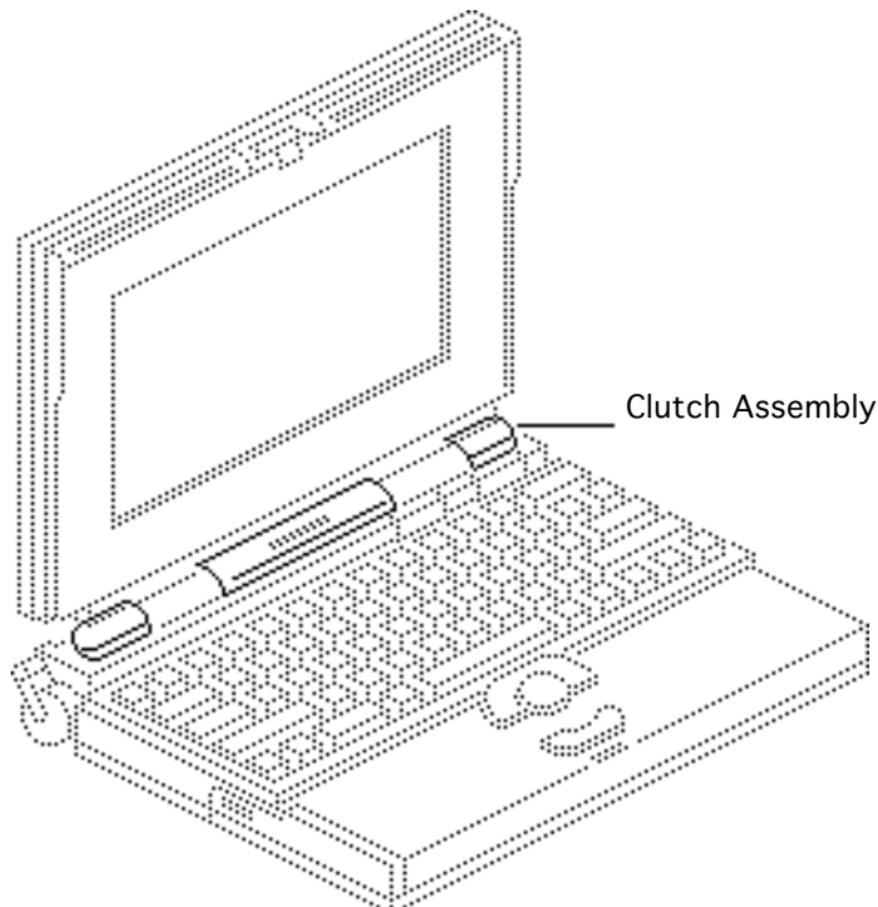
- 2 Remove the two hex nut screws and lift the motherboard out of the bottom case.

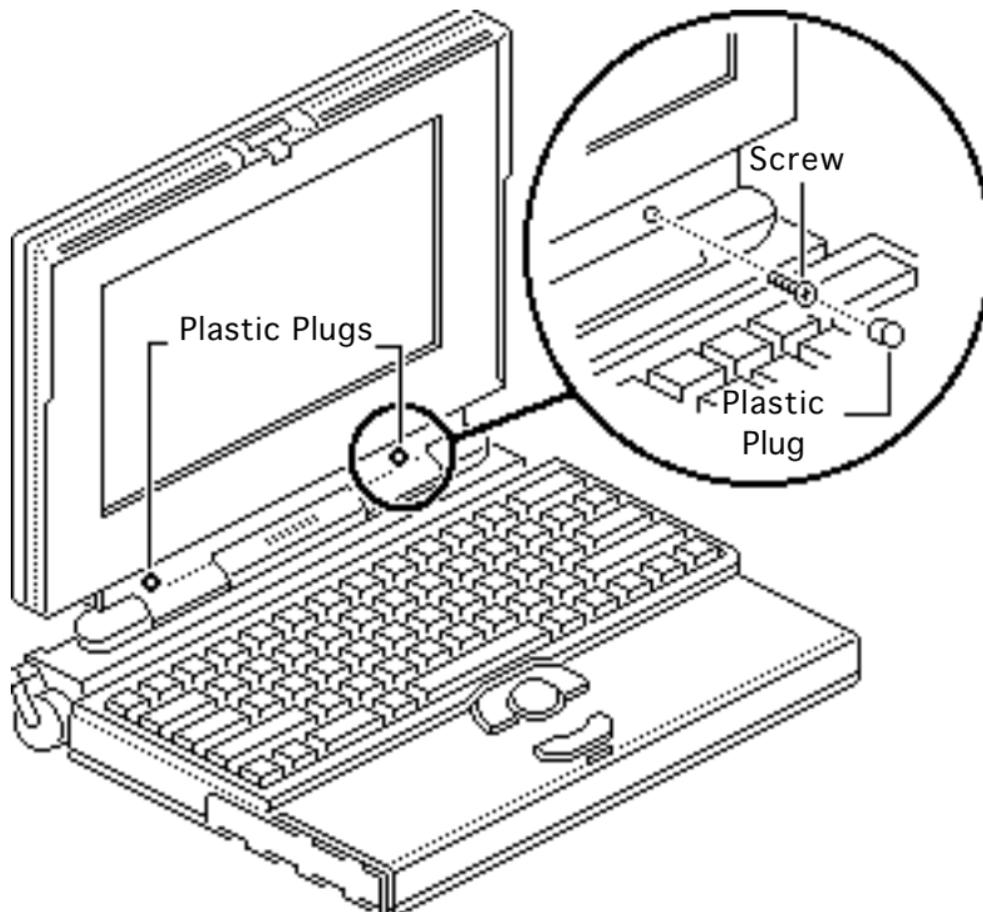




Clutches/Display Housing

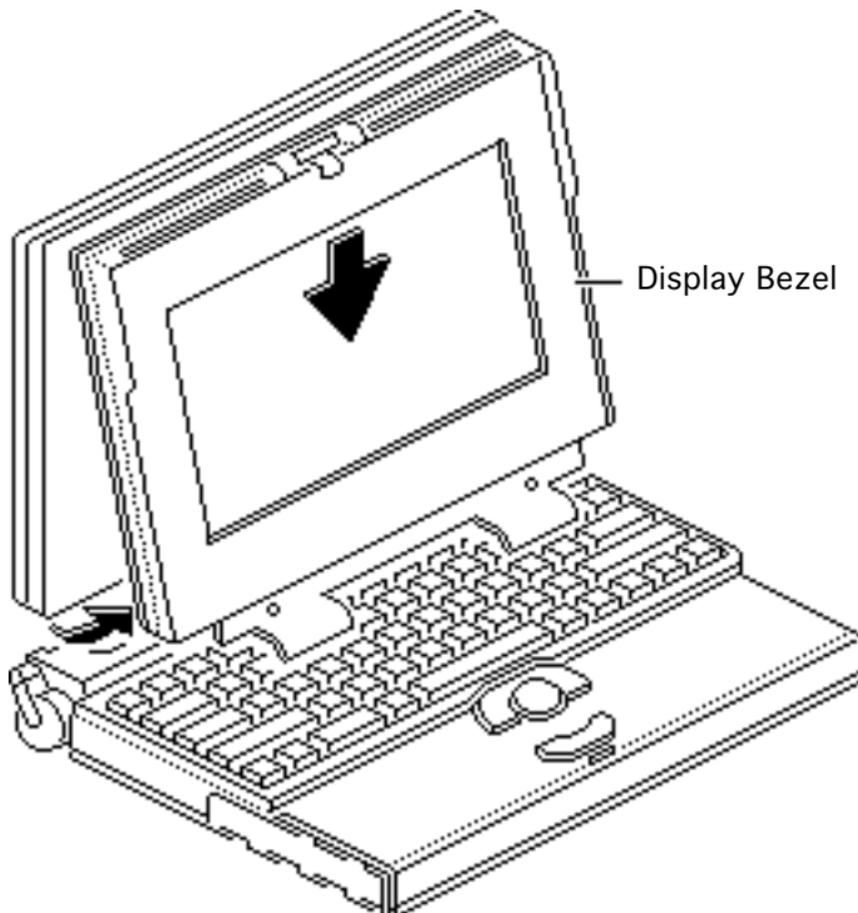
Before you begin, remove the main battery.





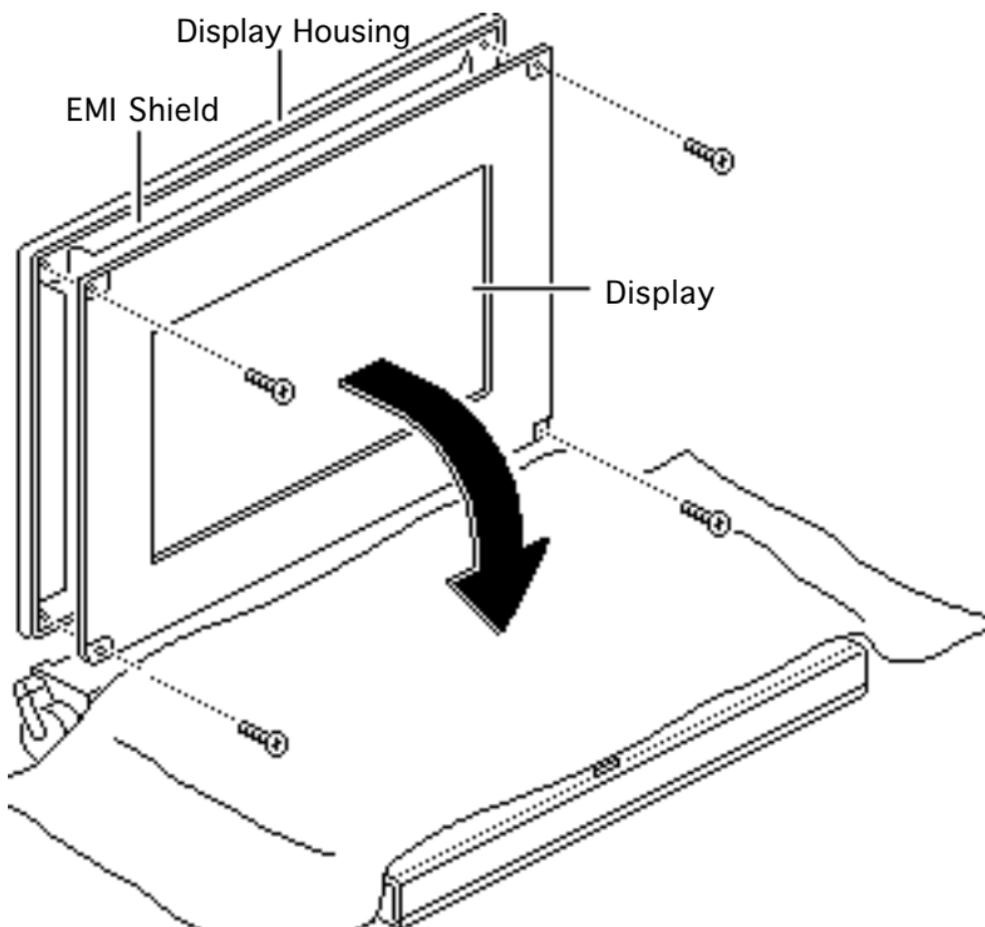
- 1 Remove the two plastic plugs.
- 2 Using a T-8 torx driver, remove the two bezel mounting screws from the display.





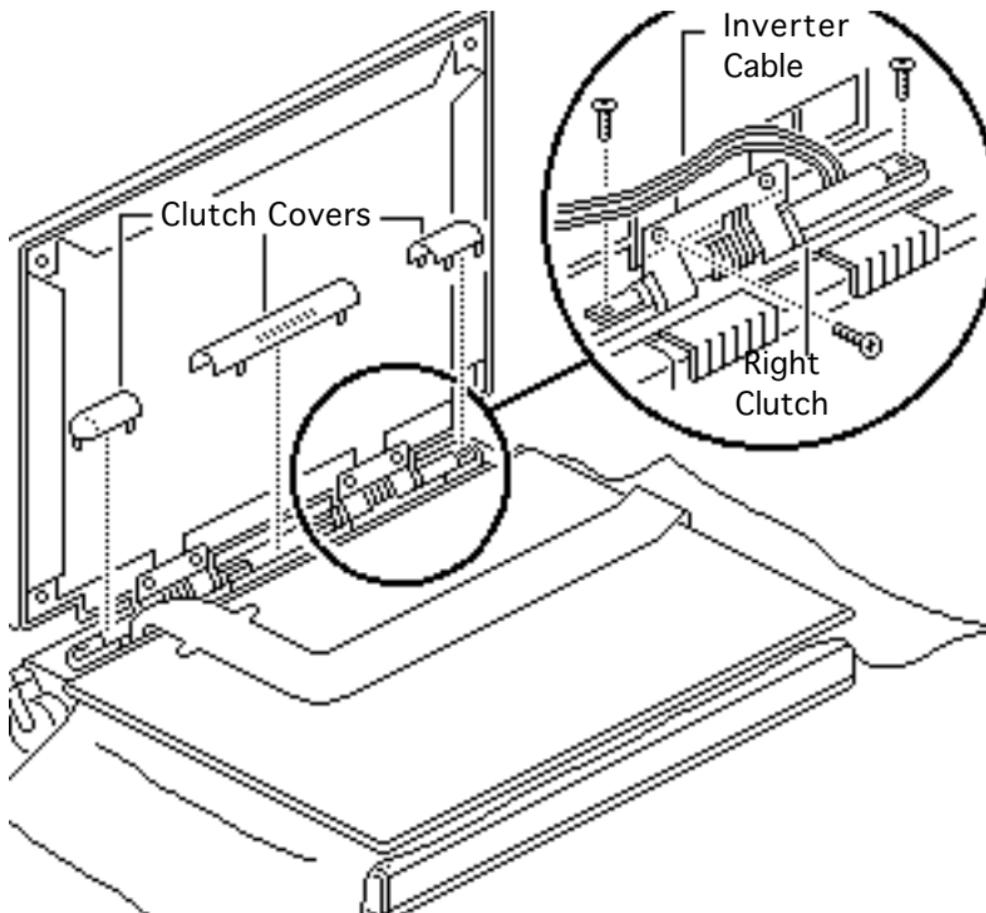
- 3 Pull the display bezel down and away to release it from the mounting tabs at the top of the display.
- 4 Lift the bezel off the display.





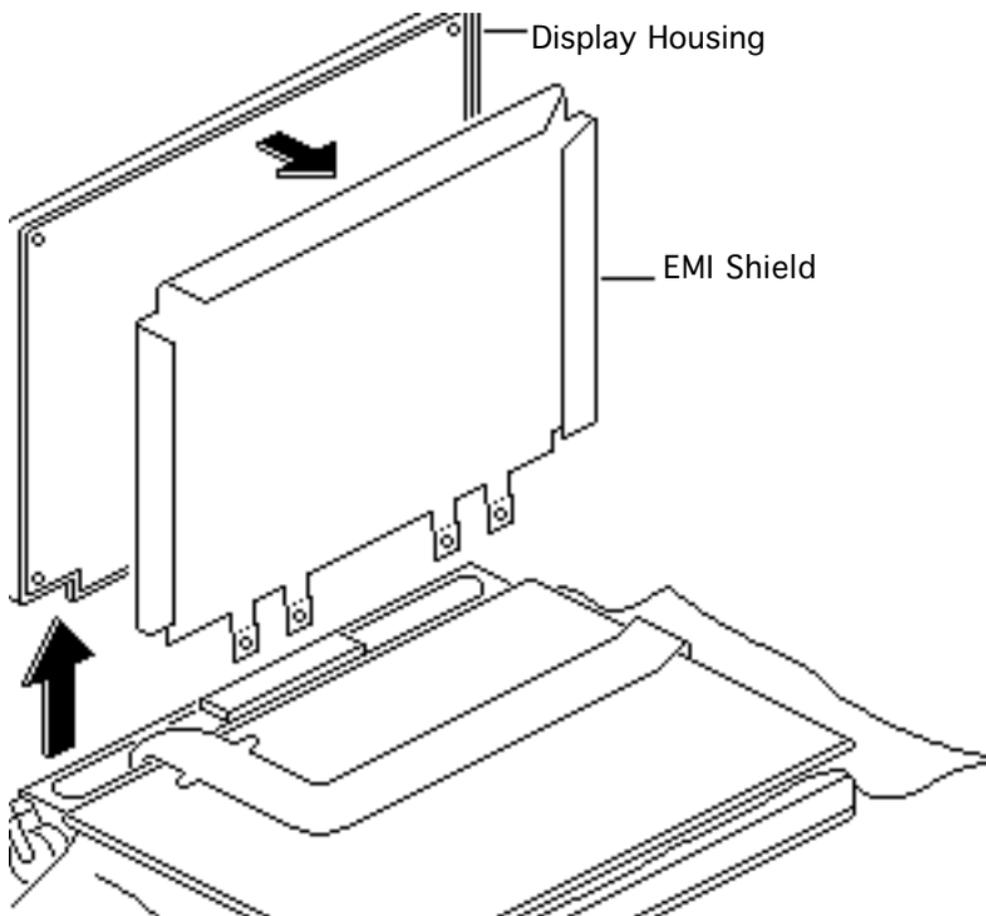
- 5 Cover the keyboard with a clean cloth or sheet of paper.
- 6 Using a T-8 torx driver, remove the four display mounting screws.
- 7 Remove the display from the housing and EMI shield.
- 8 Place the display face-down on the keyboard.





- 9 Pull off the three clutch covers.
- 10 Using a T-8 torx driver, remove the three mounting screws from the left and right clutches.
- 11 Remove the left and right clutches from the display housing.



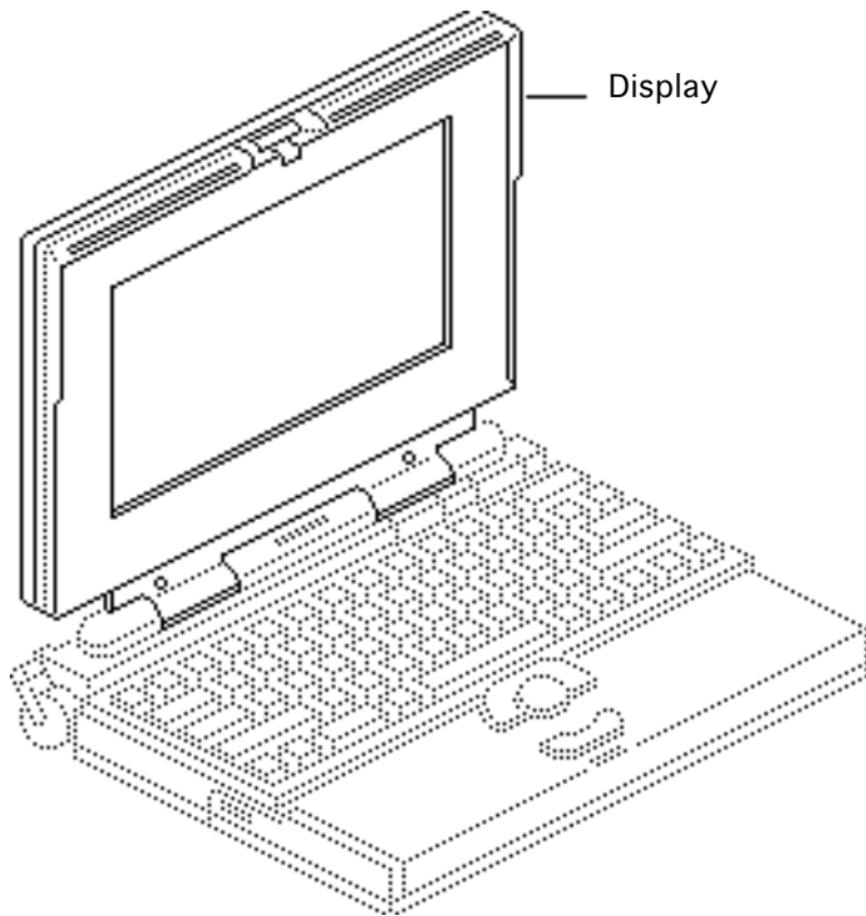


Replacement Note: Replace the short mounting screws in the top-inside clutch threadings. The top-outside threadings are used to mount the bezel.

Replacement Note: To avoid pinching the inverter cable, route the cable behind the top-right corner of the hinge on the right clutch.

12 Remove the display housing and EMI shield from the case.





Display

Before you begin, remove the main battery.

Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/Safety.

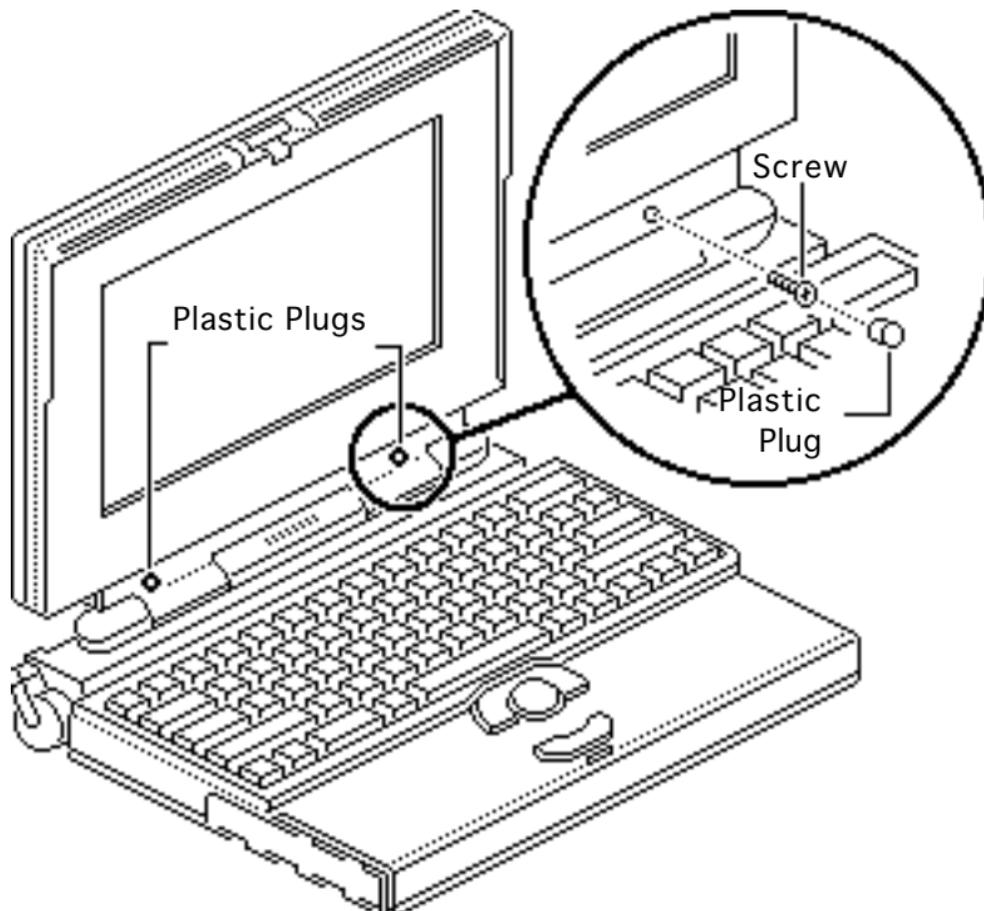




Note: This topic includes separate procedures for removing the PowerBook 140/145 FSTN display and the PowerBook 170 active-matrix display.

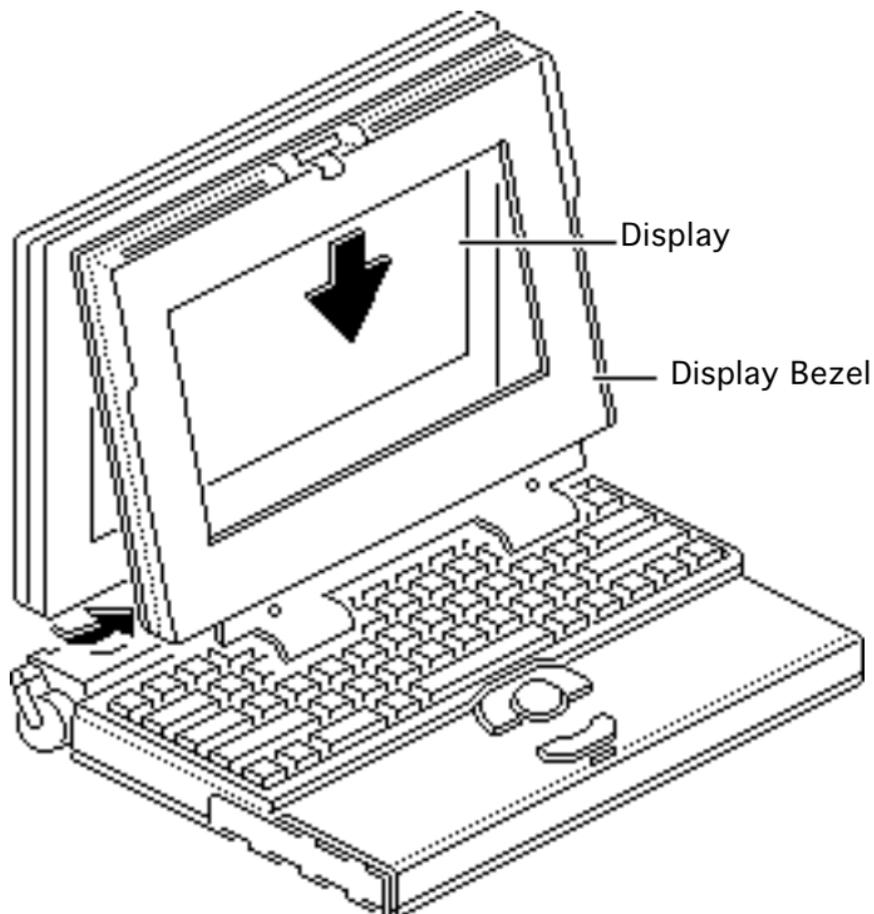
Note: The PowerBook 170 active-matrix display replacement module is available to CPRC and international repairers only.





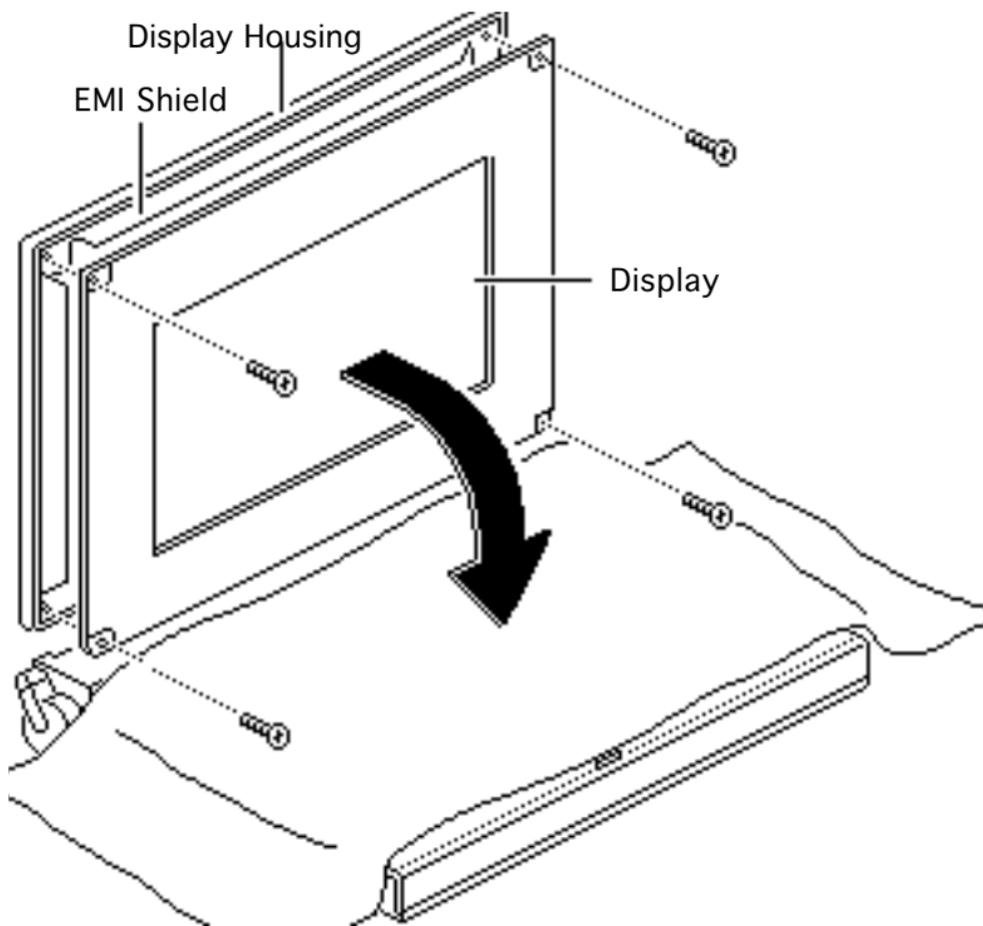
- 1 Remove the two plastic plugs.
- 2 Using a T-8 torx driver, remove the two bezel mounting screws from the display.





- 3 Pull the display bezel down and away from the display and release the bezel from the mounting tabs at the top and sides of the display.
- 4 Lift the bezel off the display.



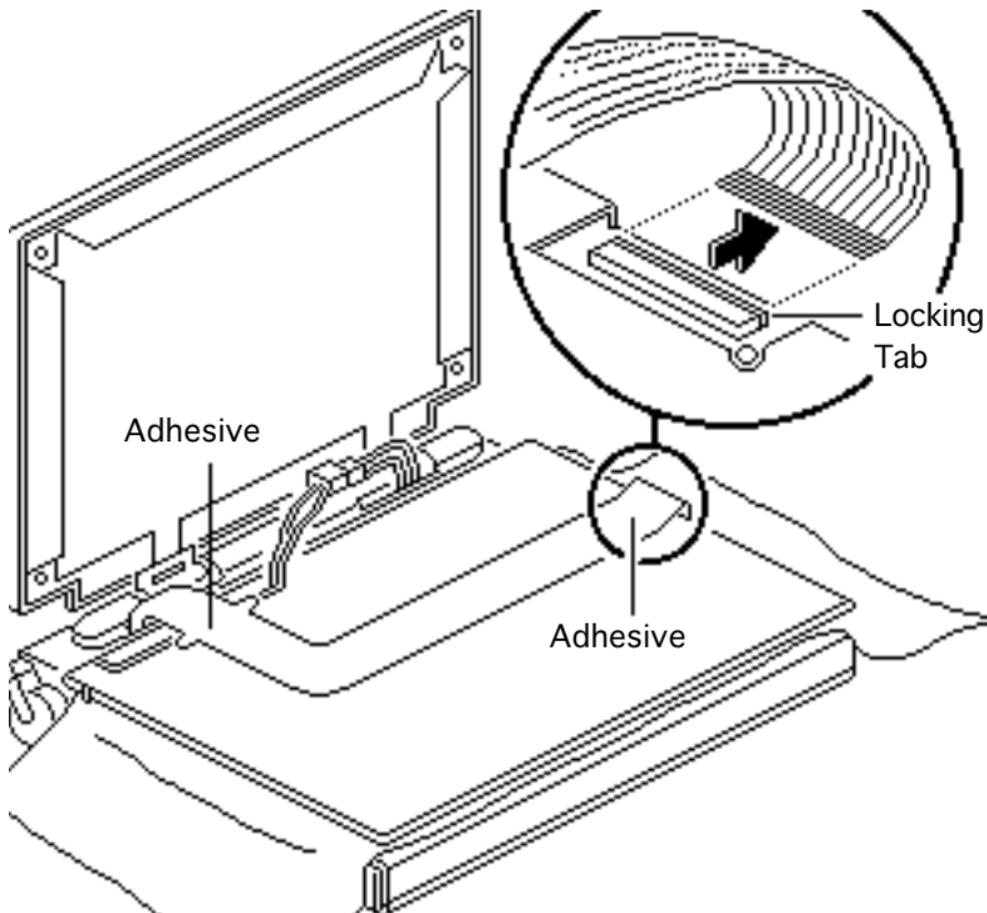


PowerBook 140/145 FSTN Display

Caution: The display cable is fragile and should be handled with care.

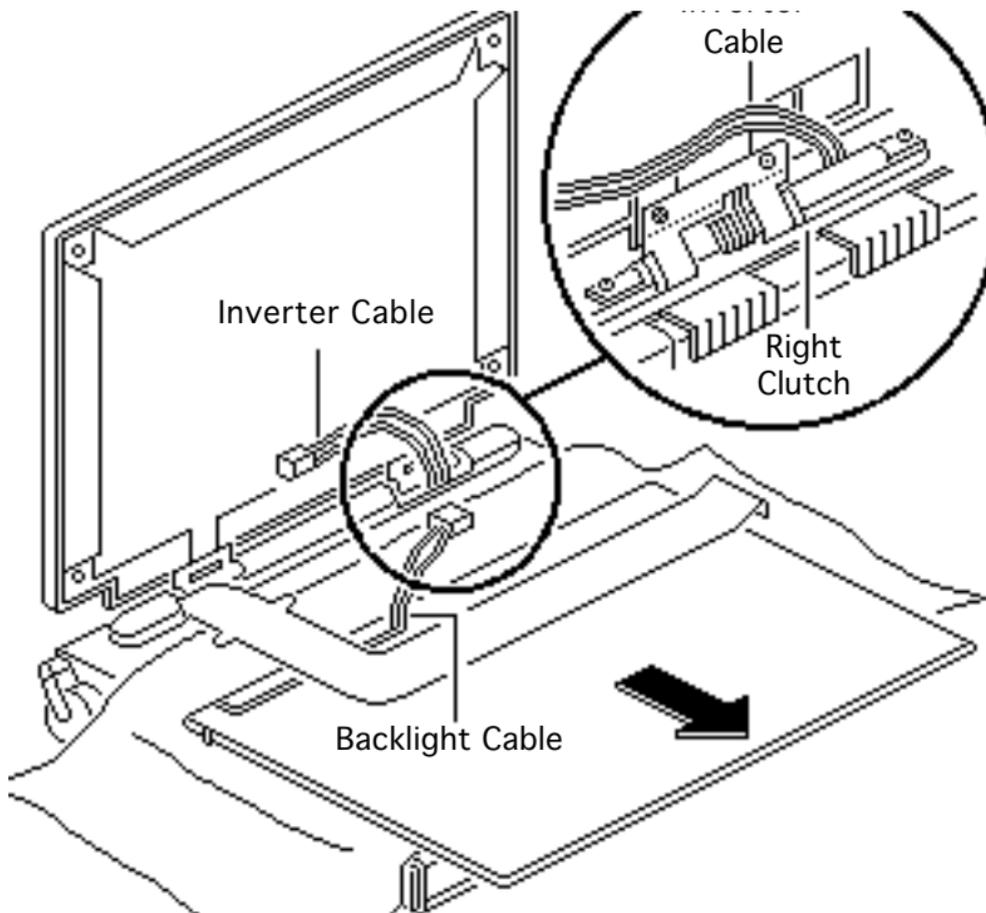
- 1 Cover the keyboard with a clean cloth or sheet of paper.
- 2 Using a T-8 torx driver, remove the four display mounting screws.
- 3 Remove the display from the housing and EMI shield.





- 4 Place the display face-down on the keyboard.
- 5 Lift the locking tab on the display connector and disconnect the display cable.
- 6 **Caution:** The PowerBook 140/145 display cable is attached to the display with adhesive near the connector and backlight ends of the cable. Carefully pry the cable off the display at these points.



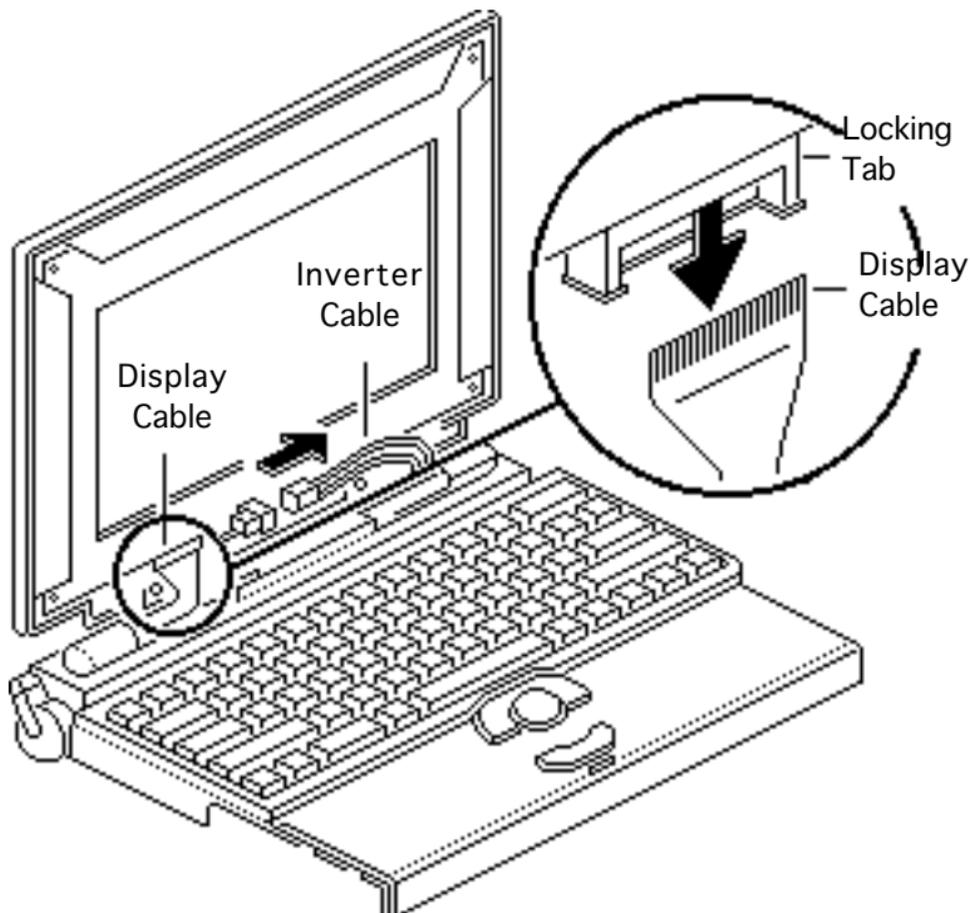


Gently detach the display cable from the back of the display.

- 7 Disconnect the inverter cable from the display backlight cable.
- 8 Remove the display.

Replacement Note: To avoid pinching the inverter cable, route the cable behind the top-right corner of the hinge on the right clutch.

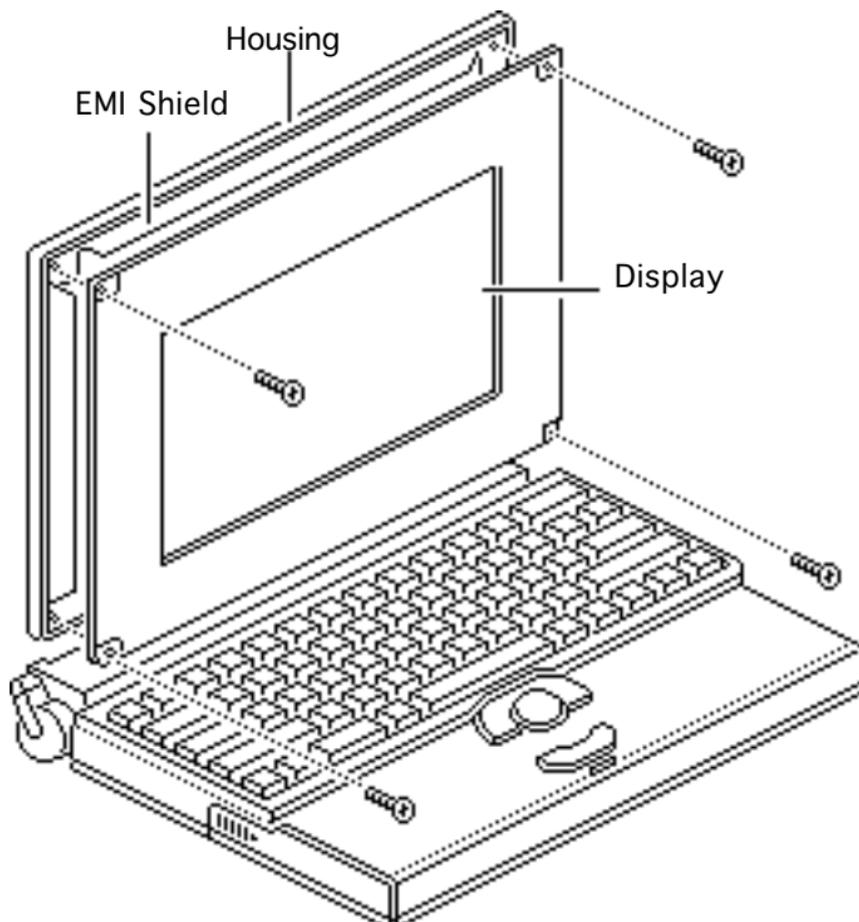




PowerBook 170 Active-Matrix Display

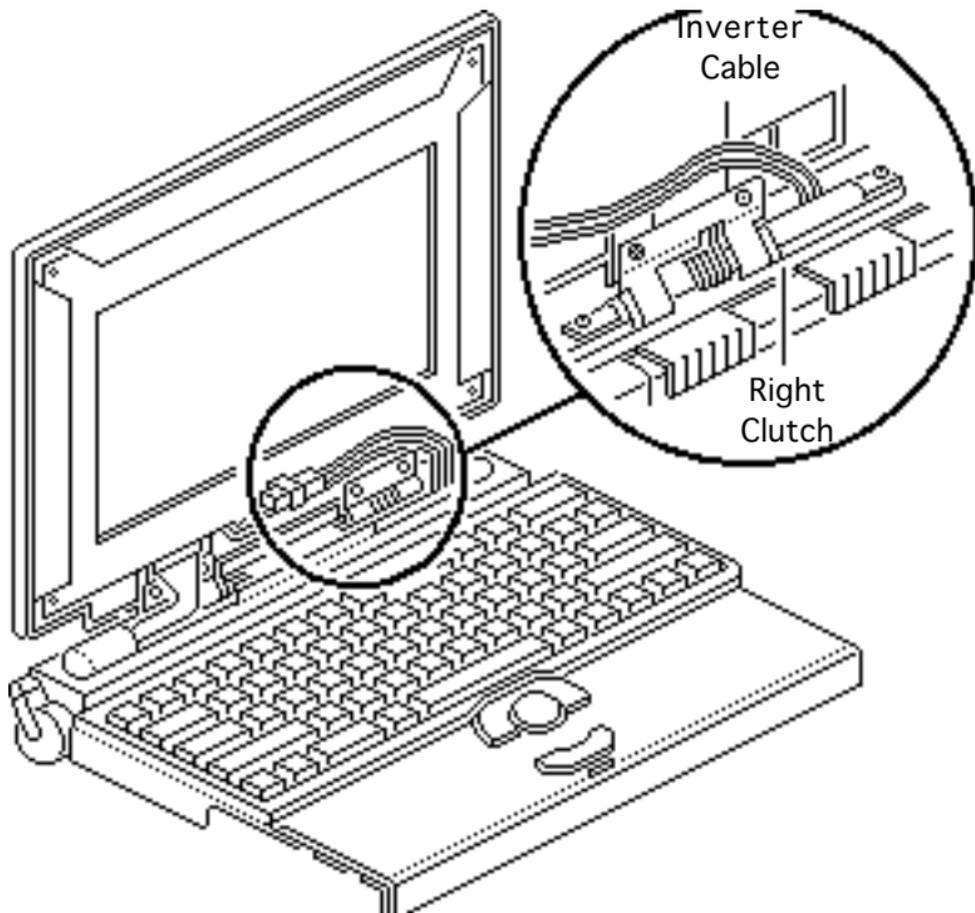
- 1 **Caution:** The display cable is fragile and should be handled with care. Lift the locking tab on the display connector and disconnect the display cable.
- 2 Disconnect the inverter cable.





- 3 Using a T-8 torx driver, remove the four display mounting screws.
- 4 Remove the display from the housing and EMI shield.





Replacement Note: To avoid pinching the inverter cable, route the cable behind the top-right corner of the hinge on the right clutch.

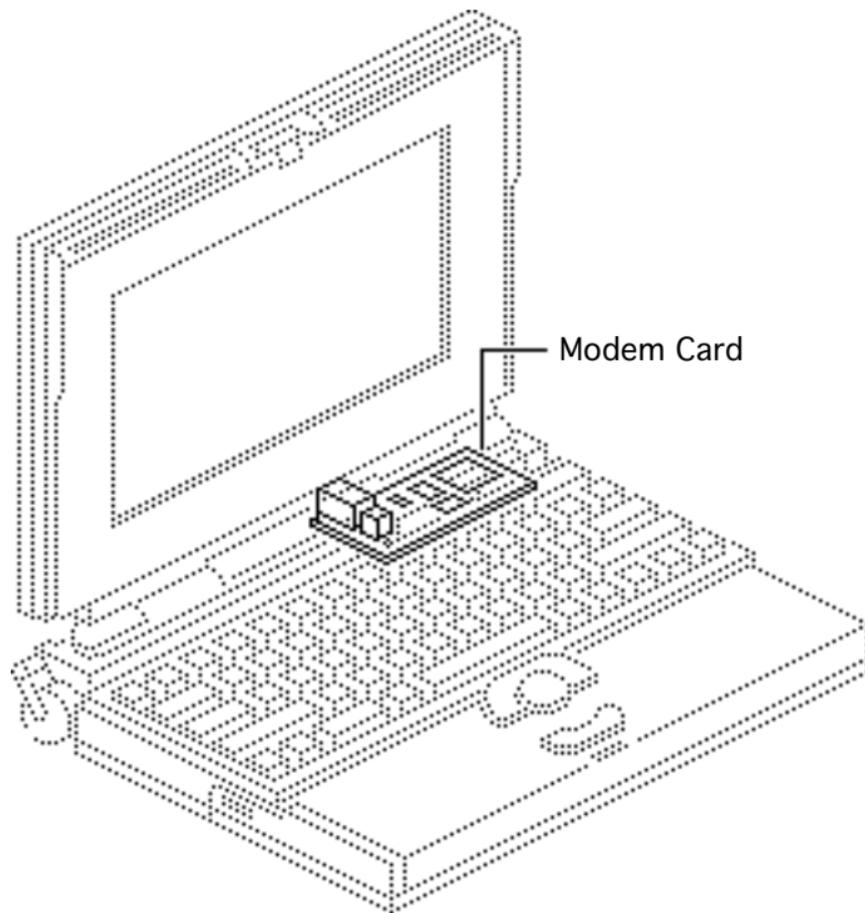




Upgrades

PowerBook 140/145/145B/170





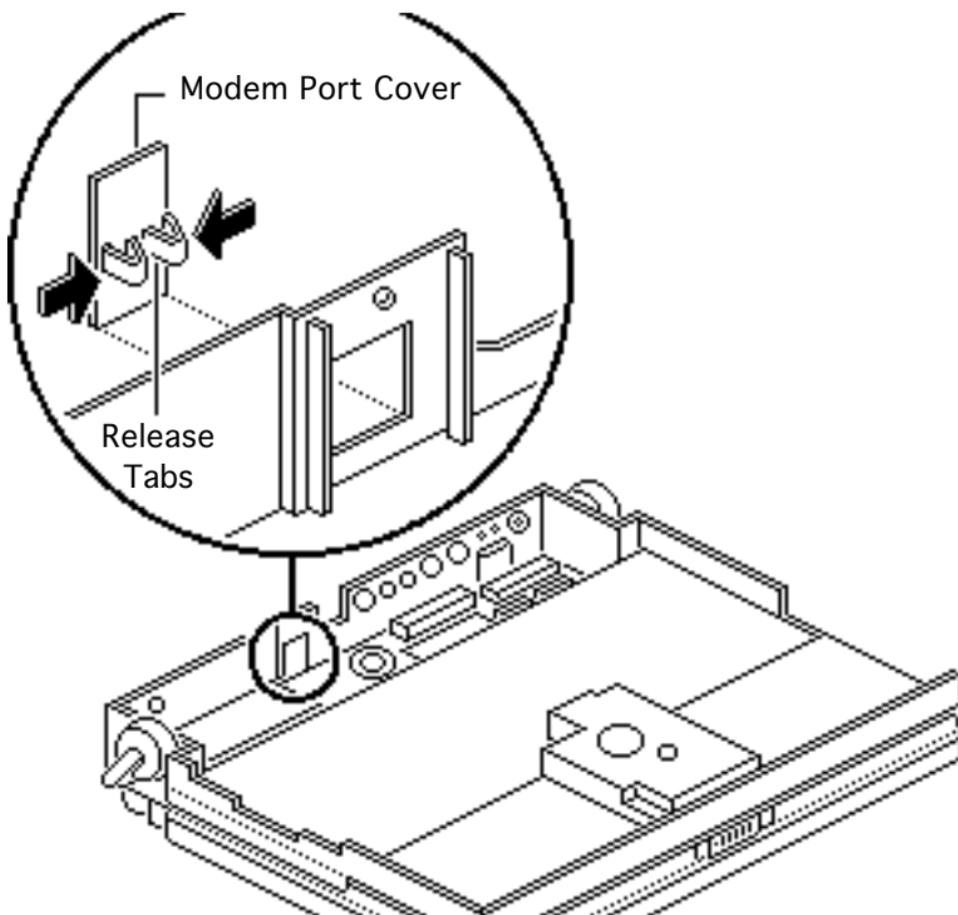
Modem Card

Before you begin, remove the following:

- Main battery
- I/O door
- Top case

Caution: The PowerBook 140/145/145B/170 contains CMOS devices that are very susceptible to ESD damage. To prevent ESD damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/ Safety.

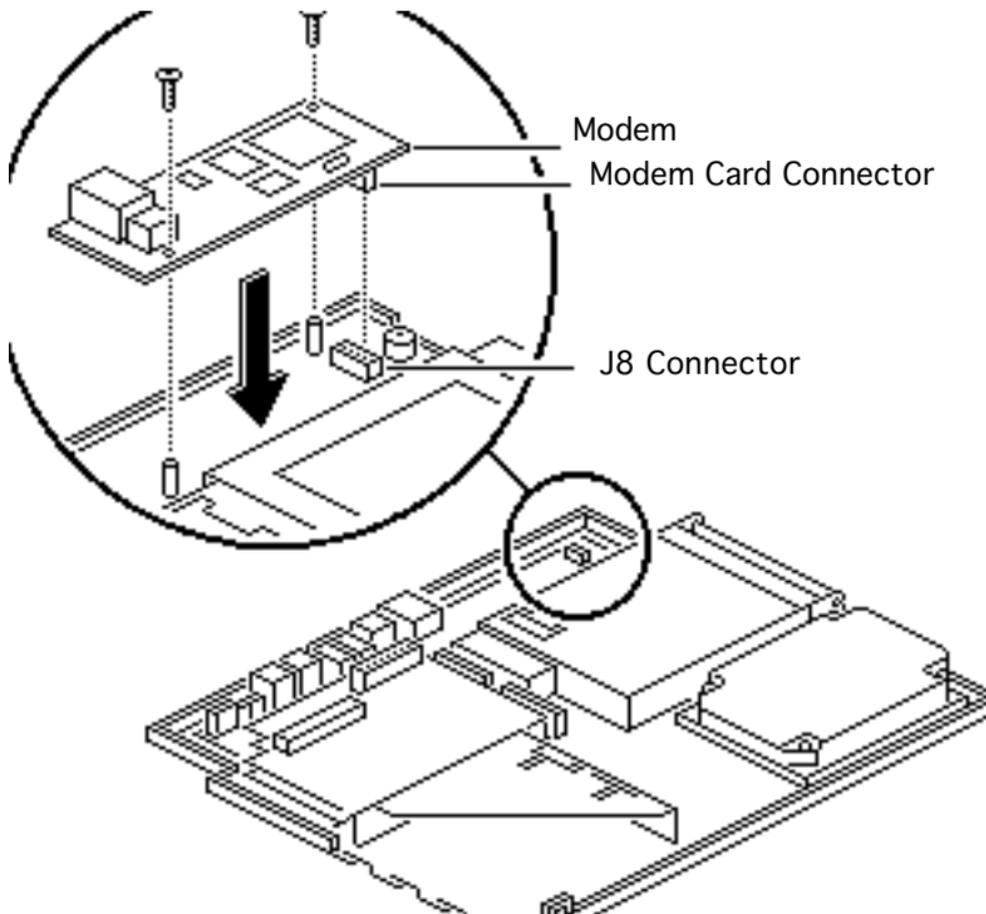




Note: The modem card is an option for the PowerBook 140/145/145B; the card is a standard feature on the PowerBook 170.

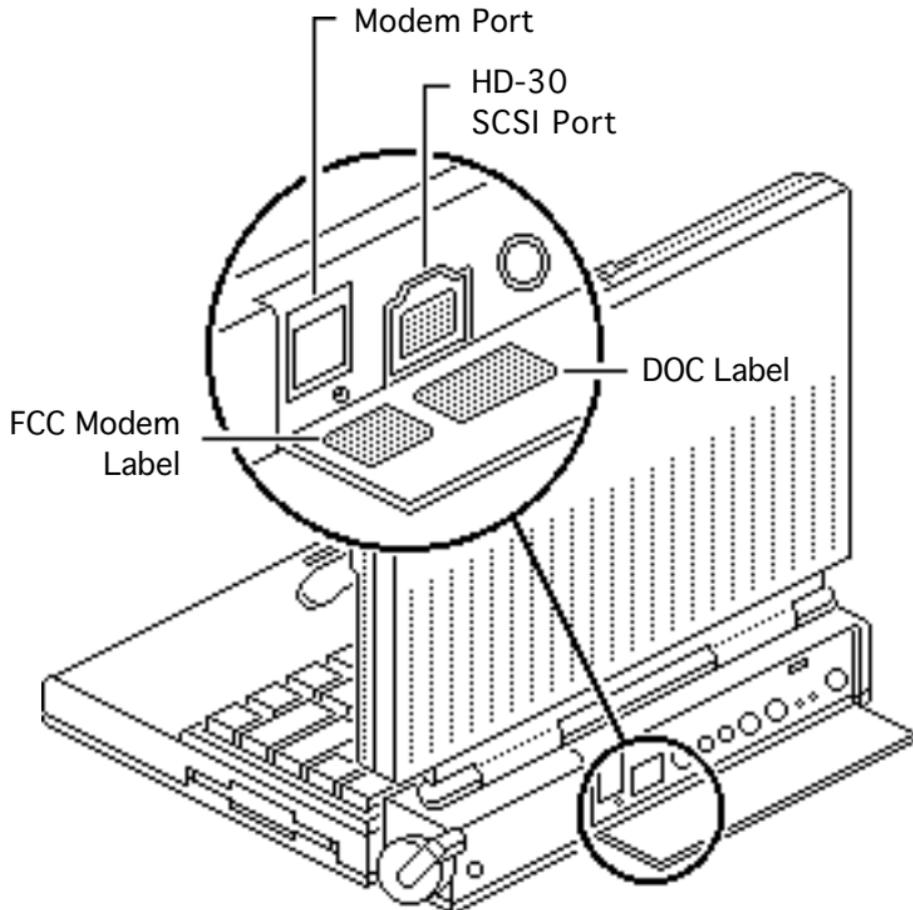
- 1 Pinch the release tabs and push out the modem port cover.





- 2 Connect the modem card connector to motherboard connector J8.
- 3 Install the two mounting screws.





- 4 Affix the FCC modem label to the inside of the I/O door. Align the label with the modem port.
- 5 Affix the DOC label to the inside of the I/O door. Align the label with the HD-30 SCSI port.



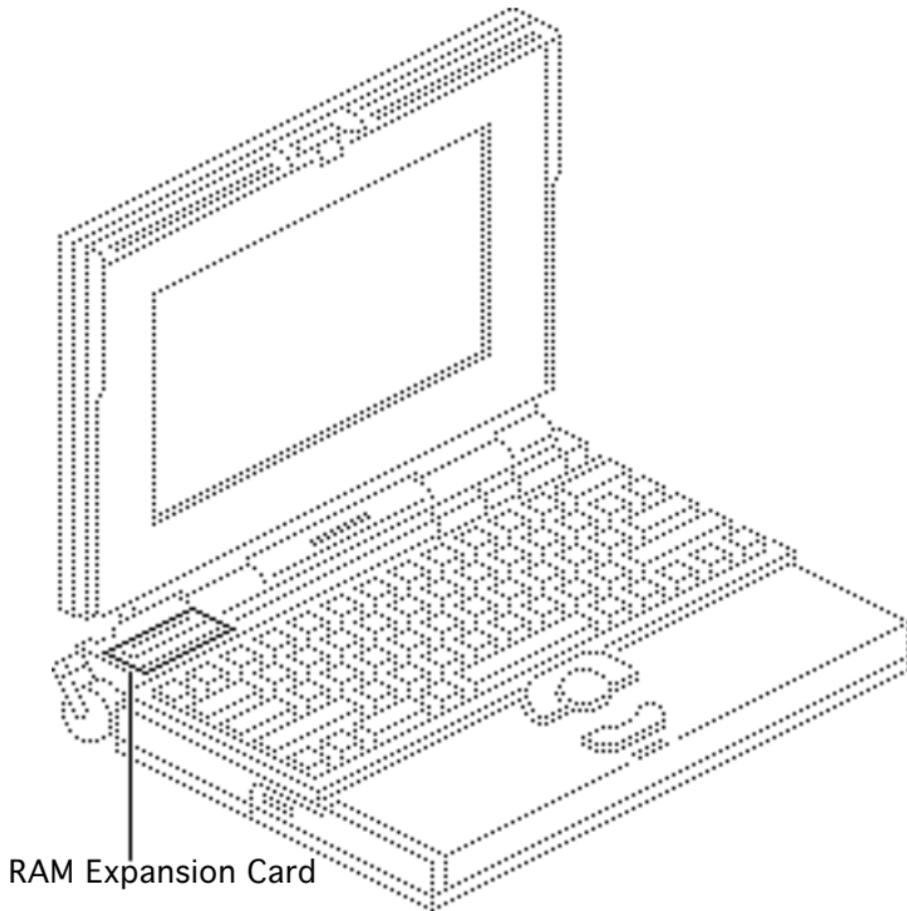


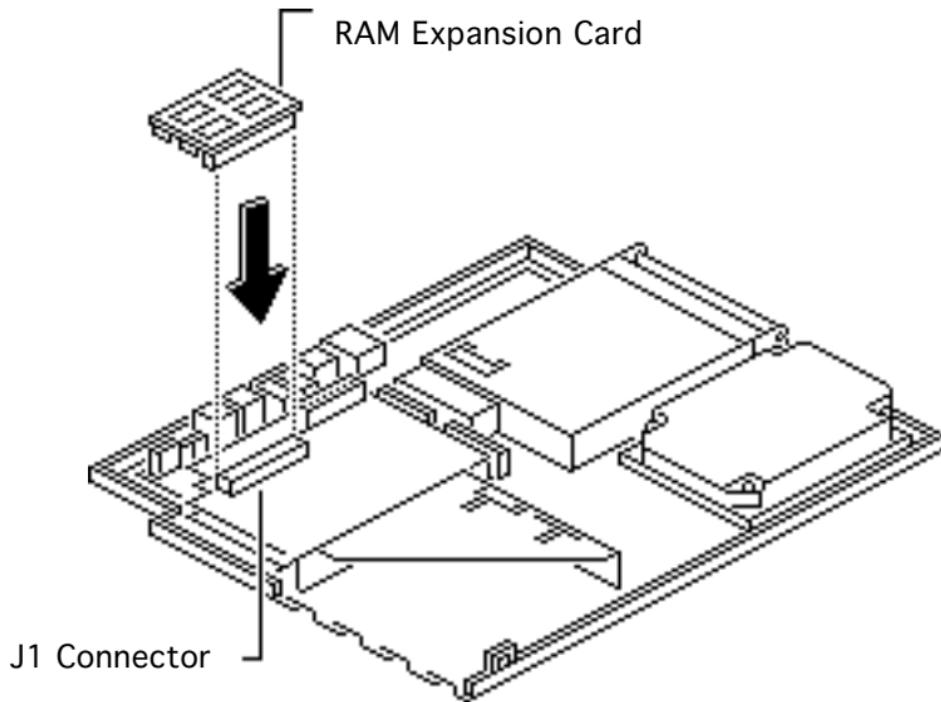
RAM Expansion Cards

Before you begin, remove the following:

- Main battery
- I/O door
- Top case

Caution: The PowerBook 140/145/170 contains CMOS devices that are very susceptible to ESD damage. To prevent ESD damage, wear a grounding wriststrap. Review the ESD precautions in Bulletins/ Safety.





Caution: Handle the RAM expansion card by the edges only. Do not touch any components on the card.

Caution: An incorrectly installed RAM card could damage the daughterboard. Note that the J1 connector and the RAM card are keyed for proper installation. Do not force the card into the connector, thereby defeating the key.





Caution: When installing the RAM expansion card, press down on the edge of the card directly above the connector. Be careful not to apply pressure to any components or you may permanently damage the card.

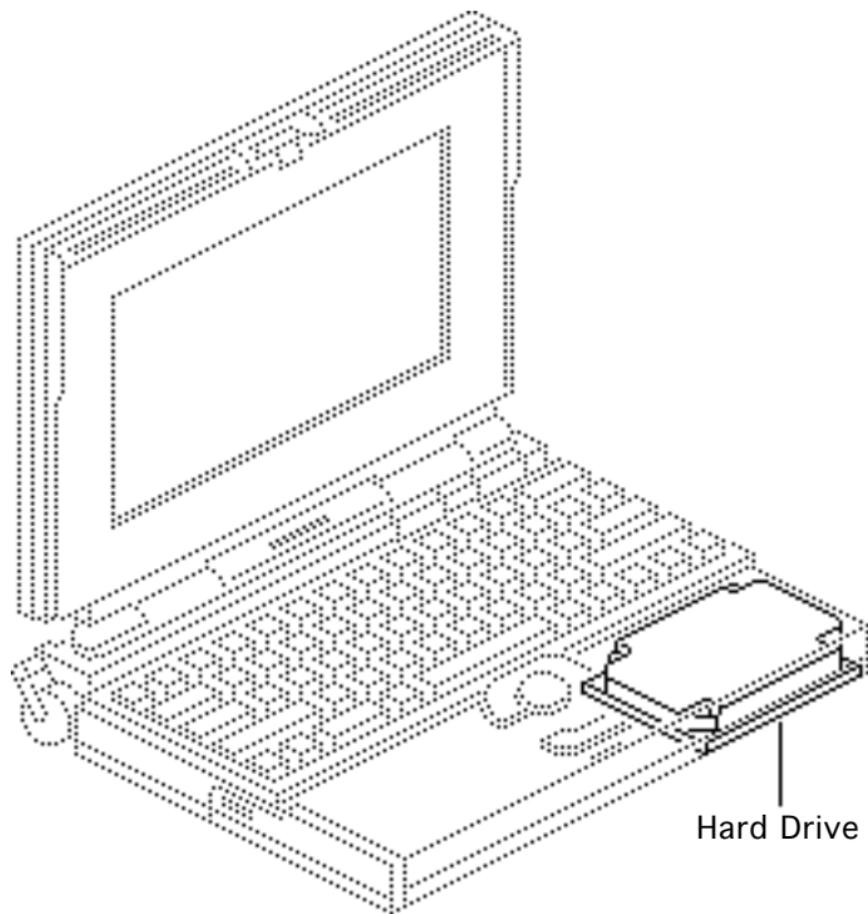
Connect the RAM expansion card to the expansion connector (J1) on the daughterboard.





Note: To verify that the upgrade is successful, check the Total Memory message (for systems with virtual memory switched off) or the Built-in Memory message (for systems with virtual memory switched on). The memory size should be 2 MB of soldered RAM plus the RAM on the expansion board. If the memory size is incorrect, replace the RAM expansion card. If the memory size is still incorrect, send the computer to Apple.





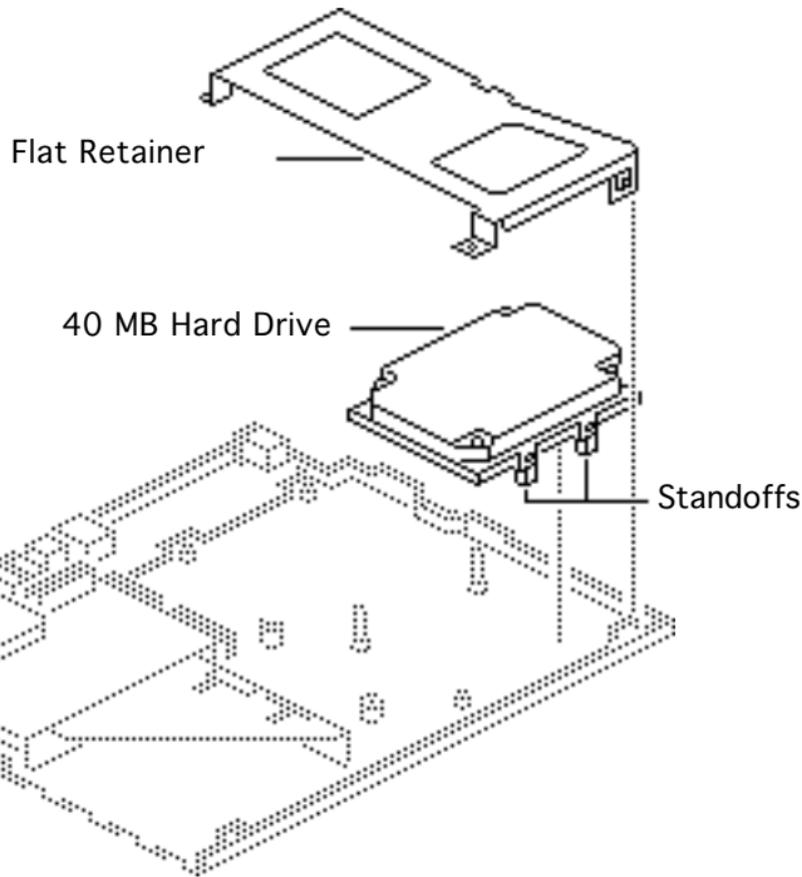
40 MB HDA Upgrade

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Modem card
- Hard drive

Note: Apple offers the 40 MB Upgrade Kit and the 2/40 MB Upgrade Kit for the PowerBook 140. Both kits include the 40 MB hard drive (with standoffs), and a 19 mm retainer. (To install





the 4 MB PSRAM Expansion Card included with the 2/40 MB Upgrade Kit, refer to “RAM Expansion Cards.”)

- 1 Do not remove the standoffs on the 40 MB hard drive.
- 2 Use the flat retainer from the upgrade kit to install the 40 MB hard drive. For installation instructions, refer to “Hard Drive” in the Take Apart chapter.

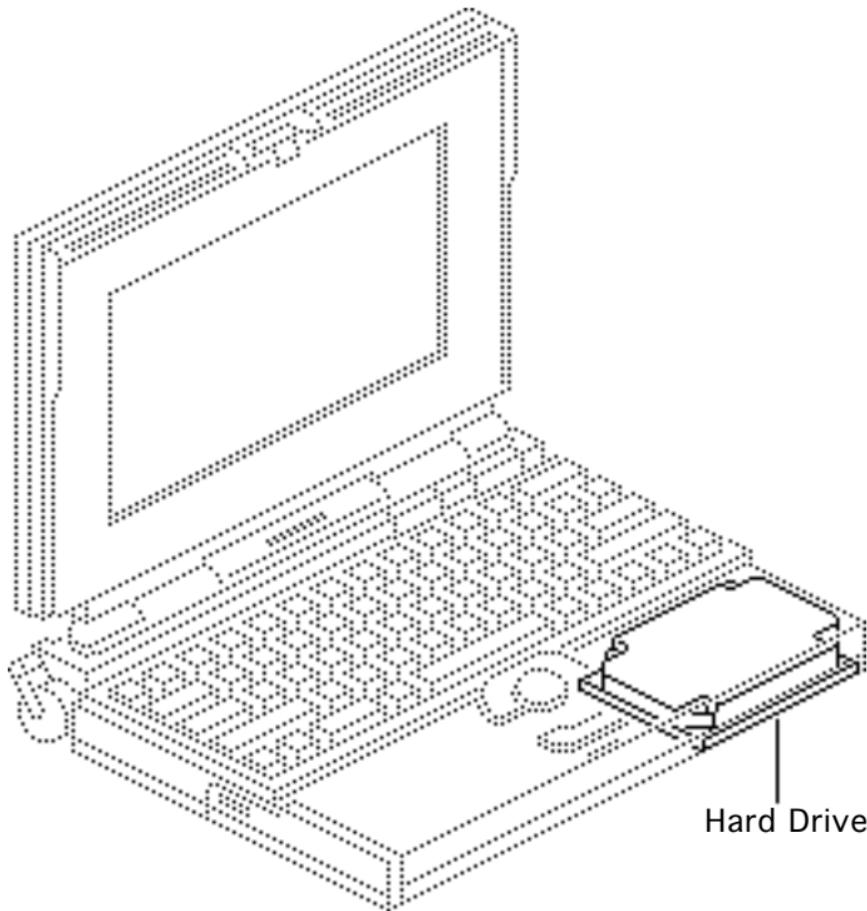




80 MB HDA Upgrade

Before you begin, remove the following:

- Main battery
- I/O door
- Top case
- Modem card
- Hard drive





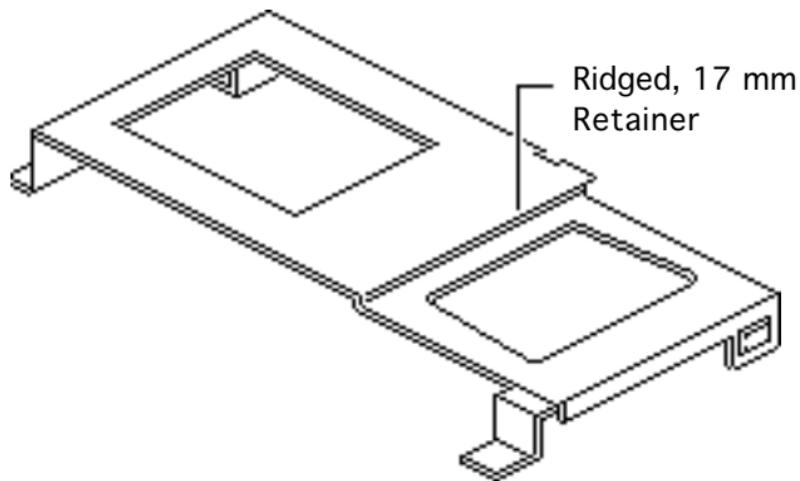
Note: Apple offers the 80 MB Upgrade Kit and the 4/80 MB Upgrade Kit for the PowerBook 140/145/170. Both kits include the 80 MB hard drive and a 17 mm retainer. Refer to the following pages to determine whether you use the 17 mm retainer shipped with the upgrade kit or the customer's original retainer. (To install the 4 MB PSRAM Expansion Card included with the 4/80 MB Upgrade Kit, refer to "RAM Expansion Cards.")





20 MB-to-80 MB Upgrades (PowerBook 140)

Use the ridged, 17 mm retainer that originally shipped with the PowerBook. For installation instructions, refer to “Hard Drive” in the Take Apart chapter.





40 MB-to-80 MB Upgrades (PowerBook 140 or 170)

Use the ridged, 17 mm retainer that shipped with the upgrade kit. For installation instructions, refer to “Hard Drive” in the Take Apart chapter.

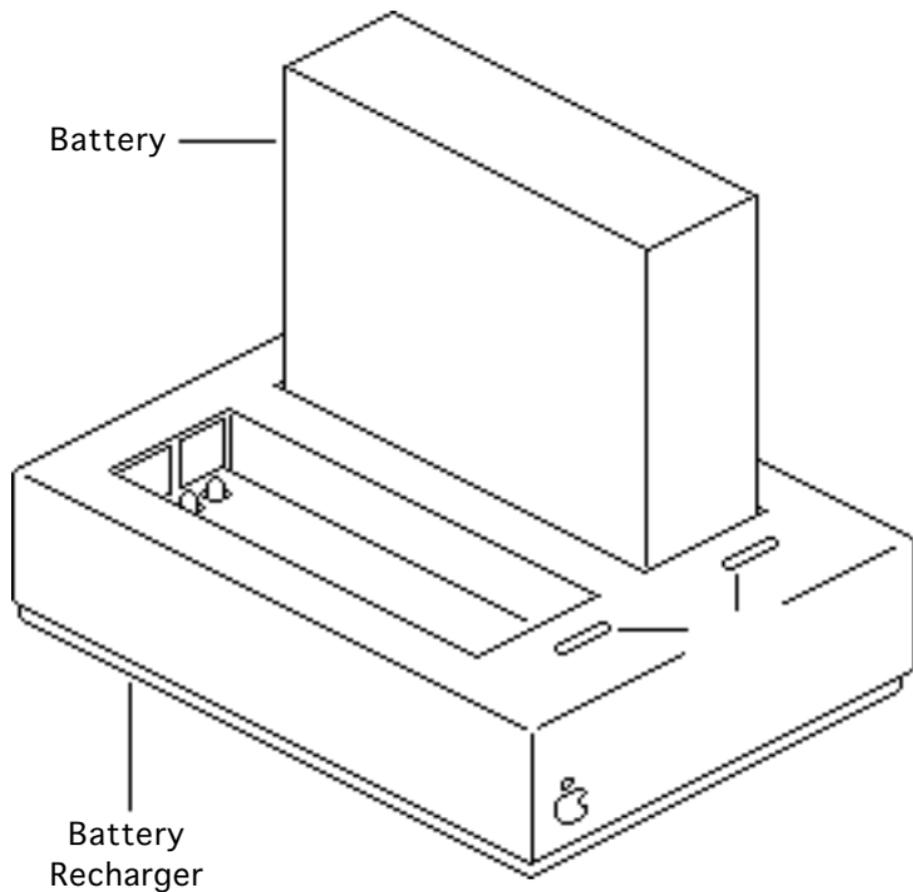




Additional Procedures

PowerBook 140/145/145B/170





Battery Recharger

No preliminary steps are required before you begin this procedure.

- 1 Using the PowerBook power adapter, plug the battery recharger into a power outlet and insert the main battery into the recharger.





- 2 Track the status of the battery. If the LED is
 - Yellow, the battery is charging.
 - Green, the battery is ready to use
 - Off, the charger is unplugged, the battery is bad, the power adapter is defective, or the charger is defective.



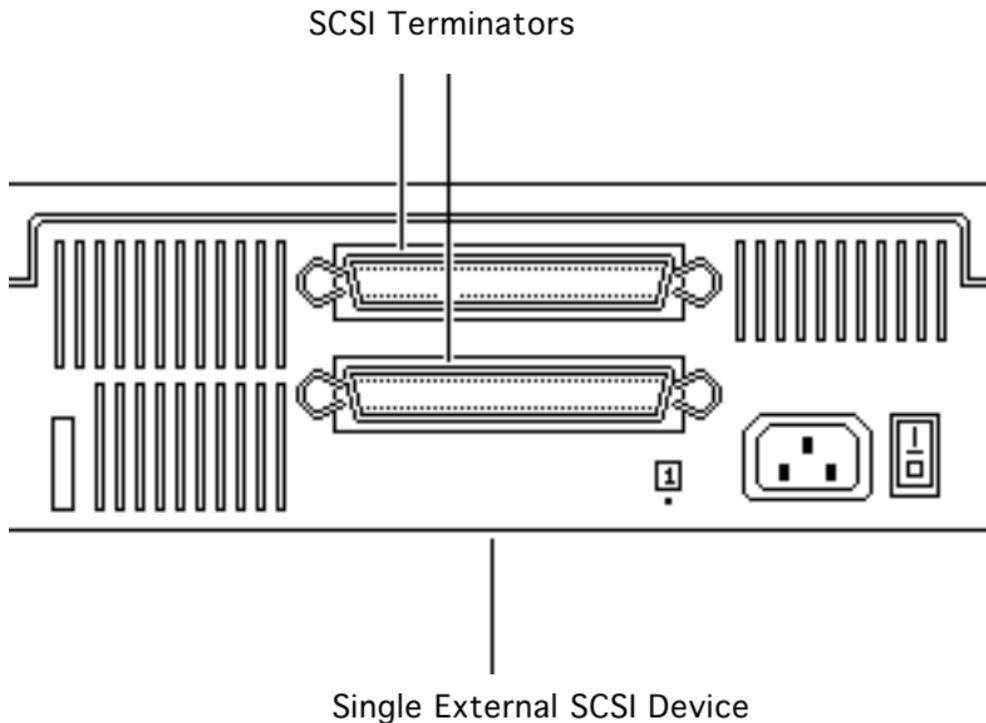


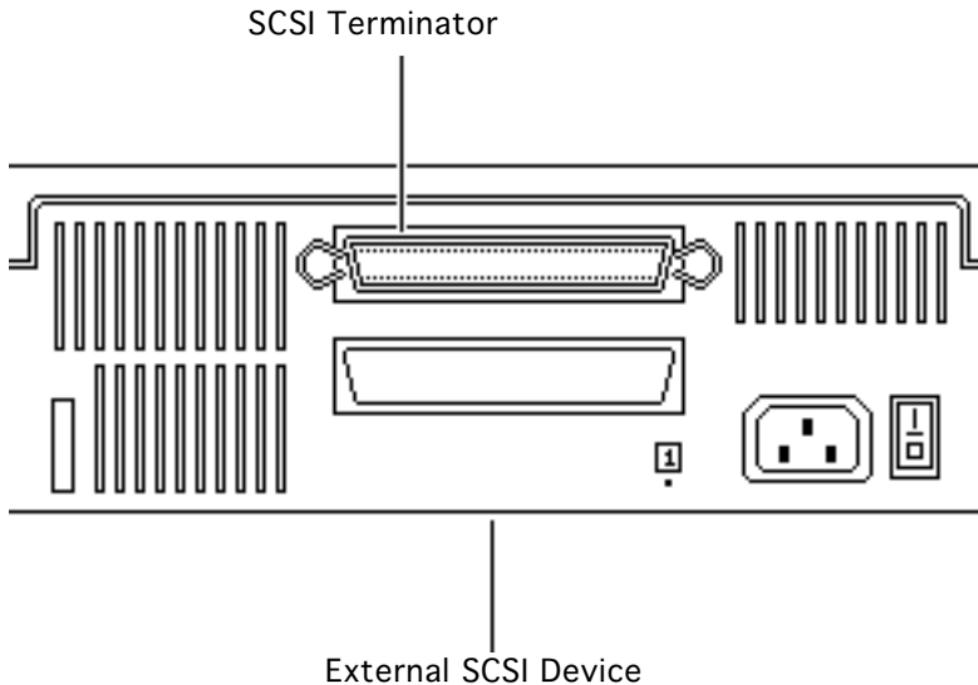
SCSI Termination

No preliminary steps are required before you begin this procedure.

Note: The PowerBook 140/145/170 do not provide SCSI termination at the logic board; remember to terminate at the beginning and end of the SCSI chain. Use the standard Apple terminator.

When terminating a SCSI chain, follow these





guidelines:

- For PowerBooks without an internal hard drive,
 - Add two terminators to a single external SCSI device, or
 - Add one terminator to the first device and another to the last when there are multiple devices.
- For PowerBooks with an internal hard drive:
 - Add one terminator to





a single external SCSI device, or

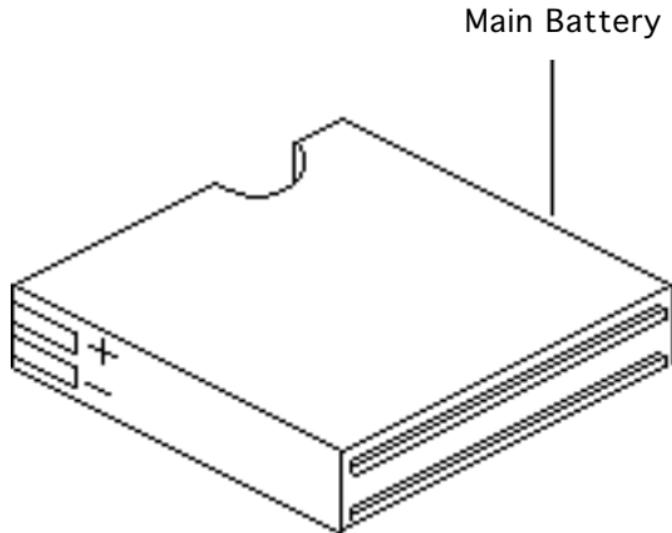
- Add one terminator to the first device and another to the last when there are multiple devices.





Battery Handling

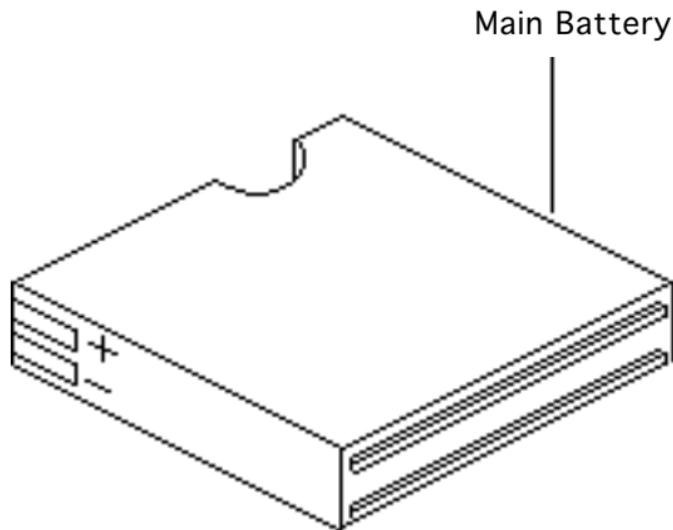
No preliminary steps are required before you begin this procedure.



Note: The PowerBook140/145/170 main battery is a nickel cadmium (NiCad) battery with a voltage of 5.65–7.5 volts. Its longevity is estimated at 500 power cycles. To extend its longevity, follow the battery handling instructions.

Warning: The main





battery contains toxic materials. Send undamaged, dead batteries to Apple for recycling—do not discard dead batteries with other waste. If the battery is damaged, do not return it to Apple. Dispose of damaged batteries according to local ordinances. Review battery handling and disposal instructions in Bulletins/Safety.

Follow the guidelines for

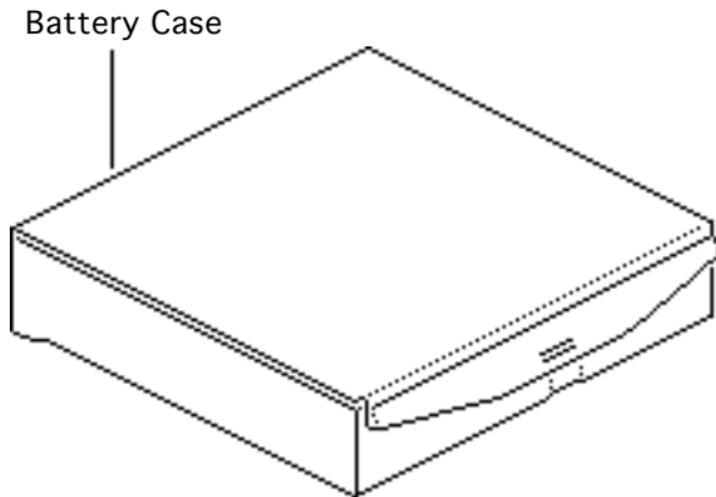




properly handling the NiCad battery:

- Handle the battery carefully. Do not drop, puncture, disassemble, mutilate, or incinerate the battery.
- Fully charge a replacement battery before using it; Apple ships batteries in a partially-charged state.
- Do not leave the battery in the computer for longer than two weeks without plugging in the power adaptor.
- Completely discharge and





- recharge the battery once a month.
- Store the battery in the protective battery case. Refer to the Parts chapter in this manual for additional battery cases.
 - Do not short-circuit the battery terminals.
 - Keep the battery in a cool, dark place; do not store it for longer than 6 months without recharging.

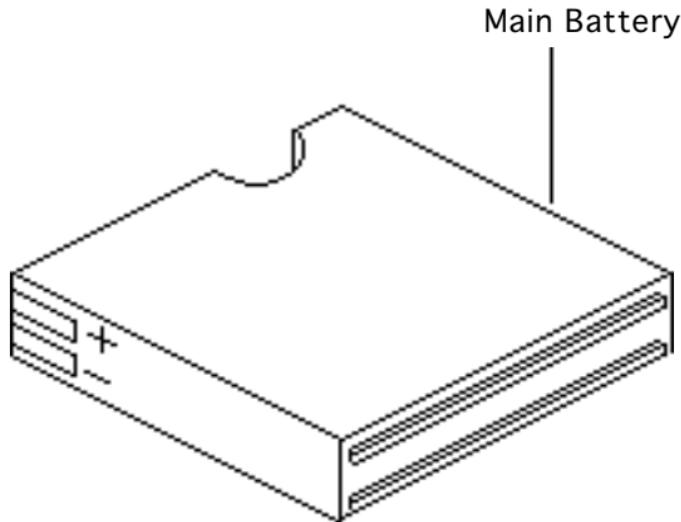




Battery Verification

Before you begin, remove the main battery.

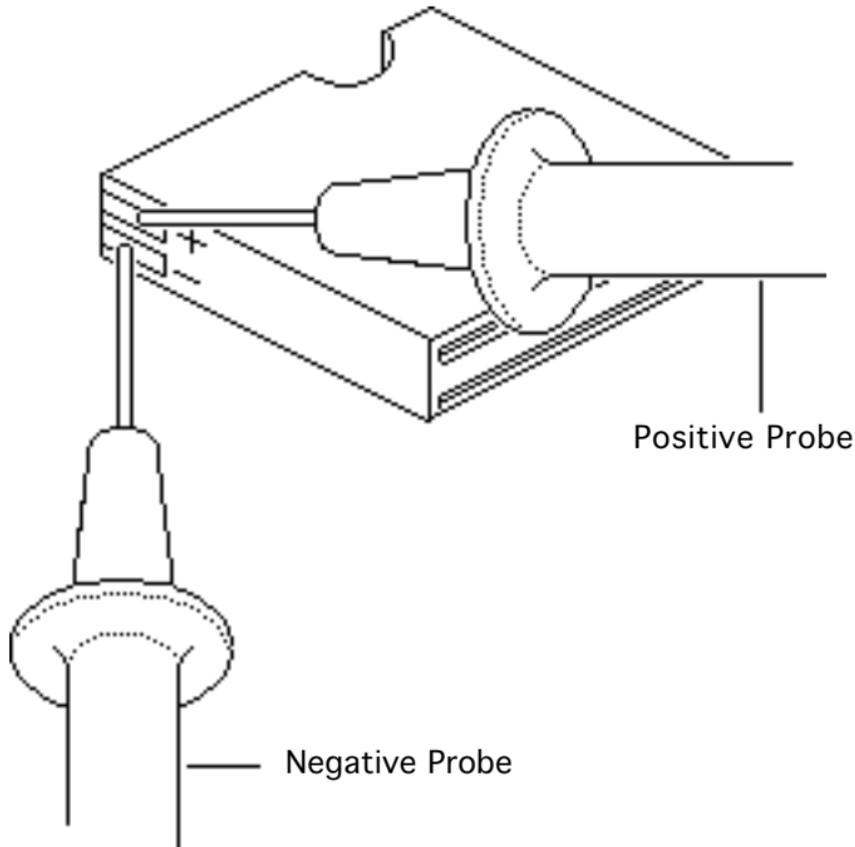
Note: The battery desk accessory is a general indicator of the battery charge. Use a voltmeter to determine the actual charge.





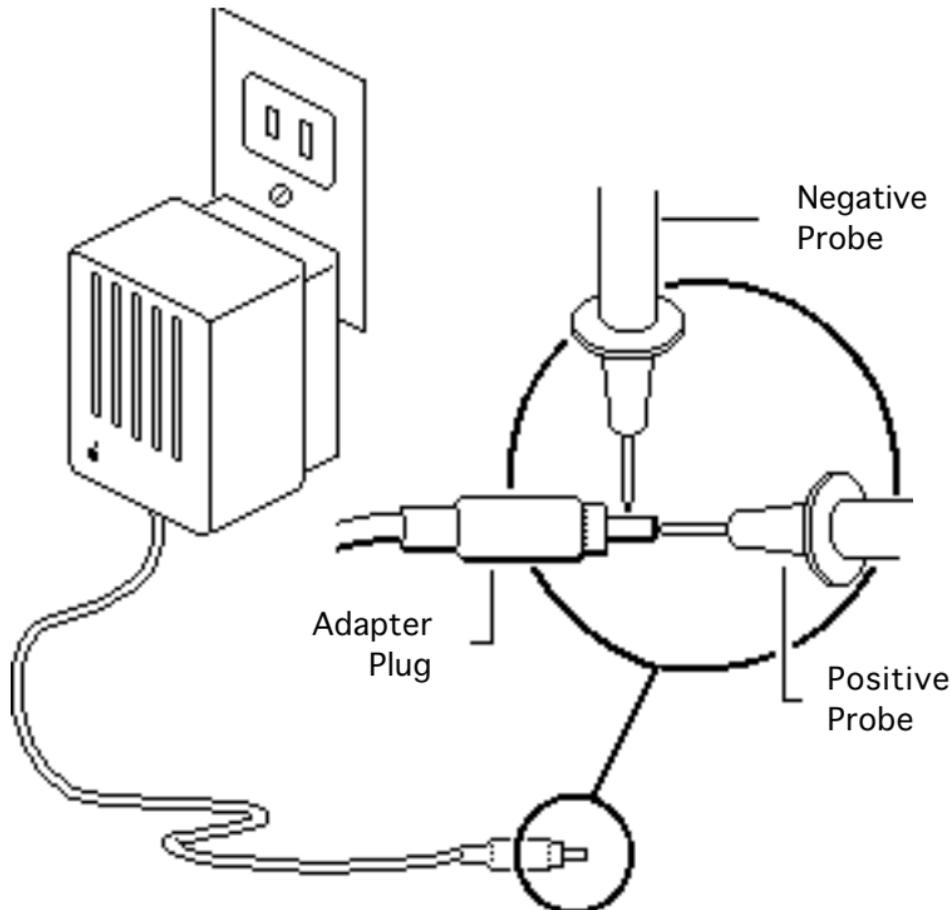
⚠ Warning: The main battery is a NiCad battery that contains toxic materials. Send undamaged, dead batteries to Apple for recycling—do not discard dead batteries with other waste. If the battery is damaged, do not return it to Apple. Dispose of damaged batteries according to local ordinances. Review battery handling and disposal instructions in Bulletins/ Safety.





Set a voltmeter to the 10 volts DC scale and touch the positive and negative terminals of the battery with the positive and negative voltmeter probes. If the reading is not above 5.7 volts, recharge (first) or replace the battery.





Adapter Verification

No preliminary steps are required before you begin this procedure.

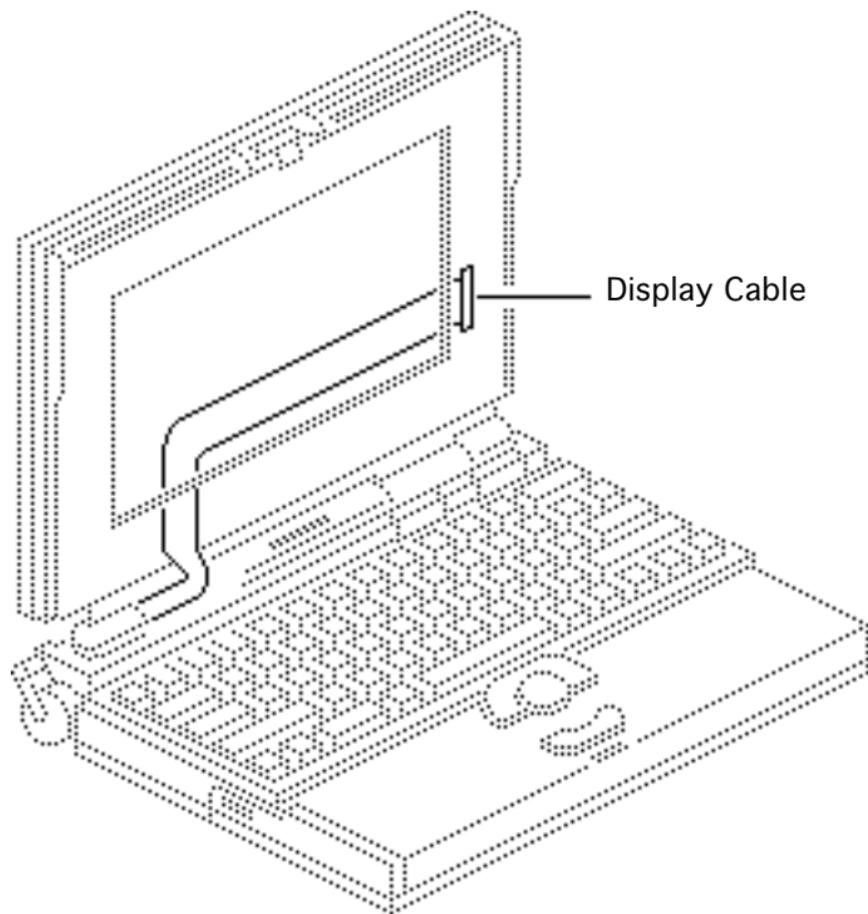
- 1 Plug in the AC adapter to a wall socket.
- 2 Set a voltmeter to the 10 volts DC scale.





- 3 Touch the positive voltmeter probe to the inside of the adapter plug, and touch the negative voltmeter probe to the outside of the adapter plug. If the reading is not 7.5–7.9 volts, replace the adapter.





Shim Installation

Before you begin, remove the main battery.

Note: Some PowerBook 140/145/170 displays may flicker, intermittently go black, or display two horizontal black lines. If you encounter any of these problems, try squeezing the right side of the display bezel. If squeezing the bezel causes the condition to improve or to worsen, install a shim on the display cable. The shim improves

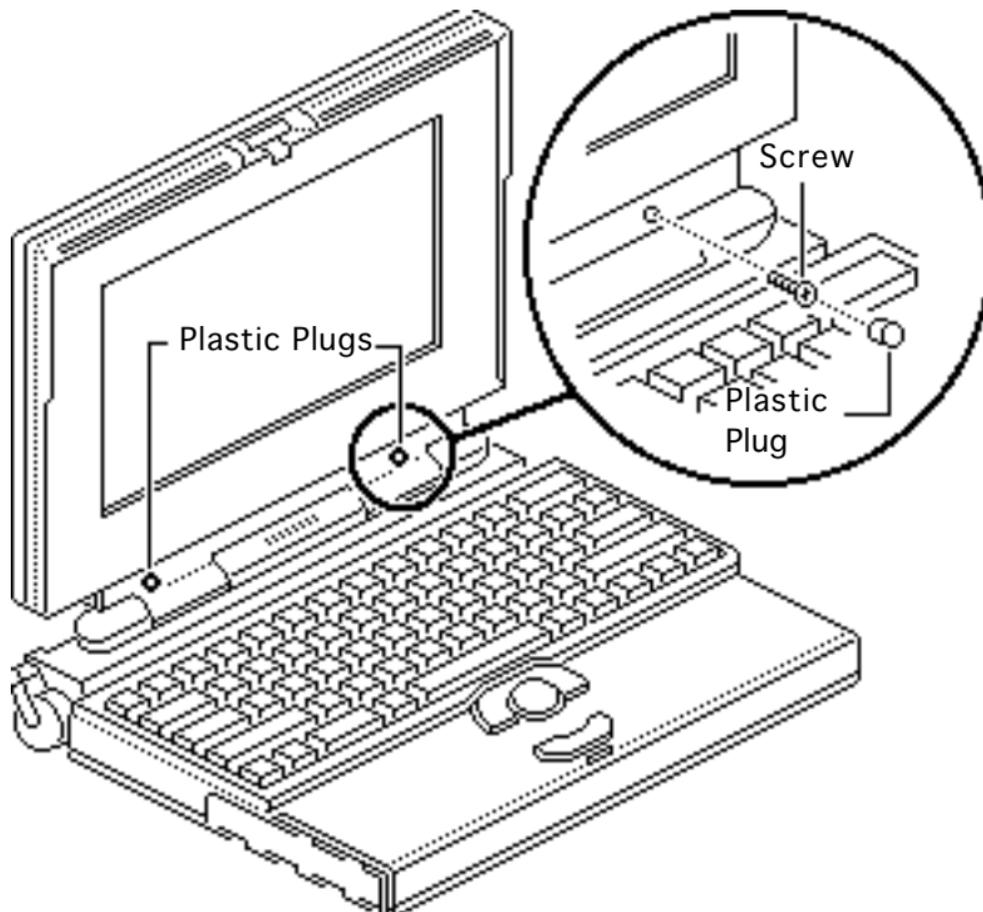




the connection between the connector fingers and the cable contacts.

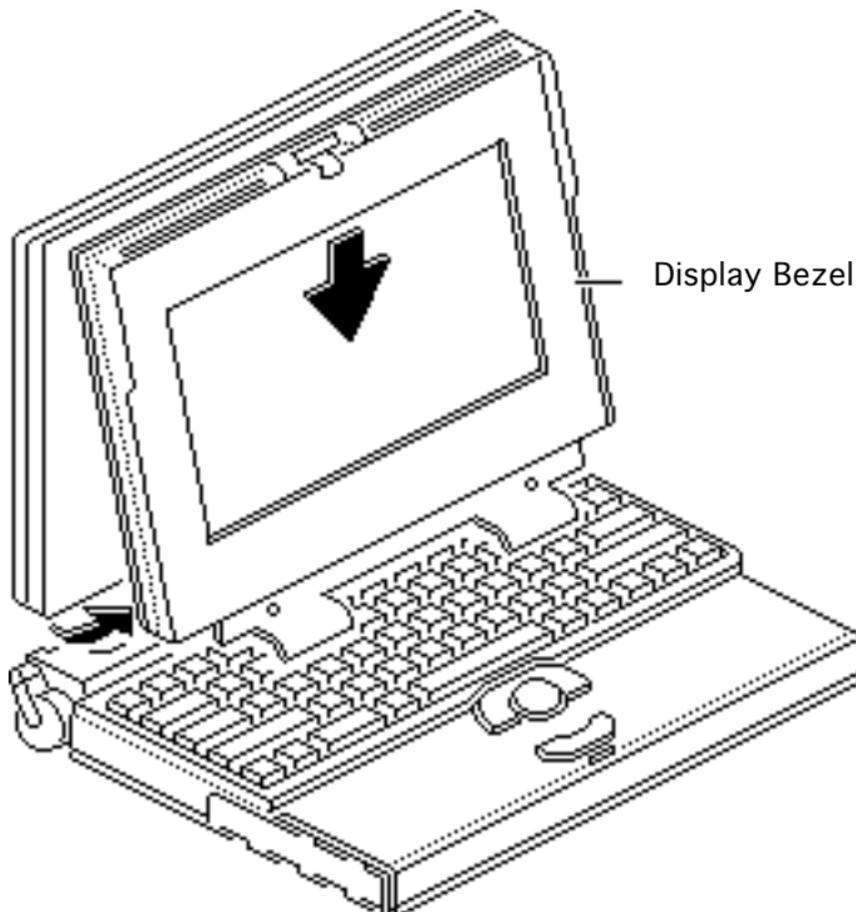
Note: Do not install a shim onto a display cable that has been stamped with part number 922-0820.





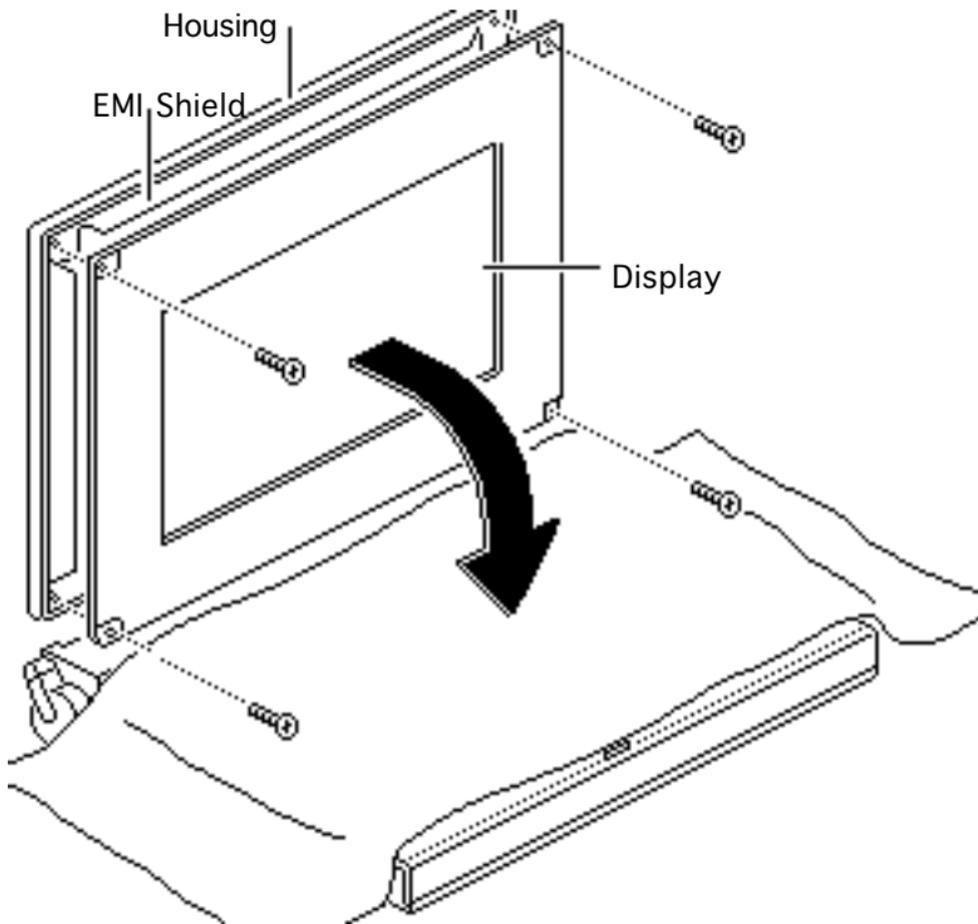
- 1 Remove the two plastic plugs.
- 2 Using a T-8 torx driver, remove the two bezel mounting screws from the display.





- 3 Pull the display bezel down and away to release it from the mounting tabs at the top of the display.
- 4 Lift the bezel off the display.





Note: If you are installing a shim on a PowerBook 170 display cable, skip to step 8. You can disconnect the display cable from the PowerBook 170 display without removing the display from the housing.

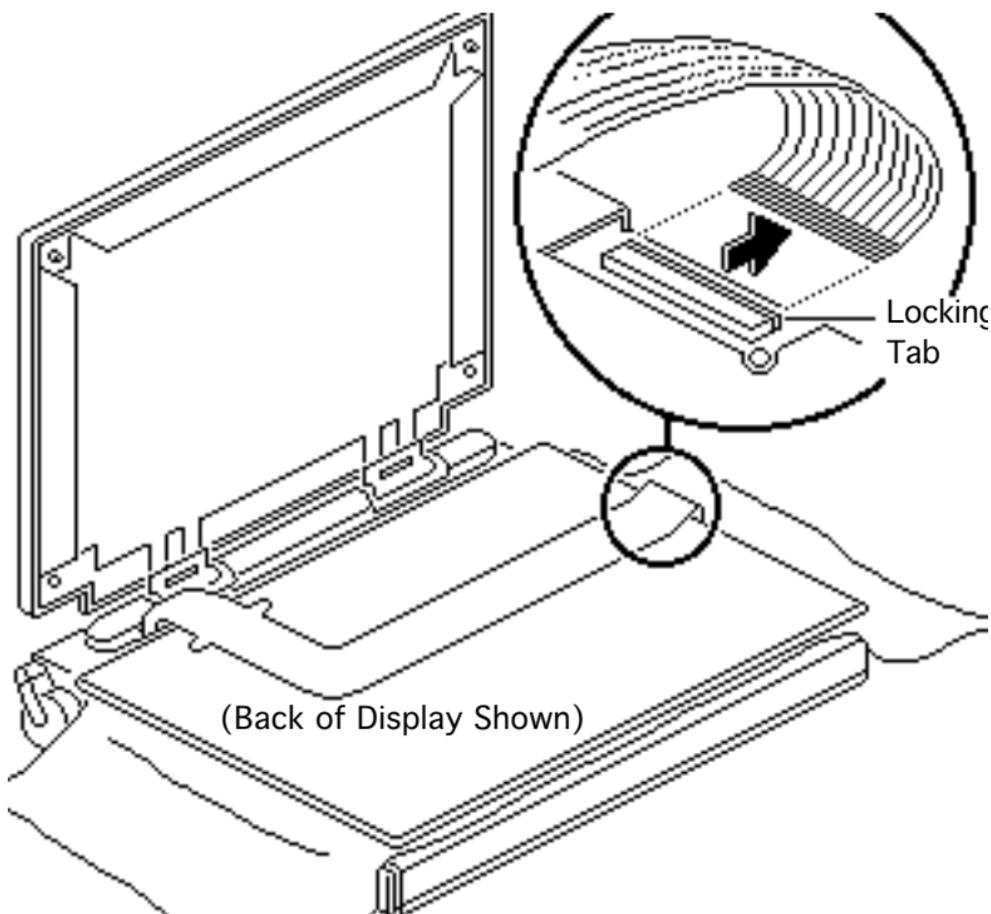
- 5 Cover the keyboard with a clean cloth or sheet of paper.
- 6 Using a T-8 torx driver, remove the four display mounting screws.





- 7 Remove the display from the EMI shield and housing. Place the display face-down on the keyboard.

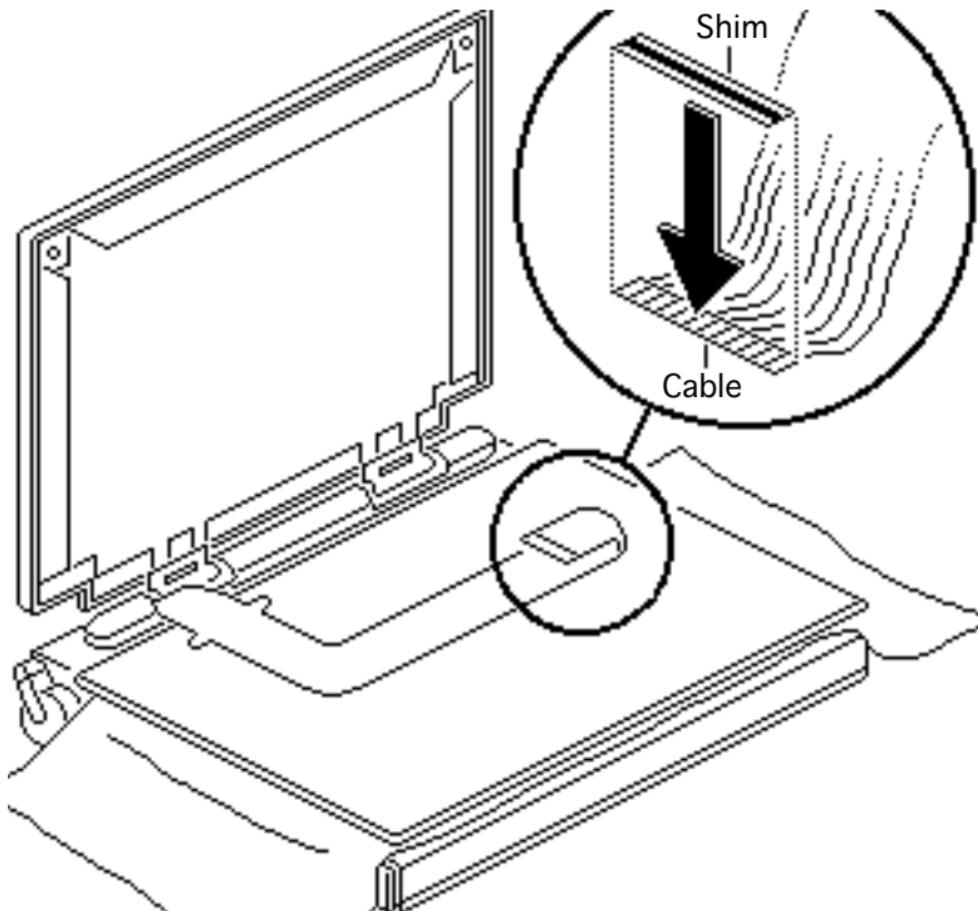




Note: The PowerBook 145 display is shown.

- 8 Lift the locking tab on the display connector and disconnect the display cable.





- 9 Remove the clear shim from its paper backing.
- 10 Turn back the display cable and press the shim onto the back (the non-conductive side) of the display cable connector. Make sure that the shim is unwrinkled and flush with the edges of the cable and that it does not cover the connector traces.
- 11 Stamp the cable with part number 936-0108.





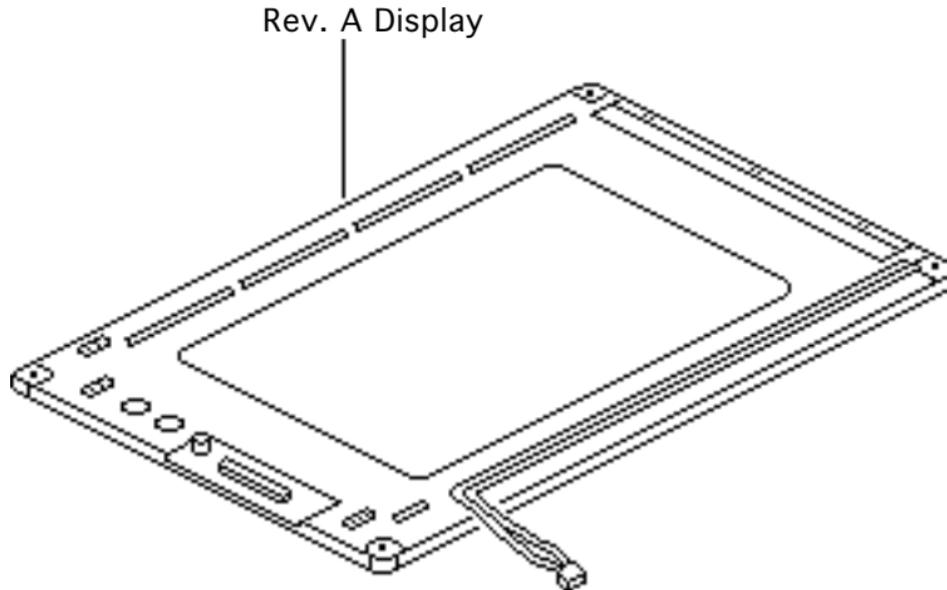
Rev. A Display Bulb

Before you begin, remove the following:

- Main battery
- Display

⚠ Warning: CCFL bulbs are thin and break easily. Handle them with care, especially at the delicate solder joints at the ends of the bulbs.

Caution: To prevent ESD damage to components, wear a grounding wriststrap.



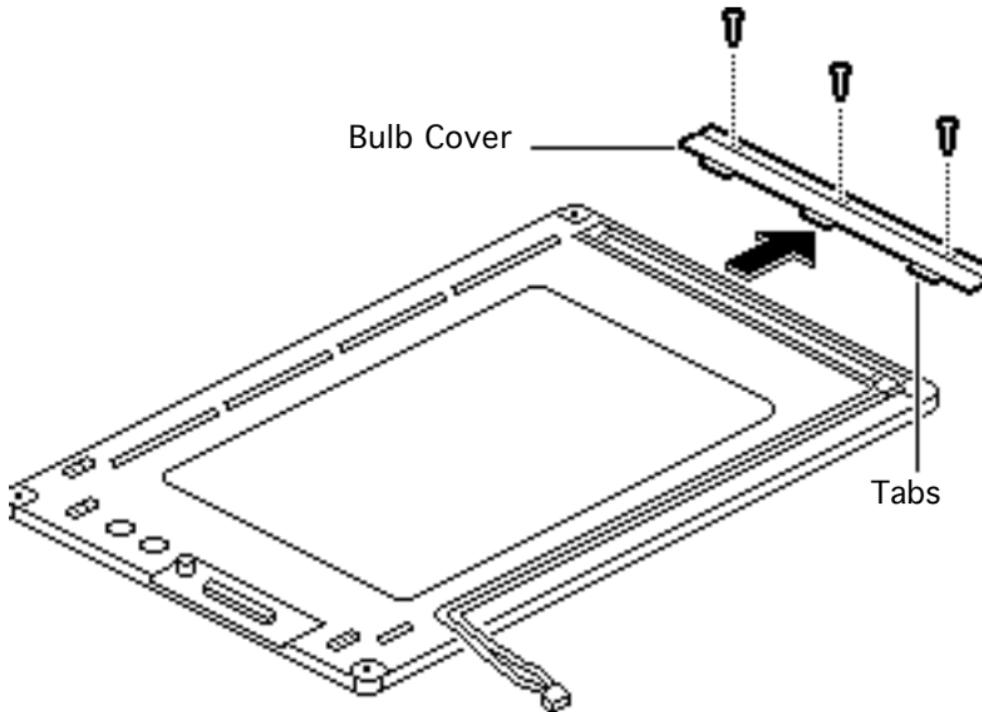


Review the ESD precautions in Bulletins/Safety.

Note: Bulb kits are available for Rev. A and Rev. C displays for the PowerBook 140 and 145. This procedure includes steps for replacing the backlight bulb in a Rev. A display.

- 1 Place the display face-down on a soft workbench pad.





- 2 Using a #1 cross-tip screwdriver, remove the three self-threading screws.

Replacement Caution: Improperly installed self-threading screws could damage the display. Do not overtighten them.

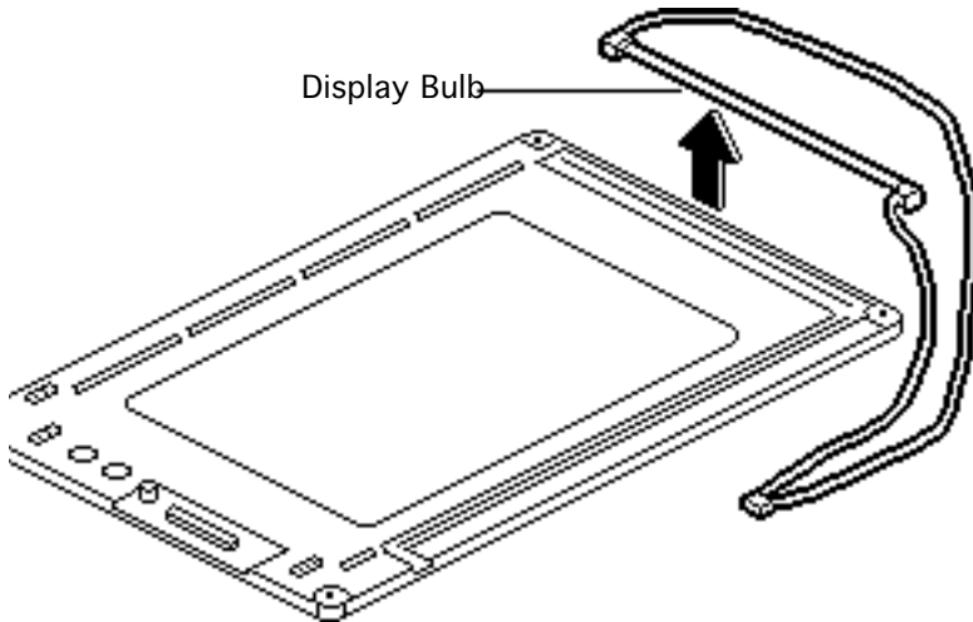
- 3 Lift the plastic display bulb cover and back it off the display.

Replacement Note: When replacing the cover, insert the three cover tabs in the display slots.





- 4 Remove the two cables from their channels and lift out the display bulb.



Note: If necessary, remove the inverter cable from the display bulb cable. Install the inverter cable on the replacement bulb cable.

Replacement Note: When replacing the bulb, make sure the longer, white cable is placed in the outside channel.





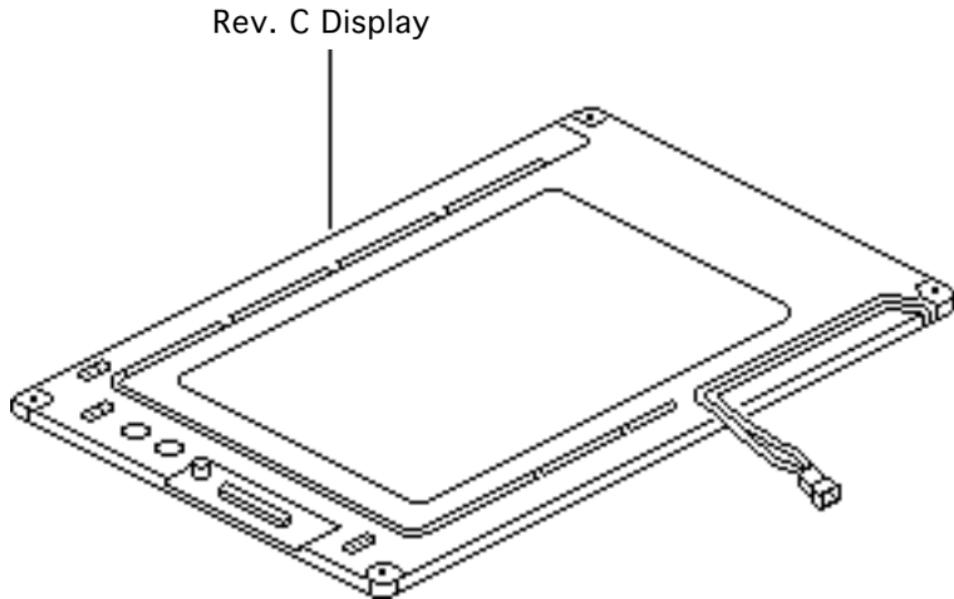
Rev. C Display Bulb

Before you begin, remove the following:

- Main battery
- Display

⚠ Warning: CCFL bulbs are thin and break easily. Handle them with care, especially at the delicate solder joints at the ends of the bulbs.

Caution: To prevent ESD damage to components, wear a grounding wriststrap.





Review the ESD precautions in Bulletins/ Safety.

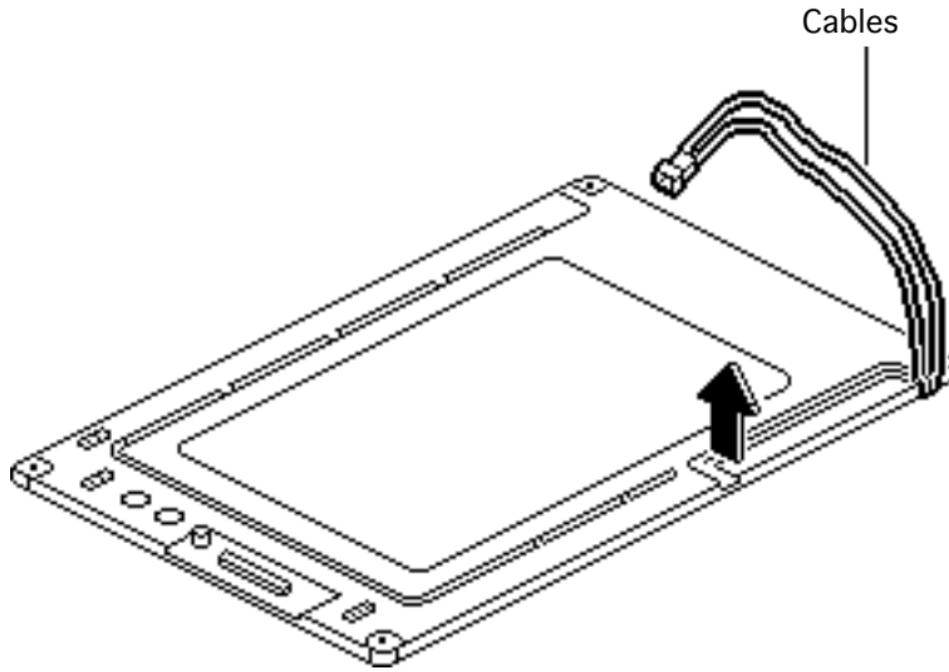
Note: Bulb kits are available for Rev. A and Rev. C displays for the PowerBook 140 and 145. This procedure includes steps for replacing the backlight bulb in a Rev. C display.

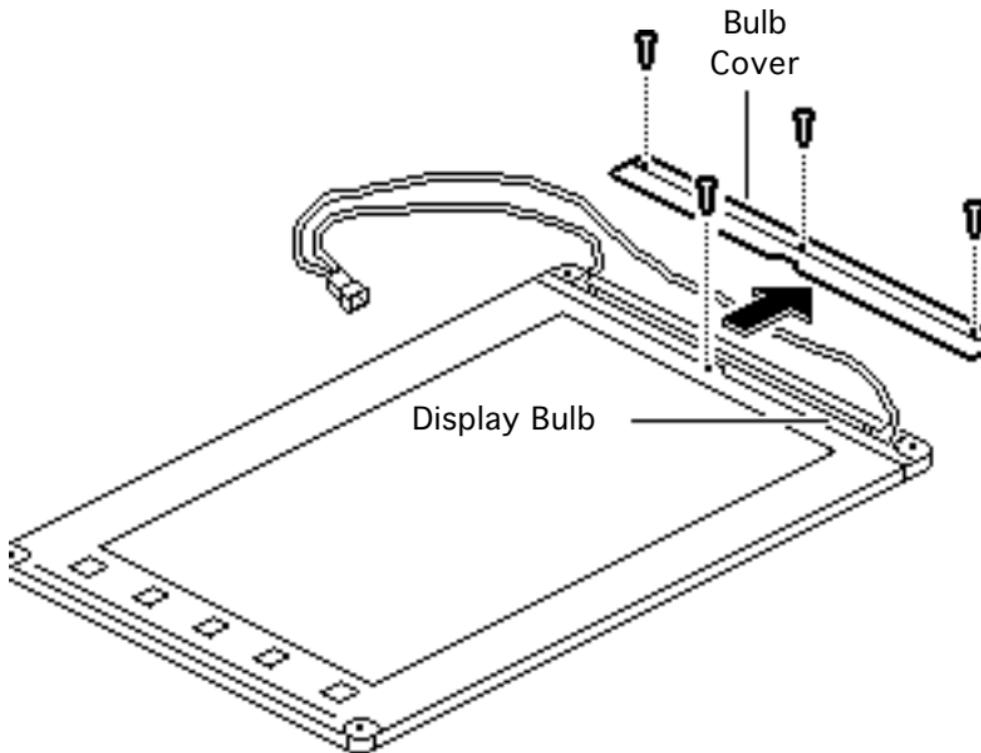
- 1 Place the display face-down on a soft workbench pad.





- 2 Remove the two cables from their channels.
- 3 Turn over the display.



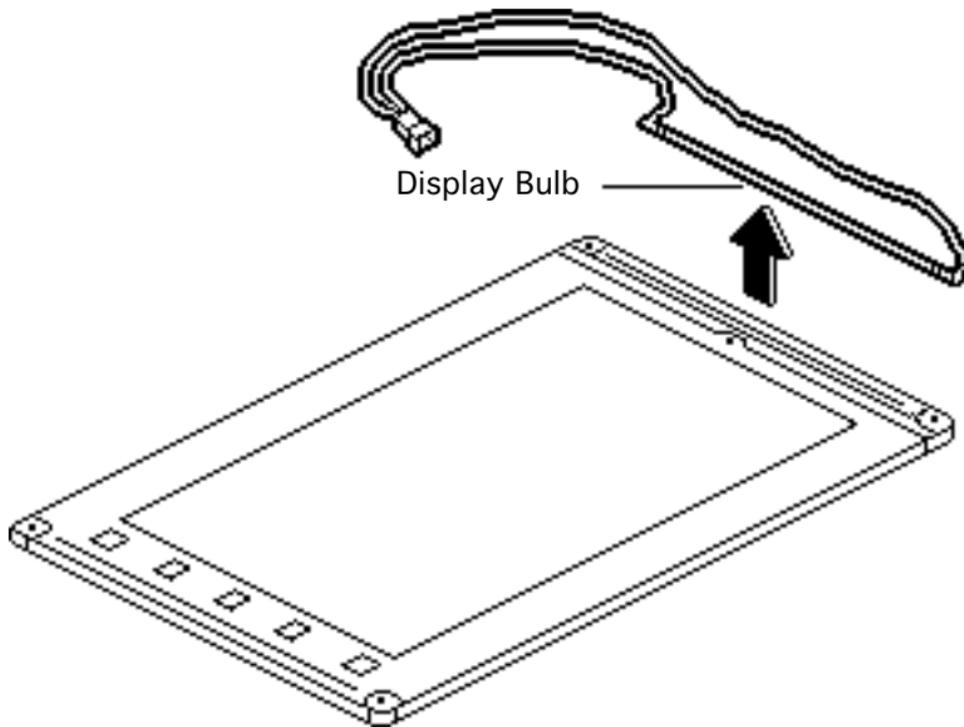


- 4 Remove the remaining length of the cables from the channels.
- 5 Using a #1 cross-tip screwdriver, remove the four self-threading screws.

Replacement Caution: Improperly installed self-threading screws could damage the display. Do not overtighten them.

- 6 Remove the plastic display bulb cover.
- 7 Remove the display bulb.





Replacement Note: When replacing the new bulb, make sure the cables are in the same position as the previous bulb's cables.

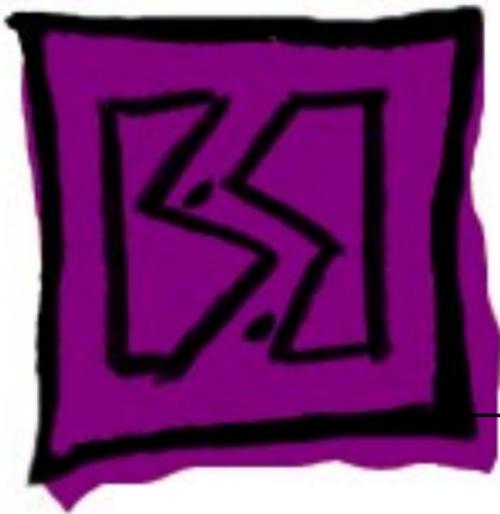




AM Bulb (Int'l Only)

Note: For CPRC and international repairers only, refer to Hardware/Service Manuals/PowerBooks for procedures for replacing a bad backlight bulb in the PowerBook 170 active-matrix display.





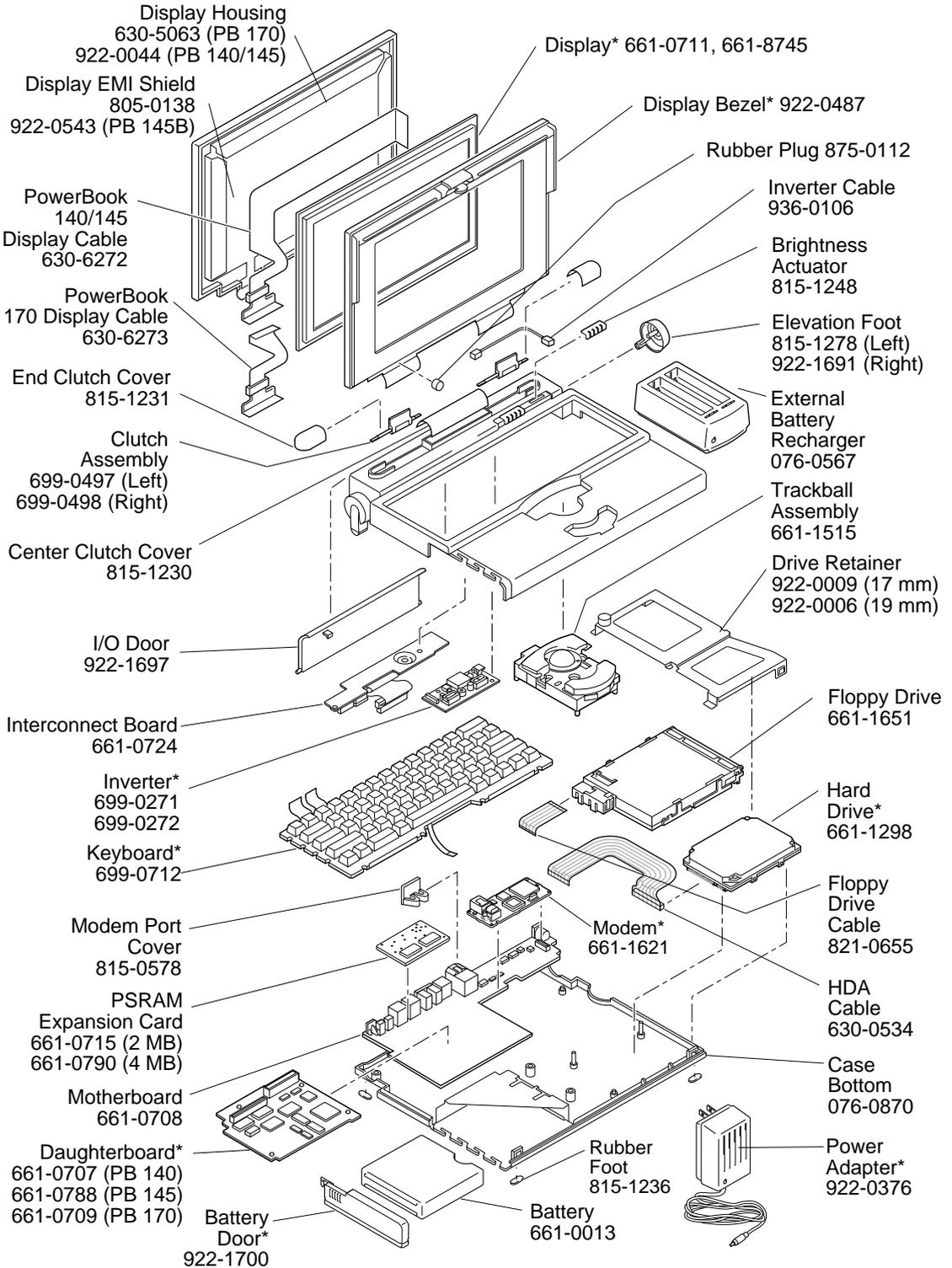
Exploded View

PowerBook 140/145/145B/170





Exploded View



Product family configurations may vary. For parts with asterisk (*), refer to parts list.

PowerBook 140, 145, 170

