

Chapter 1: Introduction

About this document...

This document is the fruit of an eight month love-affair with a PowerBook 170 during which it has shown me joy, delight, and wonder. It has also shown me great pain! Only a few weeks after finally receiving my first Macintosh, after years of longing, I was thrown into a state of despair when my computer stopped working. Panic began to come over me as I realized just how much it could cost to fix a PowerBook with a blown fuse. Gritting my teeth, I gathered up the courage to attempt to revive it myself rather than facing a hefty repair bill. After spending the better part of a day running around trying to find the proper size Torx screwdrivers, I was finally going into the computer.

Amazement filled me as I looked upon the inside of my PowerBook — the power of a Macintosh IIci is crammed into a fraction of the space. As I finished the repair I couldn't help but wonder why something that turned out to be so simple should be so expensive to have a dealer fix. At the same time as I fixed my PowerBook, I was also being introduced to the Internet. The Macintosh portables newsgroup consistently had a message from someone who was having the same problem with their computers and didn't want to pay the large repair bill. After repeatedly relating my solution, I decided to compile the motherboard fuse repair instructions into one simple and concise document, available to all.

That document went through a number of revisions until it evolved into this: *PowerBook: Repairs, Upgrades & Installations V3.0*. No longer is it just dedicated to the PowerBook 1xx series; all models from the lowly 100 to the mighty 540c have their own chapters. Hopefully, the next generation of PowerPC PowerBooks will also find a place in here.

Which Models Does This Cover?

All PowerBooks, including the 100, 140–180c, Duo 210–280c, and 520–540c, are covered by this document. However, the amount of information varies between the models for a number of reasons. First of all, the different *series* of PowerBooks have many structural differences — a Duo 280c is very different from a 180c. Secondly, the only PowerBook I have first-hand, direct knowledge of is a PowerBook 170. While all other models from the 140–180c are very similar to this, my information on the Duos and 5xx PowerBooks is based upon other sources. If I charged \$19.95 for every copy of this document, I might be able to buy myself a Duo to take apart but that's not the case.

Since my information is somewhat limited in many areas, I gladly welcome on comment, criticisms, suggestions and additions to this document. See below for details on contacting me.

The following abbreviations are used to denote various models:

PB 100 = PowerBook 100

PB 1xx = PowerBook 140–180c

PB2xx = PowerBook Duo 210–280c

PB5xx = PowerBook 520–540c

Due to major differences in its design and construction, the PowerBook 100 is not included in "PB1xx," despite its model number.

Some Words of Warning

First of all, make sure you read the disclaimer inside the front cover. By reading this document you agree to all the terms enclosed therein.

Secondly, static electricity eats computers for breakfast! Integrated circuits (i.e. RAM chips, 68xxx microprocessors, etc.) are very sensitive to static charges and can be severely damaged. The following are some precautions and suggestions for keeping your computer safe:

- use an anti-static wrist strap from your local electronics store
- ground yourself by touching waterpipes, large metal appliances, etc. before touching anything inside your computer
- avoid wool clothing, carpets, etc. while working on your computer
- increase the humidity in your work area

What Does This Cost

For starters, this document does not have any sort of "cash" value. It has been suggested that I should find a publisher but I have decided not to pursue any sort of professional distribution of this document for a number of reasons:

1. I know how well shareware works — I'd never see \$19.95 for every copy.
2. If you ask and look, you will find most of this information, for free, on the Internet.
3. All I desire is fame, glory, and world domination. \$19.95 per copy is *not* going to get me that! :-)

But seriously, while money is not my goal in making this document, I would like something in return:

1. Comments, criticisms, and suggestions. This document is in no way complete — I don't own a Duo or 5xx so until I either get one or someone sends me some detailed information, I'll never be able to cover them as completely as a 1xx.
2. Postcard. I have already received a couple, including one from overseas. It's very impressive to me to see a glimpse of where my work has gone and I'll gladly send you one in return.

Acknowledgments

While PowerBook: Repairs, Upgrades & Installations was created by myself, the information contained within comes from a wide variety of sources.

I guess had had better thank my mom first — she bought the PowerBook 170 for me in the first place!

My undying gratitude to David Kimpton, electronics teacher at Sir Winston Churchill C. & V. I. His assistance and insight, along with the use of his service bench, were essential in repairing my PowerBook.

I've never met him, but Rich Wolfson, columnist and author, deserves much thanks for all his technical information that he has written for MacUser magazine. In particular, the disassembly instructions and photos from the recent issues.

A great number of Internet users have given me much assistance with various parts of this document. PowerBook 100: James MacPhail, Brian Banks. Tim Steele, Arnd Grossman, Don Edberg. PowerBook 1xx: Steven Schreppler, Dave Kampf, Christopher Dingman, Darren Trokhan, Michael Kwun, Ulric Wilson, Willie Chang, Wong Teck Lee. PowerBook 2xx: Kim Brennan, Andreas Netzer. PowerBook 5xx: Bruce Toback, Michael Coyle.

The following people have given me a variety of little tips and suggestions that were particularly useful: James Ng, Jon Warms, Sue Godfrey, Bob Wilson, Glenn Eichel.

Great thanks goes out to my beta-testing group for all their assistance in making sure this version was as accurate as possible: Dave Kampf, Glen de Vries, Bryant Ling, Ulric Wilson, George Haynes, Stephen Schreppler, Fr. Photios Dumont, Glenn Eichel, Bharatha Moorthy, Willie Chang, Jeff Carlson, Otto Geisenfled, Tom Hawkins. Not only did they proofread, but they also offered many words of encouragement. Thanks guys, I couldn't have done it without you.

Special thanks to all those who have shared their experiences with me. It has been a great pleasure hearing your words of thanks and encouragement. I've met a lot of wonderful people, received some great postcards, and heard some hilarious stories. Without you people, I would have had no idea whether these repairs worked or not. My thanks for putting your trust in what I had written.

Inevitably, there will be others who have been forgotten and inadvertently left out. My thanks go out to you for all your assistance and please, send me some email to jog my memory and properly thank you. Your absence is not intentional.

Version History

V1.0 - Nov.13/94. What I consider to be the first version of this file is actually just a posting on the newsgroup *comp.sys.mac.portables* in response to an inquiry from another user. It gave a description of how I repaired the fuse in my PowerBook 170.

V1.1 - Dec.6/94 . This was the first official release which I entitled "PowerBook 1xx Installations and Repairs." However, this release only covered repairing a blown motherboard fuse. It included a crude diagram that I drew which pointed out the locations of major parts, like the fuse.

V2.0 - Feb.27/95. Dubbed PB RUI for short, this version included everything that V1.1 was meant to - major repairs and installations, BatterySwapper, and better graphics. The digitized and Postscript images, while a big improvement, drove the size of the file up to about 529K. When packaged with copies of Apple tech notes containing model specifications and some miscellaneous information, took up over 700K. The new images thwarted attempts by ClarisWorks to save the file in MS-Word format so it had to be released in ClarisWorks format.

V2.1 - Mar.5/95. After reworking the layout, I was able to export the file into MS-Word format and also created an HTML version which has since expanded into the "Official" PowerBook Home Page. The new WWW version was denoted with a letter "h" in the version (V2.1h). A note on the internal structure of the PB 165c and 180c was added shortly after the release of 2.1 but the version number was not incremented.

V2.1.1h - Mar.6/95. Added information on Duo RAM cards failing to function properly when installed.

V3.0 - May 23/95. In response to a request from Cary Lu, columnist at MacWorld magazine, for a copy of PB RUI to review, I embarked on the much anticipated update. With a recently purchased copy of Aldus PageMaker at my disposal, I set about producing 3.0 with it. Not only did it get a major visual overhaul, but a variety of technical information was also added and many areas were clarified.

About the Author

Rather than surprise you after you've read this document, I'll warn you now — *I am not a technician!* The only formal education in electronics that I have had is two high school courses! All my information has been gained from personal experience, magazines, books, and, most importantly, the Internet. My sources of information can be found in the Bibliography.

I as for myself, I am presently 20 years old and am enrolled in the Honours Bachelor of Arts program in Psychology at Lakehead University. I am also presently wondering why I didn't major in Computer Science or Electrical Engineering. :-) I have a Grade IX certificate in piano from the Western Ontario Conservatory of Music and am a certified Level II referee with the Canadian Amateur Hockey Association.

My present computer is a PowerBook 170 6/40 which I desperately needs a new hard drive! Previously, I used a Macintosh SE for about four years in high school to do a variety of desktop publishing work and had a brief placement, through school, at an Apple Dealer. I am currently in the process of starting a small desktop publishing and graphic design business. I also work part-time as a cook at Pizza Hut and as a layout artist at a local printing firm.

Contacting the Author

One of the benefits of this package is a lifetime of free technical support (my lifetime, not yours). Any correspondence can be directed to me through the following channels:

- Email:
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- Snailmail:
*David M. Wadson
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Thunder Bay, Ontario
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P7C 1Y7*

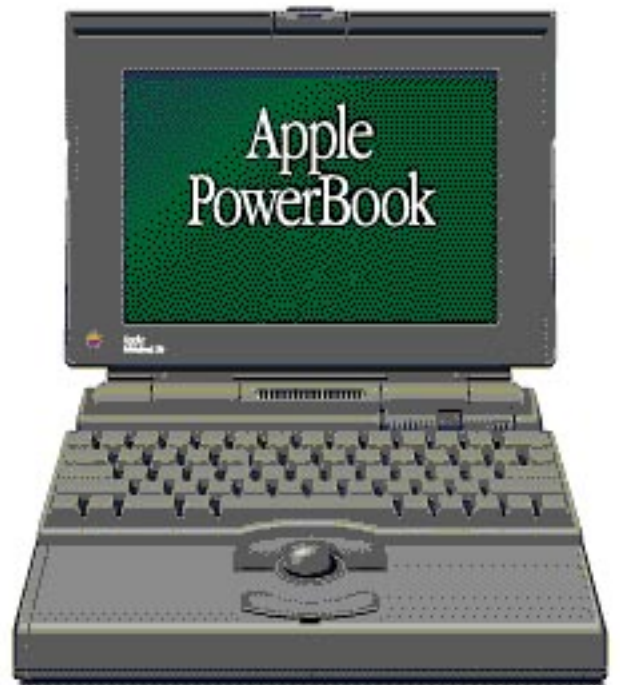
The “Official” PowerBook Home Page

Not content with the Macintosh home pages that were in existence, I have created this “masterpiece” of PowerBook information featuring:

- Apple’s specification sheets
- Usage tips
- Hardware/Software listings and reviews
- Magazine article guides (MacUser, MacWorld, TidBITS)
- Books
- Macintosh WWW links
- Home pages of PowerBook users
- PB RUI
- PowerBook related articles in Apple’s online Technical Information Library
- ...and more!!

Visit this amazing repository at:

<http://flash.lakeheadu.ca/~dmwadson/Home.html>



Chapter 2: PowerBook 100

100

Overview

The PowerBook 100 is much different from the other members of the 1xx family. Manufactured by Sony, it is the only PowerBook using a 68000 processor and has a very different internal structure. Without the floppy drive, there is much more room inside the chassis.

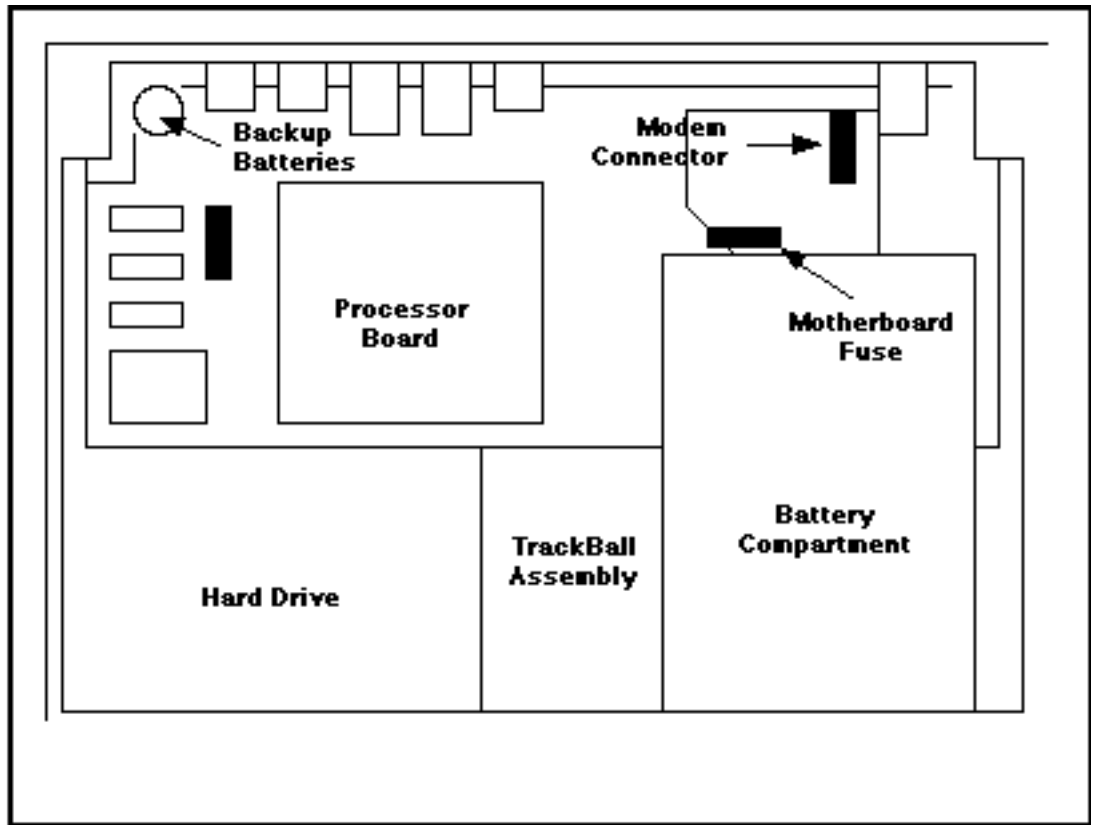
Disassembly/Reassembly

Materials Required

- Phillip's screwdriver
- Jeweller's flat-bladed screwdriver (optional)
- clean towel (optional)

Disassembly

1. Remove the AC adapter, main battery, and backup batteries (see "Lithium Battery") then turn the PowerBook 100 upside down.
2. Gently pry off the three round, rubber "feet" on the bottom of the case taking care not to tear them. They cover the screw heads and can be removed using the jeweller's screwdriver or any similar object.
3. Use the Phillip's screwdriver to remove the three long screws and set them aside (where they won't get lost!).
4. Turn the PowerBook over, making sure to hold it together so that the halves don't fall apart.
5. Open the latch and using both hands, open the screen 180 degrees so that it lies flat. Be careful - though the halves are no longer hinged together, they are still connected by the interconnect cable.
6. The towel can be used to cover the screen to prevent scratching it.
7. Remove the keyboard by lifting the back end slightly and pushing it towards the back of the computer. That will unhook it from the palm rest but it will still be attached by some cables. These do not have to be disconnected - either turn the keyboard slightly and rest it on the left side of the computer or flip it over onto the screen.
8. Carefully remove the palm rest.



Reassembly

1. Replace the palm rest making sure that there are no unusual bulges. Such bulging could indicate that a hard drive is not seated correctly (if you installed one).
2. Carefully reposition the keyboard without stressing the flat cables and hooking the two tabs at the front under the palm rest.
3. Remove the towel from over the screen and carefully engage it with the lower half.
4. Close and latch the PowerBook shut.
5. Turn the unit over, holding it together, and replace the three screws from the bottom.
6. Replace the rubber caps over the screws.

Hard Drive

The PowerBook 100 hard drive is located at the front left of the computer.

Procedure

1. Disassemble the PowerBook.
2. Gently lift up the metal shield to reveal the flat cable connector. Unlock and remove the flat cable (see above).

3. The hard drive has two spring steel brackets attached to it which hold it in place. Use a small flat-bladed screwdriver to bend the right hand ends of the brackets towards the drive, while lifting the right hand end of the drive up slightly with your fingertips. The result should be that the brackets disengage from under the protrusions in the lower case moulding. When both brackets are disengaged, lift the right hand end of the drive up and out; the left hand ends of the brackets should slide out from their sockets and the whole drive should lift out.
4. Very gently pry the SCSI connector away from the drive by inserting a small flat-bladed screwdriver between the black plastic connector on the cable and the black plastic block on the drive. Do not attempt to pull it off using the cable, which could probably be damaged.
5. Remove the new drive from its anti-static and anti-vibration packaging and pack the old drive in it for safe keeping. Fit the new brackets and screws to the new drive. Be very careful to use the proper screws.
6. Installing the new drive is fairly obvious once you have removed the old one. Be sure to fully insert the flat cable with the motherboard connector held fully open, then fully lock the motherboard connector by pressing on both ends simultaneously until the two halves are at the same height. Do not put any pressure on the flat cable itself.

Lithium Battery

The PowerBook 100 has three, user-replaceable backup batteries. Apple recommended types are the Sony CR2430 and Sanyo 2430 3-volt lithium cells, which you can find at most consumer electronic stores. You do not have to disassemble a PowerBook 100 to replace these batteries. The method, with pictures, can also be found in the manual.

1. Save any work and put the computer to sleep.
2. Close the PowerBook.
3. Open the back panel.
4. Open the battery door (located to the right side when looking at the back panel) using your fingernail or similar object to pry it open. It swings out towards the side of the computer.
5. Remove the old cells.
6. Insert the new cells with the positive (+) sides up.
7. Close the battery door and the back panel.

Modem

The modem is connected to the motherboard using a 20-pin socket located at the right side of the PowerBook, towards the rear. No detailed installation instructions are currently available; readers are invited to submit their input.

Motherboard Fuse Repair

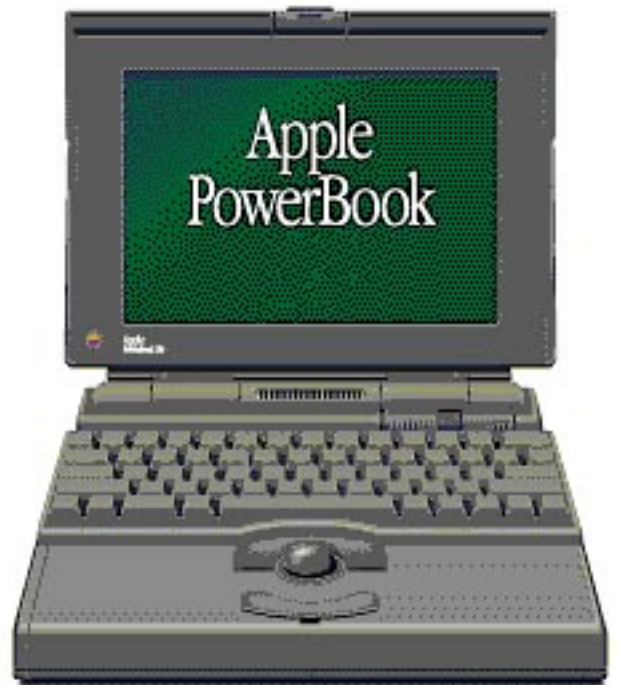
At the rear of the main battery compartment are two gold-plated contacts held in place by Phillips screws. To the left of the left-hand screw is some large print which says "F1 5A." The motherboard fuse is located just above the print. Some machines have a one piece fuse while others have a removable fuse mounted in a socket. I do not have any information on where to obtain another of the replaceable fuses. See the PowerBook 1xx for instructions on replacing a blown fuse — the procedure for soldering in a new fuse is basically the same. There are only a few differences:

1. You won't have to remove any circuit boards or connectors.
2. The PowerBook 100 is more spacious — the Radio Shack fuse should have plenty of room.

RAM Expansion Cards

The PowerBook 100 uses 100ns *pseudostatic* RAM. The chips should be of the type known as TSOP — thin, small-outline package. These chips have a thinner body and shorter legs than regular RAM chips. They are easy identify because they are thinner than the circuit board they are mounted to. It is important to get TSOP chips — some companies use thicker cards which will not fit properly into the PowerBook, causing the case to bulge.

Currently no detailed instructions are available though the method for installing the card would be similar to that of a PowerBook 1xx. Any reader who has performed such a procedure is invited to submit a description of the procedure. It is a 70-pin connector located on the lefthand side of the motherboard.



Chapter 3: PowerBook 1xx

140 • 145 • 145B • 150 • 160 • 160 • 165 • 165c • 180 • 180c

Overview

Since the introduction of the 140 and 170 in 1992, the 1xx series has seen many changes. But even though the details have changed, the basic structure has remained the same. This consistency, coupled with a straightforward construction, has made the 1xx series one of the easiest for the average user to work on.

Disassembly/Reassembly

Materials Required

- Torx T8 screwdriver
- Torx T10 screwdriver
- anti-static wrist strap (optional)
- small container to hold parts (optional)
- clean, static-free work area

General Notes

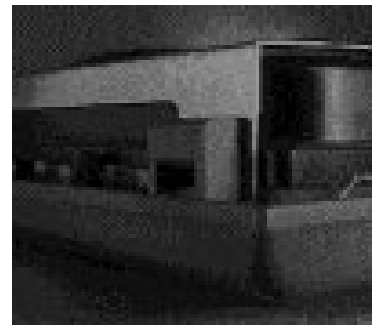
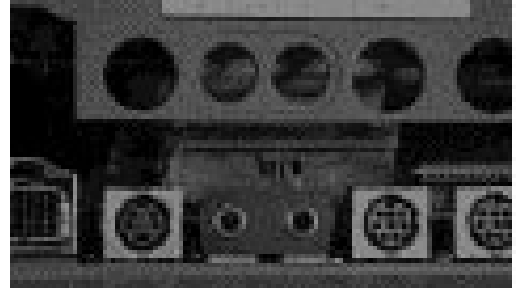
Disassembling a PB 1xx is rather straightforward but there are a few things worth mentioning. The contents of the PRAM and the system date and time are saved in memory which is sustained by a lithium backup battery. This is why your computer still keeps accurate time even if the AC adapter and battery are not plugged into it. However, as you will notice when you open up your 1xx, the backup battery and the memory are on different halves of the disassembled PowerBook. When you disconnect the video connector you are also disconnecting the backup battery so that when you restart, all settings will be lost and the date will revert to Jan 1, 1904.

This is not a major concern unless you have some sort of system extension installed that is regulated by the time. A prime example is a calendar or day planner. If it loads after you reassemble your PowerBook, all your appointments and dates will probably be lost. So when you restart your computer after it is reassembled, hold down the shift key to prevent any extensions from loading. Once it has booted up, the first thing you should do is set the date and time. Trust me, it's very frustrating to lose all your appointments!

Disassembly Procedure

1. Shut down, remove the battery, unplug the AC adapter and turn the computer upside down.
2. Remove the four T10 screws from the bottom of the computer.
3. Holding it together, carefully turn the computer right side up, with the back panel towards you.

4. Open the port door and remove the one T8 screw (by the phone port for the internal modem).
5. Grasp the top half of the case (holding the little legs works good) and lift the back of the case about an inch and a half.
6. Get your head right down and look into the computer. A little ways in, above the ports (audio in and out on a 170), is a rectangular, black connector. This is the video connector, or *interconnect cable*, and must be disconnected by reaching in and prying up both sides of the connector. A thumb on either side works well, using the nails to get the connector apart.
7. With the connector off, you can continue removing the top by lifting it up. At the front of the case, one on either side, are two plastic catches which hold the front together. The male part is on the top half of the computer, the female on the bottom half. Gently wiggle these catches apart as you separate the case.
8. The two halves come completely apart and the side you will not be working on can be set aside.



Reassembly Procedure

1. Starting with the front of the case, align the two catches into position.
2. As the top half is lowered into place over the bottom, these catches should snap into place. Make sure that the front of the case goes together properly.
3. As with the disassembly, get your head right down so that you can look into the back end of the PowerBook.
4. Slide two fingers into the computer and gently push the video connector firmly into its sockets. Push evenly on both sides because if it is pushed together crooked, pins could be bent or broken.
5. Press the back end of the computer together and check all around the computer to make sure that it fits together properly.

6. Replace the T8 screw on the back panel. Be careful not to overtighten as it is very easy to crack the plastic around the phone jack. If you do, SuperGlue has been used by at least one owner to fix such cracking but the plastic is never quite as strong.
7. Carefully turn the computer over, holding the two halves together.
8. Replace the four T10 on the bottom of the computer. Tighten snugly, but not too hard as you don't want to strip them.

Battery Swapper

Description

One of the limitations of using a PowerBook is that batteries, unfortunately, don't last forever. Many users deal with this problem by purchasing an extra battery but changing the battery reveals a serious inconvenience: if you just remove the old battery, the computer will automatically shut itself off, without performing a proper Shut Down — not a good idea. You can always plug in the AC adapter but chances are, there won't be one around (why else would you be running on battery?). With a PowerBook 1xx, your only solution is to quit all your applications, choose Shut Down, change batteries, and finally restart the computer AND all your applications. It's a big inconvenience that 100, Duo and 5xx users don't have to go through — those models have a built-in lithium backup battery which keeps the contents of RAM safe while you quickly and effortlessly swap batteries. Surely, there must be a solution for 1xx owners.

Well, there is. The trick is that when a PowerBook is sleeping, it requires only a minute amount of power from the battery to preserve the RAM contents. If you can supply that power to the AC adapter jack of a sleeping PowerBook, you would be able to change the battery without having to Shut Down. A company realised this and sold a device (PowerSwap) which used a 9V battery to provide enough current to do this and charged as high as \$39.95 for it. Lind and BTI, two of the main PowerBook product vendors have their own models retailing for under \$14.95. But I didn't know about those at the time. So I figured I would construct my own — how hard could it be? Not very, as it turns out.

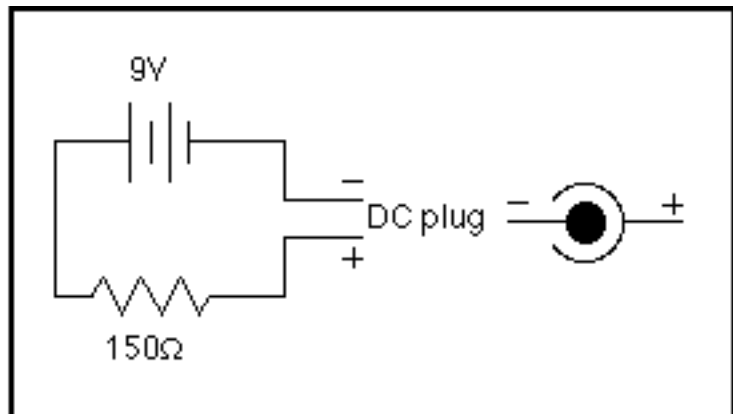
Materials

- 9 volt battery
- 9V battery connectors
- 150Ω resistor
Radio Shack (Canada) #271-1312, 5/\$.099
- barrel-type DC plug
outer diameter: 5.0mm, inner diameter: 2.5mm
Radio Shack (Canada) #274-1568, 2/\$3.29

- or just check with the PowerBook to make sure it fits properly
- heat shrinkable tubing
 - Radio Shack (Canada) #278-8310, 7 assorted pieces/ \$6.99
 - or I'm sure you can get a little piece from an electronics shop
- wire cutters/strippers
- soldering iron
- solder
- wire
- some sort of container to fit it into, if you so desire (and can find one small enough)

Assembly

1. Assemble the parts as shown in the diagram, using wire where necessary. Be careful that none of the wires short each other. It's a good idea to leave the heat shrink tubing off while you assemble it once. Then you can figure out how you want to mount it and where you will need tubing (probably over the resistor and its leads), and the easiest way to get it on.



2. Make absolutely sure that the negative (black) lead on the battery connector goes to the centre of the plug. Double check it with the battery in the connector. If the polarity is reversed the PowerBook has a funny tendency to make a sort of buzzing noise. I'm not sure if it can cause any damage — I yanked it out rather quickly and didn't bother trying to do it again!
3. Mount the assembled circuit in the package of your choice. I settled upon a 35mm film canister. I melted a hole in the lid and inserted the plug through it and, as a 9V battery does not fit completely inside, cut a hole in the bottom for the battery to stick out through. I then stuffed the whole works into the container - crude but effective at keeping the wires from getting broken as the battery connector wires had a tendency to do.

Operation

1. Upon deciding that it is finally time to change the battery, put the computer to sleep. Ideally you should save your work as well, just in case.
2. Plug the BatterySwapper into the AC adapter socket.
3. Remove the dead battery.
4. Insert the fresh battery.
5. Remove the BatterySwapper
6. Wake up the computer and keep on working. With practice, the operation will take less than one minute - a great improvement over a whole restart!

Hard Drives

Description

The PowerBooks all use 2.5-inch hard drives which connect to the computer through the internal HDI-30 SCSI connector. They are available from a number of manufacturers in sizes ranging from 20 MB (very hard to find) to just over 500 MB.

Termination

To conserve power, most drives use a partial termination setup using 1K pull-ups - 1 Kilohm resistors which absorb only the peak of the data wave that reflects back at the end of the SCSI chain. As a result, the pull-ups require less power than full termination, but limit the number of devices you can have in the SCSI chain. A drive which uses this type of termination can will generally be reliable for a chain of no longer than 1.5 feet and no more than one or two SCSI devices.

To get around this, using a pass-through terminator block between the PowerBook and the first SCSI device will reduce the signal reflections from the internal drive and the other devices. Alternatively, if you don't have the pass-through terminator but have a device that can be internally terminated, connect it between the PowerBook and the other devices. Either way, also place a terminator on the end of the SCSI chain.

However, do keep in mind that SCSI is a black art very similar to voodoo and witchcraft. Quite often a few hours of chanting and senseless raving may solve your problem.

Procedure

1. Disassemble the PowerBook.

2. Use the paper loop to gently remove the ribbon cable from the hard drive by pulling directly away from the drive . Be careful not to tear the loop or, more importantly, bend any pins on the connector. Some computers may not have the paper loop — carefully pry the connector straight away from the hard drive.
3. Remove the five T8 screws holding the drive bracket in place. One of them is located under the modem so, if you have one installed, it must be removed as well.
4. The drive bracket locks into the case at the front right corner; it snaps into the back side of the plastic connector that holds the front edge of the PowerBook together. The easiest way to remove it is to use a flat-headed screwdriver and insert it through the plastic connector and push the metal tab towards the hard drive. Using your other hand, lift the bracket off. Quite often the ribbon cable is glued to the bracket so gently fold the bracket onto the left side of the computer, leaving the cable attached.
5. Once the bracket is off, the drive will just lift right out.
6. With the old drive out, simply slip the new drive into place. The two little raised knobs by the floppy drive will sit in two of the screw holes on the bottom of the hard drive, preventing it from sliding around.
7. Replace the drive bracket, making sure it snaps into the connector at the front. Many drive mechanisms are a different thickness than the original Apple drives. Quite often they are thinner and the original bracket will not hold them in place securely. Most drive vendors can sell you a replacement bracket or you can use a few pieces of cardboard as a shim. By using small pieces that only go under the bracket, rather than one that covers the entire drive, you won't have to worry about heat build up.
8. Replace and tighten the five screws that hold the bracket in place. You can replace the modem if you had to remove one.
9. Attach the ribbon cable with gentle, even pressure across the entire connector.



I/O Door

The plastic door covering the I/O ports on the back of a PowerBook 1xx has a tendency to break after a while. A source indicated that Apple will replace the broken door for free but others have said that their dealers wanted to charge for it. My experience getting a defective AC adapter

replaced leads to believe that even if Apple was replacing broken doors, your dealer probably won't have a clue about it. A number of vendors, such as APS, sell a product called the "PowerDoor" for around \$14.95. It is a replacement door with holes cutout for the power button and the telephone jack so you don't have to open the door so much. I suppose you can cut holes in your own door that would serve the same function - I'm thinking of doing this myself.

Generally, when the doors break, one or both of the little plastic hinge pins crack off. The door itself is in one piece but that little tiny bit of hinge will never be glued back on. But you can fix it yourself with a paperclip!

1. Partially straighten a paperclip and grip it in a pair of vise grips.
2. Take an X-Acto knife and trim the broken hinge pin so that the edge of the door is smooth.
3. Look at unbroken pin (if you have one) and note exactly where it is so that you know the precise spot to stick the new pin on the other side.
4. Heat up the very end of the paperclip. I tried a soldering iron, but the heat was too low so I used a propane torch instead. When the paperclip starts to glow red-hot, it is hot enough to melt the plastic in the door.
5. Quickly insert the paperclip a little ways into the door, right where the old pin was.
6. Let it cool and then release the paperclip from the vise grips.
7. Use a pair of wire cutters to trim the paperclip down to size.
8. Use the X-Acto knife again to trim any melted plastic that bubbled up around the new hinge pin.
9. Make sure that there are no bits of the old pin stuck inside the pin hole. If there are, use a sharp pointed instrument to get it out (it usually won't just fall out).
10. Replace the new door. A gentle flex in the middle will help it pop into place. Check for fit and make any necessary adjustments.

LCD Display

Description

The screens are backlight by a *cold cathode fluorescent lamp* (CCFL) which, I have been told, burns with a pink color when it is burnt out. Replacement lamps are also very difficult to find.

Quite a few users have had their LCD screens crack or shatter for a variety of reasons, not necessarily abuse. I have not heard of any screens being replaced under warranty but have heard many cries of outrage when users find out that a new screen costs around \$1,000! Apple does not make LCD screens itself, but buys them from other companies, including some in

the U.S. So theoretically, if you found a maker of screens, you could replace a broken screen yourself. Unfortunately, I don't know which companies or how much a screen would cost.

Disassembly

1. Open the lid of the PowerBook as far as it will go and use some something to support it. A telephone book will work well, especially if you prop up the bottom half of the computer so that the LCD panel lies flat.
2. Remove the two rubber caps which are located on the hinges. Use a sharp, pointed object to carefully pry them off without tearing them. But don't worry if you do - they serve no purpose other than aesthetics. Then remove the two T8 screws under the caps.
3. The top edge of the case is held together like the bottom half of the PowerBook, except that the lid uses four sets of tabs and slots. It takes a little more wiggling to finally get them all to come free but be very carefully not to force it - you could crack the plastic.
4. With the "frame" removed, observe the location of the various wires, in particular, the pair of white wires leading from the right hinge. Notice how they tuck into place so that the case can be reassembled without pinching them.
5. Disconnect the video ribbon cable which leads out of the left hinge. The connector works just like the one for the hard drive cable; pull the little tabs on each side of the connector and the ribbon will be loosened so that it can be removed.
6. Remove the four T8 screws that are at each corner of the screen.
7. With the screws out and the blue foil along the edges of the screen held out of the way, you can lift the entire screen out. It is still attached by the two white wires but they can be disconnected at the plastic connector in the middle of them.
8. The backlight is located at the left hand side of the screen, covered by a long metal cover. It is connected by square rubber connectors at each end. The white wires each go to one end of the backlight so I presume they lead from the dimmer control.
9. The backlight cover is held in place by metal tabs on the back of the circuit board. Three are along the left hand edge of the board, and the others go right through the circuit board. Use a pair of needle nosed pliers to straighten these so you can take off the cover. I would advise not straightening the other two dozen tabs that hold the LCD panel on the circuit board!

10. This was as far as I got in the disassembly process. I did not want to risk breaking the tube by trying to remove the rubber connectors, which would also have required loosening the white wires. But, from what I have been told, the backlight assembly can just slide right out.

Assembly

1. Replace the backlight cover and bend its tabs back into place, using the pliers when necessary.
2. If you disconnected them, now is a good time to reconnect the white wires.
3. Set the assembly back under the blue foil and align the screw holes up. Make sure that the white wires are not caught under the board and then replace the four T8 screws. Be careful not to over tighten the screws.
4. Reinsert the ribbon cable into the white connector and push the tabs back in to lock the cable in place. If you need some slack on the cable, close the PowerBook slightly.
5. Make sure that the white wires are tucked in the proper place, not sticking out of the case. If you are having trouble with your video display, especially after disassembling it, check to see if these are being pinched.
6. Replace the frame starting with the connectors at the top. Lower the bottom into place and make sure the white wires are not sticking out.
7. Replace the two T8 screws at the bottom and cover them with the rubber caps.

Lithium Battery

A variety of settings, including the time, AppleTalk status, startup drive, desktop pattern, etc. are stored in what is called the PRAM. The PRAM is preserved by a 30mAh rechargeable lithium battery. If your computer starts having trouble keeping the correct time or does not retain Finder settings, chances are the battery needs replacing.

Procedure

1. Disassemble the PowerBook.
2. The battery is located on the top half of the PowerBook, next to the speaker. It has clear plastic disc glued to the top of it which is removed by just



pulling it off. The metal contact across the battery appears to be either glued or soldered to the battery. Seeing as my battery functions properly, I did not attempt to remove the battery to avoid damaging it. This information will be added when available.

Modems

Description

The motherboard includes a 20-pin dual in-line socket connector for a variety of modems made by Apple and third-party companies.

Removal

1. Disassemble the PowerBook.
2. Remove the two T8 screws that hold the modem in place.
3. Using firm, steady pressure by the connect, carefully remove the modem from the socket.
4. Reassemble the PowerBook.

Installation

1. Disassemble the PowerBook.
2. If this is the first time installing a modem, there will be a plastic cover on the back panel that covers the hole for the phone line. Remove this to avoid having trouble plugging in the phone line.
3. The modem connector is at the back right hand corner of the PowerBook, by the AC port. Connect the modem in the same manner as any other board: apply firm yet gentle pressure across the entire connector.
4. Install the two T8 screws, one at each end of the modem.

Motherboard Fuse Repair

Description

A PowerBook with a blown motherboard fuse is a rather confusing situation for even with a blown fuse, the computer will still operate under certain conditions. If the computer has both the AC adapter plugged in (to the computer, as well as an AC outlet) and the battery installed, it will run properly. As soon as either the adapter or the battery is removed, the computer will turn itself off.

The most common cause of a blown fuse is the AC adapter, model M5140, which originally came with the PowerBooks 100, 140 and 170 (occasionally with other models). The tip that plugs into the back of the PowerBook has a ring of black plastic insulation that would crack. When plugged into the computer, *whether or not the adapter is plugged into AC*, would blow the motherboard fuse. Apple has acknowledged this defect and will replace any defective adapter, free of charge. Only recently has Apple announced that any motherboard, blown by a defective M5140 AC adapter, will be replaced.

But, if your fuse has been blown by something else (it is possible), your options are more complicated. Apple will “fix” (i.e. replace) such a motherboard for around \$400. The original reason that this document came about was to detail how you can replace the fuse yourself for much less than \$400. Even if you don't want to do the repair yourself, you can have someone more experienced, like an electronics technician, do the repair for you. It is much cheaper to pay \$40–\$60 in labor than to buy a new motherboard. Just remember, Apple can (and most likely will) refuse to service a computer that has been modified by someone other than an authorized repair center. Check your adapter, and with your dealer, before resorting to fixing it yourself.

Finally, read *all* the instructions, regardless of which type of fuse you are using, before you start the repair or even buy the parts. Know what you want to accomplish before you start anything.

Materials Required

- Torx T8 screwdriver
- very small soldering iron (not a gun!)
- rosin-core solder (not ACID!)
- wire (if using DigiKey replaceable fuses)
- heat shrink tubing (if using DigiKey replaceable fuses)
- wire cutters/strippers
- anti-static wrist strap
- 5A, 125V fuse

Replacement Fuses

The original versions of this repair used a standard 5mm x 20mm, barrel type fuse and a holder:

- 5A, 125V, 5 x 20mm fuse
 - Radio Shack (Canada) #270-1248, 2/\$1.99
 - Radio Shack (USA) #270-1056, 4/\$1.99
- in-line fuse holder
 - Radio Shack (Canada) #270-1238, \$2.99
 - Radio Shack (USA) #270-1238, \$1.59

This fuse worked perfectly for me but the only problem is that this fuse and holder are quite large. Space is at a premium inside a PowerBook and I was just able to fit the fuse in place. An alternative is to use a fuse from *DigiKey*, a specialty electronics company.

- 5A, 125V fuse ("micro 5A 273")
Model #F873, 5/\$10.34
- fuse holder
Model #F0615, 5/\$6.87

- DigiKey
701 Brooks Ave. South
P.O. Box 677
Thief River Falls, MN
56701-0677
(800) 344-4539
Fax: (218) 681-3380
Customer Service: (218) 681-6674

The fuse *and* holder together are smaller than the 5mm x 20mm fuse and is faster acting. But, as you can see, they are also much more expensive AND there is a \$5 service charge on all orders under \$25. So while you will have a much smaller fuse, you will pay about \$15 more. I have had no trouble with the Radio Shack fuses not blowing quick enough. Whichever fuses you decide to use, either will work.

I have also received feedback on another DigiKey fuse that can be used:

- 5 Amp 125V
Model #F1172, 5/\$5.34

Dave Kampf actually removed the old fuse from the motherboard and soldered this one directly onto it. While it is a option, I am inclined to recommend against it as even I am wary about pulling components off the motherboard — the possibility of error is increased. As well, such a fuse is not easily replaceable like the other options are if you happen to blow the fuse again. If you do feel so inclined to remove the old fuse completely, I would still recommend using the replaceable fuse and holder. That way if the fuse does blow again, replacing it will not require any soldering.

About Soldering

Performing this procedure requires a basic knowledge of soldering which I am not about to give a lesson on. If you have never used a soldering iron before, I recommend that you either have someone more experienced do the repair or learn how to solder on something less expensive. Even for an experienced solderer, the following points are worth mentioning.

Soldering a circuit board as complex as a PowerBook's is a very delicate task. The key to success is having a soldering iron with a sharp tip that allows you to direct precisely where you want the heat to go. There are other components close to the fuse that you do not want to accidentally melt with a

blunt iron. With regards to the heat, only have the iron near the board as long as necessary to melt the solder. The heat radiating from it could affect nearby components if left there too long — get in, do the job, and get out.

Cleanliness is very important when working with solder. You definitely do not want any bits of hot soldering dripping off the end of the iron onto the motherboard — try to use as little as possible. Before you bring the iron near the board, use a piece of steel wool to scrub the tip, removing an excess solder. Touch the tip of the iron to a ground *everytime* before touching it to the circuit board to discharge any static electricity. Alternatively, use a grounded soldering iron.

If you need to add solder to the logic board, try to use a very little. Only a small amount is needed to hold anything in place and extra solder could flow into other components.

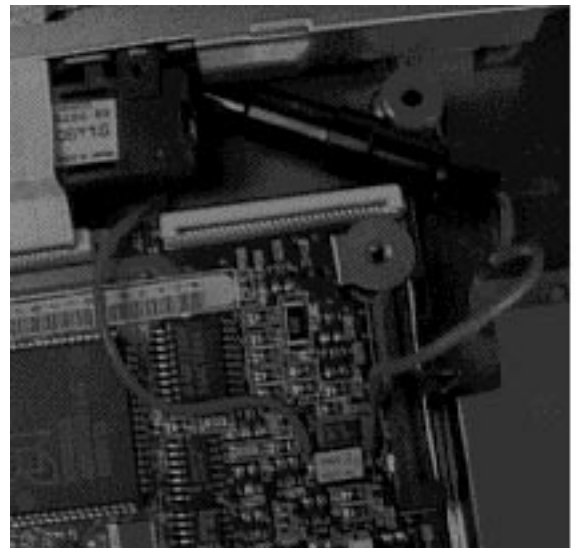
Preliminary Procedure

1. Disassemble your PowerBook as instructed above, taking all precautions regarding static electricity.
2. Remove the RAM card as explained in RAM Expansion Card section.
3. The daughterboard is held in place by four T8 screws, one towards each corner of the board. Remove these and set them aside.
Note: The PowerBook 165c and 180c have an extra *cousinboard* that sits on top of the daughterboard. It might have to be removed to get at the screws holding the daughterboard in place. Remove it in a similar fashion as the daughtercard (see below).
4. Removing the daughter board like you removed the RAM card, paying close attention to where the connector is and where you apply pressure to the card. Replacing the daughterboard will cost you quite a lot if you happen to damage it! Again, be careful not to bend any pins but the tricky part about removing this board is that the screws you removed also hold the motherboard to the case. You must apply downward pressure on the edge of the motherboard, by the connector, in order to get the daughterboard out. Use care and this should go without any trouble.
5. With the daughterboard removed and set aside, you will have clear view of the motherboard. The fuse is located (with the back of the PowerBook towards you) near the upper left corner. It is a small white square, labelled 5A 125V which, if you are having trouble finding it, is below the two metal battery contacts.
6. You can verify that the fuse is blown using a digital voltmeter if you have one.
7. While the entire motherboard could be removed and the bad fuse removed, we will leave it in place and solder the new one directly over it — it's much easier and safer.

8. The hard drive ribbon cable connects to the motherboard through a white plastic connector. Remove the cable from there by gently prying up the two little tabs on the sides of the connector. They don't come up very far - just enough to loosen its hold on the connector. The new fuse will go in the open space underneath this cable.
9. Follow either Method A or Method B below. Make sure you have read the *About Soldering* section above.
10. With the holder tucked into position, insert the hard drive cable into the connector, making sure it fits firmly. Tap down the top of the connector to lock the cable in place. If you experience trouble getting the hard drive to appear on the SCSI chain, adjusting this cable is a good place to start.
11. Carefully insert the daughterboard back into its connector. Make sure no wires you added are caught between it and the motherboard.
12. Insert the screws and carefully tighten them, watching that you don't over tighten them. Reinstall the cousinboard, if you have to remove one.
13. Reinstall the RAM card.
14. Reassemble the PowerBook

Method A — 5mm x 20mm Fuse

- a1. Being careful to touch the hot iron *only* to the old fuse, heat the solder there and attach one lead from the in-line fuse holder to each side of the fuse. You may need to add a little solder but be careful not to drip any elsewhere on the board. Remember, there will be very little, if any, strain on the wires so little solder is needed. Also, you may want to trim the wires somewhat to remove any excess (after you read the next step you'll understand exactly what I mean).
- a2. The only available spot to put the in-line fuse holder is underneath the hard drive ribbon cable. The diagram indicates exactly how it is placed. The fuse cannot protrude very far out of the cable as the trackball assembly occupies much of the open area at the top of the computer. But don't worry if the fuse



sticks out a little - it has to - as there is just enough extra space to fit it. As long as the fuse (and its wires) are tucked in tightly it will fit fine. Lead the wires from the connector around each side of the hard drive connector.

- a3. Insert a new fuse into the in-line holder and screw it shut.

Method B — DigiKey Replaceable Fuse

- b1. Gently remove the two metal legs from the white, plastic holder. This will allow you to solder them without melting the holder.
- b2. Rather than soldering the holder directly onto the motherboard, we will place this fuse underneath the hard drive ribbon cable. It will be protected there. Cut two pieces of wire that will reach from each side to the fuse, between the hard drive and floppy drive ribbon cable connectors and underneath the hard drive cable.
- b3. Solder a wire to each leg of the holder. Use a pair of needlenose pliers or a small vise to hold the legs. When the wires are attached, insert the legs back into the holder. It is easier to do this if you insert a fuse into the holder and then insert the legs. Be sure to remove the fuse when you have the legs in place.
- b4. Cut two pieces of heatshrink tubing just large enough to cover the two legs of the holder and any exposed wire. Slide them up the wire and right up to the holder so that no wire is exposed.
- b5. Use a heat source to shrink the tubing. But be careful! It is very easy to melt the holder! I should know... :-)
- b6. Being careful to touch the hot iron *only* to the old fuse, heat the solder there and attach one wire from the fuse holder to each side of the fuse. You may need to add a little solder but be careful not to drip anywhere on the board. Remember, there will be very little, if any, strain on the wires so little solder is needed.
- b7. Insert a fuse into the holder and tuck it under the hard drive ribbon cable. By leading the wires across the board and between the floppy and hard drive ribbon cable connectors, you don't have to worry about getting in the way of the trackball assembly.

RAM Expansion Cards

Description

With the exception of the 150, the PowerBook 1xx series uses *pseudostatic RAM*. The 140—145B require 100ns RAM and the 160—180c require 85ns RAM. Unlike a desktop computer, which uses *dynamic RAM*, PowerBook RAM uses much less power.

The chips should be of the type known as TSOP — thin, small-outline package. These chips have a thinner body and shorter legs than regular RAM chips. They are easy identify because they are thinner than the circuit board they are mounted to. It is important to get TSOP chips — some companies use thicker cards which will not fit properly into the PowerBook, causing the case to bulge.

The PowerBook 160 and 180 have a screw inside that will grind against a RAM card if they do not have a cutout in the board. As well, their RAM expansion boards should be thin enough so that they do not get in the way of the CPU's foam heat sink — it must touch the bottom of the keyboard.

The PowerBook 150 uses 85ns *self-refreshing DRAM*, the same as that used in the Duos. This requires a special adapter that is often, but not always, included with the RAM card. A special bracket is also required to keep the board stable. Some RAM cards have capacitors between the chips which get in the way of this brace, potentially damaging them. This can be corrected by cutting V-shaped wedges into the brace.

Some memory boards for the 150 include the adapter but not the brace. You can buy the PB150 Memory Adapter Kit (part #M3179LL/A) for about \$11 from Apple. It includes the brace and adapter which can be discarded if your board includes one.

Removal

1. Follow general disassembly instructions.
2. Be especially aware to take adequate static precautions.
3. Look closely at the card so that you are aware of exactly where the connector is. This is where all pressure on the card must be placed! If you grab the wrong end of the card, you could crack the it.
4. Making sure to hold the card on either side of the connector, carefully, yet firmly, lift the card out. The connector will probably be a very snug fit and might require a little bit of wiggling and prying. Just remember to be careful not to lift any one side much further than the other so as not to bend any of the pins. I will stress it again: make sure you lift close to the connector!

Installation

1. Line up the male and female sections of the connector. It is polarized so that it will only go in one way. You really only need to double check on a 2 MB RAM card - larger sizes would stick past the back of the case if you somehow got it connected backwards!

2. Apply firm, yet careful, downward pressure on the card, directly above the connector. Again, you want to be very careful not to press on an unsupported part of the card - you will crack it. Make sure that the pressure is directly above the connector.
3. Be sure that the card is seated completely in the socket.
4. Some RAM cards require a piece of protective plastic or rubber to be placed on it to prevent any contact with the metal lining of the PowerBook's case which can short the card. Ask the dealer/manufacturer before you accidentally toast it!

Troubleshooting

1. If, after reassembling the PowerBook, you get a series of musical tones and a sad Mac screen with various number codes, chances are that it is a problem with the RAM card. While it is possible that the RAM card is damaged or defective, it is probably just not seated completely in its socket. Open up the PowerBook and give the card a good firm push down in its socket (being sure to push directly above the connector). Hopefully the card is not damaged and works fine after this adjustment.
2. If the card you have installed gives you greater than 8 megabytes of total RAM, be sure to turn on 32-bit addressing in the Memory control panel. It is amazing how many people forget to do this and wonder why they can't use all the memory they just installed!

Trackball

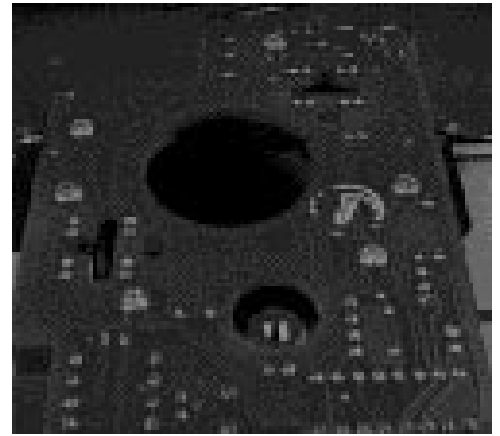
Description

A number of users have been having trouble with the buttons on the trackball. They have a tendency to stop functioning properly - they offer no resistance when pushed and no longer "click." If the warranty has expired, this can cost \$100 or more for Apple to fix (i.e. replace). Fortunately, like the motherboard fuse, it can often be fixed by the user.

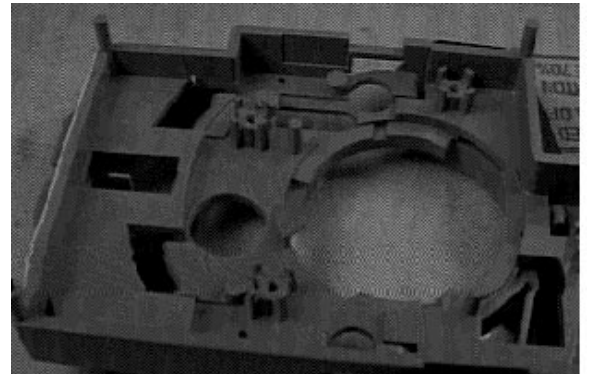
Procedure

1. Remove the retaining ring and the trackball.
2. Disassemble the PowerBook and set the bottom half aside, the trackball assembly is located on the top half.
3. There is a small ribbon cable attached to the trackball assembly. Detach it by pulling up the little tabs on the white connector. This will loosen its grip on the cable so that it can be pulled out.

4. There are three pairs of screws. Remove the two screws on either side of the large hole that goes through the assembly. Once they are removed, the entire assembly can be taken out of the top half of the PowerBook.



5. Remove the other four T8 screws.
6. Carefully separate the three parts: the grey chassis, the black roller assembly, and the circuit board. Set aside the circuit board and black roller assembly.

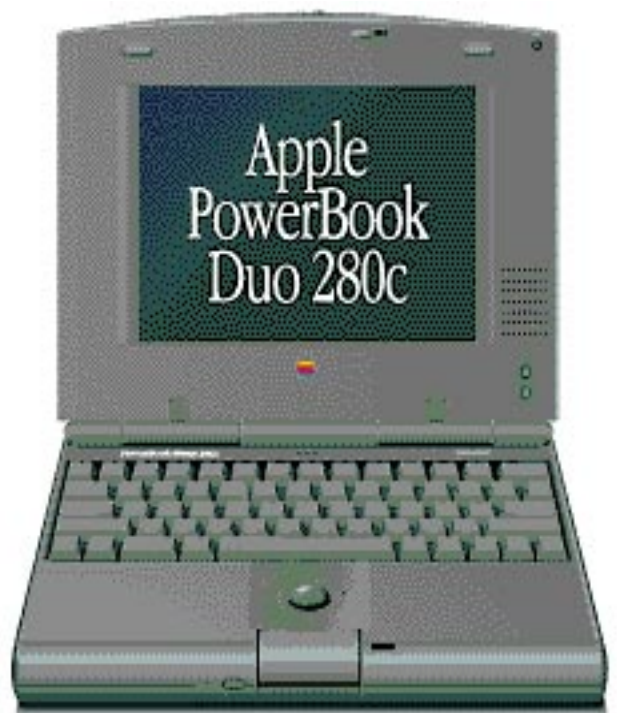


7. On the underside of the buttons, there are four round textured posts. These are the undersides of the plastic springs for the buttons and when one comes loose, the button will not work properly.
8. Put a drop of SuperGlue under the loose post and hold it in place until the glue hardens. If you like, you can put a drop at the base of the other posts as well.
9. Put the black roller assembly and the circuit board back in place.
10. Replace the four screws that hold the assembly together.
11. Drop the trackball unit back into the top half of the case.
12. Replace the two screws which fasten the unit to the case.
13. Insert the ribbon cable into the white connector and push down the tabs to lock the cable in place.
14. Reassemble the PowerBook.
15. Replace the trackball and retaining ring.

Comments

Some differences have been found in the construction of the trackball assembly. Most notably are the following comments from Dewey Markham, Jr.:

“The article described four springs as part of the button assembly, but in my 180 I found not a one. My investigation seems to have found that the trackball buttons do not bounce back because of springs beneath them; its a matter of the plastic button supports having been molded and affixed to the assembly in such a way as to force them to spring back up after being pressed down, the way a plastic knife will spring back straight after being flexed. I had been doing a lot of long scrolling the past few days, and it may be that the continual pressure on the lower button took some of the flex out of the plastic button supports. (There ‘is’ a spring in the electronic contact beneath the button which controls mouse drags, but it is only sufficient to release the contact itself, not raise the button pressing on it.) Having carefully — very carefully — flexed the plastic support back out, everything appears normal. ”



Chapter 4: PowerBook Duo 2xx

210 • 230 • 250 • 270c • 280 • 280c

Overview

The PowerBook Duo has some significant differences from the 1xx series but for our purposes, let's just say that while some things are easier, others are much more difficult...

Disassembly/Reassembly

Materials Required

- Torx T8 screwdriver
- flat-bladed screwdriver

Procedure

1. Turn the computer upside down and remove the four T8 screws. One of them, the one holding the trackball, *may* be longer than the others.
2. Holding it together, flip the computer over.
3. Open the display.
4. Gently lift out the keyboard which is still attached with two ribbon cables. For installing memory, the cables can be left attached and the keyboard flipped over onto the palm rest. Otherwise, disconnect the cables by gently pulling out the two tabs on each side of the connector which will loosen the cable so it can be pulled out.
5. **Stop here if you are only installing RAM.**
6. With the flat-bladed screwdriver remove the two hinge (clutch) covers. They slide on and off, so insert the blade between the center piece and the end piece and *pull* the pieces off. Don't pry! It will take lot of force to remove these (at least the first couple of times) and they are easy to break. However, they are replaceable (Part Number 076-0063) but your dealer will know what you've been up to!

From this point, I have two different sets of instructions (first steps are a combination of the first halves of the two sets). Unfortunately, without a Duo I don't have firsthand experience with either and as such have included both:

For the record, Rich Wolfson, PowerBook Technical Guru, recommends not going any further and getting a technician to do anything else.

Method 1 (by Kim Brennan):

7. With the hinge end pieces removed you can now remove the top cover. Begin at the left (where the battery was) and separate the top from the bottom. Work clockwise. When you get to the back, you may find it easier to move the lid back to a near horizontal position.
8. With the lid off you can now remove the remaining screws, cables, etc. Don't forget the Microphone that is in the middle of the titanium frame! There are 5 or 6 (I think) screws, plus cables to the watch batteries, screen, hard drive, trackball, lid switch and microphone. For some of these you may find it easier (microphone and watch batteries for example) to leave the cable attached and move the item itself around the frame.
9. Your object is to detach the frame from the mother board. With all the screws out and cables moved out or around (hard drive pulled out for sure) you can now lift the frame (the screen is still attached to it) off the motherboard. This will seem harder than it really is, as the connectors on the back are inserted into the back of the bottom cover.
10. You've now disassembled your Duo into its component parts. Don't panic. You can now access the modem board. Reassembly is the reverse process. Go carefully and you will have it all back together again.
11. If you have a Polaroid camera and feel queasy about this process, you might want to take photos of the Duo at each main step so that you have a reference to look at when you are putting it back together.

Method 2 (by Rich Wolfson):

7. You need to remove the center clutch cover. Close the Duo and locate the cover directly over the 152 pin connector on the back. There is a ribbon cable under it (on the left side looking at it from the back) so it is important to be extra careful (have I scared you yet?) as you use the screwdriver to pry up the right and left side and then gently pull the cover to the right (as you're looking at the back of the unit) to remove it. You can't pull it straight up as the ribbon cable snakes under the left side. A QuickTime movie of this operation would be nice here.
8. Fold the display all the way back and get a support ready (1/2 inch book does nicely) to hold the display to prevent stress on the cables when you release it. Remove the two T8 screws (one on each side) holding the display mounting clips and remove the clips. Carefully lift the display legs out of the holes in the case stiffener and move it slightly back being especially careful to be sure the display is supported. The cable is delicate and difficult to obtain and replace.
9. The top case is secured by a snap at the lower left corner of the case (as you would be looking at it in use) and four interlocking tabs along the right bottom palmrest edge. If you don't release

the four case tabs, you could break the top case. Raise the bottom left corner of the top case and release the case snap by pressing slightly inward. Slide the top case to you, off the four locking tabs to remove it. If you don't force anything you should have no problem here.

10. Now you can see everything. The drive and trackball are accessible and it's easy to see how they come out. To install a modem it looks like you'll need to actually take the logic board completely out. I think my recommendation is going to be to have an Apple tech do this as the case stiffener and motherboard has to come completely out. This may not be the case but I've yet to see a Duo modem. So when those appear we'll see what's necessary.
11. Close up in the reverse order. It's my recommendation that you test everything before you replace the clutch (hinge) covers. Be especially careful with the middle one. It takes lots of pressure to snap it back and the ribbon cable is right there. The lower trackball button will not function until the case is secured, so if you test it before you replace the bottom screws, don't be surprised. Above all, be careful and do not over tighten the bottom screws - that will flex the keyboard, restricting key movement.

Keyboard

Overview

Many owners of 2xx series PowerBooks have complained about problems with keys not working properly. The following procedure, by Andreas Netzer can possibly alleviate some of the trouble.

Thanksaying and Disclaimer

This fix is only the long version of a tip in a thread in comp.mac.portables that I tried out after hesitating for some time. I have to say thank you to those people on the net, who came up with the idea. Their names I do not remember but their wits saved me the price of a Rev.E keyboard. I only dared to do so, after my shift and backspace keys went home. I was however very surprised, when I saw, how swift and easy it is...

It has been suggested that the addition of a thin piece of cardboard under the keyboard (with appropriate holes for screws, etc.) helps a lot in stiffening the rather thin and unstable metal foil underneath pre-Rev.E keyboards.

Read this guide through once, before you decide to try it out. Clearly, I cannot take any warranty for it, but I was very impressed with how easy it worked, when I tried it myself. Apart of disconnecting the keyboard-cabling from the motherboard of the Duo and cleaning the area around the shift-lock LED, there are no sensible steps involved, and even these can be dealt with.
Andreas Netzer (anetzer@magnet.at)

Tools Required

- a flat dry wooden table of at least 1 sqm
- Torx T8 Screwdriver
- One small flat bladed jewelers screwdriver or a pocket-knife
- A small dry and clean painters brush or a small sponge
- A clean and dry piece of cloth
- A solution of water and mild detergent
- Eventually a print-out of a screenshot of the Keyboard-DA

Removal of the Keyboard

1. Shut down the Duo, latch the cover and turn it over.
2. With the T8 Torx screwdriver remove the three screws in the bottom of the Duo that form a symetrical triangle (NOT the one, that lies underneath the Trackball!). Pull the screws out, place them in a glass, or other container, and put them aside.
3. Open the Duo slowly (still upside down). The keyboard will come free but will have two ribbon cables still attaching it to the inside of the Duo. Holding the keyboard outside its recess, turn the Duo around, open the lid completely, and carefully tilt the keyboard towards you, so that it comes to lie - upside down - on the palm rest of the Duo.
4. The keyboard is fastened to the Duo with two connectors which have latches on their right and left side. These latches are very delicate and have to be pushed out about 3-5 millimeters straight back towards the screen hinges with the jewelers screwdriver or pocktet knife. After releasing these (two times two, equals four!) latches, the keyboard cables should come free and can be pulled out of the connectors.
5. With the latches left pulled out take out the keyboard and close the Duo and put it aside.

Disassembly of the Keyboard

1. A single keycap can be removed (and the re-placed) very easily without any tool, just with your fingers). Remove them in an order and one after the other and place them on the table in the

- order they were arranged on the keyboard. Place them in a distance in front of you, so that there is still some working area left for cleaning the keyboard circuitry.
2. Under the keys you will find a rubber-sheet which provides the keys with their pressure resistance. Remove this sheet and eventually take the opportunity to brush it clean with the paintbrush or sponge and the detergent solution. When cleaned, place it aside.
 3. Under the rubber-sheet two transparent foils (“mylar sheets”) imprinted with the keyboard circuitry appear. They look like overhead sheets with a funny metallic doodle-mosaic. These foils have extensions which form the flat cables that connect the keyboard to the motherboard. These cables are passed through to slits in the keyboard base. Be VERY careful when pulling these cables out of the slits, so you don’t harm the imprints on them! Place them onto the table with those sides up, that are touching each other, as they are in position in the keyboard.
 4. When you succeeded in removing the two foils (You don’t have to remember their order for reassembly, it is self-evident!), eventually brush the base of the keyboard and put it aside.

Cleaning the Keyboard Circuitry

1. The imprinting on the foils forms contacts on their adjacent sides, that are closed, when a key is pressed. These contacts are susceptible to dirt and possibly even oxidation. Using a moistened sponge, clean the foils on both (but ESPECIALLY the adjacent) sides. As you should exert enough force to remove the dirt, rub the foils with gentle force, but be very careful into the area surrounding the shift-lock - LED that is glued onto the upper of the two sheets!
2. Clean each side twice, you don’t want to repeat it too soon.

Reassembly

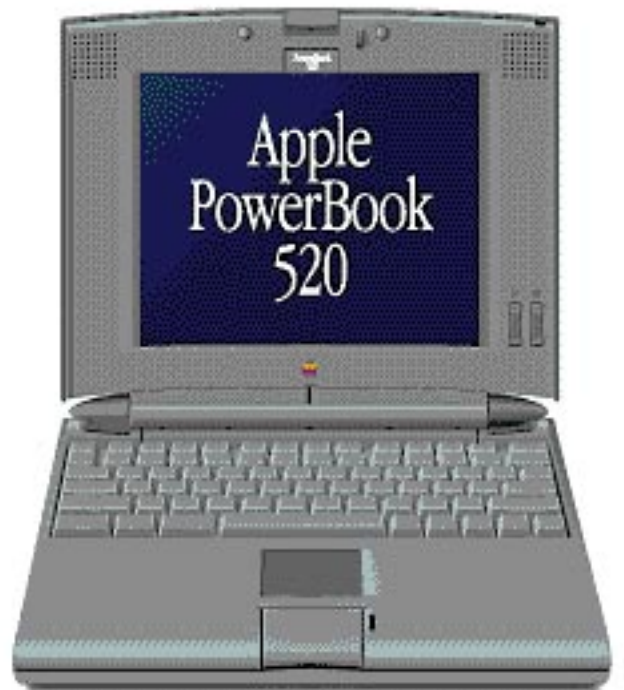
1. When the contacts are cleaned you reinsert the cables into the slits in the keyboard base and put the foils into position. MIND that the foil with the LED on it, is the upper one. Apart from that, you can’t put them in wrong. Now you replace the rubber sheet and reinsert the key caps. It should be no problem to turn on the Duo with the keyboard missing, to have a look at the keyboard DA just using the trackball... (But DON’T FORGET to shut it down before re-cabling the keyboard!). Some of the key caps have metal guides attached to their bottoms. Insert these into their counterparts in the keyboard-base during the process of replacement.

2. Now you place the Duo in front of you again, unlatch it, place the keyboard on the palm rest, so that it can be tilted back into the keyboard-recess nicely (upside down and number keys to your stomach!). Make sure that the latches on the cable-plugs on the motherboard are still pulled out. Gently reinsert the cables into their plugs and - fastening them there with one finger! - push the latches in again. Slip the keyboard in place then close and latch the lid.
3. Turn the Duo upside down and replace the three screws. Don't fasten them too tight, because that again might lead to unresponsiveness of the keyboard!
Pronto!
4. Turn the Duo back up again, open it and turn it on to try out, if everything is fine again...

RAM Expansion Cards

The PowerBook Duos use 85ns *self-refreshing dynamic RAM*, a low power version of the standard DRAM found in desktop Macs. The chips should be of the type known as TSOP — thin, small-outline package. These chips have a thinner body and shorter legs than regular RAM chips. They are easy identify because they are thinner than the circuit board they are mounted to. It is important to get TSOP chips — some companies use thicker cards which will not fit properly into the PowerBook, causing the case to bulge.

No information on the installation procedure is available at this time.



Chapter 5: PowerBook 5xx

520 • 520c • 540 • 540c

Overview

The much anticipated "Blackbird" PowerBooks were a greatly needed overhaul to the PowerBook line. Along with PCMCIA support, dual batteries, 68LC040 processor, and a unique trackpad, this series also has very unique, and often difficult, procedures.

Disassembly/Reassembly

Overview

Installing RAM is a simple procedure in a PowerBook 5xx but as for everything else...here's a little story...

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PowerBook Puzzle

by Mark H. Anbinder, News Editor <mha@baka.ithaca.ny.us> Director of Technical Services, Baka Industries Inc.

Apple designed the original Macintosh as a closed box that the user would never need to open. All the ports were outside and easily accessible; even the battery could be changed from outside. (Of course, from day one, daring owners opened their Mac cases anyway.) When the Mac II arrived in 1987, we cheered Apple's return to an easy-to-open case with easily-accessible slots and devices. Unfortunately, the recently-introduced 500-series PowerBooks make even the intricate Duo look like child's play.

Recent discussion on Global Village's OneNet support forum have focused on the difficulty of installing a PowerPort/Mercury (the new 500-series model) into one of the new PowerBooks. For example, one installation took two hours in the dealer's service department, and the customer was charged at a fairly high labor rate for the full time. It's easy to chide Global Village for making the modem difficult to install, but it's not their fault. It's even tempting to complain that the dealer shouldn't charge for their learning curve - but who should pay for the technician's valuable time?

Unfortunately, the new PowerBooks are much more difficult to take apart than previous models. Some press coverage has described how easy it is to open the machine, but that's only part of the story.

In fact, the keyboard can be released by removing two screws from the underside of the PowerBook. Once that's done, it actually is fairly easy to install a memory upgrade. Hypothetical future PowerPC-based daughterboard upgrades shouldn't be too difficult to slide in here, either.

The modem poses the most difficulty. One part of the modem goes in the easy-to-reach area under the keyboard. The other part goes in the back of the computer where the telephone jack must live - and getting there requires taking apart virtually the entire PowerBook. Just reading how to accomplish the procedure takes noticeably longer than performing the entire modem installation on a 100-series PowerBook.

Global Village says their technicians have performed quite a few installations, and have the process down to about an hour. One service technician of my acquaintance spent nearly four hours, making sure to carefully set everything aside for easy retrieval and making sure everything went back in the right place.

Even more so than for previous PowerBook models, we highly recommend that owners of the new PowerBook 500-series models have installations done by an experienced service technician. Daring owners might find their installation attempts thwarted anyway; the required Torx 8 screwdriver bit must be longer than most, or it won't fit in the recessed screw-holes. As it happens, that may be the least of the difficulties; since Apple doesn't want anyone but service technicians inside these PowerBooks, Global Village doesn't even provide installation instructions in the box. They have instead mailed detailed instructions to their dealer base. Obviously we can't carry around something the size of a Macintosh II just to get modularity. (The Macintosh Portable just leapt clumsily to mind, unbidden and overweight.) We would hope, however, that Apple could develop its next generation of PowerBooks with some semblance of accessibility in mind. If not for the sake of daring owners, how about for the sake of those poor service technicians?

Information from:
Global Village tech support

Materials Required

- Torx T8 screwdriver (not the interchangeable kind!)

Disassembly

1. Turn the computer upside down and remove the two screws underneath the keyboard, nearest the center label.
2. Turn the PowerBook back over and remove the two screws on either side of the serial number plate under the back cover (I/O door).
3. With the screws out, the front of the keyboard will lift up (you may need to use your fingers or a flat-bladed screwdriver). By pulling the keyboard forward, it will come free from the back of the case. It is attached by two fairly long cables at the lower right. They don't have to be disconnected — just lay the keyboard, face down, to the right of the keyboard.
4. Remove the plastic shield covering the very back of the computer. This is immediately below the display, extending between the hinges. It will snap out more or less reluctantly by lifting it slightly, pushing it to the right a quarter inch and lifting it out.

Reassembly

1. Reinsert the plastic shield at the back of the machine. This will require some careful maneuvering.
2. Replace the two screws on the back of the computer, on either side of the serial number plate. You should replace the screw nearest the SCSI port first to avoid warping the center base cover.
3. Carefully put the keyboard back into position, making sure the cable is not pinched.
4. Holding the keyboard in, gently flip the computer over.
5. Reinsert the two screws underneath the keyboard. Don't over-tighten them as it will probably mess up the keyboard like the Duos.

RAM Expansion Card

The PowerBook 5xx series uses 70ns *pseudostatic* RAM. The chips should be of the type known as TSOP — thin, small-outline package. These chips have a thinner body and shorter legs than regular RAM chips. They are easy to identify because they are thinner than the circuit board they are mounted to. It is important to get TSOP chips — some companies use thicker cards which will not fit properly into the PowerBook, causing the case to bulge.

The memory chips on the bottom of the card do not have to be TSOP chips — they won't interfere with the modem. But the ones on top must be or they will touch the keyboard.

Apple initially said that 5xx RAM would not be compatible with the PowerPC upgrades, when they arrive. After hearing numerous complaints, they said that the memory will be compatible. If you can manage, wait until the upgrade comes out before sinking a lot of money into RAM.

Procedure

1. Disassemble the PowerBook as above.
2. Covering the RAM card is a perforated metal plate, or EMI shield. Remove the two screws at the top of the shield and the one at the back.
3. Remove the EMI shield.
4. Remove the plastic hold-down strip by flexing it slightly. The card being held down is the memory card.
5. Take the memory card out by pulling straight up.
6. Verify that you haven't bent any pins on the connector.
7. Insert the new memory card with firm downward pressure on the connector.
8. Replace the plastic hold-down strip.

9. Replace the EMI shield and its three screws. The tabs along all four of the shield's sides must fit inside the metal frame so that the holes for the side screws line up properly.

