Table of Contents

For Apple Pro Mouse repairs, visit this most excellent page: www.sewardweb.com/appleproмouse

What Not to Do with your Expensive Keyboard

The contents of this page is very simple in nature but explicit in execution. When the keyboard you rely on for your daily work costs more than one hundred dollars and you have no spare, you should not attempt to test its limits by forcing it to eat the crumbs from the bottom of your bag of Doritos, and especially do not try to force feed your keyboard a can of soda!

The latter of the examples above is definately the most catastrophic, and it is the very reason this page now exists. Because the Apple Pro Keyboard is not your average $15 replacement you'll find everywhere for your IBM compatible, it is viable to disassemble and repair it in house, provided you've got the patience, tools and skills.

Here in painstaking detail, the method of ripping apart an Apple Pro Keyboard and giving it a thorough cleaning is presented. Found a key that refuses to work at all? As was the case with the keyboard that inspired this article, one or more keys may not function if the keyboard gulps down a soda. Presented here also is the fix for that.

ToC

First Aid for your Keyboard

Have you gone and done it recently? For your sake, hopefully within the last five minutes or so? What you should do immediately after your keyboard soaks up any of your delicious beverage choices is unplug it from the computer, and then drain it. Drain slowly at first, and always in one direction.

Tilt the keyboard slightly so that a front corner (left or right) is pointed down and is the only area draining liquid. As the flow slows, gradually lift the keyboard higher, ensuring that just one corner is pointed down instead of one entire end of the keyboard. This action helps ensure that potential damage is confined to one area of the keyboard - hopefully, anyway. The gentle tilting at first helps to keep the liquid from soaking through all the layers of the innards from top to bottom. Ideally, if you've followed this procedure quickly enough, you'll be left with a keyboard that still works when you turn it on again. But
DO NOT test that thoery yet!

ToC

Prevention is Better than Problems

Most restaurants that you visit will have a computer system of some form or another and it is most likely that each computer also has a keyboard attached. If you look closely you will likely see that every keyboard is protected in one way or another. Why?

Granted, keyboards can be extremely cheap these days. Some are so inexpensive that the protective cover for the keyboard costs the same, or more than the keyboard itself. The real reason for this seemingly silly idea is actually money. A dysfunctional keyboard in a restaurant only costs $10 to replace when the restaurant is closed. When it is open for business, that same broken keyboard may cost over $1000 in lost revenues!

You can ask any restaurant manager what happens during the rushed dinner hours when a computer fails to work, or worse, when they all fail. Granted, not every keyboard has such a high status in the world, but good user habits will certainly not go unrewarded. Keep your food stuffs away from your computer and especially its vulnerable keyboard. After all, even a $10 keyboard is better than nothing when your essay, thesis, film project or board room presentation is due by 9:00am and that's only nine hours away. Just where do you buy a keyboard at midnight, anyway?

And, having stated all that I would also like to point out that the time taken to go ahead and clean your keyboard is not your average 15 minute quick fix. Don't you have things to do, places to go and better things to do with your time in general?

ToC

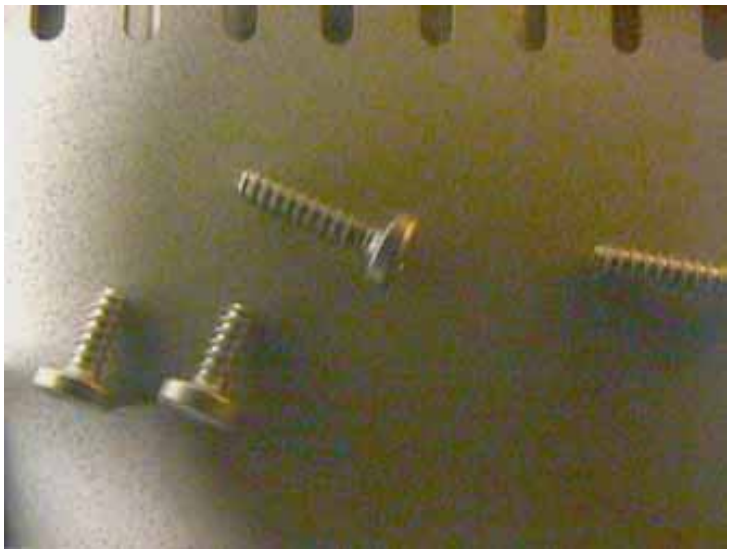
Disassembly of the Apple Pro Keyboard

The Apple web site seems to be completely lacking in its ability to help you out in times of dire need when it comes to keyboard cleaning and repair, so here is how you might figure it out.

First, flip the keyboard over on its face and stare blankly at those four allen screws found near the top left and right edges. The hex key you will need for this job is 0.05 inches in diameter (one twentieth of an inch). If by chance you have Xcelite hex drivers in your tool caddy, the part number 99-20, or LN-20 may be marked on it. The metric size is 1.27 millimetres, which happens to be exactly one twentieth of an inch, so if you have only metric tools, use a 1.27mm allen driver (Xcelite part number LN-1.27mm) to remove these four screws.

Now, before you read any further and do anything (de)constructive, HEED THIS WARNING:
The screws used to hold the keyboard together the cheapest of the cheap! In other words, use your newest, sharpest, and best tools for this job, and apply firm pressure to hold the allen key or screwdriver bit in place while you remove any screws! This will prevent you from stripping the heads from the screws and rendering them useless. Care to look in stores for replacements? I'd bet they are not easy to find - but I have been wrong before and if you know of a place, please find the e-mail link at the bottom of this page and let me know what you have found so I can post it for others to see.

Likewise for any reassembly, use good tools but at this time DO NOT use much force to replace the screws. They will strip easily, and while a couple missing screws may not mean you have to junk your keyboard I don't for a moment suggest you try your luck - after all when you go through this process it is not quick and painless, so ensure that you use care and make the endeavour worthwhile.



Notice that when these four screws are removed there are two pairs, each having a different length. This is important for proper reassembly later, so remember that the shorter ones are for the outer edges and the longer ones are used closer toward the

keyboard's centre. You can see in the image at right a few spots of cola that ended up at the bottom of the keyboard. Notice that near the bottom of the keyboard on the left and right ends there appear to be two more screws that grip the underside of the keyboard. If the keyboard is tilted sufficiently you can also find a third screw secluded by the lovely Apple logo in the centre of the shell.

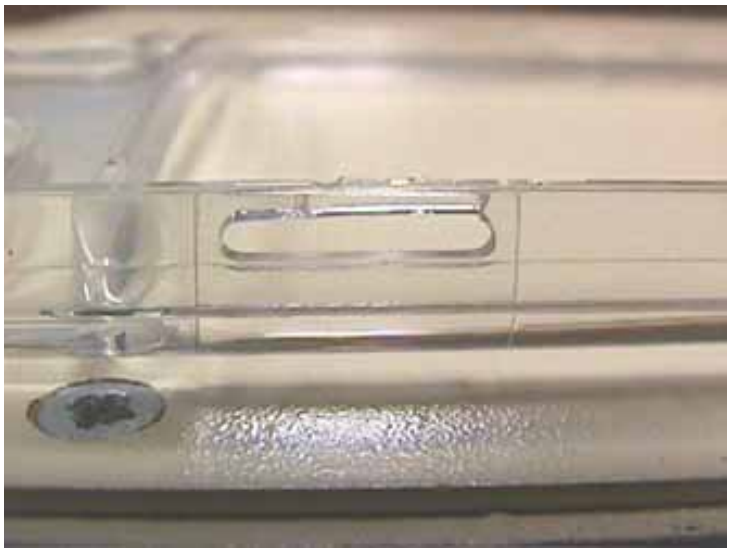
These screws are accessed from the top by removing the appropriate key caps thusly: Gently pry the key caps out of their resting places using a small slot-tipped screwdriver. Get the screwdriver tip under the key cap first, then lower the handle onto the adjacent key cap so the screwdriver becomes a miniature prying lever. The key caps will snap out of their holders easily, but be gentle and patient so the snaps do not break off during the process. To get at the three hidden screws you will need to remove these key caps: the CAPS LOCK, the SEMICOLON and the 6 (six) key of the numeric keypad.

At this point you might as well remove all of the key caps as they must come off later in the process anyway. This will also make it easier to separate the top and bottom shells from each other when that time comes.

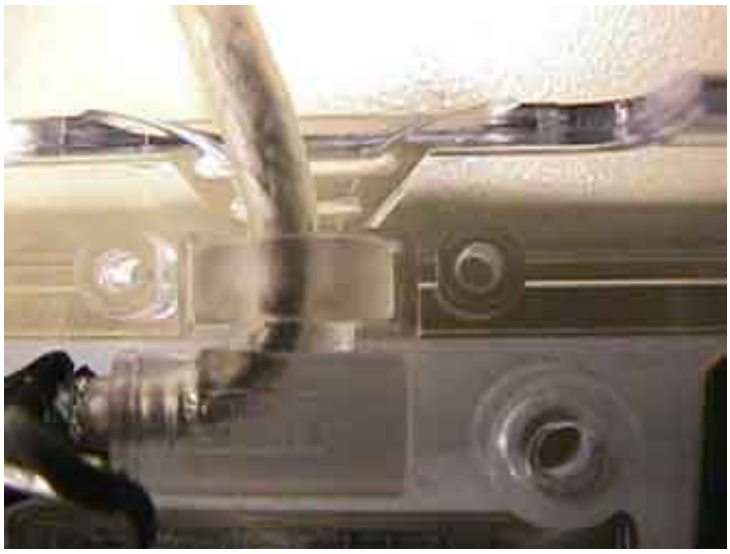
A look under the CAPS LOCK key reveals a few more cola blotches and the hole where one of the three hidden screws normally resides to keep the keyboard together. This image also shows the LED which glows green when the caps lock function is in use. Because the key caps are translucent, an LED shows through them. Note now that losing one of these LEDs is easy to do if you are not meticulously careful while disassembling this keyboard - they just sit there, sandwiched between the top shell and the membrane. You can buy green LEDs of the appropriate size to replace a lost one at any good electronics supply shop. But the process of cutting and bending the leads to just the right angle so that they don't puncture the membrane is tricky, and perhaps not worth it in the end.

There is one last hidden screw to remove before the keyboard shells will come apart and it lies beneath the Apple Pro Keyboard label on the underside shell. Locate it by applying pressure to the label with your index finger located just left of the small Apple logo on the label, and just above the first digit of the serial number label. The label will give slightly where it covers the screw hole, and once you locate it properly just drive a small screwdriver through the label and use a No. 1 or No. 2 Philips screwdriver to remove the screw.

IMPORTANT: The plasticized sticker must be pierced in order for the screw to become accessible. Once you have properly located the indentation in the sticker using the above (or similar) method, punch through the sticker with your screwdriver to get at that screw. Now the tedious task of separating the shells begins!

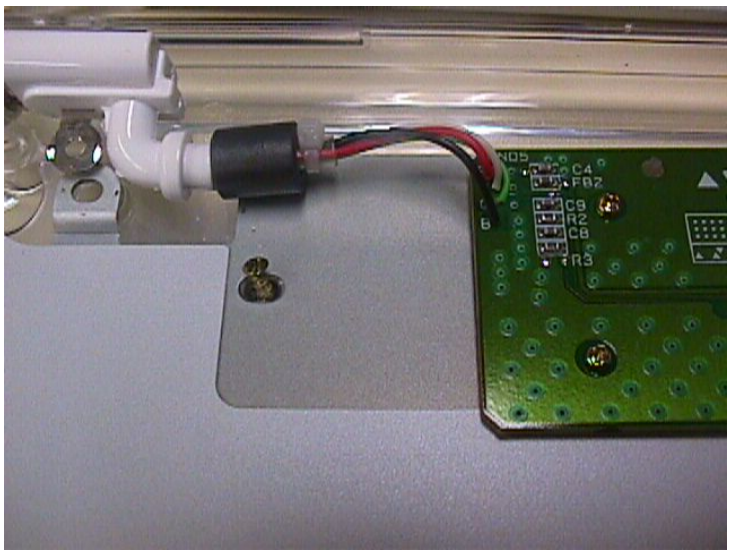


The photo at right shows the top keyboard shell and the photo at left is a close-up showing the snap together nature of the top and bottom shells. The oval hole in the top shell mates with a similar oval nib molded into the bottom shell. There are nine of these atrocities along the front edge of the keyboard and separating the two shells from each other is a slow, gentle, tedious trial-and-error process with miniature slot-tipped screwdrivers. Alternately - most likely easier and safer also - you can use your fingers if you have all the key caps removed. Place your fingers where the space bar usually resides, and your thumbs against the front-most edge of the bottom shell. Holding on with the keyboard in a position where you might normally be using it, apply pressure towards your belly to release the front edge of the top shell from the bottom shell. You should be able to separate the two pieces without breaking any supports or snaps. My thanks to Paul Ossenbruggen for this suggestion.



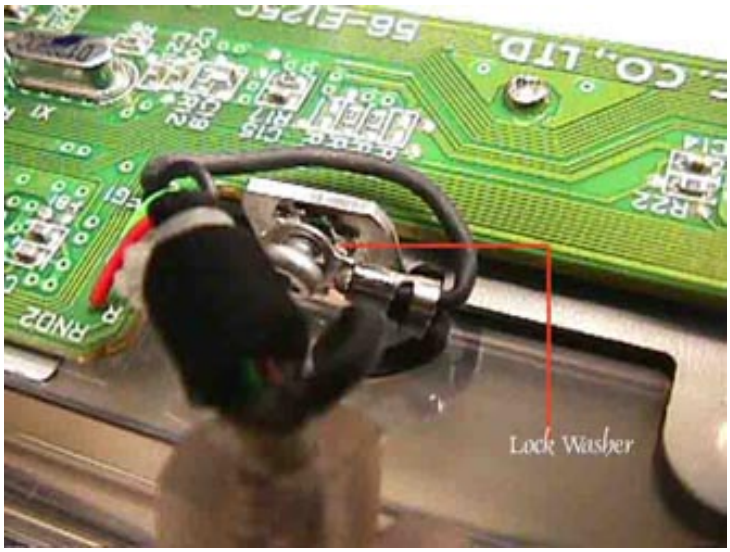
In order to fully separate the inner keyboard assembly from the bottom shell you must remove the keyboard cable strain relief. Once these two screws have been removed just pull the cable straight up off the bottom shell about an inch to release the strain relief mold from the bottom shell.

The printed circuit board (PCB) is next on the list of items to remove. A grey coloured protective plate normally hides the PCB from plain sight, but it falls away from the PCB as the inner keyboard assembly is removed from the bottom shell. This cover also helps to hold the USB ports in place when the keyboard is fully assembled.

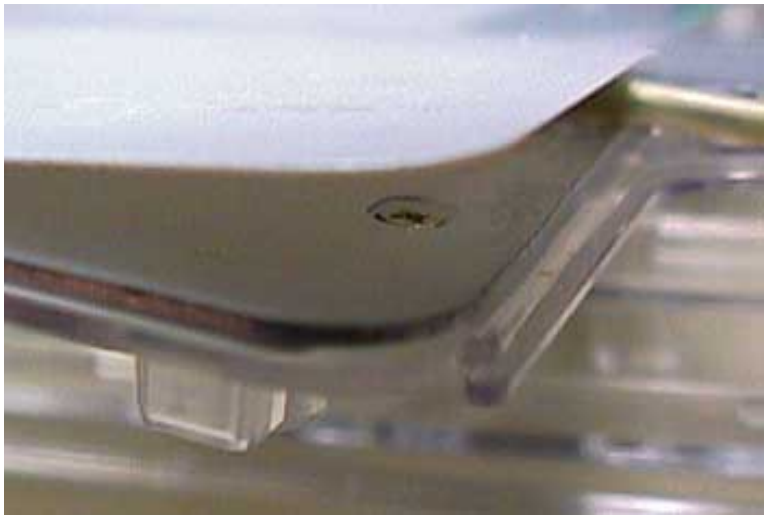


Note that pan head (or round head) Philips type screws are used to hold the PCB in place while the other screws found in the back plate have bevelled heads so they rest just below the surface of the back plate when installed properly. Remove all the pan head screws from the PCB.

The last screw to remove to get the PCB assembly away from the back plate is the grounding screw. Note in this image that there is also a lock washer between the ground wire lug and the screw hole in the back plate. Keep the lock washer handy with the ground screw for later reassembly.



At this point note that removal of all the key caps is recommended, if you haven't yet done so. Use care and have patience while removing all of the keycaps so they don't go flying and get lost or broken.



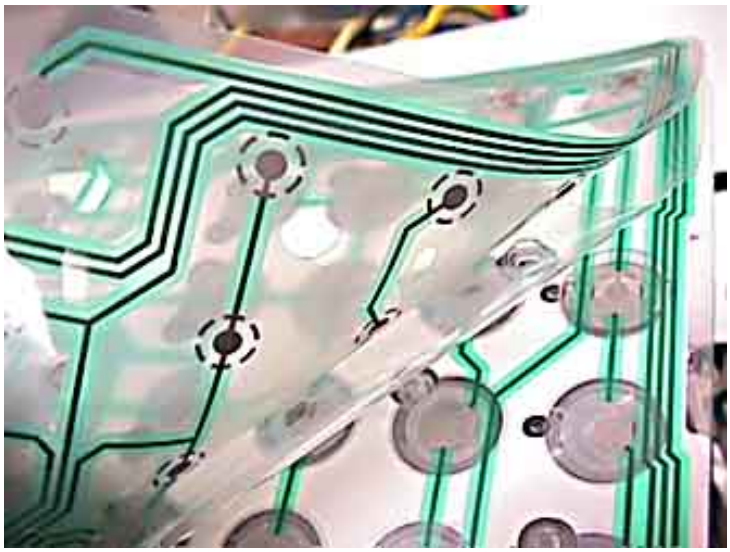
After removal of the PCB board, USB connectors and key caps, the decorative back plate cover must be lifted off to reveal over thirty small screws with bevelled heads underneath. The cover is simply a silvered piece of card stock (paper) that is held on by an adhesive. It will tear under the excessive stress of a sharp object, so exercise care in removing it. The screws hold the key button position molding in place over the keyboard membranes. They also ensure that the keyboard membranes rest flat against the back plate which translates into a higher degree of reliability and extended keyboard life. Remove all thirty-nine (39) of these bevelled head screws to get at the real meat and potatoes of the disassembly operation.

ToC

Principal Components of a Membrane Keyboard

This is the top view of the keyboard inner assembly showing the key button mold which holds in place each of the key buttons and key caps. After the bevelled head screws are removed from the back plate, this plastic piece will come away freely, as will all the key buttons themselves. Due to static attraction, some will stick to the top keyboard membrane and some will fall away with the key button mold. Again, use care when separating the layers here so none of the pieces get lost. Prone to hiding easily are the LEDs, the key buttons and the two pressure strips (usually white or clear jelly-like strips) which reside near the top of the keyboard.

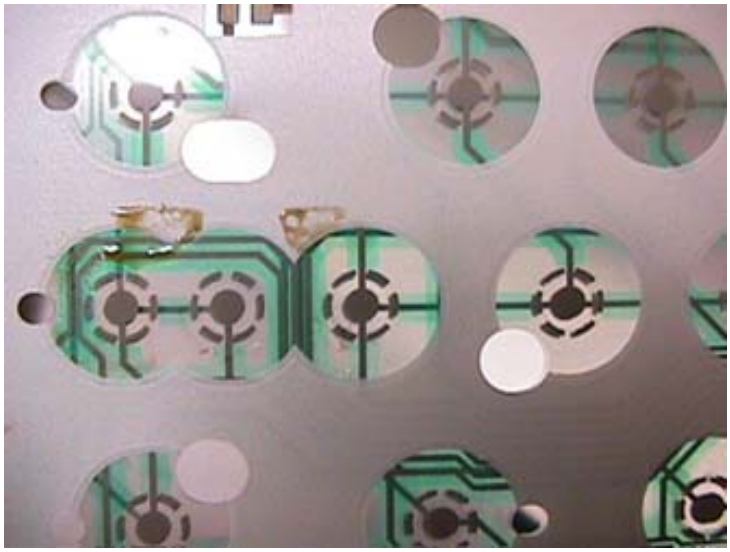
This is one key button. It is an elastic type of material which springs back into form after squishing. There are 109 of these, one per key on the keyboard. If you lose one, you lose the function of one key. These devices have a built-in plunger that - when pushed down by a key cap - pushes down on the top keyboard membrane and forces it to connect with the lower keyboard membrane, thus creating a connection which translates into a key press.



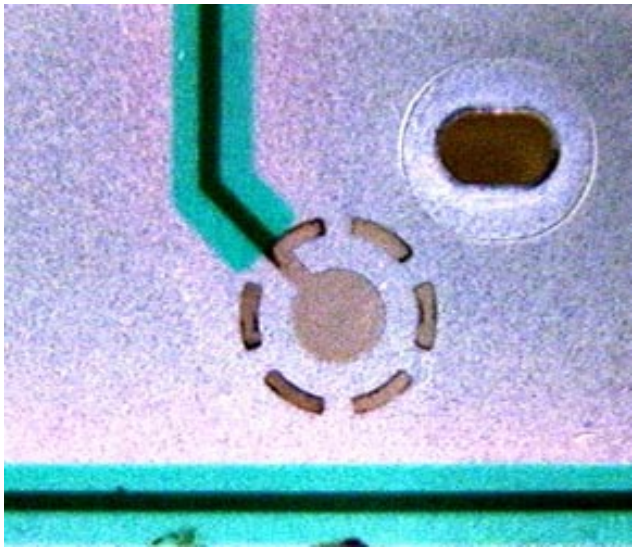
This photo depicts each of the three membrane layers that make up the electrical matrix for the keyboard. The top and bottom layers have electrically conductive paste screened onto them during manufacture. These pastes are cured into hardened electrical conductors with a rough surface. The uneven, sandpaper-like surface helps ensure a good contact by providing several electrical connection points with every keystroke. The middle membrane layer is the separator, which has one small hole punched into it for every key. The hole is not much larger than the plunger that is built into the key button. This separator keeps the top membrane from coming into contact with the bottom membrane until a deliberate key press is made by the computer user. The tracks of green in this image are insulating coatings which ensure that the traces running between all the key pads will not come into electrical contact with each other through keystrokes or other external pressures. Even water or alcohol will not get under these coatings, which is good to know for cleaning purposes.

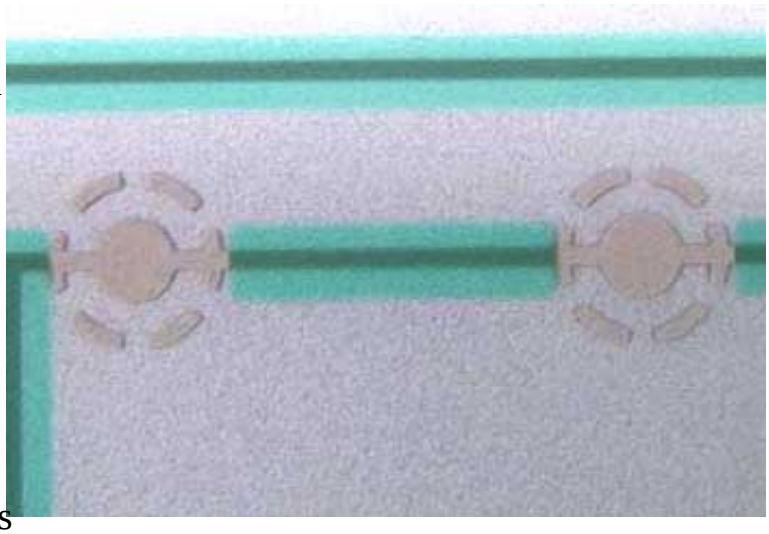
ToC

Damage and Controlling It



Seen here are the remains of last night's drinking party for this keyboard. The cola deposits are pretty easy to spot, but should your keyboard have swallowed a clear soda beverage, be sure to locate all the sticky spots for a thorough cleaning.



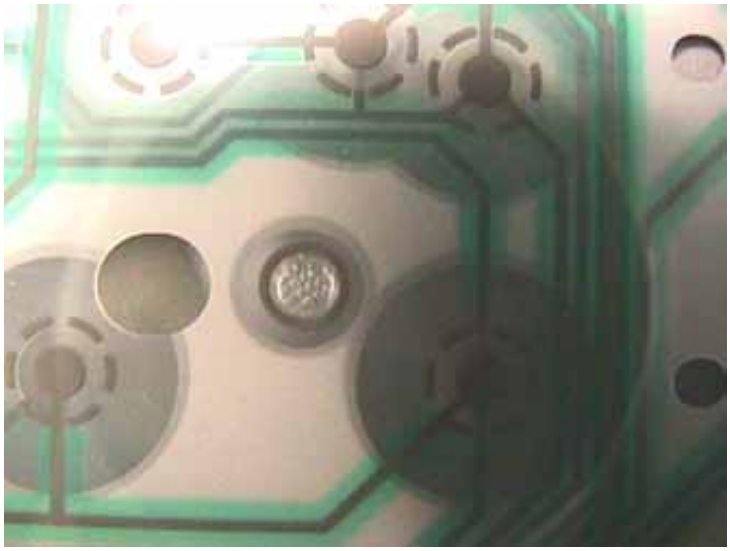


This keyboard still worked great, save a single key. The acid(s) in soda beverages digest the trace materials and can destroy the electrical connection between a keypad and its conductive trace which leads the key press signal to the computer. In the digitally enhanced photo on the left, the blackened areas are the points where the conductive material has been eaten away by the acid(s). On the right is a comparison photo showing contacts that have not been attacked by soda acids. The longer the keyboard sits uncleansed of soda beverages, the greater the damage that will occur. Notice the complete lack of any silver conductive paste between the original keypad printing and the green insulated trace portion. This key no longer was functional after the acid damage. See the section on repairing a digested keypad (below) for information on how this problem can be located and resolved. Basically, the sooner you can clean a dripping wet keyboard, the better.

ToC

Cleaning a Keyboard

It is likely that nearly every single component of a keyboard should be cleaned if there was a soda mishap. If your keyboard problems stem from too many food crumbs inside, you can probably skip a couple of the steps outlined here. First, locate the spot in the middle of this image. This is a rough

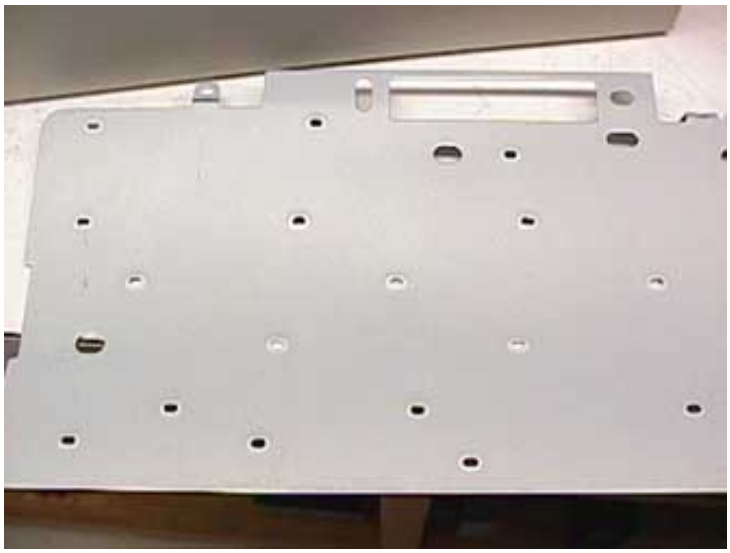


patterned circle to the right of centre where all three membrane layers have been fused together. The number one rule here is **DO NOT DISTURB!** If you tear the layers apart it will be difficult to perfectly align them in the future, and proper reassembly of the keyboard will be a long, trying process. While cleaning the membrane layers, try not to pry too hard against this fused spot and all will be well.

You can cleanse the keyboard membranes using either water or alcohol. In either case be certain that each layer is perfectly dry on both sides before you sandwich them together again - especially if you use water. If there is enough liquid sandwiched between the layers they will stick together in a manner that makes it very difficult to properly align them for the reassembly process. Use a damp, lint-free cloth or a quality paper towel wetted with the water or alcohol and gently rub it back and forth over the surfaces to be cleaned.

CAUTION: While cleaning the membranes, be careful not to fold or crease them as the reliability of the keys in the vicinity of the fold may be hampered. It is also possible to break the electrical connection if the crease is acute enough.

CAUTION 2: DO NOT USE HEAT to dry *any* part of the keyboard. No hair dryer, no blow torch, no hanging out to dry in the sun - nein!!! Your keyboard detests heat even more than it does liquid beverages. You may use cool air only, and if you have an air compressor it will work just fine, but use care with that, too as pieces will fly into corners where you will never find them if you start simply blasting them with high pressure streams of air.



The photo at left shows the back plate of the keyboard. It will likely need a rinse with alcohol or water if there was any soda beverage found elsewhere in the keyboard. On the right is a detail photo showing the key button mold. This piece will certainly need a rinse if liquid contacted the keyboard. Using alcohol here is advisable because it will evaporate much more quickly than water. You can use water if you have a pressurized air source - such as a hose linked to an air compressor - to blow the bulk of the water away.

WARNING! Do not attempt to apply heat with a heat gun or hair dryer. Did I mention this already? It s important, so read it again! One wrong move and you ve warped the mold and probably made the keyboard useless. The stuff is all plastic and the screws that hold it together bite into that plastic. I will spell it out here too much torque and the screws will tear the plastic apart, defeating their original purpose of holding it together. Correcting a warped mold via the backplate screws can prove to be a futile effort. While on the subject of screws going into plastic, assure yourself that they are going in their original spiral grooves by first rotating each screw counter-clockwise while gently pushing it down into its hole in the plastic. Rotate until it clicks at which point you know it has seated its threads into the originally cut threads of the plastic, then tighten as normal. Using this method ensures you do not continually cut a new path for the screw every time you remove then replace the screw, and therefore retains the holding power of the plastic.

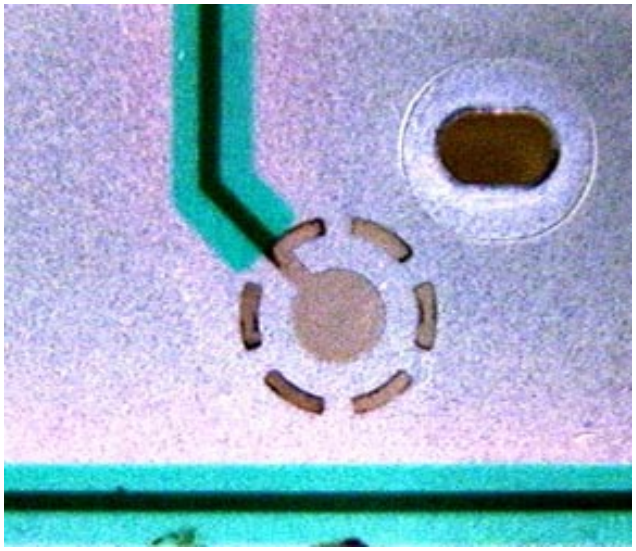
Here is a picture of all the small key caps in a bucket of water. The water will dissolve any soda residue and leave the key caps nice and clean. In hindsight, the author realized that a bath of alcohol would have been a much better choice due to its much lower boiling point. Alcohol will evaporate from a soaking wet key cap in less than one minute, but if you bathe the key caps in a bucket of water, be prepared to dry each one separately. This is something better learned before the bathing process rather than afterward.

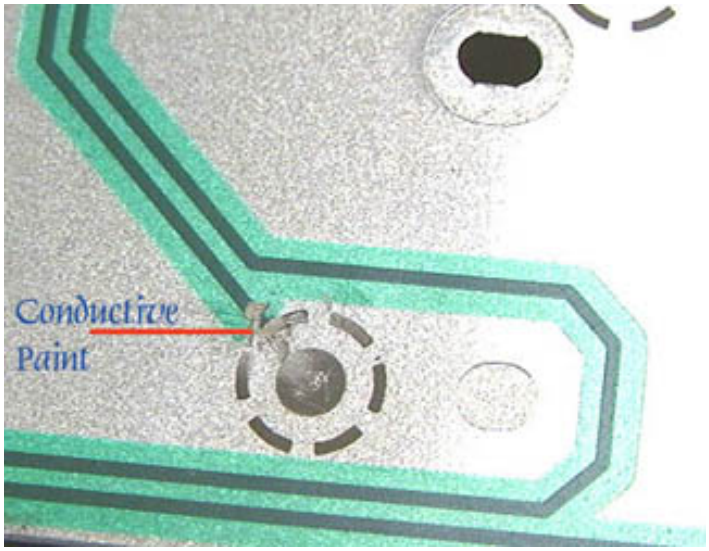
Here is the method of choice when it comes to removing water from plastic parts. A high pressure, high volume air source will disperse the water quickly and dry the pieces more quickly than you could expect to do so any other way. There is one thing to keep in mind no matter what you bathe the key caps in, however; do not bathe the larger keys such as the SPACE BAR or the ENTER, RETURN, SHIFT keys, etc. All these larger keys have wire supports to even out the pressure exerted upon them by the user, and direct that pressure to the key button belonging to the cap. To go along with the wire support is grease at each point where the support comes into contact with any plastic bits.

CAUTION: The grease needs to remain in place to prevent the wire supports from scraping the plastic pieces they touch into plastic filings over time. This is the reason you should not immerse any of the larger keys containing these wire supports in any sort of bath, especially alcohol which will likely wash all the grease away. You can add a good twenty minutes to the project if you need to put fresh grease on all those contact points, so instead of bathing them, just use a dampened cloth to remove any food stuffs that may be sticking to those larger key caps.

ToC

Repairing a Digested Keypad





On the left, again, the enhanced photograph showing the damage to the keypad caused by the acid(s) found in many soda beverages. On the right, the unenhanced portrait of the same keypad after some conductive paint from a circuit trace repair pen was applied to the area between the insulated trace and the centre of the keypad.

NOTE: If you perform this repair and find in testing that the trace did not become a complete circuit again, try carefully scraping off some of the green insulating layer beside the damaged area first, then redraw the trace with your conductive pen or paint. Sometimes the damage can reach beneath the insulating layer. You may also use rear window defogger repair paint which can be found at almost any automotive parts store. Make sure you let that paint dry completely before reassembling your keyboard for testing.

If your can or pen of conductive paint says something like "better results may be obtain by using heat to cure the paint" I'm telling you now that YOU DON'T CARE! That's right, don't mind the directions at all because as you ought to know by now, your Apple Pro Keyboard does not like heat! In truth, drawing the traces back together with a pencil (especially a 4B pencil) will probably work just fine, so do not go attempting to make the connection perfect with any form of heat curing. If the paint must cure, let it do so at room temperature only, and just let it cure for perhaps four or five times the duration suggested in the "apply heat" method. All will be well. Now continue on!

ToC

Locating the Problem

The keypads on a keyboard are arranged in a matrix, and so an entire row (or more) of keys may have one common conductive path between each and every keypad in that row. To locate the exact spot where the dysfunctional key has been damaged, you can use an ohmmeter - which measures DC circuit resistance - and pinpoint the problem area by the process of elimination. From one end of the keyboard to the other along a single path, the resistance should be no greater than about twenty (20) ohms. A marked increase from this guideline indicates a poor connection and a potential problem.

Start by placing one of the leads of the ohmmeter on the centre of the keypad under the key which fails to work. Determine by visual inspection the next closest keypad in that same circuit and place

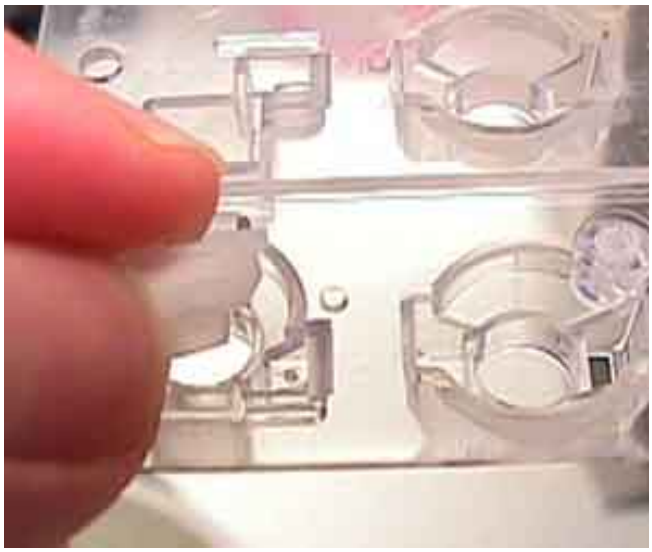
the second lead of the ohmmeter there to measure the resistance from the broken key to the next. If the resistance is high - above a couple hundred ohms - then the conductive path between those two keys is not ideal and may be the cause of the fault. In the case of this keyboard, the resistance from one key to the next closest was more than 10k (ten thousand) ohms. Chances are excellent that the problem is between the keypad itself and the border to the conductive trace that runs between the bad key and the next closest. This trace will be covered over with a green insulating plastic layer.

Apply some conductive paint starting at the edge of the insulator next to the bad keypad and draw a new path with the paint into or near the centre of the bad keypad. Use the ohmmeter to see that the resistance has lowered to less than twenty (20) ohms. If this does not solve the problem, the trace between the two keypads may be at fault. This will likely only be the case if you have creased that section of the membrane. To ensure that both keypads are not at fault, first check the key adjacent to that which you used to test the connection for your known bad keypad. Once the second pair of keypads tests good, you can draw a new trace using conductive paint between the bad keypad and the next closest one. Paint right over the green insulating layer as necessary and test again to ensure that the connection is now decent. Let all this paint cure thoroughly before sandwiching the membrane layers together again. But, as noted above, NO HEAT - okay? Continue cleaning the other parts and prepare for assembly and test.

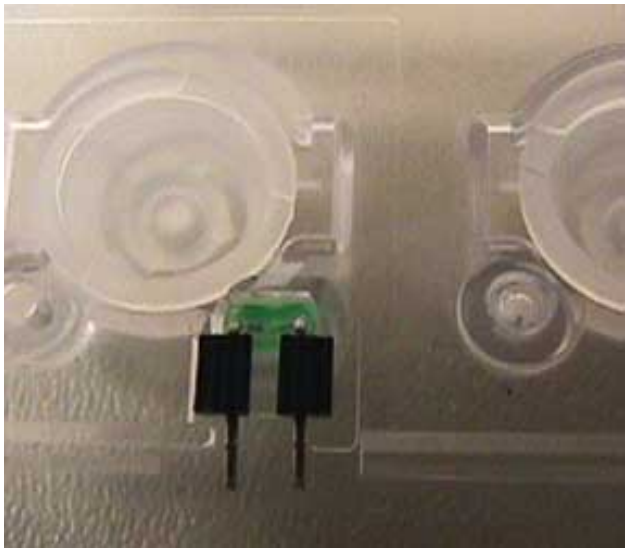
Reassembling for Testing Purposes

Taking into consideration the final resting spots of all the components that make up these keyboards you may soon realize just how far you must reassemble the parts before a proper and reliable test may be performed. The membranes have to be firmly sandwiched to the back plate, which means all the key buttons must be placed back into the mold and that mold must be fastened to the back plate using all thirty-nine (39) screws to ensure even pressure and good contact reliability. The grounding wire should also be connected and to obtain a connection to the computer, the printed circuit board (PCB) must also be mounted to the back plate. Of course the key caps must be in place and all the minute details of these wonderful tidbits are presented below.

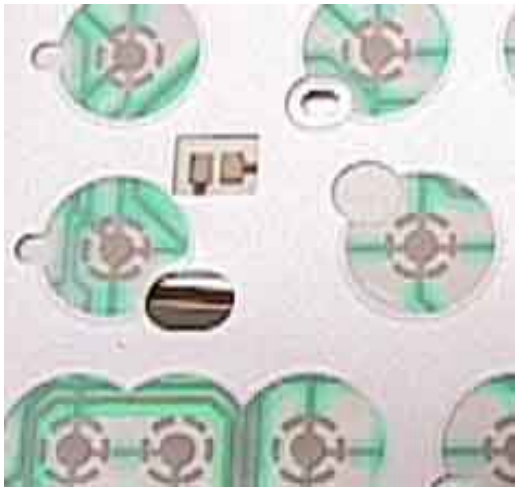
Okay, so it is often the case that all thirty-nine (39) screws need not necessarily be put back in place for testing the keyboard. In fact, you may not want to use more than a few around the outside edges to save wear and tear on the screws and the key button mold. Just be aware that if you use only a few screws and you find that one or two keys do not work during testing, it may be due to the fact that the plates are not being held together well enough. Insert more screws around that area and try again before assuming the keys do not function. Be aware also that the screws are made of very soft metal so do not use a lot of force to tighten them.

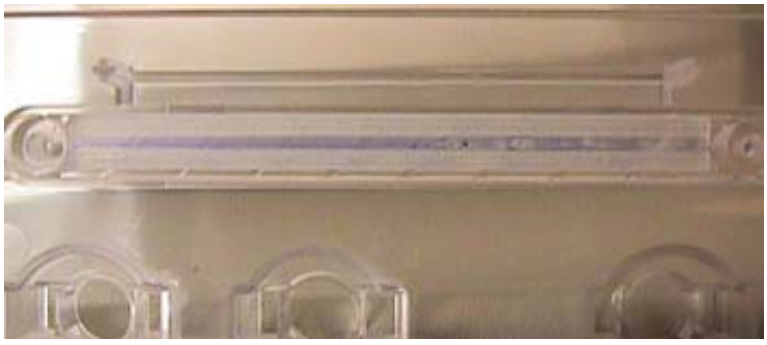


As if it wasn't obvious, the photo at left depicts the method of placing the key buttons into their mold - all one hundred eight of them! Place the mold on a flat surface and place all the key buttons in their spots. The photo at right shows what the small green LEDs look like. There are two such devices: one goes under the CAPS LOCK key, and the second goes under the NUM LOCK key at the top of the numeric keypad portion of the keyboard.



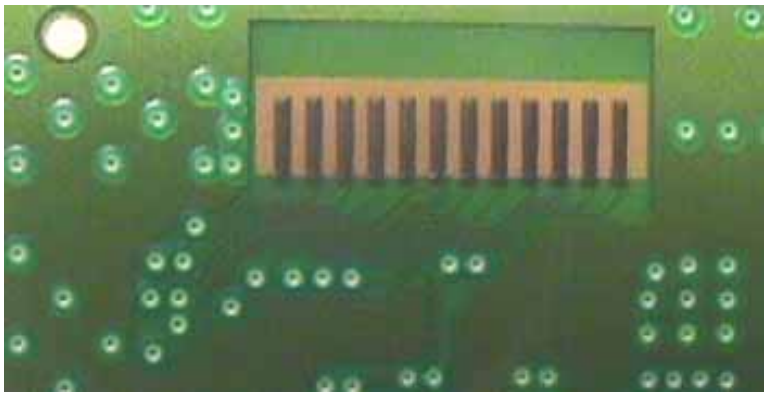
At left is a photo showing the LED in its place in the key button mold. The photo on the right shows the keyboard membrane at a point where one set of LED contacts can be seen. The two square pads near the centre of the image are what rest against the leads of the LED when the keyboard is properly assembled. The LEDs fit one way only into their respective places in the mold, so you need not worry about polarity issues.





There are two clear jelly-like strips (photo at left) that must be placed in their proper spots on the

mold as well. The photo at right shows one of those spots. Both are near the top edge of the key button mold. These pressure strips force the membrane edge contacts to mate with those found on the PCB itself. The edge connections transfer signals between the keyboard matrix and the computer via the USB cable.



At left is a look at the printed circuit board side of the edge contact mechanism. These contacts are regular PCB traces - usually copper, sometimes gold plated - with a conductive mound of material screened on them, then cured in an oven. These mounds are not exactly smooth, making the connections more reliable by virtue of the fact that more points of contact can be realized with an uneven pad rather than a perfectly smooth one. The photo at right shows the mating edge connector of the keyboard membrane. This portion of the membrane rests over the pressure strip and the two holes in the membrane align with two posts in the key button mold at either end of the pressure strip.

Place the keyboard membrane over the key buttons in the mold after the pressure strips have been installed, then place the back plate over the whole assembly and ensure that everything lines up properly. Once you are certain that everything is perfectly aligned, replace the thirty-nine (39) screws that hold the mold against the backplate. DO NOT apply any form of mechanic s torque to these screws whatsoever! All they need to do is keep the mold pressed against the back plate enough to ensure the membrane is well sandwiched. This means no power tools at all, and use a #1 Philips screwdriver with a handle having a diameter of one (1) centimetre or less. This helps prevent the possible application of too much torque on the fragile plastic mold when strong folks attempt the procedure! Also, when putting screws back into plastic pieces it is better to first rotate the screws counter-clockwise until they *click* into place. Slight downward pressure is needed to feel this click, as if you were about to fasten the pieces back together with the screw, but you turn the screw in the opposite direction. Once it clicks you know the screw threads have fallen into the spiral grooves

already present in the plastic from the original assembly process. It is at this point that you turn the screw clockwise to properly fasten things together, and you know that the screw will be using the pre-cut grooves in the plastic instead of carving a new path for itself every time you replace the screw. This little trick will save you from stripping the screw holes inadvertently, so long as you do not over tighten the screws, of course.

Before the PCB can be attached to the back plate, this thin plastic insulator must be aligned over the back plate to prevent the possibility of any exposed traces on the PCB from shorting out on the back plate when the keyboard is assembled. This film has several holes punched into it which only line up one way with holes in the mold and backplate, so locating the correct placement should be relatively easy.

Be sure to use the correct screws when mounting the PCB to the back plate. The brass-like pan head screws are the only ones of their kind found in the entire keyboard assembly.

Don't forget to reattach the grounding screw before bringing the whole mess over to your MAC for a test.

ToC

Testing Your Handywork

Testing is ultra easy. Plug your USB mouse into either port on the keyboard to see that the port works when you boot the computer. Change the mouse over to the other port or use a second USB device to ensure that nothing happened to the other USB port. Should anything have happened to the correct function of the USB ports at this stage, you will have to troubleshoot. Look for loose or broken wires, and failing that you may have zapped a component on the PCB with static electricity while you were working with it. Either scenario is highly unlikely if you treat everything with care throughout the process of disassembly, cleaning and reassembly.

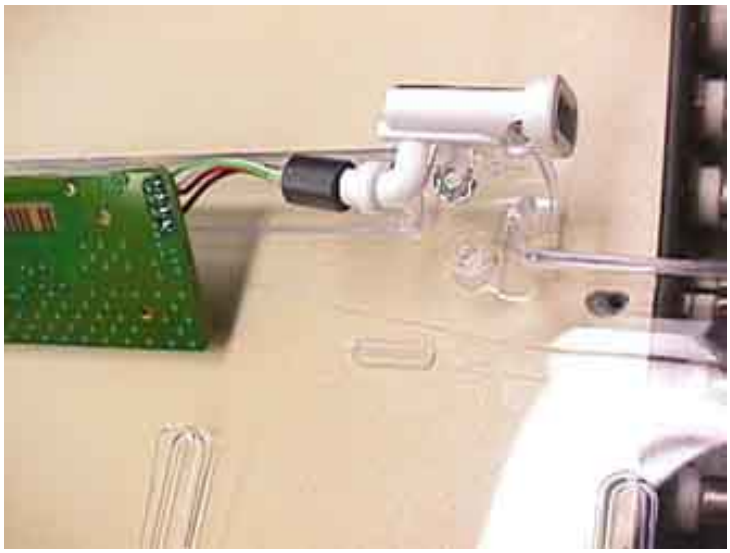
Use the "Keycaps" application in the MAC OS (or similar) to test the function of each and every key on the keyboard. Try each key several times and always try keys on an individual basis only. If more than one key icon in the application is shaded for a single key pressed, you've got a short somewhere. The exceptions here are those keys which are duplicated, like the OPTION, SHIFT, CONTROL or APPLE keys.

If you have a short or if a key still does not function correctly, you have more work to do. Take the more than 160 pieces apart once again and revisit the membrane for another look. Once testing proves successful, a full reassembly is in order.

ToC

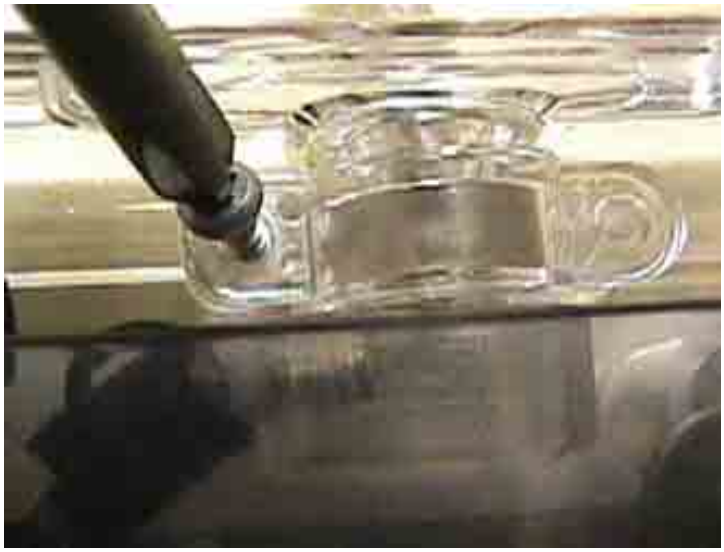
Full Reassembly

It's pretty straightforward to continue assembling the rest of the bits and make it look like a real store-bought Apple Pro Keyboard again. To begin, remove the PCB from the back plate once again. This is necessary to enable easy application of the decorative back plate cover, which is just a silvered piece of card stock with a sticky outer edge. Align the card cover over the back plate and apply medium pressure to the edges all the way around and also apply pressure at the hole in the centre. Once the card is in its place, reattach the PCB to the back plate and continue the reassembly process.



In the photo at left, the USB port is almost seated correctly in the bottom outside mold for the keyboard. This is a reference photo only since the PCB cover must be installed before the keyboard assembly is mounted into the bottom shell anyway. The photo at right shows how the PCB cover also holds the USB ports in place.

Place the PCB cover in the bottom shell as illustrated and prepare to set the keyboard in place. Before replacing the keyboard be sure to remove the three keys that cover the small Philips holding screws. These keys are the CAPS LOCK, semicolon (;) and numeric keypad number six (6) keys.



The photo on the right shows the cable strain relief clip that fits over the strain relief mold around the keyboard cable. Before the keyboard is perfectly aligned in the bottom shell this strain relief will have to be assembled as its screws will not be accessible once the keyboard is in place. Ensure that the flat part of the strain relief molding on the cable itself is seated in the bottom shell. This leaves the rounded part which goes into the strain relief mounting clip shown in the photo. The strain relief clip also fits snugly into its own spot in the bottom shell, so be certain to align it correctly in the shell also.

This is what the finished strain relief assembly looks like before the keyboard is placed correctly into the bottom shell. Note the plastic cover at the top of the keyboard that will interfere with the strain relief clip screws. This cover would prevent the use of a screwdriver to remove the strain relief clip before the keyboard is free of the bottom shell.

This is the type of screw that goes into the strain relief clip. This same type of screw is used to hold the PCB cover and keyboard back plate to the bottom shell - the screw that hides under the Pro Keyboard label.

Align the keyboard assembly in the bottom shell so that all screw holes line up and also ensure that the PCB cover and USB ports are seated correctly in the shell and against the keyboard back plate. There are a couple more small plastic covers to add before the top shell can be placed over the keyboard, one of which is illustrated in this photo. The slightly coloured area represents the plastic cover that rests between the numeric keypad and the main alphabetic portions of the keyboard. This cover has the shape outlined in colour, and at the upper tips is formed so that a small bit of each tip - about six millimetres or so - is angled about forty-five (45) degrees from flat inline with the rest of the cover. These angled tips should face downward, toward the back plate of the keyboard assembly.

The other two plastic decorative covers consist of one white and one transparent cover, both of which have exactly the same shape. These covers - white under clear - align at the top of the keyboard between the upper row of keys and the top edge where the USB ports protrude from. There is a hole at each end of these covers that align with two pins in the top shell.

Place the top shell over the whole mess starting at the top edge where the USB ports sit and be careful aligning everything as you go. Work the top shell into its place and be careful when snapping it together with the bottom shell at the edge where the SPACE BAR resides. The snaps will break easily, so engage them one at a time and try to push the top shell a bit toward the USB ports while seating each snap over its nib on the bottom shell. You're almost there!

Don't forget to replace those three screws which hide under the keys of the keyboard. After they are in place, push the key caps back in their spots and continue replacing the rest of the screws from the underside of the keyboard. These include the one that normally hides beneath the Pro Keyboard label, and the four hex screws that go into the holes near the left and right top edges. Take a look at the next three images to see where each key cap fits on the keyboard.

This image shows the left-hand side of the keyboard which will be useful in finding the appropriate spots for each of the key caps currently strewn about your work area.

Here is what the centre portion of the keyboard should look like once all the key caps have been installed in the proper places.

And finally, the right-hand side of the keyboard including the numeric keypad. The keys on the numeric keypad have only one symbol on each of them versus the ones on the numeric row of the main keyboard area which have two symbols per key. Each key cap belonging in the extended keyboard area (numeric keypad included) is unique. The cursor keys can be tricky. The one that points up is the only one with a concave key cap. The rest have a convex shape to their tops. Note also that the arrow markings of the cursor keys are positioned in the lower left portion of each key cap.

Now that all the key caps are in their proper spots, that is it! Your keyboard should look and function like new. Give yourself a well deserved pat on the back and go get some grub; this has been an arduous task!

ToC

Conclusion

This process is an involved and delicate one. Time consuming are not the words to describe this effort from a first-try perspective. About ten (10) hours were spent on it figuring out the safest way to disassemble everything and documenting the process with digital photographs. Now that this web page exists, the estimated full disassembly, cleaning and reassembly process should take no more than a couple hours on a first-time try, and even less time, should you ever have to do this more than once.

It is important to note that none of this is necessary when users take care to keep their food and drink away from the computer. Most people have swivel chairs in front of their machines making it very easy to set the foods in a completely separate area and swing around for a bite or a swig as necessary.

The case for this keyboard is that it is attached to a G4 powerhouse which runs the Final Cut Pro 2 non-linear editing software used for college film and television project editing. Students need not be reminded about the end of term and the flurry of activity everywhere as each scrambles to complete his or her project(s) before critical submission deadlines. When a keyboard is taken out of commission and has to be cleaned of spilled soda or other foods it could mean that a project goes unfinished and the final marks will reflect that. Accidents like this are completely avoidable and in light of the fact sometimes keyboards cannot be repaired at all, it should be obvious to all users that there is no benefit to force feeding a keyboard human foods. It can take days or weeks to replace a keyboard that cannot be repaired. The cost here is just under $100 to replace one of these keyboards, so spares are not kept on hand. Food for thought.

ToC

Other Potential First Aid Measures

You, as the repair technician or as the owner of the hungry keyboard might have thought of these ideas already, but in case you have not, other first aid options exist:

- Immediately after a soda spill, unplug the keyboard and immerse in a bath of distilled water,
- Immerse the keyboard in a bath of alcohol, or
- Attempt to force the remaining liquid out using compressed air

Some measures are inherently risky, especially the alcohol bath, because the grease can be dispersed by the alcohol and it may gum up the works elsewhere in the keyboard. Also, if the grease is cleaned away from the wire supports under the larger key caps those caps may be damaged by the lack of lubrication.

If alcohol or distilled water is used to clean away liquid spills immediately, there is little chance of any chemical reactions that can cause keys to malfunction, but with the alcohol bath - though it will dry out much more quickly - the grease under the keycaps must still be replaced. With distilled water - distilled so that no mineral deposits dry on the keyboard membrane and cause future faults - the drying time can be days, but the grease will likely not disappear. Either way the keyboard is out of commission for a while since both liquids must be dried completely before you can test it again.

It is advisable in both instances to disassemble the keyboard in its entirety afterward anyway because there is a good chance that not all the foreign liquid(s) will be washed away by the bathing process. Damage can still occur unless everything is thoroughly clean like it was when assembled at the factory the first time. The baths may be used as a first aid measure simply to lessen the chances of massive damage - but nothing is guaranteed, and the baths themselves might cause damage also - especially if the keyboard is still plugged into the computer.

As for the compressed air option, take a look at this photograph. The hole just above and to the right of the big cola bubble is how the soda got to the inner layers of the keyboard. Cola was found everywhere from under some of the key caps all the way to the bottom shell, and at every layer in between. It is doubtful that any dose of compressed air will clean liquid away well enough, but if it's all you've got, it's better than letting soda pop sit idle to eat away at the innards of your keyboard.

ToC

Links to other Helpful Web Places

Currently, this section is miniscule, but there is more to come:

Assistiveware.com sells - among other titles - *KeyStrokes* , which is a utility allowing a user to enter textual information using a device other than the keyboard. This could be good if you and your keyboard enjoy a drink together!

The homepage of the Niagara College Technology web space. This keyboard repair web page is a direct result of a mishap with one of the college's keyboards and as such it is hosted there. There are many other interesting topics covered in the pages under this link in the *Faculty and Staff* section, so enjoy your time here.

www.sewardweb.com/appleprotmouse is the home of a very good Apple Pro Mouse Disassembly and Repair page. My thanks to Dave Billman who pointed it out to me.

ToC

This page last updated 19 November 2003

What's new with this page?

19 Nov 2003 Philip Bell suggested a method of ensuring that screws being replaced into plastic parts of the keyboard do not strip out the grooves in the plastic. Under the Reassembling for Testing section is where you will find this technique described.

21 Oct 2003 - I've added a note about using rear window defogger repair paint to the section on repairing a digested keypad, as suggested by a reader who sent me an email saying how well it worked for him. Unfortunately, I have misplaced his email to give proper credit, but I will find it a post it when I do.

4 Sep 2003 - Stella Wu suggested that a keyboard map would be helpful for placing the keycaps back in the proper order during reassembly. Also new is the emphasis made regarding the necessity to puncture the plastic-like sticker near the serial number to access the hidden screw underneath. These new items are found in the reassembly and disassembly sections, respectively.

19 Aug 2003 - Paul Ossenbruggen suggested a better and safer shell separation method, detailed in the disassembly section.