

Opening the HP48

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version: 14-MAY-2006

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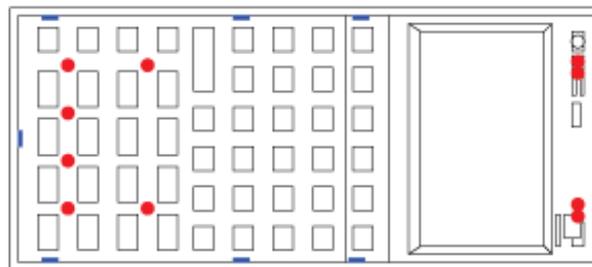
Introduction

This is a guide on how to open your HP48 calculator with as little cosmetic and structural damage as possible. This method is based on a document by [Pawel Golaszewski](http://www.hpcalc.org). His original documents can be found at <http://www.hpcalc.org>. Since the HP48S/SX and HP48G/GX have the same basic design, these instructions work for both families of calculators. Please note that these instructions are for educational purposes only. I take no responsibility for any damage you cause to your HP48 or yourself by applying the information below to your HP48.

I do not recommend opening your HP48 unless you necessarily have to open it.

Understanding the HP48 Casing

The HP48 consists of essentially two halves: an upper half containing the LCD, keyboard, and PCB, and a lower half to which the four rubber feet, battery and port covers, and nameplate are attached. These two halves are kept together by a set of 10 rivets and 7 latches. Below is a diagram in which the latch locations are marked in blue and the rivet locations are marked in red.



Locations of Latches and Rivets
(rivets marked in red; latches marked in blue)



Undone Rivets
(overlay removed)

Latch
(keyboard removed)

The general idea is to undo the rivets and latches from the top (near the LCD) of the HP48 and work toward the bottom. Also, the positive battery terminal is attached to the PCB, and hooks onto the lower half. This will need to be undone (very easy) prior to separating the two halves.





Groove
(unopened calculator)

The two halves are clearly separated by a groove that runs along all four sides of the HP48. This is where we will insert our tools to undo the rivets and latches. The plastic will likely bend; however it is very resilient and easily returns to its original state once the tool is removed.

Recommended Tools



- One (1) toenail clipper
- One (1) fingernail clipper

We will only use the parts of the clippers on which the thumb is pressed. Generally speaking, this part of a clipper is very smooth and all corners and edges are often rounded off, significantly reducing the possibility of damage caused by the tools themselves.

Step 1: The Top Rivets

To begin, take the fingernail clipper and insert it into the groove near the top of the calculator. Refer to the diagram of the rivets and latches to know where to insert the clipper. Simply press the clipper up the groove and then slowly bring the tool so that it level with the LCD screen. Use a lever motion to pry the rivets from their heat-stake points. On the older models, you may even have to use the toenail clipper (slightly thicker and wider than the fingernail clipper). You should hear a pop sound when the rivets have popped from their heat-stake points. The groove at the top will also appear more separated.



Step 1(a)



Step 1(b)



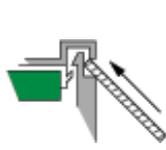
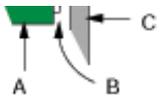
Result

Step 2: The Side Latches

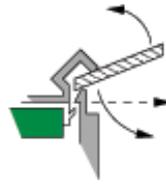
Before we begin, familiarize yourself with the latch. The latch is part of the metal plate that holds the LCD screen and the PCB; and the metal plate is attached to the keyboard via heat-staked rivets. To the right is a diagram of the cross-section of a latch point. (The spacing of the parts is slightly exaggerated.)



The labeled parts are the PCB (a), the latch itself (b), the plastic housing of the lower half (c), the groove (d), and the keyboard overlay area (e). In order to undo a latch, we must pry it away from the plastic tab to which it attaches. Insert the fingernail clipper near a latch point, and use a lever motion to pry the plastic housing (part of the lower half) away from the latch). You may or may not hear a slight sound (the metal latch scraping against the plastic tab) as you undo a latch. Refer to the diagrams below if you need more help.



Step 2(a)
Insert clipper up groove



Step 2(b)
Use lever motion to pry apart

Begin with the top two latches. Work on, say, the latch on the right side of the HP48 and then switch the corresponding latch on the left side. I generally insert the fingernail clipper just above a latch point. For example, to undo the latch near the [F] key, I insert the clipper around the bezel area between the menu row of key and the bottom of the LCD. Once the two latches near the [A] and [F] keys are undone, work on the ones near the [SIN] and [1/x] keys.



Step 2(a)
Insert clipper up groove



Four Latches Undone
(partial separation of halves)

As soon as a latch is undone, the upper half will automatically stick out from the lower half. This is normal and, in fact, desired. The latches near the [SIN] and [1/x] keys may fall back into their original positions. This, too, is normal since the six rivets at the bottom do a formidable job of keeping the two halves near the bottom together. However, it is best that these latches be kept undone.

Step 3: The Bottom Latches & Rivets

This step is the most difficult, especially for first-timers. There will often be an unusual amount of bending of the keyboard. This is normal as the metal plate will likely be bent if this is your first attempt (or if the HP48 is an older model from Singapore). **First, unhook the positive battery terminal from the battery compartment.** Then, undo the two side latches at the very bottom. These are very tough to undo, and chances are they will likely fall back into place. That is normal, and should be expected. The point is just to have undone them once so that they are not so difficult to undo when the time comes for them to be undone. There are two approaches (side vs bottom); I personally use a combination of both and find that this works best. Both approaches will require the insertion of the fingernail clipper just to the side of the bottom-most latch. You will find that this latch is the most difficult to undo and it, too, will fall back into place. To prevent this from happening, insert the fingernail clipper as shown below immediately after that latch is undone.





Bottom Latch (insert clipper to the side)

Again, you may see a lot of plastic bending as shown in the photos further below. This is quite normal so try not to be too alarmed.

With the fingernail clipper holding the bottom latch away from its plastic tab, use the toenail clipper to try to pry the rivets from the heat-stake points. This takes quite a bit of force (especially for the older Singapore units). I switch between the side approach and the bottom approach with the toenail clipper until the bottom four rivets finally give a loud popping sound. You should use a lever motion to pop the rivets. So long as the toenail clipper remains below the [4] [5] [6] row of keys, you are free to "dig" around without worrying about damaging the PCB (as it does not extend that far down).



Side Approach



Partial Rivet Separation



Side Latch Reset

Note that it is possible one of the middle side latches resets itself during this process. You must make sure that it is undone before completely undoing the set of six rivets at the bottom. Otherwise you may end up bending the top layer more than necessary. Below are some photos of a "normal" amount of bending that goes on during this process.



Bending
(normal result)

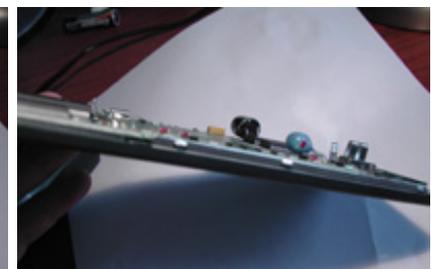


Bent Metal Plate
(normal result)

After the bottom four rivets pop, the remaining two near the [7] and [9] keys are very easy to undo. Just use the toenail clipper; there should be plenty of room to insert it now without having to rely on the fingernail clipper being inserted at the bottom. Once these six rivets are undone, the two halves should appear very separated. If you have not already unhooked the positive battery terminal, make sure to do so now. Then separate the two halves. Chances are you may have bent the metal plate. This can easily be massaged back into its straight form. (With care and experience, it is possible to perform this entire process without bending the metal plate other than at the latches.)

Final Touches

At this point, you will want to straighten the metal plate as much as possible. Use your hands to do this; make sure you are grounded to prevent damage from ESD.





**Straightened
Metal Plate
(i)**



**Straightened
Metal Plate
(ii)**



**Straightened
Metal Plate
(iii)**

It is also likely that the latches were bent as well. Make sure that these are returned to their original state. That is, they need to be angled at about 45 degrees. The edge of the latch that makes contact with its plastic tab from the lower half of the HP48 needs to be almost lined up with the edge of the groove when you look at the latch from the side. If the latches are left horizontal, then the bottom half will bulge out at these latches when you try to close the calculator. If the latches are not properly angled, then the two halves may not be as tight as they should be along the sides. I usually use a pair of needlenose pliers (unteethed) to set the latches properly. If for some reason you need to remove the PCB (say, to repair a problem with dead keys), it is much easier to reset these latches with the PCB removed.

HP48 Projects

Now that you've opened your HP48, you can do any of the following modifications:

- Upgrade the memory (the 128KB upgrade is extremely easy)
- Upgrade the IR range (requires a 100 kOhm SMR type 1206; untested)
- Repair dead keys or missing row/columns of pixels (usually an easy fix)
- Repair the zener diode if your HP48 eats up batteries
- Add electrical tape to prevent shorts underneath the positive terminal
- Add an AC/DC adaptor

Closing the HP48

Before closing the HP48, make sure that you have returned the latches to their original positions. Also double check that the rivet holes in the upper half are not blocked. In the older units, the top rivets are generally very tough to force back into place. Done incorrectly, it is easy to leave minor bumps on the overlay, often near the text indicating the RAM size and near the word HEWLETT (I learned this the hard way). (*This is only a cosmetic nuisance. Incidentally, this bumping affect can happen naturally to any HP48 due to the fact that the overlay is very malleable. So any force on the overlay near rivets can cause this bumping effect. This is often the case when the HP48 is place inside, say, a bookbag. Even inside its protective nylon case, the overlay can still be pressed on, resulting in these bumps.*) Using a pair of needlenose pliers (unteethed), squeeze the four top rivets (on the lower half) at their tips. The idea is to massage the tips with the pliers so as to "soften" them and make them easier to reinsert through their holes. *Do not try to even out each tip so that it is straight with the remaining rivet shaft!*



Flush Latches

(latch edge almost lines up with groove edge)

Once you have done all the necessary preparations, place the two halves together. *Make sure that the positive and negative battery terminals are inserted into their proper holes!* With the LCD side facing up, place a thick but soft material over the keyboard near the six rivets at the bottom. I usually use my comforter as it is thick and yet soft. This should protect the keys and overlay when we apply pressure to the rivet points to force the two halves back together. I normally place the battery compartment area on top of my left palm, and using the palm of my right hand (mostly at my wrist), I squeeze the two halves together by applying force onto the comforter in the rivets area. The rivets should create a popping sound as they pop back into their holes. The lower half of the calculator should be closed now. Squeeze the sides of the calculator to force the latches back into place if needed.

The last step is to force the top rivets back into their respective holes. Do *not* press down on the overlay this time. Try to squeeze the two halves together by pressing down on the plastic areas only. This could be very difficult to do on the older units; sometimes quite a bit of force is necessary. You may or may not hear a popping sound when the rivets are back in place. If you do not hear any sounds, you should definitely feel the two halves coming together at the rivets. Otherwise, they have not set properly. Lastly, rehook the positive terminal onto its holding place within the battery compartment. With care, your calculator should look like an unopened calculator. Moreover, the two halves should feel very tight. (I once accidentally dropped an opened unit from my desk onto my carpeted floor, and it sustained absolutely no damage, and the two halves were still held together very tightly.)

Final Comments

From my experience, it would seem that the Indonesian units are extremely easy to open up. I do not know why, but the rivets are much easier to pop; sometimes they require little to no effort at all. On the other hand, the Singapore units require so much force that, when I was just learning process, I often felt too much force was being applied (even though it was not enough).

When I have some more free time (in a few more weeks), I will add more photos, and the current images will be clickable to show higher-resolution photos. Unfortunately, this may require a great amount of disk space. So if anyone is willing to host this guide and its future revisions, feel free to email me at:

`hduong_NOSPAM_AT_ju_DOT_edu`

(remove the NOSPAM, underscores, and make the obvious adjustments). I will release my repair guides (regarding dead keys and missing pixels) and memory upgrade guides in the near future.

Han Duong

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