The MoHPC Repair Manual

This is a write-up of the collective wisdom that I found in the archives as well as some links to important information on the net with regards to the 9114 disk drives. It is an attempt to combine the large amount of knowledge with regards to the repair of those disk-drives in one convenient location. The order of information presented tries to follow the frequency of particular questions asked as well as the usual step by step test procedure the people knowledgeable about the 9114 suggest.

The appendix contains the full document from Tony Duell with pictures on how to clean the 9114. – ***CORRECTION***: Unfortunately Tony's article is too big (4mb) so it is ***not*** included for now. When I find a way to include it I will amend this document)

While there are numerous consistent providers of advice on the 9114 and I have tried to mention them at the end of this document. I ask for forgiveness if I have overlooked to give credit to certain people, it is solely due to my own limitations. Also, no knowledge provided in here is from myself yet as I was a large beneficiary of the information provided by others I want to find some way to give back something useful as well.

Index

1) How to **find all threads with regards to the 9114** or a particular problem with the 9114 in all archives simultaneously in www.google.com
    a. For all threads on the 9114 type
        i. **9114 site:www.hpmuseum.org**
    b. For all threads on battery packs in the 9114 type
        i. 9114 battery site:www.hpmuseum.org
    c. Etc…
2) A few simple **commands to test/use the 9114**
    a. If you are using a HP 71b
        i. All commands are explained in the HP-IL reference manual which can be found on the MoHPC DVD
        ii. Restore IO -> this will reset the HP-IL loop and give out addresses again
        iii. Start by commands that do not need the drive to check the HP-IL component first
            1. Devid$(1)
            2. Spoll(1) -> this gives you the status of the drive
        iv. Then move ahead and try the commands that need the disk motor to work
            1. Initialize "name:1" -> this will initialize the disk with name 'name'. It assumes that the 9114 is the first HP-IL device in the loop
            2. Create TEXT "name:1",xxx -> this creates a text file with the name 'name' on the 9114 with xxx bytes (in steps of 256kb)
            3. Cat :1 -> will give you the directory of the disk in the 9114
    b. If you are using a HP 41
        i. All commands are explained in the HP-IL manual which can be found on the MoHPC DVD.
        ii. NEWM -> it will format the disk after prompting for the directory size. 50 is fine for testing
        iii. DIR -> gives the directory
        iv. READP/WRITEP (filename in alpha) -> reads/writes a program
3) **The battery pack**
    a. The 9114 does need a working battery to function. It will not work with a dead battery and the charger attached.
    b. The battery in the **battery pack can be easily replaced**. Options for replacement batteries in order of ease of replacement
        i. PowerSonic PS-628. It can be found at numerous stores online (at least for the US) At the time of this writing this store offers it for 12 USD. It is a super easy replacement as it has the exact same dimensions as the original battery in the pack. [1]
            1. Open the battery pack, using a Torx 9 screw driver (you can try a flat head as well, but be careful not to wear out the screws)
            2. Take out the old battery. Make sure to note which cable goes to the minus and plus side of the battery. In my packs, the long, red cable goes to the plus side, the short, black cable to the minus
            3. Drop in the new battery. Double check that you have the right polarity
            4. Close the battery pack
            5. Done

[1] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv011.cgi?read=29575

   ii. 3 2.5Ah 'Cyclon' lead-acid is another option that among others Tony Duell (TD) has used and suggested. They physically fit into the battery pack, you connect them in series to get the desired Voltage. [2]
   iii. In Germany/Europe the Panasonic battery seems to be available from these stores[3]
      1. http://www.batt-mann.de/
      2. http://www.battery-kutter.de
      3. http://www.akku-shop-ladewig.de

c. To **open the battery pack**, you just remove the two screws with a TORX 9 screw-driver and carefully lift the top cover after you lift the various latches situated around the top cover. Apart from the TORX screwdriver, you don't need any other tools to replace the battery inside the pack.[4]
d. You can also fashion a **direct PSU to drive the 9114**.
   i. It has to provide 6V and at least at times provide 2Amp for the 9114. The original battery has specs of 6V, 2.4 Ah
   ii. One suitable PSU can be purchased from Radio-Schack, Part number 273-1696 (link). It can provide both 6V and 6.5V. There have been posts which suggest to use the 6V setting as well as the 6.5V setting. I tried both settings, and both work. [5]
   iii. The most important part is to get the polarity right when attaching it to the male plug on the drive. The slightly longer flat pin is the minus side in my drives, however check carefully before connecting.
   iv. You can NOT use the HP charger directly to drive the 9114. It has the wrong voltage (12V instead of 6V) and provides AC instead of the needed DC. [6]
   v. The little PCB in the battery pack transforms the 12VAC from the HP charger to about 6V DC to trickle-charge the battery. Lead-Acid batteries do not have a memory effect and actually prefer to be constantly charged. Also, when using the drive actively for formatting, reading and writing it is wise to have the charger attached to avoid a loss of power in the middle of a writing operation which could cause data loss
   vi. To stabilize the current, it is sometimes suggested to also have a large capacitor (10000 uF, 10V) in parallel to the PSU. My limited tests worked just fine with the Radio-Shack PSU. [7]
e. Another part in the **battery-packs** that breaks once in a while is a 3Amp or 5Amp **pico-fuse** that looks like a resistor. It is connected between the battery +ve terminal and the output. It has green background and then orange-black-red-red or green-black-red-red. The last red band is for 'fast acting', the other bands are coded the same as resistors and give the value in mAmp. [8] It can be purchased for example here
f. TD has created **schematics for the charger** PCB for both the 9114A and 9114B (together with the schematics for the whole controller board!) and it can be found here(9114A), here(9114B) and purchased here.

[2] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv011.cgi?read=29575
[3] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv011.cgi?read=29575
[4] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv011.cgi?read=29575
[5] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=23806
[6] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv014.cgi?read=57059
[7] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv015.cgi?read=76444
[8] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv016.cgi?read=92898

g. Do NOT short out the fuse if it goes. The battery can provide a couple of hundred Amp if there is a short somewhere in the drive. This will not be pleasant.[9]

4) What disks to use

a. It is generally advised to use try 720kb disks. They can be relatively easily purchased on eBay for little money (at least as of this writing). 720K and 1.44M media is different. The coercivity is different for one thing, and non-HD drives may well not have sufficient write current to use 1.44M disks properly. There is no reason to expect them to work -- they are not simply 'better disks'. [10]

b. Additionally, the HD hole is in the same spot as the 'Disk inserted' sensor in the 9114s. So at the very least, one has to cover up the HD hole otherwise the 9114 will not recognize that disk is inserted.[11]

5) How to open the 9114

a. You will need a TORX 9 screw driver with a long shaft. The screws on the bottom of the drive are deeply recessed so a short screw-driver will not help you.

6) The Eject mechanism

a. Especially with the 9114A, the eject mechanism is prone to getting sticky. This in turn will not only cause the floppy to not come out but also prevent the read/write head to be lifted off the media. If one forces the disk out, this might cause the whole head to be ripped off. A sad thing indeed.

b. TD wrote an excellent article with pictures on how to clean the 9114A drive mechanism.

c. Steve (Australia) also wrote a great article on repairing the 9114, focusing on the cleaning of the drive mechanism and repairing a damaged head. It also includes a step-by-step error identification tree.

d. At least some feel very strongly against using WD40 as a lubricant for the drive mechanism. [12]

e. A series of **high-res pictures** of the disk-drive without the cover showing the head and other details can be found here (Top Overview of Head, Top overview of Head v2, Head Closer from Top,Head Sideways,Head Sideways v2, Head Very Close up, Head Close Up v2)

7) Replacing the drive or repairing/realigning the head

a. The 9114A nad 9114B use different drives! The drive in the 9114A is also used in many HP HPIB drive units (such as the 9133), and in some older Apricot computers. The drive in the 9114B is also used in the HP 9153 (I think). I've never seen it used elsewhere, but many parts (head carriage, stepper motor, analoge ASIC chip, etc) are also used in the Apple 800K drive used on old Macs. That's a possible source of a head. But of course you'd need to align it after fitting (which is not hard, but you do need a 'socpe and alignment disk).[13]

b. What makes the 9114 (and other HP) drive units unusual is that they rotate at 600 rpm (PC drives rotate at 300rpm). So you can't use a PC drive in a 9114 without changes to the controller board.[14]

c. Steve (Australia) describes in his article how to repair the head

d. TD answered how to align the head in a couple posts as follows: Aligning it wasn't hard -- although I did have to buy a 3.5" alignment disk (which was not cheap). It was just a matter of stepping the head to the correct track (as I said, the signals are sufficiently close to

[9] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=24507
[10] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=24507
[11] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv007.cgi?read=15271
[12] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=24305
[13] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv012.cgi?read=32014
[14] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv012.cgi?read=32014

standard that a normal drive exerciser will work with an adapter cable), connecting a 'scope to the head preamplifier testpoints and adjusting for the right catseye pattern. Here's roughly how to align the trimmers on the controller board. You'll need the WD2793 data sheet because the procedure is _exactly_ as described in there -- HP made things easy for us. What you do is remove the controller board and put it on you bench component-side up. Power it up -- I normally use the switch wiring harness for this (plugged into J2 on the controller) with a 6V bench supply connected between the white (ground) wire and the White/Red wire (+ve). Then pull the '3060' jumper, which should stop the darn thing powering down while you're working on it. Move the jumper near the 2793 chip from the 'N' position to the 'Adj' position (this puts the 2793 into setup mode, and must be done _after_ powering up the board). Connect a 'scope or frequency counder to TP3 ('VCO'). Adjust C15 to set up the free-running read clock frequency. Connect the 'scope to TP2 ('RPW') and adjust R10 to set the read pulse window width. Connect the 'scope to TP1 ('WPW') and adjust R11 for the correct write precompensation delay -- this one is not too critical. As regards aligning the heads in the 9114A drive mechanism, it goes like all drive alignments. Connect the drive to an exerciser (or kludge one up using a PC and parallel port ...), the connect a differential-input 'scope to TP101 and TP102 on the drive logic board on FC9 PCBs or a normal 'scope to pin 1 of CN107 on FC16 PCBs. Pop in the alignment disk, step the head to the right track, and observe the catseye pattern. If one lobe is larger than the other, loosen the stepper motor mounting screws and rotate the stepper motor to align the head.

e. James McPhail did a realignment and the values for the test-points 1-3 are as follows: [15]
    i. TP1 (WPW) should be adjusted to 125 ns (high)
    ii. TP2 (RPW) should be adjusted to 250 ns (high)
    iii. TP3 (VCO) should be adjusted to 500 KHz

8) Testing of the controller board

a. TD created **schematics of the controller board** in both the 9114A(link) and 9114B(link). A high-res picture of the controller PCB with names to locate the various parts can be found here

b. The 9114A has a series of self-tests that can be invoked with the correct jumper settings on the controller board. This procedure is explained in the HP9114A service manual on page 14, 15,16 which can be found here. Especially the first (RAM, ROM, FDC,PIA) and second (HP-IL) are quite useful as they can provide a clean bill of health to a large set of areas on the controller board and/or indicate an area of error. When initiating the self-tests, take the SVC jumper piece out, then turn on the unit and then use it to short the SVC jumper within 5seconds (30 seconds with REV A Roms). I made the mistake at first to short out the jumper before powering up the unit and this does not initiate the self-tests.

c. The PSUs on the controller board
    i. There are 3 power rails in a 9114A[16]
        1. Vc on TP8, which is 5V all the time the unit is switched on (it powers the RAM chip, etc)
        2. +5V on TP10 which powers the rest of the logic and which is turned off when the unit goes into powersave mode
        3. +12V on TP9, which is only turned on to the drive power connector when the unit needs to operate the disk drive motors.
        4. common Ground is found on TP11 (for the –ve side of your voltmeter)

[15] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=24305
[16] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv017.cgi?read=113349

ii. To check out the +5V PSU: Here's how it should work : U105 (MC1403 I think) is a +2.5V voltage reference. The output of that goes (amongst other places) to the top end of the potential divider formed by R105 and R104. This maintains the +ve input of U101a (LM358) at +0.5V. The -ve input of U101a comes from the tap on the potential divider formed by R107 and R106. The top end of that goes to the +5V line. R017 and R106 are chosen so that the -ve input of U101a is at 0.5V when the +5V line is correct. Thus U101a acts as an error amplifier, comparing what the 5V line _is_ (tap of R107 and R016) with what it should be (tap fo R105 and R104). The outptu of U101a goes to the base of Q102 via R102. Q012 drives the base of Q101, which is the pass transsitor between the battery voltage and the +5V line. If U101a detects that the +5V line is too low, then it drives Q102 a little harder, which in turn drives Q101 a little harder, thus bringing the +5V line up a bit. There is one more circuit to consider.Q103's collector is connected to the base of Q102, and its emitter is grounded. Therefore id Q103 is turned on, Q102 and Q101 will be turned off, thus turning off the +5V line to save the battery. OK, how to debug it. Start by measuring the output of U105 (e.g at the -ve input of U104b (MC3302). If it's not 2.5V, check U105, CR102, and look for shorts on the reference line. Then check the votlage at the +Ve input of U101a. If it's not 0.5V, check U101, R105, R104. Then check the voltage on the -ve input of U101a. If this _is_ 0.5V (even though the +5V rail is low), then check U101, R106, R107. Now check the Q/ ouput (pin 8) of U6b (74LS74). This should be a TTL low. If it's not, then the PSU is being turned off under software control. Find out why. Check U6. Check U15 (very unlikely). Check the output of U104b (MC3302) with a 'scope. This is a reset line for the HPIL chip and power-on logic, and should go low briefly at power-on). Check CR101 too. OK, if it's not being turned off by software control, then check the 3 transistors Q101, Q102, Q103.[17]

iii. To check out the +12V PSU. U108d and U107 form an oscillator. It can be controlled by U108c which compares divided-down version of the 12V line with the reference voltage. The osciallator also feeds a monostable U106 via U108b. The output of that drives the swtiching MOSFET Q105. The 12V supply really comes from the back EMF on L101 when Q105 turns off. Now, if you have battery voltage at the 12V TP, L101 (switching coil), L102 (output filter coil) and CR103 are most likely fine. I would start by looking at the output (pin 3) of U106. There should be oscillations here. If you can't use a 'scope, maybe connecting a meter here will show something around half the battery voltage, but I'd prefer to check it was actually oscillating. If that checks out, it could be that Q105 has failed.[18]

9) Main contributors

a. Tony Duell, who provided schematics for the 9114A&B, a detailed article on how to clean the 9114A as well as numerous posts on the inner workings of the 9114
b. Steve (Australia) who created a very good article on how to trouble-shoot the 9114, including a description on how to repair a damaged head
c. Dale Richmond who provided the information on how to fashion a direct PSU without the battery pack
d. David e, Philip, Victor, Raymond Hellstern amongst others who have suggested the PS-628 as a drop in replacement for the battery as well as webpages where they could be found

[17] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv009.cgi?read=24507
[18] http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/forum.cgi?read=114082

e. Howard Owain who provided pictures and info on using a large capacitor with an fashioned external PSU
f. Andreas Mueller, Christoph Klug and Raymond DelTodo who provided websites for Germany for the drop-in replacement battery
g. Mike and Katie Wasserman who provided info on the picofuse
h. Luis Viera who provided the tip on covering the hole for HD disks
i. PeterP who provided a labeled picture of the controller PCB

Apendix 1

"*Repairing the eject mechanism of the full height Sony 3.5" disk drive"*, by Tony Duell, #788

Article text starts at next page