

Operation: Refurb 2020

By Dr Richard Holmes

I've been working on several projects during lock-down. This was only possible due to the excellent guides provided by www.iFixit.com, and I am indebted to the many users of this site for the hard work they put into documenting repair work and creating the breakdown guides. They are big supporters of the **Right to Repair** initiative and the restart project



<https://therestartproject.org/right-to-repair/>

Now, an important thing to say at this point is I'm an Apple fan. I love the build of the machines, find the operating system excellent and intuitive, and find that I can work far more efficiently on a Mac than anything else. I have used Windows and Linux and will use them when I have to, but for me, its Apple all the way. I can do everything I want quickly and with ease.

I've managed to collect a few machines, and still use most of them in one form or another. My primary system is a 13" mid-2012 MacBook Pro 9,2, with an additional screen and

soundbar plus an external keyboard and mouse. It does everything I want at the moment, so there is little need to upgrade. I've upgraded the RAM to 16Gb and added a solid-state drive.

The other systems I own are: -

- 24" iMac Core2Duo – 2006 Model
- 13" MacBook Pro – 2009 Model
- 13" MacBook Pro – 2012 Model (My wife's system)
- G5 PowerPC Tower – 2005 Model – purchased in 2020
- 20" iMac Core2Duo – 2007 Model – purchased in 2020

Now, I'm quite familiar with most things IT related, and have spent significant periods working inside PC desktop systems, building and upgrading at the component level. One of the criticisms of Apple Computers is the lack of easy user access to upgrade and service. This is especially true with the Laptops and iMacs I own, and more so with the newer designs, so to be honest, I've mostly shied away from any significant upgrades beyond replacing the SATA drive with an SSD and upgrading RAM. The idea of removing the motherboard and cleaning the heatsinks was not something I felt comfortable doing, as there are a large number of tiny connectors which are easily damaged.



Figure 1 - Inside a 24" iMac Core2Duo

Anyway, a few years back (2016), my 24" iMac decided to kill its hard drive, and I was left with a lovely system which no longer functioned. I had several choices but decided to take a chance and disassemble this machine using instruction guides on iFixit to replace the Hard Drive.

I was delighted with the result – a fully functioning iMac which at the time also doubled as my TV. I cleaned the fans and vents but did not go any further, which with hindsight was a wrong move, as I could have saved myself some work.

Anyway, rolling forward to 2020.

I first purchased some Arctic Silver Thermal Compound and made sure I had a screwdriver set with a wide variety of heads – the iFixit guide details the types of screws to expect and they even sell a handy repair kit.

1) 2009 – 13" MacBook Pro



Figure 2 - 13" MacBook Pro 2009 model

I practised on an older model before attempting my primary system. I have 2009 13" MacBook Pro, that served as an excellent guinea pig. I was in the process of loaning this to a friend so that she could use Netflix downloads during the lock-down; however, I needed to Windows 10 install, and the system ran far too hot to be useful. With nothing to lose, and everything to gain, I opened the laptop up, and following instructions on the iFixit guide stripped the system down to its components, cleaned the fans, removed and reapplied thermal paste to the CPU and GPU and rebuilt it. This particular laptop had



Figure 3 - 2009 Macbook Pro running Windows 10

suffered from excessive heat for a while, and it turned out that the thermal paste had dried to a powder, and the fans were full of. Now, it runs very well under OSX, the CPU runs cool and whilst it's a little slow running Windows 10 via Bootcamp, it has more than served its purpose – not bad for an 11-year-old laptop.

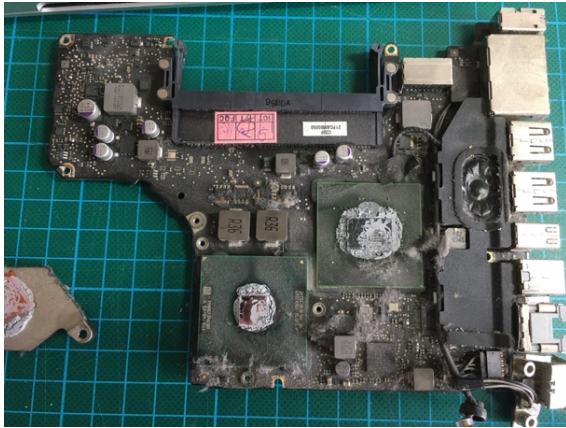


Figure 4 - MBP Mainboard before cleaning (Heat sinks removed)

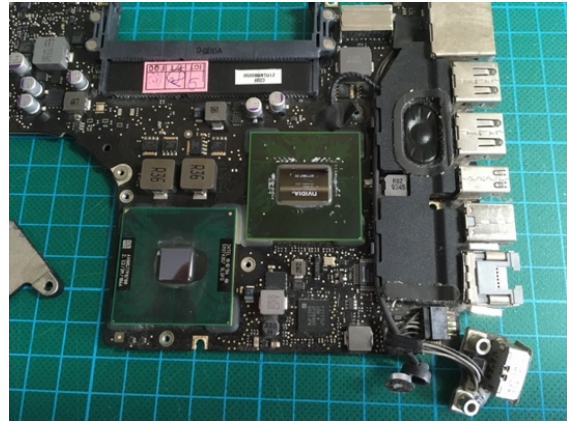


Figure 5 - MBP Mainboard after cleaning (Heat sinks removed)

2) 2006 – 24" iMac Core2Duo



Figure 6 - 24" iMac Core2Duo (2006 model)

The next system I tackled was my 2006 iMac Core2Duo. I had previously opened this up a few years ago to replace the Hard Drive, as this died, so it wasn't quite as dusty as the 2009 MacBook Pro, but the thermal paste on the CPU and GPU seriously needed replacing.

My wife uses this system as a media player, and the 24" screen is excellent for videos.



Figure 7 - iMac CPU with dried thermal paste

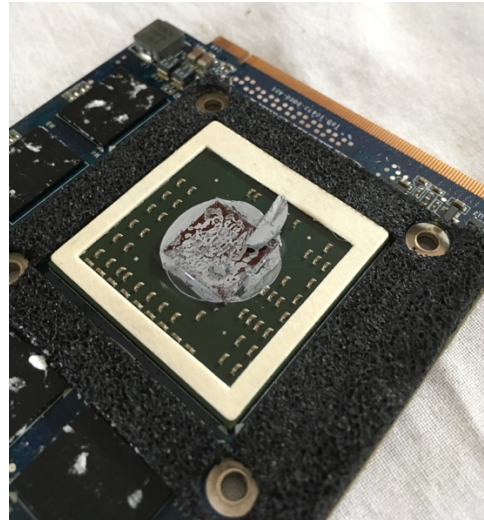


Figure 8 - iMac GPU with dried thermal paste

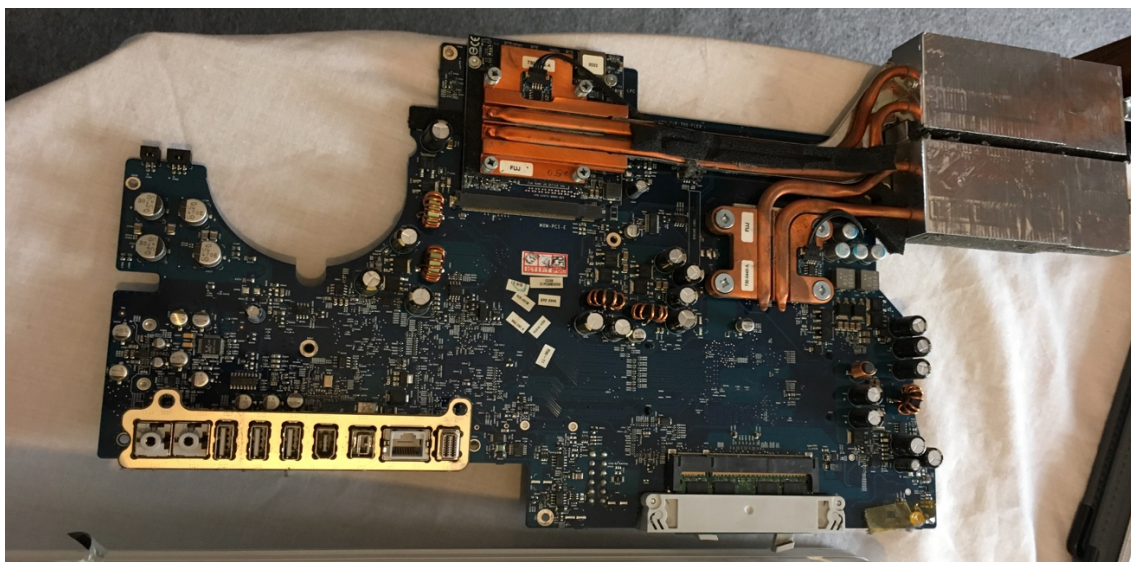


Figure 9 - 24" iMac Mainboard with heatsinks attached

Before this clean, the system had been quite temperamental, with the GPU overheating and causing a kernel panic. Disabling the GPU by deleting the NVIDIA driver (next file found in /system/library/extensions/) and using graphics via the CPU worked for a while, but the plan was still buggy.

Following the clean – it now runs like a dream and rarely gets over 40°C.

3) 2012 – 13" MacBook Pro (1)



Figure 10 - 13" MacBook Pro (2012 model)

The machine I use daily is a 13" MacBook Pro – mid-2012 model with a 2.5GHz i5 CPU. I maxed out the RAM and added a solid-state drive a while ago, and this system still runs fantastically. Granted it's not up to the spec of the new Apple MacBook with M1 ARM processor – but I don't need that (sure, I'd like it, and if anyone fancies buying me one, I won't turn it down).

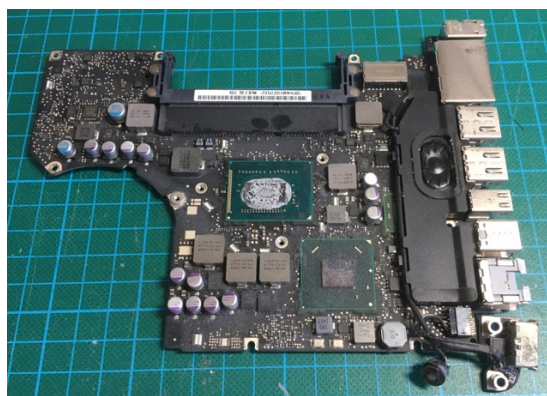


Figure 11 - MBP Mainboard before cleaning (Heat sink removed)

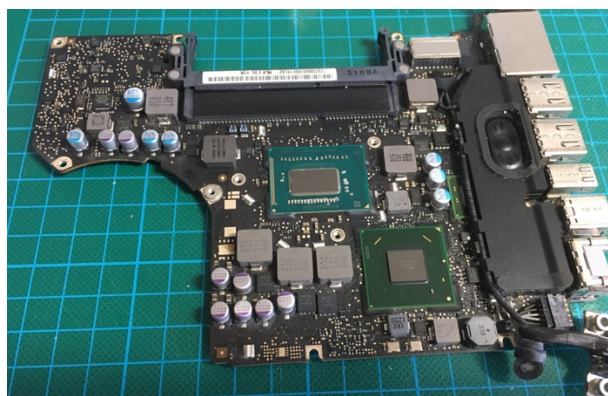


Figure 12 - MBP Mainboard after cleaning (Heat sink removed)

Still, as a 2012 model, it's seen a fair bit of use, so I decided to give it a deep clean. Again, following instructions on the iFixit guides, I stripped the system down to its components,

cleaned the fans, removed and reapplied thermal paste to the CPU and GPU and rebuilt it. Now, unless I'm playing games – which I don't tend to do very often, the CPU rarely gets over 60°C, and the fans are silent.

4) 2012 – 13" MacBook Pro (2)



Figure 13 - 13" Macbook Pro (2012 model)

The last system was another 2012 13" MacBook Pro; however this one belonged to my wife – so extra care is required – it's one thing to break your own computer, but someone else's is a different matter.

Happily, there were no issues, the system was cleaned, and thermal paste reapplied. It runs a little hotter than my system, but that's mainly due to the number of Chrome tabs frequently in use.

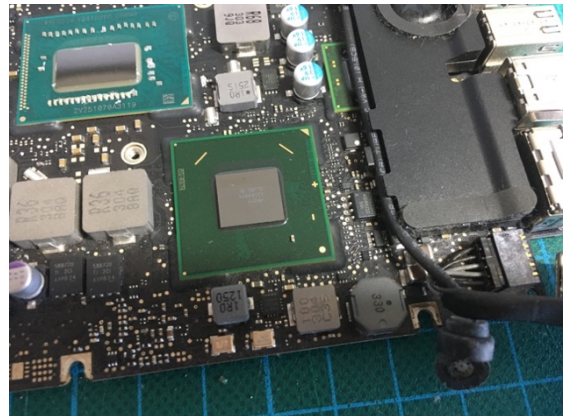


Figure 14 - MBP Mainboard following cleaning (Heat sink removed)

Both the 2012 MacBook Pros are running very well for 8-year-old laptops.

5) 2005 - PowerMac G5 Dual 2Ghz G5 PPC



Figure 15 - G5 Powermac Tower (side view)



Figure 16 - G5 Powermac Tower (oblique view)

Jumping a few months forward, I was fortunate enough to spot an Apple G5 PowerPC on Facebook Marketplace for sale at an excellent discount price.

The G5 PowerPC was non-functional when I received it, and this needed a bit more work, however not in terms of CPU and GPU cleaning as previously completed. This system required a full wipe and a reinstall of OSX to 10.4, but without any boot disks, I ran into problems. This combined with memory issues which caused kernel panics, it was a bit of an uphill slog, requiring me to delve into the Open Firmware (BIOS for Macs), and scour the internet for downloadable legacy software.

<https://www.macintoshrepository.org>

<https://macintoshgarden.org>

The two sites above provided access to the software, but additional information was sourced from a wide range of locations in an attempt to burn the downloaded installer files to DVD as a boot volume. Failing at this several times made me decide to use a USB flash drive as a boot volume, but this also came with inherent problems.

The issue was that newer Macs run 64-bit operating systems, whereas the older macs are 32-bit. Plus, Apple has a habit of removing and changing features it no-longer deems necessary from the User Interface elements of OSX.

Prepare Bootable disk - On modern Mac

Open DiskUtility

1. Use "Scan image for restore" feature found under IMAGE menu.
2. Scan the downloaded DMG file.
3. Then, open Terminal and enter the following

```
sudo /usr/sbin/asr restore --source BaseSystem.dmg  
--target /Volumes/MyVolume --erase
```

NOTE: Disk Utility needs to be given FULL DISK ACCESS from the [SECURITY AND PRIVACY/privacy] in [SYSTEM PREFERENCES]

G5 PPC - Boot from USB

1. Insert USB into G5 and restart.
2. Boot and Hold [ALT]
3. Select Installer
4. Format drives using disk utility
5. Set date using terminal - otherwise the installer fails
6. Install OSX

Fortunately, I'm competent with Terminal and was able to piece together the required commands,

Once I was able to install OSX, I discovered a new issue with the RAM modules. Of the 4 x 512Mb RAM modules installed, two were non-functional but essential for the system to boot, and two were faulty - only registering as 256Mb each.

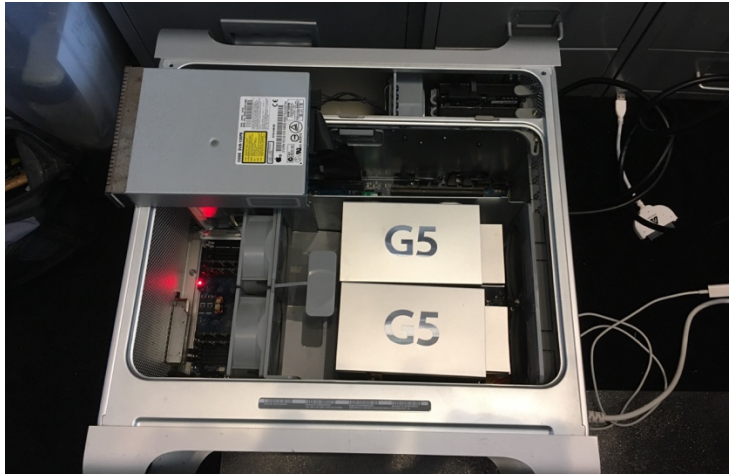


Figure 17 - Open-heart surgery on the G5 Powermac.

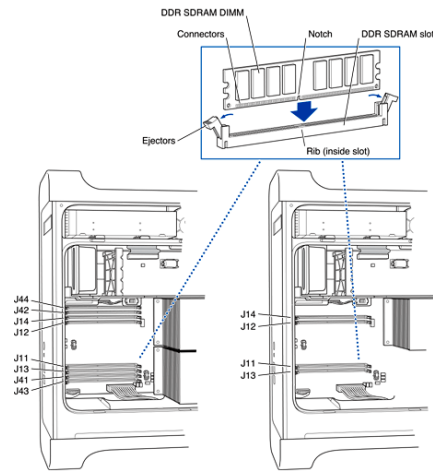


Figure 18 - RAM configuration for Powermac G5

Eventually, I found the solution, and through a combination of luck, skill, and tenacity diagnosed the issues. Since the G5 architecture required matched pairs and also needed at least RAM banks 1 & 2 to be populated, this was quite a conundrum. Fitting all four modules meant that the system booted, but only registered two of the RAM modules (in banks 3 & 4) – giving a total of 512Mb rather than the expected 2Gb (4 x 512Mb Modules). However, the two faulty RAM modules which failed to register in Open Firmware or OSX had to be installed in banks 1 and 2; otherwise, the system refused to boot. Fitting the two semi-functional modules in banks 1 & 2 failed to boot.

With no other option, I sourced new RAM, and now, it runs perfectly. Initially, I purchased 2 x 512Mb modules, and then a further 4 x 512Mb modules once I was confident the system was working.

My financial investment was: -

| | |
|-------------------------|------------|
| G5 Tower | £25 |
| 6 x RAM modules @ £3 ea | £18 |
| PRAM Battery | £4 |
| DVI to VGA cable | £6 |
| TOTAL | £53 |

Pretty good considering the system would have cost over £2,000 when new.

On the software side, I was able to obtain an original copy of the G5 PPC installation disc. It cost £20 on www.ebay.co.uk but was worth it, as I wiped the OS I had previously installed and restored using this disc. This gave me the added advantage of installing the Classic Mac OS9 alongside OSX. Although the G5 PowerMac cannot run OS9 in native mode, the classic

environment enables access to all relevant software and makes for a complete user experience.

6) 2006 – 20" iMac Core2Duo



Figure 19 - 20" iMac Core2Duo (2006 model)

My final project was a second Core2Duo 2.16Ghz system. Purchased second hand, again on Facebook marketplace for the princely sum of £25, this required a complete wipe of the hard drive, OSX installing and updating to 10.5 and a clean of the cooling systems – it was pretty grim inside.



Figure 20 - The cooling system blocked with dust.

I made an exciting discovery – the Core2Duo CPU is replaceable in these models, using a ZIF socket.



Figure 21 - iMac Intel Core2Duo CPU before cleaning



Figure 22 - iMac Intel Core2Duo CPU after cleaning

I also replaced the thermal paste on the CPU and GPU Heatsinks as this was aged and dried.

I was successful in rebuilding the iMac, and it is operating exceptionally well too – but I have come across a problem. I was not able to test the drive before I dismantled it, however, following reassembly, the DVD drive fails to spin up, and ejects any discs after a few minutes attempting to access data. Since it's impossible to know if I damaged something whilst rebuilding the machine, or if the DVD drive was faulty before my maintenance, my only option is to strip it down and investigate. I suspect its either dirt/dust in the mechanism or a failed mechanism, as the drive is detected under OSX – so it may need to be a replacement.

More on this later.

Addendum

One advantageous method I have adapted from the iFixit site is taking note of where the screws came from. The guides colour code the screws by length and head type for each stage, so I did the same – using a few pages of A4 and some Sellotape to arrange the screws in a useful manner.

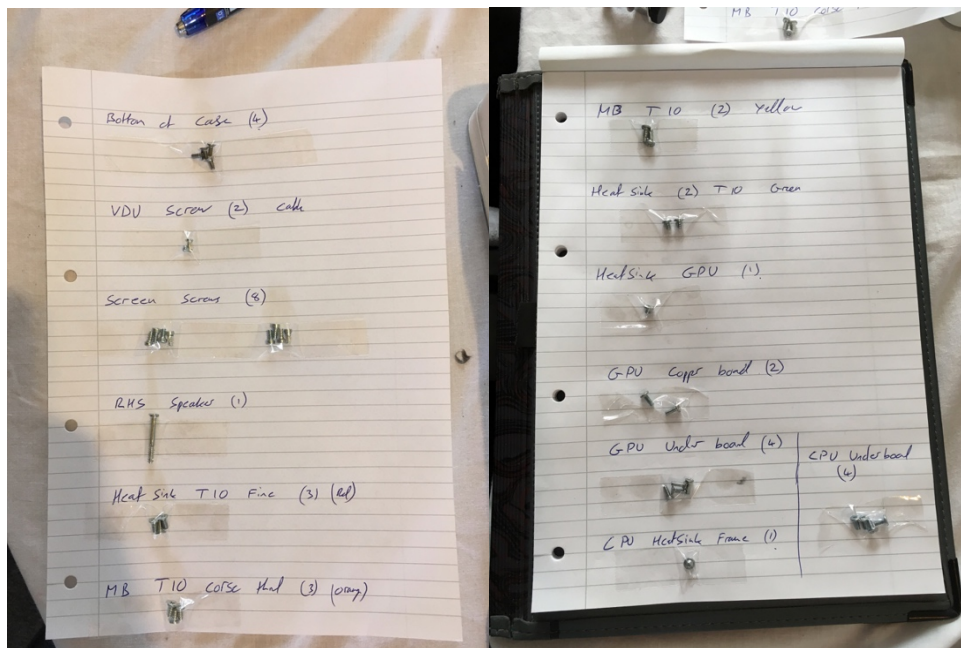


Figure 23 - Example of the organisational method employed during assembly/disassembly.