



Mac Pro 2009-2012 Dual CPU Service & Repair

Mac Pro 5,1 Dual CPU If you are lucky and you...

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INTRODUCTION

Mac Pro 5,1 Dual CPU

If you are lucky and you have made a wise choice, you will be the proud owner of a pre-used Mac Pro 5,1 dual processor machine. This repair guide is designed to take you through the initial inspection of your machine, its first periodic service and the repair where needed. In this Service & Repair Guide you will be taken you through the steps that I followed with the inspection, service and repair of a Mac Pro 5,1 Dual Processor machine recently purchased.

Service

The periodic service includes cleaning dust from the heatsinks, PCBs, fans and the interior of the Mac Pro case. It also includes re-pasting the heatsinks on the CPUs and the northbridge chip. This service should be carried out at least once a year for optimum performance of your machine.

Repair

Repair usually includes two items that are known weak points in the Mac Pro 5,1. The northbridge heatsink is held in place with spring-loaded plastic stays. The stays are subjected to high temperatures, and after a few years they become brittle and often break off. These machines are approaching ten years old, so you can safely assume that they plastic stays are either already broken or are about to break. If these break off and the heatsink moves away from the surface of the chip, the chip will overheat, fail and take your processor tray with it. They must be replaced! See the document "Upgrade Tips" for more information about this flaw in the Mac Pro 4,1 and 5,1 computers.

The second known issue with these computers is the inadequate Blue Tooth antenna. It is located behind metal components inside a metal case, and does not function as it should. May users experience this as lag on Blue Tooth items such as the Magic Mouse.

Both of these repairs are explained and illustrated in this Repair Guide. In addition, I encountered a sloppy error on the SSD that required repair.

TOOLS:

3mm Hex Key T-grip 15 cm long. (1)
Flat Needle Nose Pliers (1)
Anti-Static Brush (1)
Japanese Industrial Standard #1 (1)
ESD Safe Blunt Nose Tweezers (1)
Cordless Driver/Drill (1)
Precision Drill Bits Metal (1)
Metal File (1)

PARTS:

3M stainless steel bolts 16 mm long (2)
3M stainless steel washers (4)
3M stainless steel nuts × 2 (2)
3M nylon washers. (2)
Arctic Silver Thermal Paste (1)
Arctic Silver ArctiClean (1)
Microfiber Cleaning Cloths (4)
Compressed Air (1)
2.4 GHz Indoor Omni-Directional Antenna (1)
RP-SMA Pigtail Antenne WiFi Kabel (1)

Step 1 — Heatsink Stays, Blue Tooth Antenna



- Clear a suitable table of all irrelevant items. I always clear my table before starting work on any machine, to avoid the possibility of accidentally exchanging components with those from another machine or losing small items like screws. Lay out your tools and materials, as shown here.
- Some people service their computers without using an anti-static mat. Usually this doesn't cause a problem. However, it takes only one spark of static electrical discharge (SED) to destroy a computer. It is wiser to take precautions against this possibility by using an antistatic pad as described here.

- I recommend the Lindy Anti-Static Service Kit.
- The green & yellow cable (right) will be clipped to the central heating radiator, which is well grounded through the plumbing. Components that have been removed from the computer should be grounded with the black clip while they are being handled. The stretchy blue cable goes to the wrist connector.
- Avoid working in a room with a carpet made of synthetic fibres, especially if you are wearing silicone rubber soled shoes. If you cannot avoid this, take your shoes off.
- My practise is to place my tools and material on the left side of the mat. The area to the right will be used to temporary placement of components from the machine that is being serviced or repaired.

Step 2



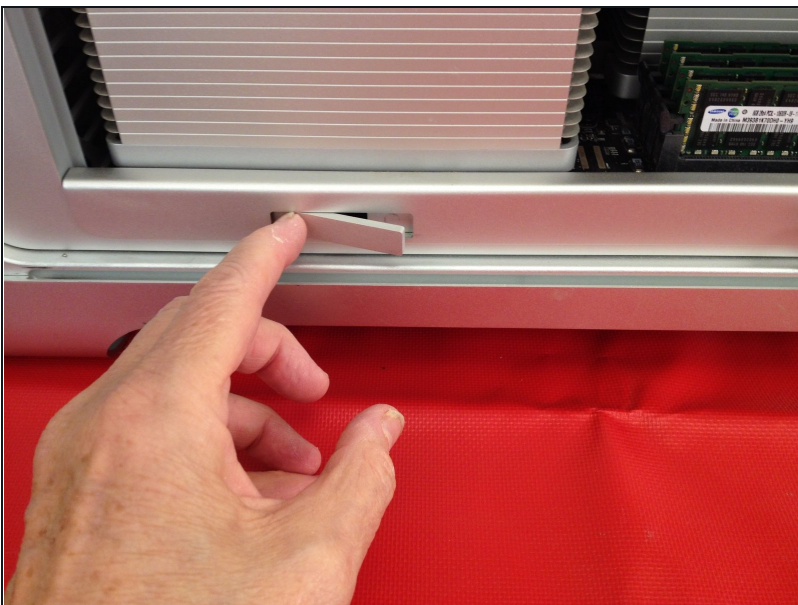
- The computer is placed on the anti-static pad and is grounded. It is therefore not necessary to attach the black clip to the computer case.
- Open the computer and remove the lid. Put the lid on the edge of the anti-static pad. This will give you additional grounded area for putting things aside while you work.
- Upon opening this computer I noticed that the lid had come from a Mac Pro 3,1. This is an earlier model. The lids of the 3,1 are interchangeable with the lids from the 4,1 & 5,1. Here is evidence of careless work practices of at least one prior owner. Upon inquiry I was told that the item was exchanged to give me a cleaner unscratched lid.

Step 3



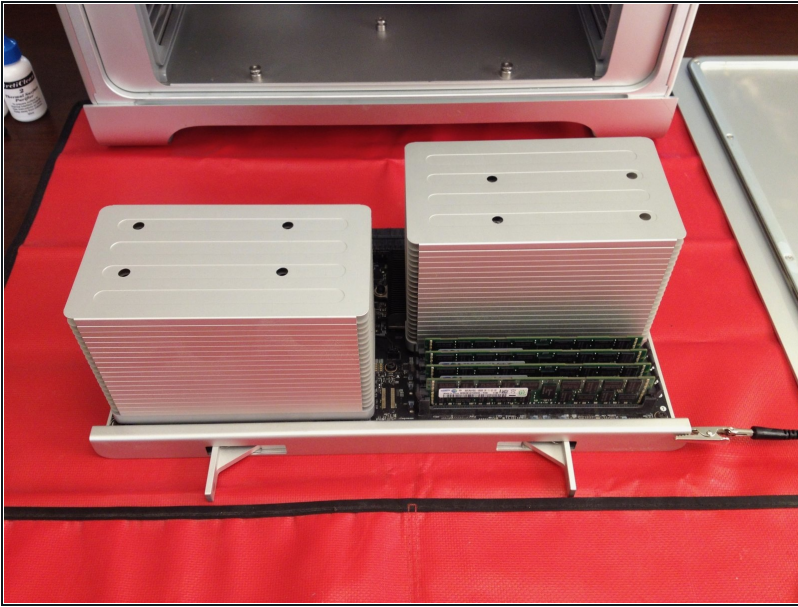
- Attach the wrist cable to your wrist before you handle electronic components. Wet your wrist with salty water or lick your wrist to ensure a good electrical contact. Make sure this stays on your wrist while working on the Mac Pro computer.
- You do not need to worry about getting a shock. However, do not handle mains powered equipment while grounded like this. Battery powered drills and screwdrivers cannot give you a dangerous shock and are safe to use.

Step 4



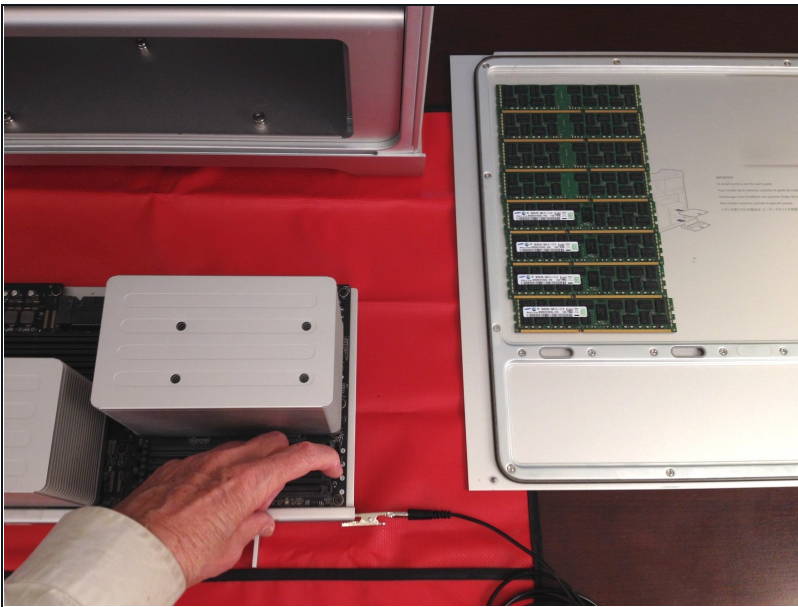
- Press the two latches (one can be seen here) to decouple the CPU tray from the case.
- Take a moment to marvel at the high quality engineering and design of this Apple product. After breathing a deep sigh of satisfaction, proceed to the next step.

Step 5



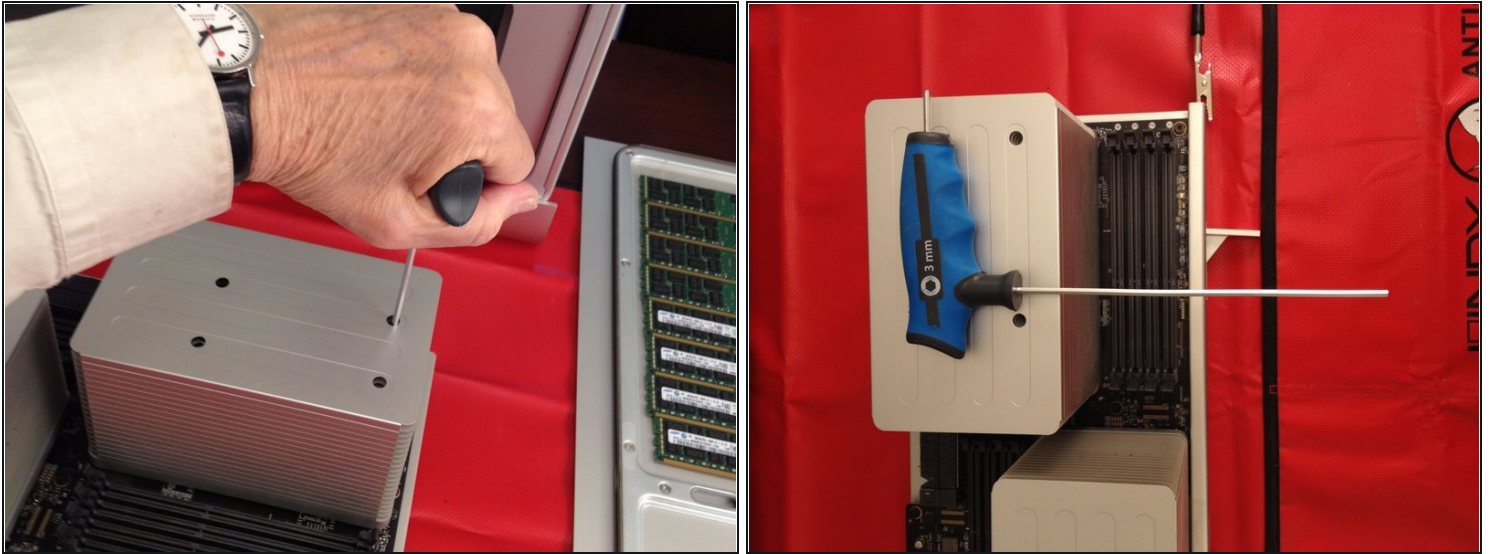
- Take out the CPU tray and place it on the anti-static mat. Clip the black ground cable to the tray.

Step 6



- Remove the memory cards and place them on the computer lid. Place them in ascending order so that you can return them to the same slots when re-assembling your machine.
- Close the latches on the memory slots. If they are left open they can more easily be accidentally broken off or damaged.

Step 7



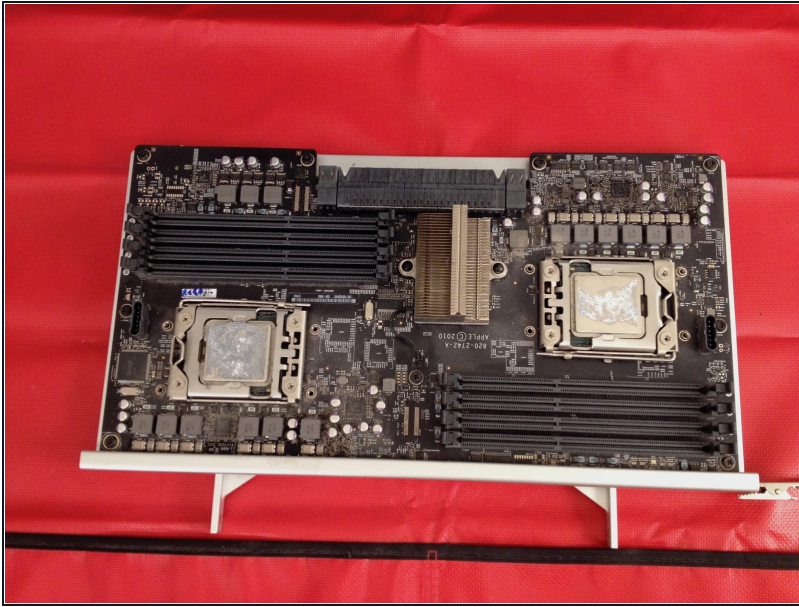
- Use a 3 mm hexagonal wrench to release the heatsink. The wrench must be at least 15 cm long.
- Release the holding bolts ONE TURN at a time, following an X pattern (top left, bottom right, top right, bottom left) and continue until you hear a release click in each of the bolts. Note: do not completely undo one bolt and then move to the next. Repeat the X pattern, making one turn at a time, until the heatsink is released from the PCB.
- When you replace the heatsink use the same pattern to tighten the bolts. Do not tighten more than finger tight. Make sure that the same tension is applied to each of the bolts. Uneven pressure can result in the CPU contacts failing. Symptoms range from boot-failure to missing or malfunctioning memory cards.

Step 8



- Put the heatsinks on the lid in the same relative position they had on the CPU board. The heatsinks are not the same. This will help ensure that they are later returned to the correct positions on the CPU board.
- You can see on the heatsink at the upper right, which came from CPU A, that the thermal paste did not cover the occluding surface of the heatsink. This attests to careless pasting and assembly by the prior owner.

Step 9



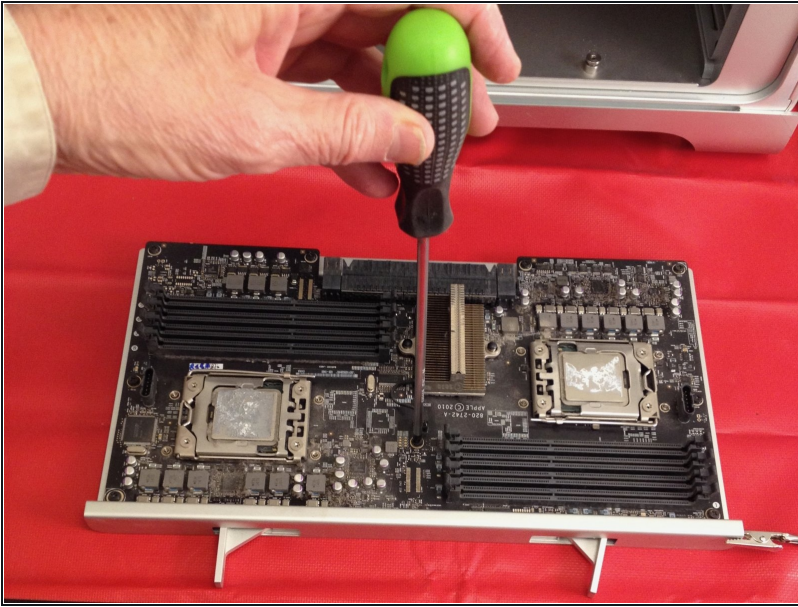
- Here you can see that the thermal paste covered about two thirds of the surface of CPU A.
- Before performing this service and repair measurements had been taken of temperatures and fan speeds. I installed Macs Fans Controller software and set limits on the temperatures permitted. The Booster Fan in the CPU A Heatsink was working hard to keep the temperature down. Here we see one reason why.
- Incidentally, I recommend installing Macs Fan Control. Read the document Upgrade Tips to find out how to configure this software for optimum Mac Pro protection.

Step 10



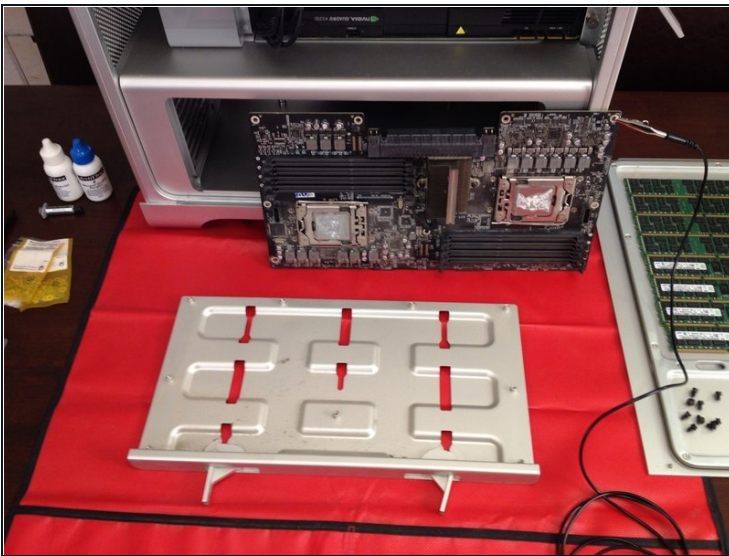
- The CPU PCB is filthy. It is covered in dust and grime.
- Dust acts like a blanket that keeps the PCB warm. Hot components are more likely to fail. A hot computer drives its fans hard in an attempt to keep cool, using more current and making noise. The life of the fans is also reduced.
- This dust is another reason why this computer was having difficulty keeping cool.
- The PCB and heatsinks, fans, case interior and other components should be cleaned regularly. Later in this Service and Repair Guide you will be shown how to clean this PCB.

Step 11



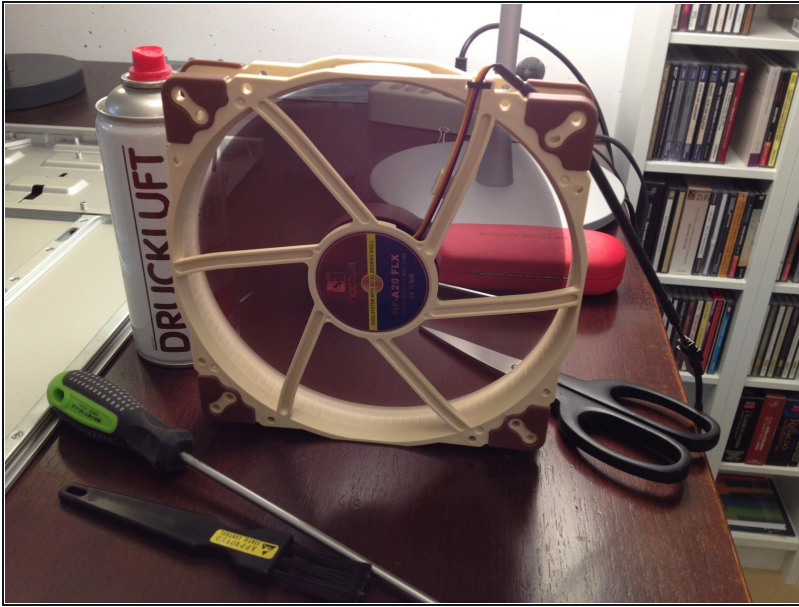
- Remove the nine screws holding the PCB to the tray.
- Place the screws on the lid, to the right of your working area, in the well below the memory cards. This will prevent the screws from rolling away.

Step 12



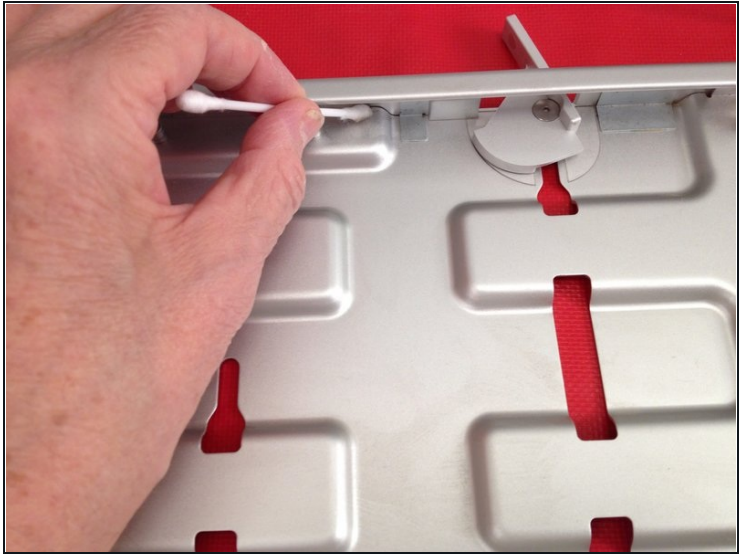
- Remove the PCB and put it in a place where it is grounded. Here it is out of the way leaning on the computer.
- Note the nine PCB screws on the lid; bottom right.
- You will discover dirt and grim on the tray under the PCB. This may not directly cause the PCB to become warm, but it can build up enough to impede the flow of air and reduce the effectiveness of the fans. This should be cleaned.

Step 13



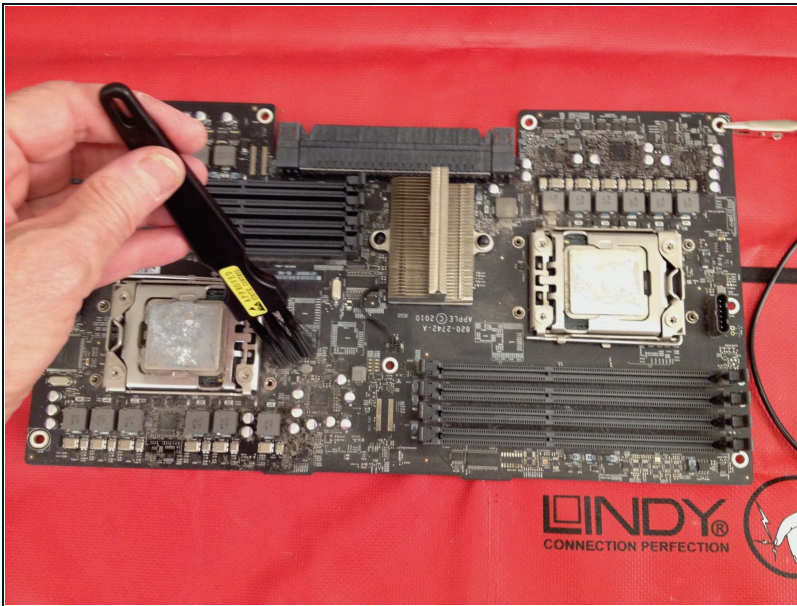
- In the following steps you will be using isopropanol, also called cleaning alcohol, to clean your computer.
- Work in a well ventilated space. isopropanol is volatile and fumes off quickly. It is not healthy to breath isopropanol fumes. Set up a fan to blow away the fumes from your work place.
- Here you can see a Noctua fan, an excellent choice. It is the highest quality fan on the market for electronic cooling applications, and it is inaudible in operation.

Step 14



- Lose dust can be blown away with compressed air. Pressure packs are available for this purpose at most consumer electronic supply outlets.
- Compressed air is especially useful for cleaning the interior of the heatsinks, cooling fans and other areas in the case that are hard to get at.
- Clean the difficult-to-reach areas on the tray with cotton buds soaked in isopropanol. Use lint-free cloth, or wet-strength paper towels to wipe the open areas.
- I also use eye-glasses cleaner pads to give the tray a finishing shine. The lint-free wet-strength paper that comes in eye-glasses cleaner packs is suitable for other cleaning tasks on the Mac Pro.

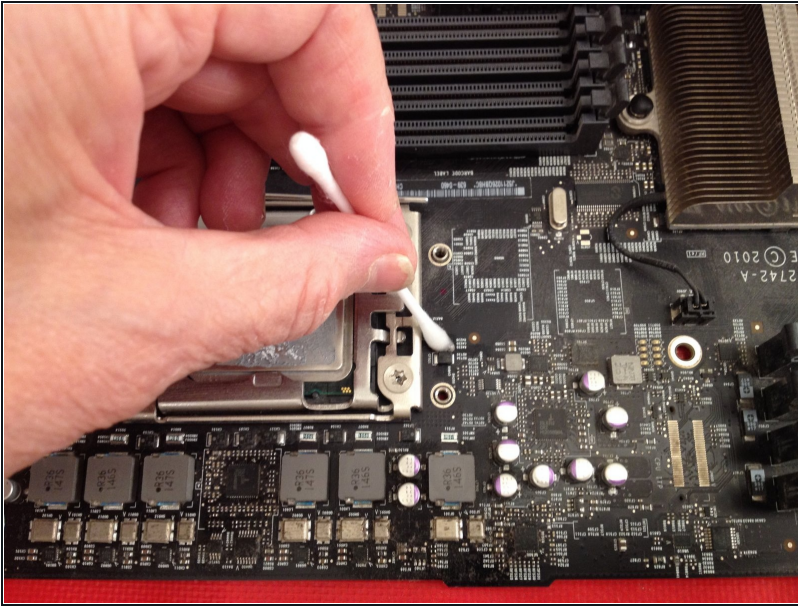
Step 15



- You will find lots of dust, and sticky gooey residue on the PCB. The gooey residue is heat-sealant from the thermal pads that lie on the R36 current regulators. The heat sealant often leaks from the thermal pads and drips onto the PCB. The gooey residue captures dust and should be cleaned away.
- After blowing with compressed air, use an antistatic brush to dislodge grimy chunks. Do not use any brush that may be available. Most brushes cause static charge to build up and can damage the electronic components.
- On some YouTube videos you will see people cleaning their PCBs and the inside of their computers with vacuum cleaners. This is risky for several reasons. The plastic tubes of typical vacuum cleaners can carry electrostatic charges. The brush tip of domestic vacuum cleaners is unlikely to be made of anti-static material.

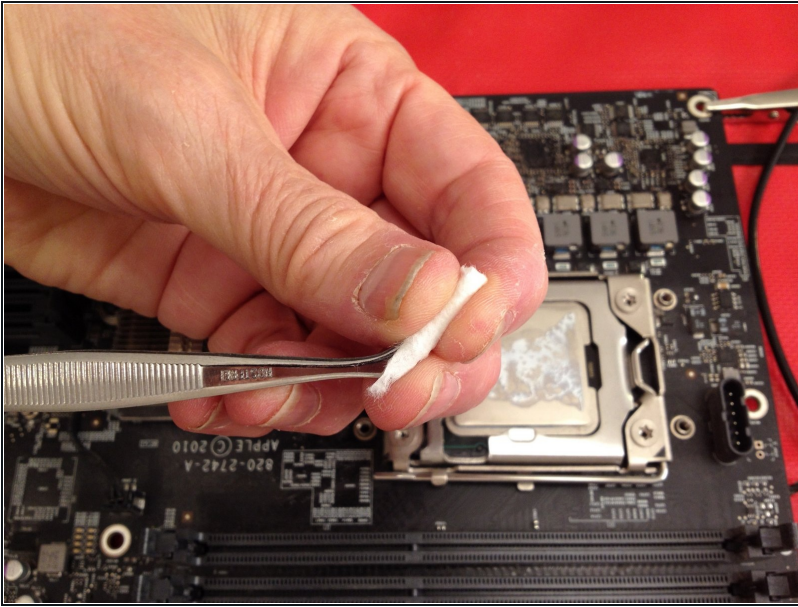
- Furthermore, you should avoid using mains-powered equipment while wearing a wrist cable connected to ground.
- Finally, typical domestic vacuum cleaners are large clumsy machines that can cause mechanical damage. Precision is required here.
- Note: You can see the black plastic stays on the northbridge heatsink in this photograph.

Step 16



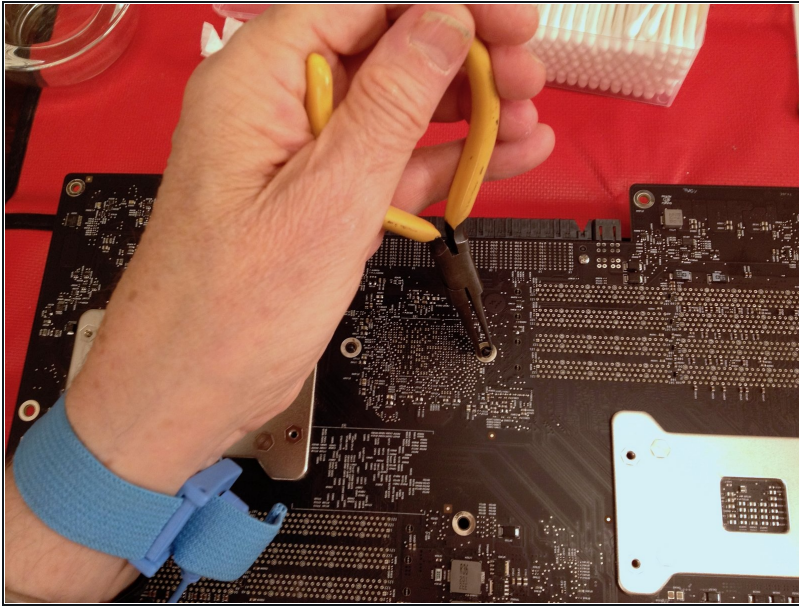
- Close precision cleaning, also called detailing, is required here. This is monks' work, requiring patience of Job and attention to detail.
- Wet cotton buds with isopropanol and wipe the board clean. When working atop small electronic components use more of a dabbing motion than a wiping motion to avoid damaging delicate components and to prevent threads of cotton being left behind on the board. Use a pair of tweezers to remove sticky clumps and trapped threads.
- When doing this I put on a CD of soothing music. J.S. Bach's Goldberg Variations played on the piano by Murray Parahia is most suitable for such occasions, and my choice for this work. Be prepared to spend an hour per side of the board.

Step 17



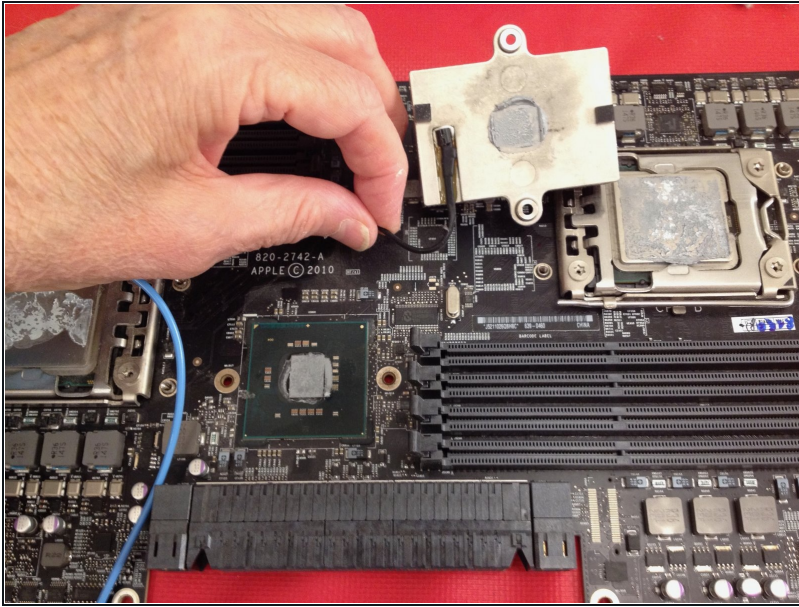
- Cut small patches of lint-free cloth and wrap the tip of a pair of tweezers. Wet the cloth with isopropanol and clean out the narrow spaces between components.
- Clean between the rows of memory bank slots, but do not attempt to clean inside. Residue from the cleaning action might degrade the contacts, and mechanical damage to the delicate spring-loaded contacts is likely.

Step 18



- After cleaning both sides of the PCB, identify the two plastic stays of the northbridge heatsink. On the bottom side of the board the stays can be seen to be fixed, each with two tiny delicate latches. It is these latches that are susceptible to failure.
- Pinch the latches on the plastic stays with a pair of needle-nose pliers so that the stays fall out. They should pop out from the force of the springs on the other side. If they do not pop out, give them a gentle push from the back side of the PCB
- Make sure not to lose the springs. You can throw away the plastic stays

Step 19



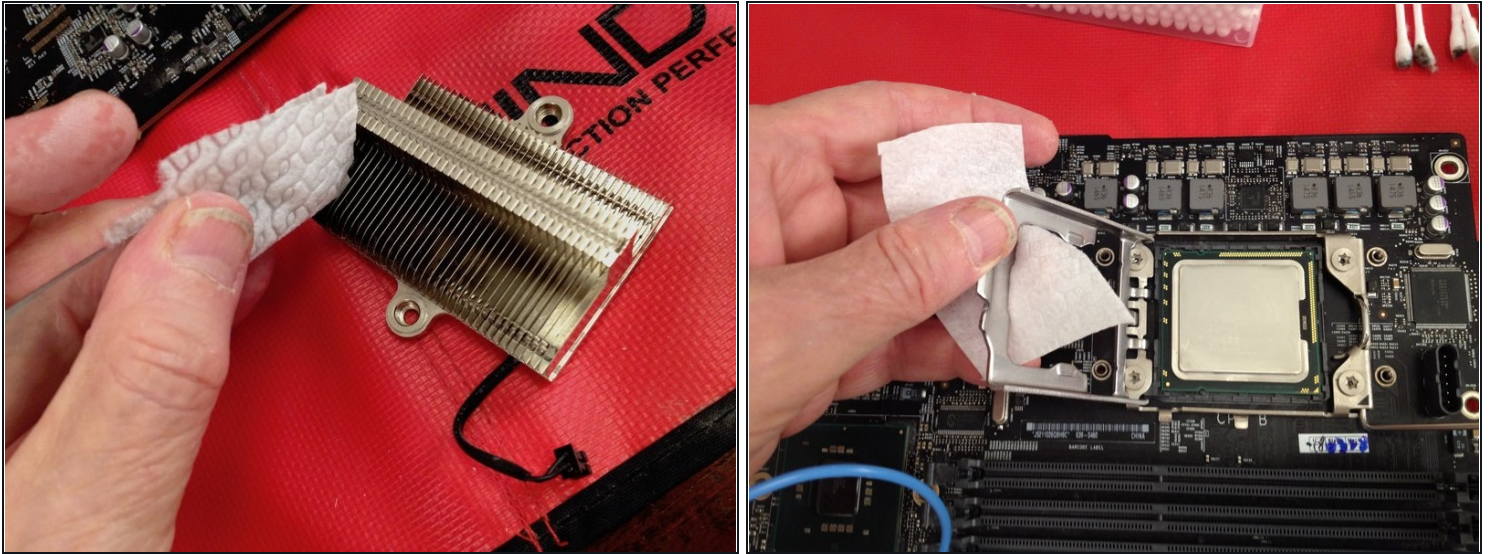
- Uncouple the temperature sensor wires from the PCB and remove the northbridge heatsink.
- You will find more dust under the heatsink, to be cleaned away.
- Don't be tempted to take shortcuts with cleaning. The dust and gooey grime are functional threats to the health of your computer. And besides, you are a perfectionist, are you not? You would not own a Mac Pro 5,1 if that were not the case. See if you can make the board look as good as new.

Step 20



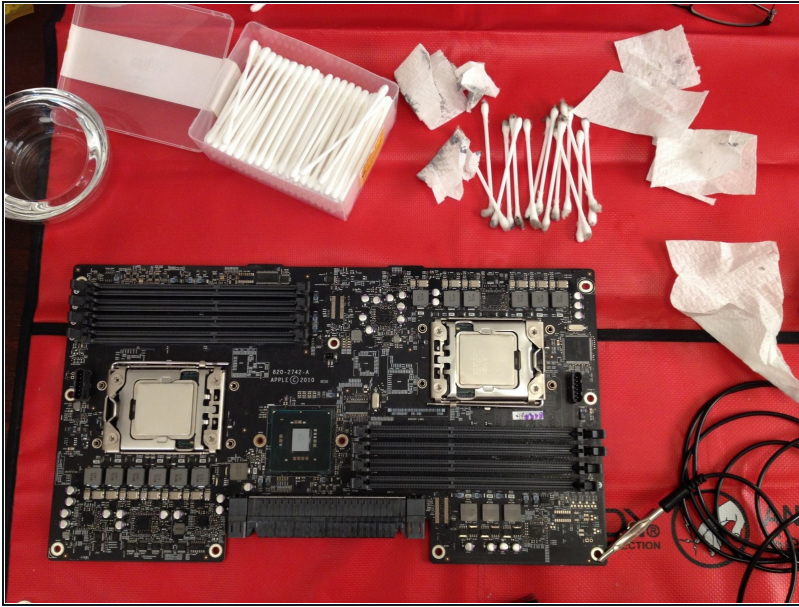
- Use Thermal Material Remover to clean the chips and the heatsinks of the old thermal paste. Clean off both of the CPU chips and northbridge chip, and all three heatsinks. Wipe off the occluding surfaces with lint-free cloth.
- Take care not to drop anything on the northbridge chip. It is an un-lidded chip in a ceramic frame.

Step 21



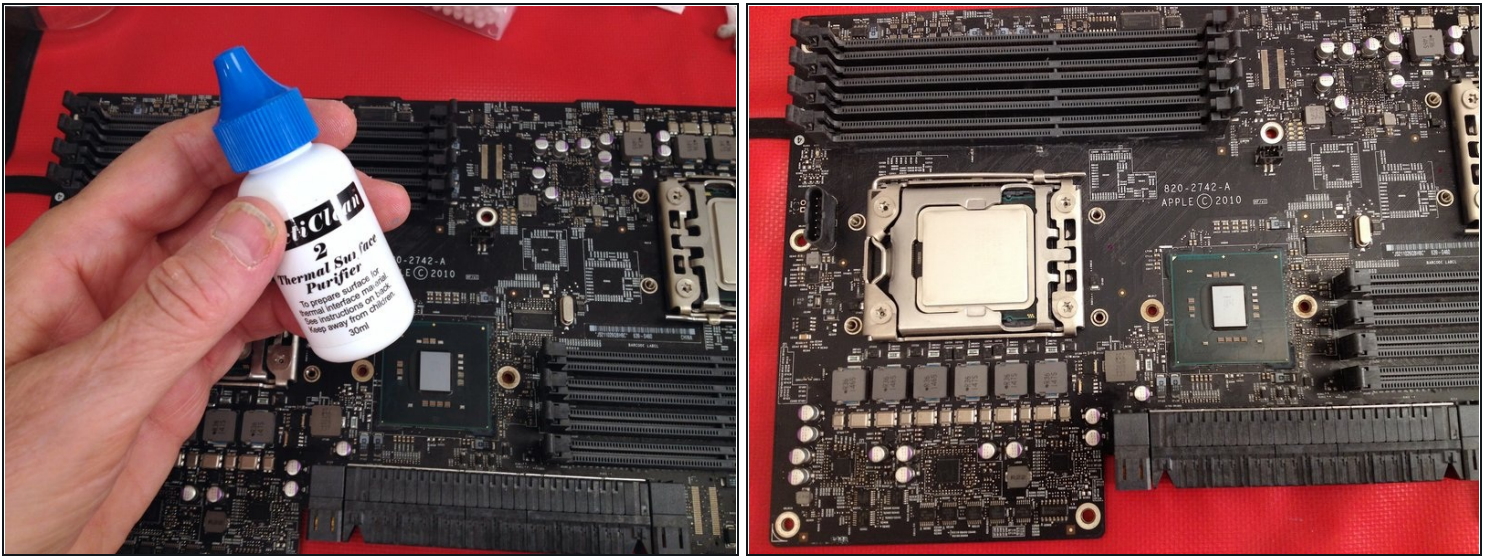
- Thoroughly clean the northbridge heatsink. After removing the old thermal paste on the occluding surface clean the fins. First use pressurised air. Then use a dinner knife with lint-free cloth soaked in isopropanol to clean each of the spaces between the fins.
- Open the latch on the processor cradle to clean around the CPU chip. Don't remove the CPU chip: An unnecessary risk. There is nothing under the chip that needs cleaning, and many things easily broken.
- If you are upgrading the chips, of course, you need to life out the old chip and replace it with the new chip at this time. However, upgrades to more powerful chips are not justified unless you are already using your Mac Pro close to its operational limit. Read the document "Upgrade Tips" to find out when and when not to upgrade.
- Be aware that upgrading the chips in some machines will require Boot BIOS upgrade as well.

Step 22



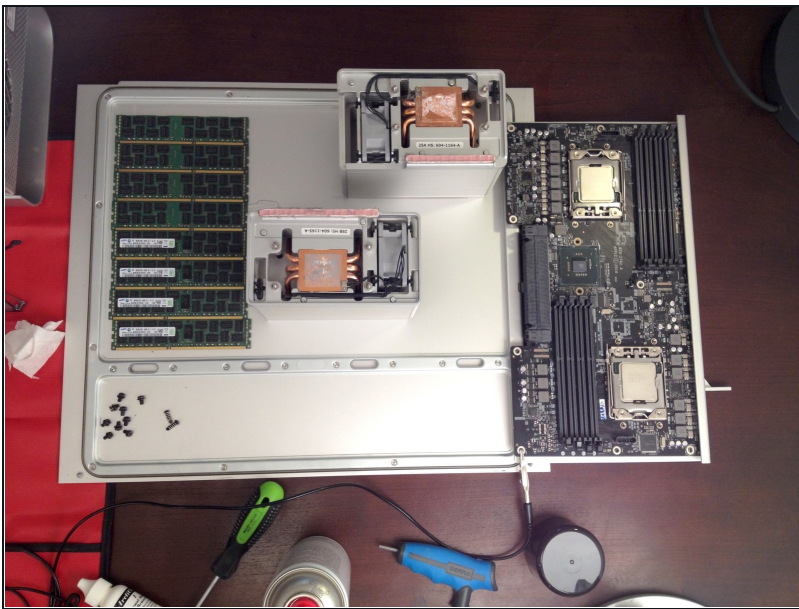
- Now doesn't that PCB look nice? You will be amazed at how much gunk comes off a dirty board. This photograph shows only a small portion of the dirty cotton buds.
- The small glass dish on the upper left of this photograph is used to hold the isopropanol. The Noctua fan is blowing from right to left, so the fumes arising from the dish of isopropanol are not driven into my face as I work.
- Isopropanol is not the same as ethanol that you can drink. It is many times more toxic. Take this warning seriously.

Step 23



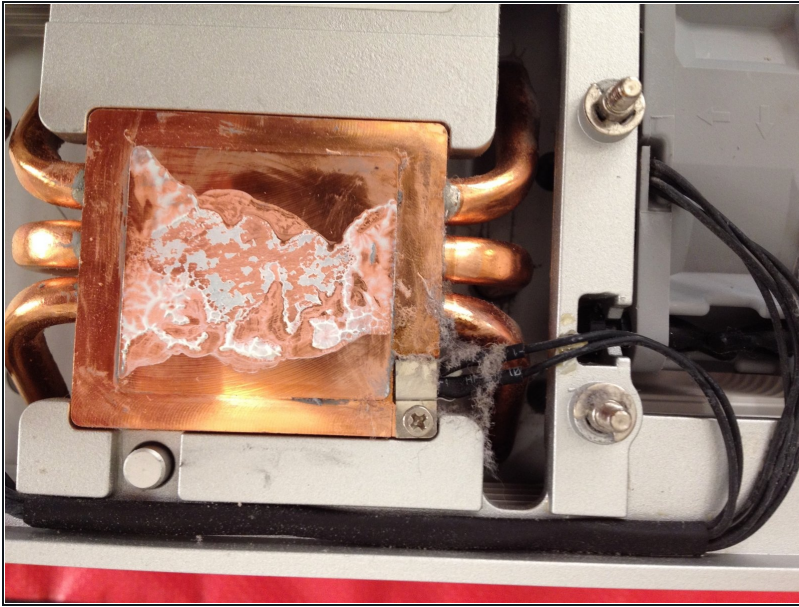
- Before re-pasting the northbridge heatsink clean the surface of the chips and the heatsink with Thermal Surface Purifier.
- Use cotton buds first then wipe down with lint-free cloth. If the occluding surfaces have been properly cleaned they will have a mirror like finish.

Step 24



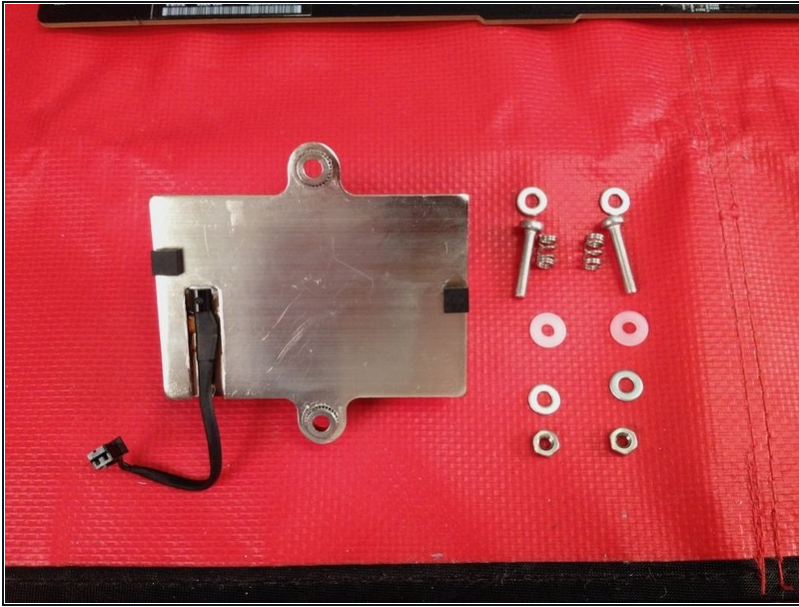
- Place the clean CPU PCB on the tray where it will be out of the way, and safe from accidents while you clean the main heatsinks.
- Although the board is grounded through the lid and the anti-static pad, it is a good idea to leave the black ground cable connected to the board.

Step 25



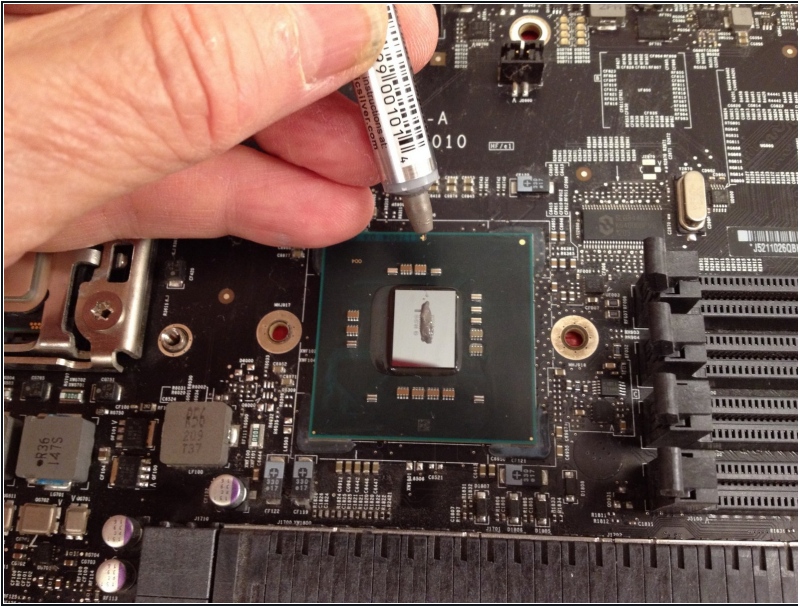
- It is now time to clean the CPU heatsinks.
- Here you can see the old paste on the occluding surface of the heatsink from CPU A. You can also see the dust inside the heatsink.
- Blow out the dust from the interior of the heatsink, paying attention to the fans. Then clean the occluding surface and the surrounding skirt with Thermal Material Remover followed by Thermal Surface Purifier.
- When these heatsinks are clean return them to the lid, out of the way.

Step 26



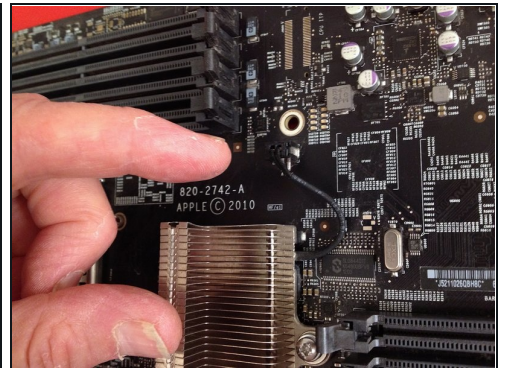
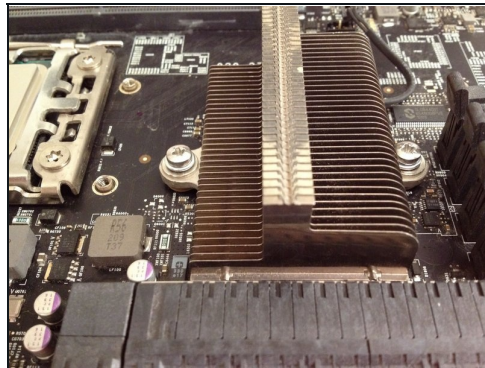
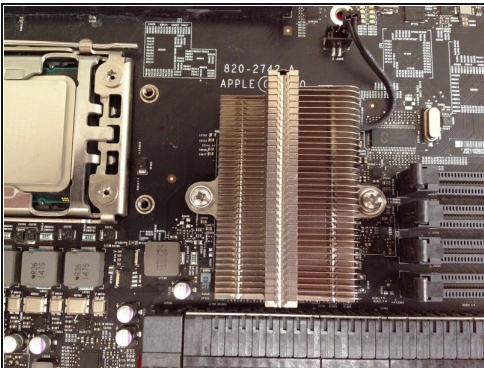
- Line up the components you will use to put the northbridge heatsink back onto the PCB.
- Use 16 mm long 3M stainless steel bolts, stainless steel washers and nylon washers. Re-use the springs from the plastic stays. The items will be assembled in the order shown from top to bottom:
- bolt; metal washer; spring; heatsink; PCB; nylon washer; metal washer; nut.
- If for some reason the springs have been lost, you can use a spring from a ball point pen. Cut out a section about 1.5 cm long.

Step 27



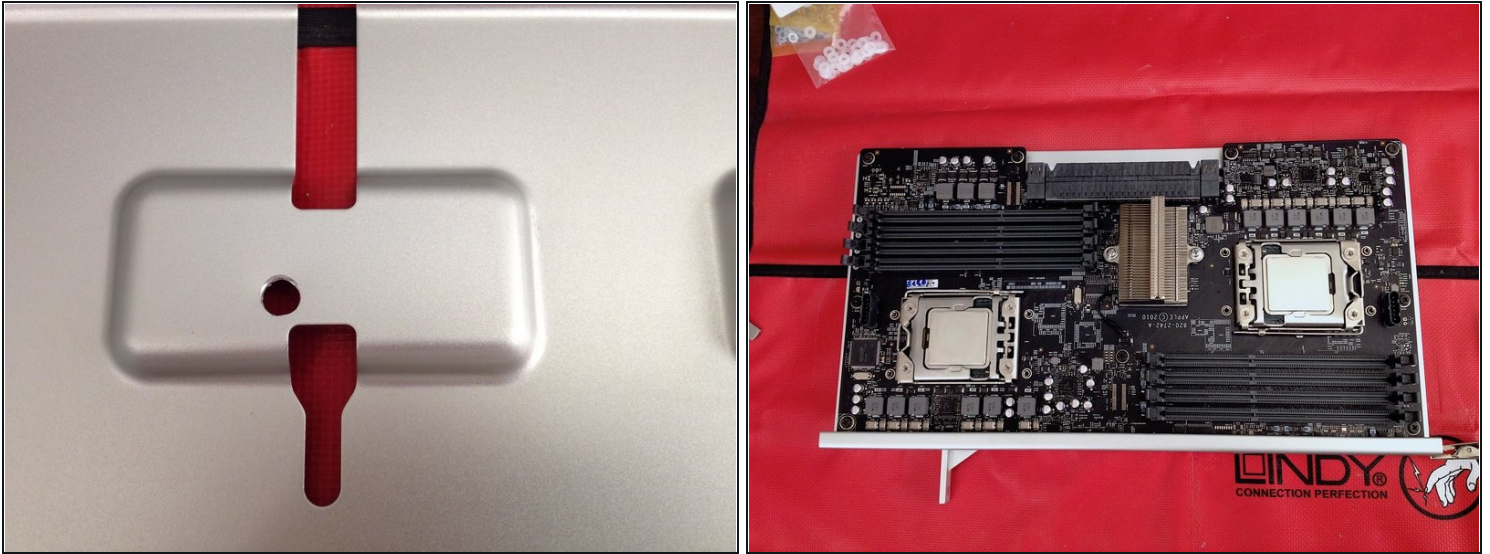
- Apply thermal paste to the northbridge chip with a line.
- Later you will paste the CPU with a line running in the orthogonal direction, that is: perpendicular to the line you see here on the northbridge chip.
- If you have never pasted a chip before, watch some YouTube instruction videos before doing this.

Step 28



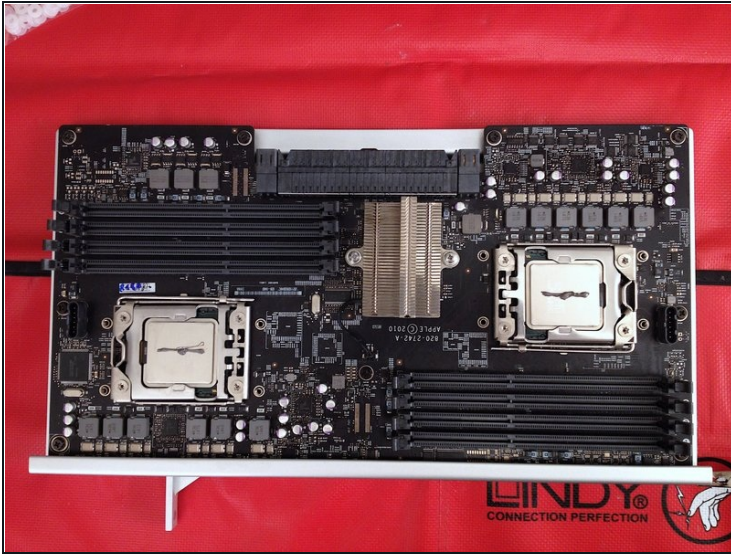
- Bolt the northbridge heatsink into place. Do not tighten until the springs are fully compressed, but make sure that the heatsink is held firmly in place. Pressure on the two side should be the same.
- The oblique view shows how close the bolt heads come to the heatsink. However, the bolt heads and steel washers do not make contact with the heatsink. It is important to permit the springs to exert the contact force. Tightening to bolts too far will crush the northbridge and may destroy your PCB.
- Don't forget to reconnect the temperature sensor wire.

Step 29



- One of the new steel bolts will penetrate the tray
- After bolting the heatsink to the northbridge chip, fit the PCB over the tray, and push gently down on the metal bolt that makes contact with the tray. It will leave a mark on the tray. Drill a 6 mm hole at that point.
- Some followers of this Service and Repair Guide have asked whether it is possible to use shorter bolts to avoid the necessity for drilling this hole. Yes it is, but it is then difficult to re-assemble the heatsink onto the PCB.
- However, shorter bolts require you to depress the bolt against the spring while applying three items on the other side of the board: nylon washer, steel washer and nut. In my experience this is difficult, and trying to do so increases the risk of an accident with the PCB
- Re-attach the CPU PCB to the tray with 9 screws.

Step 30



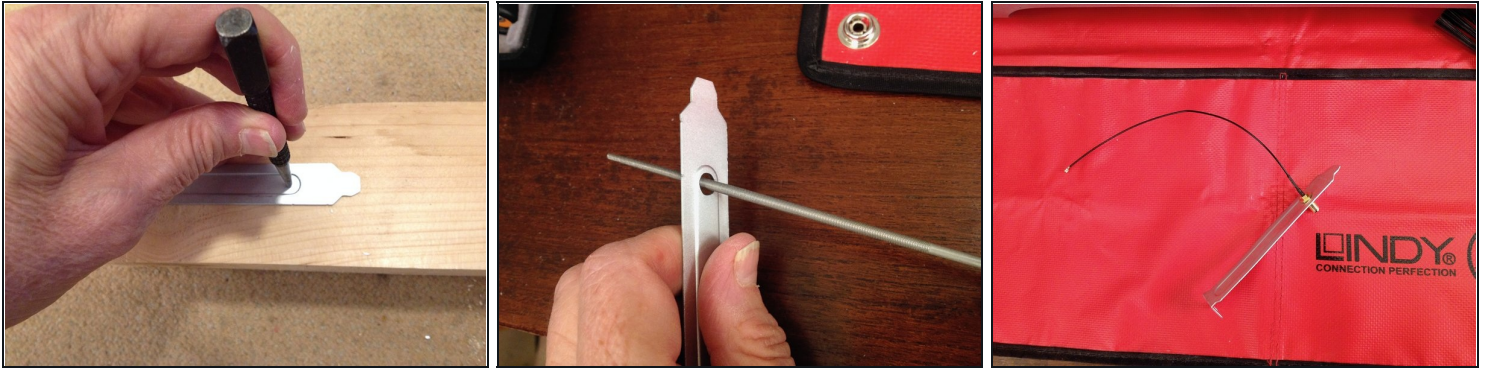
- Apply thermal paste to both CPUs. The past is applied horizontally in a line and pea fashion. Do not put more paste than needed on the chips.
- When re-assembling the CPU heatsinks, tighten the securing bolts according the to the X pattern that you used when taking them off. Tighten only finger tight.
- After the heatsinks have been reattached to the CPU PCB, put the CPU Tray out of the way, on the edge of the lid.

Step 31



- Remove the hard disks and the video card from the computer. Put them on the lid, out of the way. Also remove the video card power cables.

Step 32



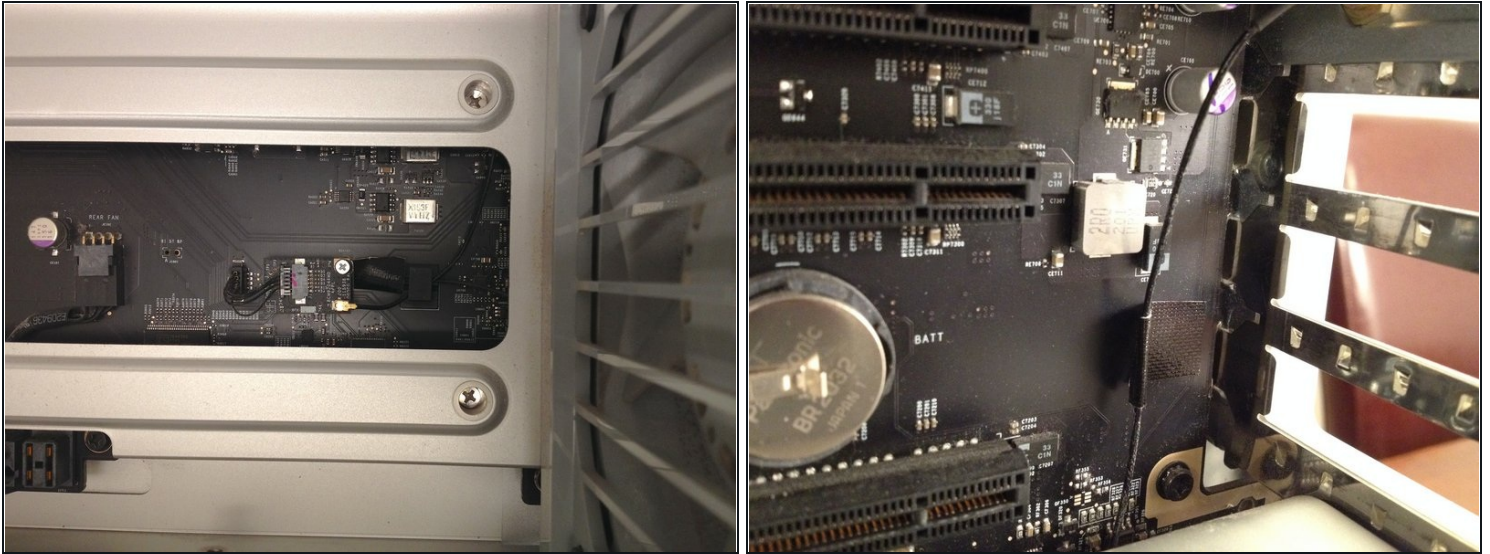
- In order to repair the Blue Tooth an external antenna must be attached to the Mac Pro. You will need a suitable antenna and cable.
- TL-ANT2408CL 2.4 GHz Indoor Omni-Directional Antenna
- U.FL Mini PCI zu RP-SMA Pigtail Antenne WiFi Kabel 20 cm length
- The antenna will be attached to a PCIe slot cover. To make a hold in the correct position, first punch a notch at the place where you want to drill. Then drill with a 3mm metal drill, then with a 6mm drill. Use the slowest speed setting on your drill to get a well shaped round hole.
- After drilling the hole, file away the rough edges of the hole. This same technique can be employed when tidying-up the hole in the CPU tray.
- Assemble the antenna cable to the PCIe slot cover.

Step 33



- Lay the Mac Pro on its side for more convenient access to the Blue Tooth device.

Step 34



- After you have placed the PCIe slot cover with cable into place, run the cable down the back to the CPU compartment at the back. At the right rear of the CPU compartment you will find the Blue Tooth device, shown above.
- I recommend taping the Blue Tooth cable in to the mother board at the level of the PCIe slots to prevent it from interfering with other cards in the PCIe area.
- Remove the old antenna wire. It snaps off easily when lifted. Tape it so that it cannot fall into the wrong position and cause a short circuit of some kind. Use durable black electricians insulation tape. Then attach the new cable. It will snap easily into place.
- Push the new cable through the plastic stay, to the right of the Blue Tooth device on the motherboard.

Step 35



- Finally the antenna can be screwed onto the outside of the PCIe slot cover.

Step 36



- Re-assemble your computer. This is quite straightforward as you replace the items in the reverse order of the disassembly. A photo-guide is not necessary for anyone who has made it this far.
- In this picture you can see the Blue Tooth antenna poking its top just above the rear of the computer.
- A test with the magic mouse showed that the new antenna had resolved the Blue Tooth lag problem. Indeed, the antenna is so strong that it detects my son's magic mouse at the other side of our home.

Step 37

Temperature Control			Temperature Sensor	
Fan	Min/Current/Max RPM	Control	Sensor	Value °C
PCI	800 — 2393 — 4500	Auto — Based on PCIe Ambient	Ambient	29
PS	600 — 1327 — 2800	Auto — Based on PSMI Supply AC/DC Supply 1	CPU A Diode	50
EXHAUST	600 — 1908 — 2800	Auto — Based on IOH Diode	CPU A HeatSink	37
INTAKE	600 — 1786 — 2800	Auto — Based on IOH HeatSink	CPU A core from PCECI	59
BOOSTA	800 — 5188 — 5200	Auto — Based on CPU A Diode	CPU B Diode	44
BOOSTB	800 — 5196 — 5200	Auto — Based on CPU B Diode	CPU B HeatSink	36
			CPU B core from PCECI	52
			DIMM Proximity 1	33
			DIMM Proximity 2	34
			DIMM Proximity 3	35
			DIMM Proximity 4	35
			DIMM Proximity 5	35
			DIMM Proximity 6	37
			DIMM Proximity 7	38
			DIMM Proximity 8	30
			Drive Bay 0	29
			Drive Bay 1	29
			Drive Bay 2	29
			Drive Bay 3	29
			IOH Diode	48
			IOH HeatSink	36
			PCI Ambient	30
			PSMI Supply AC/DC Supply 1	32
			PSMI Supply AC/DC Supply 2	32
			Disk Drives:	
			WDC WD10EACS-00D6B0	31
			Kingston SHPM2280P2/240G	32
			Hitachi HUA722010CLA330	30

Temperature Control			Temperature Sensor	
Fan	Min/Current/Max RPM	Control	Sensor	Value °C
PCI	800 — 800 — 4500	Auto — Based on PCIe Ambient	Ambient	27
PS	600 — 790 — 2800	Auto — Based on PSMI Supply AC/DC Supply 1	CPU A Diode	32
EXHAUST	600 — 1884 — 2800	Auto — Based on IOH Diode	CPU A HeatSink	29
INTAKE	600 — 1694 — 2800	Auto — Based on IOH HeatSink	CPU A core from PCECI	35
BOOSTA	800 — 1503 — 5200	Auto — Based on CPU A Diode	CPU B Diode	30
BOOSTB	800 — 1053 — 5200	Auto — Based on CPU B Diode	CPU B HeatSink	27
			CPU B core from PCECI	32
			DIMM Proximity 1	31
			DIMM Proximity 2	31
			DIMM Proximity 3	35
			DIMM Proximity 4	34
			DIMM Proximity 5	34
			DIMM Proximity 6	36
			DIMM Proximity 7	35
			DIMM Proximity 8	26
			Drive Bay 0	26
			Drive Bay 1	28
			Drive Bay 2	29
			Drive Bay 3	28
			IOH Diode	50
			IOH HeatSink	38
			PCI Ambient	29
			PSMI Supply AC/DC Supply 1	32
			PSMI Supply AC/DC Supply 2	32
			Disk Drives:	
			Kingston SHPM2280P2/240G	34
			WDC WD10EACS-00D6B0	27
			Hitachi HUA722010CLA330	26

- The moment of truth arrives with the before and after tests. I have Macs Fan Control installed. This utility enables the user to specify temperature limits. See the document Upgrade Tips for more information about how to use this utility.
- The before and after measurements showed that much lower fan speeds, less than half, were required to maintain the same temperatures for most of the fans.

This exercise has been a great success. I wish all my readers similar success and soul-soothing pleasure in their Mac Pro adventures.