# Converting a Late 2005 Power Mac G5 Quad from Liquid Cooling to Air Cooling

**June 02, 2025**
**v0.2**

Author: Michael Campbell (michael@campbell-tx.net)



*ID-Cooling FROZN A400 CPU Cooler*

## Revision History

| Version | Date | Author | Reason |
|---------|------|--------|--------|
| 0.1 | 5/31/2025 | Michael Campbell | Initial release |
| 0.2 | 6/2/2025 | Michael Campbell | Clean up, added details, throughout |

# Table of Contents

## 1. Scope

*This document presents an A-Z guide to converting a late 2005 Power Mac G5 Quad from liquid cooling to air cooling. Please note that this document does not cover the equivalent process for any other model of Power Mac G5.*

*If you prefer to service your LCS vs. converting your Quad to Air Cooling, see my companion guide to servicing an LCS, **Power Mac G5 Quad LCS Restoration, A-Z Guide, v1.1, May 25, 2025**, which is available at www.inverary.net/LCS.*

_____

## 2. Introduction

Is your late 2005 Power Mac G5 Quad running hot and/or noisy? That is unfortunate, but you are not alone. This is a common issue with older Power Mac G5 Quads (and they are all "older" these days). The source of your problem is almost certainly the Liquid Cooling System (LCS) of your Quad, a largely invisible component of the machine tucked discretely behind the shiny "G5" logo panel that you see when you open the case up.



*Power Mac G5 Quad Liquid Cooling System (LCS)*

The PowerPC 970MP chip that animates the Quad is a beast, consuming up to 100W at peak load and throwing off a lot of heat in the process... a lot! To keep that chip running cool and comfortable, Apple resorted to a liquid cooling system (LCS), not unlike the cooling system that a car engine uses – cooling fluid, fluid lines, one or more pumps to move the fluid through the lines and finally, a radiator. Variable speed fans drive outside air past the radiator and propel that air out of the back of the case, carrying with it the heat that the LCS has transferred from the two PowerPC 970MP chips to the cooling fluid and ultimately to the radiator.

If the LCS develops a leak or loses some amount of its cooling fluid over time through infinitesimally slow evaporation, or mineral deposits crystalize out of the cooling fluid and begin to obstruct the free flow of coolant, or goodness knows what else, the system has to work harder to keep its cool. For a time, you may notice that the machine gets noisier, as the fans ramp up to accomplish more of the cooling that the LCS itself should be doing.

Eventually, if LCS degradation continues long enough, you may notice that the fans go to full speed even though the machine runs hotter and hotter. This indicates that even at full speed, the fans can no longer compensate for the loss of cooling capability in the LCS.

When this happens, it is either time to service your LCS **or** time to ditch it entirely and convert your G5 Quad to cool, quiet and reliable air cooling. This guide addresses this latter option: conversion to air cooling.

# 3. Acknowledgements

I would like to thank two people who blazed the trail, and without whose efforts (and importantly, written documentation of those efforts) this present work would not have been possible:

- **Cameron Kaiser** – Cameron has been a key player in the PowerPC ecosystem for a long time, and is well known for having developed and supported TenFourFox, a PPC port of the later versions of the Firefox browser, and for maintaining **the** foundational Gopher hole, gopher://gopher.floodgap.com... and much, much more. Specific to the work detailed in this guide, Cameron documented the entire process for removing and replacing an LCS from a PowerMac G5 Quad, as part of a larger blog piece on fully refreshing a failing LCS.

- **User "Doq"** at www.macrumors.com – Doq truly blazed the G5 Quad air-cooling trail, identifying the key elements needed (ID-Cooling's FROZN A400 CPU coolers and EasyCargo's copper shims) and pioneering an initial process for using those elements to successfully air cool a G5 Quad. Doq efforts succeeded, demonstrating that a G5 Quad **can** be successfully air cooled in 2025, despite Apple's 2005 decision to use liquid cooling.

In addition, I would like to thank one group of experts, without whose support I might never have brought this work to a successful conclusion:
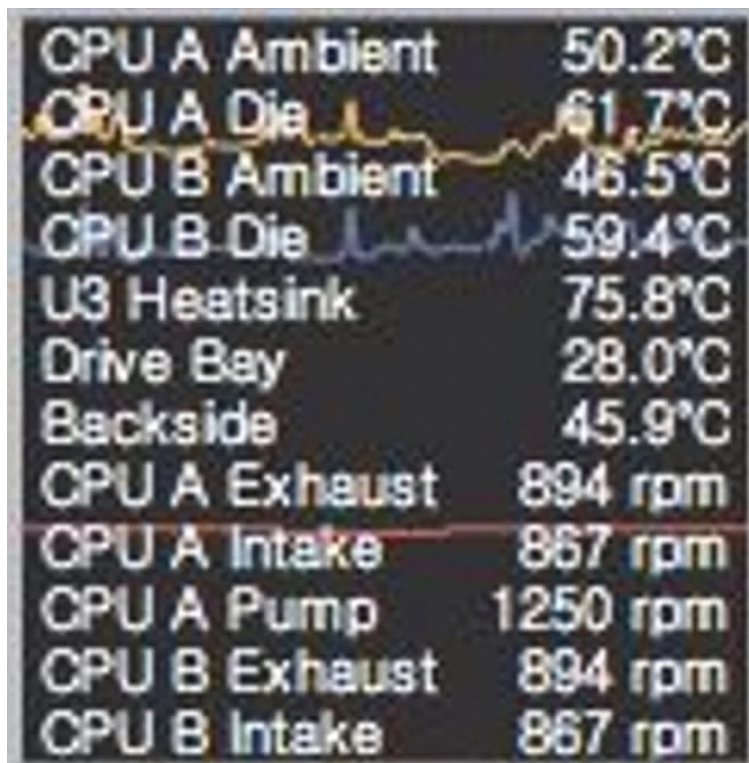
- www.macrumors.com - There are scores of members at macrumors.com, too numerous to mention here, who pitched in and offered useful advice at critical points along the way. You know who you are – my sincere thanks to all of you!

## 4. How Hot is Your Quad, and What to Do About It?

How do you know how hot your Quad is running? Install QuickFans or iStatMenus, both of which can provide you with CPU temperatures and fan speeds. Of the two, iStatMenus provides more detail and is thus the preferred choice.

**IF** you are running Leopard or Sorbet Leopard, you should also check out XRG, an excellent Leopard-only tool (Sorbet Leopard as well) that can give you all the same information as iStatMenus, but in a detailed real-time updating GUI window, showing both temperatures and fan speeds. At the time of this writing, XRG could be obtained from Macintosh Repository, at:

https://www.macintoshrepository.org/71245-xrg



| CPU A Ambient | 50.2°C |
| CPU A Die | 61.7°C |
| CPU B Ambient | 46.5°C |
| CPU B Die | 59.4°C |
| U3 Heatsink | 75.8°C |
| Drive Bay | 28.0°C |
| Backside | 45.9°C |
| CPU A Exhaust | 894 rpm |
| CPU A Intake | 867 rpm |
| CPU A Pump | 1250 rpm |
| CPU B Exhaust | 894 rpm |
| CPU B Intake | 867 rpm |

*XRG Temperatures, Fan Speeds Pane*

How hot is too hot? If any CPU is idling over 50 C, that is too hot. If any CPU gets into the high 90s C under heavy load, that is too hot. If your Quad's fans make an unbearable noise, that is too hot.

You can directly observe the CPU temps via iStatMenus and/or QuickFans, and you can directly hear the noise of the fans with your own ears. If any of these indicate values that are too high, it is time to take action.

## 5. The Dilemma – to Service Your Quad or Not?

So... your G5 Quad LCS needs service. Unfortunately, you can no longer simply take the machine to the nearest Apple store and have them do it for you. G5 Quads are now well outside of their service period; you have to do the work yourself.

That work is not easy - many people simply walk away from their Quads at this point.

Servicing an LCS is a daunting task (as the length of my companion guide on this topic attests – see Appendix B, item 2), and not one to be undertaken lightly. You will need to be **part computer technician** and **part plumber** to accomplish it. You will need lots of new tools and supplies and you will **also** need miles and miles of patience, persistence and determination. This is a task that will challenge you at every step of the way. It is definitely not for the faint of heart.

The alternative, converting your G5 Quad to air cooling, sounds even **more** daunting at first glance. If it was even possible at all, why did Apple opt for liquid cooling all those years ago? Converting a Quad to air cooling requires you to take a huge leap of faith: rip out the entire existing cooling system and replace it with a brand new one, hoping that it will work at least as well. If ever there was an undertaking that sounded incredibly risky, this is it. Happily, it turns out to be significantly easier than servicing an LCS and it also it seems to produce better results when done (lower CPU temps, lower fan RPMs).

So, your Quad needs help, and no matter what form that help takes, it looks like a hugely difficult undertaking. Should you do it? Yes! You have a brilliant piece of computing history under your feet. The G5 Quad was the last and the fastest of the PowerPC line of Macs that Apple produced. It is an engineering marvel. Restoring one that is failing saves one more of these magnificent machines from the trash heap of history.



*Power Mac G5 Quad – Engineering Brilliance*

The work is difficult to be sure, but it is well worth it. Even today (2025), when loaded with Sorbet Leopard (10.5.9) and the latest  Aquafox web browser (2.2), these machines can still surf the web, run your email, balance your budget, etc. Admittedly, they do some of this a little more slowly than today's most modern machines, but for a 2005 computer, this degree of functionality is truly amazing.

So, "screw your courage to the sticking point" and dig in. Perhaps unexpectedly, there is lots of help available. Experts in this area that are willing to help are much more numerous than you may imagine. You will find many such experts among the fine folk at www.macrumors.com, where the **real** Macintosh experts hang out. Without this group of people, I would never have been able to convert my Quad to air cooling.

So, if you don't already belong to www.macrumors.com, point your browser there and register. You will find me there, as user "mac57mac57", but I am one of the lesser lights at MacRumors. Nonetheless, all of us will do our best to help you, cheer you on and offer as much helpful advice as possible.

# 6. Converting to Air Cooling – An Overview

While it sounds daunting to be sure, converting a G5 Quad to air cooling turns out to be the simpler of the two options available (LCS overhaul or air-cooling conversion). Here is an overview of the steps that need to be taken:
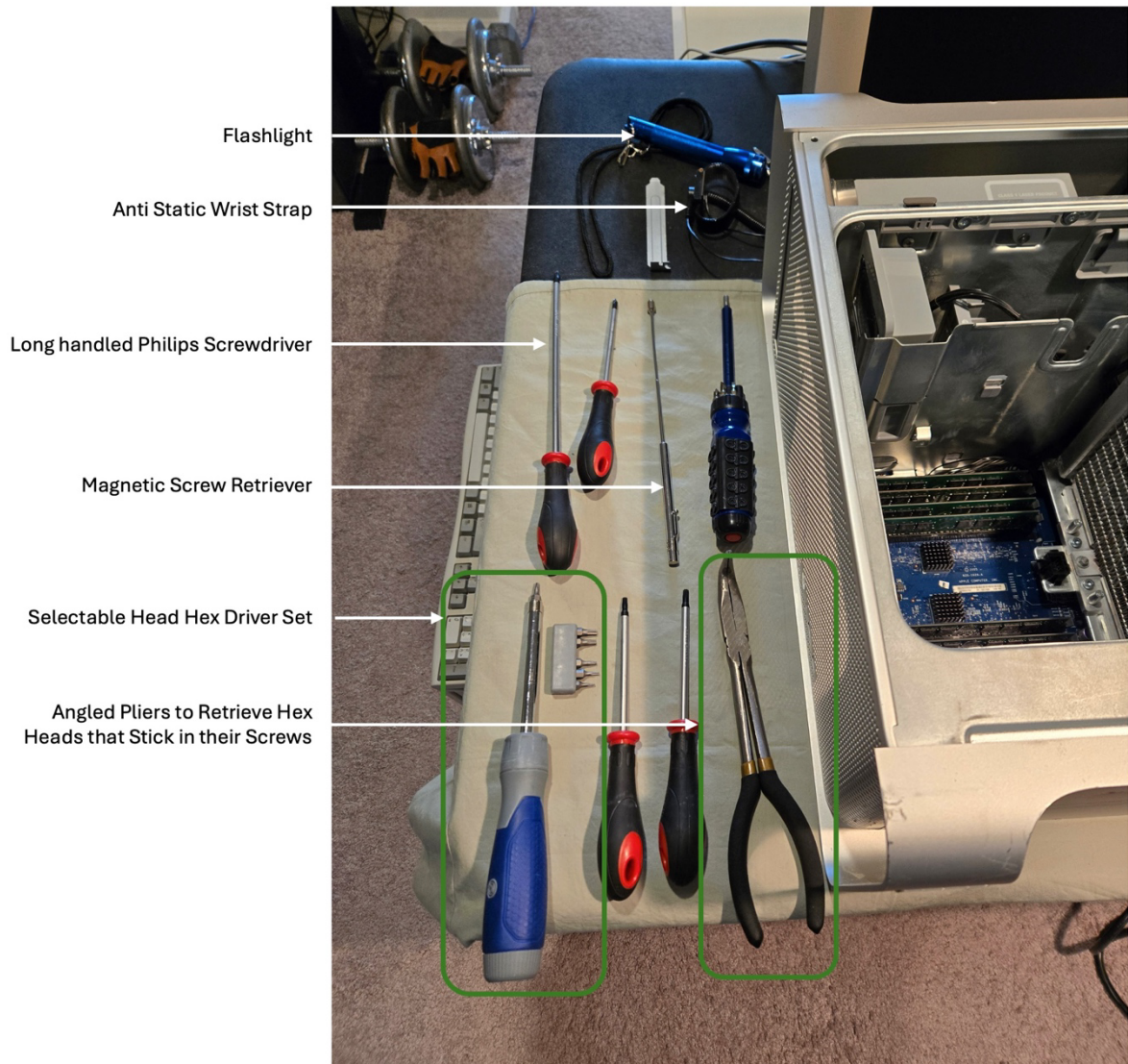
1. Purchase the needed parts including the key ID-Cooling FROZN A400 CPU coolers.

2. Extract the existing Liquid Cooling System (LCS) from the Quad.
3. Separate the CPU cards from the now extracted LCS.

4. Attach the FROZN A400 back mounting brackets to each of the two CPU cards.
5. Enlarge the mounting holes of the FROZN A400 front mounting brackets.
6. Attach the FROZN A400 front mounting brackets to each of the two CPU cards, while securing both the CPU cards and the mounting brackets to the Quad case.

7. Attach the FROZN A400 units to the front and back mounting brackets now firmly in place on each CPU card.
8. Attach the FROZN A400 fans to each of the two FROZN A400 coolers.

9. Reassemble the Quad.

10. Power on and pray!

The remainder of this guide walks through each of these steps in detail.

## 7. Tools You Will Need to Extract the LCS, CPU Cards

Let's look at the tools you will need to remove the LCS from your Quad, and the CPU cards from your LCS:

Tools for Extracting the LCS



Flashlight

Anti Static Wrist Strap

Long handled Philips Screwdriver

Magnetic Screw Retriever

Selectable Head Hex Driver Set

Angled Pliers to Retrieve Hex Heads that Stick in their Screws

## Tools for Removing the CPU Cards



12 Piece Hex Key Set

Multi Head Long Handled
Technology Screwdriver

## 8. Initial Preparation of the Quad for LCS Removal

Now that you have acquired all the necessary tools, your first task is to extract the LCS from the Quad. This is no simple job all by itself!

Let's start by opening the case, removing the plastic air deflector and extracting the front CPU fans, which simply lift straight out. Now sit back, take a moment and simply admire the beauty of the machine's interior. No wires hanging out, clean lines everywhere and simple access to all the most commonly serviced items, such as hard drives and RAM. The late 2005 G5 Quad is an engineering work of art.



*Late 2005 Power Mac G5 Quad Interior*

OK, enough admiration. Let's get to work. Start by laying the machine on its side on a work bench whose surface is covered with some form of soft material, so that neither the bench nor the Quad end up inadvertently scratched as you work. I use a bed sheet for this purpose. If you do not lay the machine down, and you drop a screw, in all likelihood that screw will end up inside the power supply at the very bottom of the machine. You will be in a world of pain to retrieve it.

So don't go there – lay the machine on its side before you start working. Even so oriented, over my time working with LCS restoration, I dropped two screws. Both ended up at the bottom of the machine. I managed to retrieve both of them eventually, but for a long time, one of them was unaccounted for, stuck in the power supply area of the Quad.



*Power Mac G5 Quad laid out on sheet covered worktable*

# 9. Partial Disassembly of the Quad (Enable LCS Extraction)

Start by removing all of the plugin expansion cards. Typically, there will be just one of these, a graphics card. Undo the retaining screw and gently lift the card up and out. Mind the sheet metal slot protector. This thin aluminum piece has razor sharp edges per slot and can give you a deep and nasty cut… I speak from experience! So much blood…

Next, you need to remove the expansion card alignment guide at the other end of the expansion card area. There are two screws, one on each end, and two clips that slide into the metal plate that separates the PCI slot expansion area of the case from the CPU area of the case. Undo the screws and then pull the guide up and towards the top of the Quad, freeing it from the metal plate. Then turn it by 90 degrees and lift it out of the Quad's case.



Now slide the front fan/speaker assembly upwards and turn it to its side, laying it inside the case; no need to disconnect its power unless you want to.

Next, we need to remove the metal plate that separates the upper PCI expansion slot area of the interior from the lower CPU area of the interior. Apple calls this plate the "PCI Divider" plate.

To remove it, there are three Philips screws securing it that must be removed. Once done, the plate lifts straight up and out.
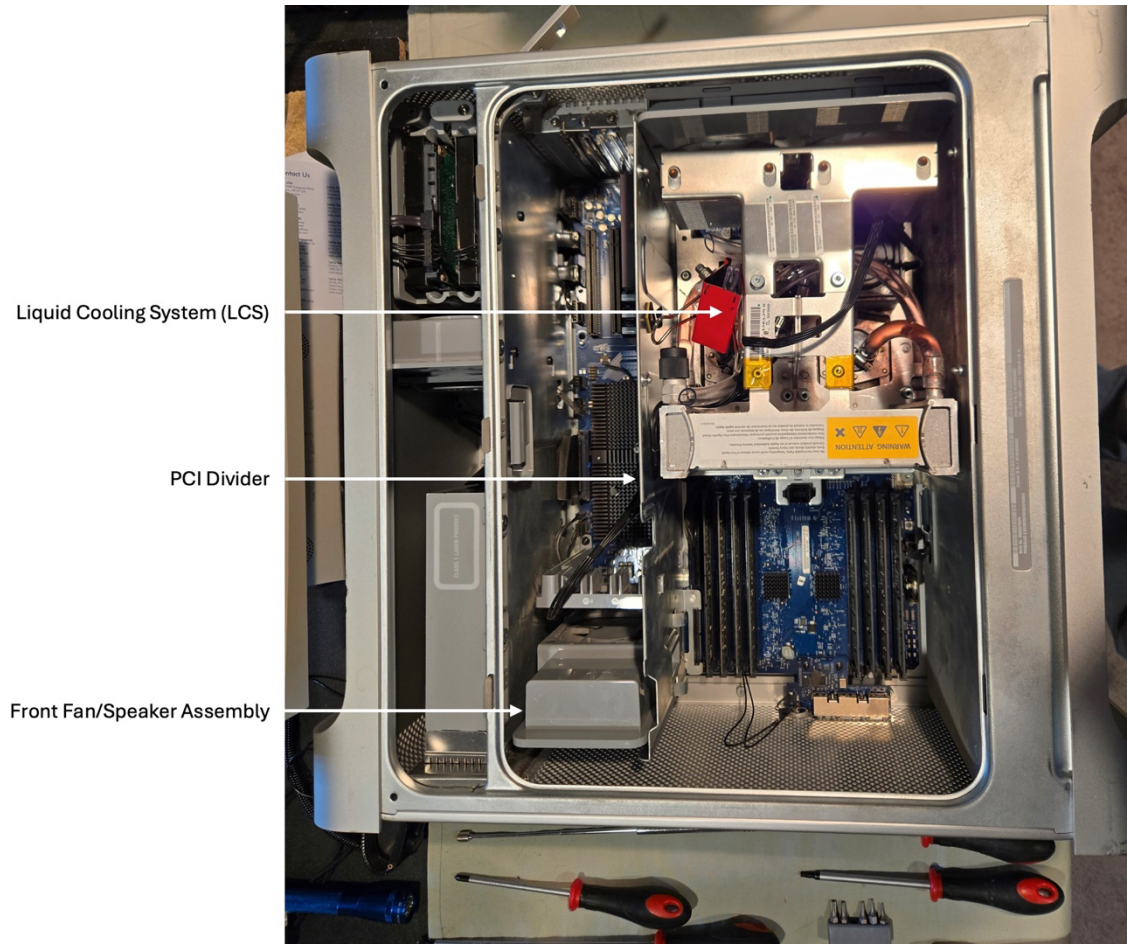


If you are lucky enough to have a Quad that is equipped with the nearly impossible to find Runway Card (a combined Bluetooth/WiFi card), that card will be attached to the PCI Divider plate and must itself be removed before proceeding with removal of the plate.

A full set of instructions for removing the Runway card can be found in Apple's service manual for the Late 2005 PowerMac G5.

With the PCI Divider plate out of the way, you can now easily remove the rear CPU exhaust fans. Do this by pressing down on the two tabs at the top of the rear fan unit and pulling it towards the CPU assembly. You can then lift it out and twist it over on its side too, laying it on top of the case or down in the PCI expansion slot area. Again, there is no need to disconnect the power unless you are so inclined.
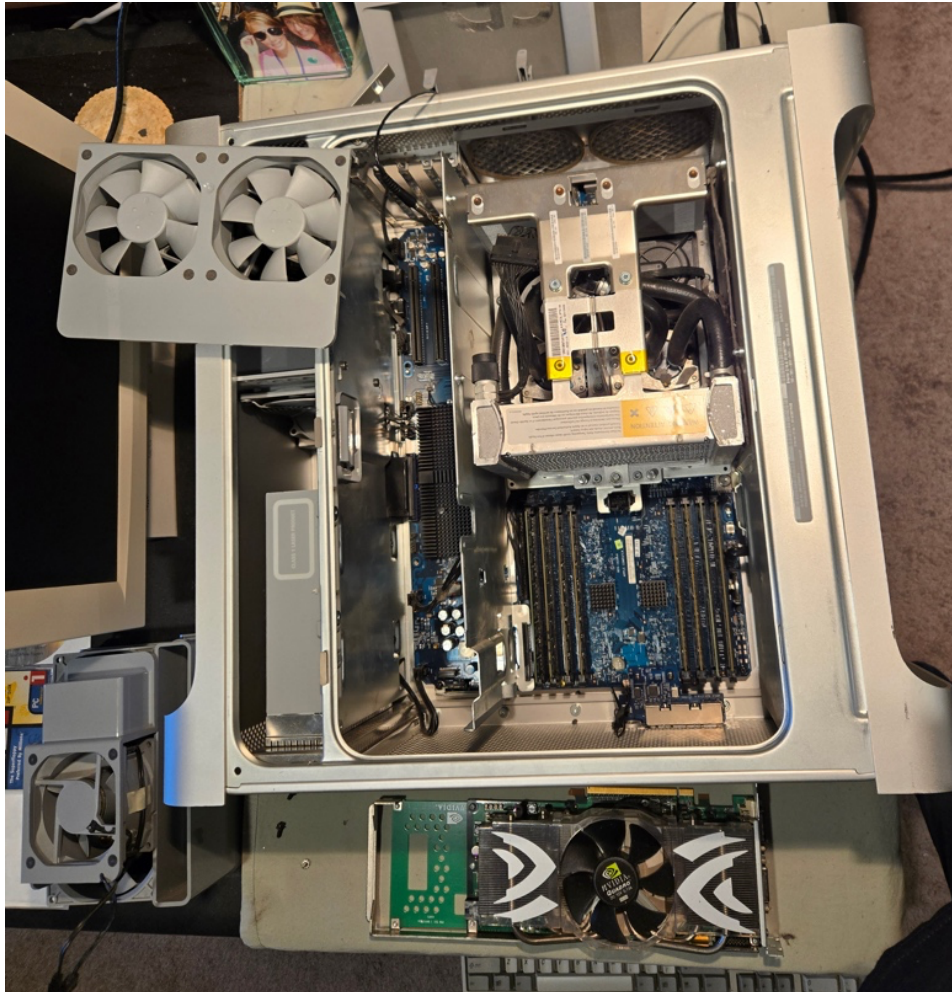


*Power Mac G5 Quad with Rear Fans Removed*

Excellent! You are now ready to extract the CPU Assembly/Liquid Cooling System (CPU/LCS, referred to hereafter simply as "LCS").

## 10.    Extracting the LCS from the Quad

Cameron Kaiser has written an excellent guide to this part of the process (see Appendix B, items [1] and [2]), but in the interests of creating a single comprehensive A-Z guide, I will cover the same steps here. The photos however are shamelessly reused from Cameron's guide. At the time of this writing, that guide can be found at:

https://tenfourfox.blogspot.com/2021/07/and-now-for-something-completely.html

See the following four pictures, which show the LCS still in place in the Q5 Quad case, and circle and number each of the screws/connectors that you need to remove to extract the LCS. It may be just street lore, but I have read that if you do not remove these screws/connectors in the order shown, or fail to reconnect them in the reverse order, the machine may not work. While this has not been my experience, I pass this information along anyway for your consideration and action.
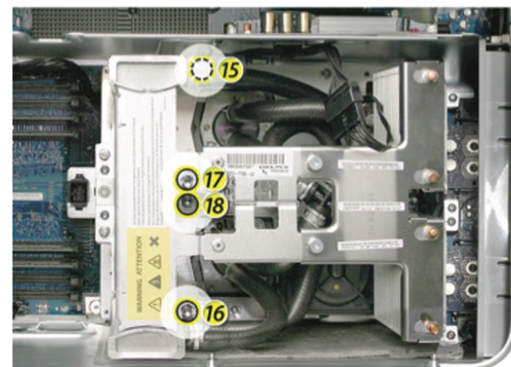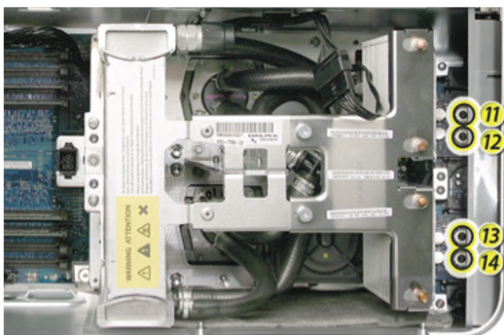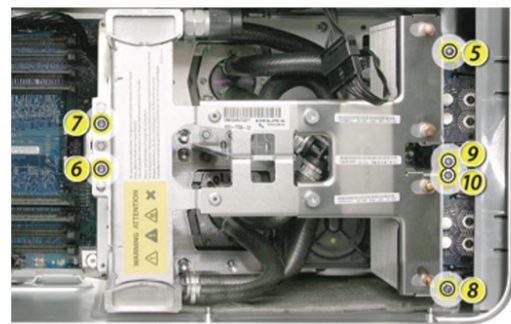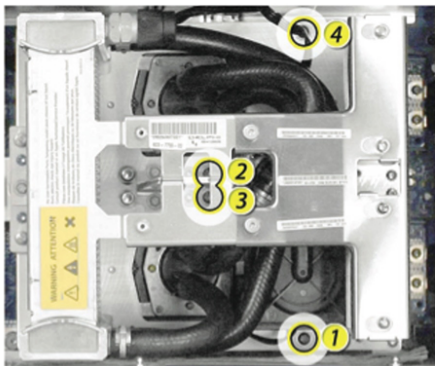


The G5 Quad case is quite deep and crowded; you will need long handled tools to reach many parts of it. You will also need an equally long loose screw retriever; you will almost certainly drop a screw from time to time in an awkward location.

Make sure you have long handled screwdrivers (primarily hex heads), preferably with magnetic heads, long handled pliers and a long telescoping magnetic screw retriever, to ...ahem... retrieve any wayward screws that might get away from you during the work. On eBay, these can be easily found by searching "telescoping magnetic screw pickup tool".

Remove all the screws in the order shown, starting with [1]. I have never found it necessary to remove screws [2] and [3] and so I have always left them in place.

A note: I found that I only needed two sizes of hex head drivers to undo everything. Connectors [15]-[18] required the larger of the two. All of the remaining screws could be removed using the smaller of the two. You will  need a long-handled screwdriver with replaceable heads, and a variety of hex head end pieces in various sizes. Find the two that fit and that should be all you need to complete LCS removal.

Once all the screws have been removed, grasp the LCS by the metal bridge piece between the front and back radiators and lift straight up. Do not use any significant force. If it does not come out easily, loosen connectors [15] - [18] more and try again. Repeat until you are able to easily lift the LCS up and out.

Note that at this point in the procedure, the Quad's two CPU cards are still attached to the underside of the LCS. In the below photo, you can see them protruding if you look carefully. Treat the LCS with extreme care. If you mess up the CPU cards, it is "game over".
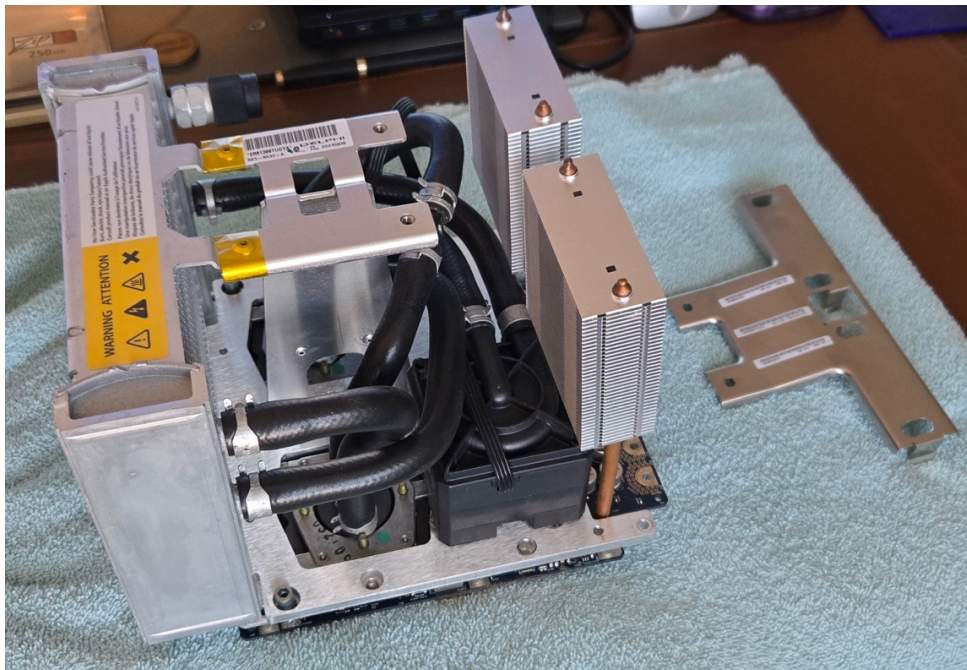


*LCS Removed from G5 Quad Case*

Congratulations! You have extracted the LCS, and there it sits, looking oh so innocent and oh so functional... except that it isn't anymore. That is why you are looking at it!
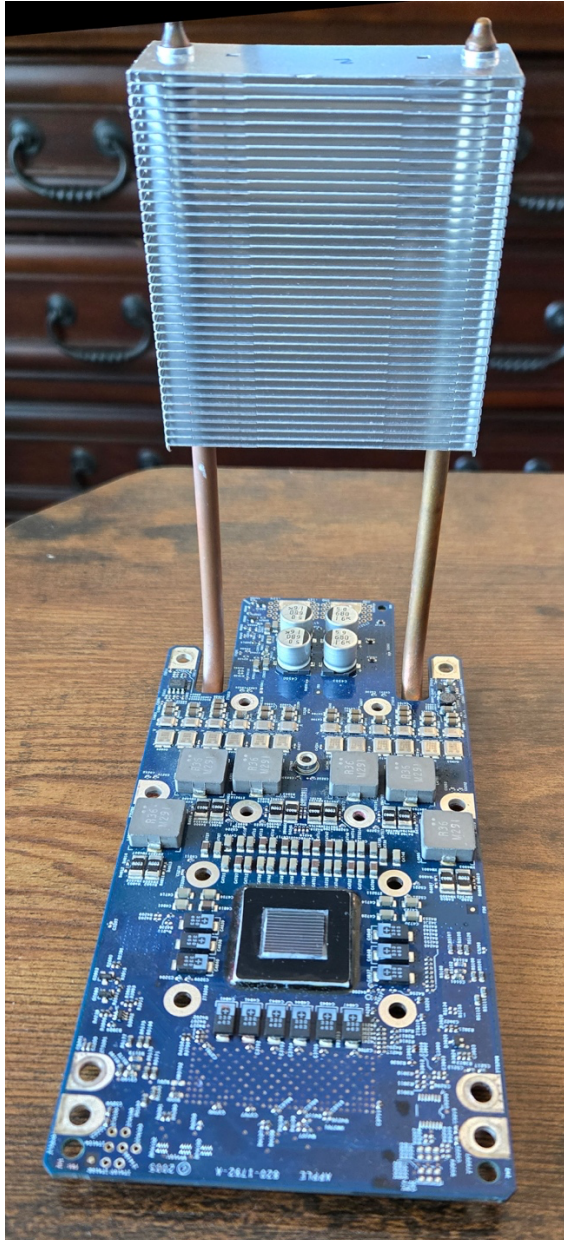
## 11.    Removing the CPU Cards from the LCS

Each CPU card is attached to the LCS with no fewer than 14 different screws/connectors. Can you say "over engineered"? ☺ Since your objective is air cooling, you don't need the LCS, but you do need the CPU cards, and so they must be removed from the underside of the LCS.

The photo below shows the location of all of the screws/connectors in question:
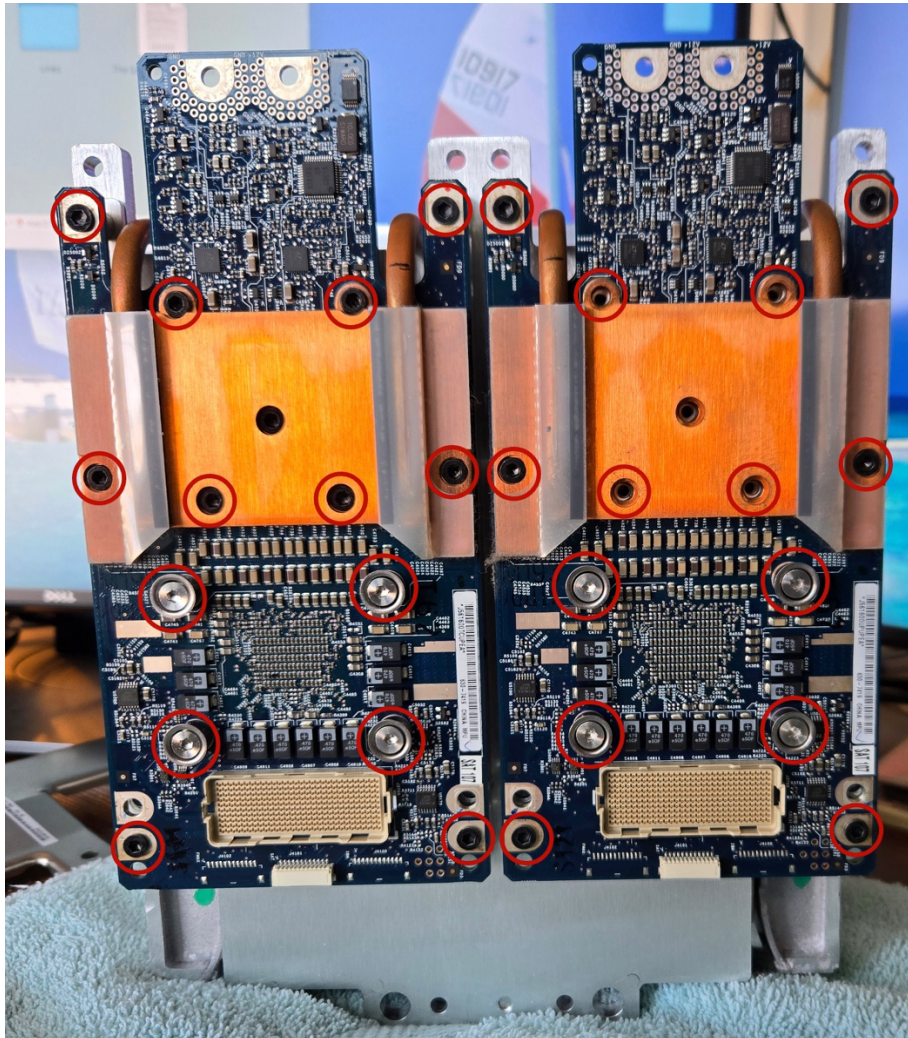


Undo these screws in any order that you wish. It is typical however to start from the outside and work in, per CPU card, with the four silver can/spring screws in the CPU chip area of the card being the last to be removed.

When you have removed all 14 screws/connectors, the card will come away from the LCS, and there before you very eyes will sit the mighty PowerPC 970MP chip. For such a powerful beast, it is a small unassuming chip, with no labeling of any nature and simply a polished reflective surface. You will not see the chip face itself however until you wipe off the old thermal paste that is on it. Go ahead and do that at this time. I used paper towel and rubbing alcohol to ensure a total clean.



*G5 Quad CPU Card*

With the CPU cards now removed from the LCS, the LCS itself is no longer needed. Set it aside, use it as a paperweight… do with it whatever you like. You no longer need it. Its function is being replaced with air cooling!

## 12.    Air Cooling Parts

Here are the parts you will need to purchase to air cool your G5 Quad:

- ID-Cooling FROZN A400 Heat Sink / Fan units (two)          $39.99 each
- 92x92x0.5 copper shims (two)                                              $7.99 (package of 4)
- MOLEX to Fan Header Conversion Cables (two)                $7.99 (package of 2)
- Duct Tape (one roll)                                                           $5.99
- Twist Tie (one)                                                                  $0.01

...for a total cost just over $100!

The photo below shows five of the above seven parts needed (two coolers, two copper shims and one tube of thermal paste – only the MOLEX cable and the twist tie are missing):



*PowerMac G5 Quad Air-Cooling Parts*

The FROZN units are PC (yes, PC) air coolers and will replace the LCS' cooling function. The copper shims (the small blue box in the center contains 4 such shims – only two are needed, one for each of the two Quad CPU cards) are used as heat spreaders between the CPU chips and the FROZN A400 coolers. Finally, the Kryonaut Extreme thermal paste will mate the CPUs to the shims, and the shims to the coolers.

Kryonaut Extreme is the most highly rated thermal paste at a "reasonable" price, sporting a thermal rating of 14.2 W/mK. Despite this high rating, Kryonaut Extreme may be considered to be a problematic choice by some: it is well known for being difficult to spread. As an alternate, note that the FROZN units come with a small tube of reasonably good thermal paste, rated at 10 W/mK. However, since Kryonaut Extreme has a higher rating, I stuck with it and set the included paste aside for possible future use on a less demanding project.

I purchased the two FROZN units on eBay, while the copper shims and the Kryonaut Extreme thermal paste were purchased at Amazon.com. I had to buy the FROZN units on eBay because they do not appear to be for sale new anymore, except for "new old stock" on eBay, having been replaced by the larger (120mm) FROZN A410. Two of these larger fans will not fit into a Quad - each one must be a maximum of 92mm to fit. It was later reported to me that if you search Amazon diligently, you can still find A400s for sale, and at a lower price than on eBay!

## 13.   A Closer Look at the FROZN A400 CPU Cooler

Looking at the FROZN A400 unit in more detail, here are the full contents of the box:



*ID-Cooling FROZN A400 Box Contents*

There is the cooler unit itself, its fan (provided in a separate box-within-the-box), and a whole set of mounting hardware, split between the left and the right of the photo above, which supports both Intel and AMD processors and motherboards.

The Intel-oriented hardware seems to fit the G5 Quad best and all further discussion of mounting hardware in this document assumes the Intel mounting hardware. Like the LCS, you can set the AMD mounting hardware aside – you will not be needing it.

One last point about the contents of the box: as mentioned above, also included in the box is a tube of reasonably good thermal paste - 10.5 W/mK. For my work however, I stuck with Kryonaut Extreme, which is rated at 14.2 W/mK – when going to air cooling, every part of the cooling set up needs to be optimized. It has to transfer a LOT of heat!

Next, below is a photo of the underside of the A400 cooler. Once you see this, it is clear why the copper shims are needed. They overcome the facts that (a) the copper on the underside of the A400 is not continuous, and (b) the cooling surface of the A400 is significantly larger that the 970MP chip surface. The shims overcome both. The part of the shim in contact with the CPU face picks up heat from it and effectively spreads that heat over the larger surface area of the shim, from which the full cooling surface of the A400 can extract it.

In the photo below, I have placed a shim directly underneath the underside of the A400:



*Underside of FROZN A400 Cooler, Along with Paired Copper Shim*

The fan must be attached to the A400 after it has been mounted and screwed down. A set of "fan clips" are provided to accomplish this attachment. As we will see later however, these fan clips alone were not sufficient for fan attachment – mechanical clearance was too small to allow them all to be used.

Nonetheless, one of these clips **will** be used and the photo below shows how the clips are used to connect the fan to the FROZN A400 cooler. Note that it does require a little bit of mechanical pressure to stretch the fan clips down to fit into the slots on the sides of the A400:



*Fan Clipped to FROZN A400 Cooler*

By the way, the side of the fan with the ID-Cooling logo is the one that faces outwards, as you can just barely see in the photo above. Air is pulled in through that side and pushed out the back side, where it passes across the air cooling fins of the FROZN A400 CPU cooler.

While still considering the FROZN A400 in detail, also note that the mounting "arms" at the bottom of the A400 are not the same length on each side, and so proper alignment of the A400 and the motherboard is key. The photo below shows the required alignment of the CPU card, the copper shim, the mounting hardware and the A400:
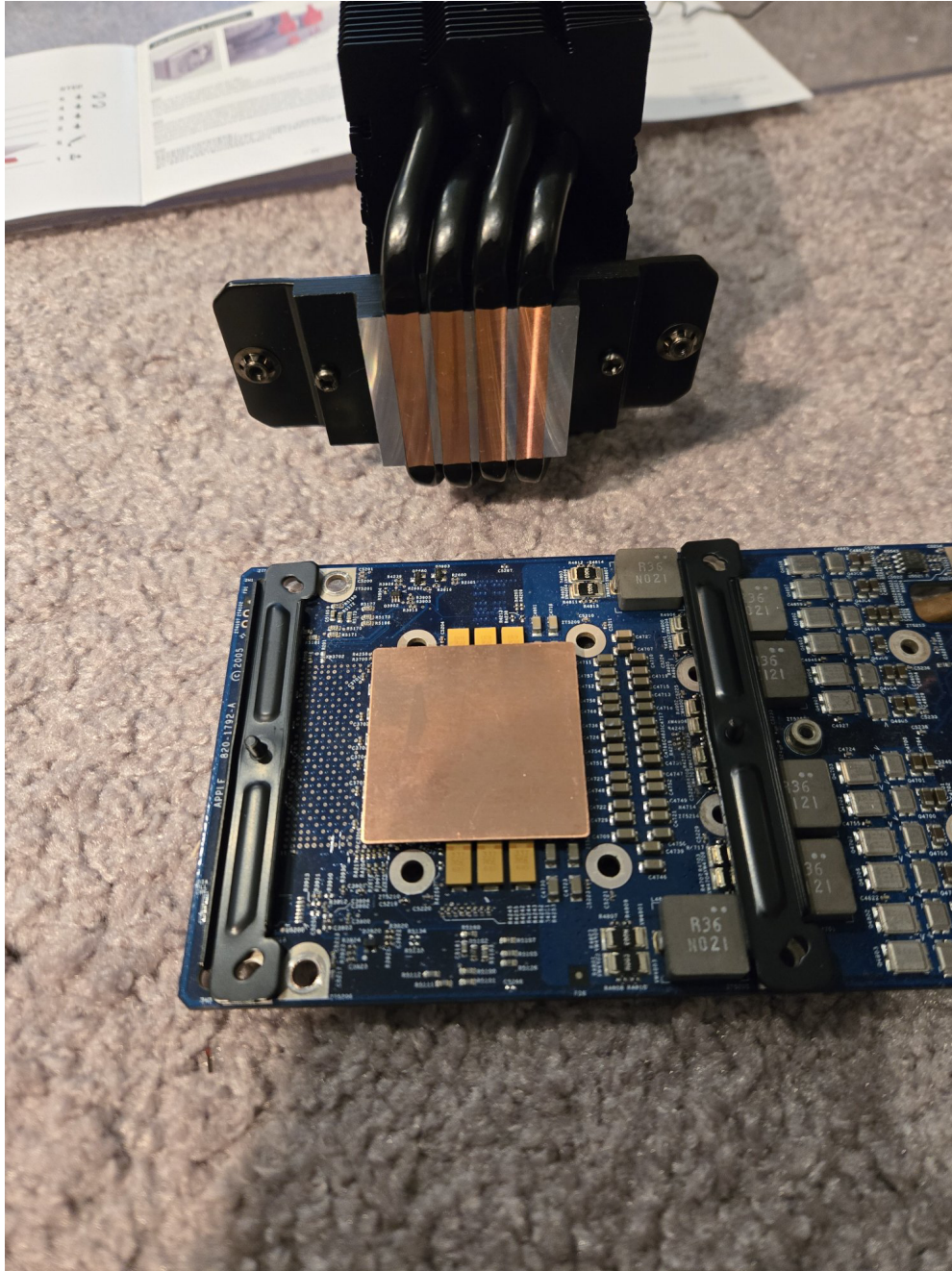
*Alignment of CPU Card, Copper Shim and FROZN A400*

Finally, the photo below shows how the A400 will fit down onto the mounting hardware, allowing it to be screwed into place, once the mounting hardware (which is just sitting on the CPU card in this photo) is itself screwed down:
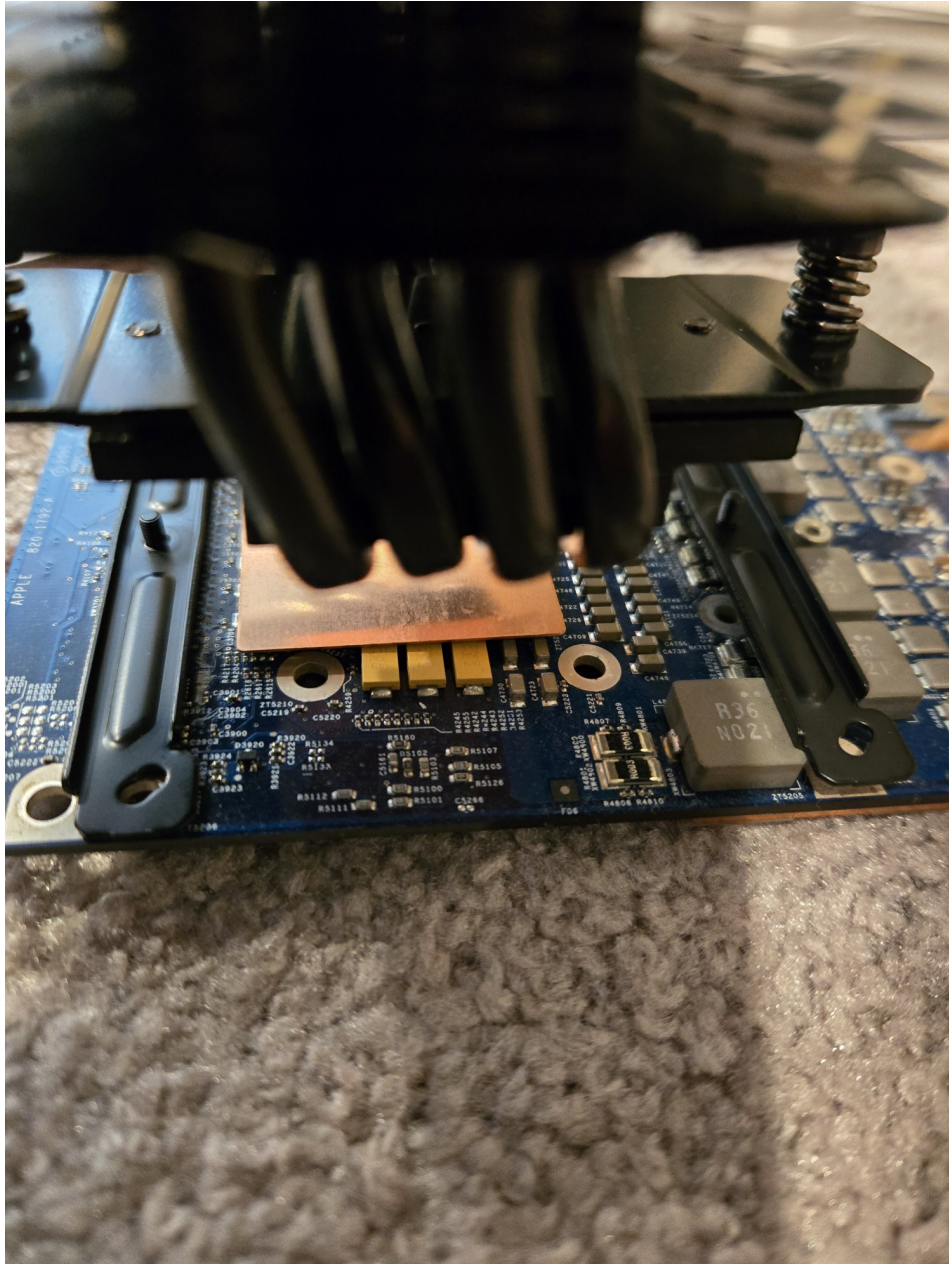
*How A400 Screws Down onto Mounting Hardware*

## 14.   Air Cooling Tools

Here are the tools you will need to accomplish installation of the air-cooling equipment.

- Electric or battery-operated drill with a drill bit that is suitable for metal (to enlarge holes in FROZN mounting hardware)

- Pliers with 90 degree bent tips (to disconnect/reconnect MOLEX in DVD/CD area)

- Scissors (to cut duct tape)

## 15.    Installing  the FROZN Mounting Brackets

The A400 mounting hardware was not designed for a Power Mac G5, and so using it to install the A400 heat sinks and their fans into a Quad requires a little bit of MacGyver'ing.

The back mounting hardware presents no issues - just put a small bolt through each of the two holes in the CPU card nearest the heat pipes and use a matching nut to screw down the front bracket. Easy.

Well, nearly easy anyway. When you do this, you will quickly realize that there are some rather tall (for a chip) surface mount components near the holes you need to use, and thus one or more non-conductive washers is needed to ensure that when the nut is added, the front bracket rests above the nearby components. I used hard white plastic washers that I had in stock, probably a quarter of an inch tall.
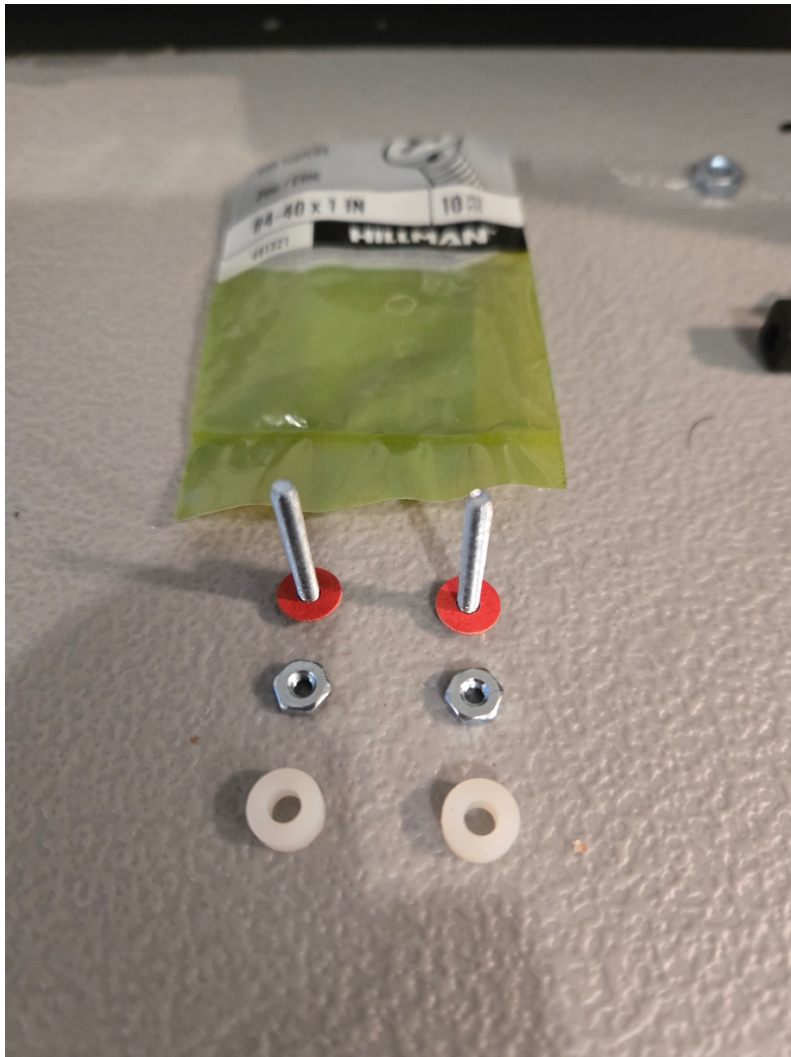


*#4 – 40 x 1inch nut/bolt to secure back mounting hardware*

Now lay the CPU cards into the Quad case where the LCS previously was, and they will naturally sit into their correct position due to the presence of mounting pegs coming up from the motherboard below, each of which slots into a corresponding hole in the CPU card, guiding it into the correct position.
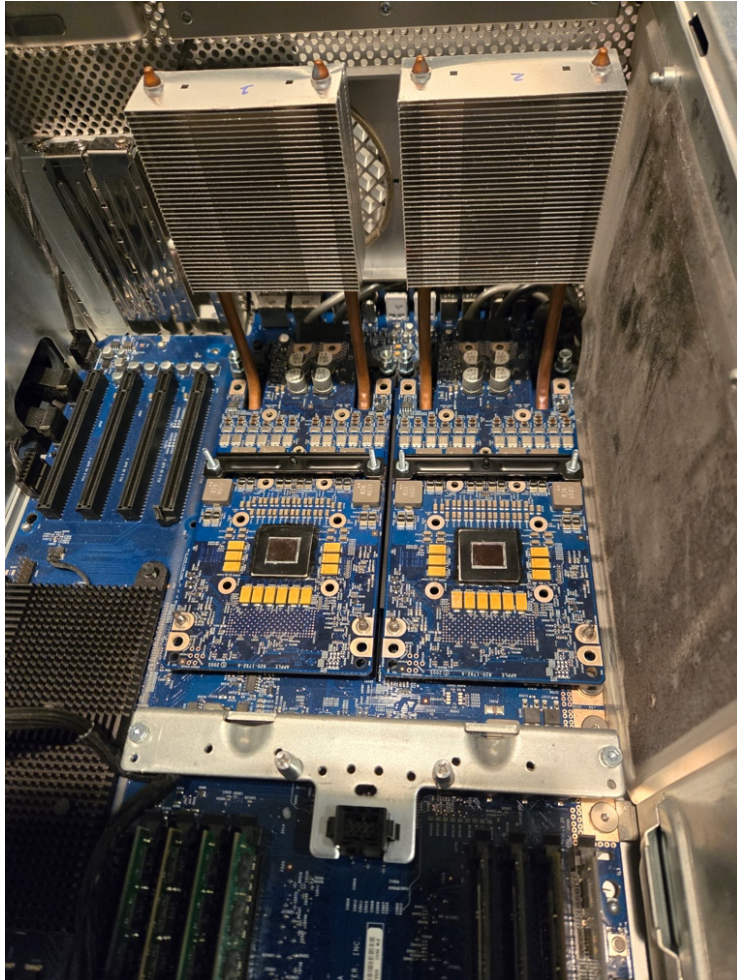


*Back mounting hardware and CPU cards in place*

At this point, replace the four screws the tighten down the backs of the two CPU cards onto the motherboard power straps. Referring back to the photos in Section 10, these are screws 11-14.

With that done, the back mounting hardware is in place and secured.

Installing the front mounting hardware is a little trickier, and this is where more MacGyvering comes in. Unless the front mounting hardware is as tightly connected as the back mounting hardware, the FROZN cooler won't mate tightly enough to the CPU face and effective cooling simply won't happen.

At first glance, installing the front mounting hardware doesn't look particularly challenging. There are four more holes near the front of each CPU card (two sets of two holes, one on each side of the card), and the inner set of holes fits the positioning requirements for the front mounting brackets almost perfectly. It looks like a slam dunk, but … Apple put those holes there for a reason!

These are the same holes mentioned above and Apple is using them! Four threaded pegs exist on the motherboard that slide up into these holes when the CPU cards are put into place and (a) ensure the correct physical alignment of the cards relative to the motherboard and (b) tighten down the front of the card, securing it in place - that is why each peg is threaded.

SO… since Apple is already using the set of CPU card holes that the front mounting hardware needs, you need a creative solution - what to do?

One thing that could be done is to extract the motherboard from the Quad's case and remove the offending pegs. However, a quick read of the Apple service manual for the Quad makes it clear that extracting the motherboard from the case is something akin to brain surgery; a better approach is needed!

My initial thought was to take advantage of the threads on each of the pegs and use nuts on them to screw down everything down tightly. I have a huge collection of nuts, bolts, screws, clamps etc., but I could not find ANYTHING that would screw onto the peg's threads… nothing! They must be a very unusual size. Regrettably, this is classic Apple engineering: why use an industry standard thread size when you can throw everyone off by creating something proprietary! ☺

No worries however; ID Cooling unintentionally provided the solution! The mounting hardware included with the FROZN units is very complete and includes four knurled top nuts. I will refer to these as "knurls" throughout the rest of this document. In a wonderful case of serendipity, these knurls screw tightly onto the top of the motherboard pegs, although they will only screw down a tiny amount from the top before stopping. Once this is done, they are quite securely in place, but they cannot be tightened down further.

I tried them early on as a front mounting solution and quickly dismissed them at the time – they fit the top of the peg just fine but provided no way to securely screw down the mounting hardware that had to sit below.

*The mounting hardware provided with the FROZN A400*

Then an "aha" moment! What if I built up the bottom of each peg, after it had come through the hole on the CPU card, with enough non-conductive washers that the front mounting bracket was raised up into near contact with the top of the peg, close enough that the knurl would provide adequate tightening for it?

I tried it and it worked. It is a delicate dance however – too many washers and the mounting bracket is raised up so high that the heat sink will not contact the CPU face, but too few washers and the mounting bracket ends up too low, making it impossible for the mounting hardware on the FROZN unit to reach down far enough to grab onto the threaded screw post in the center of the bracket.

There is another complication too. The holes in the edges of the mounting brackets are too small to fit over and through the CPU/motherboard pegs. Hence the bracket will not go all the way down the peg to reach the washers. A complication? Yes. A big one? No. Just a little more MacGyver'ing! Get an electric (or battery operated) drill, select a drill bit that is intended for metal and is of the right diameter (honestly, I just eyeballed this) and enlarge the hole at each end of the bracket.

When done, the hole is large enough that the bracket will go all the way down the peg to the washers. The result looks like this:



*Front Mounting Bracket with Enlarged Holes*

Through trial and error, I found that three 1/16" rubber washers **almost** did it. With three such washers at the base of the peg (on top of the CPU card hole), the mounting bracket almost reached up to the knurl, but there was a just a little bit of "wiggle" in it. With the knurls fully tightened down, here is what the result looked like:
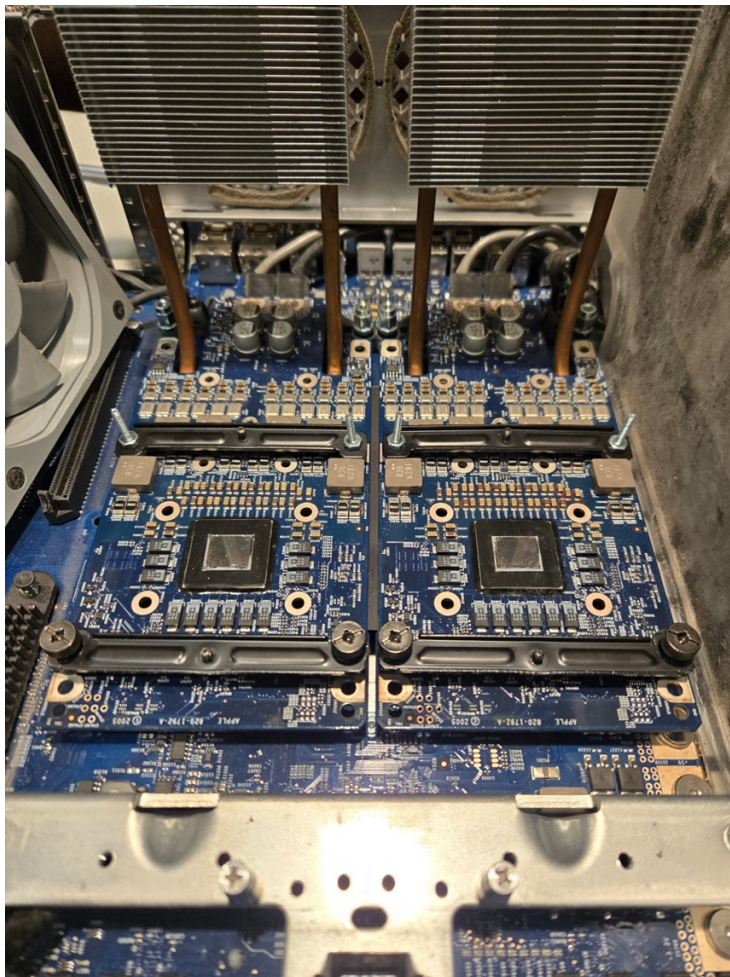


*Front and Back Mounting Hardware Secured to CPU Cards*

## 16.  Installing  the FROZN A400 Heat Sinks

With the mounting brackets now (more or less) firmly in place, the next step is to mount the FROZN A400s onto them.

When this is done, it will bring each CPU face, its copper shim and its FROZN cooler all into contact with each other. Hence, it is time to break out the thermal paste. Essentially, before mounting the A400s, both sides of each shim must be pasted, as the shim is the intermediary element between the CPU and the FROZN cooler.

You COULD paste each side of the shim, but it is easier to apply thermal paste to the things each side of the shim contacts: the bottom of each FROZN unit, and the face of the CPU chip on each CPU card.

As always, use the smallest amount of thermal paste you can per application. Thermal paste is intended to overcome microscopic unevenness between the surface of the CPU chip and the surface of the shim, and similarly, between the other surface of the shim and the surface of the cooler itself. Thermal paste is not glue – it is just a heat transfer aid – so use it sparingly but do accomplish full coverage. If you do not, "hot spots" may develop, impacting cooling.

Pasting the cooler/shim assembly takes more thermal paste than may appear obvious on first consideration. This is because the bottom of the cooler it is not a continuous surface but rather a set of four parallel heat conductive lines, each of which must be pasted separately. For each line, I used three small drops of paste and then spread them up and down the line until it was covered.

When the paste is fully spread, press one side of the shim up against it and apply a small amount of pressure for a short moment. This causes the shim to stick to the bottom of the cooler, allowing you to work with the combined entity as a single thing.

For the CPU pasting, I put one small drop of paste (about the size of a grain of rice) onto the face of the CPU chip and spread that out evenly.
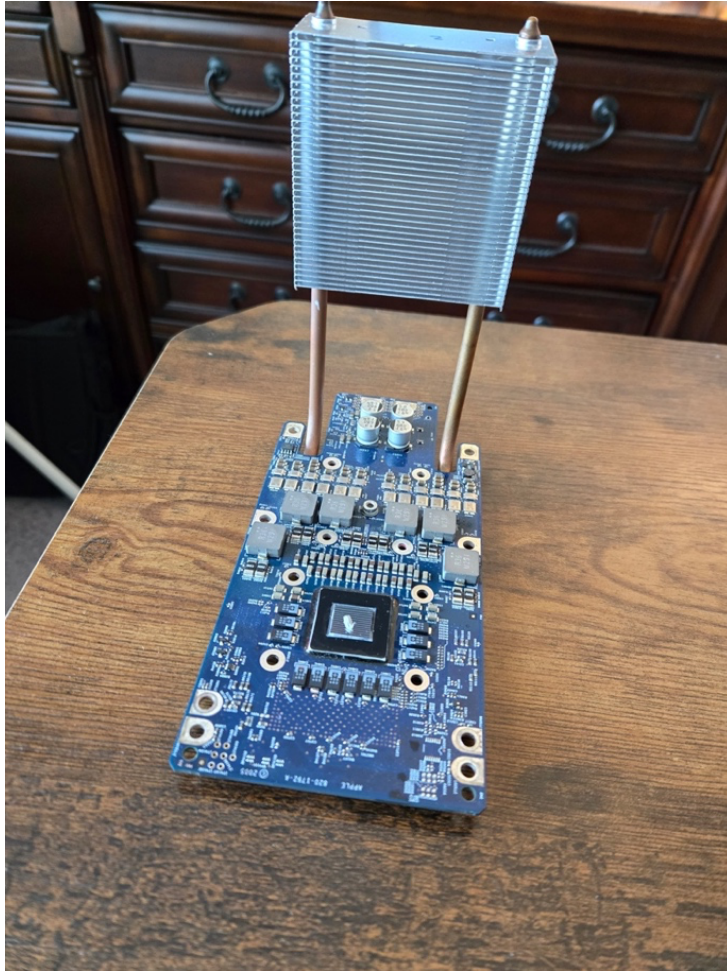
*Small Drop of Thermal Paste on CPU Chip Face*

With this done, you are now ready to attach the combined FROZN/shim assembly to the CPU face via the mounting hardware which is now firmly attached to the motherboard.

With three washers used to build up each front peg, the front mounting bracket is just marginally too low to allow the FROZN unit's front mounting hardware to reach down and grab the threaded bracket screw it tightens into. But leveraging the little bit of wiggle that exists, the FROZN unit can be tilted forward slightly, allowing the front mounting hardware to be screwed down onto its matching bracket screw. Do not screw it down very much... just enough to catch and hold.

The FROZN unit can then be tilted back the other way, causing the now attached front mounting hardware to pull the front mounting bracket up to the small extent of its wiggle room. This provides just enough "wiggle room" in the other direction to enable the FROZN's back mounting hardware to reach its bracket and tighten down. As I said above, a delicate dance...

Mission accomplished! The FROZN unit is now held firmly in place against the CPU/shim setup on the CPU card and the card itself is held in place by the pegs and the knurls. In retrospect, four washers each might have been even a little bit more effective, but it worked well with three, and since it worked, I decided not to mess with it!

I repeated the above with the second FROZN and that was that – the coolers were attached. Next up – attaching the fans to the coolers.

## 17.    Installing  the FROZN A400 Fans

Physical space is so tight in the area of the coolers that there is not enough mechanical clearance to attach the fans to the FROZN heat sinks using only the clips that ID Cooling provides. To overcome this limitation, I rely on a motley collection of items to get the job done: **one** of the mounting clips provided with the FROZN units, one twist tie and several strategically placed pieces of duct tape (when the going gets tough, the tough get duct tape!).

The fan closest to the PCI Divider plate is properly secured with one of the intended mounting clips. The far side of the same fan is secured to its paired FROZN with duct tape. The fan closest to the bottom of the Quad is secured on top entirely with duct tape, while its bottom is connected to the nearest edge of the top fan with a twist tie. The result looks like this:



*Completed Air Cooling for PowerMac G5 Quad*

## 18.    Powering  the FROZN A400 Fans

Powering the newly attached fans is the final challenge. If you follow the wires in the above photo really carefully, you can almost see that the FROZN's fans are powered from a MOLEX that I split out from the DVD/CD area of the case and then pulled through a gap near the bottom of the PCI Divider plate. Since this is the only MOLEX in the machine, splitting it was the only way to get MOLEX power to the fans.

To get at the DVD/CD unit MOLEX, you need to disconnect the ATA cable from the unit first; the MOLEX is behind it and cannot be accessed until the ATA cable is removed. While removing the ATA cable, you will discover once again that physical space is really tight inside the Quad's case. You may be able to undo the ATA cable by hand, but you will not be able to deal with the MOLEX behind it in this way – you will need a pair of long handled screw drivers with 90 degree bent tips to do the work.

Once the ATA cable is out of the way, use those pliers to remove the MOLEX from the DVD/CD drive, attach a splitter cable to it and then reattach one end of the split cable to the DVD/CD unit, powering it once more. Feed the "other" side of the splitter cable down and through the gap at the bottom of the PCI Divider plate, bringing a spare MOLEX into the CPU area of the case.

Of course, the FROZN fans do not directly consume MOLEX; instead, they use traditional fan plugs. You will need (and I had in stock) a "MOLEX to fan plug" conversion cable to bridge the gap. Such conversion cables are readily available on Amazon, eBay, etc. The one shown in the photo below is from Amazon (PNGKNYOCN 4-Pin  MOLEX to 4 x 4 Pin Fan Connector Cable), for only $7.99.

I will note that I could have chosen instead to cut into the Quad's pump control cable (it is now extraneous after all - there is no pump anymore!) and extract the +5v, +12v and Ground needed from there, but the MOLEX approach was simpler and that is the path I took.

With the FROZN units in place and their fans attached and powered, all that is left is to reassemble the Quad and try it out.

## 19.  The Moment of Truth – Success, or Repeat?

At this point, all I can do is wish you luck. If have installed the A400s and their fans correctly, and reassembled the machine without issue, you will see, via iStatMenus or XRG (Leopard only), CPU A and B temperatures somewhere in the 30 C to 50 C region. Lower is better. Neither CPU should idle at more than 50 C. If either CPU is at or above this value, you may wish to revisit your work and try again!

I am pleased to report that in my case it worked first time – wow, it really worked: all four CPUs idled in the high 30s! I had not even dared to hope for such an excellent result!

… and those noisy CPU intake and exhaust fans? Silenced! With the CPUs running nicely cool, Mac OS X does not feel the need to ramp up the fans to provide additional cooling and so they stay that their default RPMs… nicely quiet. Notice that both CPUs intake fans idle at 970 RPM, a quiet nod to the 970MP chips that power the whole thing!

The photo below shows the iStatMenus readings from my "Air Quad" once done:
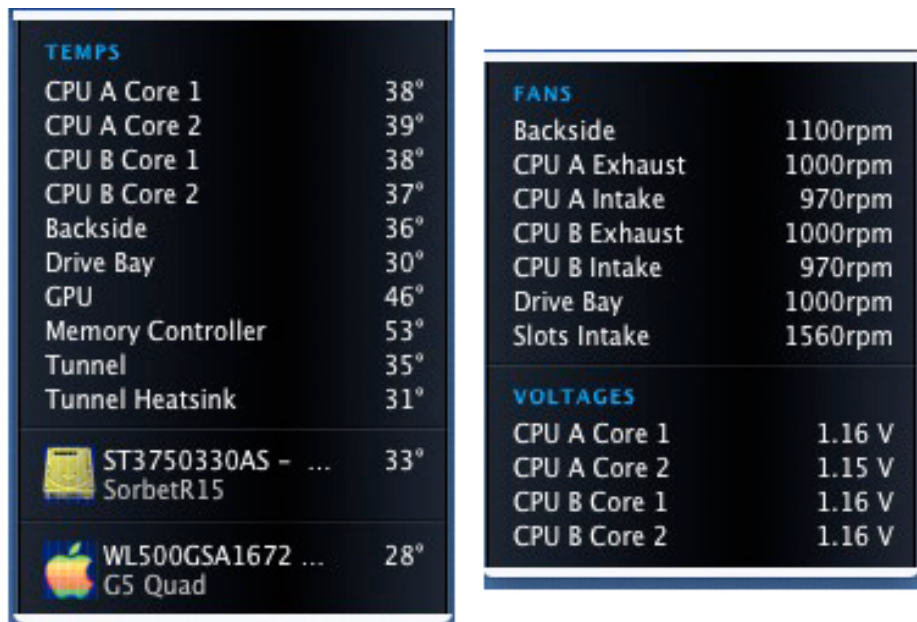


It is accepted folklore BTW that Mac OS X uses CPU B more heavily than CPU A but in this case, I did not see it – both CPUs idled at about the same temperature, suggesting similar loading.

## 20.   Wrap Up

This document has presented an A-Z guide to converting a late 2005 Power Mac G5 Quad from liquid cooling to air cooling.  If you followed this guide faithfully you too will achieve a cool, quiet Power Mac G5 Quad.

In the end, air cooling a Quad is SO much simpler than overhauling a failing LCS and less expensive as well. It takes a little persistence and a little ingenuity, but I strongly recommend it. Never again will you have to contend with coolant leaks, dried coolant crystals, roaring fans and so on. The LCS may have been a good cooling decision in 2005, but we can do much better two decades later in 2025.

## 21.   Appendix A: Key Things to Keep in Mind

Keep these things in mind as you work on your air-cooling conversion, to maximize success:

- Treat the CPU cards with extreme care as you go through this conversion process. There is a lot of handling of the cards involved, and they are easily damaged. I speak from experience; I damaged one of the CPU cards in my Quad during this process. Don't do the same!

- The Quad's 970MP chips can consume up to 100W of power each at peak load and can throw off a LOT of heat! This is why Apple felt the need to go to liquid cooling for the Quad back in 2005. You are now converting to air cooling. Use a high quality thermal paste with a heat conductivity of at least 12 W/mK or more. You need to **really** efficiently move a lot of heat away from the chip face in order for air cooling to succeed. Don't cheap out on a key part of the heat transfer mechanism!

- But… thermal paste is not glue. Use as little as you can while still achieving full coverage with it.

## 22. Appendix B: Related Work

I am not the first person to attempt an air-cooling conversion of a late 2005 Power Mac G5 Quad. There are some related efforts that may be of interest to readers of this guide. They are listed below:

1. Kaiser, Cameron, "Long Life Computing (plus: Quad G5 CPU Swapping for Dummies)", April 2014, TenFourFox Development Blog,
   Quad G5 CPU Swapping for Dummies

2. Kaiser, Cameron, "And Now for Something Completely Different: "Upgrading" Your Quad G5 LCS", July 2021, TenFourFox Development Blog,
   Upgrading Your Quad G5 LCS

3. User "Doq", www.macrumors.com, "Because I Can. Air Cooling a G5 Quad", May 28, 2024

4. Campbell, Michael, Power Mac G5 Quad LCS Restoration, A-Z Guide, v1.0, May 25, 2025

# [End of Document]