

Nighthawk CNC Controller



4th Axis Upgrade

The 4th Axis Upgrade will allow your machine to run an independent 4th axis which is usually used for a rotary axis for doing carvings or laser engravings on round stock or objects. This guide is for one of our Nighthawk CNC controllers and will work for both the Full-Stack controller or the standalone Nighthawk control card.

Please note: By making this change you will not be able to use Dual Axis Homing (Auto-squaring on Home) as the control port used to run the independent Y2 motor will be used to run the A axis.

You will need to open the Nighthawk case to run your control wire as well as change some settings in the CNC3D Commander software to enable an independent 4th Axis.

Some soldering will be required for this upgrade.

For this upgrade you will need:

- Small Phillips Head Screwdriver
- 2-Core DC Power Cable (Available from CNC3D)
- 4-Core Stepper Cable (Available from CNC3D)
- 4-Pin JST Plug (Available from CNC3D)
- Stepper Motor Driver (Available from CNC3D)
- Stepper Motor (Available from CNC3D)
- 6mm and 3mm Heat Shrink

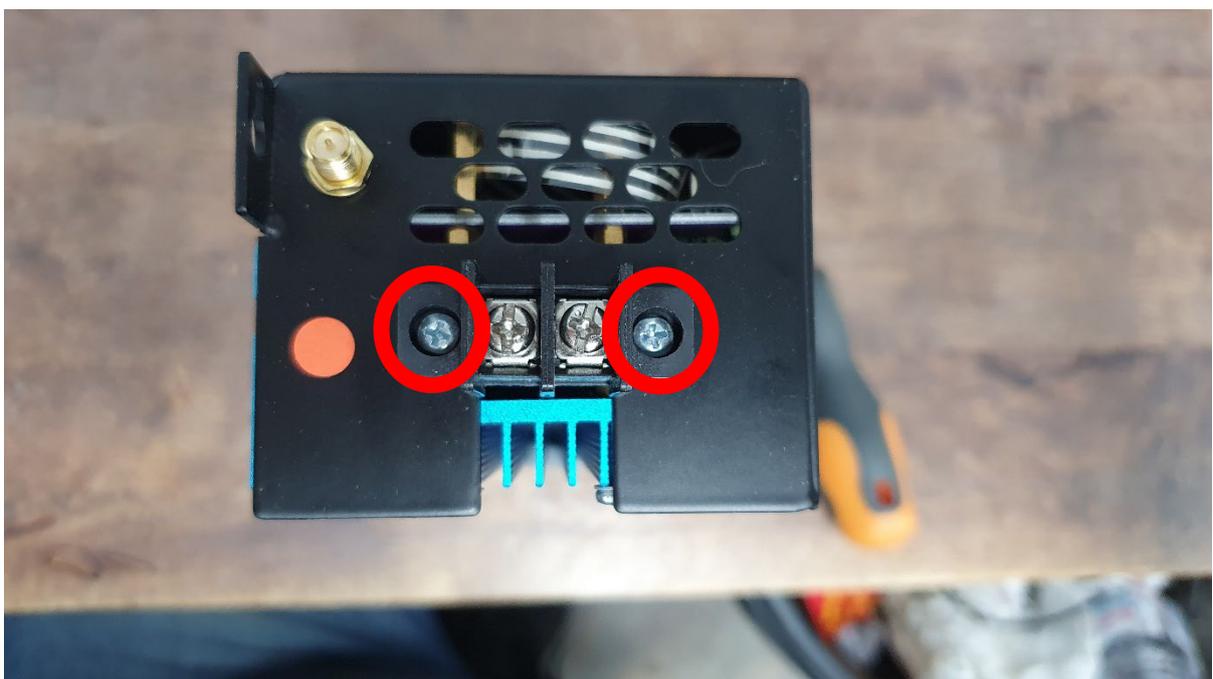
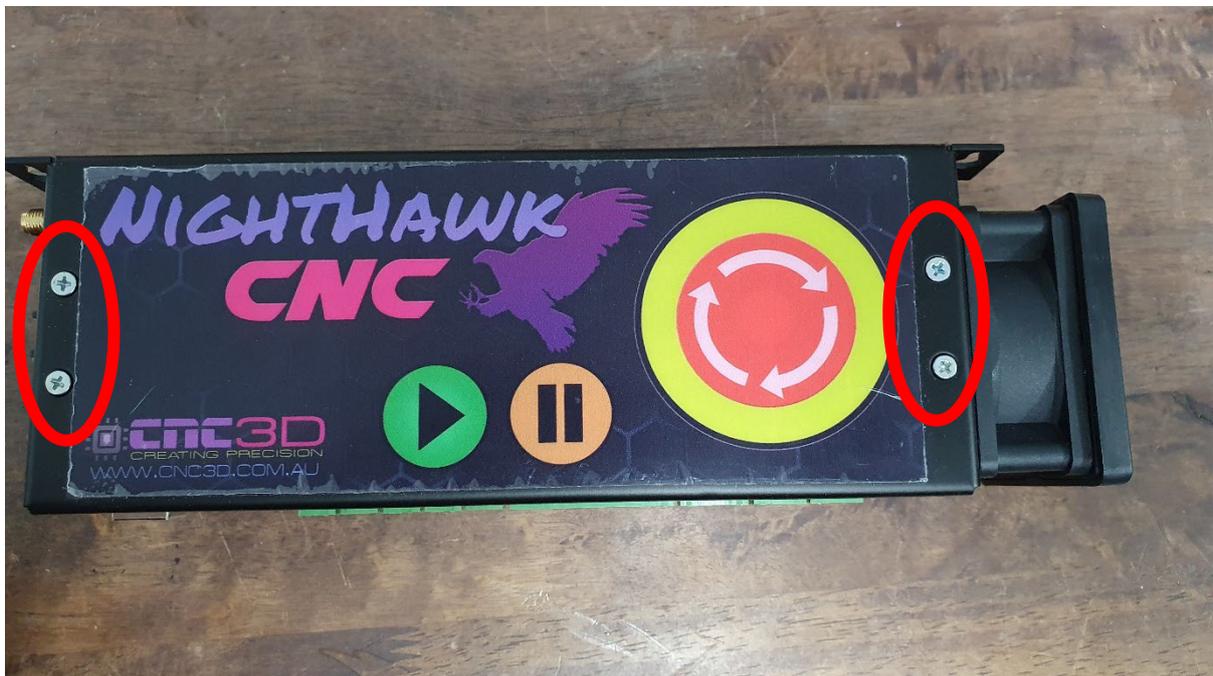
You may also like to have a multimeter on hand to ensure wiring orientation and connections are accurate before supplying power.

Be sure to power off and unplug your machine before performing any maintenance or doing any work involving wiring.

Opening the Nighthawk Controller and installing control wires

Step 1: Remove your Nighthawk Controller from your machine and unplug all green connectors, USB cable, MicroSD card and power cable from the Nighthawk. You will not be able to open the case if there is anything plugged into the controller. **You can leave the antenna attached.**

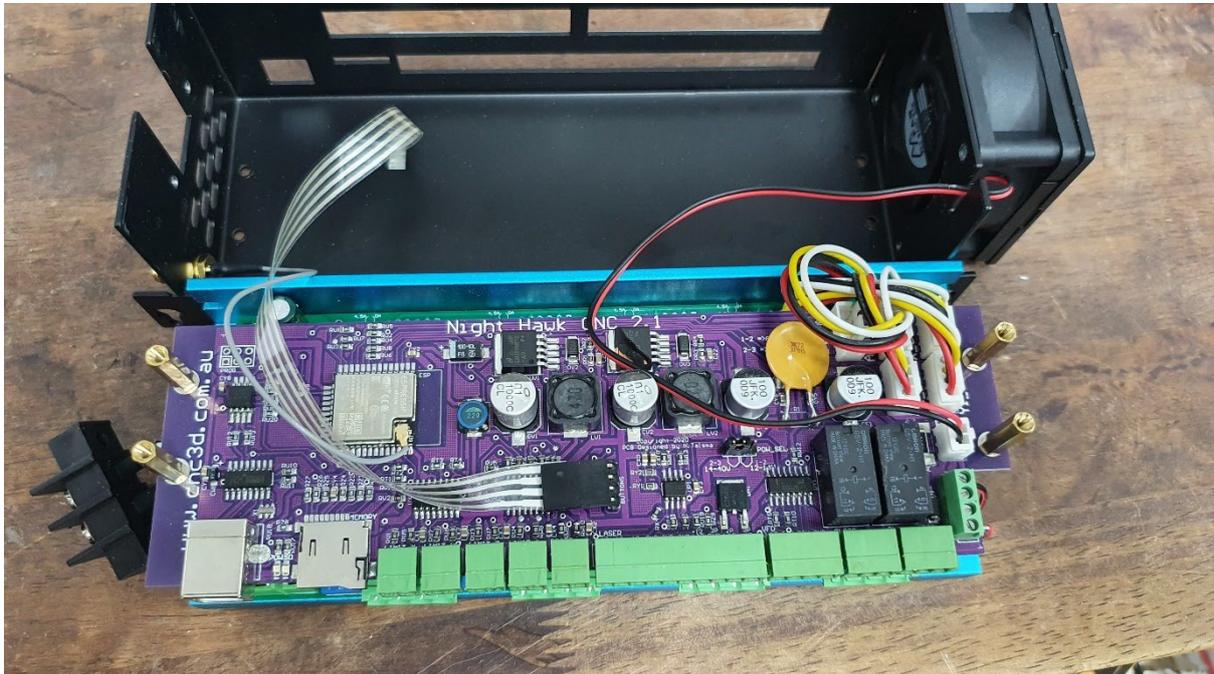
Step 2: Remove the 4 screws holding the case together.



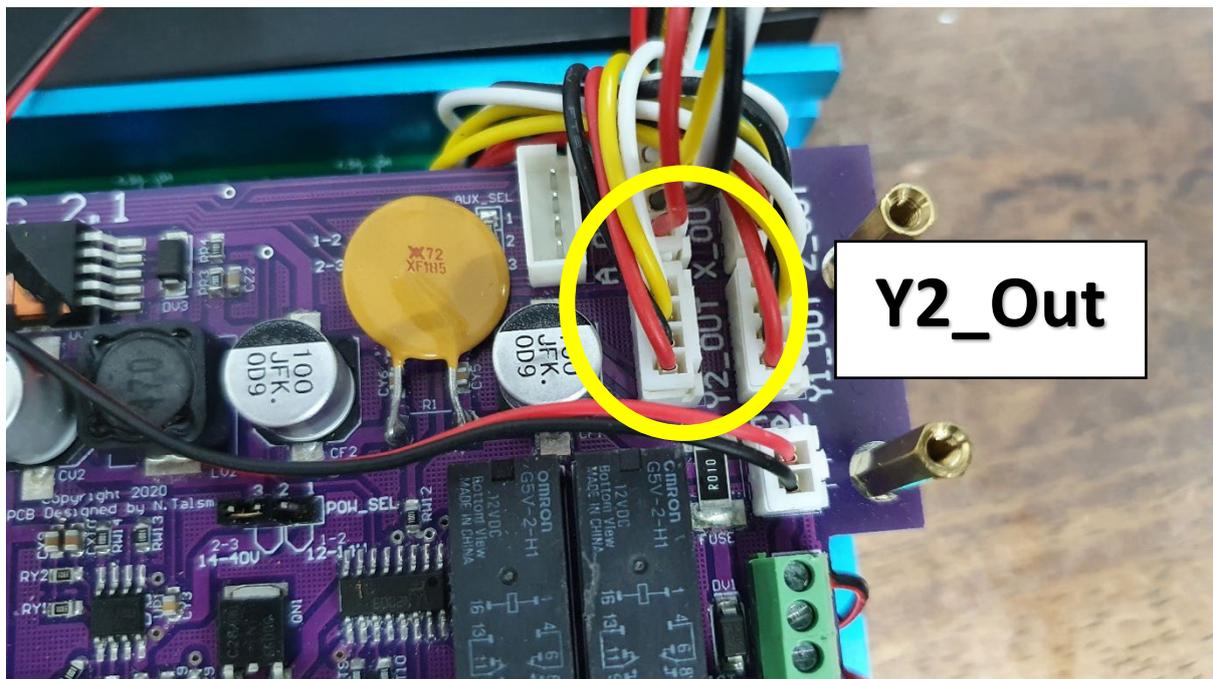
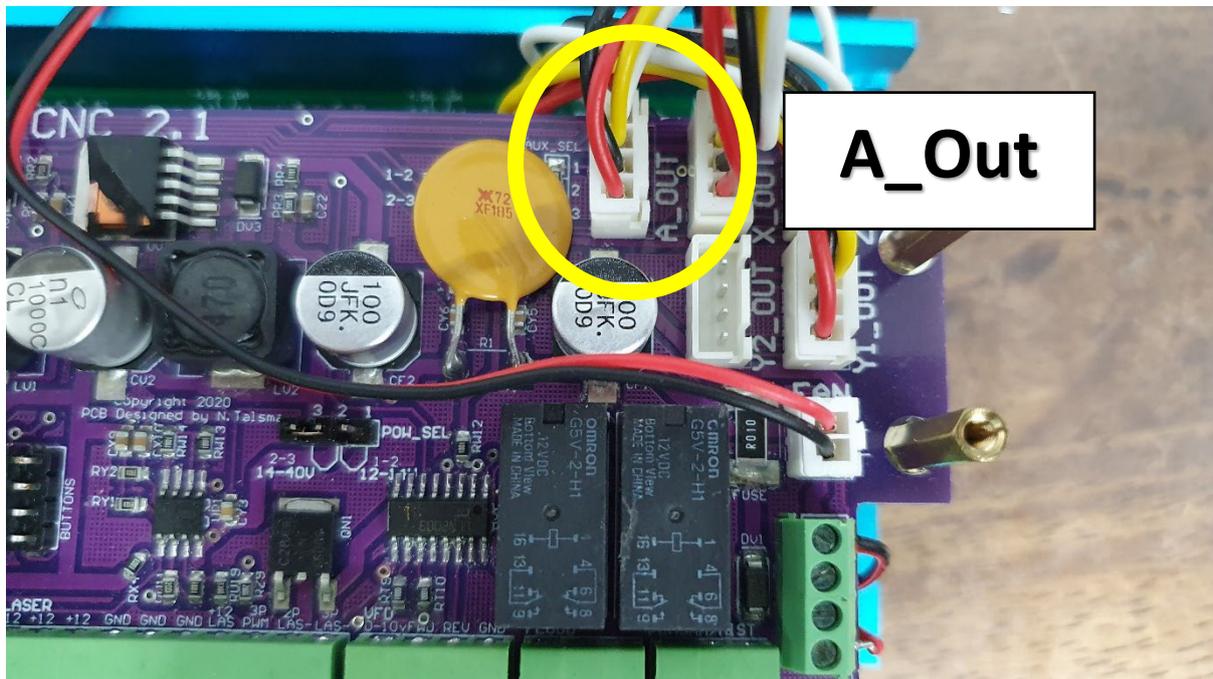
Step 4: Remove fan cover and loosen (don't remove) the 4 screws holding the fan to the case



Step 5: Gently slide open the case, be very careful as there are short wires and ribbon cables inside the case that will be damaged if pulled on.



Step 6: Unplug the white connector from the A_Out plug and move it to the Y2_Out plug.
The plug will only go in one way so make sure it is in firmly but do not put too much force on it, you may be trying to put it in backwards.



Step 7: Now you will need to run the control wire from your A axis driver to the Nighthawk control card. This will plug into the A-Out plug on the control card.

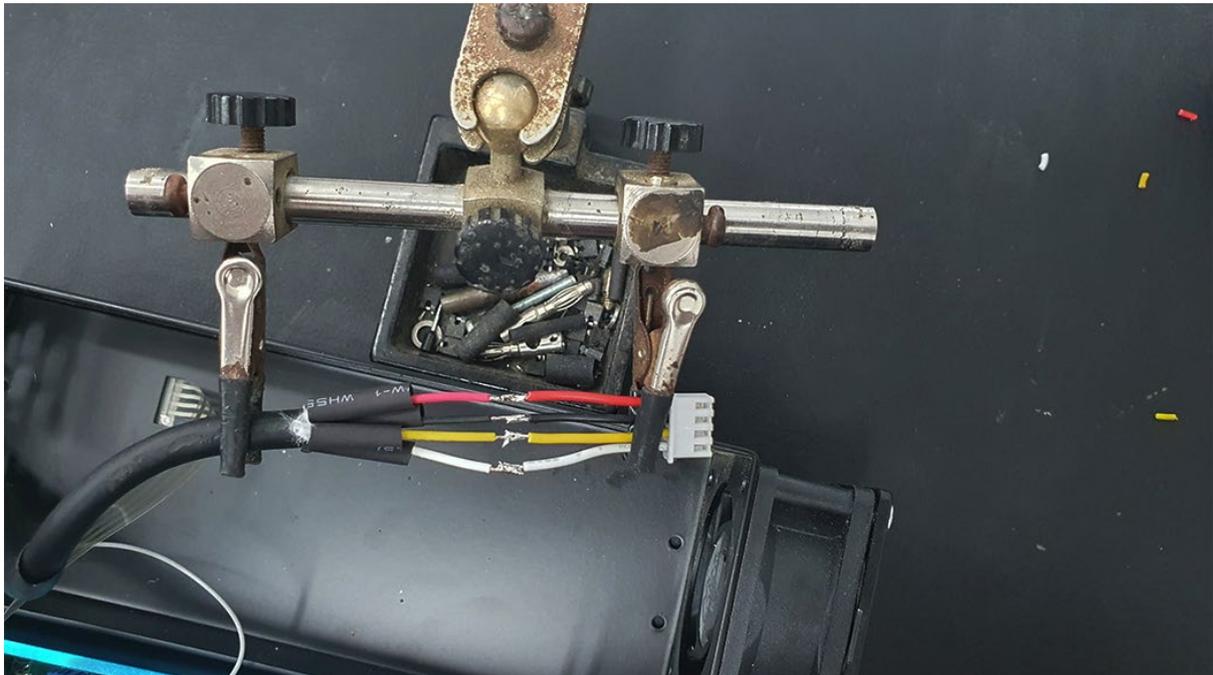
The easiest way to do this is through the Nighthawk case at the power supply end. The 4-core stepper cable available from CNC3D will fit through with some mild force but be careful not to strip the outer protective sheath.



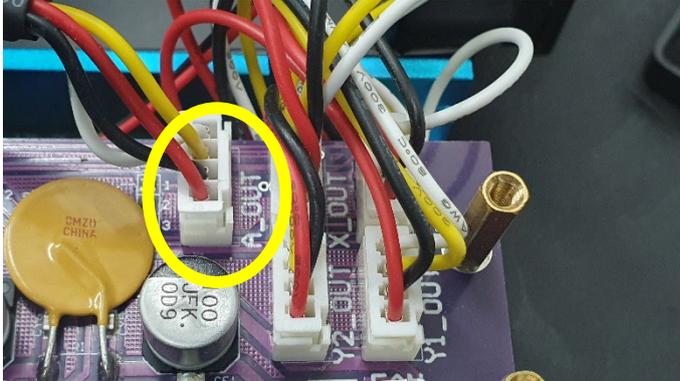
CNC3D's 4-Core stepper cable fits through the grid holes on the power supply end of the Nighthawk.

It is easiest to solder the 4-pin JST connector onto the 4-core stepper cable AFTER feeding it through the case as neither the JST plug nor the heatshrink will fit through the grid holes.

Ensure all colours match to make the rest of the installation easy.



Once you have completed soldering and heat shrinking everything, you can plug the white JST plug into the A_Out connector on the Nighthawk control card.



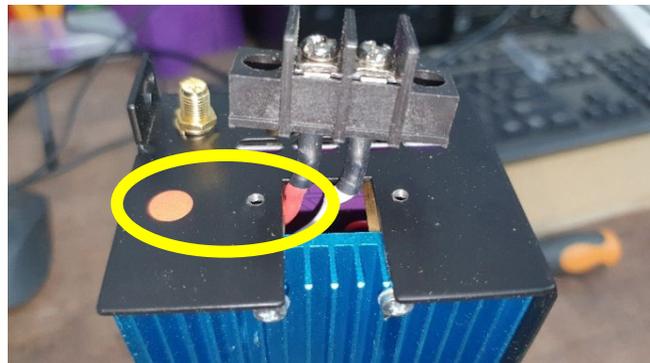
All 5 of the white motor plugs should now have a connector in it.



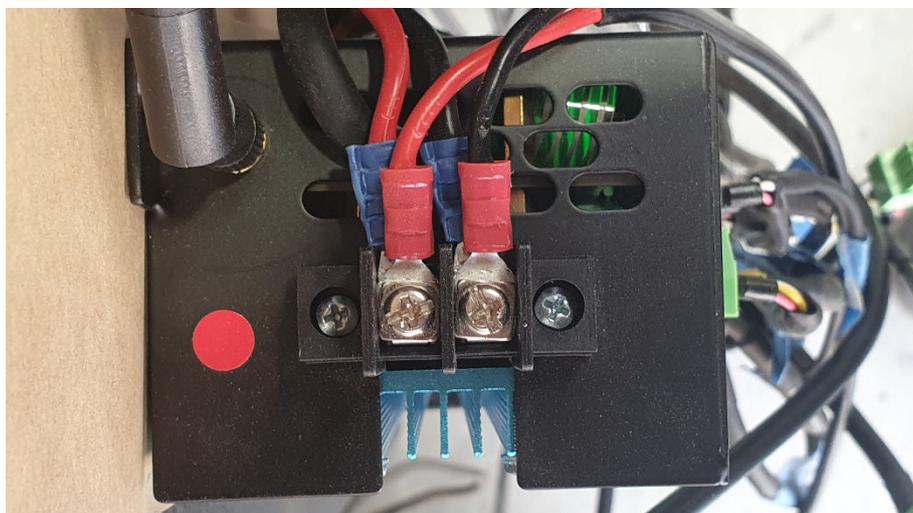
Step 8: Reverse steps 1-5 to close the case. Pay close attention to the red and black fan cable and the coloured motor cables as they can easily get pinched in the case.

The fan cable will thread through the slot on the back of the steel case.

Ensure the red wire on the power connector is closest to the antenna connector before inserting the screws.



Step 9: You can use the Nighthawk's power supply to power your A-axis stepper driver by jumping off the spade terminals. Your stepper driver will receive the same voltage as the Nighthawk. For example if you have one of our QB2 or QueenBee machines, the power supplied is 36v so both the Nighthawk and your stepper driver will receive 36v. In the picture below there are 2 sets of spade terminals on the power connector – one going to the driver and one coming from the 36v supply.



At this point you can also wire in the cable from the stepper motor and the DC power. **Pay close attention to the orientation of the power cable as wiring it backwards can damage the driver's circuitry!**

When wiring the stepper motor cable you will need to know which wires go to which terminal. The easiest way to test this is by using a multimeter on continuity mode, and testing the wires going to the stepper motor, not into the stepper motor driver.

The images below show how to test the coils in a stepper motor to find the pairs.

These photos are an example only and your wire colours may be different.



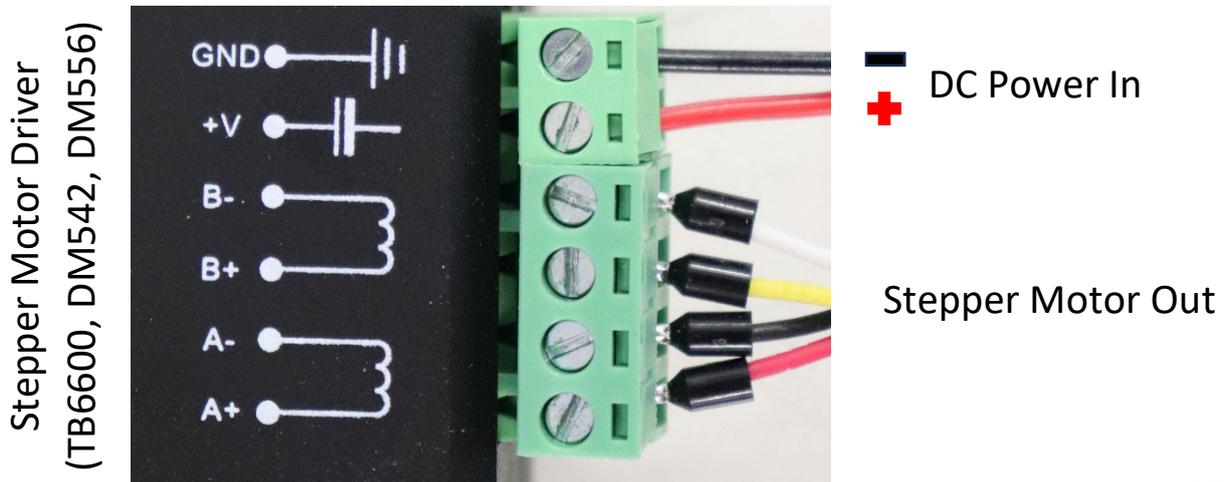
Green & Blue wire have no continuity so are not a pair



Green & Red wire have low resistance, so they are a pair

There are 2 coils (phases) in a stepper motor. If your multimeter is reading zero or very low resistance between a pair of wires, that is one coil (A) and the other pair would be the second coil (B).

There is no way to tell which would be the positive or negative (A+/A-) before powering it up, however you will not cause any damage to anything by wiring them backwards. The effect of wiring it backwards would cause the motor's coils to be out of phase with each other, causing the motor to either run backwards or simply not turn at all.



The last step in setting up the driver is to check the DIP switch positions. On the stepper driver case you will see a table which tells you how to orient the switches to get the right output and some small switches along the side. There will also be a marking on the switch telling you which way is ON.

Please Note: These switches must not be adjusted while the driver is powered on.

You will need to know the current rating of your stepper motor, and the pulse/rev you want to set it at.

Pulse/rev is the same as microstepping but is related to how many pulses the motor needs to rotate a full 360 degrees, whereas microstepping is how many times a single step of 1.8 degrees is divided up. The higher the pulse/rev or microstep setting, the higher the accuracy but the lower the torque.

For the most part, 1600 pulse/rev is perfect and equates to 1/8th microstepping.

The following table below is from a DM556 stepper driver and is an example only. You will need to refer to your stepper driver as the switch position may vary across different drivers.

Current Table			
Peak	SW1	SW2	SW3
1.4A	on	on	on
2.1A	off	on	on
2.7A	on	off	on
3.2A	off	off	on
3.8A	on	on	off
4.3A	off	on	off
4.9A	on	off	off
5.6A	off	off	off

SW4:off=Half Current on=Full Current

Pulse/rev Table				
Pulse/rev	SW5	SW6	SW7	SW8
400	off	on	on	on
800	on	off	on	on
1600	off	off	on	on
3200	on	on	off	on
6400	off	on	off	on
12800	on	off	off	on
25600	off	off	off	on
1000	on	on	on	off
2000	off	on	on	off
4000	on	off	on	off
5000	off	off	on	off
8000	on	on	off	off
10000	off	on	off	off
20000	on	off	off	off
25000	off	off	off	off

The first table, labelled “Current Table” tells you how to set your current. In this example I have a stepper motor rated for 3A. This table doesn’t have a 3A setting but the best practice is to go slightly lower so I will set my driver to 2.7A instead.

For this to work, Switches 1 and 3 need to be on, and switch 2 is off.

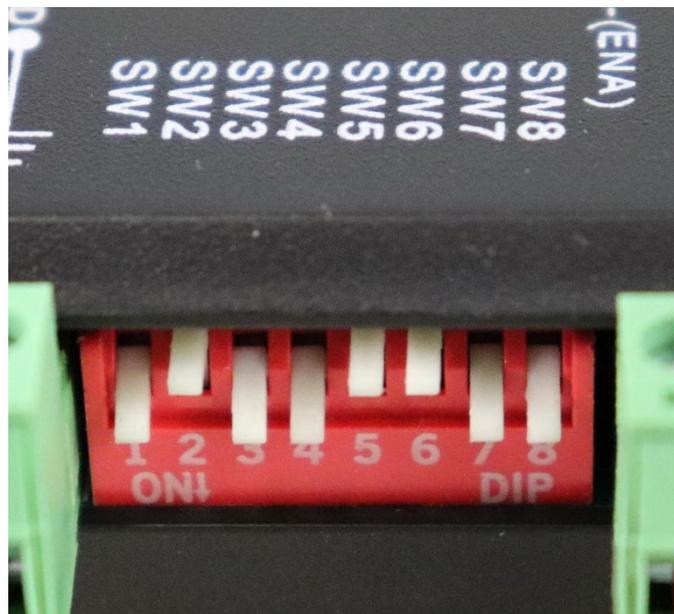
Switch 4 is how much of the available current gets sent to the motor.

For exaple a 700mA motor would be too low for this driver, but I could set it to be 1.4A, then use Switch 4 to limit that to only half current and put out only 0.7A, or 700mA.

For my 3A motor, I will use the 2.7A setting at full current so Switch 4 should be on.

We already talked about pulse/rev and I want 1600, so looking at the second table, I need Switches 5 and 6 off, Switches 7 and 8 on.

Switch 1 – On	Switch 5 – Off
Switch 2 – Off	Switch 6 – Off
Switch 3 – On	Switch 7 – On
Switch 4 – On	Switch 8 – On



Installing the 4-Axis Firmware and enabling in Commander

Once your controller is reassembled and powered up you will not be able to use the machine until you have installed the correct firmware as your Nighthawk will still be trying to run an independent Y2 motor.

DO NOT HOME YOUR MACHINE

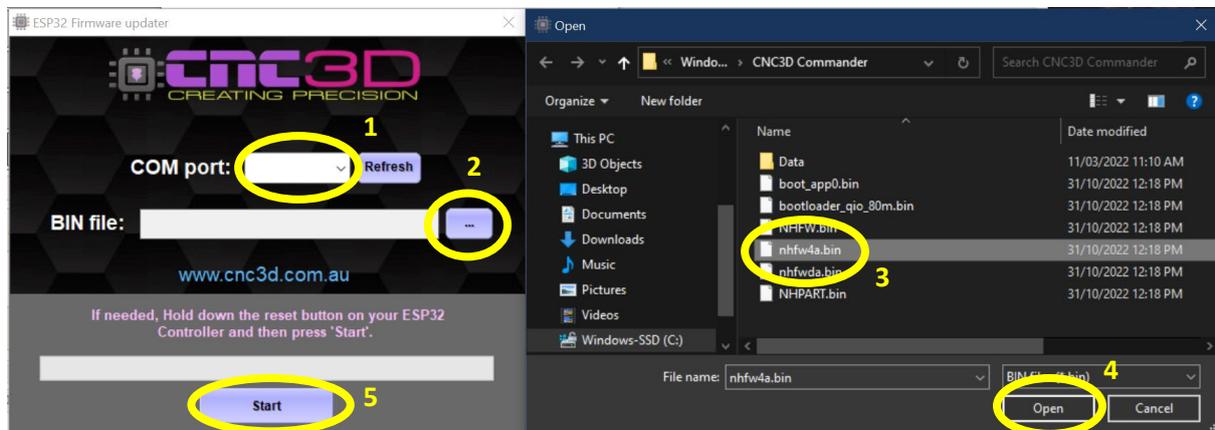
Trying to home the machine at this point will cause a crash!

Step 1: Connect your Nighthawk Controller to your computer with a USB cable, you will not be able to update the firmware over WiFi. Do not connect to your controller just yet.

Step 2: Open CNC3D Commander and navigate to the “Help” section and select “CNC3D ESP32 FW Tool”, click Yes on the popup box.

The screenshot displays the CNC3D Commander software interface. At the top, there are navigation tabs for 'COM', 'COM8 | Silico', 'Refresh', 'Disconnect', 'Tools', 'Create', 'Settings', 'About', and 'Help'. The main interface shows machine status for X, Y, and Z axes, all at 0.000. A 'Firmware warning' dialog box is open in the center, with a yellow warning icon and the following text: 'WARNING: Please ensure you choose the right firmware file to suit your controller. If you have a Nighthawk controller, please only use approved Nighthawk firmware. If you have an xPROV5 or other ESP32 controller DO NOT use Nighthawk firmware. CNC3D Will not be responsible for any damage caused by loading the incorrect firmware to your controller. Are you sure you want to proceed with using this tool?'. The dialog has 'Yes' and 'No' buttons. Below the dialog, there are buttons for 'Raw data window', 'Set \$10=3', 'View COM error log', and 'CNC3D ESP32 FW Tool'. The bottom of the interface includes 'Immediate Overrides' for Feed Rate and Spindle, and a 'Manual Command' input field.

Step 3: In the Firmware updater tool which opens, make sure you have the correct COM port selected for your Nighthawk then click on the “...” button and select the “nhfw4a.bin” file and click “open”



You will see the file show up in the BIN file dialogue box, then click “Start”. Do not unplug or turn off your Nighthawk during this process.

When the update has completed turn off your Nighthawk Controller for 10 seconds, then power it back up.

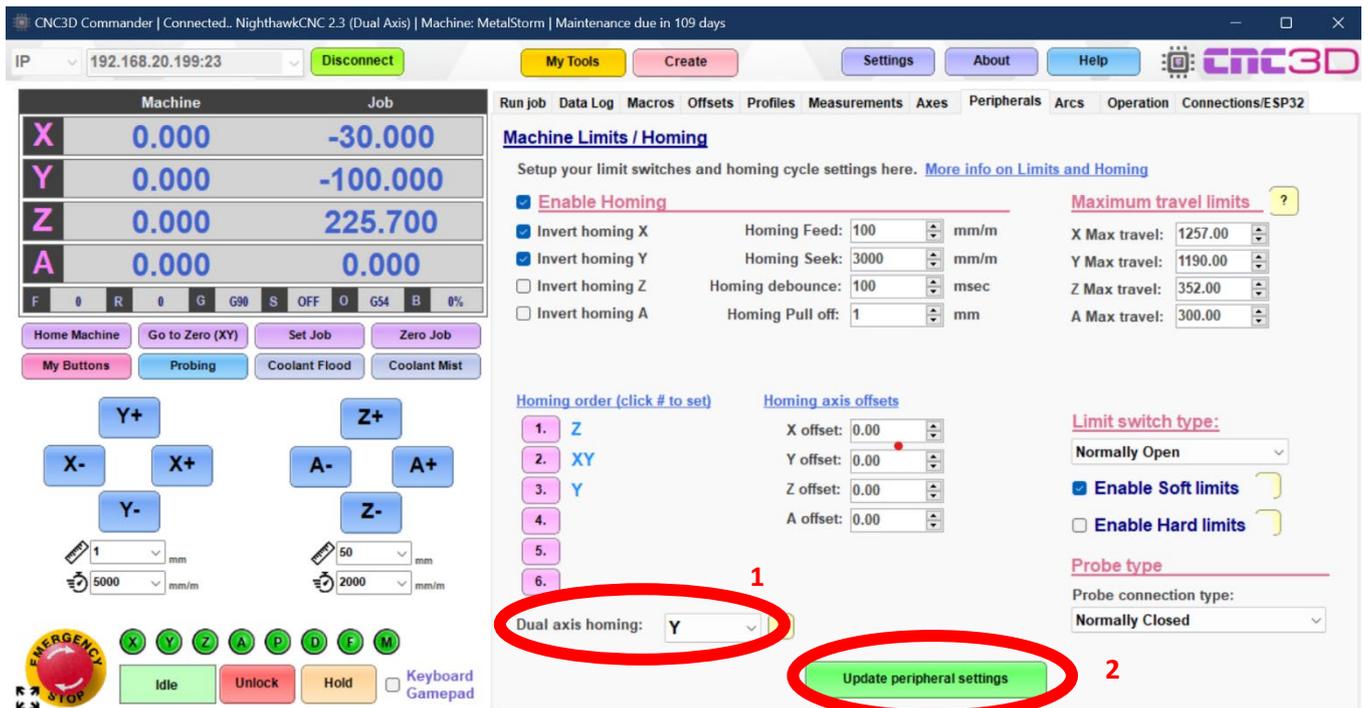
This should correctly flash your firmware. If it doesn't the following may be stopping it:

- Another program is already using that COM. Please close any other GCODE senders or programs like LaserGRBL, Lightburn, Cura etc. or click Disconnect in Commander.
- You may have the wrong COM selected. Try another port.

Step 4: Open CNC3D Commander and connect to your Nighthawk Controller. You will have a flashing Alarm next to the Emergency Stop button because the machine isn't homed. Click on the Emergency Stop button, then on the Unlock button to clear the alarm.

Once the alarm is cleared, navigate to the Peripherals tab and look for the "Homing Order" section in the bottom left of the page.

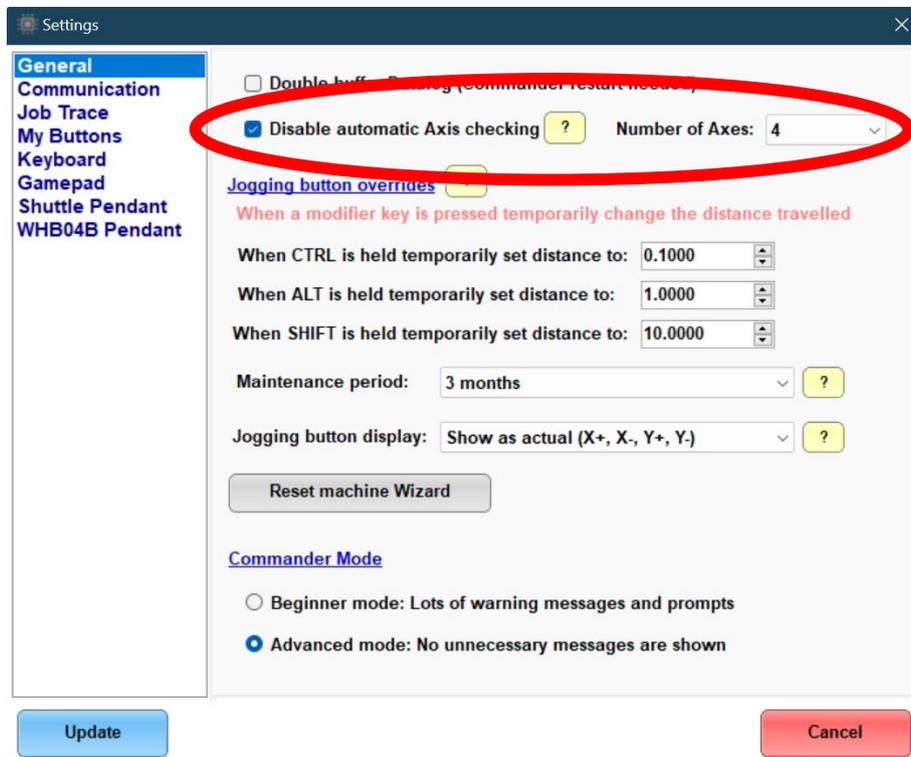
It is now necessary to disable the Dual Y Homing. You can do that by clicking on the drop-down box next to "Dual Axis Homing", selecting (none) and then clicking "Update Peripheral Settings".



When the confirmation pops up, click OK then you will need to turn the Nighthawk off, wait a few seconds then turn it back on. You will also need to click "Disconnect" in Commander.

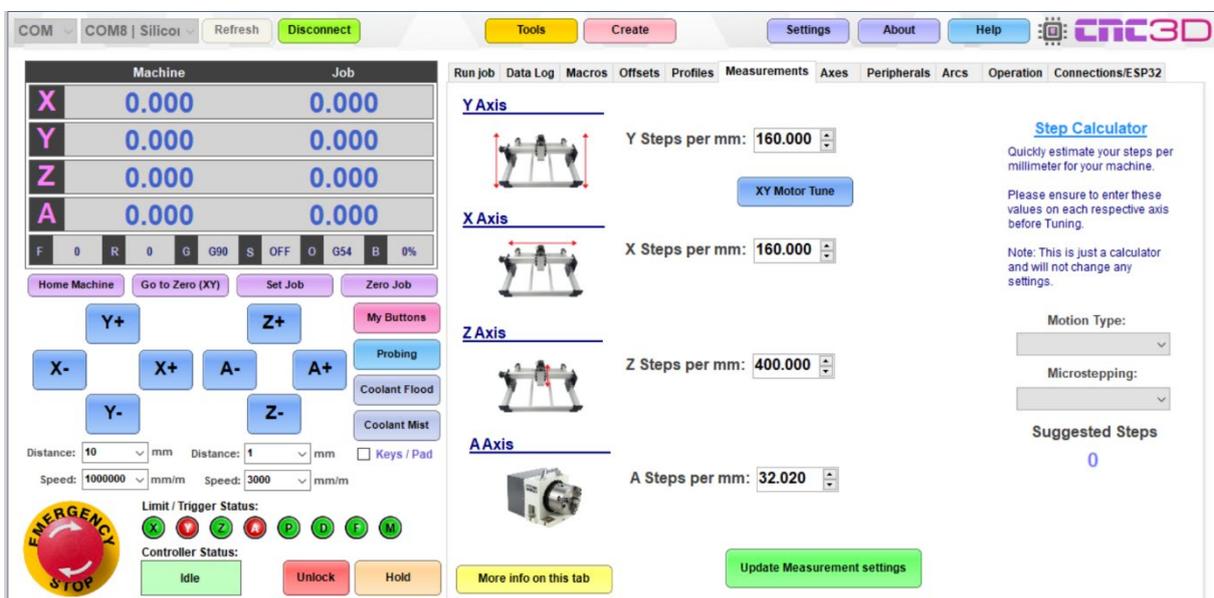
While the Nighthawk is powering back up and Commander is still disconnected, click on “Settings” and under “General”, look for the “Disable Automatic Axis Checking” button.

You will need to *check* the “Disable Automatic Axis Checking” before you can then select “4” in the “Number of Axes” drop down menu, then click “Update in the bottom left corner of the window.



When the settings window closes, you can reconnect to the Nighthawk with the “Connect” button and you will see under the DRO numbers there is now both A+ and A- buttons to control the A axis.

You can now use the Measurements and Axes tabs to set up your Steps/mm and Speed/Acceleration for your 4th axis.



**Your Nighthawk is now configured to run
a 4th axis. Happy carving!**



**Be sure to hit the Emergency Stop if the machine does not
behave in the way you expect**

If you run into any difficulties with this guide or would like some more
information, reach out to us at CNC3D.com.au!