# Nighthawk CNC Controller





## 4<sup>th</sup> Axis Upgrade

The 4<sup>th</sup> Axis Upgrade will allow your machine to run an independent 4<sup>th</sup> 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 being 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 4<sup>th</sup> 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.



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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 4core 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.



### Wiring the Stepper Motor and Driver

For the stepper motor to work it needs to receive high voltage pulses which cause it to turn. The stepper motor driver is what does that job and now is the time to wire it up.

The order in which the electrical signals travel is:



You've already done the wiring at the Nighthawk by adding the JST plug and inserting it into the A\_OUT plug on the Nighthawk card.

At the other end of the 4-Core cable coming from the Nighthawk you will need to strip between 30-40mm of the outer sheath and the wire braid to allow the individual wires to easily reach their intended terminals.

You will also need a short length of wire to link the PUL+ and DIR+ terminals, a piece of offcut of the 4-core stepper motor cable works well for this purpose. *See photo below.* 

This 4-core wire coming from the Nighthawk will be used for the low voltage inputs on the stepper motor driver and will go to the PUL+, PUL-, DIR+, DIR- and ENA- terminals. Refer to the picture below for reference. If using the cable from CNC3D the colours should match, if you matched the colours when soldering on the JST plug in the steps above.

*Pro Tip: The ENA+ and ENA- terminals are not used with a Nighthawk, however you can wire the red wire to ENA- to stop it from hanging loose.* 



From Nighthawk A\_OUT 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 1/8<sup>th</sup> 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.

Peak	SW	1 5	W2	SW3	
1.4A	on	6	n	on	
2.1A	off	6	n	on	
2.7A	on		off	on	
3.2A	off		off	on	
3.8A	on		n	off	
4.3A	of		n	off	
4.9A	on		off	off.	
5.6A	of		off	off	
400	off	on	on	on	
Pulse/rev	SW5	SW6	SW7	Iswa	
400	off	on	on	on	
800	on	off	on	on	
1600	- 11	and the second per second second	and the second se		
1000	011	off	on	on	
3200	on	off on	on off	on on	
3200 6400	on off	off on on	on off off	on on on	
3200 6400 12800	on off on	off on on off	on off off off	on on on	
3200 6400 12800 25600	on off on off	off on off off	on off off off off	on on on on	
3200 6400 12800 25600 1000	on off on off on	off on off off on	on off off off off on	on on on on off	
3200 6400 12800 25600 1000 2000	off on off off off off	off on off off on on	on off off off off on on	on on on on off off	
1000 3200 6400 12800 25600 1000 2000 4000	on off on off on off off on	off on off off on on off	on off off off on on on	on on on on off off	
1000           3200           6400           12800           25600           1000           2000           4000           5000	on off on off on off on off on	off on off off on on off off	on off off off on on on on	on on on on off off off	
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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.

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	Machine	Job	r.	Run job Data Log Macros Offsets Profiles Measurements Axes Peripherals Arcs Operation Connections/ESP32
X	0.000	0.00	00	# Help links ×
Υ	0.000	0.00	00	Get help and collaborate with our Community
Ζ	0.000	0.00	00	Troubleshooting tools         User guides         Support Links         Diagnostics
F 0 Home Mach	R 0 G -	S OFF 0 -	B Zero Jo	Raw data window         Warning: Firmware warning window op         X           Refresh         Refresh
	Y+	<b>Z</b> +	My But	Set \$10=3         Try this if i changing i         WARNING: Please ensure you choose the right firmware file to suit your controller. If you have a Nighthawk controller, please on you have an ware if you have an ware in you h
X-	X+		Probi	View COM error log         CNC3D Will not be responsible for any damage caused by loading the incorrect firmware to your controller.         Delete Job
	Y-	<b>Z-</b>	Coolant	CNC3D ESP32 FW Tool Are you sure you want to proceed with using this tool? Run SD Job
Distance: 10 Speed: 10	0 v mm Distance: 000 v mm/m Speed:	60 v mm 50000 v mm/m	Keys	Can be used for upbading custom or re controllers like the Nighthawk or xPROV firmware file to match your controller or results may be catastrophic!
				Close 0%
SERGEN	Limit / Trigger Stat	tus:	E) (M)	Immediate Overrides Spindle Control Manual Command
-	Controller Status:	Unlock	Hold	Feed Rate:         -1%         100%         +1%         +10%         Reset         ON:         M3 ✓         S:         1000 ÷           Spindle:         -10%         -1%         100%         +1%         +10%         Reset         ON:         M3 ✓         S:         1000 ÷

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"

🗰 ESP32 Firmware updater 🛛 🖂	Open	×
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CREATING PRECISION	Organize 🔻 New folder	li 🔹 🔳 🚷
	This PC	Date modified
COM port: Refresh 2	3D Objects	11/03/2022 11:10 AM
	Desktop	31/10/2022 12:18 PM
	Documents	31/10/2022 12:18 PM
BIN file:	Downloads	31/10/2022 12:18 PM
	Music	31/10/2022 12:18 PM
www.cnc3d.com.au	nhfwda.bin 3	31/10/2022 12:18 PM
	Pictures NHPART.bin	31/10/2022 12:18 PM
If needed, Hold down the reset button on your ESP32	2 Videos	
Controller and then press start.	😤 Windows-SSD (C:) 🗸 🧹	
Start 5	File name: nhfw4a.bin V BIM	Dpen Cancel

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 dropdown 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.

Settings			×
General Communication Job Trace My Buttons Keyboard Gamepad Shuttle Pendant WHB04B Pendant	<ul> <li>Double buff - Tour</li> <li>Disable automatic A</li> <li>Jogging button overrides</li> <li>When a modifier key is</li> <li>When CTRL is held temp</li> <li>When ALT is held temp</li> <li>When SHIFT is held temp</li> <li>When SHIFT is held temp</li> <li>Maintenance period:</li> <li>Jogging button display:</li> <li>Reset machine Wiza</li> <li>Commander Mode</li> <li>Beginner mode: Log</li> <li>Advanced mode: No</li> </ul>	Axis checking ? Number of Axes: 4 pressed temporarily change the distance travelled porarily set distance to: 0.1000 porarily set distance to: 10.0000 porarily set distance to: 10.0000 3 months ? ? Show as actual (X+, X-, Y+, Y-) ? ? ard	
Update	1	Cancel	

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 4<sup>th</sup> axis.

COM COM8   Silicor Refresh Disconnect	Tools Create	Settings	
Machine Job	Run job Data Log Macros Offsets	Profiles Measurements Axes Pr	eripherals Arcs Operation Connections/ESP32
X 0.000 0.000	YAxis		
Y 0.000 0.000	Y Ste	ps per mm: 160.000 🗼	Step Calculator Quickly estimate your steps per
Z 0.000 0.000 A 0.000 0.000	X Axis	XY Motor Tune	millimeter for your machine. Please ensure to enter these values on each respective axis
F         0         R         0         G         G90         S         OFF         0         G54         B         0%           Home Machine         Go to Zero (XY)         Set Job         Zero Job	X Ste	ps per mm: 160.000 🔹	Note: This is just a calculator and will not change any settings.
Y+ Z+ My Buttons	ZAxis		Motion Type:
X- X+ A- A+ Probing Coolant Flood	Z Ste	ps per mm: 400.000 🗼	Microstepping:
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Controller Status: Idle Unlock Hold	More info on this tab	Update Measurement se	ttings

## Your Nighthawk is now configured to run a 4<sup>th</sup> 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 <u>CNC3D.com.au</u>!

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