PwnCNC Spindle Kit

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Spindle Kit - Installation Guide

Safety Notice

Warning: *In order to reduce risk of injury and possible death, the user must read and understand this document and the manual packed with the VFD before using our product.*
This is industrial equipment that should be installed by a professional.

Please save all warnings and instructions for future reference. Refer back frequently and use them to instruct others who may use this product. Please pass along this document and the VFD manual if you should loan, sell, or otherwise provide this product to someone else.

For complete instructions, please refer to our website: **pwncnc.com**

Work Area Safety

1. Always wear safety equipment
2. Avoid using anything that can impair your reaction time and judgement
3. Disconnect power when not in use
4. Never use blunt bits
5. Check stock for existing metal
6. Never reach near a running spindle
7. Minimize distractions

Personal Safety

Use our products for the purpose they were intended. Using them in a way that's different from those intended could result in a hazardous situation.

To avoid the potential for injury or failures, PwnCNC Spindles and accessories should not be used for other than its intended purpose.

Please regularly inspect your PwnCNC Spindle kit for loose, missing, fatigued parts, cracks or broken parts. If the product appears to be damaged, immediately remove from service to be replaced or repaired. Failure to follow these warnings could result in serious injury or death.

Use common sense regarding what you're doing during installation and while using any of our products.

Do not use the PwnCNC Spindle while you are tired or under the influence of drugs, alcohol or medication. It only takes a fraction of a second for bad things to happen when dealing with industrial and/or manufacturing equipment like a hobby level CNC and the PwnCNC Spindle Kit.

Dress properly. Don't wear loose clothing or jewelry. Keep your hair, clothing, and gloves away from the moving parts of your CNC.

Operation

Ensure your spindle wires and coolant tubing is properly secured before plugging in and during any operation.

A wire being dragged around your machine can dislodge or disconnect from your spindle and cause damage or worse.

Please Please Please stay safe and Happy Making!

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Overview

We'd like to personally congratulate you on your choice of a PwnCNC Spindle Kit, the most advanced plug-n-play spindle kit on the market.

Your new spindle kit is designed to fit onto a variety of hobby CNC machine brands and configurations.

There are two main components of your new spindle kit: the VFD and Spindle Motor. Along with various wires which hook everything together for power, coolant, and spindle control.

What's Included?
- Spindle Motor of your size preference with a corresponding Spindle Cable
- PwnCNC VFD as well as a Power Cable for either 110v or 220v
- 3 of the most common Collet sizes and a Collet-Nut
- Two collet wrenches
- Submersible pond pump and tubes (if you chose water-cooled)
- And… stickers… of course!

What's Required?
- If you desire automatic control, a control cable.
- Correctly sized router/spindle mount.
  You may need to upgrade your router mount,
  see your CNC manufacturer for details
- You may also need to upgrade your Z-Carriage, *see your CNC manufacturer for details*
- Someplace relatively close to your CNC to mount the PwnCNC VFD
- If you chose water-cooling, you'll need to purchase a small bucket to act as a reservoir and some sort of coolant. Simple window washer fluid is a great choice.
- Also, if water cooling, you may need larger drag chains if you intend to run the inlet and outlet tubes through them.

Installation

Installing your new spindle is extremely easy. We'll cover a few of the higher-level steps here, but your experience may vary slightly depending on which brand of CNC you own.

Step 1: Remove Palm Router

Lower your Z carriage towards the bottom range then remove your current palm router from the router mount as instructed for your brand of CNC machine.
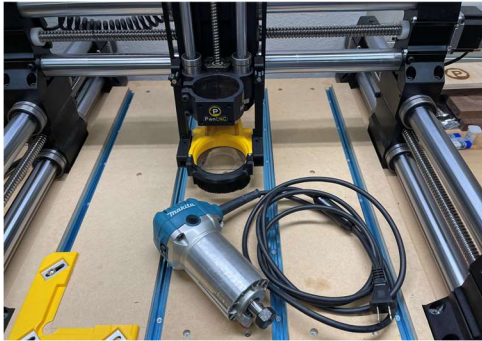

Photo of Router removed Onefinity


Photo of Router removed Shapeoko 3

Note: This may involve opening a cable chain to unthread the power cable. If this is the case, keep the chain open as you may be able to thread the spindles wire (and maybe coolant tubes) through that same cable chain.

Step 2: Prepare Spindle Motor

Preparing your spindle is super easy. Locate the spindle motor, collets, and spindle nut. For some these parts will be labeled "ER11", for others it'll be labeled "ER20".

Note: You'll want to wipe down your spindle. Remove any grease on the outer surfaces as well as the spindle shaft. You don't want that grease spinning all over the place when you turn on your spindle.

You'll want to take one of the collets and snap it into the spindle nut, then thread the nut/collet assembly onto the end of your spindle motor.
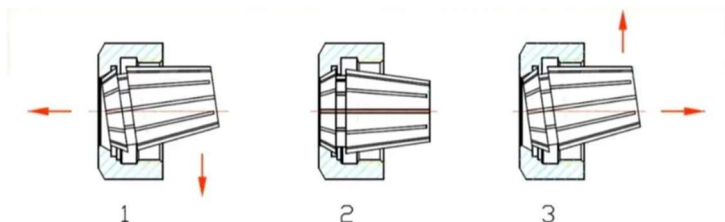
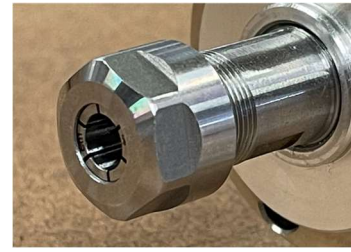*Insert a collet at an angle then straighten, locking in place*

Offset ring is a requirement

Spindle, Collet and Nut   *Collet installed in Nut*   *Collet and Nut installed*

Step 3: Install Spindle Motor

Insert the spindle motor the same way you removed the palm router from your CNC's router mount. Be sure to tighten the router mount so it properly holds the spindle motor.

Spindle Installed Onefinity   *Spindle Installed Shapeoko 3*

Note: If you're replacing a Dewalt with its' 69mm mount with any of our spindles… you will need a different router mount, or a mount "insert" which converts the 69mm mount to a 65mm mount. Additionally, if you're installing one of our 80mm spindles, you'll need a whole new router mount which is most often purchasable from the maker of your CNC machine.

Also note that the older Shapeoko's with 69mm mounts typically shipped with an aluminum spacer insert part, but if you lost it or have a different brand… we recommend contacting the manufacturer of your CNC machine. Alternatively, we have designed a few inserts which are 3d printed and would work perfectly for folks moving from 69mm down to 65mm… if you're only cutting wood and other softer materials, this is a viable option.
https://pwncnc.myshopify.com/products/shim?variant=41740875464843

Step 4: Attach Spindle Cable

You have a few options for connecting the Spindle cable (and tubes):

1. Thread them through an existing cable chain if it's large enough.
2. Setup an "umbilical" cord that comes down to the spindle from a higher location and keeps the spindle's wire and tubes together as it moves around the machines bed.

Spindle Cable

The Spindle cable is attached to the spindle motor using an H17 aircraft connector on our 65mm motors and an H20 aircraft connector on all of our 80mm motors. There is only one way these connectors can be inserted into the motor thanks to one or more notches.

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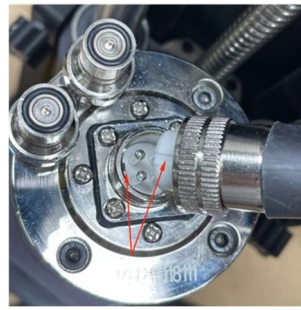
Spindle Cable *Spindle Cable into motor*

Once you've aligned the cable with the notch, press the connector onto the motor and twist the metal threading nut into place. There is no need to overtighten this nut, a simple hand tightness is sufficient.

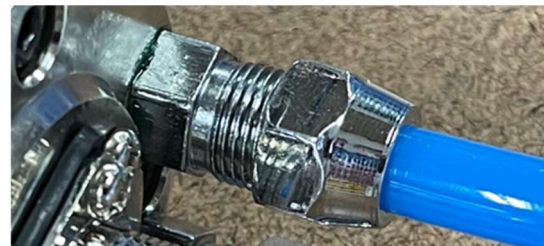## Step 5: Attach Coolant Tubes (if applicable)

If you purchased a water-cooled spindle, now's the time you'll want to attach the tubes to the top of your spindle.

Remove the stock nut

Slide the stock nut on your hose, with the threads to the outside

Tighten the stock nut down. It will work as a compression fitting

There are two tube connection points and they both will act as either an inlet or outlet depending on how your pump is attached. There is no advantage one way or the other when hooking these up.

Unthread the tube nuts and dispose of the black filler piece if it's present. Slide the nut over the tube and press the tube onto the nipple of the connector still attached to the top of your spindle motor. Then thread the nut down over the nipple to securely hold the tube in place.

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Motor Side Kool Connectors (if purchased separately from your Spindle System order)

First remove the stock connectors using an 12mm sized wrench

Get a 1" strip of Teflon tape folded in half and wrap it clockwise on the threads. An alternative to Teflon that we use in the warehouse is purple Loctite.

Then using an 5/8" sized wrench gently tightens it only to the point of the metal come really close together. Again, DO NOT OVERTIGHTEN. Broken connectors will not be replaced at our expense.

Video available on our channel "Installing our custom made Kool Connectors"

Hose Side Connectors

Very similar to the stock connectors, you would remove the nut from the end of the hose side connector and push the hose through the nut with the threads facing out. You may need to warm it slightly to accomplish this. Then move the hose onto the nipple of the receiving end of the connector. Then using 15mm & 16mm sized wrenches to tighten the nut down.

Slip the hose through the nut, threads facing out.

Slip the hose onto the nipple and tighten the nut.

Connecting / Disconnecting the Kool Connectors

Connecting is super simple, and only requires you to slip the hose side connector to the motor side connector together and snap it down until it clicks.

Disconnecting works with a push-pull motion as it is spring assisted. There is a sleeve on the hose side connector that needs to be pushed downward (when installed on a motor) and it'll spring up slightly allowing you to pull it off. Utilizing these results in a few drops of liquid falling, but without the Kool Connectors, it would result in the liquid pouring everywhere as there is nothing stopping the coolant from escaping the hose or the motor.

Installed and connected Kool Connector

*Showing the pull and arrow symbol on hose side connector *upside down*

Installed and connected Kool Connector

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Our Water-Cooled Spindle Kits comes with a water pump and 40' of Superthane Ether hose. We have both 110v and 220v pumps available. The 220v is reserved for our international customers where 110v is not available. Providing power is equivalent to turning it on, as there is not an onboard on/off switch.

Water hoses denoted with "cold (feed) line" in blue, and "hot (return) line" in red

Fully submerge the pond pump in your coolant of choice. We *recommend* either distilled water and automotive antifreeze concentrate (3:1 ratio), windshield wiper fluid, RV Antifreeze, or automotive coolant (undiluted)

Feed your lines to and from the spindle in the farthest position (down), and route it via your preferential method, and start/end in the bucket. Slip the hose over the barb, and secure with a hose clamp or zip tie (not included). The spindle's in & out port does not matter

Put the suction cups on the bottom of the water pump by slipping them in place and adhere it to the bottom of the bucket.

Tip: Save cutting it in half till all the routing is completed.
Tip: Ensure the end of the return line is below the surface of the coolant within the bucket. This will ensure there is no constant water noise being produced when the pump is in operation.

Chiller
The benefit of a chiller is that it is a bucket, pump and radiator fan in one package. The radiator fan allows for passive cooling, as there is no refrigerant involved which if there was, it would define the chiller as an active cooling chiller. Passive cooling is perfectly sufficient for spindles whereas active cooling is meant for equipment such as CO^2 lasers.

The hose barbs on our chiller accept ⅜" hoses. For this we have included two segments of ⅜" tube and two ⅜" to ¼" barb adapters.
Tip: For extra security you can use hose clamps or zip ties to secure the hose clamps on the barbs (not included).

To fill your chiller, unscrew the lid on the top, pour the coolant in, then reinstall the cap. Unlike the water pump, the chiller has a power switch on the front face. Do not turn it on until your feed and return line hoses are installed.
Note: You may need to add more of the same coolant after filling the lines and spindle reservoir or risk low coolant alarms.

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CW3000 Front

CW3000 Rear

Hose Barb's Adapters

Step 6: Wiring up your VFD

The next step is to prepare your VFD for wiring installation.

VFD Power Cable

Do NOT plug the power cable into a wall outlet at this time!!
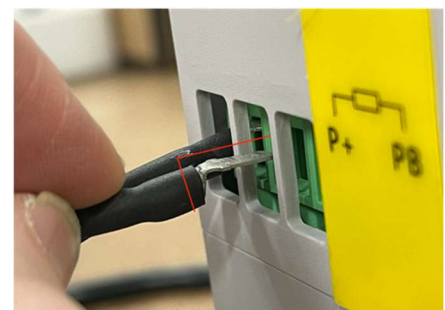***Injury or Damage to personnel or equipment will likely occur.***

Only the Spindle cable should be plugged into the spindle motor, at this time, the power cable should not be plugged into anything.

Attaching the Power Cable to your VFD is very easy, but it is important to get this right. Injury to personnel or damage to equipment will occur if done improperly. You'll need a Philips head screwdriver for this.

We've attached a sticker to the backside of the VFD's cover that shows you exactly how to wire-up your VFD. This wiring configuration is exactly how we tested your spindle kit prior to packaging. Note that your sticker's wire-color configuration may be different… but we tested each kit to function properly when wired… so trust your sticker.

Tip 1: You may need to rotate the spade slightly while inserting it into the green terminal. This is on purpose and helps to retain the wires in case they're tugged for some reason. You do NOT want these wires popping out on you, so be sure to secure the wires together with a zip-tie as they lead to your CNC.

Slide wires into the under slot

Tip 2: Be sure to insert the spade fully. To prevent the spades from being bent, be sure the flat part of the spade is up and the wire is down as shown in this picture:
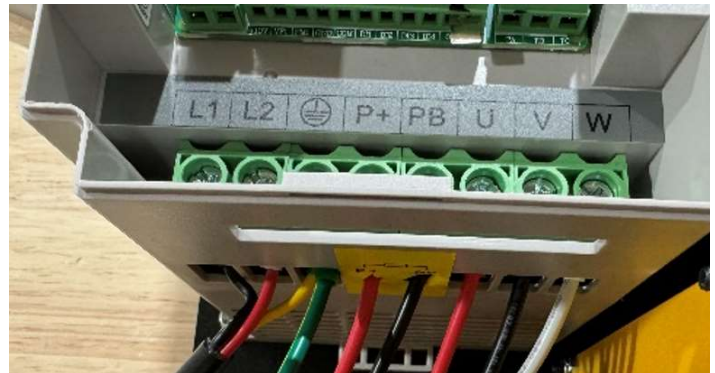
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There are 3 wires on the end of your power cable: Black, White, and Green. These wires correspond with three terminals on the bottom of your VFD.

You'll need to match up the wires as shown here:
- L1 = Black
- L2 = White
- GND = Green

VFD Spindle Cable

The next most important cable is your Spindle cable. You've already attached the motor side, now you'll be hooking up the VFD side. This cable has 4 internal wires: Red, Black, White, and Green/Yellow. These wires correspond with 4 terminals on the bottom of your VFD with one of them the same as the green ground wire of your power cable.

Note: The Red and Black wires are interchangeable depending on the direction your spindle motor is turning. During testing of your spindle kit, we applied the appropriate sticker to your VFD's cover to ensure its wired correctly.

When you're all done, your wiring should look like the picture to the above. Add the cover to your VFD and move onto mounting it.

Step 7: Power up your Spindle

With the installation of your spindle cable, your VFD is almost ready. The last step is to plug the power cable into a 110v dedicated 15-amp, 110v 20-amp or 220v 20-amp outlet as appropriate for your chosen configuration.

VFD's do not get along with GFI/GFCI circuits/outlets that are commonly found in garages, consult a licensed electrician for powering options if this situation applies. After plugging in the included power cable to your VFD you should see the VFD's keypad light up with red letters/numbers. It should be blinking which means it is in stop/standby mode.

Using your VFD in Manual Mode

Now that your spindle kit has been fully installed it's time to go over a few of the super simple operations to use it.

VFD Keypad Display

Preparing to Run

You'll want to install a bit into your new PwnCNC Spindle's collet/nut assembly.   Use the two wrenches included in your kit. The smaller wrench is to hold onto the spindle and prevent it from moving. On your old palm router, this job was likely done with a button on the side. The larger wrench is for the spindles nut.

Tip: When removing bits, there's a two-step loosening operation. After you've released the initial tension, the bit will likely still be secured. If you keep loosening the nut, the bit is libel to fall to your CNC's bed. We recommend putting a kitchen sponge or something below the bit to prevent damage as it falls out of the chuck.

Secure your bit into the spindle prior to starting the VFD.

Starting your Spindle Motor

To control your VFD manually, you'll be using the VFD's keypad. This is what it'll look like the picture above. The numbers should be blinking which indicated it is in stop or standby mode.

The turn dial just below the numbers on the right is how you'll control the RPMs and the Green/Red buttons below that is how you'll start/stop your motor.

Simple Test: Rotate the dial counterclockwise all the way until it stops. Then hit the green "RUN" button. Slowly rotate the dial clockwise until the dot indicator is straight up. This is the 12,000 RPMs setting.

Note: If the numbers displayed does not show roughly 12,000 RPM's then you can hit the (>>) button to cycle the display until it does. The base operation of your VFD is to send the frequency in Hz to your motor. The higher the Hz, the faster your motor goes. Since our motors top-out at 24,000 RPMs… we've programmed your VFD to recognize that 200Hz = 12,000 RPMs and that can be displayed via the (>>) button.

Warm-Up Procedure

Regardless of the ambient temperature of your machine, it is imperative to conduct a warmup procedure. With regular use, and warmer temperatures this procedure may be abbreviated. The intent is to evenly distribute and get the oil/grease at a proper viscosity.

With the spindle in a safe location run your spindle starting at 6,000 RPM's and hold that for 10 minutes, then increasing to 12,000 RPM's for 7 minutes, and ending at 18,000 RPM's for 3 minutes. These are only guides, and your requirements may be longer or shorter.

You'll likely hear the spindle "bubble" at a given level, stay at that level, for a little longer. Prolonged down time, and cold environments will prolong this procedure. If you have a water-cooled spindle, you can run it with your pump or chiller not running, but if you notice the motor starting to get hot, your spindle is warmed up. Turn your coolant source on before starting to carve.

Stopping your Spindle Motor

Stopping your spindle motor is as easy as hitting the red button. Watch the digital display until it shows 0.0 and that is flashing before reaching your hands towards the bit area.

Bit Changes

Ensure your VFD is stopped, and the display is blinking during bit-changes. You may need to hit the stop button on the VFD to get the blinking status.

Next… install a bit into your new PwnCNC Spindle's collet/nut assembly, use the two wrenches included in your system. The smaller wrench is to hold onto the spindle's shaft and prevent it from moving.
The larger wrench is for the spindles nut.

Tip: When removing bits, there's a two-step loosening operation. After you've released the initial tension, the bit will likely still be secured, but you still will hit a stopping point when continuing to loosen it. When you continue loosening the nut, the bit is likely to fall to your CNC's bed when the collet is no longer holding it. We recommend putting something soft below like a kitchen sponge or holding onto the bit shaft with a pinky while continuing to loosen the nut to prevent damage to the bit for when it falls out of the collet.

Explanation of PWM vs Modbus

PWM control is the most common form of automation with a digital voltage signal of either 0-5v or 0-10v is sent from your controller to the VFD which converts that voltage into a 0-24000 rpm response in the motor. On a 5v controller 2.5v signal sent to the VFD would result in a commanded 12,000 RPM, where that same 2.5v signal sent from a 10v controller would result in 6,000 RPM's. Most CNC controllers will support this method. PWM is a "Fire and Forget" method of communication. A couple hundred RPM variance is normal and acceptable in the usable range.

The other method is less common but provides direct feedback. The Onefinity "black box" / Openbuilds Buildbotics, and the Super Long Board are controller examples capable of Modbus Connection. Modbus is a "fire and verify" method where there is 2-way communication between the Controller and the VFD. Modbus is closer to the actual RPM than PWM due to this 2-way communication.

Your VFD was pre-programmed to your controller depending on the CNC machine you told us you had at the time of purchase.

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Using your VFD in Automatic Mode

One of the most powerful features and reasons for upgrading to a spindle kit is allowing your CNC controller to control the RPMs of your spindle motor. This can be done with your CNC machines controller, PwnCNC Spindle kit's PWM/Modbus cable, and VFD.

Our VFD can receive automatic spindle control commands in a few ways: PWM/GND or Modbus (e.g., RS485). The method used depends on the CNC machine you told us you had at the time of purchase.

At a high level, PWM/GND control is the most common form of automation with a digital voltage signal of either 0-5v or 0-10v is sent to the VFD which converts that into a 0-24000 rpm response in the motor. Most CNC brand controllers will support this method.

The other method is less common but is the most desirable due to its feedback capabilities. PWM/GND is more of a "fire and forget" method of setting the RPMs, whereas Modbus is a "fire and verify" method. The standard Onefinity controller as well as controllers from BuildBotics and others provide this advanced automation method. Our VFD supports either method out of the box.

The method preconfigured into your VFD depends on the CNC machine you told us you had at the time of purchase.

Orange and Blue are interchangeable.

Attach Control Cable for Automatic Control PWM

If your CNC utilizes the PWM/GND wires of automation control, then you'll be attaching the included shielded twisted pair PWM wire as pictured below.

Orange/Blue = 10v
Red = VF1
Black = GND
White = COM
Yellow = DI1
Green = DI2
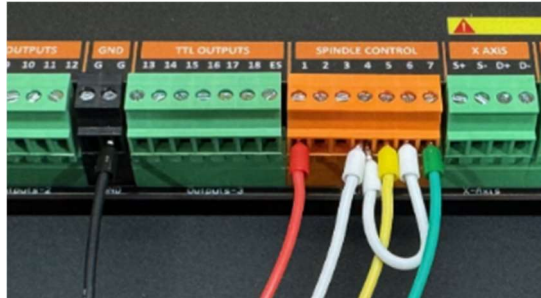
For Automatic Control via PWM, you'll also need to change:
P0.0.03 to 1
P0.0.04 to 3

To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

PWM for VFD

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Onefinity Elite / Masso (PWM Only)

On the bottom of your Masso unit (Onefinity) is a GX12 6-Pin connector where the other end of your control cable plugs in. If you do not have a Onefinity Elite, follow the wiring below:

Masso Spindle Connections

For Automatic Control via PWM, you'll also need to change:
P0.0.03 to 1
P0.0.04 to 3

To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

For programming Masso, go to the F1 Screen, and select Main Spindle:
Encoder = 100
Spindle Control Method = VFD
Maximum RPM = 24000
Spin up Delay (ms) = 6000 (This is how long it will pause before proceeding to the cut)
Spin down delay (ms) = 6000 (This is how long it will pause after the cut is complete)

Longboard (PWM ONLY)

To hook up the VFD to the Sienci Labs Longboard, the red wire goes to SpinPWM and the Black wire goes to GND.

Set the following parameters in G-Sender:
$16=Spindle Enable
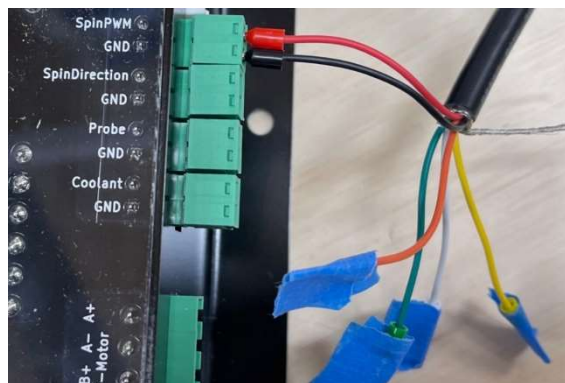$30 = 24000
$31=6000
$32 = 0
$395=MODVFD
$462=40960
$463=40961
$464=36864
$465=1
$466=2
$467=5
$468=25

Longboard

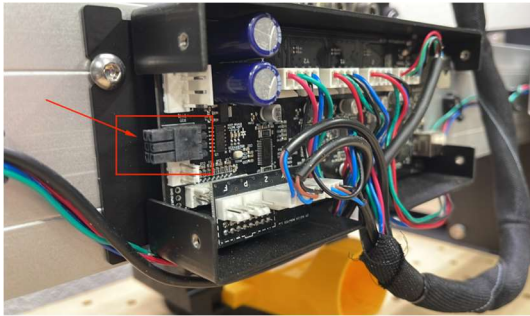For Automatic Control via PWM, you'll also need to change:
P0.0.03 to 0
P2.0.02 to 9
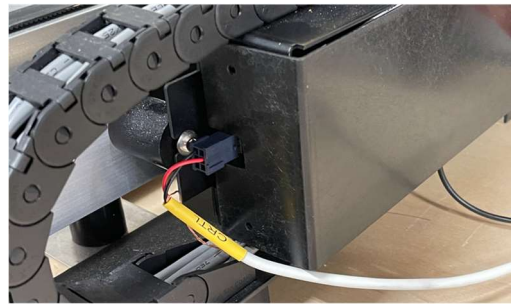
To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

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Shapeoko (PWM ONLY)

Carbide3d's Shapeoko line of machines (3, 4, and Pro) all have a molex connector. If you own a BitRunner, we'll be using that same plug in the side of your controller.

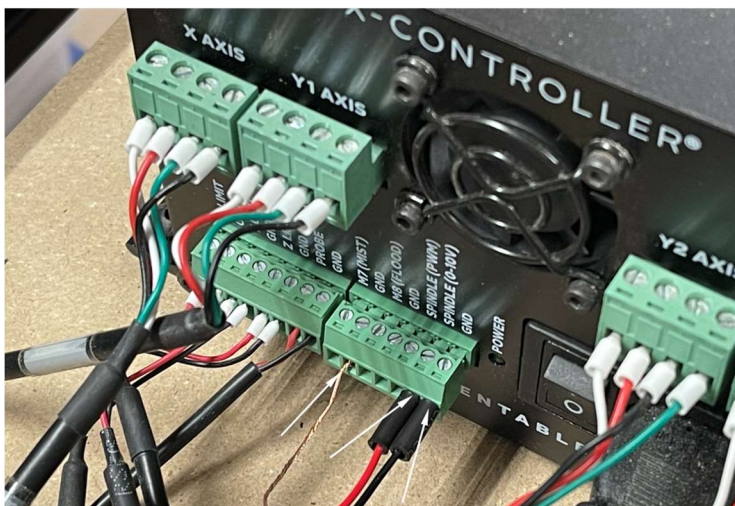*Carbide 3D controller (Pre-Warthog)*

Molex connector on Shapeoko

If you have one of these or the Warthog Controller, you'll need the special non-ferruled control cable so that it'll be easy to plug into.

You cannot have bitrunner enabled in Carbide Motion, even if you have spindle selected, the option may be enabled and ghosted. If your RPM goes to 24k RPM with ~1000 rpm commanded, you have it enabled.

For Automatic Control via PWM, you'll also need to change:
P0.0.03 to 0
P2.0.02 to 9
To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

X-Carve (PWM Only)

X-Carve is one of the simplest controllers to wire up since it has a similar Phoenix terminal as our VFD and a screwdriver is all that's required. You'll want to attach the two small wires into the "Spindle (0-10v)" and "GND" terminals.

X – Carve Connnections

For Automatic Control via PWM, you'll also need to change:
P0.0.03 to 0
P2.0.02 to 9
To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

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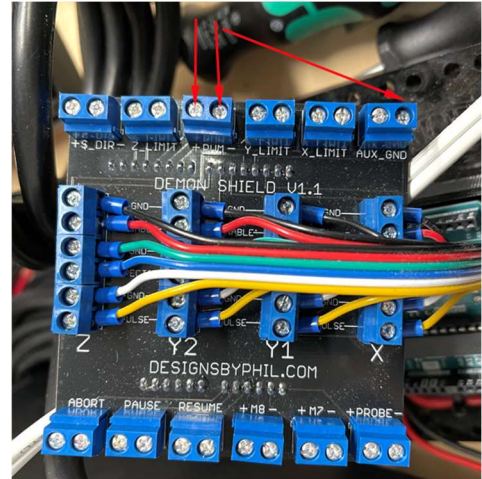**Dominate it**

CNC4NEWBIE's Demon Controller (PWM Only)

The Demon Controller has three pins and a ground pin we're going to wire our control cable into.
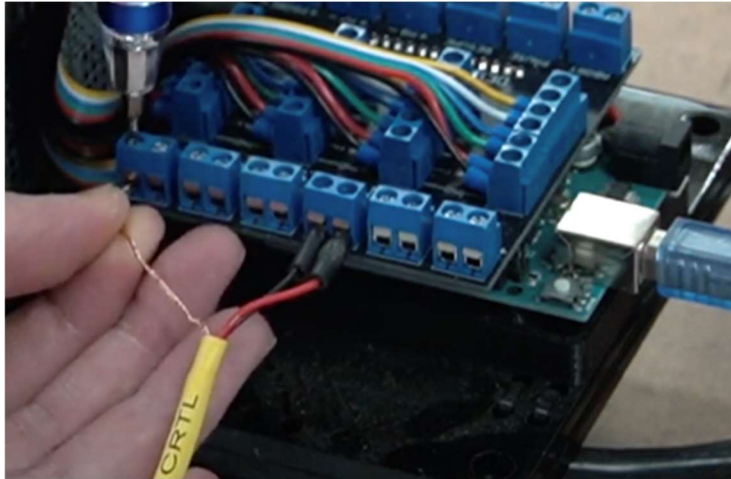
C4N Demon Controller

C4N Demon Controller

You'll be attaching the PWM cable up to the "PWM" and "GND" pins found along the left side of the Demon controller's terminal board.

Other Controllers

There are a huge number of CNC machines and controllers out there and it is impossible for us to catalog all of them.
Therefore, where to plug in the PWM and GND pins of your control cable will depend on the documentation provided by the CNC manufacturer.

For Automatic Control via PWM, you'll also need to change:
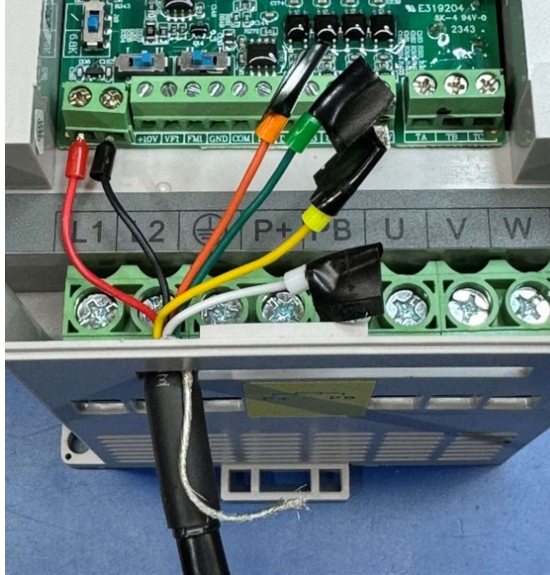P0.0.03 to 0
P2.0.02 to 9

To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

Orange / Blue wires on the control cable are interchangeable

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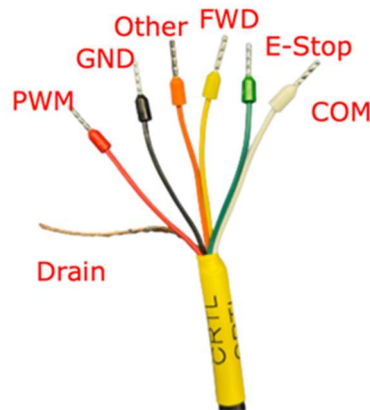
Attach Control Cable for Automatic Control MODBUS

If your CNC uses Modbus / RS485 wires for automation control, then you'll be attaching the included twisted pair Modbus wire via Black to "SG+" and Red to "SG-" terminals and the other wires get taped off separately on the VFD as shown below:

For Automatic Control via MODBUS, you'll also need to change:
P0.0.03 to 2
P0.0.04 to 9

To return to manual control:
P0.0.03 = 0
P0.0.04 = 2

Onefinity Black Box (Modbus only)

The control cable does not include a female DB25 connector on the end, this must be purchased separately. The connector can be opened if you would like to wire other things into your controller, however for Spindle control we utilize pins 13 and 14 with our Red and Black wires respectively. Attaching the female DB25 connector is easy, press into place and use the included thumb screws to securely attach the connector.


Onefinity Blackbox

*Will need to purchase
a db25 breakout board*

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Super Long Board (MODBUS or PWM)

Utilizing MODBUS wiring with the Black wire in the "B" Terminal and Red wire in the "A" Terminal, set the following parameters in G-Sender:

$16 = all off
$31=6000
$340 = 0 or 5 *
$374 = 19200
$375 = 50
$392 = 6
$395=MODVFD
$462=40960
$463=40961
$464=36864
$465=1
$466=2
$467=6
$468=25
$476** = 1
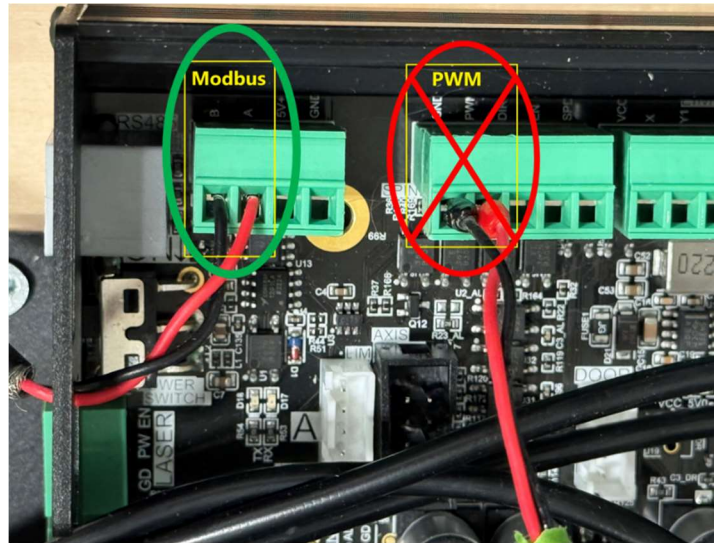
Superlong Board

For Automatic Control via MODBUS, you'll also need to change:
P0.0.03 to 2
P0.0.04 to 9
P4.1.00 to 04
P4.1.01 to 3

To return to manual control:
P0.0.03 = 0
P0.0.04 = 2
P4.1.00 = 3
P4.1.01 = 0

* If you have a SLB $340 = 0. If you have a SLB-EXT (Altmill customers), $340 = 5
** If $476 is not available a neighboring command may be substituted

Thank you for purchasing your Spindle Kit from PwnCNC.
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For more information please visit these websites.

Controller Guides   Wiring Diagram

Choose which brand of CNC machine you own and watch the video for proper setup

**If you have additional questions,
please reach out to support@pwncnc.com
We're happy to help!**

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