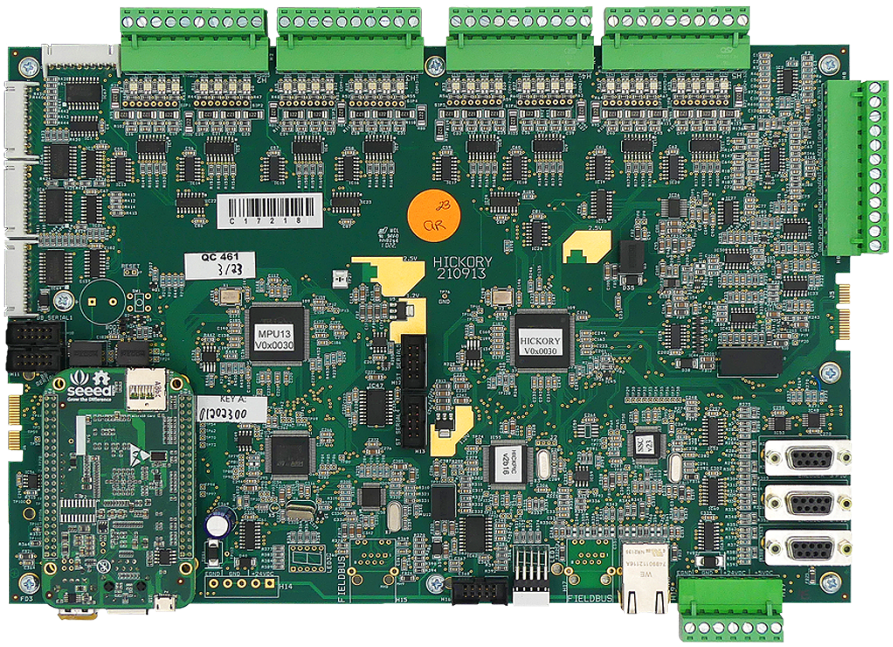
Centroid Hickory CNC Controller Installation Manual

CNC Software version: CNC12 V.5.08+
Models: Hickory



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Introduction

WARRANTY DOES NOT COVER DAMAGE BY FAULTY WIRING OR IMPROPER INSTALLATION.

The information provided by CENTROID relating to wiring, installation, and operation of CNC components is intended only as a guide, and in all cases a qualified technician and all applicable local codes and laws must be consulted. CENTROID makes no claims about the completeness or accuracy of the information provided, as it may apply to an infinite number of field conditions.

As CNC control products from CENTROID can be installed on a wide variety of machine tools NOT sold or supported by CENTROID, you MUST consult and follow all safety instructions provided by your machine tool manufacture regarding the safe operation of your machine and unique application.

Basic Safety Procedures and Best Practices

Installation of a CNC controller should be performed only by individuals trained and qualified to do the task. Before installation procedure and working with the equipment it is required to read and understand the user and installation manuals. It is necessary to be completely sure of and have full understanding possible dangers and also completely assured that installation can be performed in a safe manner. Any schematics or wiring hookup instructions presented on Centroid's website or in the online forums are incomplete educational examples for discussion only. The user, DIY'er is creating his/her own CNC device, which may include dangerous lethal voltages, powerful motors and resulting dangerous unexpected forceful motion, of dangerous cutters and fast moving heavy machine parts. If you are not qualified to accept all responsibility and/or you do not agree, DO NOT PROCEED and request a refund.

Hickory CNC LIMITED WARRANTY

By accepting delivery or operating this product, you the buyer accept all of the terms of this warranty. If you do not wish to accept the terms of this agreement, immediately call to make arrangements for the return of the product.

Centroid warrants to the original purchaser that any part of its product purchased will be free of defects in workmanship and parts for a period of twelve (12) months from the date of delivery (hereinafter "Warranty Period"). During the Warranty Period, Centroid will, at its option: (1) provide replacement parts necessary to repair the product; (2) replace the product with a comparable product; or (3) refund the amount customer paid for the product upon its return. Replacement parts or products will be new or serviceability used, comparable in function and performance to the original part or product, and warranted for the longer of thirty days for the US or the remainder of the warranty period. Any additional purchases or upgrades will not extend this warranty. This product warranty covers normal use only. This product warranty does not cover damage caused during shipment and any damage caused by: actions that are beyond Centroid's control, including without limitation, impacts, fluids, fire, flood, wind, earthquake, lightning or similar disaster, war, lockout, epidemic, destruction of production facilities, riot, insurrection, or material unavailability; unauthorized modifications, attachments or peripherals; improper use, environment, installation or electrical supply; improper maintenance; any other misuse, abuse or mishandling. Except for the warranties expressed in this agreement, Centroid disclaims all other warranties, either express or implied, including implied warranties of merchantability or fitness for a particular purpose, other than those warranties implied by and incapable of exclusion, restriction or modification under the applicable law. The term of any implied warranties that cannot be disclaimed are limited to the term of this agreement. Centroid’s and customer's maximum liability to the other is limited to the purchase price customer paid for products or services plus interest as allowed under the applicable law. Neither customer nor Centroid will be liable to the other for property damage, personal injury, loss of use, interruption of business, "down time", customer's time, loss of use of related equipment, lost profits, lost data or other consequential, incidental, punitive or special damages, however caused, whether for breach of warranty, contract, tort (including negligence), absolute or strict liability or otherwise, other than those damages that are incapable of limitation, exclusion or restriction under the applicable law. Hickory CNC is an educational DIY (do-it-yourself) product. Centroid makes no warranties or claims of safety or suitability for any application. Any schematics or wiring hookup instructions presented on Centroid’s website or in the online forums are incomplete educational examples for discussion only. The user, DIY’er is creating his/her own CNC device, which may include dangerous voltages, powerful motors and resulting dangerous unexpected forceful motion, of dangerous cutters and fast moving heavy machine parts.

If you are not qualified to accept all responsibility and/or you do not agree, DO NOT PROCEED and request an RMA# for a full refund.

Care and Handling of CNC components

For Motors

Be safely dressed when handling a motor. Wear safety shoes and gloves. Avoid loose clothing which can get caught on the motor. Be careful not to let hair get caught in the rotary section of the motor. Do not handle the motor with wet hands.

Shut off the power before working on a motor. Wait at least 5 minutes after the motor is shut off before touching any power terminals.

Ensure that the motor and motor related components are mounted securely. Ensure that the base or frame to which the motor is mounted to is strong enough.

Do not touch the rotary section of the motor when it is running, unless specifically instructed to do so.

When attaching a component having inertia to the motor, ensure any imbalance between the motor and component is minimized.

Be sure to use a key when the motor has a keyed shaft.

Use the motor in appropriate environmental conditions. Do not store flammables in close proximity to the motor. When not in use, store the motor in a dry location between 0° to 40° C.

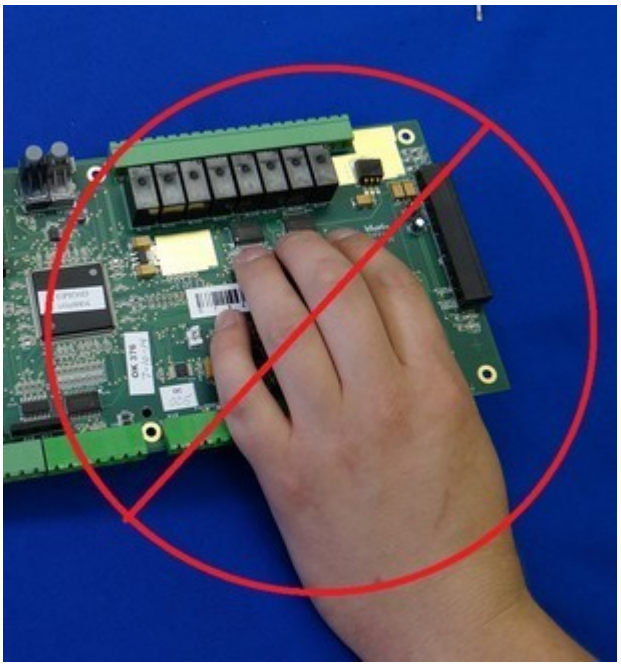
Do not remove the nameplate from a motor.

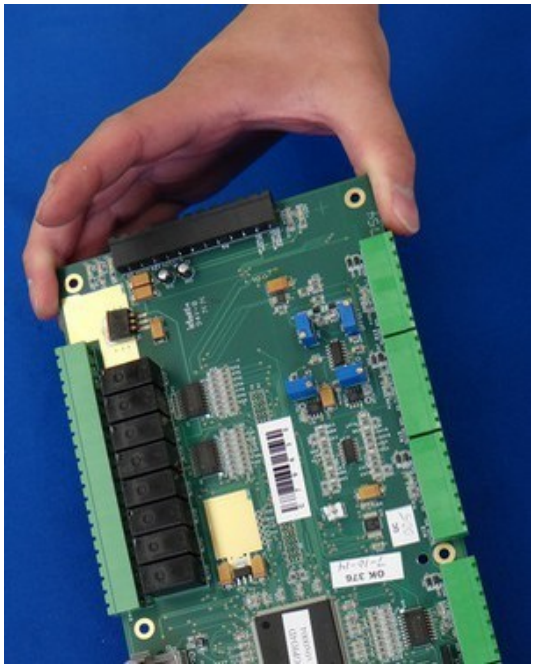
Never use a hammer or other impact device on the motor shaft for any reason.

For Circuit Boards

Minimize handling circuit boards as much as possible. If you must hold a circuit board, grasp it by the edges as shown in Figure 2. Before picking up a circuit board, always discharge any static buildup you may have by touching a grounded surface. Avoid touching any of the circuit traces, components, or component leads. Improper handling can lead to ESD (electrostatic discharge) which may damage the PCB, or shorten its lifespan.

Keep the work area free from static generating materials such as Styrofoam, vinyl, plastic, and fabrics.





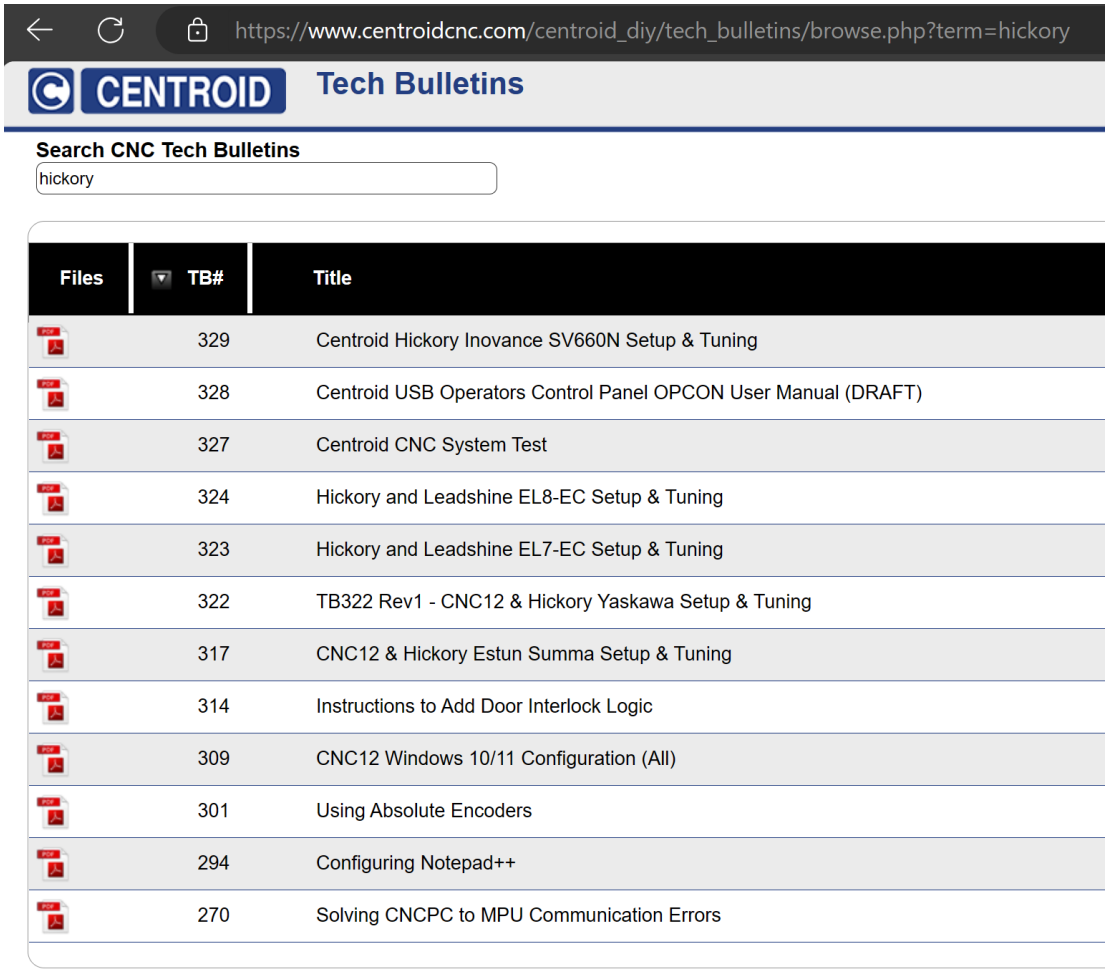
About This Manual

This manual describes how to install and configure the Centroid CNC Hickory Ethercat-based Closed-Loop Controller. The Hickory system provides up to eight axes of motion control through fast and reliable EtherCat communication protocol, controlled by industry standard G-Codes.

This manual works in conjunction with individual “Tech Bulletins” that have been created for EACH Centroid curated make and model EtherCat drive such as; Yaskawa, LeadShine, Innovance, Estun Summa etc.

The Tech Bulletins for each of these drives explaining how to configure and tune that specific drive for use with Hickory is found on the Centroid Tech Bulletin Web page.
https://www.centroidcnc.com/centroid_diy/tech_bulletins/browse.php

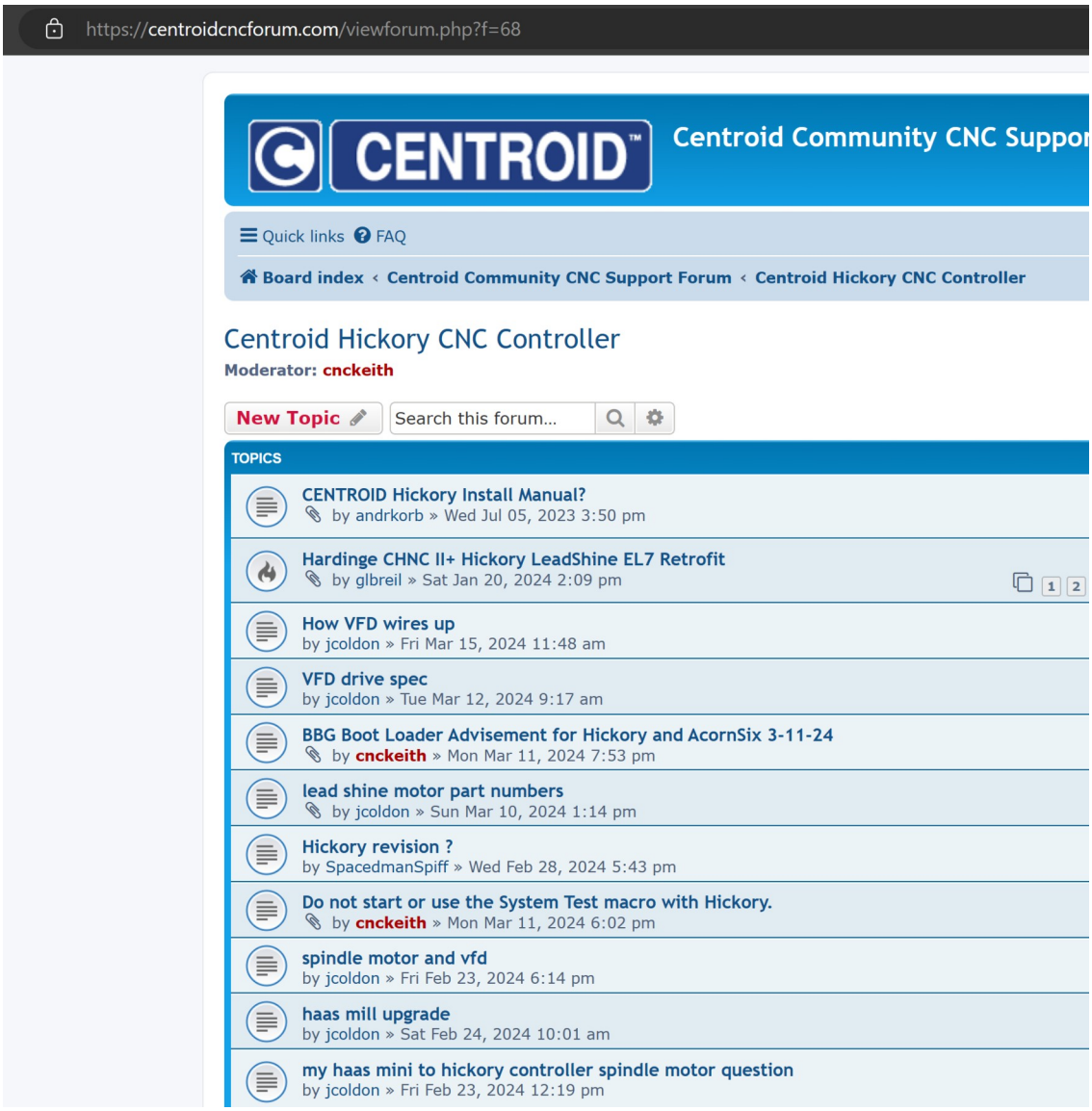
Use the Search to find them, type in “Hickory” in the search to see all tech bulletins related to Hickory.



Files	TB#	Title
	329	Centroid Hickory Inovance SV660N Setup & Tuning
	328	Centroid USB Operators Control Panel OPCON User Manual (DRAFT)
	327	Centroid CNC System Test
	324	Hickory and Leadshine EL8-EC Setup & Tuning
	323	Hickory and Leadshine EL7-EC Setup & Tuning
	322	TB322 Rev1 - CNC12 & Hickory Yaskawa Setup & Tuning
	317	CNC12 & Hickory Estun Summa Setup & Tuning
	314	Instructions to Add Door Interlock Logic
	309	CNC12 Windows 10/11 Configuration (All)
	301	Using Absolute Encoders
	294	Configuring Notepad++
	270	Solving CNCPC to MPU Communication Errors

This manual has links to relevant resources, forum posts, documentation and videos which appear throughout the manual that contained detailed information.

We suggest you create a “build thread” on the Hickory Technical Support Forum. See the “Hardinge CHNC II…” thread as an example Here is the link: https://centroidcncforum.com/viewforum.php?f=68



A build thread is a place for all your project information which located in one place that way when you request technical support we will have the required information needed to assist you.
Create an online photos album and populate with lots of photos of the machine tool, accessories and the CNC control cabinet, a photo is worth a thousand words. Post the link to the photo album on the first page of your build thread. Creating a photo album is a place for all your machine photos to be in one location that will always have the same link. Avoiding having photos scattered across multiple posts or emails. Etc.. A photo album will result in faster and better technical support response.

Before You Begin

Before getting started, please take the time to familiarize yourself with the schematics, manuals, and installation instructions which can be found here.

While doing the installation, it is very important that you follow the instructions exactly and in order. Doing the installation incrementally and testing as you go will allow you to immediately isolate the cause of any problems that may occur. Additional troubleshooting resources are included in the Appendices.

Useful Resources

Hickory Schematics: Type in "Hickory" in the search bar.
https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php

Centroid's YouTube Channel: Centroid CNC Technical Support
https://www.youtube.com/user/CentroidSupport/videos

Free Hickory CNC Support Forum https://centroidcncforum.com/viewforum.php?f=68

Centroid CNC Tech Bulletins: http://www.centroidcnc.com/centroid_diy/tech_bulletins/browse.php

Centroid Hickory and Accessories:
https://shopcentroidcnc.com/hickory-cnc-controller/#

Documentation

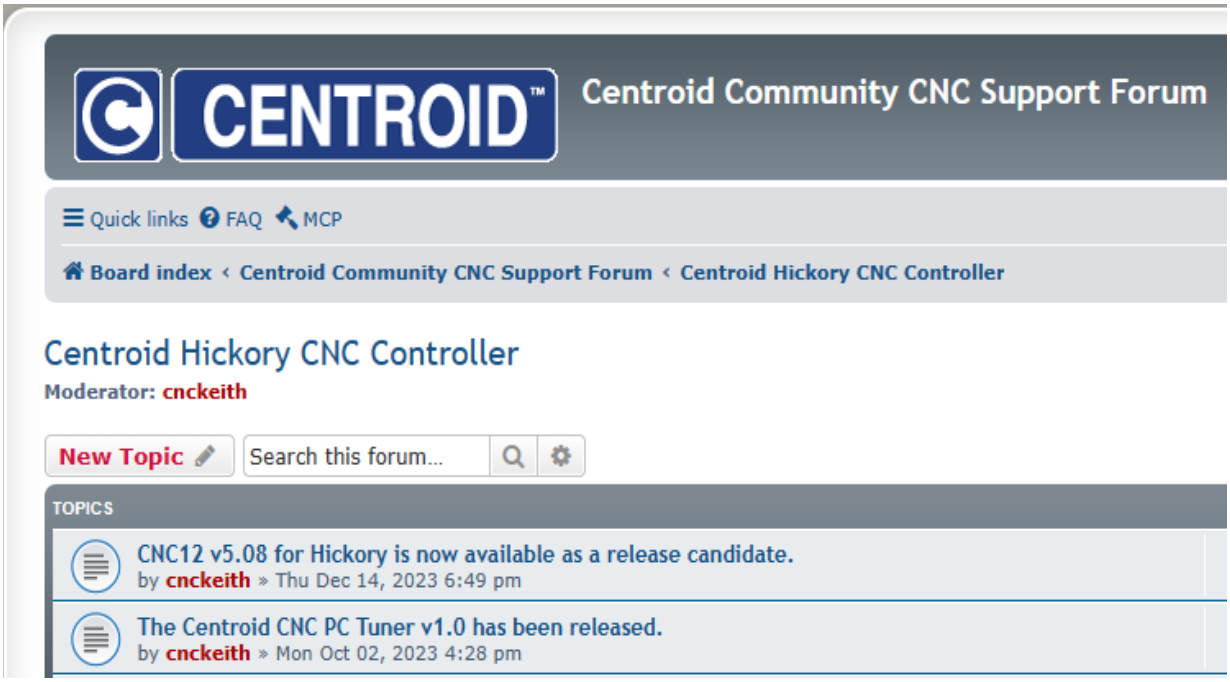
Document your installation. It is highly recommended that you document the parts used in your conversion. Once parts are installed you may not be able to read the nameplates or identification markings on the part(s).

- Photograph motor nameplates
- Photograph controllers and circuit boards (especially Model, Revision and Serial)
- Download and save documentation for all parts used for future reference
- Keep a log of the various switch/jumper settings and electronic configurations
- A labeler to mark any relays or modules is a good idea
- Create and/or update a schematic
- Save a Report after every configuration change. See the section on CNC12 Configuration Backup for thoughts on an offline backup

Where to find support

Sign up for free tech support here: https://centroidcncforum.com/viewtopic.php?f=60&t=3498

Post your question on the forum by clicking "New Topic"



Please read the posting guidelines linked below, before making a post. Always search the forums for your problem first. Somebody may have already experienced the issue you are having.

When you post to the forum, your question will be seen by many users. Possibly getting you more than one solution to your problem. Your post can be helpful others in the future.

Forum Posting Guidelines: https://centroidcncforum.com/viewtopic.php?f=60&t=1043

Factory Direct technical support is available in 1 hour blocks. Purchase here:
https://shopcentroidcnc.com/centroid-factory-direct-11-technical-support/

Chapter 1 Hickory Controller

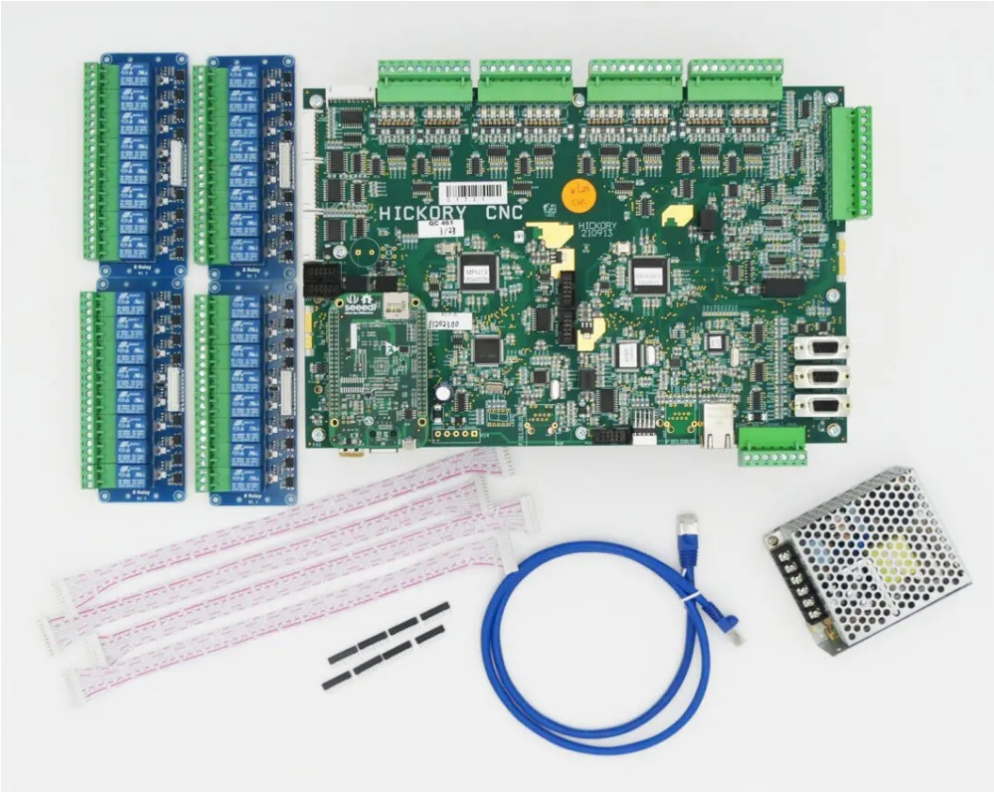
1.1 Hickory

Congratulations on your Hickory purchase!

Hickory is an 8-axis CNC control board utilizing EtherCat communication protocol with AC brushless servo motors. Make sure your kit is complete and has not been visibly damaged in shipment.

Hickory only utilizes Centroid curated AC brushless servos with EtherCat communication protocol. Currently the Centroid curated drive list is: Yaskawa Sigma 7, Glentek Gamma series, Estun Summa, Leadshine EL7 and EL8, Inovance SV660N.

Hickory is also only compatible with AC brushless servos equipped with **absolute** encoders.



The following components are included with your Hickory CNC Controller Kit Part#14924

- Hickory Control Board
- (4) Plug-and-Play Relay 8 Modules Part #14734
- Meanwell RD-35B Logic power supply with power leads Part #8903
  - (50/60 Hz 100-120 VAC and 208-240 VAC input power)
- Component Kit Part #15276
- 15ft Shielded Cat5E Ethernet Cable Part #7269
- Riser Mounting Pan Part #8654

- Full-sized Paper Wiring Schematic
- Centroid CNC12 "FREE" version of CNC software.
    - Pro and Ultimate Licenses may be purchased here: https://shopcentroidcnc.com/product-category/cnc-software/

Hickory Specifications

Characteristic	Min.	Typ.	Max.	Unit
24 Volt Supply Current	0.4	-	-	A
5 Volt Supply Current	2.5	-	-	A
Input Pullup Voltage (Vinp)	4	-	30	VDC
Input On Voltage	Vinp-1.25	-	-	VDC
Input Off Voltage	-	-	1.25	VDC
Input Operating current	9	11	15	mA
Analog Output Current	0	1	10	mA
Analog Output Voltage	-10	-	10	V
Analog Output Resolution	-	16	-	bits
Analog Output Error	-	< 0.1	-	%
Analog Input Current	-	-	2	mA
Analog Input Voltage	-10	-	10	V
Analog Input Resolution	-	16	-	bits
Analog Input Error	-	< 0.2	-	%
Encoder channel input low	0	-	0.5	V
Encoder channel input high	3.5	-	5	V
Encoder input frequency (per channel)	0	-	1200	khz
	W	H	D	
Size:	12	8	1	Inches

Chapter 2 Bench Test Hardware Setup

2.1 Introduction to Bench Testing

The first step in installing your new system is performing a Communications Bench Test and then individual component bench test. “Bench test” means connecting electronics to the Hickory on the bench to test them before installing the system in a machine. Then adding one component at a time will save you time and make things much easier to debug and configure.

The bench test allows you to:

• Find problems before spending a lot of time wiring your machine or cabinet.

• Troubleshoot hardware and software problems early on, before they can cause permanent damage to the system.

• Identify missing or defective hardware before installing the system

• Allows for greater visibility and ease of access when troubleshooting than being installed in an electrical cabinet.

• Should a serious issue arise, it gives the user a knowledge base that allows technical support to more quickly and efficiently solve the problem.

Tools and Equipment Needed

• A good location – A bench test needs to be performed on a large surface with good lighting and easy access to electrical outlets. Do not use metal or plastic surfaces or surfaces that may contain metal scraps or shavings, as we will be resting powered circuit boards on the surface. Do not use fabric covered surfaces as it may cause ESD (electrostatic discharge) damage. A wooden surface is an ideal test bench location.

• A PC or a Centroid console unit which comes with CNC12 installed. The PC must meet the specifications listed in Technical Bulletin #273, which can be found here: https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/273.pdf

• A small screwdriver set

• A digital multi-meter

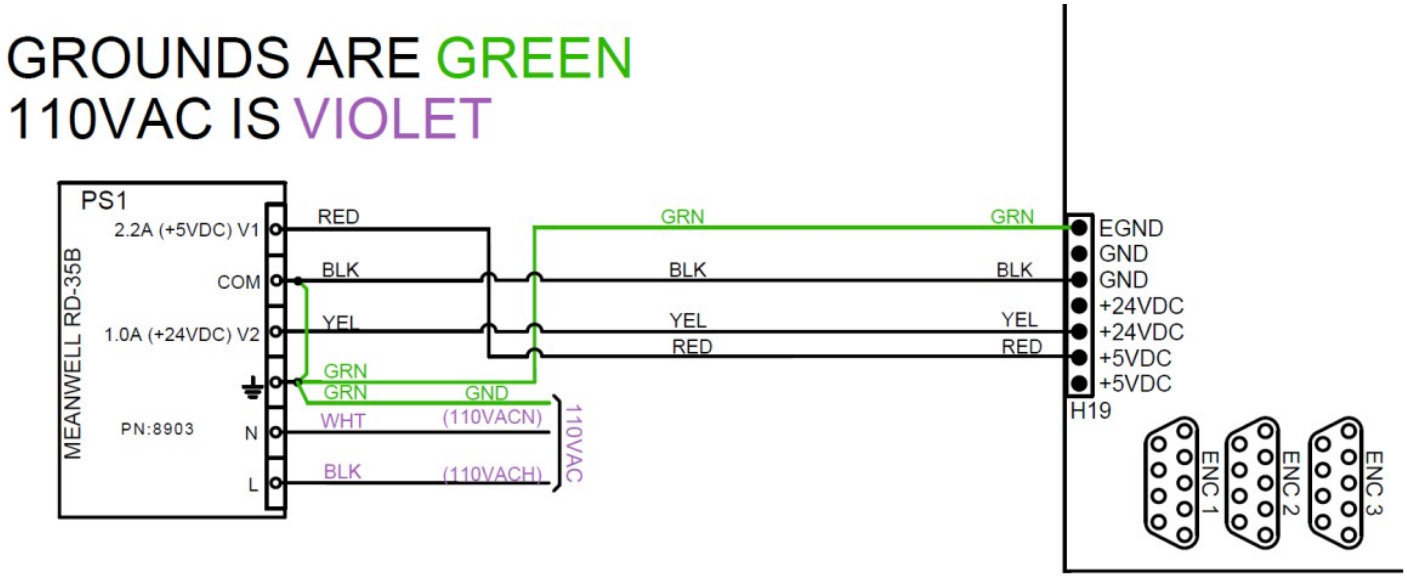
2.2 Hickory Communications Bench Setup

The very first step is to verify that there is good communications between the CNCPC, CNC12 and the Hickory.

1.) Wire the Hickory on the bench following schematic S15226.
2.) Prepare the CNC PC for CNC control use.
3.) Use the PC Tuner and follow TB309 to configure Windows for CNC use.
4.) Install CNC12 software.
5.) Load the Hickory License.
6.) Perform the communications stress test.
7.) Perform the spindle bench test.
8.) Hook up motors and drives, and setup initial motor configuration.

Lets get started.

1. Wire the provided Logic power supply to Hickory following the bench test schematic. Leaving the Meanwell power supply disconnected from 110VAC, wire the power connections to H19 on the Hickory. Note: Included Power supply will also run on 240VAC.



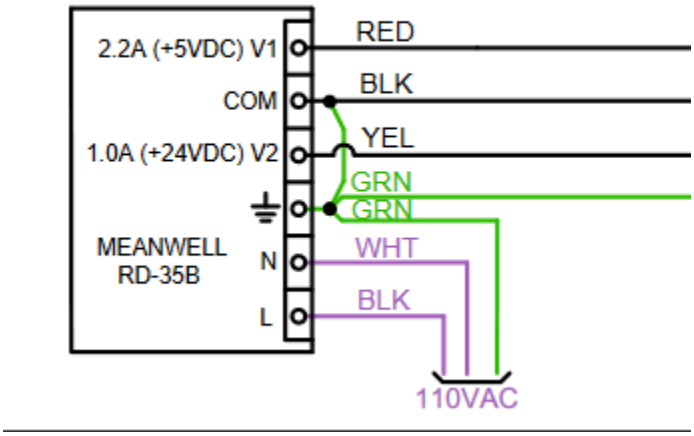
2. Connect the Ethernet Cable: Connect a shielded Ethernet cable to your PC. Connect the other end to the Hickory. A shielded Ethernet cable will have a metal clip around the RJ-45 connector it as shown by the blue cable in Figure 2.2.1. One part #7269 15ft Shielded Ethernet cable is included with the Hickory kit. Centroid also stocks part #6143 25ft Shielded Ethernet cable.

Note: An unshielded cable can result in intermittent PC Data receive errors in the software due to electronic noise and interference. See TB270:

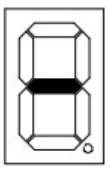
https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf

Note: The Ethernet cable from the Hickory must be connected directly to the PC through a built in Ethernet connector or a PCI/PCI-E network adapter card that has been installed in the PC. Some computer systems ship with an Ethernet adapter that connects to a USB port. This type of connector (Ethernet though USB) may be used for Internet access but must not be used for CNC control with the Centroid Hickory.

3. Connect incoming power to the Meanwell power supply. Note that the power supply accepts up to 240VAC.

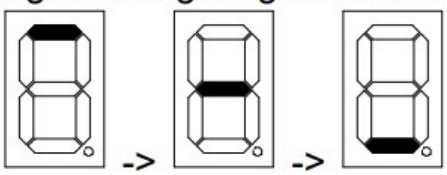


4. The Hickory will power up and goes through a booting process. It takes about 15 seconds for the Hickory to boot. The Hickory is equipped with an on board seven-segment LED number display; this will indicate that the Hickory is booted when you see the horizontal LED bar moving from top to bottom in a scrolling fashion on the display. This means all is good and Hickory is ready to connect to CNC12 software.



Ready, but not running

Center segments lighting in a scrolling pattern indicates normal operation.



-> -> Running normally

Chapter 3 CNC12 Software

3.1 Windows 10/11 Software Pre-Installation Requirements

Note: Only Microsoft Windows 10/11 (Home or Professional) is supported with CNC12. Older versions of Microsoft Windows, Mac OS, or Linux are not supported.

1. If you have purchased a console unit or computer from Centroid, it comes with Windows properly configured and the CNC12 software already installed. If you bought or built your own computer, it must meet the prerequisites listed on the Centroid Website here and to be configured for CNC use following the steps below. https://www.centroidcnc.com/cnc_pc_performance_requirements.html

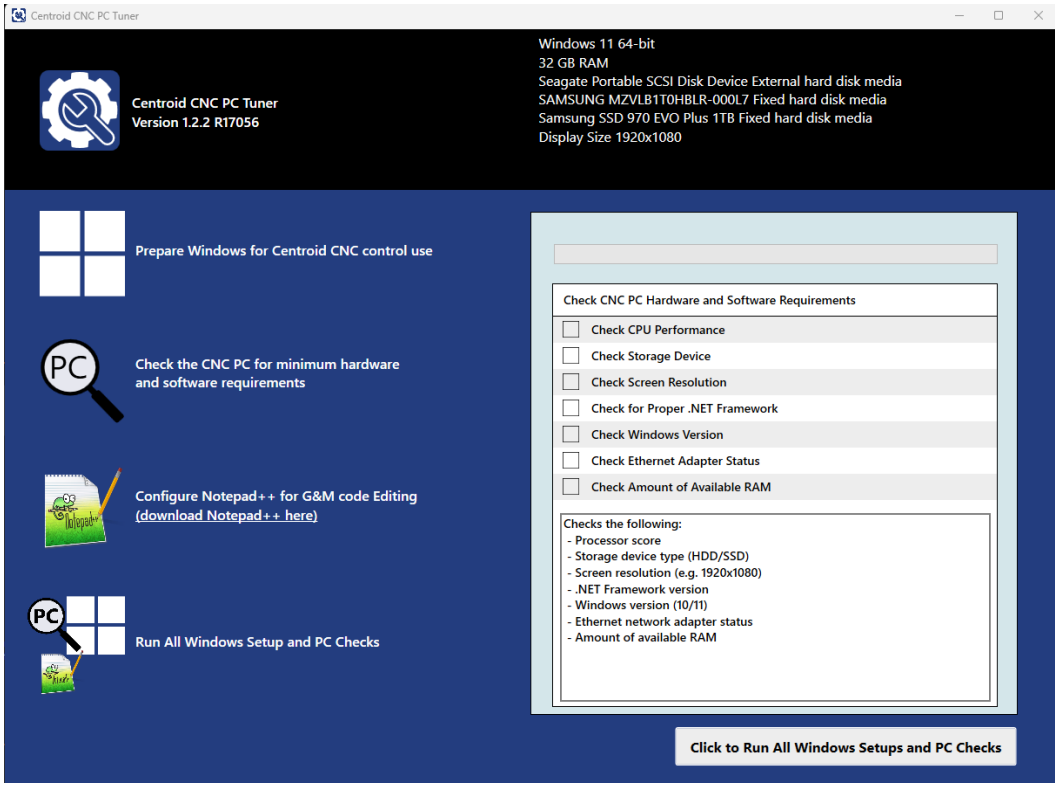
2. Before installing CNC12, all anti-virus, anti-malware, and 3rd party firewall software should be uninstalled (not disabled) and your computer rebooted.

3. Use the Centroid CNC PC Tuner App *in conjunction with Tech Bulletin 309* (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/309.pdf) to configure the PC for CNC use.

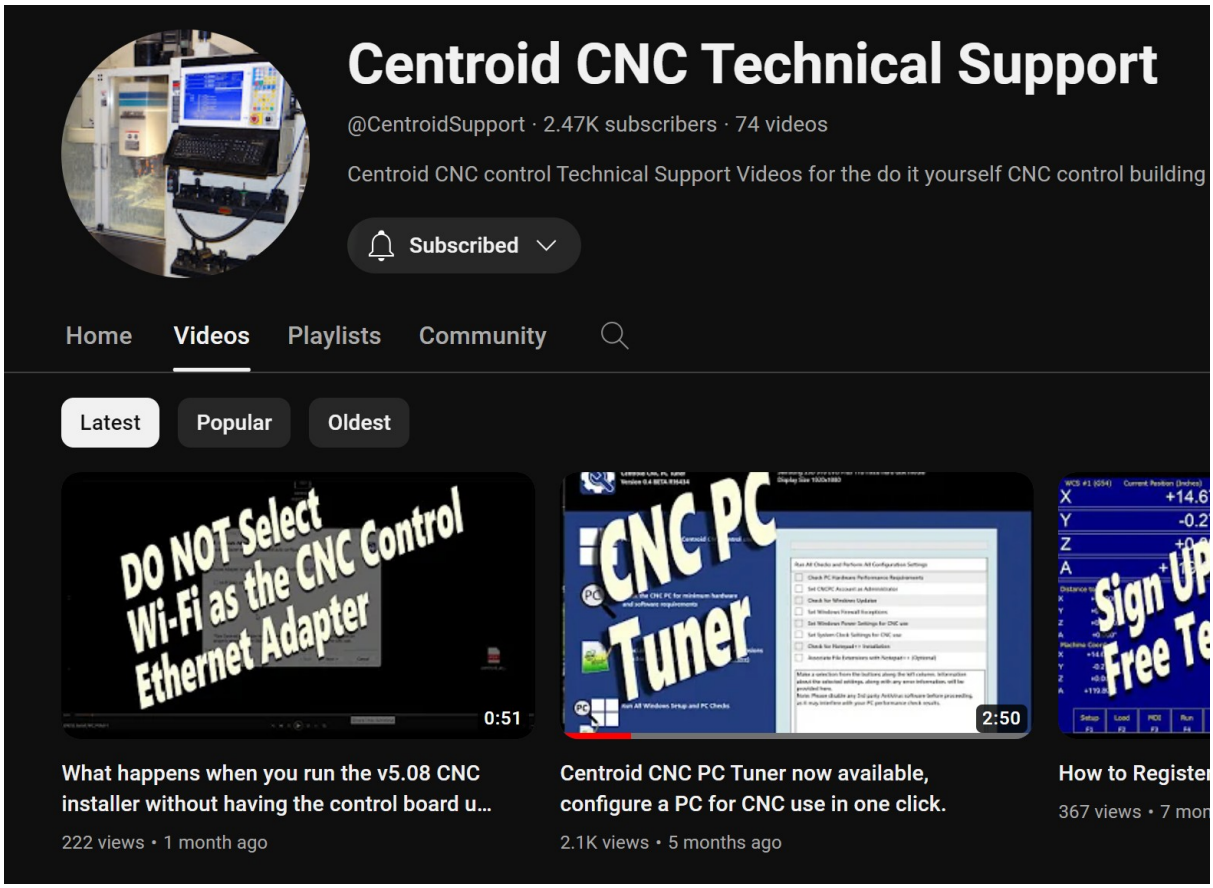
The CNC PC Tuner App will handle ***most*** of the Windows 10/11 configuration for you including checking for updates, setting firewall exceptions, configuring power settings, etc. ***TB309 has instructions for the items you must configure by hand.***

The PC Tuner App can be downloaded here:

https://www.centroidcnc.com/centroid_diy/centroid_cnc_software_downloads.html



Centroid CNC PC Tuner introduction video: https:/youtu.be/bOZVMMdzOj8?si=SIFVshBwu5eZ6INC



4. Nearly 100% of all communication problems between CNC12 and the Hickory are caused by anti-virus and 3rd party firewall software. Virus software works by stopping unusual or suspicious behavior in software, and will almost always detect the interaction between the Hickory and the PC as unusual/suspicious and interfere with the operation of CNC12. Firewalls work by blocking certain communication ports, and often these ports are needed for the operation of CNC12. The default firewall built into Microsoft Windows will work fine with CNC12 if you allow access as specified in this manual. For the communications bench test however it is best to disable the Windows firewall; you can always turn it back on after verifying good Hickory communication.

See Tech Bulletin #270 for details on how to fix hard-to-solve PC to CNC communication errors. (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf

If your corporate policy requires anti-virus software, a third-party firewall, or that certain Windows security features be enabled to connect to the network, then Centroid recommends that you keep any computers with CNC12 installed disconnected from the network.

Before installing CNC12, Windows Update should be performed. Centroid CNC software relies on Microsoft .NET Framework tools. So run “check for updates” on the CNC PC and select any updated related to .NET Framework.

3.2 CNC12 Software Installation

With the bench configuration completely powered as described in Section 2.2 and your PC powered up, install the CNC12 Software as follows:

1. Download the latest version of CNC12 v5.xx software: The latest version can be found here: https://www.centroidcnc.com/centroid_diy/centroid_cnc_software_downloads.html

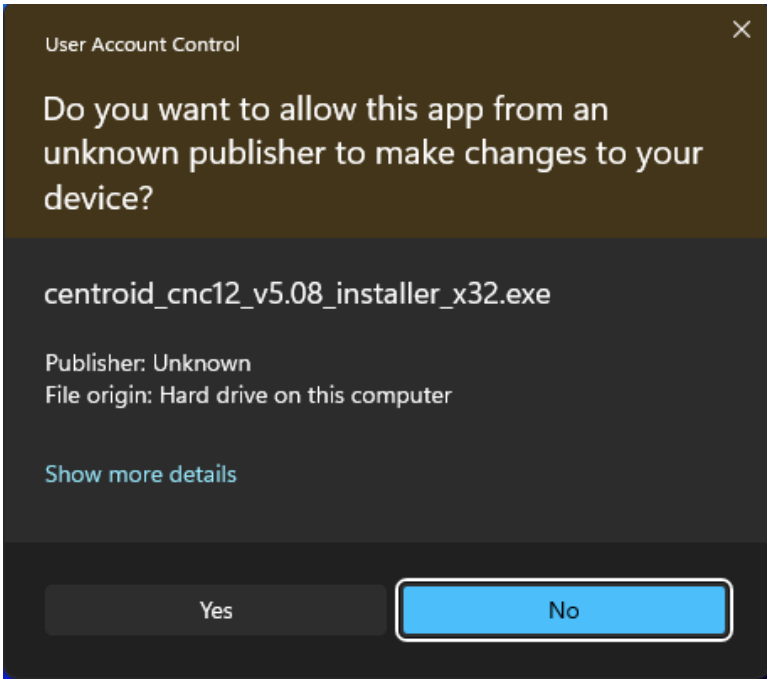
2. Navigate to the zip file you just downloaded. Depending on your Windows settings, the file you downloaded will be displayed as “centroid_cnc12_v5.xx.zip” or similar. Unzip it.

3. With the Hickory powered up and connected to the CNCPC, Double click the executable (.exe). NOTE: The Hickory must be powered on and connected to the CNCPC via the provided Ethernet cable prior to running the installer. If your PC uses an Ethernet connection for Internet access, ensure to install the software with the Ethernet for Internet **disconnected**.

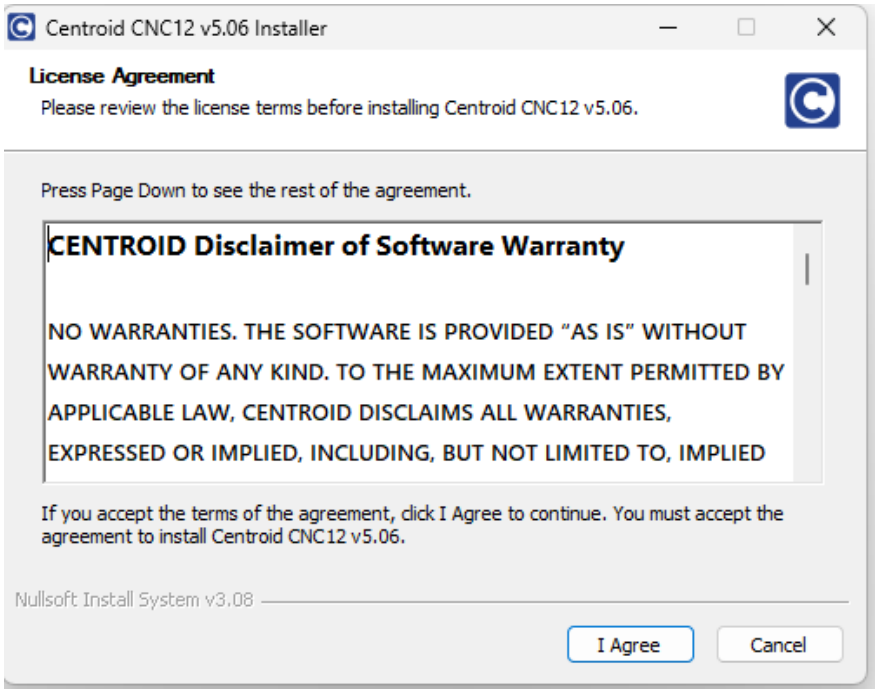
4 Windows 10/11 systems may pop up a Windows Defender SmartScreen showing “Microsoft Defender SmartScreen prevented an unrecognized app from starting (see image below). Running this app might put your PC at risk”. Click “More info”, Then Click “Run anyway”.

Microsoft Defender Smartscreen

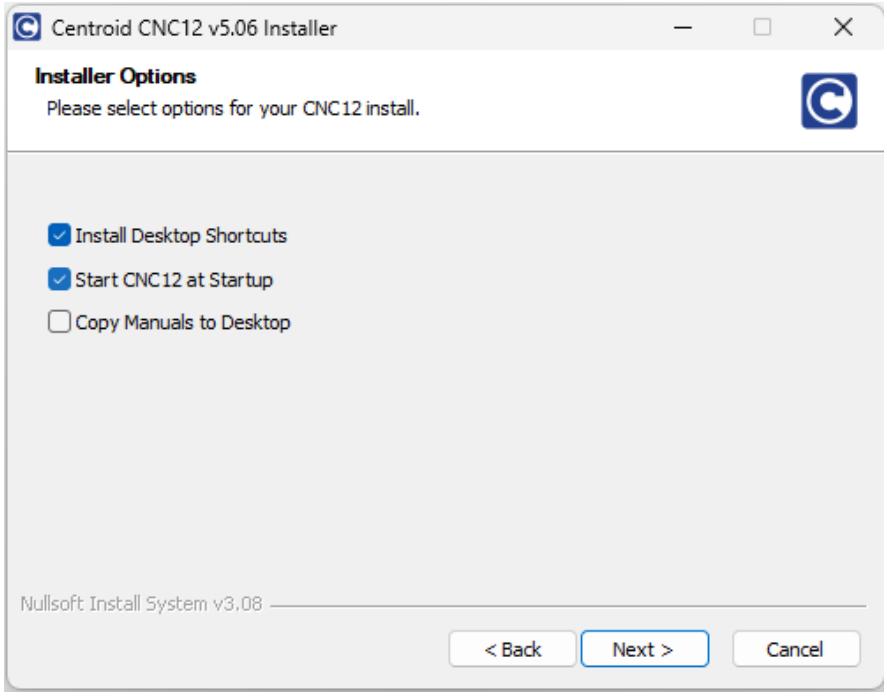
5. Depending on your Windows settings you might also get a prompt asking if you want allow the application to make changes to your device. Click “Yes”.



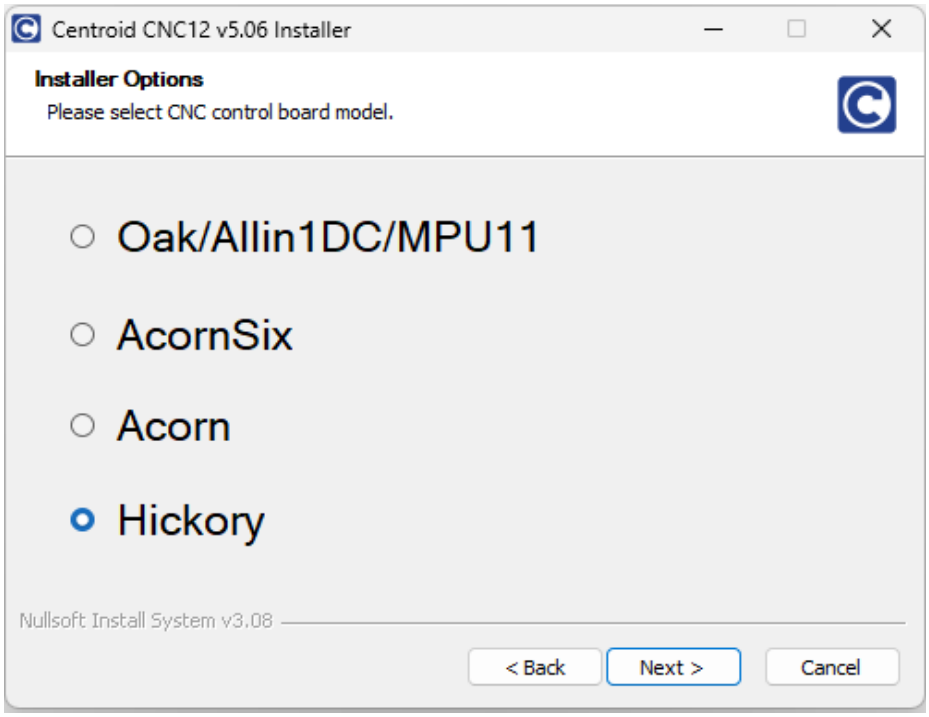
6. Read the Centroid Disclaimer of Software Warranty and if you agree click on “I Agree”.



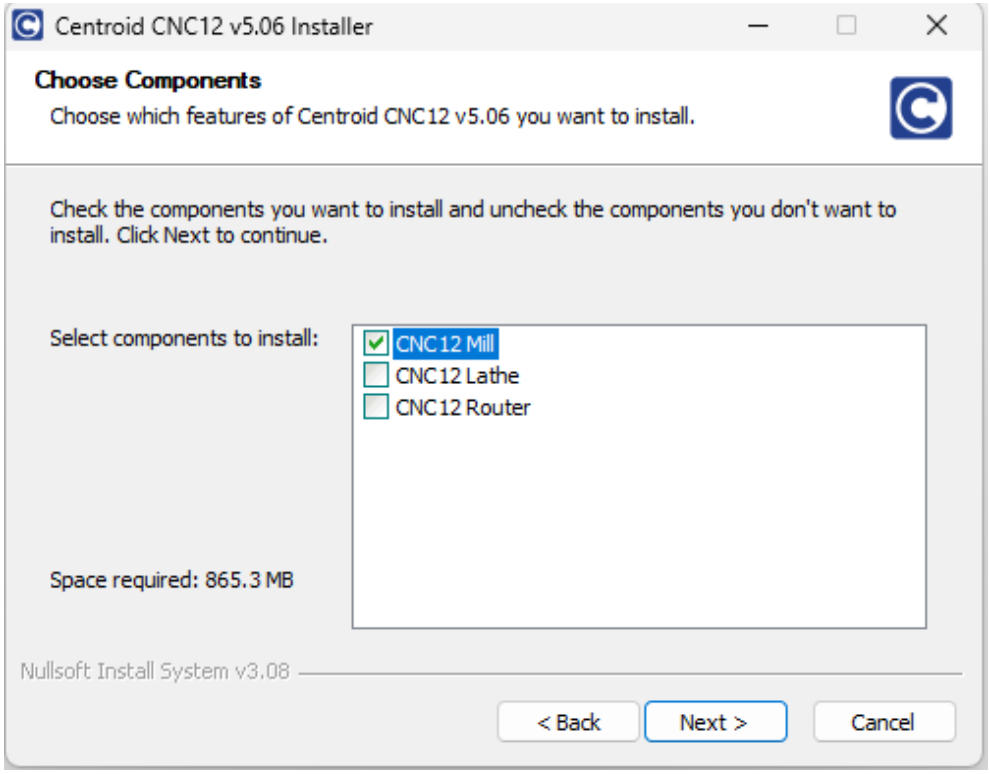
7. Select “Install Desktop Shortcuts”. Selecting “Start CNC12 at Startup” is very useful to select as well if this is a dedicated CNC setup where the PC power is turned on when machine power is turned on. Select “Next” to continue.



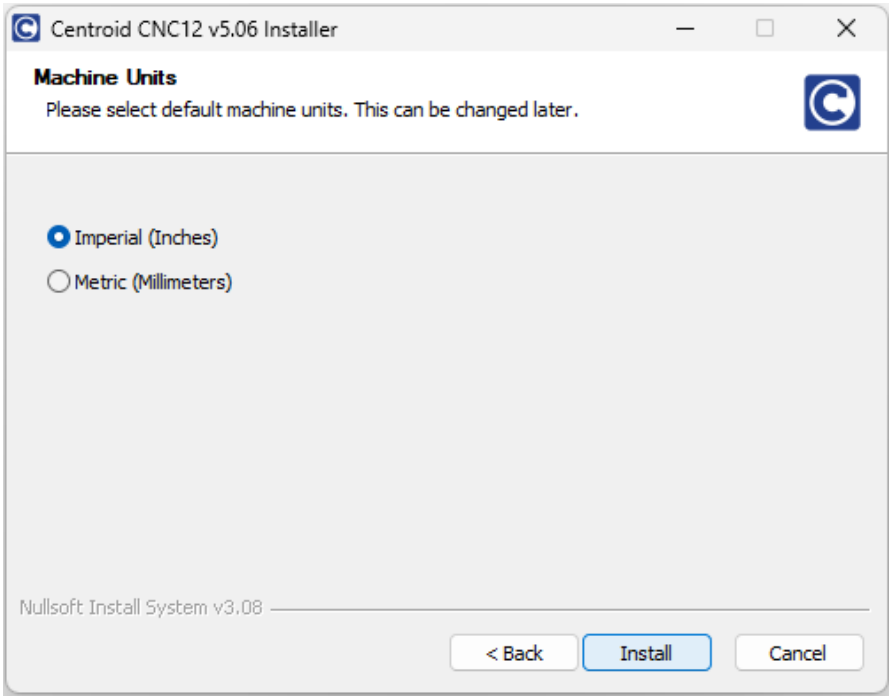
8. Select Hickory as the control option and then select “Next” to continue.



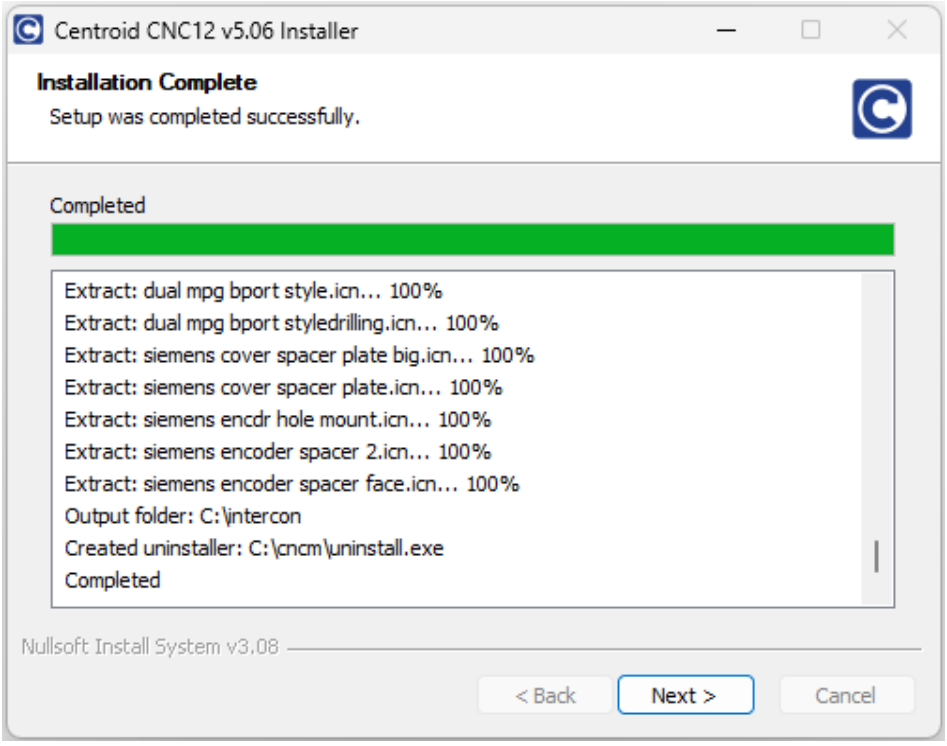
9. Select which CNC software component is correct for your machine. Select “Next” to continue.



10. Choose between Imperial (Inches) and Metric (Millimeters) as the default units. This is to help with initial setup and can be changed at any time later in the software. Select “Install” to continue.

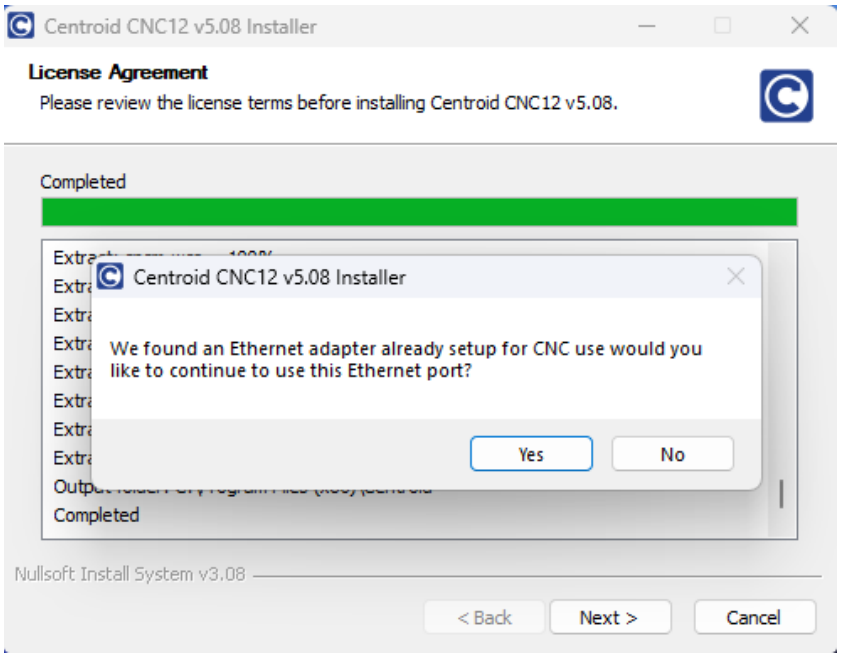


11. After seeing the “Setup was completed successfully.” screen select “Next” to continue.



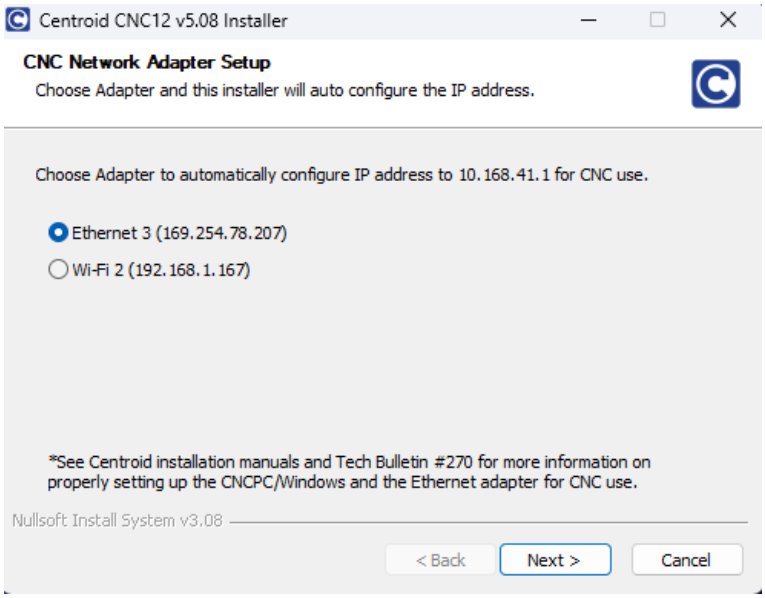
12. Network Adapter Setup: (IMPORTANT: During the software installation **Hickory is required to be powered up and connected to the CNC PC via the provided Ethernet Cable**). You will be presented with all the Ethernet connection options your computer has.

1. If the Ethernet Adapter has already been set up for CNC use, you will see the screen below. Select “Yes” to continue.

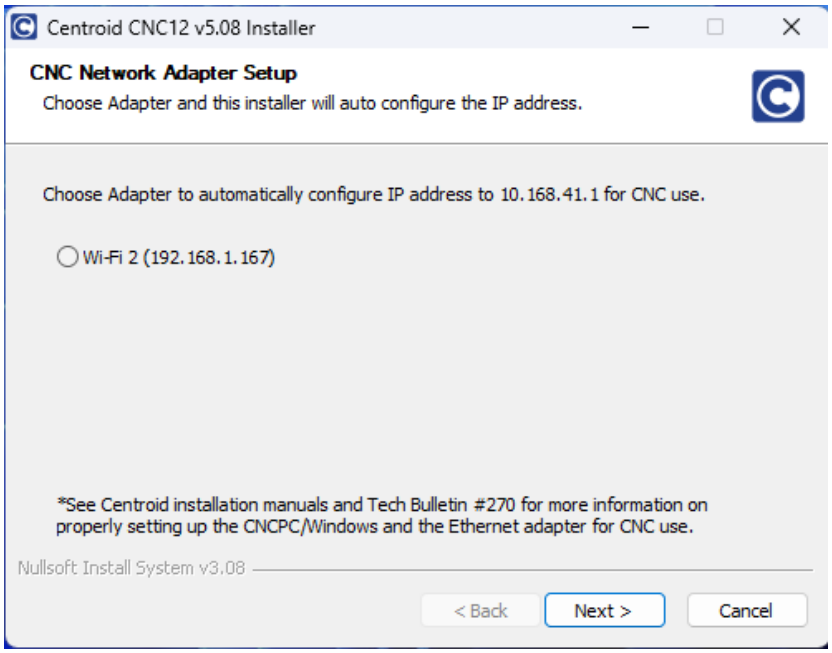


2. If the Ethernet Adapter has not yet been set up for CNC control, you will see the screen below. Select the Ethernet option to automatically configure the IP address for CNC use and click “Next”. **DO NOT** select the Wi-Fi option.

A prompt will appear asking if you want to change the IP address of the Ethernet adapter. Select “Yes”.



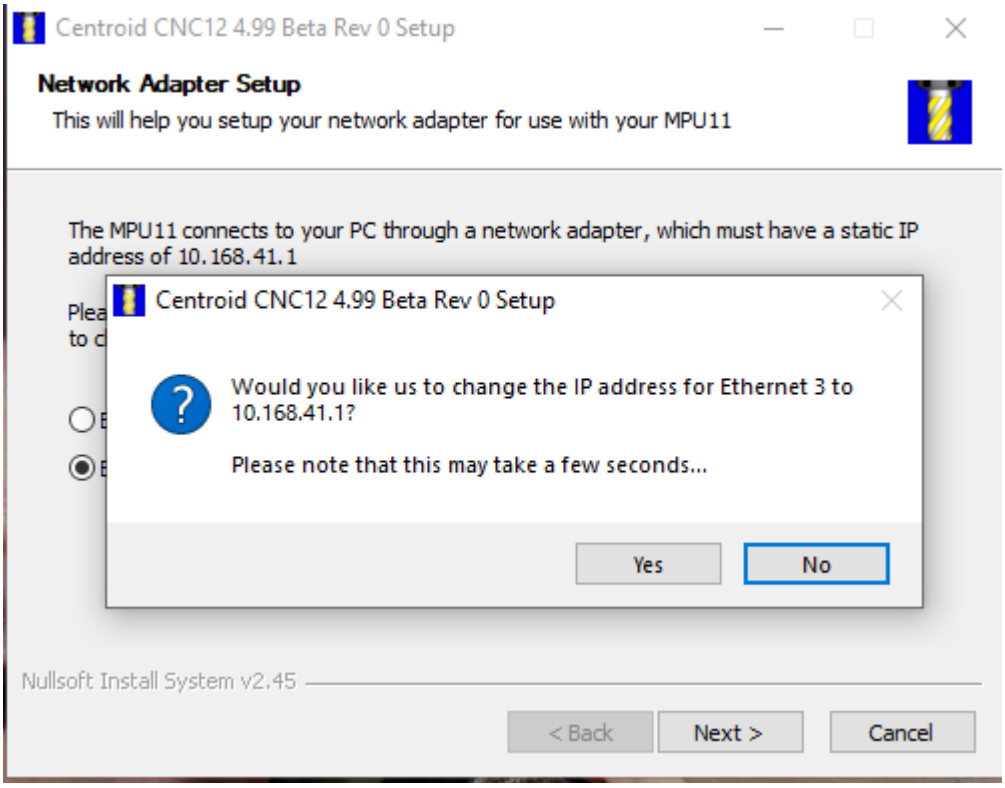
3. If the Network Adapter Setup screen does not show an Ethernet option, that means that the installer does not detect the CNC control board Ethernet connection to the PC. If you see this screen **STOP**, select “Cancel”, and ensure that the control board is powered on and connected to the PC via Ethernet. Then retry the installation. If the issue persists, go back to Section 3.1 and check the Windows 10/11 configurations are setup properly for CNC control use.



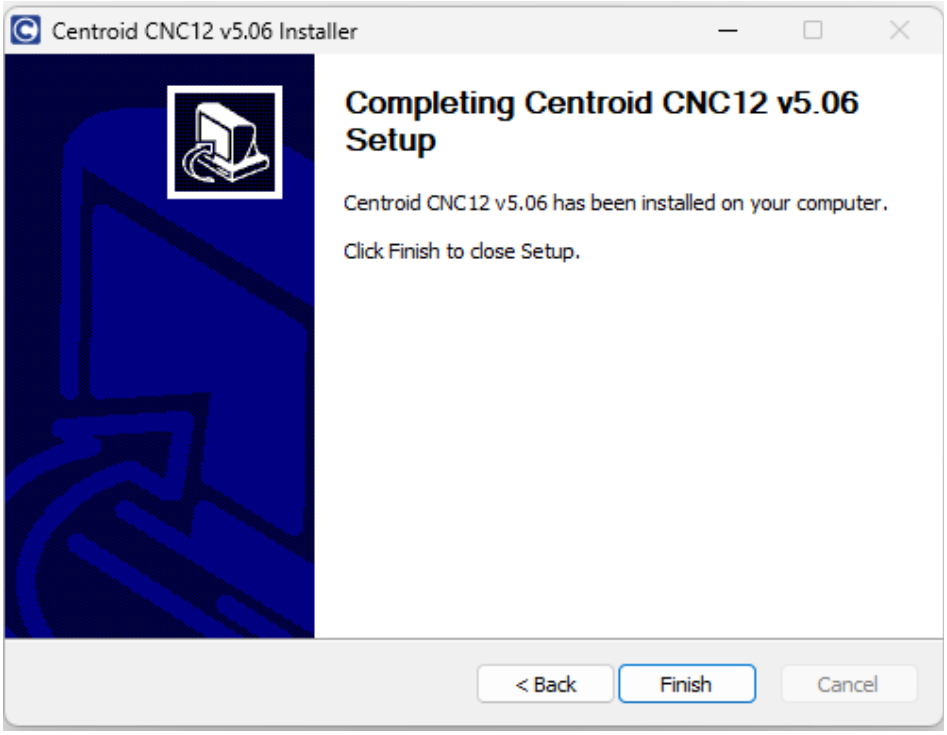
NOTE: Centroid recommends using a computer with two Ethernet ports.
Alternatively one Ethernet port and one Wi-Fi adapter is also acceptable.
That way one Ethernet port is used for the Hickory, and the second wired Ethernet port can be used to access the internet or a LAN. If you do have two Ethernet ports, install the CNC12 software with the Ethernet port that connects to the LAN/internet **disconnected**. This way the CNC12 installer will only recognize and install to the correct Ethernet port.

NOTE: Your IP address will differ from those shown in the picture.

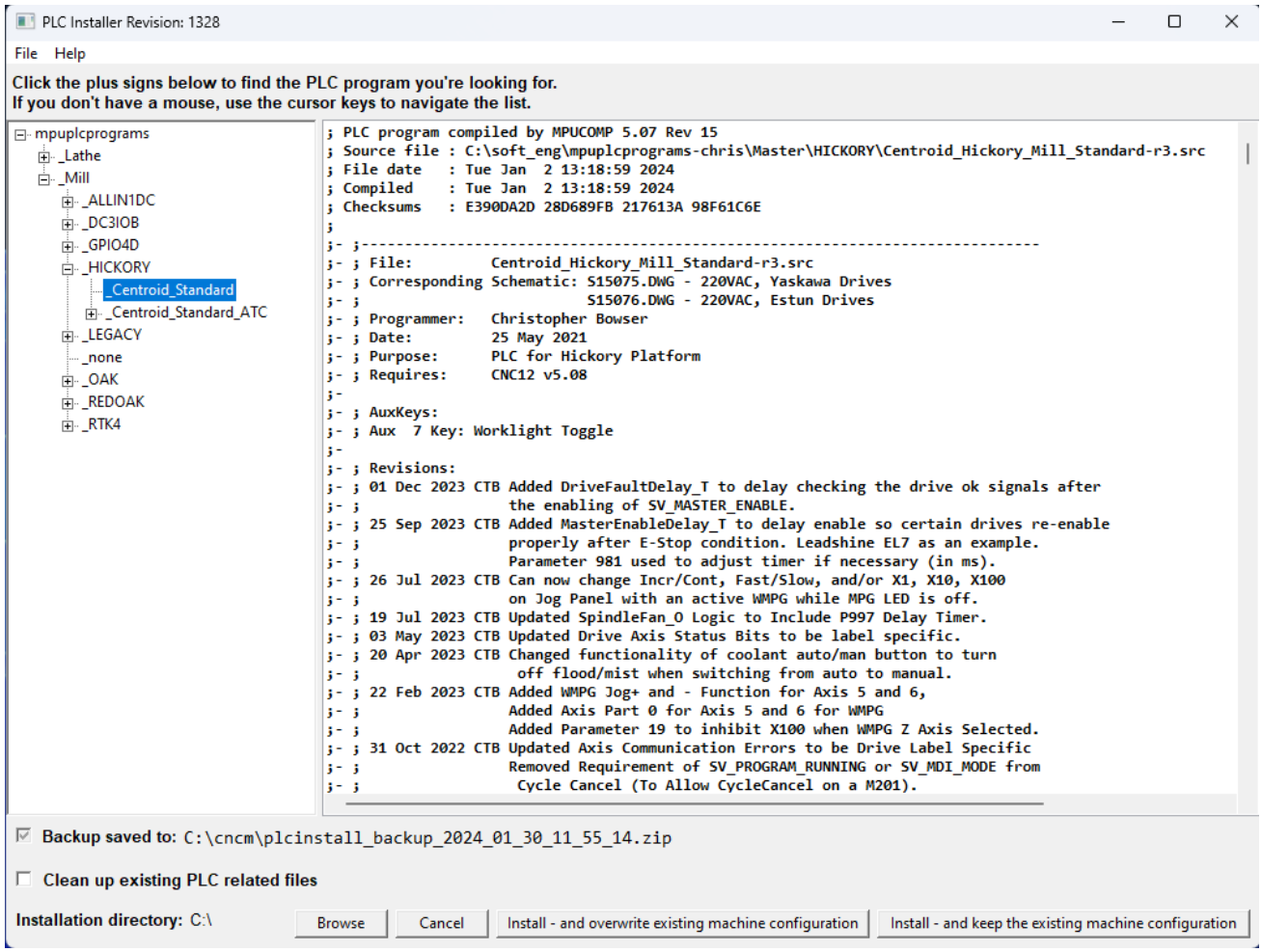
13. Confirm that the Ethernet selected is the correct one and select “Yes” to proceed.



14. Click “Finish” to complete CNC12 software installation.



15. The installer will prompt you if you want to install a PLC program. Click “Yes”. The PLC installer program will open. Use the “+” buttons to select either Mill or Lathe, then expand the _HICKORY section. Select _Centroid_Standard, then click either Install option at the bottom.



Chapter 4 Bench Testing

4.1 Load a Hickory License

CNC12 can be run using the default free version, but certain software capabilities are locked unless a Pro or Ultimate license is purchased. At least a Pro license is required to perform the communications stress test. Additionally, if your machine has paired axes, at least a Pro license is required and the license **must** be loaded before attempting to pair the axes.
For an overview of the features included with the Pro and Ultimate licenses, or to purchase a license visit https://shopcentroidcnc.com/hickory-cnc-controller/ . If you've already purchased a license, the following instructions detail how to import the license.

Hickory License Installation Instructions:

1) Download and save the license.dat file emailed to you by Centroid to the CNC PC desktop using a Windows PC. (Note: Mac or any Apple computers, will corrupt the .dat file attached)

2) With Hickory powered up and running, start the CNC12 software.
3) Press "F7" Utility menu.

4) Press "F8" Option Menu.
5) Choose the "F2" Import License function. This will open a file dialog. Navigate to the desktop (or the location where the license file attachment was saved) and select the license.dat file. Click "Open". CNC12 will then respond with a message stating that the license was successfully imported.

Centroid Community CNC Support Forum: CNC12 software License ordering process explained
https://centroidcncforum.com/viewtopic.php?f=61&t=3570

Centroid Community CNC Support Forum: Video: How to install a CNC12 License
https://centroidcncforum.com/viewtopic.php?f=61&t=3345

Trouble shooting License Issues:

TB325: Licensing Issues and Troubleshooting
https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/325.pdf

Centroid Community CNC Support Forum: Error "Serial number and license file does not match this system" https://centroidcncforum.com/viewtopic.php?f=63&t=3882

4.2 CNC12 Software Configuration

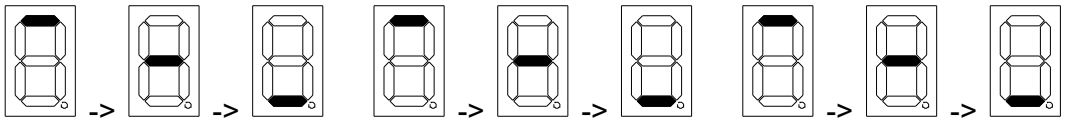
Before starting the CNC12 software verify that the Hickory CNC control is powered on and the Ethernet cable connected to the CNC PC. The seven-segment LED on the Hickory will be a continuous scrolling sequence when it is in a ready state (if you see a number it is an error code). For a list of error codes see Appendix B.

Hickory on board LED1 Operation

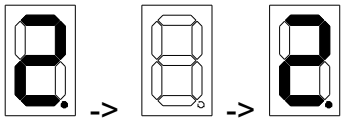
The seven-segment display (LED1) is used to display status.

At startup, LED segments will light up in a fast rotating pattern during boot up process and continue until initialization is complete. Initialization takes about 15 seconds.

Center segments lighting in a scrolling pattern indicates Hickory has booted and is running normally.

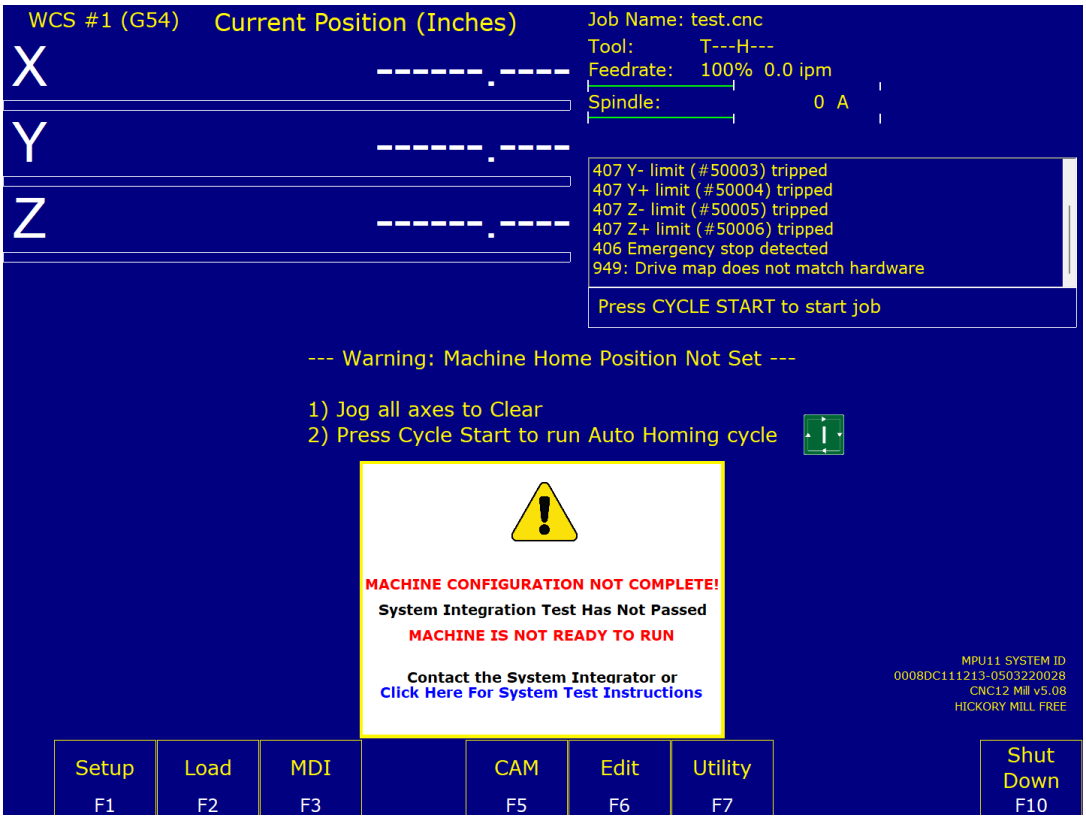


Errors are indicated by a flashing number with the decimal point lit continuously. See LED1 Error Codes chart for error descriptions.

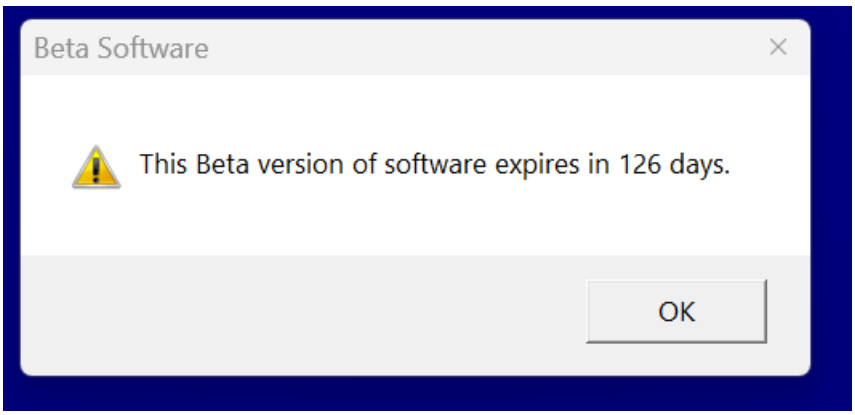
 Flashing number indicates an error

Double click the CNC12 Mill (or Lathe) icon on the desktop.

The main screen of CNC12 will appear. You have successfully connected the Hickory to CNC12.



Note: When running beta software this message will appear on start up. Click OK to continue.

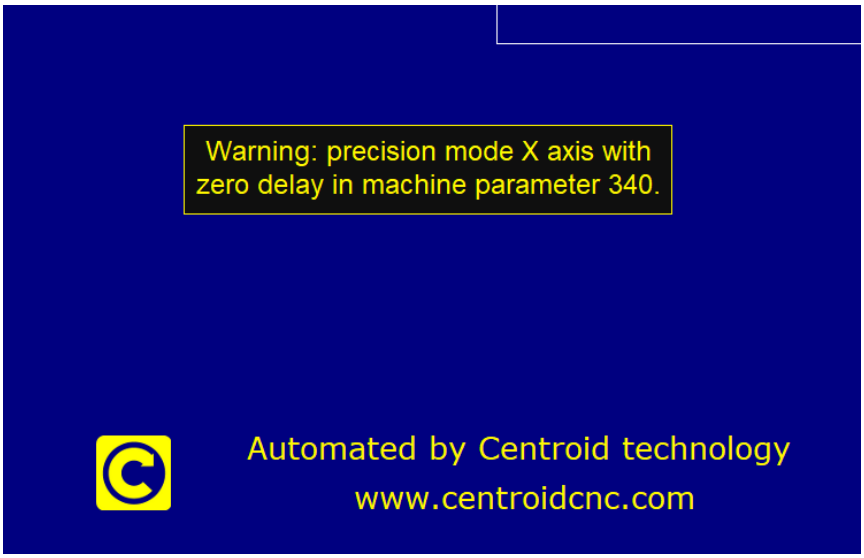


If you see this message, please STOP and download the latest released version of CNC12 found on our website. Do not use any BETA software versions on a production machine.

The current released version of CNC12 can be found here.
https://www.centroidcnc.com/centroid_diy/centroid_cnc_software_downloads.html

If you want to participate in CNC12 Beta software testing more info can be found here.
https://centroidcncforum.com/viewforum.php?f=67

Note: When first opening CNC12, it may present you with the message “Warning: precision mode X axis with zero delay in machine parameter 340” for X, Y, and Z axes. This warning can safely be ignored for now; press any key to clear these messages.



The following instructions will temporarily disable the fault logic built into the system. CNC12 monitors the signal levels of hardware such as jog panels and encoder inputs, and will generate a fault if any hardware does not respond as expected. In addition, the Centroid_Hickory_Mill_standard.src PLC program contains default logic that monitors the inputs for Limit Switches (inputs 1-6), Lube Fault (input 9), Spindle Fault (input 10), E-Stop (input 11). If ANY of these inputs are open a fault will be issued.

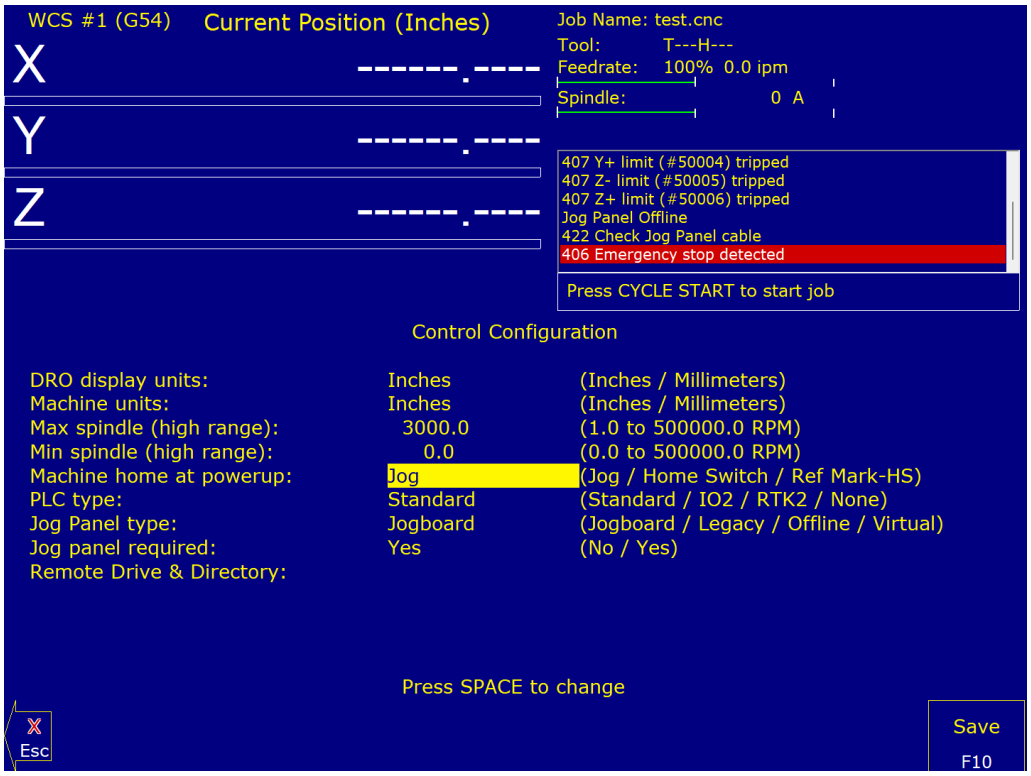
1. **Control Configurations.** Navigate to the “**Control Configuration**” screen. From the main screen press **F1 – Setup** → **F3 – Config.** The password is **137**. Then press **F1 – Contrl**.
   a) Set the units of the machine, change both the DRO display units and Machine units to either Inches or Millimeters using the space bar.
   b) Set **Max Spindle** to **3000** and **Min Spindle** to **0**.
   c) Change “**Machine home at power up**” to the desired home configuration:

i. Use **JOG** for manual homing – this is not recommended for Hickory because it does not take advantage of absolute encoders.

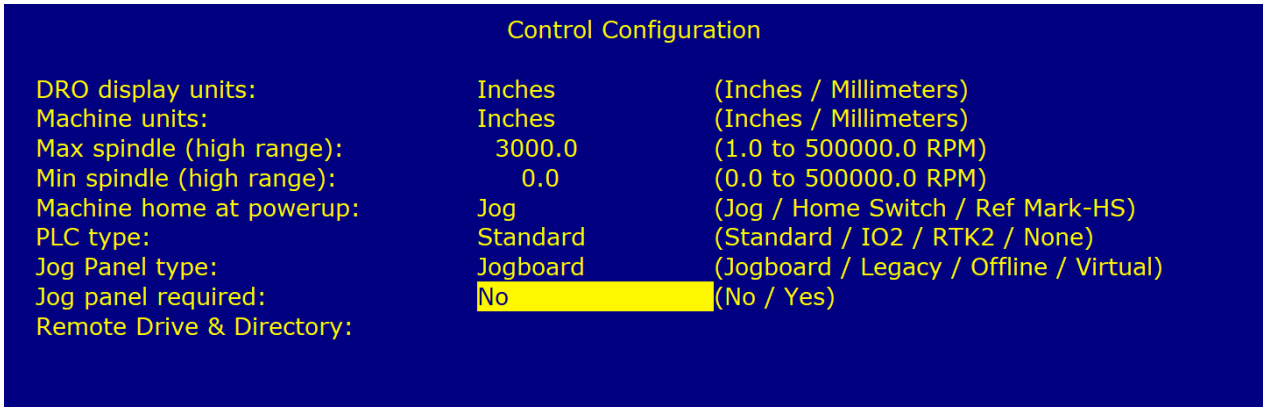
ii. Use **Home Switch** when home switches are used to set initial home position. The absolute encoders remove the need to move to the switches on every startup.

iii. Use **Ref Mark-HS** when reference marks are used to set initial home position. This option is recommended for machines without home switches. Refer to TB127 for more details.

d) If you wish to use the virtual control panel (VCP), select the “Virtual” Jog Panel Type option.



2. **Disable Jog Panel Communication Faults** *(If you have a jog panel or pendant, connect it and skip this step.)* Disable Jog Panel communication faults. Use the arrow keys to select “Jog Panel Required” in the Control Configuration and press the space bar to toggle to “No”. Press **F10-Save**.

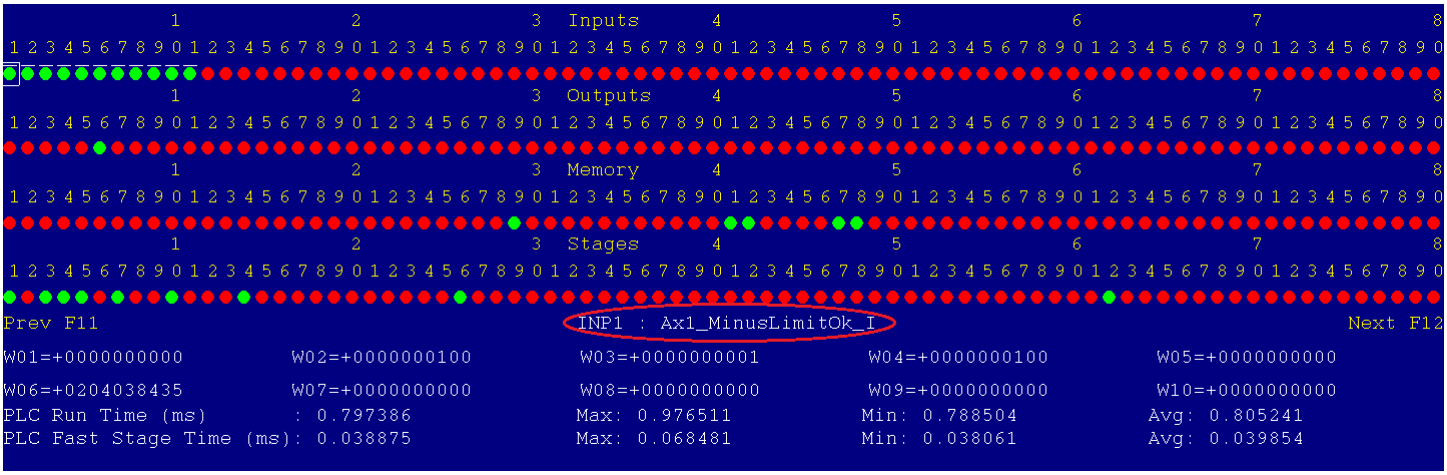


After saving, press **ESC** to go back to the Main Screen. Press **F10-Shutdown → F2-Power Off.** After the computer shuts down, cut the power to the Hickory and the PC via switching off your outlet strip. Wait 30 seconds and power everything back up.

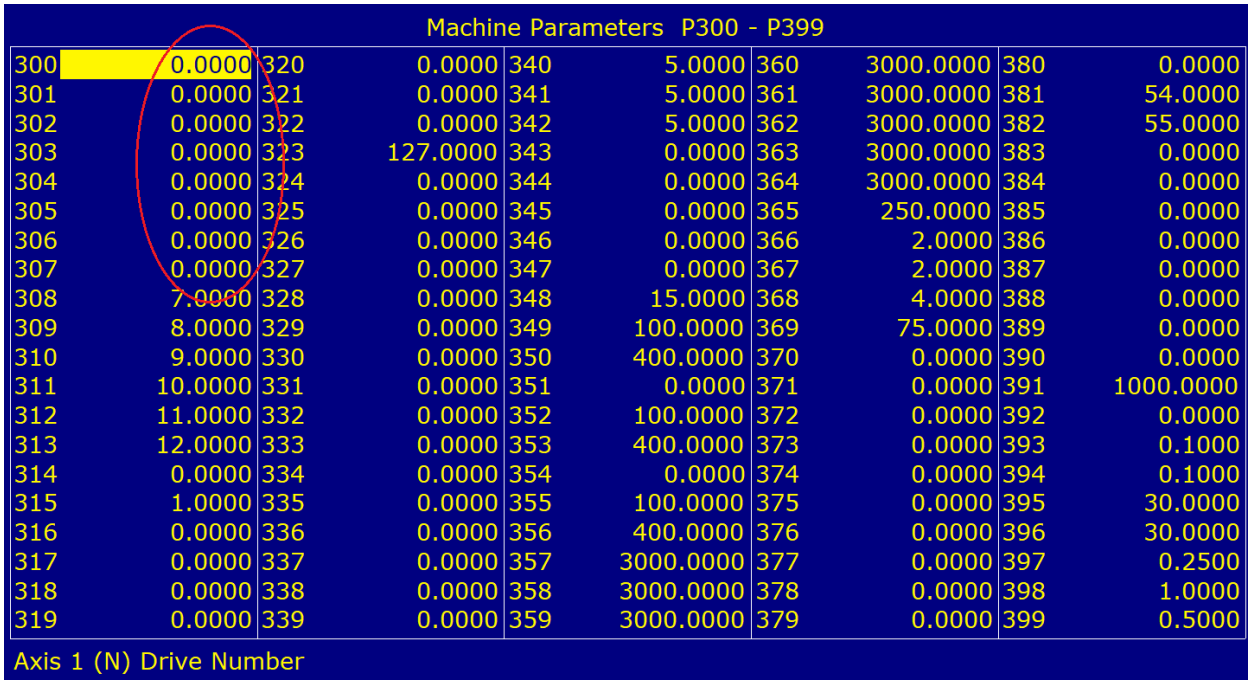
TROUBLESHOOTING TIP: If you cannot save any of your changes in CNC12, close CNC12 by pressing **F10 – Shut Down → F9 – Exit CNC12**. Right click on CNC12 desktop shortcut. Select **properties.** Click on the **Compatibility** tab. Check the box labeled “**Run this program as an administrator**”. Click “**Apply**”. Click “**OK**”. Start the CNC12 software and try again.

3. **Disable PLC faults for Limit Switches, Lube, Spindle, E-Stop and Axis Faults.** At the main screen press <Alt + i> to bring up the real-time I/O display as shown below. Using the arrow keys, move the selection box to the top left of the inputs. The screen should read “INP1 : Ax1_MinusLimitOk_I”. Press the <Ctrl + Alt + i> keys simultaneously to invert this input.

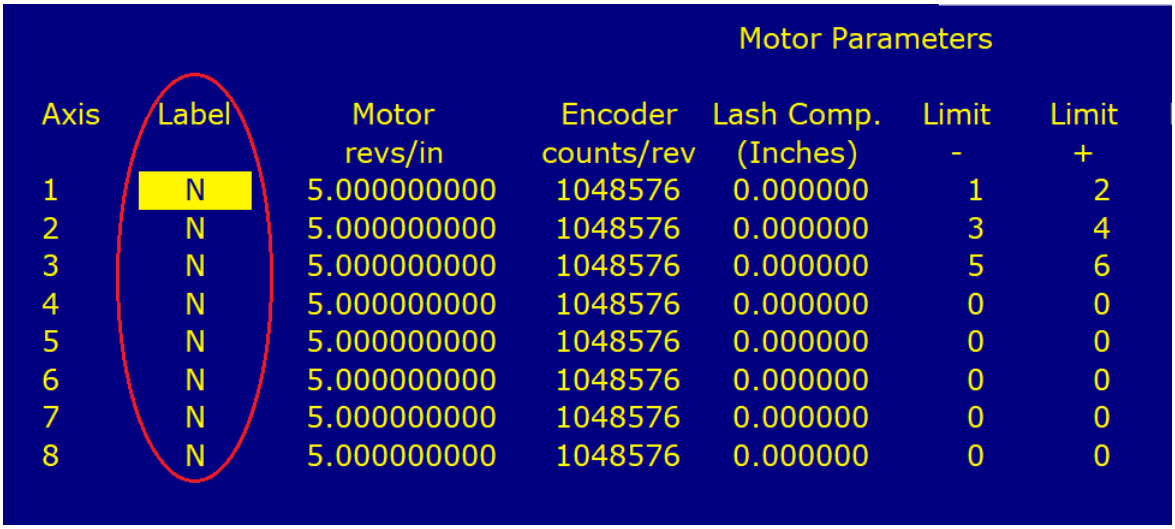
   You will notice that the LED will turn from red to green and a line will be drawn over the top to indicate that the state of the input has been programmatically inverted. Repeat the process until inputs 1-11 are green as shown below. If the input is already green, leave “as is” and don't invert. When you’re done, press alt and i again to exit the PLC diagnostic menu.



4. **Clear the default drive mapping settings**. The Hickory control board relies on communication via the EtherCat daisy-chain to the motor drives. For the purposes of bench testing, we must tell CNC12 that there are no drives to communicate to. From the main menu, press **F1-Setup** → **F3-Config** → **Password: 137** → **F3-Parms**. Use the arrow keys or F8 to navigate to Parameters 300-307. For each of these parameters that has a non-zero value, set it to 0. Press **F10-Save** to save the parameters and exit to the previous menu.



5. **Clear the default motor labels**. We must also tell CNC12 that none of the axes are currently connected by clearing the motor labels in the motor parameters menu. From the main screen, **F1-Setup → F3-Config → Password: 137 → F2-Mach → F2-Motor**. For each axis that is not already labeled 'N', set it to 'N'. Press **F10-Save** to save the motor parameters and exit to the previous menu.



Motor Parameters

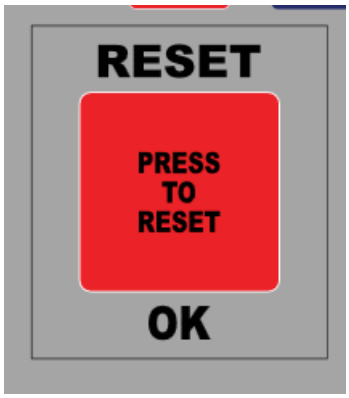
Axis	Label	Motor revs/in	Encoder counts/rev	Lash Comp. (Inches)	Limit -	Limit +
1	N	5.000000000	1048576	0.000000	1	2
2	N	5.000000000	1048576	0.000000	3	4
3	N	5.000000000	1048576	0.000000	5	6
4	N	5.000000000	1048576	0.000000	0	0
5	N	5.000000000	1048576	0.000000	0	0
6	N	5.000000000	1048576	0.000000	0	0
7	N	5.000000000	1048576	0.000000	0	0
8	N	5.000000000	1048576	0.000000	0	0

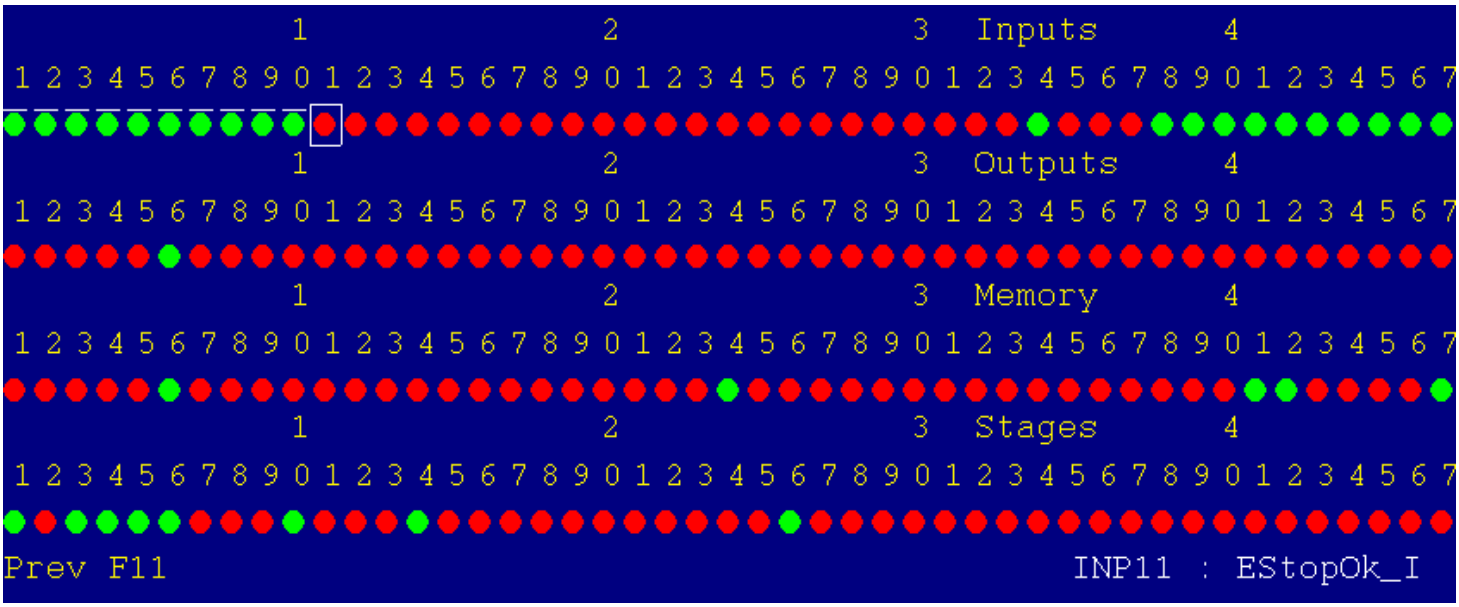
6. **Close CNC12 and power off Hickory**. From the main menu, press **F10-Shut Down → F2-Power Off**. Once the computer shuts down, cut power to the Hickory by shutting off your outlet strip. Wait 30 seconds, then power the Hickory back on and open CNC12. CNC12 is now ready for the communications bench test and the spindle analog voltage bench test.

4.3 Hickory Communications Stress Test

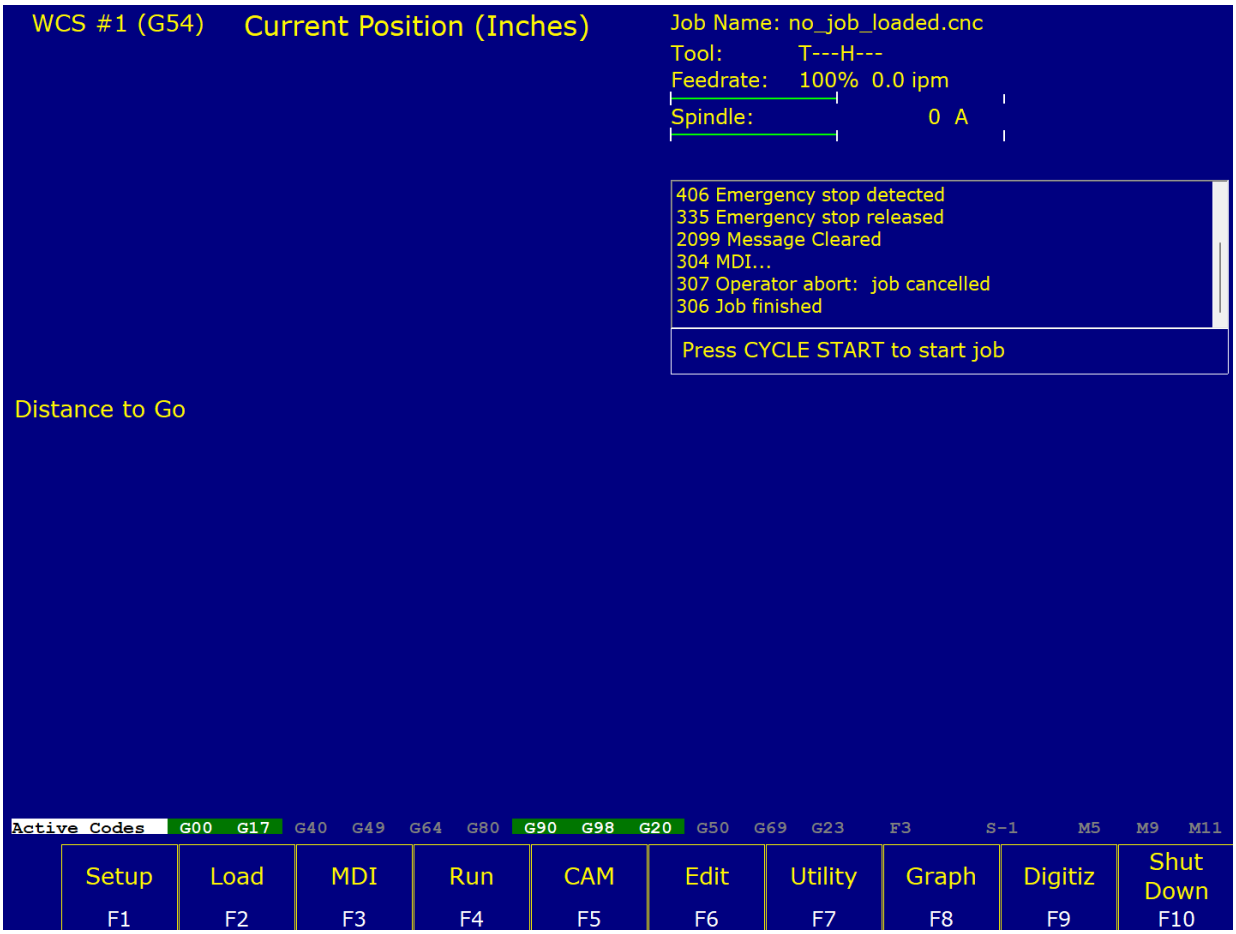
The CNC12 communications stress test is designed to evaluate the communication flow between the CNC12 software and the control board. It will send many packets of information back and forth between the two and ensures that each packet is received on each side. The ideal scenario is a stress test where no packets are lost, no packets are requested to be resent, and all of the packets are received in-order, indicating that the communication stream between the PC and controller is stable.

1. Start CNC12 with Hickory Powered up.
2. Ensure there are no present faults. If there are, see Step 3 in the previous section about clearing PLC input faults.
3. Toggle the Reset button if you are using the VCP. If you are not using the VCP, you must toggle input 11 using the <Alt + i> PLC Diagnostic display. Press <Ctrl + Alt + i> to set input 11 red, then press it once again to turn it back to green.

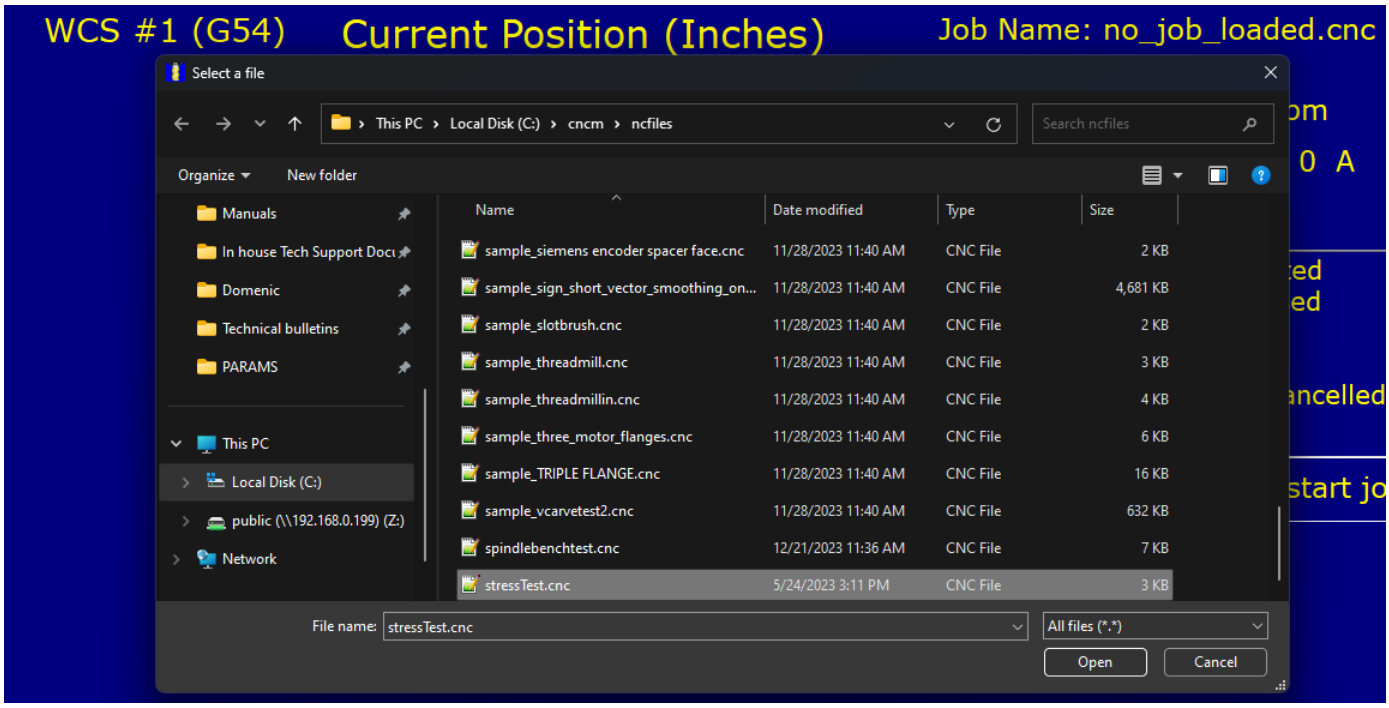




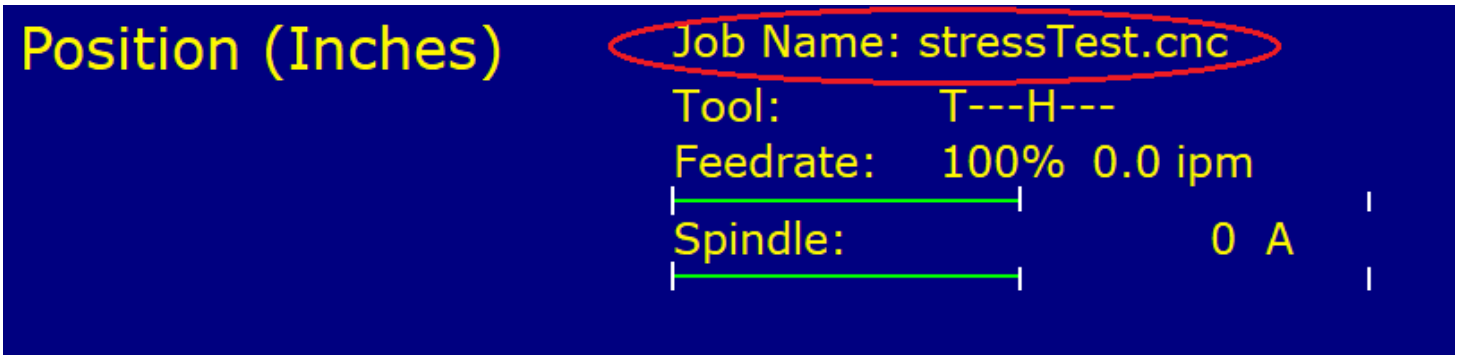
4. The DRO should be clear of any labeled axis. Because of this, the software should not require the home position to be set. If the DRO has any labeled axis, see Step 5 in the previous section on how to clear the axis labels.



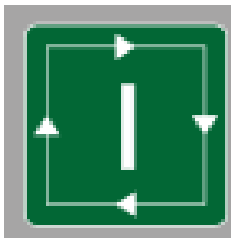
5. Press **F2-Load** and navigate to the communications stress test program. The default location of the file is: C:\cncm\ncfiles. **Note:** cncm would be replaced by 'cnct' on lathes.



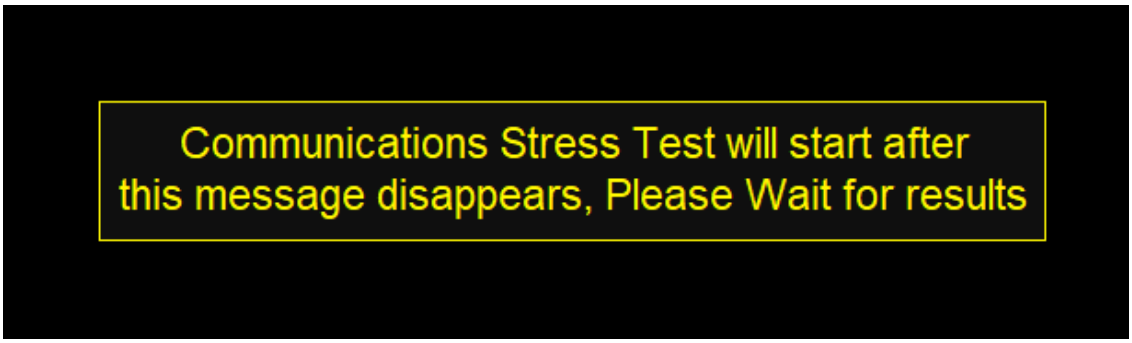
stressTest.cnc will appear beside "Job Name:"



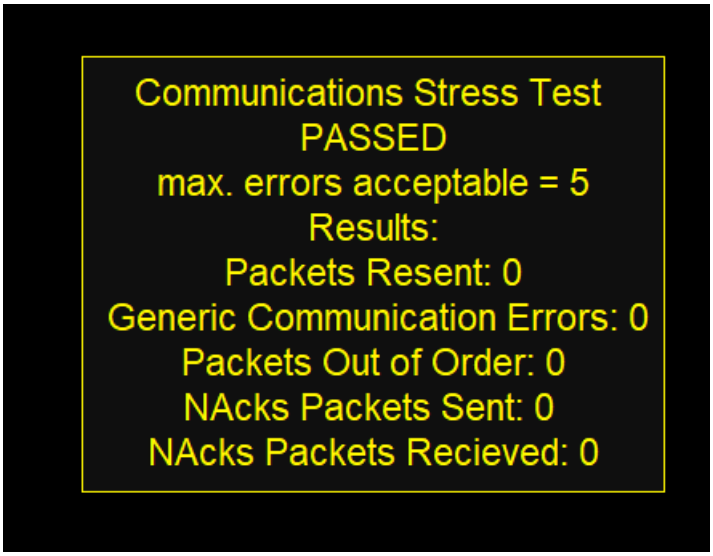
6. Press cycle start to run the communications stress test.



This message will appear indicating the start of the stress test.



Then the results.



If the stress test fails, that indicates that there are major communication issues between the PC and the controller which can result in a non-functioning machine and potentially a hazardous working environment.

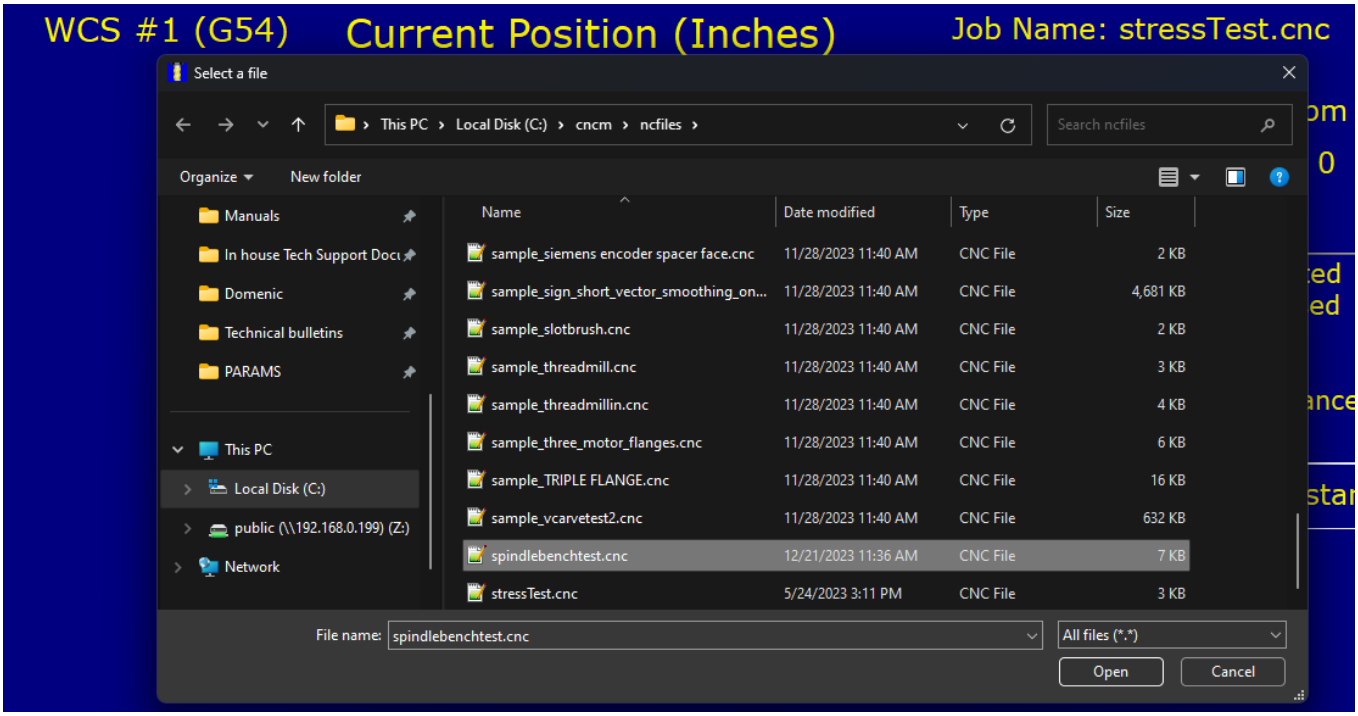
Review this information on solving communication errors:

Review IP settings, Virus and Firewall. For complete guidance on this see this post.
https://centroidcncforum.com/viewtopic.php?f=61&t=1451
and supported document Tech Bulletin 270
https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf

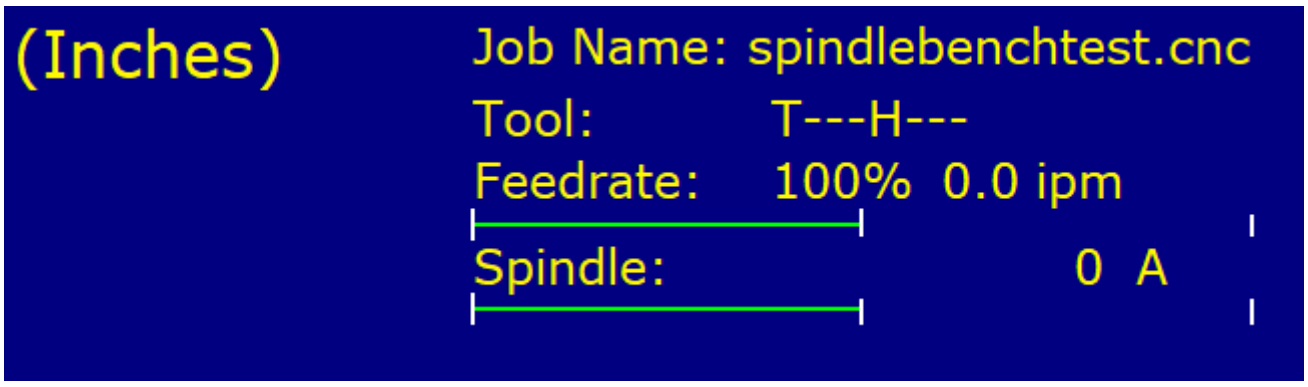
4.4 Hickory Analog Spindle Output Test “Spindle Bench Test”

The spindle bench test checks that the correct voltage is generated by the Hickory’s Analog Out terminal in response to a given S command. For this test, you will need a way of measuring DC voltage, such as a digital voltmeter.

1. Load spindlebenchtest.cnc. From the main menu, press **F2-Load** and navigate to the spindlebenchtest.cnc file located in the ncfiles folder, then click “open”.



2. spindlebenchtest.cnc appears as the job name in the upper-right corner of the CNC12 window.



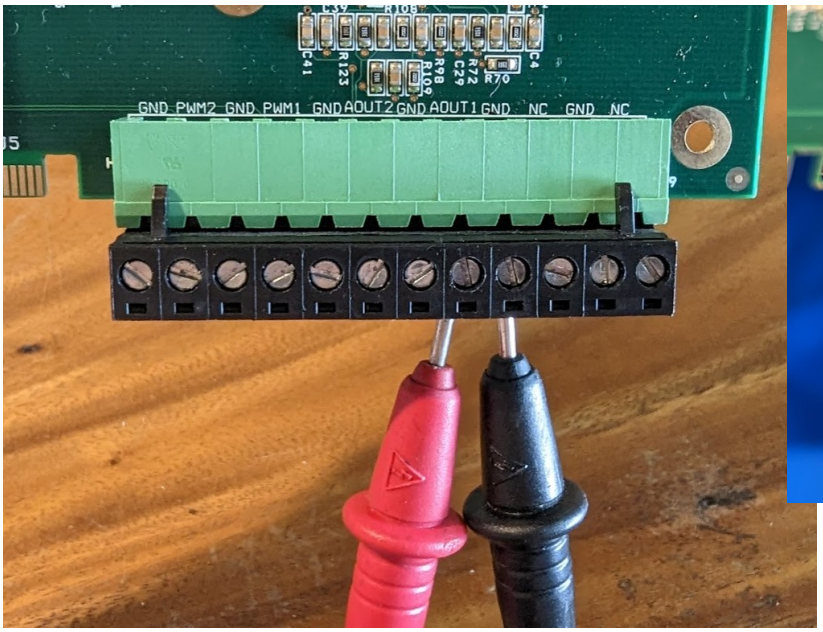
3. **Testing the analog output**. Hickory provides 0 to +10VDC analog output for the purpose of programmable spindle speed control using a VFD (variable frequency drive). The default maximum spindle speed specified in the Control Configuration is 3000rpm. This configures the control to scale the 0 to +10VDC signal from 0 to 3000rpm. A spindle speed command of S1500 should therefore output +5VDC, a command of S1000 should output +3.33VDC, and so on.

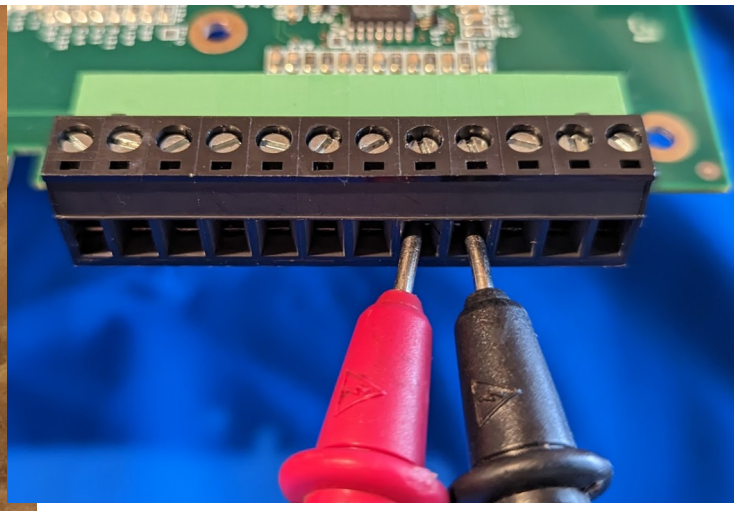
   a) Set your digital voltage meter to VDC. If it is not auto-ranging, set the range to 20VDC.

   b) Connect the twelve-pin terminal block into header H8.

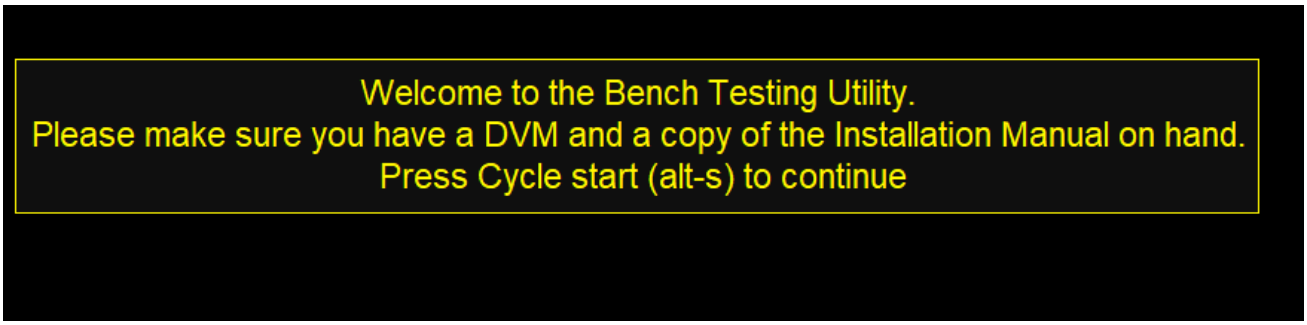
   c) Insert the red lead of the voltmeter into AOUT1 and the black lead into GND (any of the grounds on H8 will work).

   d) Tighten down the screw terminals to firmly grasp the probes.

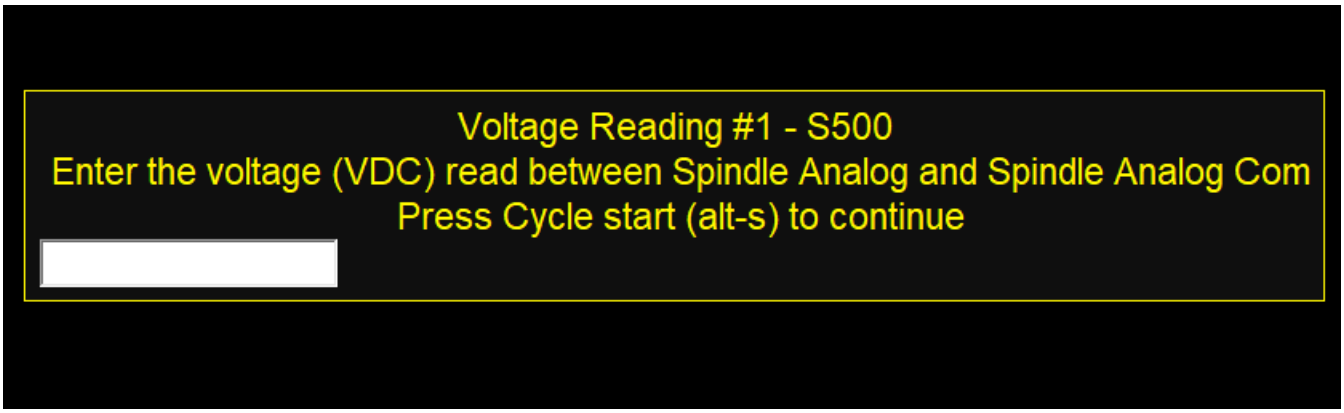




4. With spindlebenchtest.cnc loaded, press Cycle Start or the keyboard shortcut <Alt + s>to begin. The following screen will be displayed:



5. CNC12 will issue various spindle speed commands. Enter the voltage readings as pictured below and press Cycle Start to continue. spindlebenchtest.cnc will throw an error if the spindle does not output as expected. Continue to enter readings when prompted until the program is finished. The program will exit and the status window will say “Job finished” after a successful completion.



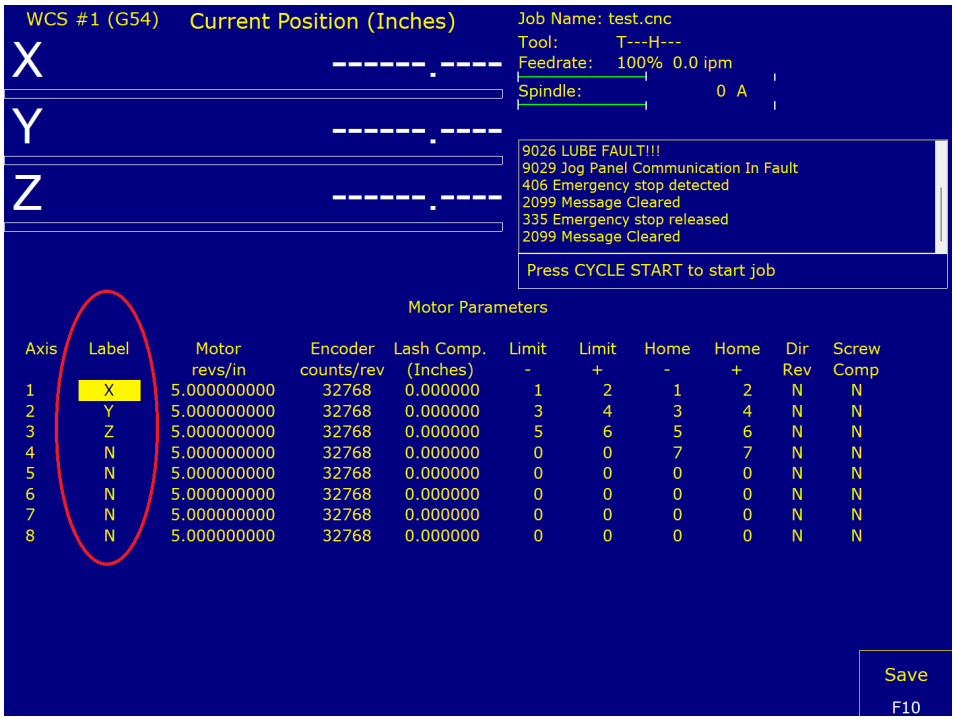
If the spindle bench test program fails, please contact support@centroidcnc.com with details about the failed test along with images of each failed voltage reading.

4.5 Axis and Motor Setup

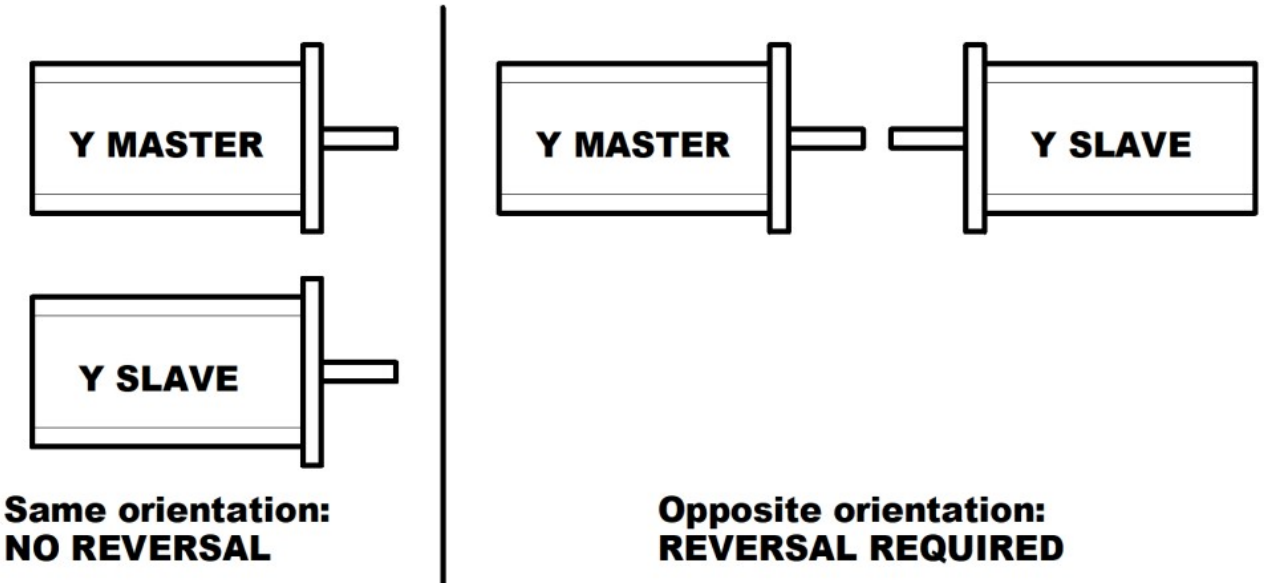
Now that the communication bench test and spindle bench test have been completed, it is time to start bench testing the motors. Warning! It is HIGHLY recommended to have the motors ***NOT*** installed on the machine tool at this point. During Axis Motor/Drive setup fast unexpected motor movements can happen. Clamp them to a table top or build a motor box to sit them in, if they are bolted to the machine tool disconnect the belt or drive coupling so the motor is disconnected from the machine tool.

1. **Label the Axes:** From the main menu, press **F1 – Setup** → **F3 – Config.** The password is **137**. Press **F2 – Mach** → **F2 – Motor**. Under "**Label**" configure the software for the correct number of axes and label them appropriately.
   Typical setups:

Machine Type	Axis 1 Label	Axis 2 Label	Axis 3 Label	Axis 4 Label
Mill, 3 axis	X	Y	Z	
Gantry, paired Y	X	Y	Z	W
Lathe, 2 axis	Z	X		



You may need to set the direction reversal flag on the slaved axis on a machine with paired axes. Refer the image below:



Navigate to Dir Rev column with arrow keys and press space bar to change value to “Y” for any axis that requires direction reversal.

When finished, press **F10-Save** to save changes and leave the menu.

2. **Configure Drive Mapping** – The CNC12 software needs to be configured to know where each axis of the Hickory is. The Hickory employs an EtherCat fieldbus to communicate with the CNC12 software. For a three axis mill, Hickory **axis 1** should be configured as **drive bus channel 1**, Hickory **axis 2** should be configured as **drive bus channel 2**, etc… The channel number represents how far along the EtherCat fieldbus chain the axis drive is. Channel 1 inputs from the Hickory’s Fieldbus OUT and outputs to the Channel 2 drive IN port.

   These parameters can be reached by pressing **F1 – Setup** → **F3 – Config** from the main menu**.** The password is **137**. Press **F3-Parms** then **F8-Next Table** multiple times until parameters 300 – 307 are visible.

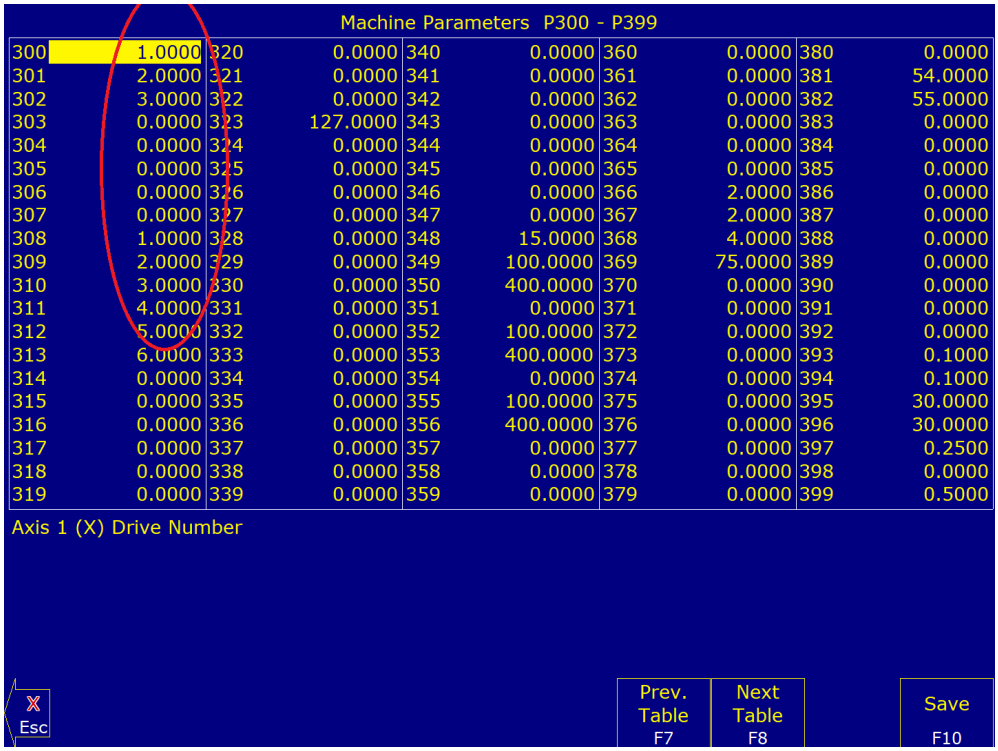
   Typical configuration for a 3-axis CNC:

   300 = 1 301 = 2 302 = 3

   Typical configuration for a 4-axis CNC:

   300 = 1 301 = 2 302 = 3 303 = 4

   Unused axes need to be set to zero, or errors will occur!



3. **Configure Encoder Assignment** – Just like in the previous step, the CNC12 software needs to know where each encoder of the Hickory is. Encoder information is passed along the EtherCat fieldbus, so parameters 308-315 let the software know where each axis's encoder information is coming from on the fieldbus chain.

   Typical configuration for a 3-axis CNC:

   308 = 7 309 = 8 310 = 9

   Typical configuration for a 4-axis CNC:

   308 = 7 309 = 8 310 = 9 311 = 10

   Note that on Hickory, axis encoder index parameters start at 7.

   If you have a spindle encoder, ensure that it is plugged into Encoder Port 1 on the Hickory and set the following parameters:

   Parameter 34 = your spindle encoder counts/rev

   Parameter 35 = 8 (Spindle Axis number)

   Parameter 78 = 1 (Spindle Speed display and operation)

   Parameter 315 = 1 (Axis 8 encoder index)

4. **Set Drive Mode to Precision**. In the parameter menu, set Parameter 256 to **2** to set the drive mode to precision. Hickory only operates in precision mode.

5. **Set Precision Mode Axis Delay Default Values.** Still in the Parameter Menu, navigate to parameters 340-347. Parameter 340 is the X axis, parameter 341 is the Y axis, and so on. Set the parameters for all used axes to 5. This will give a baseline delay value to use until the system is ready to use autotune to calculate the correct values.

   Hickory only runs in precision mode. These delay values synchronize each drive to compensate for delays caused by differences in axis response. The values are in milliseconds with 0.25 millisecond resolution. Press **F10-Save** to save the parameter values.

6. **Initial Setup for Absolute Encoders**. Set machine parameter 316 Absolute Encoder Bits appropriately. Refer to the examples for common configurations. The adder value is calculated from the encoder axis index that has an absolute encoder installed. The formula is adder = $2^{index-1}$ and calculations are of this form axis 1adder = 2^{7-1} = 64 Thus, the value of P316 is the sum of the adders for each axis with an absolute encoder installed. For Hickory, this will be all of the axes.

Axis Number	Axis Encoder index	P316 adder
1	7	64
2	8	128
3	9	256
4	10	512
5	11	1024
6	12	2048
7	13	4096
8	14	8192

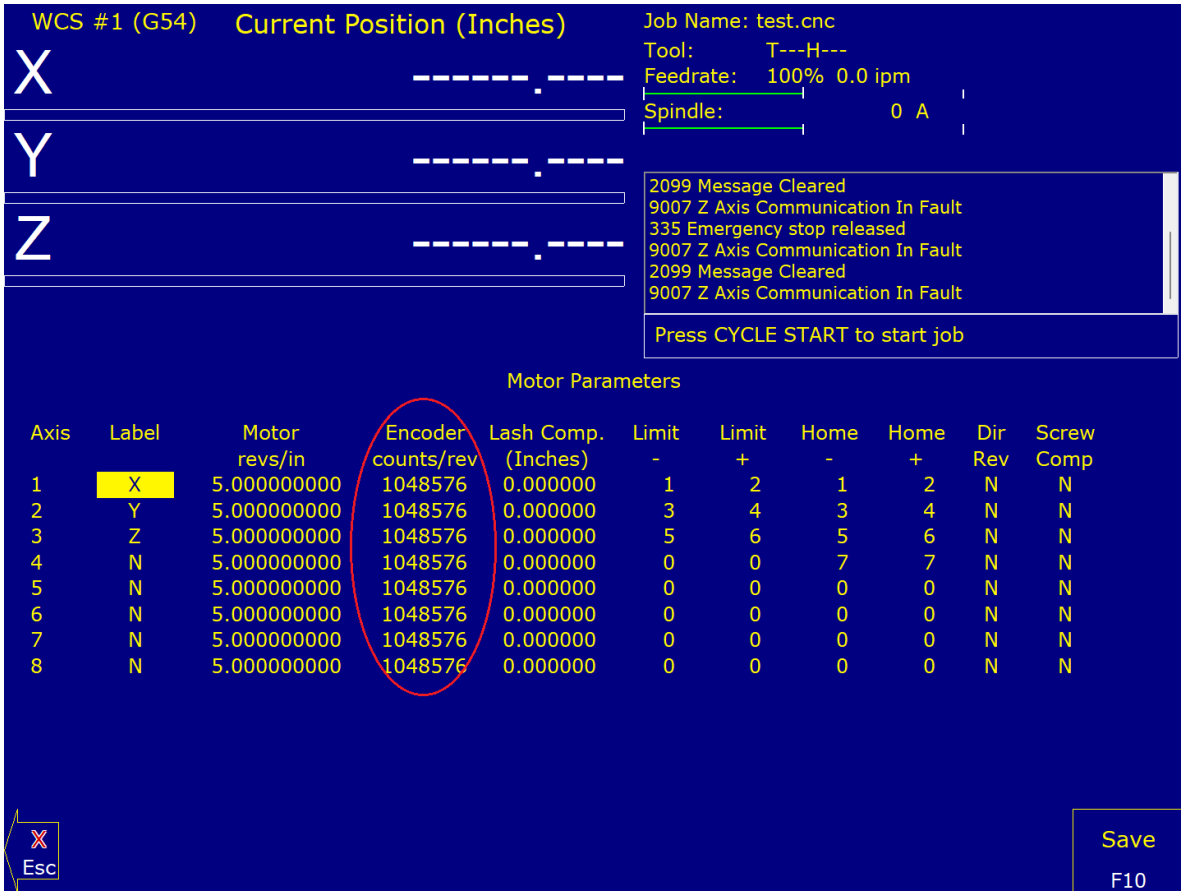
Parameter 316 examples:

---

1 axis = 64
2 axis = 192 (128+64)
3 axis = 448 (256+192)
4 axis = 960 (512+448)
5 axis = 1984 (1024+960)
6 axis = 4032 (2048+1984)
7 axis = 8128 (4096+4032)
8 axis = 16320 (8192+8128)

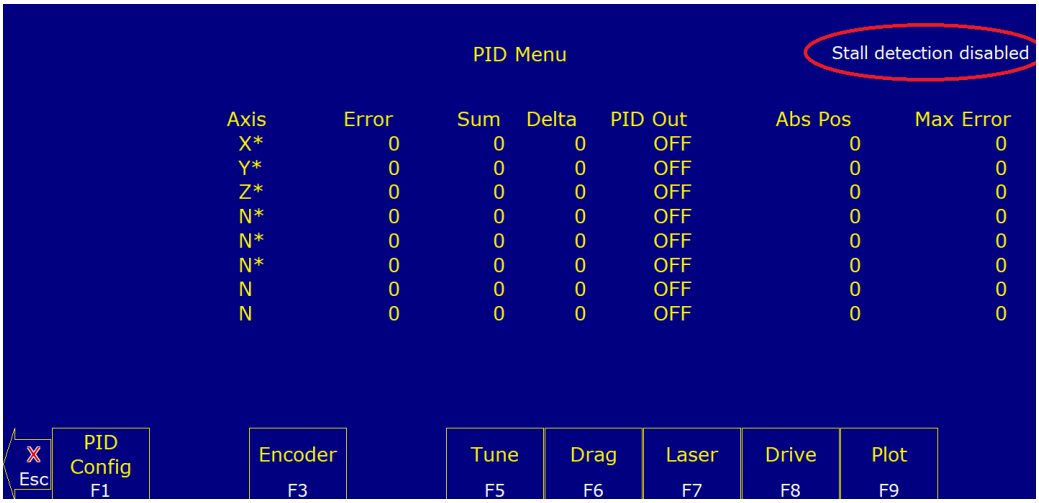
Press **F10-Save** to save the parameter values and exit to the previous menu.

7. **Configure Encoder Counts per Revolution** – The encoders need to be set up for the correct counts per revolution. A quadrature encoder line count is multiplied by 4 to get the counts per revolution. From the main menu, press **F1-Setup** → **F3-Config**. The password is 137. **F2-Mach** → **F2-Motor**. Enter the counts into the “Encoder counts/rev” field corresponding to the axis’s encoder counts. Repeat for each used axis. After setting the values in this section, **power cycle the Hickory and drives**.

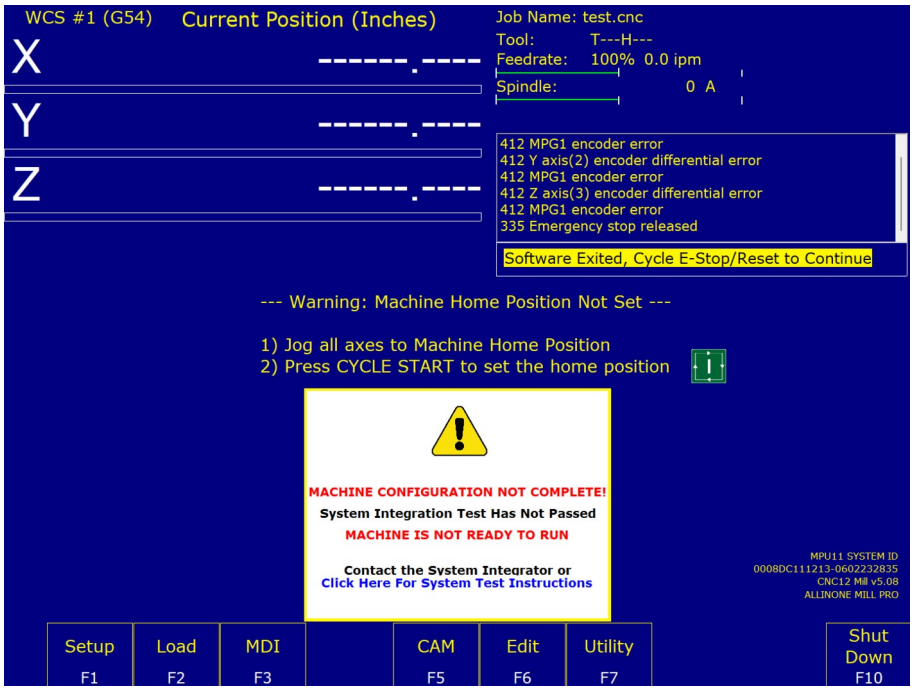


8. **Disable Stall Detection –** Stall Detection must be disabled from the PID menu. From the main menu, press **F1-Setup** → **F3-Config.** Password is 137. **F4-PID**. Press <Ctrl + v> to disable stall protection. If done correctly, text saying “Stall detection disabled” will appear right below the status window.

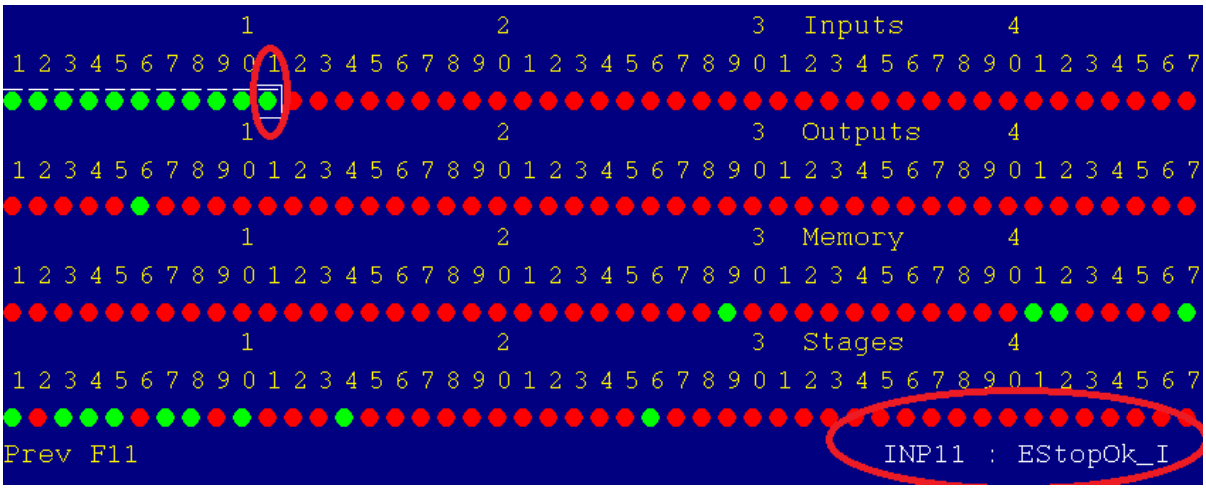
   a) Note: If you restart the Hickory during the bench testing process, you will have to disable stall detection again.

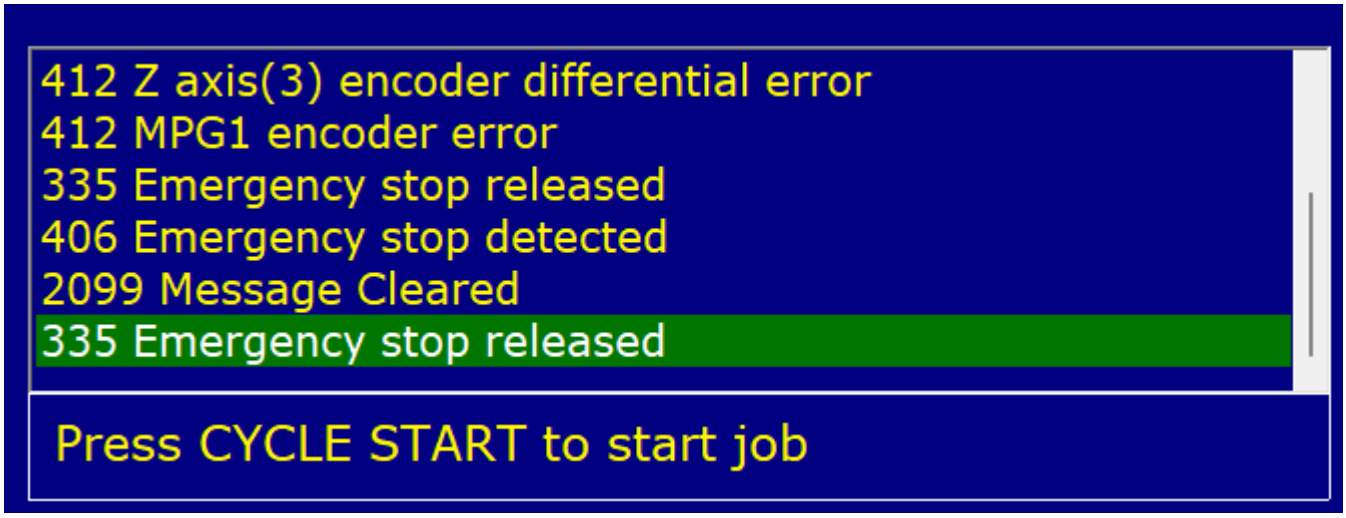


9. **Clear Software Ready Faults –** Anytime the CNC12 software has been exited and restarted without the hardware also being powered off and restarted, CNC12 will report a “Software Exited” fault as shown below. A “Software Exited” fault like spindle, lube, encoder, and position fault is a “Stop Fault,” which removes power from all servo motors, revents program or MDI operation, turns off all drive and spindle enables, and requires that the E-Stop input **MUST** be cycled in order to clear the fault. During the bench test we will trick the software into thinking the we cycled the E-Stop by toggling input 11.



To clear a stop fault, press <Alt + i> to bring up the real-time I/O screen. Use the arrow keys to select “INP 11: EstopOK_I” as shown below. Press <Ctrl + Alt + i> to toggle the E-Stop input so that it turns red, then again so that it turns back to green.





Notice that as you toggle the E-Stop input to red, “406 Emergency stop detected” is displayed in the status window, followed by “2099 Message Cleared.” When the E-Stop input is toggled green, notice how “335 Emergency stop released” is displayed.

4.6 Setup for Bench Testing Drives and Motors

Warning! It is HIGHLY recommended to have the motors ***NOT*** installed on the machine tool at this point. During Axis Motor/Drive setup fast unexpected motor movements can happen. Clamp them to a table top or build a motor box to sit them in, if they are bolted to the machine tool disconnect the belt or drive coupling so the motor is disconnected from the machine tool.

Follow these steps to setup the motor drives for bench testing.

1. Exit CNC12 and power off the Hickory.
2. Follow the schematic that shipped with your order to connect the drives to the Hickory. It is not necessary to use drives solely from the same manufacturer in a system.
3. Power up the Hickory and the drives. Ensure that the drives power on before applying power to the Hickory.

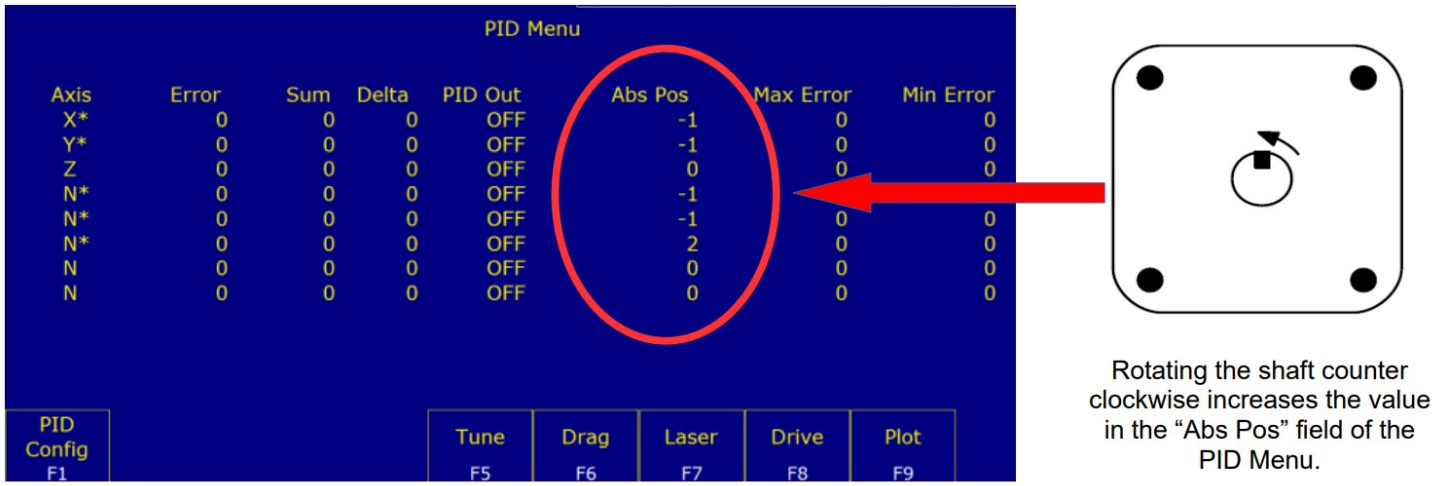
4. If the machine has paired axes, parameter 64 will need to be set the appropriate value at this point. From the main menu, press **F1-Setup → F3-Config.** Password is 137. Press **F3-Parms**. Navigate using the arrow keys to parameter 64, then set the parameter to the value from the table below that corresponds to your machine's configuration.

Function Description	Value
No Pairing (Default)	0
Pair 4th-axis with 1st-axis	1
Pair 4th-axis with 2nd-axis	2
Pair 4th-axis with 3rd-axis	3
Pair 5th-axis with 1st-axis	16
Pair 5th-axis with 2nd-axis	32
Pair 5th-axis with 3rd-axis	48
Pair 5th-axis with 4th-axis	64

Press **F10** to save the parameter and exit the Parameter Menu.

5. **Confirm Encoder feedback**. Invert input 11 “EstopOk_I” using the PLC Diagnostic screen (<Alt + i> so that it is **red**. From the main menu, press **F1-Setup → F3-Config.** Password is 137. Then press **F4-PID**. If possible, manually rotate each motor while watching the abs pos field (circled below) for that axis as seen in the figure below. Confirm that you have smooth feedback on all axes and that X updates the X DRO, Y updates Y DRO etc. **Note**: This may not be possible for motors with brakes. Skip this section for those axes.

   Confirm that the absolute position increases while rotating the shaft counter clockwise as shown in figure below. Direction reversal settings will not influence this.



Rotating the shaft counter clockwise increases the value in the “Abs Pos” field of the PID Menu.

6. **Jog the motors.** Once each motor is wired and encoder feedback is received, set the software to “slow jog” continuous control. Press the tortoise/hare button on the jog panel or VCP until the LED is lit. Press the INCR/CONT button on the jog panel or VCP until the LED is off.

   One motor at a time, use the controls to jog the motor in each direction. Confirm that jogging in the negative direction rotates the motor in the opposite direction than jogging in the positive direction. For paired axis motors, ensure that the motors move simultaneously, and if the direction reversal field is set for one of the motors, ensure that the motors rotate opposite of one another.

   Now install the

Chapter 5 Cabinet Wiring

5.1 Introduction to Electrical Cabinet Wiring Layout

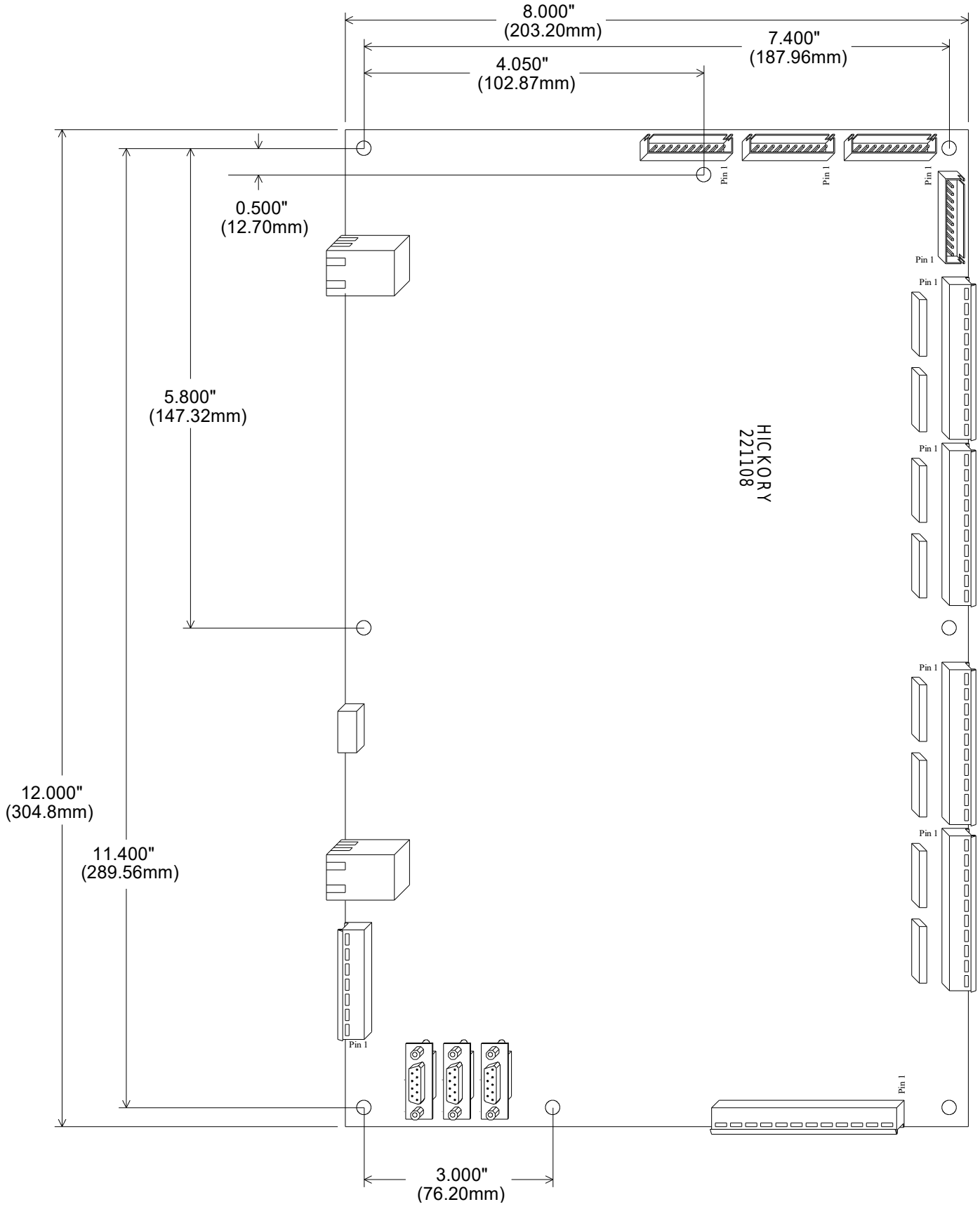
Now that you are finished with the board level test it is time to think about electrical cabinet installation. This chapter of the manual will go into detail about how to wire the various systems into your cabinet. During cabinet wiring, it is important that you follow the schematic examples provided by Centroid.

Schematic sets may be found here:

https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php

Centroid Community CNC Support Forum: Control Box Building Tips

https://centroidcncforum.com/viewtopic.php?f=61&t=2443&sid=00f5418e46966cadb26ca1f3b6567b17


8.000"
(203.20mm)
7.400"
(187.96mm)
4.050"
(102.87mm)
0.500"
(12.70mm)
5.800"
(147.32mm)
12.000"
(304.8mm)
11.400"
(289.56mm)
3.000"
(76.20mm)
HICKORY
221108
Pin 1

Best practices for Electrical Cabinet Wiring

Minimize Noise and Interference

- Keep sensitive electronics away from noisy equipment. Install high voltage transformers, contactors, and other electrically noisy equipment as far away from low voltage circuit boards as practical. For example, it would be a bad practice mount a contactor block or large transformer directly underneath the AcornSix. See TB270 for more information.

  https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf

- Keep high voltage power lines far away from low voltage signal lines. Keep the high-voltage AC power lines and motor power lines as far away from low voltage logic signals as practical.
- Grounding Principle. Wire the incoming chassis (earth) ground lug directly to a single ground bus bar. Wire all cabinet doors, power supply chassis grounds, and other equipment chassis ground to one single ground bus bar. What you should NOT do is have several different grounding points throughout the cabinet, as this could increase electrical noise and interference.
- Leave plenty of space between wire ducts and components. Keep wire ducts at least 2” away from circuit boards when practical.
- Use Snubbers on Contactors. Contactor blocks and relays need a snubber across the coil. Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise. If you are new to using snubbers more information can be found in Technical Bulletin #206, the latest version can be found here.
  - http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/206.pdf
- Keep wires short. Keep all cabinet wiring under 6ft.

Keep the cabinet maintainable and easily serviceable.

- Centroid can provide electrical cabinet materials such as contactors blocks, time delay contactor blocks, relays, fuse blocks, din rails, overload relay with fuses, din rail end stops, terminal blocks, etc. We only carry the part if it has a Centroid part number on the schematic. Call Centroid for with the part # ready for pricing and availability.
- For wire management use PVC wire ducts (such as Panduit Panduct) to keep your wires neat and organized.
- Use DIN rails for mounting relays, contactors, terminal blocks, circuit protection blocks, disconnects, etc.
- Leave a little bit of slack in the wire. Take all corners in the wiring ducts as wide as possible to leave a small amount of slack in the wires.
- Keep all the wiring in neat horizontal and vertical lines. Never run wires diagonally.

- Label **EVERYTHING**. Label everything so that it matches the labels on your schematic. This includes labeling each individual wire at both ends, circuit boards, relays, contactors, etc.
- Keep the schematic attached to the cabinet somewhere so it does not get lost.

Use the correct wire gauge.

- 22 Gauge stranded is suitable for signal wires such as limit switches and VFD inputs and outputs. A twisted pair cable is ideal of devices with like limit switches with one signal and one return run.
- 18 Gauge stranded is used for 5V, 12V, 24V low current power wires. 18 gauge is used to power the Hickory and control devices connected to the outputs.
- 16, 14, 12 gauge should be used for Power wires connected to Axis drives, contactors, spindle drive, pumps and other higher current accessories. Consult the drive manual to determine current requirements. If a drive can accept 110VAC or 220VAC, Wiring for 220VAC will reduce the required current.
- Stranded wire in these gauges can be purchased from most home improvement centers in the electrical section and from automotive suppliers for automotive wiring.

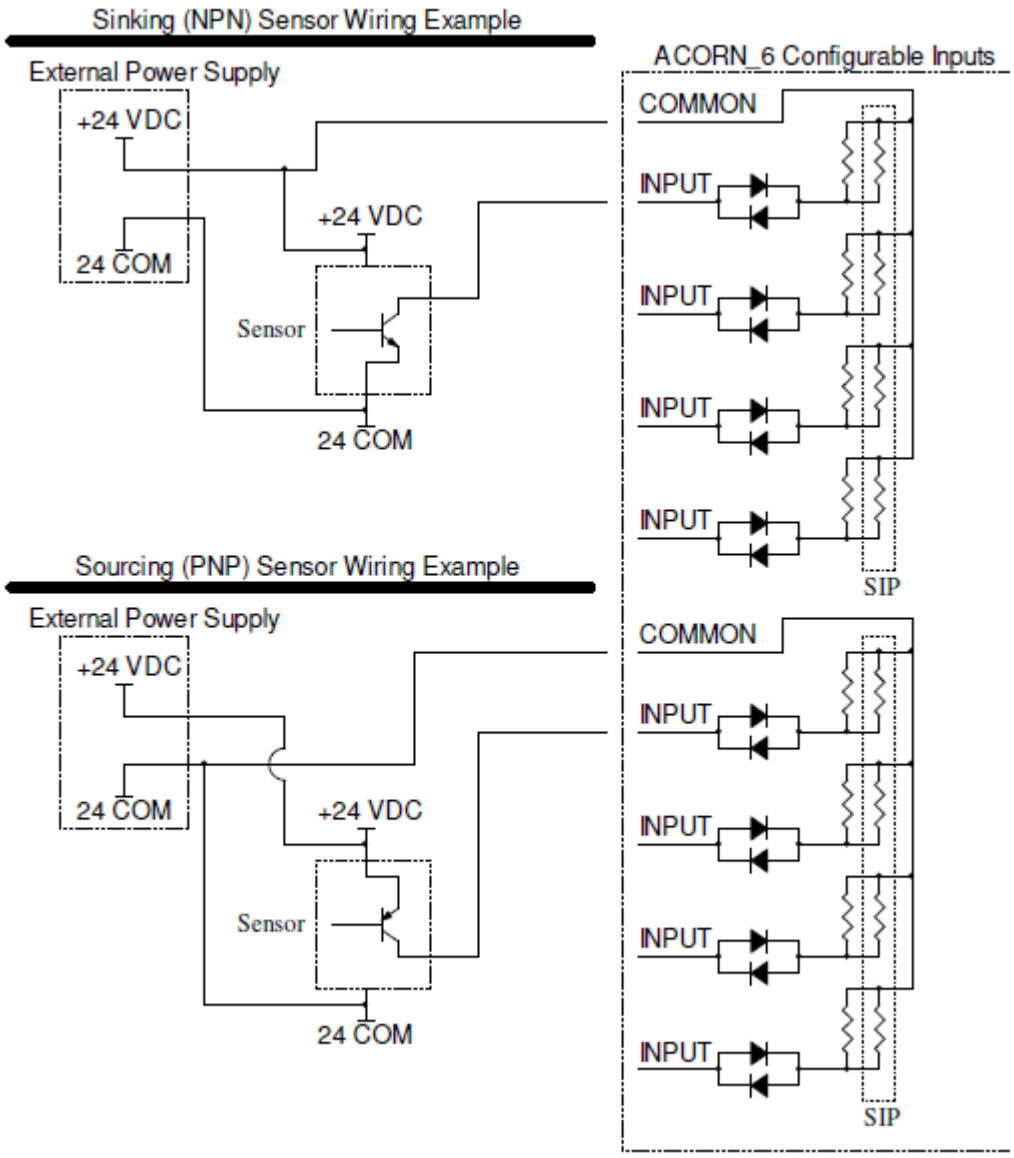
Common Wiring Problems

The following information covered in Technical Bulletin #78 which can be found here:

(http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/78.pdf)

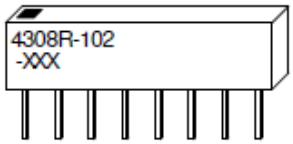
5.2 Hickory Digital Inputs

The Hickory is equipped with 32 optically-isolated inputs. Inputs can be wired for either sourcing or sinking. This is determined by wiring the common terminal for the bank to supply positive (sinking), or supply common (sourcing). Inputs are divided in banks of four.



Voltages can be selected by installing the appropriate SIP. Without a SIP installed (default configuration when shipped from Centroid) the voltage is set to 24V. Optional SIPs can be installed to use 12V or 5V input voltage.

SIP Identification - XXX Indicates Value



SIP Input Voltage Selection

SIP Value Marking	Resistor Value (Ohms)	Input Voltage
221	220	5
102	1.0k	12
None	None	24

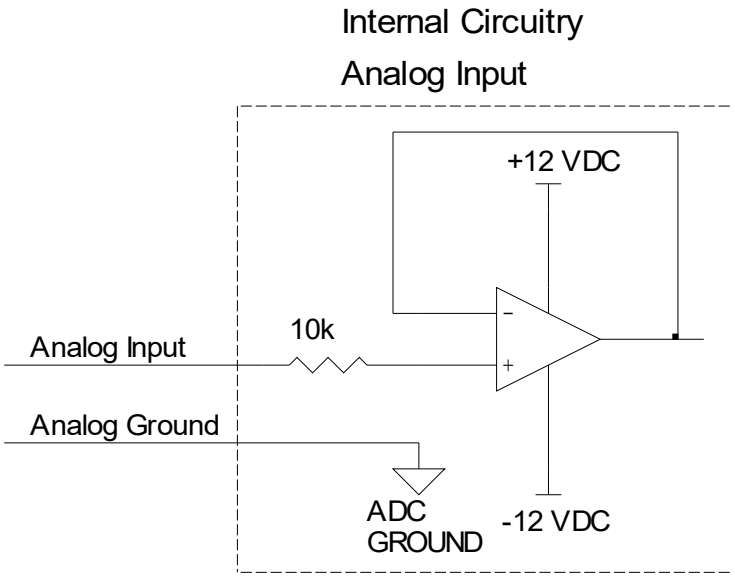
VDC is supplied via Common (1-4, 5-8, 9-12, 13-16) on H2, H3, H4, and H5. These terminals are NOT connected internally. An example showing Home All, Limit All, Drive OK, and E-Stop is below.

5.3 Hickory Analog Inputs

Two analog inputs are available. The input range is -10 to 10 volts. The analog ground is connected internally to other Hickory GND pins. However, for best wiring results, use the GND pin adjacent to the analog input pin for analog connections. Do not share analog ground wires or connect multiple wires from different devices to an analog GND pin.

Analog Input Bits

Analog Input	Input Bits
1	33 – 48
2	49 – 64

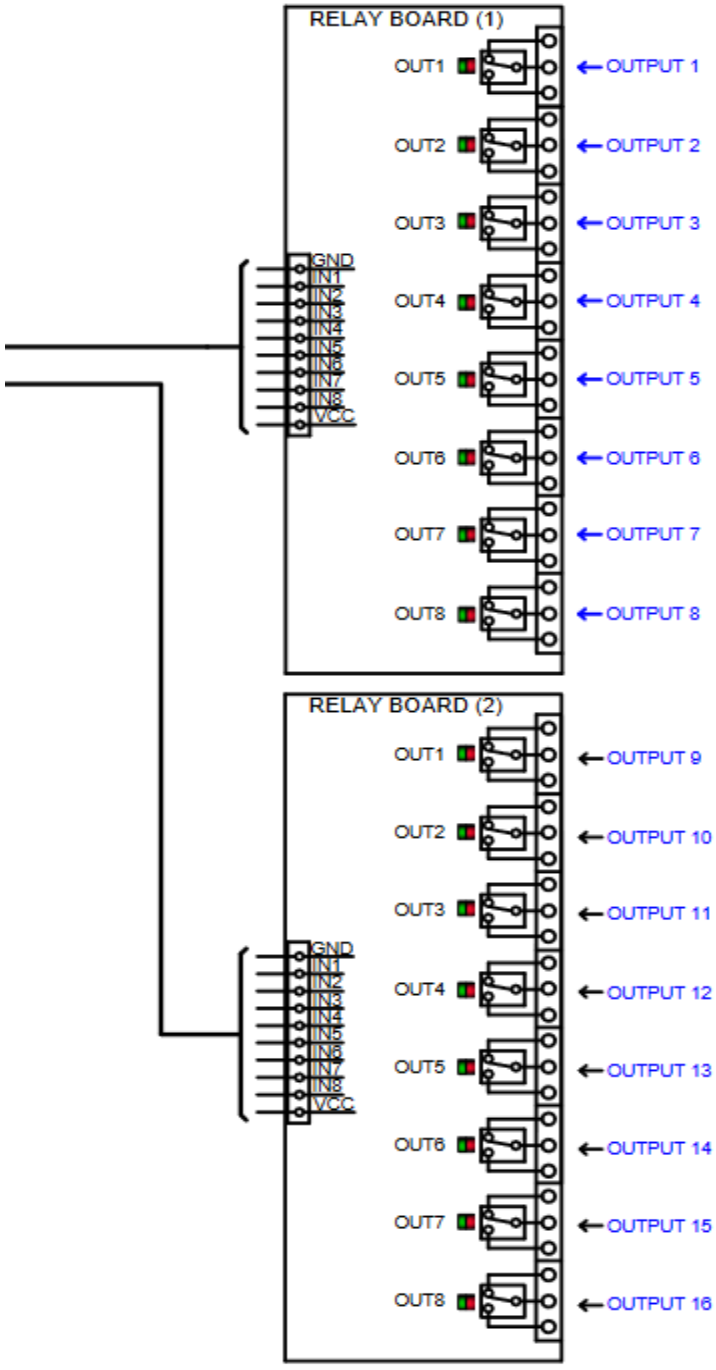


Analog Input Calculations

$$\text{Input Voltage} = \text{ADC result} * \left(\frac{20}{65536} \right)$$

5.4 Hickory Outputs

The Hickory is equipped with a total of 32 relayed outputs via four (4) 8 relay boards. The relay boards come equipped with LEDs showing output status.



5.5 Hickory Analog Outputs

Hickory is equipped with two analog outputs. One is normally used as a speed request to the spindle drive, while the other is free for special applications. The analog outputs also output a 5V PWM signal. For example, PWM 1 and Analog Out 1 can both be connected on H8, but they are controlled by the same PLC output bits.

Four voltage output ranges are available on the analog output. Mode bits are used to select the output range. The analog output is factory trimmed for high accuracy, and will not require adjustment when changing ranges. Mode bits A and B for Analog Output 1 are set using Parameter 420. The mode bits for Analog Output 2 require PLC implementation to set the range to anything other than 0-10V.

The mode bits also change the PWM frequency to match different applications. For example, laser power controllers often take around 1 kHz and hobby servos can be controlled with 40 to 200 Hz.

The analog ground is connected internally to other Hickory GND pins. However, for best wiring results, use the GND pin adjacent to the analog output pin for analog connections.

Do not share analog ground wires or connect multiple wires from different devices to an analog GND pin.

Analog Output Ranges

P.420*	Mode Bit A	Mode Bit B	Range	Resolution
3	1	1	-10 to 10	16 bits
2	0	1	-5 to 5	15 bits
1	1	0	0 to 5	14 bits
0	0	0	0 to 10	15 bits

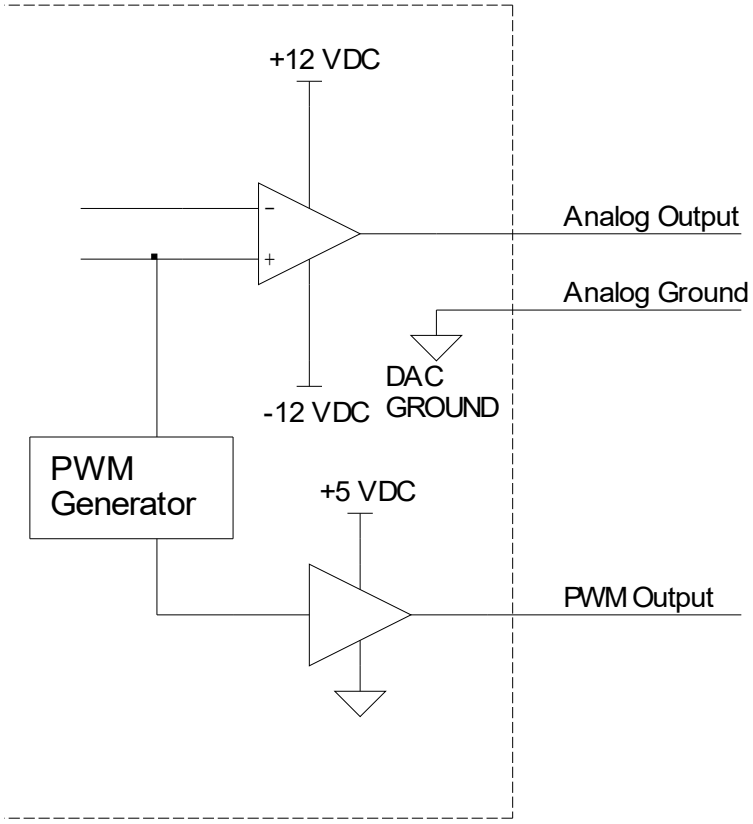
*Parameter 420 only sets the mode bits of Analog Out 1.

Analog Output Bits

Analog Output	Output Bits	Mode Bit A	Mode Bit B
1	33 – 48	69	70
2	49 – 64	71	72

Internal Circuitry

Analog Output



Analog Output Calculations

0 to 5V Range

$$\text{output voltage} = \frac{\text{Analog Request}}{65536} * 5$$

-5 to 5V Range

$$\text{output voltage} = \left(\frac{\text{Analog Request}}{65536} * 10 \right) - 5$$

0 to 10V Range

$$\text{output voltage} = \frac{\text{Analog Request}}{65536} * 10$$

-10 to 10V Range

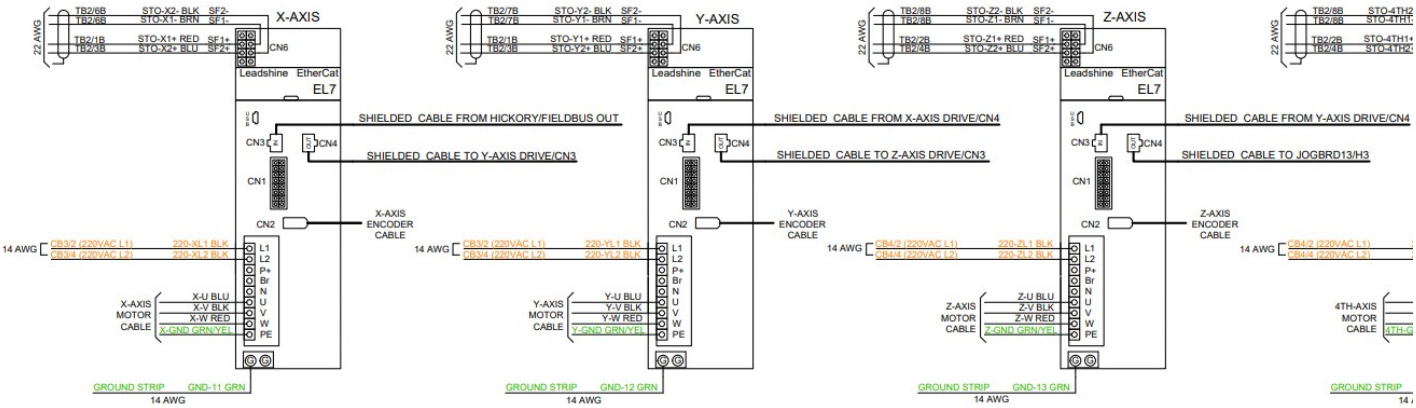
$$\text{output voltage} = \left(\frac{\text{Analog Request}}{65536} * 20 \right) - 10$$

5.6 Wiring Axis Drives

Warning! It is HIGHLY recommended to have the motors ***NOT*** installed on the machine tool at this point. During Axis Motor/Drive setup fast unexpected motor movements can happen. Clamp them to a table top or build a motor box to sit them in, if they are bolted to the machine tool disconnect the belt or drive coupling so the motor is disconnected from the machine tool.

The Hickory interfaces with the supported drives via EtherCAT communication protocol, along an Ethernet-based fieldbus network that can support up to 8 drives. Centroid curated drives currently supported by the Hickory are Yaskawa Sigma7, Glentek Gamma Series, Estun Summa, Leadshine EL7 and EL8, and Inovance SV660N.

Each Centroid curated drive has its own dedicated hookup schematic that was shipped with your order or search the Centroid Hookup Schematics page with “Hickory” and the name of your drive.



Each of the Centroid curated supported drives have their own Technical Bulletins that describe in detail the steps to configure the drives for use with Hickory:

- Leadshine EL8-EC Setup and Tuning: TB 324 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/324.pdf)
- Leadshine EL7-EC Setup and Tuning: TB 323 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/323.pdf)
- Yaskawa SGD7S EtherCat Setup and Tuning: TB 322 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/322.pdf)
- Estun Summa Setup and Tuning: TB 317 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/317.pdf)
- Glentek Gamma Setup and Tuning: *Tech Bulletin in progress*
- Inovance SV660N Setup and Tuning: TB 329 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/329.pdf)

5.7 Wiring E-Stop Circuit

Follow the Estop circuit hookup on the Centroid provided Hickory for your drive type.
https://centroidcnc.com/centroid_diy/schematics/pbrowse.php?term=hickory

E-Stop Wiring

- The emergency-stop (or E-Stop) is a safety mechanism used to shut off the machine during an emergency.
- The switch should be closed when the machine is in its operational state.
- **NOTE:** Wiring E-Stop in a normally open configuration is dangerous as it will not stop the machine in the event of a wire break. It also prevents noise from causing spurious faults because the signal is being electrically held at the operational level.
- For additional safety, multiple E-Stops can be added to a machine, but they all must be wired in series.

E-Stop Switch

- Use a double pole single throw (DPST), normal closed, twist to release, emergency stop switch. Such as Centroid part number #1009 used with #5934
- Hickory E-Stop – There are two E-Stop signals, one input and one output.
- Input 11 is typically assigned to the E-Stop. Input 11 on header H3 needs to be routed in series with any E-Stop switches, so that if any of the E-Stop switches are tripped the PLC knows the E-Stop is engaged.
- Output 1 (AKA drive fault relay). The E-Stop contactor must be routed in series with output 1 and any E-Stop switches, so that if any of the E-Stop switches are tripped the power is removed from the contactor block.
- The Hickory output 1 relay is rated for up to 10 amps at 125 VAC or up to 5 amps at 30 VDC. Please use the lowest voltage practical, as a high voltage can result in excessive noise that will create undesirable effects. Centroid recommends using 24 VAC.

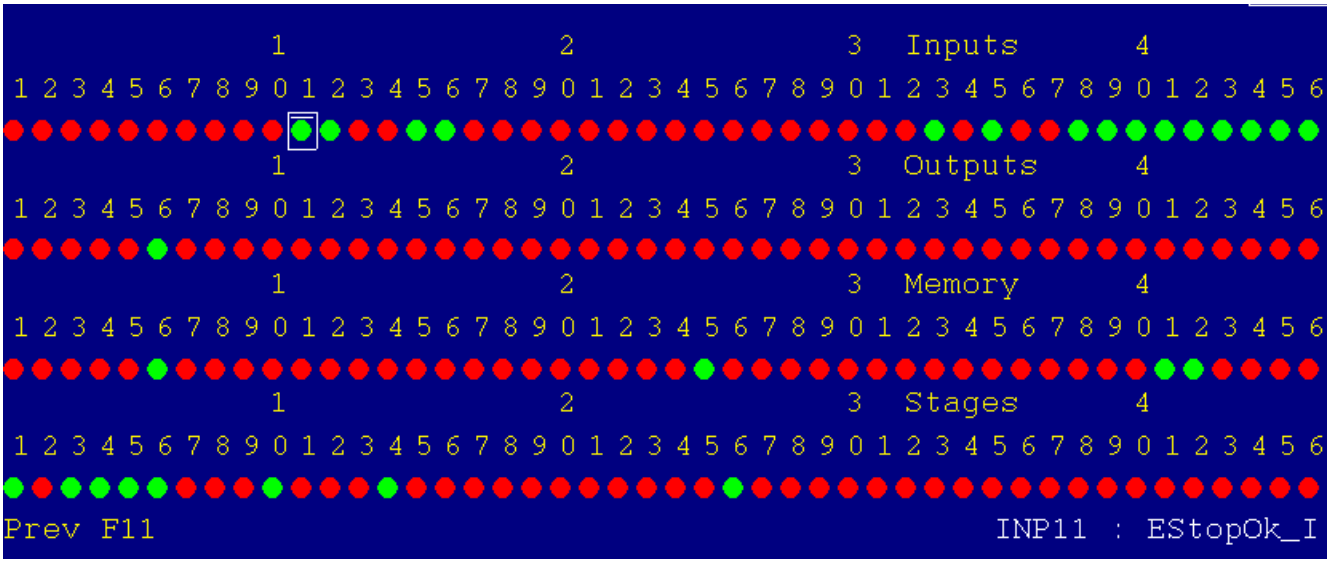
Contactor

- A contactor is an electrically controlled switch. It can be thought of like a higher current relay.
- These are used to turn on and off power to the main spindle and the axis drive. The Centroid recommendation for contactors is a 24VAC type, although 24VDC and 110VAC contactors are available.
- If you are not using a contactor with a built in or addon snubber, a snubber needs to be placed across the contactor(s). Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise when the servo motor power is cycled on and off.

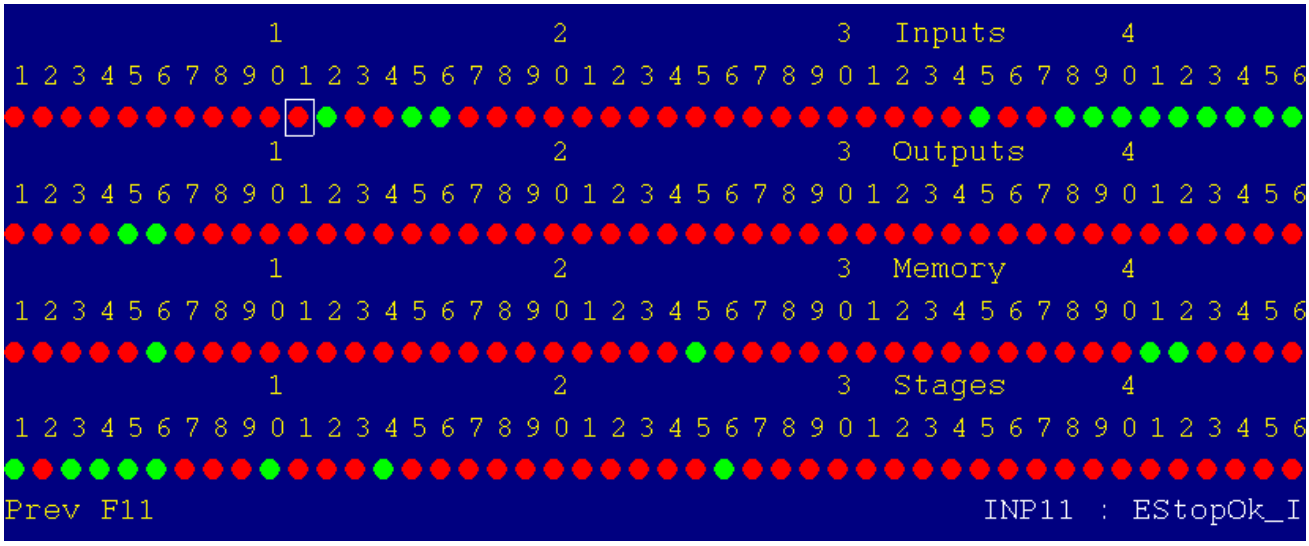
- For larger machines with AC servos, Centroid recommends using a Scheneider Electric/Telemecanique LC1DT40B7A or similar device for the E-Stop contactor (Centroid PART# 14374). This Contactor assembly includes snubber assembly and uses 24VAC to control it.
- For smaller desktop machines with steppers and small spindle motors, The LC1K0610B7 24VAC Flood Contactor w/snubber (#14377 from Centroid) can be used. This contact is also useful on all machines for turning on and off accessories like spindle, pumps, vacuums and other high current accessories.

Testing the E-Stop Switch

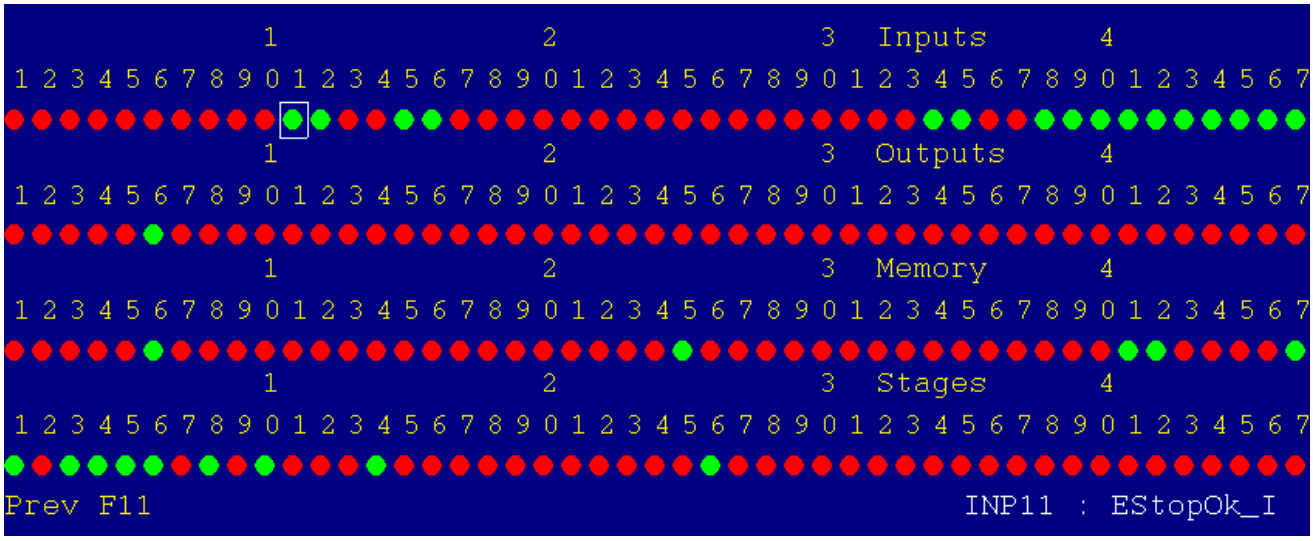
- Wire a Normally Closed E-Stop switch to the Hickory following E-Stop examples on any of the Hickory schematics.
- Power up the system
- Start CNC12
- Input #11 likely is still inverted since the Bench Testing Section 4.1. Up until this point, the inverted E-Stop input #11 allowed CNC12 to run without a physical stop switch connected to the Hickory. The inversion is indicated by the horizontal white bar above the Virtual LED in the PLC Diagnostic menu (Alt+ i) for input 11.



- Remove the inversion on input #11. Press the <Ctrl-Alt-i> keys simultaneously to remove the bar over the input in the display, setting the E-Stop for normally closed operation.



- Confirm that there is not bar over input 11. Toggle the E-Stop. Observe that input 11 is green when the E-Stop is released (not tripped), and red when E-Stop is depressed.



Note: A general guide to E-Stop wiring and motor power troubleshooting is contained in Technical Bulletin #286 which is located here.

(https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/286.pdf)

5.8 Wiring Limit Switches

Some users might find the use of limit switches redundant since the Hickory employs the use of absolute encoders that remember machine home position and CNC12's software limits perform the same function as physical limit switches. If you choose to forego the use of physical limit switches, this section may be skipped, but ensure that inputs 1-6 remain inverted and that the steps listed in Section 6.7 are followed correctly for setting up software travel limits.

If you choose to install Limit Switches, All inputs used for limit switches should be wired in a normally closed configuration. Normally-closed (NC) means that the switch should be **closed** when the machine is in its **normal** operational state. This is the CNC industry standard way of doing things.

While there are situations when a normally-open configuration would be used, in general a normally-open (NO) setup is dangerous as the machine will not stop in the event that a wire breaks or switch failure/damage etc. Using normally-closed switches (and other devices) prevents noise from causing spurious faults because the signal is being electrically held at the operational level.

Regular dry contact switches can be utilized as well as 3 wire proximity switches.

Avoid long throw limit switches commonly used on conveyor belts and heavy equipment.

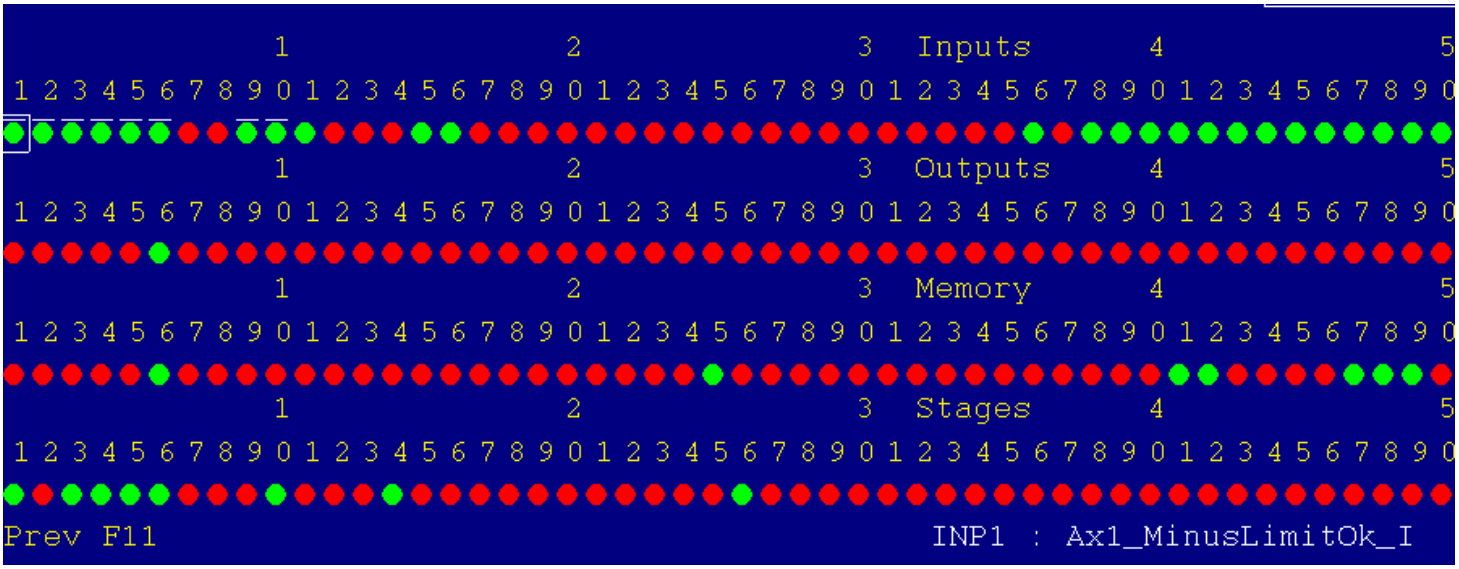
Connect limit switches as shown in the Hickory schematics.

Use the PLC Diagnostic menu to verify Limit Switch Wiring and Functionality.

1. Power up Hickory wait for boot to complete.

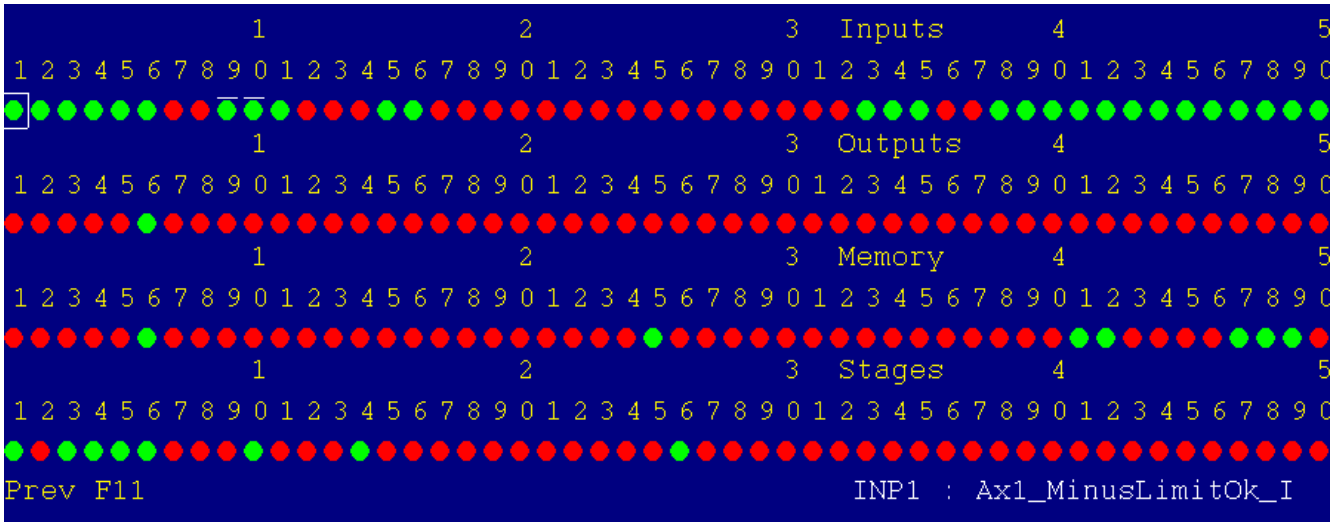
2. Start CNC12.

3. From the main menu on CNC12 press <Alt + i> to bring up the PLC Diagnostic menu, this menu displays real time I/O state.

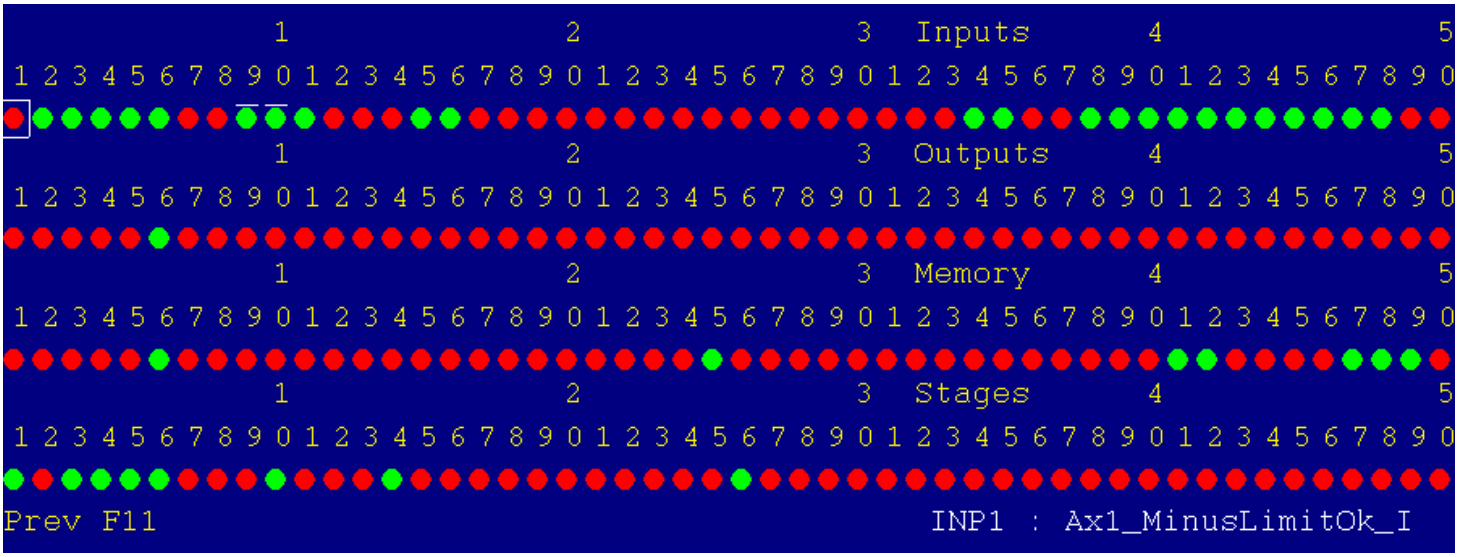


4. If the limits are still inverted from bench testing, there will be a bar above inputs 1-6. Remove the inversion from these inputs by pressing <Ctrl + Alt + i> for each input 1-6.

5. Confirm that all limit switches are green when no switch is tripped.



6. Confirm that the correct input turns red when the switches are manually tripped.



5.9 Wiring the Spindle

STOP! Before wiring up the spindle make sure that you tested the spindle analog output as described in Section 4.3.

There are two main methods of wiring a spindle motor to Hickory.

1.) Variable Frequency Drive (VFD):

- The terms “inverter”, “AC Drive”, and “VFD” can all refer to the spindle controller.
- Centroid has Technical Bulletins for the following drives:
  - Delta VFD-B: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/182.pdf
  - Delta VFD-V: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/183.pdf
  - Delta VFD-VE: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/250.pdf
  - Delta VFD-VE (V2): http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/229.pdf
  - AutomationDirect GS3: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/203.pdf
  - AutomationDirect GS2: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/209.pdf
  - Yaskawa VS-616G3: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/255.pdf
  - Yaskawa VS-606V7: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/256.pdf
  - Control Techniques SP: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/278.pdf
- Consult Tech Bulletin 152 for a general guide on VFDs (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/152.pdf

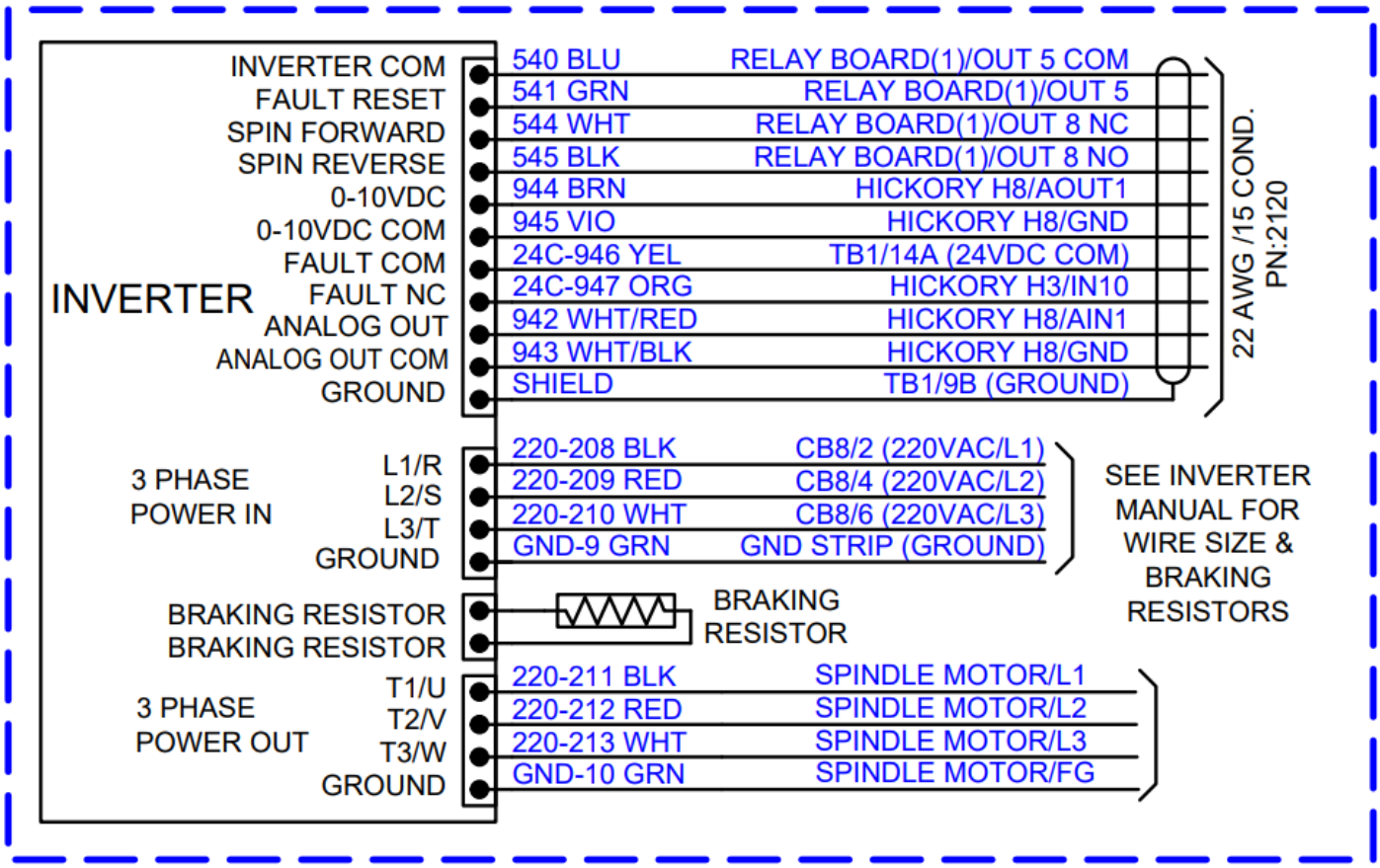
2.) Use Contactors

- The 3 phase is connected to mechanically interlocked reversing contactors, controlled by outputs 7 and 8 on the Hickory board.
- This method is simple but prevents the Centroid CNC software from being able to control the speed of the spindle. When using contactors the spindle speed will have to be adjusted by mechanical methods.
- A contactor can be used to turn the spindle on and off with the software.
  A reversing contractor with snubber p/n 14375 from Centroid can be used to change direction.

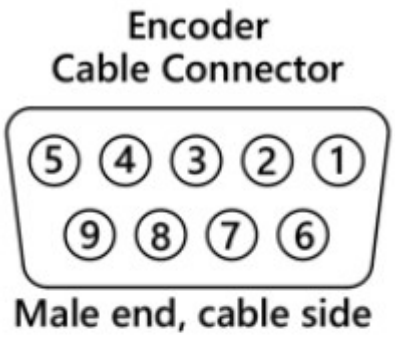
- All contactors need snubbers! Centroid recommends using the Quencharc snubber network (Centroid p/n 1819) on the coil of the contactor. This reduces electrical noise when the spindle is turned off and on.

Wiring a VFD

Wire the VFD according to the schematic for your system, the image below from S15076 shows common wiring for a generic inverter.



Spindle Encoder: For spindle slaved movements such as rigid tapping, the spindle encoder needs to be connected to the Hickory. The spindle encoder must meet the Centroid encoder type requirements to be compatible with Hickory. See this post. https://centroidcncforum.com/viewtopic.php?f=63&t=921



Pin 1 = N/C
Pin 2 = COM (BLK/RED)
Pin 3 = Z / (BLK/GRN)
Pin 4 = A / (BLK/WHT)
Pin 5 = B / (BLK/BLU)
Pin 6 = Z (GRN)
Pin 7 = A (WHT)
Pin 8 = B (BLU)
Pin 9 = +5 VDC (RED)

When making your own cables or using your own encoders, make sure they adhere to the guidelines listed below:

Spindle Encoder Cable:

- Encoder cable MUST be twisted pair shielded cables.
- The shield wire of the encoder cable is grounded to the metal shield of the DB-9 connector
- If the D-sub connector does not provide a method of attaching the shield wire, the shield wire should to be soldered to the metal shield DB-9 connector.
- **NOTE**: Failure to ground the cable shield may cause encoder errors in the software.

Encoder Output:

- Compatible Encoder type: RS422 type (differential) quadrature outputs with A, B, and Z channels to work with Hickory.
- A low encoder count creates poor performance and accuracy.

- Centroid recommends a 1000 to 2000 line encoder (4,000 to 8,000 encoder counts per revolution)
- The encoder must be rated for the RPM of the Spindle (since it must be mounted 1 to 1)
- The outputs have additional voltage level requirements described in this table:

Characteristic	Typical	Minimum	Maximum	Unit
Encoder channel low level	-	0.0	0.5	V
Encoder channel high level	-	3.5	5.0	V

Centroid sells 2000 line encoders in multiple shaft sizes as well as encoder cables (plug and play between the encoder pigtail and the AcornSix) in 12’ and 16’ lengths. These encoders should be installed on a jack shaft and be protected from the environment. AutomationDirect sells enclosed sealed encoders of many types and sizes.

Chapter 6 Final Software Configuration

6.1 Clearing Software Faults

Clear any existing faults before continuing: To confirm that all faults have been cleared before continuing, press **F3-MDI** from the main menu.

If all faults have been cleared correctly, the screen should look the image below.

Troubleshooting: If the screen shown below is not displayed, there is an existing fault. Check the status window to determine the cause of the fault, fix it and try again.
If you do not know the cause of the fault, confirm that all parameters are set as required in Chapter 4 and that all inputs are in the correct state. Also, confirm your drive is wired correctly and configured to work with the Hickory board as set up in the drive's technical bulletin.

CNC12 keeps a log file containing all errors and faults, along with the time and date that these errors occurred at. You can access this log from the main menu by pressing **F7-Utility** → **F9-Logs** → **F1-Errors**.

6.2 Servo Drive Final Setup and Tuning

Once the electrical components and motors are all set up on the machine, it is time to configure the motor drives and prepare for tuning the motors.

Install the axis motors on the Machine Tool.

Each of the supported drives have their own Technical Bulletins that describe in detail the steps to configure the drives:

- Leadshine EL8-EC Setup and Tuning: TB 324 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/324.pdf)
- Leadshine EL7-EC Setup and Tuning: TB 323 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/323.pdf)
- Yaskawa SGD7S EtherCat Setup and Tuning: TB 322 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/322.pdf)
- Estun Summa Setup and Tuning: TB 317 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/317.pdf)
- Glentek Gamma Setup and Tuning: *Tech Bulletin in progress*
- Inovance SV660N Setup and Tuning: TB 329 (https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/329.pdf)

6.3 Setting the Home Position with Absolute Encoders

Hickory and CNC12 utilize Absolute Encoders that are ‘always on’, reporting the current position even when the CNC controller main power has been removed/shut down. Absolute encoders have a 10 year battery installed (typically in the encoder cable) which keeps the encoder ‘alive’ when the cnc controller main power has been removed. This feature allows the CNC controller to always know where it is at. When powered up, Hickory/CNC12 read the absolute encoder position and know exactly where the machine currently is in space even if it was moved when powered off. Absolute encoders make installing limit and home switches optional since once a home position is set the Hickory equipped machine will never run a typical incremental home program (one that will seeks out the home switches each day before work begins). After every power cycle the Hickory machine knows where the machine home position is at no matter of the current position of each axis so homing to a switch has been eliminated. In the setup example below Home switches will not be used and Limit switches can still be installed they will act as LIMIT switches only and will not be used to home off of.

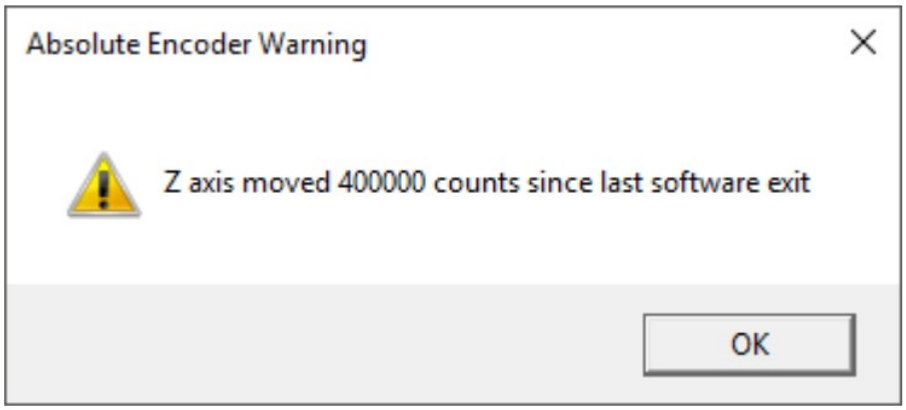
Setup the CNC12 Home program for use with Absolute Encoders:

1. Jog the axes to the desired machine home position.

2. **Prepare any paired axes for Auto Squaring: UNPAIR the two motors.** Navigate to Parameter 64 and make a note of the current value then set P64 to zero and press F10 Save.

   This Un-pairs each of the paired motors so we can now both jog and set individual home positions for each of the Gantry motors. The individual home positions for master and slave motors allow us to set and record the absolute home position on each side the Gantry when it is in the square position.

3. Power down the CNC control main power (which includes drives) then power the system on again. Upon CNC12 start up you may see some warning dialogues related to the absolute encoders. If you see one about axis movement like below, this is not unexpected during initial setup and can be safely ignored.



4. **Use M26 to Set the Machine Coordinates Home position for each motor.**

Note: at this point, Do not press Cycle Start to initiate the day to day homing procedure.

For Paired axis: If necessary, very carefully/slowly individually jog each of Gantry axis motors to the Gantry square position. NOTE: At this point the Gantry motors are un paired and each motor will move independently! So be cautious to prevent damage to the machine tool.

Now, Press **F3-MDI** and set the absolute encoder machine coordinate position one axis at a time.

M26/X

then issue

M26/Y ; Master Gantry motor in this example if necessary jog each of the paired axis very carefully to the square position before issuing this command

then issue

M26/Z

then issue

M26/W ; Slave Gantry motor in this example if necessary jog each of the paired axis very carefully to the square position before issuing this command

Notes:

- M26 will Reset the CNC12 Machine Home position at the current position.
- M26 Reads the current Absolute Encoder Position of that motor and records it.
- M26 is typically only used for this one time initial home position setup or when you wish to reset or move the Machine Home position to a different location.
- You can reissue an M26 as many times as you like when initially setting up the machine home position until you are satisfied with the home position.
- Use M26 with one axis at a time “M26/X” , “M26/Z” etc.
- Once you have the absolute encoder home position set be sure not to use M26 or it will overwrite your home position.
- How it works in the background: as long as parameter 316 is set to mark an axis as having an absolute encoder then the CNC12/Hickory system will save the absolute encoder position in non-volatile memory when an M26 is executed for that motor.
- Never issue a M26 on a paired axis. For example: Never issue M26/Y when that axis is paired

(P64 not zero)!

5. **Edit the CNC12 Home Program to use the Absolute Home position set in Step 4:**

   For regular day-to-day “homing” of the machine tool, we will edit and modify the cncm.hom (lathe = cnct.hom) file to use the “Q1” word, after the M26. The Q1 word tells CNC12 to set home to the position stored by the M26 initial setup and to NOT reset the Machine Coordinate Home position.

   For example a typical Absolute Encoder Hickory Milling Machine Home file will look like this.

   M26/Z Q1
   M26/X Q1
   M26/Y Q1 ; where Y is the master axis on the Gantry in this example.
   M26/W Q1 ; where W axis in this example is the drive letter being used as the slave axis on the gantry. This is effectively the “auto squaring” line of the home program which tells CNC12 to use the Gantry is square absolute encoder position set in Step 4 above.

6. **Repair the Paired Axes**:

   - Push in the E-Stop button.
   - Re-enable Gantry axis motor pairing by setting P64 to its previous value recorded in Step 2, press **F10-Save** to confirm and exit the parameters menu.

7. Close CNC12 and Shut Down the CNC Control system and power up.

   Press Cycle Start to “Home the Machine”

   After homing for the first time , double check for expected position and gantry squareness.

   It is a good idea to test this several times by moving to different positions and rebooting to verify that the positions are correct after homing.

Cautions:

- Calling M26 without the Q1 word in the homing file or any other place will reset current position being set to the machine coordinate home position. If an M26 is issued not at the desired Machine Coordinate Home position it will cause the machine coordinates to be incorrect and step 4 will have to be repeated. Always use the Q1 word with absolute encoders (except during initial machine setup or repairs as instructed above) when using daily homing of the machine.

- Setting CNC12 homing type to “JOG” defeats the Q1 word and is not recommended with Hickory. This “JOG” setting will constantly reset the machine coordinate system to the current position which is not desirable.

- It may be desirable to issue other commands as part of the homing procedure such as retracting the Z axis etc.. See Centroid’s Operator Manuals and Macro Programming guide for more information on creating custom home programs.

Refer to Tech Bulletin 301 for additional information regarding absolute encoders.

6.4 Motor Software Setup

With the motors tuned and machine home set, turn the feedrate override down to 10%. Then attempt to jog each axis in both the positive and negative directions. After ensuring that each axis can be jogged in either direction, try slowly increasing the feedrate to 100% while jogging. Pay attention to each axis and check that each motor is behaving as expected. See Appendix A: Troubleshooting for troubleshooting a motor that behaves in an unexpected manner.

Configure axes to move in the correct direction: It is important to understand that correct servo motor direction is determined by **the motion of the tool relative to the part**. This is not necessarily the same as the motion of the table.

More information on the following procedure is also covered in Technical Bulletin 137, which can be found here: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/137.pdf)

On an axis where the table moves while the tool remains stationary, axis motion is opposite tool motion. In the figure below, if the table is moving to the left, in the -X direction, the tool is moving in the +X direction, it is going to the right relative to the table. Therefore, a positive X movement should move the table to the left.

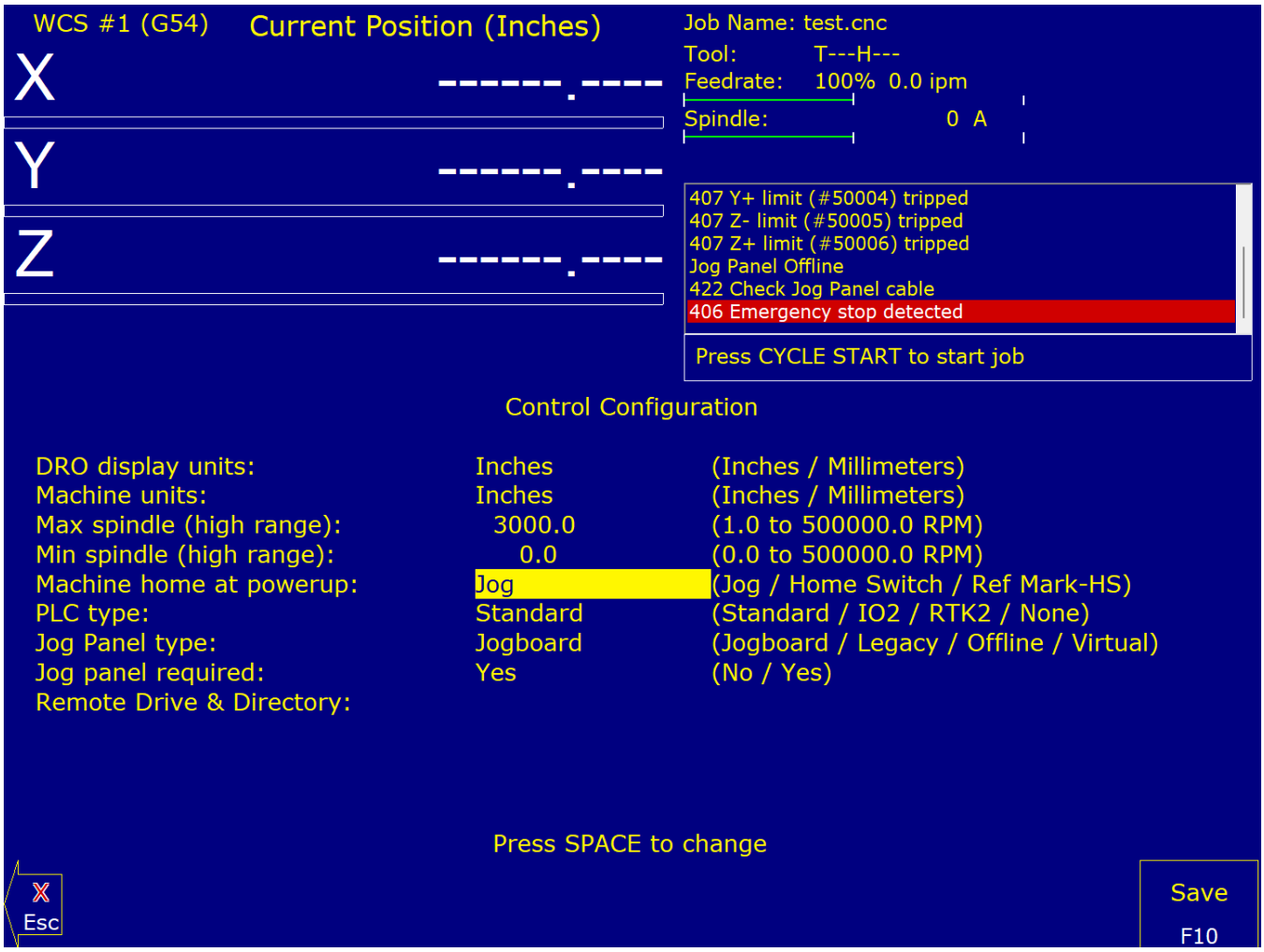
For axes that move the tool, axis motion is the same as the tool motion. In the figure below, if the tool moves up, it is moving in the +Z direction. Therefore, a +Z movement should move the tool up.

6.5 Spindle Setup

From the main menu, press **F1-Setup** → **F3-Config** → **Password: 137** → **F1-Contrl**.

The Control Configuration screen provides you with a method of changing controller dependent data.

If you wish to change a field, use the up and down arrow keys to move the cursor to the desired field. Type the new value and press <ENTER>. When you are done editing, press **F10-Save** to save any changes you have made. If you wish to discard your changes and restore the previous values, press <ESC>.



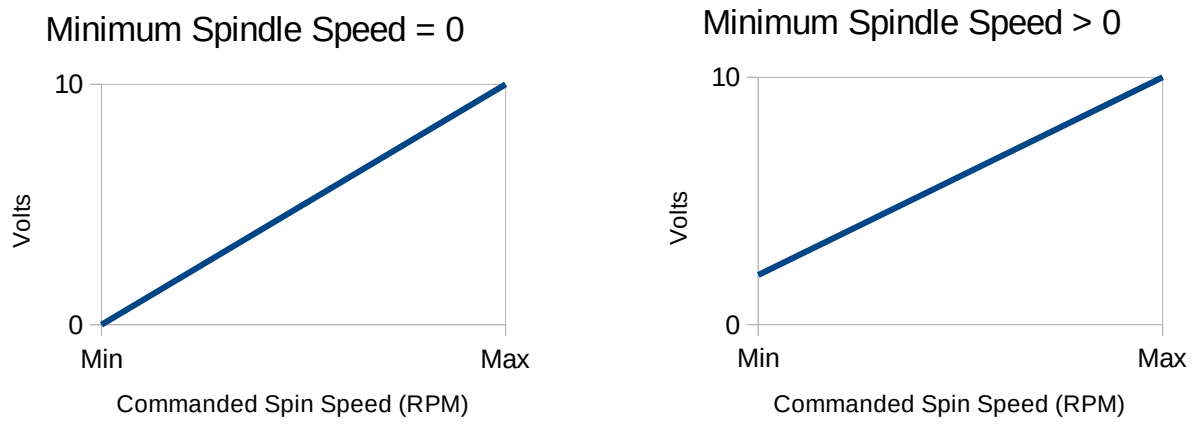
Maximum Spindle Speed (High Range)

This field sets the high range maximum spindle speed for those machines that have a variable frequency spindle drive (VFD). All spindle speeds entered in a CNC program are output to the PLC as percentages of this maximum value.

If your machine is equipped with a dual range spindle, see the Parameters 65-67 section below.

Minimum Spindle Speed (Low Range)

This parameter sets the minimum spindle speed when in high range. If minimum spindle speed is set to a value greater than zero, the spindle voltage will output the minimum voltage equivalent until the commanded spindle speed is greater than the minimum spindle speed. The values stored can range from 0 to 500000.0 RPM.



Enabling the Spindle Fault Inputs

If the spindle fault circuitry is used, invert the spindle fault input (which was inverted during board level testing). In the main menu press <Alt + i> to bring up the real time I/O display. Press the <Ctrl + Alt + i> keys simultaneously to remove the over input 10 if there is one. This will enable the SpindleOK input.

Enable Spindle Encoder Parameters

If a spindle encoder is being connected to the Hickory, modify the following parameters as specified in the CNC12 Operator's Manual.

Parameter	Description	
34	Spindle Encoder Counts/Rev	Dependent on Line Count of Spindle Encoder (Line x 4)
35	Spindle Encoder Axis Number	6
78	Spindle Speed Display and Operations	1

Parameters 65-67 – Spindle Gear Ratios

These parameters tell the control the gear ratios for a multi-range spindle. Up to four speed ranges are supported; high range is the default. Parameters 65-67 specify the gear ratio for each lower range, relative to high range. For example, if the machine is a mill with a dual range spindle, and the spindle in low range turns 1/10 the speed it turns in high range, then parameter 65 should be set to 0.1.

Parameter 65 is the low range gear ratio.
Note: Some machines use a Back Gear, if one is in use then the low range gear ratio will need to be a negative value.

Parameter 66 is the medium-low range gear ratio.

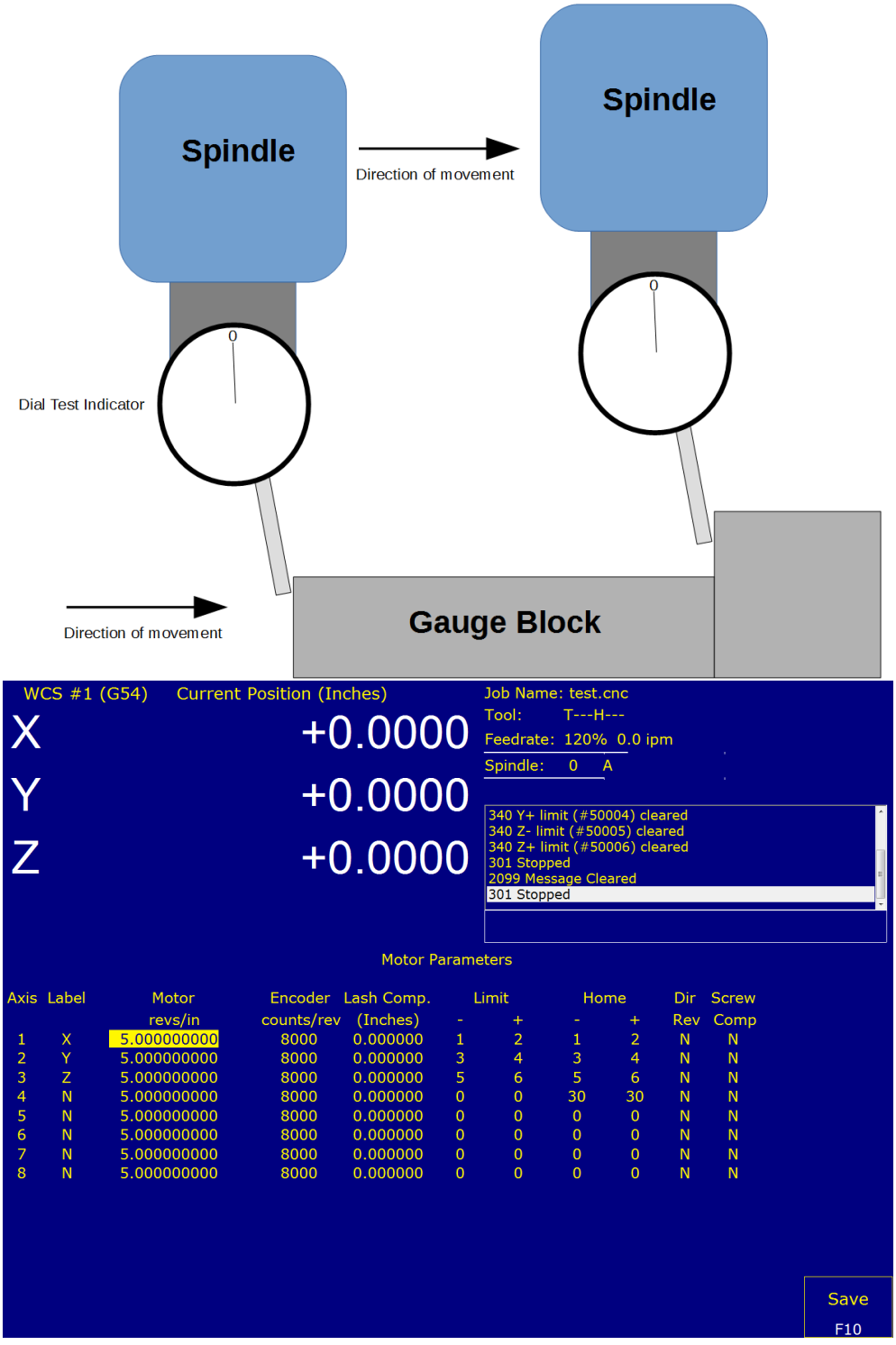
Parameter 67 is the medium-high range gear ratio.

These parameters work in conjunction with the PLC program, which uses the states of inputs 13 (low range), 14 (medium range), and 15 (high range) to signal to the CNC12 software which range is in effect.

6.6 Configuring Overall Turns Ratio

Complete information about configuring your machine's overall turns ratio can be found in Tech Bulletin 36: https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf

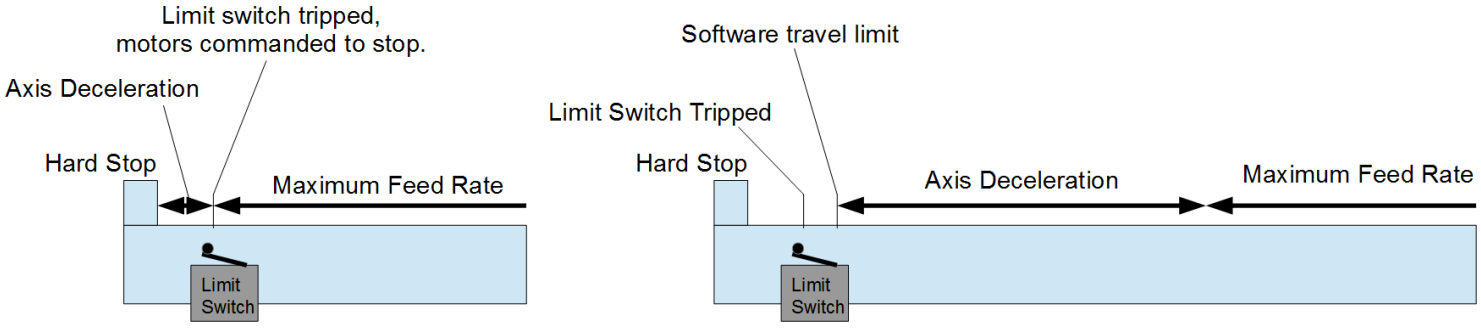
Refer to the setup shown in the image below. To reach the motor parameters screen to set Motor revs/in from the main menu, press **F1-Setup → F3-Config → Password: 137 → F2-Mach → F2-Motor**.



Axis	Label	Motor revs/in	Encoder counts/rev	Lash Comp. (Inches)	Limit -	Limit +	Home -	Home +	Dir Rev	Screw Comp
1	X	5.000000000	8000	0.000000	1	2	1	2	N	N
2	Y	5.000000000	8000	0.000000	3	4	3	4	N	N
3	Z	5.000000000	8000	0.000000	5	6	5	6	N	N
4	N	5.000000000	8000	0.000000	0	0	30	30	N	N
5	N	5.000000000	8000	0.000000	0	0	0	0	N	N
6	N	5.000000000	8000	0.000000	0	0	0	0	N	N
7	N	5.000000000	8000	0.000000	0	0	0	0	N	N
8	N	5.000000000	8000	0.000000	0	0	0	0	N	N

6.7 Software Travel Limits

Setting software travel limits will automatically decelerate an axis while approaching the limit, preventing possible damage as shown below. If a programmed move would send the machine beyond a software travel limit, CNC12 will throw an error, “907: _ axis travel exceeded on line NNNN” and prevent that move from even beginning.



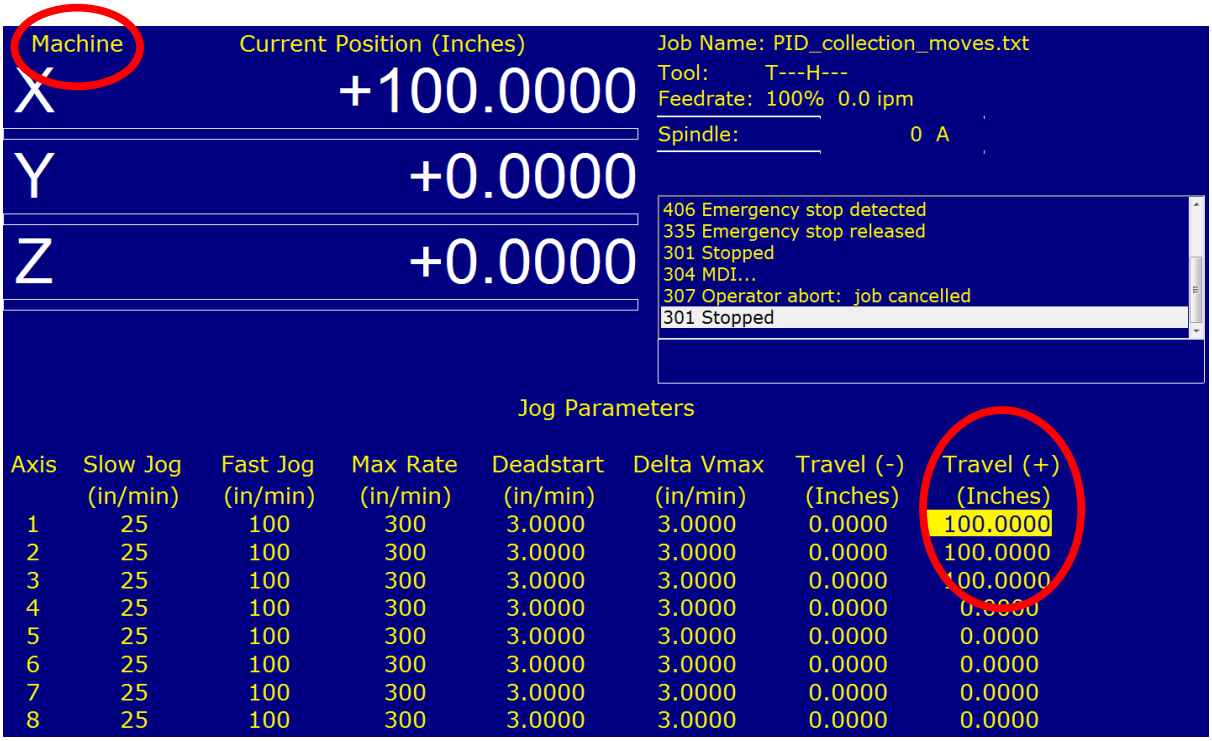
Prerequisites:

- The overall turns ratio must be calibrated correctly, set up in Section 6.6.
- If present, the limit switches must be functioning, set up in Section 5.6.

Restart the machine and ensure machine home is set before continuing.

1. Check that the DRO is displaying machine position. If the machine is showing any work coordinate system such as WCS #1 (G54), press <Alt + d> until “Machine” is displayed in the upper-left corner of CNC12.
2. Select Slow Jog and position one axis near the desired endpoint of travel in the positive direction. Note the DRO reading for this position.
   a) If the limit switch is present, slow jog until the limit is tripped, then jog off the limit switch in **incremental mode: x10** until the switch is cleared. Then jog another 0.1” (2.5mm) away from the switch and note that position.
3. Move the axis to the other end of travel and position it near the desired endpoint of travel in the negative direction. Note the DRO reading for this position.
   a) Just like Step 2.a, if the limit switch is present, slow jog until the limit is tripped, then jog off the limit switch in incremental mode: x10 until the switch is cleared. Then jog another 0.1” (2.5mm) away from the switch and note that position.
4. **Enter the Jog Parameters Menu**: From the main menu, press **F1-Setup** → **F3-Config** → **Password: 137** → **F2-Mach** → **F1-Jog**. In the Jog Parameters menu, enter the DRO value of the noted positive position for the measured axis in the Travel (+) box. Do the same for the noted negative position in the Travel (-) box.

a) **Note:** When both the Travel (-) and Travel (+) boxes are set to zero, software travel limits are disabled for that axis. As soon as **one** of the two values changes to a non-zero value, **both** limits are enabled.



5. Repeat steps 2-4 for each axis.
6. Test by manually jogging each axis towards the software limits. Ensure that the machine automatically stops the axis at the software travel limit (and before tripping the limit switch, if present).
7. Enter **F3-MDI** to issue a G-code that asks the software to move just beyond the software travel limit. Verify that the CNC12 status window throws the “907: _ axis travel exceeded” error.

6.8 Performing the System Test

System Test Advisement for Hickory

Do not start or use the System Test macro with Hickory or with a system that has software paired axes.

The Centroid System Test was created to ensure OEM's properly setup the CNC Controller and don't drop ship a CNC machine Tool to an enduser that has not been properly configured. The System Test has been around for years and has not been updated for use with Hickory.

The System Test is largely trying to verify the Limit and Home switches are properly configured. For Hickory systems that use absolute encoders Limit and Home switches are redundant and most users will elect not to install them as they are optional items with Hickory systems.

The System Test also has an issue with systems that are setup with Software Paired Axes.
Do not start or use the System Test macro with Hickory or with system using paired axes.

You can eliminate it from the CNC12 start menu by running this macro attached or hand typing each line in MDI and then closing CNC12 and rebooting the CNC controller.

```
#100 = #1233
#100 = #1234
#100 = #1234
#100 = #1234
M225 #100 "System Test has been defeated\n \n Shut Down CNC12 \n  \n Then
Power Cycle the CNC controller \n \n Press ECS to Exit"
```

System test will be removed from the upcoming v5.1 CNC12 release and reintroduced in v5.2 after we have updated it and thoroughly tested it.

CNC12 Configuration Backup

Once you start having some time and energy into configuring the CNC control system it is suggested that you create a backup of the CNC configuration settings on a USB memory stick. This is easily accomplished with the Centroid “Create Report” feature found in the CNC12 Utility Menu.

Keep making new report.zip files as you progress through the CNC control setup process. If a problem arises, you can simply use the “Restore Report” feature also found in the Utility menu to return to the last known ‘good’ report file.

The report.zip file is also used to quickly setup a new computer so you don’t have to re-enter every control configuration or parameter that was changed with the previous version. This is very convenient when a hard drive or computer crashes. If you made a report.zip when everything was running good and stored it in a safe place, the entire system configuration can easily be restored.

It is a 5 second operation to restore the CNC12 configuration back to the day the machine was commissioned on a new hard drive or PC.

This memory stick should contain:

- The installer.exe file that you used to install CNC12
- The ‘final’ good report.zip file
- any License Key files
- Copy of the entire working good cncm directory (optional)

NOTE: It is a very good idea to keep the USB memory stick in a safe location. See this post on the forums about USB backups: https://centroidcncforum.com/viewtopic.php?f=63&t=5667

Chapter 7 Appendices

Appendix A Troubleshooting

Symptom Or Error	Troubleshooting
Error Initializing MPU11	• Firewall or antivirus problem, see Section 3.1. • Ethernet Cable is not shielded, see Section 2.2. • Lack of power to the Hickory, check wiring and power supply. • An incorrect IP configuration, see Section 2.2.12. For further troubleshooting, refer to TB 279: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/279.pdf)
452 PC Receive Data Error	Most often caused by noise. • Ensure the Ethernet cable is shielded, it will have metal clips on each end. See Section 2.2. For further troubleshooting, refer to TB 270: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf)
Axis does not move the correct distance	The motor revs/inch, or mm's/rev, has not been set correctly. Ensure you have properly calibrated your machine. Section 6.5. For more information see TB 36: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf)
Axes don't move – No Error or Fault displayed	• The feedrate override is turned down to zero. Confirm that the feedrate override is set to ~100%. • E-Stop button is depressed. Release the E-Stop button, the “Emergency Stop Released” message should appear. • The control is in incremental jog mode. If the LED is lit on the INCR/CONT key, the control is set to incremental jog. Press the INCR/CONT key to toggle the LED off and attempt to jog. See TB 285 for more information: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/285.pdf)

Full Power Without Motion, Position Errors and SV_STALL Errors	Problem with power to the motors and/or feedback from the encoder on the motor. If SV_STALL error is displayed, it is almost always caused by a previous error – such as full power without motion, position error, encoder error, drive fault etc. Refer to TB 26: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/26.pdf)
Motor Behaving Unexpectedly	• Check the Max RPM is set correctly in the drive and in Parameters **357-364** • If you are getting **position errors**, disable stall detection in the PID menu of CNC12 and try moving again. Does the motor move as expected? Do you need to reverse the direction of the axis? • Quadrature Errors are either a problem with the encoder shield, grounds, or faulty wiring.

Appendix B LED Error Codes

LED1 Error Codes

Error Number	Meaning	Cause	Corrective Action
6	Voltage failure	Power was lost	If error appears briefly at startup, it is normal, otherwise check for loose power connections
7	Communication out of sync	Data in and out are not locked together in a synchronous relationship	Internal error, contact Centroid
8	Too many counts per interrupt requested (>511) or too many steps per interrupt (based on p968 rate)	Communication error or too fast movement requested by CNC12	Cycle E-Stop to clear. Maximum rate may need to be lowered.

HICKORY User Guide
For Revision 240227
3/26/24

Overview

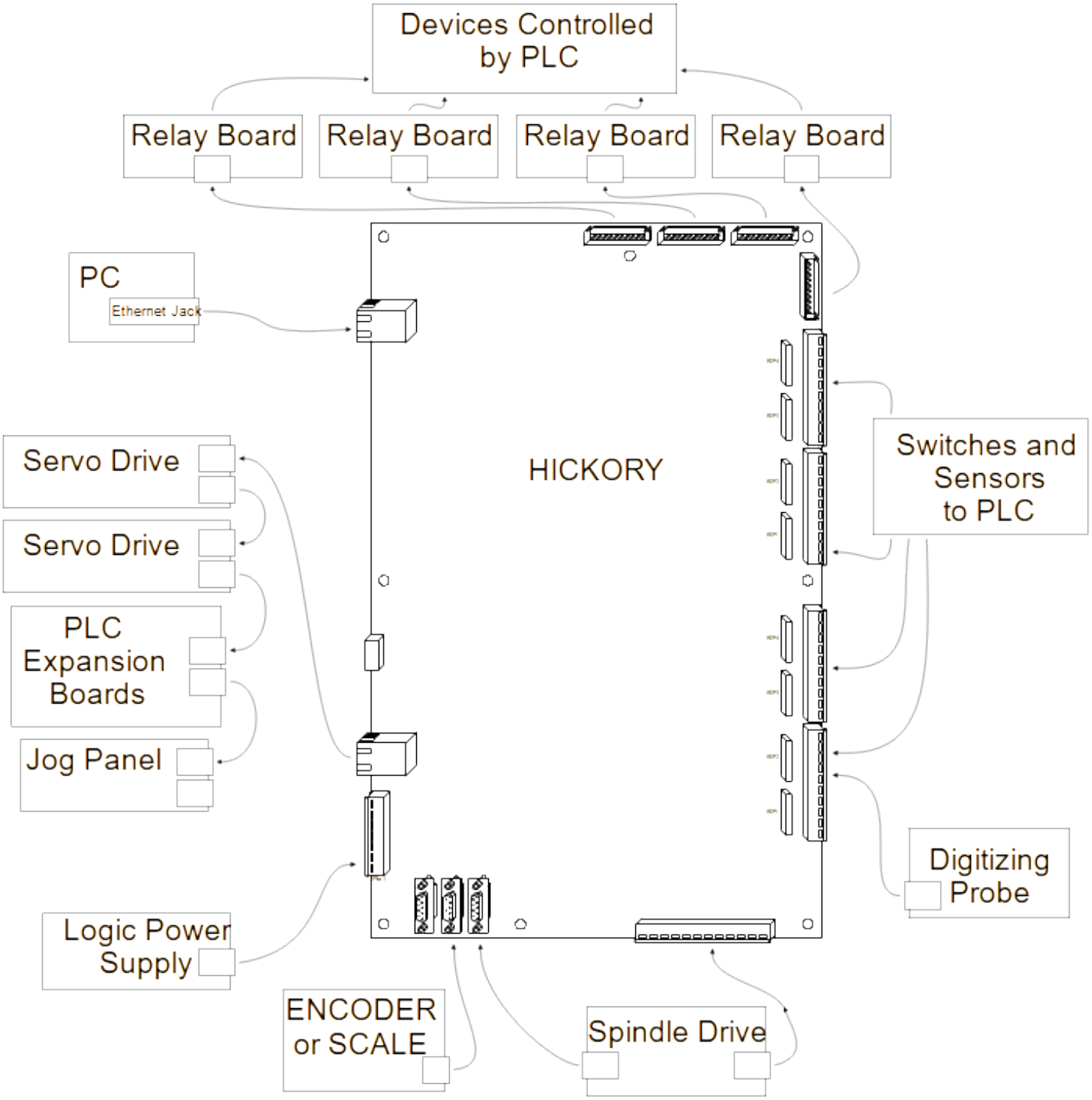
The HICKORY is an integrated PLC and motion control processor. HICKORY uses an Ethernet based fieldbus to communicate with all accessories over RJ45 shielded twisted pair (Ethernet) cables. The new protocol and connection scheme are the defining features of HICKORY versus previous products such as Oak.

Communication with a host PC is performed over Ethernet. Three encoder inputs are available through DB9 connectors. The integrated PLC includes 32 digital inputs and 32 digital outputs for general purpose use. Two analog inputs and outputs with PWM option for outputs are provided (see “PLC Section” for details). Additional functions are added with expansion boards connected to the fieldbus.

A new motion control section is built in, which is code named MPU13. The MPU13 section has increased processing power over MPU11 by up to 4 times. The additional speed can be appreciated by those running complex 5 or more axis programs.

Function:	Motion Control Processor, PLC, and Drive Interface
Maximum number of Axes:	8
Encoder and Scale Inputs:	3 Incremental Encoders (A, B, and Z channels)
Control Interface:	100 Mb/s Ethernet to PC
Number of Axes:	Up to 8
Digital PLC Inputs:	32
Digital PLC Outputs:	32
Analog Inputs:	2
Analog Outputs:	2
Analog Input resolution:	16 bits
Analog Output resolution:	16 bits
Dimensions (W*D*H):	8 * 12 * 0.75 inches

HICKORY Typical Connection Overview

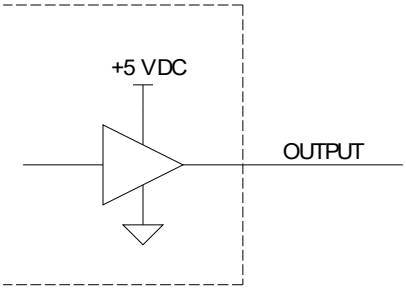


PLC Section

Digital Outputs

32 5 volt logic outputs are available on the HICKORY. The outputs are intended to be used with external 8 relay modules. The default (off) logic state is high. A low level will activate a relay on the external board.

Internal Circuitry
H1, H6, H7 and H9 Connector Outputs



Analog Outputs

HICKORY is equipped with two analog outputs. One is normally used as a speed request to the spindle drive, while the other is free for special applications. The analog outputs also output a 5V PWM signal. For example, PWM 1 and Analog Out 1 can both be connected on H8, but they are controlled by the same PLC output bits.

Four voltage output ranges are available on the analog output. Mode bits are used to select the output range. The analog output is factory trimmed for high accuracy, and will not require adjustment when changing ranges.

The mode bits also change the PWM frequency to match different applications. For example, laser power controllers often take around 1 kHz and hobby servos can be controlled with 40 to 200 Hz

The analog ground is connected internally to other HICKORY GND pins. However, for best wiring results, use the GND pin adjacent to the analog output pin for analog connections. Do not share analog ground wires or connect multiple wires from different devices to an analog GND pin.

Analog Output Ranges

Mode Bit A	Mode Bit B	Range	Resolution
1	1	-10 to 10	16 bits
0	1	-5 to 5	15 bits
1	0	0 to 5	14 bits
0	0	0 to 10	15 bits

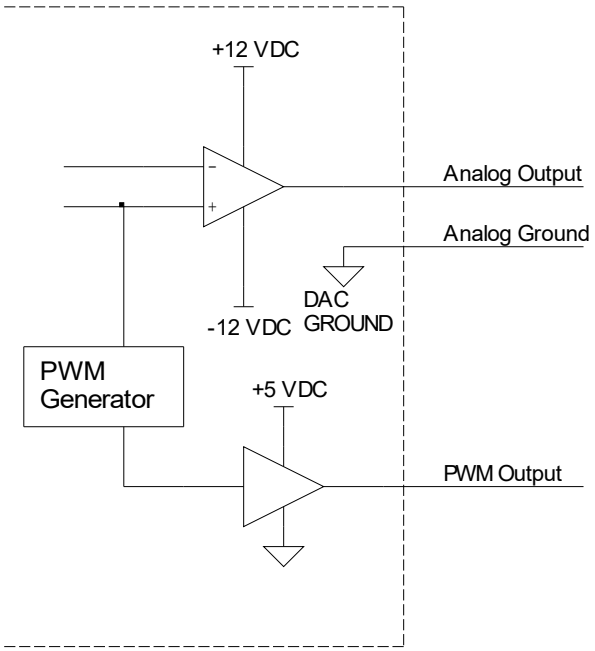
PWM Output Frequencies

Mode Bit A	Mode Bit B	Frequency (Hz)	Resolution
1	1	76	16 bits
0	1	610	16 bits
1	0	1221	16 bits
0	0	4883	14 bits

Analog Output Bits

Analog Output	Output Bits	Mode Bit A	Mode Bit B
1	33 - 48	69	70
2	49 - 64	71	72

Internal Circuitry
Analog Output



Analog Output Calculations

0 to 5V Range

$$\text{output voltage} = \frac{\text{Analog Request}}{65536} * 5$$

-5 to 5V Range

$$\text{output voltage} = \left(\frac{\text{Analog Request}}{65536} * 10 \right) - 5$$

0 to 10V Range

$$\text{output voltage} = \frac{\text{Analog Request}}{65536} * 10$$

-10 to 10V Range

$$\text{output voltage} = \left(\frac{\text{Analog Request}}{65536} * 20 \right) - 10$$

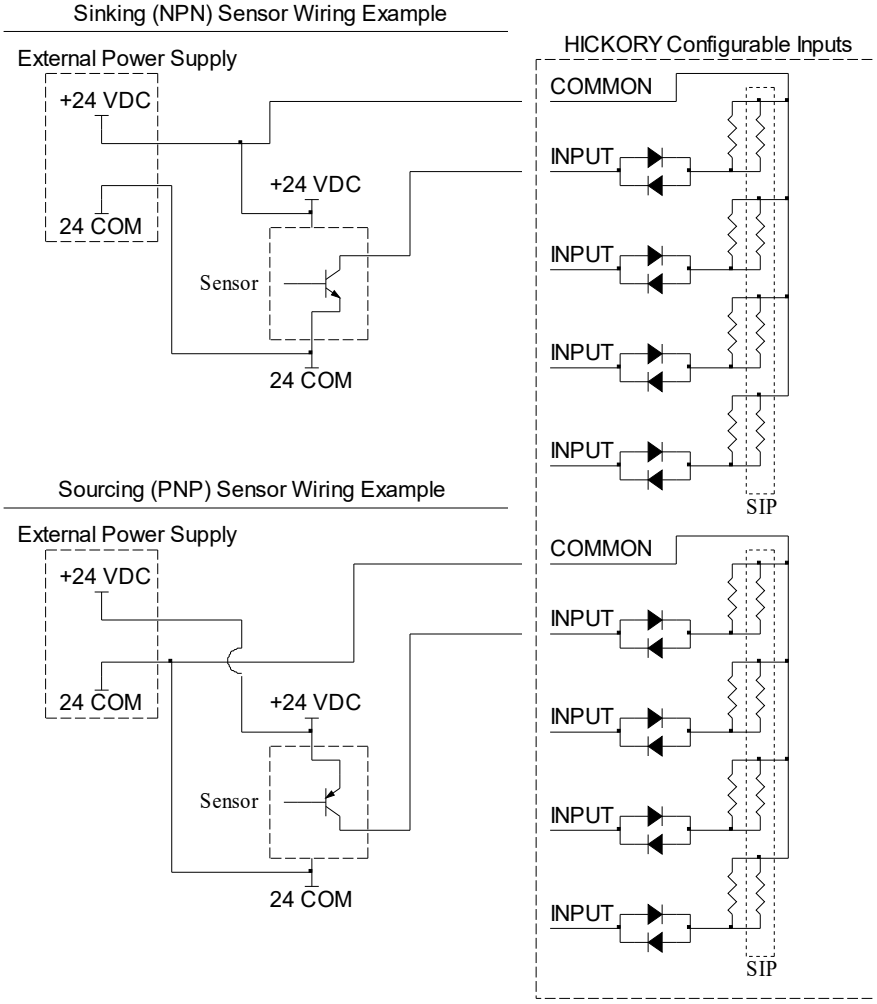
PWM Output Calculations

PWM output can be calculated using the following equation with one exception. Analog request of 65535 will output continuous 5VDC (100% duty cycle, not 99.998%).

$$\text{PWM duty cycle (\%)} = \frac{\text{Analog Request}}{65536} * 100$$

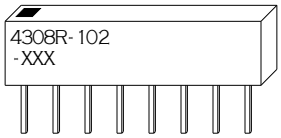
Digital Inputs

HICKORY has 32 optically isolated inputs. Inputs are divided into banks of four. Each bank is configurable for various voltages and sinking or sourcing polarity. Voltage may be selected by installing the appropriate value resistor pack or SIP into a socket for each bank. Without a SIP installed, input voltage is set to 24V. Optional SIPs may be installed to use 12V or 5V input voltage. Polarity is determined by wiring the common terminal for the bank to the supply positive or supply common.

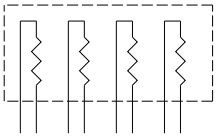


.

SIP Identification - XXX Indicates Value



SIP Internal Wiring / Pinout



SIP Input Voltage Selection

SIP Value Marking	Resistor Value (Ohms)	Input Voltage
221	220	5
102	1.0k	12
None	None	24

Analog Inputs

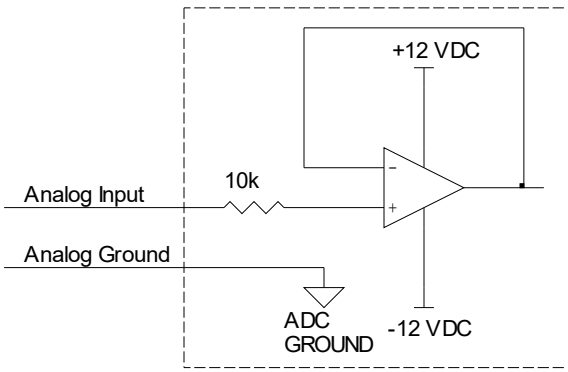
Two analog inputs are available. The input range is -10 to 10 volts. The analog ground is connected internally to other HICKORY GND pins. However, for best wiring results, use the GND pin adjacent to the analog input pin for analog connections. Do not share analog ground wires or connect multiple wires from different devices to an analog GND pin.

Analog Input Bits

Analog Input	Input Bits
1	33 - 48
2	49 - 64

Internal Circuitry

Analog Input



Analog Input Calculations

$$\text{Input Voltage} = \text{ADC result} * \left(\frac{20}{65536} \right)$$

Communication

HICKORY uses an Ethernet based fieldbus to communicate with all accessories over RJ45 shielded twisted pair (Ethernet) cables. The communication update cycle is 4000 times per second.

Internally, the I/O section of HICKORY is connected over the fieldbus. This assigns HICKORY to the beginning of I/O space, as discussed below. Additional accessories are connected in series with Ethernet cables. PLC expansion devices must be connected in the correct order to match the system's PLC program. JOGBRD13 jog panel controller is assigned a fixed area in memory, so its position in the communication chain is not important for I/O mapping.

Servo drives are assigned in sequence, with the one closest to HICKORY in the communication chain being assigned to drive channel 1. See parameters 300 to 307 in the Operator's Manual to map a drive channel to an axis in the CNC12 software. The connection order between drives and PLC devices is not important.

Accessory Device Memory Assignments

Accessory devices are assigned space based on their connection order. The amount of space required varies depending on the device. Devices may request input and output space in 16 bit increments, which are referred to as slots. The number of input slots must be equal to the number of output slots for all devices.

Jog panel, MPG, and probe devices always map to the same memory areas. These special cases allow for better compatibility with all PLC programs. The location of this I/O is always known. Only one Jog Panel, MPG, and probe expansion device may be used on a system because of the fixed locations for data. Currently, the only device on the fieldbus that fits these categories is the JOGBRD13 jog panel controller. The probe is wired to HICKORY inputs and the wireless MPG uses a USB data path to the PC. Therefore, the mention of probe and MPG fieldbus devices only applies to possible future products.

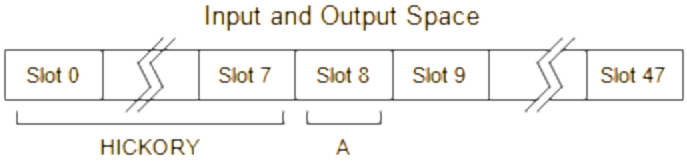
PLC Program INP / OUT, Slot, and I/O Area Relationship

INP / OUT 1 to 16	INP / OUT 17 to 32	INP / OUT 33 to 48	INP / OUT 49 to 64	INP / OUT 65 to 80	INP / OUT 81 to 96	INP / OUT 97 to 112	INP / OUT 113 to 128		INP / OUT 753 to 768
Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7		Slot 47

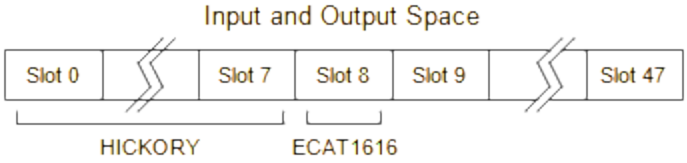
Assignment of I/O slots occurs in a linear fashion starting at the device closest to the HICKORY in the communication chain. The HICKORY I/O is the first device in the communication chain. In the following general example, the HICKORY I/O takes the first two slots. Other devices may change locations if they are plugged into the communication chain in a different order. Additional PLC devices will be assigned starting at the slot marked “A”.

Since I/O space must be reserved in 16 bit increments, some I/O space may be lost if a device has an I/O count that is not a multiple of 16. For example, HICKORY inputs 122 – 128 are not used, but must be reserved to match the 16 bit boundary. Input and output space must be reserved in the same quantity. If a device has 16 inputs and no outputs, one slot must be still be reserved in both the input and output space.

PLC Expansion Location Assignment General Example



PLC Expansion Example with ECAT1616



PLC I/O Slot Requirements

	Function	Slots Used
Total Available	Any	48
HICKORY	Digital and Analog I/O	8
ECAT1616	Digital I/O	1

PLC I/O Map

Input Specification			Input Location	
Number	Function	Type	Connector	Pin
1	General Purpose		H2	1
2	General Purpose		H2	2
3	General Purpose		H2	3
4	General Purpose		H2	4
5	General Purpose		H2	6
6	General Purpose		H2	7
7	General Purpose		H2	8
8	General Purpose		H2	9
9	General Purpose		H3	1
10	General Purpose		H3	2
11	General Purpose		H3	3
12	General Purpose		H3	4
13	General Purpose		H3	6
14	General Purpose		H3	7
15	General Purpose		H3	8
16	General Purpose		H3	9
17	General Purpose		H4	1
18	General Purpose		H4	2
19	General Purpose		H4	3
20	General Purpose		H4	4
21	General Purpose		H4	6
22	General Purpose		H4	7
23	General Purpose		H4	8
24	General Purpose		H4	9
25	General Purpose		H5	1
26	General Purpose		H5	2
27	General Purpose		H5	3
28	General Purpose		H5	4
29	General Purpose		H5	6
30	General Purpose		H5	7
31	General Purpose		H5	8
32	General Purpose		H5	9
33	Analog In 1 b0		H8	1
34	Analog In 1 b1			
35	Analog In 1 b2			
36	Analog In 1 b3			
37	Analog In 1 b4			
38	Analog In 1 b5			
39	Analog In 1 b6			
40	Analog In 1 b7			
41	Analog In 1 b8			
42	Analog In 1 b9			
43	Analog In 1 b10			
44	Analog In 1 b11			
45	Analog In 1 b12			
46	Analog In 1 b13			
47	Analog In 1 b14			
48	Analog In 1 b15			

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
1	General Purpose		H9	2
2	General Purpose		H9	3
3	General Purpose		H9	4
4	General Purpose		H9	5
5	General Purpose		H9	6
6	General Purpose		H9	7
7	General Purpose		H9	8
8	General Purpose		H9	9
9	General Purpose		H7	2
10	General Purpose		H7	3
11	General Purpose		H7	4
12	General Purpose		H7	5
13	General Purpose		H7	6
14	General Purpose		H7	7
15	General Purpose		H7	8
16	General Purpose		H7	9
17	General Purpose		H6	2
18	General Purpose		H6	3
19	General Purpose		H6	4
20	General Purpose		H6	5
21	General Purpose		H6	6
22	General Purpose		H6	7
23	General Purpose		H6	8
24	General Purpose		H6	9
25	General Purpose		H1	2
26	General Purpose		H1	3
27	General Purpose		H1	4
28	General Purpose		H1	5
29	General Purpose		H1	6
30	General Purpose		H1	7
31	General Purpose		H1	8
32	General Purpose		H1	9
33	Spindle Analog b0		H8	5
34	Spindle Analog b1			
35	Spindle Analog b2			
36	Spindle Analog b3			
37	Spindle Analog b4			
38	Spindle Analog b5			
39	Spindle Analog b6			
40	Spindle Analog b7			
41	Spindle Analog b8			
42	Spindle Analog b9			
43	Spindle Analog b10			
44	Spindle Analog b11			
45	Spindle Analog b12			
46	Spindle Analog b13			
47	Spindle Analog b14			
48	Spindle Analog b15			

PLC I/O Map Continued

Input Specification			Input Location	
Number	Function	Type	Connector	Pin
49	Analog In 2 b0		H8	3
50	Analog In 2 b1			
51	Analog In 2 b2			
52	Analog In 2 b3			
53	Analog In 2 b4			
54	Analog In 2 b5			
55	Analog In 2 b6			
56	Analog In 2 b7			
57	Analog In 2 b8			
58	Analog In 2 b9			
59	Analog In 2 b10			
60	Analog In 2 b11			
61	Analog In 2 b12			
62	Analog In 2 b13			
63	Analog In 2 b14			
64	Analog In 2 b15			
65	Encoder 1 b0		P12	
66	Encoder 1 b1			
67	Encoder 1 b2			
68	Encoder 1 b3			
69	Encoder 1 b4			
70	Encoder 1 b5			
71	Encoder 1 b6			
72	Encoder 1 b7			
73	Encoder 1 b8			
74	Encoder 1 b9			
75	Encoder 1 b10			
76	Encoder 1 b11			
77	Encoder 1 b12			
78	Encoder 1 b13			
79	Encoder 1 b14			
80	Encoder 1 b15			
81	Encoder 2 b0		P11	
82	Encoder 2 b1			
83	Encoder 2 b2			
84	Encoder 2 b3			
85	Encoder 2 b4			
86	Encoder 2 b5			
87	Encoder 2 b6			
88	Encoder 2 b7			
89	Encoder 2 b8			
90	Encoder 2 b9			
91	Encoder 2 b10			
92	Encoder 2 b11			
93	Encoder 2 b12			
94	Encoder 2 b13			
95	Encoder 2 b14			
96	Encoder 2 b15			

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
49	Analog2 b0		H8	6
50	Analog2 b1			
51	Analog2 b2			
52	Analog2 b3			
53	Analog2 b4			
54	Analog2 b5			
55	Analog2 b6			
56	Analog2 b7			
57	Analog2 b8			
58	Analog2 b9			
59	Analog2 b10			
60	Analog2 b11			
61	Analog2 b12			
62	Analog2 b13			
63	Analog2 b14			
64	Analog2 b15			
65				
66				
67				
68				
69	Analog Out 1 setup 1		Internal	
70	Analog Out 1 setup 2		Internal	
71	Analog Out 2 setup 1		Internal	
72	Analog Out 2 setup 2		Internal	
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				

Input Specification			Input Location	
Number	Function	Type	Connector	Pin
97	Encoder 3 b0		P10	
98	Encoder 3 b1			
99	Encoder 3 b2			
100	Encoder 3 b3			
101	Encoder 3 b4			
102	Encoder 3 b5			
103	Encoder 3 b6			
104	Encoder 3 b7			
105	Encoder 3 b8			
106	Encoder 3 b9			
107	Encoder 3 b10			
108	Encoder 3 b11			
109	Encoder 3 b12			
110	Encoder 3 b13			
111	Encoder 3 b14			
112	Encoder 3 b15			
113	Encoder 1 Quad. Error			
114	Encoder 1 Z			
115	Encoder 1 Diff. Error			
116	Encoder 2 Quad. Error			
117	Encoder 2 Z			
118	Encoder 2 Diff. Error			
119	Encoder 3 Quad. Error			
120	Encoder 3 Z			
121	Encoder 3 Diff. Error			
122				
123				
124				
125				
126				
127				
128				

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
97				
98				
99				
100				
101				
102				
103				
104				
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				
121				
122				
123				
124				
125				
126				
127				
128				

HICKORY Specifications

Characteristic	Min.	Typ.	Max.	Unit
24 Volt Supply Current	0.4	-	-	A
5 Volt Supply Current	2.5	-	-	A
Input Pullup Voltage (Vinp)	4	-	30	VDC
Input On Voltage	Vinp-1.25	-	-	VDC
Input Off Voltage	-	-	1.25	VDC
Input Operating current	9	11	15	mA
Analog Output Current	0	1	10	mA
Analog Output Voltage	-10	-	10	V
Analog Output Resolution	-	16	-	bits
Analog Output Error	-	< 0.1	-	%
Analog Input Current	-	-	2	mA
Analog Input Voltage	-10	-	10	V
Analog Input Resolution	-	16	-	bits
Analog Input Error	-	< 0.2	-	%
Encoder channel input low	0	-	0.5	V
Encoder channel input high	3.5	-	5	V
Encoder input frequency (per channel)	0	-	1200	khz
Size: 12 * 8 * 1 (W*D*H)				Inches

Inputs may be wired either polarity. Input "on" and "off" ratings in the chart refer to the absolute difference between the input terminal and common terminal. Input devices must meet these specifications for long term reliability.

8 Relay Board Specifications

Characteristic	Min.	Typ.	Max.	Unit
5 Volt Supply Current	0.576	-	-	A
Relay Output Current (resistive load)	0.01	-	7	A @ 240VAC
Relay Output Current (resistive load)	0.01	-	7	A @ 28VDC
Relay Output Current (inductive load)	0.01	-	3	A @ 120VAC
Relay Output Current (inductive load)	0.01	-	3	A @ 28VDC

HICKORY Troubleshooting

Symptom	Possible Cause	Corrective Action
LED1 out	Power loss	Check 24V wiring to H19
	Power supply overloaded	Check external loads connected to supply and HICKORY
LED1 segments not scrolling	Offline	Start CNC12 software. Check communication cables.
Encoders or relays not working	Power loss	Check 5V wiring to H19
	Power supply overloaded	Check external loads connected to supply and encoder or relay connectors
Input doesn't work with sensor	Incorrect wiring	Correct wiring for sensor type (sinking or sourcing), check that SIP values are appropriate for the input voltage
	Voltage drop across sensor is too high	Use 3-wire sensors with lower voltage drop spec.

LED1 Error Codes

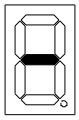
Error Number	Meaning	Cause	Corrective Action
1			
2			
3			
4			
5			
6			
7			
8			
9			

*No LED codes are currently displayed by HICKORY

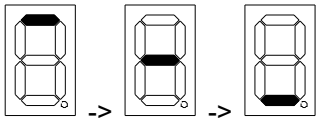
LED1 Operation

A 7 segment display (LED1) is used to display status. At startup, all number segments will light in a rotating pattern until initialization is complete. Initialization takes several seconds.

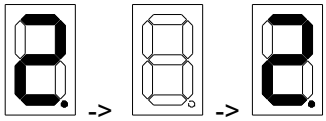
After initialization, one segment will light if HICKORY is ready, but not enabled. Usually the HICKORY is only briefly in this state immediately after initialization.

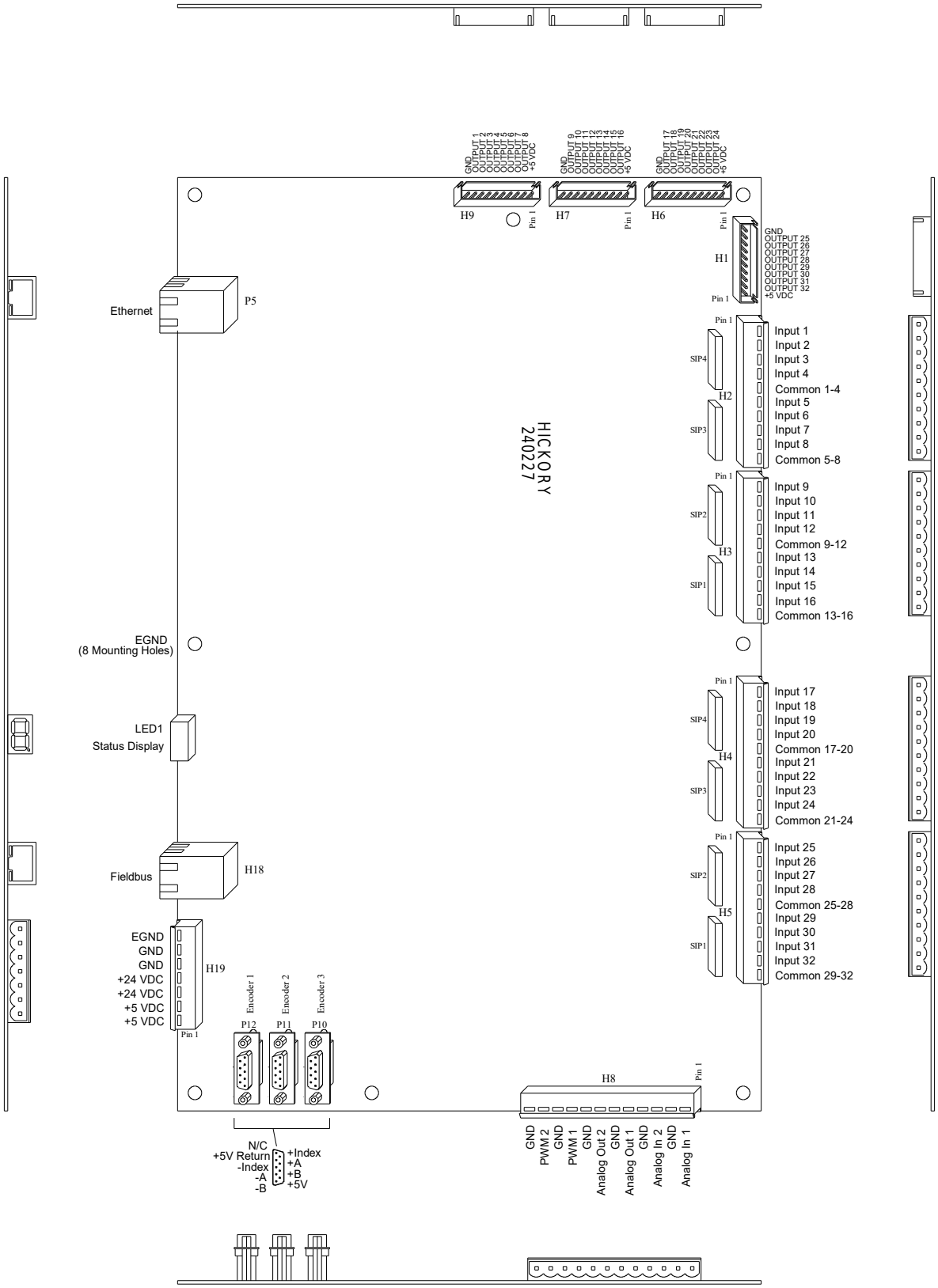
 Ready, but not running

Center segments lighting in a scrolling pattern indicates normal operation.

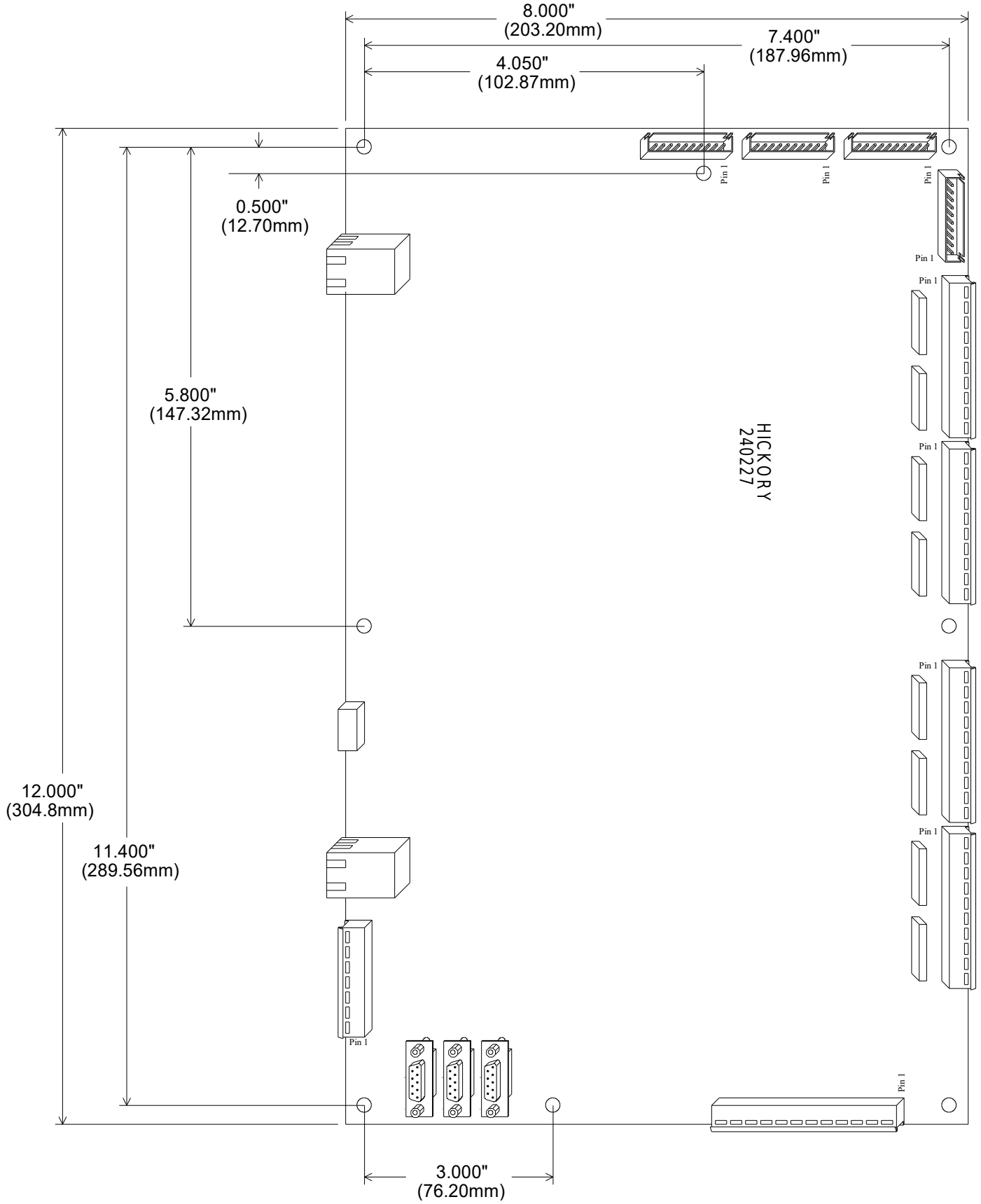
 Running normally

Errors are indicated by a flashing number with the decimal point lit continuously. See “LED1 Error Codes” chart for error descriptions.

 Flashing number indicates an error


HICKORY
24027
H9
H7
H6
H1
H2
H3
H4
H5
H8
H18
H19
P5
P12
P11
P10
Ethernet
EGND
(8 Mounting Holes)
LED1
Status Display
Fieldbus
Encoder 1
Encoder 2
Encoder 3
Pin 1
SIP4
SIP3
SIP2
SIP1
GND
OUTPUT 1
OUTPUT 2
OUTPUT 3
OUTPUT 4
OUTPUT 5
OUTPUT 6
OUTPUT 7
OUTPUT 8
+5 VDC
OUTPUT 9
OUTPUT 10
OUTPUT 11
OUTPUT 12
OUTPUT 13
OUTPUT 14
OUTPUT 15
OUTPUT 16
OUTPUT 17
OUTPUT 18
OUTPUT 19
OUTPUT 20
OUTPUT 21
OUTPUT 22
OUTPUT 23
OUTPUT 24
OUTPUT 25
OUTPUT 26
OUTPUT 27
OUTPUT 28
OUTPUT 29
OUTPUT 30
OUTPUT 31
OUTPUT 32
Input 1
Input 2
Input 3
Input 4
Common 1-4
Input 5
Input 6
Input 7
Input 8
Common 5-8
Input 9
Input 10
Input 11
Input 12
Common 9-12
Input 13
Input 14
Input 15
Input 16
Common 13-16
Input 17
Input 18
Input 19
Input 20
Common 17-20
Input 21
Input 22
Input 23
Input 24
Common 21-24
Input 25
Input 26
Input 27
Input 28
Common 25-28
Input 29
Input 30
Input 31
Input 32
Common 29-32
EGND
GND
GND
+24 VDC
+24 VDC
+5 VDC
+5 VDC
N/C
+5V Return
-Index
-A
-B
+Index
+A
+B
+5V
PWM 2
PWM 1
Analog Out 2
Analog Out 1
Analog In 2
Analog In 1

HICKORY Mounting Dimensions



8 Relay Module Connections and Mounting Dimensions