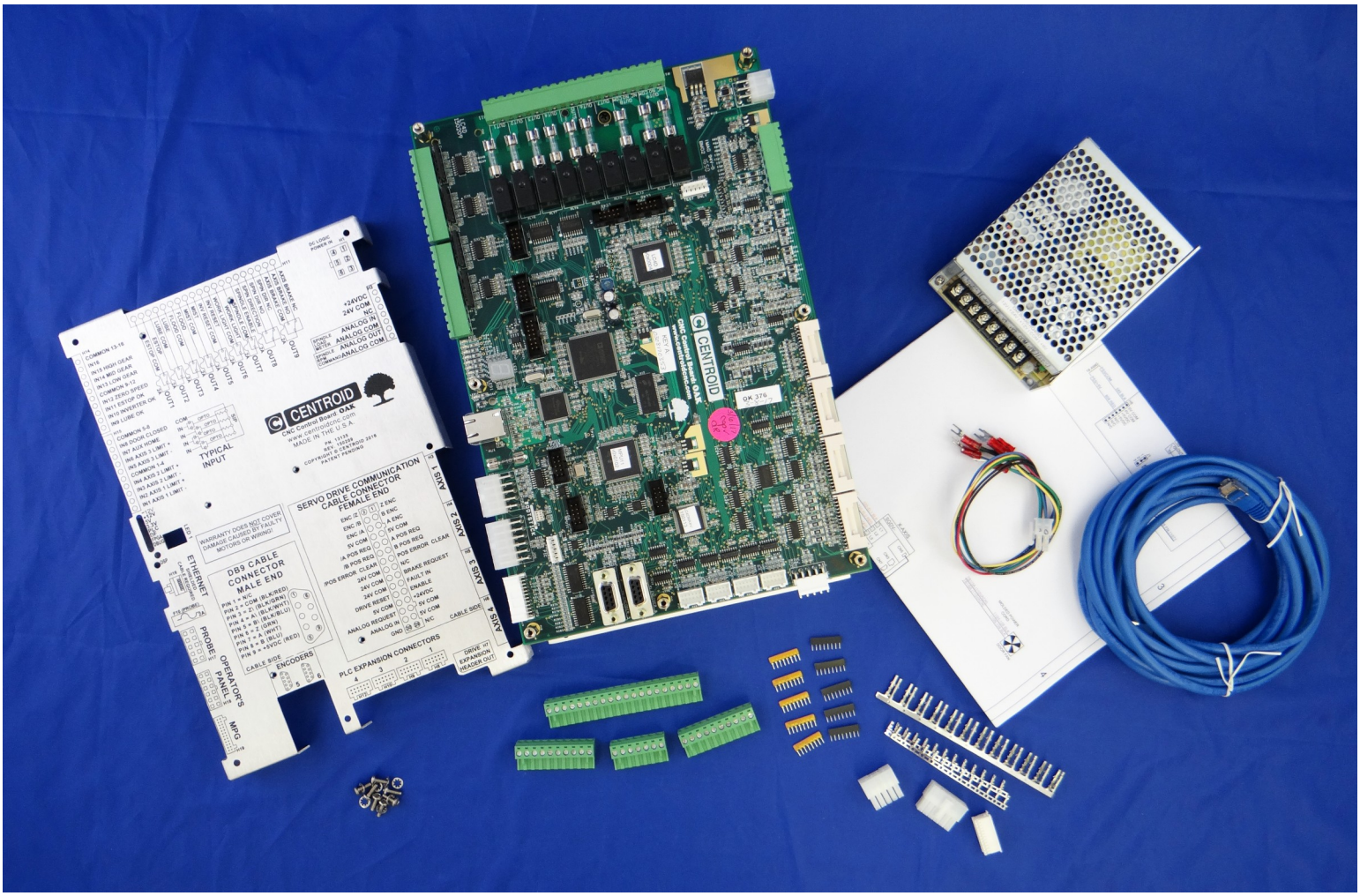
CENTROID Oak CNC Controller Installation Manual

V12 – 01/26/2024



Change log

V12 Author 490 01/26/2024
Updated Sections 3.2 and 4.1 to match v5.08 software install and bench test process.

V11 Author: 423 7/19/2021
Fixing format issues and links from V10 for website. Added License information.

V10 Author: 423 6/1/2020
Update for website

V9 Author: 423 4/19/19
Major Update for CNC12 v4.14

File Location: Z:\Docs_Docs working\Centroid_Oak_Install_manual

SERVO DRIVE WARRANTY DOES **NOT** COVER DAMAGE BY FAULTY MOTORS OR WIRING.

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 support 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.**

Servo Motor Handling

When working with servo motors:

·**NEVER pick up or carry the motor by the cables or the shaft. (Always carry by the frame.) Use a crane or lift to move the motor when necessary.**

·**NEVER drop or subject the motor to impact. The servo motor is a precision device.**

·**NEVER set heavy or sharp objects on the motor or cables. Do not step or sit on the motor or cables.**

·**NEVER use a metal hammer on any part of the motor. If it is absolutely necessary to use a hammer, use a plastic hammer.**

Keep the motor properly secured and away from the edge of the work area when servicing the motor, as a dropped motor could cause personal injury or destroy the motor.

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 instructed to.

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

Be sure to attach a key to a motor with 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.

For Circuit Boards

Minimize handling circuit boards as much as possible. If you must hold a circuit board, grab it by the edges as shown below in figure 2. Avoid touching any of the circuits, components, or component leads. Improper handling lead to ESD (electrostatic discharge) which can damage the PCB, and shorten the operational lifespan.

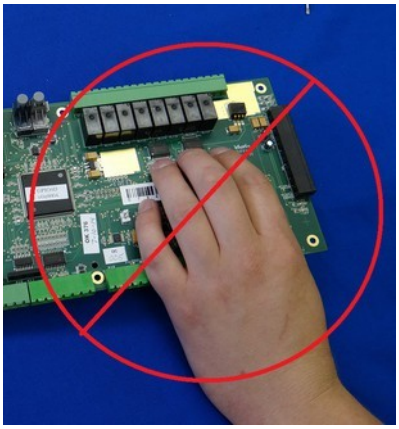


Figure 1.
Improper PCB Handling

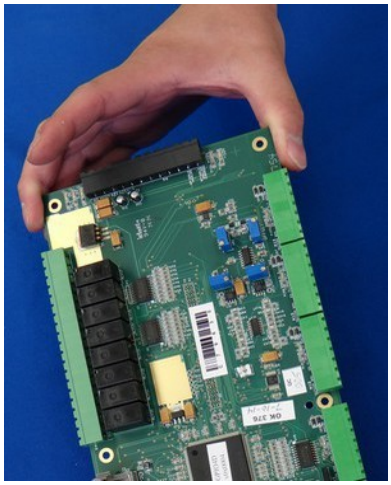


Figure 2.
Proper PCB Handling

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

Table of Contents

INTRODUCTION

This manual describes how to install the Centroid CNC (Computer Numerical Control) system with an OAK CNC Control. The PC based system provides up to four axes (upgradable to eight axes) of closed loop servo interpolated motion, controlled by industry standard G-Codes.

The Oak can be used for the CNC control of milling machines, routers, lathes, flame cutters, plasma cutters, laser cutters, water jet cutters, drill presses, grinders, and other specialized applications.

This installation manual covers the most common Oak hardware setups. For the rest of the manual, we will assume the installation is a three axis mill.

This system is intended to be installed by competent installers, retro-fitters, and machine tool builders who want to do their own installation. This installation manual is not intended for casual end users. Users of this manual should be comfortable with the following:

- basic wiring
- reading basic electrical schematics
- PC skills (copying, pasting, extracting zip files, knowledge of directories)

BEFORE YOU BEGIN

Installing the Centroid CNC12 based Oak Board system is a straight forward process if the directions are followed. Before getting started, please take the time to familiarize yourself with the schematics, manuals and installation instructions.

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 you may run into. Additional troubleshooting is included in the appendices.

USEFUL RESOURCES

Appendix A includes troubleshooting procedures for various common problems.

If you run into a problem first refer to the troubleshooting procedure, then the Appendix.

Centroid Product Manuals: http://www.centroidcnc.com/centroid_diy/centroid_manuals.html

Centroid Schematic Database: https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php

Centroid's YouTube Channel: Centroid CNC Technical Support

martyscncgarage YouTube video series: FADAL TRM meets Centroid (more to come)

Free community support: Centroid Community CNC Support Forum

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

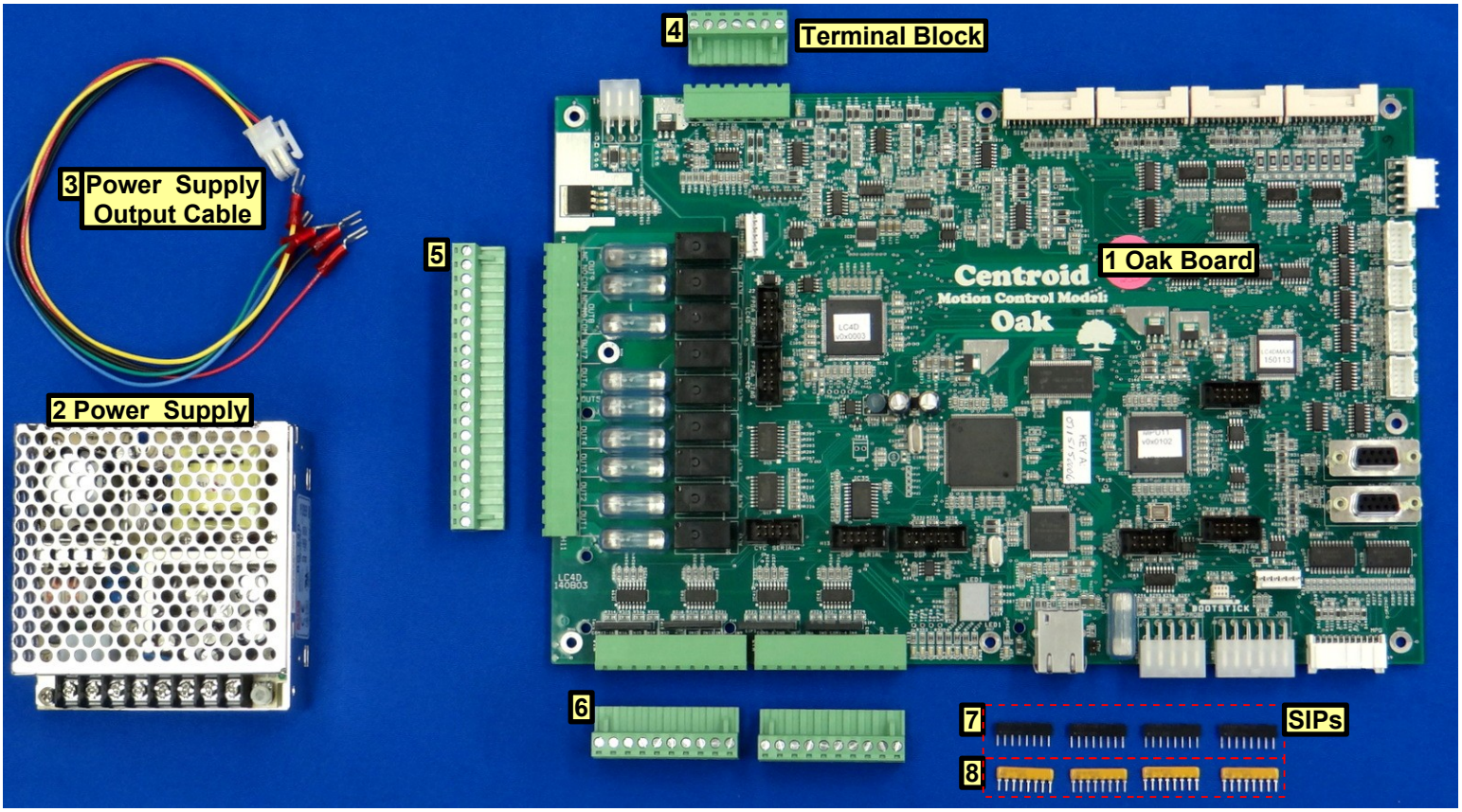
Centroid OAK and Accessories: https://shopcentroidcnc.com/oak-cnc-controller/

Oak Installation Photo Album https://photos.app.goo.gl/RL9DRbY3wzuWJN9L9

Paid factory tech support is available by Phone or Email: Purchase Tech Support

CHAPTER 1 WHAT'S INCLUDED

1.1 OAK BOARD

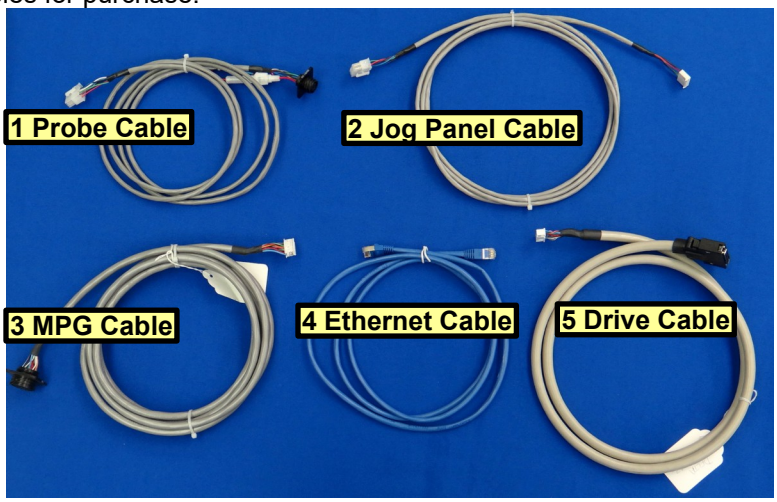


The following components are included with your Oak Board:

1. Oak Board ..... Part Number 13126
2. Power supply..... Part Number 7135
3. Power supply Output cable..... Part Number 13106
4. Seven position terminal block..... Part Number 2611
5. Twenty position terminal block..... Part Number 3450
6. 2 Ten position terminal block..... Part Number 3904
7. 4 Twelve volt SIPs (color and appearance may vary)..... Part Number 4152
8. 4 Five volt SIPs (color and appearance may vary)..... Part Number 3956

1.2 CABLES

Centroid offers the following cables for purchase:

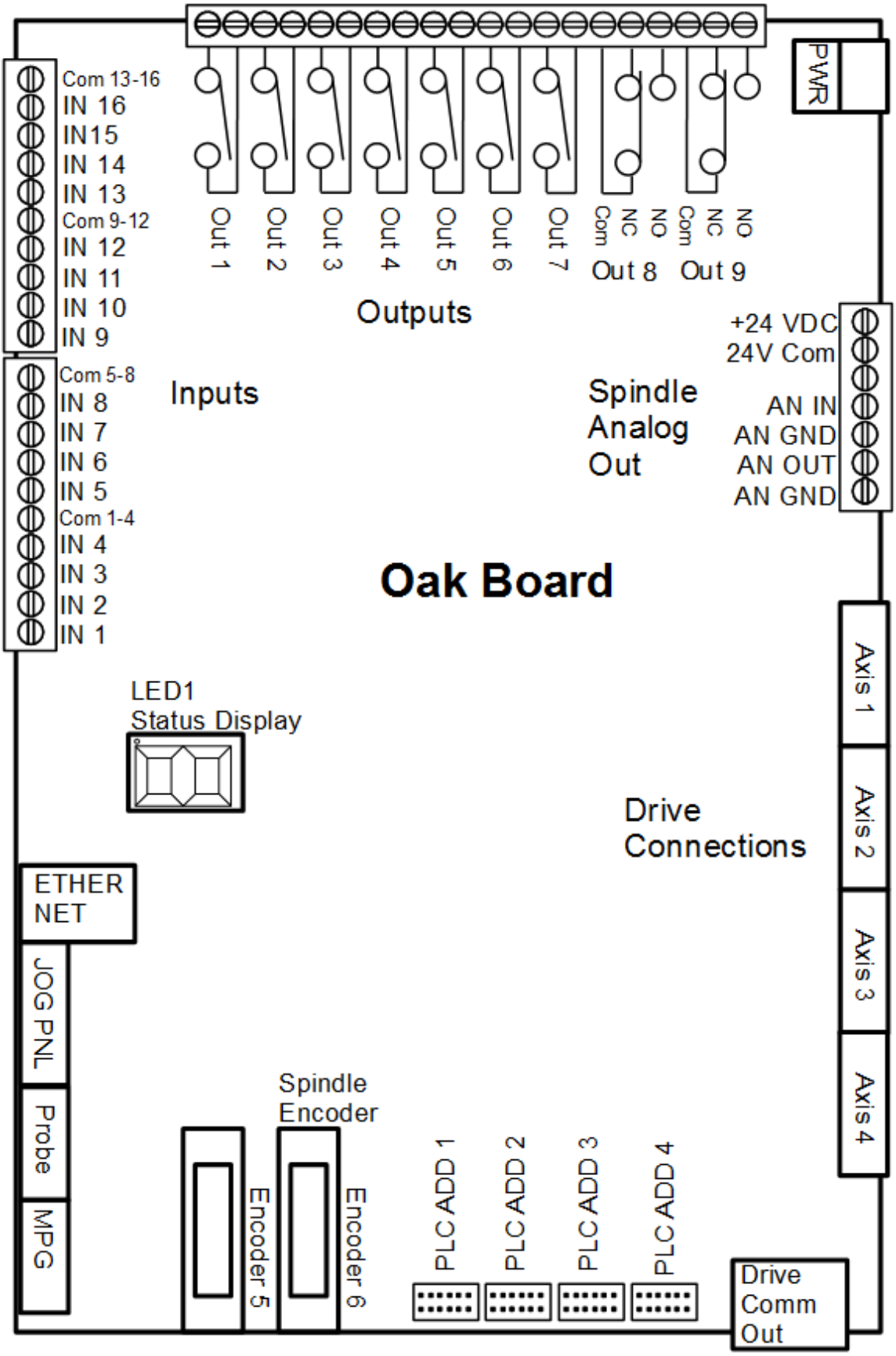


1. Probe Cable (multiple lengths available) ..... Part # 11211
2. Jog Panel Cable (multiple lengths available) (Supplied with Jog Panel)..... Part #12991 (10 ft)
3. MPG Cable (multiple lengths available)..... Part #12987 (10 ft)
4. Ethernet Cable (multiple lengths available)..... Part # 6144 (6 ft), #7269 (15 ft)
5. Drive Cable..... Part Numbers Below

Drive	Centroid Part Number
Delta ASDA-A2	13131
Estun	13132
Yaskawa Sigma I, II, V	13134
Flying Lead	13133

6. Console Extension Cable (Custom Lengths Available) ..... Part Number 11028 (6 ft)
   - Includes Jog, MPG, Ethernet. Console Power, and E-stop cables

1.3 OVERVIEW


PWR
Com 13-16
IN 16
IN15
IN 14
IN 13
Com 9-12
IN 12
IN 11
IN 10
IN 9
Com 5-8
IN 8
IN 7
IN 6
IN 5
Com 1-4
IN 4
IN 3
IN 2
IN 1
Out 1
Out 2
Out 3
Out 4
Out 5
Out 6
Out 7
Com
NC
NO
Out 8
Com
NC
NO
Out 9
Outputs
Inputs
+24 VDC
24V Com
AN IN
AN GND
AN OUT
AN GND
Spindle
Analog
Out
Oak Board
LED1
Status Display
Drive
Connections
Axis 1
Axis 2
Axis 3
Axis 4
ETHER
NET
JOG PNL
Probe
MPG
Spindle
Encoder
Encoder 5
Encoder 6
PLC ADD 1
PLC ADD 2
PLC ADD 3
PLC ADD 4
Drive
Comm
Out

CHAPTER 2 CONNECTING COMPONENTS FOR A BENCH TEST

The first step in installing the new system is performing a bench test. A "bench test" consists of connecting all of the electronics together to test them **before** installing the system in a machine.

The bench test **ALWAYS** needs to be performed **BEFORE** applying **HIGH VOLTAGE** to the drive, not bench testing could cause physical harm to the technician or operator and permanent damage to the hardware.

Bench Testing the Oak is shown in martyscncgarage video: Centroid CNC Oak CNC12 4 14 Software Install and Oak Benchtest

2.1 BENCH TEST – TOOLS AND EQUIPMENT

- **Picking a good location:** A bench test needs to be performed on a large table or desk with good lighting and easy access to electrical outlets.
    - **A clean wooden surface is an ideal test bench location**.
    - The surface should **NOT** be made out of metal or contain metal scraps or shavings.
- Some method of powering the board on and off. An outlet strip with an "on/off" switch and some 120VAC power cords is the recommended and easiest method.
- A PC with an internet connection, or a Centroid console unit (comes with CNC12 already installed).

    Note: The PC must meet the specifications listed in Technical Bulletin 273, which can be found here: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/273.pdf)
- Small screw driver set
- Digital Multimeter
- Some method of splicing wires such as crimp terminals or a terminal block.
- Wire Strippers

2.2 Bench Test – Power Supply Configuration

Connect Oak Board to the power supply: Follow the instructions below.

1) Connect the supplied cables to the Mean Well power supply and the plug labeled Power on the Oak board. Connect position 1 and 2 from H1 on the Oak Board to V4 and COM respectively.

2) Splice a 110 V power cord to the power supply AC input. Live to L, Neutral to N, and Ground to ground.

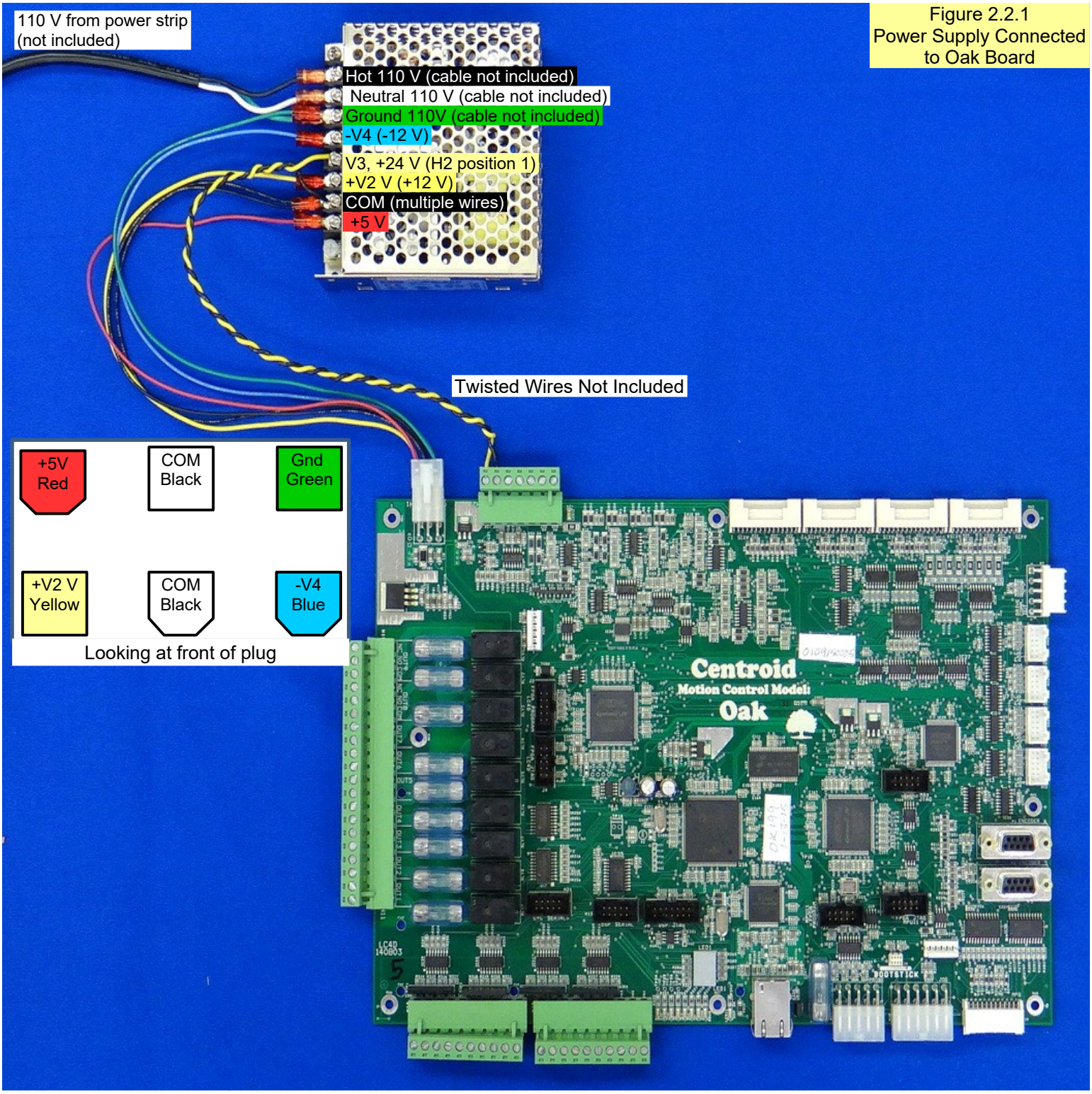


Figure 2.2.1
Power Supply Connected to Oak Board

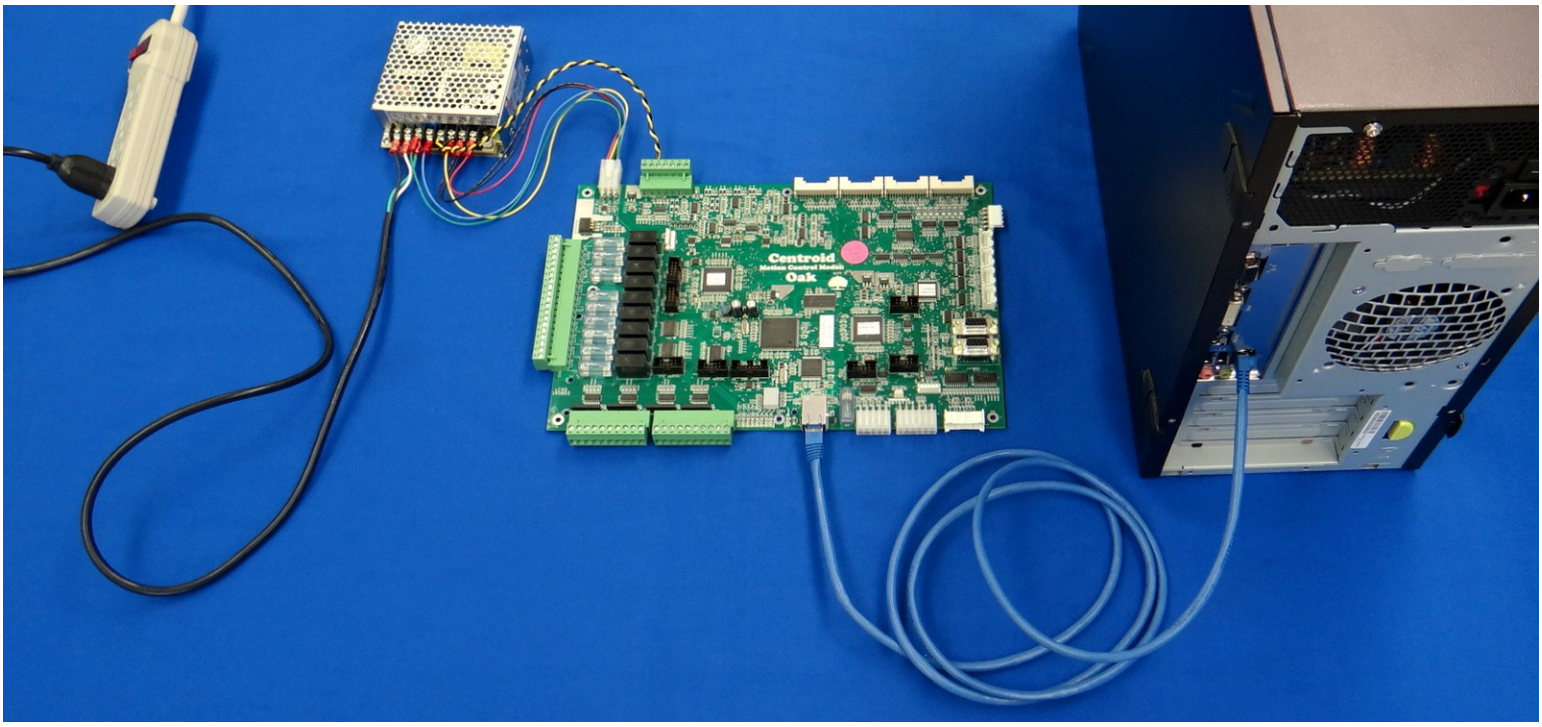
2.3 Bench Test – Communication Configuration

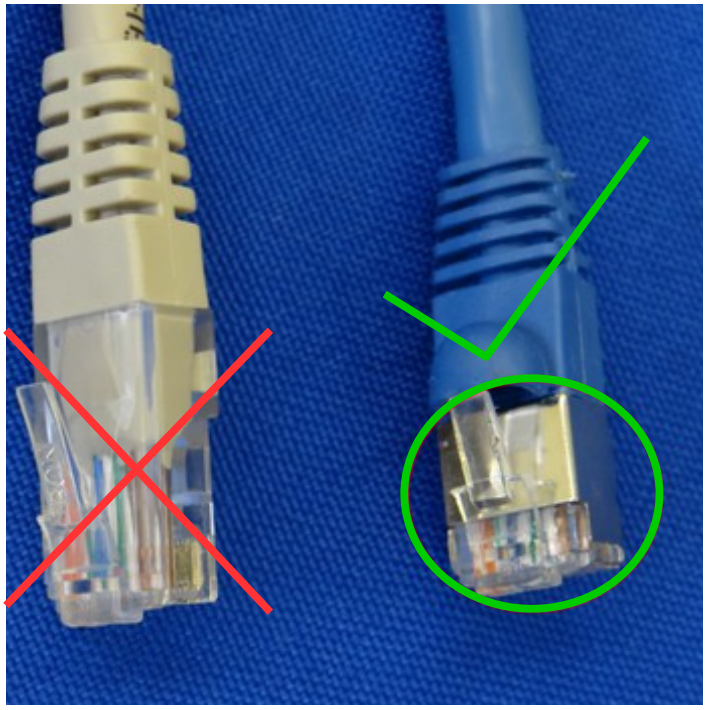
Connect the Shielded Ethernet Cable: Connect a shielded Ethernet cable from your Oak Board to the PC.

- A shielded Ethernet cable will have a metal clip around the RJ-45 connector as shown on the cable on the right in Figure 2.3.1.

- Centroid recommends using snagless patch cables from StarTech. Use the shortest practical cables. This information is outlined in Technical Bulletin 251. The latest version can be found here: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/251.pdf

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





Length (ft)	Centroid Part Number
6	6144
15	7269
25	6143

Figure 2.3.2
Unshielded Ethernet cable (left) compared to
Shielded Ethernet cable (right)

2.4 Bench Test – Connecting Accessories

Connect Any Accessories: Connect optional accessories

- If a Jog Panel/Pendant or MPG was ordered, please connect it to the Oak Board as seen in Figures 2.4.1 and 2.4.2.

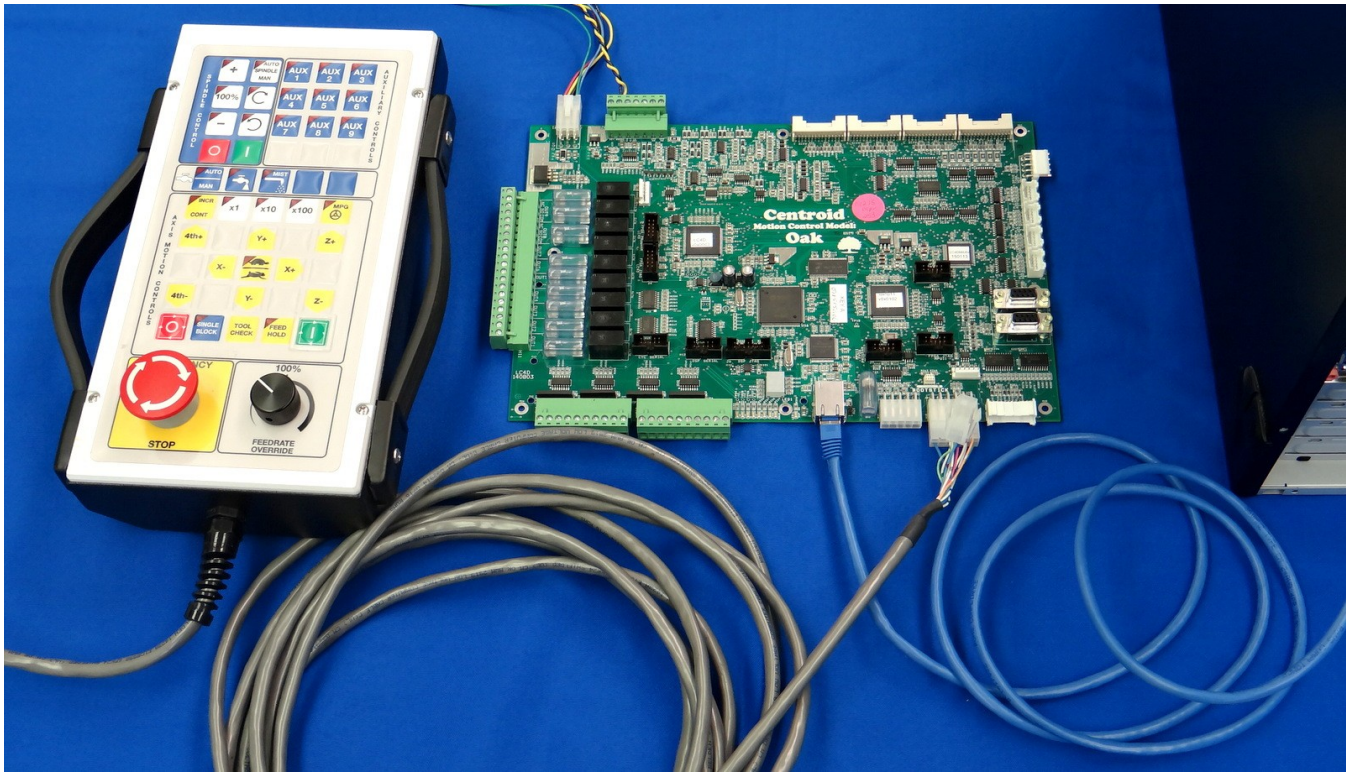


Figure 2.4.1
Jog Pendant

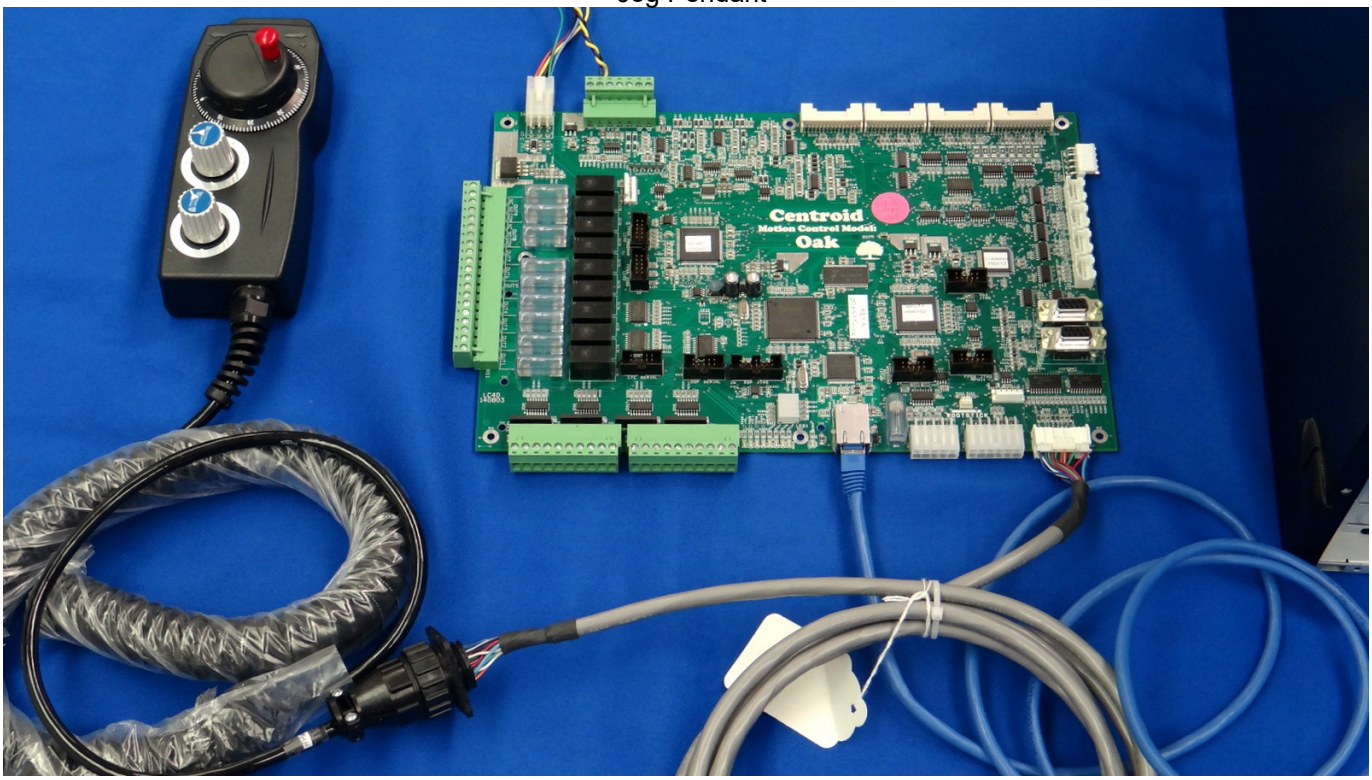


Figure 2.4.2
MPG

2.5 Bench Test – Powering On & Verifying LED States

Before you begin:

Before powering on, verify that nothing metallic can touch the circuit boards and cause a short. Make sure all wiring is firmly in place.

Switch the outlet strip on: Powering the Oak Board and any accessories.

Oak Board Status LED states:

After 15-30 seconds the status LED's should all be solid on except for DEBUG, which should flash once per second, and DF, which doesn't turn on until the software is installed.

Figure 2.5.1 shows where these status LED's are located.

If they are not all on, or the DSP DEBUG is flashing faster than once per second, refer to the table below for troubleshooting.

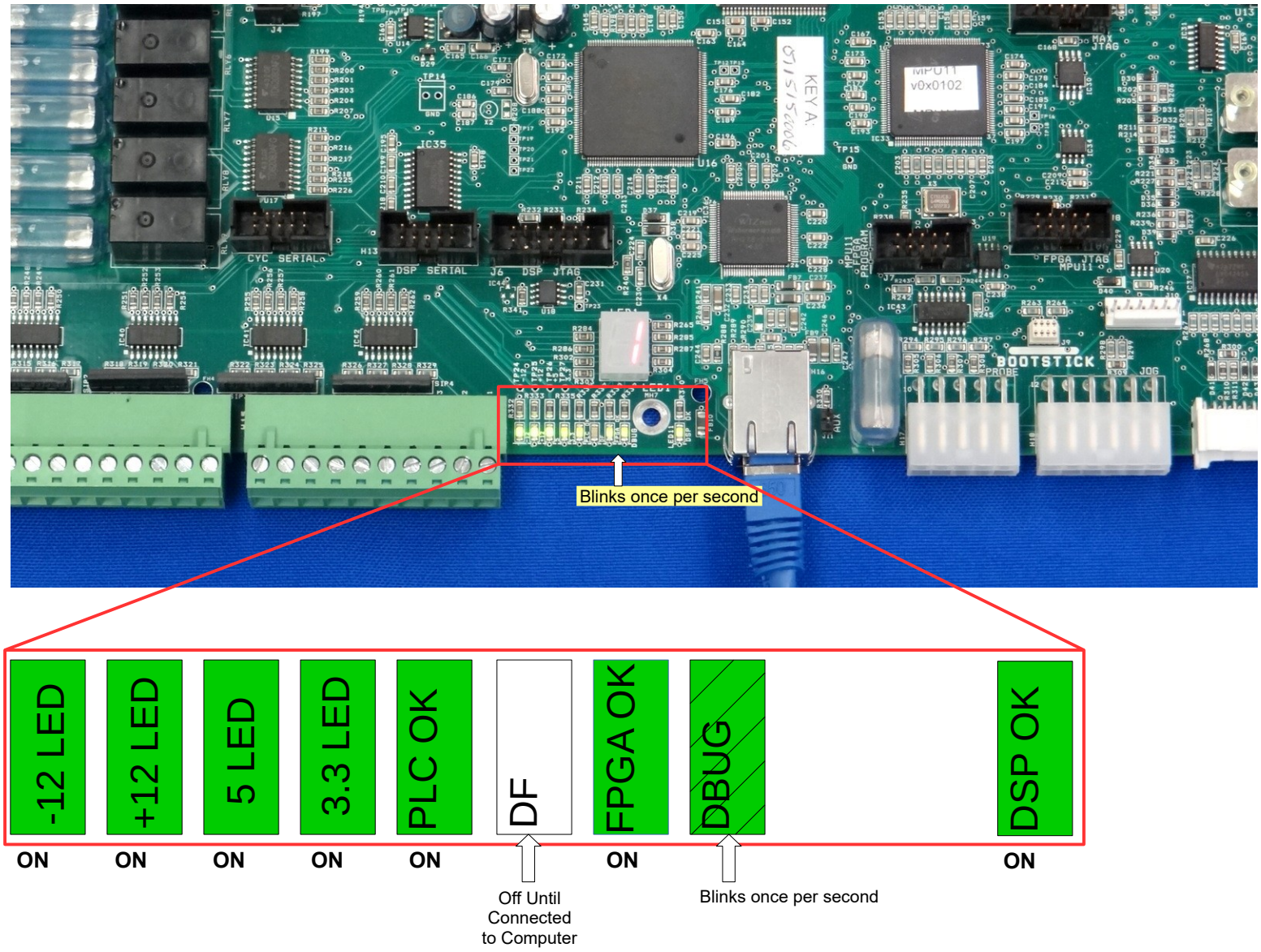


Figure 2.5.1
Status LEDs on the Oak Board

Oak Board Status LED Troubleshooting		
LED Symptom	**Possible Cause**	**Corrective Action**
All status LED's out	Logic power not applied	Measure AC coming into power supply, correct wiring or supply problems
5, 3.3, 12, or -12 LED out	Power supply or connection problem	Measure AC coming into power supply, correct wiring or supply problems
FPGA LED not lit	Oak not ready	Wait 45 seconds
	Internal Fault	Return for repair
DSP LED not lit	Oak is booting up	Wait 45 Seconds
DSP DEBUG LED flashing fast	Detecting hardware	Wait to detect hardware
DSP DEBUG LED flashing one time per second	New drive protocols active	None, normal operation
DSP DEBUG LED flashing two times per second	Legacy drive protocols active	Internal fault, only new protocols should be in use, return for repair
DF LED out	Motion control processor section hasn't booted up	Start software, wait for the main screen to load
	"Servo Power Removed" due to fault	Restart system to reset runaway or other serious fault condition
PLC OK LED out	Motion control processor section hasn't booted up	Start software, wait for the main screen to load
LED1 display flashing with decimal point lit	An error condition has been detected	See the "LED1 Error Codes" section in Oak Manual for details on the error

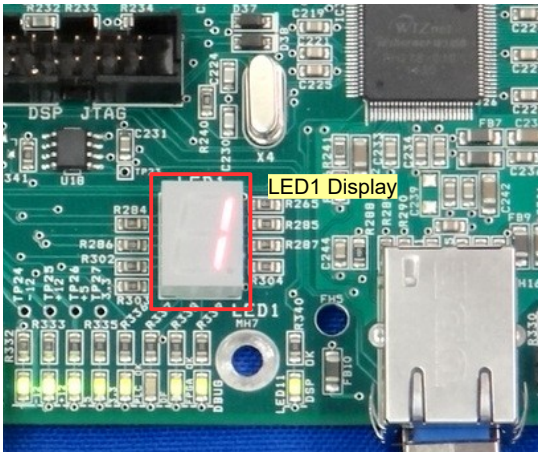


Figure 2.5.2
LED1 Display

CHAPTER 3 SOFTWARE INSTALLATION

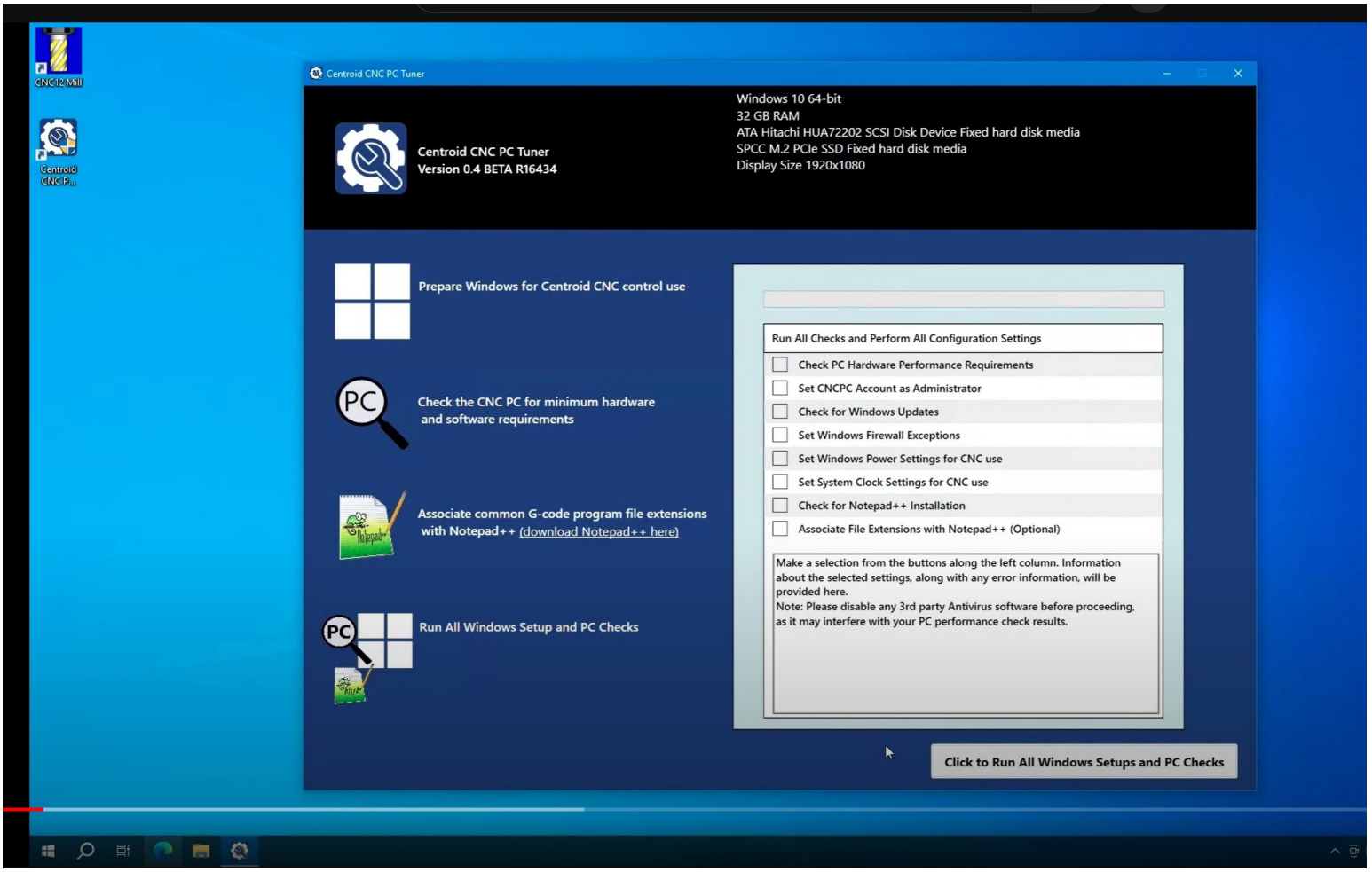
3.1 WINDOWS SOFTWARE PREINSTALLATION

1. If you have purchased a console unit or computer from Centroid, it already 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 http://www.centroidcnc.com/cnc_pc_performance_requirements.html and Tech Bulletin 273 - Centroid CNC PC Minimum Hardware and Benchmark Requirements

2. To configure your own computer running Microsoft Windows 10 or 11, and setup the CNC PC following the instructions in TB 309.

   Note: Microsoft Windows 10 and 11 are supported with CNC12. Microsoft Windows 8.1, 7 and older versions of Windows are not supported. Mac OS and Linux operating systems are also not supported.

   Run the Centroid PC Tuner and have the PC Tuner do most of the work for you. Download the PC Tuner here: https://www.centroidcnc.com/centroid_diy/centroid_cnc_software_downloads.html



See the Centroid PC Tuner Video. https://youtu.be/bOZVMMdzOj8

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

   1) **Nearly 100% of all communication problems between CNC12 and the OAK 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 OAK 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.

   2) 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.

      Detailed How to Solve Communication Problems information is found in TB270
      https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf

3.2 CNC 12 SOFTWARE INSTALLATION

With your bench configuration completely powered as described in Section 2.4 and your PC powered up, install the CNC12 Software as follows:

1. **Download the latest CNC12 Software version.** It is important that you download the latest version of the Centroid CNC12 software before continuing. Click on the link to download the latest version of CNC12 software: Centroid Software

2. **Navigate to the CNC12 Software you just downloaded.** Depending on your Windows settings, the file you downloaded will be displayed as "centroid_cnc12_v5.08_installer_x64.zip". Double click this zip folder.

3. **Drag the installation folder from the compressed file to your desktop as shown below in Figure 3.2.1.** The folder in this example is called centroid_cnc12_v5.08_installer_x64.zip, your version may be newer but the name will be the same other than the "v5.08" which signifies the CNC12 version. Alternatively, you may extract the .zip folder to your desktop.

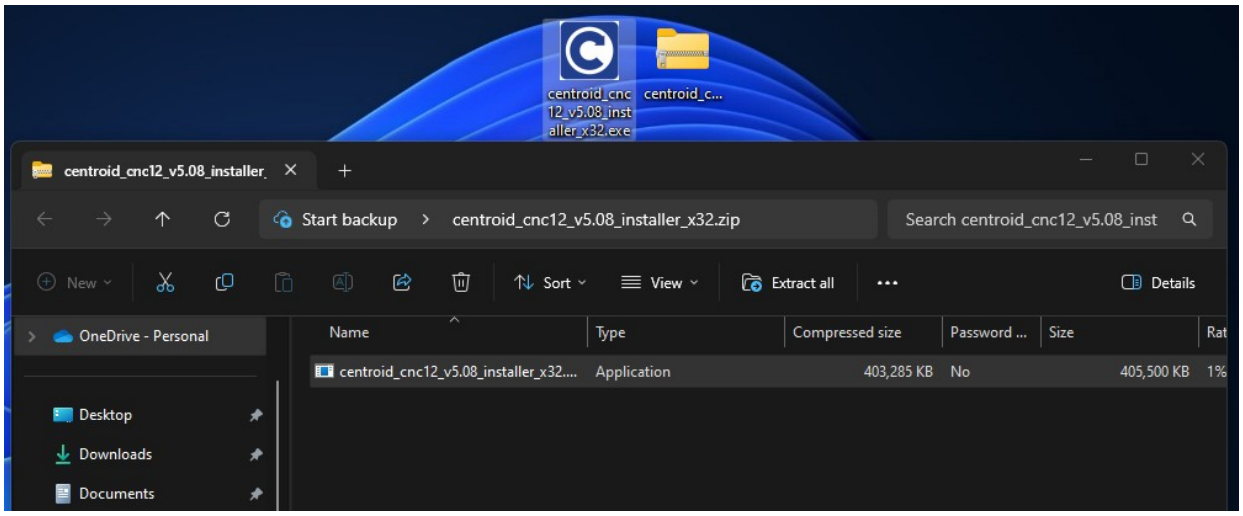


Figure 3.2.1
Copy to desktop

4. **Double click the install application to begin CNC12 install.** NOTE: The Oak MUST be powered on and connected to the PC via Ethernet cable before running the installer.

5. If "**User Account Control**" is enabled, Windows will ask **"***Do you want to allow the following program from an unknown publisher to make changes on this computer?***"**. Click "**Yes**". Windows 10 systems may pop up a Windows Defender SmartScreen showing "Windows Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk". Click "More info", Then Click "Run anyway"

6. **Read License Agreement** Read the Software license agreement for using the CNC12 Software. If you accept the terms of the agreement, click "I Agree" to continue, Otherwise, click "Cancel" as seen in figure 3.2.2.

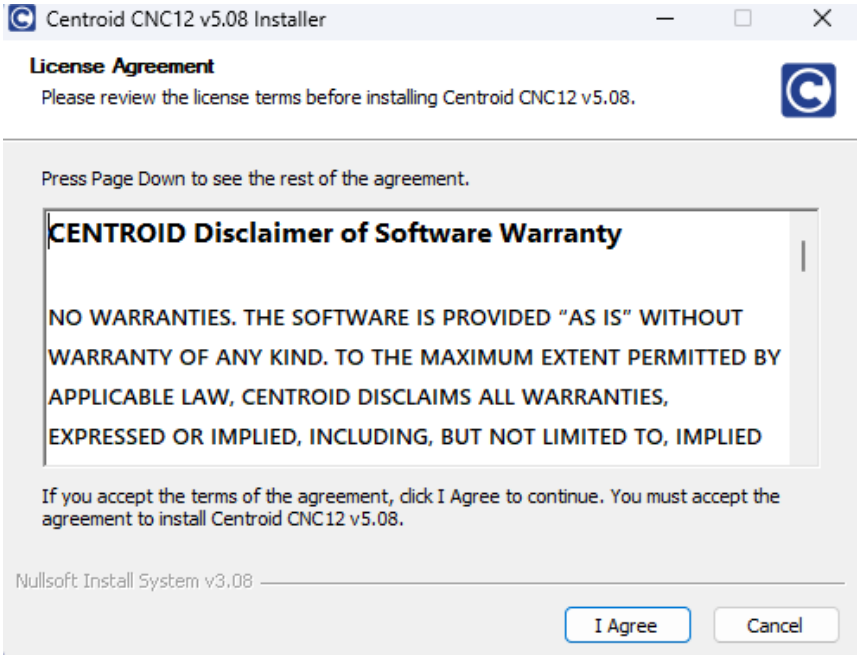


Figure 3.2.2
License Agreement

7. **Installer Options.** Select the option to Install Desktop Shortcuts shown in Figure 3.2.3. If desired, also select the option to start CNC12 at Startup. Click "Next" to continue.

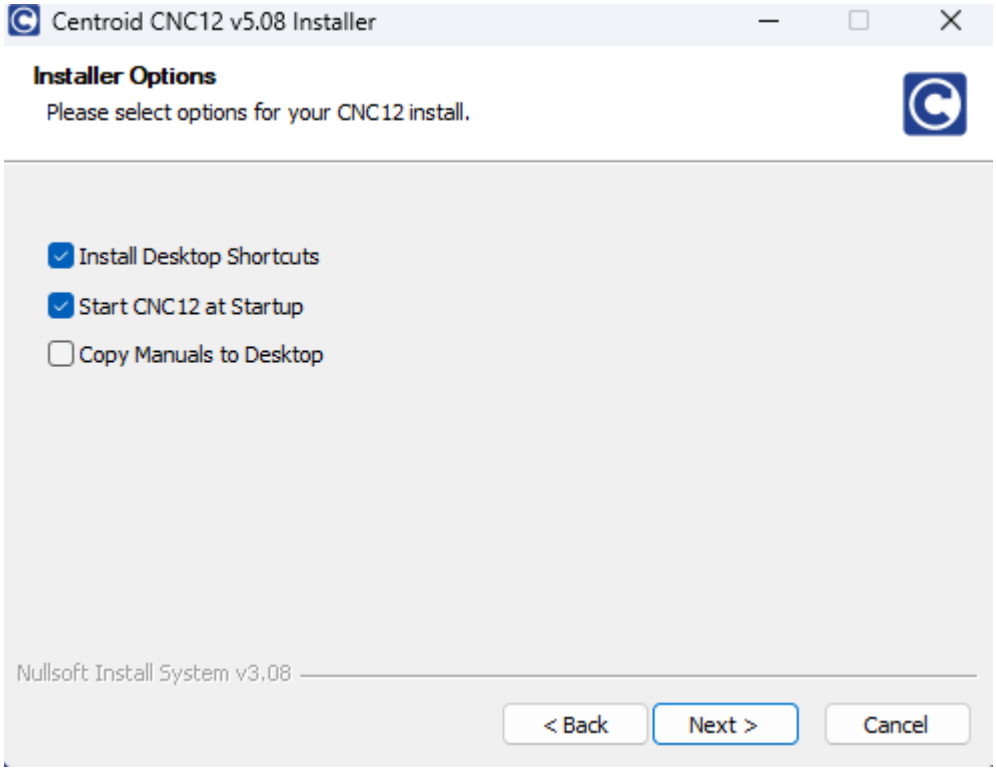


Figure 3.2.3
Installer Options

8. **Installer Options – Control board model**. Select “Oak/Allin1DC/MPU11” component of CNC12 shown in Figure 3.2.4.

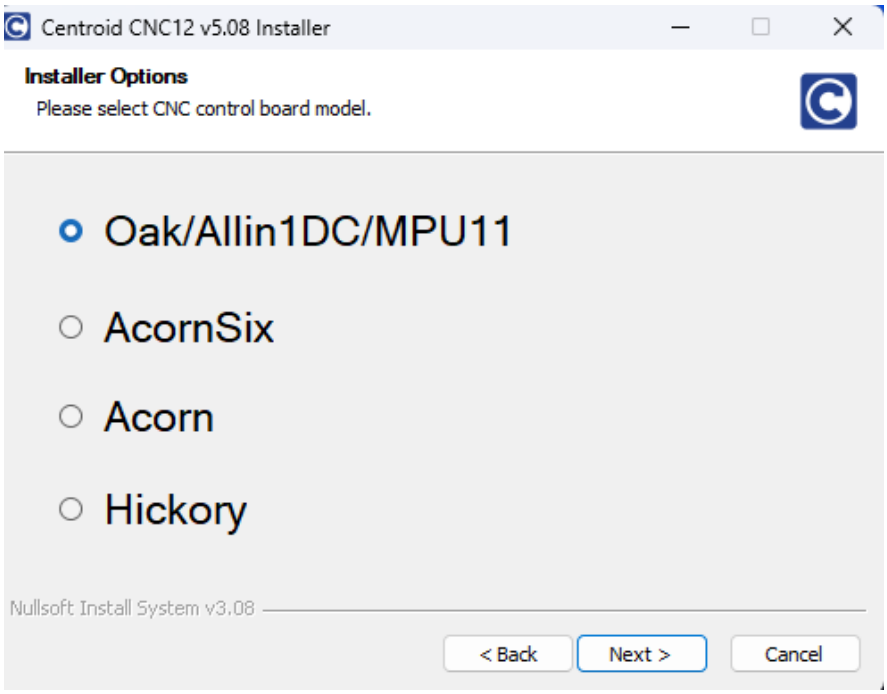


Figure 3.2.4
Select CNC control board model

9. Select **CNC12 Mill** for a Mill installation as shown in Figure 3.2.5.

   Select **CNC12 Lathe** for a Lathe installation. For the remainder of this document we will assume the system is being installed on a mill.

   Click “Next” to continue.

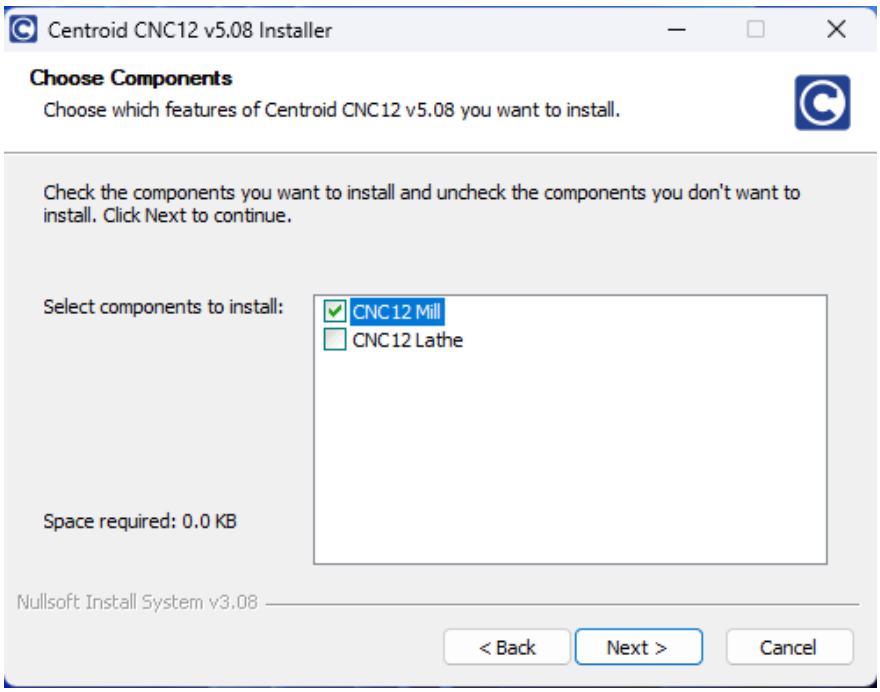


Figure 3.2.5
Choose Components

10. **Select Units.** Select the default units by CNC12, either “Imperial” or “Metric” (Figure 3.2.6). Click “Install” to begin the installation.

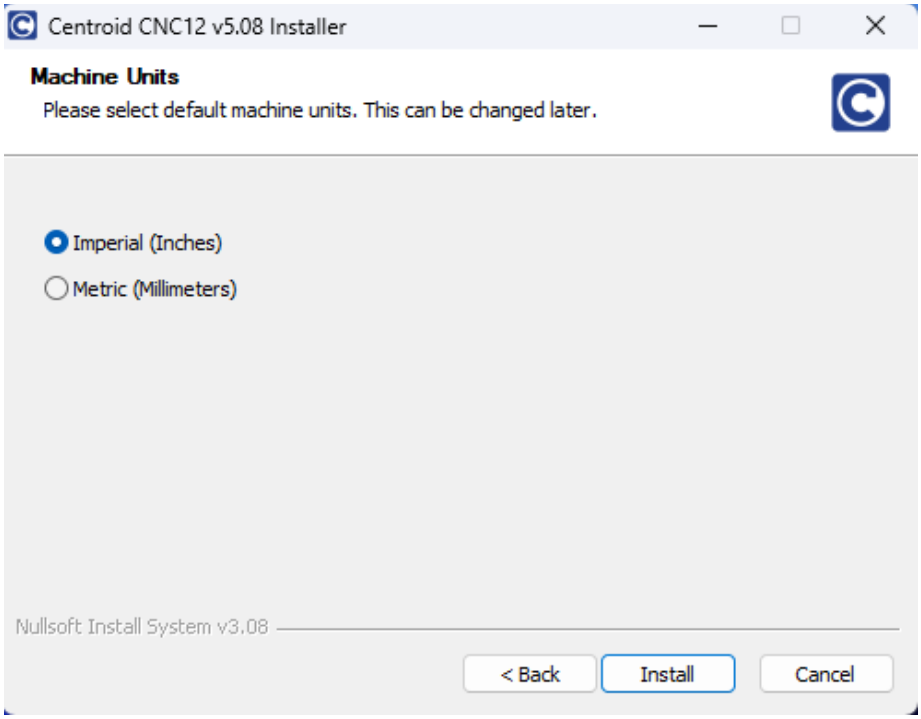


Figure 3.2.6
Select Units

11. **Installation.** The CNC12 files will now be installed, and the “**Installation Complete**” screen (Figure 3.2.7) should appear when it finishes. Click “Next” to continue.

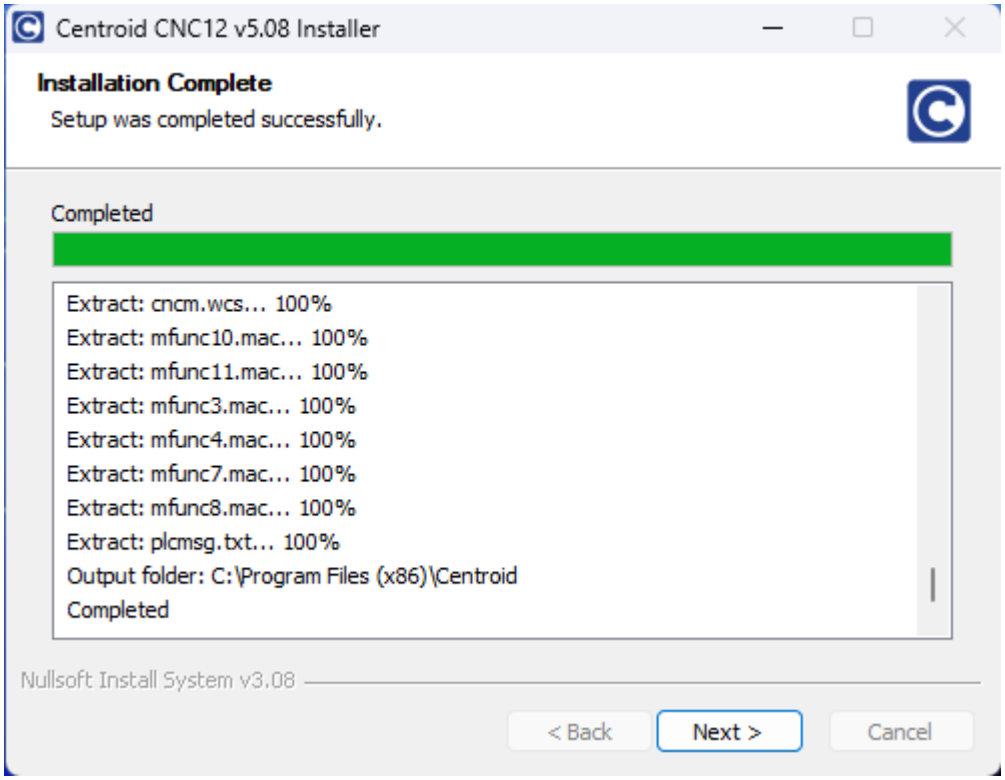


Figure 3.2.7
Installation Complete

12. **Network Adapter Setup:** (**REMINDER**: Oak needs to be powered up and connected to the CNC PC via the provided Ethernet Cable).
    1. If the Ethernet Adapter has already been set up for CNC use, you will see a screen as shown in Figure 3.2.8. Select "Yes" to continue.

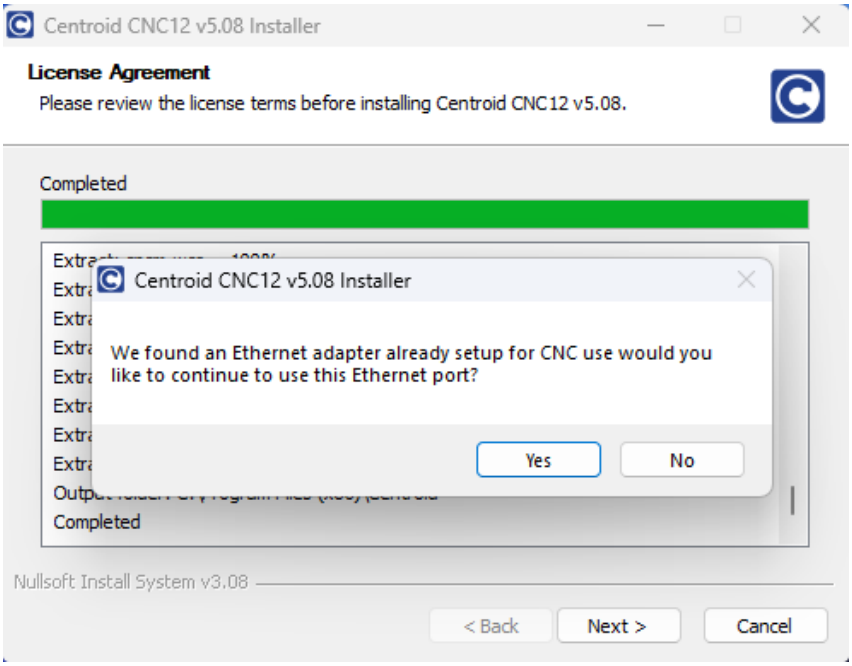


Figure 3.2.8
Network Adapter Setup

    2. If the Ethernet Adapter has not yet been set up for CNC control, you will see a screen as shown in Figure 3.2.9. 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".

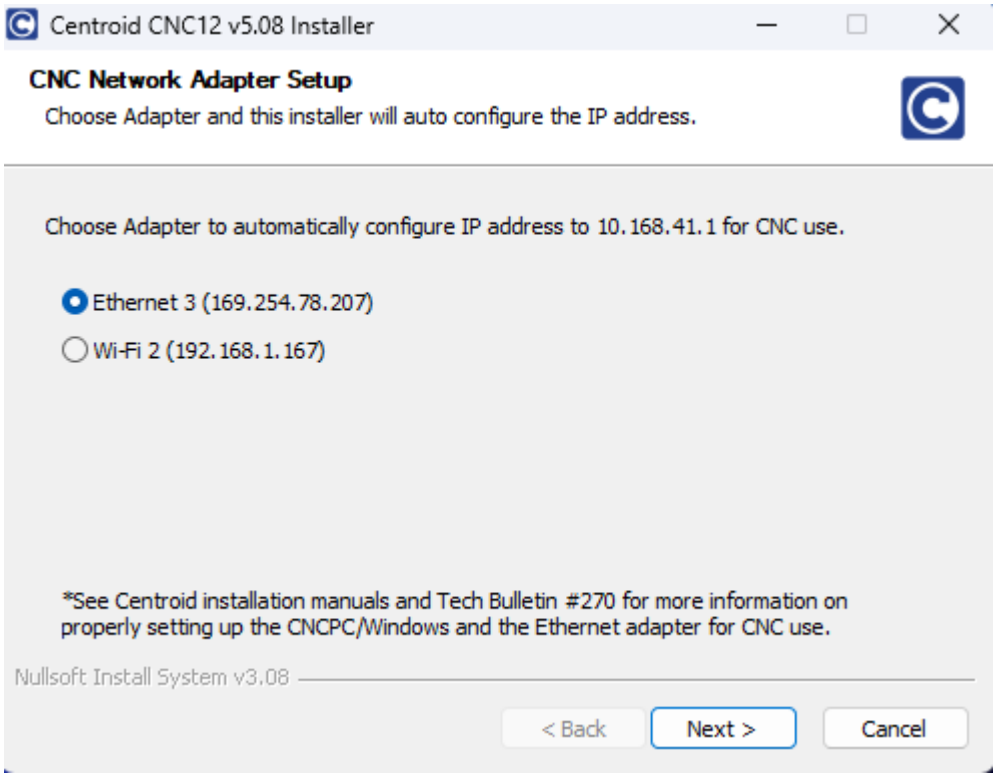


Figure 3.2.9
Ethernet Adapter Setup

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.

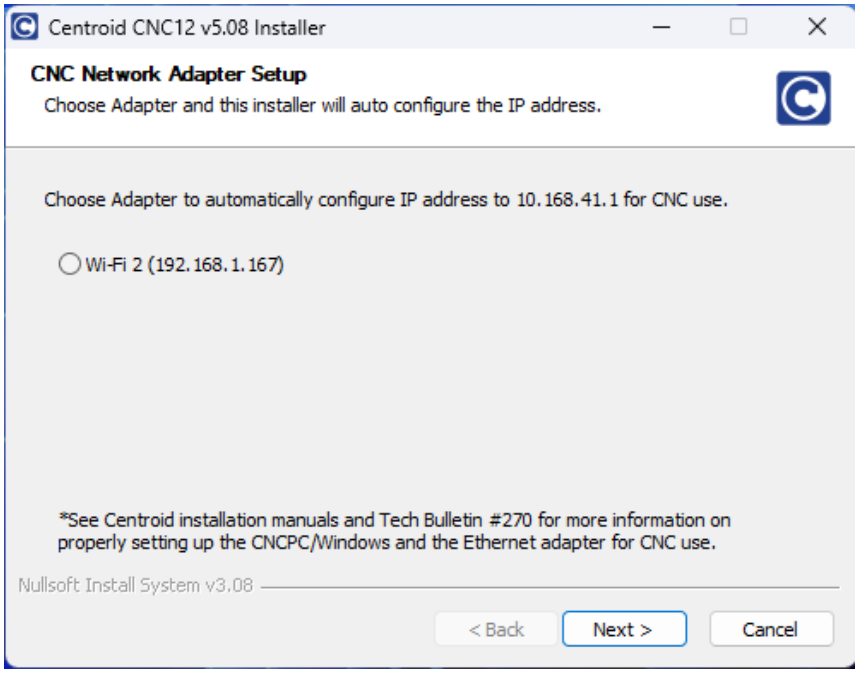


Figure 3.2.10
No Ethernet Adapter

4. **NOTE**: Centroid recommends using a computer with two Ethernet ports. One Ethernet port and one Wifi adapter is also acceptable. That way one Ethernet port is used for the OAK, 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 software will install to the correct Ethernet port.

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

13. **Installing a PLC program:** After the CNC12 software has been installed, the installer will prompt you to install a PLC program, select "**Yes**". This will open the PLC installer. Click on the "+" signs next to Mill and OAK. Click on "**_Centroid_Standard**", then click either "**Install**" option as shown in Figure 3.2.11.

    1. **NOTE**: If you have a Lathe the path is _Lathe → _OAK → _Centroid_Standard. Make sure to select the correct PLC for your machine.

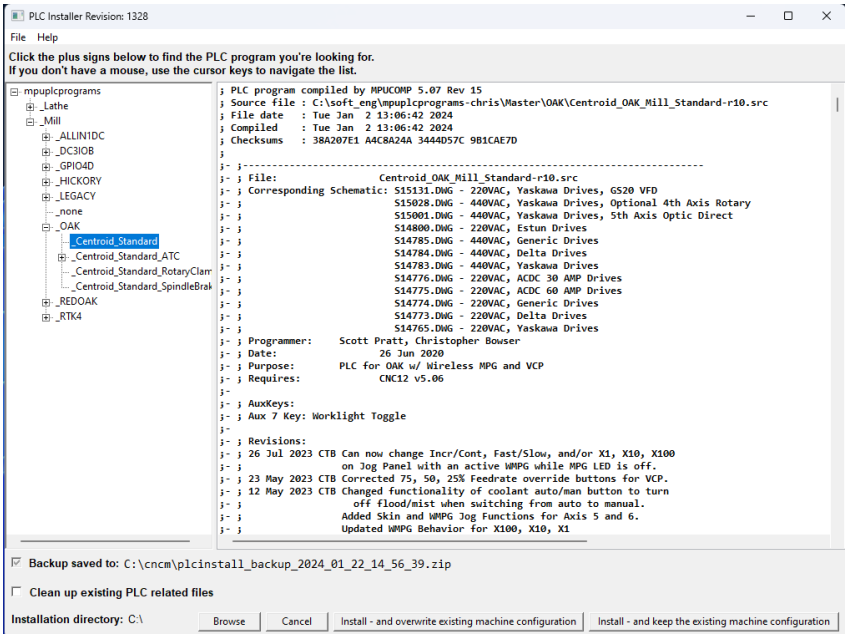


Figure 3.2.11
Install PLC program

    2. **NOTE:** The following is a quick reference explaining each PLC program and which schematics work with the program. The Standard OAK schematics can be downloaded here:
    https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php
    The latest version of the Chart is available as Tech bulletin 312 – Standard PLC Program Quick Reference

TB312 (Rev 0) – Standard PLC Program Quick Reference

Purpose: Provide a quick reference of all Centroid Standard PLC programs so end users can choose an appropriate program that matches the system schematic

Machine Type	Control Type	Machine Features	Feature Type	PLC Program	Purpose	Schematic
Mill	ALLin1DC	Standard		Centroid-Mill-Standard-ALLIN1DC-r2.src	PLC for ALLIN1DC w/ wireless MPG and VCP	S14745, S14746, S14747, S14748, S14749, S14750, S14751, S14752, S14753, S14754, S14760
		Standard_ATC	Swingarm			
			Umbrella	Centroid-Mill-Standard-ALLIN1DC-ATC-Umbrella.src	PLC for MPU11 and allin1dc, 16/16 umbrella atc	S14817
			umbrella_no_throwaway-std-io	Centroid-Mill-Standard-ALLIN1DC-ATC-Umbrella-Skip-First-Count.src	PLC for MPU11 and allin1dc, standardized I/O, 16/16 umbrella atc with no throwaway count on carousel reversal	
		Custom	BP-Boss	Centroid-Mill-Standard-ALLIN1DC-BP-Boss-r2.src	PLC for ALLIN1DC w/ wireless MPG and VCP	S14755, S14756, S14757
Lathe	ALLin1DC	Standard		Centroid-Lathe-Standard-ALLIN1DC-r2.src	PLC for ALLIN1DC w/ wireless MPG and VCP	S14758, S14761, S14762
Machine Type	**Control Type**	**Machine Features**	**Feature Type**	**PLC Program**	**Purpose**	**Schematic**
Mill	Oak	Standard		Centroid-Mill-Standard-OAK-r2.src	PLC for OAK w/ VCP and wireless mpg	S14765, S14773, S14774, S14775, S14776, S14783, S14784, S14785,
		Standard_ATC	Umbrella	Centroid-Mill-Standard-OAK-ATC-Umbrella.src	PLC for OAK Board and umbrella ATC	S14798, S14804
Lathe	Oak	Standard		Centroid-Lathe-Standard-OAK-r2.src	PLC for ALLIN1DC w/ wireless MPG and VCP	S14777, S14778, S14780, S14786, S14787, S14788
		Custom	8 Tool electric turret	oak-lathe-8te-v2.src	Basic Lathe PLC program for OAK with 8-tool turret	S14789, S14791,

14. **Click "Ok" to complete CNC12 software installation**. After the PLC program installation has completed, click "Ok" to complete the installation.

15. **Power off the computer and OAK, then restart everything.**

16. Confirm that CNC12 starts up correctly. Close CNC12 and continue on to the next step.

    1. **NOTE** On wide screen monitors, CNC12 will only take up 2/3rds of the monitor screen while running in "full screen". Turning on Virtual Control Panel will fill the rest of this space.

Troubleshooting

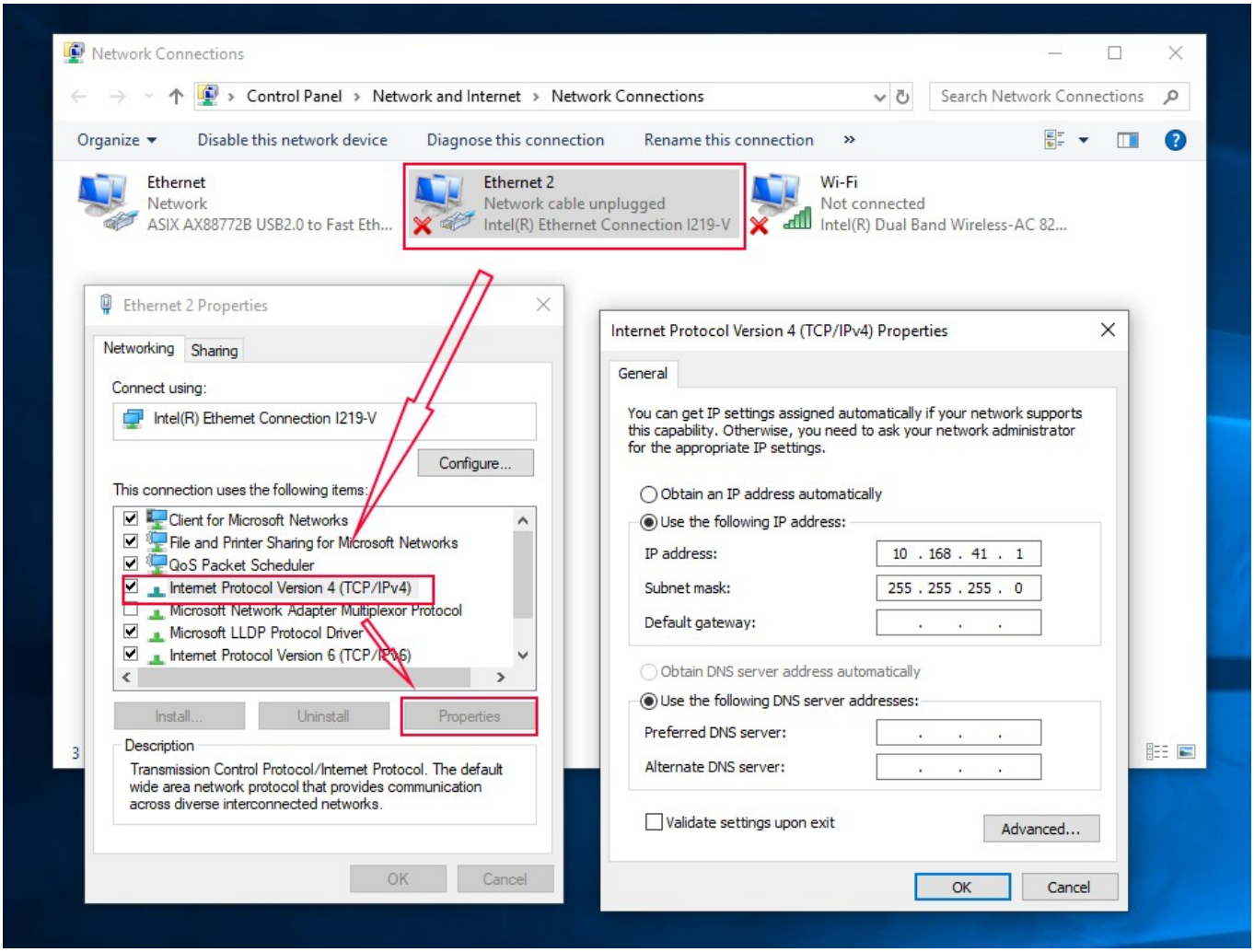
If you clicked on the CNC12 icon to start the software and you are getting "**Timeout: MPU11 not responding**" errors, you most likely didn't have the right Ethernet port configured correctly.

Check your Ethernet card to make sure it is configured properly.
Go to "**Control Panel**", select "**Network and Internet**", and then "**Network and Sharing Center**". Click on "**View network computers and devices**", Click on the "**Ethernet _**" for the connection being used by the OAK, select "**Properties**". Highlight "I**nternet Protocol Version 4 (TCP/IPv4)**", then click "**Properties**" again.
Select "**Use the following IP address**" then set the IP address and Subnet mask to:

IP address: 10.168. 41.1
Subnet mask: 255.255.255.0

Figure 2.5.8
Make a firewall exception

Click **OK** and then try to start the CNC12 software again.
For more in troubleshooting see Appendices C.


Network Connections
Control Panel › Network and Internet › Network Connections
Search Network Connections
Organize
Disable this network device
Diagnose this connection
Rename this connection
Ethernet
Network
ASIX AX88772B USB2.0 to Fast Eth...
Ethernet 2
Network cable unplugged
Intel(R) Ethernet Connection I219-V
Wi-Fi
Not connected
Intel(R) Dual Band Wireless-AC 82...
Ethernet 2 Properties
Networking
Sharing
Connect using:
Intel(R) Ethernet Connection I219-V
Configure...
This connection uses the following items:
Client for Microsoft Networks
File and Printer Sharing for Microsoft Networks
QoS Packet Scheduler
Internet Protocol Version 4 (TCP/IPv4)
Microsoft Network Adapter Multiplexor Protocol
Microsoft LLDP Protocol Driver
Internet Protocol Version 6 (TCP/IPv6)
Install...
Uninstall
Properties
Description
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.
OK
Cancel
Internet Protocol Version 4 (TCP/IPv4) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
10 . 168 . 41 . 1
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

CHAPTER 4 CONFIGURING FOR A BENCH TEST

4.1 BENCH TEST – CNC12 SOFTWARE CONFIGURATION

If your software has been configured correctly, you should see the screen below, Figure 4.1.1. If CNC12 does not start because it timed out waiting for the MPU11, see the troubleshooting listed above and **Appendix C**. If you see messages saying "Warning: precision mode _ axis with zero delay…": these warnings can be ignored for now, press any button to continue.

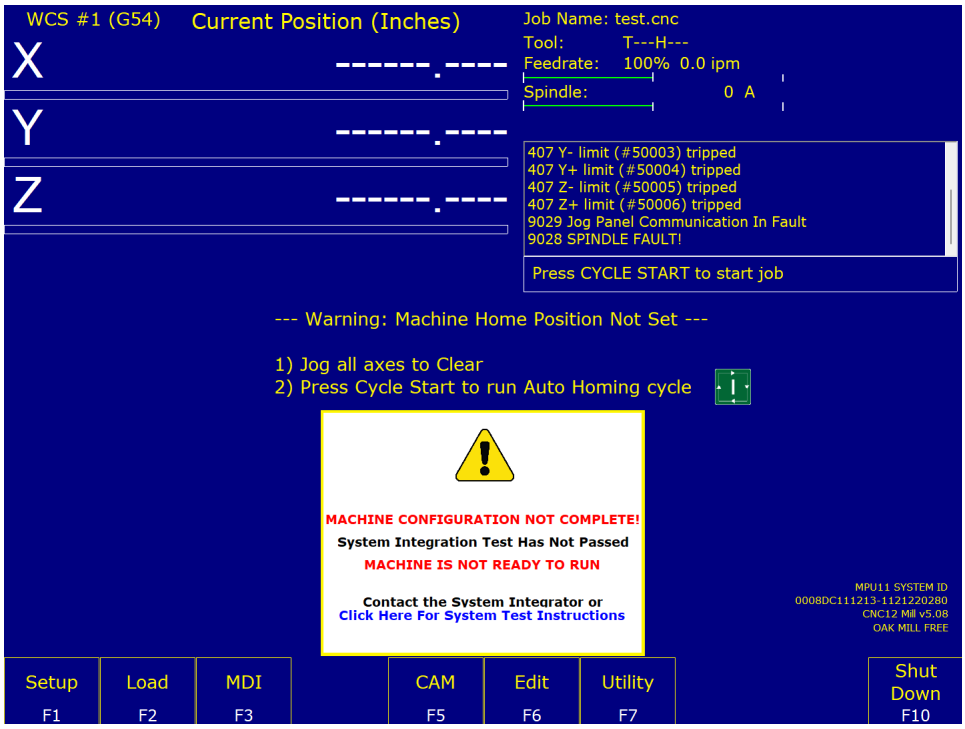


Figure 4.1.1
Initial CNC12 Startup

CNC12 can be run using the default free version, but certain software capabilities are locked unless a Pro or Ultimate license is purchased. For an overview of the features included with the Pro and Ultimate licenses, or to purchase a license visit https://shopcentroidcnc.com/shop/cnc-software/cnc12-mill-cnc-software-license/ for a mill license or https://shopcentroidcnc.com/shop/cnc-software/cnc12-lathe-cnc-software-license/ for a lathe license.
If you have already purchased a license, follow the instructions below for importing the license.

1. From the main startup screen, press **F7 – Utility** to enter the Utility Menu. Then press **F8 – Option**.

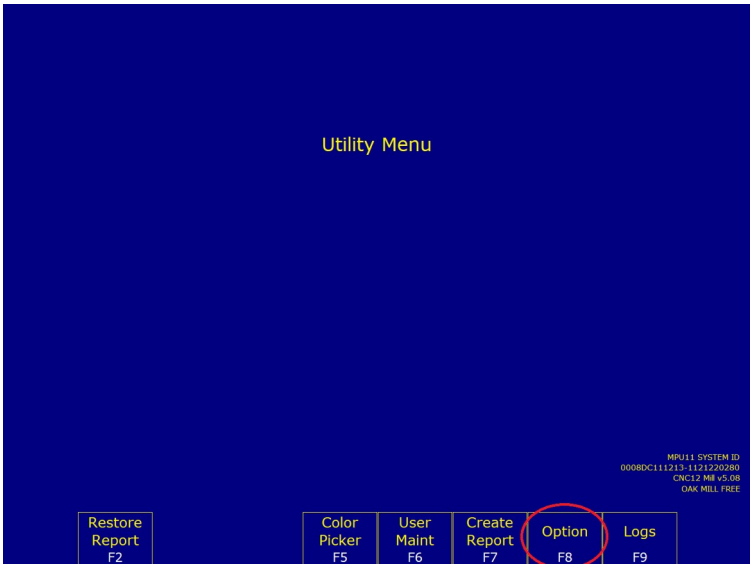


Figure 4.1.2
Utility Menu – F8 Options

2. You should now see a screen that lists the current software level, plugins, PLC type, and system ID. Press **F2 – Import License**. A Windows file dialog will open.

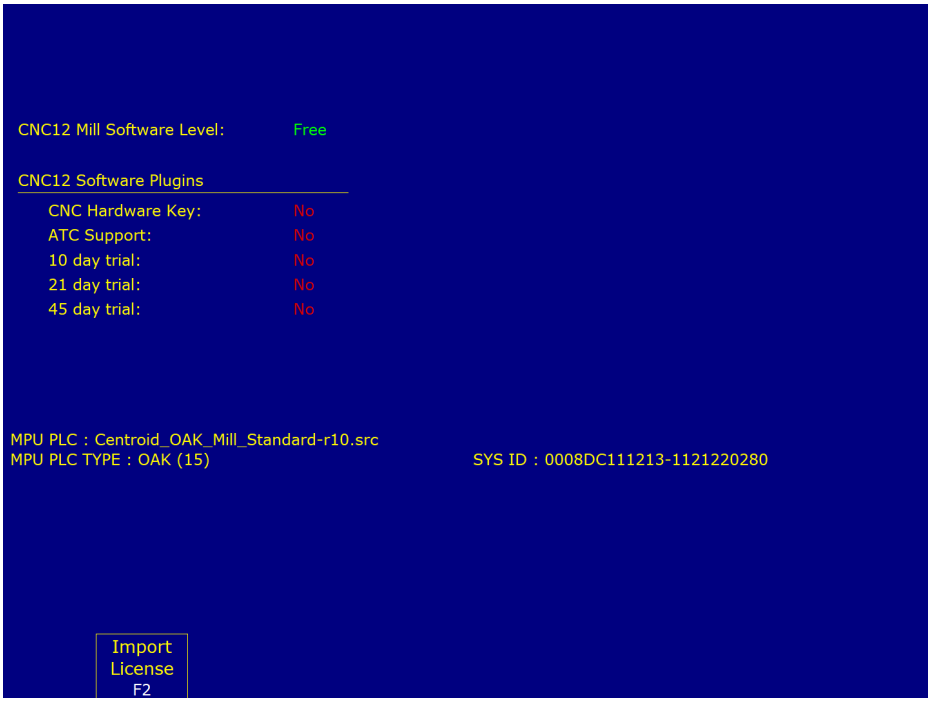


Figure 4.1.3
Software Options Menu

3. Navigate to the location where you downloaded the license hardware key .dat file provided by Centroid. It is usually advised that the license be downloaded to the Desktop for easy access. Select the license file and click “Open”.
4. The license file will be loaded and you should see a pop-up saying “License successfully imported”, the Software Level should match the license type, and CNC12 Hardware Key should say Yes. If you receive any other message, consult TB 325 - Licensing Issues and Troubleshooting for guidance on solving this issue.

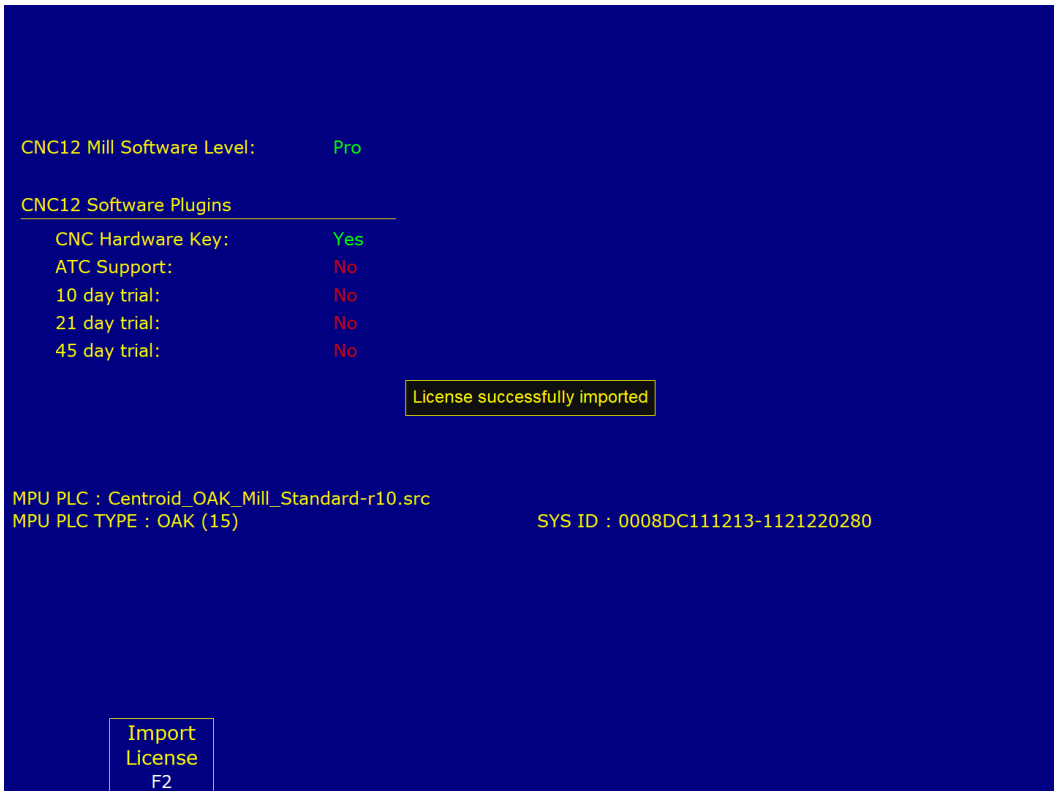


Figure 4.1.4
License successfully imported

The ESC key can be used to move up one menu level. Press ESC until you reach the main screen again.

In the following pages we will be temporarily disabling the fault logic built into your MPU11 based CNC 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_OAK_Mill_standard.src PLC program contains default logic that monitors the inputs for Limit Switches (inputs 1-8), Lube Fault (input 9), Spindle Fault (input 10), Estop (input 11). If ANY of these inputs are open a fault will be issued.

1. **Change Machine Home Type** Navigate to the "**Control Configuration**" screen as seen in Figure 4.1.5. From the main screen press **F1-Setup** → **F3 -Config.** The password is **137**. Then press **F1 Contrl.** Using the keyboard space bar change "**Machine home at power up**" to "**Jog**". Press **F10-Save**

    1. **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.

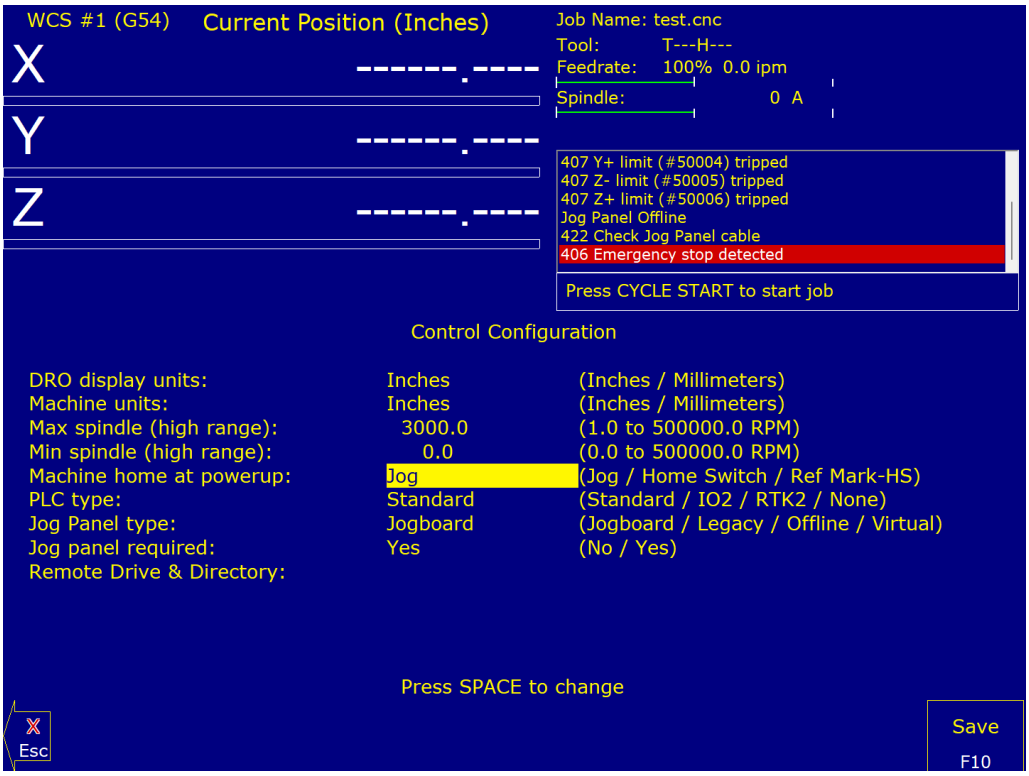


Figure 4.1.5
Changing machine home at powerup to disable limit switches

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 as seen in Figure 4.1.6. 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**.

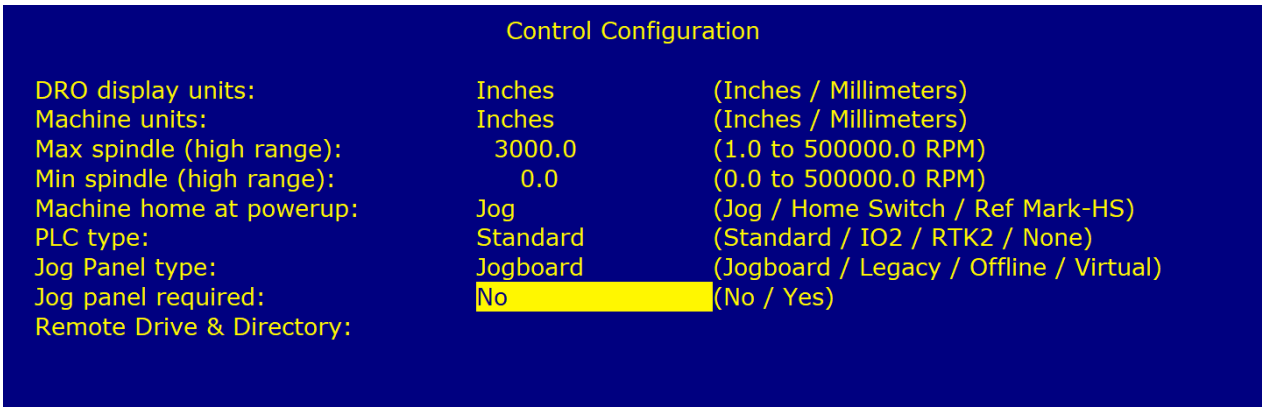


Figure 4.1.6
Disabling jog panel

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 OAK and the PC via switching off your outlet strip. Wait 30 seconds and power everything back up.

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 in Figure 4.1.7. 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,** and **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 it 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.

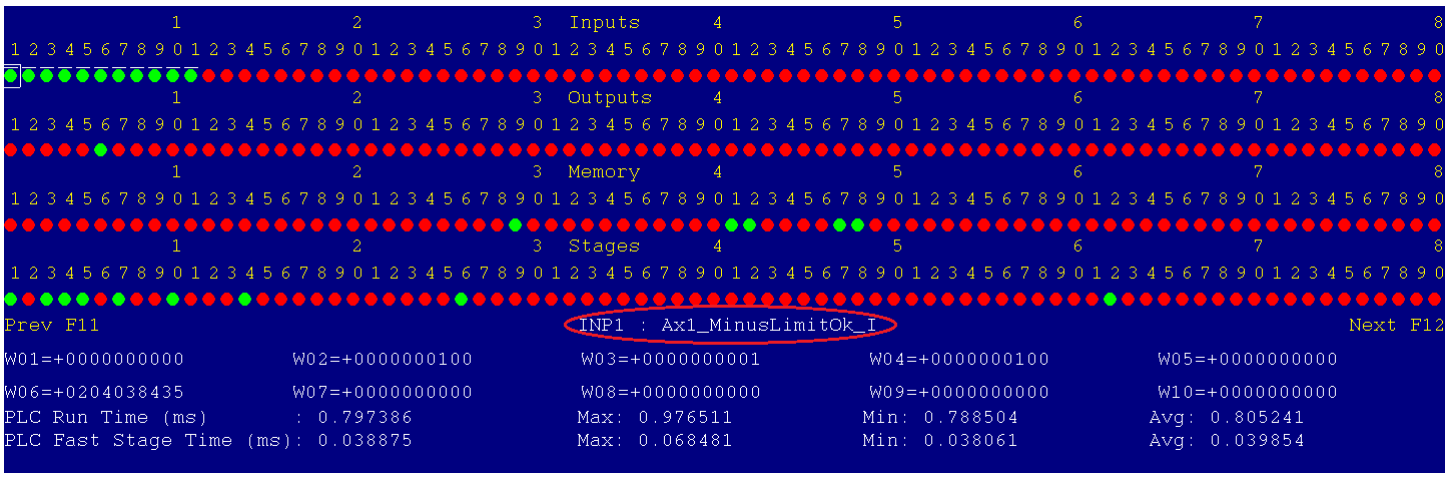


Figure 4.1.7
Disabling inputs PLC Diagnostic menu

4. **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 set up for a mill is axis 1 labeled X, axis 2 labeled Y, axis 3 labeled Z. Any unused axes should be set to "**N**" to disable the axis as seen in Figure 4.1.8. The Spindle Axis will be set up in section 6.4.

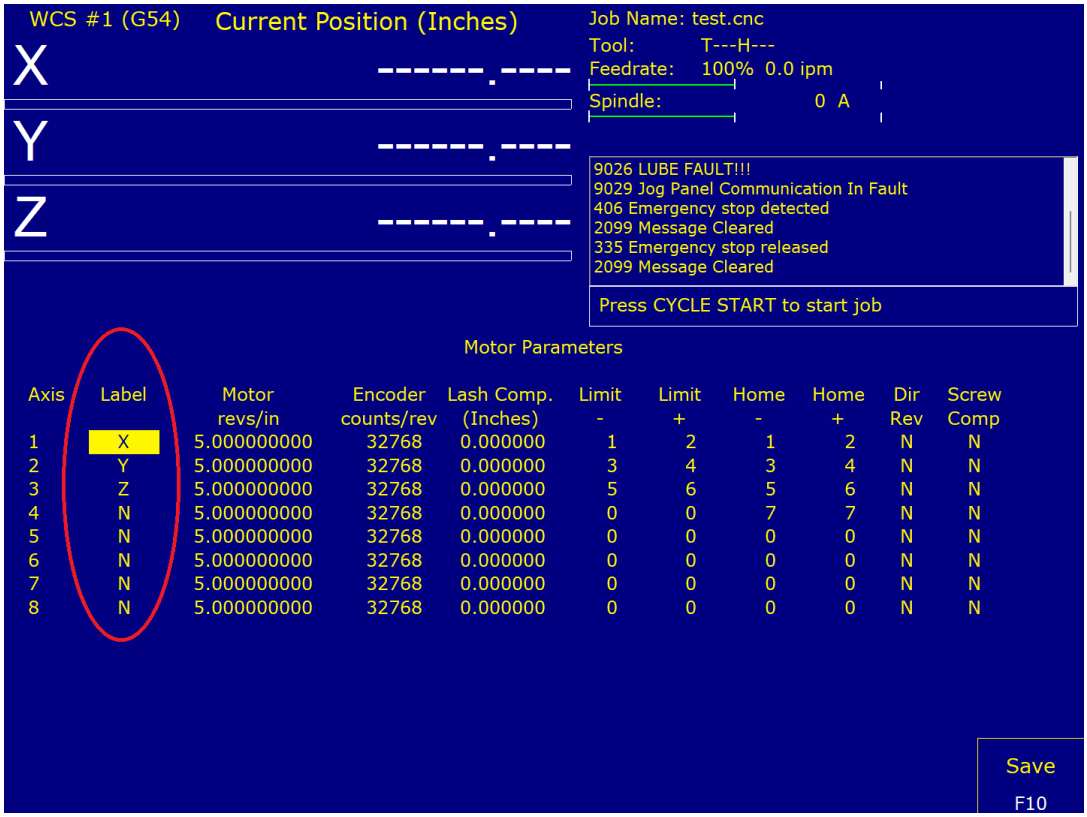
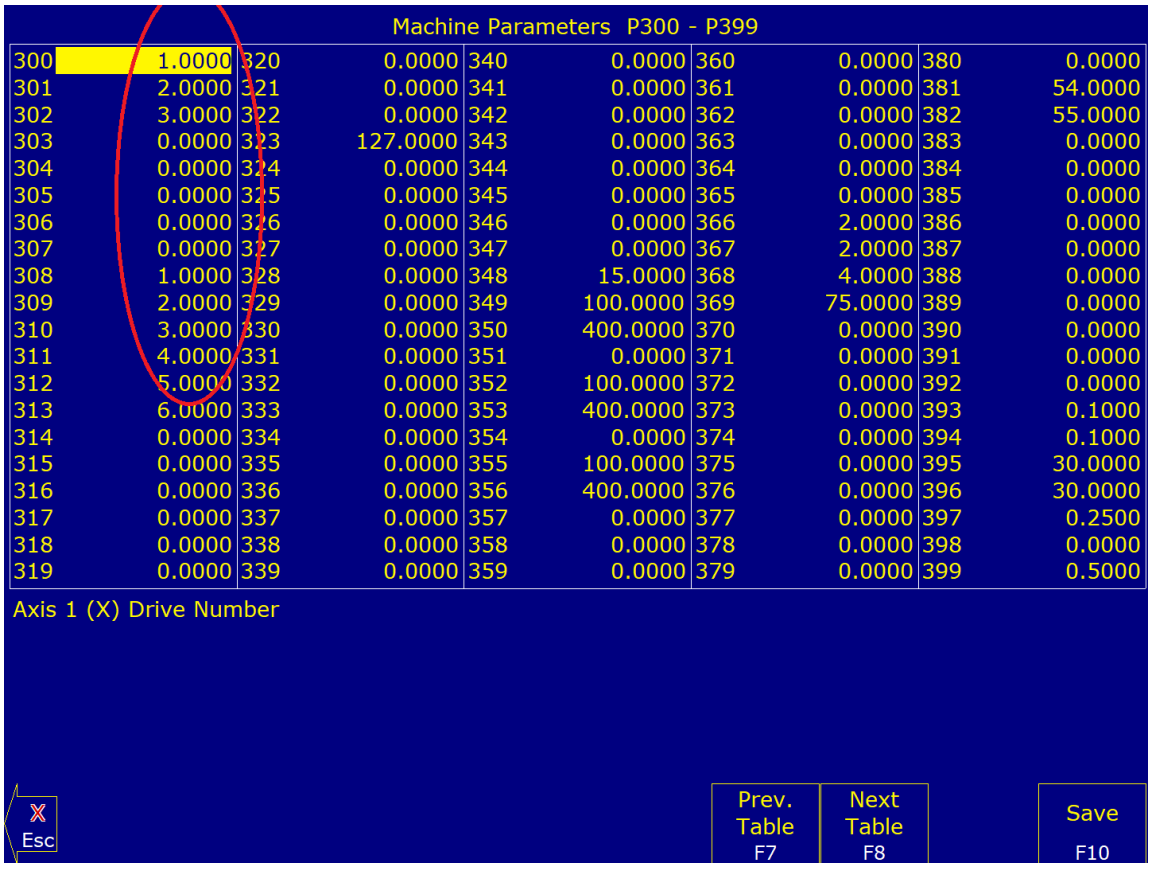


Figure 4.1.8
Labeling the axes.

5. **Configure Drive Bus Assignment** – The CNC12 software needs to be configured to know where each axis of the OAK is. The OAK using something called “Drive Bus” to communicate with the CNC12 software. For a three axis mill, OAK **axis 1** *(labeled axis 1 on the OAK drive cover)* should be configured as **drive bus channel 1**, OAK **axis 2** should be configured as **drive bus channel 2**, etc...

   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 parameter 300 – 307 is displayed. Typical configuration for a three axis CNC is to set parameter 300 = 1, 301 = 2, 303 = 3 as seen in Figure 4.1.9. **Unused axes need to be set to zero, or errors will occur!**



300	1.0000	320	0.0000	340	0.0000	360	0.0000	380	0.0000
301	2.0000	321	0.0000	341	0.0000	361	0.0000	381	54.0000
302	3.0000	322	0.0000	342	0.0000	362	0.0000	382	55.0000
303	0.0000	323	127.0000	343	0.0000	363	0.0000	383	0.0000
304	0.0000	324	0.0000	344	0.0000	364	0.0000	384	0.0000
305	0.0000	325	0.0000	345	0.0000	365	0.0000	385	0.0000
306	0.0000	326	0.0000	346	0.0000	366	2.0000	386	0.0000
307	0.0000	327	0.0000	347	0.0000	367	2.0000	387	0.0000
308	1.0000	328	0.0000	348	15.0000	368	4.0000	388	0.0000
309	2.0000	329	0.0000	349	100.0000	369	75.0000	389	0.0000
310	3.0000	330	0.0000	350	400.0000	370	0.0000	390	0.0000
311	4.0000	331	0.0000	351	0.0000	371	0.0000	391	0.0000
312	5.0000	332	0.0000	352	100.0000	372	0.0000	392	0.0000
313	6.0000	333	0.0000	353	400.0000	373	0.0000	393	0.1000
314	0.0000	334	0.0000	354	0.0000	374	0.0000	394	0.1000
315	0.0000	335	0.0000	355	100.0000	375	0.0000	395	30.0000
316	0.0000	336	0.0000	356	400.0000	376	0.0000	396	30.0000
317	0.0000	337	0.0000	357	0.0000	377	0.0000	397	0.2500
318	0.0000	338	0.0000	358	0.0000	378	0.0000	398	0.0000
319	0.0000	339	0.0000	359	0.0000	379	0.0000	399	0.5000

Figure 4.1.9
Setting up the Drive Bus and encoders

6. **Configure Encoder Assignment** – Just like in the previous step, the CNC12 software needs to be configured to know where each encoder of the OAK is. Unlike the previous step, the OAK does not use “Drive Bus” to allow the encoder to communicate. Instead, the OAK uses the on board MPU11 encoder channels via parameters 308 – 315. For a three axis mill parameter 308 = 1, 309 = 2, 310 = 3. Unused encoders axes can be left “as is”, they do not need to be set to zero.

7. **Configure Encoder Counts per Revolution** The encoders need to be set up for the correct number of 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 your encoder counts. Repeat this for each axis.

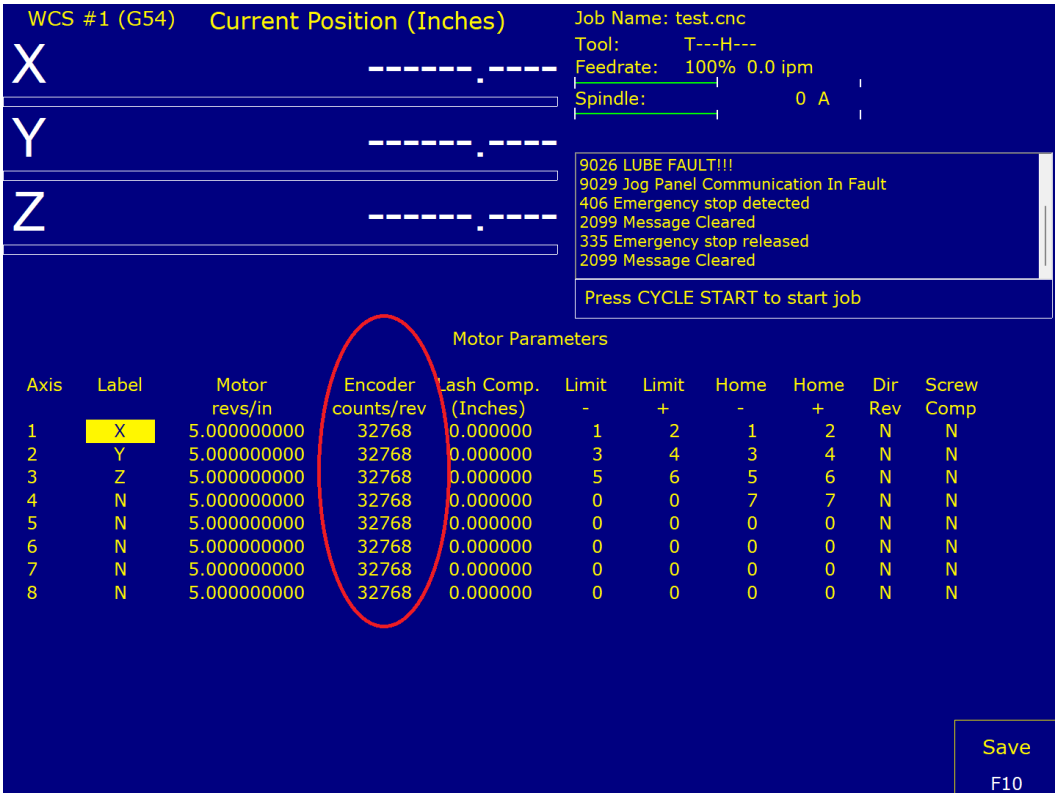


Figure 4.1.10
Encoder Counts/Rev

8. Disable Stall Detection – Stall detection must be disabled from the PID menu. From the main menu, press **F1 – Setup** → **F3 – Config.** The password is 137. Press **F4 – PID**. Press **ctrl + v** keys simultaneously to disable stall detection. If done correctly text saying "**Stall detection disabled**" will appear right below the status window.

    1. **NOTE**: Every time you restart the OAK, you will have to disable stall detection again.

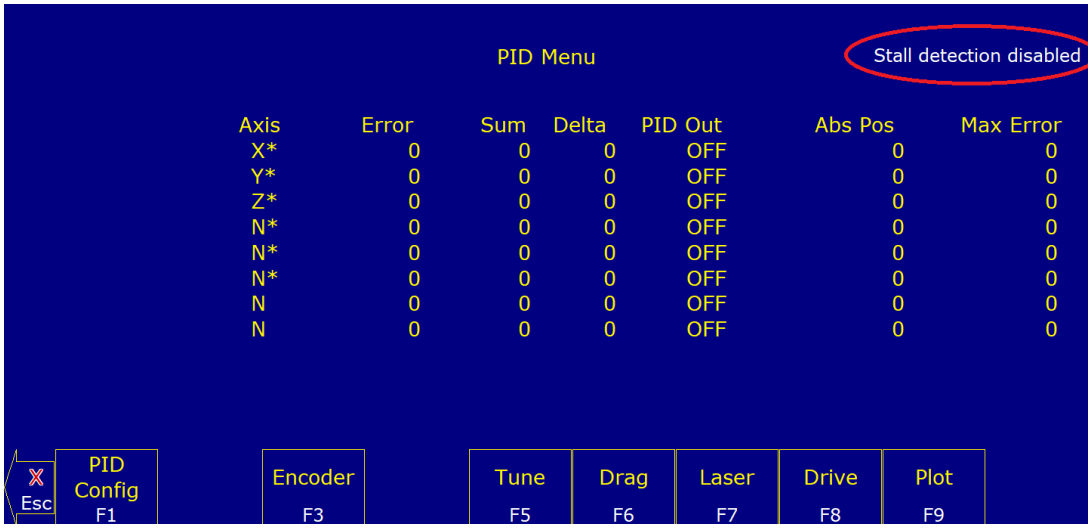


Figure 4.1.11
Disabling Stall Detection

9. **Clear Software Ready Faults** Anytime the CNC12 software has been exited and restarted without the hardware also being powered off and restarted, the CNC12 software will report a "**Software Exited**" fault as demonstrated below in Figure 4.1.12. A "Software Exited" fault like spindle, lube, encoder and position fault is a "**stop fault**". A "stop fault" removes power from all servo motors, prevents 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 we cycled the E-Stop (not connected yet), by toggling the input 11.

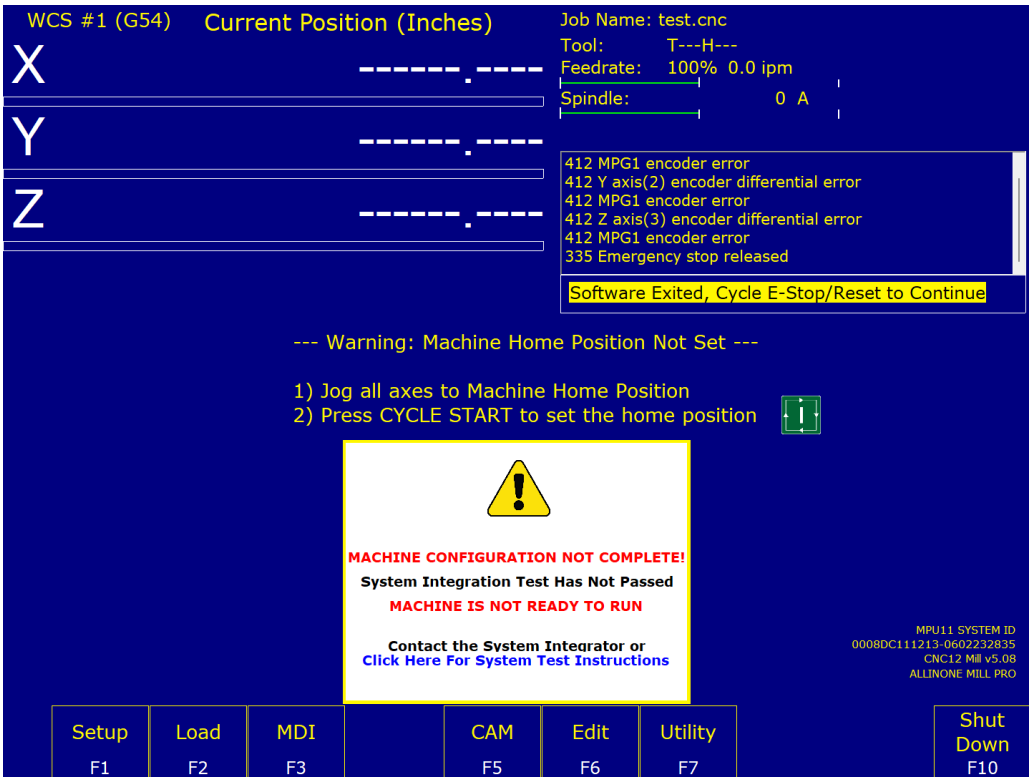


Figure 4.1.12
Software Exit Fault

To clear a stop fault, press the alt-i keys to bring up the real-time I/O screen. Use the arrow keys on the keyboard to select the "*INP11 " EStopOK_I*" as shown below in Figure 4.1.13. Press the ctrl, alt, and i keys to toggle the E-StopOK_I input until it turns red then green.

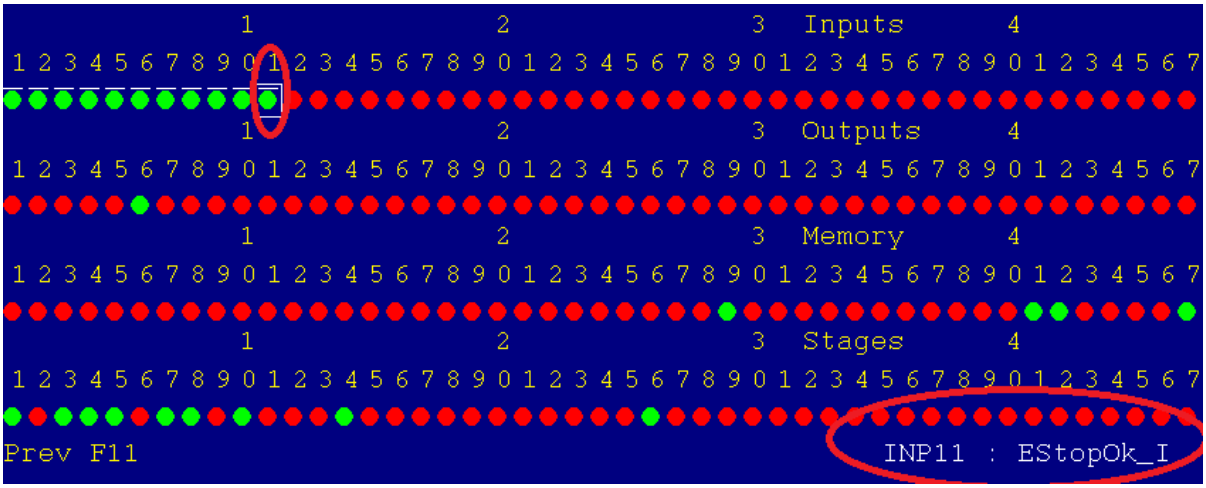


Figure 4.1.13
Toggling E-stop

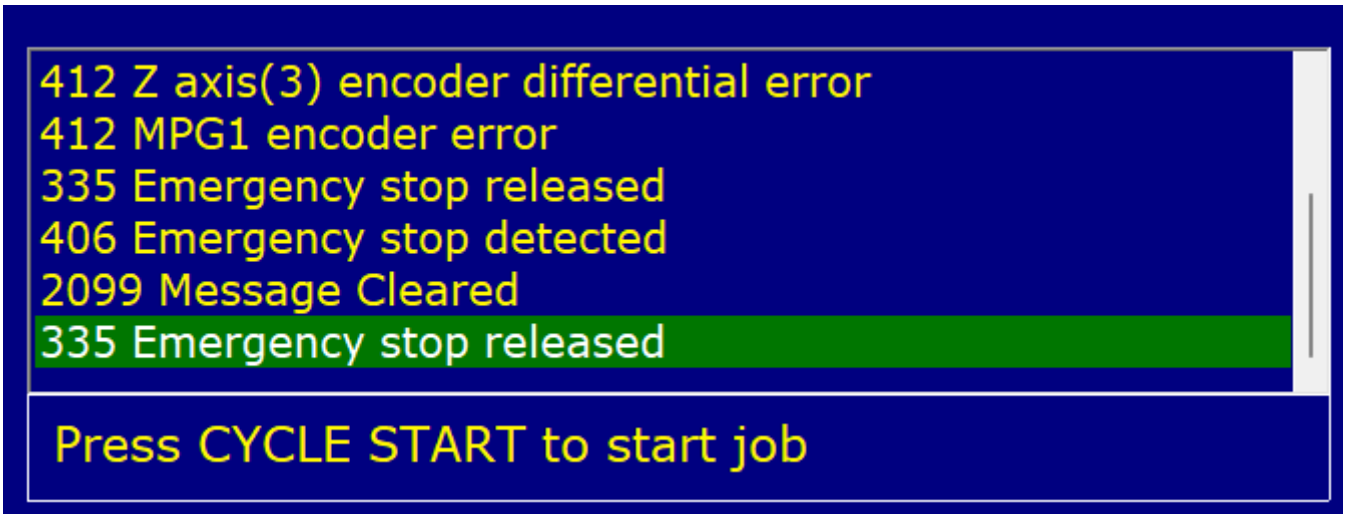


Figure 4.1.14
Status window showing the emergency
stop clearing faults.

Notice that as you toggle the EStopOk_I input to red "*406 Emergency Stop Detected*" is displayed in the status window. When the emergency stop is pressed notice how "*2099 Message Cleared*" is displayed. Toggling *EStopOK_I* back to green displays "*335 Emergency Stop Released*".

10. **Clear Any Existing Faults Before Beginning Bench Testing.** 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 like Figure 4.1.15.

    If the screen shown in Figure 4.1.14 is not displayed, there is an existing fault. Please check the status window to determine the cause of the fault and then cleared of faults. Confirm that all parameters are set as required and that all inputs (1-11) are in the correct state.

    Troubleshooting Tip: 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**.

    All faults shown in Figure 4.1.16 (as well as other faults) are “Stop Faults”. Stop faults cancel existing jobs, prevent new jobs from being started, stop the spindle, prevent motion, and require that the E-Stop PLC input be cycled (opened and closed) to clear the fault(s) before continuing. If you have any stop faults, they will have to be removed then E-Stop will have to be toggled as shown in the previous step.

Figure 4.1.15
MDI Command Mode

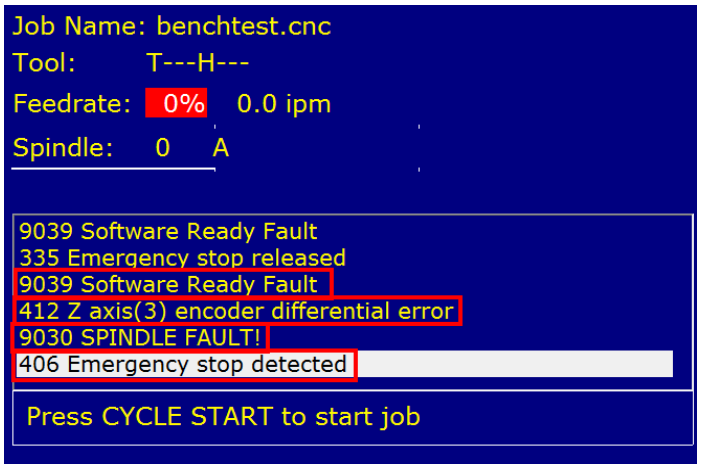


Figure 4.1.16
Faults detected

11. **Set up Virtual Control Panel (VCP).** This option can be selected if the use of a physical jog panel is not necessary or desired. The virtual control panel can be reached by accessing the control options menu. Select **F1 – Setup** → **F3 – Config** from the main menu**.** The password is **137**. Press **F1 – Contrl**. Use the arrow keys to navigate down to the Jog Panel Type field. Click the **spacebar** until Virtual is selected, then **F-10 save**.

12. **Set up Wireless MPG.** Use of a Wireless MPG requires at least a Pro License. If you haven’t already follow the instructions at the beginning of this chapter to install your license file. Go to **F1 – Setup** → **F3 Config** from the main menu. The password is **137**. Press **F3 – Parms** and set MPG CNC12 parameter #218 = 15 for 4 axis Mills/Routers, #218=7 for 3 axis Mills/Routers and #218 = 3 for Lathes. (MPG Type) Set MPG CNC12 parameter #348 = 15 (MPG ON) and #350 = 100 (100 steps per rev). Shut down and restart CNC12 for new parameters to take effect.

13. **New Features.** As new features and parameters are defined, these will be documented in the CNC12 Mill and Lathe manuals as well as in Tech Bulletin 313 - Centroid CNC12 New Parameter Quick Reference

4.2 OAK SPINDLE BENCH TEST

Bench testing the Oak will confirm that the Oak is operational and that the software has been properly configured to begin the installation process. Bench Testing is **required** as it provides a known base configuration that our support engineers can refer to when trying to diagnose any issues that may arise. To complete Bench Testing, a DVM (Digital Volt Meter) is required.

1. **Set Home and load spindlebenchtest.cnc:** Home the machine by pressing start. From the main menu press **F2-Load.** Use the arrow keys to select the file spindlebenchtest.cnc

    1. **If spindlebenchtest.cnc is not present in the c:\cncm\ncfiles directory it can be downloaded here: spindlebenchtest.cnc** (http://centroidcnc.com/usersupport/support_files/benchtest/spindlebenchtest.cnc)

    2. Download spindlebenchtest.cnc If your web browser does not provide an option to download spindlebenchtest.cnc and instead displays a bunch of code, copy the code from your web browser into your default text editor (such as notepad++). Save the file as spindlebenchtest.cnc in the CNC12 root directory (see next step).

    3. Place spindlebenchtest.cnc in your CNC12 root directory.

        1. Right click on your CNC12 shortcut
        2. Click **properties** as shown in figure 4.2.1.
        3. A window will pop up, go to the “shortcut” tab and click “**open file location**” as shown in Figure 4.2.2.
        4. Open the folder labeled “ncfiles”. Paste spindlebenchtest.cnc into the ncfiles directory.
        5. In the load menu of CNC12 press **F5-refresh**.

2. With spindlebenchtest.cnc highlighted, press **F10 Accept**. If the DRO does not display when you press alt-s, you likely encountered a fault. See clearing faults is covered in section 4.2.3

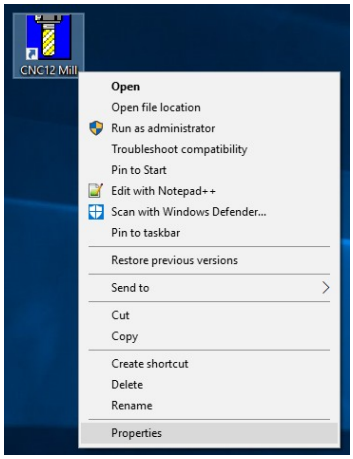


Figure 4.2.1
Right click on CNC12 and click “properties”

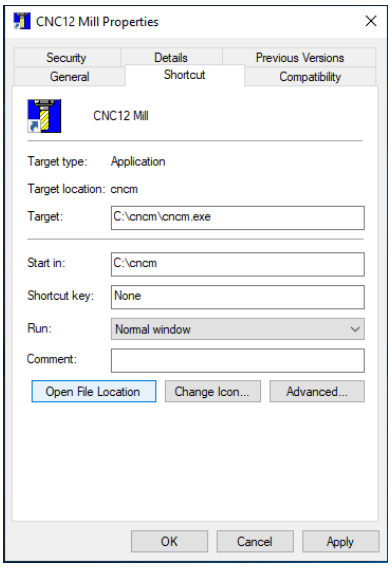


Figure 4.2.2
Select the “shortcut” tab and click “Open File Location”

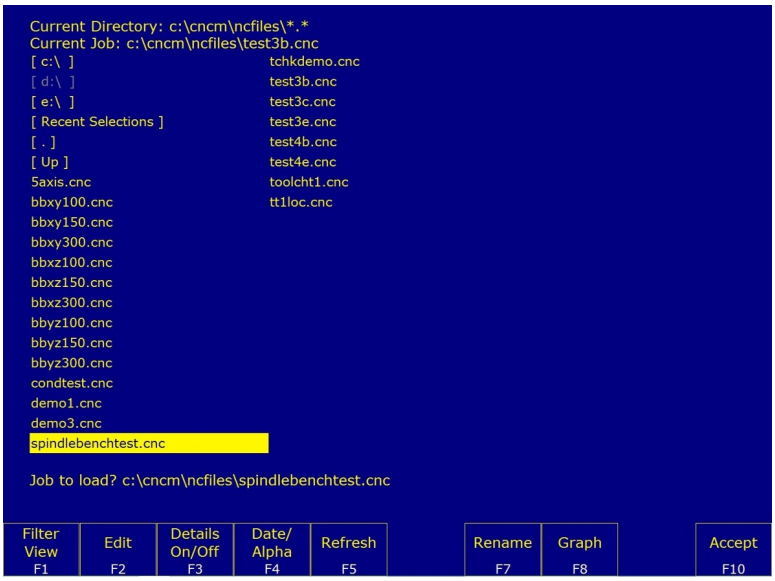


Figure 4.2.3
Selecting spindlebenchtest.cnc

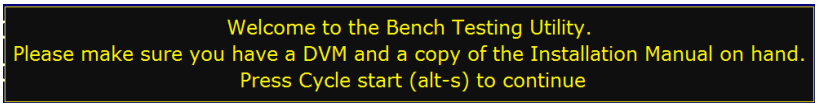
Testing the analog output for the spindle: The Oak provides a 0 to +10VDC analog output to provide programmable spindle speed control using a VFD (variable frequency drive). The default maximum spindle speed specified in the Control Configuration is 3000rpm. This configures the control to scale the 0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

1. Set a digital voltage meter to VDC

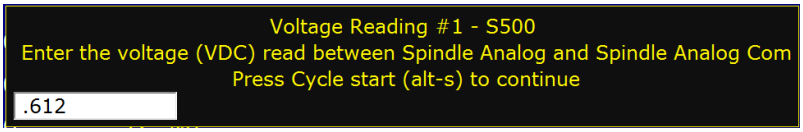
2. Connect the seven pin terminal block into connector H9

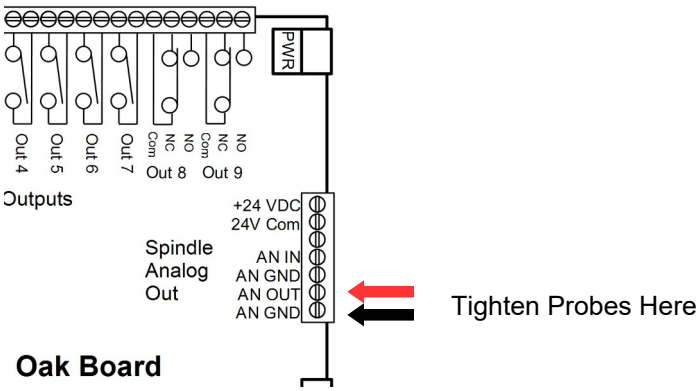
3. Insert the digital voltage meter leads into H9 as shown in Figure 4.2.4. Tighten **down the screw terminals to firmly grip the probes.**

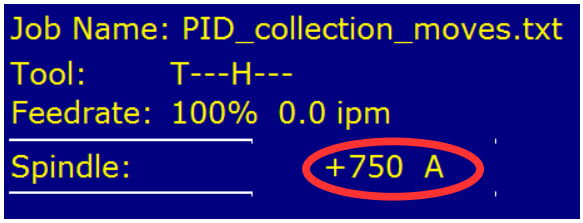
4. With spindlebenchtest.cnc loaded, press **Cycle start** (alt-s) to begin. The following screen will be displayed: (You may have to press Cycle start twice)



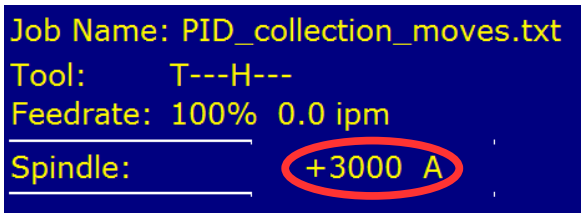
5. Enter the voltage readings as pictured, and press **Cycle Start** to continue. Spindlebenchtest.cnc will throw an error if the spindle does not output as expected. Continue to press cycle start as requested until the program is finished. The program will exit and the status window will say "**Job finished**" after a successful completion.







2.5 V on multimeter



10 V on multimeter

Figure 4.1.11
Spindle Testing

Bench Testing Completed. Power off and disconnect the components.

At this point it is confirmed that the Oak Board powers up, the parameters are set correctly, and the spindle voltage works.

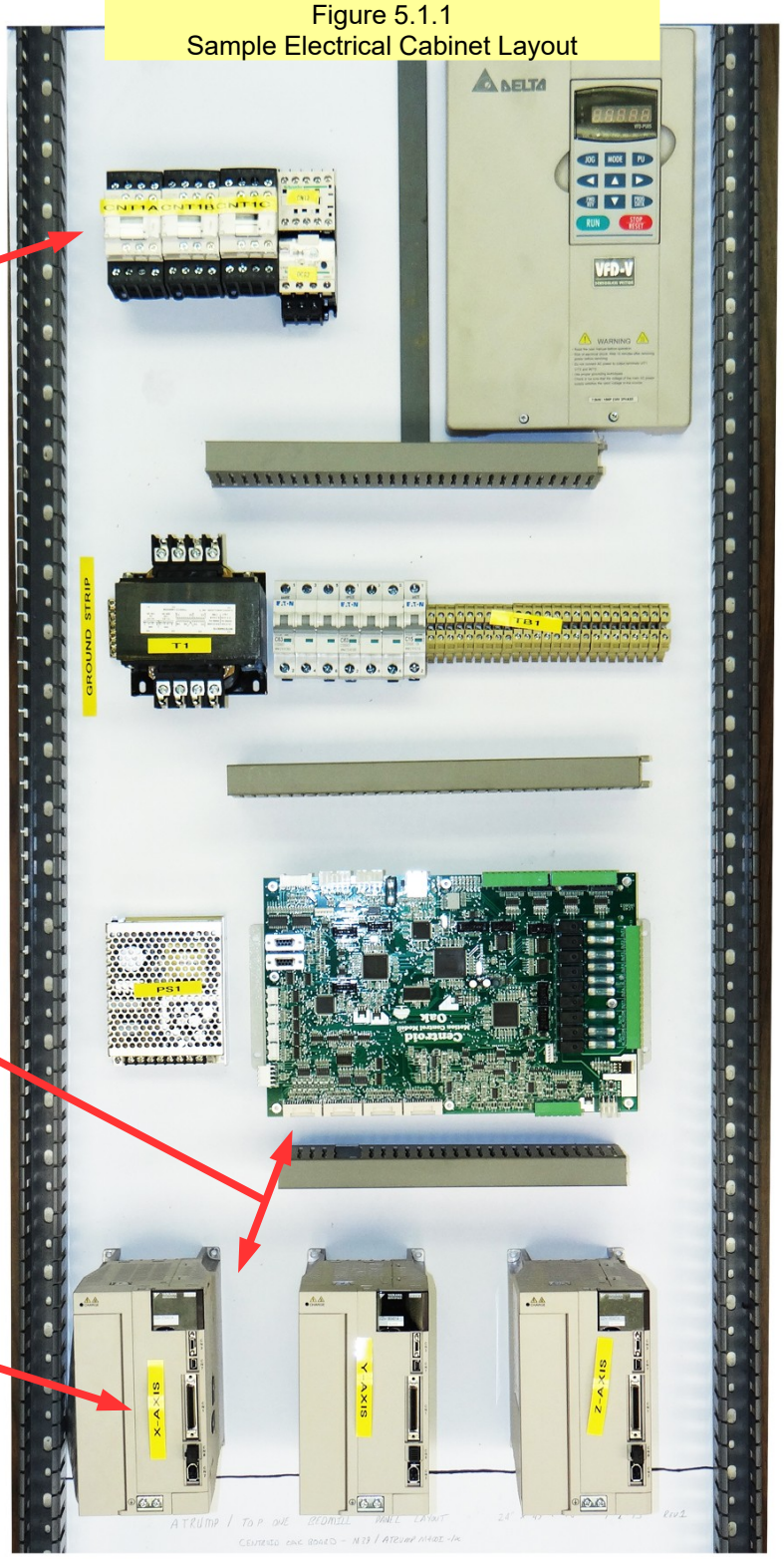
CHAPTER 5 ELECTRICAL CABINET WIRING

5.1 INTRODUCTION TO ELECTRICAL CABINET WIRING

During cabinet wiring it is important that you follow the schematic provided by Centroid.

Decide on a layout for the cabinet and mount all the components.

Figure 5.1.1
Sample Electrical Cabinet Layout



Contactors and high voltage lines kept far away from sensitive electronics.

Minimize the distance between the Oak board and third party drives. This minimizes potential interference.

Everything is labeled, including all wires.

Best Practices:

- **Minimize Noise and Interference**
    - **Keep the distance between the Oak Board and the drive as short as possible.**
    - **Use shielded twisted pair to prevent interference.** Shielded twisted pair is required for both the encoders and for the spindle analog output and input.
    - **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 bad practice to mount a contactor block or large transformer directly underneath the Oak Board. Keep the high-voltage AC power lines and motor power lines as far away from low voltage logic signals as practical.
    - **Grounding Principles** Wire the incoming chassis (earth) ground lug directly to a single ground bus bar, which is grounded to the electrical panel. Wire all power supply chassis grounds, and all equipment chassis ground to the single ground bus bar.
      DO NOT have several different grounding points throughout the cabinet, this could increase electrical noise and interference.
    - **Keep wire tracks at least 2" away from circuit boards when practical.**
    - **Snubbers Must Be Used.** Contactor blocks, relays, motors, and any other solenoids need a snubber across the coil. Centroid recommends 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 the cabinet maintainable and easily serviceable.**
    - **Wire management.** Use PVC wire tracks (such as Panduit Panduct) to keep your wires neat and organized.
    - **Use DIN Rails.** Use DIN rails for mounting relays, contactors, terminal blocks, circuit protection blocks, disconnects, etc.
    - **Leave some slack in the wire.** Take all corners in the wiring tracks as wide as possible. Always leave 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.
    - **Don't lose the schematic.** Keep the schematic attached to the cabinet somewhere so it does not get lost.
- **If you do not have 3 phase available, refer to TB 163 for information on Single Phase:** (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/163.pdf)

Common Wiring Problems:

The following information is also covered in Technical Bulletin 78 which can be found here: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/78.pdf)

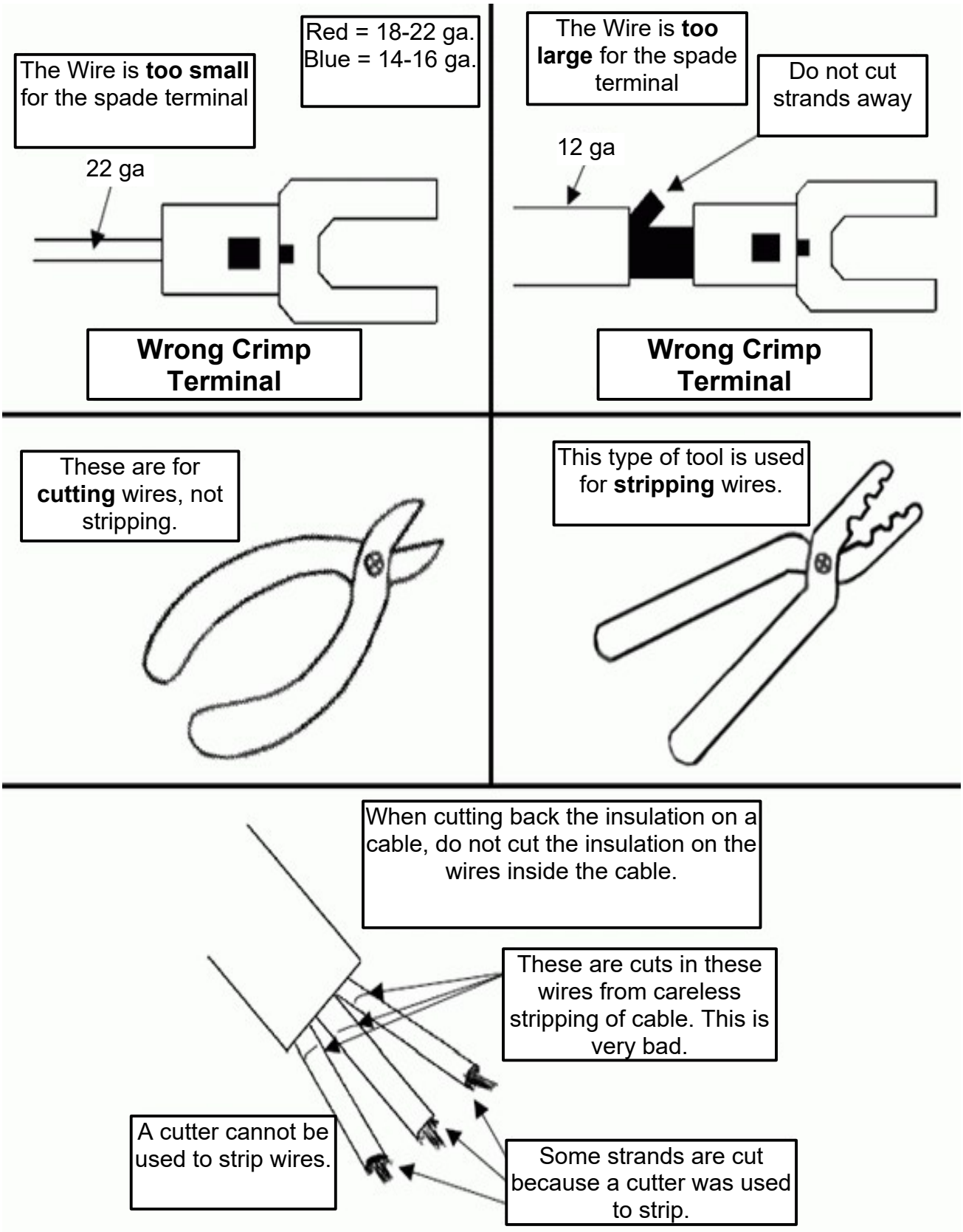


Figure 5.1.2
Common Wiring Problems

5.2 Electrically Configuring Inputs on the Oak Board

The inputs of the Oak Board can be configured for either 5, 12, or 24 volts DC. The input voltage is changed by changing the resistance of the SIP (single inline package) resistor.

By default the Oak Board is supplied with SIPs for 24VDC installed. If you are using a voltage other than 24VDC, the SIPs need to be changed.

Turn off all power to the board when changing the SIPs.

The voltage of your input devices determine which SIP to use, use the chart below. The last three numbers of the manufacturers part number, shown in Figure 5.2.1, determine the resistance. Of the last three numbers, the first two digits signify the value of the resistance. The last digit signifies the number of zeros after the value.

For example, if the manufacturers part number is “4308R-102 LF – 222”, the values 222 define the resistance. The resistance is 22 plus two zeros, so the final value is 2200 Ohms. The chart next to Figure 5.2.1 defines which resistors are needed for which voltages.

Centroid Part Number	Voltage Level	Last 3 numbers of manuf. part number	SIP Resistance Value
3950	5 VDC	471	470 Ω
4152	12 VDC	102	1 KΩ
1548	24 VDC (default)	222	2.2 KΩ

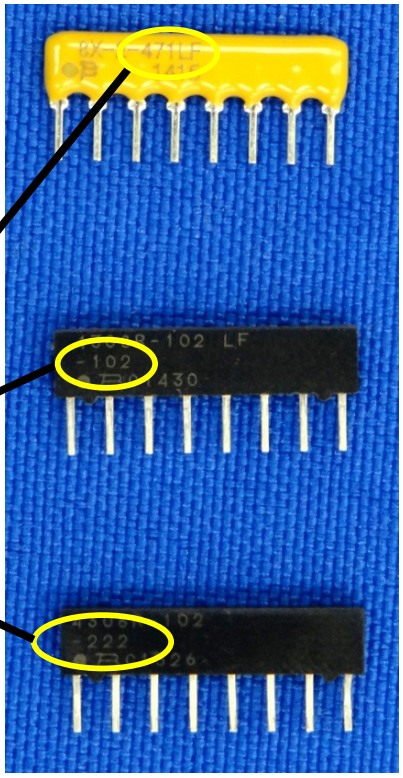


Figure 5.2.1
Reading SIPs

Looking closely at the Oak Board, the silkscreen is labeled **SIP1**, **SIP2**, **SIP3**, and **SIP4**, see Figure 5.2.2.

Each SIP controls a group of I/O as demonstrated by the table below. Change the SIPs Corresponding to which inputs are using a different voltage.

Input Group	SIP Number
Inputs 1-4	4
Inputs 5-8	3
Inputs 9-12	2
Inputs 13-16	1

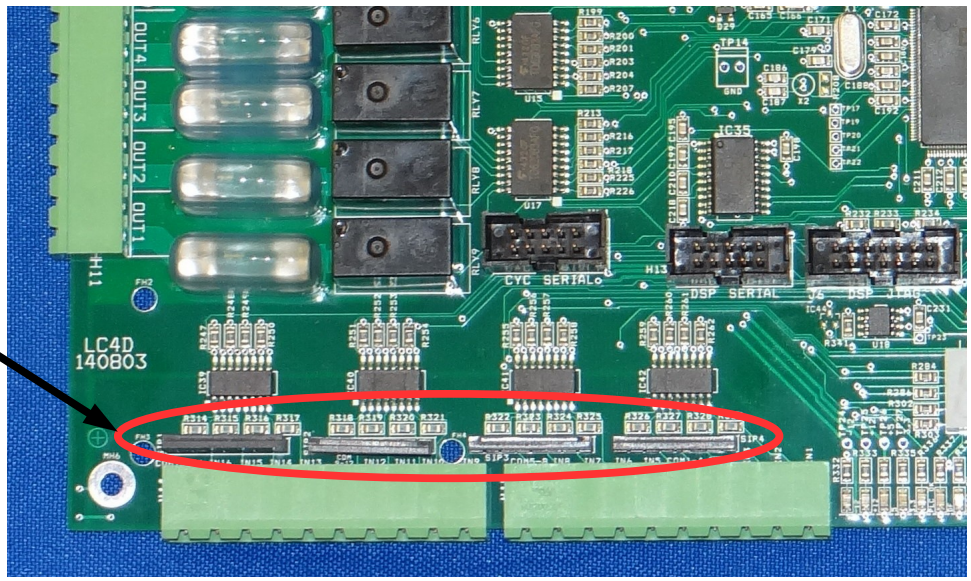


Figure 5.2.2
Location of SIPs

Sourcing and Sinking

All inputs on the Oak Board can be configured in banks of 4 for sourcing or sinking operation. Whether you will use sinking or sourcing depends on your devices. The inputs can use 5, 12 or 24 VDC, be sure to install the appropriate SIP resistor. The inputs are arranged in groups of four with a common shared by each input in a group.

- **Sourcing:** Connecting the inputs to power is sourcing. The negative lead of the power supply must be connected to common. This is demonstrated on inputs 13-16 in Figure 5.2.3.

- **Sinking:** Connecting the inputs to ground is sinking. The positive lead of the power supply must be connected to common. This is demonstrated on inputs 9-12 in Figure 5.2.3.

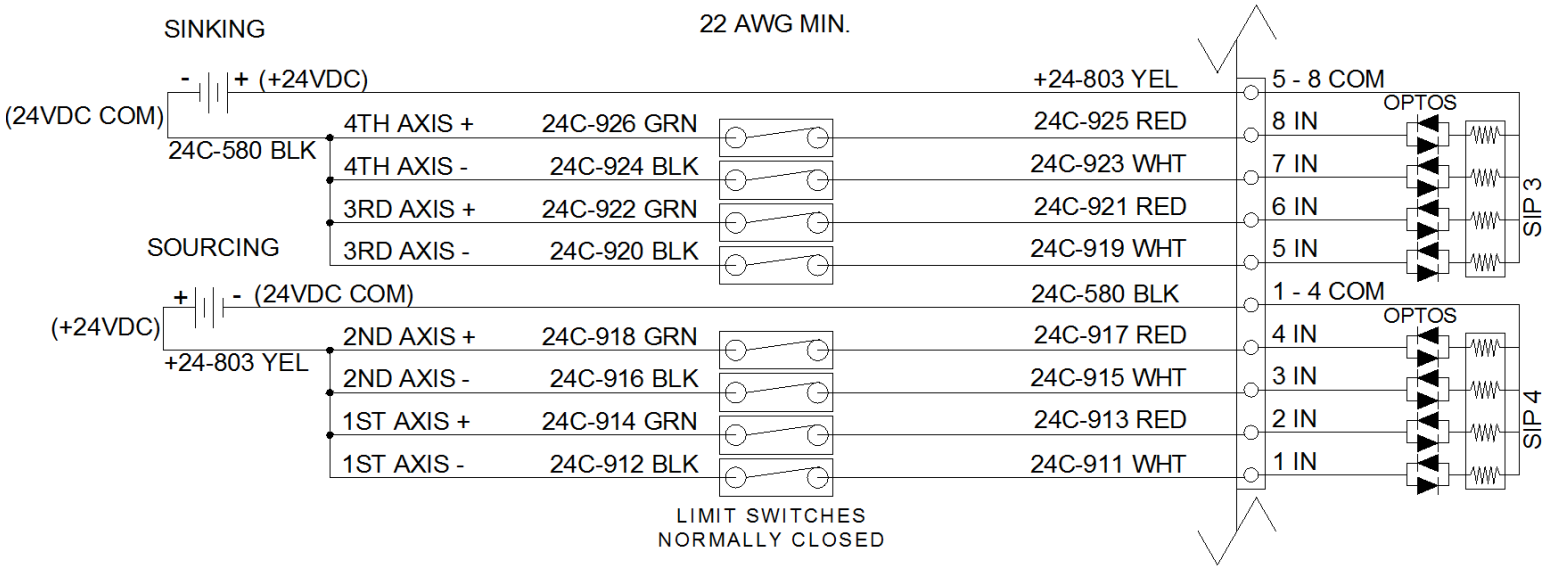
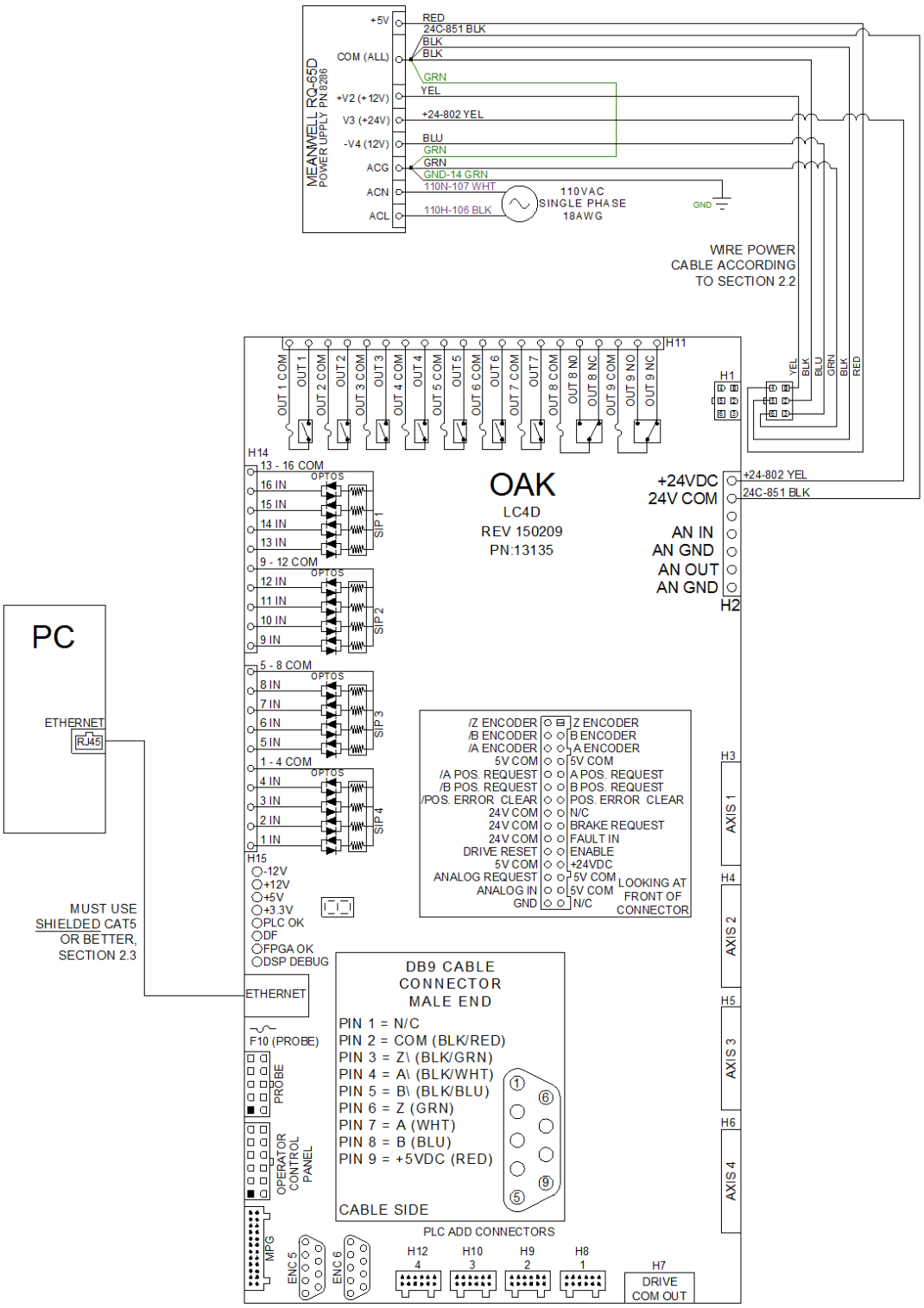


Figure 5.2.3
Sinking vs Sourcing

5.3 Install Major Components in Cabinet

Install the major components according to the schematic.

The default inputs and outputs are listed in the following sections, if you have a custom PLC program they may be different.



5.4 WIRING E-STOP

E-Stop Wiring: The switch must be closed when the machine is in it's operational state. Wiring E-Stop in a normally open configuration is dangerous as it will not stop the machine in the event that a wire breaks.

1. **E-Stop Switch:** Use a double pole single throw (DPST), normal closed, twist to release, emergency stop switch. Centroid part number #14534

2. **Contactor with Snubber –** Centroid recommends using a Scheneider Electric/Telemecanique LC1DT40B7A or similar device for the E-stop contactor (Centroid PART# 14374). This Contactor includes snubber assembly and uses 24VAC to control it. A snubber needs to be placed across the contactor(s). Centroid offers Quencharc snubber networks (Centroid PART# 1819) for use with other contactors. This reduces electrical noise when the servo motor power is cycled on and off. See Tech Bulletin 206 on use of snubbers

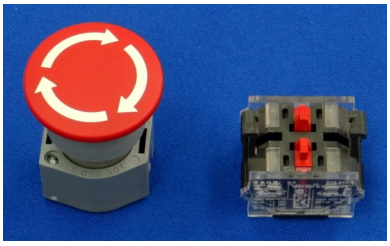


Figure 5.4.1
E-Stop

Testing E-Stop Wiring:

1. Power up your system.
2. Start CNC12 and press F10 to continue to the main screen.
3. In the main menu press alt + I to bring up the real time I/O display.
4. Navigate input 11 with the arrow keys.
5. If there is a bar over the input, press ctrl-alt-i until the bar over the input in the display is removed.
6. Toggle the E-Stop. Confirm that input 11 is green when the E-Stop is released (not tripped), and red when the E-Stop is pressed.
7. Check that output 1 is green and the E-Stop contactor coil is closed.

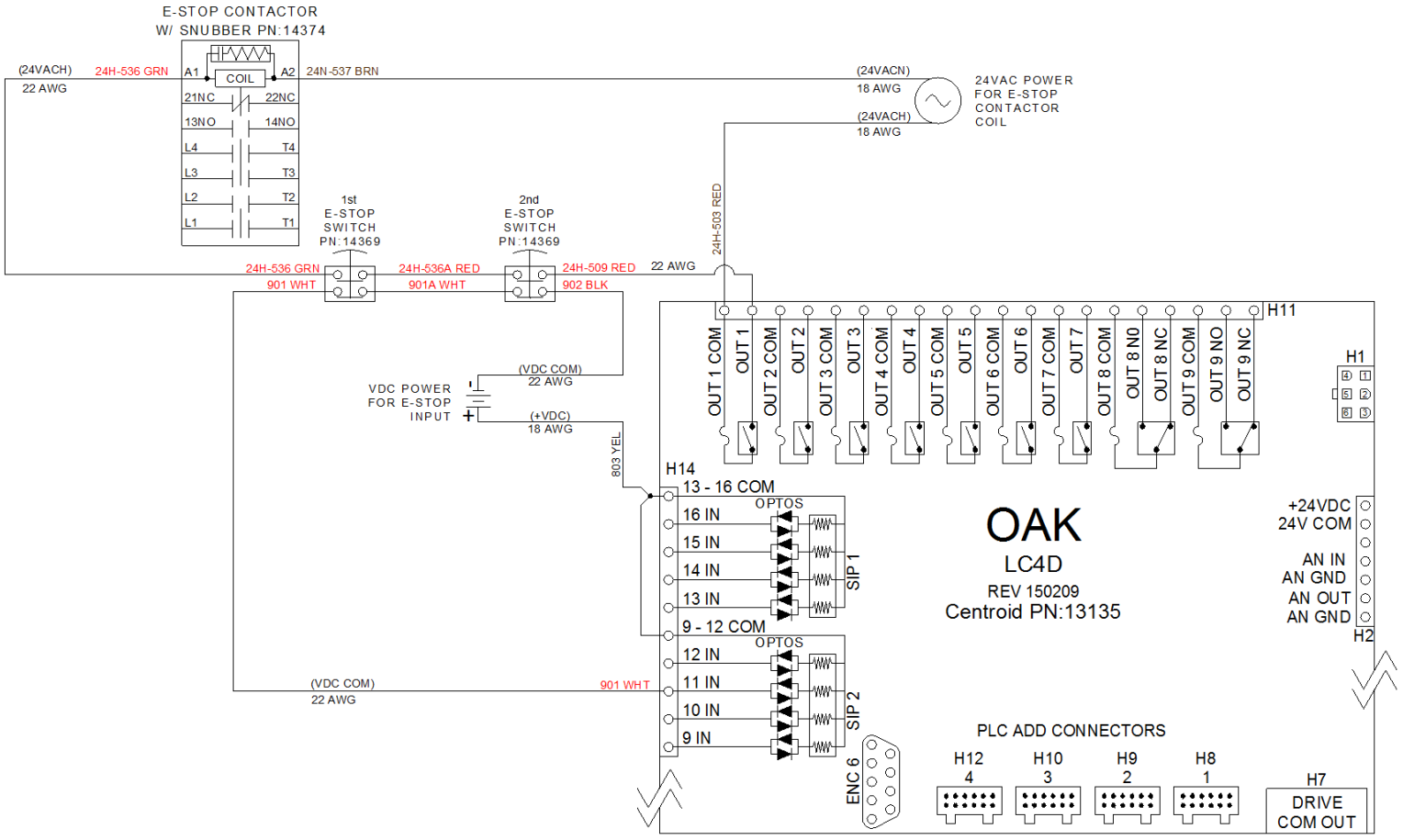


Figure 5.4.2
E-Stop Wiring

5.5 Wiring Limit Switches

All inputs used for Limit switches must be wired in **normally closed** configuration for safety.

The switch should be closed when the machine is in its operational state. Wiring any of these inputs in a Normally Open configuration is dangerous as the machine will not stop in the event that a wire breaks. It also prevents noise from causing spurious faults.

The I/O configuration on every machine is different. While the examples below assume mechanical switches and utilize 24VDC, your machine may utilize different voltage levels and different type devices, such as NPN, or PNP proximity sensors. If your devices are proximity sensors, they **MUST be 3-wire sensors**, 2-wire sensors will not work.

Connect your limit switches as shown below in Figure 5.5.1.

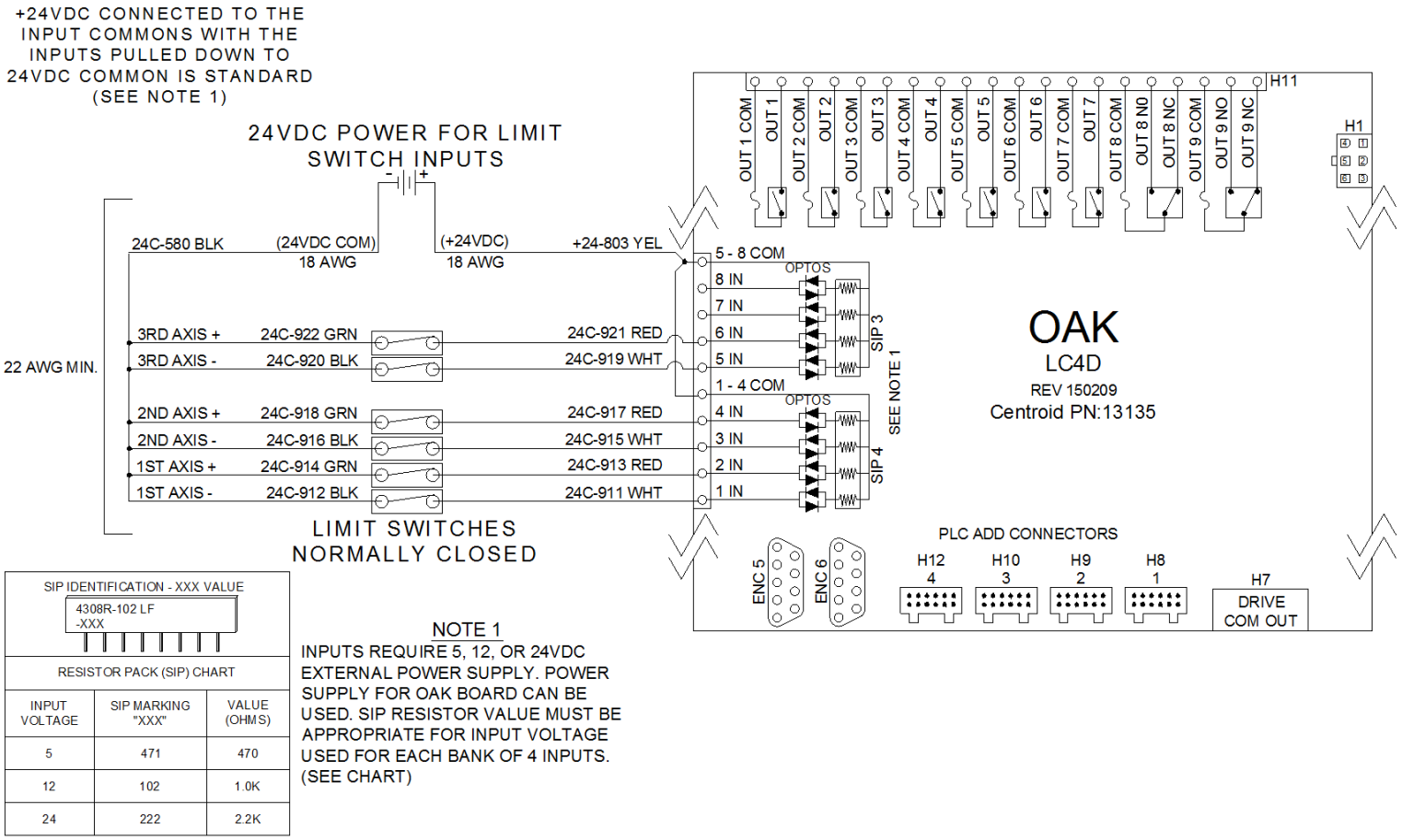


Figure 5.5.1
Limit switches.

Testing Limit Switch Wiring:

1. Power up your system.
2. Start CNC12 and press F10 to continue to the main screen.
3. In the main menu press alt + I to bring up the real time I/O display.
4. Navigate to limit switch inputs (input 1 – 8), and press the ctrl-alt-i keys to remove the bar over the input in the display.
5. Confirm that all limit switches are green when nothing is tripped. Confirm that the corresponding input turns red when the switch is tripped.

5.6 Wiring Lube Pump

The typical lube pump circuit consists of two parts:

1. The first part is the control of the lube pump itself, which is controlled by **output 2** sending 110VAC to the lube pump.

2. The second part is the low lube alarm signal which gets wired to **input 9**. The alarm signal will produce a **405 Low lube** alarm when the lube level is low.

Keep in mind that the Oak Board output relay is rated for up to 5 amps DC or 10 Amps AC. If your lube pump draws more current you will need to install a contactor (Centroid PART# 3959).

When setting up the lube pump it is important to know which type of lube pump you have so that you configure it correctly. See Tech Bulletin 171 and Parameter 179 in the operators manual for further explanation.
https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/171.pdf

Enabling Lube Inputs:

1. Power up your system.
2. Start CNC12 and press F10 to continue to the main screen.
3. In the main menu press alt + I to bring up the real time I/O display.
4. Navigate to input 9, and press the ctrl-alt-i keys to remove the bar over the input in the display.
5. Confirm that lube fault is green when lube is full.
6. Go to parameter 179 and set it to 0.
7. At the main screen, press **F3 MDI**, confirm that output 2 is green and the pump has power.
8. Follow Tech Bulletin 171 to finish setting up parameter 179.

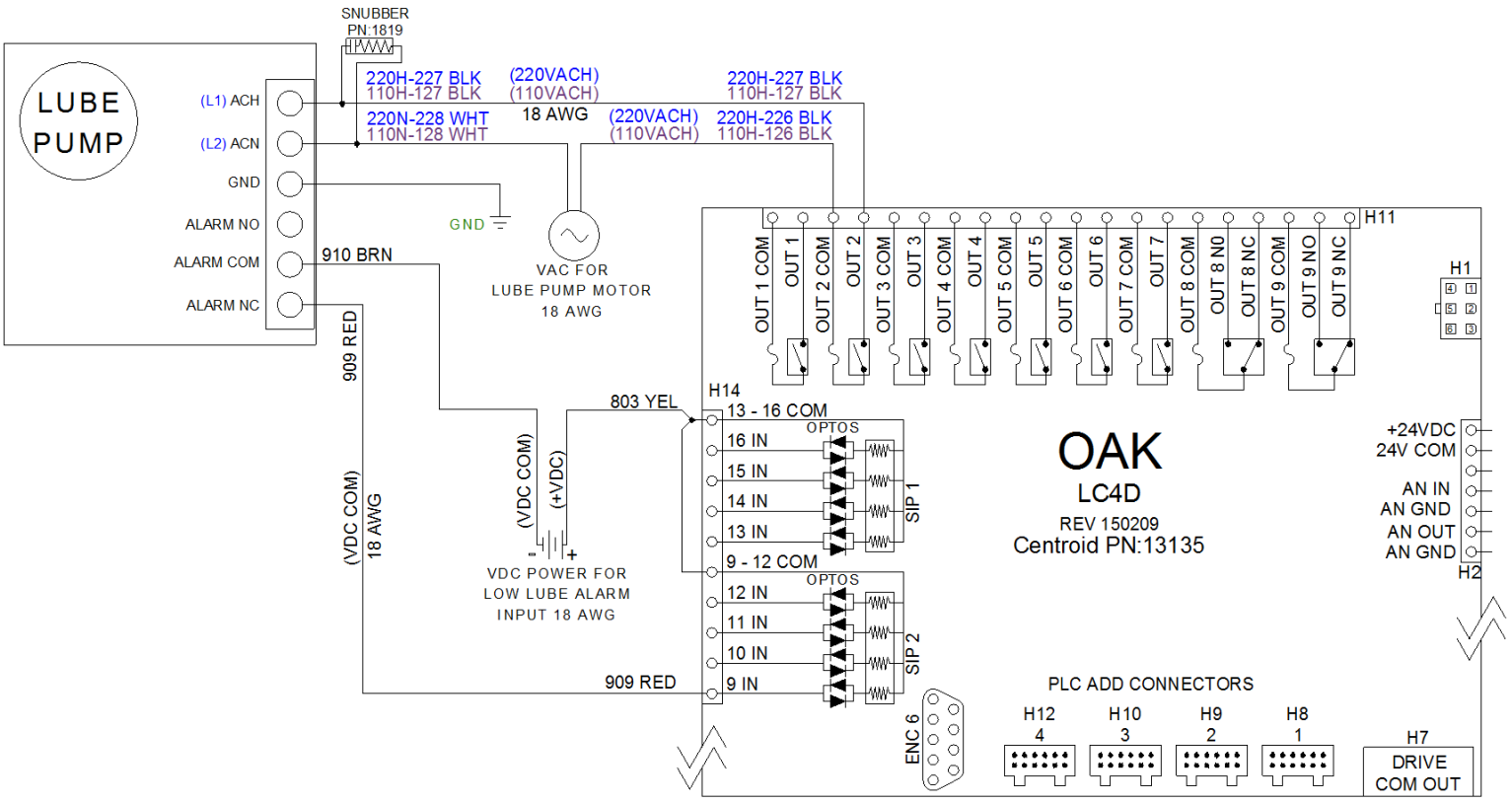


Figure 5.6.1
Sample Lube Pump Circuit

5.7 Wiring Coolant Pump

By default, **Output 3** on the Oak Board is the coolant flood pump output.
If you have mist, refer to the schematic for how to wire it.

Figure 5.7.1 shows how to hook up a 3 phase Flood Pump. A Contactor (Centroid PART# 3959) is needed, shown in the figure.

If you do not have access to 3 phase, refer to Tech Bulletin 163:
(http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/163.pdf)

All contactors need a snubbers. Centroid recommends using the Quencharc snubber network (Centroid PART# 1819) on the coil of the contactor.

Centroid requires a thermal overload protector to protect the motor. The example diagram below depicts the 24VAC wired through the normally closed contacts on the overload section of the contactor. The overload protection circuit on your existing contactor may be labeled differently.

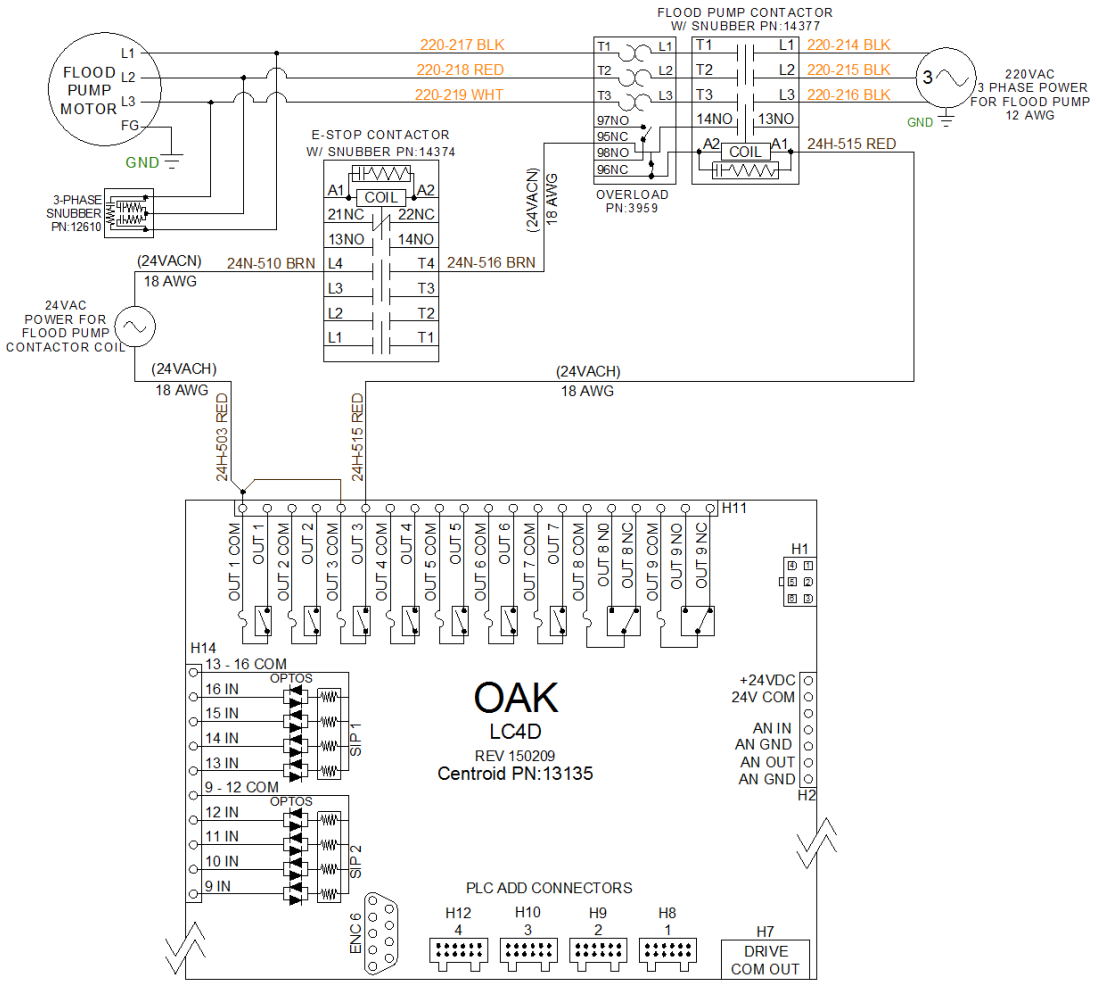


Figure 5.7.1
Sample Coolant Pump Circuit

5.8 WIRING SPINDLE

STOP: Before wiring up the spindle make sure that the analog output was tested as directed in Section 4.1.9.

There are two methods of wiring a spindle:

- **Reversing Contactors:** (logic connections shown in Figure 5.8.2, power connections in 5.8.3)
  The 3 phase is connected to mechanically interlocked reversing contactors, controlled by outputs 7 and 8 on the Oak board.

- **Variable Frequency Drive (VFD):** (shown in Figure 5.8.1)
  The terms “inverter”, “AC Drive”, and “VFD” (Variable Frequency Drive) can all refer to the spindle controller. Centroid has Technical Bulletins for the following drives:
  1) Delta VFD-B: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/182.pdf
  2) Delta VFD-V: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/183.pdf
  3) Delta VFD-VE: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/250.pdf
  4) Delta VFD-VE (V2): http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/229.pdf
  5) Automation Direct GS3: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/203.pdf
  6) Automation Direct GS2: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/209.pdf
  7) Yaskawa VS-616G3: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/255.pdf
  8) Yaskawa VS-606V7: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/256.pdf
  9) Control Techniques SP: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/278.pdf

A general guide on VFDs is in TB 152: http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/152.pdf

The max and min spindle speed set up in Section 4.1.3 as well as the spindle analog range need to match the inverter settings. If this is different than 3000 rpm and 0 to +10 VDC, they need to be changed.

With the default PLC program, several of the I/O are used with a spindle:

Oak Input/Output	Function
Input 10	Fault input from spindle controller
Output 5	Fault reset to spindle controller
Output 7	Fault output to spindle controller
Output 8	Spindle direction
Output 10	Cooling fan

Always refer to the schematic that came with the system.

In the example below the thermal overload protector is wired directly to the spindle fault. If your spindle controller has a fault condition it should be wired in series with the thermal overload protector.

All contactors **need** snubbers. Centroid recommends using the Quencharc snubber (Centroid PART# 1819) on the coil of the contactor. This reduces electrical noise when the spindle is turned off and on.

Enabling Spindle Fault Inputs:

1. Power up your system.
2. Start CNC12 and press F10 to continue to the main screen.
3. In the main menu press alt + I to bring up the real time I/O display.
4. Navigate to Input 10.
5. Press the ctrl-alt-i keys to remove any bars over the input.

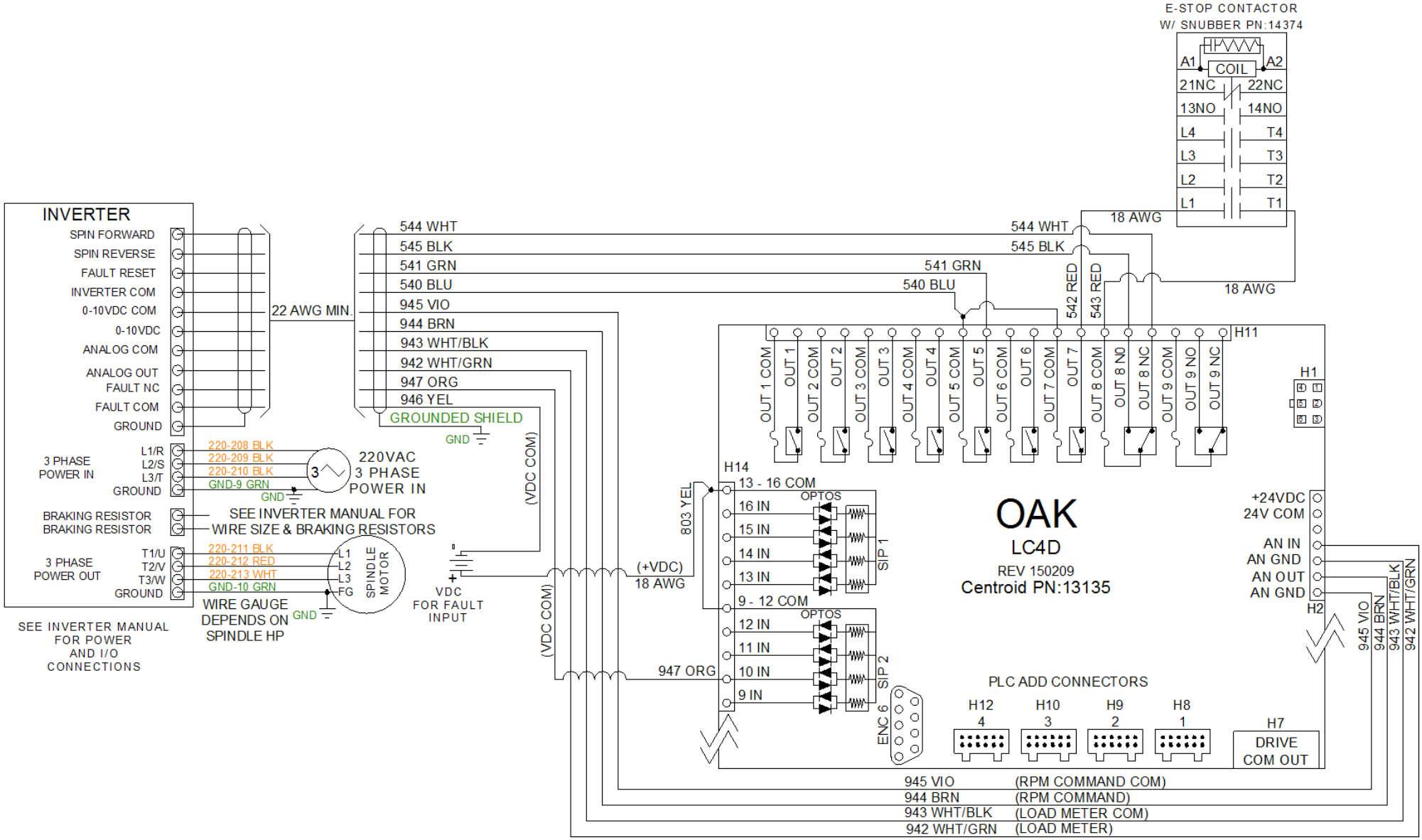


Figure 5.8.1
Sample VFD Wiring

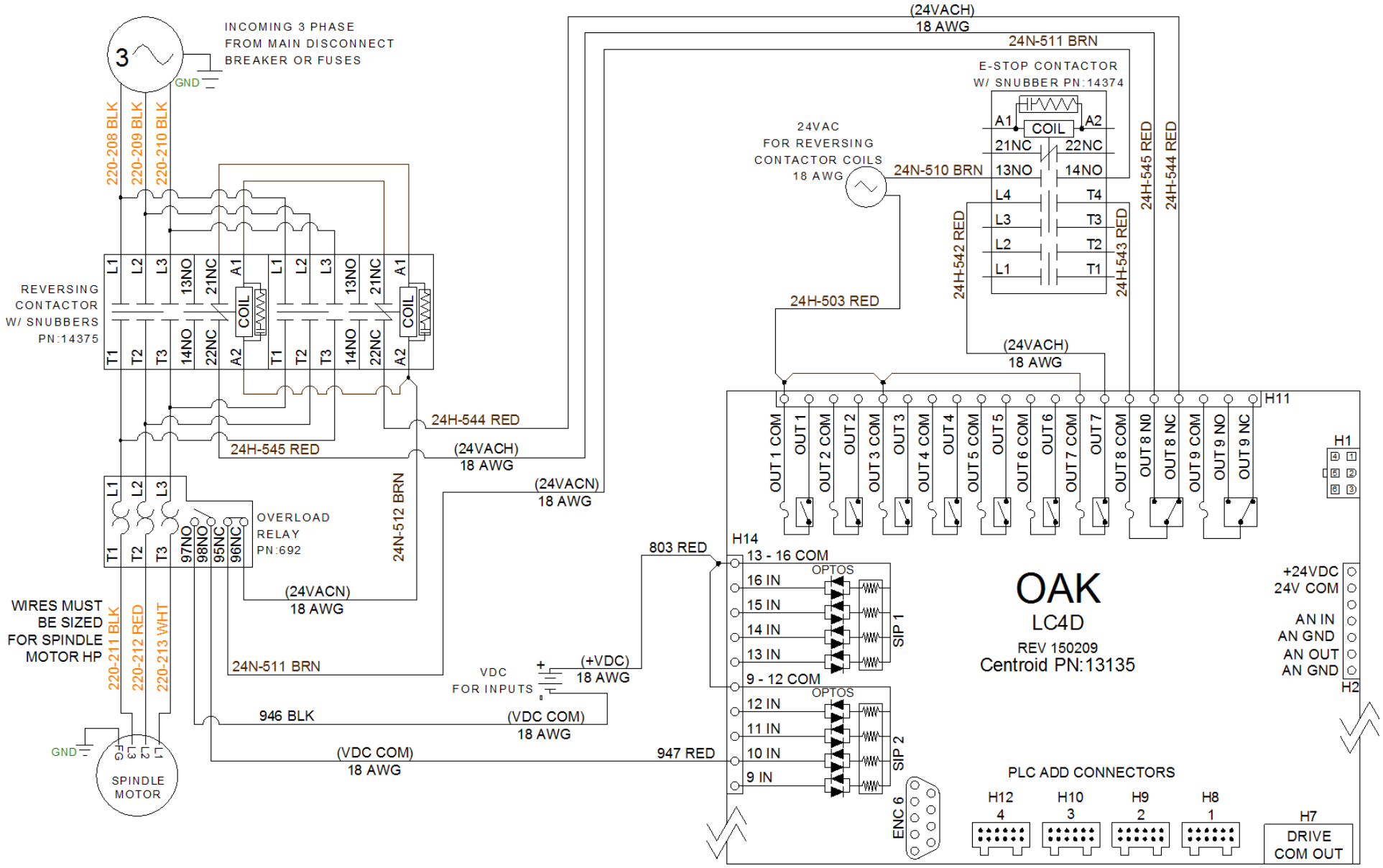


Figure 5.8.2
Spindle Wiring

5.9 Wiring 3rd Party Servo Amplifiers to the Oak Board

Connect drives to Oak Board:

Drive	Centroid Cable Part Number
Delta Drives	13131
Estun Drives	13132
Yaskawa Drives	13134
Flying Lead	13133

- Plug the drives into the Oak Board where it is labeled **Axis 1, Axis 2, Axis 3, etc.**
  - If flying lead cables were purchased, please reference Appendix C for signal information.
  - Appendix B has more information on all the cables

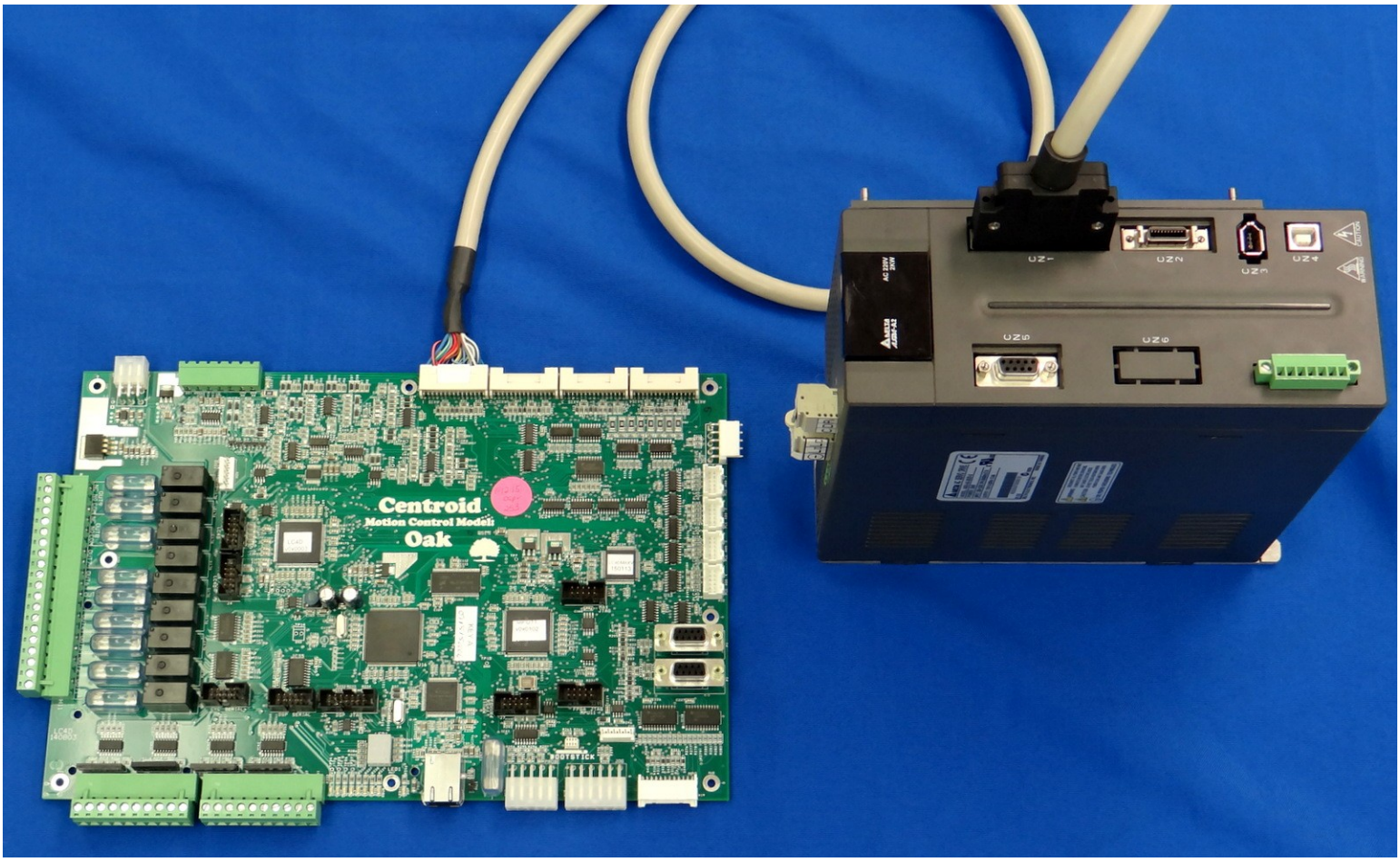


Figure 5.9.1
Axis 1 Drive Connection

CHAPTER 6 FINAL SOFTWARE CONFIGURATION

6.1 PROGRAMING YOUR THIRD PARTY DRIVE

Stop and program your third party drive. Refer to the relevant tech bulletin:

- Velocity mode tuning: TB 234 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/234.pdf)
- Yaskawa Sigma 5: TB 267 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/267.pdf)
- Delta ASDA-A2: TB 264 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/264.pdf)
- Estun Pronet: TB 291 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/291.pdf)

You must have completed the bench test from section 4.

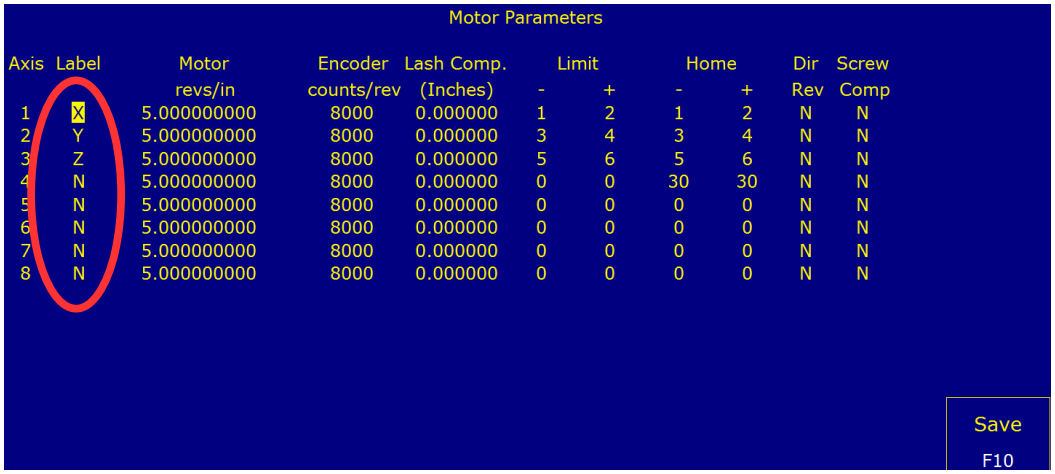
1. **Label the Axes:** From the main menu press **F1 Setup** → **F3 Config.** Password is **137**. Press **F2 Mach**. → **F2 Motor**.

   Under **Label** configure the software for the correct number of axes and label them appropriately. Typical set up for a mill:

   axis 1 labeled **X** **axis 2** labeled **Y** **axis 3** labeled **Z**

   Any unused axes should be set to **N** to disable the axis as seen in Figure 6.1.1.

Figure 6.1.1
Labeling the axes and verifying the axes



2. **Drive Mapping:**
   From the main menu pres **F1 Setup** → **F3 Config.** Password **137**. Press **F3 Parms** → **F8 Next Table** multiple times until parameter **300 – 399** are displayed.

   Typical configuration for a three axis CNC is to set parameters:
   300 = 1 **301** = 2 **302** = 3 **303** = 4
   308 = 1 **309** = 2 **310** = 3 **311** = 4

   See figure 6.1.2.

   If you have more than 4 axes, a lathe, or a unique drive configuration, refer to the CNC12 Operator's manual for more information about these parameters.

3. **If you have a spindle encoder:** be sure it is plugged into the Encoder 6 header on the Oak board
   Parameter **313** = 6
   Parameter **34** = spindle encoder counts/rev (not shown in figure)
   Parameter **35** = 6 (not shown in figure)
   Parameter **78** = 1 (not shown in figure)

   See TB 123 for information on rigid tapping: www.centroidcnc.com/dealersupport/tech_bulletins/uploads/123.pdf

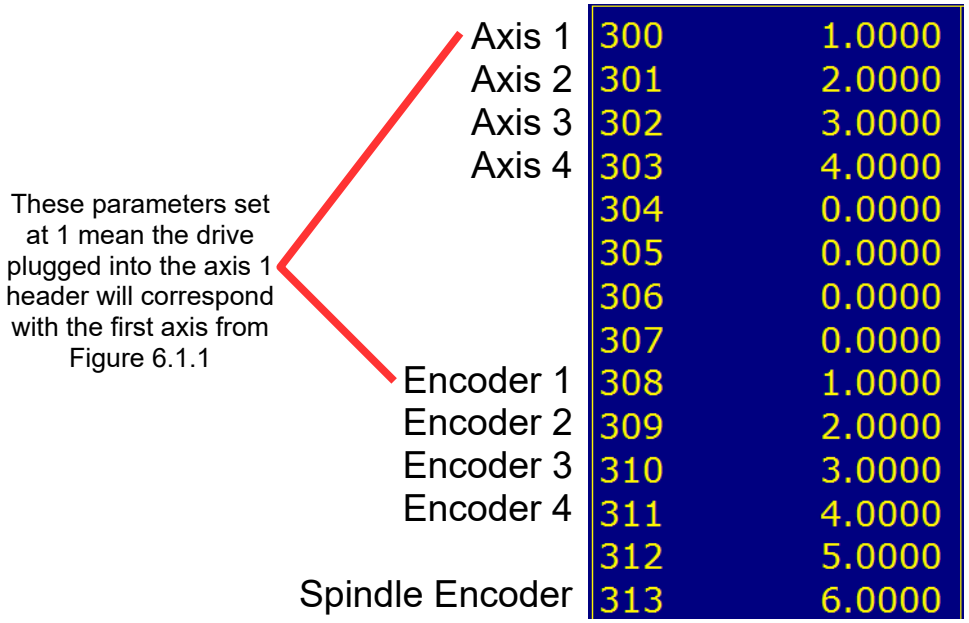


Figure 6.1.2
Setting up the Drive Output and Encoders

4. **Set Mode:** CNC 12 can either be in velocity or precision mode.

- Go to the parameters menu (From the main menu press **F1 Setup** → **F3 Config.** Password **137**. Press **F3 Parms.**)
  - **If using velocity mode (Estun Drive):** Set parameter **256 to 1**.
  - **If using precision mode (Yaskawa or Delta Drive):** Set parameter **256 to 2**.

5. **Verify Heating / Cooling Parameters:** Heating and cooling do not apply for 3rd party drives.

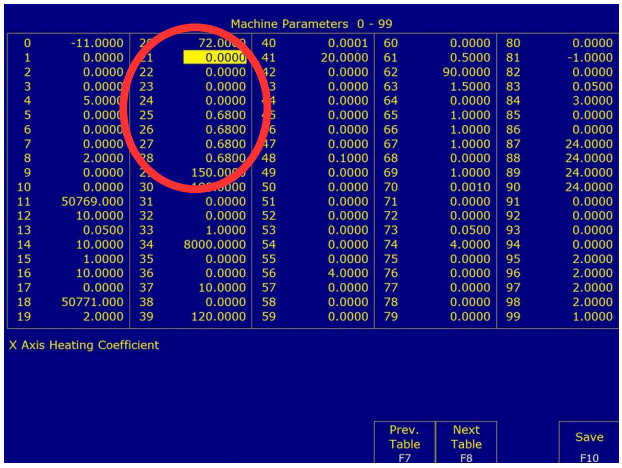
   Go to the parameters menu. (From the main menu press **F1 Setup** → **F3 Config.** Password **137**. Press **F3 Parms.**)

   Set parameters **21- 24** to **0** and **132 – 135** to **0**.

   Make sure the cooling coefficients (parameters **25 – 28** and **236 – 239**) are set to their default value of "**0.68**".

   Press **F10** to save when finished.

Figure 6.1.3
Heating Coefficients Disabled



6.2 Confirm Encoder Communication

Confirm Encoder Feedback on all axes:

1. Push in the E-Stop switch to disable motors.

2. From the main menu, press **F1 Setup** → **F3 Config**. Password is **137**. Press **F4 PID**.

3. **If possible**, manually rotate each motor while watching the abs pos field (circled below) for that axis as seen in Figure 6.2.1. 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 if the motor has a brake, for these axes skip this section, the tech bulletin for the drive should have described how to confirm the communication.

4. Confirm that the absolute position increases while rotating the shaft counter clockwise as shown below in Figure 6.2.1.

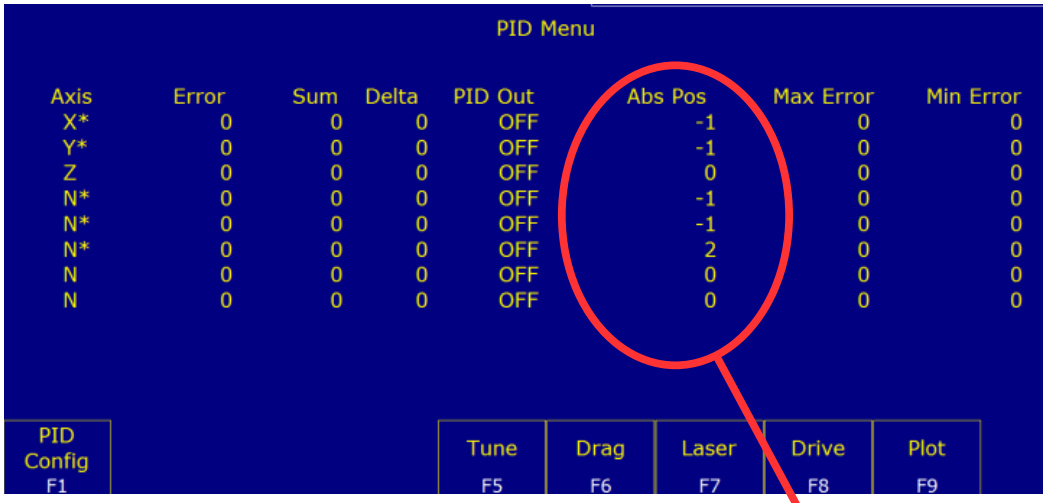


Figure 6.2.1
Watching the “Abs Pos” field

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

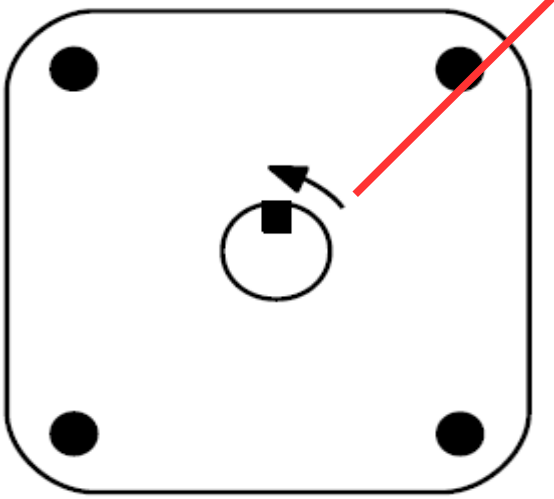


Figure 6.2.2
Motor Faceplate

6.3 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 like Figure 6.3.1.

Troubleshooting: If the screen shown in Figure 6.3.1 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 section 4.1 and 6.1, and that all inputs are in the correct state. Also, confirm your drive is wired correctly and configured to work with the Oak 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**.

Figure 6.3.1
MDI mode, indicating
that all faults have been
cleared.

6.4 Motor Software Setup

1. **Check home configuration:** From the main screen press **F1 Setup** → **F3 Config.** Password **137**. Press **F1 Contrl**.

   Check that **machine home at pwrup** is set to **Jog**.

   Esc to main menu.

   DANGER: Homing to limit switches right now could cause physical damage to your machine. The limit switches have not been configured correctly yet.

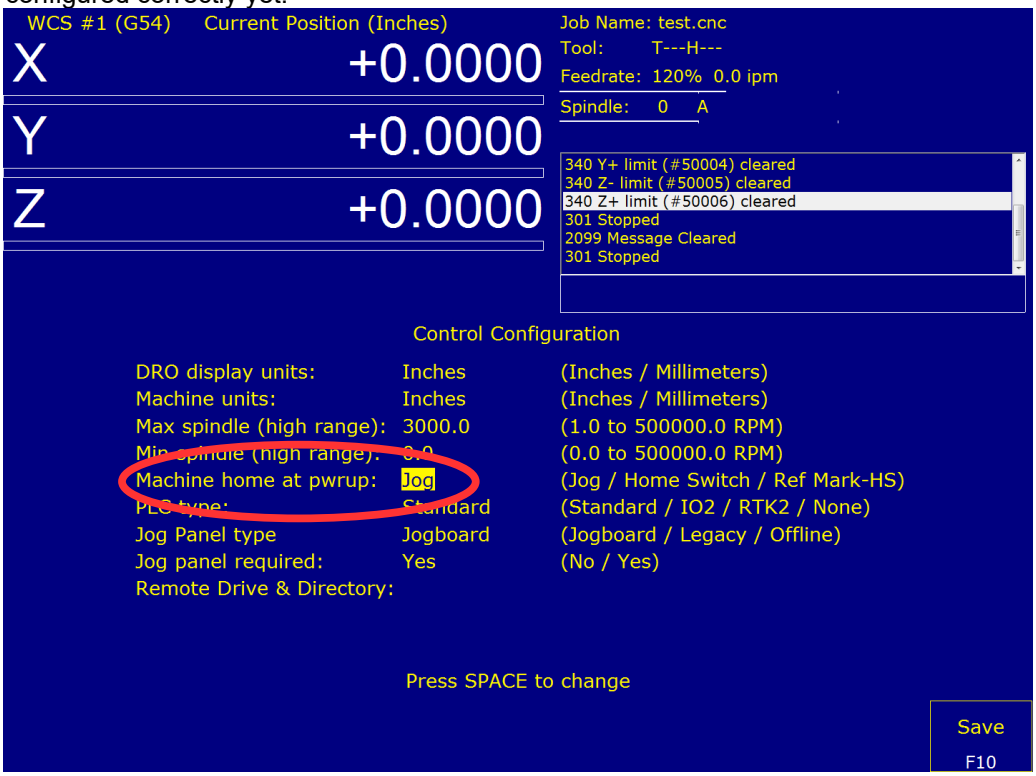


Figure 6.4.1 Checking home configuration

2. **Turn the feedrate down to around 10%**

3. **Press the Cycle Start button** on the Jog Panel, or Alt+S from the keyboard. This will cause the machine to set home where it is.

4. **Slow jog each of the servo motors:** Checking that each axis of the machine can move. Try slowly increasing the feedrate to 100% while jogging the motor.

   DANGER: Use extreme caution the first time attempting to move the motor, they may move unpredictably as they have not yet been tuned. Keep a hand on the E-Stop.

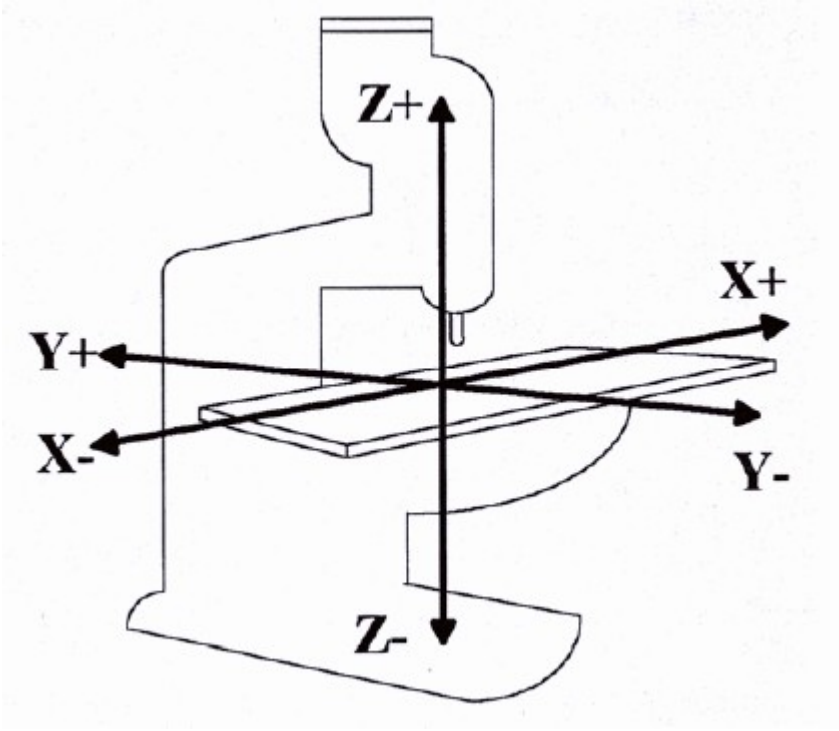
   See Appendix A: Motor Behaving Unexpectedly for troubleshooting help.

5. **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.



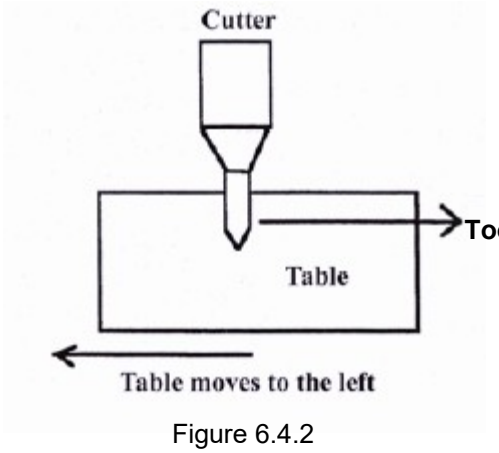


Figure 6.4.2
Table verses tool movement

Use MDI to move each axis and determine if the axis is moving in the correct direction. To determine this, observe that the DRO counts up while moving a tool in the positive direction and that it counts down while moving in the negative direction.

To correct for an axis that is moving in the wrong direction:

1. From the main menu press **F1 Setup** → **F3 Config**. Password **137**. Press **F2 Mach** → **F2 Motor**.
2. Use the arrow keys to select the **Dir Rev** field for the axis that needs to be reversed.
3. Press the space bar to change it's state.

   Refer to Figure 6.4.3.

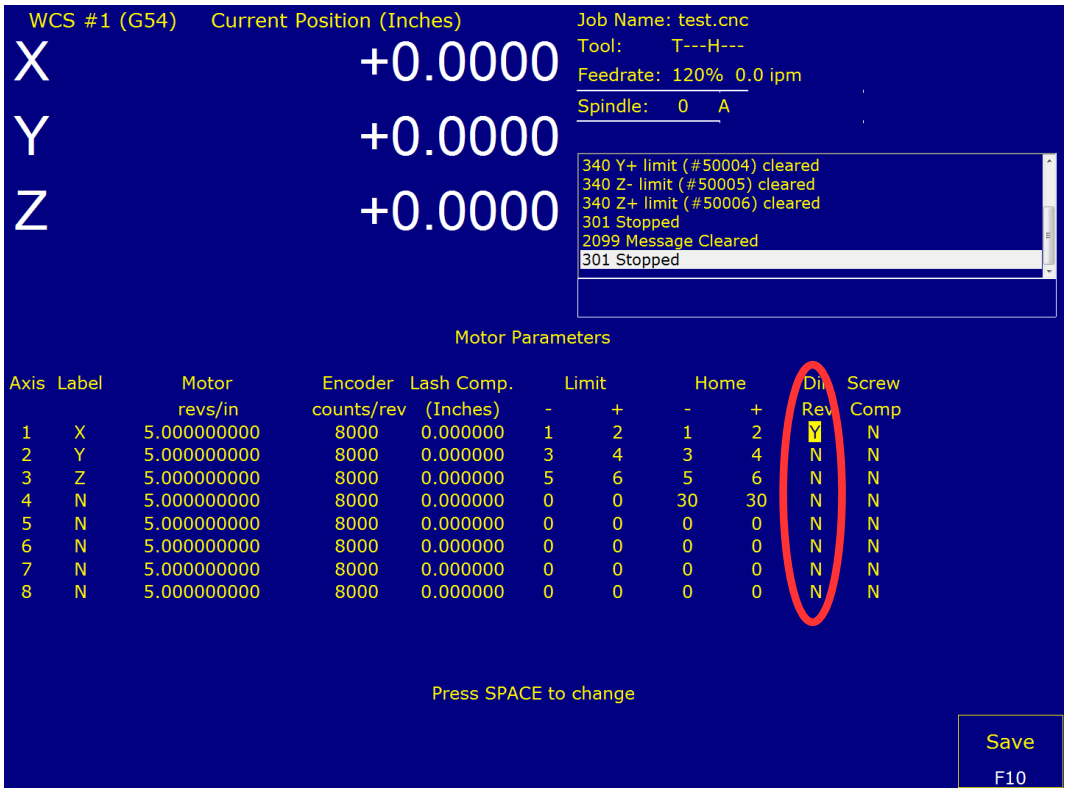
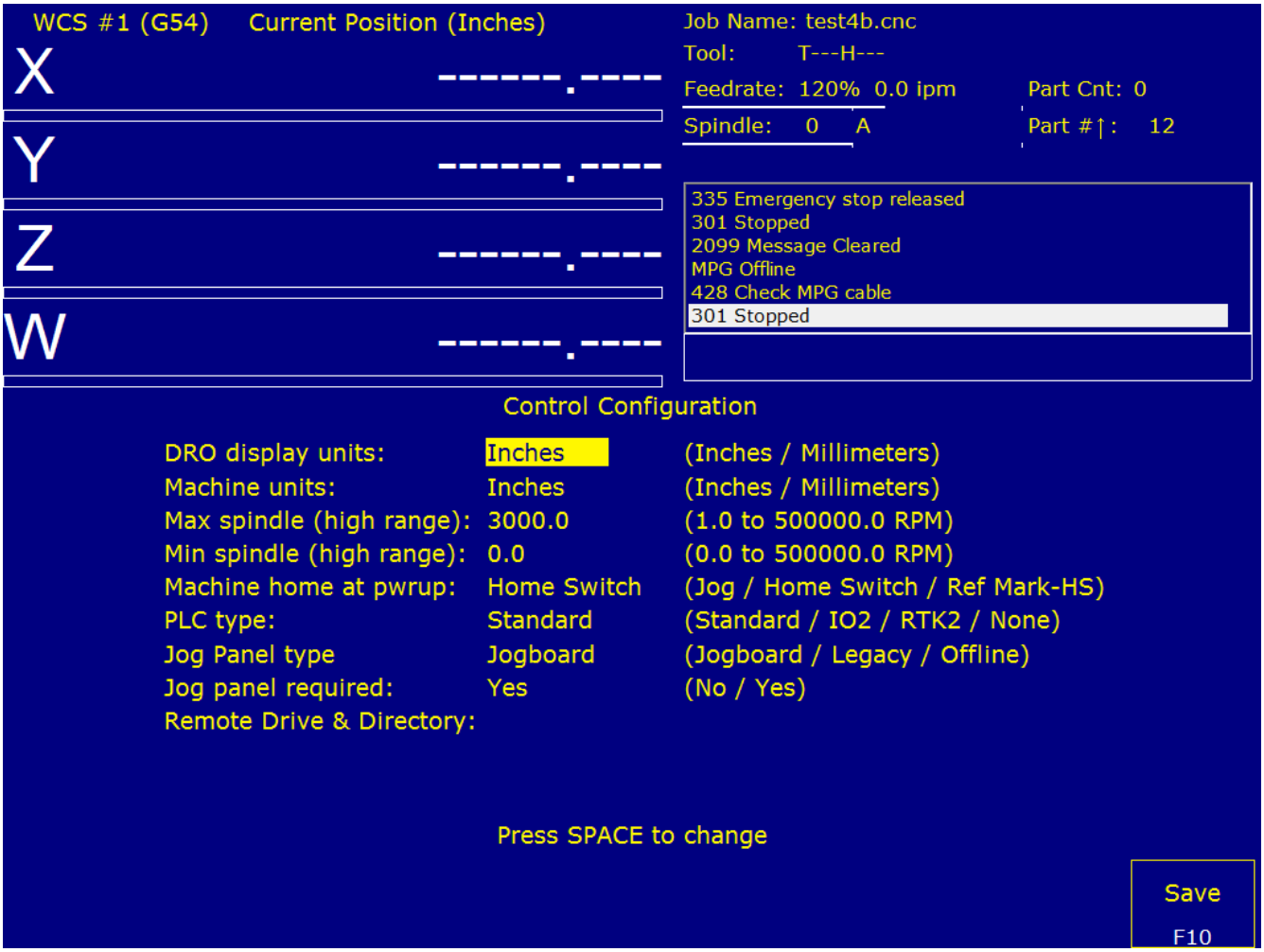


Figure 6.4.3
Direction reversal

6.5 SPINDLE SETUP

From Main Screen **Setup (F1)** → **Config (F3) (Default Password = 137)** → **Contrl (F1)**



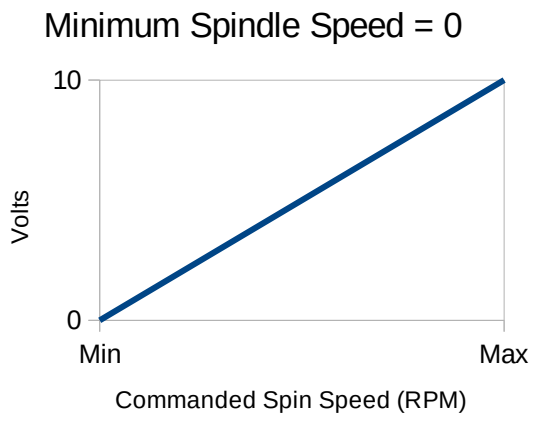
The Control Configuration screen provides you with a method of changing controller dependent data.
If you wish to change a field, use the up and down arrow keys to move the cursor to the desired field. Type the new value and press <ENTER>. When you are done editing, press <F10> to save any changes you have made. If you wish to discard your changes and restore the previous values, press <ESC>.

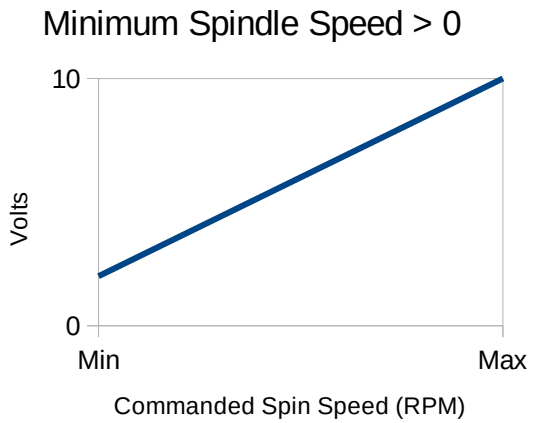
Maximum Spindle Speed (High Range)

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 (High 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 any bars over the input in the display. This will enable the spindle inputs.

Enable Spindle Encoder Parameters

If a spindle encoder is being connected to the OAK, 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 INP63 and INP64 to signal to the CNC10 software which range is in effect, according to the table below.

PLC INPUT	Spindle Range			
	High Range	Medium High Range	Medium Low Range	Low Range
INP63	0	1	1	0
INP64	0	0	1	1

6.6 Configure Axes to Move Correct Distance

Refer to Technical Bulletin #36, the latest version can be found here:
(http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf)

The setup used is shown in figure 6.6.1. The screen to enter the corrected values is shown in figure 6.6.2, from the main screen press **F1 Setup** → **F3 Config.** Password **137**. **F2 Mach.** → **F2 Motor**.

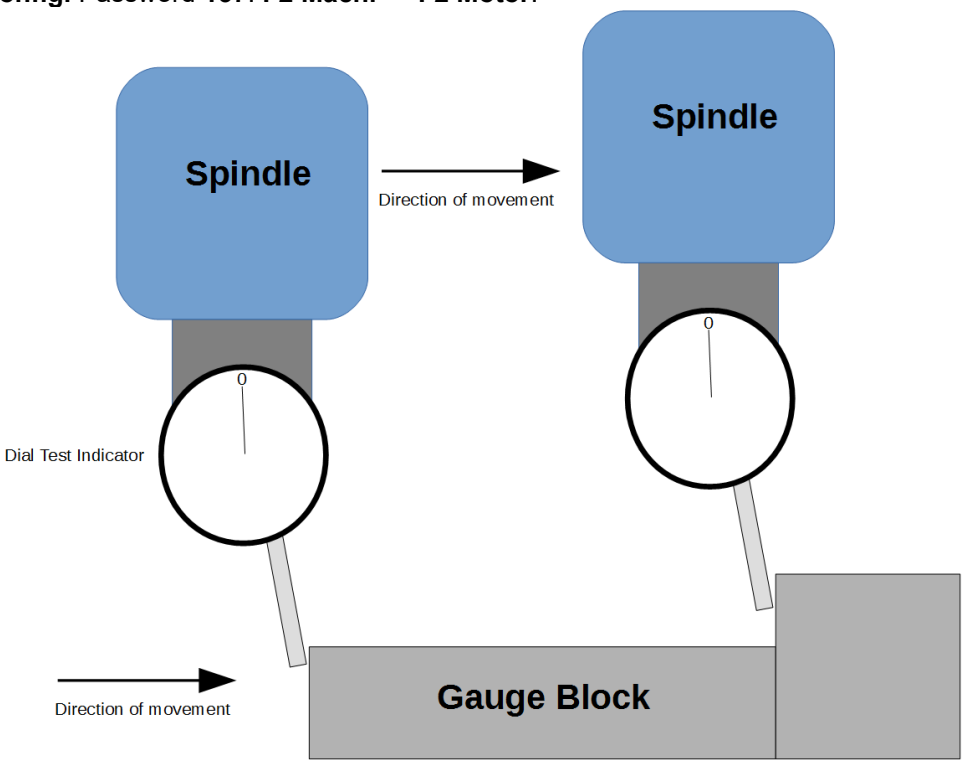


Figure 6.6.1
Test Procedure

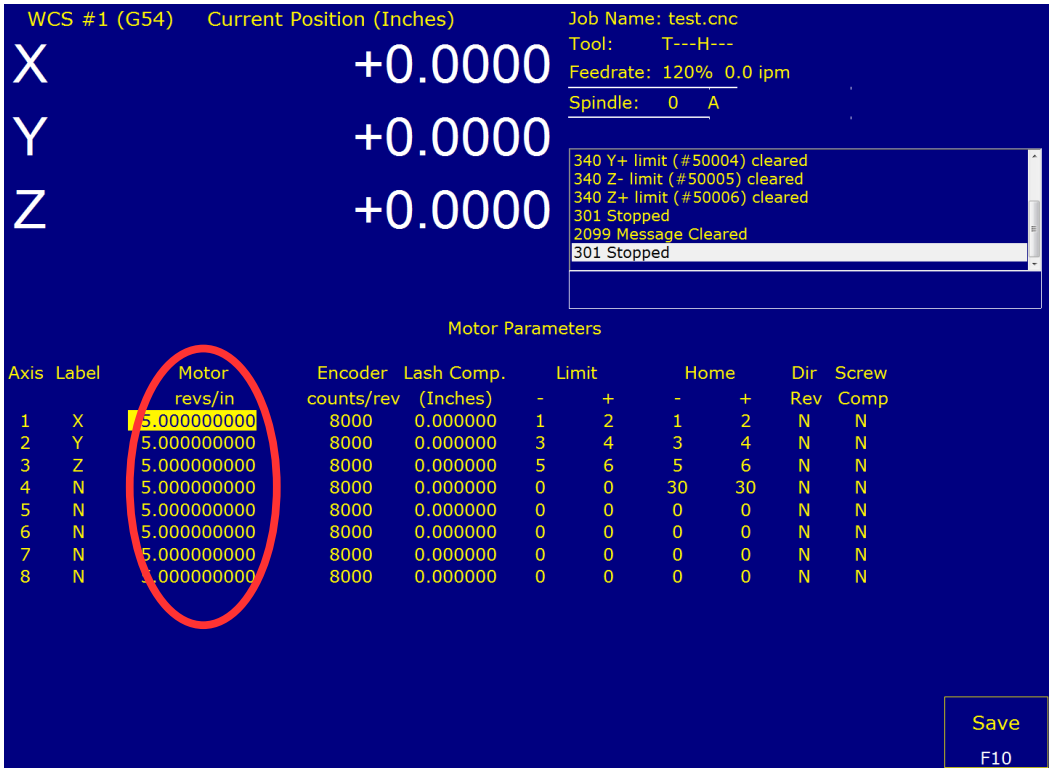


Figure 6.6.2
Fine adjustment of motor revs/in or mm's/rev

6.7 HOMING THE MACHINE

1. **Configure Limit Switches:**

   Note: Information on homing to reference marks can be found in Technical Bulletin 127. (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/127.pdf)

   1) **Bring up the Real Time I/O screen:** Press **Alt+i**

      - If any inputs are still inverted, highlight them and press **Ctrl+Alt+i** to remove any bars over inputs **1-6**

   2) **Manually trip the -X limit switch by physically pressing it / blocking it.** Take note of which input changes color, this input is the -X limit switch.

   3) **Enter the motor parameters menu:** From the main menu press **F1 Setup** → **F3 Config**. Password **137**. Press **F2 Mach** → **F2 Motor**.

   4) Enter the input number of the tripped limit switch.
      - **Example:** If input 1 turned red when the -X limit switch was tripped, enter 1 into the -X field in figure 6.6.1 (highlighted)

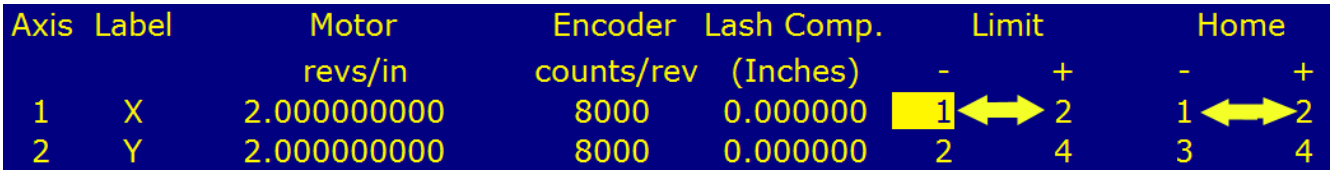


Figure 6.6.1
Reversing limit switches in software

   5) **Repeat for the + and – limits for other axes.**

   6) Continue to step **2.**

2. **Change the home type:** From the main screen press press **F1 Setup** → **F3 Config.** Password **137**. Press **F3 Parms.**

   Using the keyboard space bar change **Machine home at pwrup** to **Home Switch**.

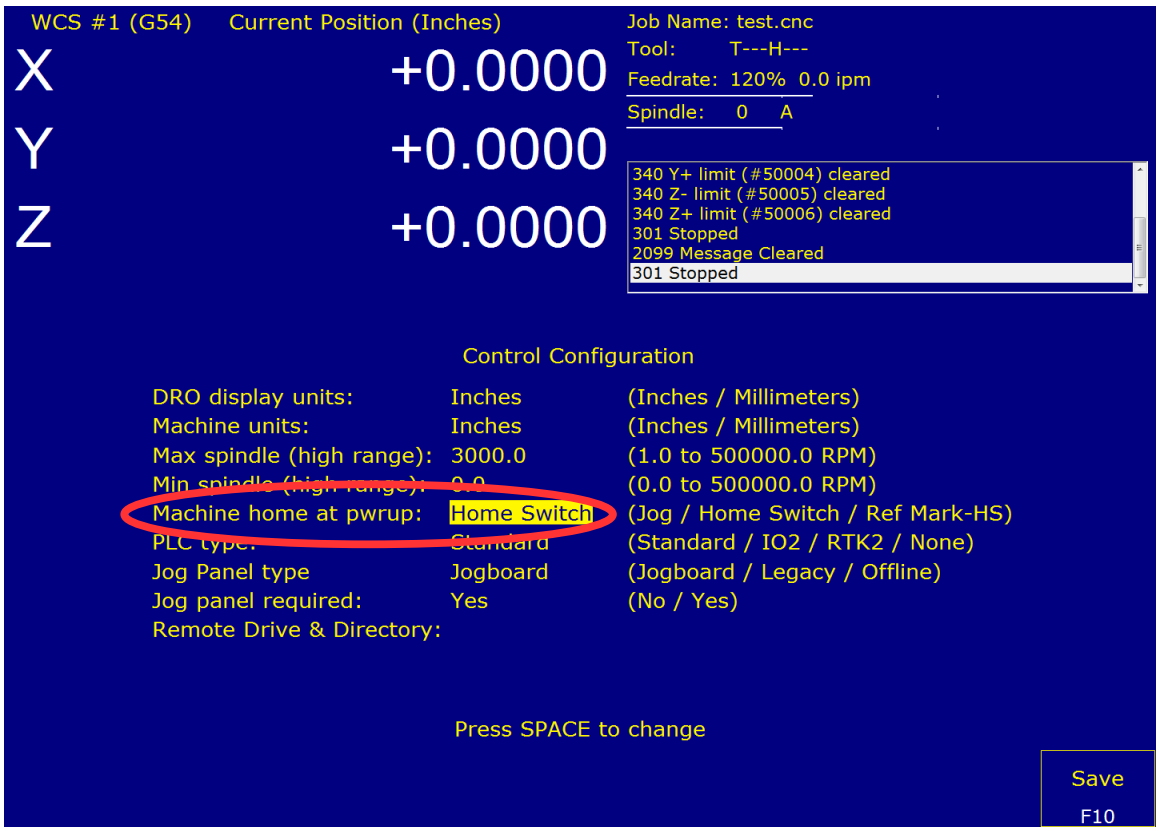


Figure 6.6.2
Enabling Homing

3. **Restart the Machine**

4. For 2, 3, and 4 axis machines, the default home file is sufficient. If the machine has more axes a home file will need to be made. Refer to Technical Bulletin 22, the latest version can be found here. (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/22.pdf)

5. **Home the Machine:** From the main menu press **cycle start** on the Jog Panel or **Alt+S** to home the machine. The machine should move slowly towards each limit switch.

   DANGER: Adjust the feedrate as needed so that the machine moves slowly. Be prepared to press E-Stop if anything unexpected occurs.

   Note: If the machine stops homing and the main menu says **Warning: Machine not homed** a limit switch was pressed in the wrong order and the machine faulted out. Refer to Technical Bulletin 22.

6.8 TUNE THE PID

To get to the PID screen in Figure 6.7.1, press **F1 Setup** → **F3 Config.** Password **137**, **F4 PID** → **F1 PID Config.**

- **If using precision mode (Yaskawa or Delta):** Tuning is handled in the drive software, refer to the technical bulletin on setting up those drives:

  Yaskawa Sigma 5: TB 267 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/267.pdf)

  Delta ASDA-A2: TB 264 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/264.pdf)

  - PID values should be:
    Kp=0 **Ki**=0 **Kd**=0 **Limit**=2560000 **Kg**=0 **Kv1**=0 **Ka**=0 **Accel.**=0.500
  - Ensure that parameter **256** is set to **2**.
  - Ensure The Axis Encoder Counts in the Centroid software are the same as the ones used for tuning.

- **If using Velocity mode (Estun):** follow Tech Bulletin 291, then follow the tuning guide in Tech Bulletin 234.
  (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/291.pdf)
  (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/234.pdf)

  - Initial PID values for the axes should be:
    Kp=0.04 **Ki**=0.0005 **Kd**=0.00 **Limit**=2560000 **Kg**=0 **Kv1**=80 **Ka**=0 **Accel.**=0.500
  - Ensure that parameter **256** is set to **1**.

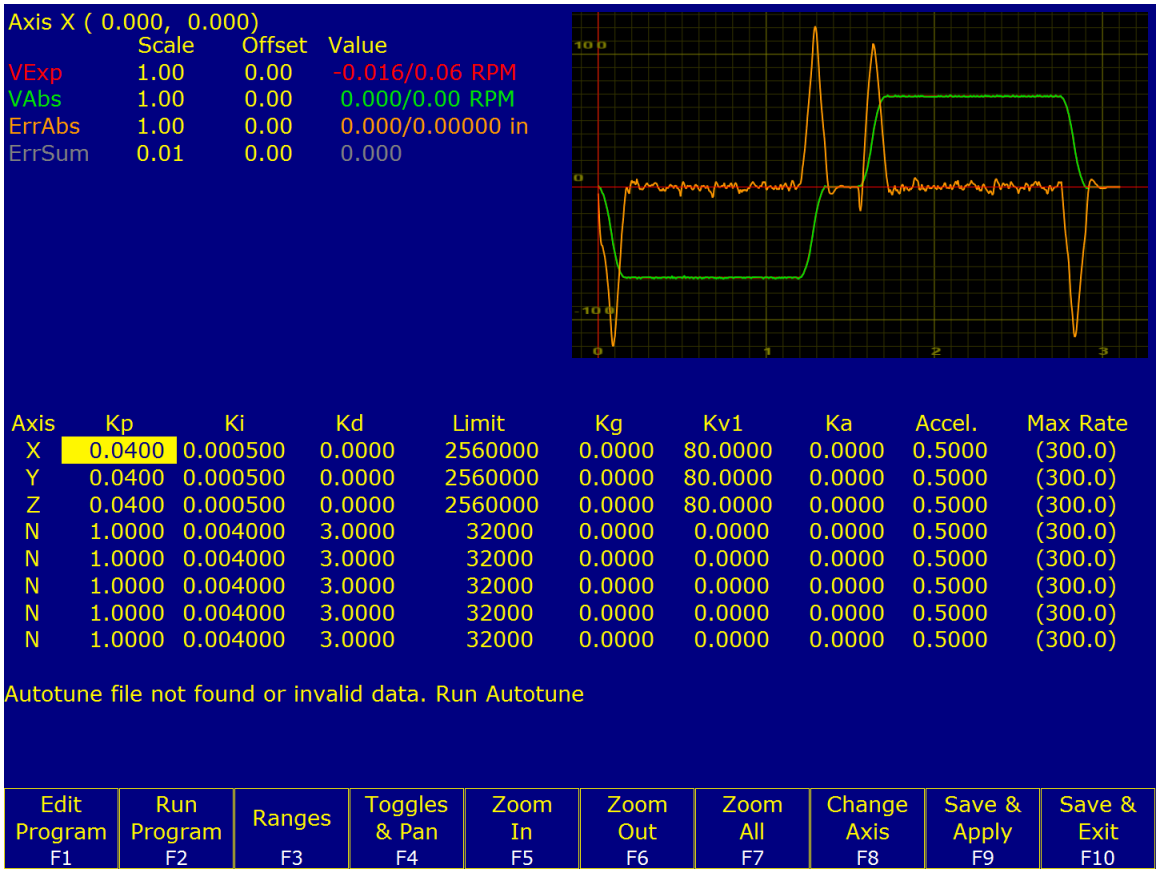


Figure 6.7.1
PID Configuration Screen

6.9 BACKLASH COMPENSATION

Follow the procedure outlined in Technical Bulletin 37, the latest version can be found here: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/37.pdf)

- **Adjust Mechanical Lash:** Before configuring the electronic backlash compensation in the control, every effort should be made to reduce the mechanical lash in your machine to less than **0.001"**. (Use the test below to verify your backlash is less than 0.001").

  The setup used is shown in figure 6.8.1. The screen to enter the corrected values is shown in figure 6.8.2, from the main screen press **F1 Setup** → **F3 Config.** Password **137**. **F2 Mach.** → **F2 Motor**.

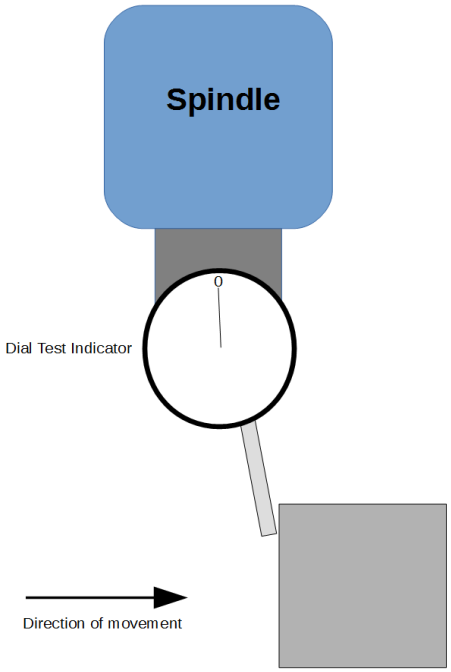


Figure 6.8.1 Backlash Compensaton

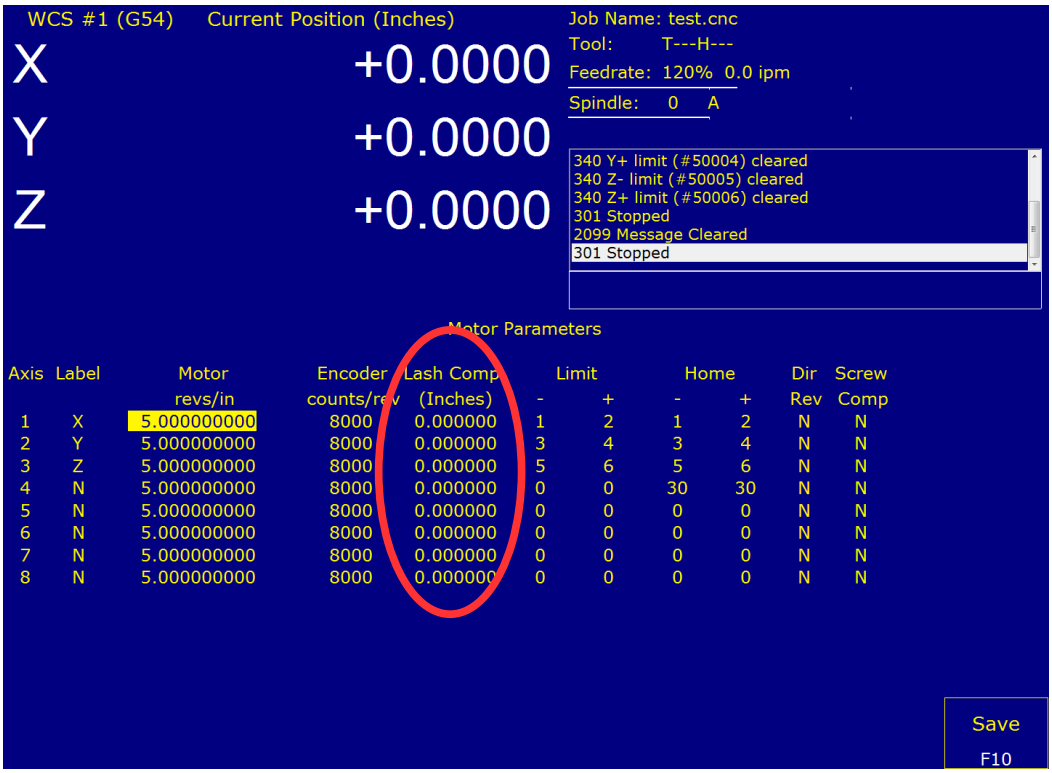


Figure 6.8.2 Entering Backlash Compensaton

6.10 SOFTWARE TRAVEL LIMITS

Setting software travel limits will automatically decelerate the axis right before it reaches the limit switch, preventing possible damage to the machine as shown in Figure 6.10.1.

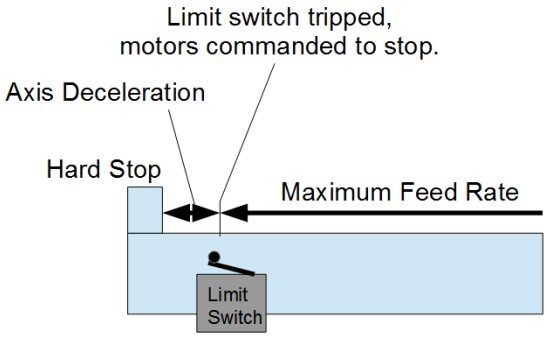


Figure 6.10.1
Machine without software travel limits.

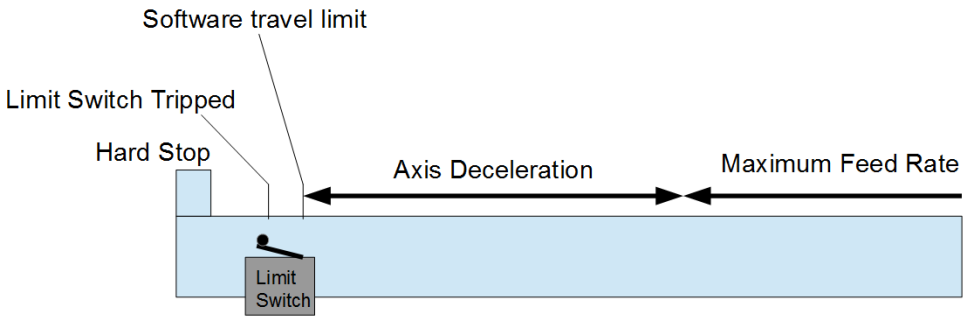


Figure 6.10.2
Machine with software travel limits.

Prerequisites: Before starting the machine:
- The revs per inch or mm needs to be calibrated correctly, as in section 6.5.
- The limit switches need to be functioning, set up in section 6.6.

Restart the machine and home it before continuing.

1. **Check that the DRO is displaying machine position:** From any menu, press the **alt** and **D** keys simultaneously until **machine** is displayed in the top left corner of the DRO, shown in Figure 6.9.3.

2. Put the machine into **Slow jog** and turn the feedrate **down**.

   Move the axis away from home toward the limit switch on the opposite end of the axis until the limit switch trips.

   The status screen will display message such as "**407 X- limit (#50001) tripped**".

3. Put the Jog Panel into **incremental mode**, **x10**. Increment away from the limit switch until the limit switch is cleared.

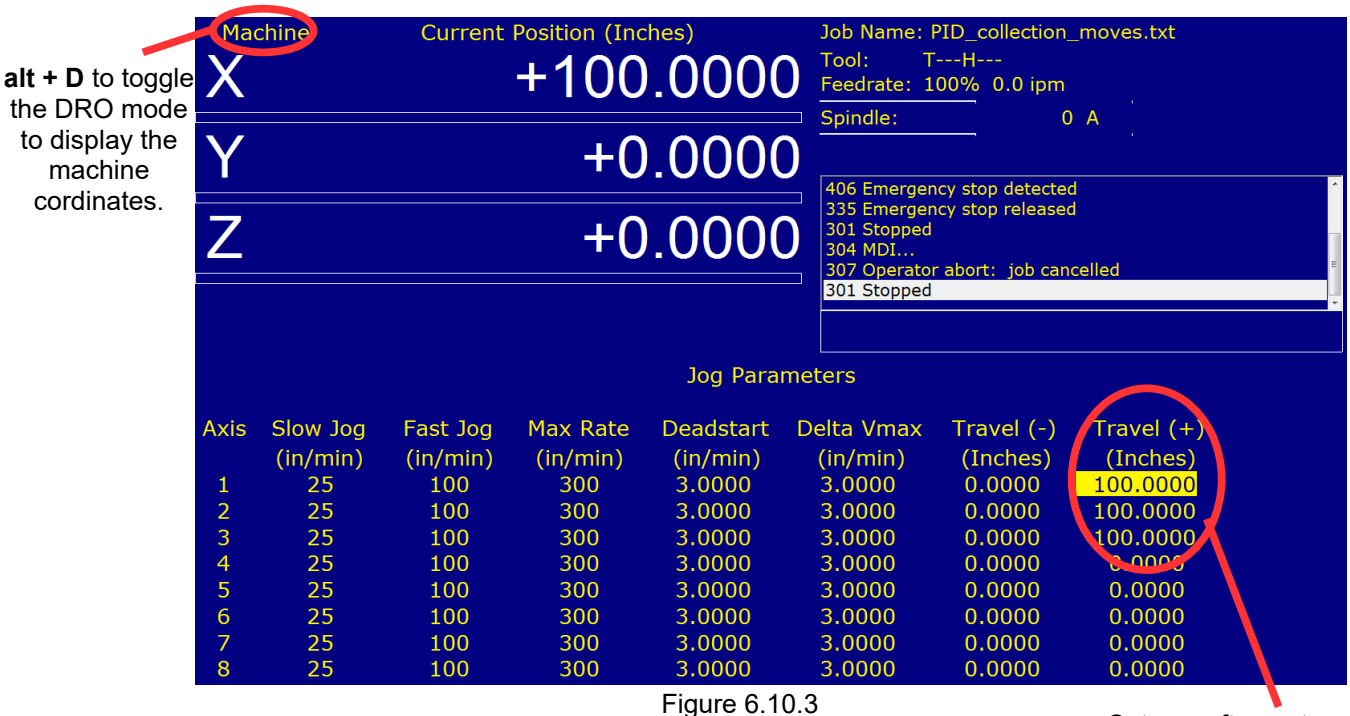
   The status screen will display a message such as "**340 X- limit (#50001) cleared**".

   Jog another **0.1" (2.5mm)** away from the limit switch.

   Continue to step 4.

4. **Enter the Jog Parameters Menu:** From the main menu, press **F1 Setup** → **F3 config**. The password is **137**. Press **F2 Mach.** → **F1 Jog**.

   In the Jog Parameters menu. Enter the DRO value into the appropriate **Travel (-)** or **Travel (+)** box, whichever is ***opposite*** the side the machine homes to. Refer to figure 6.10.3.



alt + D to toggle the DRO mode to display the machine cordinates.

Set up software travel limits here.

Figure 6.10.3
Setting Software Travel Limits

   Note: When both the Travel(-) limit and the Travel(+) limit are set to zero, software travel limits are disabled. As soon as **one** of the two values change to a non-zero value, **both** limits are enabled. Since everything is referenced to machine position, the side of each axis that you home to should be left at zero.

5. Repeat for each axis.

6. **Test by manually jogging each axis toward the limit switch:** Ensure that the machine automatically stops the axis at the software travel limit **before** the limit switch is tripped.

   Use the **F3 MDI** menu to issue a G-code that asks the software to move just beyond the software travel limit, verify the CNC12 status window throws an error such as **907 # axis travel exceeded, 325 Limit: job canceled**

6.11 Performing a System Test

When finished, the main menu will display a message saying ***Machine Setup Not Completed. Machine Is Not Ready To Run. Contact Your Dealer*** as shown below.

At this point you will need to run the **System Test**, which ensures that:

- The Home Switch is not set too close to the index pulse of the motor's encoder.
- The software travel limits are within the physical hard limit.

  Documentation on how to perform a system test is located here:
  (https://www.centroidcnc.com/downloads/Systemtest.pdf)

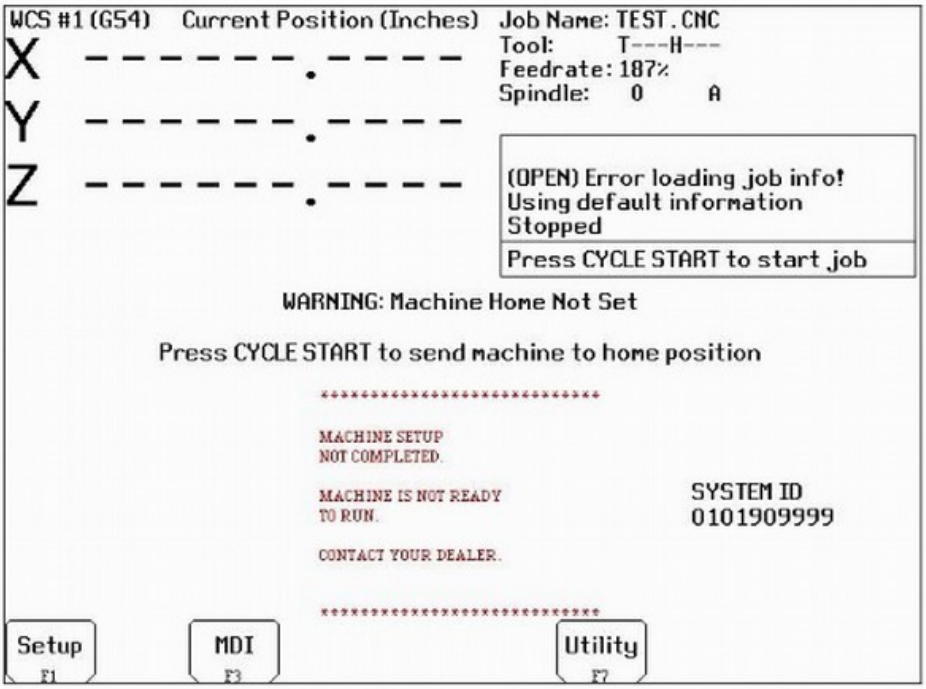


Figure 6.11.1
Machine Requiring a System Test

6.12 Create A Report

1. From the main menu press **F7 Utility → F7 Create Report → F10 Accept**
2. **Save The report somewhere safe.** A usb stick or an external hard drive is a good place to save the backup.
3. Send the **Report.zip** to **Support@centroidcnc.com**

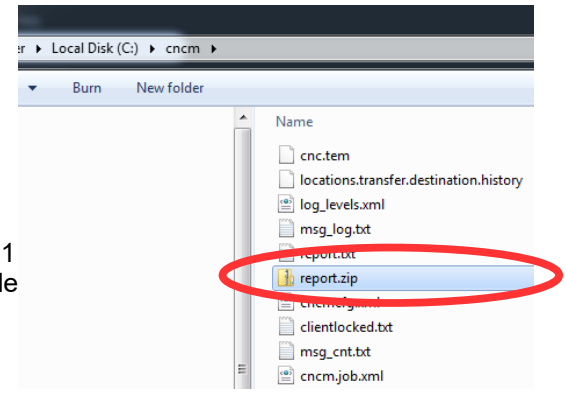
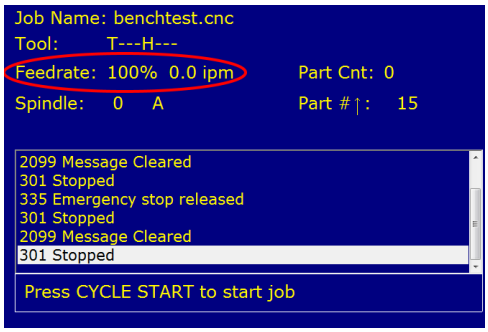


Figure 6.12.1
Report.zip file

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 2.3. • Lack of power to the Oak Board. • An incorrect IP configuration, see Section 3.2.9. 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 2.3. For further troubleshooting, refer to TB 270: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/270.pdf)
Jog Panel Communication In Fault	• If the optional Jog Panel/Pendant will not be installed, change the "Jog Panel Required" to "No" in the control configuration screen. Power off the system and restart. • If the optional Jog Panel/Pendant was ordered, confirm that it is plugged at both the Oak Board and on backside the Jog Panel board itself on the header labeled CPU10. For more information see TB 282: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/282.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	Problem with power to the motors and/or feedback from the encoder on the motor.

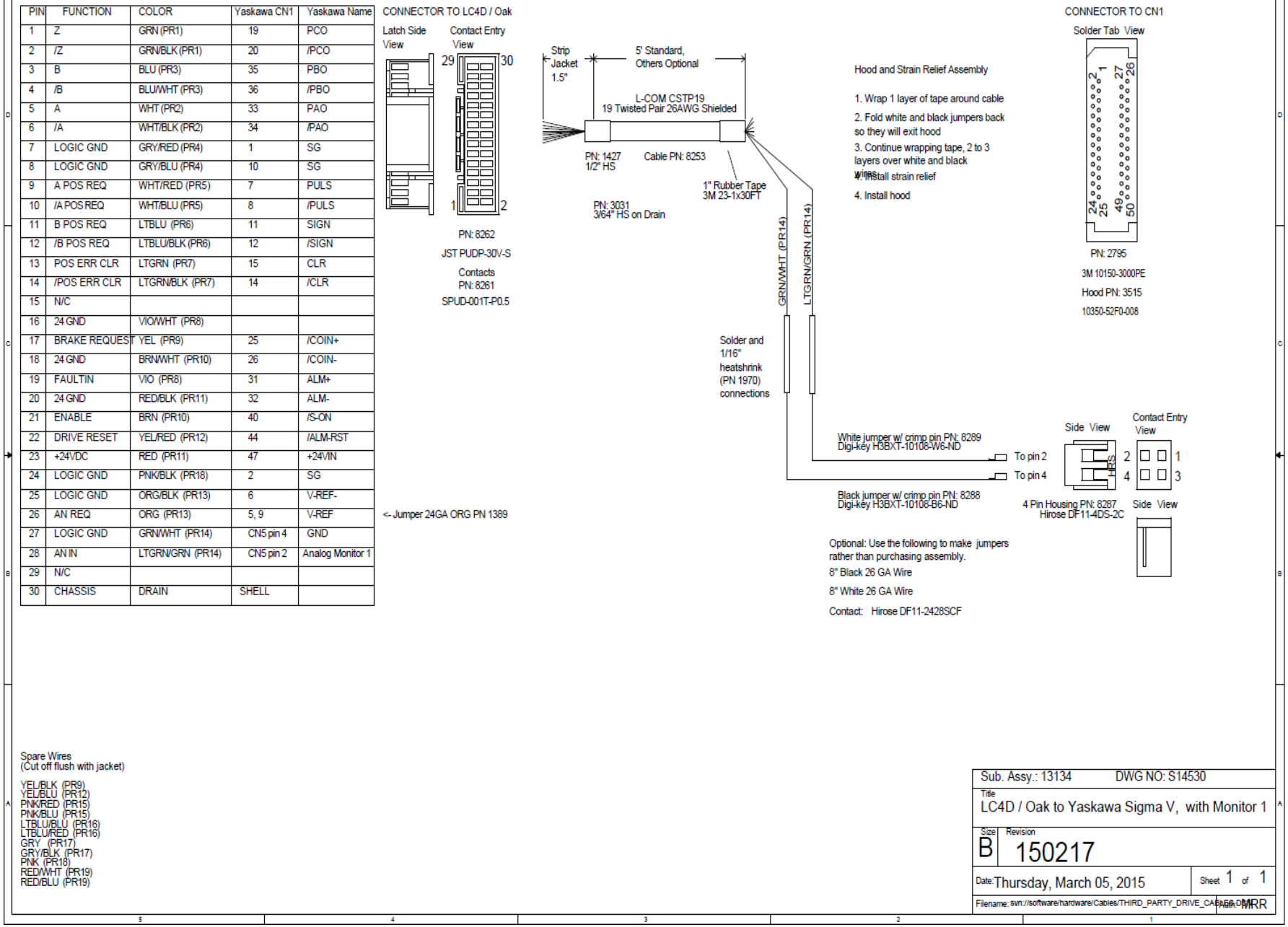
Motion, Position Errors and SV_STALL Errors	If SV_STALL error is displayed, it is almost always caused by a previous error – such as full power without motion, position error, encoder error, drive fault etc. Refer to TB 26: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/26.pdf)
Motor Behaving Unexpectedly	• If in velocity mode, Check the drive's setting for Input gain or Input scale, set it for -10 to +10 volts • 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.

For other errors, please see the Operator's Manual.

APPENDIX B - 3RD PARTY DRIVE CABLE INFORMATION

Additional Schematics may be found here:
Centroid Schematic Database: https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php

PIN	FUNCTION	COLOR	Yaskawa CN1	Yaskawa Name
1	Z	GRN (PR1)	19	PCO
2	/Z	GRN/BLK (PR1)	20	/PCO
3	B	BLU (PR3)	35	PBO
4	/B	BLU/WHT (PR3)	36	/PBO
5	A	WHT (PR2)	33	PAO
6	/A	WHT/BLK (PR2)	34	/PAO
7	LOGIC GND	GRY/RED (PR4)	1	SG
8	LOGIC GND	GRY/BLU (PR4)	10	SG
9	A POS REQ	WHT/RED (PR5)	7	PULS
10	/A POS REQ	WHT/BLU (PR5)	8	/PULS
11	B POS REQ	LTBLU (PR6)	11	SIGN
12	/B POS REQ	LTBLU/BLK (PR6)	12	/SIGN
13	POS ERR CLR	LTGRN (PR7)	15	CLR
14	/POS ERR CLR	LTGRN/BLK (PR7)	14	/CLR
15	N/C			
16	24 GND	VIO/WHT (PR8)		
17	BRAKE REQUEST	YEL (PR9)	25	/COIN+
18	24 GND	BRN/WHT (PR10)	26	/COIN-
19	FAULTIN	VIO (PR8)	31	ALM+
20	24 GND	RED/BLK (PR11)	32	ALM-
21	ENABLE	BRN (PR10)	40	/S-ON
22	DRIVE RESET	YEL/RED (PR12)	44	/ALM-RST
23	+24VDC	RED (PR11)	47	+24VIN
24	LOGIC GND	PNK/BLK (PR18)	2	SG
25	LOGIC GND	ORG/BLK (PR13)	6	V-REF-
26	AN REQ	ORG (PR13)	5, 9	V-REF
27	LOGIC GND	GRN/WHT (PR14)	CN5 pin 4	GND
28	AN IN	LTGRN/GRN (PR14)	CN5 pin 2	Analog Monitor 1
29	N/C			
30	CHASSIS	DRAIN	SHELL	



Spare Wires
(Cut off flush with jacket)

YEL/BLK (PR9)
YEL/BLU (PR12)
PNK/RED (PR15)
PNK/BLU (PR15)
LTBLU/BLU (PR16)
LTBLU/RED (PR16)
GRY (PR17)
GRY/BLK (PR17)
PNK (PR18)
RED/WHT (PR19)
RED/BLU (PR19)

Sub. Assy.: 13134 DWG NO: S14530

Title: LC4D / Oak to Yaskawa Sigma V, with Monitor 1

Size: B Revision: 150217

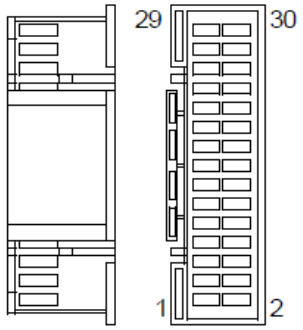
Date: Thursday, March 05, 2015 Sheet 1 of 1

Filename: svn://software/hardware/Cables/THIRD_PARTY_DRIVE_CABLES.DWG Author: MRR

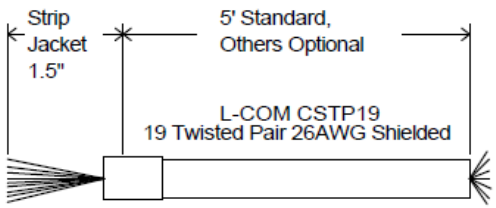
PIN	FUNCTION	COLOR	Delta CN1	Delta Name
1	Z	GRN (PR1)	50	OZ
2	/Z	GRN/BLK (PR1)	24	/OZ
3	B	BLU (PR3)	25	OB
4	/B	BLU/WHT (PR3)	23	/OB
5	A	WHT (PR2)	21	OA
6	/A	WHT/BLK (PR2)	22	/OA
7	LOGIC GND	GRY/RED (PR4)	13	GND
8	LOGIC GND	GRY/BLU (PR4)	19	GND
9	A POS REQ	WHT/RED (PR5)	38	HPULSE
10	/A POS REQ	WHT/BLU (PR5)	29	/HPULSE
11	B POS REQ	LTBLU (PR6)	46	HSIGN
12	/B POS REQ	LTBLU/BLK (PR6)	40	/HSIGN
13	POS ERR CLR	LTGRN (PR7)		
14	/POS ERR CLR	LTGRN/BLK (PR7)		
15	N/C			
16	24 GND	VIO/WHT (PR8)	47	COM-
17	BRAKE REQUEST	YEL (PR9)	1	DO4+
18	24 GND	BRN/WHT (PR10)	26	DO4-
19	FAULTIN	VIO (PR8)	28	DO5+
20	24 GND	RED/BLK (PR11)	27	DO5-
21	ENABLE	BRN (PR10)	9, 10	DI1-, DI2-
22	DRIVE RESET	YEL/RED (PR12)	33	DI5-
23	+24VDC	RED (PR11)	11	COM+
24	LOGIC GND	PNK/BLK (PR18)	12	GND
25	LOGIC GND	ORG/BLK (PR13)	44	GND
26	AN REQ	ORG (PR13)	42, 18	V_REF
27	LOGIC GND	GRN/WHT (PR14)	45	COM-
28	AN IN	LTGRN/GRN (PR14)	16	MON1
29	N/C			
30	CHASSIS	DRAIN	SHELL	

Possible cost reduction for future versions:
17 VDD +24V 500mA Power supply may be connected to COM+
instead of using external supply

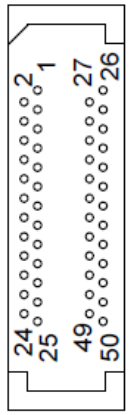
CONNECTOR TO LC4D / Oak



PN: 8262
JST PUDP-30V-S
Contacts
PN: 8261
SPUD-001T-P0.5



CONNECTOR TO CN1



PN: 2795
3M 10150-3000PE
Hood PN: 3515
10350-52F0-008

<- Jumper 24GA Buss wire PN 86

<- Jumper 24GA ORG PN 1389

Also works for Delta ASDA-AB

Spare Wires
(Cut off flush with jacket)

YEL/BLK (PR9)
YEL/BLU (PR12)
PNK/RED (PR15)
PNK/BLU (PR15)
LTBLU/BLU (PR16)
LTBLU/RED (PR16)
GRY (PR17)
GRY/BLK (PR17)
PNK (PR18)
RED/WHT (PR19)
RED/BLU (PR19)

Sub. Assy.: 13131 DWG NO: S14533

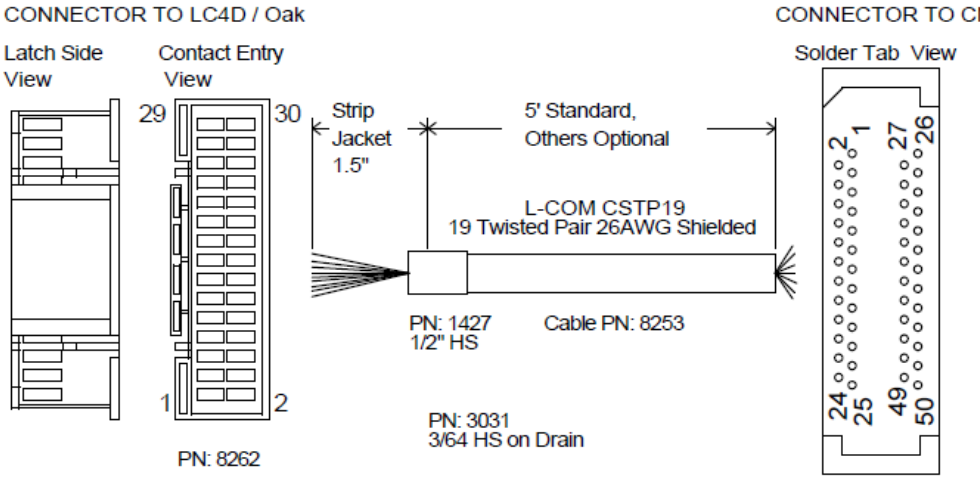
Title
LC4D / Oak to Delta ASDA-A2

Size A | Revision 150206

Date: Thursday, March 05, 2015 | Sheet 1 of 1

Filename: svn://software/hardware/Cables/THIRD_PARTY_DRIVE_CABLES.DSN | Author: MRR

PIN	FUNCTION	COLOR	Estun CN1	
1	Z	GRN (PR1)	24	PCO+
2	/Z	GRN/BLK (PR1)	25	PCO-
3	B	BLU (PR3)	22	PBO+
4	/B	BLU/WHT (PR3)	23	PBO-
5	A	WHT (PR2)	20	PAO+
6	/A	WHT/BLK (PR2)	21	PAO-
7	LOGIC GND	GRY/RED (PR4)	3	DGND
8	LOGIC GND	GRY/BLU (PR4)	28	DGND
9	A POS REQ	WHT/RED (PR5)	30	PULS+
10	/A POS REQ	WHT/BLU (PR5)	31	PULS-
11	B POS REQ	LTBLU (PR6)	32	SIGN+
12	/B POS REQ	LTBLU/BLK (PR6)	33	SIGN-
13	POS ERR CLR	LTGRN (PR7)		
14	/POS ERR CLR	LTGRN/BLK (PR7)		
15	N/C			
16	24 GND	VIO/WHT (PR8)	8	ALM-
17	BRAKE REQUEST	YEL (PR9)	11	/COIN+
18	24 GND	BRN/WHT (PR10)	12	/COIN-
19	FAULTIN	VIO (PR8)	7	ALM+
20	24 GND	RED/BLK (PR11)		
21	ENABLE	BRN (PR10)	14	/S-ON
22	DRIVE RESET	YEL/RED (PR12)	39, 40	/ALM-RST, /CLR
23	+24VDC	RED (PR11)	13	DICOM
24	LOGIC GND	PNK/BLK (PR18)		
25	LOGIC GND	ORG/BLK (PR13)	2	VREF-
26	AN REQ	ORG (PR13)	1	VREF+
27	LOGIC GND	GRN/WHT (PR14)		
28	AN IN	LTGRN/GRN (PR14)		
29	N/C			
30	CHASSIS	DRAIN		



<- Jumper 24GA Buss wire PN 86

Spare Wires
(Cut off flush with jacket)

YEL/BLK (PR9)
YEL/BLU (PR12)
PNK/RED (PR15)
PNK/BLU (PR15)
LTBLU/BLU (PR16)
LTBLU/RED (PR16)
GRY (PR17)
GRY/BLK (PR17)
PNK (PR18)
RED/WHT (PR19)
RED/BLU (PR19)

Sub. Assy.: 13132 DWG NO: S14532

Title
LC4D / Oak to Estun Pronet-E-10A

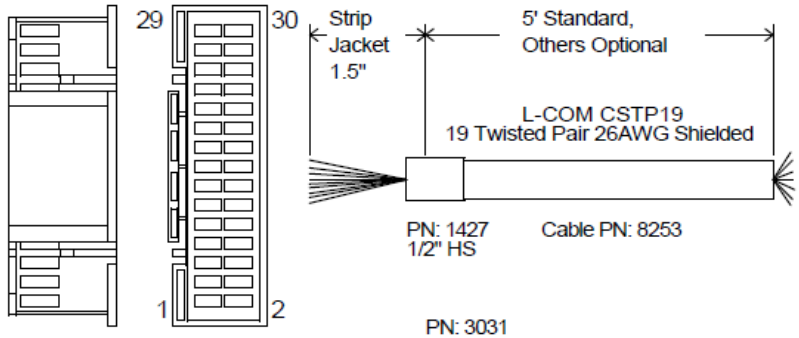
Size A | Revision 141202

Date: Thursday, March 05, 2015 | Sheet 1 of 1

Filename: svn://software/hardware/Cables/THIRD_PARTY_DRIVE_CABLES.DSN | Auth: MRR

PIN	FUNCTION	COLOR
1	Z	GRN (PR1)
2	/Z	GRN/BLK (PR1)
3	B	BLU (PR3)
4	/B	BLU/WHT (PR3)
5	A	WHT (PR2)
6	/A	WHT/BLK (PR2)
7	LOGIC GND	GRY/RED (PR4)
8	LOGIC GND	GRY/BLU (PR4)
9	A POS REQ	WHT/RED (PR5)
10	/A POS REQ	WHT/BLU (PR5)
11	B POS REQ	LTBLU (PR6)
12	/B POS REQ	LTBLU/BLK (PR6)
13	POS ERR CLR	LTGRN (PR7)
14	/POS ERR CLR	LTGRN/BLK (PR7)
15	N/C	
16	24 GND	VIO/WHT (PR8)
17	BRAKE REQUEST	YEL (PR9)
18	24 GND	BRN/WHT (PR10)
19	FAULTIN	VIO (PR8)
20	24 GND	RED/BLK (PR11)
21	ENABLE	BRN (PR10)
22	DRIVE RESET	YEL/RED (PR12)
23	+24VDC	RED (PR11)
24	LOGIC GND	PNK/BLK (PR18)
25	LOGIC GND	ORG/BLK (PR13)
26	AN REQ	ORG (PR13)
27	LOGIC GND	GRN/WHT (PR14)
28	AN IN	LTGRN/GRN (PR14)
29	N/C	
30	CHASSIS	DRAIN

CONNECTOR TO LC4D / Oak



PN: 8262

JST PUDP-30V-S

Contacts
PN: 8261
SPUD-001T-P0.5

Spare Wires
(Cut off flush with jacket)

YEL/BLK (PR9)
YEL/BLU (PR12)
PNK/RED (PR15)
PNK/BLU (PR15)
LTBLU/BLU (PR16)
LTBLU/RED (PR16)
GRY (PR17)
GRY/BLK (PR17)
PNK (PR18)
RED/WHT (PR19)
RED/BLU (PR19)

Manufacturing Note: Cut cable twice as long as requested. Put connector on both ends. Once the cable passes test, cut it in half to get two flying lead cables.

Sub. Assy.: 13133 DWG NO: S14531

Title
LC4D / Oak Drive Flying Lead

Size A | Revision 150127

Date: Thursday, March 05, 2015 | Sheet 1 of 1

Filename: svn://software/hardware/Cables/THIRD_PARTY_DRIVE_CABLES.DSN | Auth: MRR

APPENDIX C - OAK MOTION CONTROLLER USER GUIDE

LC4D_MAN.PDF attached below

Oak Motion Controller User Guide

Code Name LC4D
150209
Updated 10/24/16

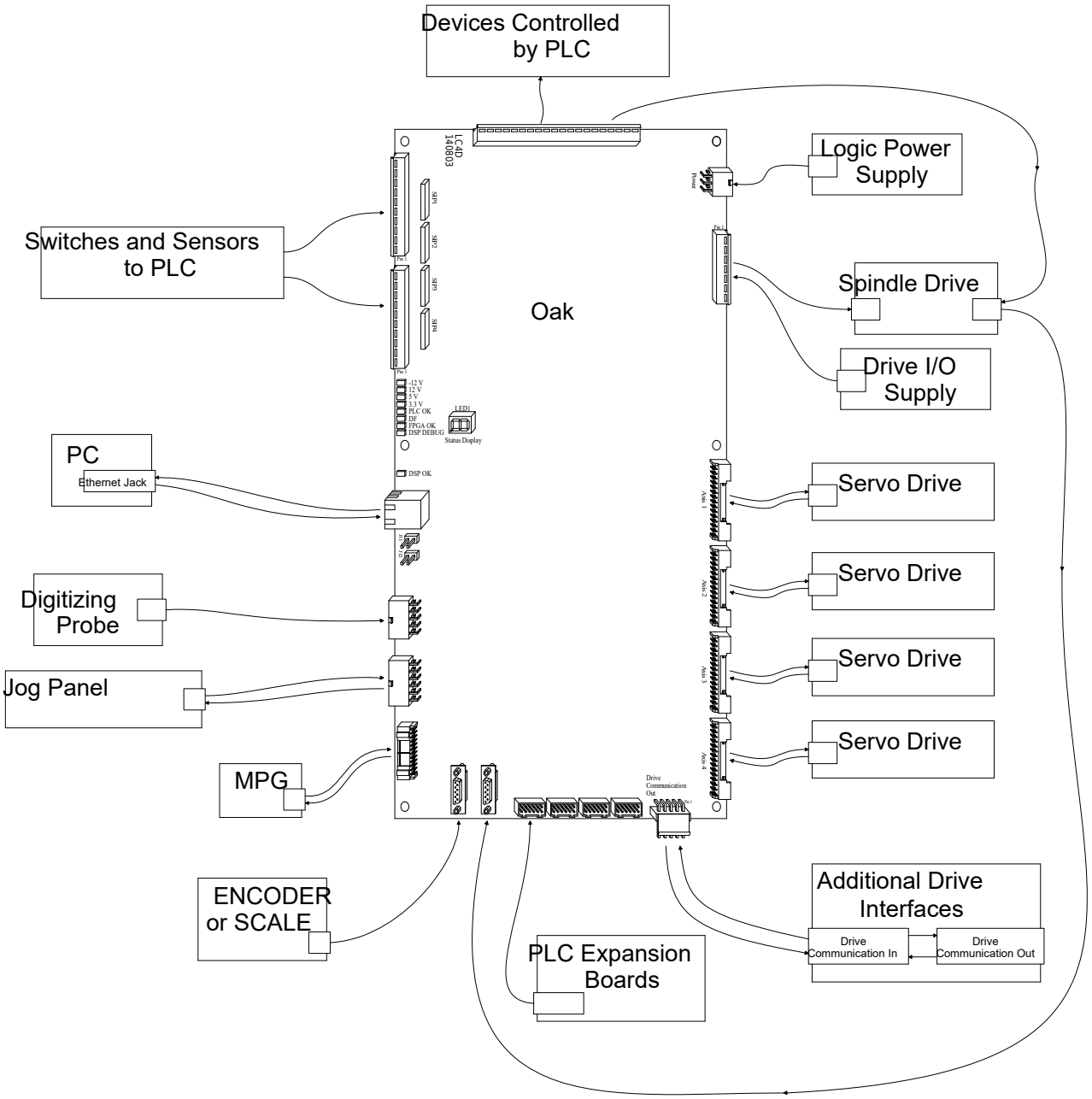
Overview

The Oak Motion Controller is a 4 axis third party drive interface with an integrated PLC and motion control processor. Centroid's MPU11 and OpticDirect technology have been integrated into one unit to provide a highly functional, yet compact motion control product. Communication with a host PC is performed over Ethernet. Four encoder inputs are available on the axis headers and two on DB9 connectors. The integrated PLC includes 16 digital inputs and 9 relay outputs for general purpose use. One analog input and output are provided for spindle drive interfacing (see "PLC Section" for details). Four analog inputs and outputs are dedicated to axis servo drive interfacing.

Features

Function:	Motion Control Processor, PLC, and Drive Interface
Maximum number of Axes:	8
Encoder and Scale Inputs:	6 Incremental Encoders (A, B, and Z channels)
PLC Protocol Support	PLCbus protocol up to 768in / 768 out miniPLC protocol with 4 expansion ports
Drive Protocol Support	DriveBus Protocol
Jog Panel Protocol Support	JogLink Protocol
MPG Support	Differential encoder and discrete inputs (no serial MPG support)
Control Interface:	100 Mb/s Ethernet to PC
Drive Application:	Third party servo drives
Number of Axes:	4
Digital PLC Inputs:	34
Digital PLC Outputs:	12
Analog Inputs:	5
Analog Outputs:	5
Analog Input resolution:	12 bits
Analog Output resolution:	16 bits
Dimensions (W*D*H):	8 * 12 * 1 inches

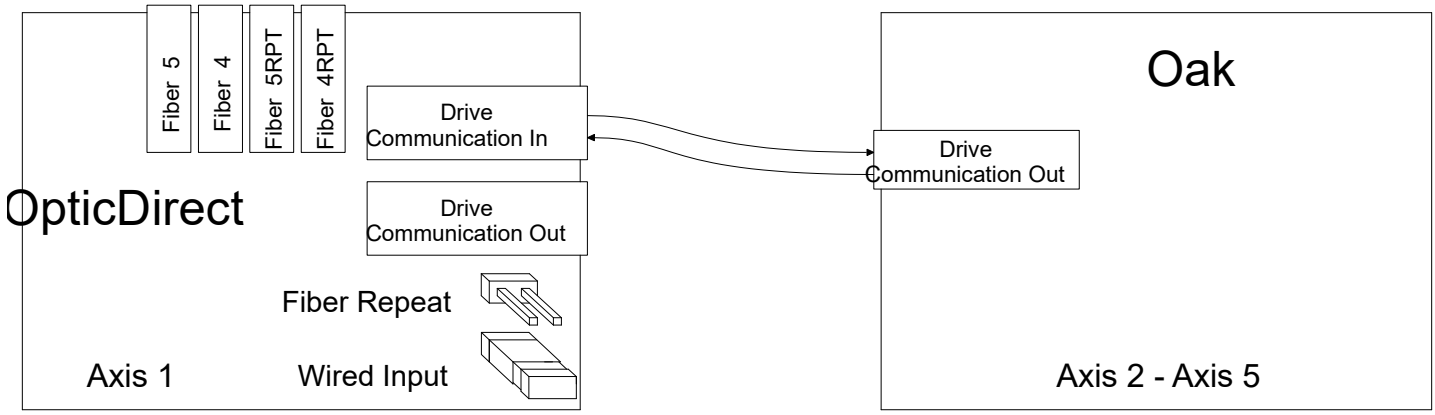
Typical Connections



Additional drive interfaces or Centroid servo drives may be connected to Oak through the "Drive Communication Out" connector. OpticDirect is the most common addition to the Oak for interfacing to additional servo drives. LED1 status display will show the base or first axis number for the drive. For example, an Oak that is running as axes 2, 3, and 4 will display 2 on LED1 as long as no error codes are present. The axis farthest from the Oak in the communication chain will always be axis 1. Axis numbers increase along the chain toward the Oak. In most systems, Oak will not need axis expansion, and LED1 will always show a solid 1.

If error codes exist, the decimal point on LED1 will light and an error number will flash. See the "LED1 Error Codes" chart for information on error codes.

Drive Communication Connection for OAK and OpticDirect



Parameters

The following table lists the parameters directly related to Oak that must be checked during installation. The Oak control board can output signals to operate third party drives in torque, velocity, or position modes. The desired operating mode must be known before setting drive dependent parameters.

Oak Parameters

Parameter	Setting	Description
300-307	1 through 8	Drive axis mapping
308-315	1 through 6	Encoder assignments
357-364	Motor Dependent	Maximum RPM
340-347	Drive Dependent	Precision mode delay
256	Drive Dependent	Drive mode

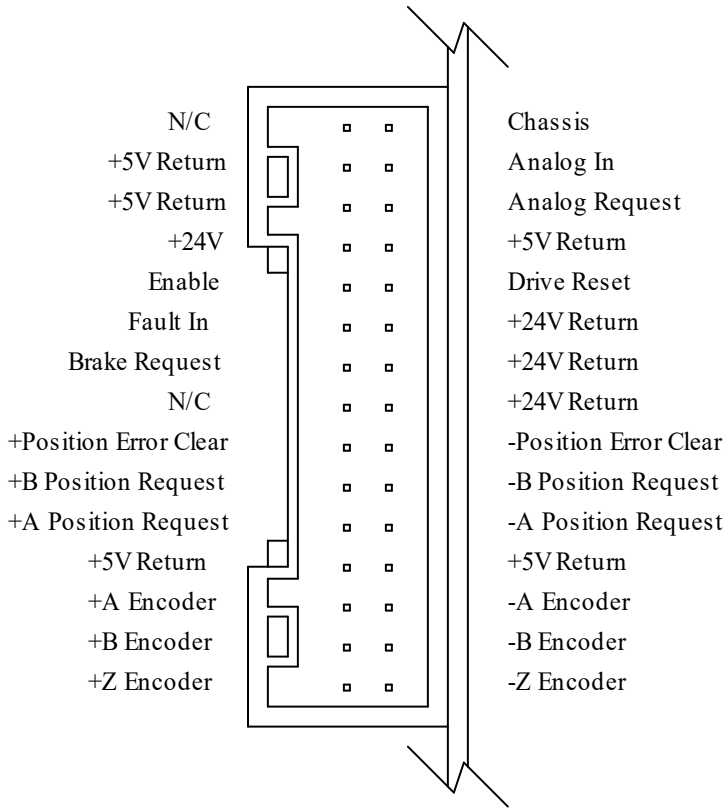
Drive and encoder mapping parameters may be set to the values in the following chart under normal circumstances if no additional devices are connected to H7 "DRIVE COMM. OUT" header. Additional devices in the DriveBus communication chain will change the axis numbers as described previously. This will require appropriate settings in parameters 300-307.

Most Common Oak Parameter Settings

Parameter	Setting
300	1
301	2
302	3
303	4
308	1
309	2
310	3
311	4

Axis Headers

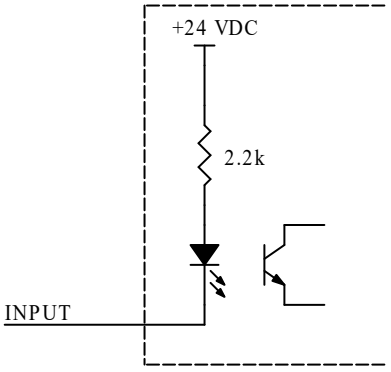
Four axis headers are supplied on Oak to connect servo drives. These headers have all the signals typically needed to communicate with a servo drive in velocity or position mode.



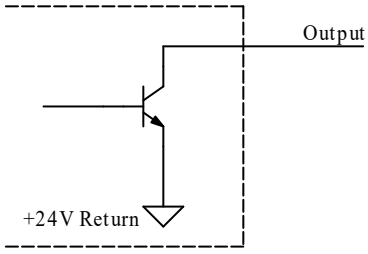
Axis Header Functions

Signal Name	Type	Purpose	Source or Destination
+5V return	power ground	Ground reference for analog and differential I/O	H1
+24V	power out	Power to servo drive I/O	H2
+24V Return	power ground	Ground reference for OC outputs, isolated inputs	H2
Enable	open collector output	drive enable	SV_DRIVE_CONTROL_x
Fault In	optically isolated input	drive fault	SV_DRIVE_STATUS_x
Brake Request	optically isolated input	drive request to turn on holding brake	SV_DRIVE_STATUS_x
+Position Error Clear	differential output	clear drive position request register	SV_DRIVE_CONTROL_x
-Position Error Clear	differential output	clear drive position request register	SV_DRIVE_CONTROL_x
+B Position Request	differential output	request drive to move to a position	drive map
-B Position Request	differential output	request drive to move to a position	drive map
+A Position Request	differential output	request drive to move to a position	drive map
-A Position Request	differential output	request drive to move to a position	drive map
+A Encoder	differential input	position feedback from drive	encoder map
-A Encoder	differential input	position feedback from drive	encoder map
+B Encoder	differential input	position feedback from drive	encoder map
-B Encoder	differential input	position feedback from drive	encoder map
+Z Encoder	differential input	position feedback from drive	encoder map
-Z Encoder	differential input	position feedback from drive	encoder map
Drive Reset	open collector output	clear drive errors	SV_DRIVE_CONTROL_x
Chassis	Chassis ground	shielding ground	mounting holes and H1
Analog In	+/- 10V analog input	feedback for load meters	PLC I/O
Analog Request	+/- 10V analog output	request drive to move at a velocity	PLC I/O

Internal Circuitry
24VDC Opto Input
(H3 - H6 Axis Headers)



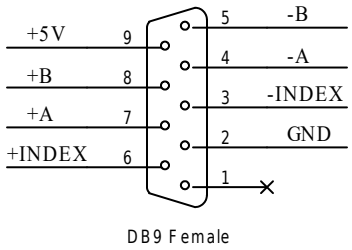
Internal Circuitry
Open Collector Output
(H3 - H6 Axis Headers)



Encoder Inputs

Six encoder inputs are available on the Oak. Four inputs are located on the axis connectors. Axis connector pinouts can be found in the "Oak Connections" section. Two spare DB9 encoder connectors can be used for scale or handwheel feedback. Connector P2 is encoder input 5 and P1 is input 6 for encoder mapping purposes.

Encoder Pinout

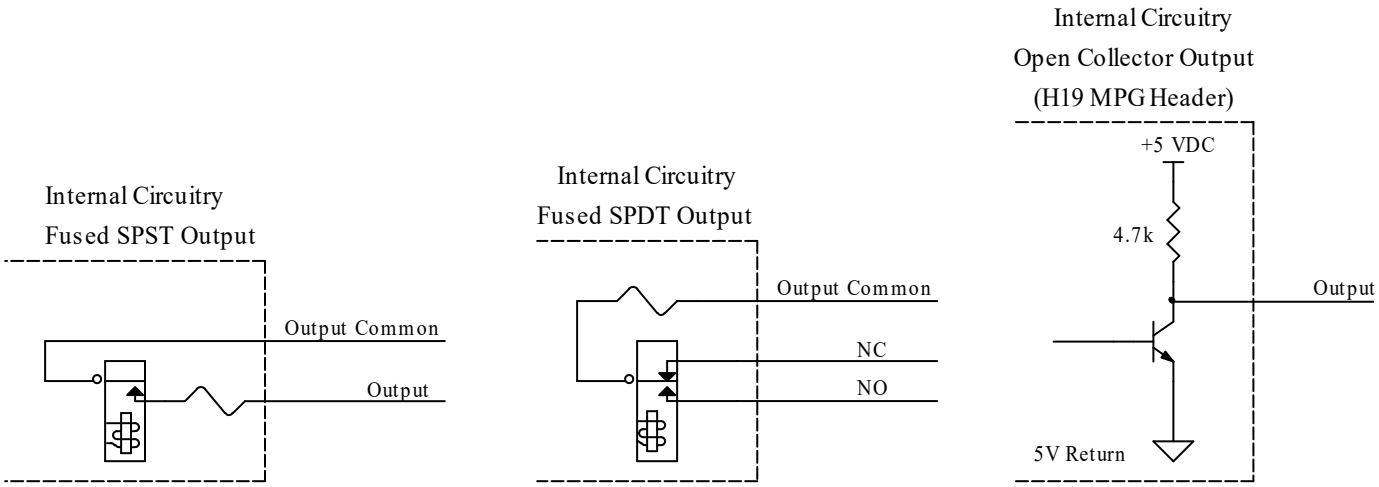


PLC Section

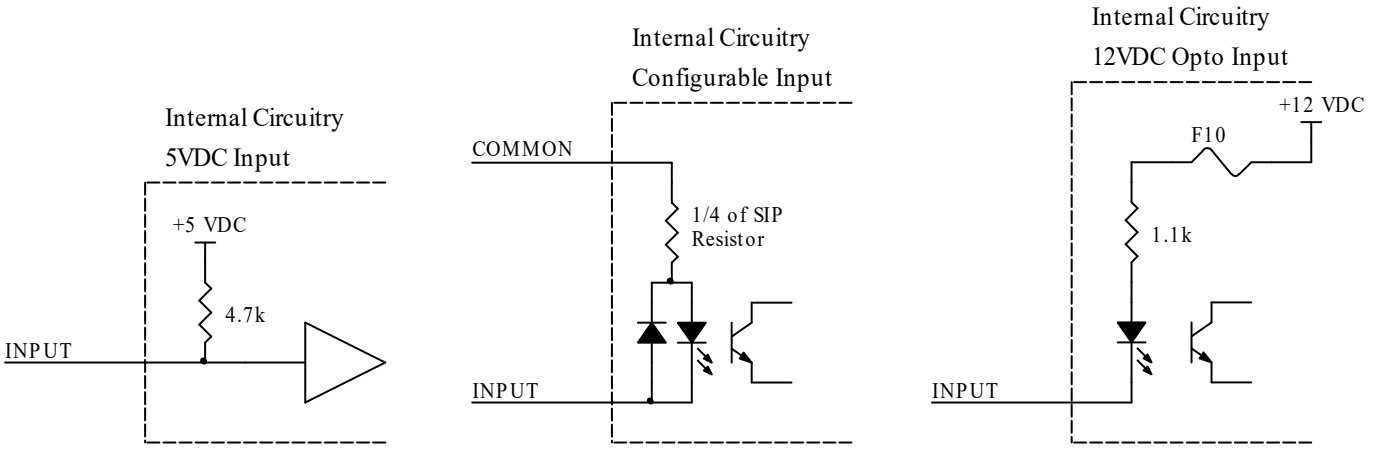
Oak has 34 digital inputs, 12 digital outputs, five analog inputs, and one analog output accessible from the PLC program. Some I/O is dedicated to a particular function. Four inputs are dedicated to supporting the digitizing probe, and 11 inputs and 3 outputs are used for MPG support. The remaining 16 configurable, optically isolated inputs and 9 fused relay outputs are available for general purpose use. Check the "Oak I/O Map" and "Oak Specifications" sections to determine I/O type and capability. Accessory boards can be connected to increase I/O capacity. See the "PLC Expansion" section for details.

Digital Outputs

Two SPDT and 7 SPST fused outputs are available on board, as well as 3 open collector outputs designed to connect to the MPG.



Digital Inputs

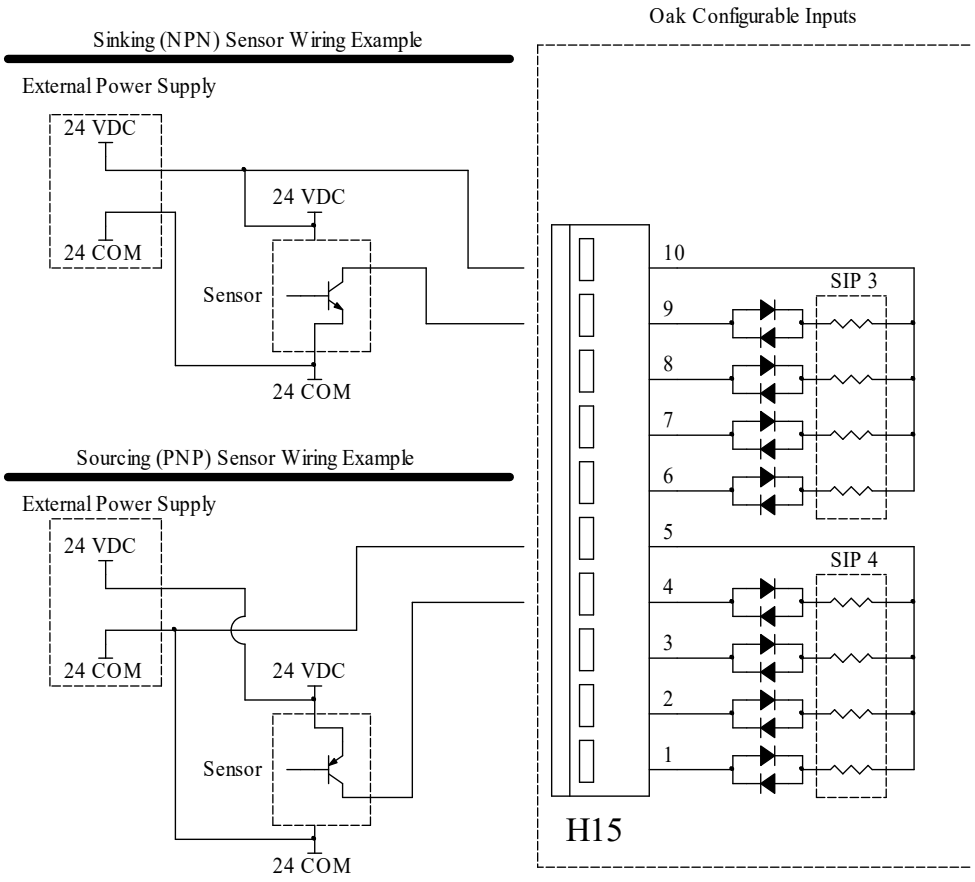


Configurable Inputs

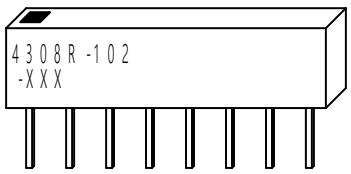
Configurable inputs are used for general purpose inputs. These inputs can be used with 5, 12, or 24 VDC sensors or switches. Compare the specifications of sensors to the "Oak Specifications" chart to ensure reliable operation. Inputs are arranged into banks of 4 that can be individually configured for voltage and polarity. Resistor packs SIP1, SIP2, SIP3, and SIP4 must be changed to match the input voltage for each bank of inputs. Sinking or sourcing operation is determined by the wiring configuration.

Configurable Input Connection Examples

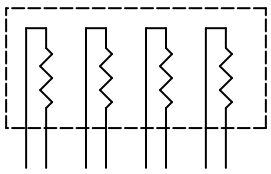
Notice: Do not use 2 wire sensors. The voltage drop across 2 wire sensors usually causes unreliable operation. If a 2 wire sensor works when connected, it still may be unreliable for long term use.



SIP Identification – XXX Indicates Value



SIP Internal Wiring / Pinout



SIP Input Reference

SIP Designator	Related Inputs
SIP1	13,14,15,16
SIP2	9,10,11,12
SIP3	5,6,7,8
SIP4	1,2,3,4

SIP Resistor Values

SIP Value Marking	Resistor Value (Ohms)	Input Voltage
471	470	5
102	1.0k	12
222	2.2k	24

Dedicated I/O

Several inputs and outputs are dedicated to particular functions and route directly into the MPU11 processor section of the Oak. As can be seen in the "Oak I/O Map" section, these I/Os are mapped after normal PLC space, starting at location 769. Probing and MPG functions use the dedicated I/O.

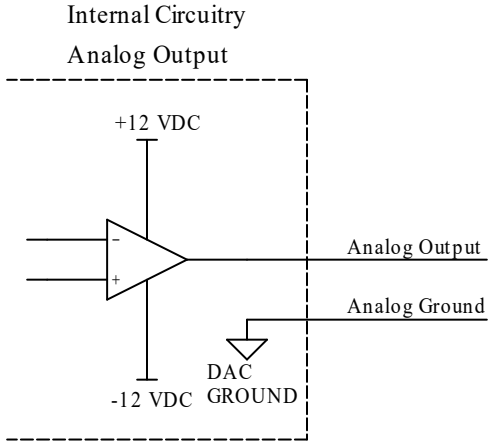
Analog Output

Oak is equipped with five analog outputs. Four outputs are used to request motion from axis drives and are fixed in the -10V to 10V range. Because these four outputs are controlled at a low level, this section will focus on the analog output accessible from the PLC program, which normally is used as a speed request to the spindle drive.

Four voltage output ranges are available on the analog output. Outputs 15 and 16 are used to select the output range. The analog output is factory trimmed for high accuracy, and will not require adjustment when changing ranges.

Oak Analog Output Ranges

Output 15	Output 16	Range	Resolution
1	1	-10 to 10	16 bits
1	0	-5 to 5	15 bits
0	1	0 to 5	14 bits
0	0	0 to 10	15 bits



Analog Output Calculations

The analog output takes a 16 bit request in all ranges. The 16 bit request value allows a DAC request of 0 to 65535, which corresponds to 0 to 9.9998 volts in the 0 to 10V range.

0 to 5V Range

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

-5 to 5V Range

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

0 to 10V Range

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

-10 to 10V Range

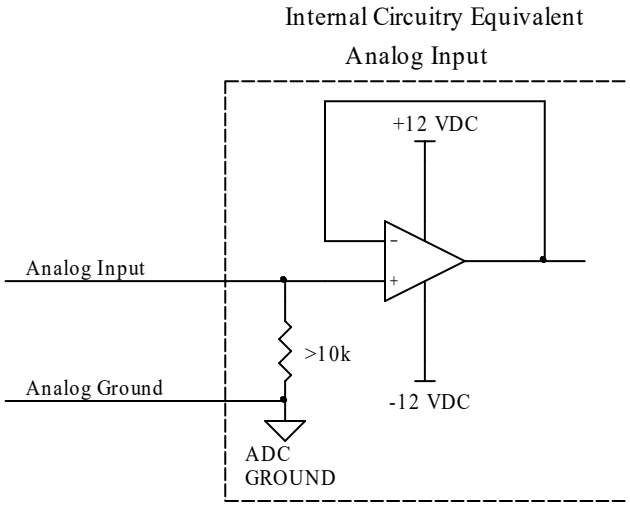
$$\text{output voltage} = \left(\frac{\text{DAC Request}}{65536} * 20\right) - 10$$

Analog Output Wiring

Analog outputs should be wired using a shielded twisted pair for best results. The analog output terminal is paired with a common terminal for direct wiring of the signal, common, and shield. In most cases, it is best to connect the shield to the common only at Oak H2. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “Oak Connections” section for terminal locations.

Analog Inputs

Five analog inputs are available to capture data from the axis and spindle drives. The analog inputs have a range of -10 to 10V and convert to a 12 bit signed value.



Analog Input Calculations

The analog input uses a 12 bit analog to digital converter (ADC) to generate a digital result from an analog signal. The 12 bit ADC allows a result of -2048 to 2047, which corresponds to -10 to 9.995 volts. The ADC is factory trimmed for optimum accuracy and requires no further adjustment.

$$\text{Input Voltage} = \text{ADC result} * \left(\frac{20}{4096} \right)$$

Analog Input Wiring

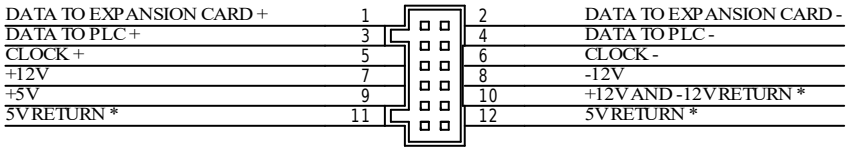
The analog inputs should be wired using shielded twisted pairs for best results. Analog input terminals are paired with common terminals for direct wiring of the signal, common, and shield. In most cases, it is best to connect the shield to the common only at the Oak headers. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “Oak Connections” section for terminal locations.

PLC Expansion

PLC I/O expansion is possible through the four "PLC ADD" connectors. Each PLC expansion port can accept 16 – 128 inputs, outputs, or inputs and outputs in 16 bit increments. This allows for digital I/O, DACs, ADCs, or other devices to be added to the system as needed.

PLC ADD 1 – 4 Connector Pinouts

PLC ADD



* +12V AND -12V RETURN and 5V RETURN are connected on the Oak

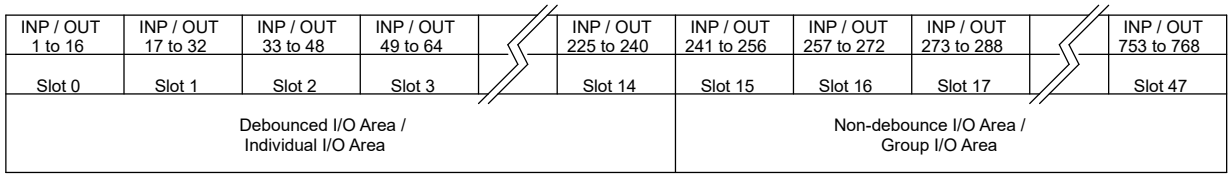
PLC Expansion Memory Assignments

PLC I/O is arranged in 16 bit groups or slots. As a general rule, slots 0-14 are used for individual I/Os such as switches and have a programmable debounce time for the inputs. Slots 15-47 are reserved for ADCs, DACs, or other devices that do not require debounce. Every device using I/O space must use space in 16 bit multiples by reserving slots. PLC expansion boards with inputs and outputs must have a matching number of input and output slots.

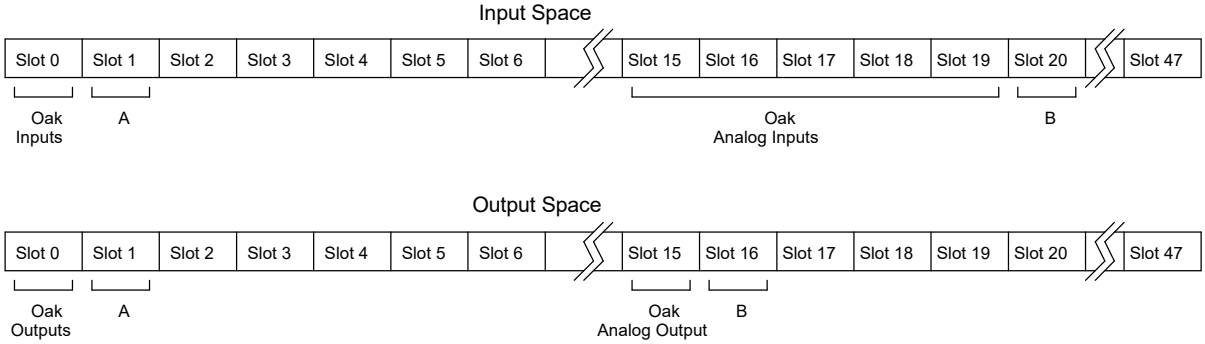
Assignment of I/O slots occurs in a linear fashion starting at the Oak, then "PLC ADD" port 1, "PLC ADD" port 2, etc. In the following general example, the Oak I/O is shown in its fixed location, which can not be changed. Other devices may change locations if they are plugged into PLC ADD ports in a different order. PLC ADD port devices that require debounce will be assigned starting at the slot marked "A", while devices that do not require debounce will start being assigned at the slot marked "B".

Oak uses 6 slots for its inputs and 2 slots for outputs. Since I/O space must be reserved in 16 bit increments, some I/O space is lost. For example, the Oak has 12 bit analog inputs which reserve 16 bits each, leaving 4 input bits unused per analog channel. Also note that Oak inputs and outputs are not assigned contiguously. The individual outputs take slot 0, while the DAC is assigned to the non–debounce / group output area starting at slot 15. The individual (debounced) inputs take slot 0, while the ADCs are assigned to the non–debounce / group input area starting at slot 15.

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



PLC Expansion Location Assignment General Example



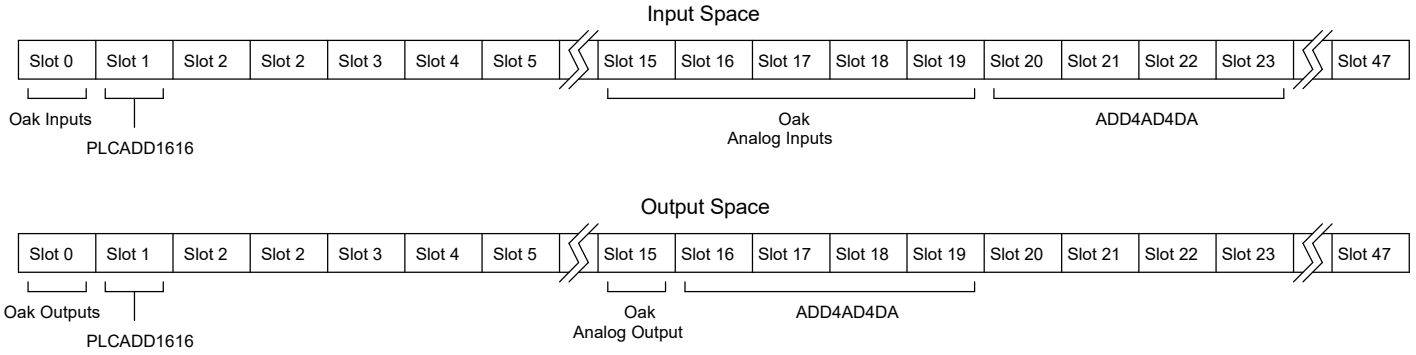
The remaining example shows how specific devices will map into the PLC under certain conditions. PLC Expansion devices have a variety of memory requirements, which are summarized in the following chart for devices used in the example.

PLC I/O Slot Requirements

	Function	Input Debounce Slots Used	Input Non-Debounce Slots Used	Output Debounce Slots Used	Ouput Non-Debounce Slots Used
Total Available		15	33	15	33
Oak	Digital and Analog I/O	1	5	1	1
PLCADD1616	Digital I/O	1	0	1	0
ADD4AD4DA	Analog I/O	0	4	0	4

Example 2 illustrates I/O assignments on a system that has an Oak main PLC, a PLCADD1616 plugged into “PLC ADD 1”, and an ADD4AD4DA to “PLC ADD 2". Note that the ADD4AD4DA is an ADC/DAC expansion card and is assigned in the non-debounce / group area since it does not require debounce.

PLC Expansion Example 2



In this example, it does not matter which "PLC ADD" port each device is plugged into because the different I/O requirements cause exclusive placement in the I/O map.

Oak System Variables

Oak axis connectors have I/O connected through the DriveBus protocol to PLC system variables. These system variables are called SV_DRIVE_STATUS_x and SV_DRIVE_CONTROL_x, where "x" is the number of the axis as mapped on the DriveBus. SV_DRIVE_STATUS_x contains input information (read only), while SV_DRIVE_CONTROL_x is used to control outputs (write only).

The axis connectors are normally mapped to DriveBus axes 1-4. However, if additional devices are connected to H7, the axis mapping numbers will increase. See page 3 for further explanation.

SV_DRIVE_STATUS_x

Bit	SV_DRIVE_STATUS_x	Related Pin	Notes
0	not used	-	
1	not used	-	
2	not used	-	
3	Quadrature Generation Error	-	Requested pulses per interrupt > 300
4	not used	-	
5	not used	-	
6	not used	-	
7	not used	-	
8	not used	-	
9	Holding Brake Request	H3, H4, H5, H6 Pin 17	Brake request normally echoed to a relay output
10	not used	-	
11	not used	-	
12	not used	-	
13	not used	-	
14	not used	-	
15	Drive Fault	H3, H4, H5, H6 Pin 19	Input connected to drive's alarm output

SV_DRIVE_CONTROL_x

Bit	SV_DRIVE_CONTROL_x	Related Pin	Notes
0	not used	-	
1	not used	-	
2	not used	-	
3	not used	-	
4	not used	-	
5	not used	-	
6	Position Request Invert	-	Inverts analog output, reverses position count direction
7	Position Error Clear	H3, H4, H5, H6 Pin 13, 14	Position mode output to clear error (differential)
8	not used	-	
9	not used	-	
10	not used	-	
11	not used	-	
12	not used	-	
13	not used	-	
14	Alarm Reset	H3, H4, H5, H6 Pin 22	If set on any axis, all 4 axis outputs pull down
15	Enable *	H3, H4, H5, H6 Pin 21	

*Do not use - firmware controls this directly

Oak I/O Map

Input Map

Input Specification			Input Location	
Number	Function	Type	Connector	Pin
1	General Purpose	Sink / Source	H15	1
2	General Purpose	Sink / Source	H15	2
3	General Purpose	Sink / Source	H15	3
4	General Purpose	Sink / Source	H15	4
5	General Purpose	Sink / Source	H15	6
6	General Purpose	Sink / Source	H15	7
7	General Purpose	Sink / Source	H15	8
8	General Purpose	Sink / Source	H15	9
9	General Purpose	Sink / Source	H16	1
10	General Purpose	Sink / Source	H16	2
11	General Purpose	Sink / Source	H16	3
12	General Purpose	Sink / Source	H16	4
13	General Purpose	Sink / Source	H16	6
14	General Purpose	Sink / Source	H16	7
15	General Purpose	Sink / Source	H16	8
16	General Purpose	Sink / Source	H16	9
241-256	Analog In 1	12 bit ADC	H3	28
257-272	Analog In 2	12 bit ADC	H4	28
273-288	Analog In 3	12 bit ADC	H5	28
289-304	Analog In 4	12 bit ADC	H6	28
305-320	Analog In 5	12 bit ADC	H2	4
769	Mechanical Probe	12VDC Opto	H13	6
770	DSP Probe	12VDC Opto	H13	4
771	Probe Detect	12VDC Opto	H13	8
772	Probe Auxiliary	12VDC Opto	H13	10
773	MPG x1	5VDC	H19	9
774	MPG x10	5VDC	H19	11
775	MPG x100	5VDC	H19	13
776	MPG Axis 1	5VDC	H19	4
777	MPG Axis 2	5VDC	H19	6
778	MPG Axis 3	5VDC	H19	8
779	MPG Axis 4	5VDC	H19	10
780	MPG Axis 5	5VDC	H19	12
781	MPG Axis 6	5VDC	H19	14
782	MPG Axis 7	5VDC	H19	16
783	MPG Axis 8	5VDC	H19	18
784	MPG Aux 1	5VDC	H19	15
785	MPG Aux 2	5VDC	H19	20
786	MPG Aux 3	5VDC	H19	22

Output Map

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
1	General Purpose	Relay SPST	H11	1,2
2	General Purpose	Relay SPST	H11	3,4
3	General Purpose	Relay SPST	H11	5,6
4	General Purpose	Relay SPST	H11	7,.8
5	General Purpose	Relay SPST	H11	9,10
6	General Purpose	Relay SPST	H11	11,12
7	General Purpose	Relay SPST	H11	13,14
8	General Purpose	Relay SPDT	H11	15,16,17
9	General Purpose	Relay SPDT	H11	18,19,20
10				
11				
12				
13				
14				
15	Spindle DAC mode bit 1	Internal		
16	Spindle DAC mode bit 2	Internal		
241-256	Spindle Analog	16 bit DAC	H2	6
769	MPG LED	Open Collector	H19	17
770	MPG Aux 1	Open Collector	H19	19
771	MPG Aux 2	Open Collector	H19	21

*Open Collector outputs are pulled up to 5V

*5 VDC inputs are not isolated

Oak Specifications

Characteristic	Min.	Typ.	Max.	Unit
5 Volt Supply Current	2.5	-	-	A
12 Volt Supply Current	0.5	-	-	A
-12 Volt Supply Current	0.2	-	-	A
Input Pullup Voltage (Vinp)	4	-	30	VDC
Input On Voltage	Vinp-1.25	-	-	VDC
Input Off Voltage	-	-	1.25	VDC
Relay Output Current	0.1	-	10	A @ 125VAC
Relay Output Current	0.1	-	5	A @ 30VDC
Open Collector Output Current	-	10	12	mA
Open Collector Output Voltage	-	24	30	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	-	-	1	mA
Analog Input Voltage	-10	-	10	V
Analog Input Resolution	-	12	-	bits
Analog Input Error	-	< 0.2	-	%
PLC ADD Port 5V Current Output*	0	-	2	A
PLC ADD Port 12V Current Output*	0	-	0.5	A
PLC ADD Port -12V Current Output*	0	-	0.5	A
Encoder channel input low	0	-	0.5	V
Encoder channel input high	3.5	-	5	V
Encoder input frequency low speed (per channel)**	0	-	1200	khz
Encoder input frequency high speed (per channel)**	0	-	6000	khz
Size: 12 * 8 * 1 (W*D*H)				Inches

*PLC ADD Port Current is the total for all 4 ports in any combination. Voltage drop may increase too much beyond this rating, requiring external power wiring to the expansion boards. The rating is for current passed through the PCB, total power supply current must also be considered.

**See parameter 323 for switching encoder filter speed

LED1 Error Codes

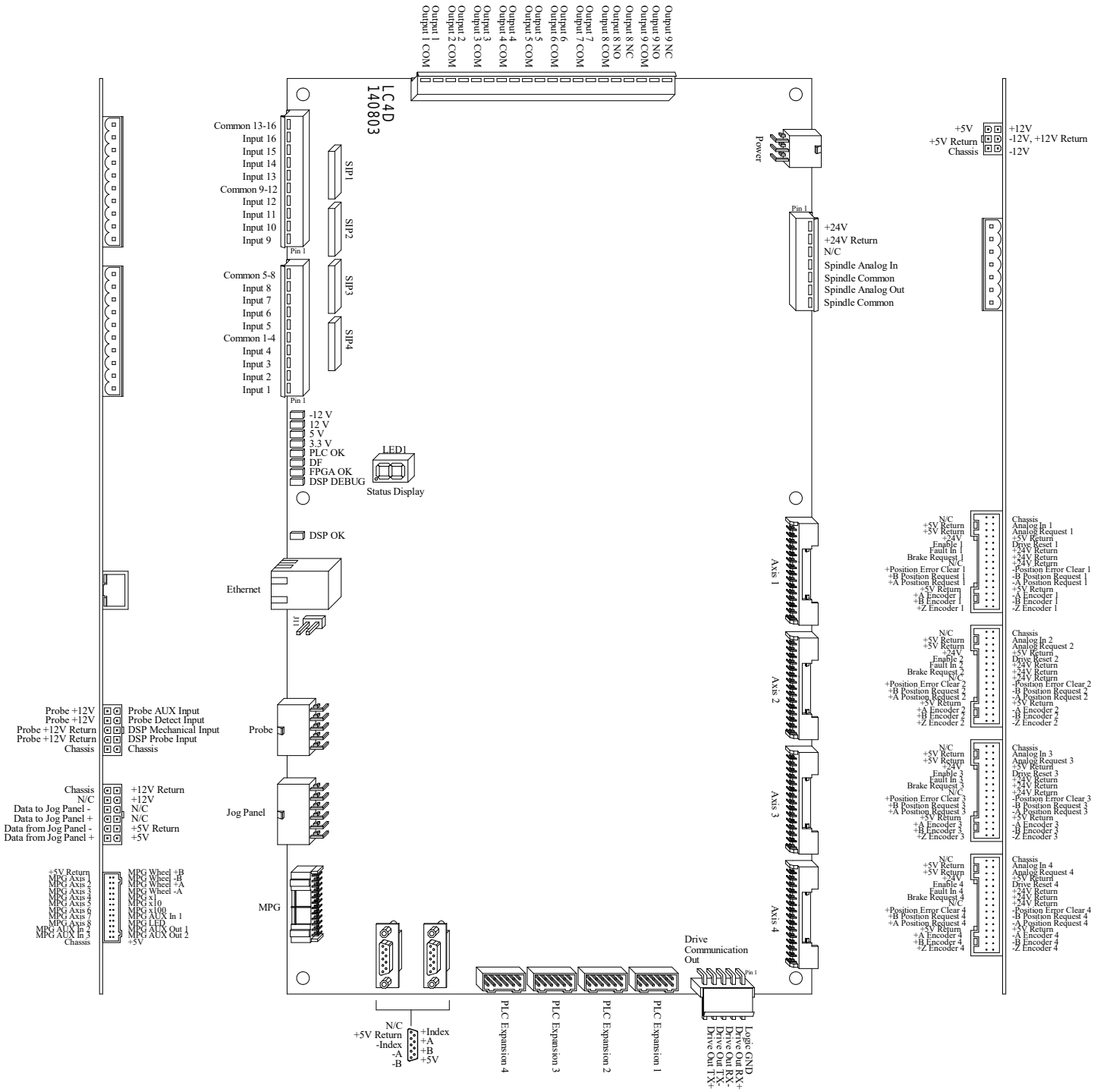
LED1 normally displays the base axis number (see "Overview" section for details). If error codes exist, the decimal point on LED1 will light and an error number will flash.

Error Number	Meaning	Cause	Corrective Action
1	Communication Failure	Drive section has not been enabled	Wait several seconds after power up.
		The drive section has lost communication with the MPU11 section	Internal error, return for repair.
2			
3			
4			
5			
6			
7			
8	Too many counts per interrupt requested	Communication error or too fast movement requested by CNC11	Cycle Estop to clear
9			

Oak Troubleshooting

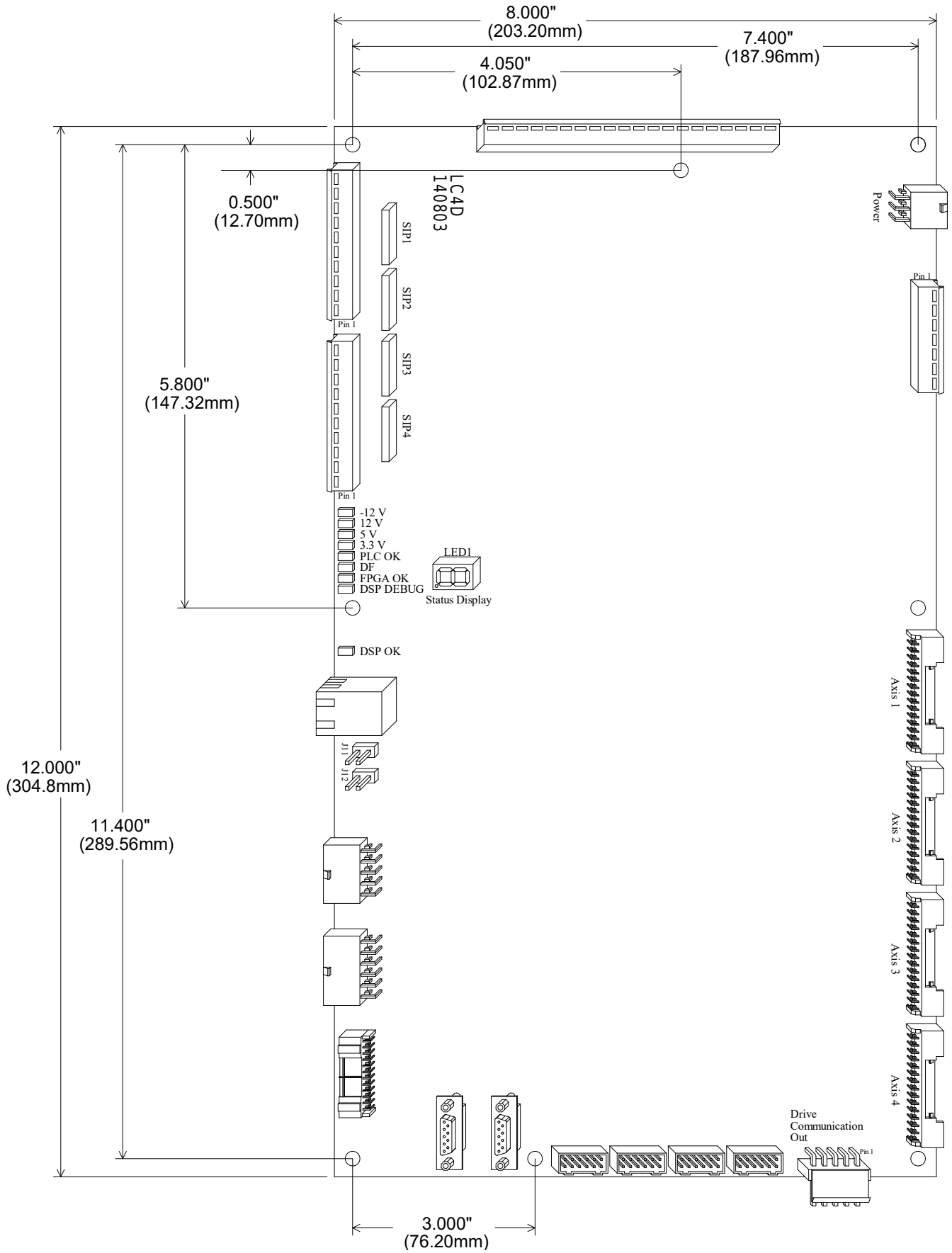
Symptom	Possible Cause	Corrective Action
All status LEDs out	Logic power not applied	Measure AC coming into power supply, correct wiring or supply problems
5, 3.3, 12, or -12 LED out	Power supply or connection problem	Measure AC coming into power supply, correct wiring or supply problems
FPGA LED not lit	MPU11 not ready	Wait for MPU11 section to start and enter run mode
	Internal Fault	Return for repair
DSP LED not lit	MPU11 section is booting up	Wait for MPU11 section to detect hardware and start run mode
DSP DEBUG LED flashing fast	MPU11 section is detecting hardware	Wait for MPU11 section to detect hardware and start run mode
DSP DEBUG LED flashing one time per second	New drive protocols active	None
DSP DEBUG LED flashing two times per second	Legacy drive protocols active	Internal fault, only new protocols should be in use, return for repair
Encoder connection bad	Bad encoder or wiring	Check or replace encoder and cable
	Return not connected	Connect return line. If the encoder is not powered by Oak's +5V, this is sometimes overlooked.
DF LED out	Motion control processor section hasn't booted up	Start software, wait for the main screen to load
	"Servo Power Removed" due to fault	Restart system to reset runaway or other serious fault condition
PLC OK LED out	Motion control processor section hasn't booted up	Start software, wait for the main screen to load
LED1 display flashing with decimal point lit	An error condition has been detected	See the "LED1 Error Codes" section for details on the error
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.

Oak Connections



*See previous sections for larger diagrams of encoder headers, axis headers, PLC expansion, etc.

Oak Mounting Footprint



Optional Mounting Pan Hole Locations