CENTROID

GPIO4D + MPU11 Install Manual

Velocity Mode For 3rd party drives

Without Optic Direct Interface

Table of Contents

Introduction

This manual describes how to install the Centroid CNC system.

Follow each step in order without skipping steps.

The system provides up to 4 axes (upgradable to 8 axes) of closed loop servo interpolated motion, controlled by G-Code.

The system is intended for CNC control of milling machines, routers, lathes, flame, plasma, laser/water jet cutters, and other specialized applications.

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 CNC11 based GPIO4D 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 in order and that you follow them exactly.

Your system will not function if you attempt to take shortcuts by skipping steps.

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.

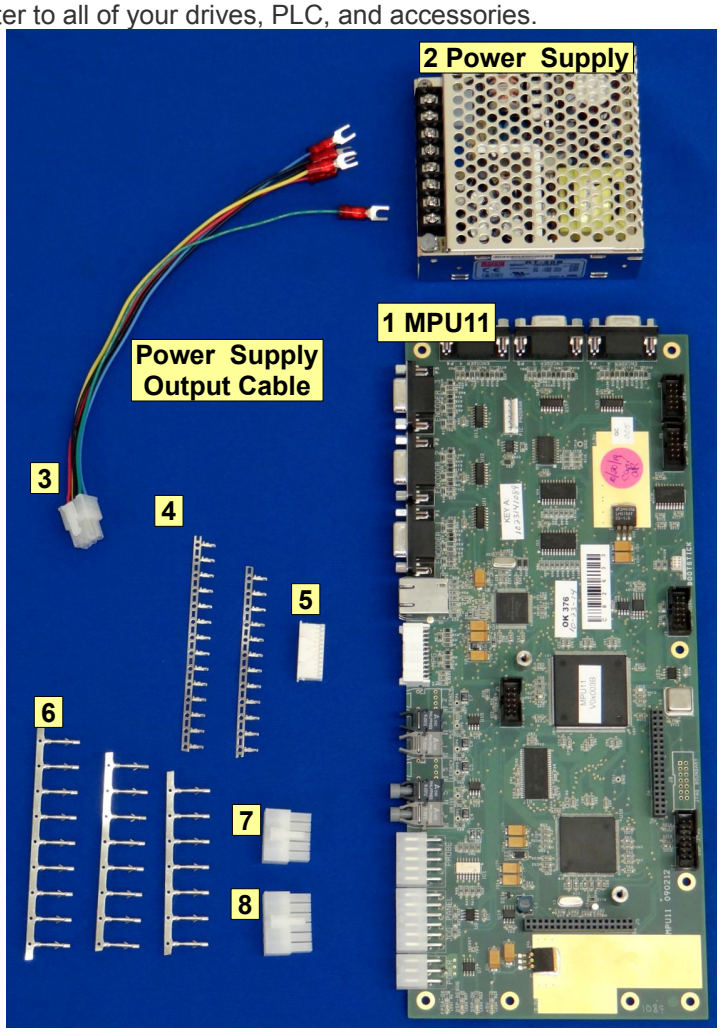
Troubleshooting:

- Appendix A includes troubleshooting procedures for various common problems.
- If you run into a problem first refer to the troubleshooting procedure, then the Appendix.
- If the problem persists after exhausting all other options, visit centroidcnc.com and fill out a help request form, found under the **tech support** tab.
- Fee based phone support is also available if needed.

Chapter 1 – What's included

1.1 MPU11

The MPU11 connects your computer to all of your drives, PLC, and accessories.



The following components are included with your MPU11:

1. MPU11 ..... Part Number 11012
2. Power supply..... Part Number 7820
3. Power supply DC output cable ..... Part Number 13106
4. Twenty six crimp pins for MPG connector ..... Part Number 5983
5. Twenty four pin MPG connector..... Part Number 5984
6. Twenty four crimp pins for jog panel connector and probe connector ..... Part Number 5511
7. Ten Pin Probe connector..... Part Number 5918
8. Twelve Pin Jog panel Connector..... Part Number 5919

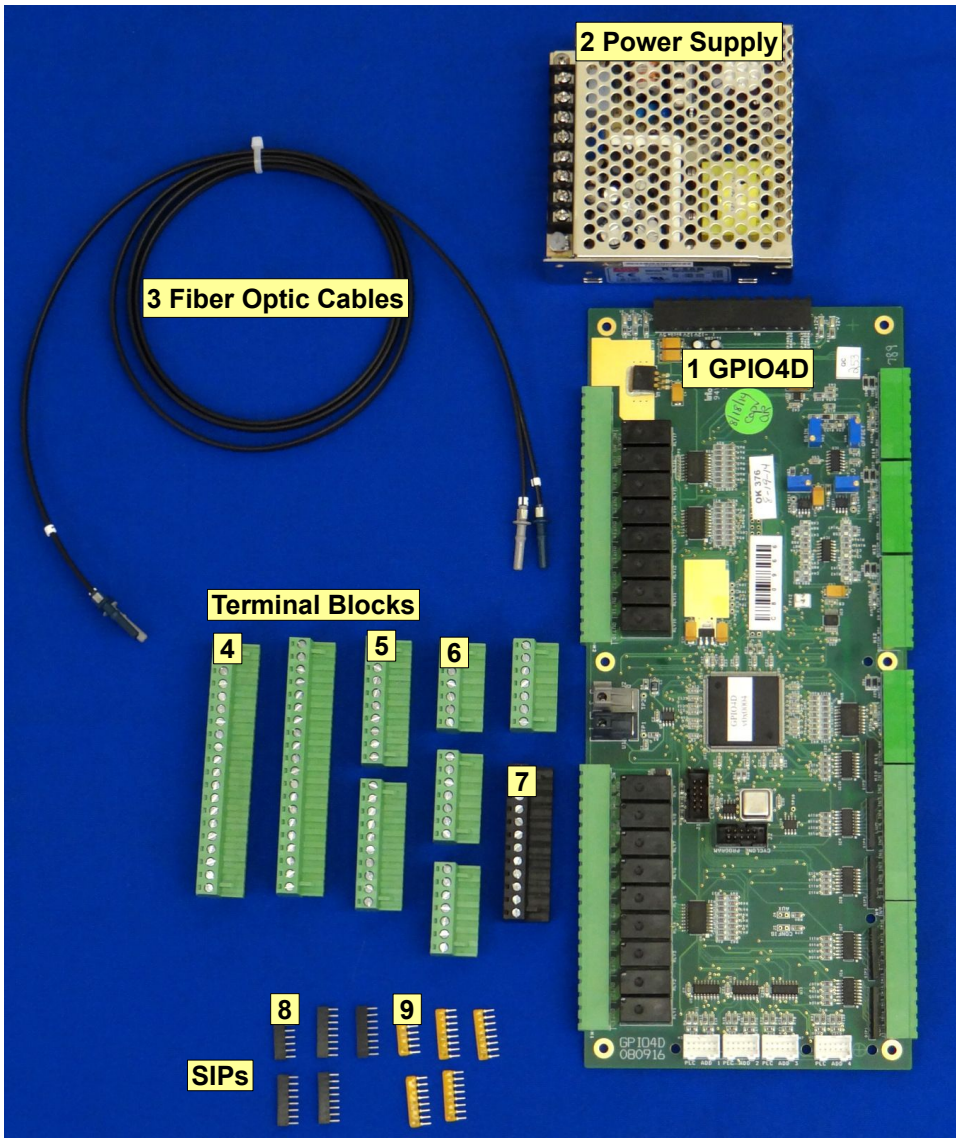
Crimpers:

If you have a jog panel or MPG and did not choose to buy fully assembled cables from Centroid, you will need to assemble the cables. Reference Appendix B to learn what crimpers are needed.

1.2 GPIO4D

The GPIO4D stands for “General purpose input / output (for up to) four drives”.

The GPIO4D is a PLC, meaning it is a “programmable logic controller”.

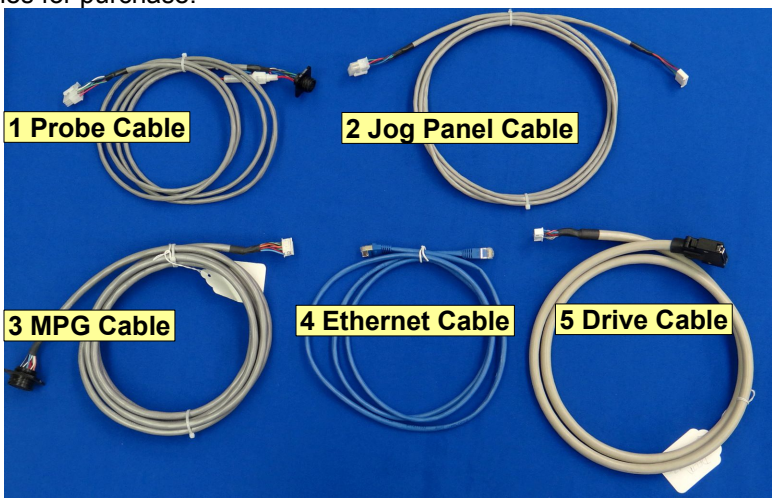


The following components are included with your GPIO4D:

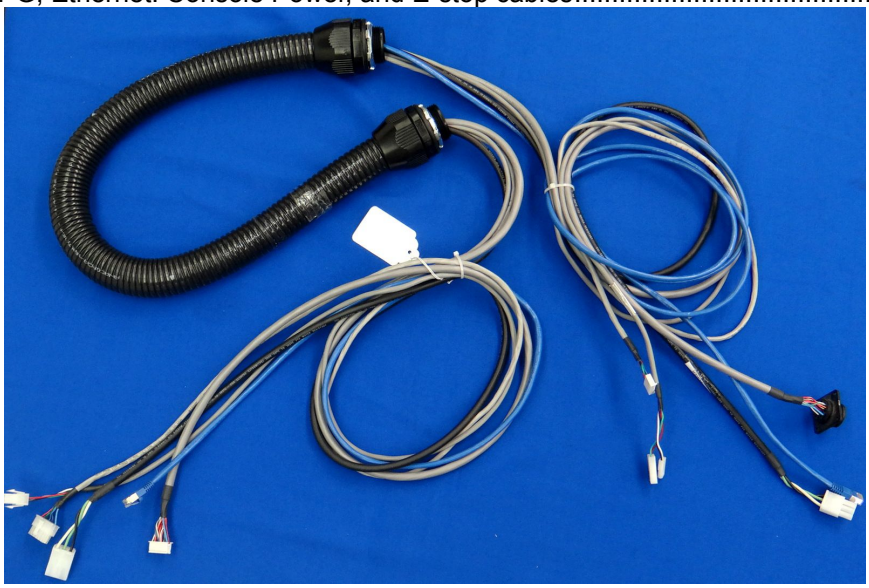
1. GPIO4D.....Part Number 11018
2. Power supply.....Part Number 7820
3. Optic fibers labeled “1” and “3”.....Part Number 10018
4. 2 twenty position terminal blocks .....Part Number 3450
5. 2 ten position terminal blocks.....Part Number 3904
6. 4 seven position terminal blocks .....Part Number 2611
7. Twelve position terminal block .....Part Number 1551
8. 5 twelve volt SIPs (color and appearance may vary).....Part Number 4152
9. 5 five volt SIPs (color and appearance may vary).....Part Number 3956

1.3 Cables

Centroid offers the following cables for purchase:



1. Probe Cable (multiple lengths available) .....Part Number 11211
2. Jog Panel Cable (multiple lengths available) (Supplied with Jog Panel).....Part Number 12991 (10 ft)
3. MPG Cable (multiple lengths available).....Part Number 12987 (10 ft)
4. Ethernet Cable (multiple lengths available).....Part Number 6144 (6 ft)
5. Console Extension Cable (extensions available).....Part Number 11028 (6 ft)
   - Includes Jog, MPG, Ethernet. Console Power, and E-stop cables.....



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.

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 CNC11 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

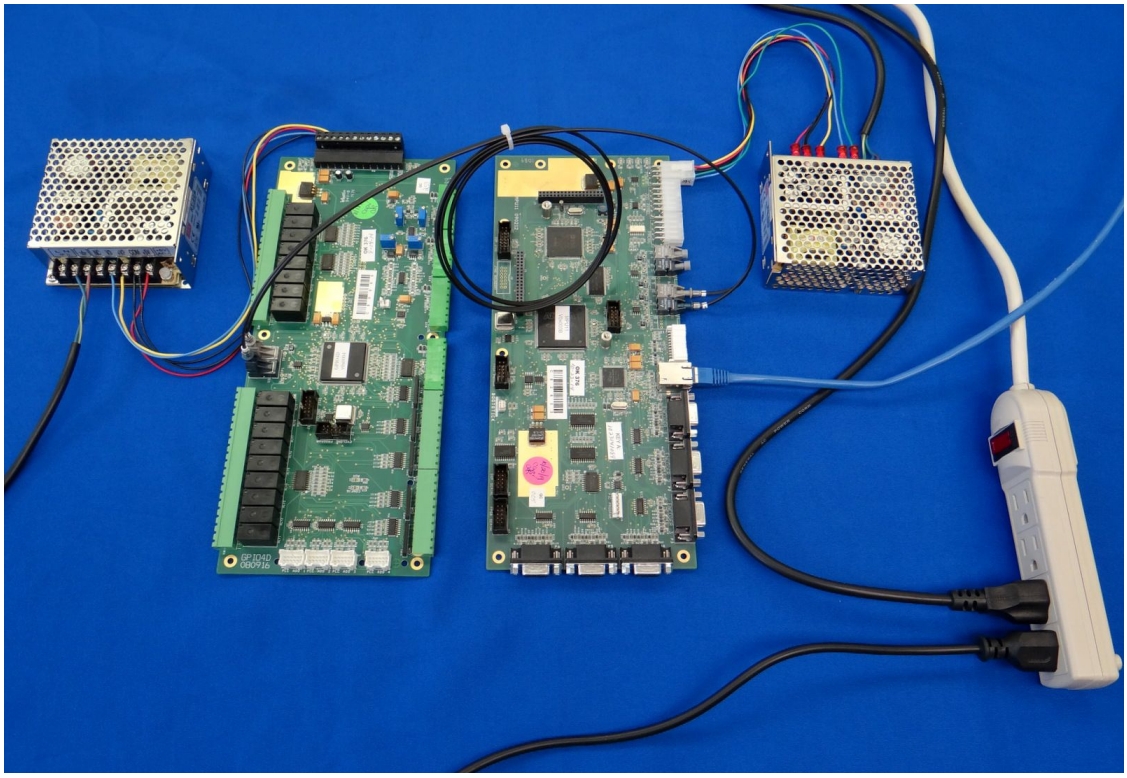


Figure 2.1.1 Performing a board level test

2.2 Bench Test – Power Supply Configuration

1. **Connect MPU11 to the power supply:**

   1) Plug the DC output cable (PN 3951) into the power supply (PN 1331).

   2) Splice your power cord to the power supply, power cord not included. Connect the power cord to the outlet strip.

   3) Connect the power supply input cable to rectangular plug labeled “power” in the MPU11 as shown in figure 2.2.1

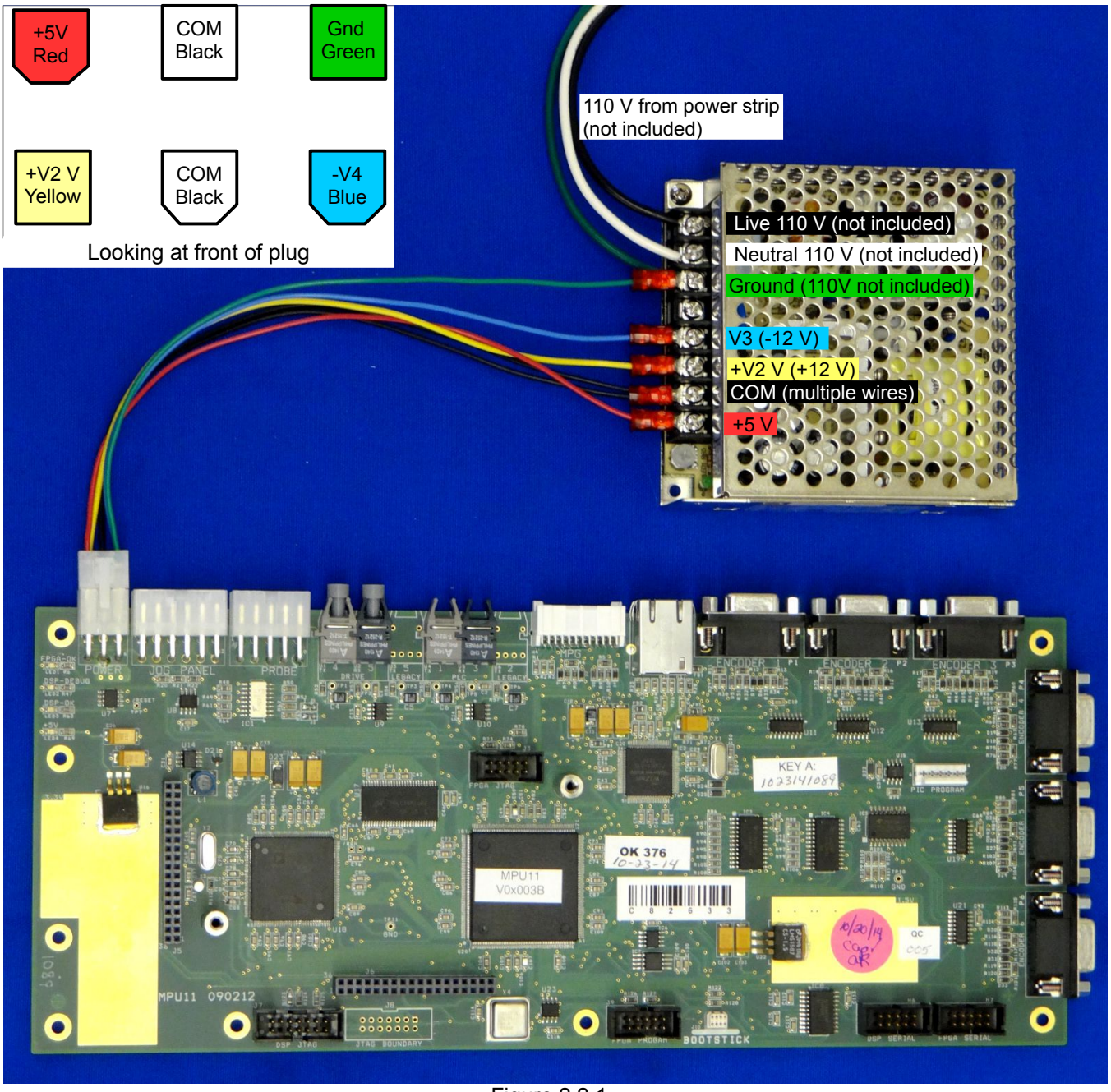


Figure 2.2.1
Power Supply Connect to MPU11

2. Connect GPIO4D to the power supply:

1) Splice your power cord to the power supply, power cord not included. Connect the power cord to the outlet strip.

2) Connect the power supply to the twelve pin terminal block connecting to header H6 as shown below in Figure 2.2.2. Centroid recommends 22 AWG, not included.

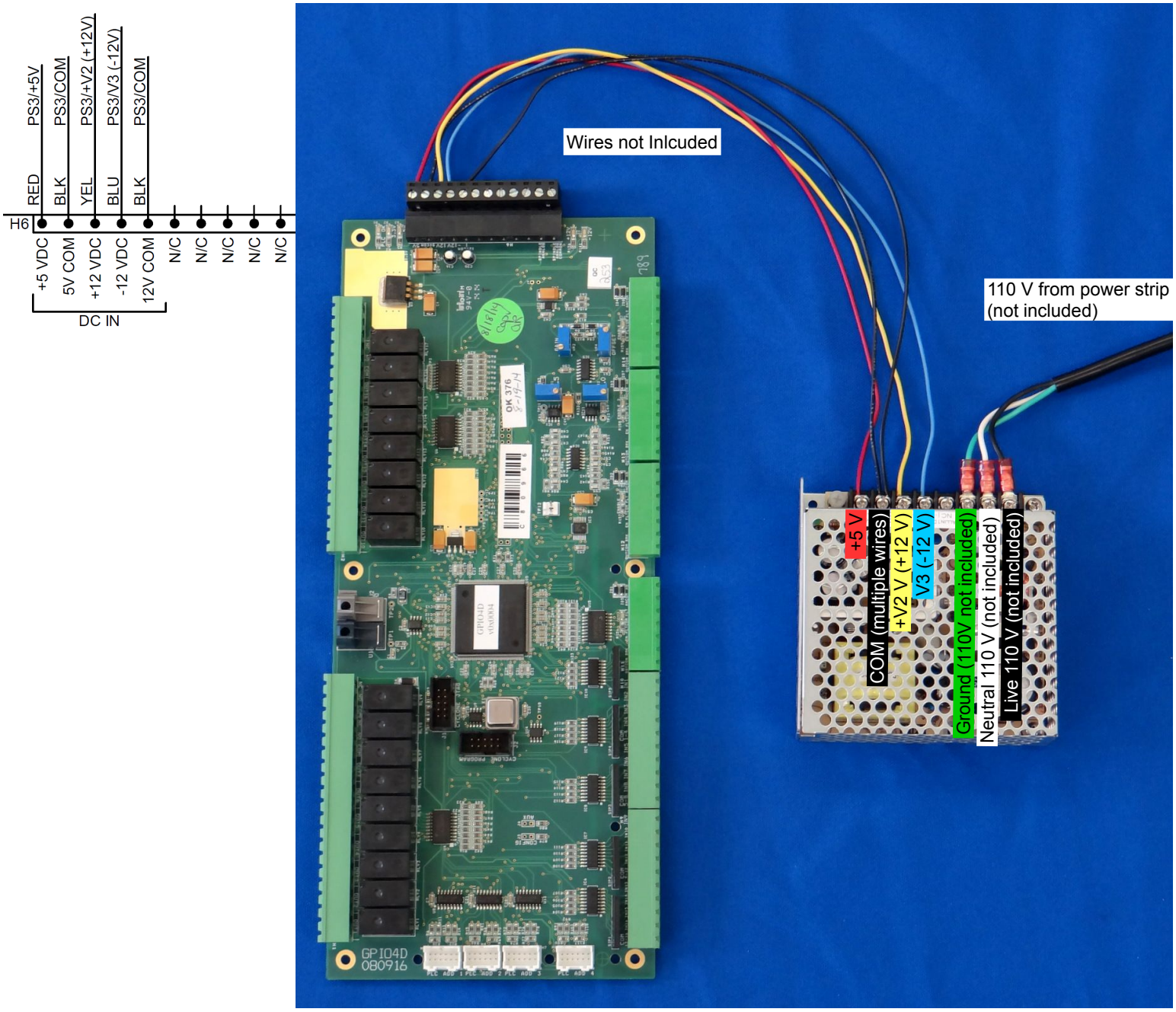


Figure 2.2.2
Power Supply Wiring Diagram For GPIO4D

2.3 Bench Test – Communication Configuration

1. GPIO4D Communication and setup

1) **Connect PLC communication fibers:** labeled “3” and “1” (PN 10018) from the GPIO4D to the MPU11 as shown in Figures 2.3.1 and 2.3.2.

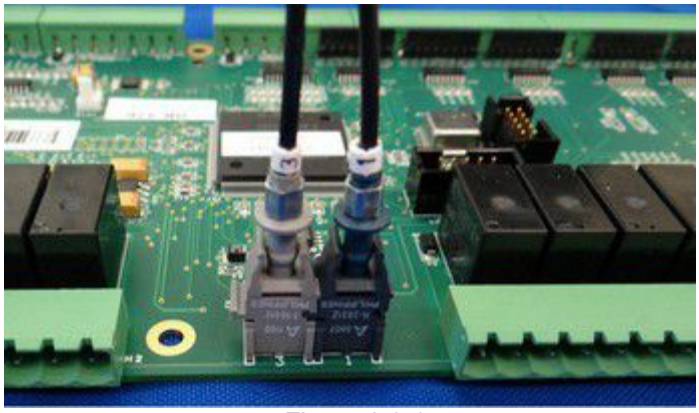


Figure 2.3.1
Connect PLC communication fibers to the GPIO4D.

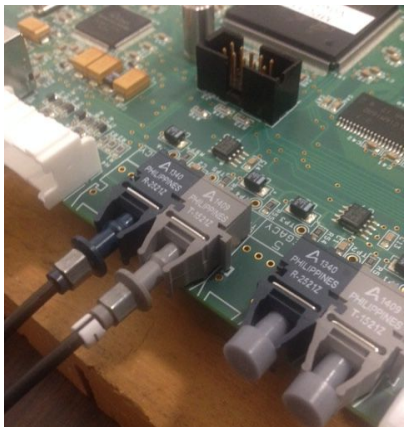


Figure 2.3.2
Connect PLC communication fibers to the MPU11.

2) **Connect the Shielded Ethernet Cable:** Connect a shielded Ethernet cable from your MPU11 to the PC.

A shielded Ethernet cable will have a metal clip around the RJ-45 connector it as shown by the blue cable in Figure 2.3.3.

Centroid recommends using snagless patch cables from StarTech. **StarTech ID# S45PATCH25BL**. 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.

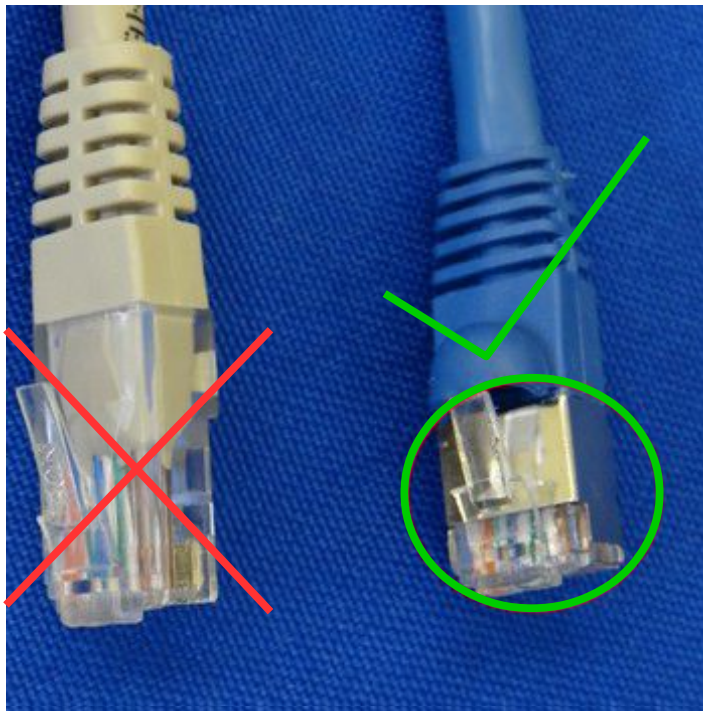


Figure 2.3.3
Unshielded Ethernet cable (gray) compared to Shielded Ethernet cable (blue)

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

2.4 Bench Test – Connecting Accessories

2. **Connect Any Accessories:** Connect optional accessories

   If a jog panel/pendant or MPG was ordered, please connect it to the MPU11 as seen in Figures 2.4.1 and 2.4.2.

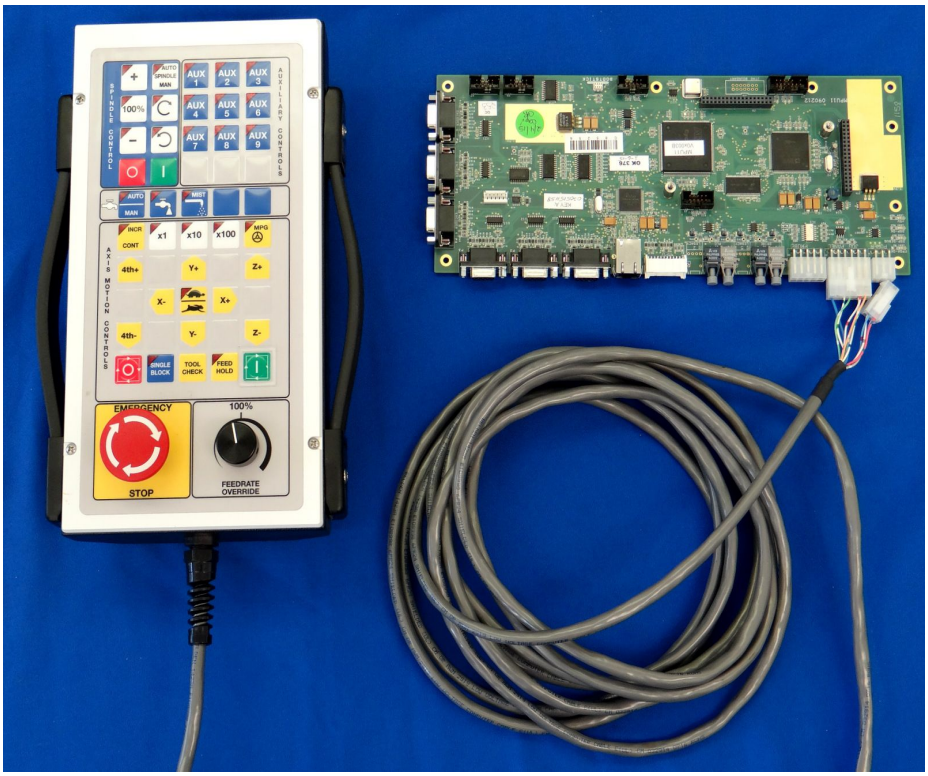


Figure 2.4.1
Jog Pendant

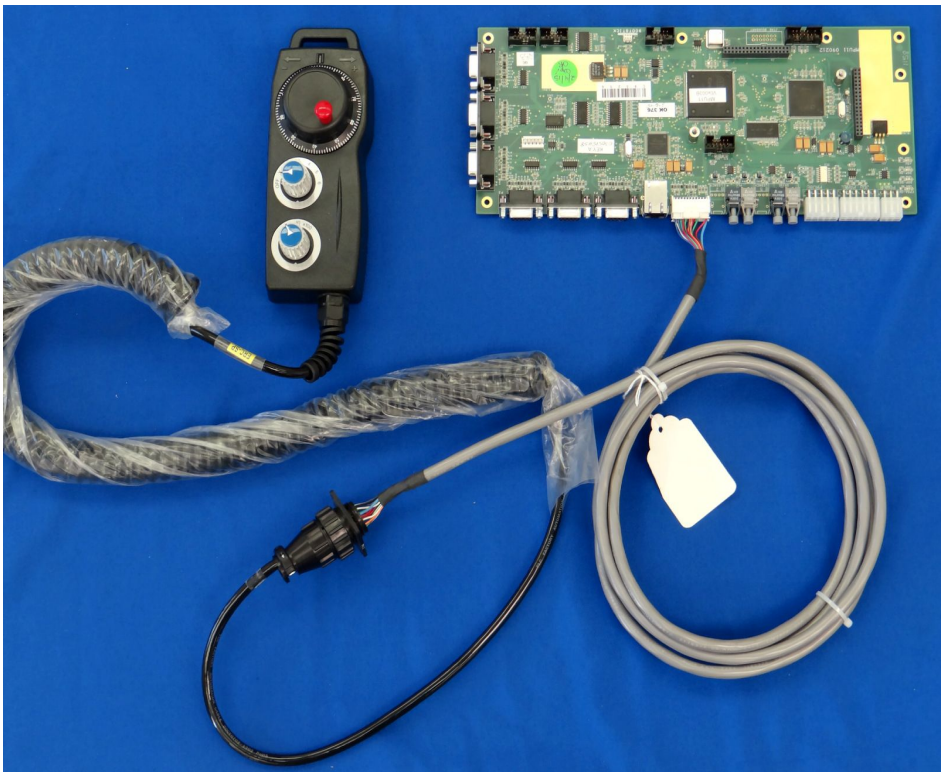


Figure 2.4.2
MPG

When finished: your setup should look like figure 2.4.3 (accessories not shown) or Figure 2.1.1.

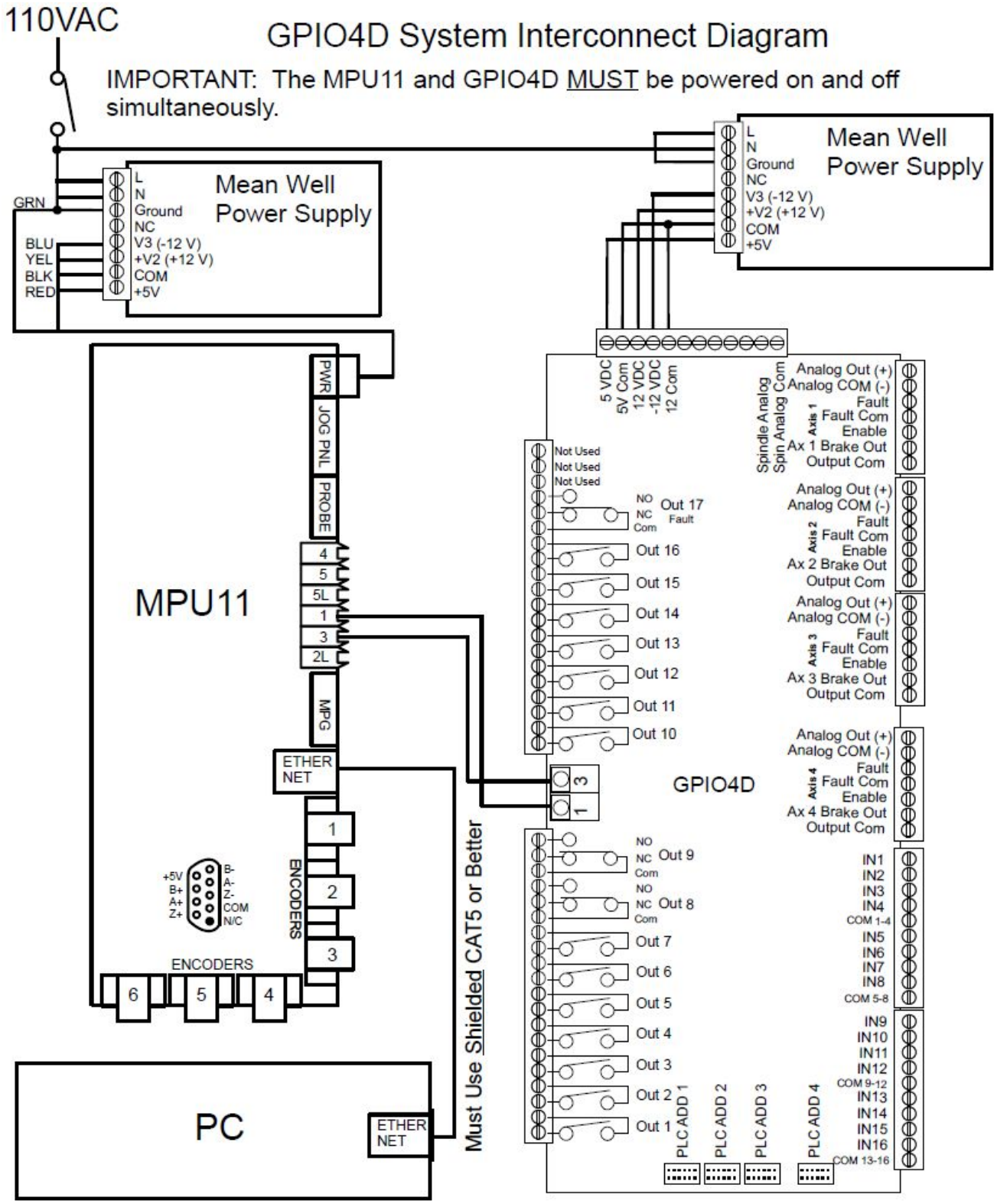


Figure 2.4.3
GPIO4D connected with MPU11 and powered

2.5 Bench Test – Powering On & Verifying LED States

Before you begin:

The GPIO4D and the MPU11 should be connected, as well as the encoder from the motor. The drive itself should not be connected or powered.

Before powering on make sure no metal object can touch the circuit boards and cause a short. Make sure all wiring is firmly in place.

Switch the outlet strip on: Powering the MPU11, GPIO4D, and any accessories.

GPIO4D LED States: After 15 to 30 seconds all LEDs should initialize to solid green. Make sure that all lights are on, indicating the GIO4D has proper power and is communicating with the MPU11. Refer to figure 2.6.1.

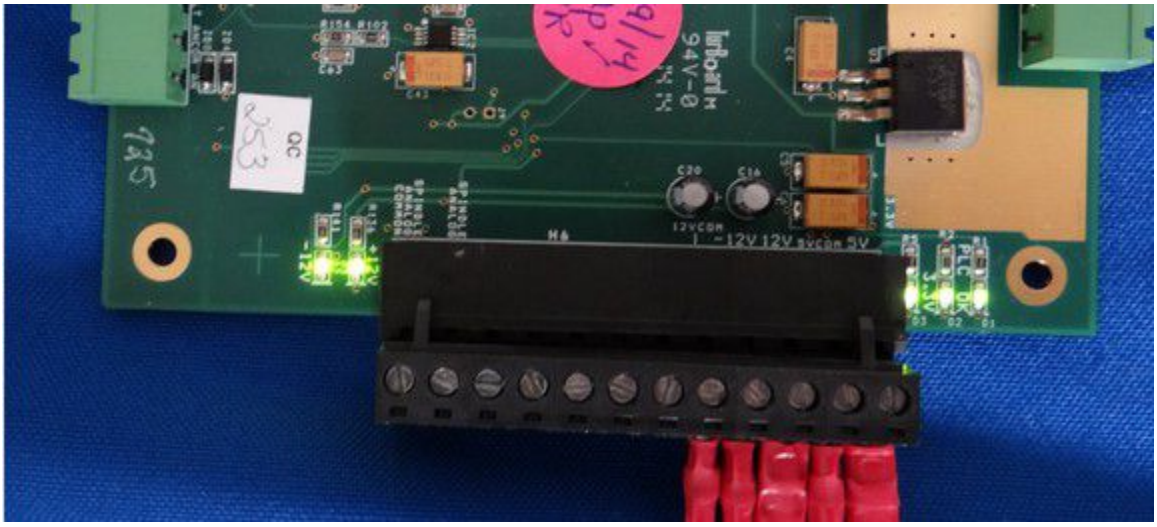


Figure 2.5.1
LEDs on the GPIO4D

GPIO4D LED States		
LED Name	LED Function	Nominal State
PLC OK	Indicates that the PLC is communicating with the MPU11	Solid Green
3.3V	The PLC has 3.3 volt power.	Solid Green
5V	The PLC has 5 volt power.	Solid Green
+12V	The PLC has +12 volt power.	Solid Green
-12V	The PLC has -12 volt power.	Solid Green

MPU11 LED states: While powering up, the 4 LED's next to the power connector on the MPU11 flicker. After 15-30 seconds the LED's should initialize to the state shown in the table below. Refer to figure 2.6.2.

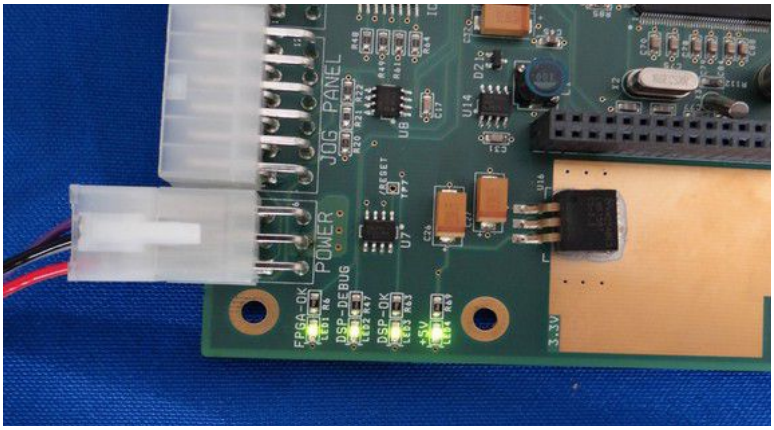


Figure 2.5.2
LEDs on the MPU11

MPU11 LED Nominal LED States		
LED Name	**LED Function**	**Nominal State**
FPGA-OK	The FPGA is working correctly	Solid green
DSP-DEBUG	Flashing indicates drive detected.	Flashing ~1 per second
DSP-OK	The DSP is working correctly	Solid Green
+5V	The board has 5 volt power.	Solid Green

MPU11 LED LED Troubleshooting		
LED Symptom	**Possible Cause**	**Corrective Action**
FPGA-OK not lit	MPU11 Not Ready	Wait for the MPU11 to start and enter run mode
	Internal hardware Fault	Return for repair
DSP-OK not lit	MPU11 is booting up	Wait for the MPU11 to start and enter run mode
DSP-DEBUG LED flashing twenty times per second	MPU11 is detecting hardware	Wait for MPU11 to detect hardware and start run mode
DSP-DEBUG and DSP-OK LED flashing alternately eight times per second	FPGA memory test failed	Return for repair
DSP-DEBUG and DSP-OK LED both on continuous	DSP Failed to initialize	Return for repair

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 CNC11 software already installed.

   If you bought or built your own computer, it must meet the prerequisites listed in TB 273 posted here: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/273.pdf)

   If using windows 8, you must follow the procedure outlined in TB 283: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/283.pdf)

   If using windows 7, you must follow the procedure outlined in TB 244: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/244.pdf)

   Note: Microsoft Windows Xp, Vista, and older versions of Windows are not supported. Mac OS and Linux operating systems are also not supported.

2. **Before installing CNC11 all anti-virus, anti-malware, and 3rd party firewall software should be *uninstalled* (not disabled) and your computer rebooted.**

   - **Turn off windows Firewall:**

     1) Click the **start** button

     2) Search for “firewall”, click on **Windows Firewall**

     3) Click **Turn Windows Firewall on or off**

     4) Click **Turn off Windows Firewall**

     5) Click OK

   - **Nearly 100% of all communication problems between CNC11 and the MPU11 are caused by anti-virus and 3rd party firewall software.** Virus software almost always detects the interaction between the MPU11 and the PC as unusual/suspicious and interferes with the operation of CNC11. Firewalls often block the ports needed for the operation of CNC11.

   - 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 CNC11 installed disconnected from the network.

3.2 CNC 11 Software Installation

With your bench configuration completely powered as described in Section 2.4 and your PC powered up, install the CNC11 Software as follows:

1. **Download the latest CNC11 Software version:**
   The latest version can be found here: CNC11 Software download
   (http://www.centroidcnc.com/usersupport/support_files/latest_release/cnc11_latest.zip)

2. **Copy the downloaded file to your desktop:**
   Depending on your Windows 7 settings, the file you downloaded will be displayed as either **cnc11_win7_current.zip** or **cnc11_win7_current**. Copy this file to your desktop and then double click on the file from your desktop.

3. **Drag the installation folder from the compressed file to your desktop as shown below in Figure 3.2.1:**

   The compressed file may be called either **cnc11_win7_current.zip** or **cnc11_win7_current** enter or extract this folder.

   The installation folder in this example is called centroid-cnc11-v312-D. The "v312" signifies the CNC11 version, yours may be different. Copy this to the desktop.

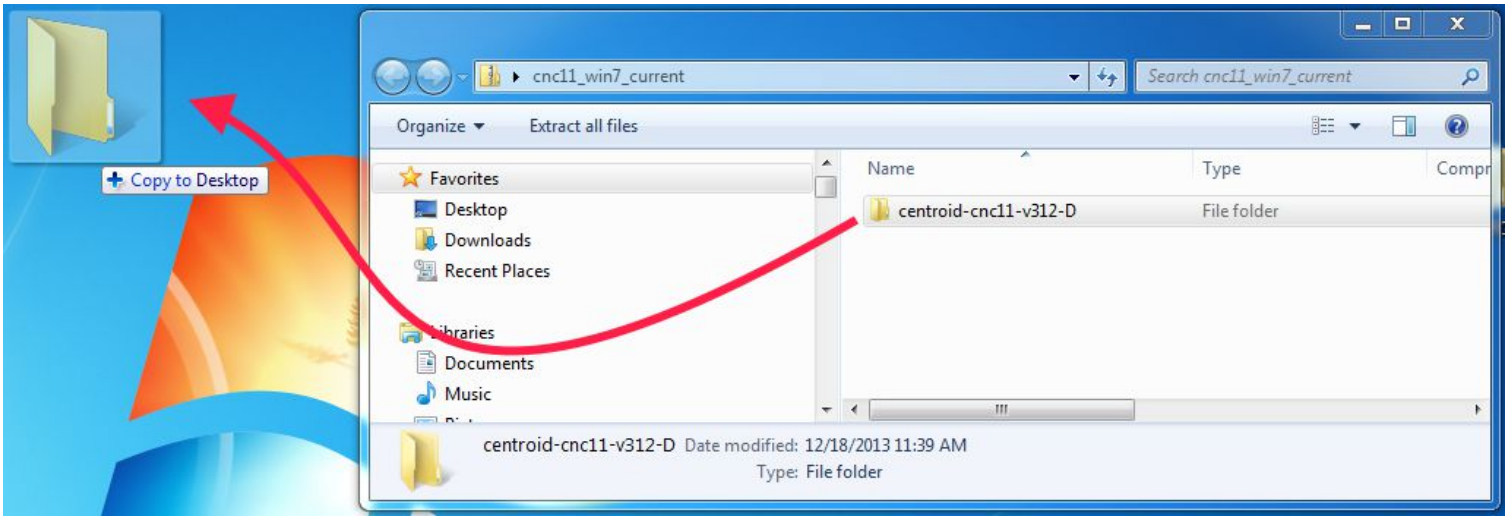


Figure 3.2.1
Copy to desktop

4. **Double click the install folder. Then double click "setup" to begin CNC11 install as seen in Figure 3.2.2**

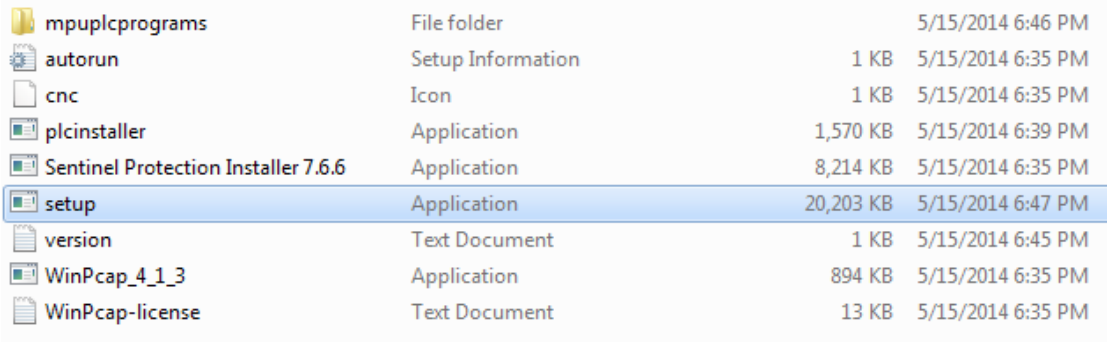


Figure 3.2.2
Double click "Setup"

5. Windows may ask **"***Do you want to allow the following program from an unknown publisher to make changes on this computer?***"**

   Click "**Yes**".

6. Select **CNC11 Mill** and **WinPcap** for a Mill installation as shown in Figure 3.2.3.

   Select **CNC11 Lathe** and **WinPcap** for a Lathe installation.

   Click "**Next**", accept default installation servo drive and directory (c:\) and click "**Install**" as seen in Figure 3.2.4. The software will extract as shown in Figure 3.2.5.

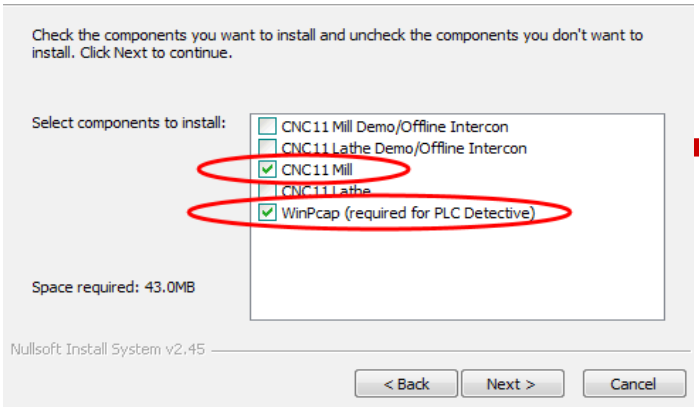


Figure 3.2.3
Selecting CNC11 and WinPcap

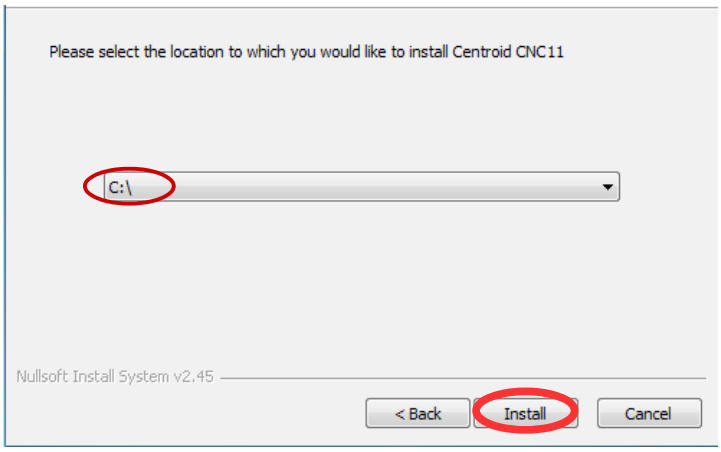


Figure 3.2.4
Select the C drive

7. **Install WinPcap:** Click "**Next**" in the WinPcap Setup Wizard window as circled in Figure 3.2.6.

   Check the "**Automatically start the WinPcap at boot**" box when prompted (not shown).

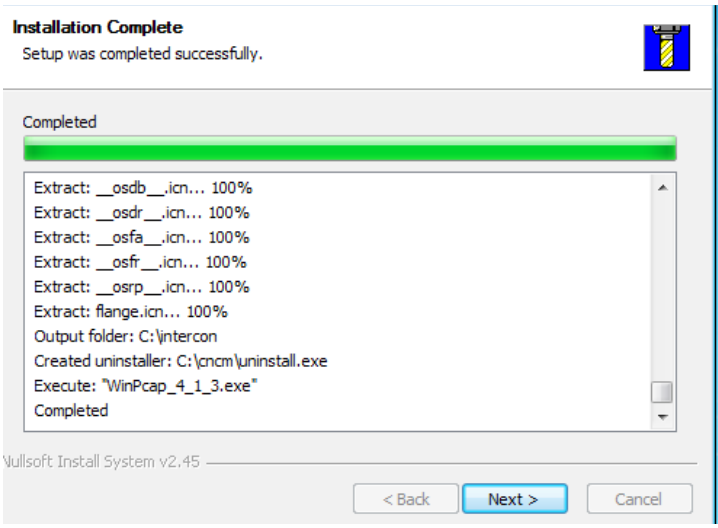


Figure 3.2.5
Software installation

Figure 3.2.6
Installation complete

8. **Click "Next" to continue:** After the WinPcap installation has finished, click "**Next**."

9. **Network Adapter Setup:** Click the down arrow to display the network adapters that are currently installed.

   Select the network adapter that is connected to the GPIO4D as circled in Figure 3.2.7.

   Disconnect all ethernet cables from the PC except for the one connecting to the MPU11. The board should be powered

   If you see multiple options, return to step 4 and make sure only the MPU11 is plugged into the Ethernet ports.

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

   Note: Centroid recommends using a computer with two Ethernet ports. One Ethernet port is used for the MPU11 and the second Ethernet port can be used to access the internet or a LAN.

   Click **Next** to continue.

   When asked if you would like to change the IP address for the adapter selected, click "**yes**".

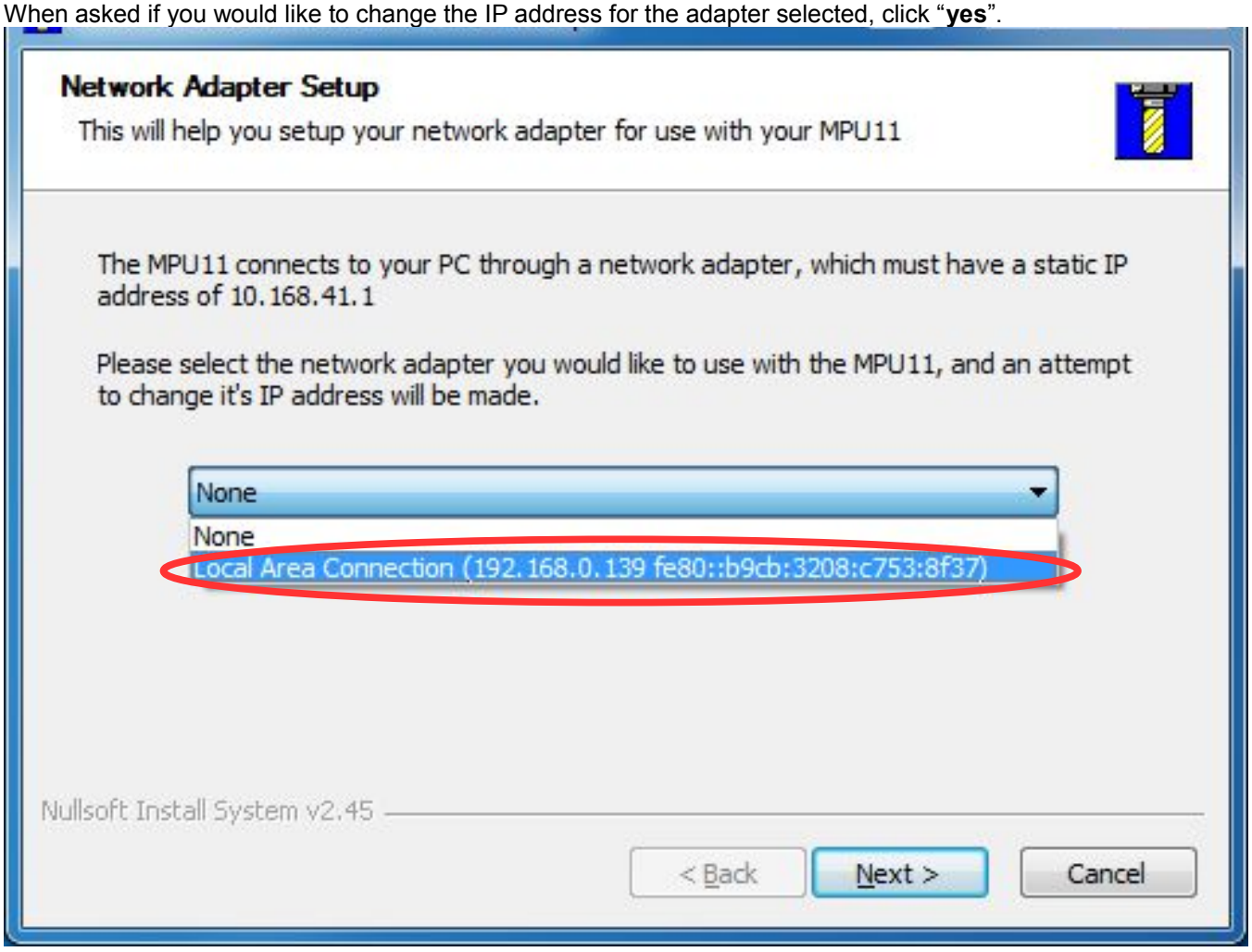


Figure 3.2.7
Select the network adapter that is connected to the Oak

10. **Installing a PLC program:** After the CNC11 software has been installed, the installer will prompt you to install a PLC program, select "**Yes**".

    Click on the "**+**" signs next to **Mill** or **Lathe** and **_GPIO4D**.

    Click on "**_basic**"

    Click "**Install**" as shown in Figure 3.2.8.

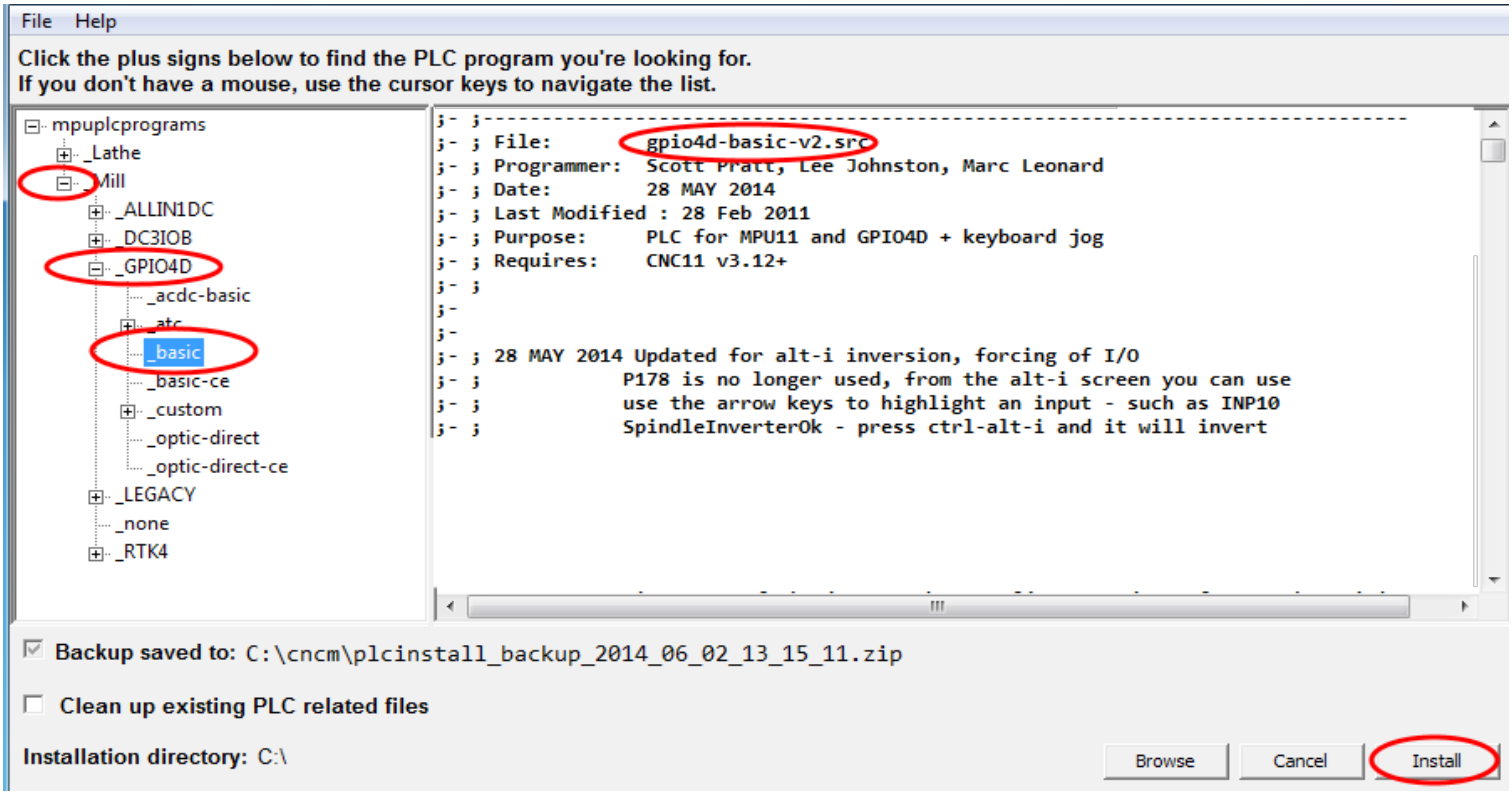


Figure 3.2.8
Install the PLC program

11. **Click "Finish" to complete CNC11 software installation.**

12. **Power off everything and restart.**

13. **Configuring Windows Firewall To Allow CNC11 to Communicate with The MPU11:** The first time you run CNC11 under Windows 7, you will see a pop up window, shown in figure 3.2.9.

    Check both the "**Private**" and "**Public**" check boxes.

    Click "**Allow access**" to continue.

Figure 3.2.9
Make a firewall exception

14. Confirm that CNC11 starts up correctly. Close CNC11 and continue on to the next step.

    Note: On wide screen monitors, CNC11 will only take up 2/3rds of the monitor screen while running in full screen.

    Troubleshooting: If you clicked on the CNC11 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.

    1) Go to **Control Panel**, select **Network and Internet**, and then **Network and Sharing Center**.

    2) Click on **change adapter settings** on the upper left corner of the window, right click on the network icon, select **Properties**.

    3) Highlight **Internet Protocol Version 4 (TCP/IPv4)**, then click **Properties** again.

    4) 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

    5) Click **OK** and then try to start the CNC11 software again.

Chapter 4 – Configuring for a Bench Test

4.1 Bench Test – CNC11 Software Configuration

Start the CNC11 Software, you should see the screen in figure 4.1.1.

1. **Enter your Software Unlock Demo Code:** Press **F1 Unlock Option** as shown in Figure 4.1.1.

   In **Enter Unlock #:** enter **297** for demos, or **298** for permanent unlocks.

   Enter the value from your Software Unlocks sheet. Press **ENTER**.

2. **Install All Other Unlocks:** Enter all unlocks provided on your unlock sheet using **F1 Unlock Option**.

   If you have a permanent unlock **AND** a demo mode code, install **both** so you will get a Demo mode for features you did not purchase, allowing you to try out features like rigid tapping, Intercon, or DXF Import.

   When the demo expires, the software add-ons labeled "**DEMO**" will go away and any options labeled "**ON**" will remain.

   To get back to the main menu from the Software Add-Ons menu screen press the Esc key.

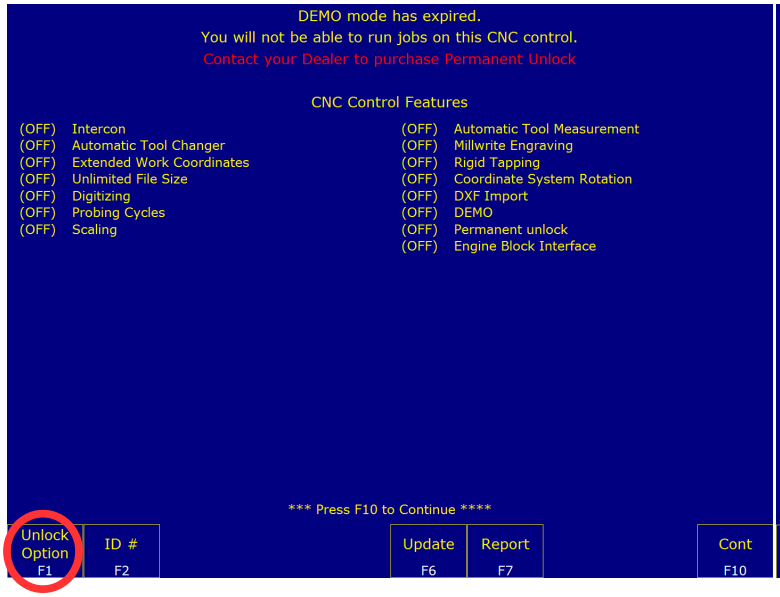


Figure 4.1.1
Options screen the first time starting CNC11

Figure 4.1.2
Options screen the first time starting CNC11

In general, when using CNC11, you can always go up one menu level by pressing the escape key (**ESC**). Tapping escape multiple times from any menu will eventually take you back to the main menu.

3. **Control Configuration:**

From the main screen press **F1 Setup** → **F3 Config.** The password is **137**. Press **F1 Contrl.**

1) Set the units of the machine, change both DRO display units and Machine units to either **Inches** or **Millimeters** with spacebar.

2) Set **Max Spindle** speed to **3000** and **Min Spindle** to **0**.

3) Change **Machine home at power up** to **Jog** with the spacebar.

Press **F10 Save.**

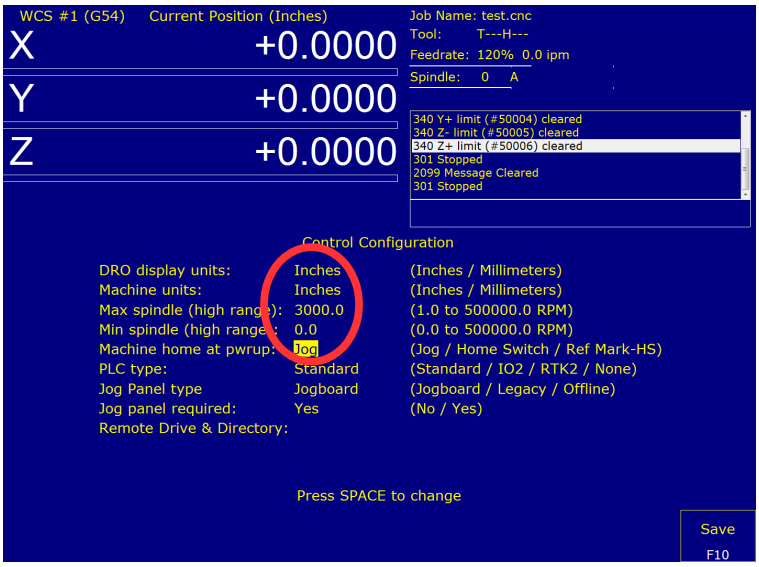


Figure 4.1.3
Changing machine home at powerup

4. **If no Jog Panel is being used disable it:** This step is only required if you do not have a Jog Panel. If you have a Jog Panel or Pendant, connect it and continue to step 6.

Select **Jog Panel Required** in the Control Configuration and press the space bar to change to **No**.

Press **F10 Save**.

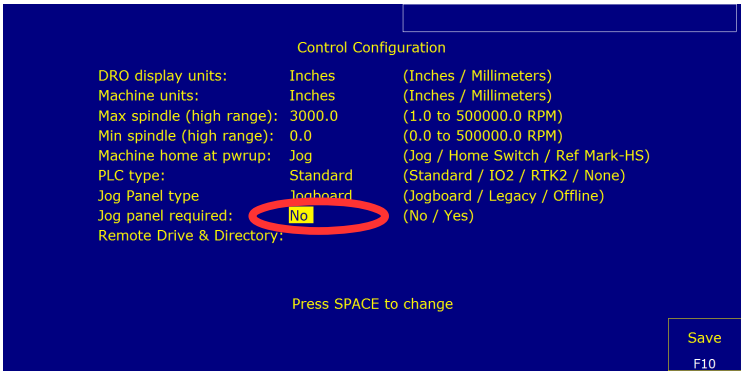


Figure 4.1.4
Disabling jog panel

5. **Disable PLC faults:** At the main screen press the **alt** and **i** keys to bring up the real-time I/O display as shown in Figure 4.1.5.

   Using the arrow keys, move the selection box to the top left of the inputs.

   The screen should read “INP1: *Ax1_MinusLimitOK*” as circled below.

   Press the **ctrl, alt** and **i** keys simultaneously to invert this input.

   The LED will turn from red to green and a line will be drawn over the top.

   Repeat the process until inputs **1-11** and inputs **17-20** are **green** as shown below.

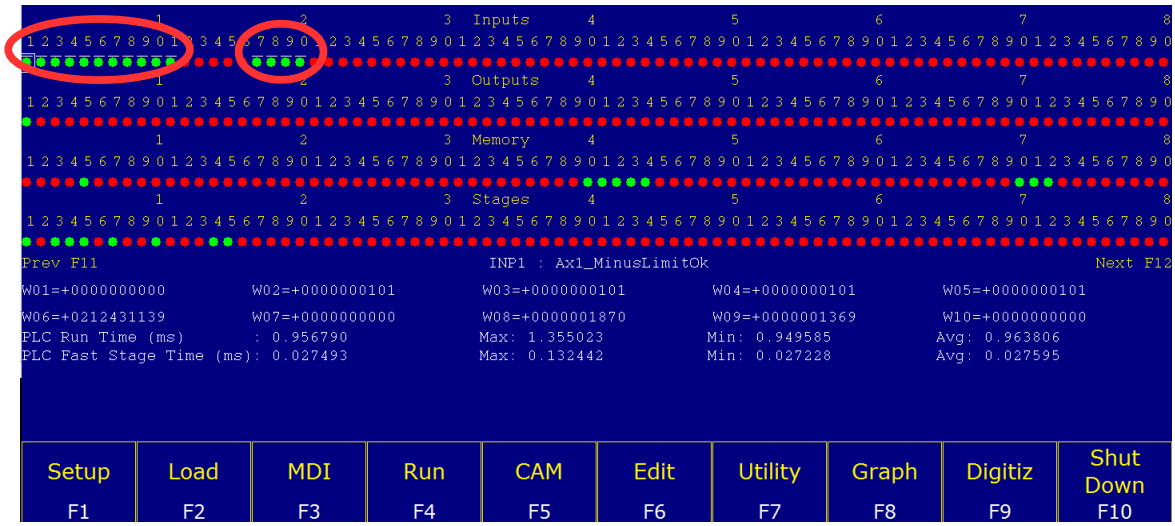


Figure 4.1.5
Disabling inputs using alt + i

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

   Under **Label** all axes should be set to **N** to disable the axis for bench testing as seen in Figure 4.1.6.

7. **Save:** Press **F10 Save**.

Figure 4.1.6
Labeling the axes

Motor Parameters

Axis	Label	Motor revs/in	Encoder counts/rev	Lash Comp. (Inches)	Limit -	Limit +	Home -	Home +	Dir Rev	Screw Comp
1	N	5.000000000	65536	0.000000	1	2	1	2	N	N
2	N	5.000000000	8000	0.000000	3	4	3	4	N	N
3	N	5.000000000	8000	0.000000	5	6	5	6	N	N
4	N	5.000000000	8000	0.000000	0	0	30	30	N	N
5	N	5.000000000	8000	0.000000	0	0	0	0	N	N
6	N	5.000000000	8000	0.000000	0	0	0	0	N	N
7	N	5.000000000	8000	0.000000	0	0	0	0	N	N
8	N	5.000000000	8000	0.000000	0	0	0	0	N	N

8. **Clear Any Existing Faults:** use the procedure below if you have a fault.

   To clear a fault, cycle the E-Stop.

   1) Press the alt-i keys to bring up the real-time I/O screen.

   2) Use the arrow keys on the keyboard to select the "*INP11 : EStopOK*" as shown below in Figure 4.1.7.

   3) Press the **ctrl**, **alt**, and **i** keys to cycle the EstopOK input until it turns red then green.

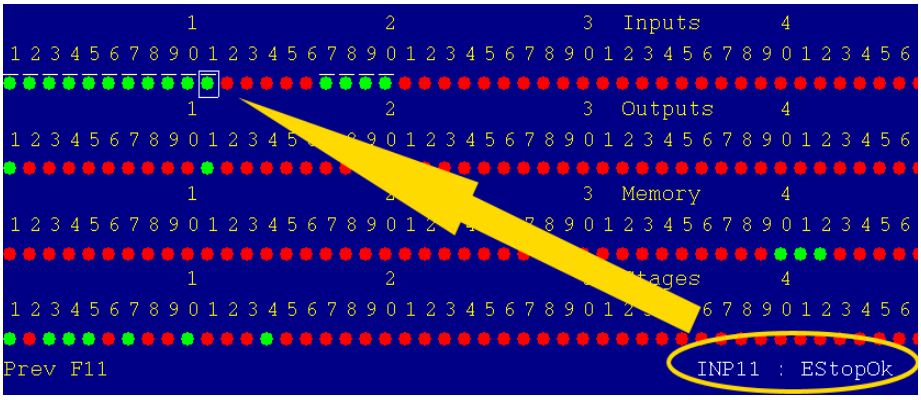


Figure 4.1.7
Toggling E-stop

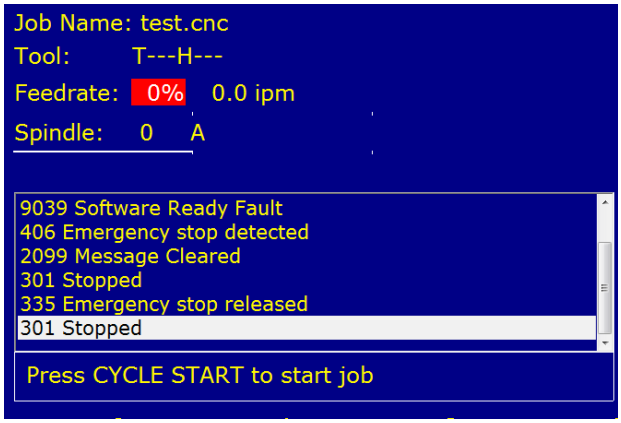


Figure 4.1.8
Status window showing the emergency stop clearing faults.

Note: as you toggle the EstopOk 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, referring to clearing the *"9039 stop fault".* Toggling *EStopOK* back to green displays *"335 Emergency Stop Released".*

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 4.1.9.

If the screen shown in Figure 4.1.9 is not displayed, there is an existing fault, return to the beginning of Section 4.1 and ensure all instructions are followed.

Remember to cycle the E-Stop to clear the fault and press **F3 MDI** to test if it is cleared.

Figure 4.1.9
MDI Command Mode

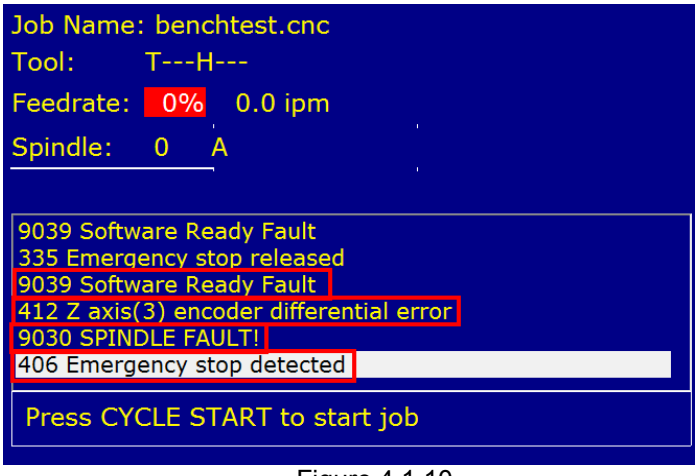


Figure 4.1.10
Faults detected

4.2 Bench Test – Performing the Bench Test

Bench testing the MPU11 and GPIO4D will confirm that the MPU11, GPIO4D, encoders, and encoder wiring are 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 have arisen. To complete Bench Testing, a DVM (Digital Volt Meter) or DMM (Digital Multimeter) is required.

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

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

   2) **Download benchtest.cnc.**

      Note: If your web browser does not provide an option to download benchtest.cnc and instead displays a bunch of code, copy the code from your web browser into your default text editor.
      Save the file as "**benchtest.cnc**" and put it in the CNC11 root directory (see next step).

   3) **Place benchtest.cnc to your CNC11 root directory.**

      I. Right click on your CNC11 shortcut

      II. Click **properties** as shown in figure 4.2.1.

      III. A window will pop up, go to the **shortcut** tab and click **open file location** as shown in Figure 4.2.2.

      IV. Open the folder labeled **ncfiles**. Paste benchtest.cnc into the ncfiles directory.

      V. In the load menu of CNC11 press **F5 refresh**.

2. With benchtest.cnc highlighted, press **F10 Accept**.

   Now press alt-s (cycle start).

   If the DRO does not display you likely encountered a fault, see clearing faults is covered in section 4.1.17.

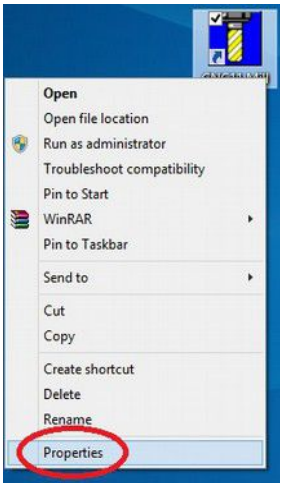


Figure 4.2.1
Right click on CNC11 and click "properties"

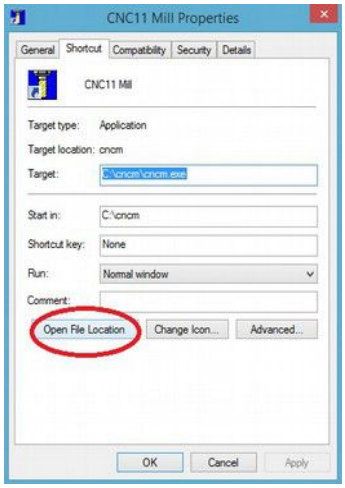


Figure 4.2.2
Select "shortcut" tab, click "Open File Location"

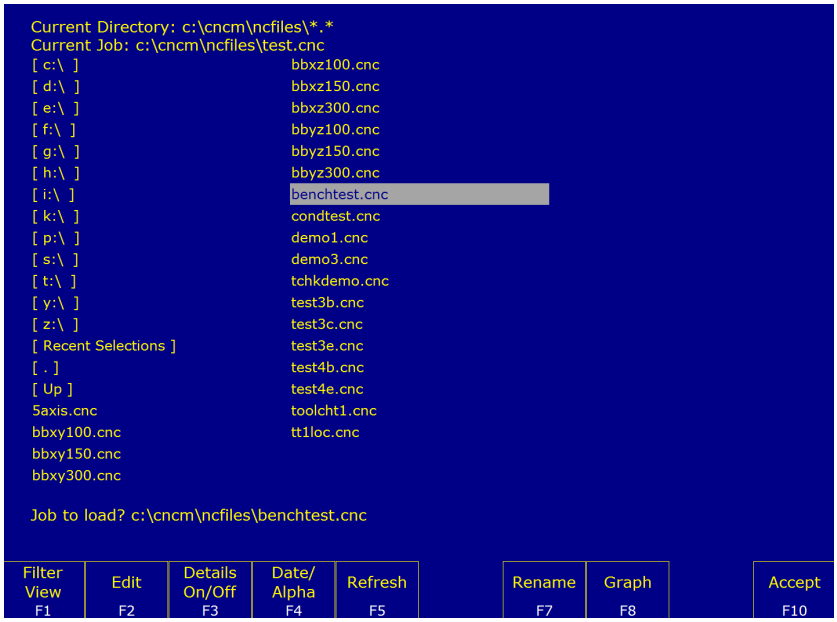


Figure 4.2.3
Selecting benchtest.cnc

Testing the Spindle:

Background: The GPIO4D provides a 0 to +10VDC analog output to provide programmable spindle speed control. 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, for example, will output +5VDC, a command of S1000 will output +3.33VDC and so on.

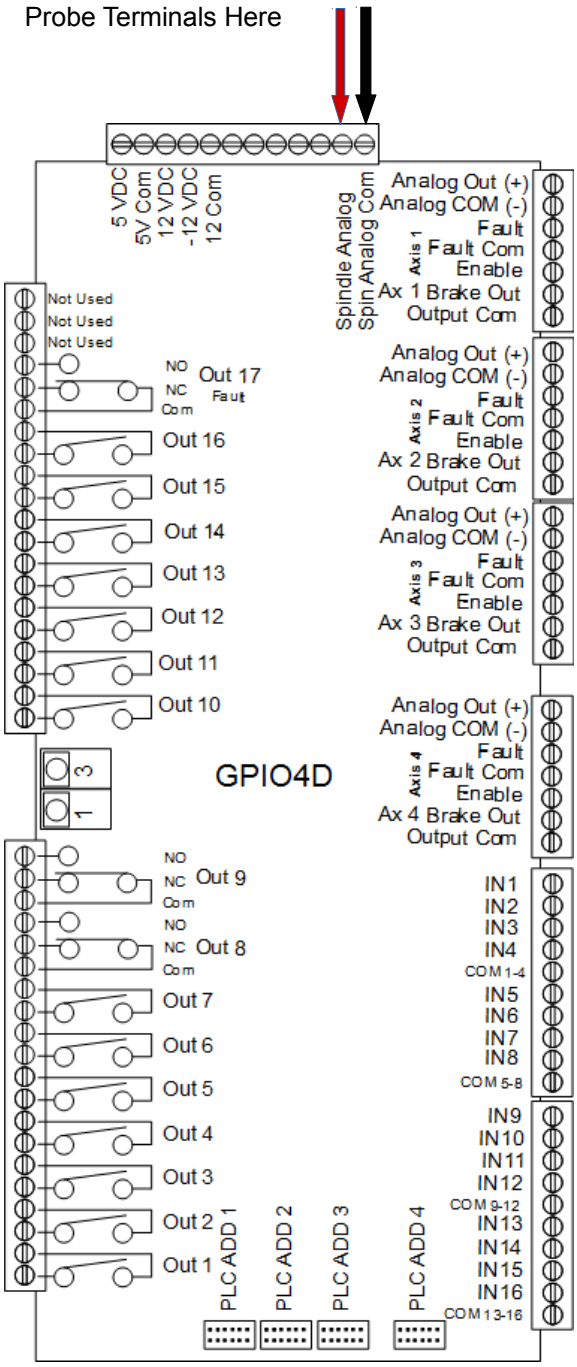
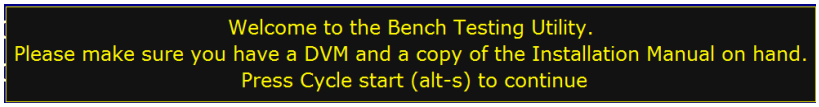


Figure 4.2.6
Testing the Spindle

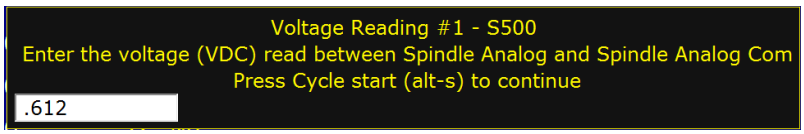
1. Set a digital voltage meter to VDC.

2. Insert the digital voltage meter leads into the terminal block as shown in Figure 3.9.4. Tighten **down the screw terminals in the terminal blocks to firmly grip the probes.**

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



4. Enter the voltage readings from the multimeter, and press Cycle start to continue.



5. If the test fails, an error will be displayed. If the test was passed the program will automatically continue to the next section.

Testing the Axis Outputs:

The GPIO4D outputs -10 to +10VDC signals for control of up to four axes. When testing the -10 to +10VDC analog output for each axis, place your probes in the appropriate location as indicated below for the axis being tested.

Remember, during this section your motor drive should not be hooked up.

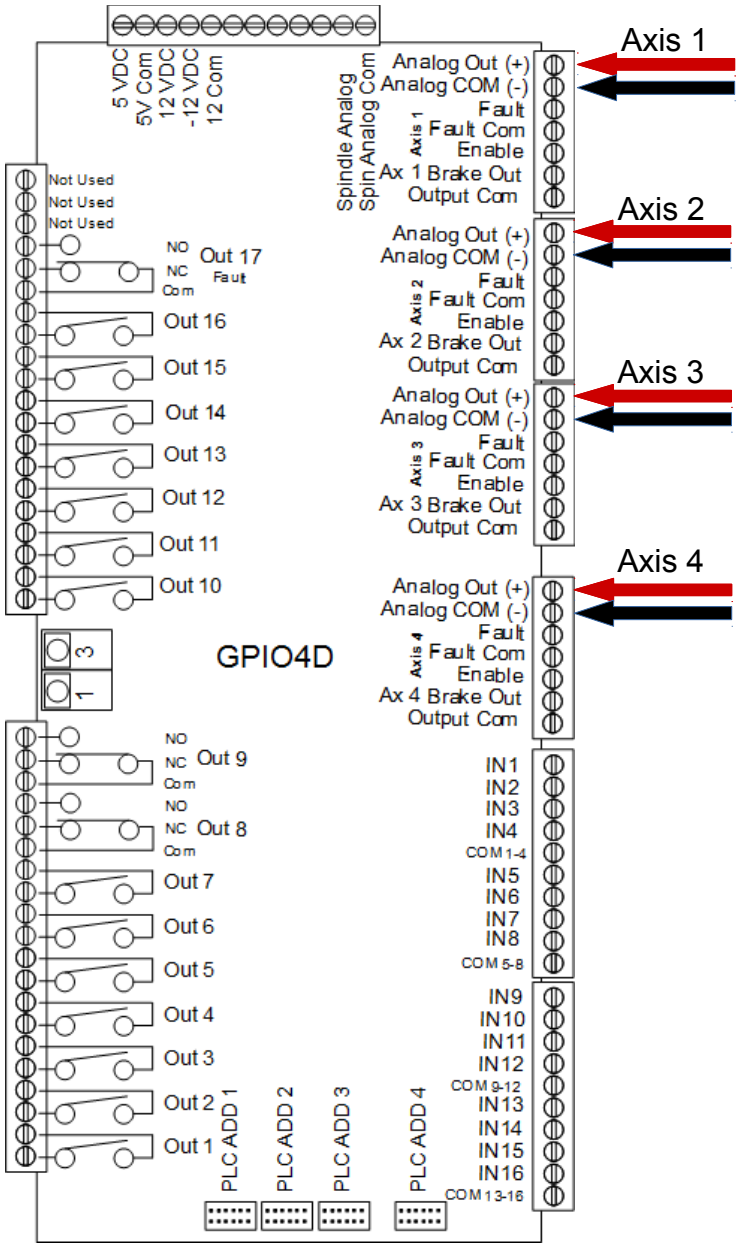
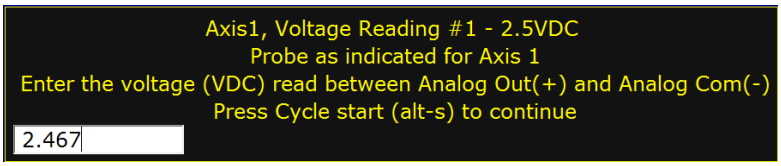


Figure 4.2.7
Testing the Axes

1. Set a digital voltage meter to VDC.

2. Insert the digital multimeter leads into the Analog Out (+) and Analog Out (-) of Axis 1. Tighten down the screws in the terminal blocks to firmly grip the probes.

3. Benchtest.cnc will test each axis. In total, 8 measurements are made for each axis. Enter the readings from the multimeter as prompted.



4. When finished with that axis, continue to the next axis.

5. The program will throw an error if the value is incorrect or unexpected. If done correctly the program will stop upon completion.

Bench Testing Completed. Power off and disconnect the components.

Chapter 5 – Electrical Cabinet Wiring

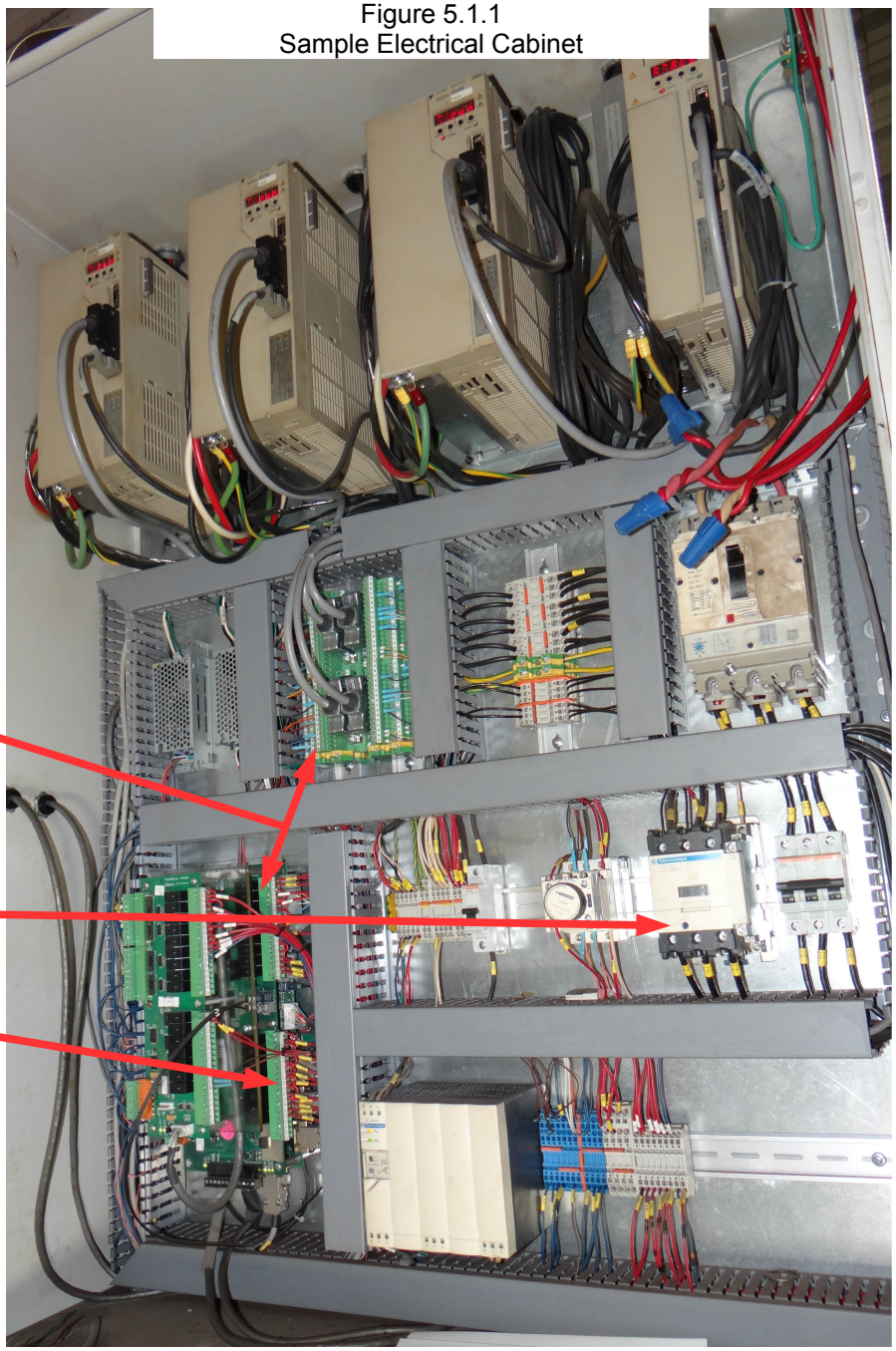
5.1 Introduction to Electrical Cabinet Wiring

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.

For more detailed wiring instructions, please see the schematic that was shipped with your kit, or if a CD was included, your schematic can be found in the "schematics" directory of your installation CD.

Figure 5.1.1
Sample Electrical Cabinet



Best Practices:

- **Minimize Noise and Interference**
  - **Keep the distance between the GPIO4D 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 Boards. 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/078.pdf)

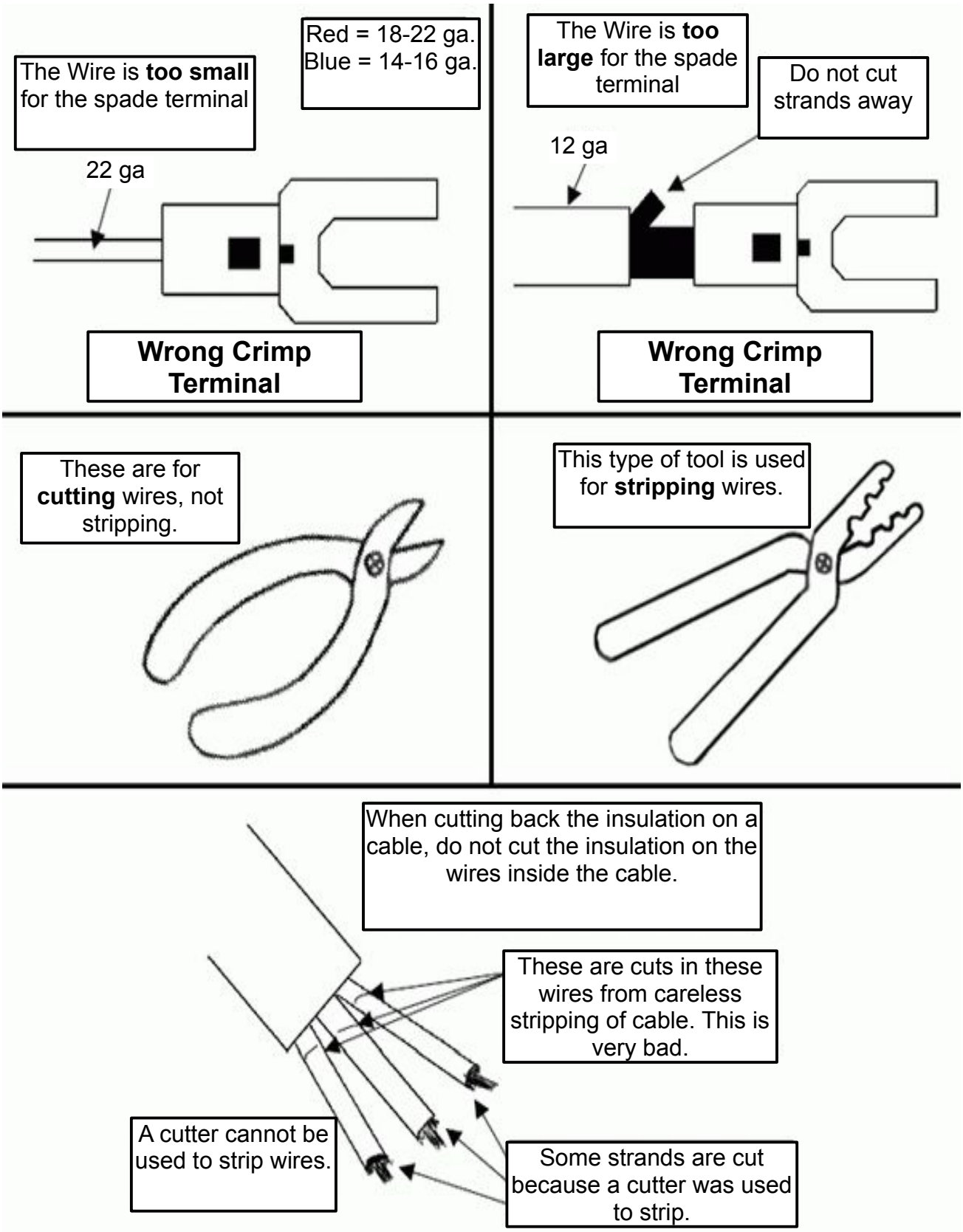


Figure 5.1.2
Common Wiring Problems

5.2 Electrically Configuring Inputs on the GPIO4D

The inputs of the GPIO4D 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 GIO4Ds 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 boards when changing the SIPs.

To find out which SIP to use, use the chart below to read the labels. 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

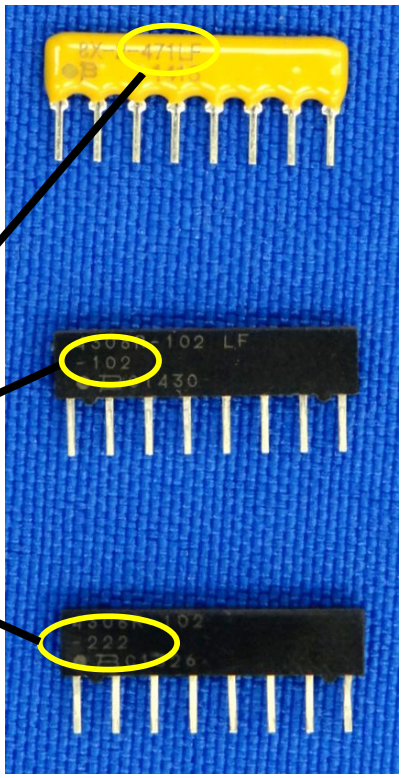


Figure 5.2.1
Reading SIPs

Looking closely at the GPIO4D, the silkscreen is labeled **SIP1**, **SIP2**, **SIP3**, and **SIP4** as shown in 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
Axes Fault Inputs 1-4	5
Inputs 1-4	4
Inputs 5-8	3
Inputs 9-12	2
Inputs 13-16	1

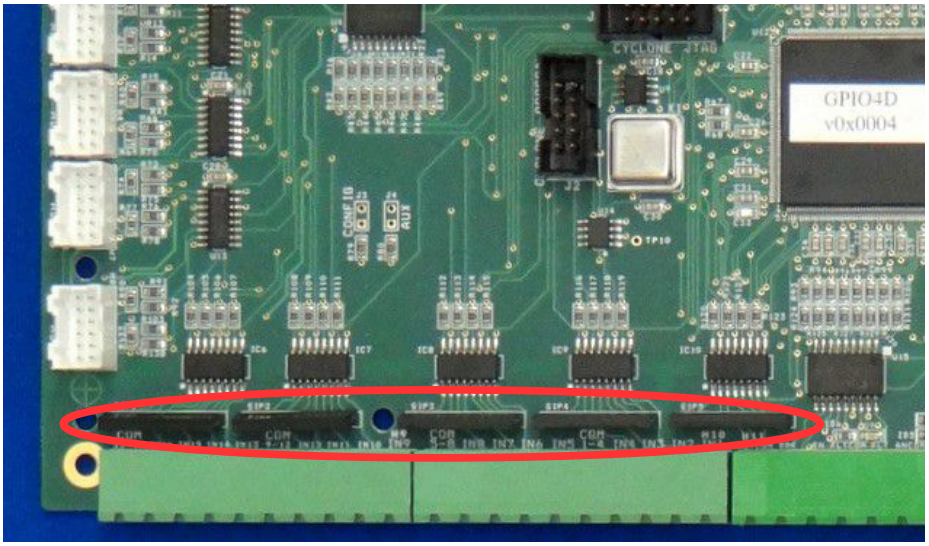


Figure 5.2.2
Location of SIPs

All inputs on the GPIO4D can be configured for sourcing or sinking operation.

Whether you will use sinking or sourcing depends on your setup. These 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 netagive lead of the power supply must be connected to common. This is demonstrated on inputs 1-4 in Figure 5.2.3.

- **Sinking:** By connecting the inputs to ground is sinking. The positive lead of the power supply must be connected to common. This is demonstrated on inputs 5-8 in Figure 5.2.3

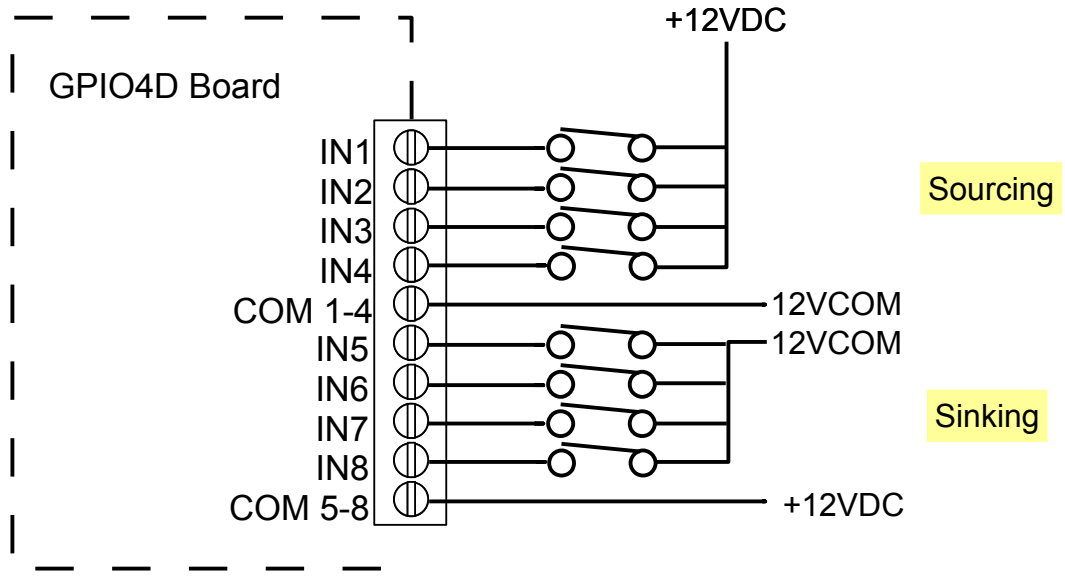


Figure 5.2.3
Wiring Limit
Switches

5.3 Connect major components in your cabinet

Connect the major components in your electrical cabinet just you had done on your desktop in section 4.

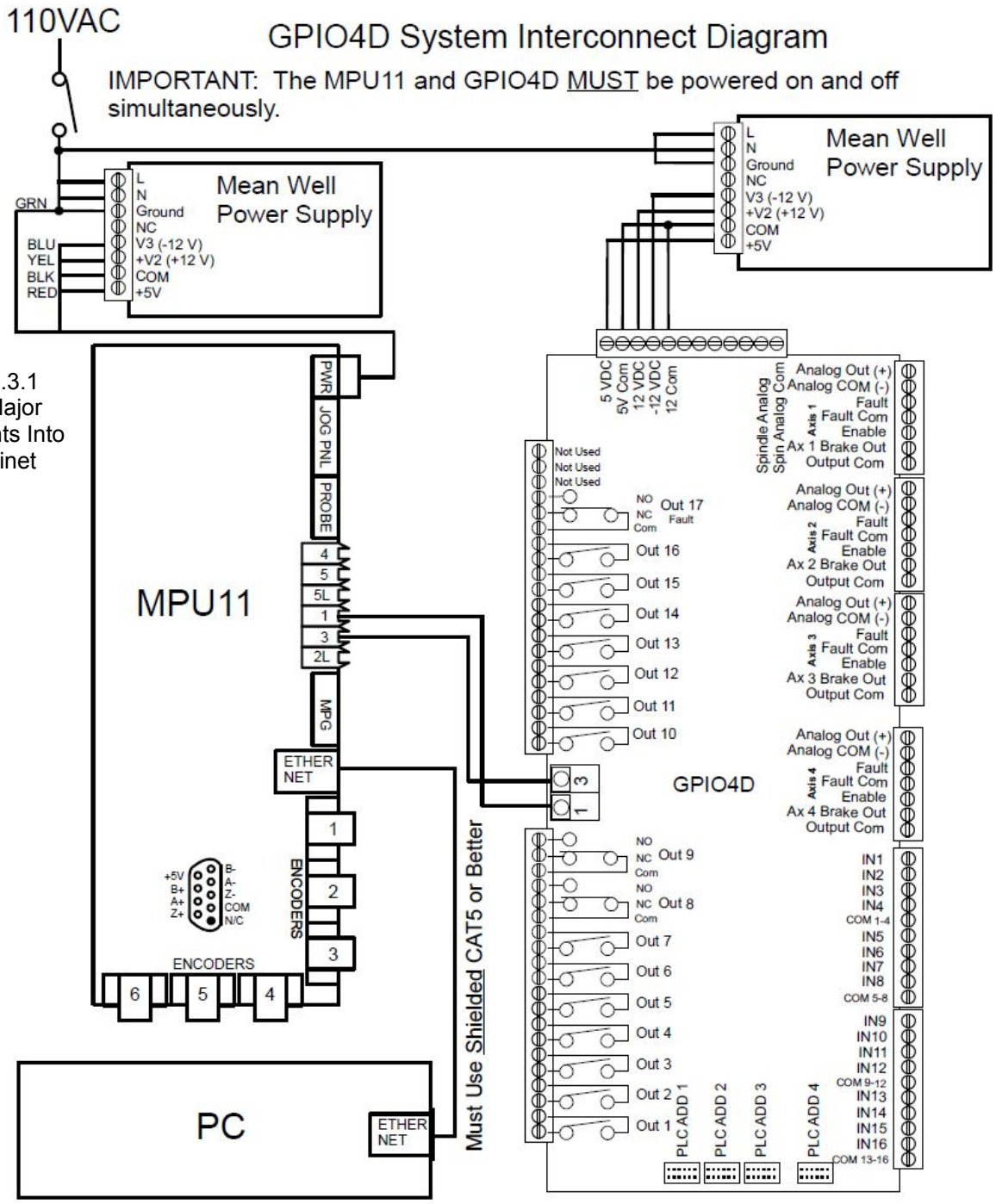


Figure 5.3.1 Wiring Major Components Into the Cabinet

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 #1009 used with #5934 is recommended, shown in figure 5.4.1.

2. **Snubber:** A snubber needs to be placed across the E-Stop contactor coil. Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise when the motor power is cycled on and off.

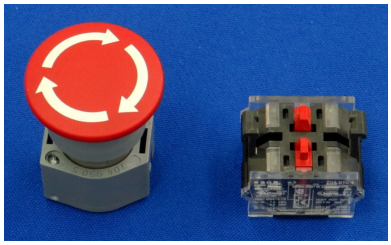


Figure 5.4.1
E-Stop

Testing E-Stop Wiring:

3. Power up your system.
4. Start CNC11 and press F10 to continue to the main screen.
5. In the main menu press alt + I to bring up the real time I/O display.
6. Navigate input 11 with the arrow keys.
7. If there is a bar over the input, press ctrl-alt-i until the bar over the input in the display is removed.
8. 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.
9. Check that output 1 is green and the E-Stop contactor coil is closed.

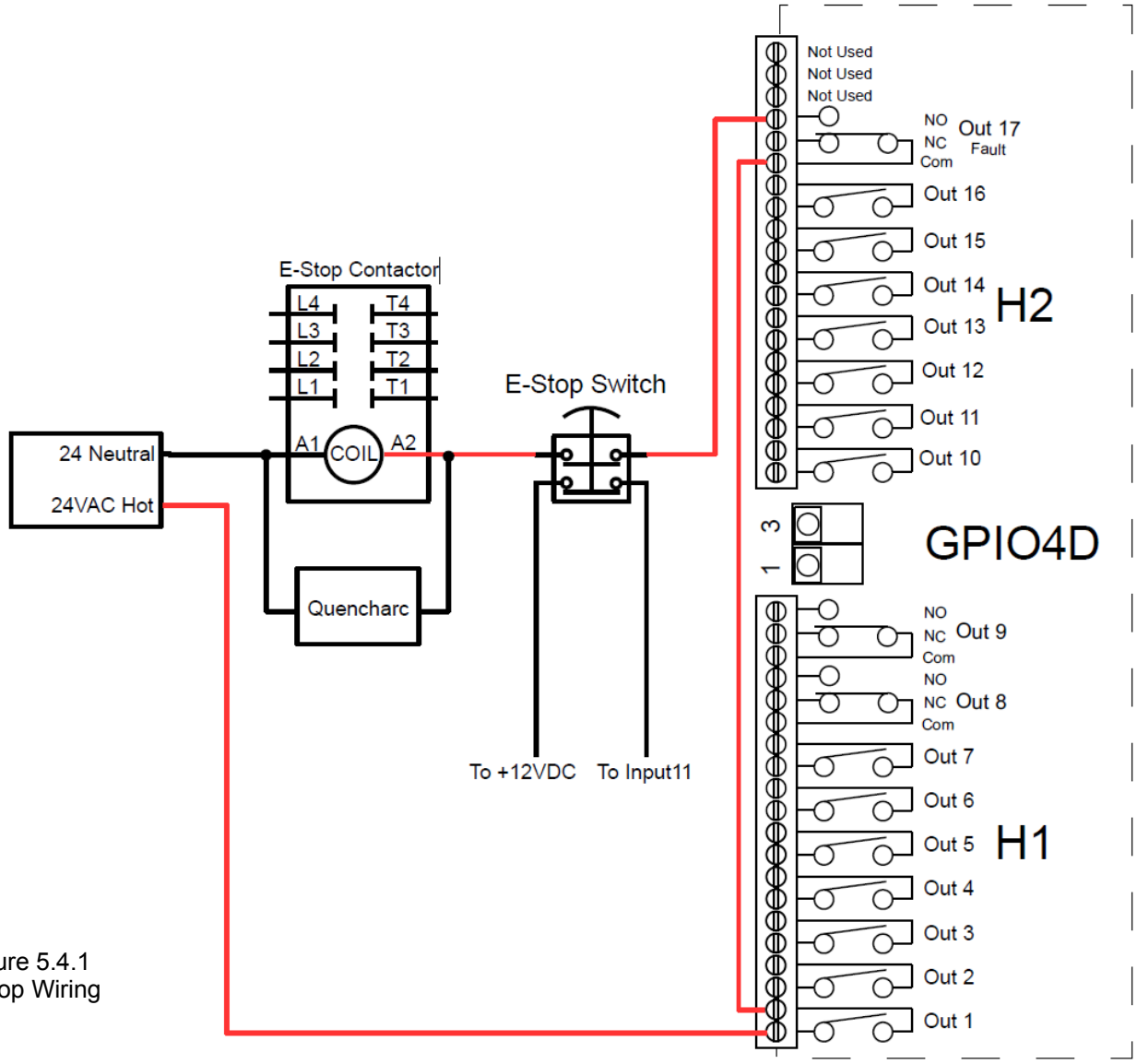


Figure 5.4.1
E-Stop Wiring

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 devices such 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.

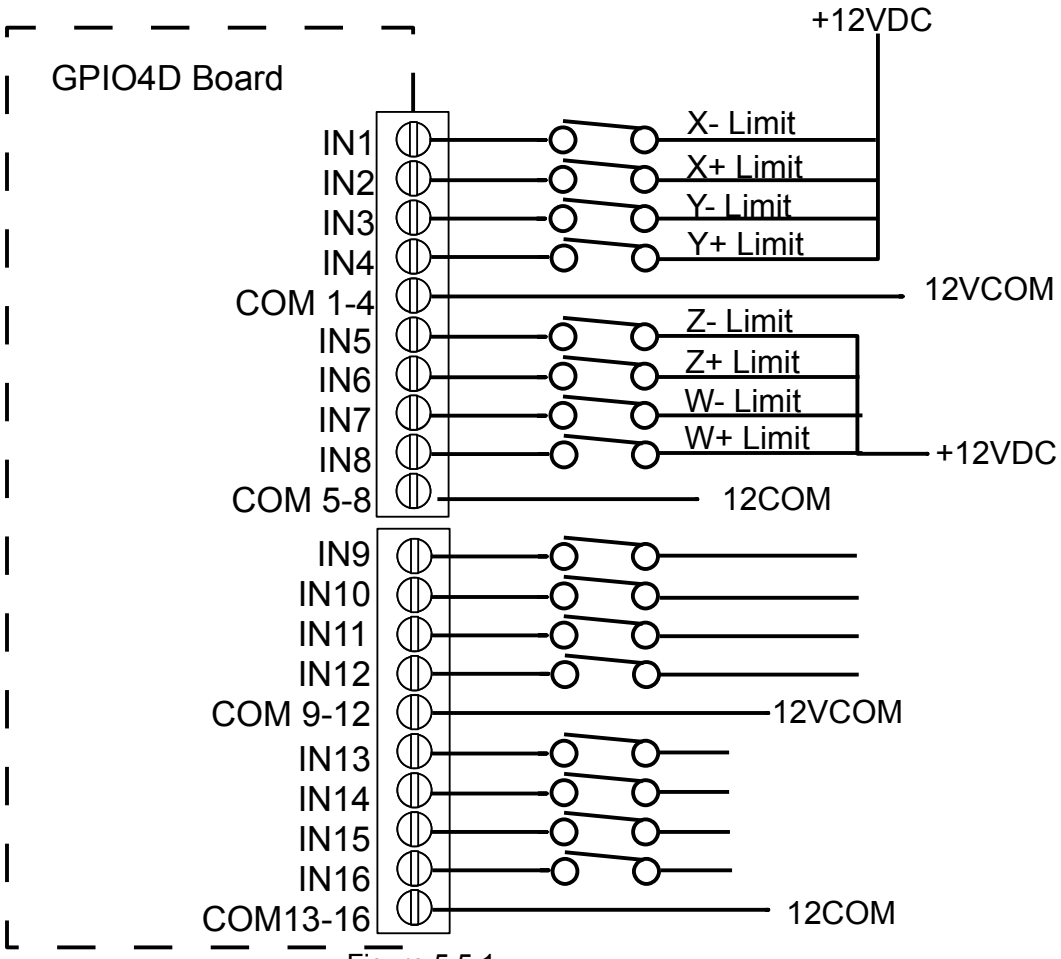


Figure 5.5.1
AC/DC limit switches.

Testing Limit Switch Wiring:

1. Power up your system.
2. Start CNC11 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. Click on limit switch inputs (input 1 - 8), and press the ctrl-alt-i keys simultaneously to remove the bar over the input in the display. This will enable your limit switches.
5. Confirm that all limit switches are 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 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. (http://www.ajaxcnc.com/downloads/Technical%20Bulletins/171.pdf)

Enabling Lube Inputs:

1. Power up your system.
2. Start CNC11 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.

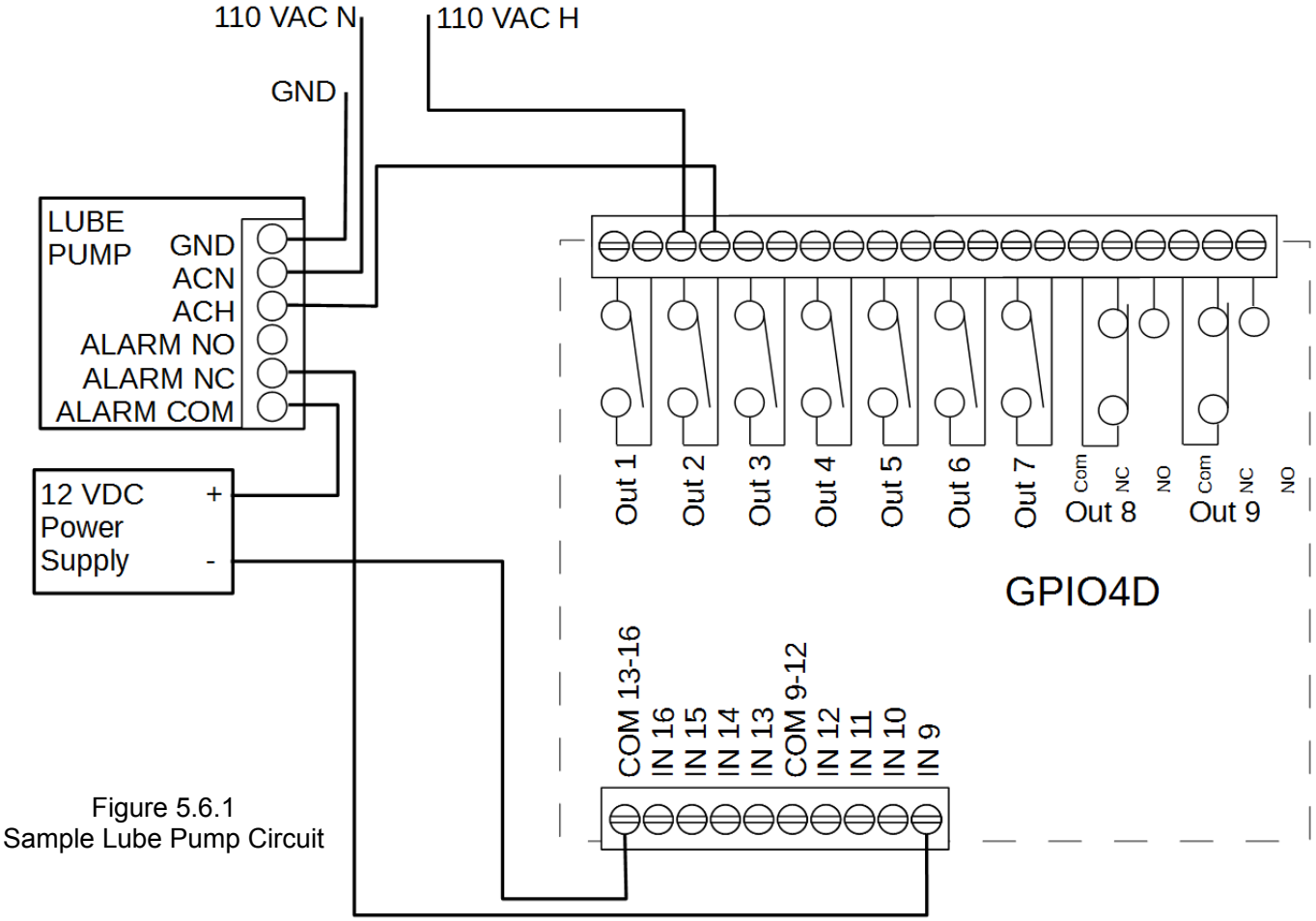


Figure 5.6.1
Sample Lube Pump Circuit

5.7 Wiring Coolant Pump

By default, **Output 3** 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.

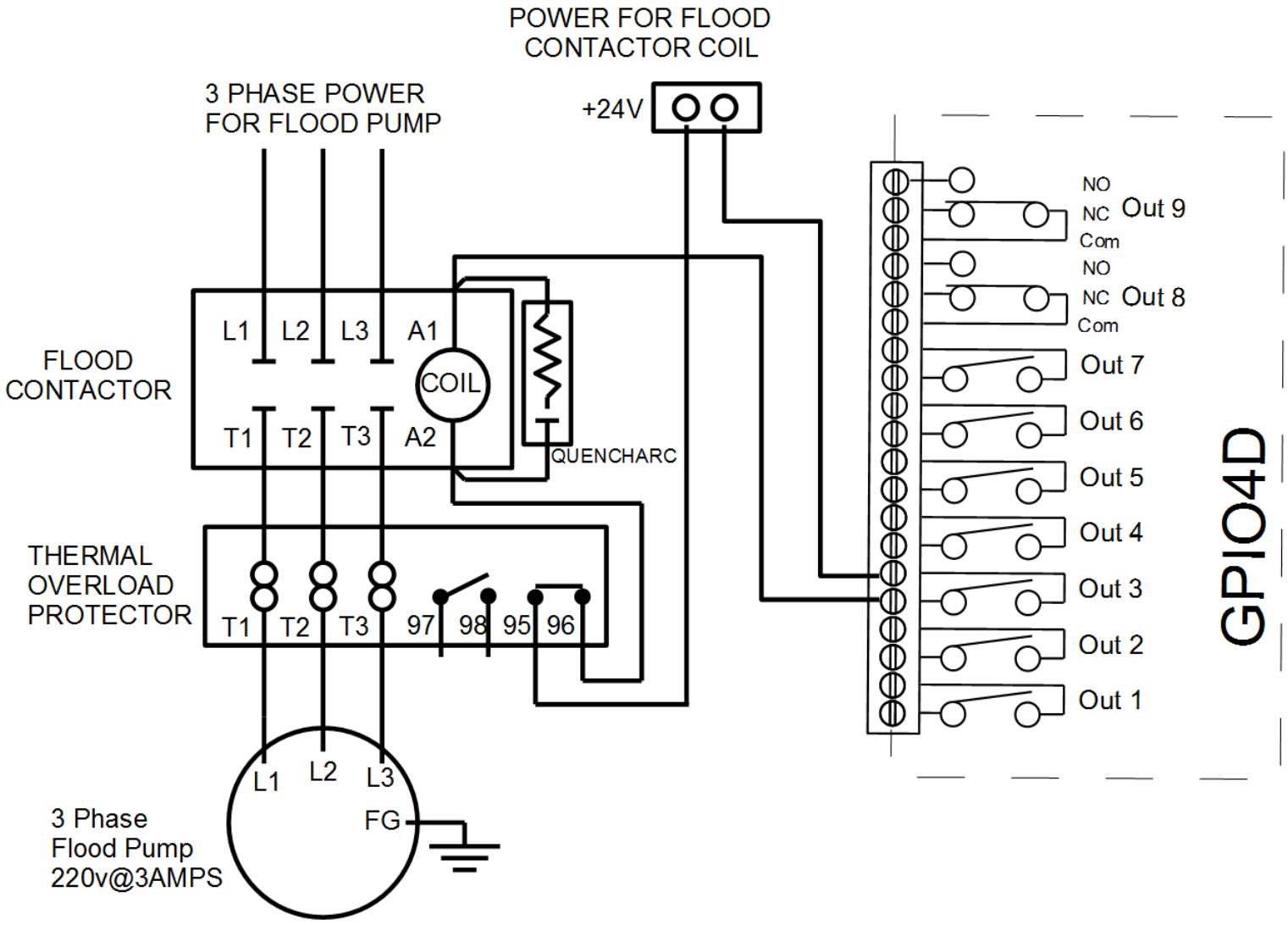


Figure 5.7.1
Sample Coolant Pump Circuit

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 5.8.1, power connections in 5.8.2)
  The 3 phase is connected to mechanically interlocked reversing contactors, controlled by outputs 7 and 8 on the board.

- **Use a Variable Frequency Drive (VFD):** (shown in Figure 5.8.3)
  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:

- **Input 10** is the VFD fault input.
- **Output 5** is the VFD fault reset.
- **Output 7** is the VFD fault output.
- **Output 8** is the VFD direction.
- **Output 10** is for a VFD cooling fan.

Always refer to your schematic.

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 CNC11 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.

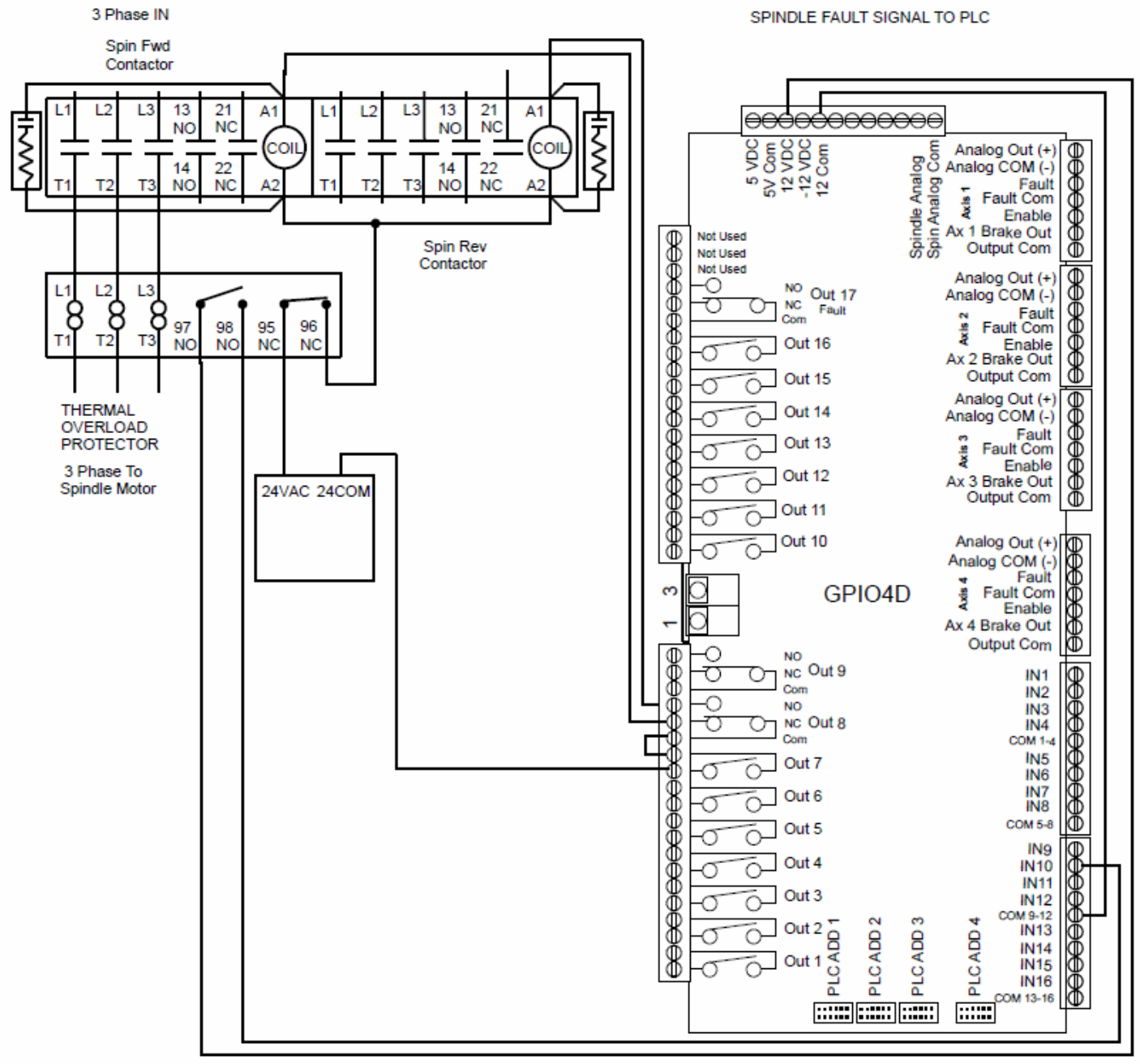
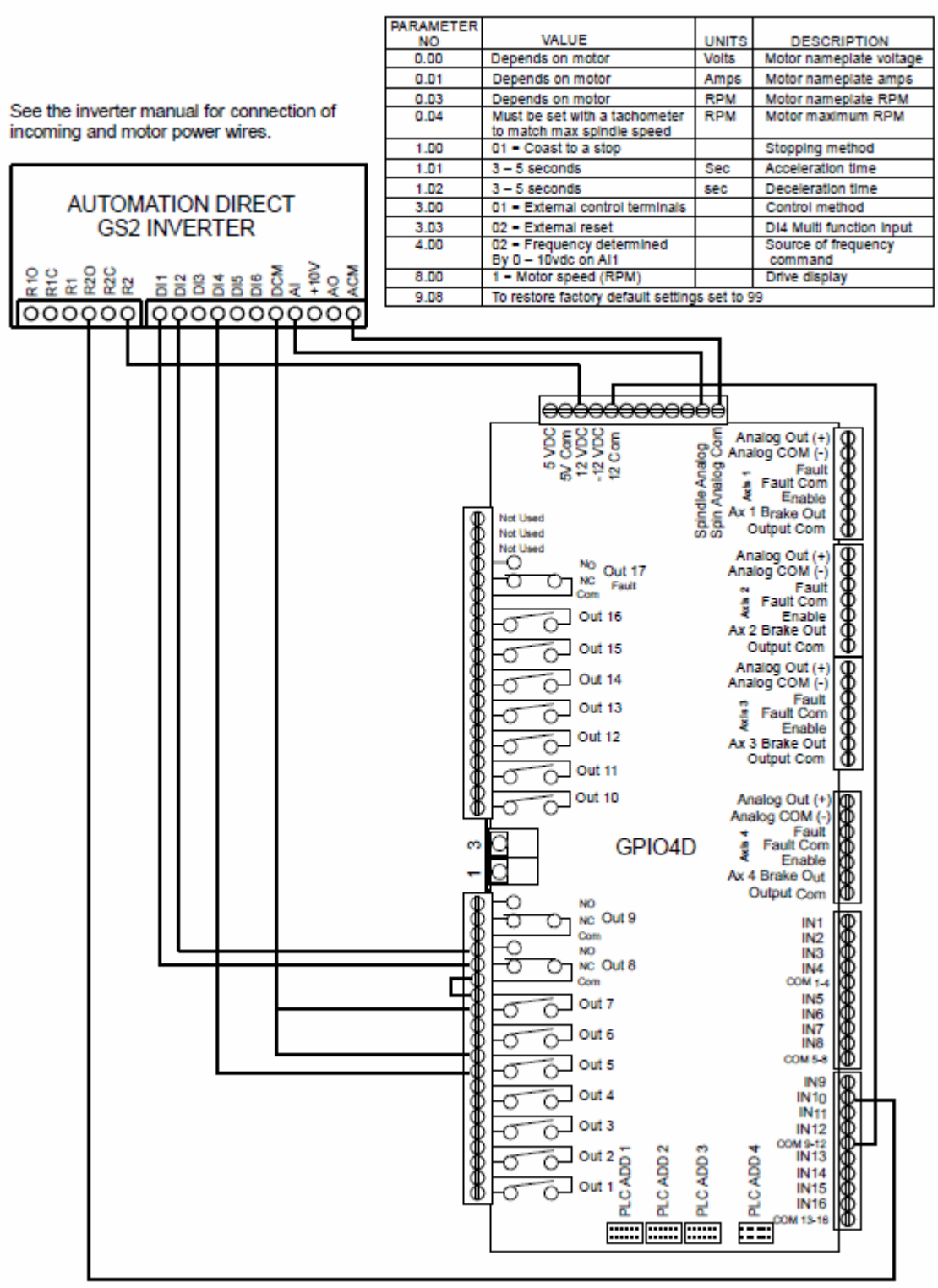


Figure 5.8.1
Sample Spindle Wiring for Direct Wiring

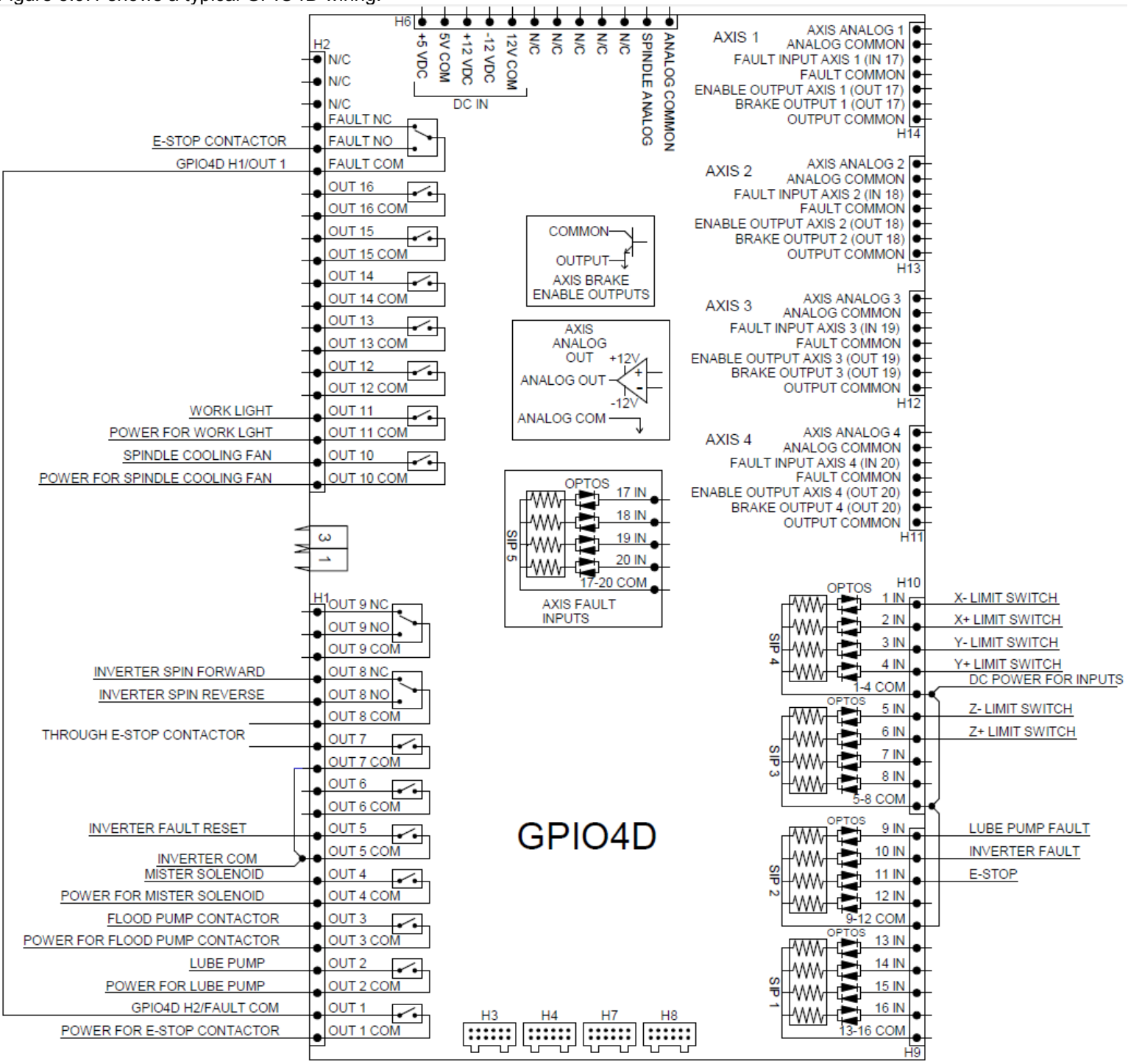


PARAMETER NO	VALUE	UNITS	DESCRIPTION
0.00	Depends on motor	Volts	Motor nameplate voltage
0.01	Depends on motor	Amps	Motor nameplate amps
0.03	Depends on motor	RPM	Motor nameplate RPM
0.04	Must be set with a tachometer to match max spindle speed	RPM	Motor maximum RPM
1.00	01 = Coast to a stop		Stopping method
1.01	3 – 5 seconds	Sec	Acceleration time
1.02	3 – 5 seconds	sec	Deceleration time
3.00	01 = External control terminals		Control method
3.03	02 = External reset		DI4 Multi function input
4.00	02 = Frequency determined By 0 – 10vdc on AI1		Source of frequency command
8.00	1 = Motor speed (RPM)		Drive display
9.08	To restore factory default settings set to 99		

Figure 5.8.2
GS2 Sample Spindle Wiring Using a
Spindle Controller

5.9 GPIO4D WIRED

Figure 5.9.1 shows a typical GPIO4D wiring:



5.10 Wiring 3rd Party Servo Amplifiers to the GPIO4D

Before You Begin:

Since the analog output is sensitive to electrical noise and interference, it is also very important to keep the cables **as short as possible**.

> **Note:** If very long cables are needed between the third party servo drive controller and the GPIO4D, Centroid recommends using the Optic Direct instead of the GPIO4D as it uses fiber optic cables for communication.

Keep the cables far away from electrically noisy transformers and contactors. Do not allow the analog output cables share the wire ducts with high voltage cables. Refer to section 5.1 for a sample electrical cabinet layout.

Encoder Setup:

The MPU11 requires **incremental differential quadrature encoders** on the servo motors. Centroid has encoders, cables, connectors, and additional hardware available for purchase.

The MPU11 requires only the encoder channels listed below and does **NOT** use the tachometer, tachogenerator, or commutation channels that may be on the encoder.

If you have not already, stop to read the manufacturers documentation that came with your third party drive before continuing.

1. **Encoder Cables:** The encoder cables **MUST** be twisted pair shielded cables.

   The shield wire of the encoder cable needs to be grounded **on both ends**.

   On the MPU11 side of the cable, connect the cable shield to the metal shield of the DB-9 connector as seen in figure 5.10.1.

   > **Note:** If the D-sub connector does not provide a method of attaching the shield wire, the shield wire should to be soldered to the metal shield DB-9 connector.

   Ground the other end of the shield to the third party drive as recommended in the manufacturers documentation.

   Failure to ground the cable shield may cause encoder errors in the CNC11 software.

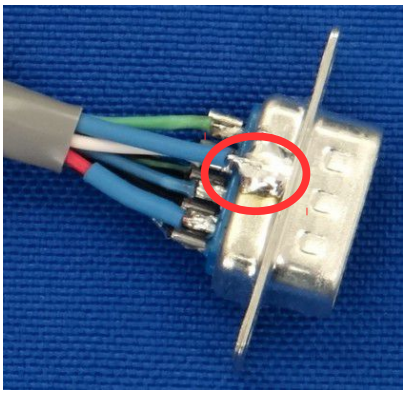


Figure 5.10.1
Cable shield ground attached using solder to the metal shield of the D-sub connector.

2. **Encoder Output:** Encoders must have RS422 type (differential) quadrature outputs with A, B, and Z channels to work with the MPU11. The outputs have voltage level requirements described in the table below:

Characteristic	Minimum	Typical	Maximum	Unit
Encoder channel low level	0.0	0.3	0.5	V
Encoder channel high level	3.0	3.5	5.0	V

3. **Wiring Code:** Wire the encoder according to the figure 5.10.2 and the table shown below. Refer to the encoder manufacturers data sheet for the wiring color code.

   Note: If the encoder is already powered by the third party drive, connecting the **5V** and **COM** on the MPU11 side is unnecessary.

Pin	Quadrature
1	Not used
2	Common (ground)
3	Z-
4	A-
5	B-
6	Z+
7	A+
8	B+
9	+5V

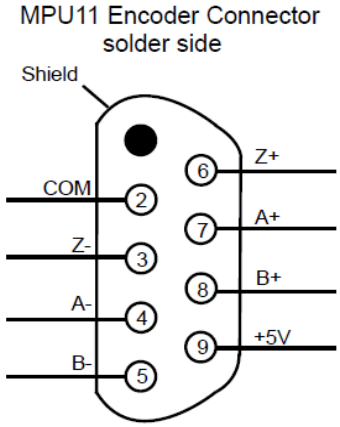


Figure 5.10.2
Hooking Encoders to the MPU11

4. Plug In Encoder: Plug encoders into MPU11 board where it is labeled **Encoder 1, 2, 3...**

The encoders should correspond to which axis it's motor is connected to.

Refer to Figure 5.10.3

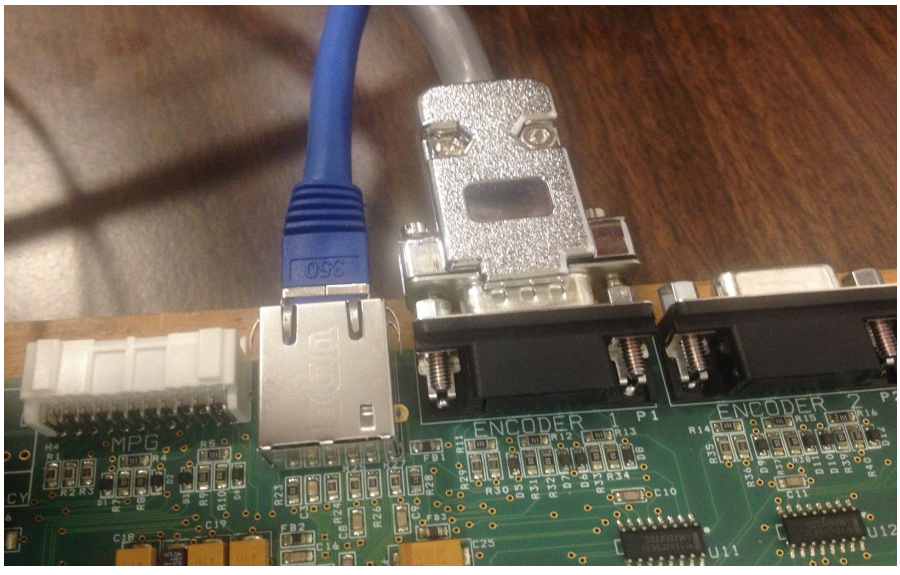


Figure 5.10.3
Hooking Encoders to the MPU11

Enabling Third Party Drives:

The GPIO4D provides an “active low” enable to 3rd party Servo amplifiers. This means when the GPIO4D enables an axis, the enable output on the GPIO4D will be the voltage of 5VCOM. If your third party drive uses an active low enable (sometimes referred to as the “**servo-On**” or “**S-On**” signal) wire as shown in Figure 5.10.4 then continue to the next page.

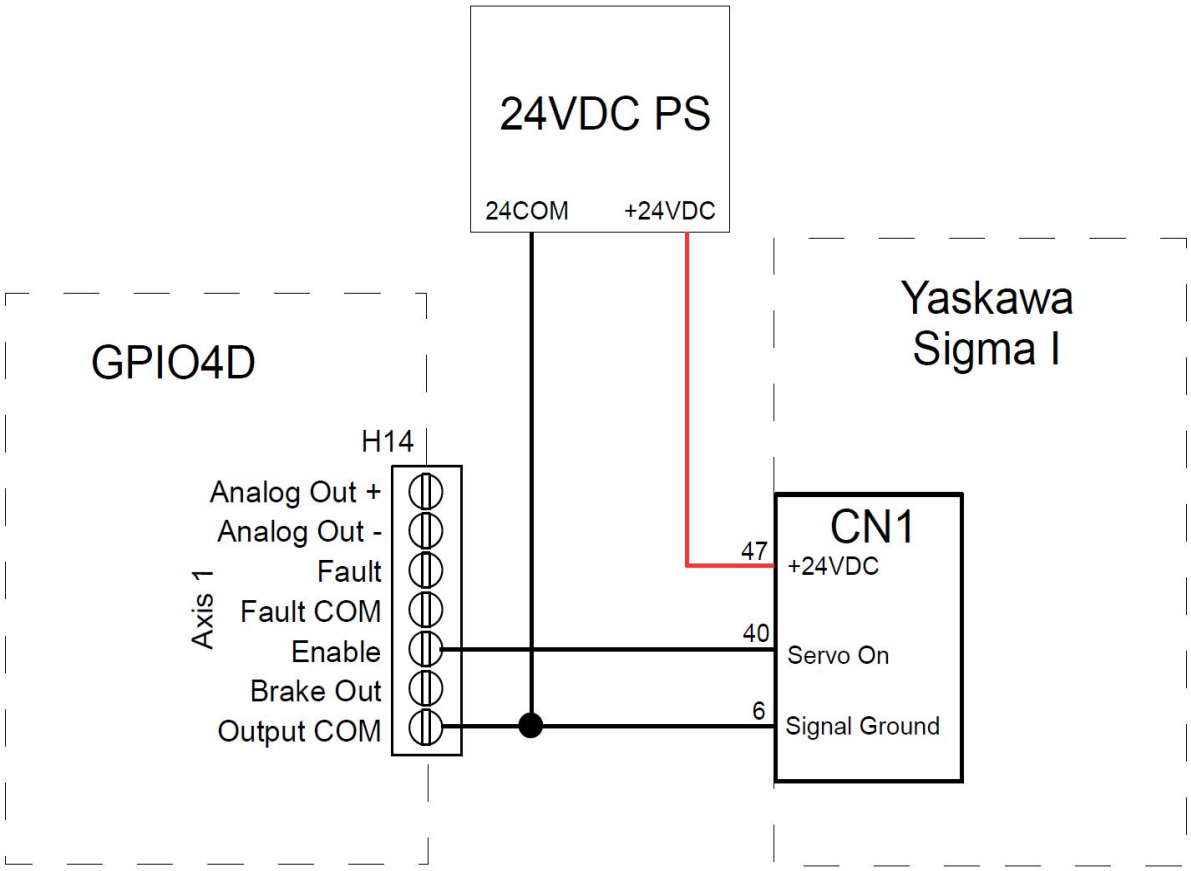


Figure 5.10.4
Example Setup for Enabling Third Party Drives

Wiring GPIO4D External Drive Fault Input:

Third party servo drive controllers have a relay that opens when an error occurs. The name of this relay differs from manufacturer to manufacturer, but it is typically referred to as "**alarm**", "**error**" or "**fault**". The output of this relay needs to be wired to the "**Fault**" input of the GPIOD, so that the Centroid software can stop the machine.

The voltage difference between the Fault and Fault Com needed to close the input is set by the SIP as described in section 5.2. Remember to take "sinking" and "sourcing" into account.

If, for example, a sinking application is used, "Fault COM" is connected to 5V, and "Fault" needs to be connected to 0V.

A sourcing application is shown in figure 5.10.5

Failure to install the proper SIPs to match the voltage levels being used on the Fault inputs on axes 1-4 will damage the GPIO4D.

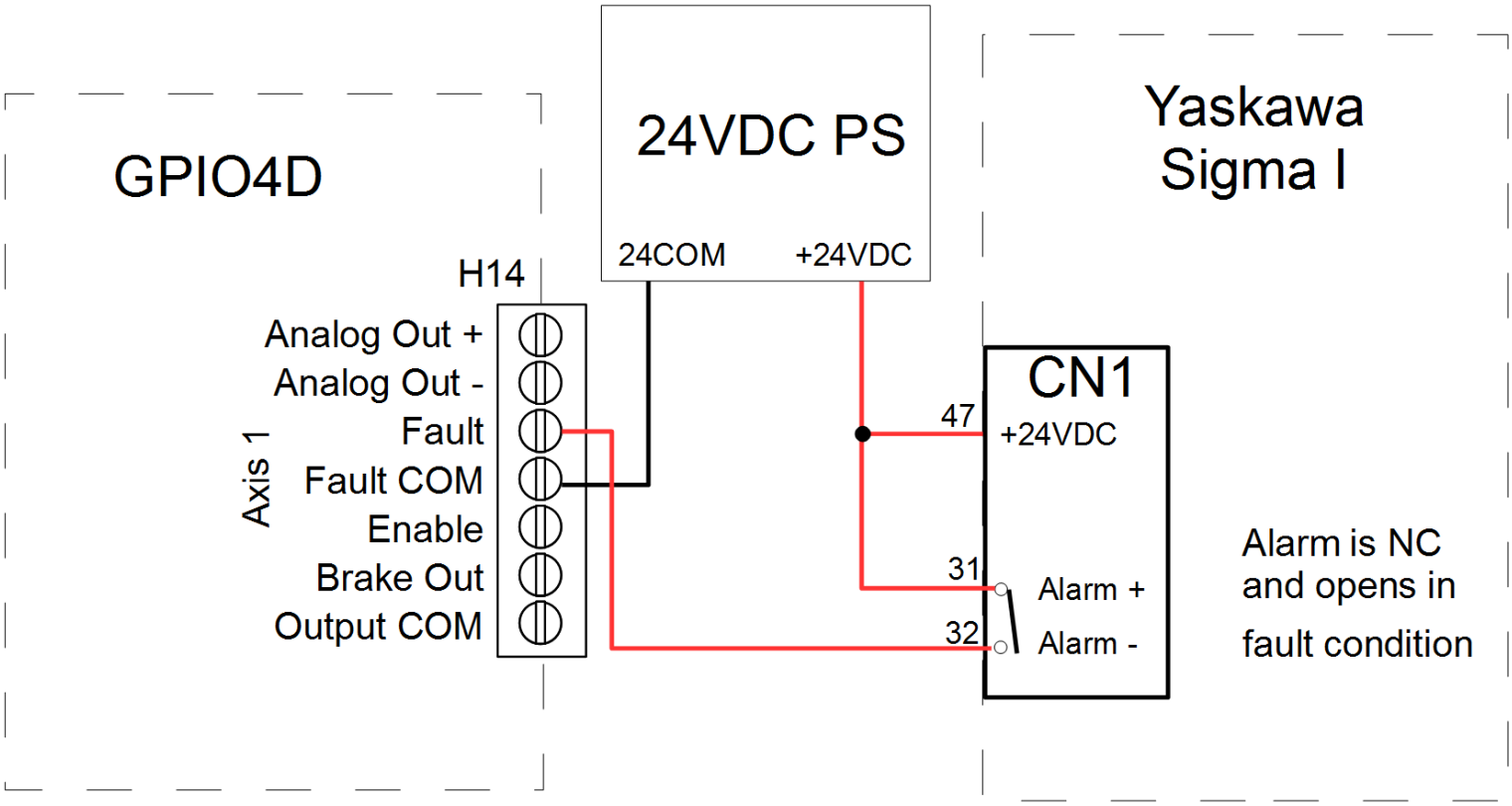


Figure 5.10.5
Example Setup of Drive Fault/Alarm Relay
(Sourcing application)

Wiring GPIO4D Analog Control Voltage :

A shielded twisted pair is required for the analog output connection. On the twisted pair cable, connect one end to "**Analog Out +"** and the other end to "**Analog Out -"**. Connect the analog output of the GPIO4D to the analog input of the third party drive. The "**analog out –**" is not an output, but actually the **analog ground** or "**AGND**".

Different third party drives use different names to refer to the analog input. It may be refereed to as the "**velocity**", "**speed**", or "**analog**" input "**reference**" or "**instruction**".

Grounding of the shield is very important. The shield should be grounded on **BOTH ENDS**.
On the GPIO4D end, all the shields should be on "**Output COM**".
The third party drive end should be grounded as recommenced by the third party drives documentation (not shown).

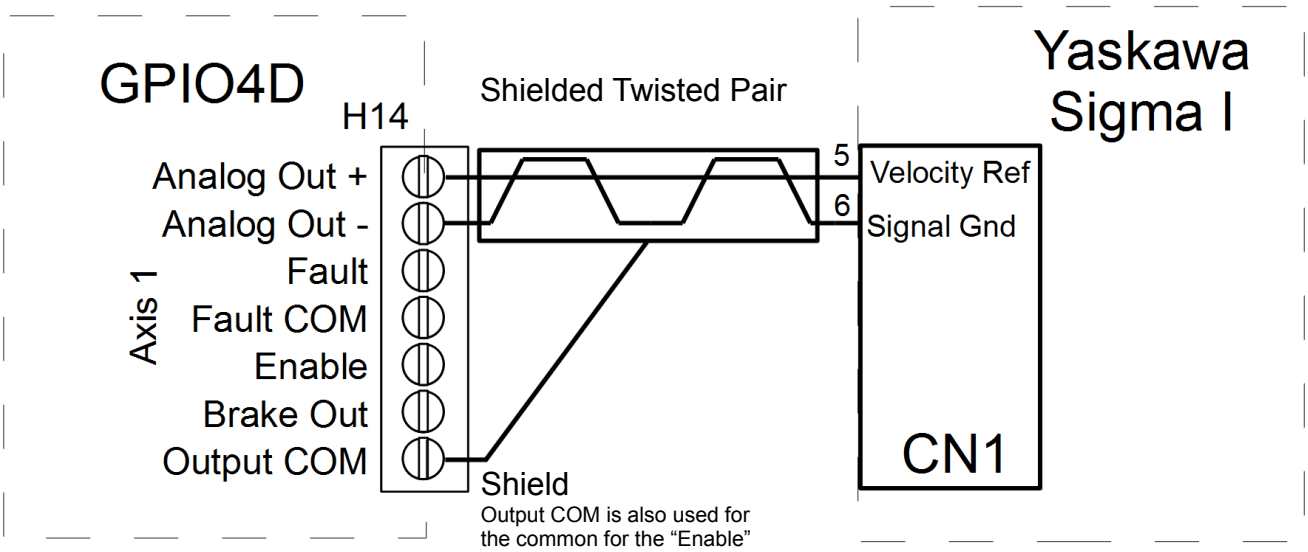


Figure 5.10.6
Example Setup for Wiring Analog Out
(shield ground on drvie not shown)

Alarm Reset:

If the third party drive has an "**alarm reset**", "**error reset**", or "**fault reset**" it may be tied into input11 (E-stop) of the GPIO4D. Keep in mind that the E-stop is normally closed during operation. Wire it so that when the E-stop is pressed (opens) the faults will be reset.

Failure to install the proper SIPs to match the voltage levels being used on E-Stop input 11 will damage the GPIO4D.

Putting It All Together:

The figure below is an excerpt from a schematic showing how to wire the GPIO4D to a Yaskawa Drive.

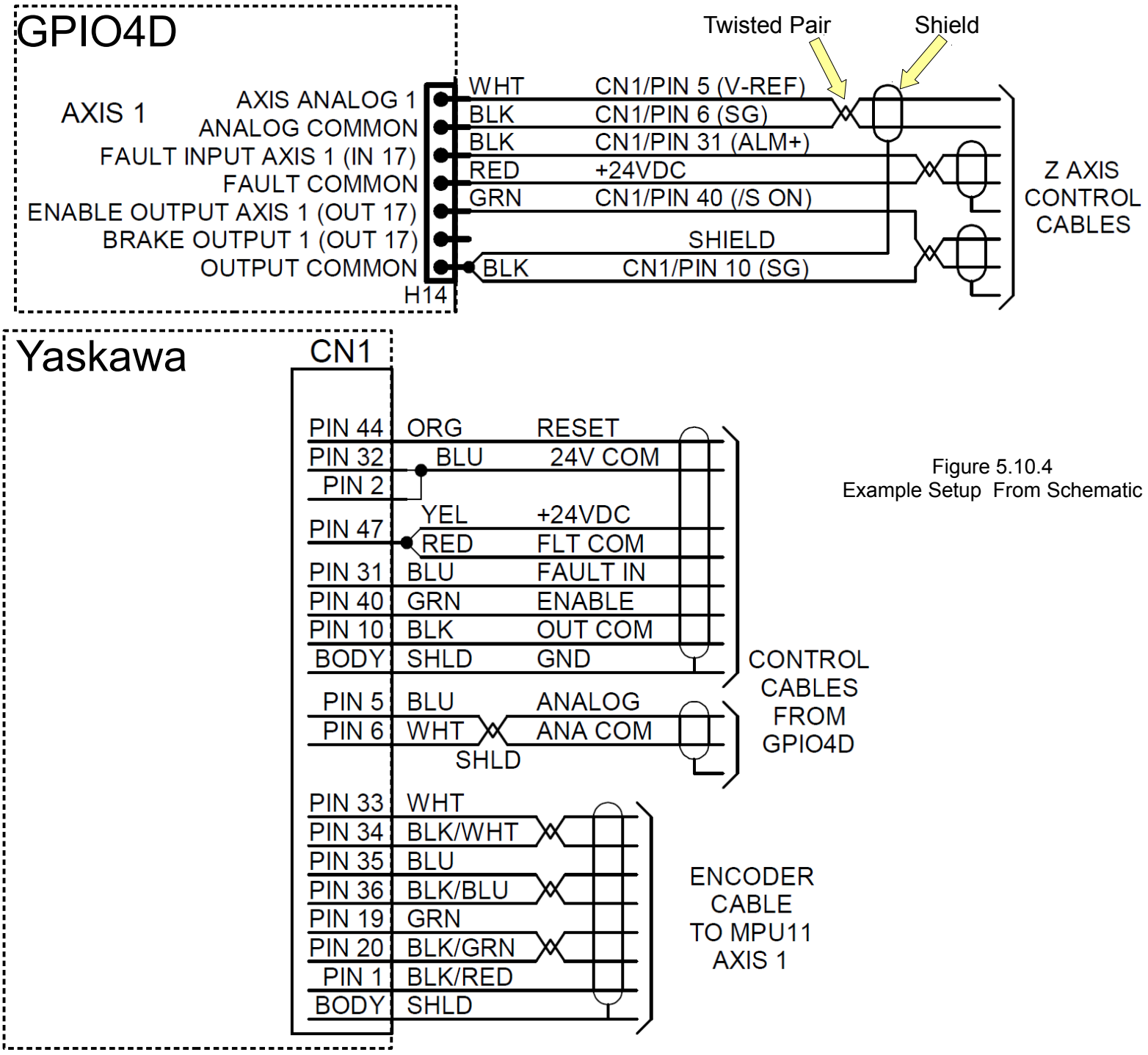


Figure 5.10.4
Example Setup From Schematic

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:

- 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: TB 234 (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/234.pdf)

You must have completed the bench test from section 4.

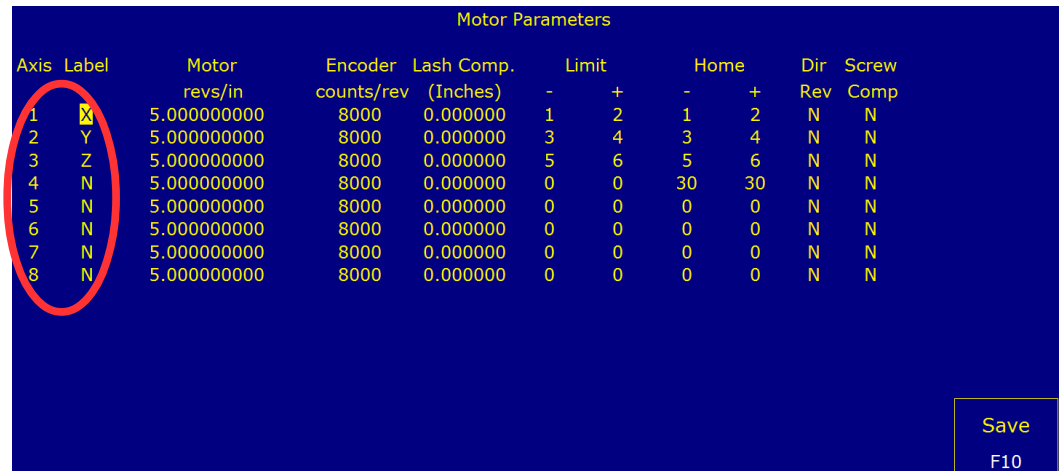
1. **Label the Axes:** From the main menu press **F1 Setup** → **F3 Config.** Password is **137**. Press **F2 Mach**. → **F2 Motor**.

   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 = 9 **301** = 10 **302** = 11 **303** = 12
   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 CNC11 Operator's manual for more information about these parameters.

   If you have a spindle encoder: be sure it is plugged into the Encoder 6 header on the board
   Parameter **313** = 6
   Parameter **35** = 6 (not shown in figure)

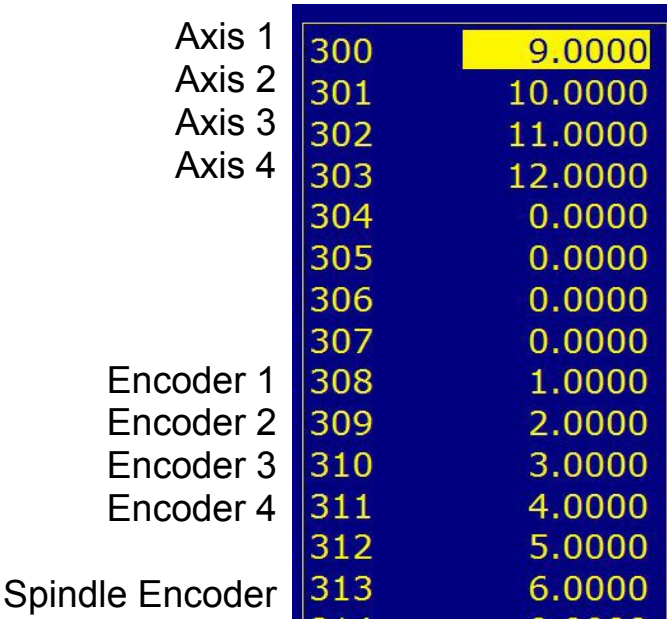


Figure 6.1.2
Setting up the Drive Output
and Encoders

3. Set Velociity Mode:

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

2) Set parameter **256 to 1**.

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

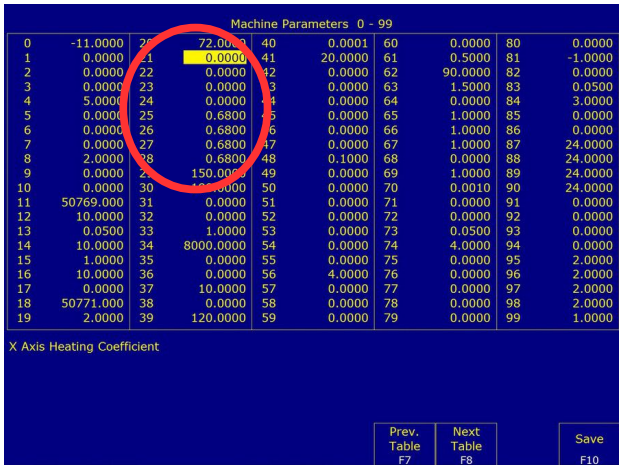
Go to the parameters menu. (From the main menu press **F1 Setup** → **F3 Config.** Password **137**. Press **F3 Parms.**)

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



5. **Enabling your drive fault inputs:**
   1) From the main screen, press the **alt** and **i** keys simultaneously to bring up the Realtime I/O display.

   2) Select input 17 and press **ctrl**, **alt** and **i** simultaneously to remove the bar over the input in the display.

   3) Repeat for inputs 17-20, removing the bars.

6. **Testing Drive Fault Inputs:**

   If your Drive Fault inputs are wired correctly, inputs 17-20 should be green. If any are not, either your drive is reporting a fault or the drive fault input for that axis is wired incorrectly.

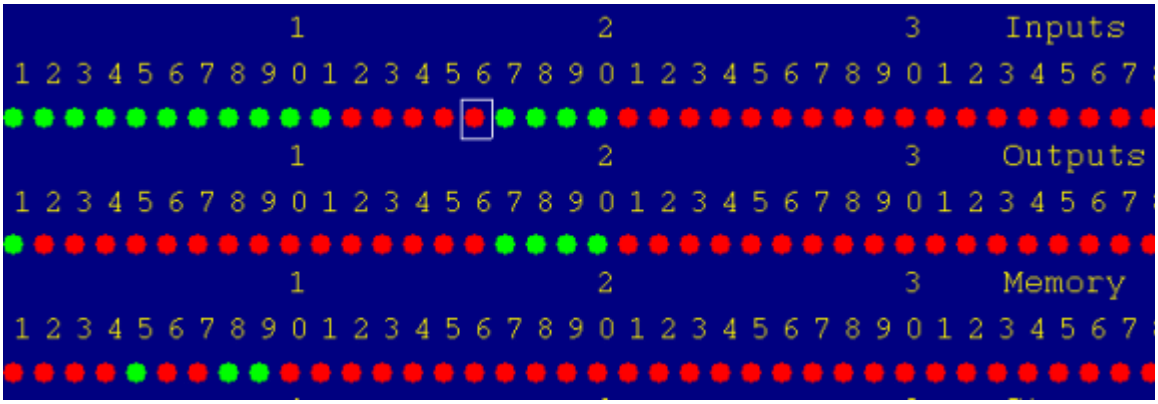


Figure 6.1.4
Drive faults inputs 17-20

6.2 Confirm Encoder Communication

This section assumed encoders are already set up, which was done during section 4.1.

1. **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.

    4. Confirm that the absolute position increases for while rotating the shaft counter clockwise as shown below in Figures 6.2.1 and 6.2.2.

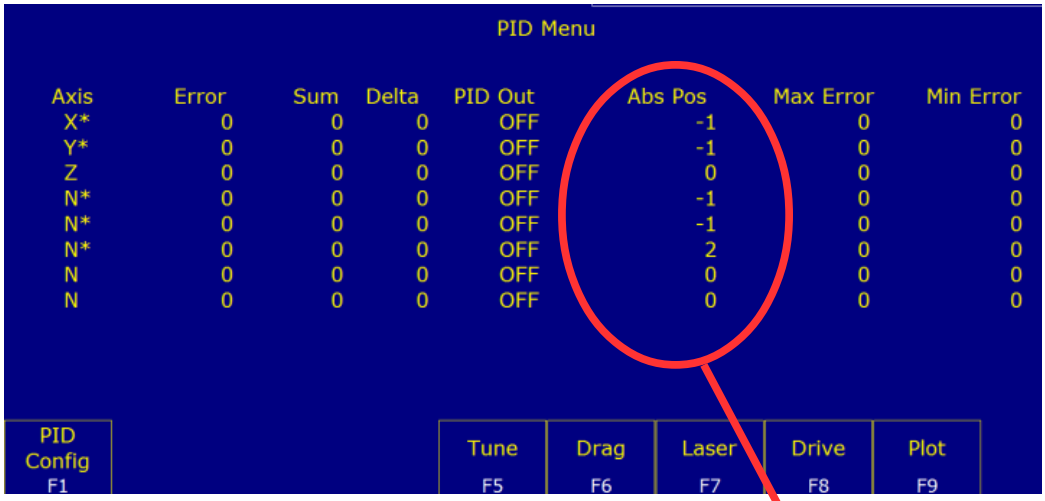


Figure 6.2.1
Watching the “Abs Pos” field

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

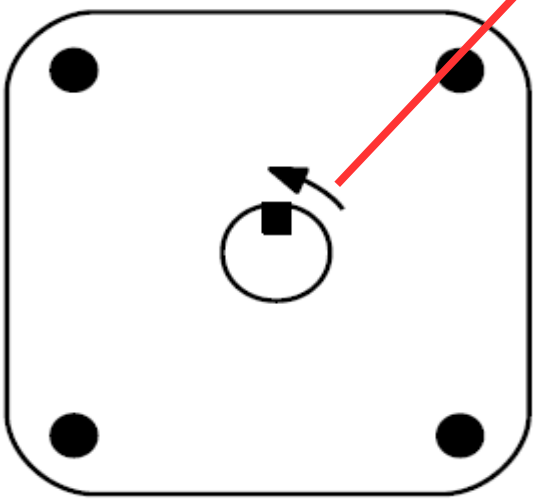


Figure 6.2.2
Motor Faceplate

6.3 Clearing Software Faults

The PID settings and appropriate CNC11 parameters for the MPU11 need to be entered into the software as described in section 4.1.

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.

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 J**og**.

   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.

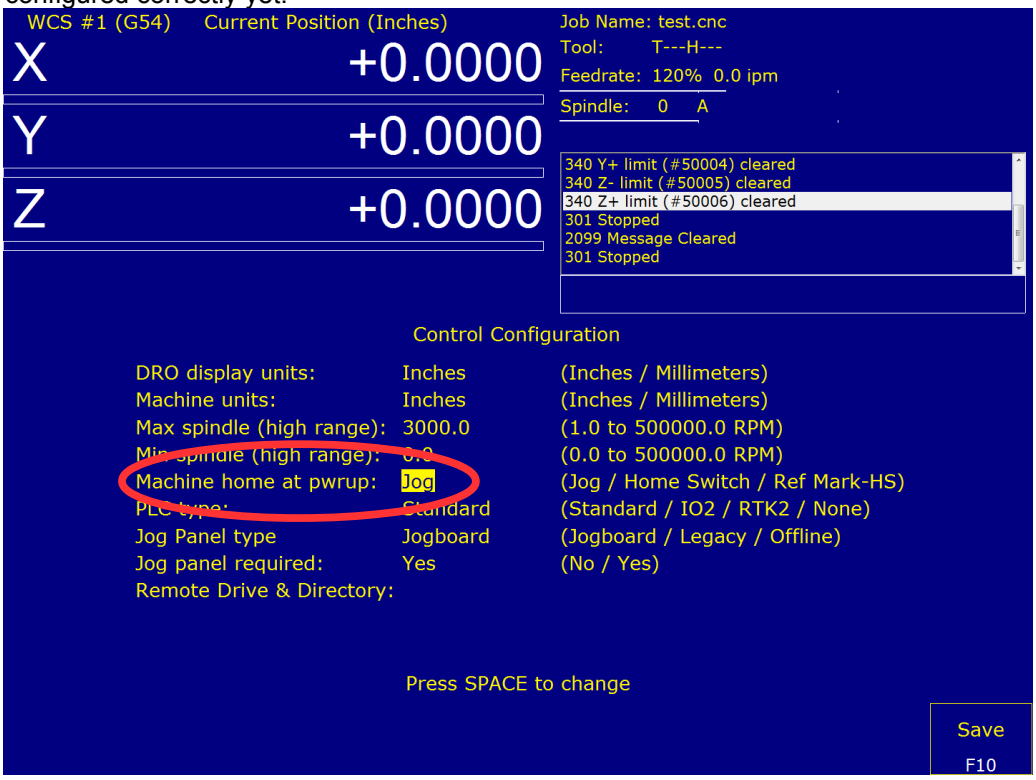


Figure 6.4.1 Checking home configuration

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.

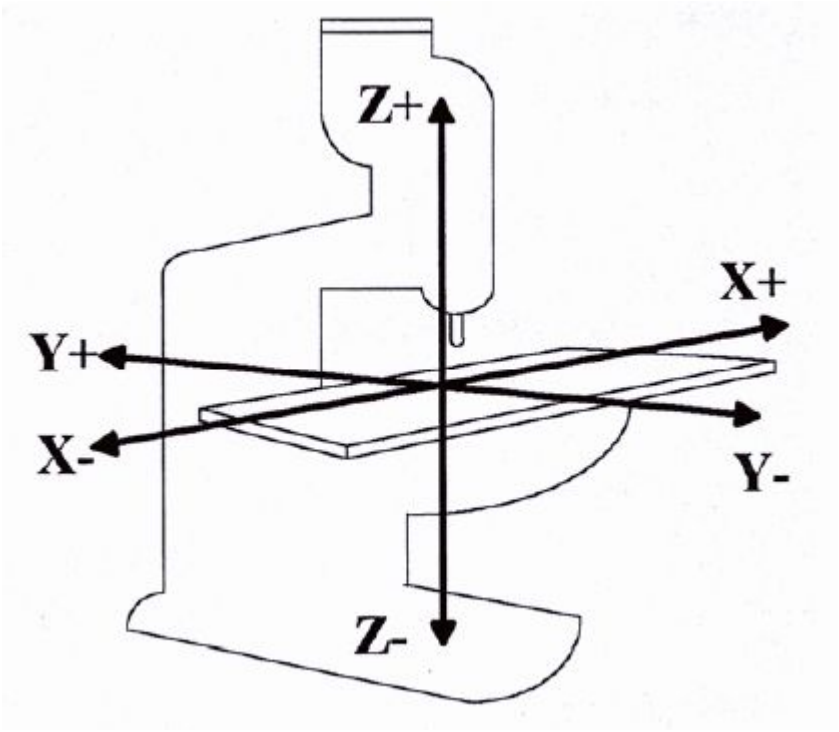
   See Appendix A: Motor Behaving Unexpectedly for troubleshooting help.

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.



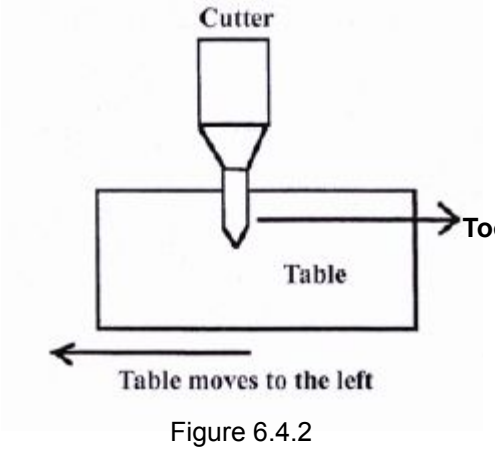


Figure 6.4.2
Table verses tool movement

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.

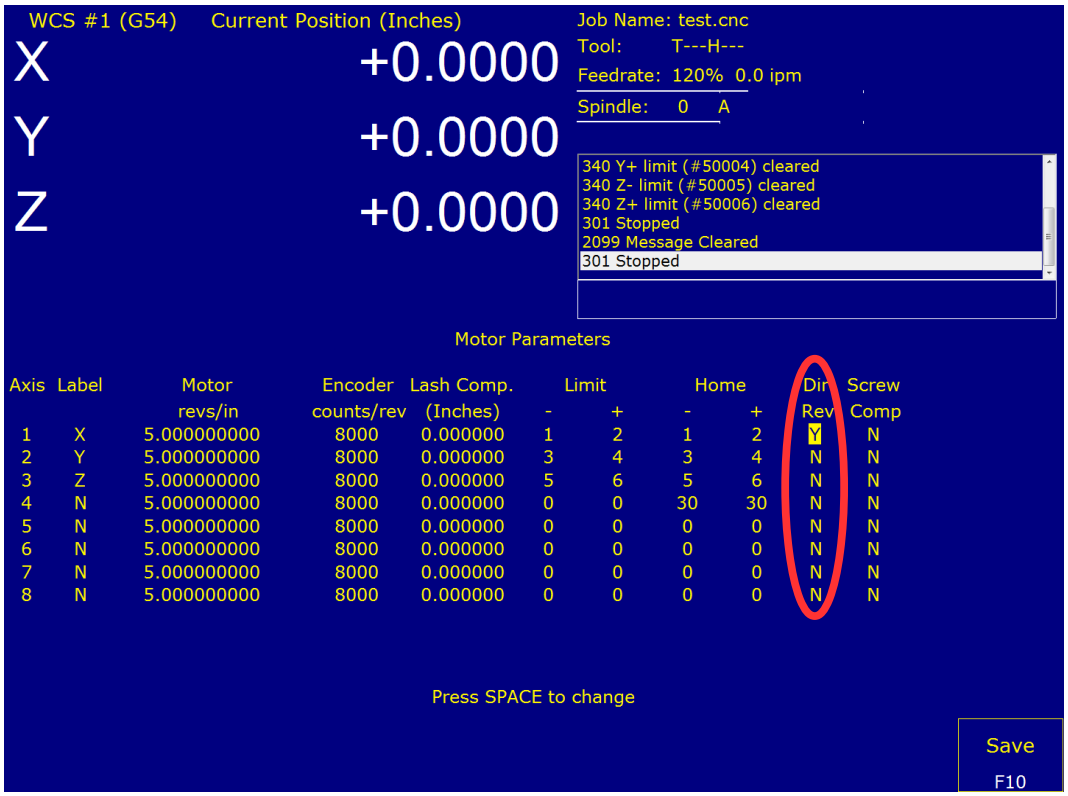


Figure 6.4.3
Direction reversal

6.5 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 6.5.1. The screen to enter the corrected values is shown in figure 6.5.2, from the main screen press **F1 Setup** → **F3 Config.** Password **137**. **F2 Mach.** → **F2 Motor**.

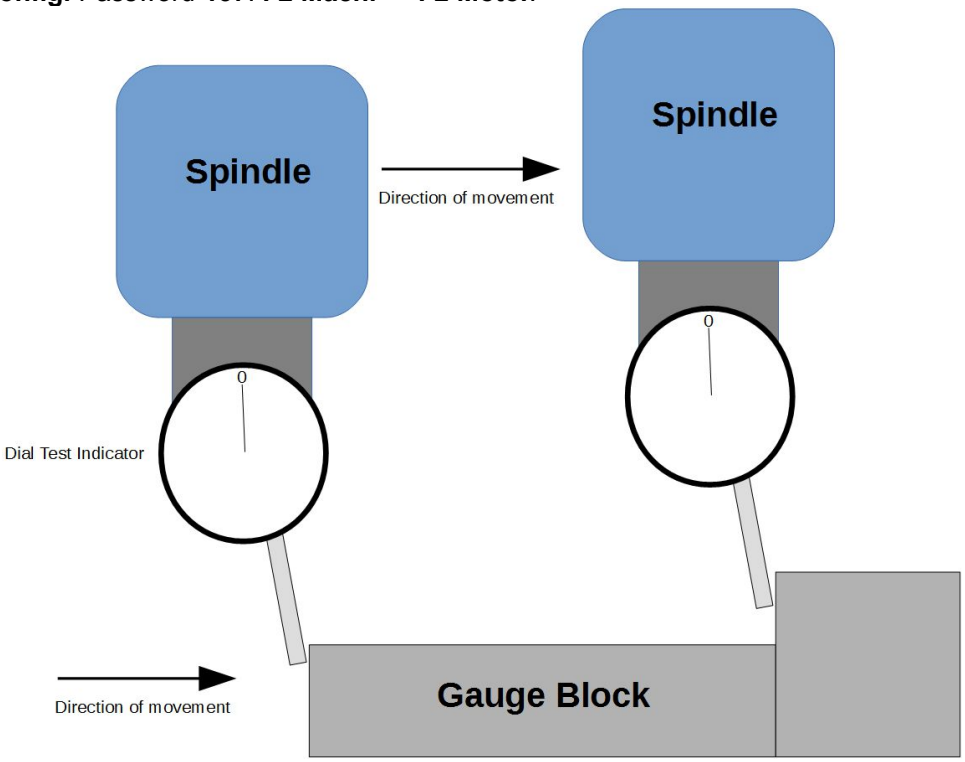


Figure 6.5.1
Test Procedure

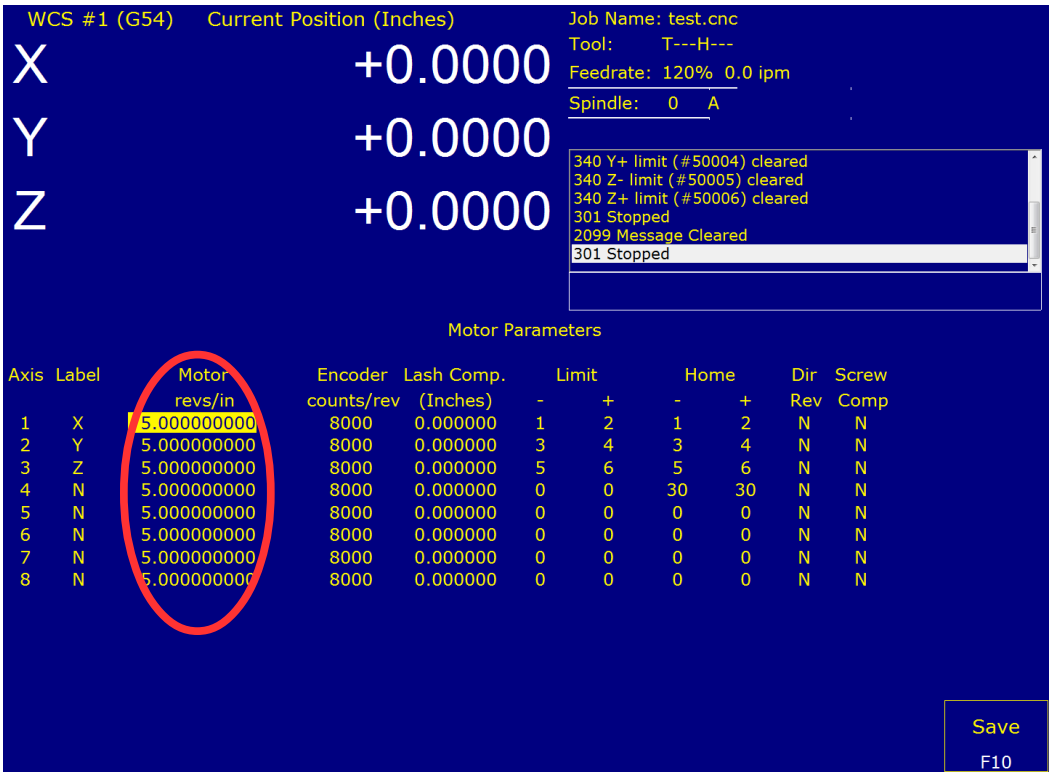


Figure 6.5.2
Fine adjustment of motor revs/in or mm's/rev

6.6 Homing the Machine

1. **Configure Limit Switches:**

   Note: More information on Limit switches can be found in Technical Bulletin 127, which can be found here. (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)

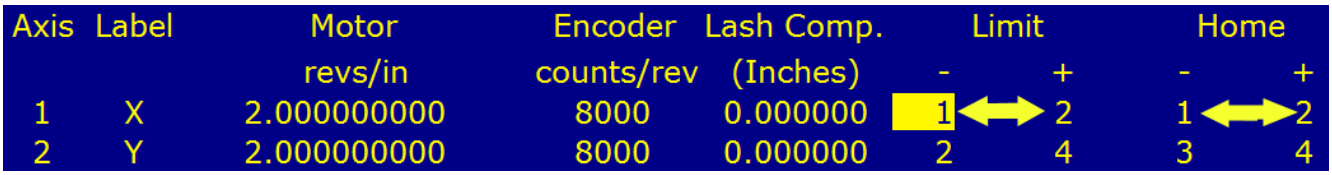


Figure 6.6.1
Reversing limit switches in software

   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**.

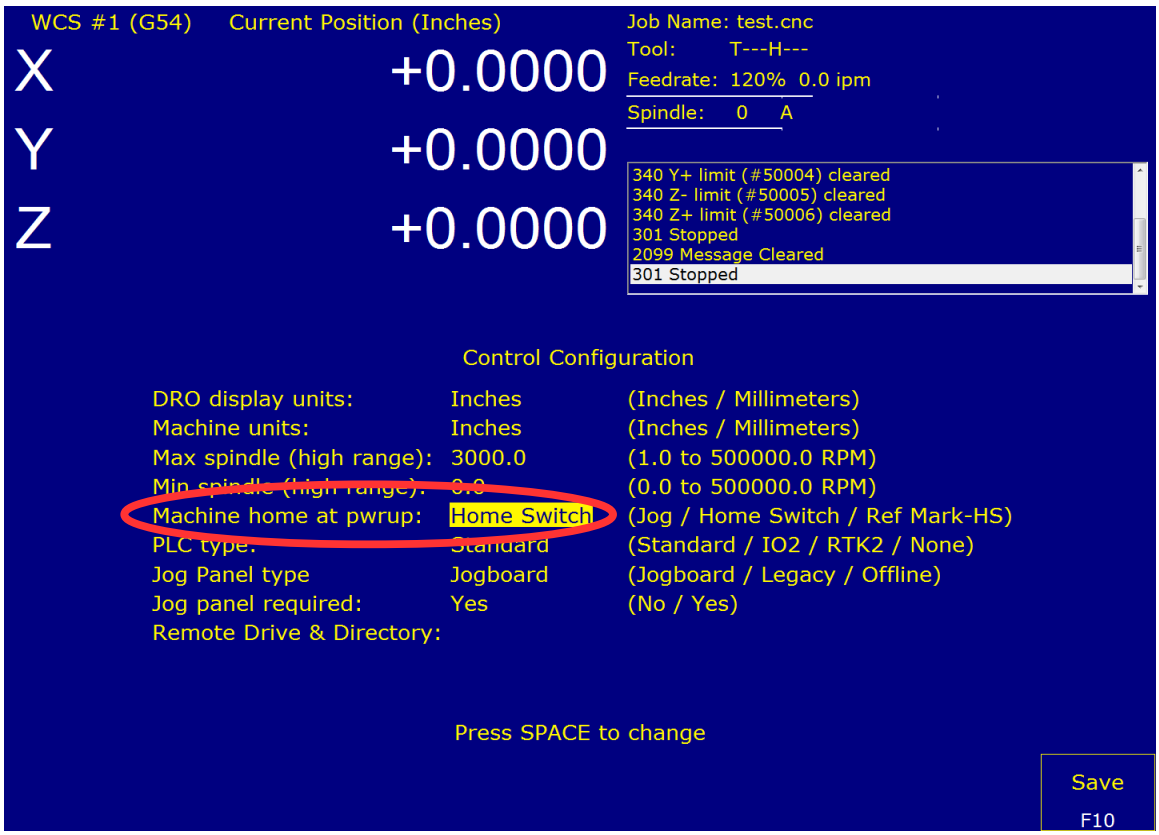


Figure 6.6.2
Enabling Homing

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.

6.7 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.**

Follow the tuning guide in Tech Bulletin 234. (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**.

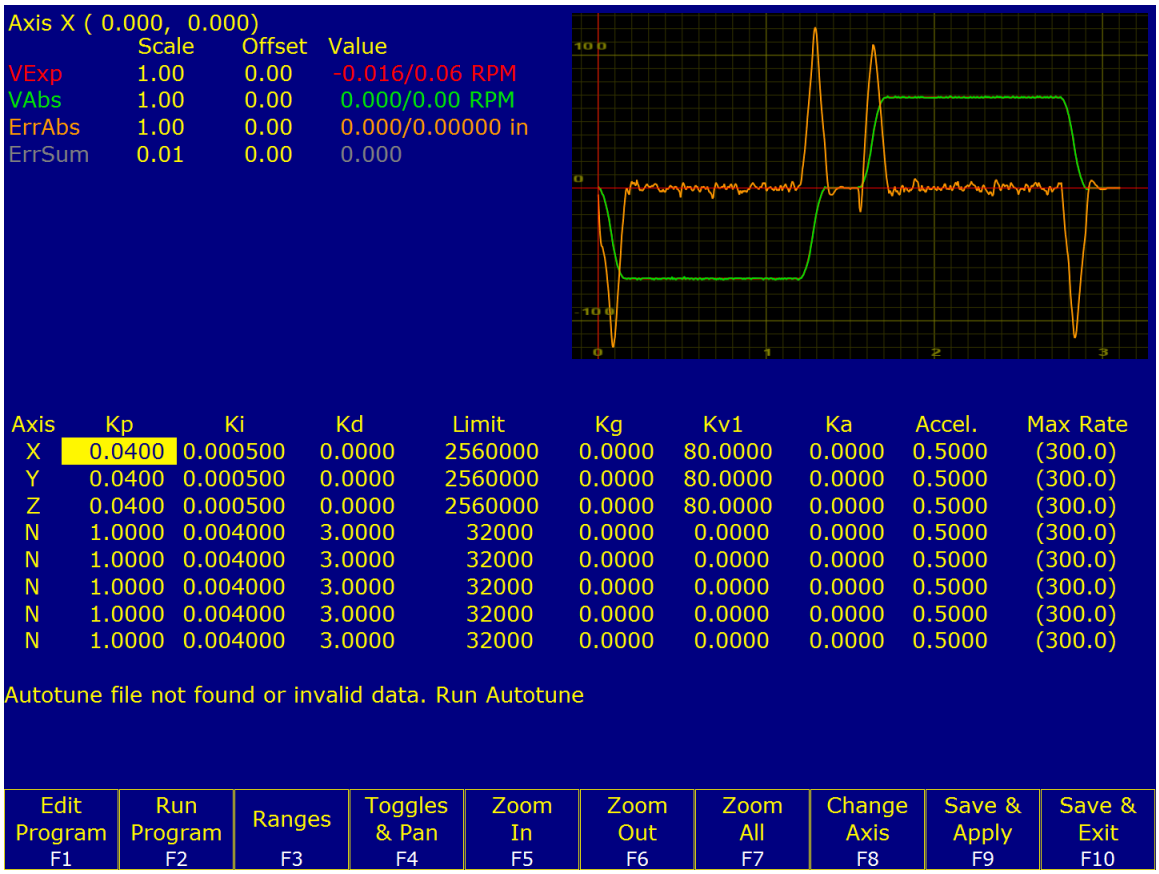


Figure 6.7.1
PID Configuration Screen

6.8 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**.

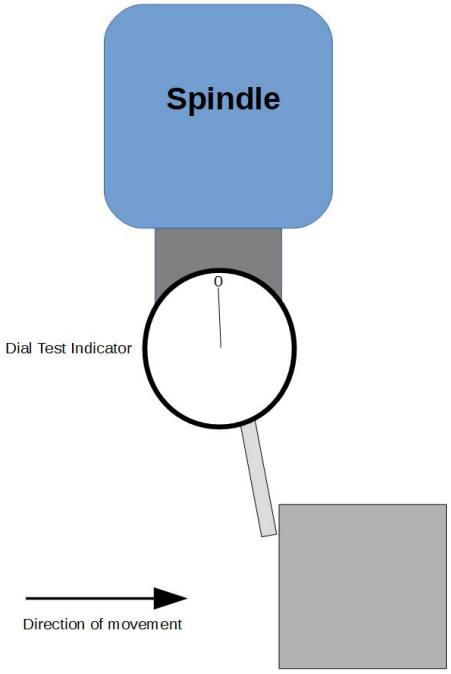


Figure 6.8.1
Backlash
Compensaton

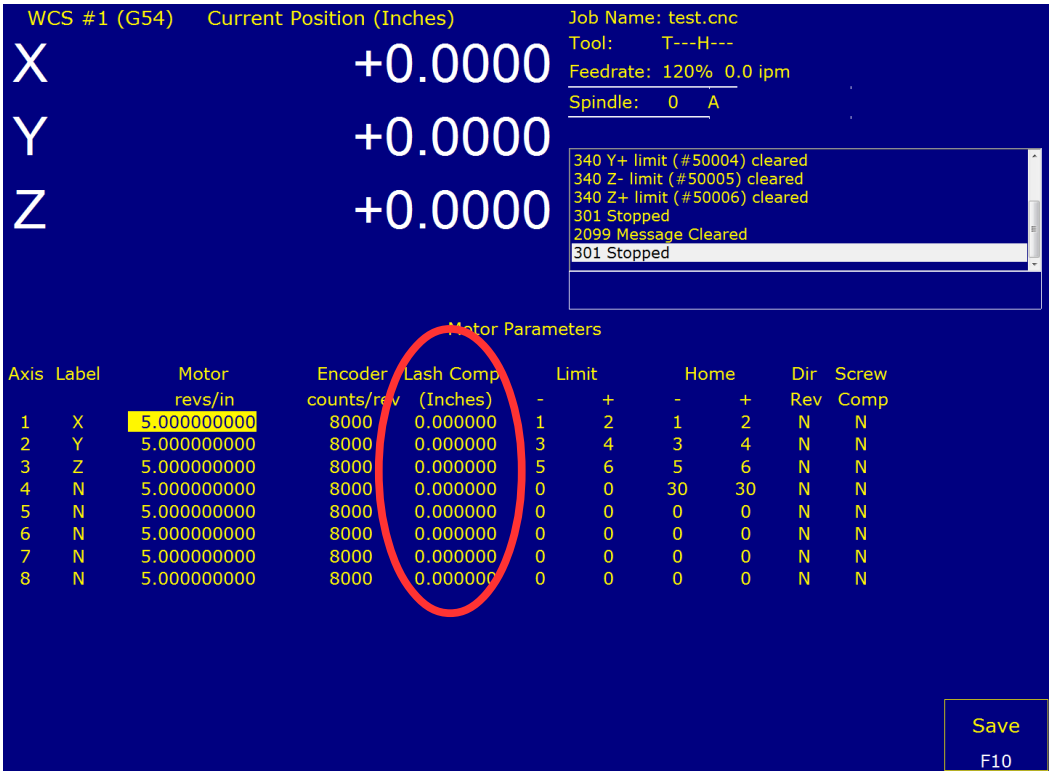


Figure 6.8.2
Entering Backlash
Compensaton

6.9 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 6.9.1.

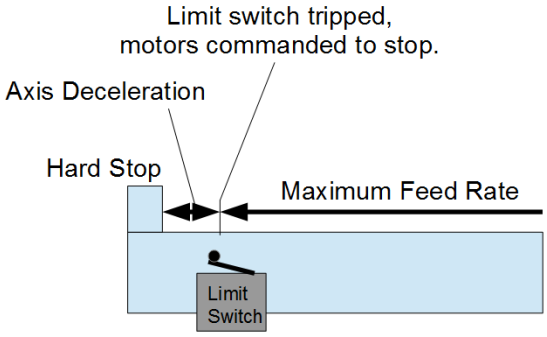


Figure 6.9.1
Machine without software travel limits.

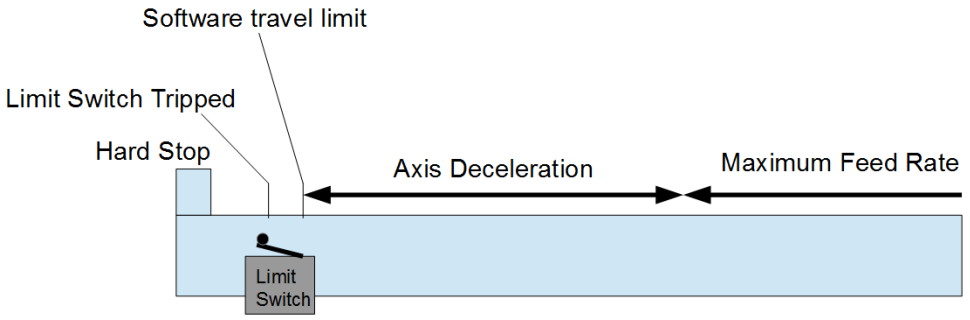


Figure 6.9.2
Machine with software travel limits.

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 6.9.3.

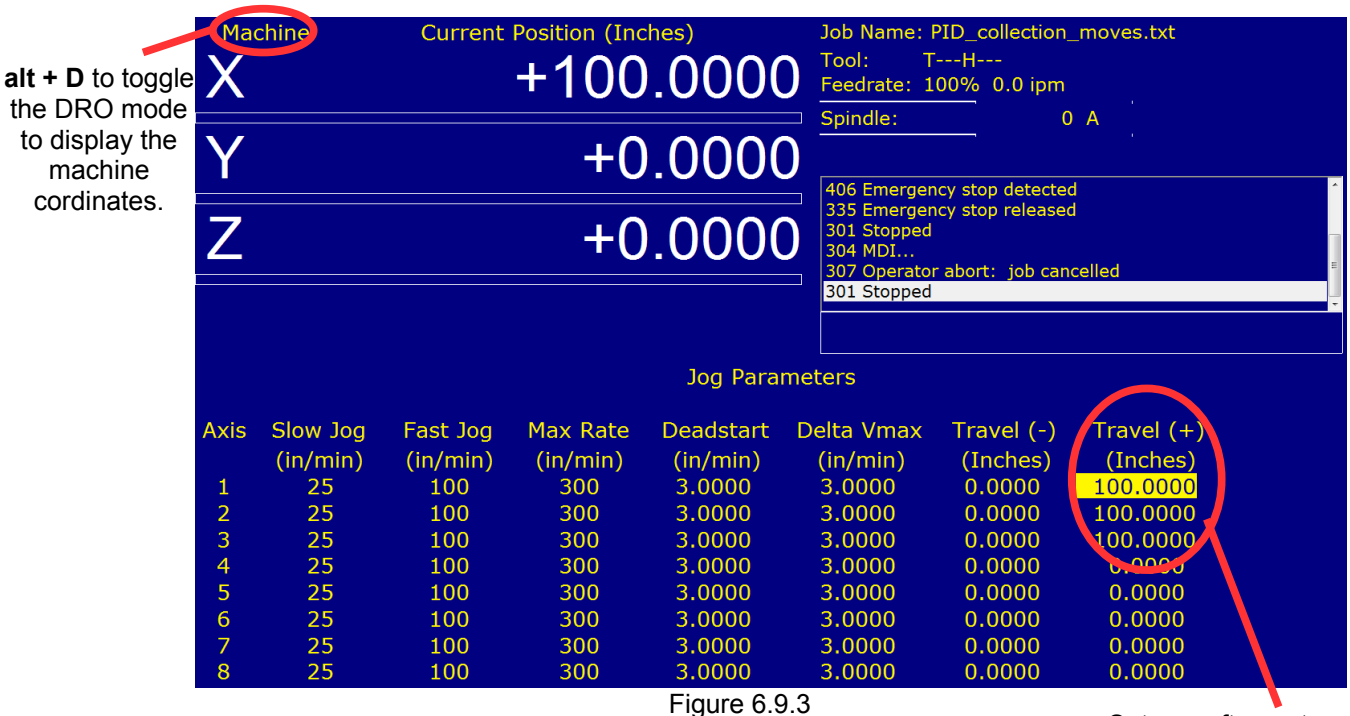


Figure 6.9.3
Setting Software Travel Limits

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 CNC11 status window throws an error such as **907 # axis travel exceeded, 325 Limit: job canceled**

6.10 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:
(http://www.ajaxcnc.com/tech/downloads/manuals/install/Systemtest.pdf)

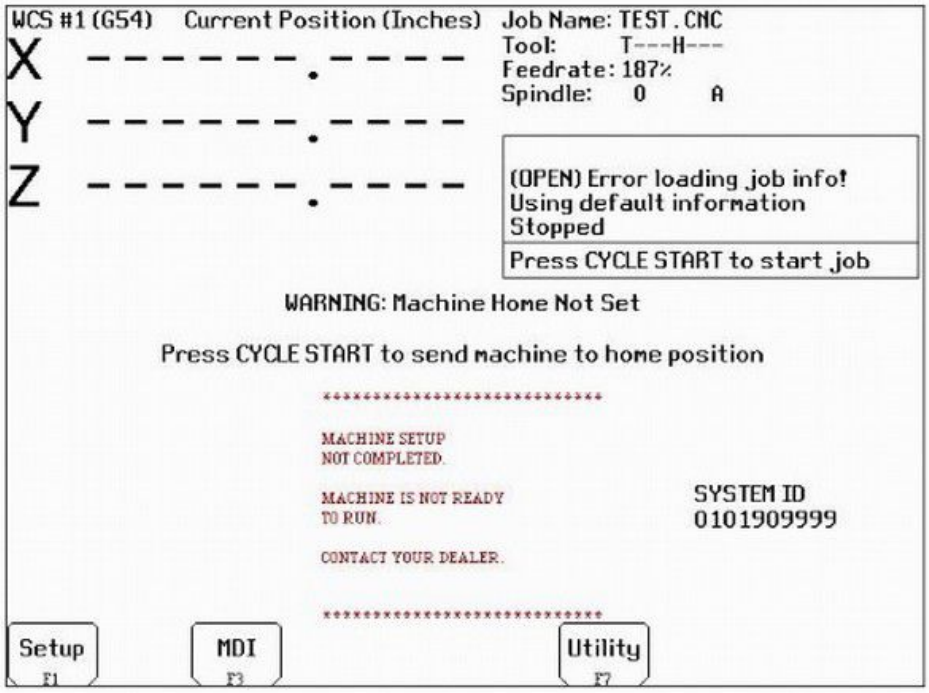


Figure 6.10.1
Machine Requiring a System Test

6.11 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**

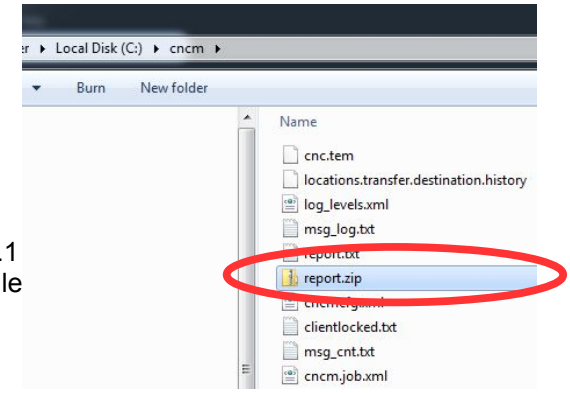
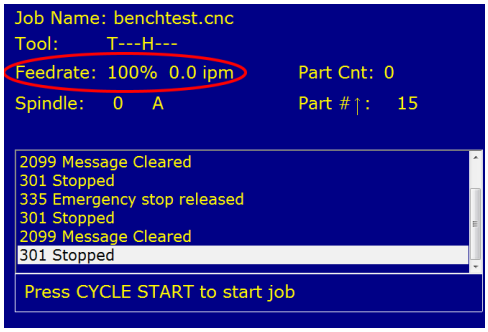


Figure 6.11.1
Report.zip file

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 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 MPU11 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 Motion, Position Errors and SV_STALL Errors	Problem with power to the motors and/or feedback from the encoder on the motor. If SV_STALL error is displayed, it is almost always caused by a previous error – such as full power without motion, position error, encoder error, drive fault etc. Refer to TB 26: (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/26.pdf)
Motor Behaving Unexpectedly	• 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 CNC11 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: Crimpers

Crimp Pin Part Number 5511 (Used for making jog panel and probe cables)

The appropriate hand crimpers are available from TE Connectivity as "*PRO-CRIMPER III Hand Tool Assembly 91387-1 with Die Assembly 91387-2 (26-22 AWG)*" or "*PRO-CRIMPER III Hand Tool Assembly 91388-1 with Die Assembly 91388-2 (22-18 AWG)*". These tools are sold separately and can be purchased from most major electronics components distributors such as Digi-Key.

Fully assembled cables for jog panels and probes can be bought through Centroid.

Crimp Pin Part Number 5983 (Used for making MPG cables)

The appropriate hand crimpers are available from JST as "YRS-245". These tools are sold separately and can be purchased from most major electronics components distributors such as Digi-Key.

Fully assembled cables MPG cables can bought through Centroid.

Appendix C: Custom PLC Program For Active High Drives

An example PLC program that performs this function is available here: gpio4d-basic-inv-en-v2.zip. (http://centroidcnc.com/usersupport/support_files/plc_examples/gpio4d-basic-inv-en-v2.zip)

Always make a report before changing the PLC program. A report allows you to restore your software to a previous point in case something goes wrong. A report can be made by pressing:

- **F7 Utility → F7 Create Report**.
- Using the arrow and enter keys, select a location on your computer.
- Press **F8 New Directory**, and come up with a descriptive name.
- Use the arrow keys and the enter key to select the directory you just made.
- Press **F10 Accept** to generate the report.

In the event that you want to restore a previous report press **F7 Utility → F2 Restore Report**. You will need to completely restart the system after restoring a report.

To use “gpio4d-basic-inve-en-v2.zip” copy the files in this zip file to c:\cncm for mills or c:\cnct for lathes.

In the PLC programming code, the enables are the following relay outputs: X axis enable = OUT13, Y axis enable = OUT14, Z axis enable = OUT15.