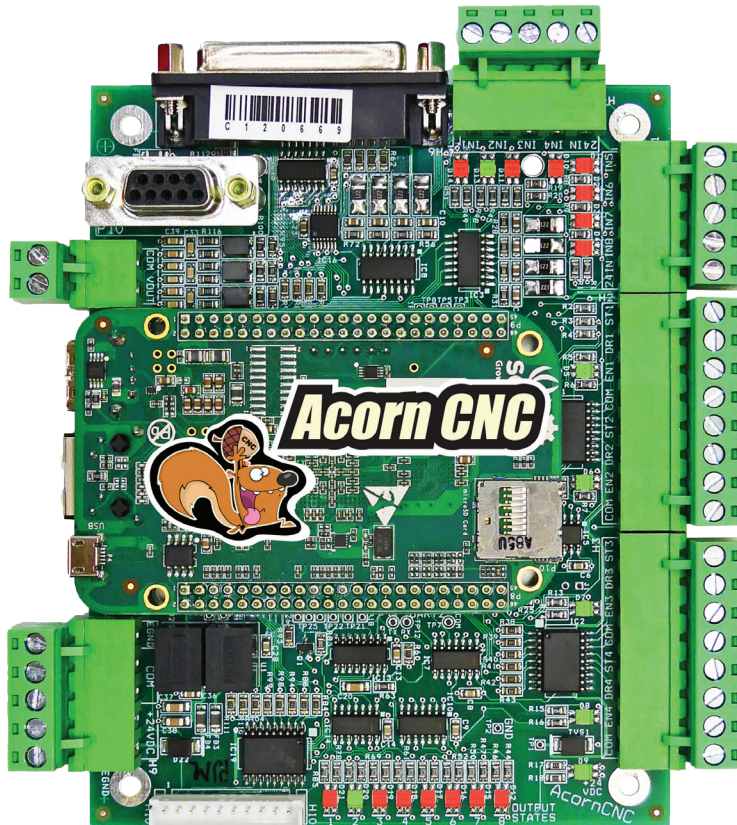




Centroid AcornCNC Installation Manual

CNC Software version: CNC12 V.4.64+

Models: AcornCNC



Acorn CNC Control Kit	6
Bench Test Hardware setup	7
Windows 10 config for CNC use	9
Acorn Communications Bench Testing	11
Spindle Bench Testing Procedure	19
Electrical Cabinet Layout	24
Axis Motor Wiring	36
Acorn CNC configuration Wizard	45
Machine Motion Tuning	75
Appendix A: Windows 10	89
Appendix B: Troubleshooting	90
Appendix C: CNC Support	93
Appendix D: Acorn Specifications	94

WARRANTY DOES NOT COVER DAMAGE BY FAULTY WIRING OR INSTALLATION.

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

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

Acorn Warranty details are here.

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

Basic Safety Procedures and Best Practices



Motor Safety and Handling

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.

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

Be sure to use a key when the motor has a keyed shaft. Review good coupling practices as motor shaft breakage can result if over tightened or misaligned.

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° and 40° C.

Do not remove the nameplate from a motor.

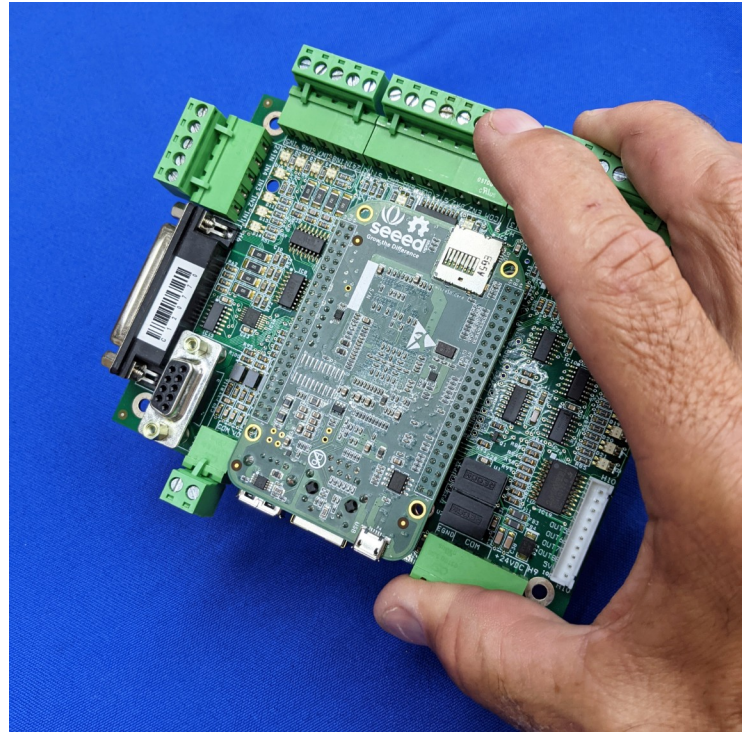
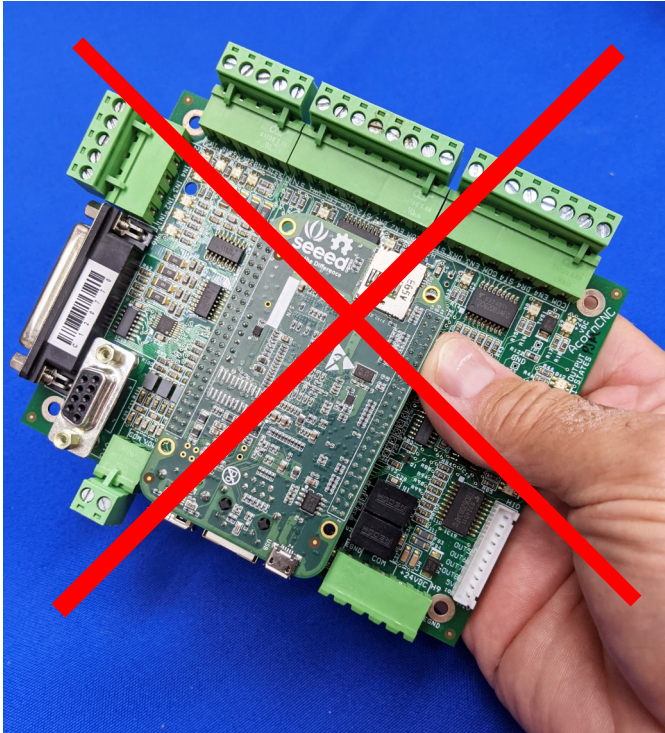
Circuit Board Safety and Handling

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

Never work on a metal or electrically conductive surface.

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

Circuit board handling procedures



Document the CNC control system installation.

It is highly recommended that you document the components used in the CNC control system. Once parts are installed you may not be able to read the nameplates or identification markings on the part(s).

It is recommended to:

- Photograph motor nameplates
- Photograph controllers and circuit boards (especially Model, Revision and Serial)
- Download and save individual component manuals and related documentation for all parts used for future reference
- Keep a log of the various switch/jumper settings and electronic configurations
- Use a labeler to mark any relays or modules
- Create and/or update an existing schematic
- Save the CNC control configuration using the “Create Report” feature in CNC12 after every configuration change.

About This Manual

This manual describes how to install the Centroid CNC Acorn Step and Direction Motion Controller. The Acorn system provides up to four axes of step and direction interpolated motion, controlled by industry standard G and M Codes.

Acorn can be used for the CNC control of milling machines, routers, lathes, engravers, flame cutters, plasma cutters, laser cutters, water jet cutters, drill presses, grinders, and other specialized applications using most any step and direction axis motors and drives.

This installation manual covers the common Acorn hardware setups. For the rest of this manual, we will assume the installation is for a three-axis cnc milling machine the techniques and settings apply to Lathes, Routers and other machines as well.

Document Conventions

Please note the following conventions used in this document:

- **Key Combinations:** At various steps along the way you will be instructed to hold down a key (the “Alt” or “Control” key for instance) and press another key such as S or I without lifting your finger from the first key. The convention in this document to indicate this will be alt+i, ctrl+s for ctrl+alt+i for example.

Before You Begin

Before getting started, please take the time to read this document and familiarize yourself with the schematics, manuals, and [all Acorn documentation which can be found here](#):

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

Accompanying Acorn CNC Controller Requirements and Installation Videos:

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

Useful Technical Resources

All Acorn Documentation links <https://centroidcncforum.com/viewtopic.php?f=60&t=3397>

Acorn CNC Knowledge base Videos: <http://centroidcncforum.com/viewforum.php?f=61>

Acorn CNC Tech Tips Knowledge: <http://centroidcncforum.com/viewforum.php?f=63>

Centroid's YouTube Channel: Centroid CNC Technical Support

<https://www.youtube.com/user/CentroidSupport/videos>

Martyscncgarage YouTube video playlist: Centroid CNC Acorn Playlist <https://tinyurl.com/ascxfev4>

Free Centroid Community CNC Support Forum <https://centroidcncforum.com/viewforum.php?f=20>

Centroid Acorn and its CNC Accessories:

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

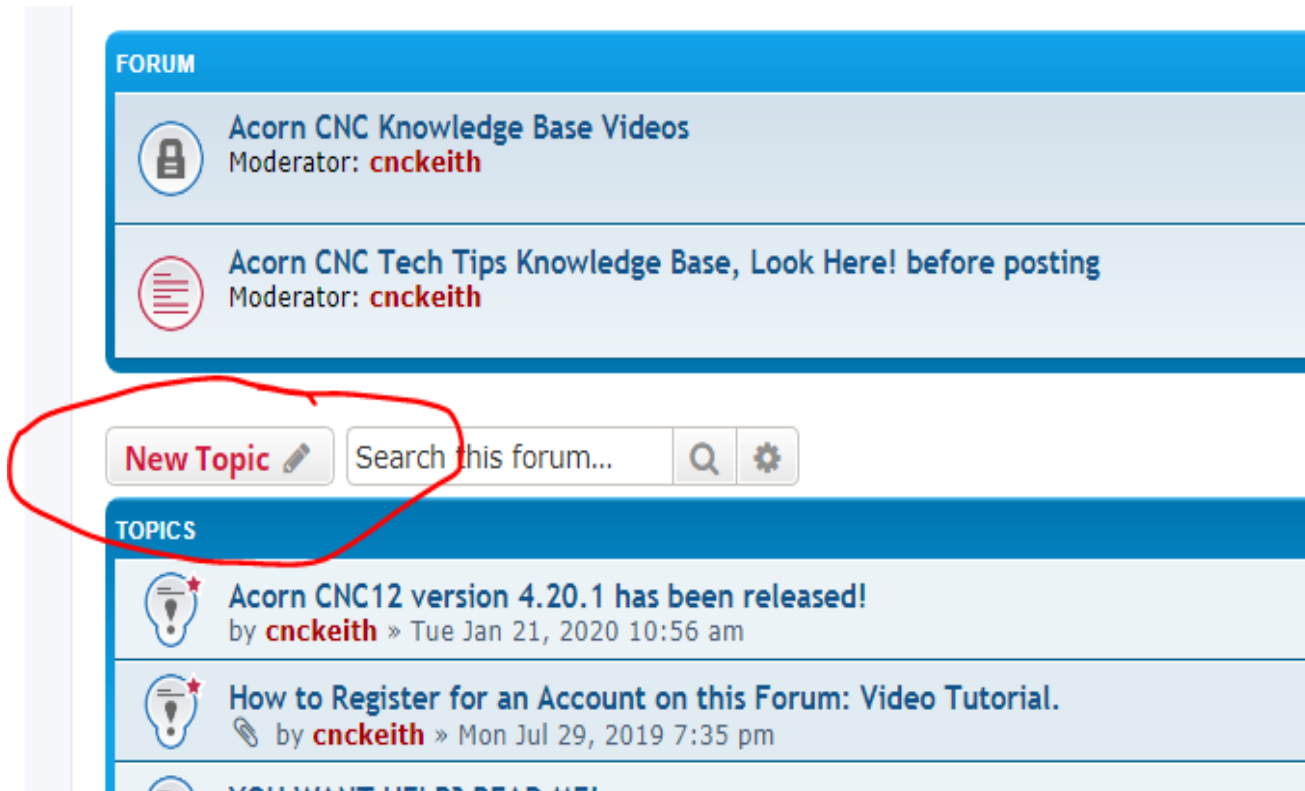
Centroid CNC Components: http://www.centroidcnc.com/centroid_diy/cnc_components.html

Where to find support

Sign up for free tech support here: <https://centroidcncforum.com/index.php>

How to find answers on the Tech Support Forum and Knowledge base.

- 1.) Review “Acorn CNC Knowledge Base Videos” and the “Acorn CNC Tech Tips Knowledge Base” before posting questions as almost every novice question has been answered here.
- 2.) Use Advanced Search to look for answers to your question in the main Acorn users forum.
- 3.) Post a specific question in the Acorn users forum, be sure to follow the [posting guidelines](#) so your question will get answered quickly. Post your question on the forum by clicking "new topic"



When you post to the forum, your question will be seen by many users. Possibly getting you more than one solution to your

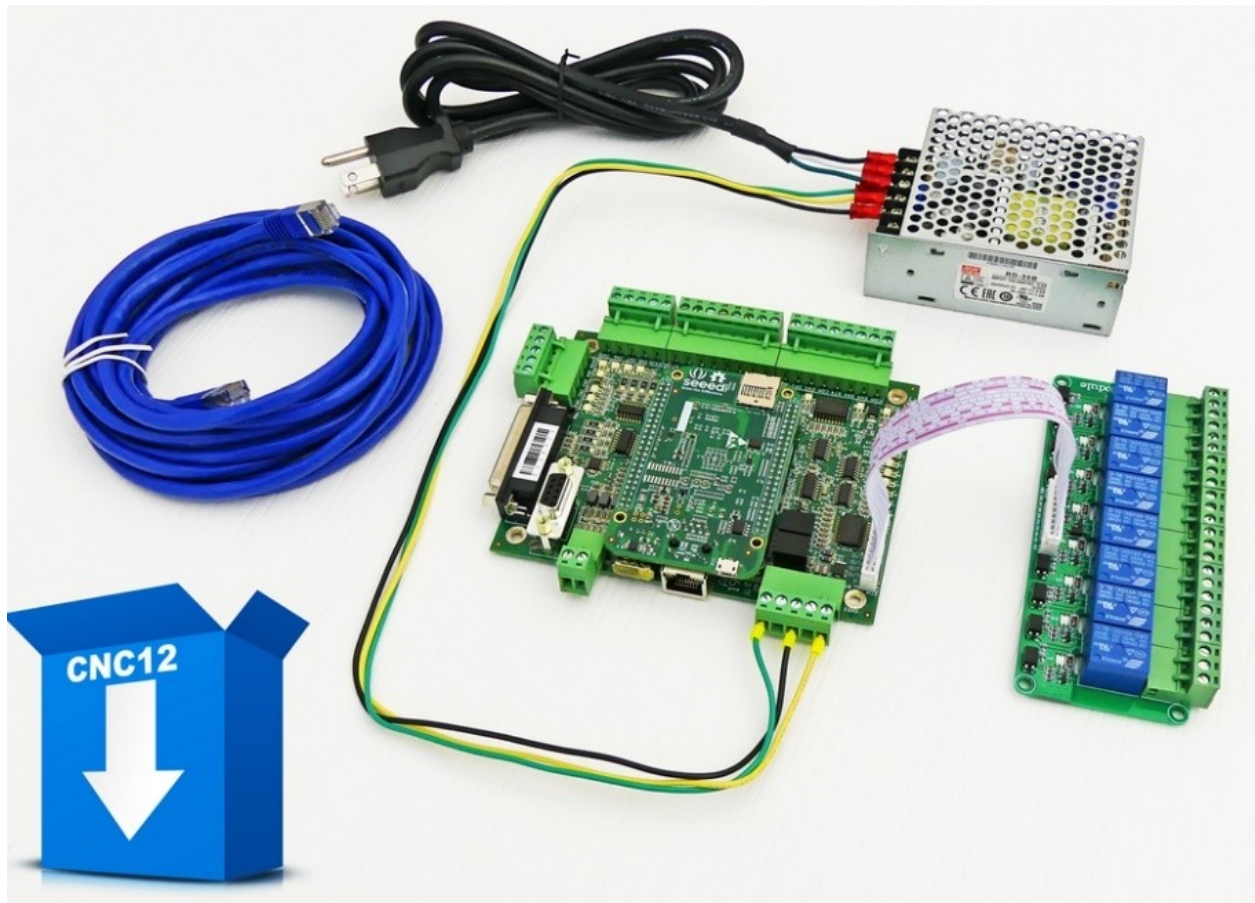
problem. Your post can be helpful others in the future.

An alternative to the free support offered on the Acorn Tech support forum is to purchase one on one Factory Direct technical support. Purchase 1 hour blocks of support time here: https://www.centroidcnc.com/centroid_diy/purchase_tech_support.html

Chapter 1 Acorn CNC Control Kit

Congratulations on your Acorn CNC control kit purchase!

The Acorn is a step and direction motion control solution. Providing up to 4 axes of step and direction signal outputs and full Programmable Logic Controller (PLC). Make sure your kit is complete and has not been visibly damaged in shipment.



The following components are included with your Acorn CNC Controller Kit Part# 14455

- The Acorn with BeagleBone Green installed and all terminal blocks installed. Part#14756
- 8 output relay board with flat cable. Part #14734
- Meanwell RD-35B power supply Part #8903 with
 - 110VAC input cord Part #14459
 - 24V output to Acorn H9 header cable Part #14460
- 15ft Shielded Cat5E Ethernet cable Part #7269

Chapter 2 Bench Test Hardware Setup

2.1 Introduction To Bench Testing

[Accompanying Bench test video for this section is on this page.](#)

The first step in installing your new system is performing a bench test. “Bench test” means connecting all of the electronics together to test them before installing the system in a machine. This test should be done on a work bench, hence the name.

A bench test allows you to:

- Confirm communication between the Acorn and the CNCPC a critical first step.
- Find problems before spending a lot of time wiring your machine or cabinet.
- Troubleshoot hardware and software problems early on, before they can cause permanent damage to the system.
- Identify missing or defective hardware before installing the system
- Allows for greater visibility when troubleshooting than when installed in an electrical cabinet.

Tools and Equipment Needed

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

• A Windows 10 PC with an internet connection that meets the Centroid CNCPC minimum performance specifications, or a Centroid supplied CNCPC.

https://www.centroidcnc.com/cnc_pc_performance_requirements.html

- A small screwdriver set.
- A digital multimeter

Items needed to setup the Acorn controller for bench testing



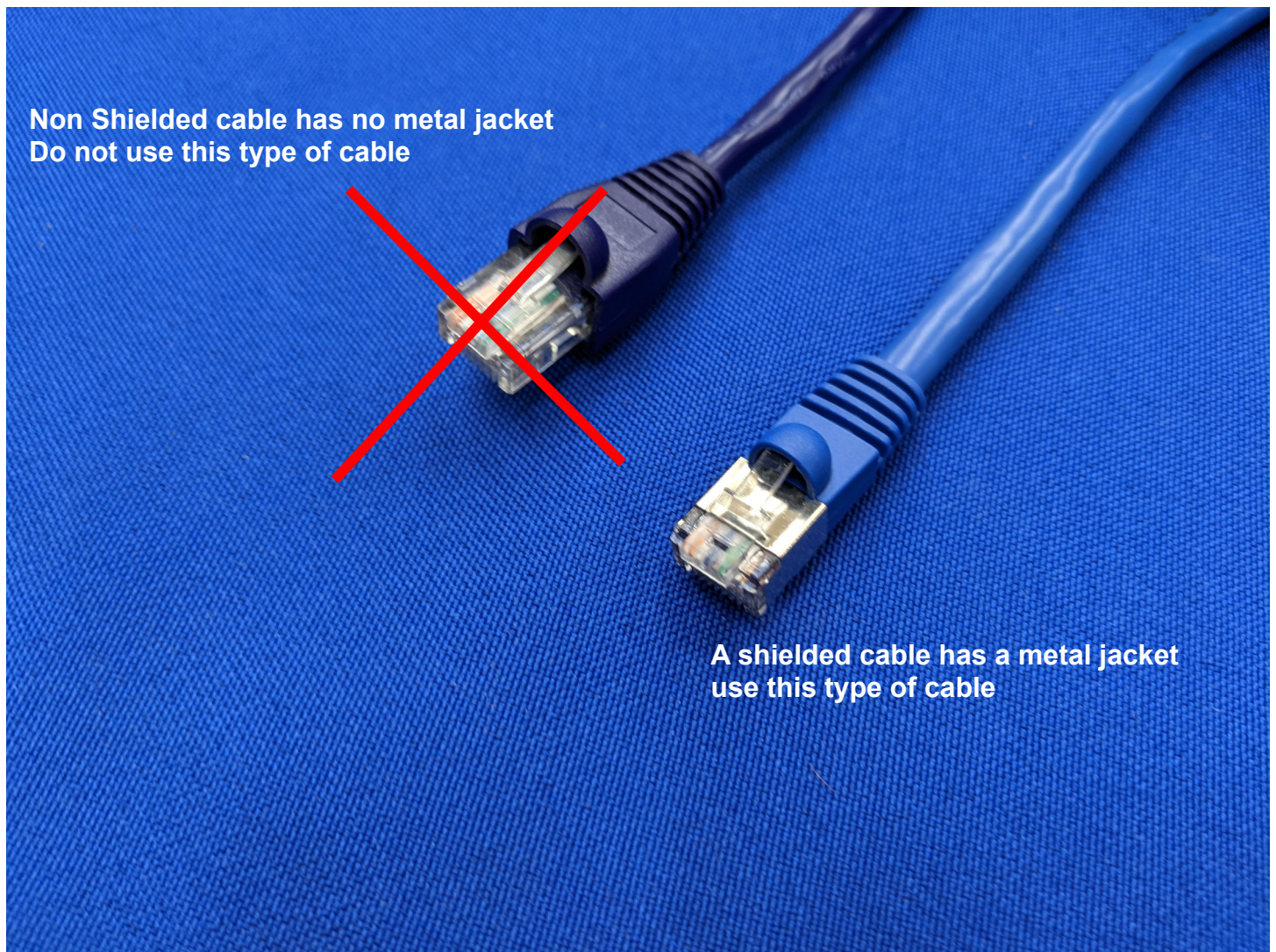
2.2 Acorn Bench Test Setup

[Accompanying Bench test video for this section is on this page.](#)

- 1 Connect the relay board: Use the included flat white 10 conductor cable to plug the relay board into the Acorn.
- 2 Connect the power supply to the Acorn: Leaving the Meanwell power supply disconnected from 110VAC, Plug the 5-pin terminal block into H9. Note: Power supply will also run on 240VAC.
- 3 Connect the Ethernet Cable: Connect the supplied shielded Ethernet cable to your PC's built in Ethernet port. Do not use a USB to Ethernet adapter to connect to the Acorn. Connect the other end to the Acorn. A shielded Ethernet cable will have a metal clip around the RJ-45 connector as shown on the blue cable in image below. Use the provided 15ft Shielded Ethernet cable that is included with the Acorn kit.

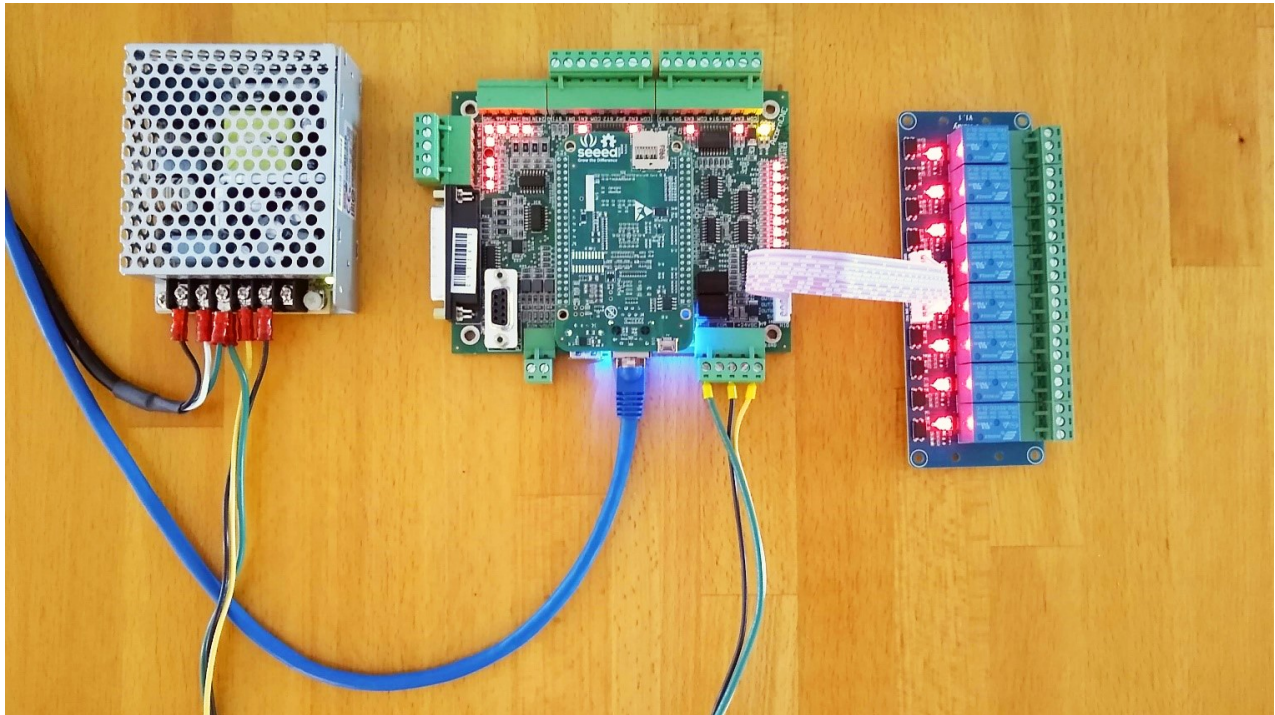
Note: An unshielded cable will result in intermittent PC Data receive errors in the software due to electronic noise and interference. See TB270:

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



Shielded vs non-shielded Ethernet cables

- 4 Plug in Meanwell power supply. The Acorn comes pre-wired to plug into 110VAC US outlet. When you are finished, the Acorn should be wired as shown in the image below.
Note: the power supply will also work with up to 240VAC supply.

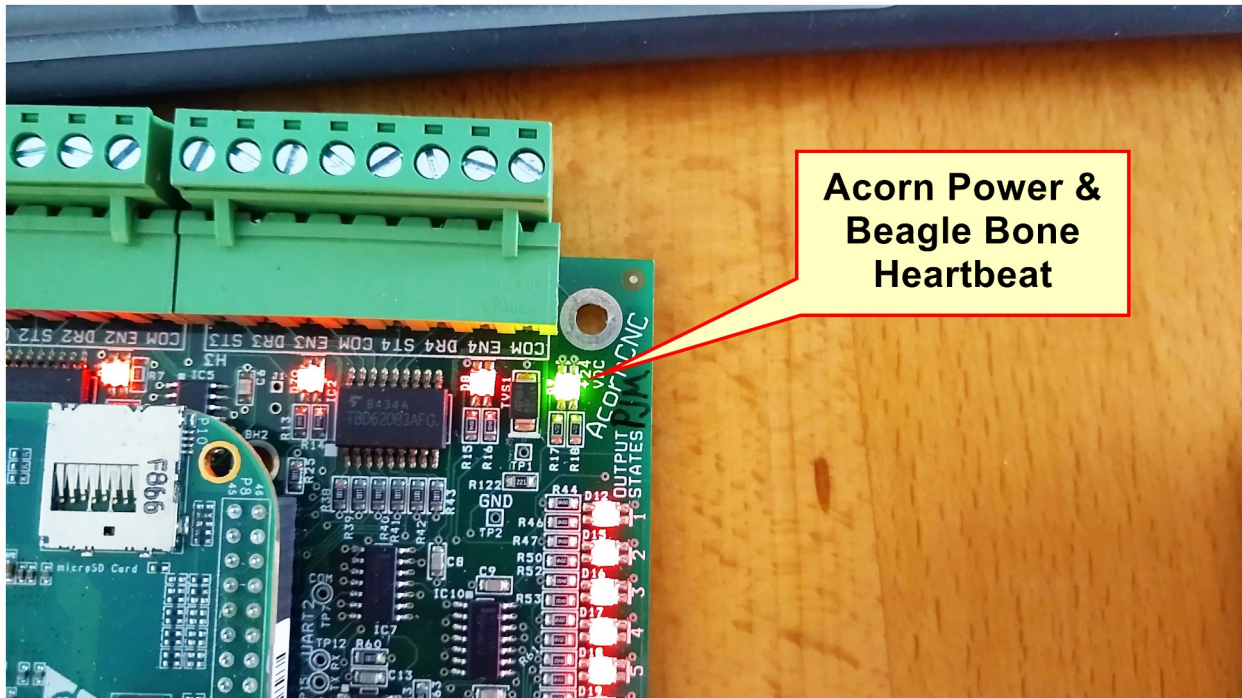


Acorn controller powered up and ready for bench testing

- 5 Apply power to the power supply and the Acorn will power up. The green power LED in the upper right corner on the Acorn should be lit, and the blue “Heartbeat” LED on the BBG will blink rapidly (booting) and then blink at one pulse per second (all good and running). This denotes that the Acorn is booted and ready. [See Acorn LED’s Explained Video.](#)

NOTE: The Power LED also serves as an indicator for the Heartbeat of the BeagleBone Green controller. The LED will light green with 24VDC power applied to the board and will also flash if there is a good Heartbeat (firmware booted and running) from the BeagleBone Green.

All versions will have the Power LED feature as well as the Heartbeat LED found on the BeagleBone Green controller (shown below).



Acorn combination Power and BeagleBone Green Heartbeat LED



Beagle Bone Green (BBG) Heartbeat LED

If the Acorn Power LED is not on or Heartbeat LED is not blinking properly, see:

Centroid Community CNC Support Forum Centroid Acorn Ethernet and Firmware Heartbeat status LED lights are explained in detail:

<https://centroidcncforum.com/viewtopic.php?f=61&t=1460>

Note: Do not plug anything into the USB port on the BeagleBone Green board!

Chapter 3 Windows 10 configuration and CNC12 Installation

3.1 Windows 10 Configuration for CNC control use.

Note: Microsoft Windows 10 is the only supported OS with Centroid Acorn CNC12. Microsoft Windows 8.1, 7 and older versions are not supported. Mac OS and Linux operating systems are also not supported.

1. If you have purchased CNCPC from Centroid, it comes with Windows 10 properly configured for CNC control use and the CNC12 software pre-installed so you can skip this section.

If you bought or built your own computer, it must meet the prerequisites listed on the Centroid Website http://www.centroidcnc.com/cnc_pc_performance_requirements.html

2. [Accompanying Bench test video for this section is step 3 on this page.](#)

Technical bulletin 309 covers this topic as well.

http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/309.pdf

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

99% of all communication problems between CNC12 and the Acorn 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 Acorn 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 [Appendix B](#)

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 do not connect computers with CNC12 installed to the network.

3.2 CNC12 Software Installation

[Accompanying Bench test video for this section is step 3 on this page.](#)

With the Acorn in bench configuration powered up with a heartbeat as described in [Section 2.2](#) , install the Acorn CNC12 software as follows:

1. Click on this link to download the latest version of CNC12 software:

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

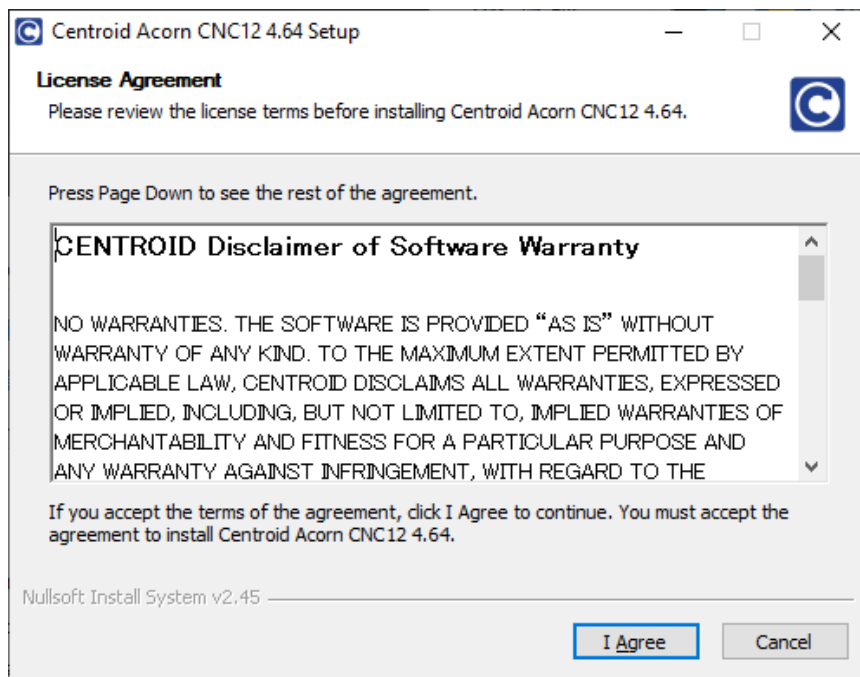
2. Navigate to the CNC12 installer zip file you just downloaded. Depending on your Windows settings, the file you downloaded will be displayed as "centroid_acorn_cnc12_v4.64_installer" or similar. Right click and choose "Extract All"

3. Copy the extracted .exe to the CNCPC's desktop. The extracted folder in this example is called "centroid_acorn_cnc12_v4.64_installer". Your version may be newer, but the name will be the same other than the "v4.64" which signifies the CNC12 version. Alternatively, you may extract the .zip folder to your desktop.

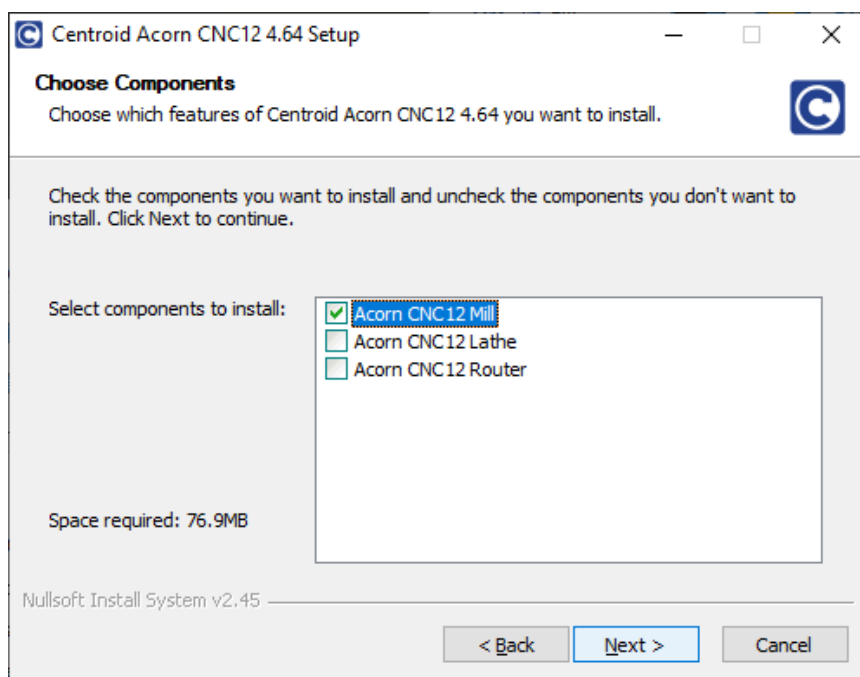
4. Double click "centroid_acorn_cnc12_v4.64_installer .exe" now on desktop.

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”.

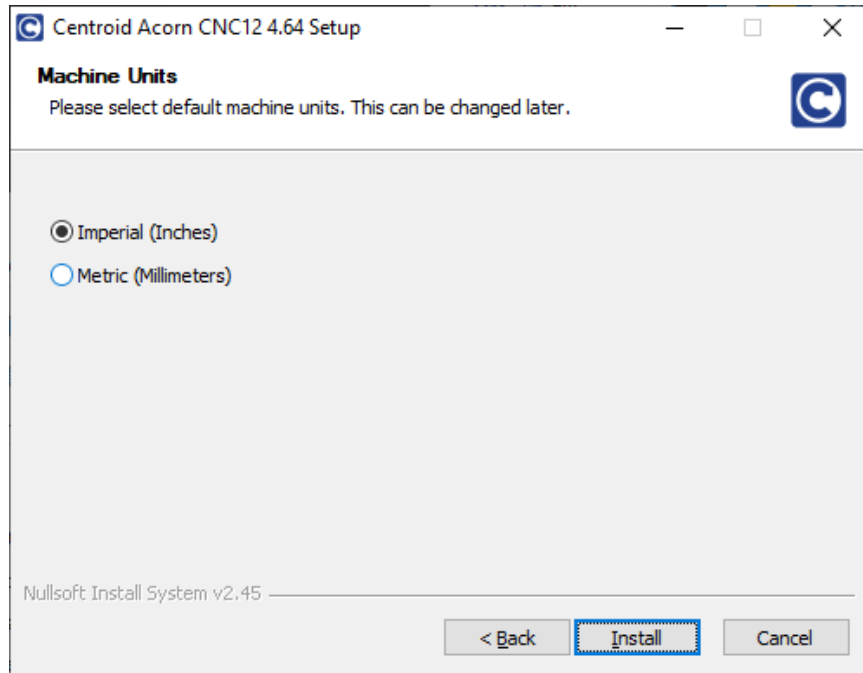


7. Select CNC12 Mill, Lathe or Router depending on the type of installation required. For the remainder of this document, we will assume the system is being installed on a mill. Click “Next”.



Machine Type Selection

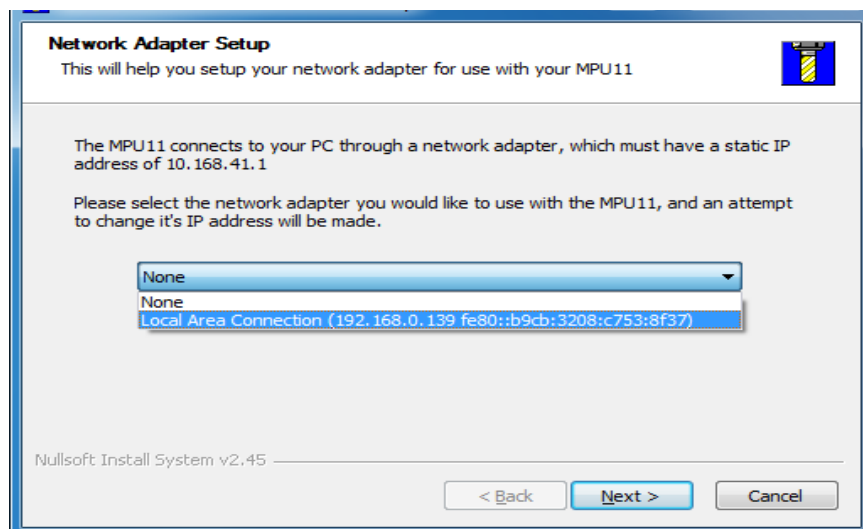
8. Select the default machine units, Imperial or Metric. Then click “Install”



Units Selection

9. CNC12 will be installed. Click “Next” in the “Installation Complete” window to continue.

10. Network Adapter Setup: (IMPORTANT: The PC and the Acorn MUST be powered up and connected to the CNC PC’s onboard Ethernet port via the provided shielded Ethernet Cable) while the installation process is going on. Click the down arrow to display the network adapters that are currently installed and select the network adapter that is connected to the Acorn as shown below. Click “Next” to continue. When asked if you would like to change the IP address for the adapter selected, click “yes”.



Network Adapter Selection

NOTE: Centroid recommends using a computer with two Ethernet ports. That way one Ethernet port is used for Acorn while the second is used for internet access (Windows updates, software updates, TeamViewer Remote access etc.) If you do have two built in Ethernet ports, install the CNC12 software using the Ethernet port that indicates no network access. This way the software will install to the correct Ethernet port. It is acceptable to use a USB to Ethernet adapter for Internet access if the PC is not equipped with Wi-Fi. You may also elect to purchase a USB to Wi-Fi adapter. Do not connect the Acorn to a USB Ethernet adapter. Always connect the Acorn to the PC's built in Ethernet port!

NOTE: Your IP address may differ from those shown in the screen shot above

11. Click "Finish" to complete the CNC12 software installation.
12. Start CNC12: Double Click on the CNC12 Icon that was created on your desktop during the CNC12 software installation.



You may see the following message below the first time you start CNC12. Simply wait until it completes, This message indicates that CNC12 is updating the Centroid CNC Acorn firmware located on the BBG. Every version of CNC12 has its own unique matching firmware that is installed automatically with the CNC12 installation. As the message says, do not power off the Acorn while the firmware is being updated.

13: The "Main" CNC12 Screen will appear.

The screenshot shows the main CNC12 control interface. The top left displays 'WCS #1 (G54) Current Position (Inches)' with X, Y, and Z axes. The top right shows 'Job Name: NO_JOB_LOADED.cnc' and 'Tool: T---H---'. The center displays 'Feedrate: 100% 0.0 ipm' and 'Spindle: 0 M'. A red error message reads '335 Emergency stop released' and '9033 Reset Initiated, Press Reset to Clear'. Below this is a 'WARNING: Machine Home Not Set' with instructions: '1) Jog all axes to their home positions' and '2) Press CYCLE START to set machine home'. The bottom left shows 'Machine Coord.' with X, Y, and Z all at '+0.0000'. The bottom center features a 'Machine Home' diagram and 'SYSTEM ID 0479B7AD9092-0218202997 MPU12 System'. The bottom right has a 'RESET' button and 'FEEDRATE OVERRIDE 100%'. The bottom of the screen has function keys: Setup (F1), Load (F2), MDI (F3), CAM (F5), Edit (F6), Utility (F7), and Shut Down (F10). The right side of the screen is a control panel with buttons for AUTO SPINDLE MAN, SPIN HIGH, SPIN MED, SPIN LOW, SPIN BRAKE, FLOOD, MIST, VAC ON, RAPID OVER, INCR CONT, x1, x10, x100, MPG, 4th+, Y+, Z+, X-, X+, 4th-, Y-, Z-, SINGLE BLOCK, TOOL CHECK, FEED HOLD, and a large 'RESET' button with 'PRESS TO CLEAR' and 'TRIPPED' text.

3.3 Installing an Acorn CNC12 software level License

If you have not purchased an Acorn License upgrade, please skip to the [next section](#).

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

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

Acorn License Installation Instructions:

- 1) From you email save the attached license.dat file to the CNC PC desktop using a Windows PC. (Note: Mac or any Apple computers, will corrupt the .dat file and render it useless, do not use an Apple product to download the Acorn License file)
- 2) With Acorn powered up and running, Start the CNC12 software.
- 3) Press "F7" Utility menu.
- 4) Choose the "F8" Option menu.
- 5) Choose the "F2" Import License function. This will open a file dialog. Navigate to the desktop (or the location where the license file attachment was saved) and select the license.dat file. Click "Open". CNC12 will then respond with a message stating that the license was successfully imported.

Trouble shooting License Issues:

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

3.4 CNC control configuration Reports

Centroid CNC12 software contains a powerful way to "capture" all the CNC and Machine tool specific configuration settings in one easy to use file called a "report.zip". The report.zip file will contain and can be used for:

- Records all the machine and CNC control specific parameters & settings
- Contains Log files of the machine during operation
- The report.zip can be used to quickly restore the settings after a new installation of the CNC12 software or restore an existing installation to its previously know working state.
- Users can easily create fresh report.zip files with the "create report" button in the utility menu. CNC12 will automatically generate a report on a weekly basis as well.
- When asking for technical support a fresh report is required as it contains critical information about your specific CNC configuration that allows the CNC technician to 'see' how your system is setup and configured.

To create a report:

- 1 From the main CNC12 screen press F7 Utility
- 2 Then F7 Create Report
- 3 A windows dialog will appear, select the location you want to save this file

NOTE: Once the machine is configured and running, Create a backup copy of the report.zip file on a USB memory stick (or network drive) and save it in a safe location.

Video on Creating and Restoring a Report file:

<https://centroidcncforum.com/viewtopic.php?f=61&t=3216>

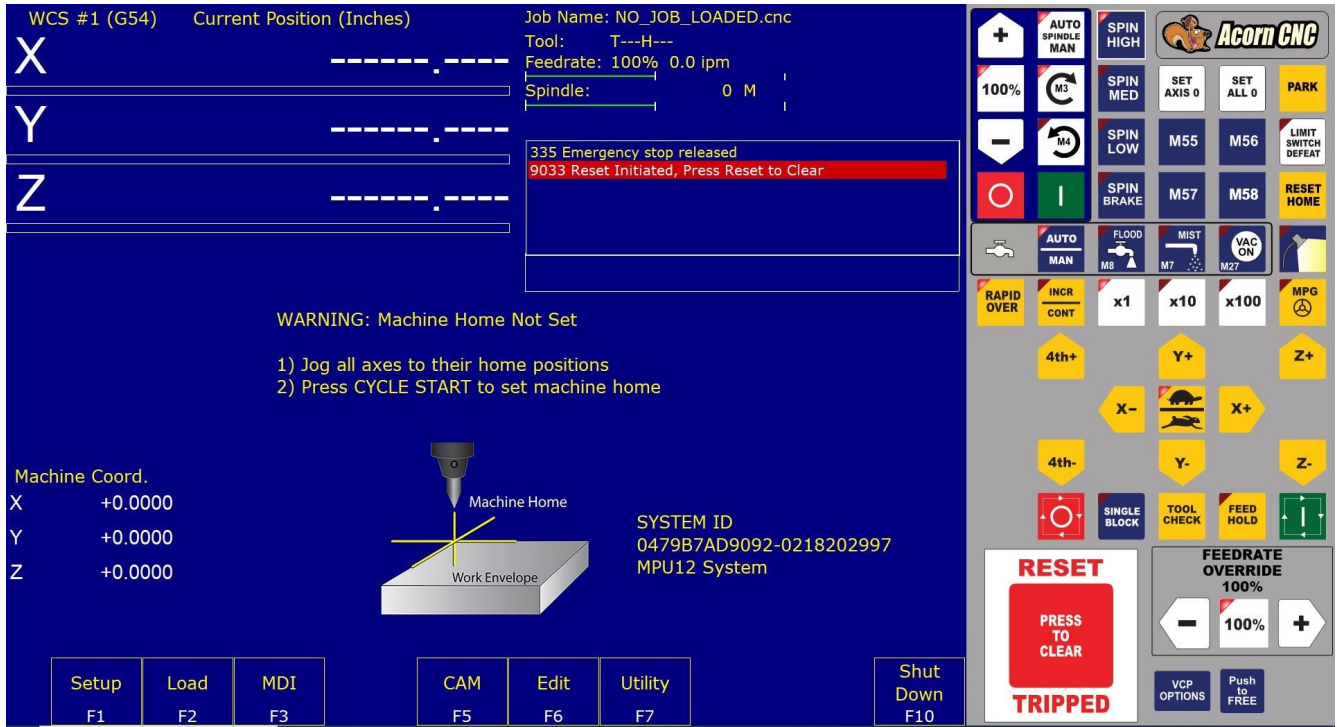
NOTE: It is a good idea to keep the USB memory stick in a safe location. See this post on the forums about USB backups: <https://centroidcncforum.com/viewtopic.php?f=63&t=5667>

Chapter 4 Bench Testing

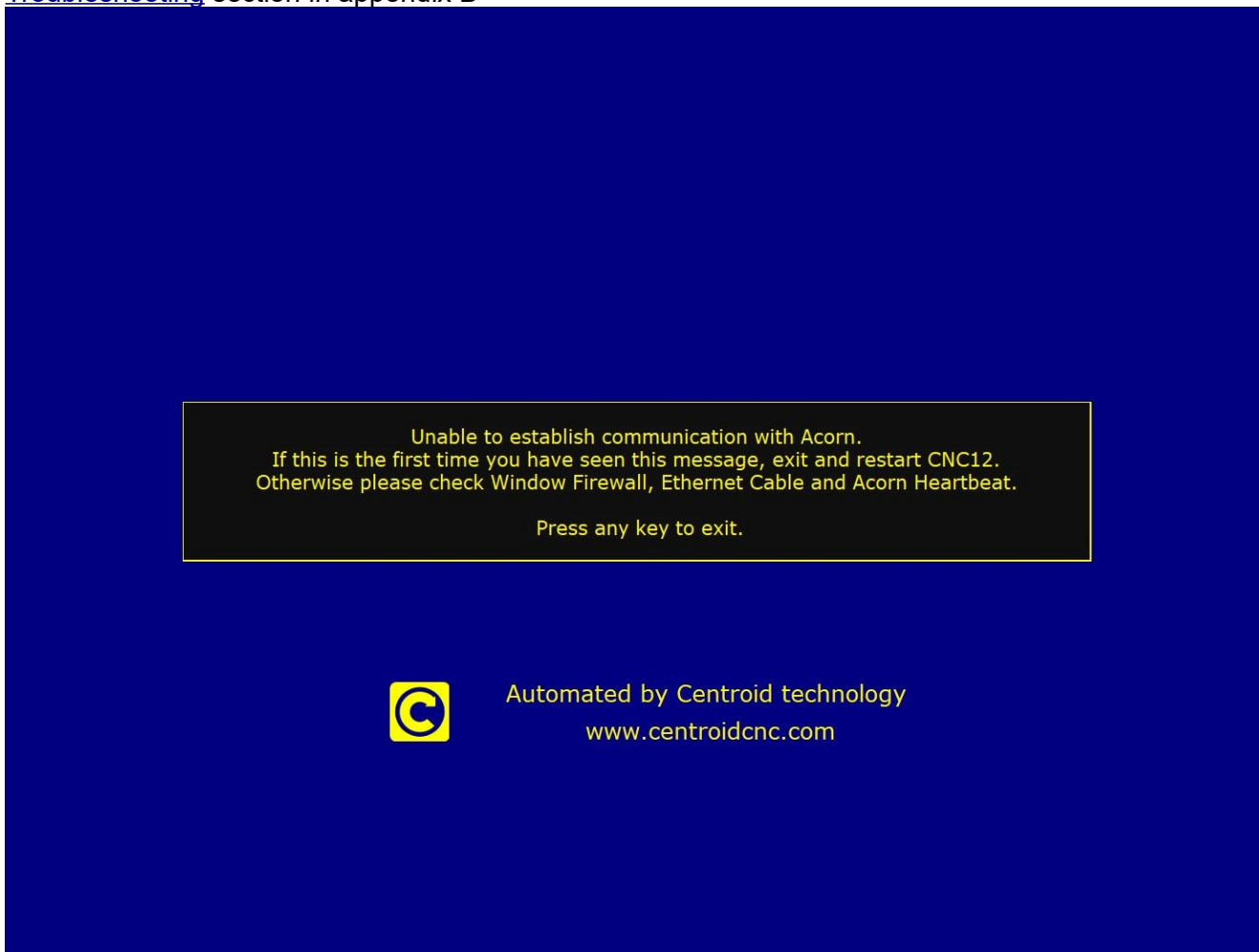
4.1 CNC12 Software Configuration

Verify that the Acorn CNC control is powered on and the Ethernet cable connected to the CNC PC. Double click the CNC12 Icon on the desktop.

The main screen of Acorn CNC12 will appear:



If CNC12 does not start because it timed out with the pictured message below, see the [Acorn Communications Troubleshooting](#) section in appendix B



The image above will appear for a number of reasons. [See this post for more information](#)

NOTE: Do not attempt to run the Windows 10 Network Troubleshooter on it.

HINT: From now on when using CNC12, you can always go up (back) 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 of CNC12.

4.2 Acorn Spindle Bench Test

Start CNC12 with the Acorn Powered up.
Once CNC12 is running you should see this display:

WCS #1 (G54) Current Position (Inches) Job Name: NO_JOB_LOADED.cnc
 Tool: T---H---
 Feedrate: 100% 0.0 ipm
 Spindle: 0 M

335 Emergency stop released
9033 Reset Initiated, Press Reset to Clear

WARNING: Machine Home Not Set

- 1) Jog all axes to their home positions
- 2) Press CYCLE START to set machine home

Machine Coord.
 X +0.0000
 Y +0.0000
 Z +0.0000

Machine Home
 Work Envelope

SYSTEM ID
 0479B7AD9092-0218202997
 MPU12 System

Setup F1 Load F2 MDI F3 CAM F5 Edit F6 Utility F7 Shut Down F10

Virtual Control Panel (VCP) includes: AUTO SPINDLE MAN, SPIN HIGH, SPIN MED, SPIN LOW, SPIN BRAKE, SET AXIS 0, SET ALL 0, PARK, M55, M56, M57, M58, RESET HOME, FLOOD M8, MIST M7, VAC ON M27, RAPID OVER, INCR CONT, x1, x10, x100, MPG, 4th+, Y+, Z+, X-, X+, 4th-, Y-, Z-, SINGLE BLOCK, TOOL CHECK, FEED HOLD, FEEDRATE OVERRIDE 100%, VCP OPTIONS, Push to FREE.

RESET
 PRESS TO CLEAR
TRIPPED

Press the RESET Button on the Virtual Control Panel. Your screen should look like this:

WCS #1 (G54) Current Position (Inches) Job Name: NO_JOB_LOADED.cnc
 Tool: T---H---
 Feedrate: 100% 0.0 ipm
 Spindle: 0 A

335 Emergency stop released
 9033 Reset Initiated, Press Reset to Clear
4032 Reset Cleared

Press CYCLE START to start job

WARNING: Machine Home Not Set

- 1) Jog all axes to their home positions
- 2) Press CYCLE START to set machine home

Machine Coord.
 X +0.0000
 Y +0.0000
 Z +0.0000

Machine Home
 Work Envelope

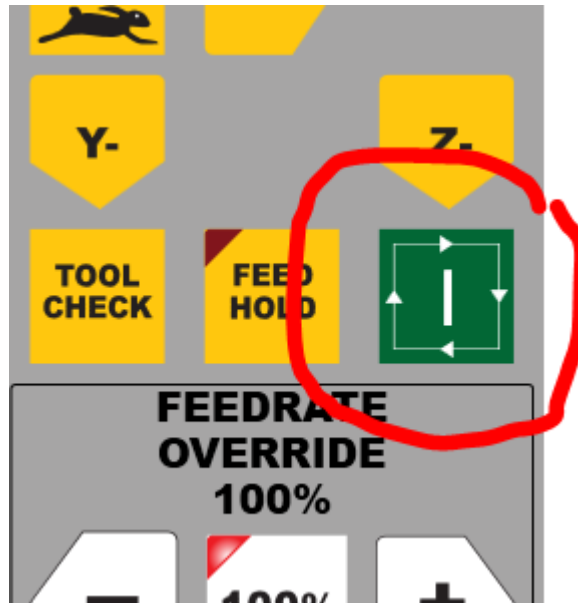
SYSTEM ID
 0479B7AD9092-0218202997
 MPU12 System

Setup F1 Load F2 MDI F3 CAM F5 Edit F6 Utility F7 Shut Down F10

Virtual Control Panel (VCP) includes: AUTO SPINDLE MAN, SPIN HIGH, SPIN MED, SPIN LOW, SPIN BRAKE, SET AXIS 0, SET ALL 0, PARK, M55, M56, M57, M58, RESET HOME, FLOOD M8, MIST M7, VAC ON M27, RAPID OVER, INCR CONT, x1, x10, x100, MPG, 4th+, Y+, Z+, X-, X+, 4th-, Y-, Z-, SINGLE BLOCK, TOOL CHECK, FEED HOLD, FEEDRATE OVERRIDE 100%, VCP OPTIONS, Push to FREE.

RESET
 PRESS TO RESET
OK

Set Home by pressing Cycle Start.



The XYZ Digital Read Out (DRO) will now look this with 0.0000 for XYZ:

WCS #1 (G54) Current Position (Inches) Job Name: NO_JOB_LOADED.cnc
Tool: T---H---
Feedrate: 100% 0.0 ipm
Spindle: 0 A

X +0.0000
Y +0.0000
Z +0.0000

Distance to Go
X +0.0000
Y +0.0000
Z +0.0000

Machine Coord.
X +0.0000
Y +0.0000
Z +0.0000

9033 Reset Initiated, Press Reset to Clear
335 Emergency stop released
9033 Reset Initiated, Press Reset to Clear
4032 Reset Cleared

Press CYCLE START to start job

RESET
PRESS TO RESET
OK

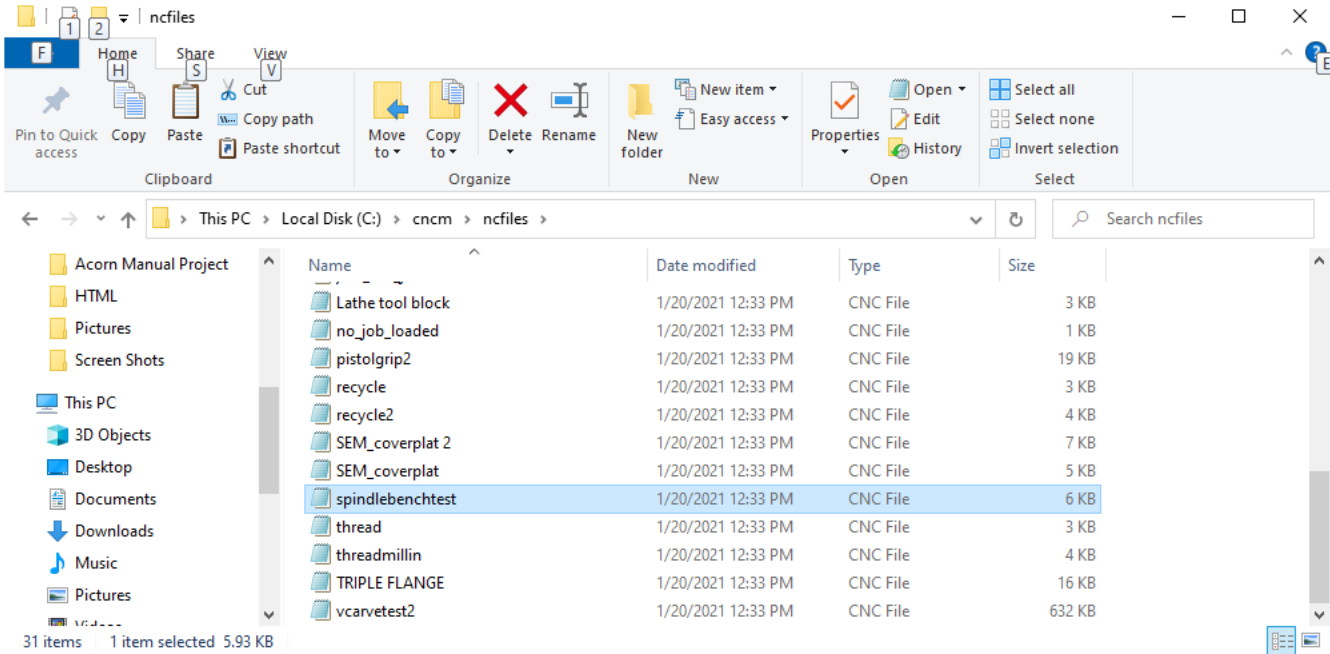
FEEDRATE OVERRIDE
100%

SETUP
F1
LOAD
F2
MDI
F3
RUN
F4
CAM
F5
EDIT
F6
UTILITY
F7
GRAPH
F8
DIGITIZ
F9
SHUT DOWN
F10

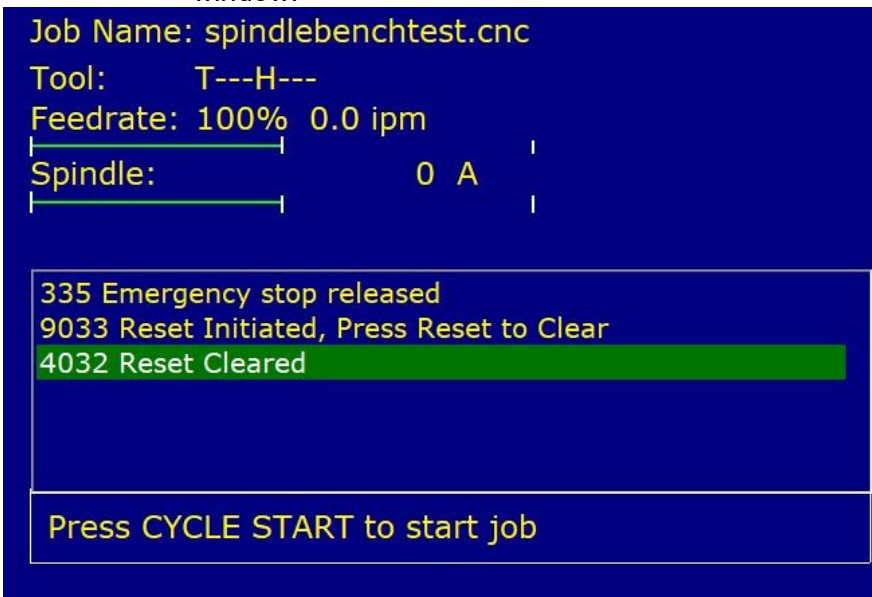
Load the G&M code program called "spindlebenchtest.cnc":


- Click Load (F2)
- A windows dialog box for C:/cncm/ncfiles will open

- c Look for spindlebenchtest.cnc (see below)
- d Highlight the file
- e Click Open



- f Spindlebenchtest.cnc should appear as the job name at the upper right corner of the CNC12 window:

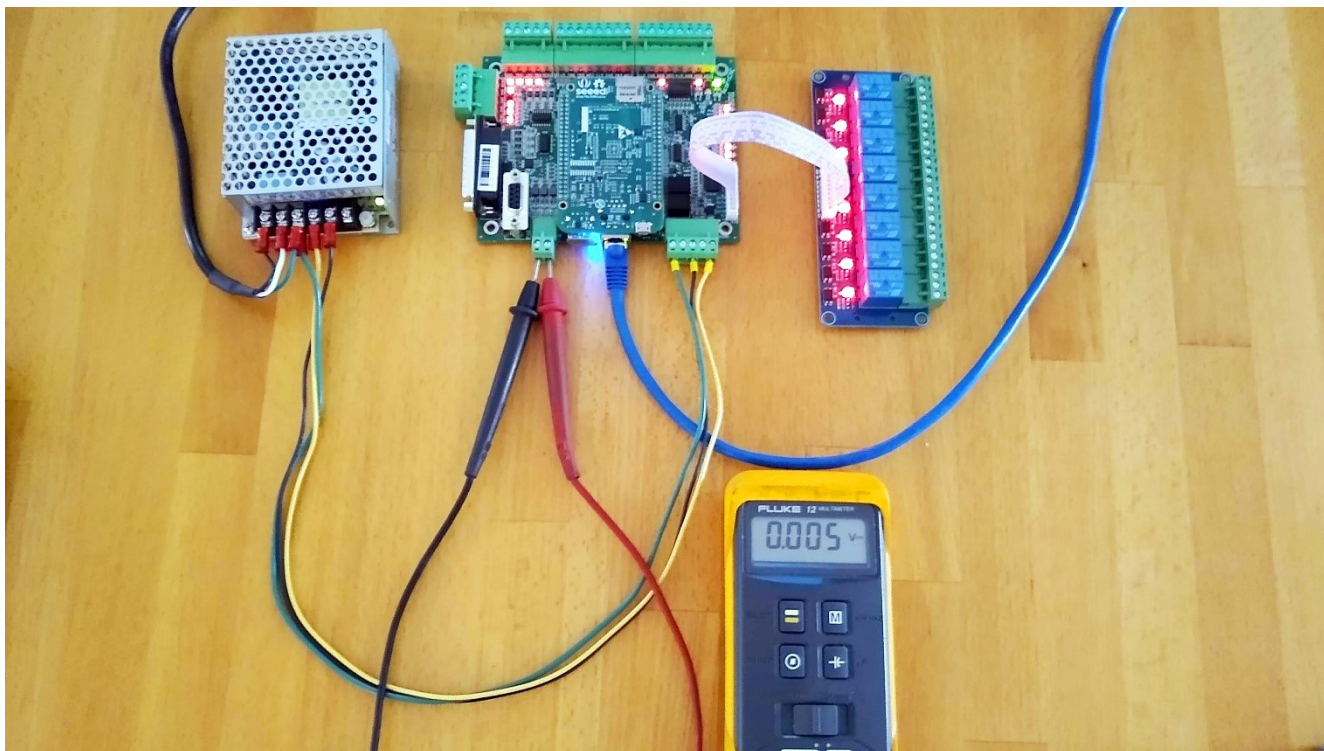


- g Press Cycle Start (Keyboard shortcut alt+s) or the Virtual Control Panel Cycle Start button  to start the Spindle Bench test program


Video showing the spindle analog output bench test procedure: <https://centroidcncforum.com/viewtopic.php?f=61&t=2184>

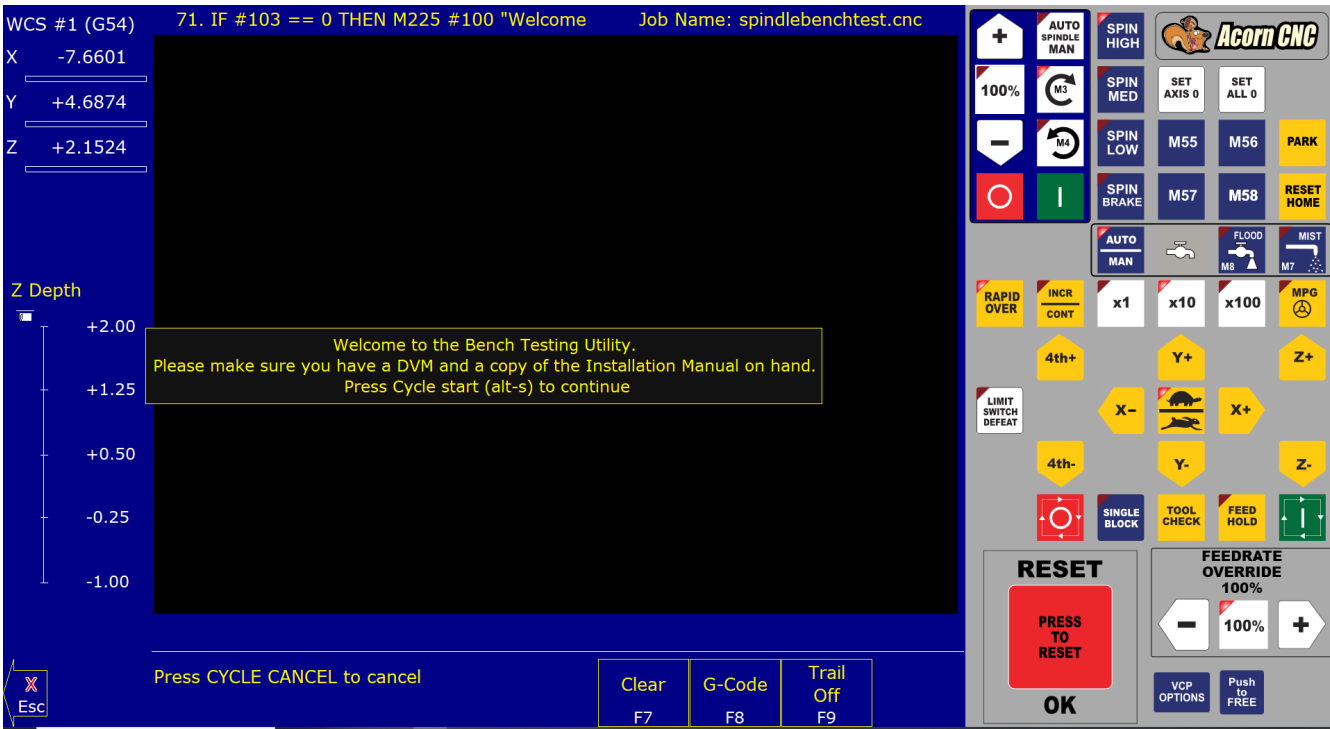
Testing the analog output for the spindle: Acorn provides a 0 to +10VDC analog output to provide programmable spindle speed control using a VFD (variable frequency drive). The default max spindle speed specified in the Control Configuration is 3000rpm. This configures the control to scale the 0 to +10VDC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

- 1 Set a digital voltage meter to VDC
- 2 Insert the digital voltage meter leads into H8 as shown below. Tighten down the screw terminals to firmly grip the probes.

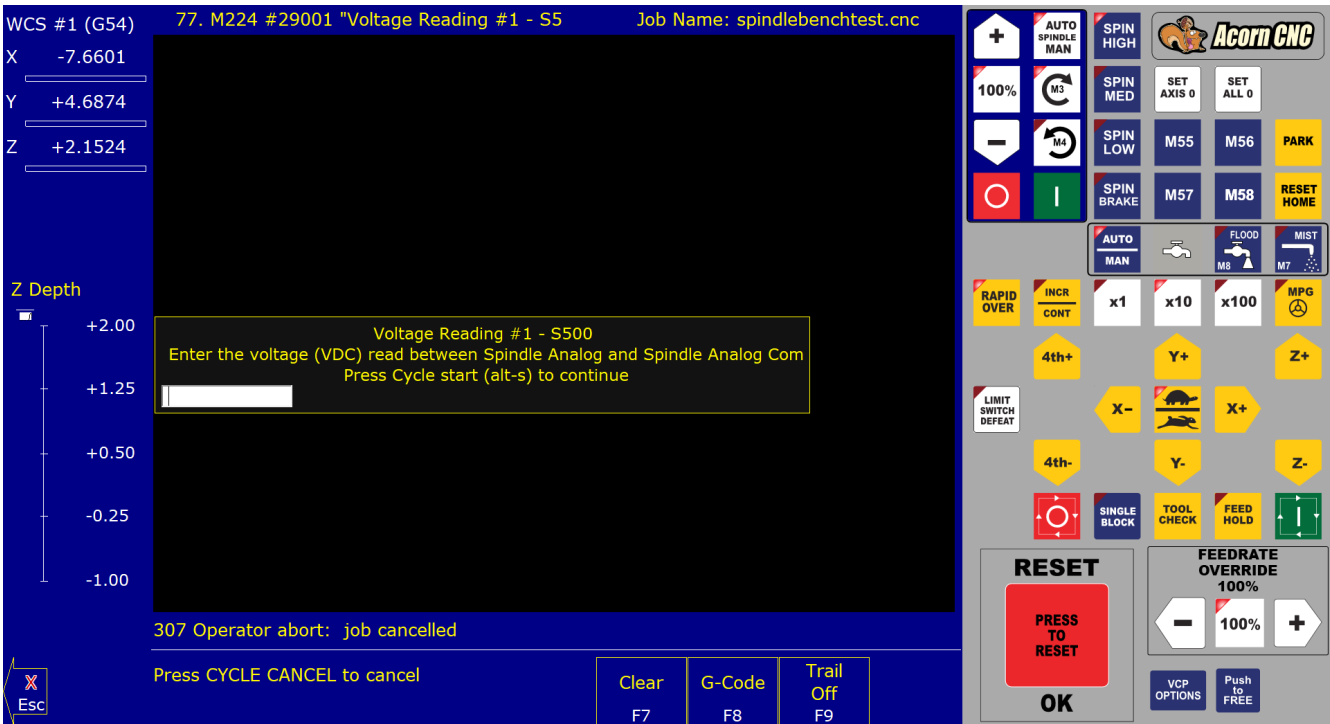


Meter connections for spindle bench testing

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



5. Enter the voltage readings when prompted in the Voltage reading box. Press Cycle Start to continue. Spindlebenchtest.cnc will display 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.

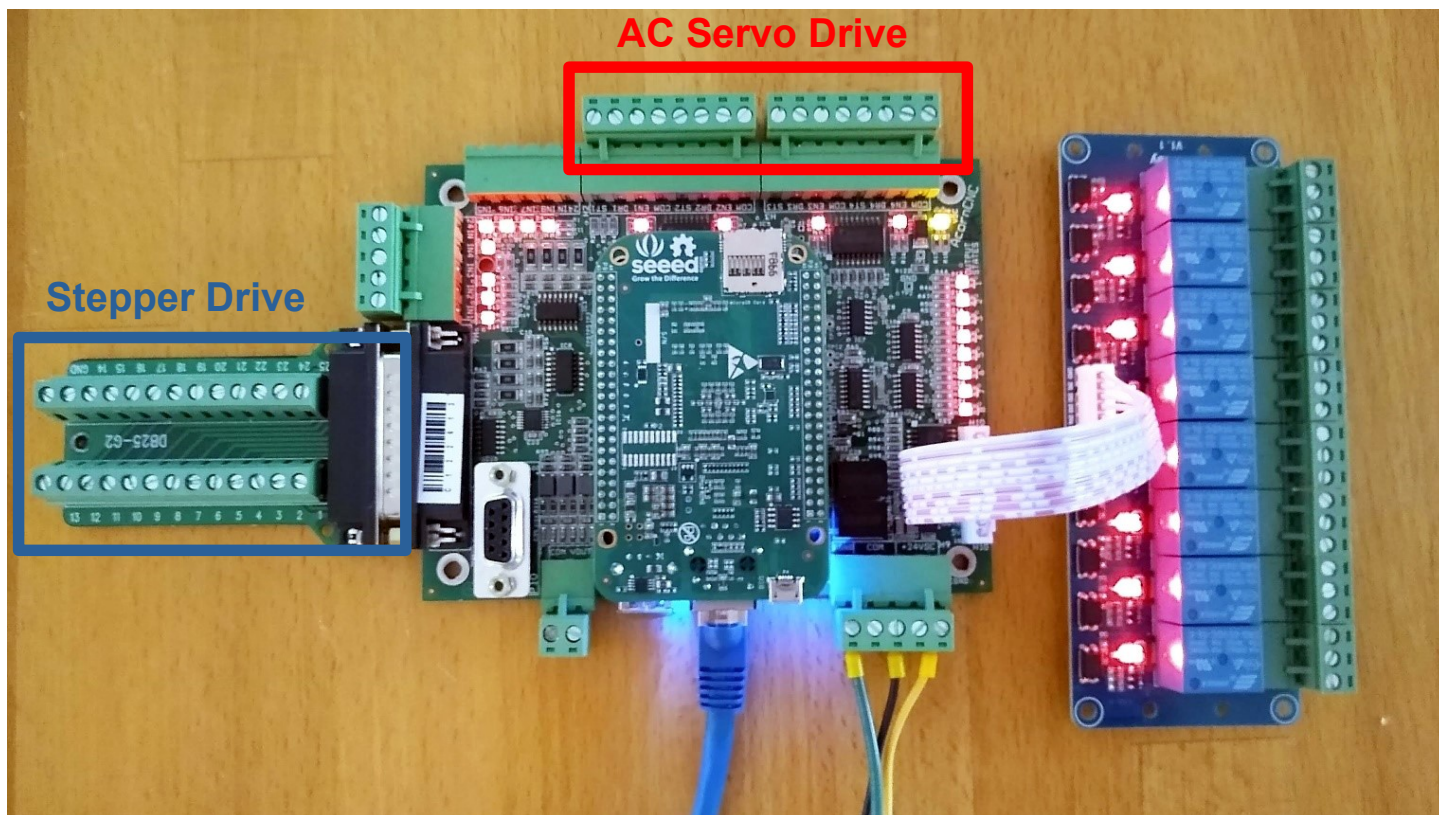


Voltage entry dialog for spindle bench test
Chapter 5 CNC Electrical Cabinet Wiring

5.1 Introduction to Electrical Cabinet Layout and Drive Type connections.

Now that CNCPC to Acorn communication has been confirmed it is time to think about electrical cabinet installation and basic axis motor drive type connections.

Stepper Drives connect to the DB25 port, most common method is to use a DB25 breakout connector board as seen below. [These DB25 BOB's can be purchased here.](#)



AC Servo motor drives connect to the "Screw Terminals" as seen above.

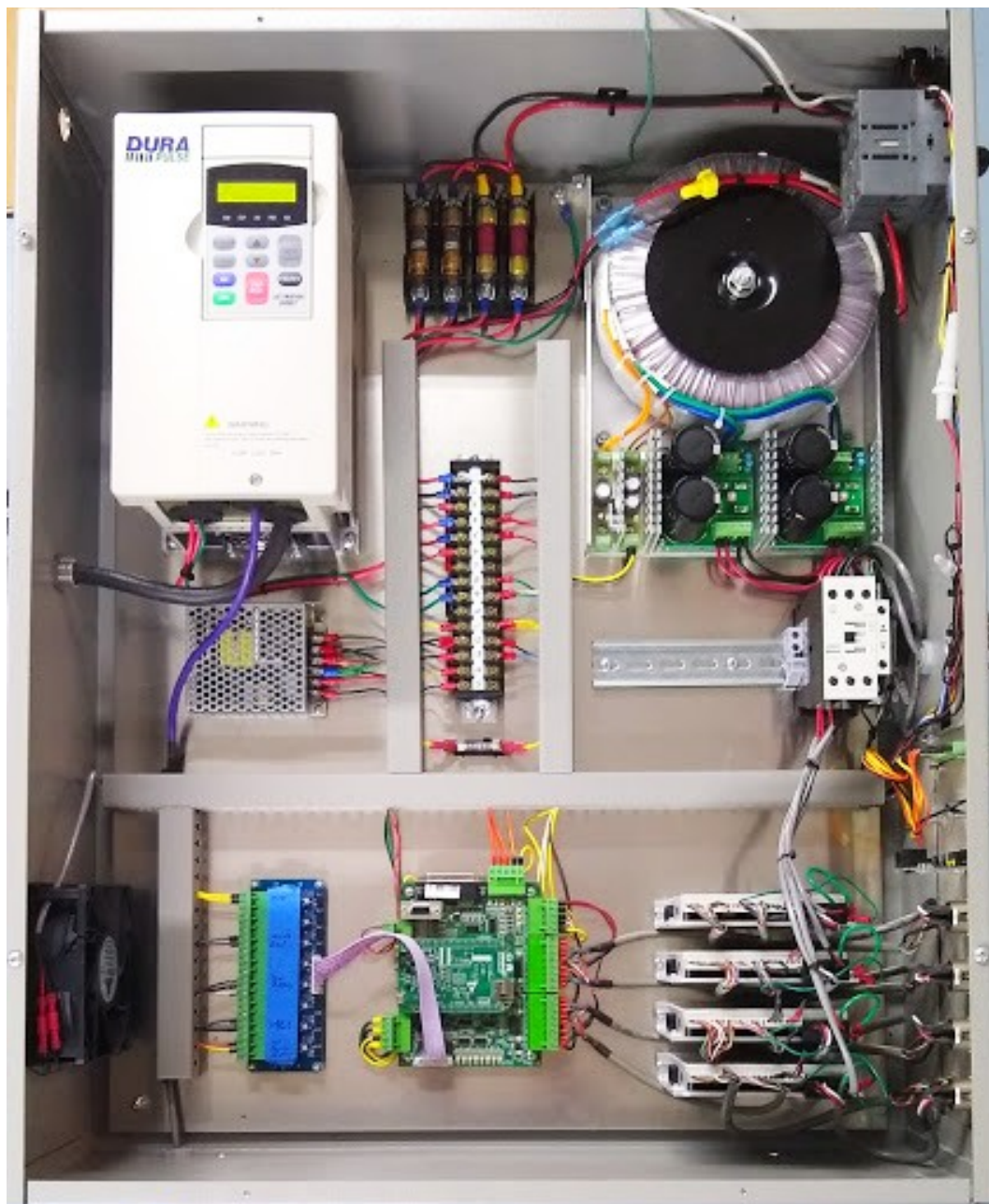
In this chapter of the manual we will go into detail about how to wire the various systems in the electrical cabinet.

Related post on the Centroid Community CNC Support Forum: Control Box Building Tips

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

Centroid provided Hookup Schematic sets are provided as a guide and may be found here:

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



Suggested layout for the major components of the electrical panel:

- Main Power Supply – Upper Right
- Over Current Protection (fuses) Top Center
- Master ON/OFF Switch – tight in Upper Right corner
- Variable Frequency Drive – Upper Left
- E Stop Contactor – Center Right
- Axis Drives – Lower Right
- Acorn – Bottom Center
- Acorn 24VDC Logic Power Supply – Left Center
- Acorn Relay Module – Lower Left
- Cabinet Cooling Fan – Left of Acorn Relay Module
- TB1 Terminal Block - Center

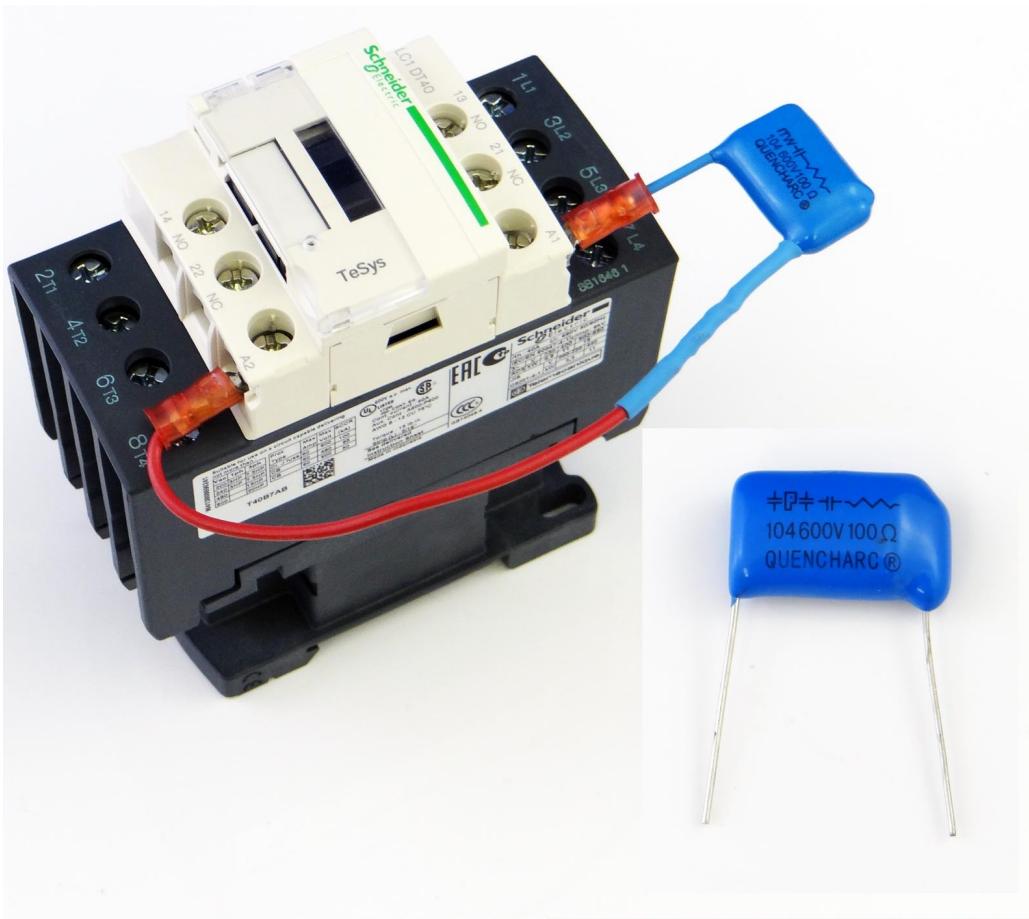
Best practices for Electrical Cabinet Wiring

Minimize Noise and Interference

- Keep sensitive electronics away from noisy equipment. Install high voltage transformers, contactors, and other electrically noisy equipment as far away from low voltage circuit boards as practical. For example, it would be a bad practice mount a contactor block or large transformer directly underneath the Acorn.
- Try to keep high voltage power lines far away from low voltage signal lines. Keep the high-voltage AC power lines and motor power lines as far away from low voltage logic signal wiring as practical.
- Grounding Principle. Wire the incoming chassis (earth) ground lug directly to a single ground bus bar. Wire all cabinet doors, power supply chassis grounds, shields/drain wires and other equipment chassis ground to one single ground bus bar. What you should NOT do is have several different grounding points throughout the cabinet, as this could increase electrical noise and interference. This is very important!
- Leave plenty of space between wire ducts and components. Keep wire ducts at least 2” away from circuit boards when practical.
- Use Snubbers on Contactors and Solenoids. Contactor blocks, solenoids and relays need a snubber across the coil. Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise. If you are new to using snubbers more information can be found in Technical Bulletin #206, the latest version can be found here.

(http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/206.pdf)

- Keep wires short. Keep all cabinet wiring under 6ft.



Snubber (Quencharc) installed across contactor coil

Keep the cabinet maintainable and easily serviceable.

- Centroid can provide electrical cabinet materials such as contactors blocks, time delay contactor blocks, relays, fuse blocks, din rails, overload relay with fuses, din rail end stops, terminal blocks, etc. for purchase: https://www.centroidcnc.com/centroid_diy/cnc_components.html
- Wire management: Use PVC wire ducts (such as Panduit's Panduct) to keep your wires neat and organized.
- Use DIN rails for mounting relays, contactors, terminal blocks, circuit protection blocks, disconnects, etc.
- Take all corners in the wiring ducts as wide as possible. Always leave a little bit of slack in the wires.
- Keep all the wiring in neat horizontal and vertical lines. Never run wires diagonally.
- Take detailed pictures of the cabinet.
- Label EVERYTHING. Label everything so that it matches the labels on your schematic. This includes labeling each individual wire at both ends, circuit boards, relays, contactors, etc.

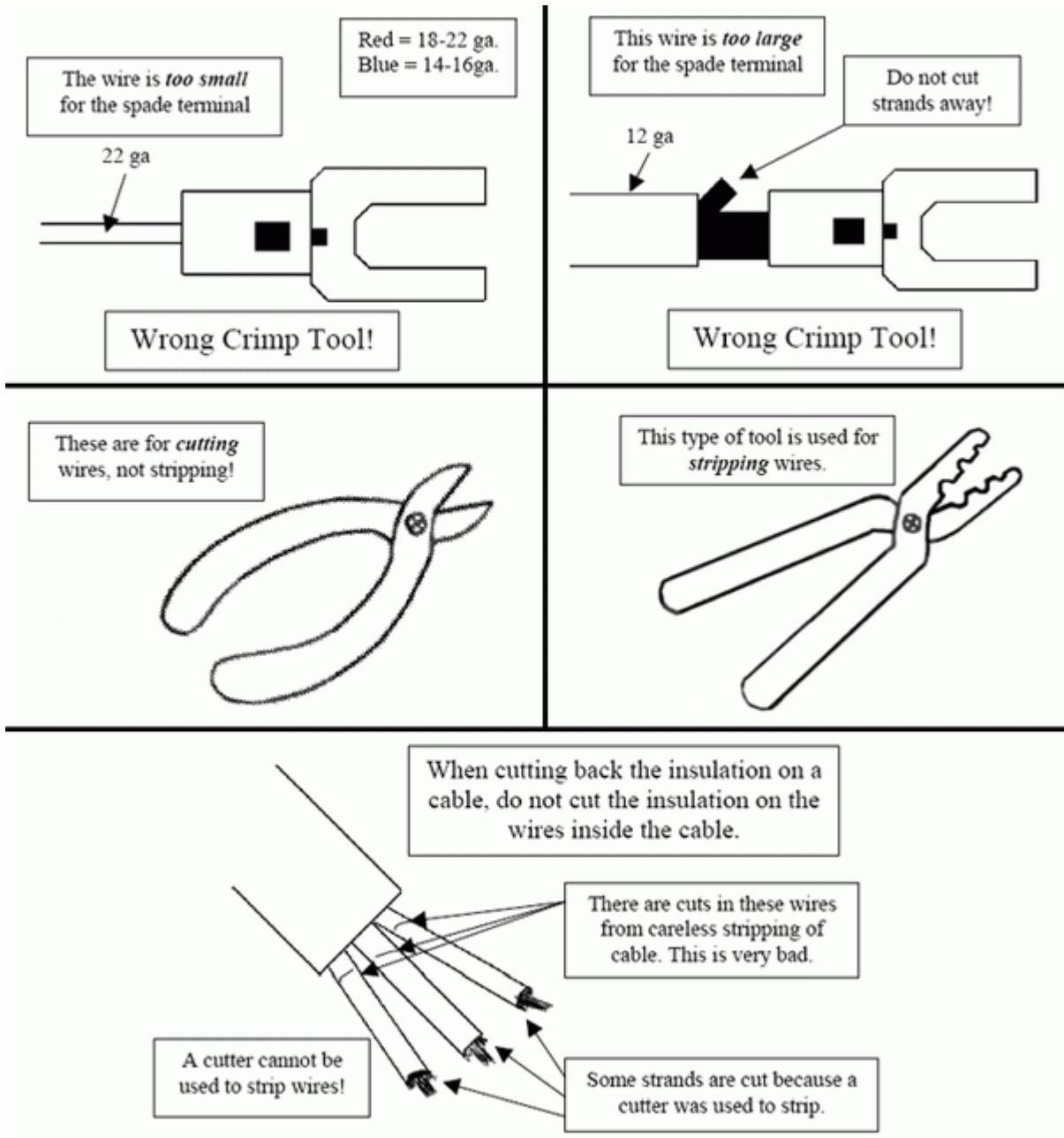
- Keep the schematic attached to the cabinet somewhere so it does not get lost.

Use the correct wire gauge.

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

Common Wiring Problems

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

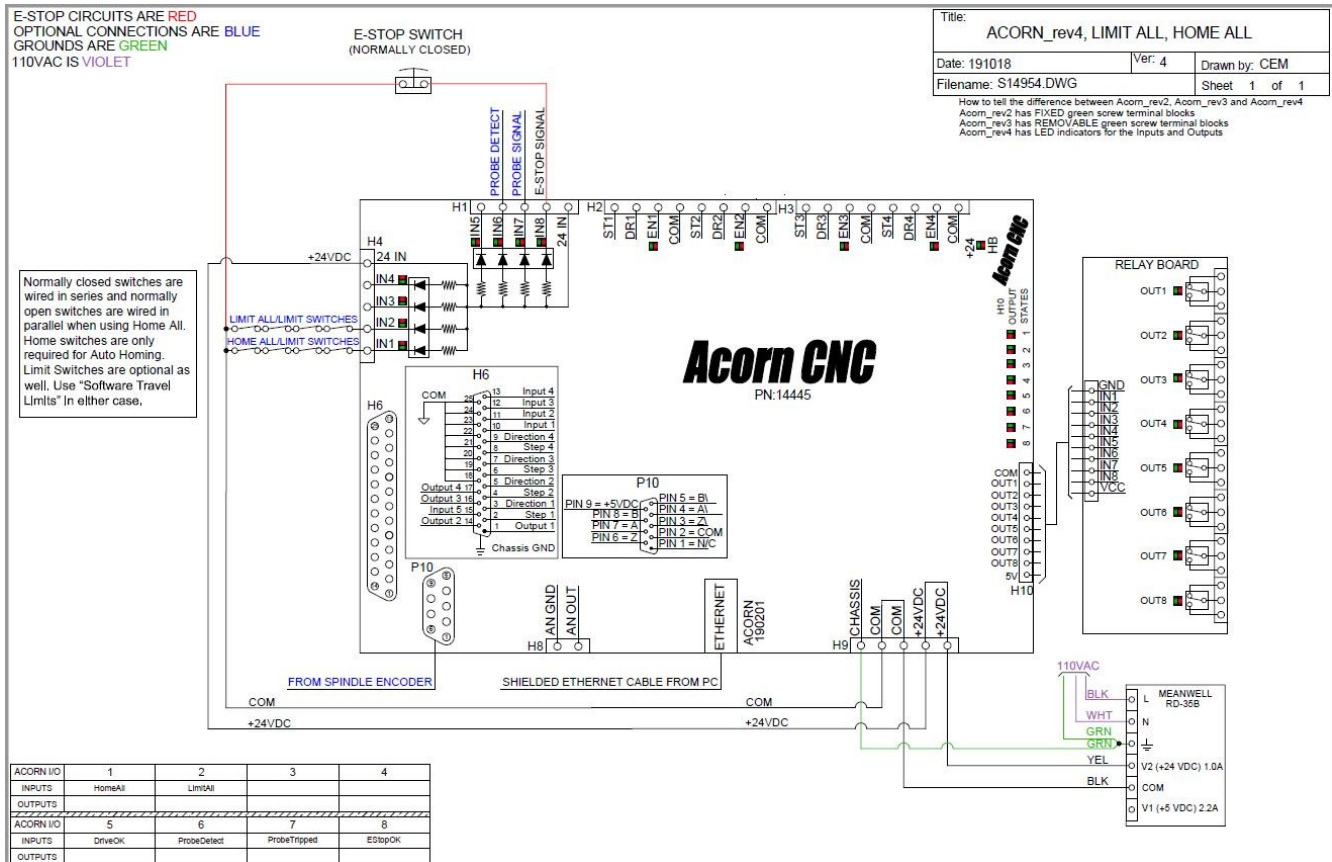


5.2 Acorn Inputs

The inputs of the Acorn are SOURCING 24VDC.

That is, the Acorn supplies 24VDC at the input and they must be “SINKed” to COMmon to activate them.

24VDC is supplied via 24IN on H4 or H5. These terminals are connected internally. Inputs 1-8 can be connected to home switches, drives, inverters, probes and other sensors and switches which sink the input to 0VDC COM.



Drawing S14954 Acorn Homing, Limit and E Stop

24VDC is supplied to Limit Switches/E Stop input in the example above. The switches connected to IN1 are the Homing switches and the optional limit switches connected to IN2 are for limit switches designed to stop an accidental over travel.

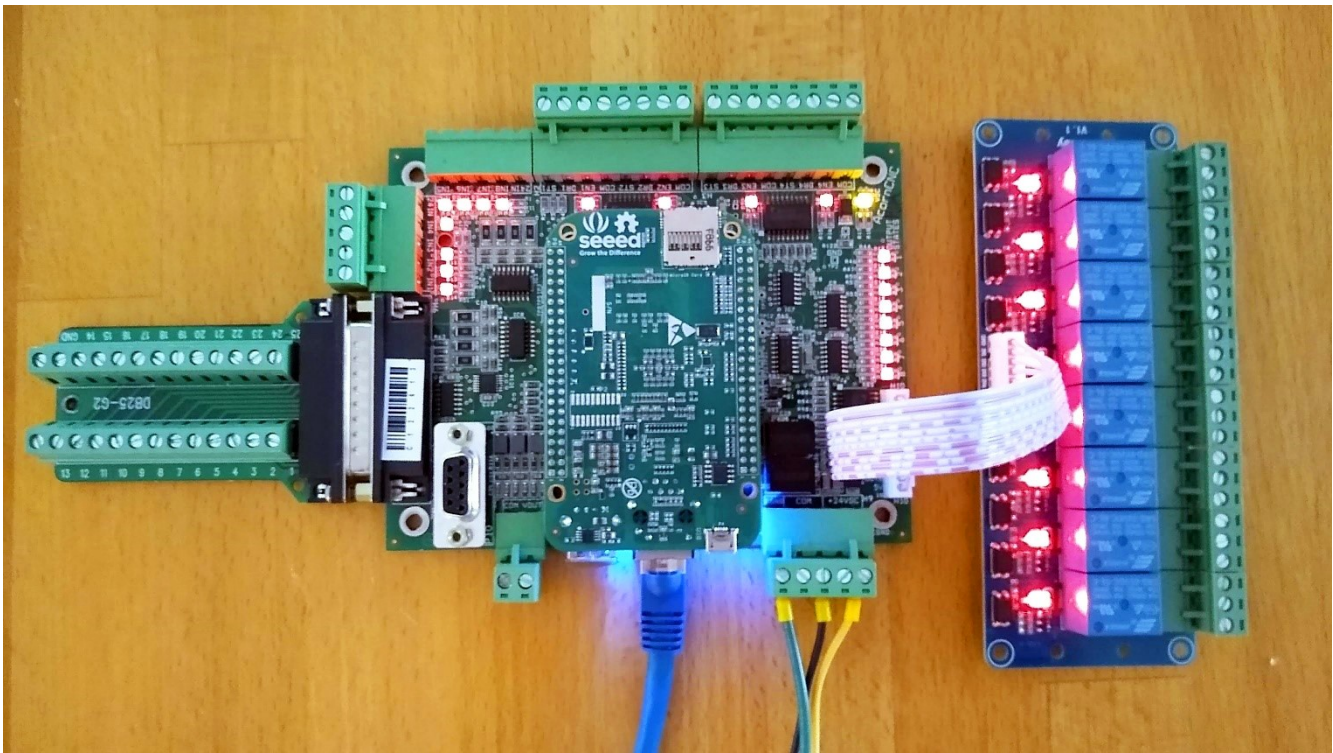
When the device is active, a complete circuit is made allowing current to flow from 24VDC to 0V COM. This activates the input on the Acorn.

Acorn inputs are activated by closing simple external switches. This is known as the “contact closure to ground (COM)” method.

When using Proximity Switches, Hall Effect Sensors etc., use NPN type sensors compatible with +24VDC for use with Acorn. See Acorn schematic #S14955 for hookup of Proximity Switches.

5.3 Acorn Outputs

Centroid Acorn is equipped with 8 relay outputs. Each Acorn output toggles one SPDT relay.



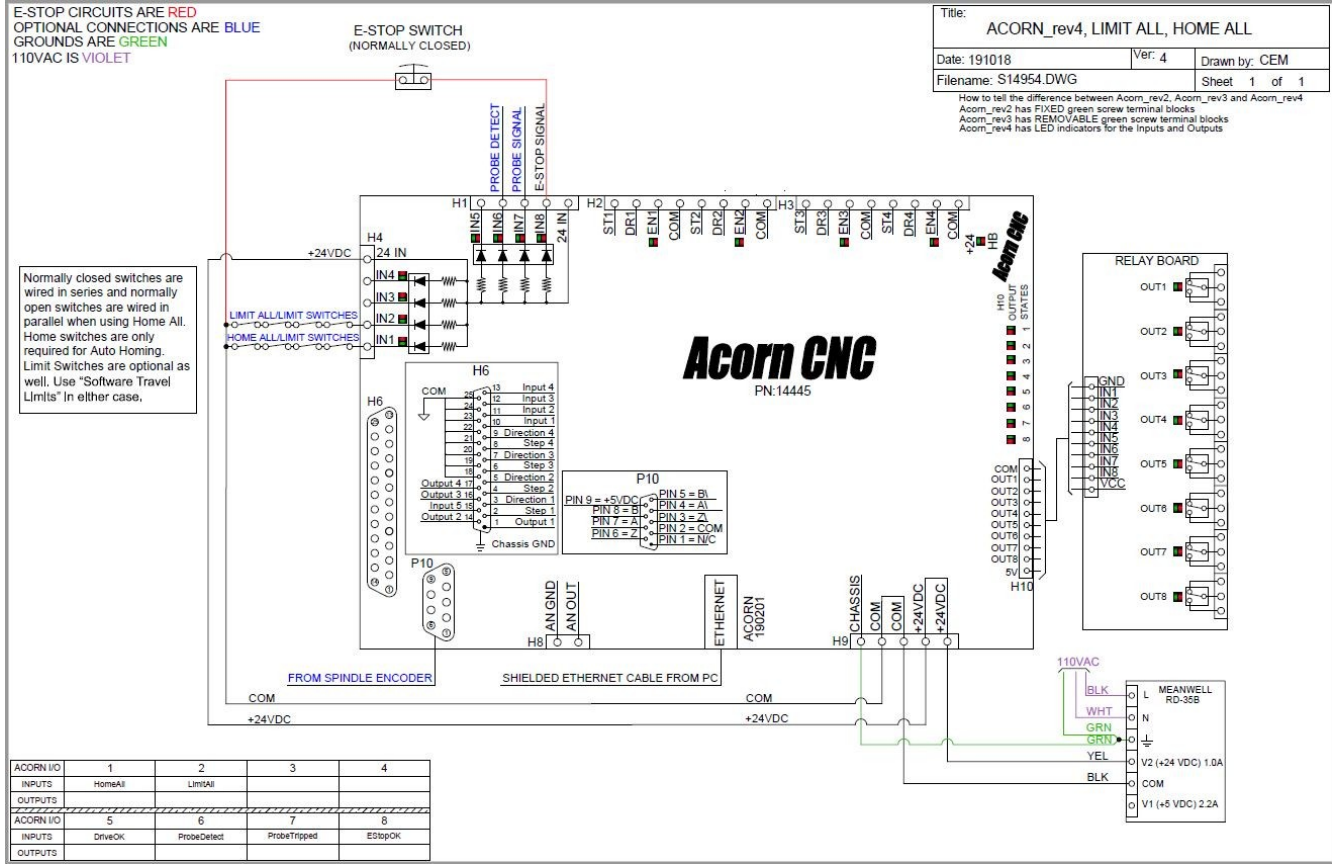
Acorn board with Output Relay Module and DB25 Breakout installed

5.4 Wiring +24VDC jumper to inputs.

Install a jumper from the spare +24VDC terminal H9 and run it to either H1 OR H4 24V IN. (they are internally tied together on the Acorn).

5.5 Wiring E-Stop Circuit

Basic Bench Test Estop Circuit wiring schematic S14954



Acorn Schematic: S14954 Acorn Limit, Home and E Stop wiring example

E-Stop Basics

- The required emergency-stop (or E-stop) circuit is a safety mechanism used to shut off the machine during an emergency.
- The E-stop switch(s) is closed when the machine is in its operational state.
- A normally closed E-stop circuit prevents noise from causing spurious faults because the signal is closed when in a good state.
- For additional safety, multiple E-stops can be added to a machine and can simply be wired in series with the first estop switch.
- NOTE: Wiring E-stop in a normally open (NO) configuration is dangerous as it will not stop the machine in the event of a wire break or switch failure. Do not use a Normally Open (NO) switch for Estop.

E-Stop Switch

- Use a double pole single throw (DPST), normal closed, twist to release, emergency stop switch. Such as Centroid part number #1009 used with #5934 [available on this page.](#)
- Acorn E-Stop connections - There are two E-stop signals, one input and one output.
- Input 8 is typically assigned to the E-Stop. Input 8 on header H1 needs to be routed in series with any E-stop switches, so that if any of the E-stop switches are tripped the Acorn PLC knows that the E-stop switch is engaged.
- Any Acorn Output can be used to energize an Estop Contactor. Centroid typically uses Acorn Output 1 for Estop duty. The Acorn PLC output designation for the Estop circuit is “NoFaultOut”.
- The Acorn's Output 1 relay is rated for up to 10 amps at 125 VAC or up to 5 amps at 30 VDC. Typically 24 volts DC or AC is used to energize the Estop contactor coil.

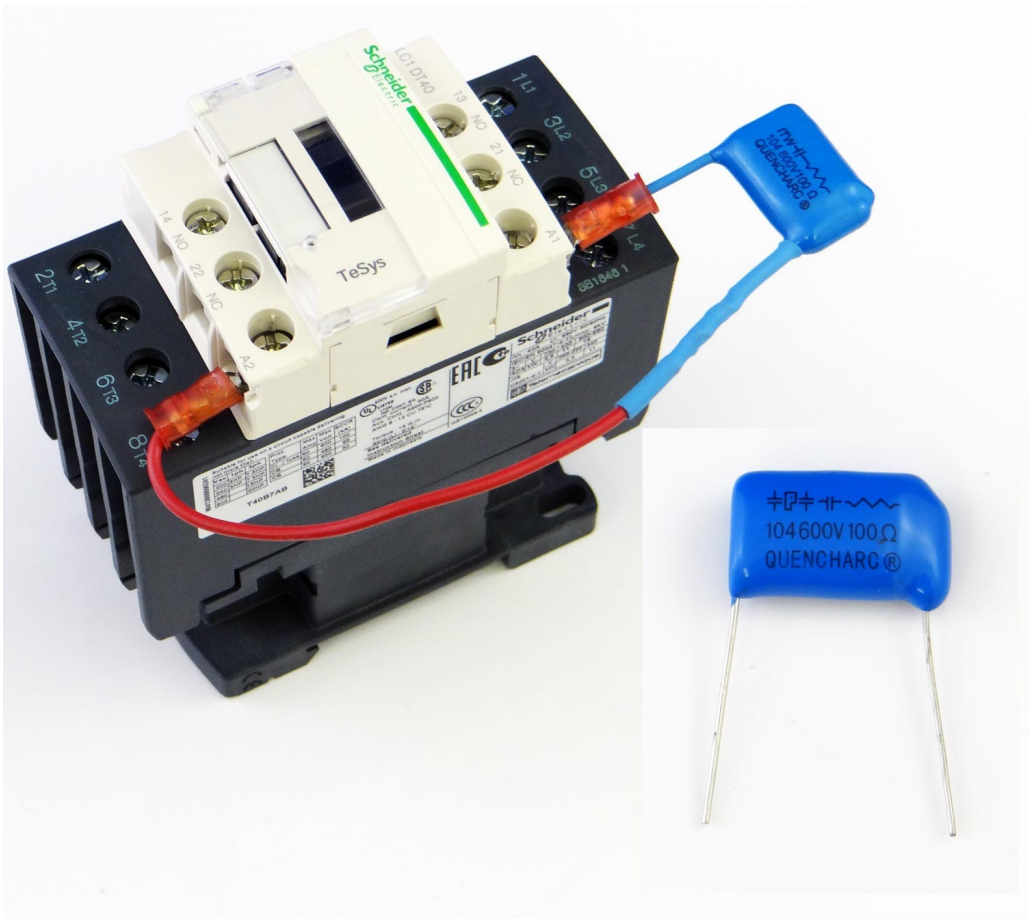
E-Stop Switch wiring:

Wire a Normally Closed Estop button (NC): Connect one wire from one NC terminal on the Estop button to Acorn power supply COM (or the spare COM Terminal on H9). Connect another wire from the other NC terminal on the Estop button to H1 IN8 (Input 8).

E-Stop Contactor

It is good practice to incorporate what is known as an “E-Stop” contactor in your build. It is powered by a separate power supply and energized with Acorn Output Relay 1 NO contacts. (Assigned in the Wizard NoFaultOut) Note: Do not use the Acorn Logic power supply to power any contactor. (Reminder, USE a snubber across the E-Stop Contactor coil)
Diagram shown above.

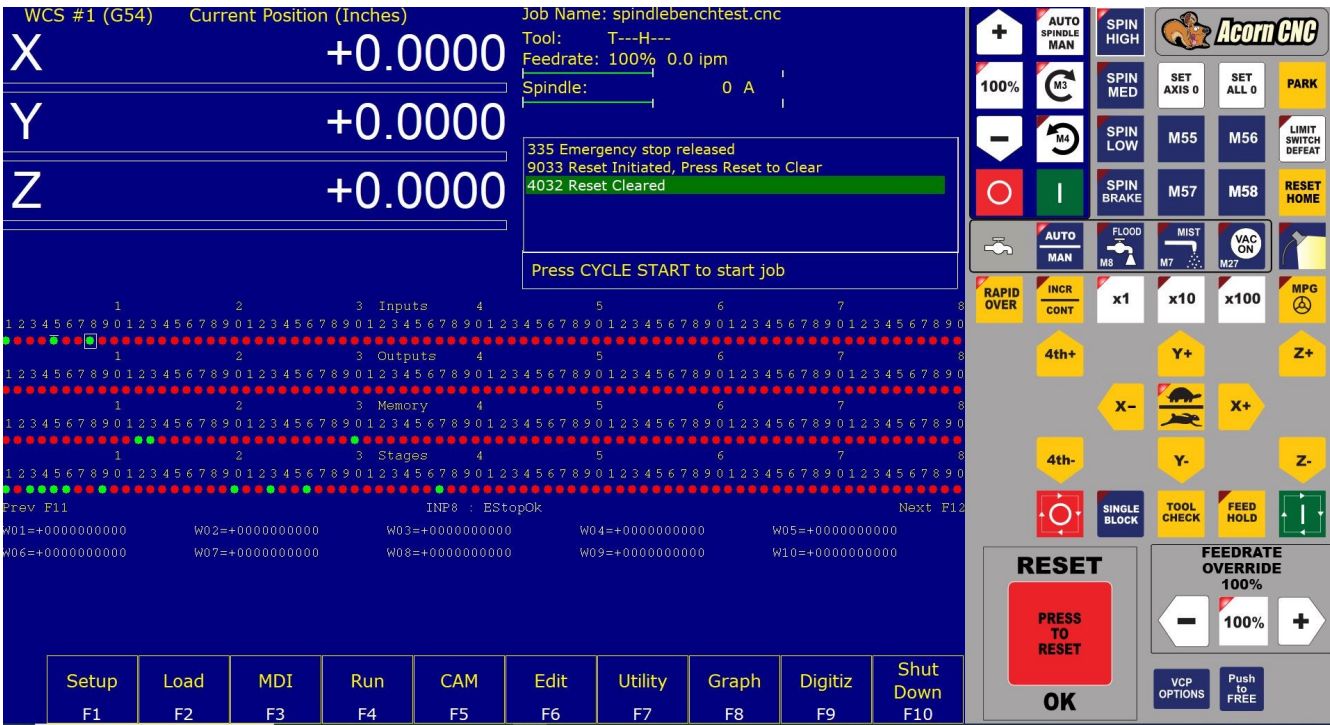
- A contactor is an electrically controlled switch. It can be thought of like a higher current relay. The contactor is energized by low voltage low amp power that is switched by one of the Acorn Relay Outputs, typically Output 1. The contactor allows the Acorn board to cut high power devices automatically when the Estop Button is depressed.
- Estop contactors are typically used to turn on and off high power (high voltage/high amps) to axis drives as well as to turn off the main spindle and any other high power device connected installed on the machine tool.
- If you are not using a contactor with a built in or addon snubber, a snubber needs to be placed across the contactors. Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise when the contactor is cycled on and off.
- For larger machines with AC servos, Centroid recommends using a Schneider Electric/Telemecanique LC1DT40B7A or similar device for the E-stop contactor (Centroid PART# 14374). This Contactor assembly includes the snubber assembly and uses 24VAC to control it. Contactors must be sized appropriately to the given load, AC or DC voltage and the current requirements.



Contactors with snubber installed across the coil

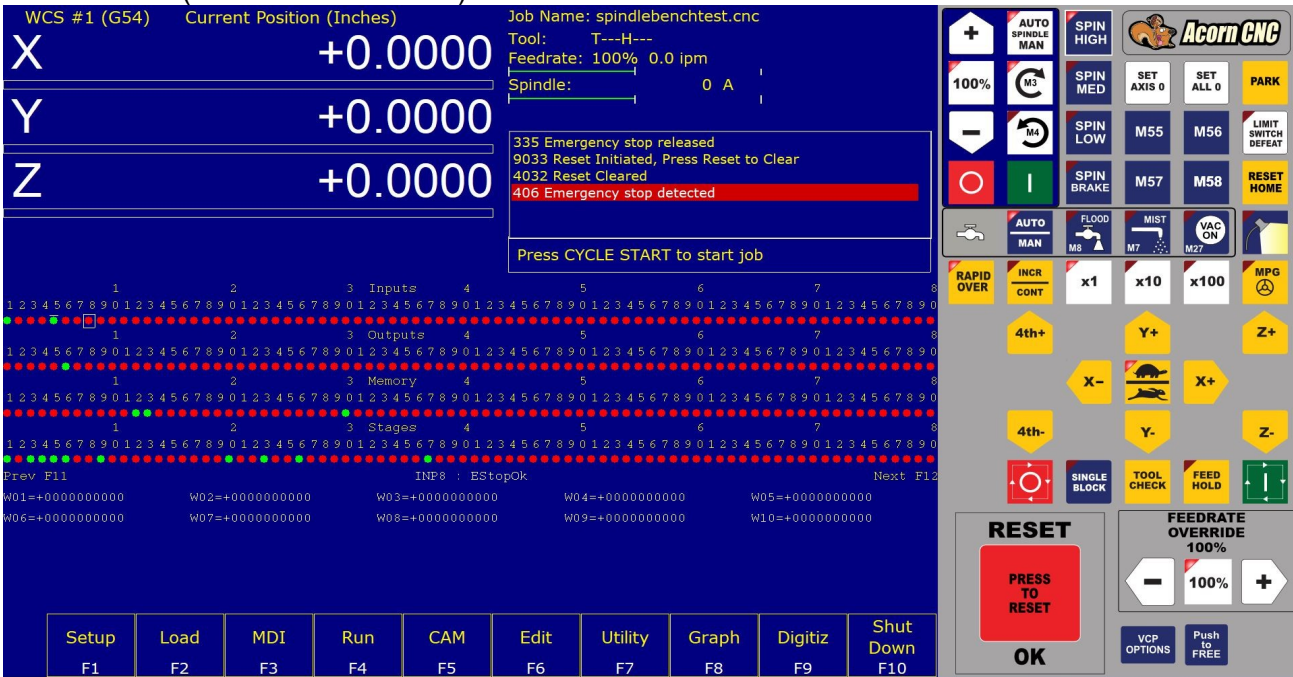
Testing the E-Stop Wiring

- Power up the system
- Start CNC12
- In the main menu press alt+i, to bring up the real time I/O display. Using the arrow keys, move your cursor to the top row of virtual LED's (inputs). From the far left, move the cursor to the 8th LED from the left:
 1. The "Screw Terminal" bench test drive type configuration defaults the Estop Input 8 as inverted. This is done this way so the first time the Acorn system is powered up for the communications bench test CNC12 will not go into Estop mode this is required since at this point there is no estop switch connected to input 8. Now that we have an Estop switch wired to input 8 it is necessary to un-invert input 8 so the NC Estop switch will work properly. How to invert an input or un invert an input is explained in the PLC diagnostic user manual here.
https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/cnc12_PLC_diagnostic_screen.pdf



Real time I/O display Estop input 8 is green indicating the Estop has been released.

The Estop Input 8 LED will change states (Red to Green) when the E-Stop button is pressed (button IN = Red) and released (button OUT = Green).



Real time I/O display Input 8 is RED indicating the Estop button has been depressed.

5.6 Wiring Axis Motor Drives

Each Centroid Acorn drive schematic has a corresponding “Drive Type” found in the Wizard. Choose a schematic that matches your drive type, and select that same drive type in the Wizard and the Wizard will automatically configure CNC12 to match the schematic.

For instance:

IMPORTANT: While on the bench, take the time to wire ONE axis drive and one Axis Drive and Motor. Configure and test it. Once you have one drive and motor successfully configured and turning, then replicate the steps to attach and configure the remaining drives and motors on the bench. Verify all are working by jogging each axis using the Virtual Control panel before proceeding.

[top](#)

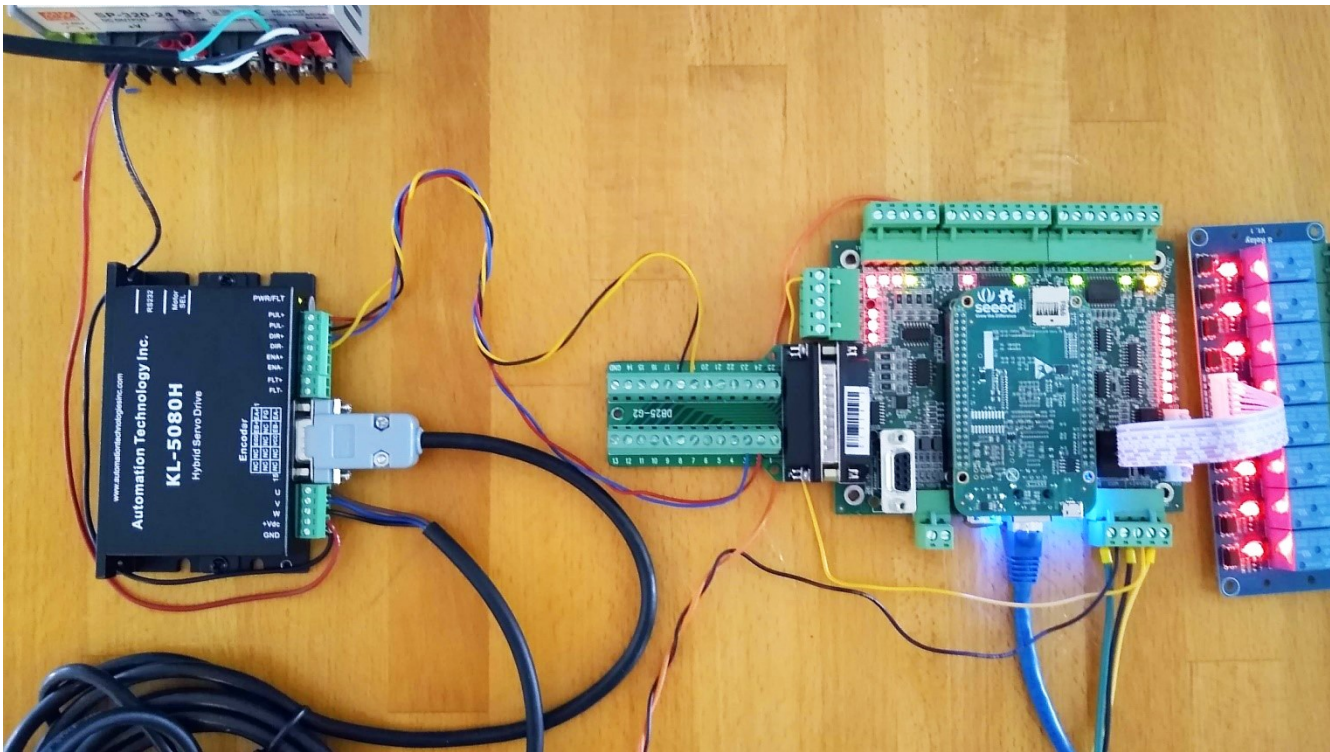
The Acorn supports a wide variety of Axis drives that take standard step and direction input. There are two ways to connect AXIS motor drives to the Acorn. The Axis drive headers (H2 and H3) are generally reserved for AC servo motor drives. These are open collector outputs used to signal step, direction and enable to a connected axis drive. Below is an example of Acorn to Estun AC servo drive wiring using the Acorn open collector step and direction outputs. Schematic S14965.

The DB25 connector is also provided for drives that use a +5VDC Logic input. This is the recommended method of connecting most Stepper Motor drives such as Leadshine and other similar drives using +5VDC logic.

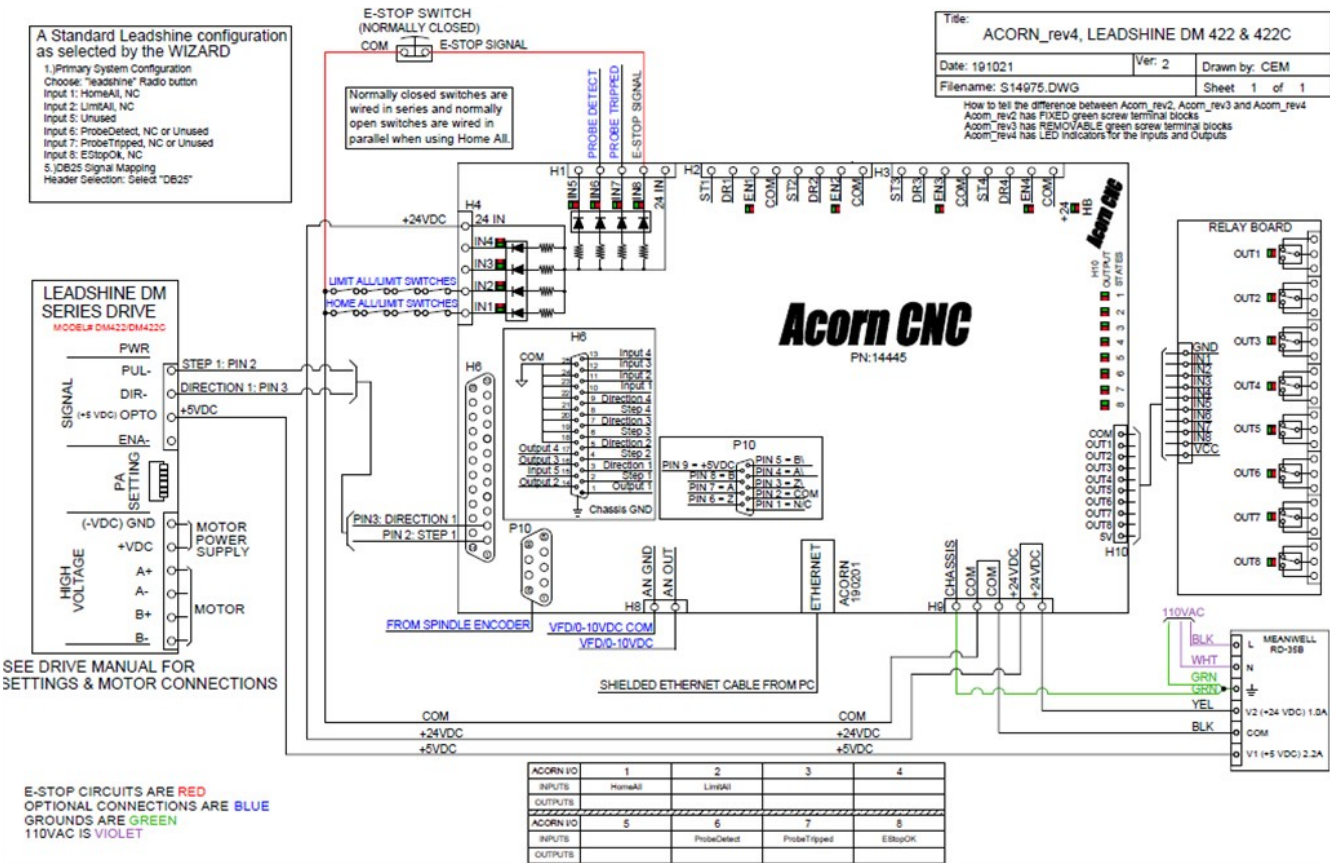
More information on DB25 vs Drive headers can be found here:

Centroid Community CNC Support Forum: DB25 or Header? for drive connections...
<https://centroidcncforum.com/viewtopic.php?f=63&t=2227>

A DB25 male breakout board is recommended for easy stepper motor to Acorn DB25 connection.



Stepper motor driver wiring to Acorn using the DB25 connector.



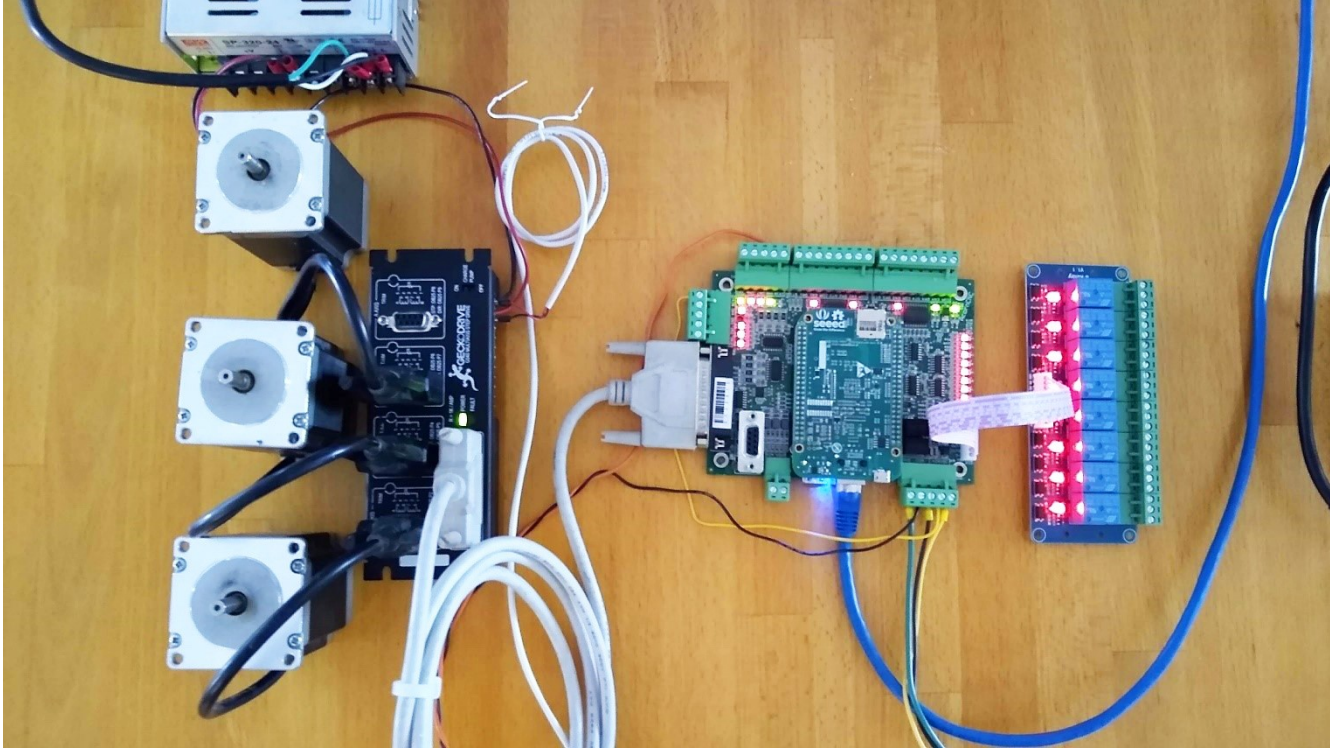
Schematic S14975 of a typical Leadshine stepper drive wiring

Legacy Parallel Port support

The DB25 can also be used to connect directly using a straight through parallel cable to legacy control systems that previously used a PC compatible parallel port.

This style connection is found in some import tabletop routers and the Gecko G540 is also cable compatible.

Note: For non standard DB25 pin configurations, the Acorn DB25 pin functions can be rearranged and reassigned in the CNC12 wizard that saves creating a custom cable or connection.



Teknic Clearpath

Acorn systems with multiple Clearpath servos require a unique setup so that the servo fault signals reliably trigger one Acorn input. There are currently two approved methods for connecting Clearpath SDSK/SDHP motors to Acorn.

That information can be found here:

<https://centroidcncforum.com/viewtopic.php?f=60&t=5531>

Centroid has created example schematics for many popular axis motor drives. Search “Acorn” on the Centroid schematic page to see all Acorn schematic. As of this writing Acorn to: Yaskawa, Estun, Delta, Clearpath, Leadshine, Stepper Online, GeckoDrive, Centroid Micro 1, DMM. [Links to all Acorn schematics are here along with All Acorn documentation.](#)

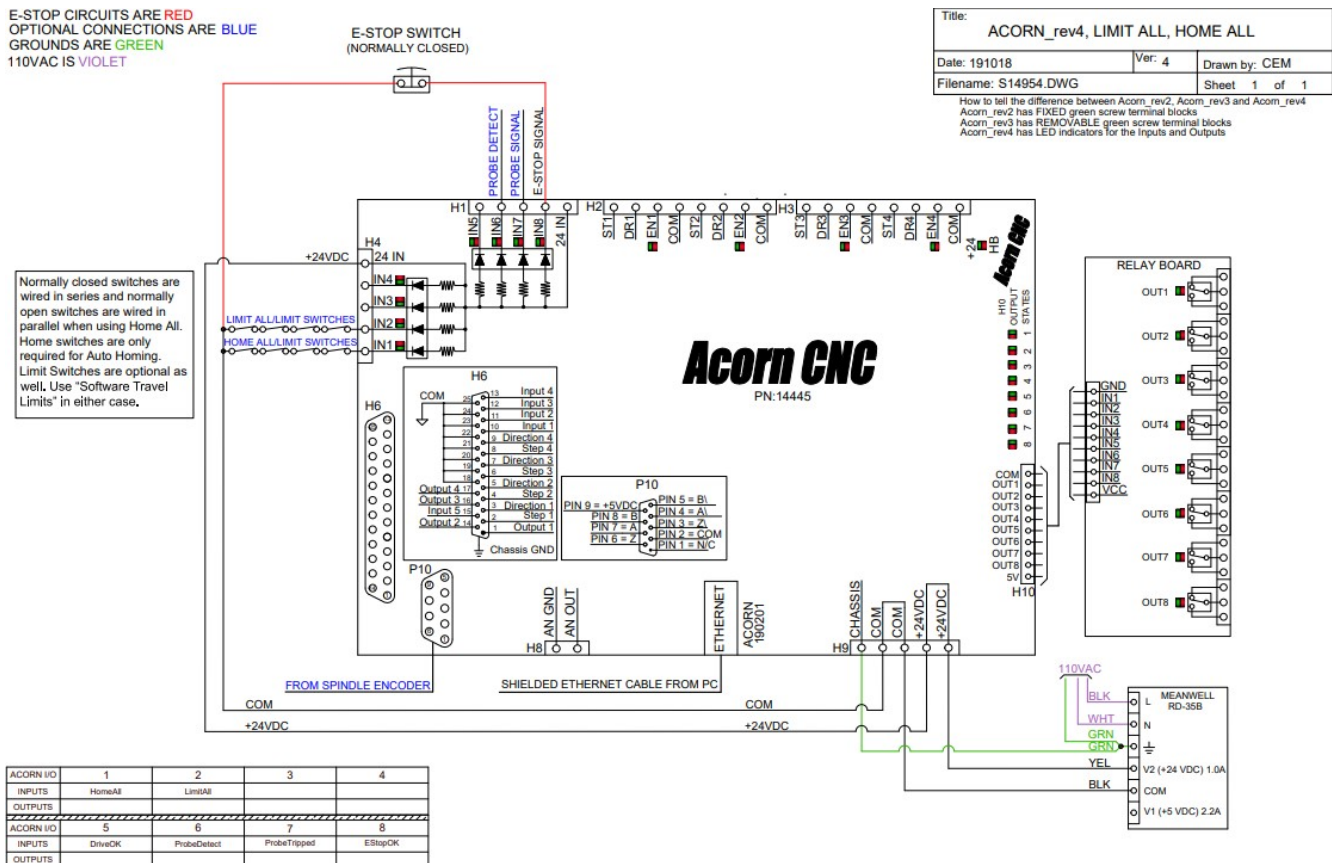
5.7 Wiring Home and Limit Switches

All inputs used for Limit and Home switches should be of the normally closed type switch. The switch should be closed when the machine is in its operational state.

Note: Using Normally Open switches for Limit or Home switches is dangerous as the machine will not stop in the event of a wire break or switch failure. Using NO switches also introduces more sustainability of electrical noise causing an erroneous input trigger.

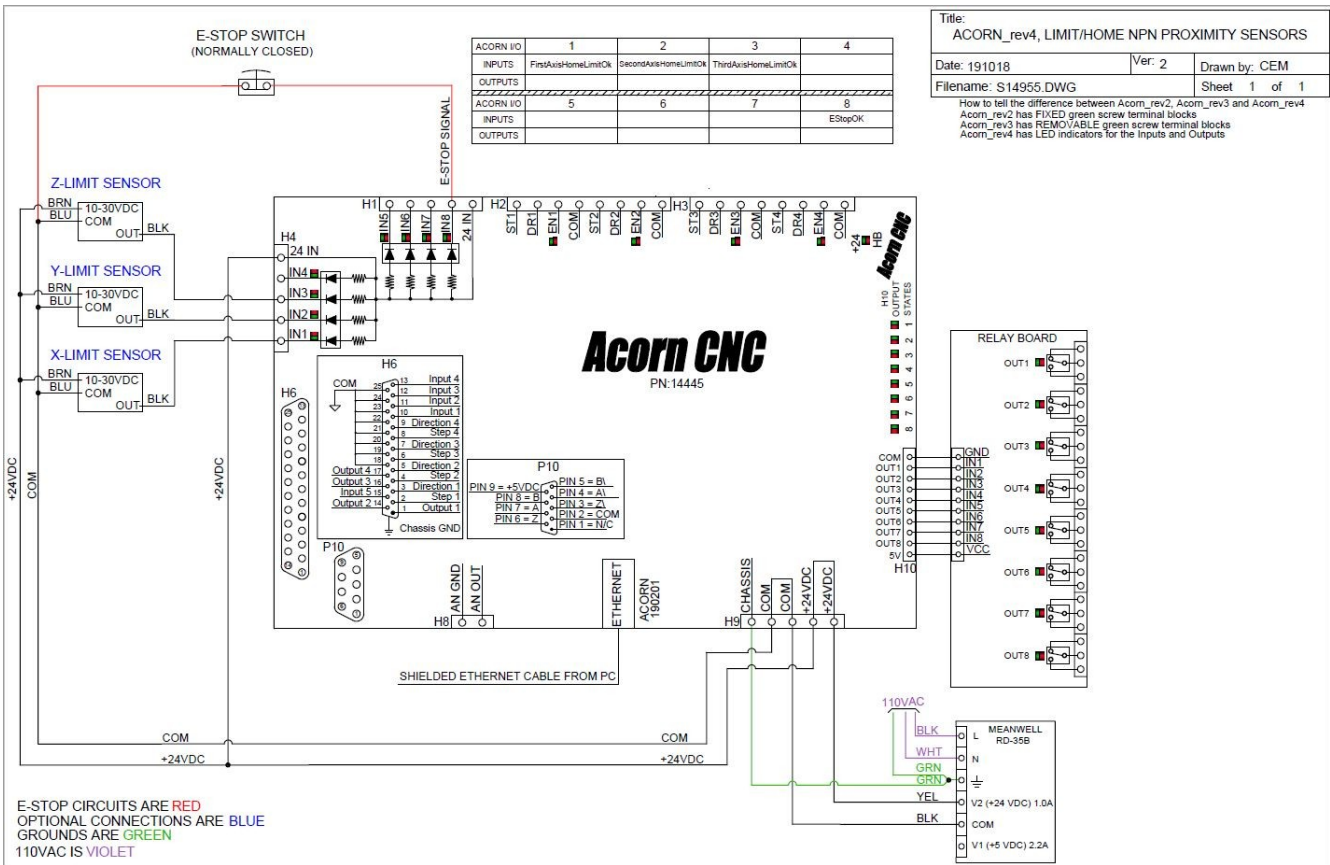
The I/O configuration on every machine is different. While the examples below assume dry contact type switches utilizing 24VDC, your machine may utilize different voltage levels and different type devices such NPN or PNP proximity sensors. If your devices are proximity sensors, they **MUST** be 3-wire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

Connect the Home and the OPTIONAL limit switches as shown below in schematic S14954. When Input 1 is configured as HomeAll, the normally closed switch from each axis will all be wired in series conserving 2 inputs, while this is not the only way to wire and configure home switches this is the preferred Acorn Home switch wiring technique.



Schematic S14954

If using proximity sensors (THEY MUST BE NPN) as home switches follow this example:



Schematic S14955 Proximity sensor wiring

Testing Limit Switch Wiring

- 1 Power up your system.
 - 2 Start CNC12.
 - 3 From the main menu press alt+i to bring up the real time I/O display.
 - 4 Top line of virtual LED's are the inputs. Input 1 starts at the far left.
 - 5 Confirm that all limit switches are green when nothing is tripped.
 - 6 Confirm that the correct input turns red when each switch is manually tripped.
 - 7 To toggle the diagnostic screen, press alt+i to return to the main CNC12 screen.
- See the PLC Diagnostic Menu Users guide for more info located in [All Acorn Documentation page here.](#)

REFERENCE:

Martyscncgarage: Centroid Acorn CNC Basics - N.O. vs. N.C. Switches & E-stop Contacts
<https://www.youtube.com/watch?v=j3VPnozuuug>

Special cases such as axis pairing and auto squaring refer to the Centroid Acorn CNC12 Axis Pairing and Squaring Manul which has detailed home switch wiring examples.

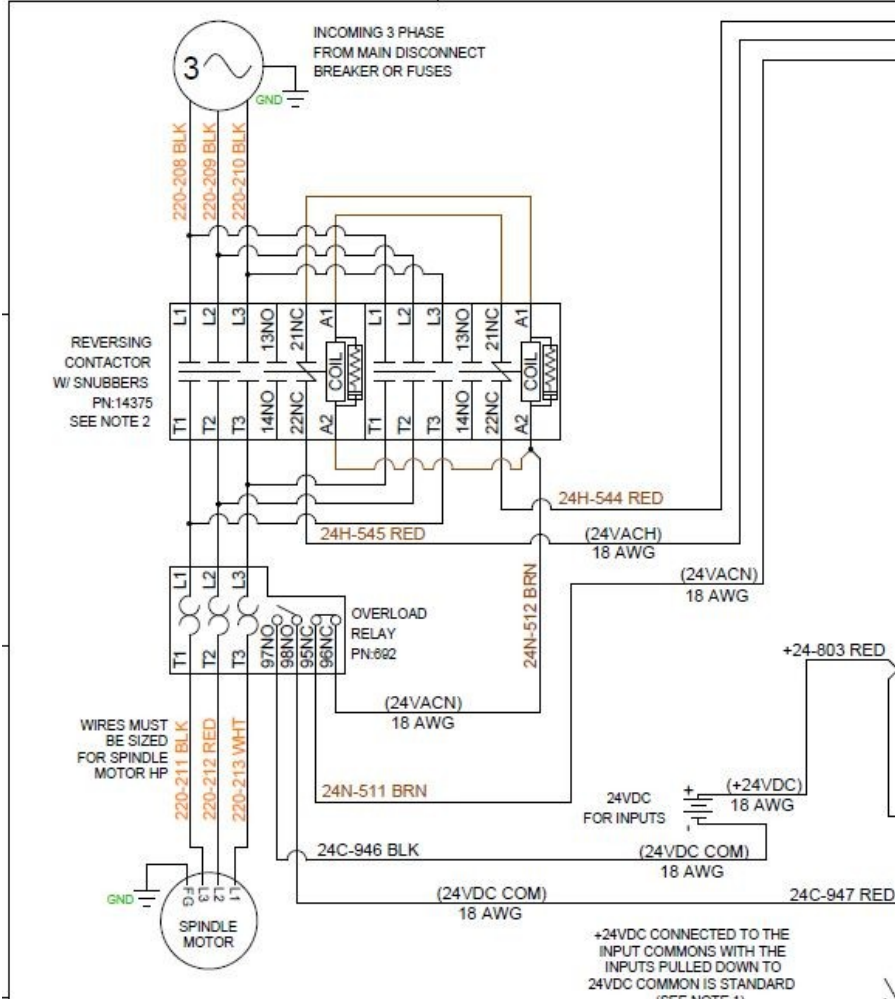
https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/paired_axes_acorn_user_guide.pdf

5.8 Wiring the Spindle Motor

STOP! Before wiring the spindle make sure that you have already bench tested the spindle analog output as previously directed during the board level tests.

There are two methods of wiring a spindle:

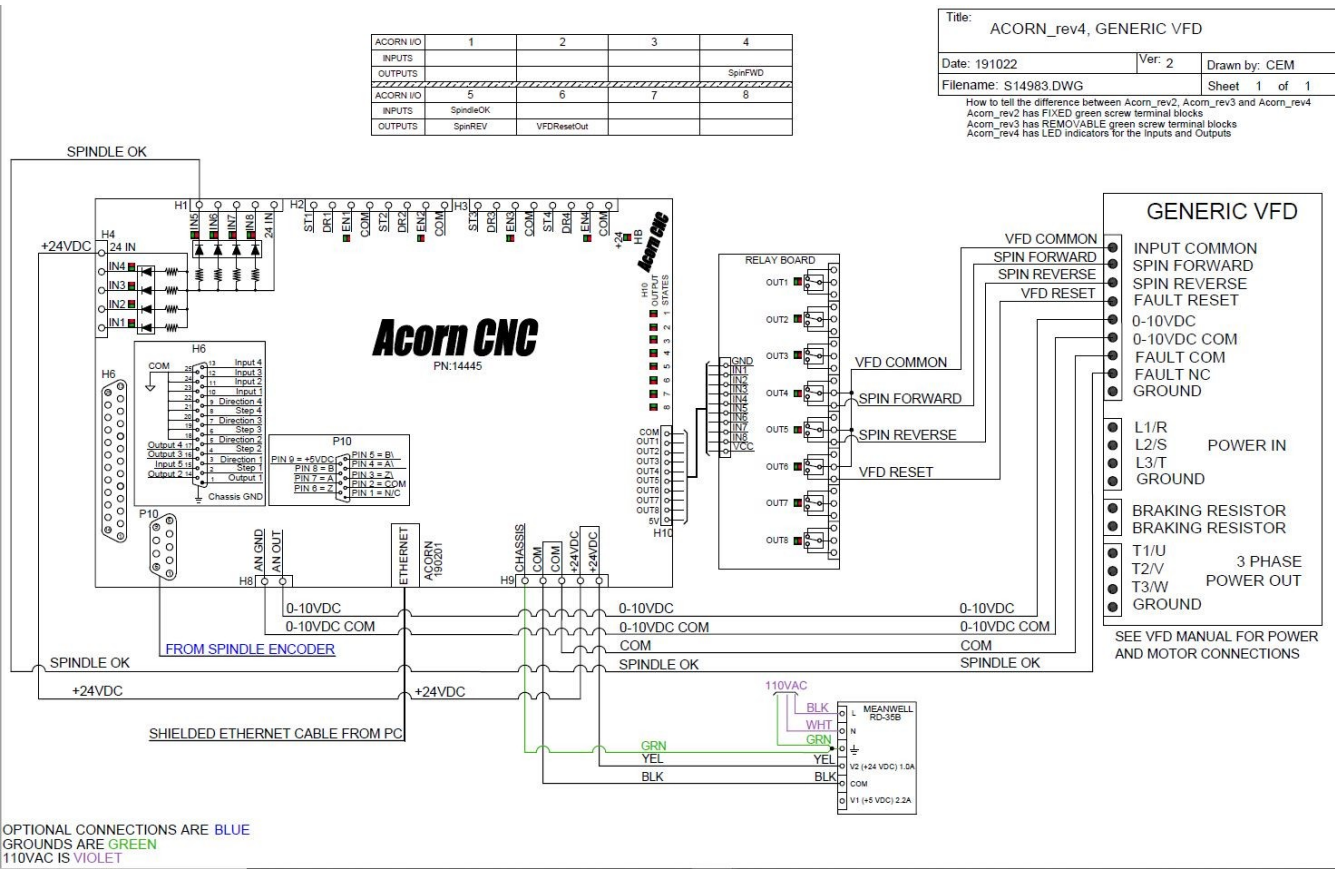
- 1 Connect three phase directly to an induction spindle motor using contactor(s) as shown in this example:



Hooking the three phases directly saves costs, but prevents the Centroid CNC software from being able to control the speed of the spindle. The spindle speed will have to be controlled by mechanical methods such as pulleys.

A contactor can be used to turn the spindle on and off with the software. A reversing contactor with snubber #14375 from Centroid can be used to change direction.

- 2 Preferred method: Use a spindle controller. Variable Frequency Drive for example:



Spindle VFD Controller example

Note: “Inverter”, “AC Drive”, and “VFD” (Variable Frequency Drive) are terms that are used interchangeably and refer to the spindle controller.

Centroid does not provide spindle controllers and recommends:

- Delta Products VFDs
- Automation Direct GS2 and GS3 AC drives
- Yaskawa VS (Varispeed) Inverters

It is the responsibility of the installing technician to consult their spindle controller manufacturer for support.

The Acorn Wizard can configure the I/O for use with a spindle. For example:

- Input 6 could be used for the Spindle Fault input
- Output 4 is SpinFwd
- Output 5 is SpinRev
- Output 6 is the inverter fault reset
- An input needs to be assigned to the spindle fault output SpinOk (Input 5 in the diagram above)
- Always refer to your schematic

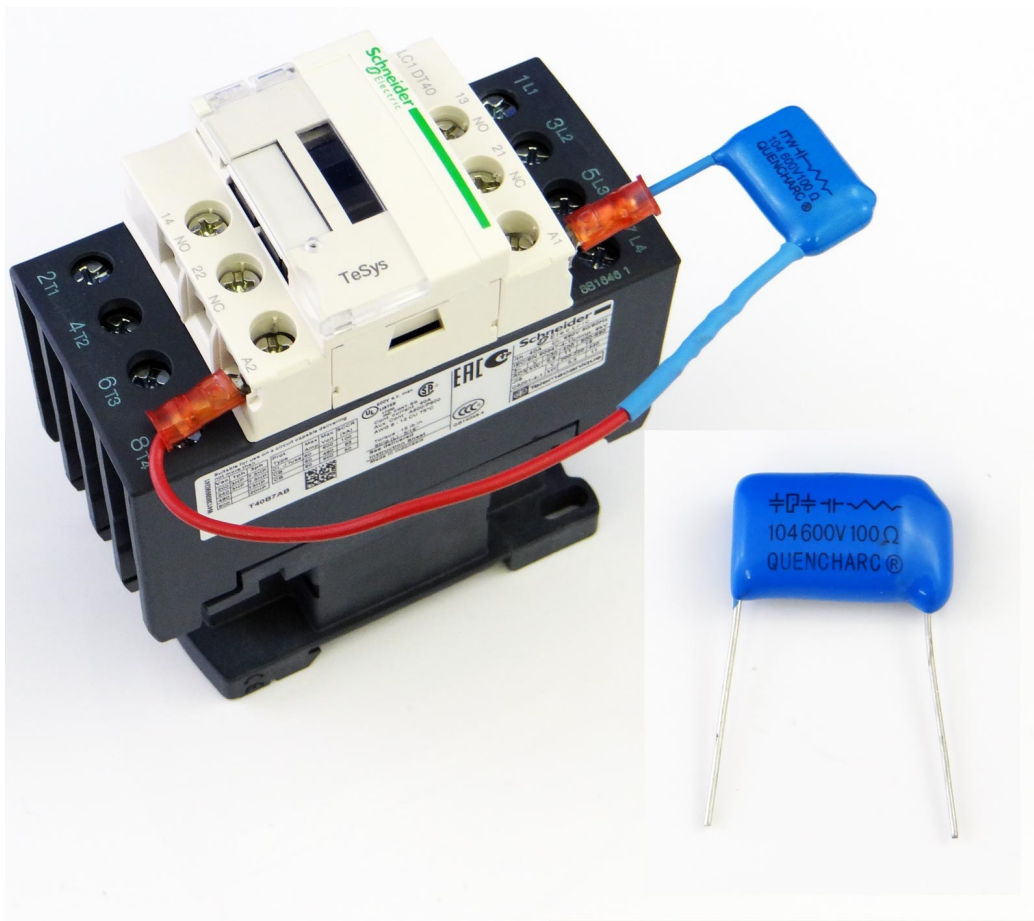
Other spindle drives may be used. (DC Spindle Drive) HOWEVER, it is important to verify that the Analog inputs are isolated. If they are not, or it is not known and you connect them to the Acorn’s 0-10V analog output, you may severely damage the Acorn and possibly your spindle drive. If they are not isolated, you will need to

source a signal isolator such as the KB Electronics KBSI-240D or replace your drive with one that has a Signal Isolator on it.

Centroid Community CNC Support Forum: Video: Installing a KB Electronics KBIC-120 & SI5
<https://centroidcncforum.com/viewtopic.php?f=61&t=2027>

Centroid Community CNC Support Forum: Setting up and Benchtesting an Automation Direct GS1 VFD:
<https://centroidcncforum.com/viewtopic.php?f=61&t=2446>

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



Contactors with snubber installed across the coil

5.9 Spindle Encoder Wiring and Configuration

For spindle slaved movements such as rigid tapping and threading (lathe), the spindle encoder needs to be connected to the Acorn. The spindle encoder must meet the prerequisites listed in [section 5.9](#).

[Additional Encoder basics information is located in the Acorn Knowledge Base forum here.](#)

[Video covering Acorn Encoder basics with Rigid Tapping parameter sheet is here.](#)

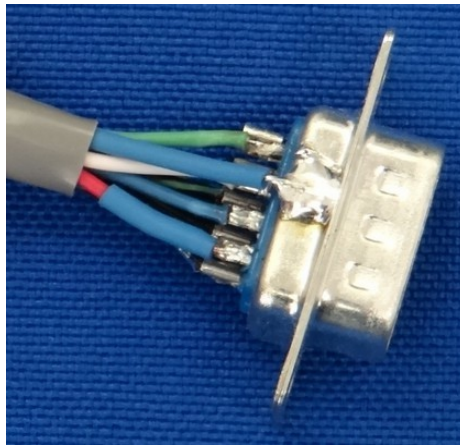
Rigid tapping should be enabled last, after the spindle is functioning and the machine is successfully wired and configured.

A multitude of software parameters need to be set up for rigid tapping, which is beyond the scope of this document. More information on how to set up rigid tapping is contained in your CNC12 operator's manual and the Acorn Rigid Tapping parameters cheat sheet [both are found in the All Acorn Documentation thread here.](#)

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

- 1.1 Encoder Cables: The encoder cables MUST be twisted pair shielded cables. The shield wire of the encoder cable needs to be grounded to the metal shield of the DB-9 connector as seen in figure 2.3.1. If the D-sub connector does not provide a method of attaching the shield wire, the shield wire should to be soldered to the metal shield DB-9 connector.

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



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

- 1.2 Encoder Output: Encoders must have RS422 type (differential) quadrature outputs with A, B, and Z channels to work with the Acorn. A 1000-line encoder count is suitable for a spindle. Be sure to check the specifications of the encoder to ensure it will operate at the highest spindle RPM.

The following link lists encoders and premade encoder cables available through Centroid.
http://www.centroidcnc.com/centroid_diy/cnc_components.html

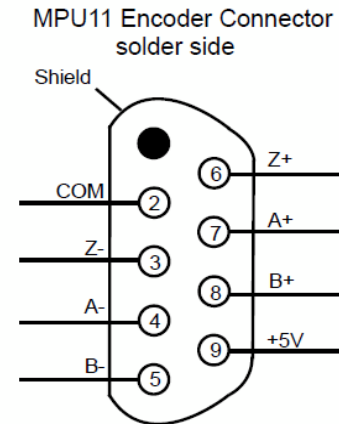
- 1.3 The outputs have additional voltage level requirements described in the table below:

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

1.4 Wiring Code: Wire the encoder according to the diagram and the table shown below. Refer to the encoder manufacturer's data sheet for the wiring color code.

4.1 Note: The +5V is an output provided by the ALLIN1DC.

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



If you have a spindle encoder, ensure it was connected to the Acorn spindle encoder port prior to powering up the Acorn. If not, stop, power down the Acorn, the CNC PC, connect the encoder, and power the Acorn and the CNC PC up and start CNC12.

- 1 From the main menu press F7-Utility → F10 Acorn Wizard. Then go to SPINDLE and under it, SETUP. Make sure the proper Spindle Encoder Counts value is entered. (Encoder counts per revolution X 4. For example, if you have a 1000-line encoder, enter 4000 in the Spindle Encoder Counts field).
- 2 From the main menu press F1-Setup → F3-Config. The password is 137. Press F4- PID.
- 3 Manually rotate the encoder one full revolution. Record how much the motor has counted. (This value should be close to equal to the WIZARD Spindle Encoder count field).

Chapter 6 CNC 12 Software Configuration Using the Wizard

6.1 Introduction to Software Configuration

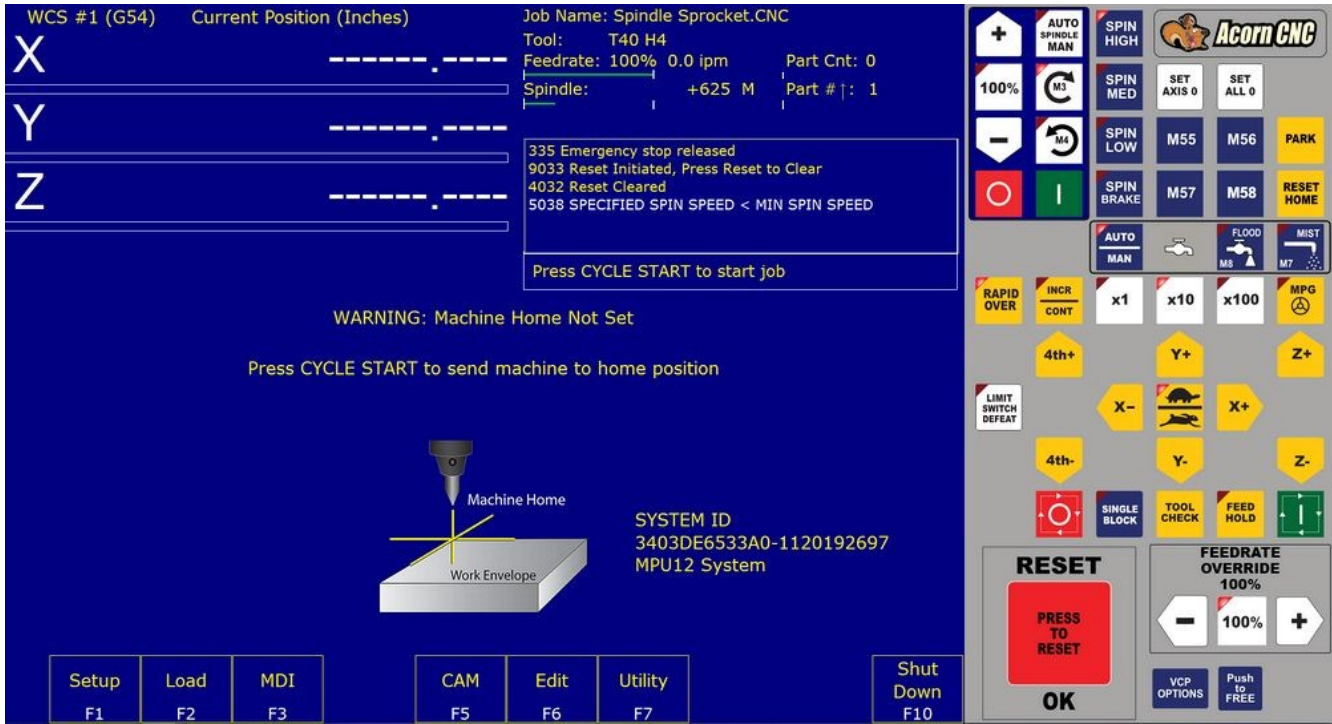
This chapter assumes that you have completed the board level test above, do not proceed to this section until the bench test above have been completed..

Acorn CNC12 provides a "WIZARD" for setting the parameters needed for proper CNC Control of the machine. It allows the user the ability to select, adjust, and assign:

- AXIS motor Drive Type
- Inputs and Outputs
- Machine Overall Turns Ratio
- Axis direction reversal
- Motor/Drive steps per revolution
- Machine Travel Limits

- Homing routines
- Axis Pairing
- Step Rate
- Spindle configuration
- Touch Device (Tool Touch off Probes and Probes)
- Input Devices such as Wireless Manual Pulse Generator (MPG), Keyboard Emulators
- DB25 Signal Mapping
- CNC Control and Wizard Preferences.

Lets start at the top of the Navigation tree and work our way down through it. To access the Wizard Screen, from Main Screen F7 Utility:



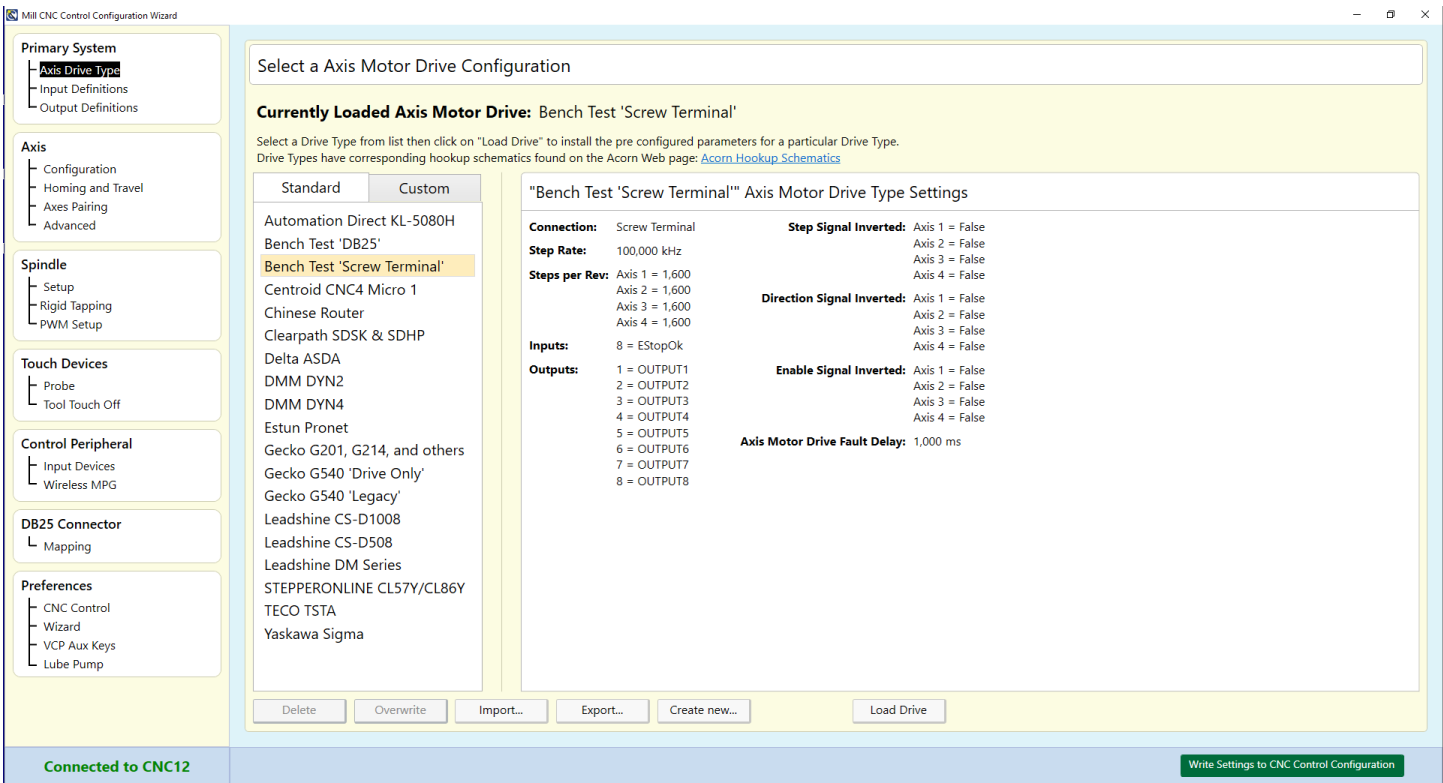
CNC12 Main Screen

Then select F10 Wizard:



CNC12 Utility Menu

6.2 Primary System Axis Drive Type



Wizard Axis Motor Drive Type Menu

This screen allows you to manage and select and even create “drive types” A “drive type” is a pre set configuration for a given make and model of axis motor drive. The drive type was create to make configuration of the Acorn system easy with its matching schematic. Select the drive type and wire the system according to the match schematics. By default a new installation of CNC12 will default to “Bench Test ‘Screw Terminal’ as the drive type. This is fine for communication bench testing the Acorn with no axis drives connected. After passing that test, choose the drive type that matches the axis motor drives that are being employed, click on a drive type and click “Load Drive”.

As a convenience, this will pre-populate the IO map and some other screens of the Wizard that match the corresponding Acorn to axis drive schematic. The matching schematics are here, use when wiring the control for the particular drive type being used.

[The Acorn Schematics are found in the All Acorn Documentation thread found here.](#)

Note: While we have tested and provided many different proven Acorn to axis drive schematics and Wizard drive types to make hookup simple and easy, when using an axis drive that is not on the list pick one that is close and use that and/or even modify the drive type and save it as a custom. You can even export the custom drive type and import it on another system or share it on the forum.

The “Create new...” button will allow you to create a “Custom” Drive type with currently selected settings in the wizard. These Drive Types can be Exported and Imported using the available buttons on screen. Step and direction signals will be present on the Acorn regardless of the drive type selected. However, it is best if you start with a drive type that closely matches the drives you are using. You can then work your way down through the Wizard tree to tailor the control to your application.

IMPORTANT: When you have completed any or ALL changes done in the Wizard pages, you must click “Write Settings to CNC Control Configuration” for the changes to take effect.

Follow any on screen prompts to complete the changes.

6.3 Primary Input Definitions

Mill CNC Control Configuration Wizard

Primary System

- Axis Drive Type
- Input Definitions**
- Output Definitions

Axis

- Configuration
- Homing and Travel
- Axes Pairing
- Advanced

Spindle

- Setup
- Rigid Tapping
- PWM Setup

Touch Devices

- Probe
- Tool Touch Off

Control Peripheral

- Input Devices
- Wireless MPG

DB25 Connector

- Mapping

Preferences

- CNC Control
- Wizard
- VCP Aux Keys
- Lube Pump

Input Type: Mill

Acorn Integrated Inputs 1-8

Definition	Definition
1 (NC) IN1	HomeAll
2 (NO) IN2	ToolTouchOffDetect
3 (NO) IN3	
4 (NC) IN4	SpindleOk
5 (NC) IN5	DriveOk
6 (NO) IN6	ProbeDetect
7 (NO) IN7	ProbeTripped
8 (NC) IN8	EStopOk

Click and Drag an Input function definition from list to the Input number Definition box to assign a function to an input.

Click the Input number circle to toggle the input state from NC to NO. Note: Probe Input states are determined in the Probe setup menus.

Ether1616 Expansions

Auto detection did not find any Ether1616 expansion boards connected to the system Ethernet switch.

For more information about the Ether1616 Acorn input/output expansion module, [click here](#).

Connected to CNC12

Write Settings to CNC Control Configuration

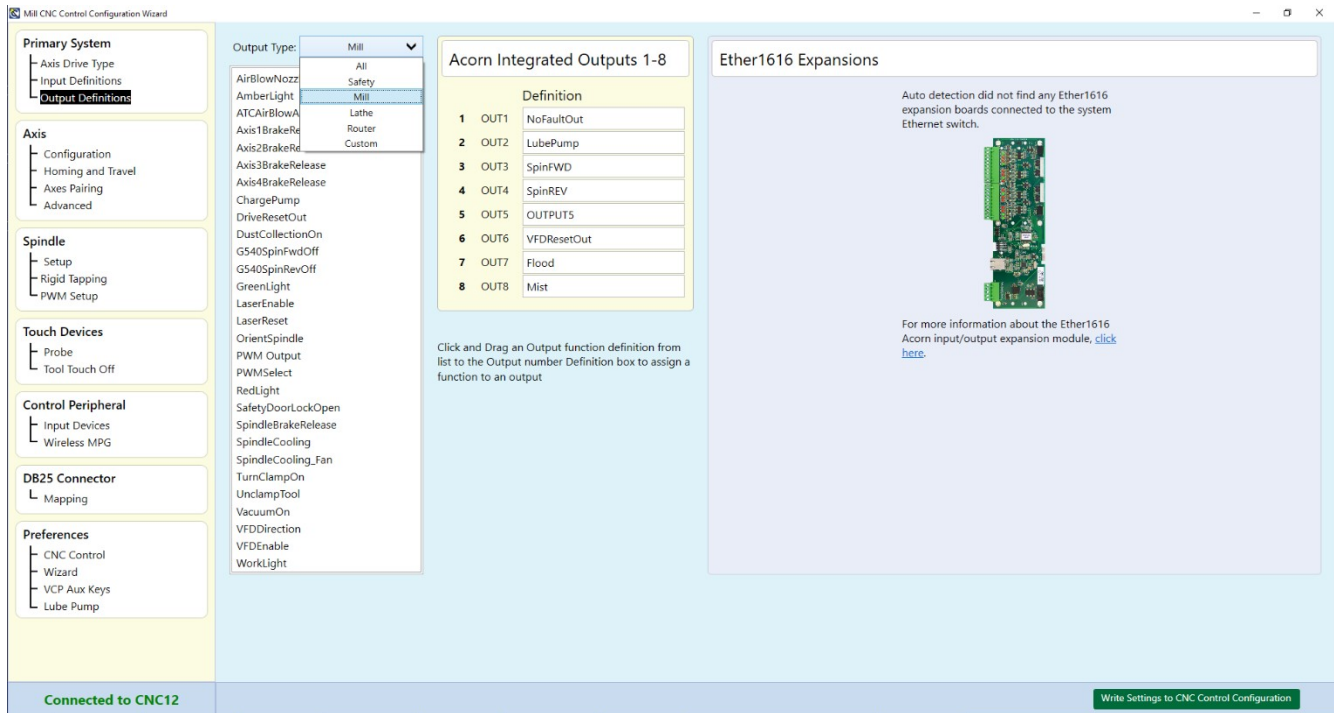
Wizard Inputs Dialog: Mill example (yours will be different)

- Use the sort drop down list to select the machine type on the Input Type Drop down box shown above. (Alternatively, select ALL to see ALL the inputs)
- For a list and definition of all available inputs click here: https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn_wizard_input_output_plc_functions.pdf
- To select an Input, from the drop down, click on the desired Input, hold and drag it over to the appropriate input number and drop it
- Click on the input number to change the input state from Normally Open (Red) to Normally Closed (Green)
- Remove an input definition by clicking on it and dragging it back to the Input box

The Input number corresponds to the input terminal number on the Acorn.

Inputs are found on H1 and H4

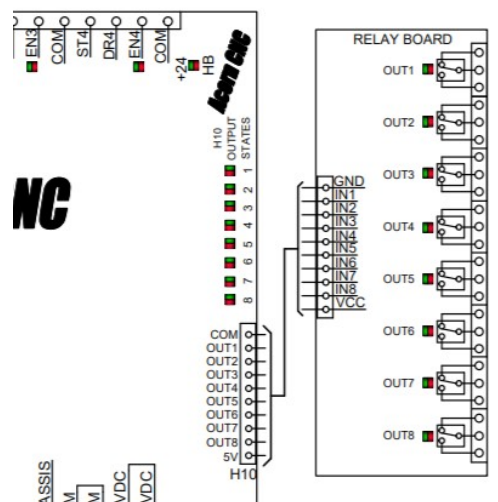
6.4 Primary System Output Definitions



Wizard Outputs dialog Mill example (yours will be different)

- Use the sort drop down list to select the machine type on the Output Type Drop down box shown above. (Alternatively, select ALL to see ALL the Outputs. Example shown above of a currently configured milling machine, yours will be different.
- For a list and definition of all available inputs click here: https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn_wizard_input_output_plc_functions.pdf
- To select an Output, from the drop down, click on the desired Output, hold and drag it over to the appropriate Output number and drop it.
- Remove an Output definition by clicking on it and dragging it back to the Output box

The Output number corresponds to a Relay on the Acorn relay board.



6.5 Axis Configuration

	Axis 1	Axis 2	Axis 3	Axis 4
Linear or Rotary	Linear	Linear	Linear	Rotary
Label	X	Y	Z	N
Steps / Revolution	1600	1600	1600	1600
Overall Turns Ratio <i>turns/in. or rev/deg</i>	5	5	5	0.25
Lash Comp. <i>inches</i>	0	0	0	0
Max Rate <i>in./min or deg/min</i>	50	50	50	360
Fast Jog <i>in./min or deg/min</i>	50	50	50	360
Slow Jog <i>in./min or deg/min</i>	10	10	10	36
Accel / Decel <i>seconds</i>	0.5	0.5	0.5	0.5
Direction Reversal	N	N	N	N
Drive Enable Delay <i>milliseconds</i>	250	250	250	250
x1 Linear Jog Increment <i>inches</i>	0.001			
x1 Rotary Jog Increment <i>degrees</i>	0.01			

Connected to CNC12 Write Settings to CNC Control Configuration

Wizard Axis Configuration menu

Note: 4th axis simultaneous motion is not included in the free version of CNC12, a Pro license is required for four axis interpolated simultaneous movement. CNC12 "Free" is limited to 3 axis simultaneous moves with single axis 4th axis moves.

- LINEAR defines that an axis moves in a linear fashion (left/right or up/down etc)
- ROTARY select rotary if the axis in not linear and rotates. (such as a rotary table)
- LABEL definitions allow you to choose the axis labels that will appear on the main screen Digital Read Out (aka DRO) see machine tool axis labeling industry standards for proper axis labeling.
- STEPS/REVOLUTION: Defines the number of steps it takes for the axis motor shaft to rotate ONE revolution.

Most stepper motors turn 1.8 degrees per step. It takes 200 FULL steps to turn the motor 360 degrees but in modern times now many stepper drives have a feature called microstepping. Most drives are equipped with the microstepping feature, follow the drive instructions and enter the number of MICROSTEPS it takes to turn the motor one full revolution. For example, if a drive can microstep 10X, then you would enter a value of 2000 (200 steps per revolution X 10) in the Steps/Revolution field.

When using closed loop drives (highly recommended as they prevent the dreaded lost steps of open loop stepper systems) closed loop drive use an Encoder, typically would usually enter the encoder value X 4 in the Step/Revolution field. For example, if you have a 1000-line encoder, in quadrature (X 4) you would enter 4000 in the Steps/Revolution field. Consult your drive manufacturer's manual.

It is important to note, ONLY the number of steps it takes to turn the motor ONE full revolution goes in the Steps/Revolution Field! This field must MATCH the settings on the drive, do not adjust this field to adjust the commanded distance. [Please read this post for more info on machine on how NOT to do it like Mach3 does it.](#)

- **OVERALL TURNS RATIO:** The Overall Turns Ratio is a physical constant there is only one number possible for the overall turns ratio of a particular axis. The overall turns ratio is defined by the machine's ballscrew (or rack) pitch and the motor to ballscrew (or rack) pulley reduction ratio (Number of teeth on the axis drive motor pulley and number of teeth on the axis ballscrew pulley x the pitch of the ballscrew)

For example, a ballscrew that requires 5 turns of the screw to move the axis 1 inch of linear travel, connected to an axis motor via belt and pulleys with 10 teeth on the axis drive motor pulley and 20 teeth on the ballscrew pulley would result in an overall turns ratio of 10. Said another way it takes exactly 10 turns of the axis motor to produce one inch of linear travel on the axis. The axis pulley reduction is $20/10=2$ times the ballscrew pitch of 5 so $2 \times 5=10$. Mechanical systems are often not perfect so some fine tuning of this calculated number can be done with physical measurements see fine tuning of the overall turns ratio in section 7.11.

- **LASH COMP:** Axis machine backlash compensation is the LAST thing you should setup once the machine is fully configured and operational.

Software backlash compensation is effective but limited in its scope. For backlash compensation to work well the free play aka lash of an axis should be mechanically minimized. Lash Comp will not compensate for large and inconsistent backlash in a mechanical system. That being said it works quite well when the mechanical system has a repeatable and small lash amount that can be accurately measured. Then and only then can CNC12 "compensate" for mechanical backlash by adding movement to that axis motor. If you have a very accurate system with measured lash under .0002" (2 tenths) often it is best to leave the lash comp set at zero. Typical lash numbers for good milling machines are zero to .0015" for routers zero to .005" Lash comp cannot cure mechanical play so it is very important that every effort is made to remove mechanical backlash from all axes before setting this value.

[See section 7.4](#) for detailed instructions on how to properly measure and correct for backlash.

- **MAX RATE:** This is the maximum rapid rate (a G0 Move) that an axis is allowed to travel at. This number is heavily dependent on many factors.

Correctly sizing the axis motors and drives to the machine is important, as well as the voltage supplied which relates to the power and speed of a given axis motor.

As a general starting point on an open loop stepper machine start this number low and work your way higher until you see or hear the stepper stall and then reduce that number by 30-40% to create a safe operating zone that will be free of lost steps due to the motor and drive not being able to perform the commanded accelerations and velocities. .

You can also use the following equation to get a rough max rate estimation: (maximum motor rpm / overall turns ratio) * 0.85 = maximum feed rate

- **FAST JOG:** This is the fastest the axis will move when in the RAPID (Hare) Continuous Jog mode on the VCP.
- **SLOW JOG:** This is the slowest the axis will move when in the SLOW (Tortoise) Continuous Jog mode on the VCP. It is also the speed that the machine will home at.
- **ACCEL/DECEL:** Acceleration is the time for the axis to reach maximum velocity.

An acceleration rate of 0.1 second is very fast, where an acceleration rate of 1.0 is considered very slow.

CNC12 defaults to an acceleration of 0.5 this number is used for both acceleration and deceleration.

Acceleration tuning is a fairly subjective process. What might be acceptable for one person or machine might be unacceptable for another person or machine.

Often the limiting factors are the amount of mechanical stress that the machine can handle and the amount of current that can be provided to the motors. Quick acceleration numbers can lead to jerking of the machine and lost steps if motor is undersized/under powered.

- **DIRECTION REVERSAL:** Change this from No to Yes if you need to reverse the direction of the axis motor in order to move the machine in the PROPER direction. See axis conventions for definition of industry standard tool motion directions in Chapter 7.
- **DRIVE ENABLE DELAY:** This is the amount of time the control allows your drive to “come online” and ignores the DRIVE FAULT input (If used in the I/O map). Generally, this can be left at the default value.

6.6 AXIS (Homing and Travel)

The screenshot shows the 'MBI CNC Control Configuration Wizard' window. The left sidebar contains a tree view with categories: Primary System, Axis, Spindle, Touch Devices, Control Peripheral, DB25 Connector, and Preferences. The 'Axis' category is expanded, and 'Homing and Travel' is selected. The main area is divided into several sections:

- Home Program (cncm.hom) Creation:** Includes a description and two radio buttons: 'Wizard to generate Automatic home program based on selections below.' (selected) and 'I will create my own home program, do not overwrite cncm.hom'.
- Homing Type:** Includes a description and two radio buttons: 'Automatic Homing: machine seeks switches to home' (selected) and 'Simple Homing: operator logs machine to home position'.
- Automatic Homing Direction:** Includes a description and four dropdown menus for Axis 1 through 4, all set to '+ (M92)'. Axis 1 is also labeled as '-(M91)'.
- Automatic Homing Sequence:** Includes a description and four input fields for Axis 1 through 4, with values 3, 2, 1, and 0 respectively.
- Software Travel Limits:** Includes a description and a table for setting limits for each axis.
- Machine Parking:** Includes a description and a toggle for 'Override default park behavior?' set to 'No', with an 'Edit "park.mac"' button.

At the bottom, there is a status bar showing 'Connected to CNC12' and a 'Write Settings to CNC Control Configuration' button.

Wizard Homing and Travel dialog

In this screen, we will setup how the machine will:

- Home
- The directions in which it will Home
- Software Travel Limits
- Machine Parking.

HOME PROGRAM:

CNC12 Generates a .HOM file automatically. IF you have a custom .HOM file, then change Home file to: "Custom User Defined". Otherwise leave it to the default of Wizard Generated. A ".hom" file is simply a G code program that defines how the machine will "home out" based on the selections made in this menu.

HOMING TYPE:

- Select "Simple Homing" if the machine uses no home switches. Simple Home means that the operator will simply jog the machine to the desired home position and then press cycle start to set home at that position.
- Select "Home to Switch" if the machine is equipped with home switches.
- Selecting "Automatic Homing" will display additional homing options for Automatic Homing.

Homing Direction:

- If the machine axis must move in the positive direction to seek the home switch, then use +(M92).
- If it must move in the negative direction to seek the home switch, then use -(M91).
- Set Homing Direction for each axis.

Homing Sequence:

- Sets the order in which the axis is homed.
- By default, the order is 3rd axis, 2nd axis, 1st axis, and 4th axis in sequence. This is important, generally you want to move the cutter away from the table first. So typically the Z axis is first, followed by the Y axis and then the X axis last. IF the machine is equipped with a rotary axis, and it has a home switch, that will be last to home.

SOFTWARE TRAVEL LIMITS:

Travel limits are used so that CNC12 knows the usable work envelope of the machine tool use of software travel limits is strongly suggested in all cases (whether you are using home switches and or limit switches in any combination)

- Travel Limit (+) is used if the home switch is on the NEGATIVE end of the axis. The value entered here would be a positive number. This number is the distance between the home switch and the other end of the axis travel, typically just shy of hitting a hard stop.
- Travel Limit (-) is used if the home switch is on the POSITIVE end of the axis. The value here would be a negative number. This number is the distance between the home switch and the other end of the axis travel, typically just shy of hitting a hard stop.

For example, the home switch is on the Y Positive end of the travel and there is 12.2" of travel on Y. The value entered would be -12.2.

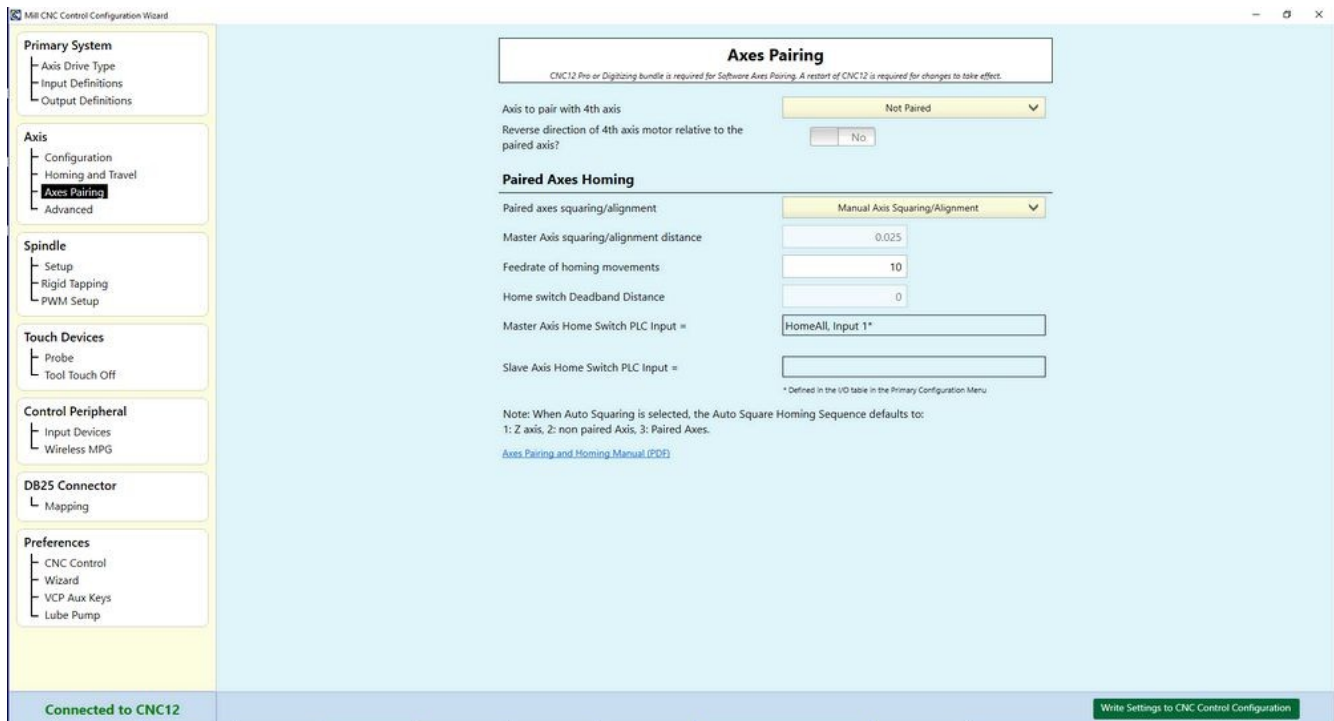
For more information, see [section 7.5](#)

MACHINE PARKING:

Parking the machine before shut down is not necessary but is useful. When parking before “Shut Down” of the machine, all axes will travel to a predetermined position

- By default, “PARKing” the machine will send all axis near, but not tripping, the home switch so that the next time the machine is powered up, it will not take so long for the machine to find its home position
- For a milling machine for example, you can send Z up near its +Z axis Home switch, and you can send the Y axis near its Home switch. But you could center the X axis so the table isn’t hanging off to one side
- The feature’s intent is twofold. To speed up the Homing routine the next time the machine is started by not having to travel so far at a slow rate to reach the home switch and/or to put the machine into a convenient position when shutting down
- Find the PARK feature by pressing F10 SHUTDOWN and F1 PARK or by selecting PARK on the Virtual Control Panel
- To EDIT the default park.mac click on the EDIT button

6.7 Axis Pairing.



Wizard Axis Pairing dialog. Note: Software Axis Pairing feature is not included in the Free version of Acorn CNC12 software. A Pro license is required to enable this feature.

Axis to pair with 4th Axis

- Select axis for Software Pairing.

Reverse direction of 4th axis motor

- Setting this to “Yes” will reverse the direction of the 4th axis motor relative the master axis. For when the two paired motors are mounted in such a way that they have to spin in opposite directions to produce the same axis movement.

Paired axes squaring/alignment

- Select between Manual and Automatic Squaring/Alignment.

Master Axis squaring/alignment distance

- Maximum independent movement distance of the master axis during home program. This is always away from the master home switch and typically close to the value of the slave switch offset from square.

Feedrate of Homing Movements

- The speed in which the home program will move the axis to seek home switches.

Home Switch Deadband Distance

- The amount of travel the home program will move into the home switch once the home switch has been triggered to eliminate switch flicker (deadband).
- Note: Typically, cheaper switches have more deadband.

Master Axis Home Switch PLC Input

- Shows the input for the Master Home switch as set in Input Definitions.

Slave Axis Home Switch PLC Input

- Shows the input for the SlavedHomeInput as set in the Input Definitions.

For more information on proper pairing techniques, check out the Axis Paring and Squaring Acorn Guide. (https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/paired_axes_acorn_user_guide.pdf)

6.8 Advanced Axis Configuration

In general changes to settings in this section are usually not required. Only make changes when advised to do.



Wizard Advanced Axis Configuration dialog

Axis Signal Inversion

- Invert the Step, Direction, or Enable signal for each individual axis. Sometimes required depending on type of drives used. **DO NOT USE the “Direction” on this menu to change the Axis movement direction!** See Axis Configuration to change the Axis movement direction.

Step Rate

- Maximum steps rate in steps per second that Acorn will feed to the drive. (be sure to check the maximum rating of the drive step Frequency value in the drive manual) If a value HIGHER than your drive can tolerate, you may have unpredictable movement. Start with 100,000 if you are not sure as that is typically the fastest a stepper motor driver can handle, AC drives typically can handle faster step rates.

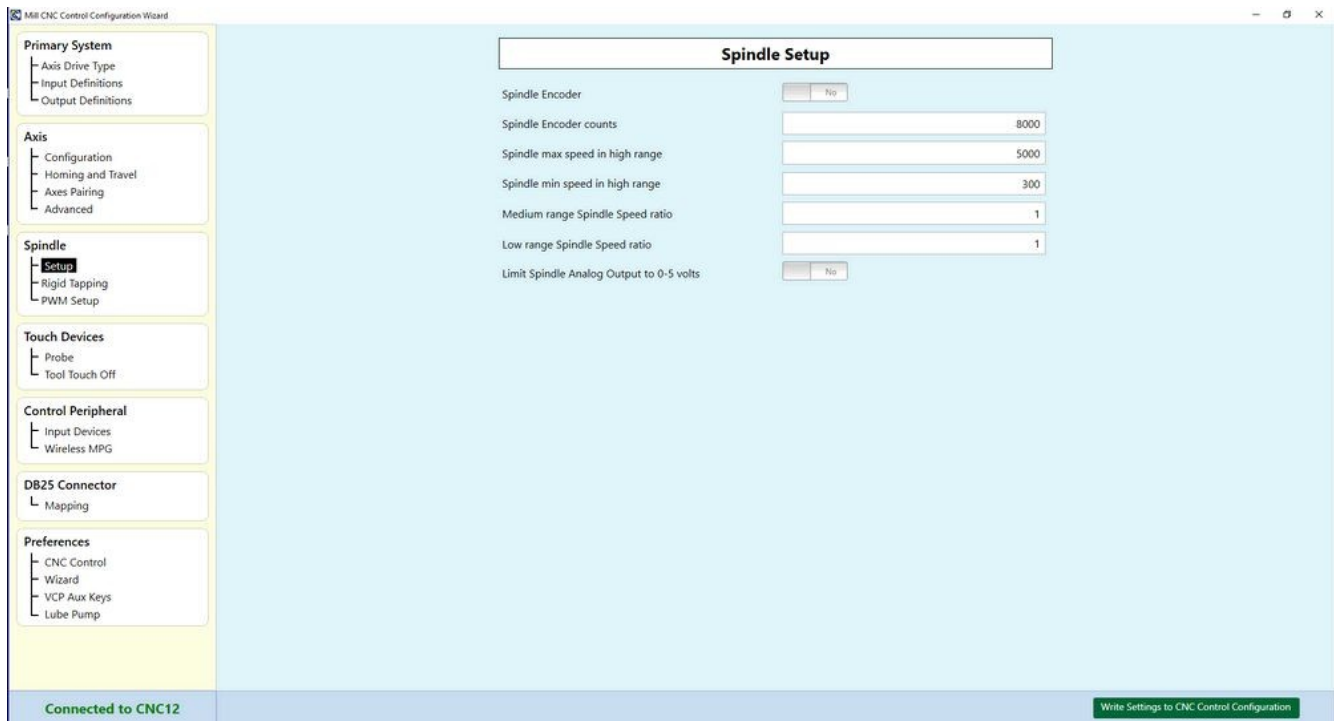
Axis Motor Drive Fault

- Fault Delay for when the DriveOK input is not active. Used to give some time to the drive to send the DriveOK signal to Acorn so Acorn knows that it is good to go.

Charge Pump:

This is a legacy drive support function for older drives that require a charge pump signal.

6.9 SPINDLE (Setup Mill)



Wizard Spindle Setup menu - Mill example

Mill:

Spindle Encoder

- Is there a Spindle Encoder connected to the Acorn? If Yes, click on the button to move it to YES.

Spindle Encoder Counts

- Encoder Counts per Revolution of the spindle. This value will be the line number on the encoder multiplied by 4. For example, for a 1000 line encoder, enter a value of 4000.

Spindle max speed in high range

- Maximum speed in rpm for spindle in high range gear.

Spindle min speed in high range

- Minimum speed in rpm for spindle in high range gear.

Medium range spindle speed ratio

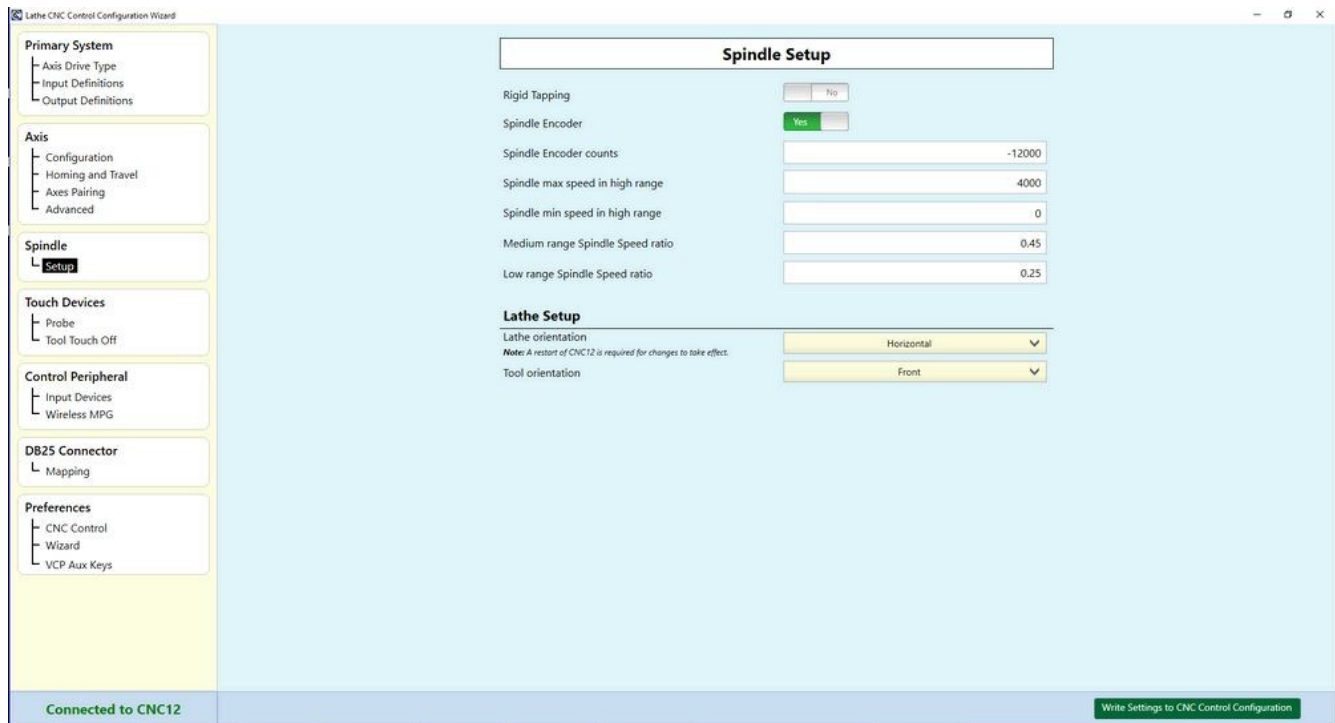
- Medium gear ratio (Medium max RPM divided by High max RPM). Used for spindles that employ step pulleys or transmissions. For example if the spindle MAX RPM is 3000 and the Medium range is 1500, enter .5 ($1500/3000$) =.5 For cases when the gear range reverses spindle direction set the ratio as a

negative value. For our example if the gear range mechanically reverses direction of the spindle enter -.5

Low range spindle speed ratio

- Low gear ratio (Low max rpm divided by high max rpm). For example, if the Max RPM is 3000 and them Max RPM in Low range Low range is 500, then enter .166. If the gear reverses spindle direction then make ratio a negative value. (-.166)

6.10 Spindle (Setup Lathe)



Wizard Spindle Setup dialog - Lathe example

Lathe Orientation

- Designate lathe as horizontal or vertical. (Most lathes are Horizontal)
- Note: After “write settings to CNC control” follow the instructions, a CNC12 reboot is required after a change is made.

Tool orientation

- Front or Rear. This will reverse the X axis direction. If the tool is presented to the work piece from the front, then it is a Front Tool Orientation. If the tool is presented to the work-piece from the rear, then it is a Rear Tool Orientation.

Spindle Encoder

- Is there a Spindle Encoder connected to the Acorn? If Yes, click on the button to move it to YES.

Spindle Encoder Counts

- Encoder Counts per Revolution of the spindle. This value will be the line number of the encoder multiplied by 4. For example, for a “1000-line” encoder, enter a value of 4000 counts per revolution.

Spindle max speed in high range

- Maximum speed in rpm for spindle in high range gear. T

Spindle min speed in high range

- Minimum speed in rpm for spindle in high range gear.

Medium range spindle speed ratio

- Medium gear ratio (Medium max RPM divided by High max RPM). Used for spindles that employ step pulleys or transmissions. For example if the spindle MAX RPM is 3000 and the Medium range is 1500, enter $.5$ ($1500/3000$) = $.5$ For cases when the gear range reverses spindle direction set the ratio as a negative value. For our example if the gear range mechanically reverses direction of the spindle enter $-.5$

Low range spindle speed ratio

- Low gear ratio (Low max rpm divided by high max rpm). For example, if the Max RPM is 3000 and them Max RPM in Low range Low range is 500, then enter $.166$. If the gear reverses spindle direction then make ratio a negative value. ($-.166$)

6.11 Spindle (Rigid Tapping)

The screenshot shows the 'Mill CNC Control Configuration Wizard' window. On the left is a navigation tree with categories: Primary System, Axis, Spindle, Touch Devices, Control Peripheral, DB25 Connector, and Preferences. The 'Spindle' category is expanded, and 'Rigid Tapping' is selected. The main area is titled 'Rigid Tapping Configuration' and contains the following settings:

Parameter	Value	Parameter ID
Enable Rigid Tapping	No	(P36)
Minimum Rigid Tapping RPM	640	(P68)
Duration For Min. Rigid Tapping RPM (Seconds)	1.75	(P69)
Spindle Drift (Degrees)	500	(P82)
Spindle Accel/Decel Time	3	(P37)
M Func To Run At Bottom Of Hole G84 Tapping	M4	(P74)
M Func To Run At Top Of Hole For G74 Counter Tapping		
M Func To Run At Bottom Of Hole G74 Tapping(Left Hand Taps)	M3	(P84)
M Func To Run At Top Of Hole For G84 Counter Tapping		
Rigid Tapping Accel Distance For Tapping and Threading	0.1	(P240)
Rigid Tapping Z Axis Sync Distance	20	(P241)
Allow Spindle Override	No	(P36)
Do Not Wait For Index Pulse	No	(P36)

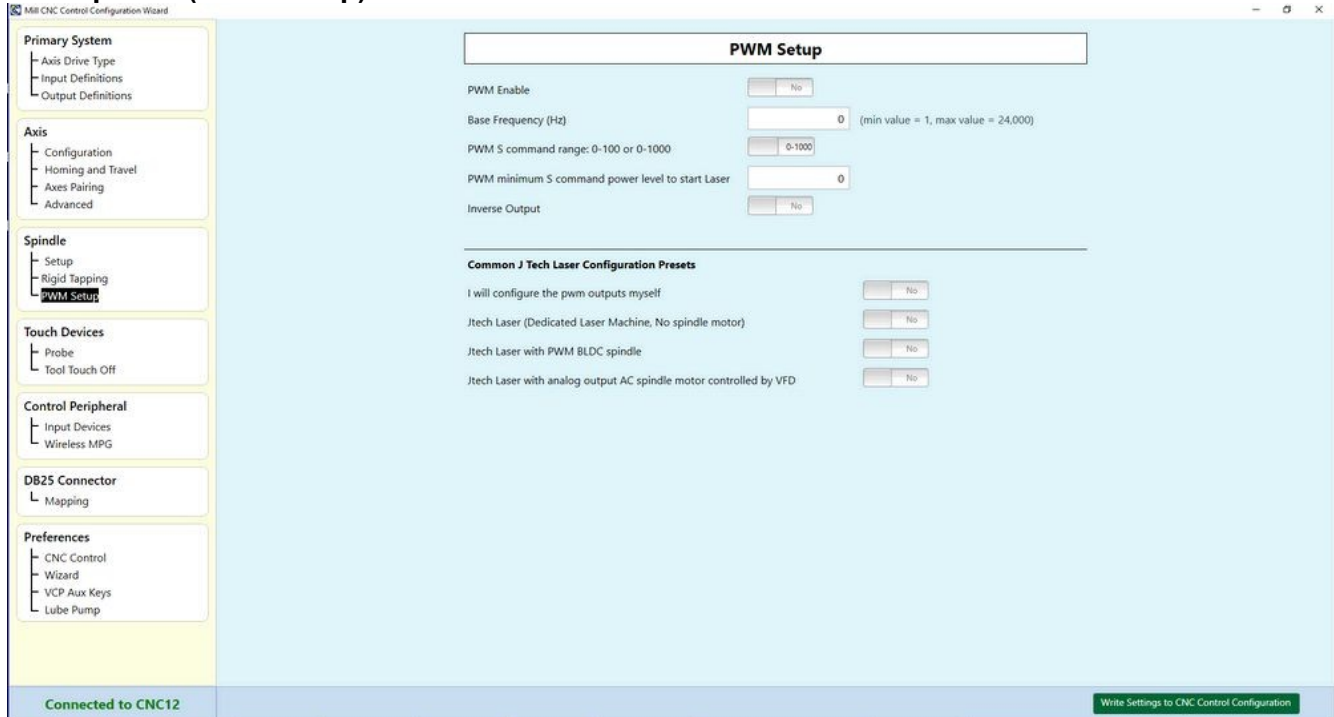
Below the settings, there is a note: 'Not Recommended. Choosing This Option Eliminates The Ability To Re-enter Hole.'

At the bottom of the window, there is a status bar that says 'Connected to CNC12' on the left and a button 'Write Settings to CNC Control Configuration' on the right.

Wizard Rigid Tapping Menu

- Centroid Technical Support Bulletin: Acorn CNC Spindle Speed Calibration with VFD Hz Adjustment & Rigid Tapping setup must be done before proceeding with the section. See https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/304.pdf
- See [Section 5.9](#) for wiring the encoder
- Rigid tapping also requires PRO License. Do not enable and test Rigid Tapping until have completely configured, setup and tested your machine!

6.12 Spindle (PWM Setup)



Wizard Spindle PWM Setup menu

The Acorn PWM can be used to command a Laser and/or a PWM Spindle Drive and use the Gcode “S function” (Note: PWM output is not to be confused with 0-10 s command analog output which is used with VFD’s to control 3 phase spindle motors which has its own dedicated output on H8.)

PWM Setup

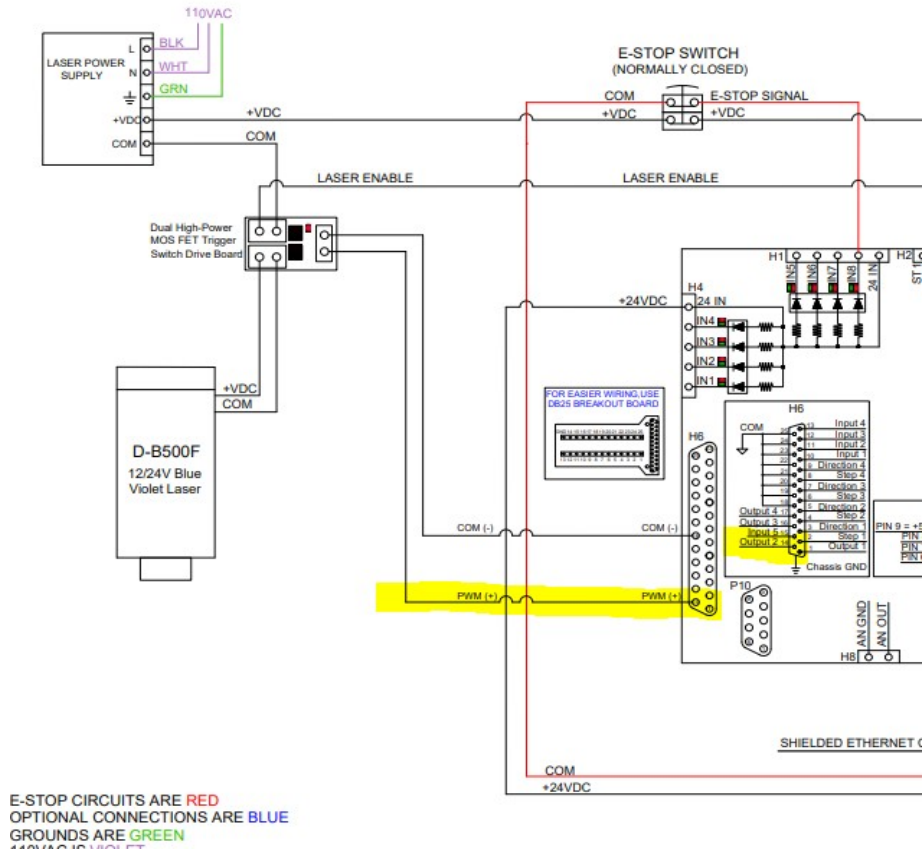
- PWM enable
- Base Frequency (HZ)
- PWM Command Range 0-100 or 0-1000 this divides up the laser power or spindle RPM by 100 or 1000 increments. For example: A S command of S1000 would result in max laser power or max spindle RPM when 0-1000 range is selected.
- PWM Minimum S command power level to start Laser
- Inverse Output
- Jtech Laser Presets with matching Acorn Schematics

Laser specific setup documentation.

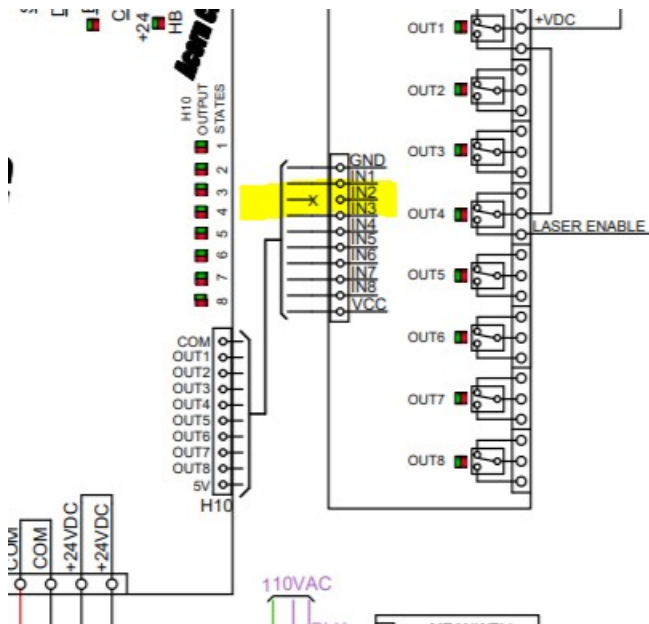
https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn-CNC12_v4.60_laser.pdf

Search "Acorn Laser" on this page to see all the Acorn to Laser hook up schematics.
https://www.centroidcnc.com/centroid_diy/schematics/pbrowse.php

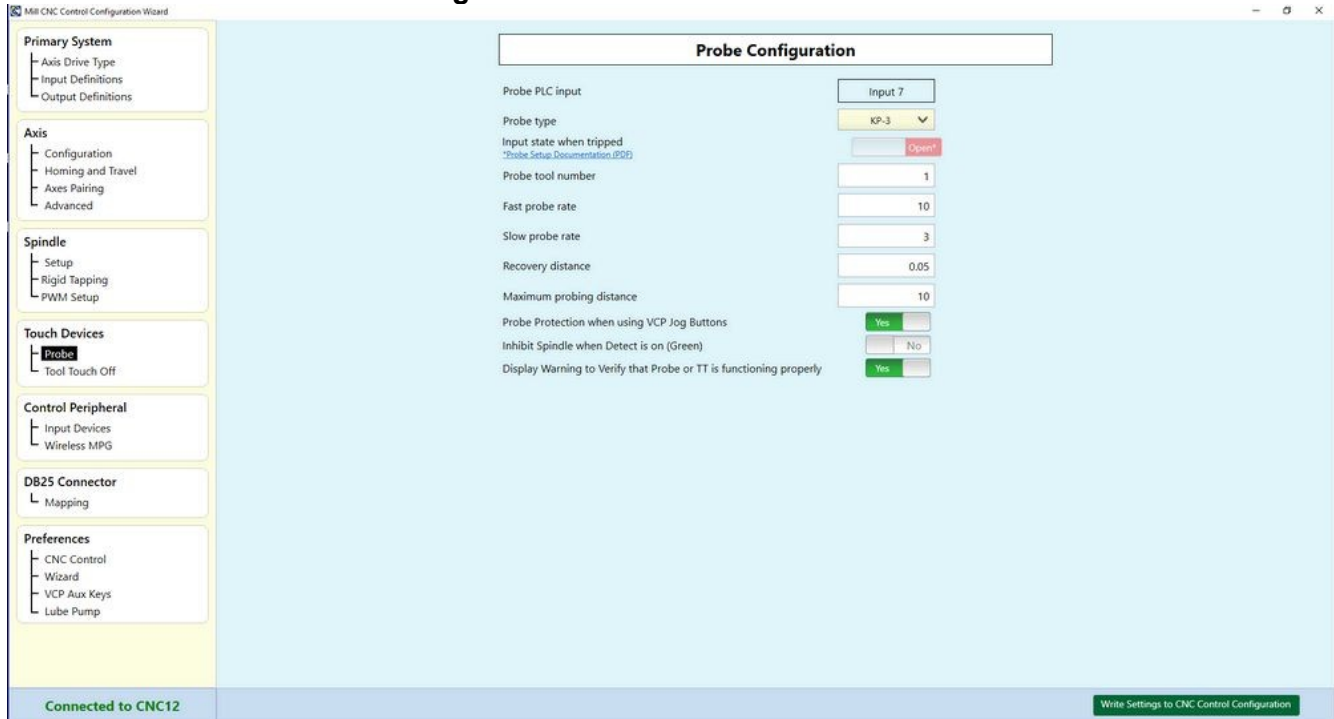
Note: PWM output is located on DB25 connector, Output #2, Pin 14.
 When PWM is employed it 'takes over' output #2 which can not be used for any other purpose.
 The output ribbon cable to the relay board must be modified to cut the output #2 signal to the relay when PWM is used.



Cutting of Output #2 wire in ribbon cable when PWM feature is being used.



6.13 Touch Devices Probe Configuration



Wizard Probe Configuration menu

Probe PLC Input

- The Acorn input number used as the ProbeTripped input, as set in the Input Definitions.

Probe type

- Choose the type of probe being used. Centroid DP-4, Centroid KP-3, or 3rd party Mechanical/Conductive.

Input state when tripped

- The state of the input when the probe is tripped. [Refer to the Acorn Probe Setup Guide for more info located in the All Acorn Documentation thread here.](#)

Probe tool number

- The tool number assigned to the probe, used to look up the length offset and tip diameter of the probe from the CN12 tool library.

Fast probe rate

- Used for positioning moves and initial surface detection, this parameter is determined by machine response and permitted probe deflection as well as desired accuracy tolerance.
- Default value is 10 ipm (30 to 10 inches per minute is typical for milling machines and 20 to 40 inches per minute for most CNC routers, adjust as needed)

Slow Probe rate

- Used for final measuring moves for maximum accuracy, this parameter value is determined by speed/accuracy trade off.
- Default value is 3 inches per minute which is a typical rate for milling machines and routers.
- Adjust this value as needed for accuracy required.
- Warning: setting this parameter to very slow rates will often cause issues with “double triggers.

Recovery Distance

- The additional distance the probe moves off of a surface after contact is broken, before attempting to traverse parallel to the surface.

Maximum Probing Distance

- The Maximum distance that a probing cycle “searches” for a surface in a given direction

Probe Protection when using VCP Jog Buttons

- This feature ‘protects’ the probe by immediately stopping all motion of the machine tool when an “unexpected probe contact” has been made. For instance when an operator is using the VCP axis jog buttons to move an axis with the probe connected, if the probe is tripped all motion is stopped and CNC12 waits for the operator to clear the probe by slow jogging it off the contacted surface. Set to YES then moves from the VCP are probe protected. If set to No, VCP Jogging is no longer protected and the machine will continue to move even when probe is tripped therefore crashing the probe due to operator error.

Inhibit the Spindle from moving when probing

- Determines if spindle is allowed to spin while the probe is detected.
- This feature requires that the probe to has a detect signal and the input Probe Detect assigned in Input Definitions. All Centroid supplied probes have a detect signal so CNC12 knows when a probe is in use.
- By default it is set to “Yes” for Mills and “No” for Lathes.

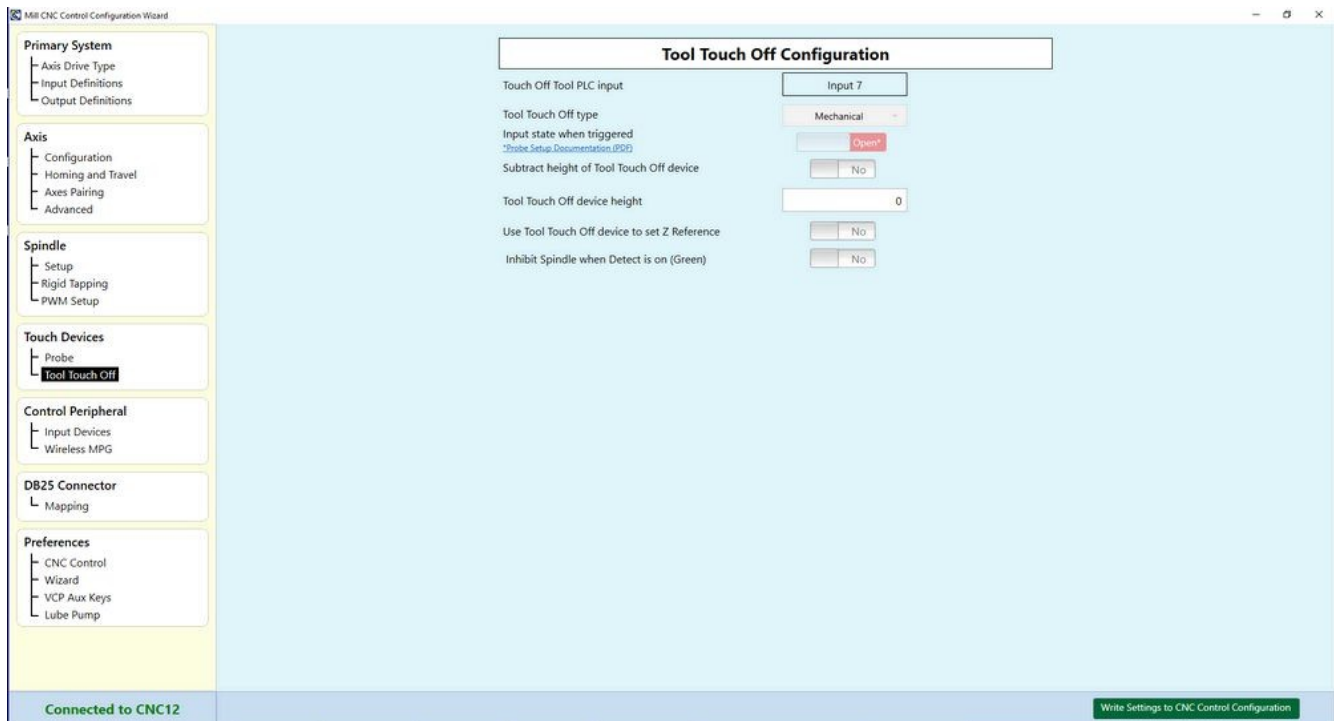
Display Warning to Verify that the Probe or TT is functioning properly

CNC12 will ask to you verify that the probe is working properly before each probing cycle to prevent user error such as, not plugging in a probe or not testing it by hand before running a probing cycle. This section allows the user to turn off this warning/help message if they do not want this message to display each time a probing cycle is run.

For more information on setting up your probe, check out the Probe Setup Guide.

(https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn_probe_setup.pdf)

6.14 Touch Devices Tool Touch Off, (aka Touch Plates) Configuration



Wizard Tool Touch Off Configuration dialog

Tool Touch Off PLC Input

- The Acorn input number used as the ToolTouchOffTriggered input, as set in the Input Definitions.

Tool Touch Off Type

- Choose the type of TT being used. Centroid's TT-1, TT-2 or 3rd party Mechanical/Conductive.

Input state when triggered

- The state of the input when the tool touch off device is triggered
- Refer to Probe Setup Guide for more info.
- Centroid's tool touch offs are closed when tripped

Subtract height of tool touch off device

- When using Auto Part Z zero probing cycle with TT device, subtract the height of the TT device when setting Z part zero.
- Used when TT is sitting on top of the material you wish to set zero for.

Tool Touch off device height

- Value is taken into account when the TT device is being utilized with auto part Z zero location probing cycle.
- This height value is typically the distance from the top to the bottom of the TT device.

Use Tool Touch Off device to set Z reference

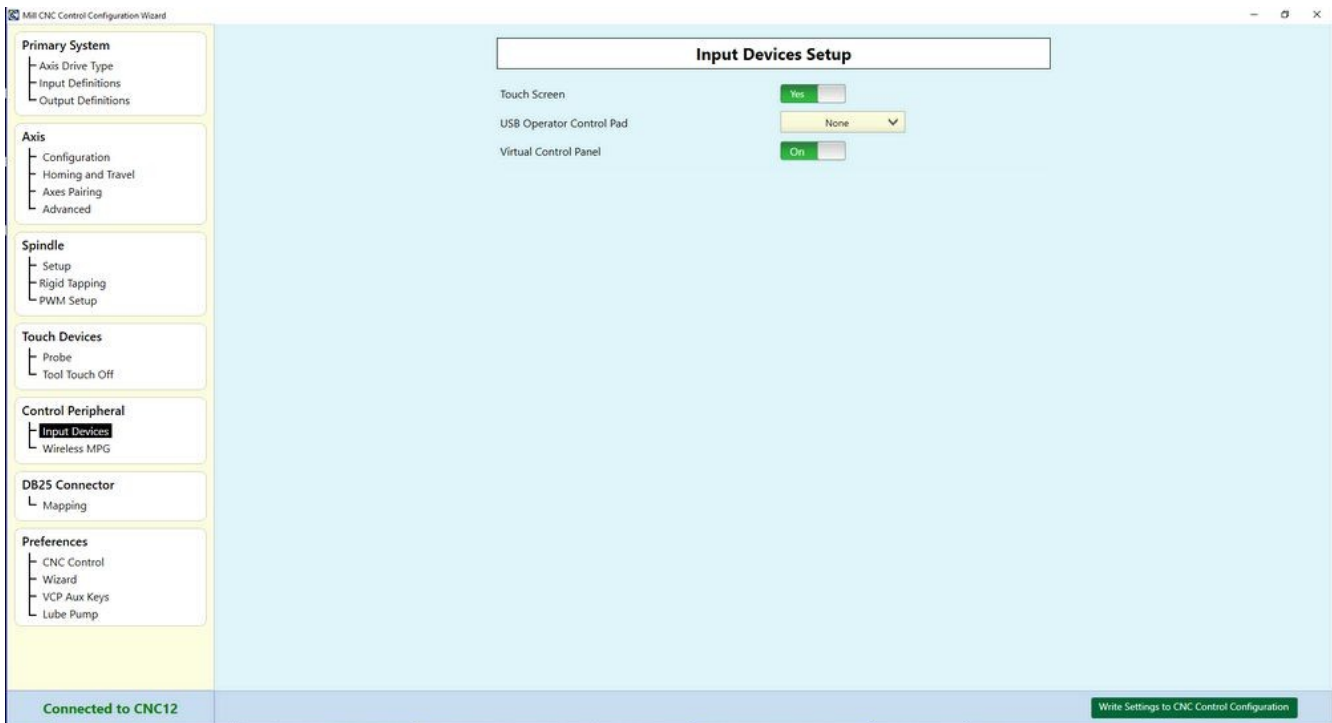
- Use the top of the TT device as the Tool Height measurement reference location when measuring tool heights automatically.
- Typically used when top of TT is a fixed Z position to measure all tool heights from. Commonly found on routers and bed mills. Is not used for Knee Mill Applications.

Inhibit the Spindle from moving when probing with ToolTouch

- Determines if spindle is allowed to spin while TT is detected.
- This requires the TT to have a detect signal and the input ToolTouchOffDetect assigned in Input Definitions.
- By default, this is set to “No” on Mills and “Yes” on Lathes.

For more information on setting up your Tool Touch Device, check out the Probe Setup Guide.
(https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn_probe_setup.pdf)

6.15 Control Peripheral Input Devices Setup

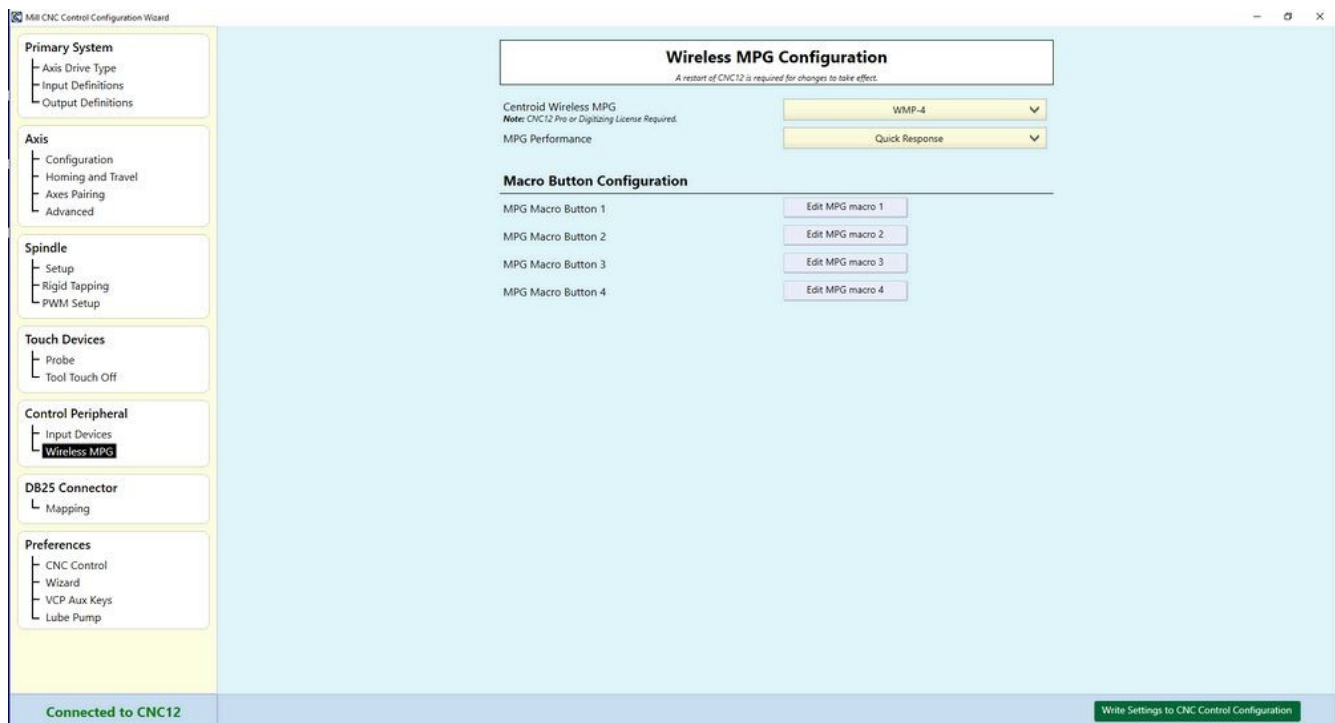


Wizard Input Devices menu

Input Devices Setup

- Touchscreen Yes/No
- USB Operator Control Pad (if you are using a keyboard emulator such as X-Keys)
- Virtual Control Panel. On if you want the VCP on the display.

6.16 Control Peripheral Wireless MPG Configuration



Wizard Wireless MPG Configuration Menu

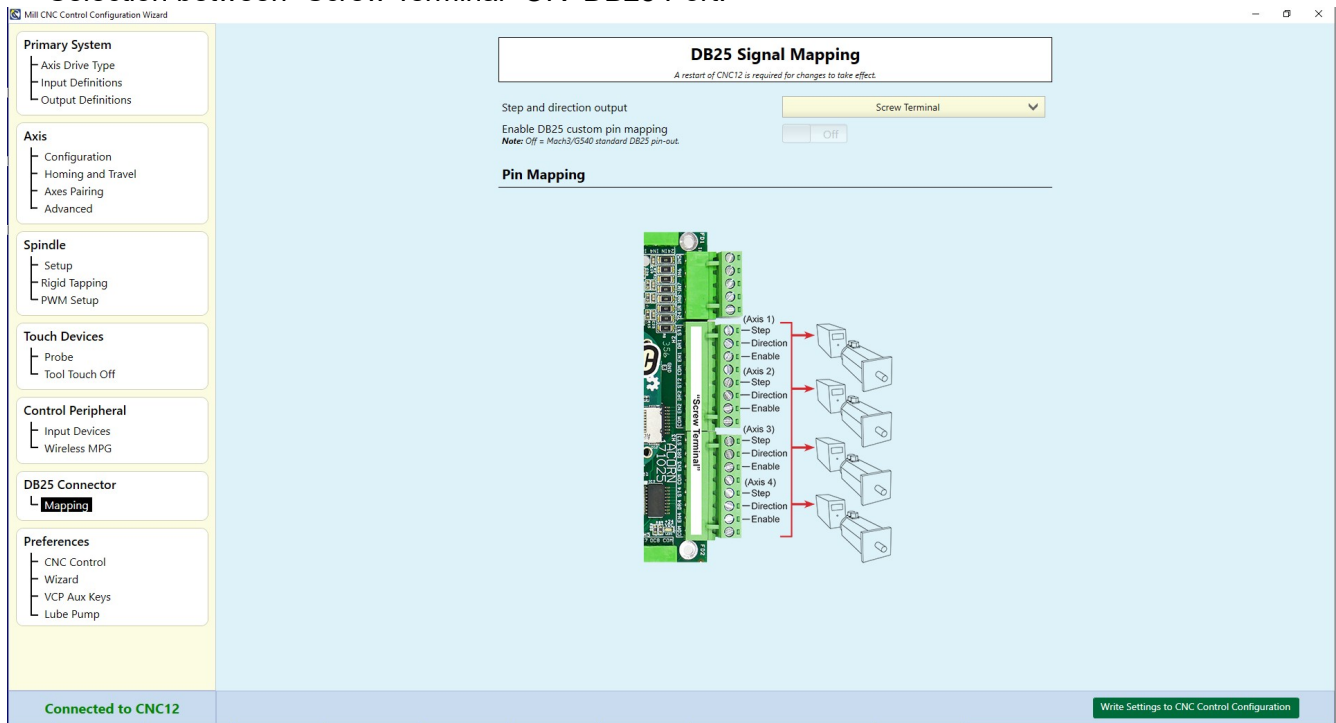
Wireless MPG Configuration.

- [Centroid Wireless MPG](#). Select the correct MPG model
- MPG Performance allows user to change the reaction speed of the MPG.
- Macro Button Configuration. User defined Macros used on the WMPG. Click on buttons 1-4 to Edit each Button Macro and program them for a custom use.

6.17 DB25 Connector selection and optional Mapping

Step and direction output

- Selection between “Screw Terminal” OR DB25 Port.



Wizard DB25 selection and optional Signal Mapping Menu

Screw Terminal step and direction output

Screw Terminal Step and Direction outputs are designed for AC servo motor drives that accept 24 volt open collector signals.

- “screw terminal” is the Default setting
- Screw Terminal Pins cannot be re-mapped, follow provided Acorn schematics.

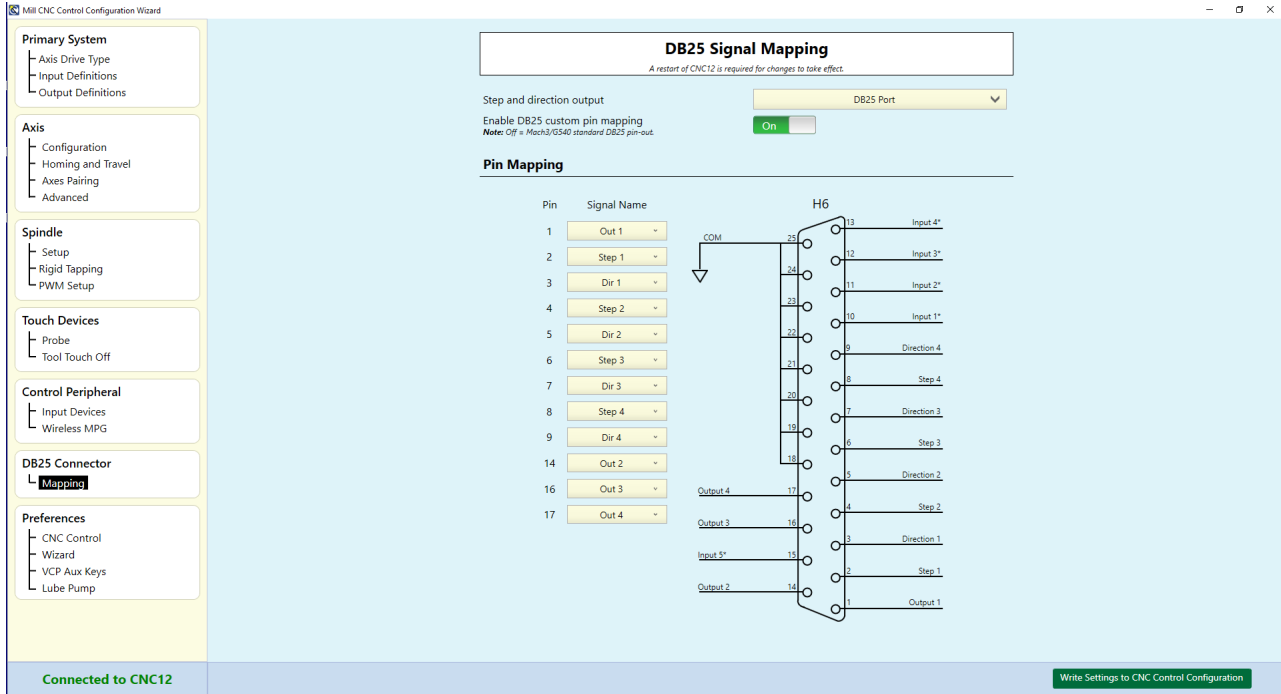
DB25 connector step and direction output

The DB25 connector is designed for stepper motor drives that use 5 volt step and direction signals. In most every case use the DB25 connector step and direction output for use with stepper motor drives.

Enable DB25 use default pin mapping OR create a custom DB25 pin map

- The default DB25 pin configuration uses the long time Gecko G540/Mach3 standard This is what most users will use. The Acorn Wizard allows the user to change the pin out (which pins do what) of the DB25 connector via software therefore saving on custom cable or adapter creation for connection to non standard pin out drives and breakout boards.

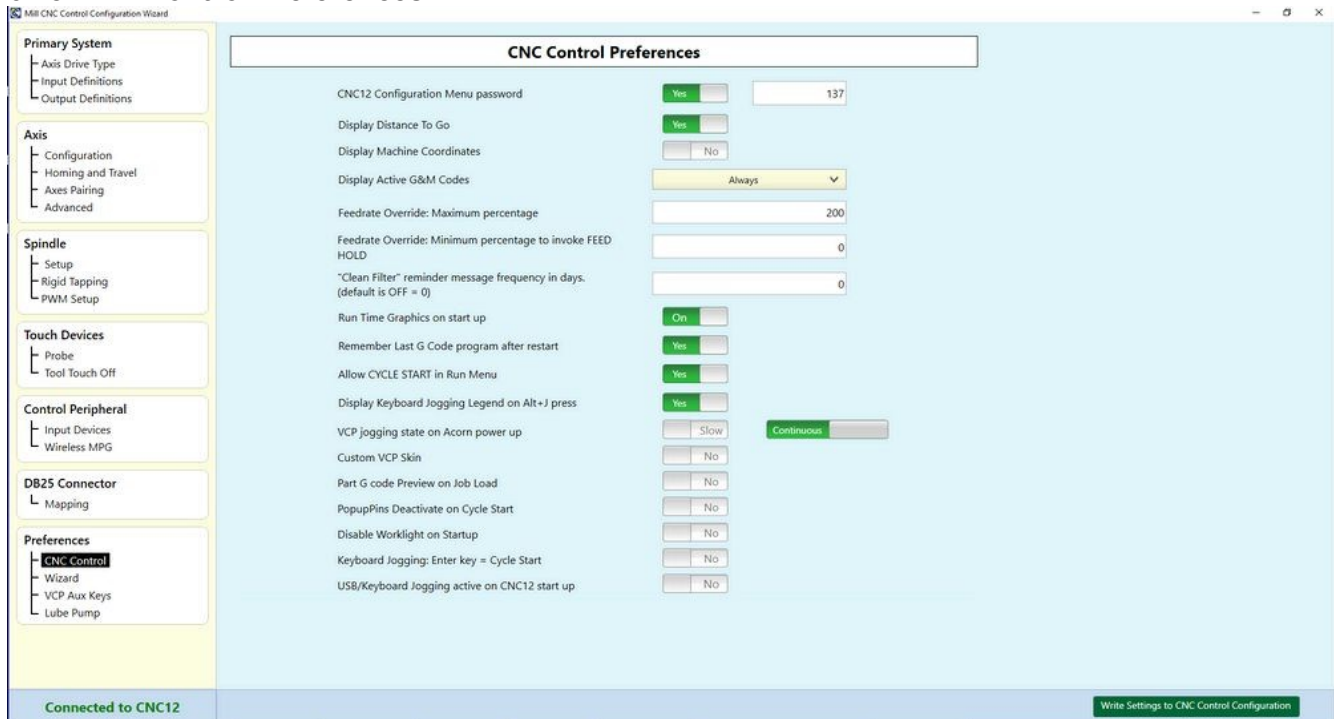
Wizard DB25 Signal Mapping dialog



DB25 port

- Enabled
- Use default Pin assignments or re-map them to match your application.
- Note: Charge Pump cannot be re-mapped from pin 16 Output 3. It is only physically available on that pin.

6.18 CNC Control Preferences



Wizard CNC Control Preferences menu

CNC12 Configuration Menu password

- Set Password to access CNC12 Configuration menus. Prevents accidental editing of the CNC12 configuration menu by operators.
- Default password is 137, you can change it or eliminate it
- The Wizard automatically sets many of the parameters in the CNC12 configuration menu for you. Sometimes during special applications it is necessary to edit a parameter in the CNC12 configuration menu directly (one that the wizard doesn't edit)

Display Distance To Go

- Choose to display "Distance to Go" readout on the main CNC12 screen.

Display Machine Coordinates

- Choose to display Machine Coordinates readout on the main CNC12 screen.

Display Active G&M Codes

- Choose to display currently active G&M codes when while in MDI or Always.

Feedrate Override

- Maximum percentage: Allows to override maximum feedrate to a maximum of 200%, for most open loop systems is it advised to set this value to 100%

Minimum percentage to invoke Feed Hold

- Feed hold will be active when Feedrate override is below this value. This is a nice feature when used in conjunction with the [Wireless MPG](#) as turning the MPG knob will down to slow down the machine will put the machine into feed hold mode automatically once the feedrate override goes below this threshold. Nice threshold values are typically 1-2% and 2-3 percent for routers. Set to zero if you do not want feed hold to be invoked with the Feedrate override controls.

Clean Filter Reminder Message

- 0=Do Not Display. Otherwise enter the days between the clean filter message.

Run Time Graphics on Start Up

- Set to have CNC12 always start run time graphics while running job. (Requires CNC12 restart for changes to take effect) If you select NO you can still always use CNC12 to select run time graphics on a per job basis. This selection simply forces RTG to start with every job automatically.

Remember Last G Code Program after restart

- If set, CNC12 will load last G Code Program set on start up. Otherwise upon restart of CNC12 the operator would have to reload the last job run.

Allow CYCLE START in Run Menu

- When set, allows operator to start a G Code Program from the Run Menu.
- Disables the forced return to CNC12 main menu to run a G Code Program saving keystrokes after using the Run menu.

Display Keyboard Jogging Legend on Alt+J press

- Displays Keyboard shortcut legend when using Keyboard Jogging (Alt+J). Or don't display it. Its best to print out a copy of the keyboard jogging short cuts and not display the legend but this is user preference.

VCP jogging state on Acorn power up

- Sets when on startup the VCP defaults for Fast/Slow and Continuous/Incremental. Typical setting for a Mill or Lathe are Slow Incremental or Slow Continuous
Typical settings for router are Slow Continuous or Fast Continuous

Custom VCP Skin

- When a custom VCP is in use this selection stops the Wizard from overwriting the custom VCP. See VCP manual for more info on customizing the VCP found the [All Acorn Documentation thread here](#).

Part G Code Preview on Job Load

- Displays the beginning of the G code program when the G code file is loaded. This allows operator to see the beginning of the G code program before pressing cycle start without having to open it in an editor to see it.

Pop Up Pins Deactivate on Cycle Start

- Automatically retracts the pop up pins when cycle start is pressed. This prevents tools from crashing into the pop up pins if the operator/programmer forgot to retract the pins in the G code program.

Disable Worklight on Startup

- Most machines are setup so that the worklight is ON when the machine is on by default. This selection allows user to choose to NOT have the worklight come on when the machine is on. The work light is still always activated by the VCP worklight button in either case.

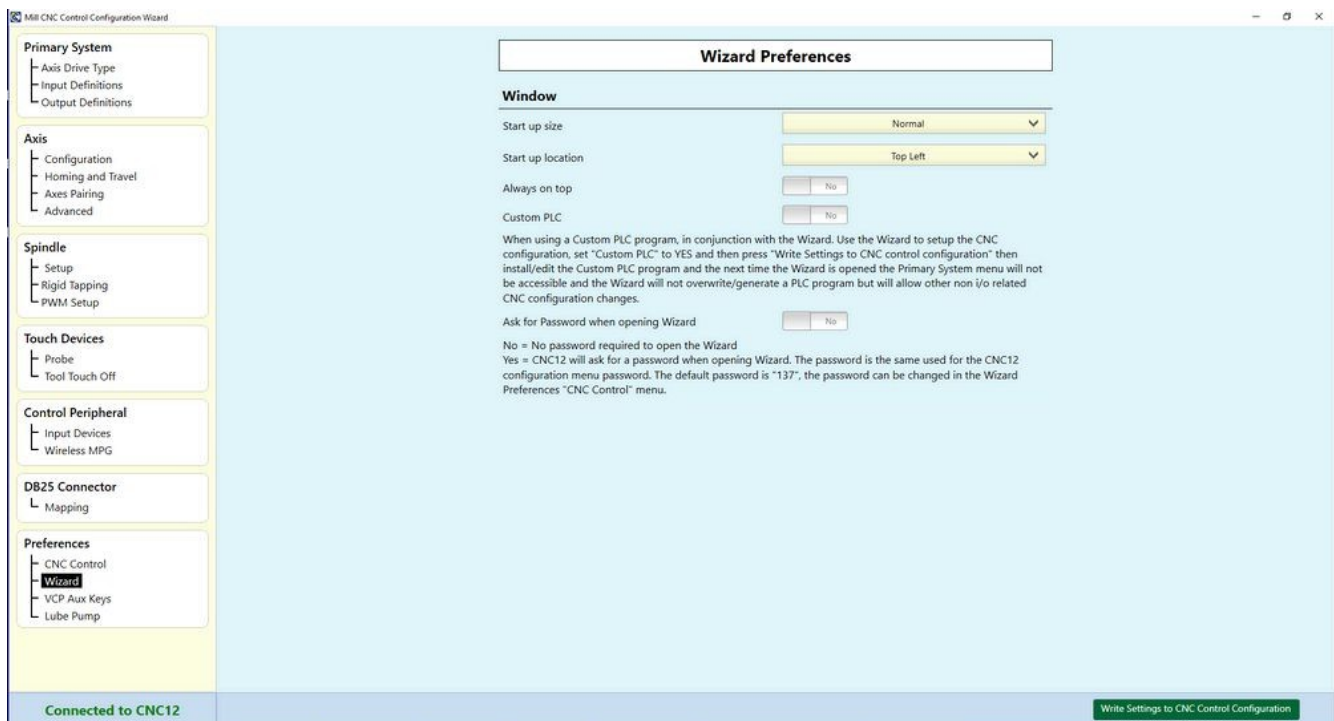
Keyboard Jogging: Enter Key = Cycle Start

- Many router customers are familiar with other cnc controls that use the Enter key on a PC keyboard to act as cycle start button. This selection allows this functionality.

USB/Keyboard Jogging active on CNC12 Startup

- Normally as a safety feature CNC12 USB and keyboard jogging is not active on boot up, the user has to enter into that mode (alt j) after boot up. This selection forces CNC12 to activate Keyboard and USB device jogging upon boot up.

6.19 Wizard Preferences



Wizard Preferences dialog

Start Up Size

- Window size of the Wizard dialog
- Default is Normal

Start Up Location

- Where on the Windows desktop the Wizard is located
- Default is Top Left

Always on Top

- Keeps the wizard on top of all other screens

- Yes/No

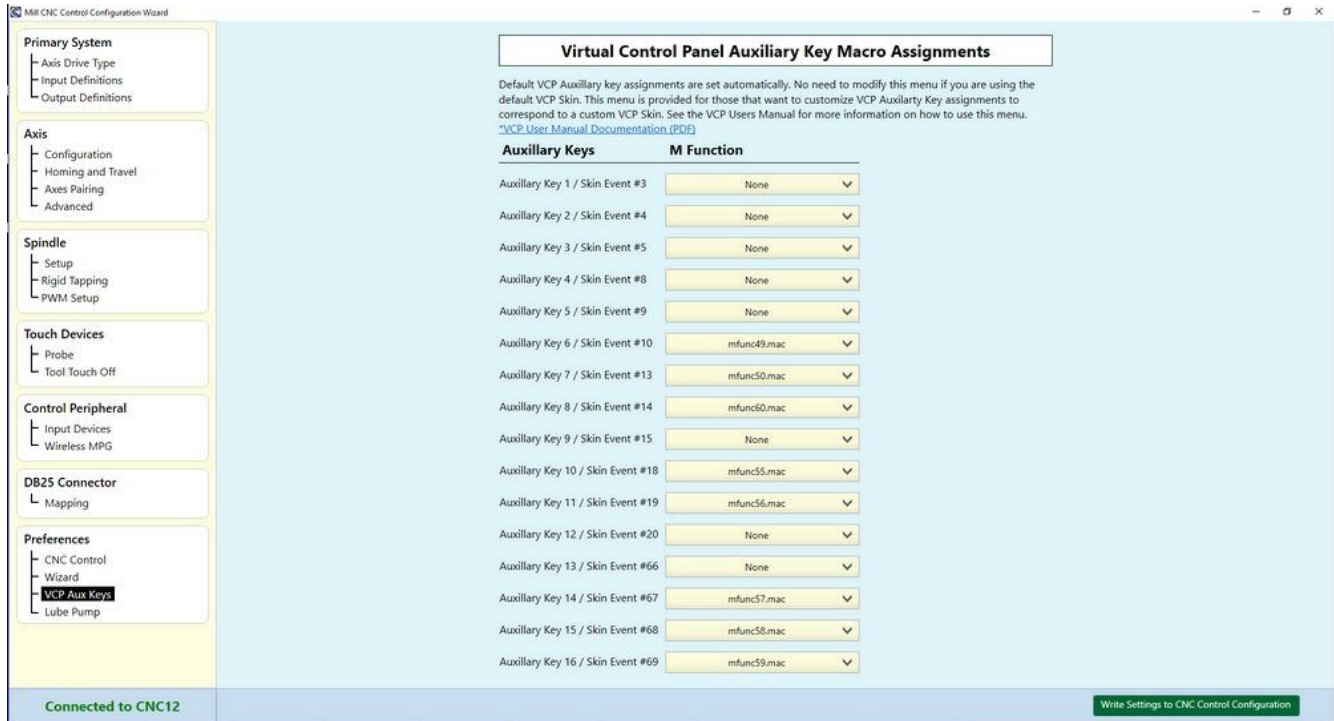
Custom PLC

- If a custom PLC program is in use, use this selection to let the Wizard know not to overwrite the custom PLC program.

Ask for password when opening Wizard

- Locks user out of Wizard unless password is entered
- If enabled, uses the same as the Configuration Menu Password

6.20 Preferences VCP Aux Keys Macro Assignments

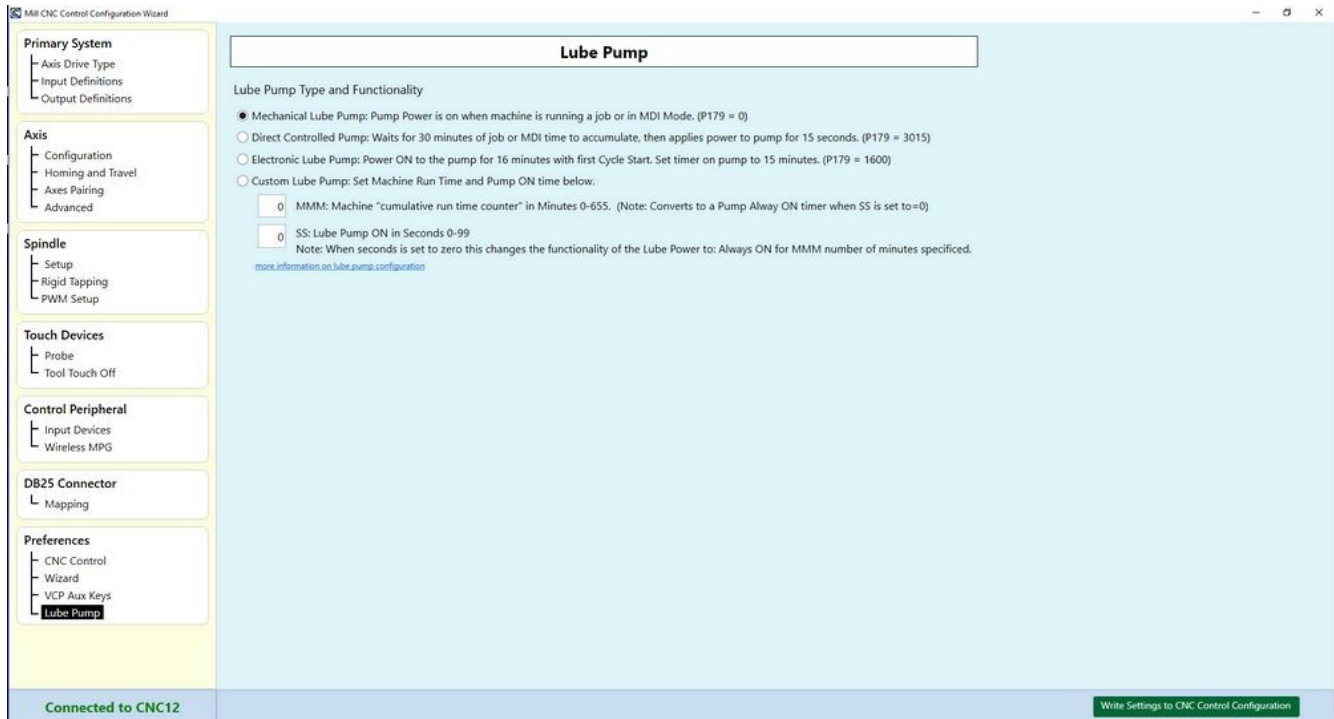


Wizard VCP Auxiliary Key Macro Assignments menu

Virtual Control Panel Macro Assignments

- Lists the macros that are pre assigned to the VCP buttons.
- Defaults shown
- See the VCP Users manual for details:
https://www.centroidcnc.com/centroid_diy/downloads/centroid_vcp_users_manual.pdf

6.21 Lube Pump Preferences



Wizard Lube Pump Menu

Lube Pump Type and Functionality

Define Lube Pump type, Mechanical, Direct Controlled, Electronic, or Custom.

- **Mechanical:** The Lube Pump Output is on at all times when CNC12 is running job or in MDI mode. This is used for Lube Pumps with their own timer.
- **Direct Controlled:** After 30 minutes of MDI or Job Running, the Lube Pump Output is turned on for 15 seconds applying power to the lube pump which in turns pumps oil into the lube system. Used with Lube Pumps that pump when power is applied to them.
- **Electronic:** for "Lube First" or "Lube Last" pumps
- **Custom:** User defined timer for Lube Pump Output.

[See Lube Pump Techbulletin #171 for more info.](#)

Chapter 7 Machine Motion Tuning

7.1 Axis Motor Testing & Configuration Setup

DANGER: MECHANICALLY DISCONNECT THE AXIS MOTORS FROM THE MACHINE TOOL before proceeding.

The first time jogging of an axis motor, the best practice is to have it disconnected from the machine. (Either by physically removing the motor from the machine or removing a gear or drive belt.) This way if something goes wrong, there is a minimal risk of mechanical damage to the machine. If one of the parameters or settings was entered incorrectly during the setup, the motor may oscillate violently or move out of control.

The axis motors need be able to move freely. Failure to disconnect the motors from the machine could result in personal injury or damage to the machine.

- 1 Release E-stop to clear all errors and provide VM power to the axis motors.
- 2 Set the feedrate to around 10%
- 3 Jog each axis motor while it is disconnected from the machine (or on the bench) if you have not already done so. Use the arrow keys on the Virtual Control Panel (VCP) to confirm that the motors are moving correctly.
- 4 While jogging, disable increment mode by making sure the button on the VCP labeled 'Incr Cont" is not lit up.
- 5 TROUBLESHOOTING TIP #1: If movement does not occur, some things to check:
 - 5.a Make sure you are using the DB25 for +5VDC logic drives (most all stepper drives)
 - 5.b Make sure you are using a schematic that closely matches your drives
 - 5.c Make sure you have wired the drive per the manufacturer's manual
 - 5.d Make sure E-Stop button is OUT, and you have no "406 Emergency Stop Detected" in the dialog box
 - 5.e Make sure VCP RESET button does not show "Tripped"
 - 5.f Make sure you have motor power to your axis drive
 - 5.g Make sure your axis motor is properly wired to your drive, including encoder if applicable.
 - 5.h Try NOT using the enable signal connection during testing, as this could inadvertently DISABLE the drive under Acorn control. This can be setup later after motor is moving under CNC12 control

(If these tips do not resolve the issue, visit the [Centroid Acorn User Forums](#):


and be sure to follow [this post explicitly about how to request support](#):

The more information you can provide, the better suggestion we can make. This includes a FRESH REPORT (F7 Utility, F7 Create Report) Links to axis drive manuals, Spindle drives, pictures of your setup and machine etc.

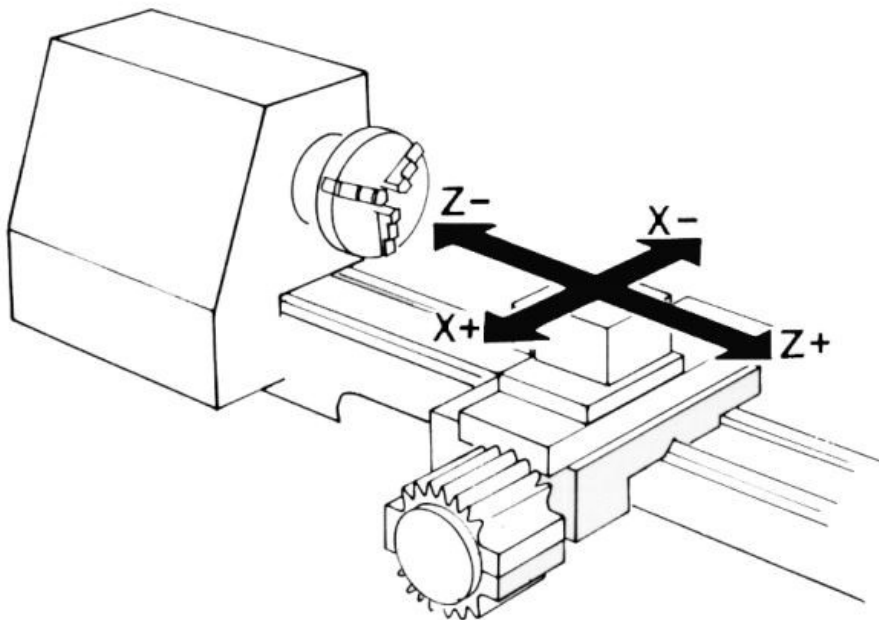
- 6 After successful axis motor movement, power down the system.
- 7 Manually move all axes to the center of their travel to provide safe clearance when the motors are connected to the machine.

- 8 Mechanically connect the axis motors to the machine, allowing the motors to control the movement of the machine.
- 9 Power up the machine. Release E-stop to provide power to the axis motors
- 10 Check home configuration: Make sure in the Wizard (F7 Utility, F10 Wizard), you have SIMPLE HOME selected next to Homing Type.

DANGER: Since the home switches have not been configured correctly yet, homing to switches right now could cause physical damage to your machine.

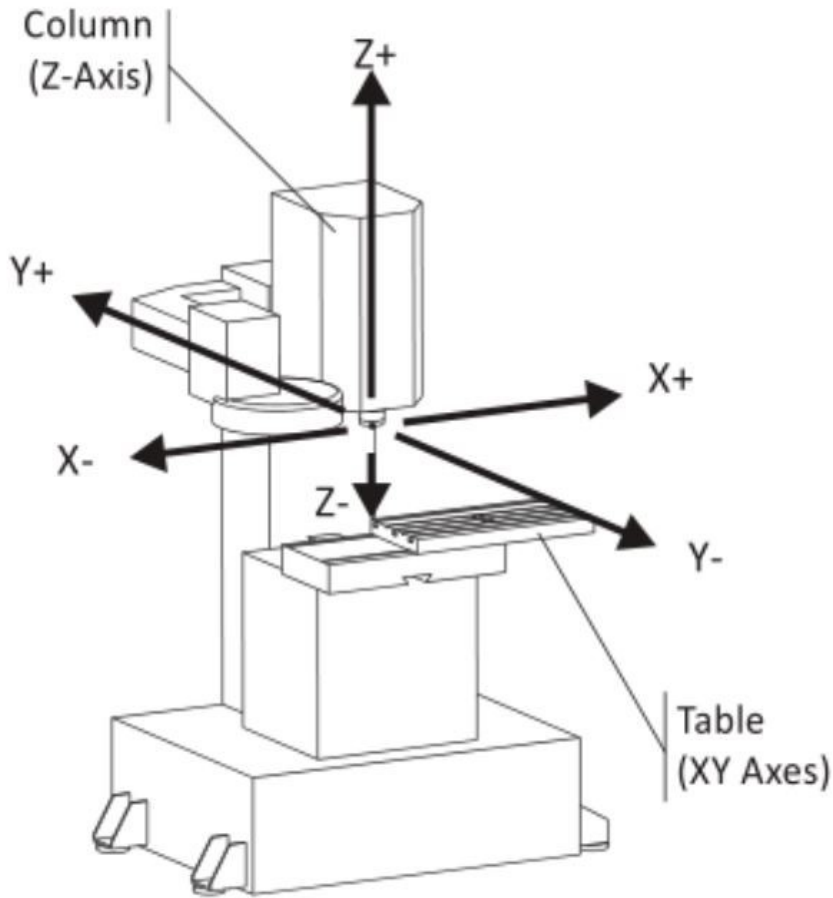
- 11 Make sure the feedrate is turned down to around 10%
- 12 Press the Start button  on the Virtual Control Panel, or press alt+s key from the keyboard. This will set home right where it is. DRO's should now show Zeros.
- 13 Slow jog each of the axis motors, checking that each axis of the machine can move by pressing the axis jog keys on the VCP.
- 14 Configure axis motors to move in the correct direction: It is important to understand that correct axis motor direction is determined by the motion of the tool relative to the part.

14.a Lathe with Front Mount Tool Post:



Lathe note: On a rear mounted tool post, the X axis would be reversed compared to a front mounted tool post.

14.b Milling Machine axis movement conventions is based on TOOL movement.



NOTE: For machines that move the table while the tool remains stationary such as the X & Y axes on a typical Bridgeport type knee mill, the table motion is the opposite of the “tool motion”. For machines that move the tool, such as the quill on a knee mill, axis motion is the same as the tool motion. .

- 15 Use the axis jog buttons on VCP to move each axis, observe and determine if the axis is moving in the correct industry standard direction. [See this related post for more information.](#)

Jog the axis and observe that the DRO position moves more positive while moving an axis in the positive direction and that it counts more negative while moving in the negative direction.

To correct for an axis that is moving in the wrong direction, if necessary, reverse the axis motor direction from within the Acorn Wizard, F7-Utility → F10 Acorn Wizard Under Axis, select Configuration. Then in the appropriate Axis Column, in Direction Reversal, select Y to reverse the direction. Review [Section 6.5 Axis Configuration](#)

Once axis direction is confirmed, then you may move on to the next section.

7.2 Coarse configuration of commanded movement vs actual/DRO display.

For imperial machine configurations the “Overall Turns Ratio” is the number of motor revolutions required to move an axis 1”

For metric machine configurations the “Overall Turns Ratio” is the number of mm's traveled during one revolution of the motor.

NOTE: The best way to determine the “Overall Turns Ratio” for a machine tool axis is to use simple math calculations to get a good starting value that we will fine tune later. This is described in the first part of [Technical Bulletin #36, which can be found here.](#)

And read [Related detailed information on overall turns ratio is here](#)

While it is always best to use the method in TB36 to set the Overall Turns Ratio, An alternative trail and error method can be used in situations where it is very difficult to determine the # of teeth on a pulleys or gearbox etc. This method simply compares the commanded movement with the actual movement of the axis using a scale or tape measure to observe and measure the movement. Before we can fine tune the DRO to an exact number, this trail and error method will get in the ballpark so we can move forward with the rest of the machine tool configuration. Later in this chapter, we will perform a fine adjustment on the overall turns ratio to calculate an exact value.

- 1 Jog the machine so that the spindle is in the center of the table.
- 2 Zero the DRO position for the axis being tested: From the main menu, press F1 – Setup → F1 Part → F10 Set Zero as shown below in Figure 7.12.1.
- 3 Set Up a Tape Measure or machinist scale on the table so that 0” is lined up under the center of the spindle/tool/pointer.
- 4 Command the machine to move. The longer the move the more accurate the measurement will be. It is recommended that you move the machine at least 1 foot. To move a specified amount MDI (Manual Data Input) screen. From the main menu, press F3 MDI. If we were testing the X axis for example, type “G1 X12 F10”. Which commands the control to “move in straight line (G1) the X axis in the positive direction(X12) at 10 inches per minute (F10)”, they press cycle start to execute the entered command.

WARNING: It is a good idea to use slow feedrate and be prepared to hit E-stop to prevent and accidental crash if the machine moves too far or too fast unexpectedly. If it does either then it is likely that either the Steps per Rev or Overall turns ratio is not configured properly. Related: Often it is a good idea to have some sort of ‘soft’ mechanical bumper on the axis so if an overtravel occurs the axis simply ‘bumps’ into the bumper and stalls the motor not damaging anything. Polyurethane bumpers are often employed for this use.

- 5 Measure the amount of travel moved and adjust the Overall Turns Ratio Value if necessary. Obviously if the measured movement equals the commanded movement we are done. If not perform the calculation below to determine a new overall turns ratio.

Using Imperial Units When command to move 10 inches via MDI and the machine moves 10 inches you have the correct overall turns ratio and you can stop here. If the machine moves a different amount than commanded calculate a new value to be entered in the revs/inch field, Divide the distance moved (Digital Read Out value) by the distance that the axis actually moved (measuring tape). Multiply this result by the current value in the Overall Turns Ratio field for the axis you are working on. This the new value that you will enter in the Overall Turns Ratio field. For example If the axis traveled 6”, but the commanded move entered

into MDI was 7.5”, then: $7.5/6 = 1.25$, if the current Overall Turns Ratio is $5.000 * 1.25 = 6.25$ is the new value to enter in the Overall Turns Ratio field.

Using Metric Units To calculate the value to be entered in the overall turns ratio, when using metric the units are mm/revolution of the motor. This distance that the machine moves in mm for one revolution of the axis motor. When command to move 2500 mm and the machine moves 2500 mm you have the correct overall turns ratio and you can stop. If the machine moves a different amount than commanded, calculate a new value for the overall turns ratio, Divide the distance that the axis actually moved (measuring tape) by the distance commanded in MDI (DRO value). Multiply this result by the current value in the Overall Turns Ratio field. This the new value that you will enter in the Overall Turns Ratio field. If the axis traveled 150mm”, but the commanded move entered into MDI was 175mm, then: $150/175 = .85714$, if the current Overall Turns Ratio is $5.08 * .85714 = 4.35428$ is the new value to enter in the Overall Turns Ratio Field.

Enter this new Overall Turn Ratio value: Axis Configuration section of the Wizard. From the main menu press F7 Utility → F10 Acorn Wizard. Click on Axis Configuration, adjust value, press “Write Settings to CNC Control” follow the instructions.

- 6 Repeat the test as needed until the commanded movement/DRO matches the measuring tape movement.
- 7 Repeat the test for each axis.

7.3 Fine Adjustment of overall turns ratio.

For imperial machine configurations the overall turns ratio is the number of motor revolutions required to move an axis 1”

For metric machine configurations the overall turns ratio is the number of mm's traveled during one revolution of the motor.

The method to fine tune the overall turns ratio is based on measuring an accurate gauge block of known dimensions. There are two typical measurement tools employed to do this measurement, a Dial Indicator and a [Touch Probe](#). This document covers how to fine tune the overall turns ratio using a Dial Indicator.

- 1 Attach a dial test indicator (also known as a lever arm test indicator or a finger indicator) to the spindle.

Create a Test Fixture: Create a fixture that is “L” shaped using a standard to act as a reference for measurement. Precision ground ‘standards’ are available at the typical machine shop supply websites. The exact length of the “long” part of the “L” is the precision ground standard of known dimensions.. An example of a typical test fixture is shown below.

The long part of the “L” is a gauge block measuring 12.000”

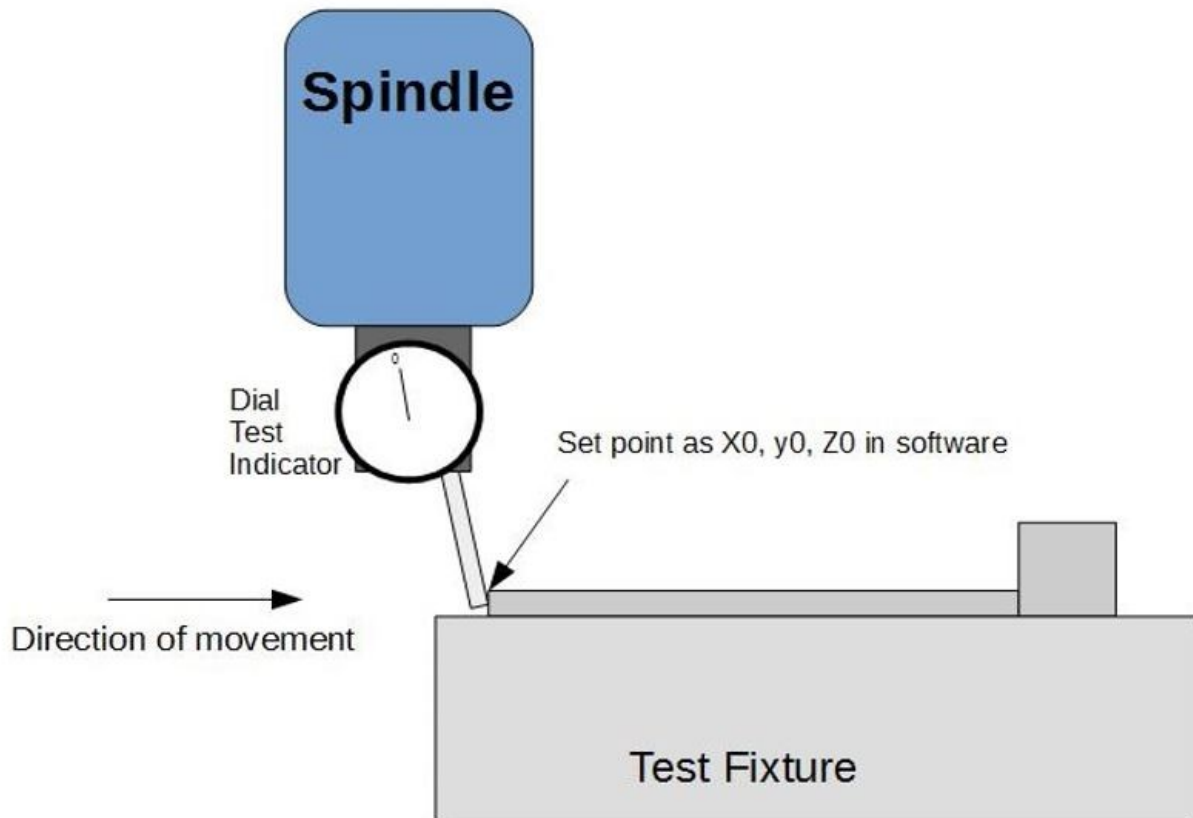


Test Fixture

The gage block should be appropriately 6 inches to 12 inches in length. A longer standard will give you better accuracy. (alternatively several 1-2-3 blocks can be measured and used in place of the gauge block shown. It is important the exact dimensions are known of the gauge block being used.)

- 2 Secure the test fixture so that it runs parallel to the axis being tested.
- 3 Move the dial indicator into position: Start from away from the standard block and slow jog towards standard. (open end of the “L” see below). Set VCP jog buttons to incremental x100 when close and continue to move the spindle/indicator so that it touches the standard block. Now switch to x10 and increment a few more times into the standard to take up an spring or play in the system, stop and observe the dial position on the indicator, do not touch the indicator.

NOTE: Only jog towards the block. If you jog too close and have to back up slightly, backlash will be introduced into your measurement. In that case you will have to start the test again. Move away and the move back towards the gauge block so that you are only moving in one direction during the measurement process.



- 4 Zero the DRO position in CNC12. From the main menu, press F1 – Setup → F1 Part → F10 Set Zero for the given axis you are working on:

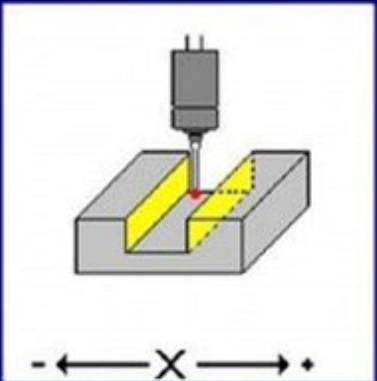
WCS #1 (G54) Current Position (Inches) Job Name: flange.cnc
 X +0.0000 Tool: T1 H---
 Y +0.0000 Feedrate: 100% 0.0 ipm
 Z +0.0000 Spindle: -4 M
 Coolant

335 Emergency stop released

Set Part 0/Position

- 1) Select Axis with F1
- 2) Jog to Touch Off on Part
- 3) Edit the Value if Necessary
- 4) Press F10 to Set Position

Axis	Part Position	Edge Finder Diameter	Approach From
X	0.0000	0.0000	Center



WCS #1 (G54)

Next Axis F1 Auto F4 Probe F5 Prev WCS F6 Next WCS F7 CSR F8 WCS Table F9 **Set F10**

Setting Part Zero

- 5 Raise the spindle axis: Move the axis that the indicator is on so that it is away from the test fixture. If we are configuring the X or Y axis we need to raise the Z-axis and jog the indicator towards the base of the "L". Set jog panel mode to incremental when you get close, x100 then x10, then x1 until the indicator just touches the end block.

NOTE: Only jog towards the block. If you jog too close and have to back up slightly, backlash will be introduced into your measurement. In that case you will have to start the test again.

- 6 Observe the distance moved on the DRO. For our example the observed distance moved on the DRO is 12.005. What this means is we moved exactly 12 inches by using the standard and the indicator but the control thinks we moved more than that. These kind of results are typical and are due to ballscrew pitch not being perfect. High quality ball screw typically will not have this issue.
- 7 Calculate new Overall Turns ratio values:

Imperial Units: To calculate the new overall turns ratio for inch units, divide the distance moved (Digital Read Out value) by the distance that the axis actually moved (the dimension of the standard). Multiply this result by the current value in the Overall Turns Ratio field for the axis you are working on. This the new value to be entered in the Overall Turns Ratio field. In our example the standard is exactly 12” but the DRO shows a distance moved of 12.005. $12.005 / 12 = 1.000416$ Now, if the current Overall Turns Ratio is 5.000 multiply by $1.000416 = 5.00208$ this is the new value to enter in the Overall Turns Ratio field. Save it and run the measurement test again until the actual distance moved and the DRO match.

Metric Units To calculate the new overall turns ratio. Divide the distance that the axis actually moved (gage block length) by the distance observed on the DRO. Multiply this result by the current value in the Overall Turns Ratio field. In our example the axis traveled is 300 mm (gage block length) but, the DRO displays 304.927. $300 / 304.927 = .98384$, Multiply $.98384$ by the the current Overall Turns Ratio for example if the axis has a 20 mm pitch ballscrew belted 1:1 with the axis motor the “rough” overall turns ratio is 20. $20 \times .98384 = 19.6768$ is the new value to enter in the Overall Turns Ratio Field. Save it and run the measurement test again until the actual distance moved and the DRO match.

- 8 Repeat the test as needed until the DRO measures the same as the gauge block.
- 9 Repeat the test for each axis.

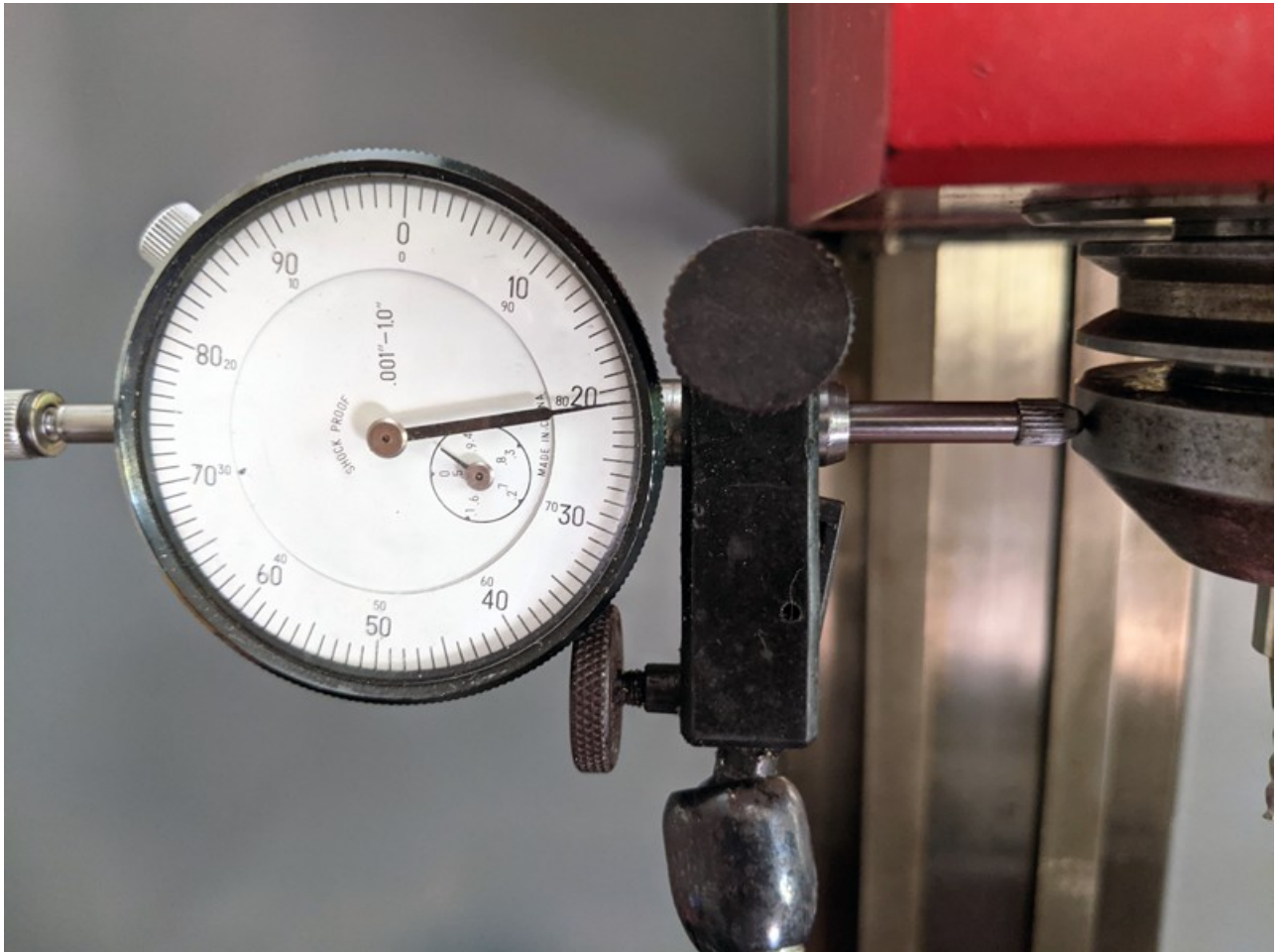
7.4 Machine Axis Backlash Compensation

Axis machine backlash compensation is the LAST thing to setup once the machine is fully configured and operational.

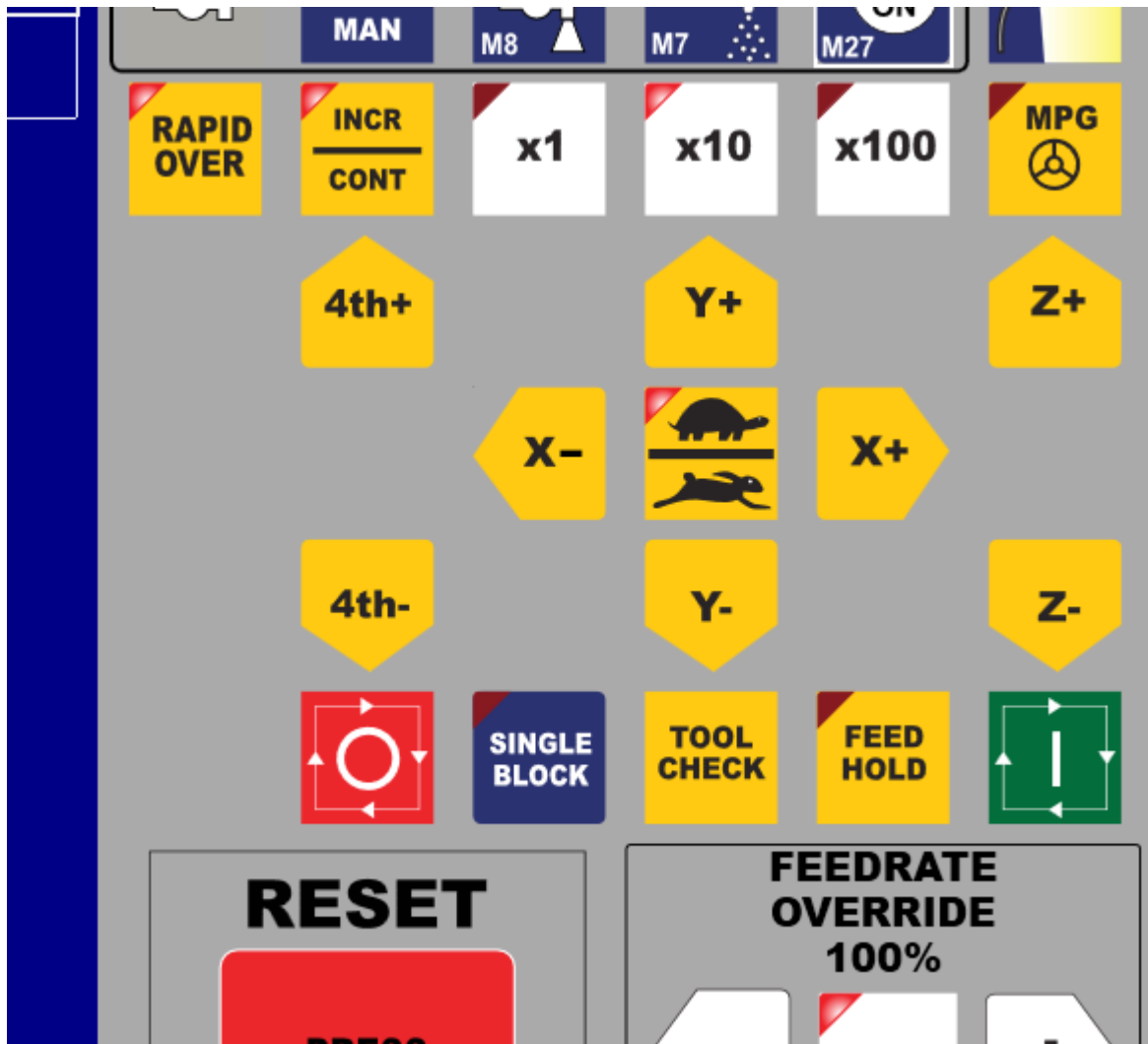
1. Software backlash compensation is effective but limited in its scope. For backlash compensation to work well the free play aka ‘lash’ or ‘backlash’ of an axis should be mechanically minimize. Lash Comp will not compensate for large and inconsistent backlash in a mechanical system. That being said it works quite well when the mechanical system has a repeatable small lash amounts that can be accurately measured. Then and only then can CNC12 “compensate” for mechanical backlash by adding movement to that axis motor on turn arounds. Typical lash numbers for good milling machines are zero to .002”, and for routers zero to .005”
Lash comp cannot cure mechanical play so it is very important that every effort is made to remove mechanical backlash from all axes before setting this value. (Note: More advanced techniques of axis position compensation are available with CNC12 and can be employed with Ballscrew Mapping techniques using either a Laser or digital scale to generate commanded position vs actual position correction tables. Also if the system is very accurate with measured lash under .0002” (2 tenths) often it is best to leave the lash comp set at zero.)
 - 1 Always manually measure and adjust Mechanical Lash Before configuring the “electronic” backlash compensation in the control, every effort should be made to reduce the mechanical lash in the machine to less than 0.002”. (Use the test below to verify the backlash is less than 0.002).
 - 2 Attach a plunge type dial indicator, roughly align it parallel to the axis being measured and perpendicular to the touch surface
 - 3 In the Acorn Wizard axis configuration menu make sure to Zero any Previous Backlash Values: Do not attempt to measure the backlash with the CNC control while the CNC control is

compensating for backlash! Enter the Wizard. F7 Utility, F10 Wizard. Proceed to the Axis Configuration Screen. Zero out any backlash values that was previously entered into the Lash Comp fields save the zero settings with “write settings to cnc control” and confirm changes were made.

- 4 Move the dial indicator into position: Start from away from the touch point and SLOW jog towards it then once touching it, Set VCP jog mode to “incremental” (INC) and set to .010” (X10) then continue to jog incrementally in the same direction pressing the axis jog button until the dial indicator lands on a position that is easy to remember. Any position will work, just so its easy to remember. (doesn't have to be zero) DO NOT TOUCH THE DIAL INDICATOR. For this example the dial indicator needle has 'landed' very close to 21, remember this position.

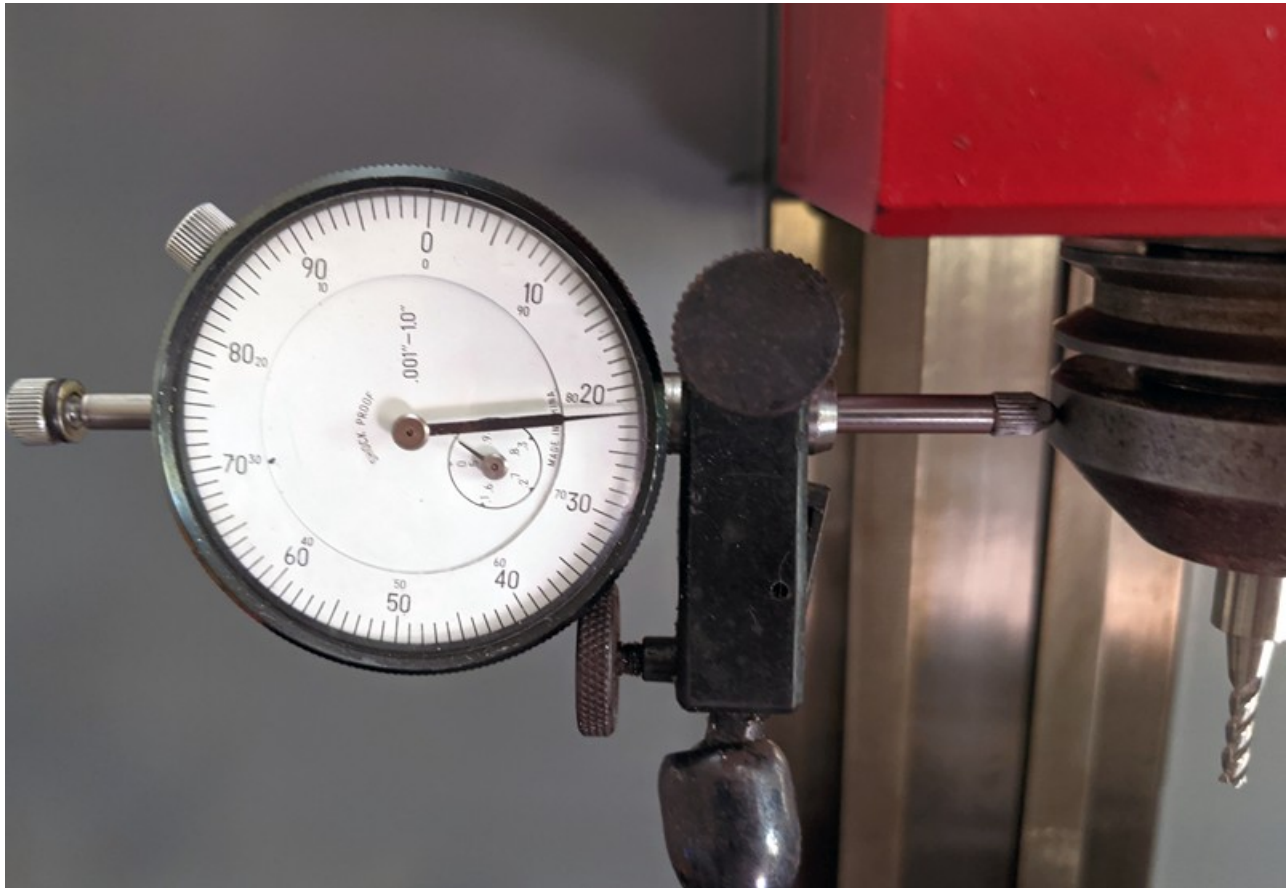


- 5 Now press the incremental jog button 10 times moving in the same direction and do not worry about the indicator value at this point it is irrelevant.



Now press the incremental jog button 10 times in the opposite direction.

The dial indicator will do one of two things, it will return to the observed and remembered starting location (in this case “21”) or it will ‘fall short’ of the observed position of 21, the amount that it falls short is the mechanical backlash of the axis. In our example the indicator fell short of the starting position of 21 and landed on 22. this means that this axis has .001” of back lash.



- 6 Enter the measured backlash value in the Acorn Wizard for the axis being measured and re run this test. If the backlash compensation value is accurate the dial indicator will return to the remembered position.

Follow backlash Technical Bulletin #37:

https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/37.pdf

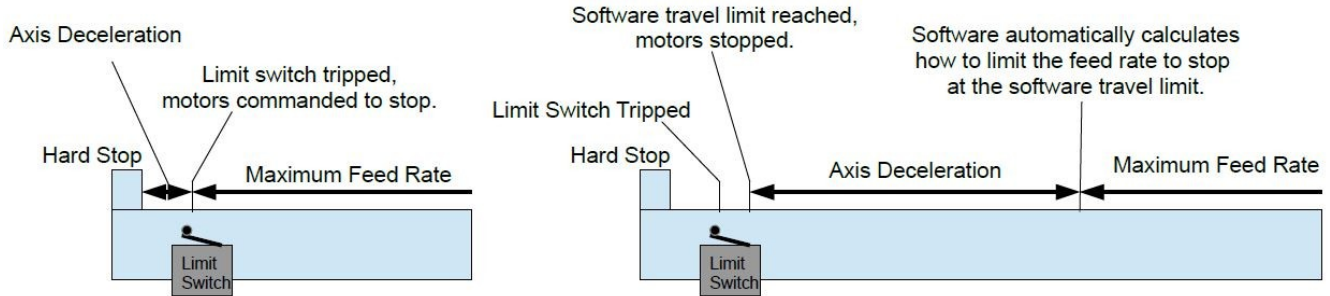
more info on how to accurately measure backlash is here.

<https://centroidcncforum.com/viewtopic.php?p=46199#p46199>

7.5 Software Travel Limits

Relevant Video: [Setting Software Travel Limits https://youtu.be/X7i4bKGLwVQ](https://youtu.be/X7i4bKGLwVQ)

NOTICE: Without software travel limits the machine can go maximum speed until a limit switch is tripped as shown below. Sometimes there is not enough time to decelerate the axis after the limit switch is tripped causing the machine to crash into the hard stop. This collision may cause serious damage to both the mechanical and electrical system.



Machine without software travel limits.

Machine with software travel limits

Setting up software travel limits will let CNC12 know the machine work envelope and automatically decelerate the axis right before it reaches the limit switch preventing possible damage to the machine as shown above. Additionally, CNC12 will stop the machine if a G code has commanded the machine to move past the software travel limit and produce an error message letting the operator know that the travel of the machine has been exceeded.

Prerequisites: Before starting, the steps per rev and overall turns ratio is required to be configured correctly and the maximum feed rate and acceleration should be correctly set up. Restart the machine and home it before continuing with this procedure.

- 1 Set the DRO to display the Machine Coordinate System. Press the “alt” key and “D” key simultaneously until “machine” is displayed in the top left corner of the DRO as shown below: When at the “home” position the Machine Coordinates will read zero.

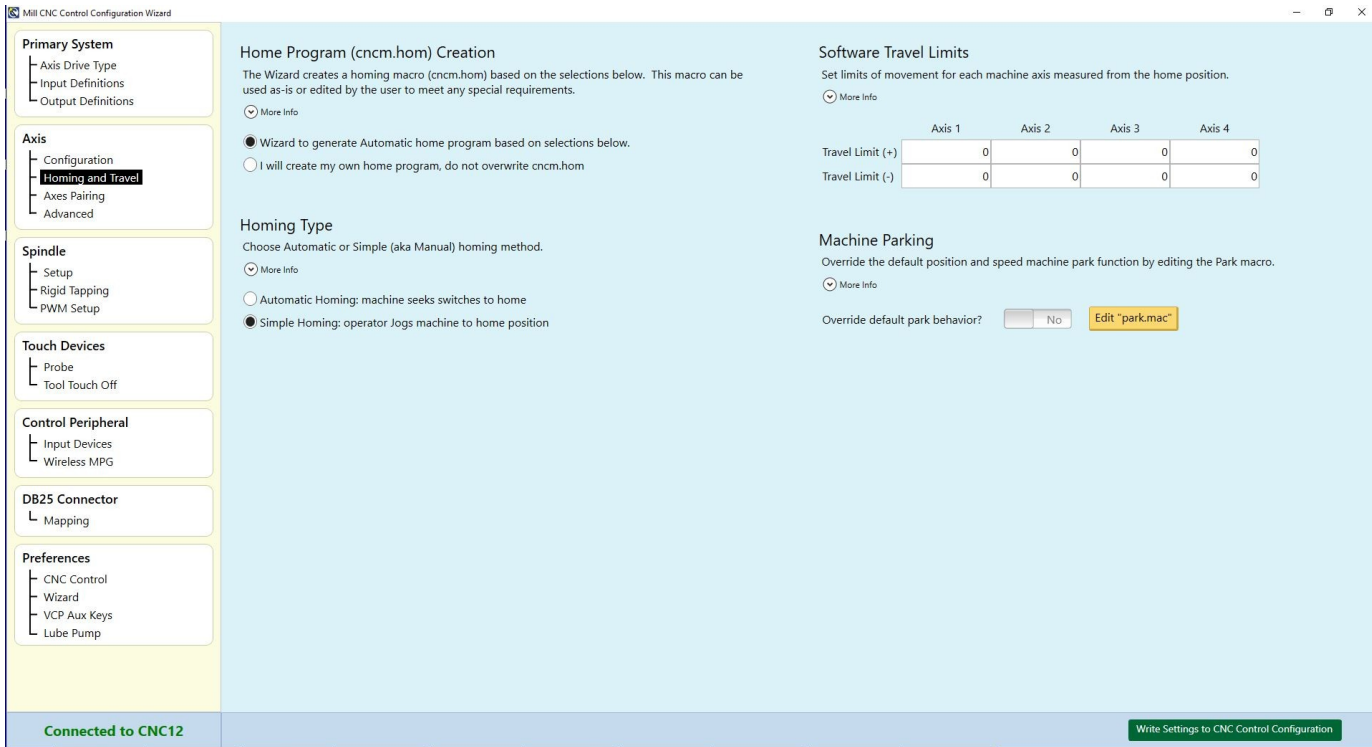
Machine	Current Position (Inches)	Job Name: NO_JOB_LOADED.cnc
X	+0.0000	Tool: T---H---
Y	+0.0000	Feedrate: 100% 0.0 ipm
Z	+0.0000	Spindle: 0 A
Distance to Go		335 Emergency stop released
X	+0.0000	9033 Reset Initiated, Press Reset to Clear
Y	+0.0000	4032 Reset Cleared
Z	+0.0000	Press CYCLE START to start job

Machine Coordinates DRO

- 2 From the home position Jog an axis to the opposite end of travel. Stop just short of the hard stop at the end of travel an amount that is ‘safe’ this is machine dependent typical values are .1”

to .37” . Now note the distance displayed on the DRO for the axis being set. This DRO position will be the software travel limit for that axis. (Note: Some values may be a negative number, (it all depends on where you decided to set the home position) record the negative number) Repeat and write down the values for each individual axis.

- 3 From the CNC12 main screen, enter the Wizard by pressing F7 Utility, F10 Wizard. Enter the Homing and Travel Screen:



Wizard Homing and Travel dialog

Enter the position for the software travel limit into the appropriate “Travel (-)” or “Travel (+)” box.

NOTE: When both the Travel(-) limit and the Travel(+) limit are set to zero, software travel limits are disabled for that axis. As soon as either one of the two values (plus or minus) change to a non-zero value, that axis movement will be limited on both ends using the values you entered based in the machine coordinate system. (distance from the Home position)

- 4 Repeat for each axis.
- 5 Test by manually jogging each axis toward the limit/home switch in CONTINUOUS Slow mode via the VCP. Watch that the axis automatically stops at the software travel limit position set before the limit/home switch is tripped. As another confirmation test use the F3 – MDI menu and issue G-code that asks the CNC12 to move just beyond the software travel limit, if travel limits are set up correctly the CNC12 will not move the axis and the status window will produce an error such as “907 # axis travel exceeded, 325 Limit: job canceled”

Appendix A Windows 10 Configuration

Windows 10 configuration for use with Centroid CNC software and hardware.

This procedure is outlined here on this

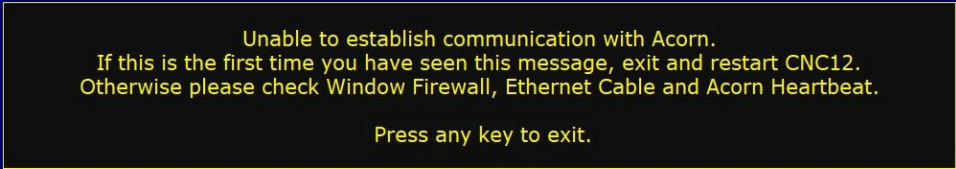
[page.https://www.centroidcnc.com/centroid_diy/acorn_quick_start_guide.html](https://www.centroidcnc.com/centroid_diy/acorn_quick_start_guide.html)

and in TB#309 https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/309.pdf

Appendix B Troubleshooting

CNC12 Acorn Communication Time Out

If you received the message in the screen below:



Unable to establish communication with Acorn.
If this is the first time you have seen this message, exit and restart CNC12.
Otherwise please check Window Firewall, Ethernet Cable and Acorn Heartbeat.

Press any key to exit.



Automated by Centroid technology
www.centroidcnc.com

- 1 Manually check the Ipv4 Settings for the Ethernet adapter being used with Acorn.

Ethernet adapter used with Acorn should have IPv4 manually configured:

- Ip Address 10.168.41.1
- Subnet mask 255.255.255.0

Visit the Community CNC Support Forum: Quick Tip: Checking Network IP Address Settings (solving communication errors) <https://centroidcncforum.com/viewtopic.php?f=61&t=1451>

- 2 Ensure that Windows defender firewall is turned off OR CNCM.EXE or CNCT.EXE are allowed through the Windows Defender Firewall. (Choose to allow them in both Public and Private Networks when prompted when CNC12 starts for the first time)
- 3 In the Windows Search Box, type Windows Defender Firewall
- 4 On the left side of the screen, select "Turn Windows Defender Firewall On or Off"

- 5 Click "Turn Windows Defender Firewall off" for both Public and Private networks
- 6 Windows defender is now off.
- 7 Now check the CNCPC for Antivirus or Antispyware software. These software programs will block CNC12. Sometimes these programs will allow CNC12 to run however, the program will slow communication between CNC12 and the Acorn causing inconsistent performance. These types of program must be uninstalled and not simply disabled.
- 8 Reboot the CNCPC and power the Acorn down and back up for good measure and then try and restart CNC12. If it starts, allow it to do any firmware updates and then continue with the installation
- 9 If CNC12 again does not start:
 - 9.a Make sure the CNCPC's Ethernet port drivers are the latest.
 - 9.b Try another shielded cable

PLC Diagnostic Screen

From the main program window press alt+i, to bring up the real time I/O (input output) display.

- Using the four arrow keys on the keyboard, you can move your cursor from row to row and within the row to select the item you want to use.
- The rows are:
 - Inputs
 - Outputs
 - Memory
 - Stages
- Most users will be primarily interested in Inputs and Outputs
- When an item is highlighted with the cursor the definition of the item is shown below the last row of LED indicators.
- Active items are Green, inactive are Red
- To exit the PLC Diagnostic Screen use alt+i

The screenshot displays the PLC Diagnostic Screen with the following information:

- WCS #1 (G54) Current Position (Inches):** X +0.0000, Y +0.0000, Z +0.0000
- Job Name:** NO_JOB_LOADED.cnc
- Tool:** T---H---
- Feedrate:** 100% 0.0 ipm
- Spindle:** 0 A
- Status Messages:**
 - 335 Emergency stop released
 - 9033 Reset Initiated, Press Reset to Clear
 - 4032 Reset Cleared
- Press CYCLE START to start job**
- I/O Indicators:** A grid of 120 LEDs (10 columns x 12 rows) for Inputs, Outputs, Memory, and Stages. The '3 Stages' row shows several green LEDs, indicating active stages.
- Control Panel (Right):** Includes buttons for AUTO SPINDLE MAN, SPIN HIGH/MED/LOW/BRAKE, SET AXIS 0, SET ALL 0, PARK, M55, M56, M57, M58, RESET HOME, FLOOD, MIST, VAC ON, M27, RAPID OVER, INCR CONT, x1, x10, x100, MPG, 4th+, Y+, Z+, X-, X+, 4th-, Y-, Z-, SINGLE BLOCK, TOOL CHECK, FEED HOLD, FEEDRATE OVERRIDE 100%, VCP OPTIONS, and Push to FREE.
- Bottom Panel:** Function keys Setup (F1), Load (F2), MDI (F3), Run (F4), CAM (F5), Edit (F6), Utility (F7), Graph (F8), Digitiz (F9), and Shut Down (F10).

For details on the PLC diagnostic screen see:

https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/cnc12_PLC_diagnostic_screen.pdf

Appendix C Free CNC Tech Support Forum and Knowledge Base

Review the information in the Acorn knowledge base: <https://centroidcncforum.com/viewforum.php?f=63>

Review the Acorn Knowledge base Video Library: <https://centroidcncforum.com/viewforum.php?f=61>

Please Read this post before posting questions on the forum (Fresh Reports are always required. F7 Utility, F7 Create Report): <https://centroidcncforum.com/viewtopic.php?f=60&t=1043>

When you post to the forum, then your question will be seen by many, possibly get more than one solution, and be there to be found by others and potentially help many more. Go here

All Acorn Documentation link

<https://centroidcncforum.com/viewtopic.php?f=60&t=3397>

Alternatively, Factory Direct Technical Support is available. Purchase here.

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

Centroid Community CNC Support Forum: Quick Tip: Setting up TeamViewer for remote technical support

<https://centroidcncforum.com/viewtopic.php?f=61&t=1448>

Centroid Community CNC Support Forum: Quick Tip: Creating and Restoring from a Report file

<https://centroidcncforum.com/viewtopic.php?f=61&t=3216>

Appendix D: ACORN CNC controller _rev4 Specifications Manual

For Revision 190201

Updated 9/16/19

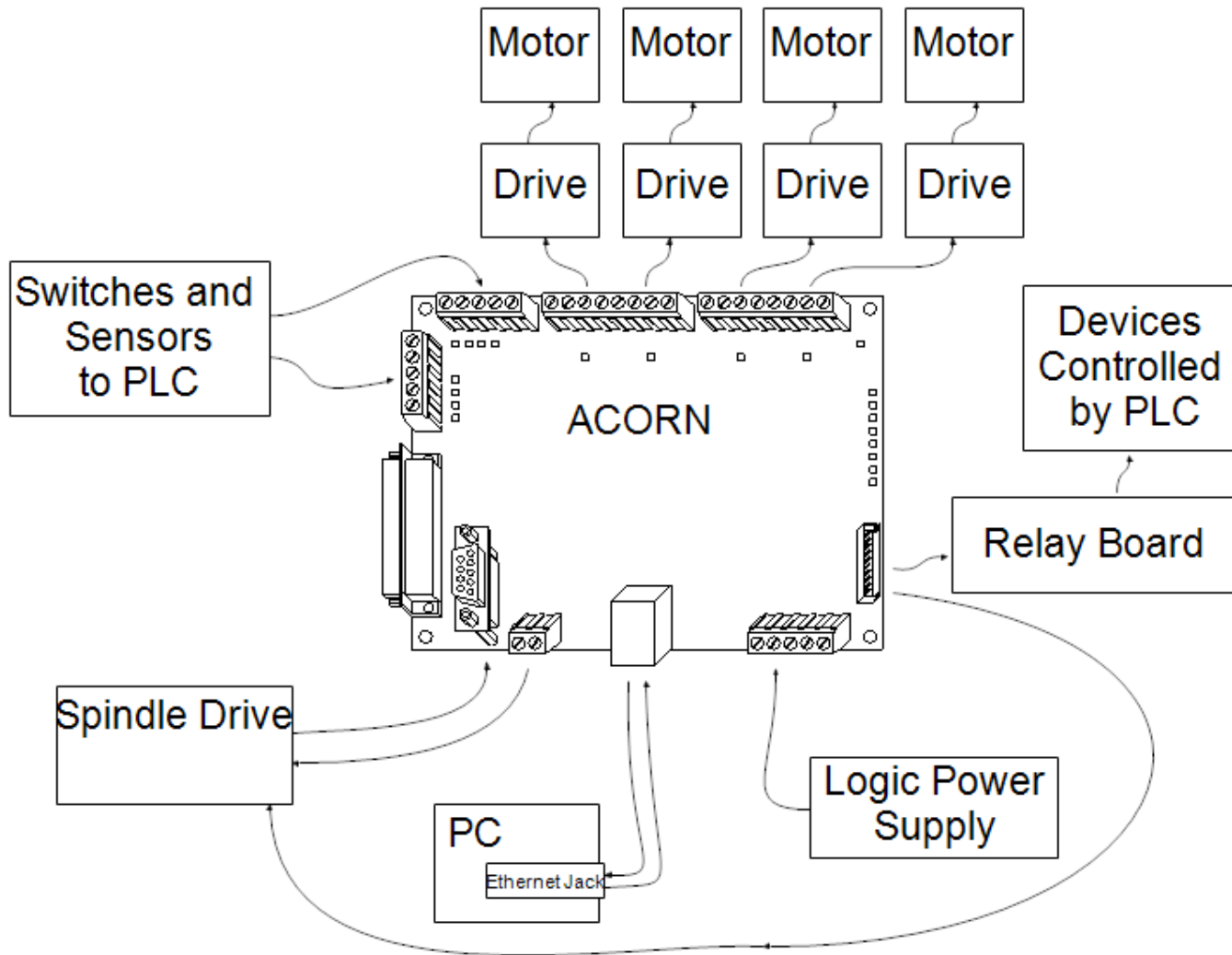
Overview

ACORN is technically a breakout board for the BeagleBone Green or BeagleBone Black embedded computer. The remainder of this document will refer to the breakout board with BeagleBone installed as ACORN. It is a low cost motion control processor, PLC, and drive interface board. It is intended to operate entry level machining equipment with up to four axes.

Features

Function:	Motion Control Processor, PLC, and Drive Interface
Maximum number of Axes:	4
Maximum pulse rate:	400kHz
Control Interface:	100 Mb/s Ethernet to PC
Drive Application:	Drives with step and direction inputs
Digital PLC Inputs:	8
Digital PLC Outputs:	8
Analog Output resolution:	12 bits
Dimensions (W*D*H):	5.4 * 4.2 * 0.7 inches

Typical Connections



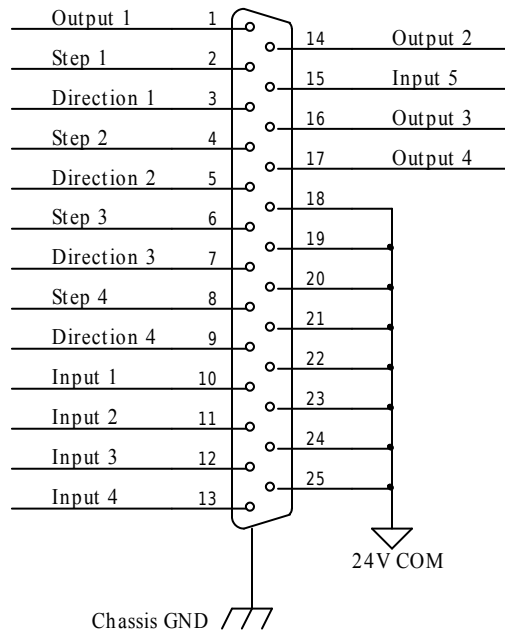
Connections

Two connection methods are available. A female DB25 connector is available that can mate with many stepper control units with a straight through cable. The inputs and outputs are 5V compatible. Check the DB25 pinout and circuit descriptions to determine if it is compatible with a particular control unit. The DB25 provides the simplest and quickest connection method if it is compatible.

Screw terminals are available for custom configurations. This allows for additional I/O and the most connection versatility. All input and output signals on the DB25 connector are available on the screw terminals except with 24V levels.

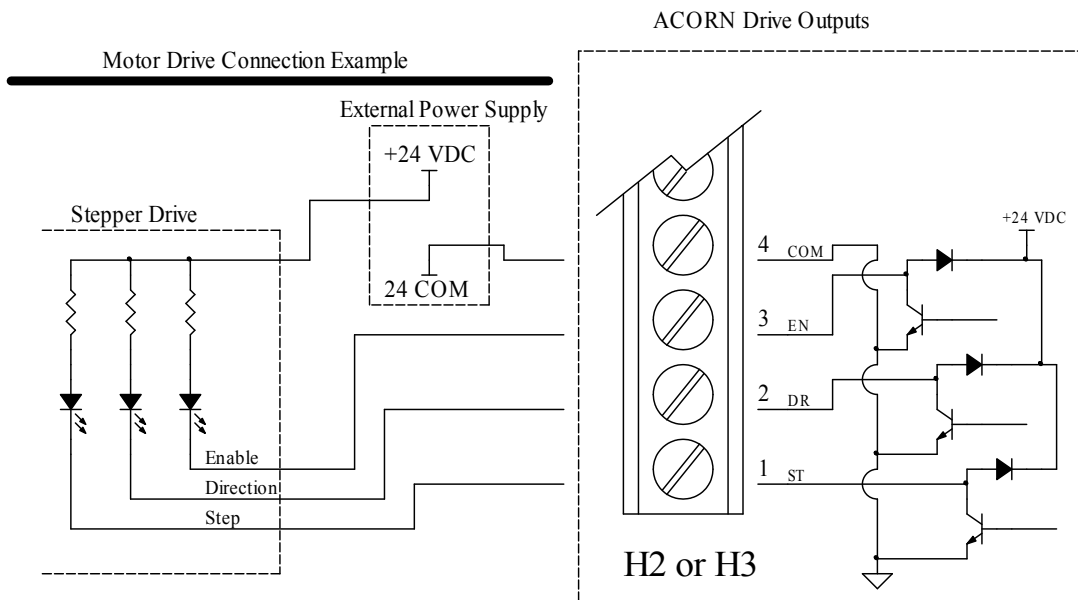
Inputs may only be used on the DB25 or screw terminal, not both. For example, only screw terminal input 1 or DB25 input 1 may be connected at the same time. However, screw terminal input 1 may be used at the same time as DB25 input 2.

DB25 (H6) Signals



Drive Interface Section

Four sets of step, direction, and enable outputs are provided to control motor drives. The outputs are open collector type and can provide up to 400kHz step frequency.

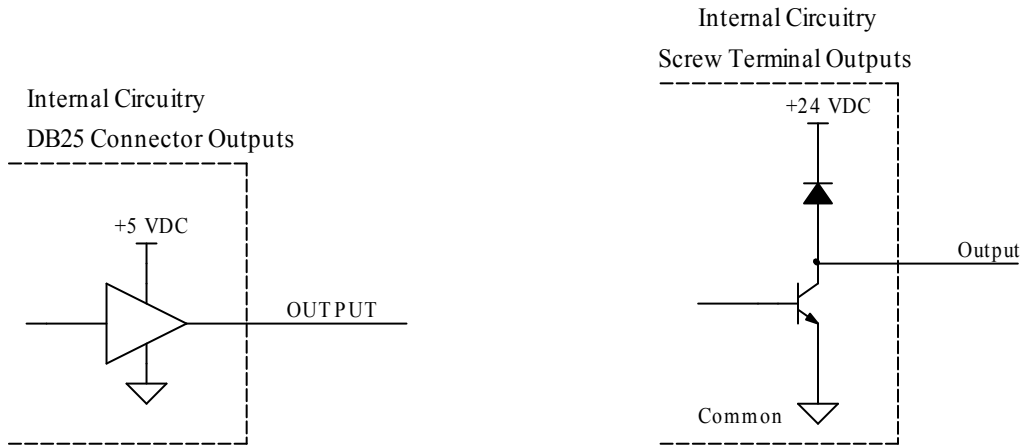


PLC Section

The ACORN has 8 digital inputs, 8 digital outputs, and one analog output. Check the “ACORN I/O Map” and “ACORN Specifications” sections to determine I/O type and capability.

Outputs

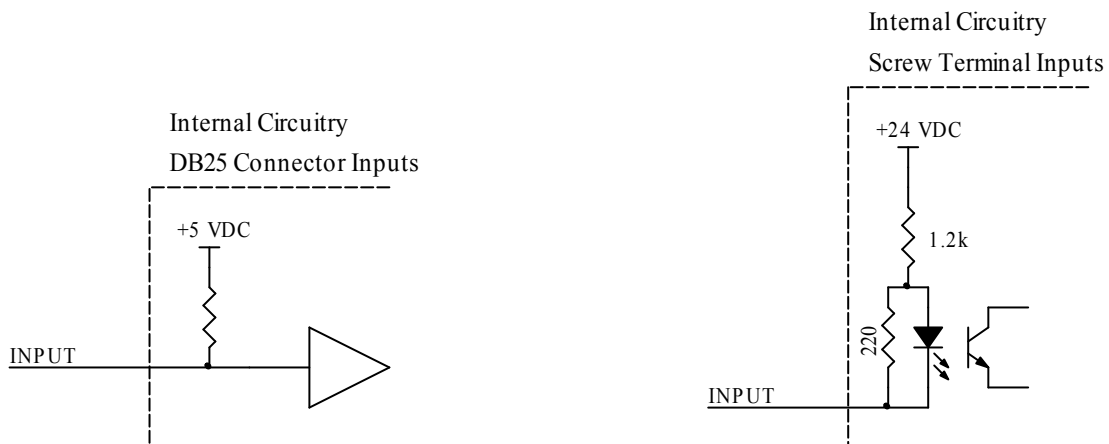
5V logic level relay outputs are available on the DB25 connector. 8 open collector outputs are normally wired with a ribbon cable to an external 8 relay board.



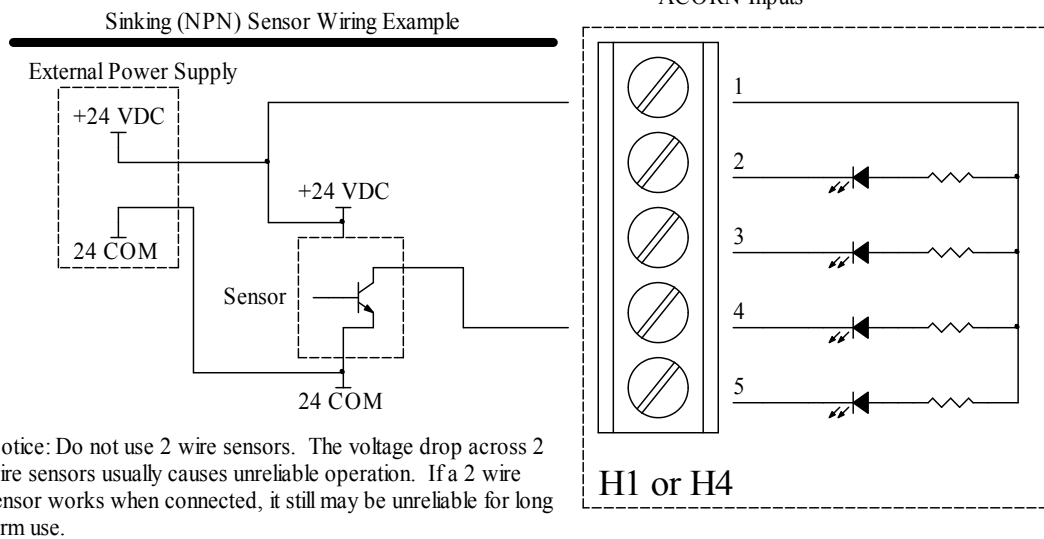
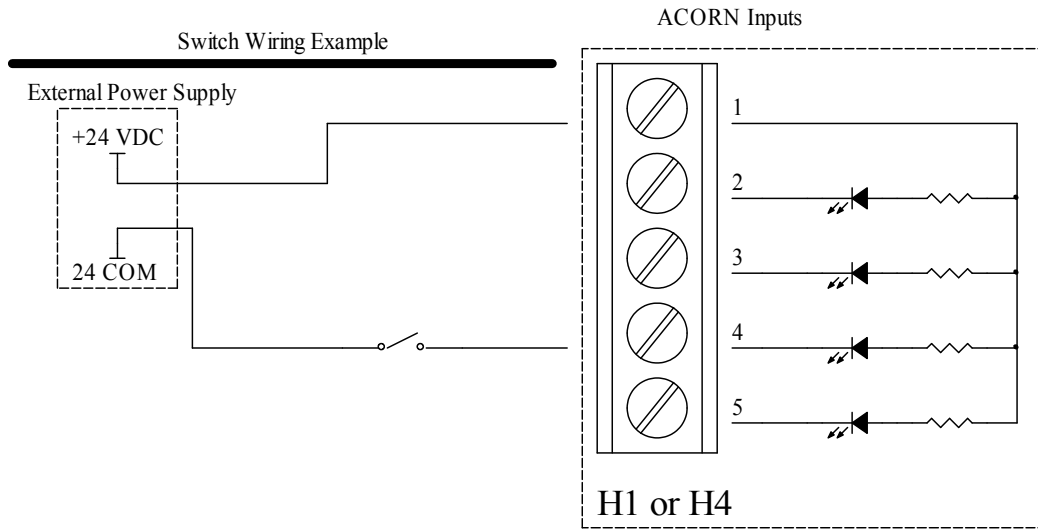
Inputs

ACORN uses optically isolated inputs for screw terminal inputs. These inputs can be used with 24 VDC sensors or switches. The 24 VDC for inputs may be supplied from the ACORN logic supply. For improved isolation and noise immunity, a separate 24 VDC may be used to power the inputs. Compare the specifications of sensors to the “ACORN Specifications” chart to ensure reliable operation.

DB25 inputs are only compatible with 5V logic levels. These inputs are not isolated.

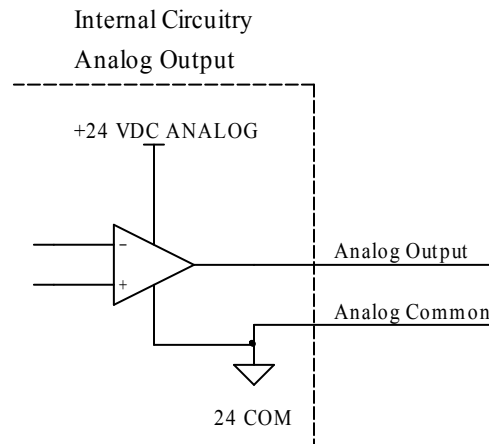


Input Connection Examples



Analog Output

An analog output is provided for controlling spindle speed. The output voltage range is 0 to 10 VDC.



Analog Output Calculations

The analog output uses a 12 bit digital to analog converter (DAC) to generate analog from the DAC request sent from the PLC program. The 12 bit value allows a DAC request of 0 to 4095, which corresponds to 0 to 9.998 volts in the 0 to 10V range.

$$\text{output voltage} = \frac{\text{DAC Request}}{4096} * 10$$

Analog Output Wiring

The analog output 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 the ACORN. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “ACORN Connections” section for terminal locations.

ACORN I/O Map

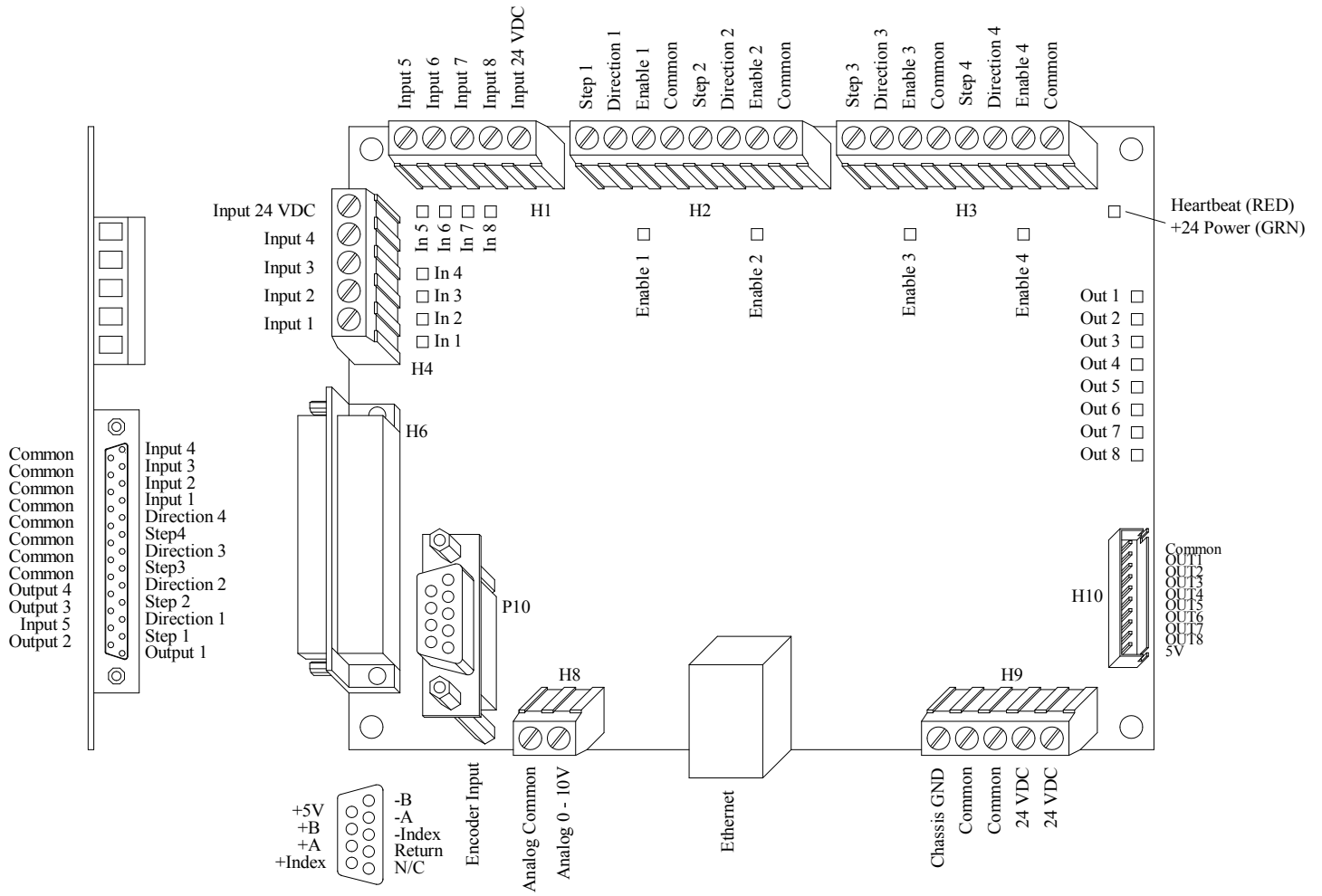
Input Specification		Input Location 1			Input Location 2		
Number	Function	Type	Connector	Pin	Type	Connector	Pin
1	General Purpose	Sourcing	H4	5	Logic w/ 5V Pullup	H6	10
2	General Purpose	Sourcing	H4	4	Logic w/ 5V Pullup	H6	11
3	General Purpose	Sourcing	H4	3	Logic w/ 5V Pullup	H6	12
4	General Purpose	Sourcing	H4	2	Logic w/ 5V Pullup	H6	13
5	General Purpose	Sourcing	H1	5	Logic w/ 5V Pullup	H6	15
6	General Purpose	Sourcing	H1	4	-	-	-
7	General Purpose	Sourcing	H1	3	-	-	-
8	General Purpose	Sourcing	H1	2	-	-	-

Output Specification		Output Location 1			Output Location 2		
Number	Function	Type	Connector	Pin	Type	Connector	Pin
1	General Purpose	Open Collector	H10	2	5V Logic	H6	1
2	General Purpose	Open Collector	H10	3	5V Logic	H6	14
3	General Purpose	Open Collector	H10	4	5V Logic	H6	16
4	General Purpose	Open Collector	H10	5	5V Logic	H6	17
5	General Purpose	Open Collector	H10	6	-	-	-
6	General Purpose	Open Collector	H10	7	-	-	-
7	General Purpose	Open Collector	H10	8	-	-	-
8	General Purpose	Open Collector	H10	9	-	-	-
17-28	Analog out	12 bit DAC	H8	1	-	-	-

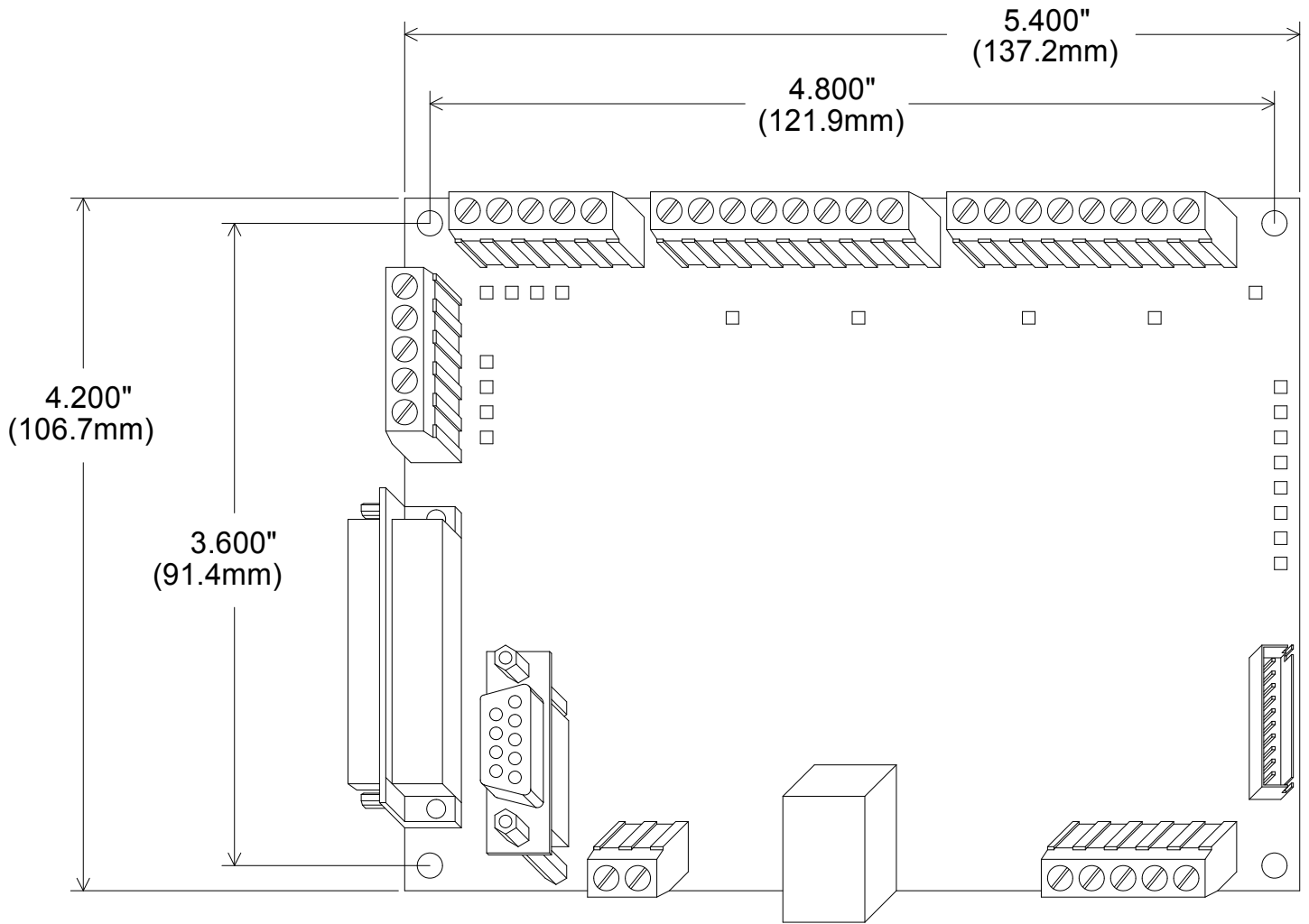
ACORN Specifications

Characteristic	Min.	Typ.	Max.	Unit
24 Volt Supply Current (Vsupply)	0.5	-	-	A
24V Input Pullup Voltage (Vinp)	22	-	26	VDC
24V Input Off Voltage	19.1	-	26	VDC
24V Input On Voltage	0	-	5.9	VDC
24V Input Operating current	9	11	15	mA
Open Collector Output Current	0	10	50	mA
Open Collector Output Voltage	0	24	Vsupply	VDC
DB25 Input Pullup Voltage (internal) (VCC)	3.8	4.4	5.5	VDC
DB25 Input On Voltage	VCC x 0.7	-	-	VDC
DB25 Input Off Voltage	-	-	VCC x 0.3	VDC
DB25 Output High Voltage	3.66	4.4	VCC	VDC
DB25 Output Low Voltage	0	0.1	0.44	VDC
DB25 Low Level Output Current	0	3	20	mA
DB25 High Level Output Current	0	3	20	mA
Analog Output Current	0	1	10	mA
Analog Output Voltage	0	-	10	V
Analog Output Resolution	-	12	-	bits
Relay Output Current (relay board)	0.01	-	10	A @ 125VAC
Relay Output Current (relay board)	0.01	-	10	A @ 28VDC
5 Volt Supply Current (relay board)	0.3	-	-	A
Size: 5.4 * 4.2 * 0.7 (W*D*H)				Inches

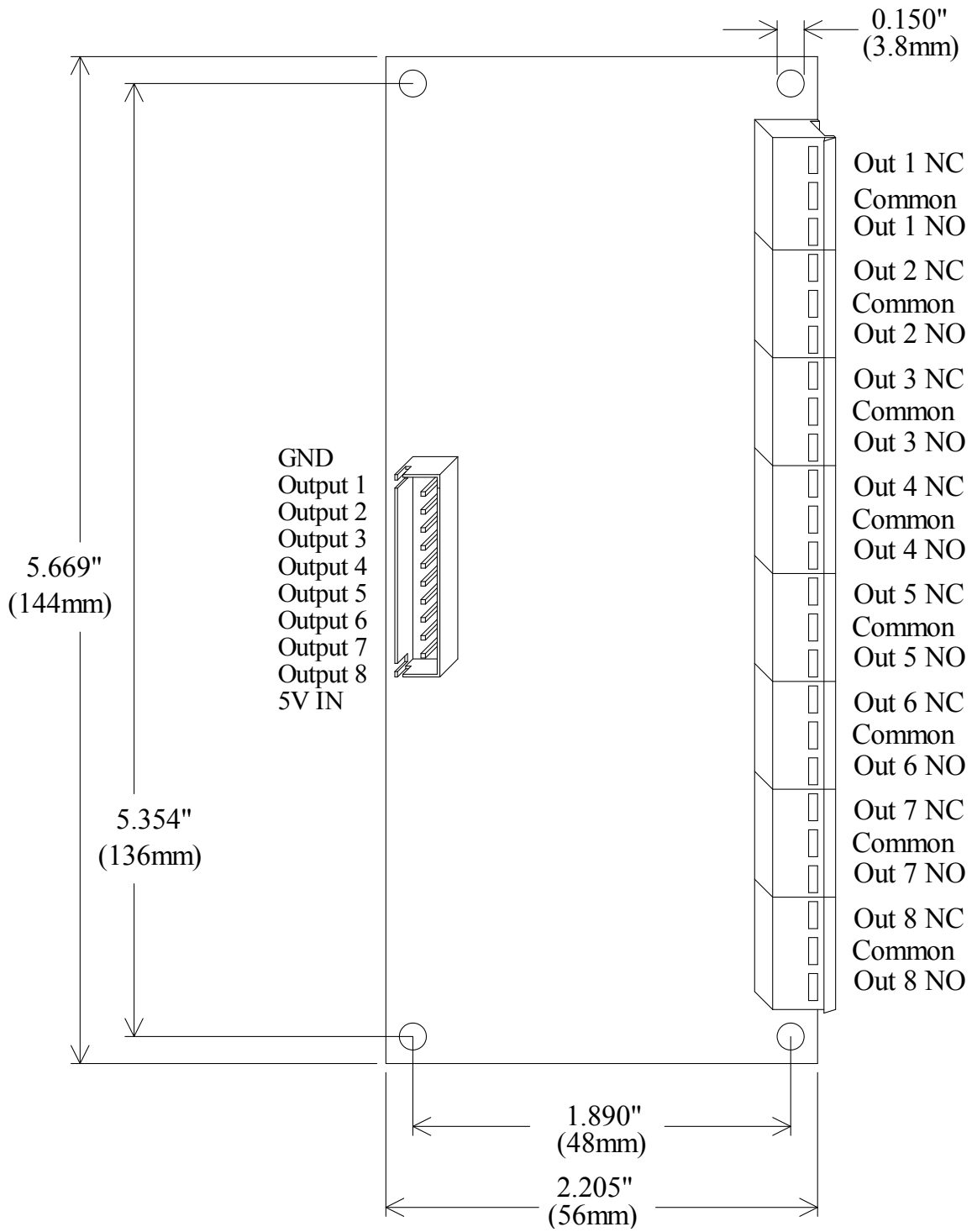
ACORN Connections



ACORN Mounting Footprint



8 Relay Board Mounting Footprint



SONGLE RELAY

	RELAY ISO9002	SRD
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1. MAIN FEATURES

- Switching capacity available by 10A in spite of small size design for highdensity P.C. board mounting technique.
- UL,CUL,TUV recognized.
- Selection of plastic material for high temperature and better chemical solution performance.
- Sealed types available.
- Simple relay magnetic circuit to meet low cost of mass production.

2. APPLICATIONS

- Domestic appliance, office machine, audio, equipment, automobile, etc.
(Remote control TV receiver, monitor display, audio equipment high rushing current use application.)

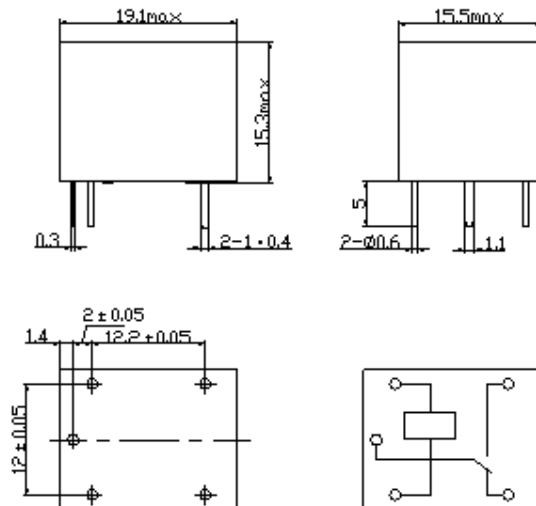
3. ORDERING INFORMATION

SRD	XX VDC	S	L	C
Model of relay	Nominal coil voltage	Structure	Coil sensitivity	Contact form
SRD	03、05、06、09、12、24、48VDC	S:Sealed type	L:0.36W	A:1 form A
		F:Flux free type	D:0.45W	B:1 form B C:1 form C

4. RATING

CCC	FILE NUMBER:CH0052885-2000	7A/240VDC
CCC	FILE NUMBER:CH0036746-99	10A/250VDC
UL/CUL	FILE NUMBER: E167996	10A/125VAC 28VDC
TUV	FILE NUMBER: R9933789	10A/240VAC 28VDC

5. DIMENSION (unit:mm) DRILLING (unit:mm) WIRING DIAGRAM



6. COIL DATA CHART (AT20°C)

Coil Sensitivity	Coil Voltage Code	Nominal Voltage (VDC)	Nominal Current (mA)	Coil Resistance (Ω $\pm 10\%$)	Power Consumption (W)	Pull-In Voltage (VDC)	Drop-Out Voltage (VDC)	Max-Allowable Voltage (VDC)
SRD (High Sensitivity)	03	03	120	25	abt. 0.36W	75%Max.	10% Min.	120%
	05	05	71.4	70				
	06	06	60	100				
	09	09	40	225				
	12	12	30	400				
	24	24	15	1600				
	48	48	7.5	6400				
SRD (Standard)	03	03	150	20	abt. 0.45W	75% Max.	10% Min.	110%
	05	05	89.3	55				
	06	06	75	80				
	09	09	50	180				
	12	12	37.5	320				
	24	24	18.7	1280				
	48	48	10	4500	abt. 0.51W			

7. CONTACT RATING

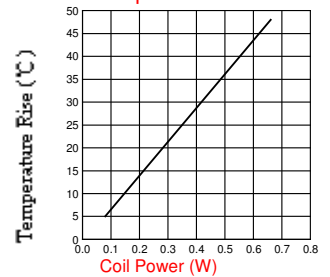
Item	Type	SRD	
		FORM C	FORM A
Contact Capacity Resistive Load ($\cos\Phi=1$)		7A 28VDC 10A 125VAC 7A 240VAC	10A 28VDC 10A 240VAC
Inductive Load ($\cos\Phi=0.4$ L/R=7msec)		3A 120VAC 3A 28VDC	5A 120VAC 5A 28VDC
Max. Allowable Voltage		250VAC/110VDC	250VAC/110VDC
Max. Allowable Power Force		800VAC/240W	1200VA/300W
Contact Material		AgCdO	AgCdO

8. PERFORMANCE (at initial value)

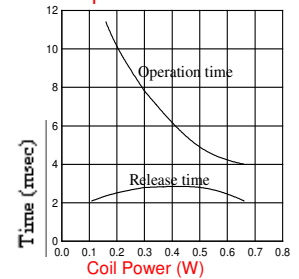
Item	Type	SRD
Contact Resistance		100m Ω Max.
Operation Time		10msec Max.
Release Time		5msec Max.
Dielectric Strength		
Between coil & contact		1500VAC 50/60HZ (1 minute)
Between contacts		1000VAC 50/60HZ (1 minute)
Insulation Resistance		100 M Ω Min. (500VDC)
Max. ON/OFF Switching		
Mechanically		300 operation/min
Electrically		30 operation/min
Ambient Temperature		-25°C to +70°C
Operating Humidity		45 to 85% RH
Vibration		
Endurance		10 to 55Hz Double Amplitude 1.5mm
Error Operation		10 to 55Hz Double Amplitude 1.5mm
Shock		
Endurance		100G Min.
Error Operation		10G Min.
Life Expectancy		
Mechanically		10 ⁷ operations. Min. (no load)
Electrically		10 ⁵ operations. Min. (at rated coil voltage)
Weight		abt. 10grs.

9. REFERENCE DATA

Coil Temperature Rise

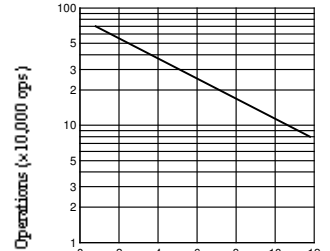


Operation Time



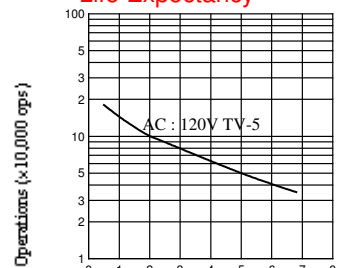
Life Expectancy

AC120V/DC24V $\cos\Phi=1$



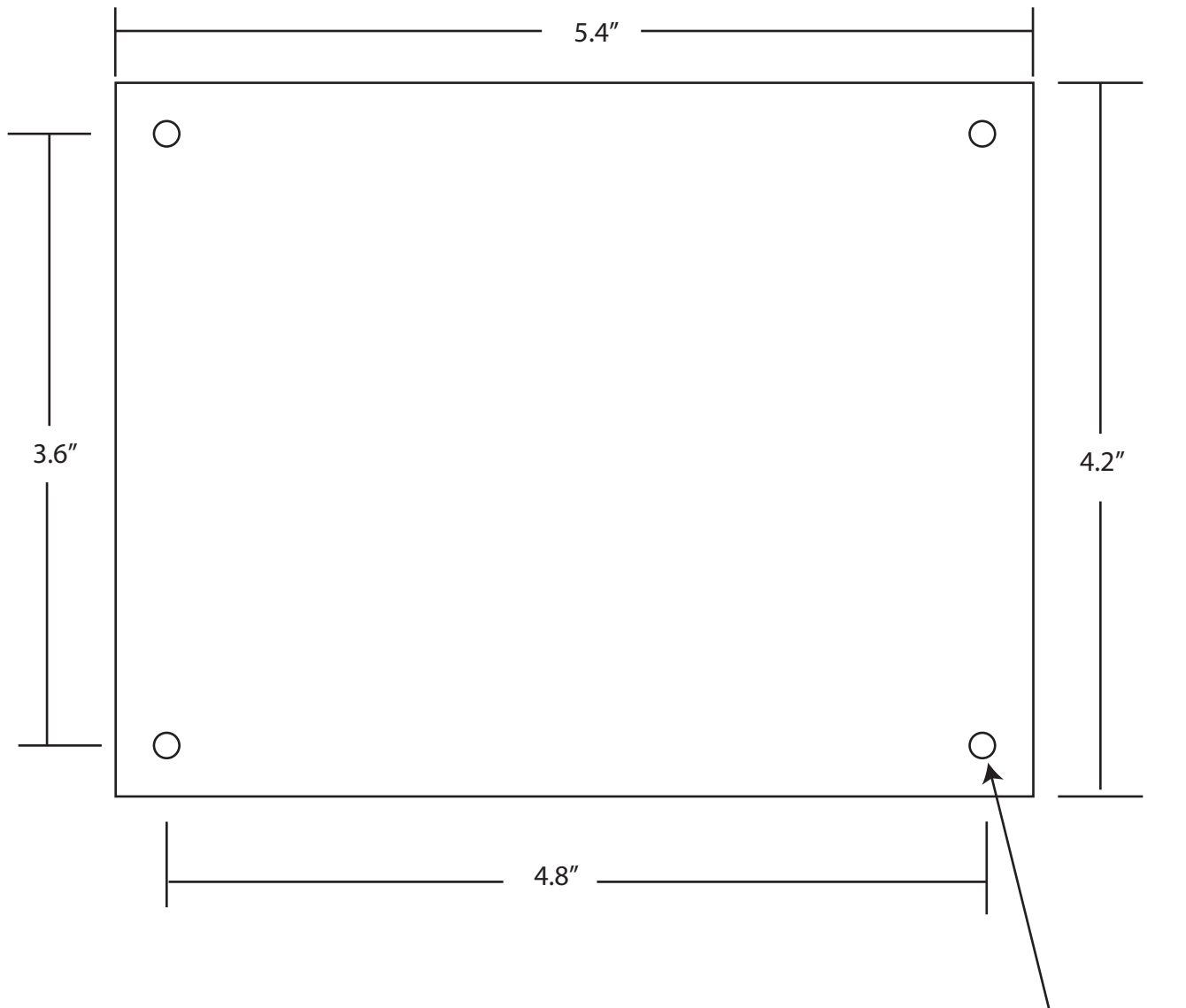
Current of Load (A)

Life Expectancy



Current of Load (A)

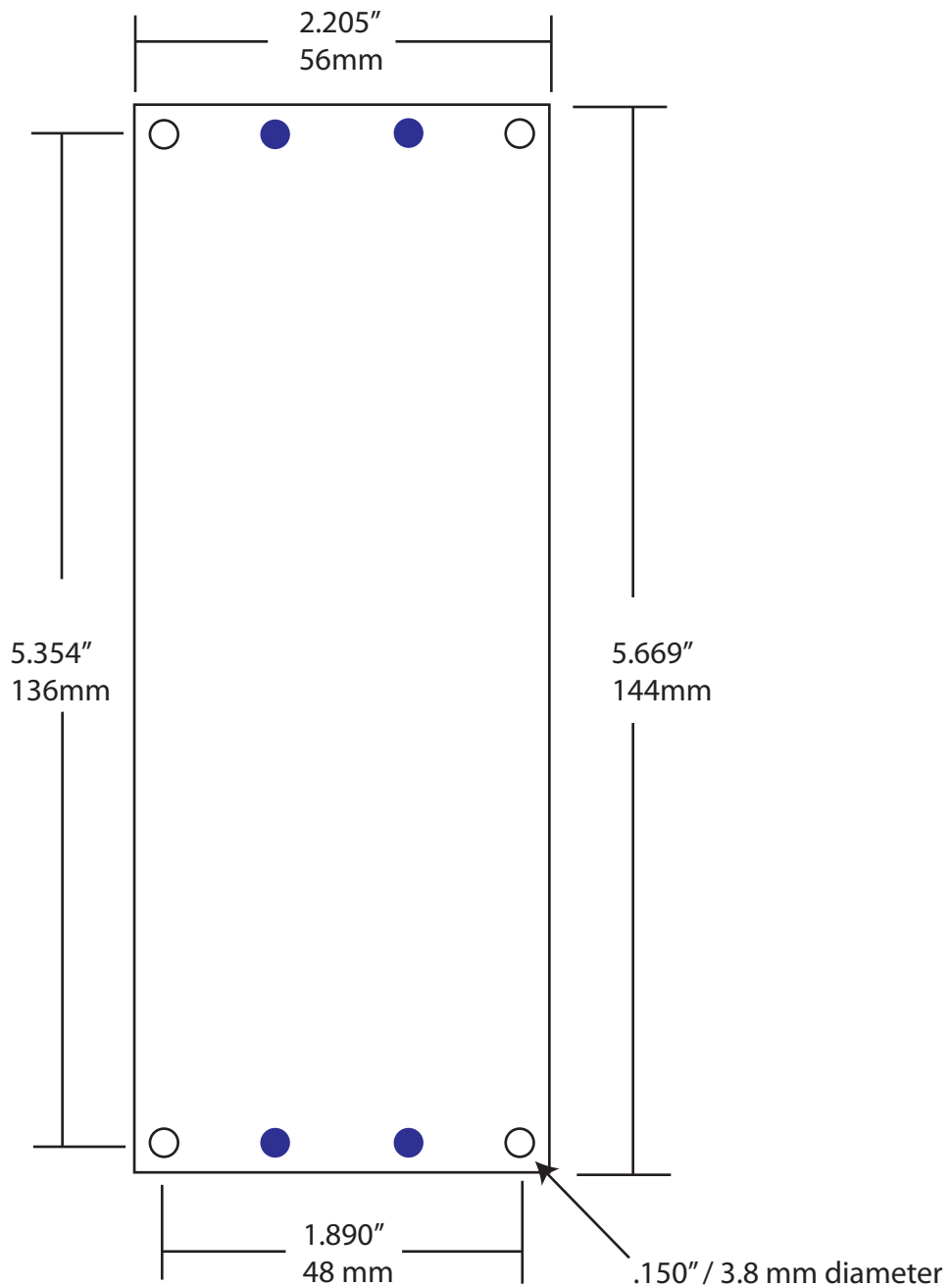
Acorn CNC control board Mounting Footprint.



- Holes are clearance for 6-32 (.150" / 3.8 mm diameter diameter)
- 6-32 metal standoffs are recommended

.150" / 3.8 mm diameter

Acorn CNC 8 Relay Module Mounting Footprint.



- Holes are clearance for 6-32 (.150" / 3.8 mm diameter)
- 6-32 metal standoffs are recommended

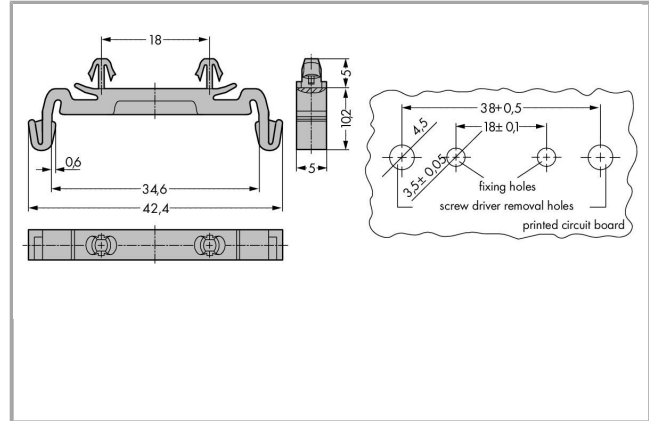
● The 8 Relay Module Din Rail Mounting holes accept Din Rail standard clips such as the Wago 209188 clip and alternatives. <https://www.wago.com/us/rail-chassis-terminal-blocks/mounting-foot/p/209-188>

Data sheet | Item number: 209-188

Mounting foot; can be assembled on terminal blocks with fixing flange; gray



www.wago.com/209-188



Data

Geometrical Data

Width	5 mm / 0.197 inch
Height from upper-edge of DIN-35 rail	5.1 mm / 0.201 inch
Depth	42.4 mm / 1.669 inch

Material Data

Weight	0.96 g
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Commercial data

Product Group	2 (Terminal Block Accessories)
Country of origin	DE
GTIN	4017332200998

Downloads

CAD/CAE-Data

CAD data

3D Download 209-188	URL	Download
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EPLAN

EPLAN Data Portal 209-188	Download
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