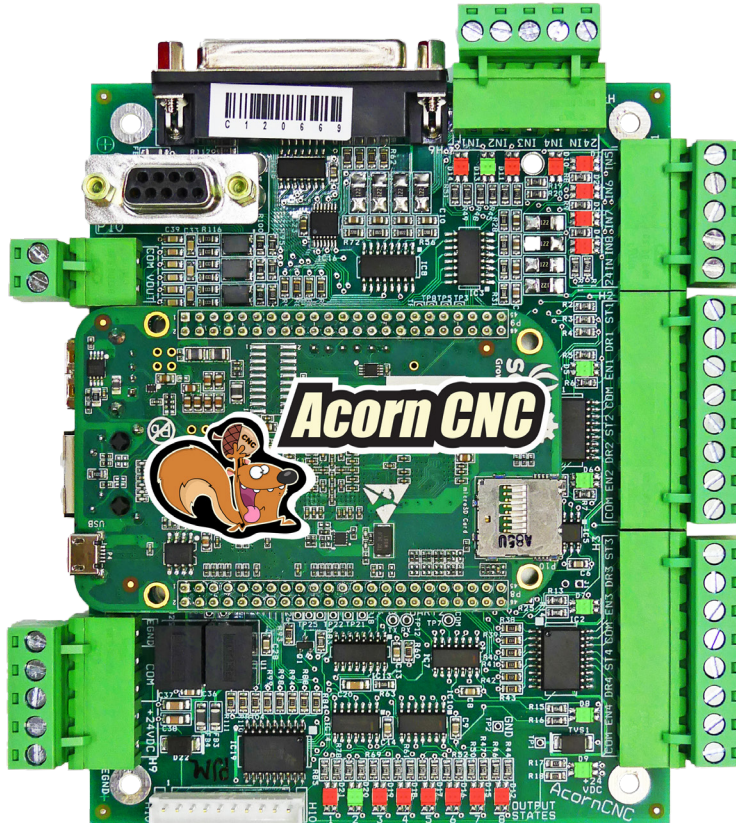




Centroid Acorn CNC12 Axis Pairing and Squaring

CNC Software version: CNC12 V.5.08+

Models: Acorn & AcornSix



Hardware Pairing vs Software Pairing

2

Hardware Pairing and Axis Squaring

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Software Pairing and Axis Squaring

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Acorn Paired Axes Homing and Squaring CNC12 v5.08+

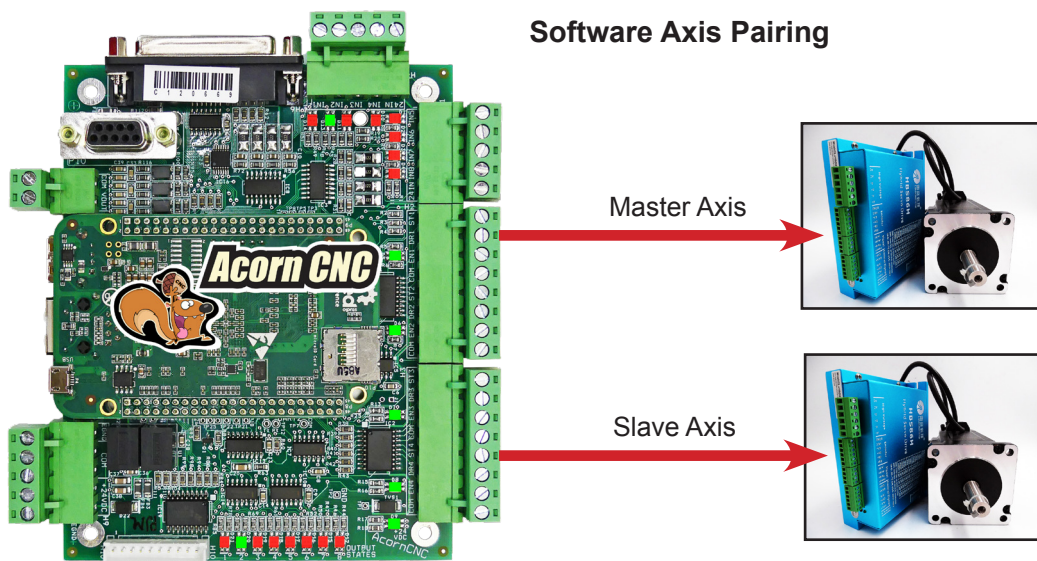
Paired Axes are two axis motors that move as one. Commonly found in CNC Routers and Bridge Mills that have a moving gantry machine tool configuration. The moving gantry employs two axis motors one on each side that work in unison to move the gantry axis.

There are two ways to pair (connect) two axis motors together to move in unison as one axis motor.

1.) Software Pairing and 2.) Hardware Pairing

Software Pairing: Software Pairing is when the Centroid CNC software is used to send one axis movement commands to two axes of outputs on the Acorn CNC controller. For example, If the user chooses to pair the Y axis motor with the 4th axis motor (using the Acorn setup Wizard), the Y axis step and direction signals are sent to both the Y and the 4th axis output connections on the Acorn CNC control board. The same Y axis motion control signal is sent to both the Y axis and 4th axis drive connections on the Acorn board therefore both motors move in unison following any Y axis commands. There are some basic requirements for Software Pairing. Both motors should have the same basic parameters such as “Steps per revolution” and “Overall Turns Ratio” For example: you can not pair two motors that have different “Overall Turns Ratios”.

It is common that paired motors are mounted on the machine tool in such a way (typically facing each other) that they don't spin the same direction when paired. In this case, the direction of rotation will need to be reversed on the “slave” motor (the 4th axis) this is easy to do using the Acorn Wizard, select that the Paired motor rotation direction is reversed and the motors will spin the same direction at the same time when facing each other. Note: always bench test paired axis motors before connecting to the machine tool. When Software Pairing is implemented the Acorn CNC controller effectively becomes a 3 axis CNC controller as the 4th axis is used to command the slaved motor (4th axis).



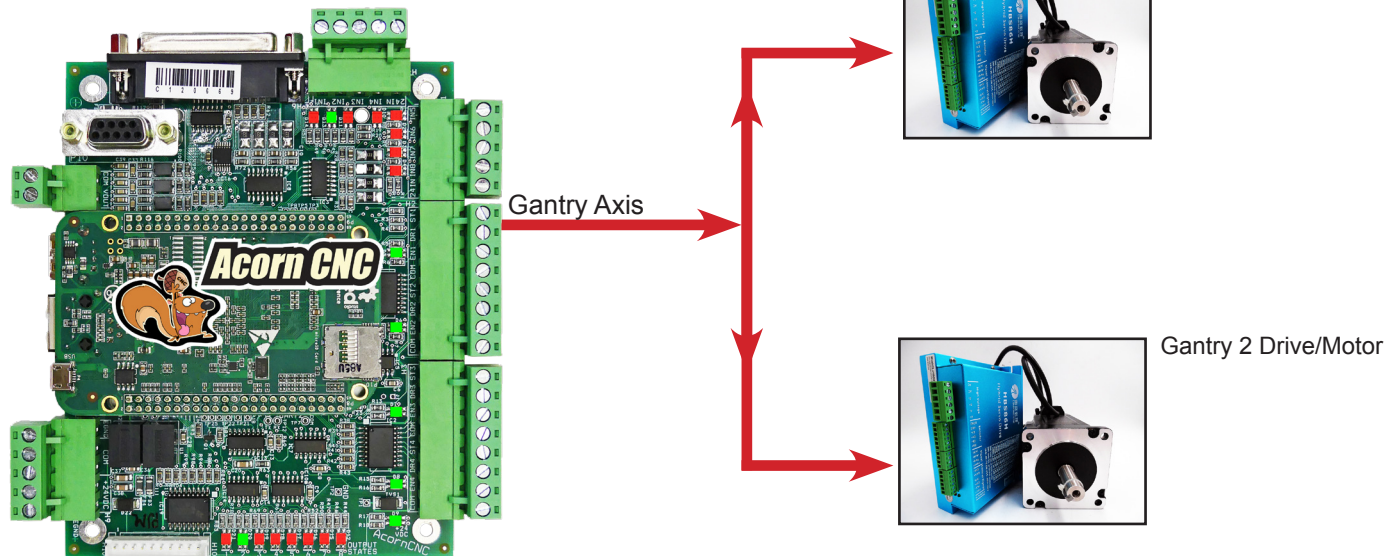
Software Pairing Homing and Squaring with Software Pairing methods.

With Software Pairing there are several ways to both home and square the paired axis machine tool.

- a.) Auto Homing and Auto Squaring: Auto Home to switch is used in conjunction with Auto Squaring. This is fully automatic method to both home and square up the machine tool.
- b.) Auto Homing with Manual Squaring: Operator manually squares the gantry axis then “Auto Home to Switch” is used to home automatically. The auto homing cycle seeks the home switches and sets the home position automatically.
- c.) Manual homing with Manual Squaring: Operator manually squares the gantry axis and then Jogs machine to the home position, presses cycle start and then the control sets home at this position.

Hardware Pairing: Hardware paired axis motors use only one drive port connection on the Acorn Board freeing up the 4th axis drive port. Hardware Pairing is when two drives are physically connected to the same single axis step & direction command signal from the Acorn CNC control board. For example, the Y axis Acorn output is wired to two motor drives in parallel. Hardware Pairing is typically used when it is not desired to ‘use up’ the 4th axis drive output on the Acorn board to command a slaved gantry motor for example, Hardware pairing is common on a CNC router with a two axis motors moving gantry that is also equipped with a 4th axis rotary table. In this case, Hardware Pairing of the two gantry axis motors allows the 4th axis output on the Acorn to be used for the rotary table axis. Essentially this turns the Acorn into a 5 axes drive output board.

Hardware Axis Pairing



Hardware Pairing has similar requirements, both motors need to have the same “steps per rev” and “overall turns ratio” and should be the same size and type of motors and drives. If needed, the motor direction reversals will also be done with hardware by using the axis drive software or hardware direction reversal facility, note on very simple drives often used for small open loop steppers the drive has no software or hardware facility to switch directions of the motor, in this case the motor wiring can be flipped to change the direction of the motor.

Hardware Pairing Homing and Squaring Methods

With Hardware Pairing there are several ways to both home and square the paired axis machine tool.

- a.) Manual homing with Manual Squaring:** Operator manually squares the gantry axis and then Jogs machine to the home position, press cycle start and then the control sets home at this position.
- b.) Auto Homing with Manual Squaring:** Operator manually squares the gantry axis then “Auto Home to Switch” is used to home automatically. The auto homing cycle seeks the home switches and sets the home position automatically.
- c.) Auto Homing and Auto Squaring:** Auto Home to switch is used in conjunction with “Relay Auto Squaring”. This is a fully automatic method to both home and square up the machine tool.
- d.) Auto Homing and Auto Squaring to hard stop with Clearpath axis motors.**

Homing and Squaring with Hardware Pairing

a.) Hardware Pairing with Manual Homing with Manual Squaring.

By far the simplest and initially the quickest way to home a machine tool is with “Manual Homing with Manual Squaring”.

Use this setting first when commissioning a machine tool even if you plan on setting up fully automatic homing and squaring later, choose “Simple Homing” in the Wizard Homing Setup menu. This will allow you home and run the machine so you can configure the rest of the CNC setups easily before setting up the Auto Homing cycle.

Requirements: No home/limit switches are required. Choose “Simple Home” in the Acorn Wizard setup.

The screenshot shows the 'Router CNC Control Configuration Wizard' interface. On the left is a sidebar with a tree view containing: Primary System (Axis Drive Type, Input Definitions, Output Definitions), Axis (Configuration, Homing and Travel, Axes Pairing, Advanced), Spindle (Spindle #1, Rigid Tapping, PWM Setup), Touch Devices (Probe, Tool Touch Off), Control Peripheral (Input Devices, Wireless MPG), and DB25 Connector (Mapping). The 'Homing and Travel' item under 'Axis' is selected and highlighted. The main panel is titled 'Homing Type' and contains the following sections:

- Homing Type:** Choose Automatic, Simple (aka Manual), or Clearpath Hard Stop homing method. There are three radio buttons: 'Automatic Homing: machine seeks switches to home', 'Simple Homing: operator logs machine to home position' (which is selected and highlighted with a red box), and 'Clearpath Hard Stop Homing: Warning: See [TB319](#) for setup info.' There is also an option 'Do not use Machine Home'.
- Home Program (cncm.hom) Creation:** The Wizard creates a homing macro (cncm.hom) based on the selections below. This macro can be used as-is or edited by the user to meet any special requirements. There are 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'.
- Software Travel Limits:** Set limits of movement for each machine axis measured from the home position. There are two rows of input fields for 'Travel Limit (+)' and 'Travel Limit (-)' across four axes (Axis 1 to Axis 4). All values are currently 0.
- Machine Parking:** Override the default position and speed machine park function by editing the Park macro. There is a button 'Edit "park.mac"'. Below it, 'Override default park behavior?' has a 'No' button selected.
- Homing Feedrate:** Set the feedrate that the machine will run at to home each axis. There are four input fields for Axis 1 to Axis 4. The values are 10, 10, 10, and 36 respectively.

Let CNC12 know that you don't want to software pair any axis, In the Wizard Axes Pairing Menu choose: Not Paired

“Not Paired” = NO **Software** axis pairing, choose this when motors are hardware paired.

The screenshot shows the 'Router CNC Control Configuration Wizard' interface. The sidebar is the same as the previous screenshot, but 'Axes Pairing' under 'Axis' is now selected and highlighted. The main panel is titled 'Axes Pairing' and contains the following sections:

- Axes Pairing:** A note at the top states: 'CNC12 Pro, Ultimate, or Ultimate+ is required for Software Axes Pairing. A restart of CNC12 is required for changes to take effect.' Below this, there is a section for 'Axis to pair with 4th axis' with a dropdown menu set to 'Not Paired' (highlighted with a red box). Below that, 'Reverse direction of 4th axis motor relative to the paired axis?' has a 'No' button selected.
- Footnote:** * Requires a Pro, Ultimate, or Ultimate Plus License

Note: After pressing “Write Settings to CNC Control Configuration” in the Wizard, CNC12 requires a restart when changing Axis Pairing Settings

Hardware Pairing with Manual Homing with Manual Squaring Procedure

First time setup

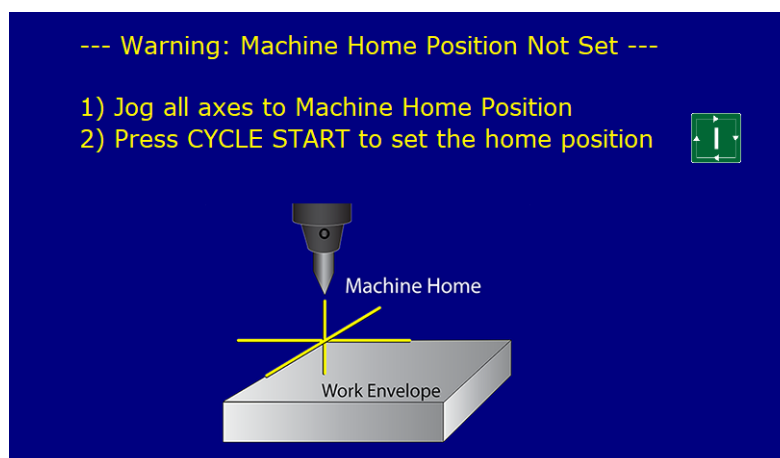
- 1.) With the power off, manually move the gantry axis to square it up to the axis that it sits on. Once the square position is determined, place marks on the machine tool or setup hard stop so that it is easy to realign the gantry axis manually to the square position in the future.
- 2.) Power up the Acorn CNC controller, (since the two gantry motors are hardware paired on power up the gantry motors will be paired and move in unison)
- 3.) Jog all axes to the desired home position and press cycle start to set home at that position. Machine is ready to use.
- 4.) Proper shut down: Once the machine has been homed and is square be sure to "Park" the machine tool at the home position before powering off. This leaves the gantry in the Squared position and the axes in the home position ready to home out for when the next time power is applied saving the work of having to manually re-square the gantry axis. The G53 command can be used to Park the machine at the home position.

Note: The Park button on the Acorn operators control panel will move the machine back to the home position. For example "G53 X0Y0Z0 L100" moves all axes to the machine home position at 100 ipm. (G53 uses the Machine Coordinate system not the WCS (part zero) position.) The action of the Park Button can be edited by the user. It is a simple macro (mfunc60.mac), a common modification to the park macros is to command the machine to park at a position just before the actual home position for example: G53 X.25Y.25Z.25 L200 see the Macro Programming Guide for more information on programming with Centroid macros. https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/centroid_cnc_macro_programming.pdf

Subsequent homing procedure.

- 1.) Move the machine to the home position, manually push/pull on gantry to square it up against hard stops or line up with marks, If the machine was Parked on the home position at power down you are good to go : Power on the Acorn CNC Controller and press cycle start to Home the machine at its current position, the machine is homed and square ready to use.

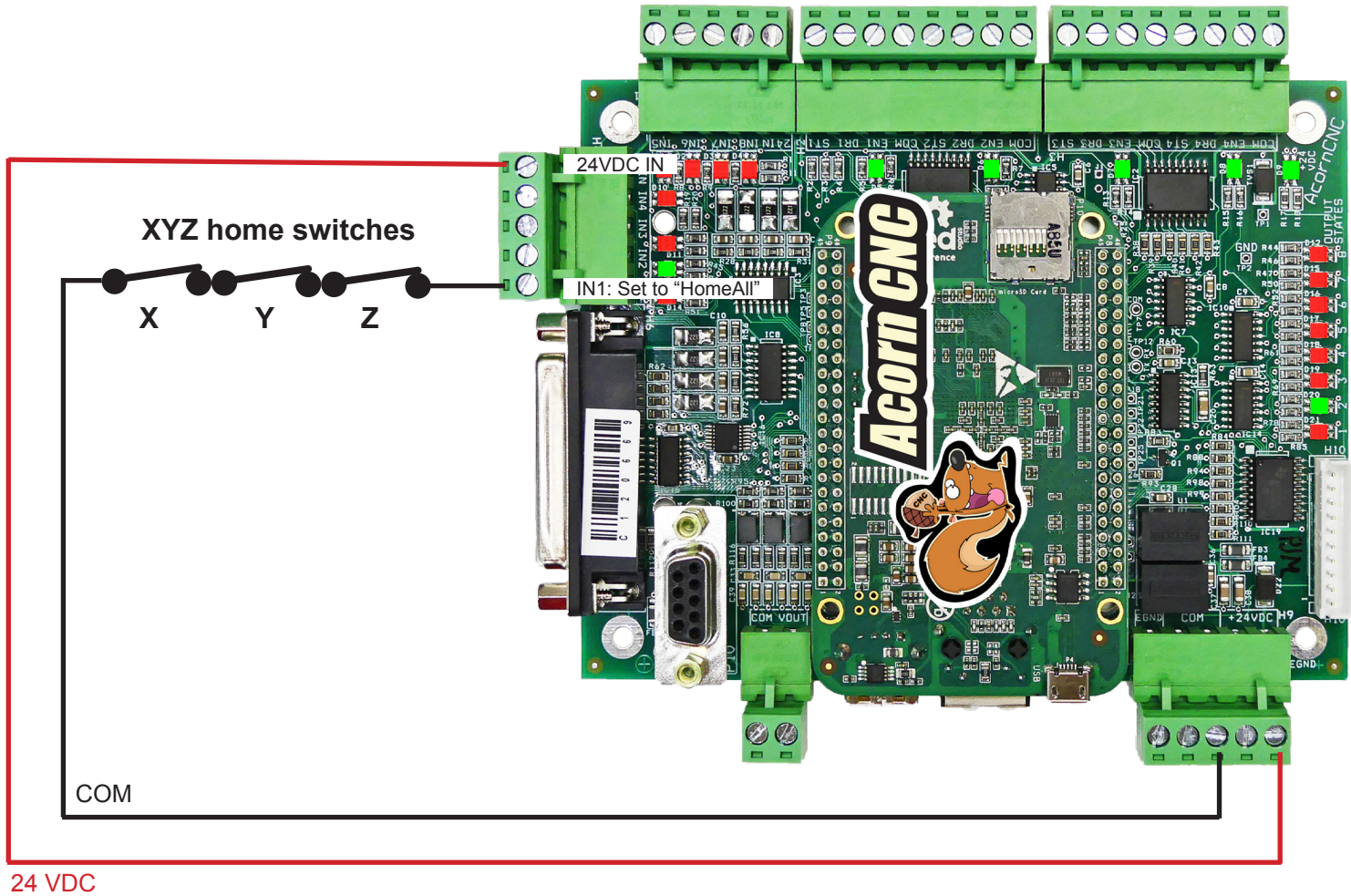
Discussion: In the event of power failure during machine tool movement or lost steps, follow the First Time homing procedure. Simple Home with Manual Axis Squaring has its advantages. There are no limit/home switches to purchase and install. There are no long home switch cables to flex, break and go bad over time, there are no limit/home switches to come loose or fail. With a little attention to detail Simple Home with Manual Axis Squaring can be quite reliable and accurate enough for most wood working/plasma/flame machine tools. The only con is that it is up to the operator to remember to Park the machine at the home position when they are done so the machine is ready to set home at that position the next time power is applied. If the machine was not parked at home or if the machine was moved out of square for any reason (bumped when off, lost steps , power loss during operation etc) its no big deal. To recover from such events, the operator simply jogs the machine tool to the home position, powers off, and manually realigns the gantry axis to be square using the marks made in the first time setup, powers back up and presses cycle start to reset the home position and the machine is ready to use. Be sure to setup the machine tool travel limits in the Wizard as they work from the home position and will stop the machine from over-traveling **in each direction** without limit/home switches.



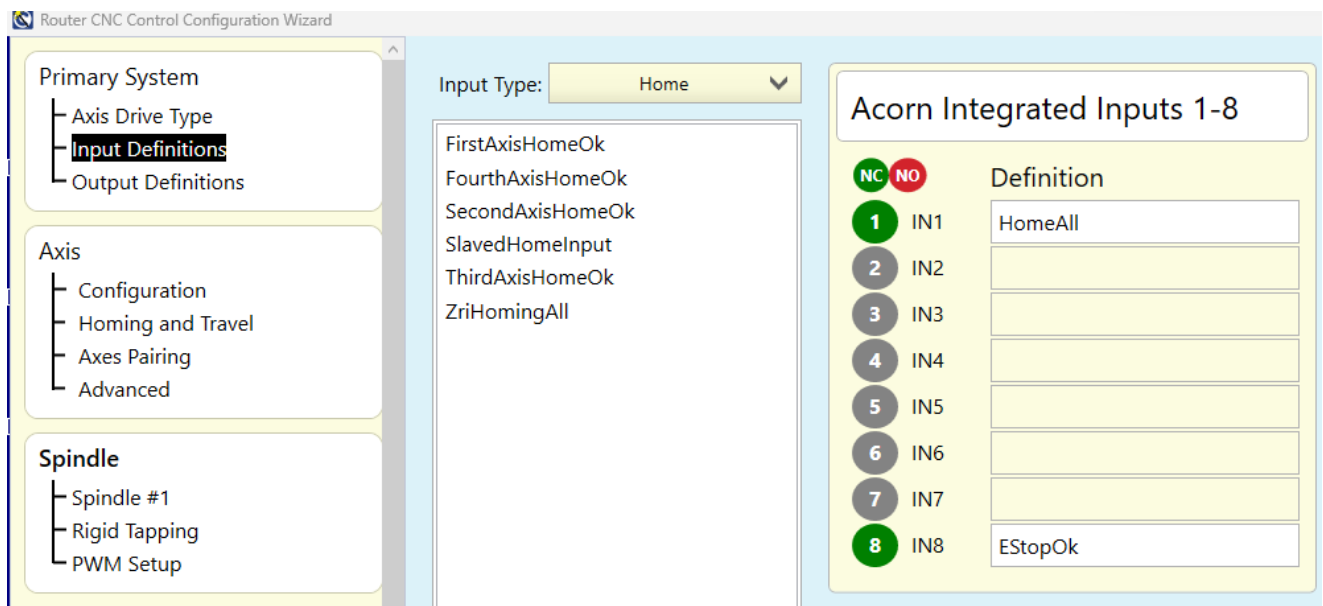
Hardware Pairing with Auto Homing with Manual Squaring

b.) Auto Homing with Manual Squaring.

Requirements: Three Home Switches for Axes 1,2,3 wired into one input called “HomeAll”. In this example Axes 1,2,3 are labeled X,Y,Z respectively. Wire all home switches to input 1 (or any input of your choosing) using the “HomeAll” selection in the Wizard I/O drop down menu.



Setup Input 1 (IN1) = HomeAll in the Wizard Input definition menu



Choose “Automatic Homing” ” in the Acorn Wizard homing menu

and configure Homing Directions, Sequence, Travel Limits and Homing rates.

The screenshot shows the 'Homing' configuration screen in the CNC12 wizard. The left sidebar contains a tree view with categories: Primary System, Axis, Spindle, Touch Devices, Control Peripheral, DB25 Connector, ATC, and Preferences. The 'Axis' category is expanded, showing 'Configuration', 'Homing and Travel' (selected), 'Axes Pairing', and 'Advanced'. The main content area is divided into several sections:

- Homing Type:** Options include Automatic Homing (selected), Simple Homing, Clearpath Hard Stop Homing, and Do not use Machine Home.
- Home Program (cncm.hom) Creation:** Options include Wizard to generate Automatic home program (selected) and I will create my own home program.
- Automatic Homing Direction:** A table for Axis 1-4 with dropdowns for direction (e.g., -(M91), +(M92)).
- Automatic Homing Sequence:** A table for Axis 1-4 with input boxes for sequence order (e.g., 3, 2, 1, 4).
- Software Travel Limits:** A table for Axis 1-4 with input boxes for Travel Limit (+) and Travel Limit (-).
- Machine Parking:** A section with a toggle for 'Override default park behavior?' set to 'No' and an 'Edit "park.mac"' button.
- Homing Feedrate:** A table for Axis 1-4 with input boxes for feedrate (e.g., 10, 10, 10, 36).

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

Let CNC12 know that you don't want to software pair any axis, In the Wizard Axes Pairing Menu choose: Not Paired

“Not Paired” = no **Software** axis pairing, choose this when motors are hardware paired.

The screenshot shows the 'Axes Pairing' configuration screen in the CNC12 wizard. The left sidebar is similar to the previous screen, but the 'Axes Pairing' option under the 'Axis' category is selected. The main content area is titled 'Axes Pairing' and includes a note: 'CNC12 Pro, Ultimate, or Ultimate+ is required for Software Axes Pairing. A restart of CNC12 is required for changes to take effect.'

The configuration options include:

- Axis to pair with 4th axis:** A dropdown menu set to 'Not Paired'.
- Reverse direction of 4th axis motor relative to the paired axis?** A toggle switch set to 'No'.

A note on the right states: '* Requires a Pro, Ultimate, or Ultimate Plus License'.

Operator Auto Homing and Manual Squaring with Hardware Pairing Procedure.

Auto Homing and Manual Squaring with Hardware Pairing requires the operator to square the gantry/paired axis manually before running the Automatic homing cycle. The Auto Homing cycle moves each axis of the machine tool to their respective Home switches, backs off to clear the switch and sets home at that location. The home program is automatically generated by the Wizard or Customized by the user/installer. In this example we are using the Wizard generated home program using the settings shown.

First time setup (or in the event of power failure during movement or lost steps)

- 1.) With the power off, manually move the gantry axis to square up the gantry axis. Once the square position is determined, place marks on the machine or setup hard stops so that it is easy to realign the gantry axis manually to the square position in the future.
- 2.) Power up the Acorn CNC controller. (using hardware pairing, the gantry motors are paired on power up so the gantry motors move in unison)
- 3.) Jog all axes close to home switches and press cycle start to seek the home switches automatically. Acorn will seek in the direction specified and trigger each of the three home switches one axis at a time, when the home switch is tripped Acorn will back off to clear the switch and set home for all three axis at that position. The machine is ready to use.
- 4.) Proper Shut down: "Park" the machine tool near the home position before powering off using the G53 command. This leaves the gantry in the squared position and the axes near the home position ready to home out for when the next time power is applied saving the work of having to manually re-square the gantry axis in preparation for Automatic Homing. To setup a Park position, use the G53 move to a location just about an inch from home. For example: G53 X1Y1Z-1 L100 this will park the machine 1" away from the HOME position (for our example the machine travel away from the X and Y home switch is positive and away from the Z switch is negative). The gantry is square so Mark the Park position so its easy to see if the gantry is square prior to homing before subsequent homing cycles. The CNC12 Park Button can be edited by the user to customize the functionality of the Park button to the machine tool operator requirements. For example the park button can easily be edited to run this command. G53 X1Y1Z-1 L100



Subsequent homing procedure .

- 1.) Verify machine is at the Park position and gantry is square.
- 2.) Power on the Acorn CNC Controller and press Cycle Start to Home the machine, the machine will seek out the home switches and set home automatically, the machine is then homed and square ready to use.

Discussion: Auto Home with Manual Axis Squaring. Has the convenience of Auto Homing but still requires the operator to make sure the Paired axis is square before starting the homing cycle. Auto Home with Manual Axis Squaring can be quite reliable and accurate enough for most wood working/plasma/flame machine tools. The only con with this method is that it is up to the operator to remember to make sure the Paired axis is square before homing the machine. If the machine was moved out of square for any reason (bumped when off, lost steps , power loss during operation etc) its no big deal, To recover from such events, the operator powers off or presses E stop and manually realigns the gantry axis to be square using the marks made in the first time setup, powers back up (or release E stop) and then press cycle start to reset to run the home program and the machine is ready to use.

c.) Hardware Pairing with Auto Homing and Relay Auto Squaring.

How can we have 5 axis motors on a 4 axis Acorn with the 4th axis being available for Rotary (or another type of 4th axis) and Auto Squaring of a Gantry with two axis motors? Hardware pair the axis motors on the gantry and auto square the gantry with a custom home program and relays. This is an old 'trick' used for many years by cnc controllers in the same situation.

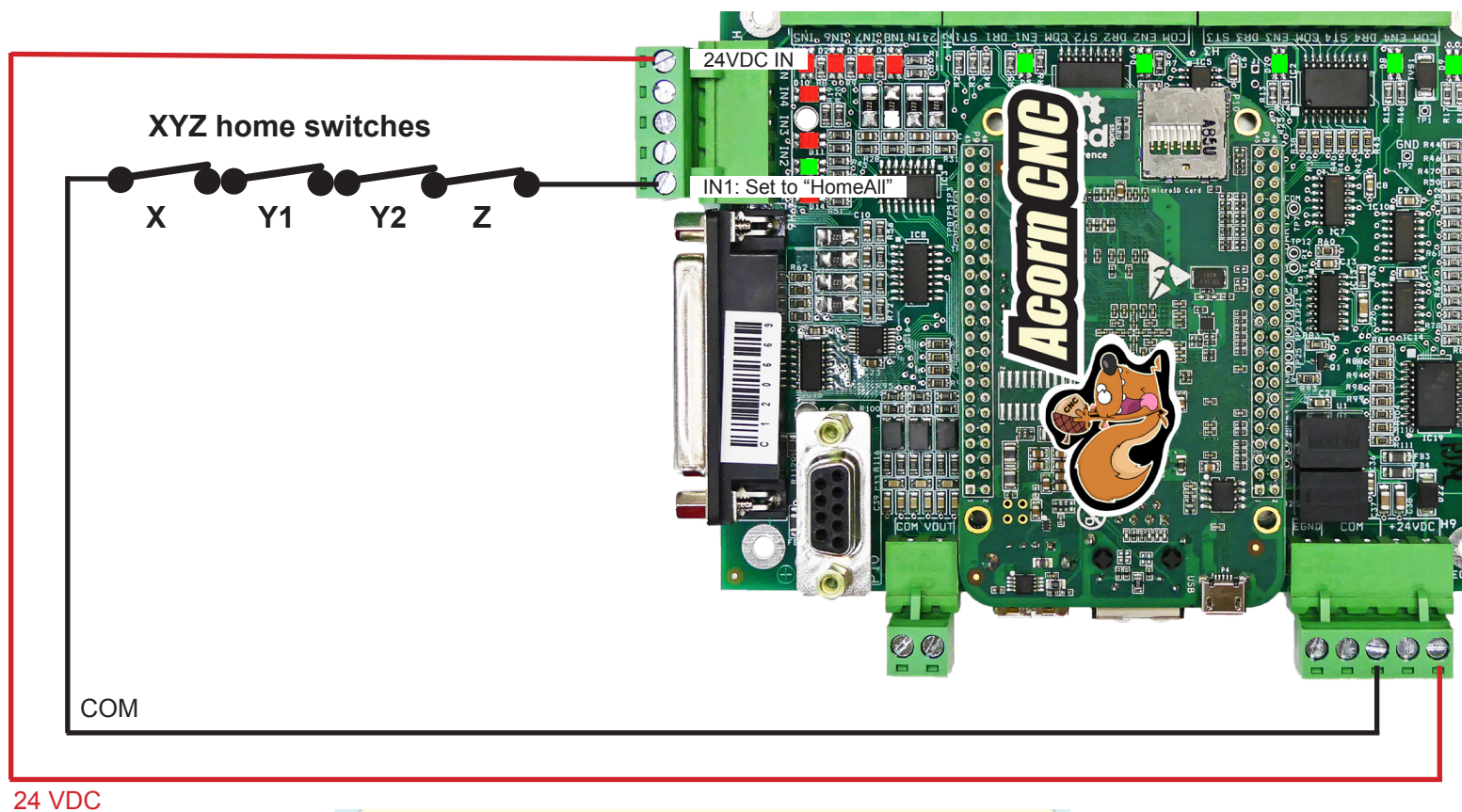
Solution: Hardware Pair the gantry motors but have the step signals for those motors run through a relay that was then controlled by the homing program (macro). This homing macro would simply disconnect either of the gantry motor step signals that would then result in independent gantry motor motion allowing the macro to seek homing switches on each side of the gantry one at a time to 'find square'. Once squaring is done the relays return the gantry axis motors step signals to be joined at the hip again. We call this "Relay Auto Squaring". Centroid provides all the necessary G and M g-codes for the user to create their own "Relay Auto Squaring" macro so the machine can be a 4 axis CNC machine tool that has 5 axis motors in total.

Relay Auto Squaring and Homing: Home Switch setup

Requirements:

- 1.) Four Home Switches for Axes 1,2,3 wired into one input called "HomeAll".

In this example Axes 1,2,3 are labeled X, Y and Z respectively. the Y axis is the Gantry and has a switch on each side: Y1 and Y2. Wire all home switches to input 1 and define input 1 as "HomeAll" using the HomeAll selection in the Wizard I/O drop down menu.



Acorn Integrated Inputs 1-8		
		Definition
NC NO		
1	IN1	HomeAll
2	IN2	

c.) Hardware Pairing with Auto Homing and Relay Auto Squaring.

Requirements cont.

2.) Acorn Wizard set to “Automatic Homing:....” and “I will create my own home program.....”

The screenshot shows the 'Mill CNC Control Configuration Wizard' interface. On the left, a sidebar lists the configuration steps: Primary System, Axis, Spindle, and Touch Devices. The 'Axis' section is expanded, showing 'Configuration', 'Homing and Travel' (highlighted), 'Axes Pairing', and 'Advanced'. The main area is titled 'Homing Type' and 'Home Program (cncm.hom) Creation'. Under 'Homing Type', the 'Automatic Homing' option is selected. Under 'Home Program Creation', the 'I will create my own home program, do not overwrite cncm.hom' option is selected.

Primary System

- Axis Drive Type
- Input Definitions
- Output Definitions

Axis

- Configuration
- Homing and Travel**
- Axes Pairing
- Advanced

Spindle

- Spindle #1
- Spindle #2
- Rigid Tapping
- PWM Setup

Touch Devices

- Probe
- Tool Touch Off

Homing Type

Choose Automatic, Simple (aka Manual), or Clearpath Hard Stop homing method.

☒ More Info

☒ Automatic Homing: machine seeks switches to home

☐ Simple Homing: operator Jogs machine to home position

☐ Clearpath Hard Stop Homing: Warning: See [TB319](#) for setup info.

☐ Do not use Machine Home

Home Program (cncm.hom) Creation

The Wizard creates a homing macro (cncm.hom) based on the selections below. This macro can be used as-is or edited by the user to meet any special requirements.

☒ More Info

☐ Wizard to generate Automatic home program based on selections below.

☒ I will create my own home program, do not overwrite cncm.hom

3.) CNC12 Home inputs set to input number used for HomeAll.

Motor Parameters										
Axis	Label	Motor revs/in	Encoder counts/rev	Lash Comp. (Inches)	Limit -	Limit +	Home -	Home +	Dir Rev	Screw Comp
1	X	5.000000000	1600	0.000000	0	0	1	1	N	N
2	Y	5.000000000	1600	0.000000	0	0	1	1	N	N
3	Z	5.000000000	1600	0.000000	0	0	1	1	N	N
4 py	N	5.000000000	1600	0.000000	0	0	0	0	N	N
5	N	5.000000000	1600	0.000000	0	0	0	0	N	N
6	N	5.000000000	1600	0.000000	0	0	0	0	N	N
7	N	5.000000000	200	0.000000	0	0	0	0	N	N
8	N	5.000000000	200	0.000000	0	0	0	0	N	N

Do this last!. F1 setup, F3 Config, enter password (137), F2 Mach, F2 Motor

c.) Hardware Pairing with Auto Homing and Relay Auto Squaring.

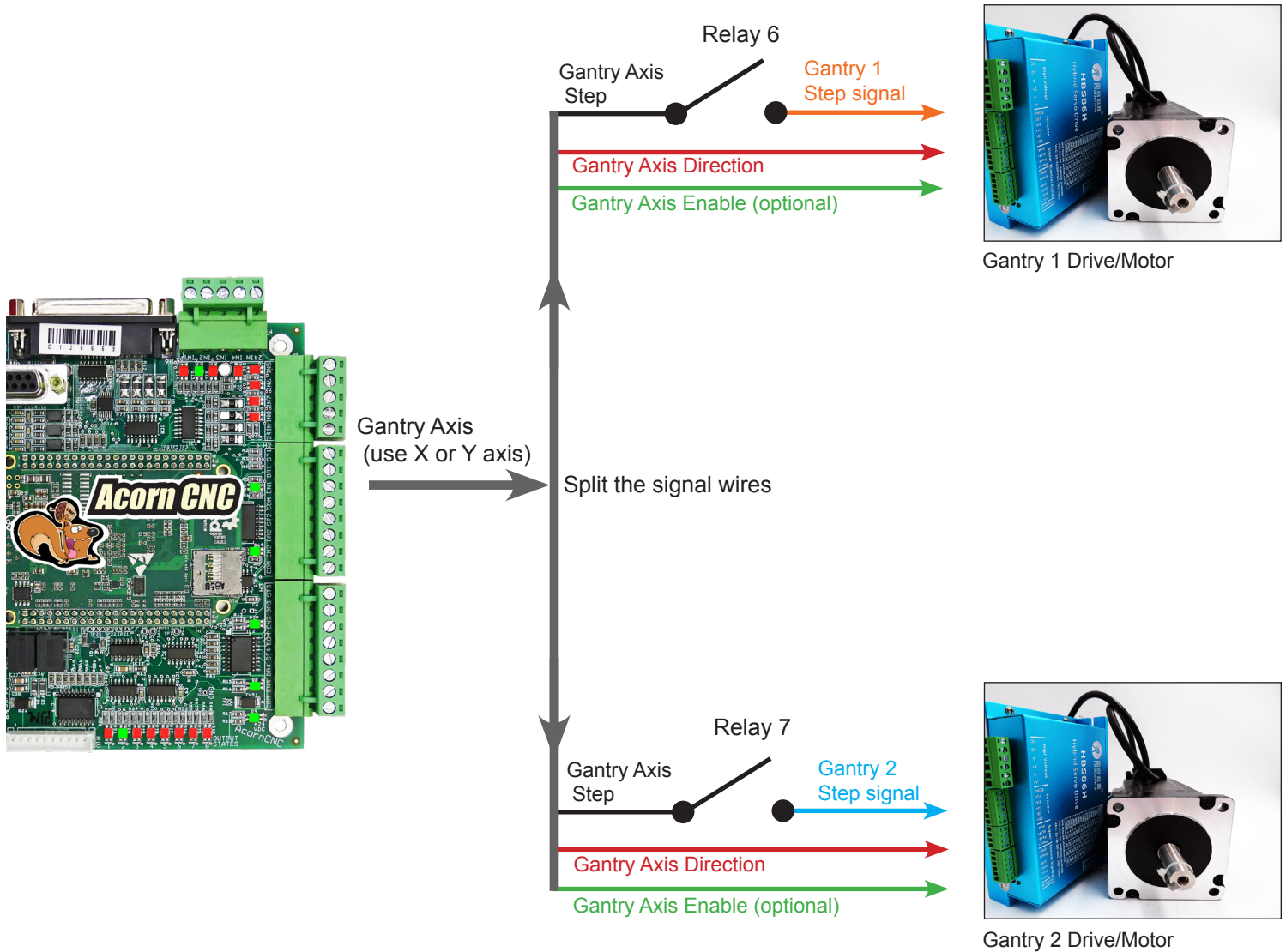
Relay Auto Squaring requirements cont.

4.) Hardware Paired Gantry Axis motor step and direction signal.

See schematic # 15200 for details.

<https://www.centroidcnc.com/dealersupport/schematics/uploads/s15200.r1.pdf>

Hardware Axis Pairing with Relay Autosquaring



Relay Auto Squaring requirements cont.

5.) A Relay Auto Squaring Home program (aka macro) “cncm.hom”

A typical Relay Auto Squaring Home program flow (In this example we are assuming the Gantry Axis is labeled Y.)

- 1.) Home Z to Z home switch, set Z home
- 2.) Home X (the other non gantry axes) to X home switch, set X home
- 3.) Home Rotary / 4th Axis if equipped, set 4th home
- 4.) Move the Y Gantry Axis with both motors active (both relay 6 and 7 closed) until either the Gantry 1 or Gantry 2 Home switch is triggered, back off to clear switch.
- 5.) Open Relay 6 and move Gantry 2 to trigger and back off to clear switch, close relay.
- 6.) Open Relay 7 and move Gantry 1 to trigger and back off to clear switch and close relay.
- 7.) Optional: move Gantry away from switches some amount (sometimes called stand off distance)
- 8.) Set Y axis home.

```
; Sample Relay Auto Squaring Home program for a typical Gantry equipped machine tool with a
; Hardware Paired set of axis motor/drives on the Gantry
; Requirements:
; Refer to schematic #15200 for hookup information
; https://www.centroidcnc.com/dealersupport/schematics/uploads/s15200.r1.pdf
; and the Acorn Axis Pairing and Squaring Manual
; https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/paired_axes_acorn_user_guide.pdf
; Set Acorn Wizard Output 6 = OUTPUT6
; Set Acorn Wizard Output 7 = OUTPUT7
;
;
N100 ;Check for open home switch
IF !#[50000 + #9822] THEN M225 #100 "HomeAll switch tripped!!!\nPlease clear before Homing.\n\nPress Cycle Cancel to end Homing"
IF !#[50000 + #9822] THEN GOTO 100
;
; Perform Relay Autosquaring Homing commands
M92/Z L1          ; Home Z to Z positive home switch, this single command moves Z up to trigger switch and then backs off to clear
the switch
M26/Z            ; Set Z home here
M91/X L1         ; Home X in the negative direction, X axis will seek and back off the negative home switch
M26/X            ; Set X home here
;
;
M91/Y L1          ; Move Gantry Axis together in the negative direction until a switch is tripped
;
; Move Gantry 2 Motor only to Switch and clear it
;
M66              ; Disrupt step signal to Gantry 1 Drive by opening relay 6
M91/Y L1         ; Move Gantry 2 motor in the negative direction to trigger Switch then Clear
M86              ; Close relay
;
; Move Master Motor only to Switch and clear it
;
M67              ; Disrupt step signal to Gantry 2 Drive by opening relay 7
M91/Y L1         ; Move Gantry 1 motor in the negative direction to trigger Switch then Clear
M87              ; Close relay
;
; Optional move Gantry Axis away from switches (aka stand off distance)
;
G91G1X.050Y.05Z-.050F20 ; Move X and Y axis .05" in the positive direction at 20 inches pre minute
M26/Y            ; Set Gantry axis home position here
```

Refer to the Centroid Macro Programming Guide for more information on custom macro programming.

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

Hardware Pairing with Clearpath Home to hard stop and Auto Squaring.

d.) Clearpath Home to Hard Stop with Hardware pairing and Auto squaring.

Just like “Relay Auto Squaring” this method retains the Acorn 4th axis drive connection for use with a Rotary axis (or other 4th axis use). It also has the advantage of not needing any home switches at all to function, (Limit switches can still be used if desired) thereby eliminating all the related home switch wiring and labor costs as well as reducing possible maintenance and down time in the future due to faulty switches and/or wiring issues. For Auto Squaring, the Gantry squareness is simply determined by the hard stop position, so adjust the hard stops on each side of the Gantry so that the Gantry is square.

Note: The Teknic Power Hub is required for this feature to work properly.

From page one of the Centroid Tech Bulletin #319 “Acorn/AcornSix Teknic Clearpath Hard Stop Homing Setup”
https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/319.pdf

What is hard stop homing?

CNC machine tool hard stop homing is when each Clearpath axis motor moves the axes to the end of travel until it hits a hardstop to determine a repeatable home position. No switches are used in the hard stop homing process. Hard Stop Machine Homing is required on machine power up or after an Estop event.

Why you would want to use it?

Hard stop homing does not require homing switches. Less switches means less wiring. Eliminates problems associated with broken switches, wiring and the initial expense of buying and installing home switches. Some cheap home switches may be less accurate and prone to varying trip distances and also may induce electrical noise into the CNC system so these issues are avoided with hard stop homing. Autosquaring can be achieved with either a software paired axis or a hardware paired axis. Hardware paired axes have advantage that autosquaring is achieved without having to utilize the software pairing feature which consumes the 4th axis on an Acorn. Hard Stop homing with hardware pairing leaves the Acorn’s 4th axis free for other uses such as a rotary table or other 4th application.

Pitfalls of hard stop homing:

Each axis motor presses against the hard stop when homing to determine the end of axis travel. Hitting the end of axis travel can damage the machine if the Clearpath MSP software motor hard stop threshold is not set properly.

Setup: Follow the setup instructions here: https://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/319.pdf

Operator Homing procedure.

- 1.) Power up Acorn, jog machine if necessary so that each axis has a clear path for homing (no obstructions in the way)
- 2.) Press Cycle Start to start the Clearpath Hard Stop Homing procedure, all axis will move at the same time seeking the hard stops, each axis motor will hit the hard stop and back off and set home at that position.

Auto Homing and Auto Squaring with Software axis motor Pairing

Auto Square Homing will perfectly square a paired axis Gantry automatically.

Upon power up or when operator is required to “reset home”.

Auto Square Homing saves the operator time, makes the machine easier to use and provides consistency in part geometry day in a day out. For Auto Square with a Software Paired axis to work these conditions must be met.

Rules for Auto Square Homing:

1.) **Auto Square Homing does not compensate for mechanically out-of-square machine tools.**

Integrator must “dial in” the Gantry axis so that it is close to MECHANICALLY SQUARE before setting up software Auto Square Homing.

2) **The Gantry must be very close to square when the Gantry is in its “relaxed” position.**

Integrator must verify machine tool is very close to square when the gantry is in its “relaxed” state (no torque needed to hold it in position) for auto square homing to function properly.

3.) **The Gantry must be close to square when the machine is powered ON.**

4.) **The Gantry must be close to square before starting the Auto Square Home program.**

5.) **The Gantry Home Switches must not be square to the machine.** The Slave side Home Switch must trigger first when the Gantry axis begins to seek Home position. Line them up with Gantry then offset slave switch 0.025” closer to the Gantry.

6.) **CNC12 Mill version 5.xx+ with Pro or Ultimate license.** (Software Axis Pairing is not available with the Free version of CNC12)

Gantry Home Switch Installation and Master Axis Alignment Distance adjustment

Step 1. With the power off, measure how much play the gantry has from side to side. This is the distance one side can move before dragging the other side along.

Step 2. Mechanically square the gantry. (There are a number of good methods to do this, use a granite surface plate to sweep and indicator on, make marks/hole in table in corners of large square and measure diagonals etc..)

Step 3. Enter MDI and issue M26/X/Y/Z to temporarily home the machine and jog the gantry (with both gantry axis motors paired) to the extreme end of travel where you want to install the home switches.

Step 4. Install home switches on both sides of the now square gantry...One is called the master, one is called the slave. Put the master switch on the master side with the master motor put the slave switch on the slave side with the slave motor. Install the switches perfectly in-line with the gantry which is currently now very close to square.

Step 5. Unbolt the master home switch and offset it AWAY from the gantry .025” (this distance can typically be up to two thirds of the measurement made in step one, bigger machines can usually have bigger distances).

Step 6. In the Wizard set the Master Axis Alignment distance equal to the amount you moved the master switch away from the Gantry. In our example set the Master Axis Alignment distance equal to .025”

Step 7. Run the Wizard generated home program, check gantry for square. Add or subtract any adjustment amount needed to perfectly square the gantry from the Master Axis Alignment distance. For example.. If i needed to pair the Master axis .005” closer to the Master Switch to make the Gantry square... $.025" - .005" = .020"$ Set the Master Axis Alignment distance to .020” Or If i needed to pair the Master axis .005” further away from the Master Switch to make the Gantry square... $.025" + .005" = .030"$ Set the Master Axis Alignment distance to .030” etc..

Note: When mounting the Gantry/Y axis Master home switch and the Y axis slave home switch you might be inclined to leave the home switches perfectly lined up and square to the machine. In practice the Y axis Master and Slave should be offset from one another (not in alignment with square). Acorn Wizard generated Auto Square Home program requires The Slave switch to be installed on the machine so that it trips FIRST. So how much offset between the switches to use? The offset amount varies per machine tool but typically anywhere from 0.025” to 0.15”. Twenty Five Thousandths of an inch is a common value for a Gantry that is considered “tight”. The Offset amount depends on how big the machine is, how tight the gantry axis is and how consistent the home switches are. Which side to add the offset to? The Master axis switch is offset further away from the gantry (when it is square) so the Slave triggers first.

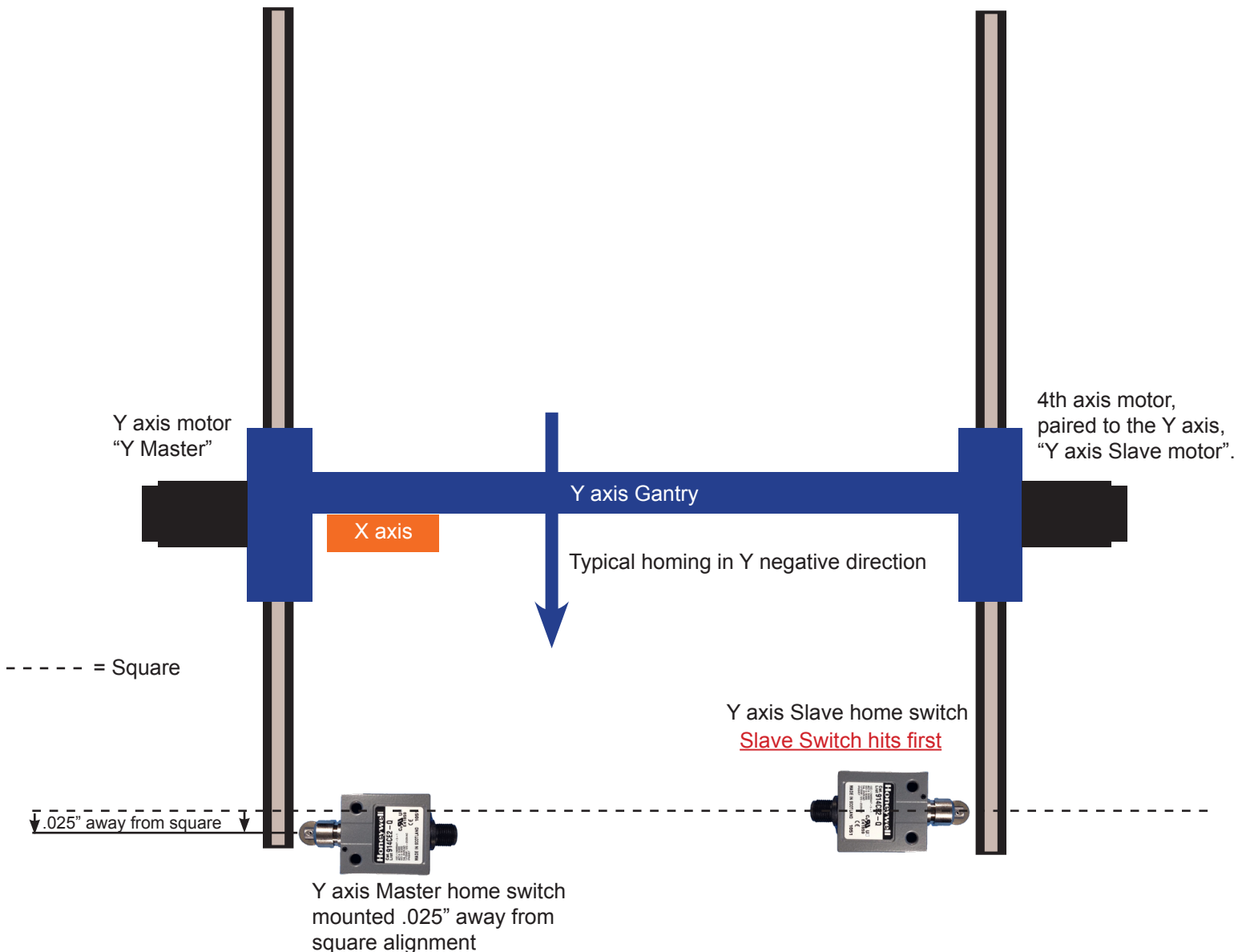
Master and Slave Home Switch Mounting on a Paired Axes CNC Gantry

Step 1 Mechanically square the gantry.

Step 2 Jog the gantry (with both gantry axis motors paired) to the extreme end of travel where you want to install the home switches.

Step 3 Install home switches on both sides of the gantry...one is called the master one is called the slave. put the master switch on the master side with the master motor put the slave switch on the slave side with the slave motor. Install the switches perfectly in line with the gantry which is currently now very close to square.

Step 4. Unbolt the master home switch and offset it AWAY from the gantry .025"



Offsetting the Y axis Master and Y axis Slave home switch is required for Auto Square Homing to function.

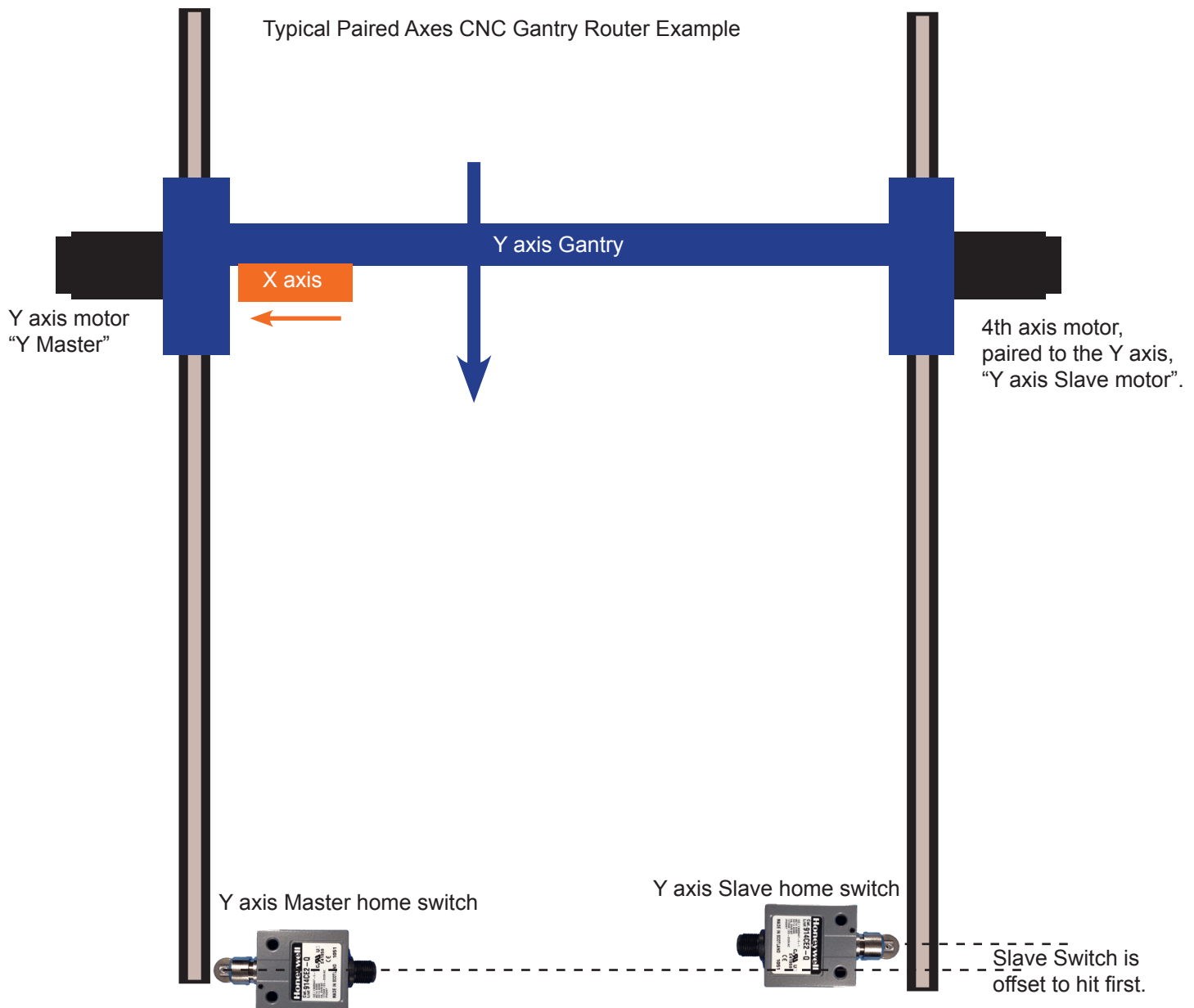
When re-homing, the Y axis gantry is typically is very close to square. The Slave Switch is offset closer to the Gantry so it will trigger FIRST so both switches will not be triggered at the same time. Slave Switch triggering first is a requirement for the Acorn Wizard generated Auto Square Homing program. Setup of the switches is simple, the integrator typically mechanically squares the Gantry then uses the Gantry to align the switches square to the machine and then simply offsets the Master switch about 0.025" away from Gantry so the Slave trips first the during the auto homing/squaring cycle.

Auto Homing and Auto Squaring with Software Pairing ACTION

The Wizard will automatically generate the Auto Home program with the Auto squaring moves based on your Wizard selections and will function follows:

Auto Squaring Home Program works like this:

- 1.) Upon initial power up, Operator presses “cycle start” to begin the machine tool automatic homing cycle.
- 2.) Machine moves Z axis first to seek the positive Z axis home switch, detects home switch and backs off to clear and holds position.
- 3.) Machine moves X axis next to seek the (typically) negative X axis home switch, detects the home switch and backs off to clear and holds position.
- 4.) Machine moves the Gantry with both motors paired (typically Y on a Gantry machine) moving in unison in the (typically) negative direction until the Slave Home Switch is detected, backs off the Slave Switch to clear.
- 5.) UnPairs the Y axis motors, and moves the Master motor independently of the Slave until Master home switch is tripped, backs off to clear Master home switch, then moves (in the same direction away from the switch) the “squaring distance” specified by the user to square the Gantry, then RePairs the Master motor with the Slave motor and then sets Machine Home for X,Y and Z at this position.



Auto Homing and Auto Squaring with Software Pairing

1.) Auto Homing and Auto Squaring with Software Pairing with normally closed (NC) home switches

Auto Homing and Auto Squaring as the name implies will Automatically Home and Square up the paired axis. Suggested wiring: 4 Home switches, Axis 1,2,3 Home Switches wired into the “HomeAll” input and Axis 4 Home switch wired into the “SlavedHomeInput” input. (use the Wizard i/o menu to configure the inputs)

Home Switch setup example..

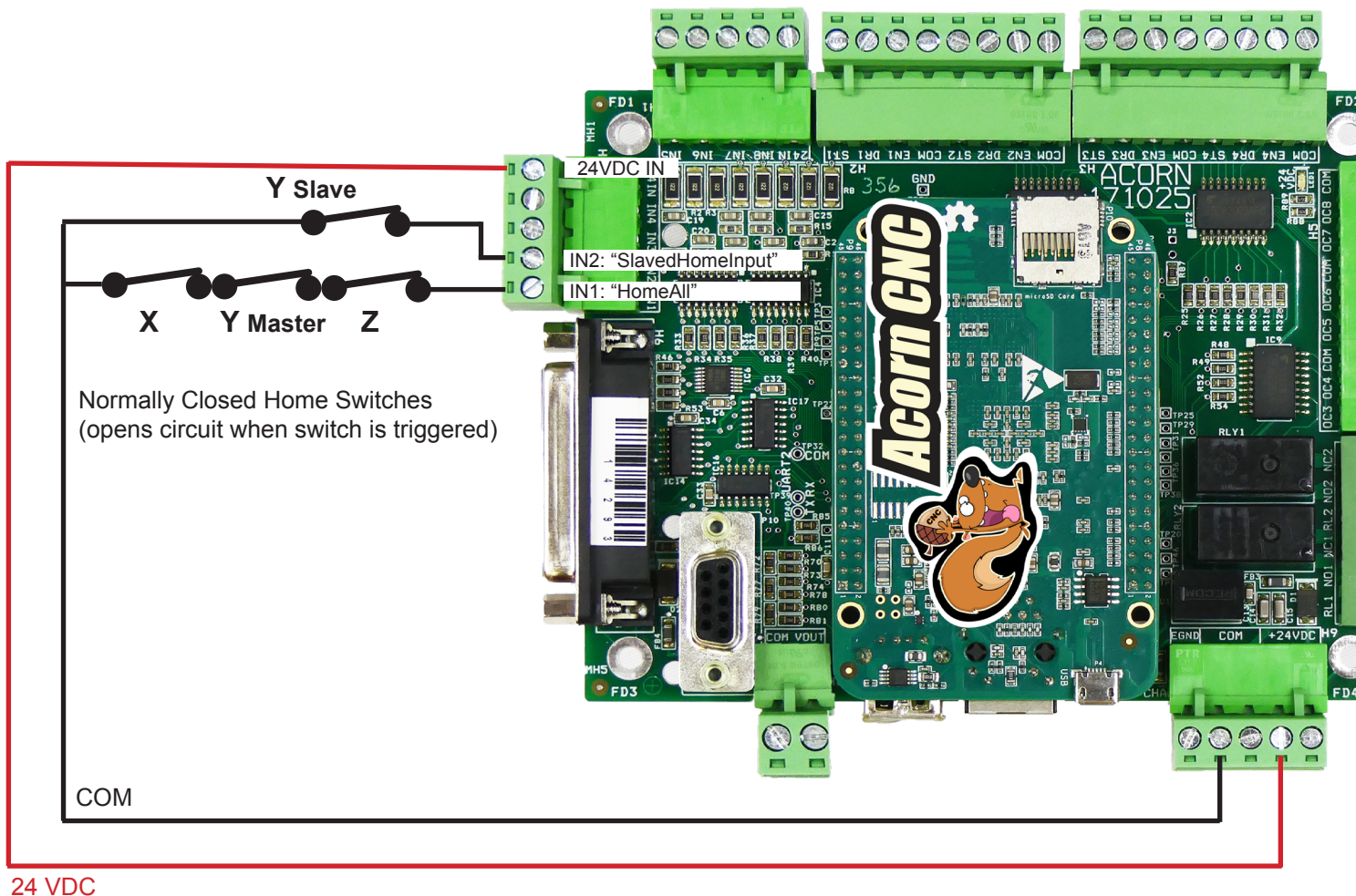
For the purpose of this example Axis 1,2,3 are labeled X,Y,Z respectively.

Axis 4 is the slave axis which has no label and does not appear on the DRO display

Axis 4 is Paired to the Y axis. (the Y axis is also referred to as the Master axis.)

The Slave home switch must be installed on the machine so that it trips BEFORE the master switch.

Install the X,Y and Z normally closed home switches onto the machine so they trigger at the home position and wire them into the “HomeAll” input. In this example we have chosen Input 1 as the HomeAll input using the Acorn setup Wizard i/o setup menu. Wire all three X,Y,Z home switches in series into Input 1 as see by the schematic below.



Install the Slave Axis Home Switch and wire into its own dedicated input as seen in the schematic above, use the Wizard i/o table and assign this input to “SlavedHomeInput” input definition. For this example we have set the “SlavedHomeInput” to use Input 2 using the Acorn setup Wizard i/o setup menu as seen below. The Slave switch must be installed on the machine so that it trips FIRST.

Acorn Integrated Inputs 1-8		
NC	NO	Definition
1	IN1	HomeAll
2	IN2	SlavedHomeInput

Homing and Squaring with Software Pairing

Auto Homing and Auto Squaring with Software Pairing Wizard configuration

Homing Type

Choose Automatic, Simple (aka Manual), or Clearpath Hard Stop homing method.

More Info

- ☒ Automatic Homing: machine seeks switches to home
- ☐ Simple Homing: operator Jogs machine to home position
- ☐ Clearpath Hard Stop Homing: Warning: See [TB319](#) for setup info.
- ☐ Do not use Machine Home

Home Program (cncm.hom) Creation

The Wizard creates a homing macro (cncm.hom) based on the selections below. This macro can be used as-is or edited by the user to meet any special requirements.

More Info

- ☒ Wizard to generate Automatic home program based on selections below.
- ☐ I will create my own home program, do not overwrite cncm.hom

Automatic Homing Direction

Choose the direction in which the machine individual axes will move to seek a home switch.

More Info

Axis 1	Axis 2	Axis 3	Axis 4
-(M91) ▾	-(M91) ▾	+(M92) ▾	-(M91) ▾

Automatic Homing Sequence

Set the order of the Automatic Homing Cycle. Choose which axes to home first, 2nd, 3rd and 4th. Automatic Homing moves one axis at a time.

More Info

Axis 1	Axis 2	Axis 3	Axis 4
3	2	1	2

Software Travel Limits

Set limits of movement for each machine axis measured from the home position.

More Info

	Axis 1	Axis 2	Axis 3	Axis 4
Travel Limit (+)	0	0	12	0
Travel Limit (-)	-48	-96	0	-96

Machine Parking

Override the default position and speed machine park function by editing the Park macro.

More Info

Override default park behavior?

Yes

Edit "park.mac"

Homing Feedrate

Set the feedrate that the machine will run at to home each axis

	Axis 1	Axis 2	Axis 3	Axis 4
Feedrate	20	20	20	20

Axes Pairing

CNC12 Pro, Ultimate, or Ultimate+ is required for Software Axes Pairing. A restart of CNC12 is required for changes to take effect.

Axis to pair with 4th axis

Reverse direction of 4th axis motor relative to the paired axis?

Axis 4 paired to Axis 2 ▼

Yes

* Requires a Pro, Ultimate, or Ultimate Plus License

Paired Axes Homing

Paired axes squaring/alignment

Master Axis squaring/alignment distance

Feedrate of homing movements

Home switch Deadband Distance

Master Axis Home Switch PLC Input =

Slave Axis Home Switch PLC Input =

Automatic Axis Squaring/Alignment ▼

0.025

20

0.005

HomeAll, Input 1*

SlavedHomeInput, Input 2*

* Defined in the I/O table in the Primary Configuration Menu

Note: When Auto Squaring is selected, the Auto Square Homing Sequence defaults to:
1: Z axis, 2: non paired Axis, 3: Paired Axes.

[Axes Pairing and Homing Manual \(PDF\)](#)

Note: After pressing “Write Settings to CNC Control Configuration” in the wizard, CNC12 requires a restart when changing Axis Pairing Settings

Axis to Pair with 4th Axis: In our example Axis 2 is the Y axis and the 4th axis is paired to the Y.

Reverse direction of 4th axis motor?: Depends on machine mechanical configuration. Typically a rack and pinion paired gantry requires a direction reversal of the paired motor as seen in our example since the motors are facing each other. In other cases such as a ballscrew driven gantry axis direction reverse would not be required.

Paired Axis Alignment type? : Choose “Automatic Axis Squaring/Alignment” and the home program will square up the machine automatically using the master and slave switches mounted to either side of the gantry axis.

Master Axis Squaring/Alignment Distance: The amount of independent movement from the master axis home switch that the home program will move the master axis to square up the gantry axis. This squaring movement is ALWAYS AWAY from the Master Switch and is typically close in value to the amount the slave switch has been offset from square.

Feedrate of Homing Movements: The speed in which the home program will move the Gantry axis to seek the 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: cheap switches have more deadband.

Master Axis Home Switch PLC Input: A courtesy display to show the user which input they have set for HomeAll

Slave Axis Home Switch PLC Input: A courtesy display to show the user which input they have set for SlavedHomeInput. The Master and Slave Axis Home Switch PLC inputs are set in the Primary System Configuration screen using the Input Output Map drop down boxes and are echoed here for convenience.

Homing and Squaring with Software Pairing

2.) Auto Homing and Auto Squaring with Software Pairing with normally open (NO) home switches.

Requirements: 4 Home switches, Axis 1,2,3 Home Switches wired in parallel to the “HomeAll” input and Axis 4 Home switch wired into the “SlavedHomeInput” input. (use the Wizard i/o menu to configure the inputs)

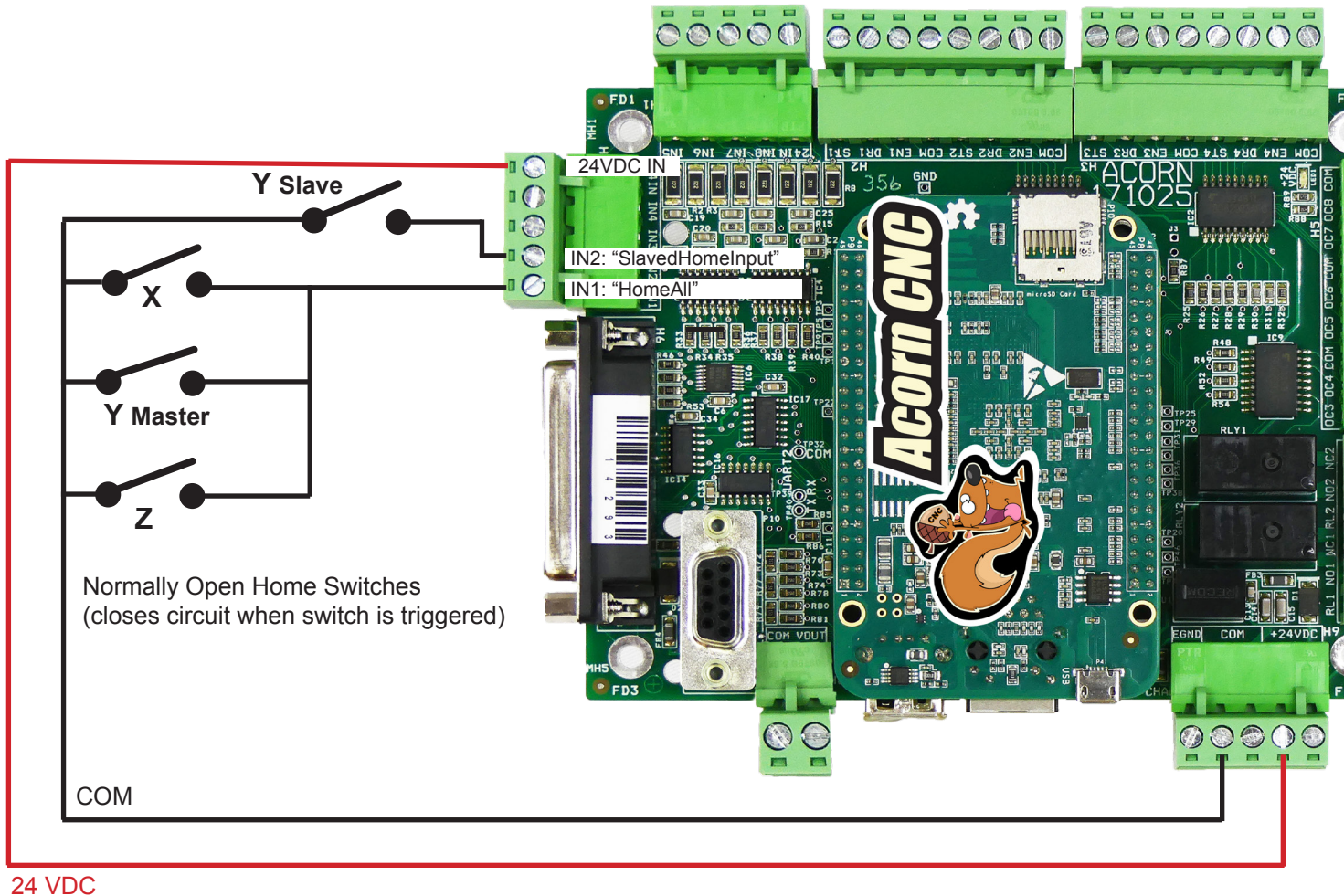
Home Switch setup example..

For the purpose of this example Axis 1,2,3 are labeled X,Y,Z respectively.

Axis 4 is the slave axis which has no label and does not appear on the DRO display

Axis 4 is Paired to the Y axis. (the Y axis is also referred to as the Master axis.)

Install the X,Y and Z home switches onto the machine so they trigger at the home position and wire them into the “HomeAll” input. In this example we have chosen Input 1 as the HomeAll input using the Acorn setup Wizard i/o setup menu. Wire all three X,Y,Z home switches in parallel into Input 1 as see by the schematic below.



Install the Slave Axis Home Switch and wire into its own dedicated input as seen in the schematic above, use the Wizard i/o table and assign this input to “SlavedHomeInput” input definition. For this example we have set the “SlavedHomeInput” to use Input 2 using the Acorn setup Wizard i/o setup menu as seen below. The Slave switch must be installed on the machine so that it trips FIRST.

Acorn Integrated Inputs 1-8		
	NC	NO
1		IN1
2		IN2
3		IN3
		Definition
		HomeAll
		SlavedHomeInput

Homing and Squaring with Software Pairing

3.) Auto Homing and Auto Squaring with Software Pairing with NPN normally open (NO) proximity switches.

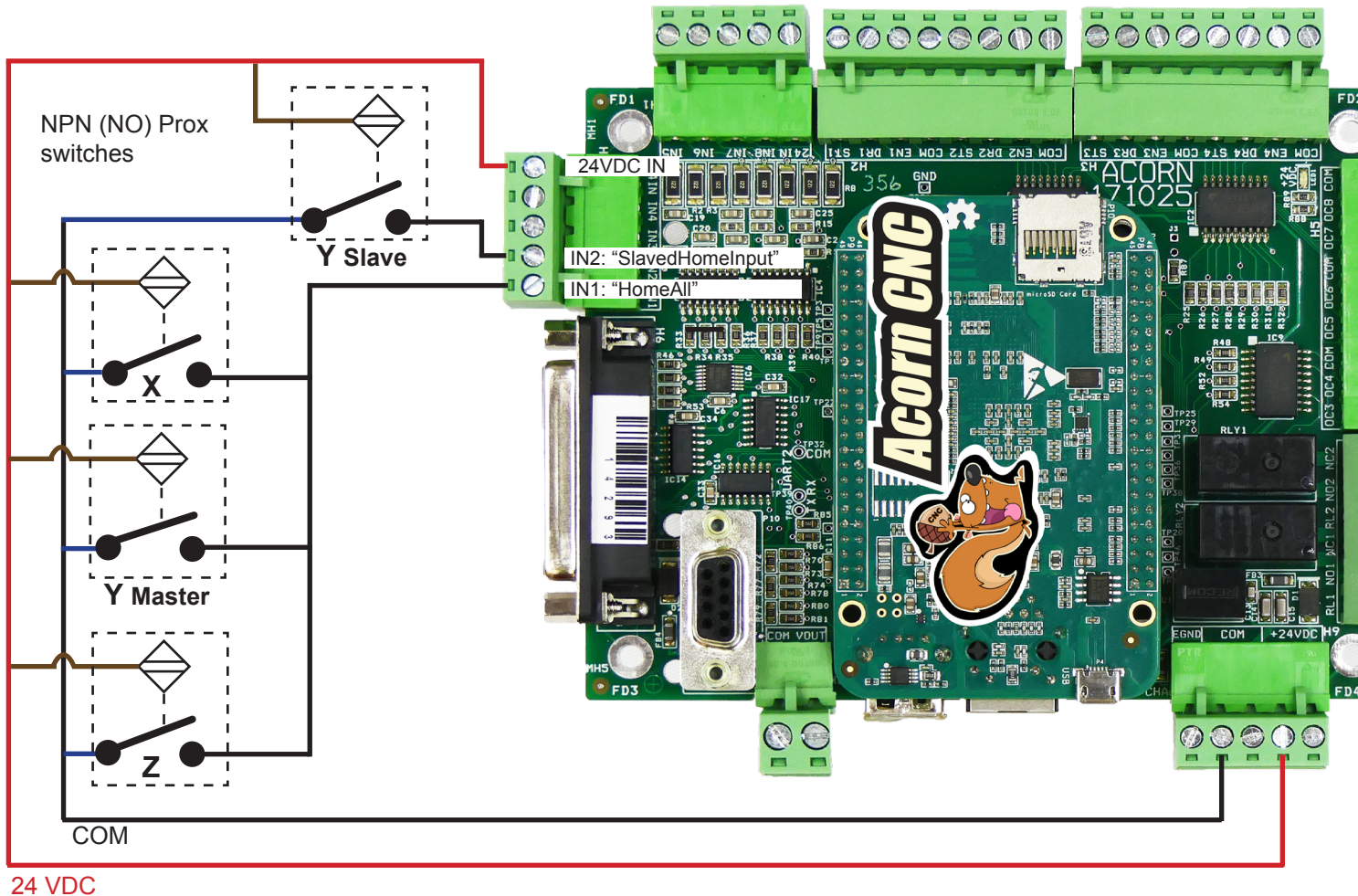
Requirements: 4 NPN normally open Prox switches, Axis 1,2,3 Home Prox Switches wired in parallel to the “HomeAll” input and Axis 4 Home switch wired directly into the “SlavedHomeInput” input. (use the Wizard i/o menu to configure the inputs)

For the purpose of this example Axis 1,2,3 are labeled X,Y,Z respectively.

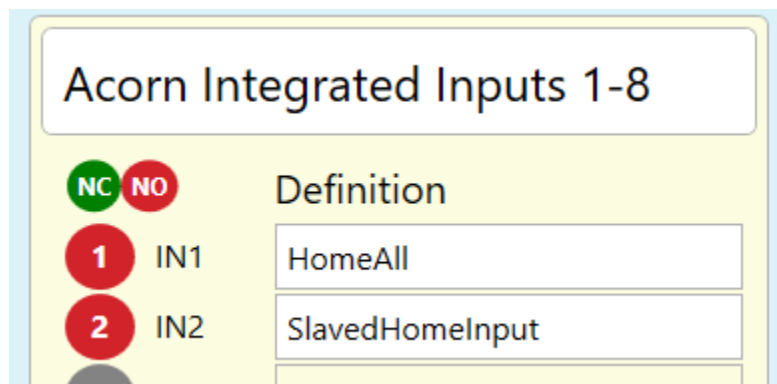
Axis 4 is the slave axis which has no label and does not appear on the DRO display

Axis 4 is Paired to the Y axis. (the Y axis is also referred to as the Master axis.)

Install the X,Y and Z home prox switches onto the machine to trigger at the home position and wire them into the “HomeAll” input. In this example we have chosen Input 1 as the HomeAll input using the Acorn setup Wizard i/o setup menu. Wire all three X,Y,Z home switches in parallel into Input 1 as see by the schematic below.



Install the Slave Axis Home Switch and wire into its own dedicated input as seen in the schematic above, use the Wizard i/o table and assign this input to “SlavedHomeInput” input definition. For this example we have set the “SlavedHomeInput” to use Input 2 using the Acorn setup Wizard i/o setup menu as seen below. The Slave switch must be installed on the machine so that it trips FIRST.



Homing and Squaring with Software Pairing

3.) Auto Homing and Auto Squaring with Software Pairing with NPN normally closed (NC) proximity switches

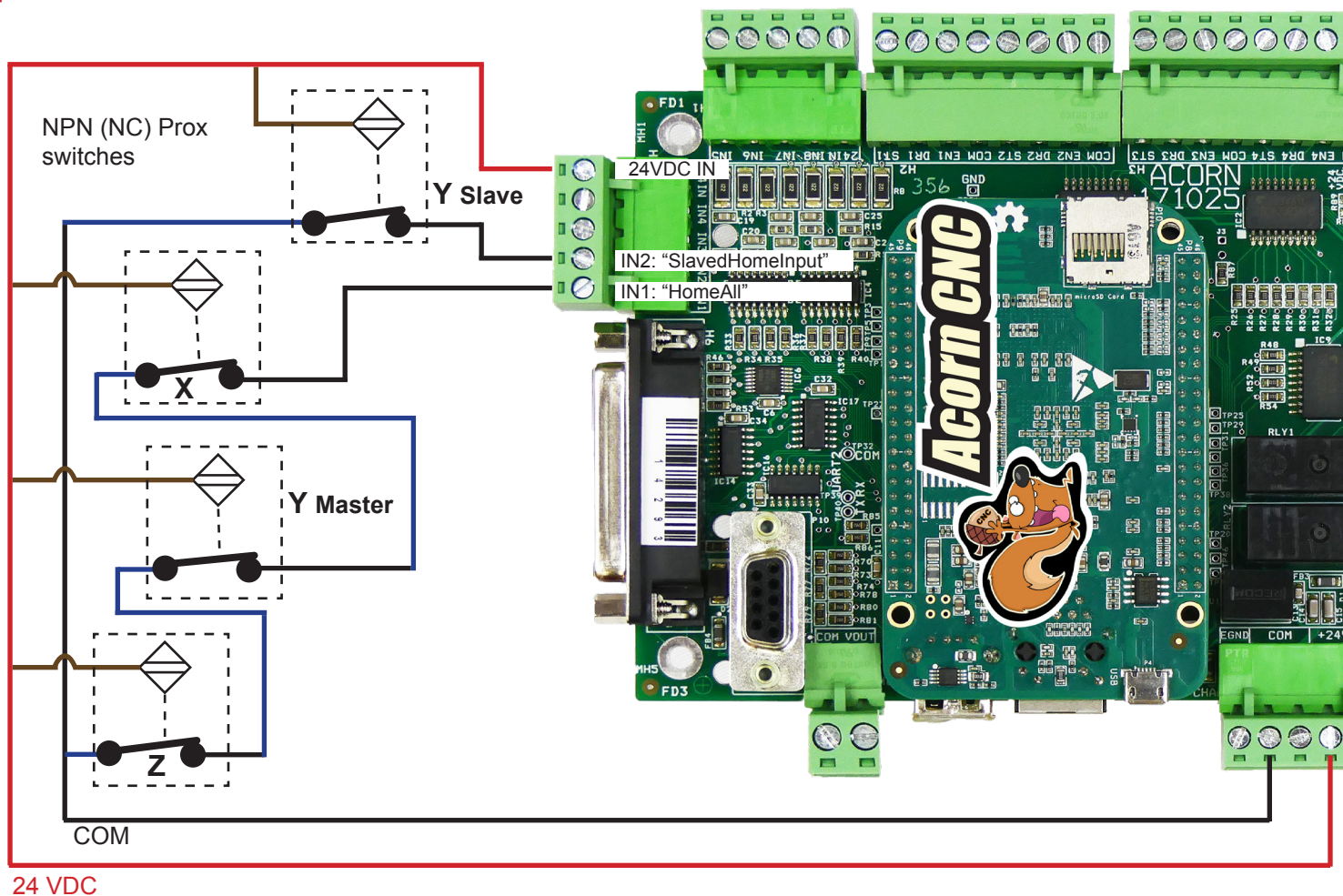
Requirements: 4 NPN normally open Prox switches, Axis 1,2,3 Home Prox Switches wired in series to the “HomeAll” input and Axis 4 Home switch wired directly into the “SlavedHomeInput” input. (use the Wizard i/o menu to configure the inputs)

For the purpose of this example Axis 1,2,3 are labeled X,Y,Z respectively.

Axis 4 is the slave axis which has no label and does not appear on the DRO display

Axis 4 is Paired to the Y axis. (the Y axis is also referred to as the Master axis.)

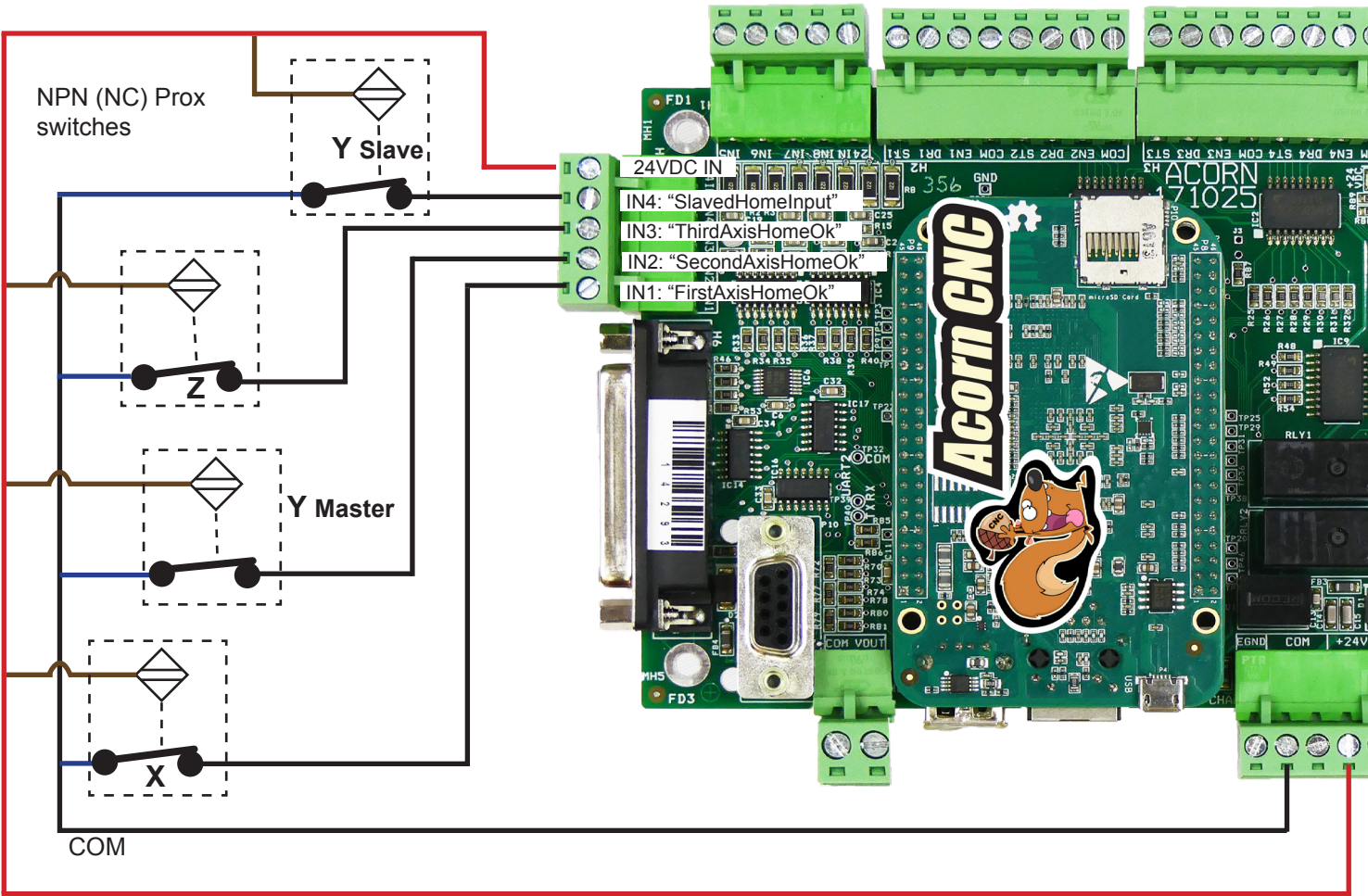
Install the X,Y and Z home prox switches onto the machine to trigger at the home position and wire them into the “HomeAll” input. In this example we have chosen Input 1 as the HomeAll input using the Acorn setup Wizard i/o setup menu. Wire all three X,Y,Z home switches in series into Input 1 as see by the schematic below. **NOT ALL PROX SWITCHES LIKE TO BE WIRED THIS WAY, your results may vary. This is an input saving technique that works with some types of Prox switches but not all.**



Install the Slave Axis Home Switch and wire into its own dedicated input as seen in the schematic above, use the Wizard i/o table and assign this input to “SlavedHomeInput” input definition. For this example we have set the “SlavedHomeInput” to use Input 2 using the Acorn setup Wizard i/o setup menu as seen below. The Slave switch must be installed on the machine so that it trips FIRST.

Acorn Integrated Inputs 1-8		
NC	NO	Definition
1	IN1	HomeAll
2	IN2	SlavedHomeInput

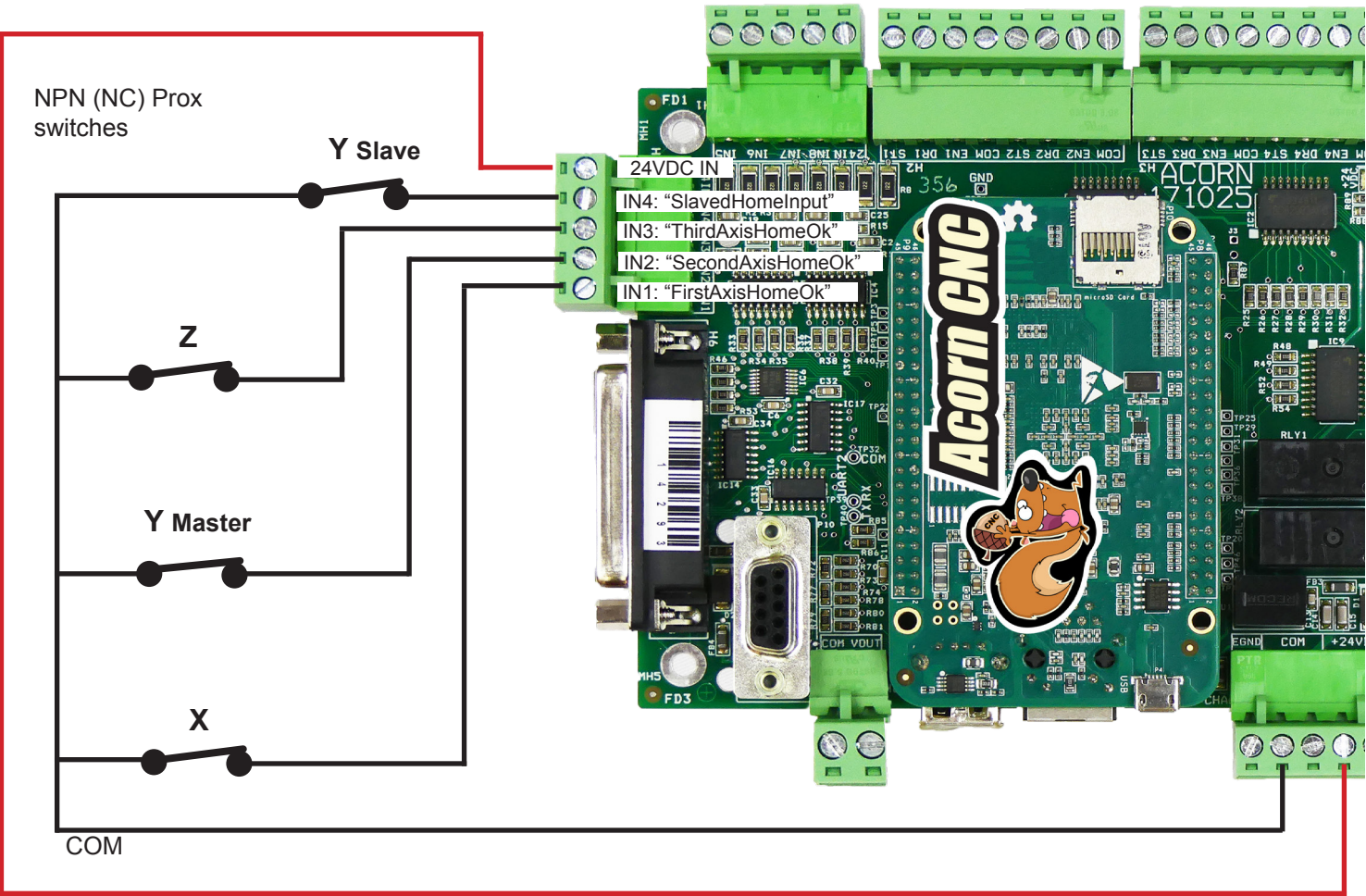
Alternatively NC Prox switches (or regular switches) can be wired to individual inputs as well.



Either of these input assignments will work with this wiring configuration above.

Acorn Integrated Inputs 1-8			Or	Acorn Integrated Inputs 1-8		
NC	NO	Definition		NC	NO	Definition
1	IN1	FirstAxisHomeOk		1	IN1	FirstAxisHomeLimitOk
2	IN2	SecondAxisHomeOk		2	IN2	SecondAxisHomeLimitOk
3	IN3	ThirdAxisHomeOk		3	IN3	ThirdAxisHomeLimitOk
4	IN4	SlavedHomeInput		4	IN4	SlavedHomeInput
5	IN5			5	IN5	

Regular switches can be wired to individual inputs as well.



Either of these input assignments will work with this wiring configuration above.

Acorn Integrated Inputs 1-8		
NC	NO	Definition
1	IN1	FirstAxisHomeOk
2	IN2	SecondAxisHomeOk
3	IN3	ThirdAxisHomeOk
4	IN4	SlavedHomeInput
5	IN5	

Or

Acorn Integrated Inputs 1-8		
NC	NO	Definition
1	IN1	FirstAxisHomeLimitOk
2	IN2	SecondAxisHomeLimitOk
3	IN3	ThirdAxisHomeLimitOk
4	IN4	SlavedHomeInput
5	IN5	

Homing and Squaring with Software Pairing

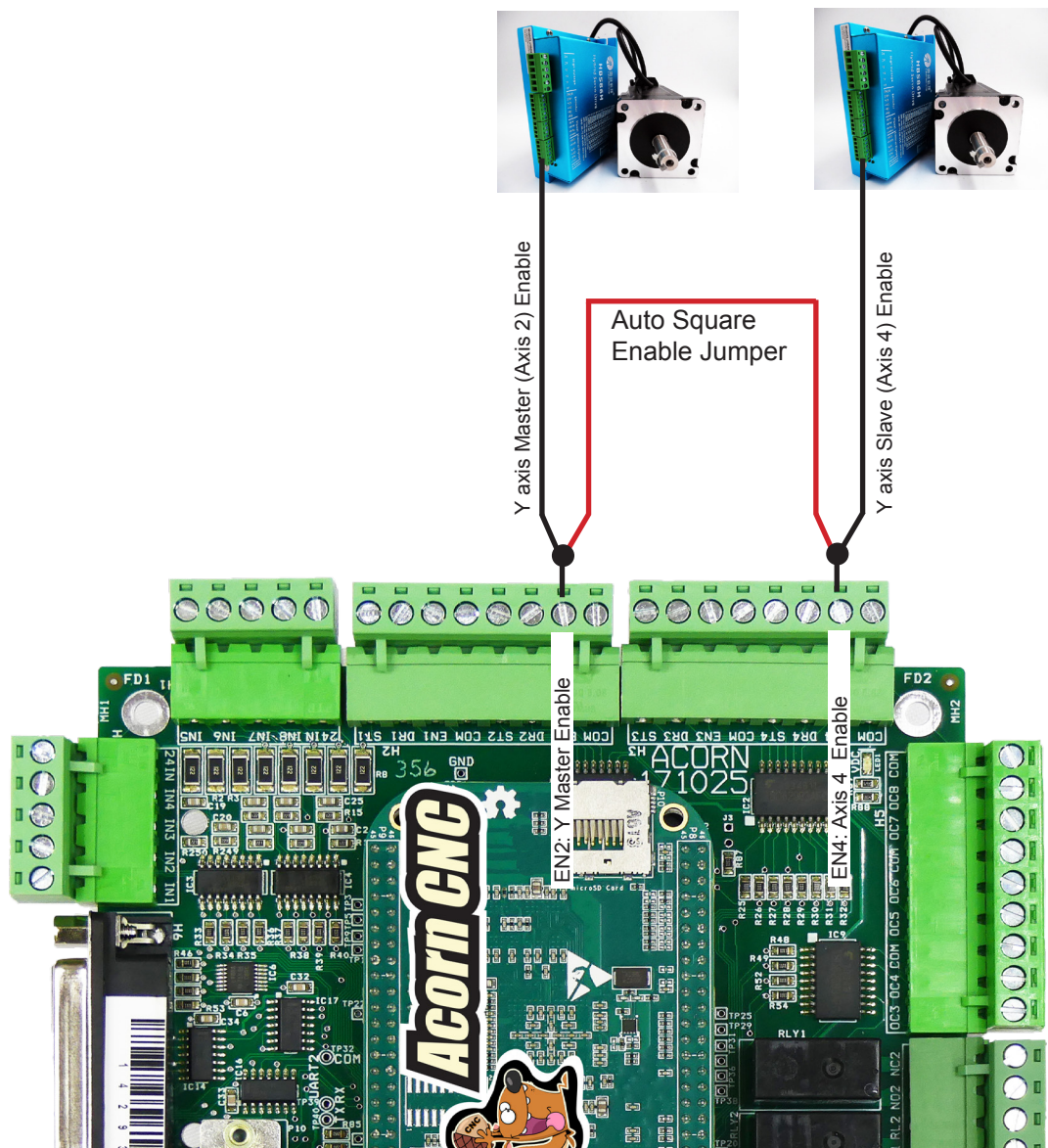
Auto Homing and Auto Squaring with Software Pairing: Axis Motor Enable Signal configuration.

Enable signal discussion: There are axis motor drives that use an enable signal and ones that don't. Some are even user programmable to either make use of the enable signal or ignore it. If you are using an axis drive that doesn't use the enable signal from the Acorn board then you can stop right here, you have nothing further to do.

If using an axis motor drive that makes use of the enable signal then read on.....

The axis drive enable signal is used to tell an axis motor DRIVE to put power to the motor whether that be to hold position or move, without the enable signal the axis drive will free the motor. If the axis drive is 'enabled' then the drive is ready to take step and direction commands and while it is enabled, if its not receiving any step and direction commands it HOLDS the motor position so the axis won't move.

Some axis drives don't use or have an enable input, in these cases the drive is always enabled so, if the drive has power to it the drive is enabled and the motors will hold position until the drive receives step and direction command(s) to move. Other drives like Yaskawa, Estun, Delta, have an enable input and look to that input to keep the drive active (enabled) to hold position or move. When CNC12 runs the auto squaring home program at some point it has to un-pair the two axis motors on the gantry and move them independently. While the two motors are un paired it is usually necessary to keep one of the motors holding position while the other moves independently so the non moving side of the gantry doesn't get dragged along by the independent movements. When Acorn issues an independent move, the enable signal for the non moving motor is removed, this will cause the motor to NOT hold position and if the gantry is tight or the independent movement is large the independent move will drag the non moving side of the gantry out of position. To prevent this we need the non moving motor during an independent move to HOLD position, to accomplish this we simply jumper the paired axis Enable signals. In our examples: Axis 4 is paired to Axis 2 (the Y axis). In order for Axis 4 to hold position during an independent move of Axis 2 (Y axis) simply jumper the enable signal between the two drives. This can be done at the drive or at the Acorn board. See example below.



Auto Homing and Auto Squaring with Software Pairing Procedure.

First time setup

- 1.) With the power off, manually move the gantry axis to roughly square it up.
- 2.) Power up the Acorn CNC controller.
- 3.) Jog all axes close to home switches and press cycle start to seek the home switches automatically.
- 4.) In our example the machine will home the Z axis first, the X axis second and then move the Y gantry axis until the Slave switch is triggered. The slave axis switch will hit first, clear the switch and then the master axis will move independently to seek the master switch, trigger the switch and then back off the switch to the master axis squaring amount set in the wizard.
- 5.) Now check for squareness of the machine using any method feasible and adjust the master axis squaring amount if needed to tweak in the gantry axis squareness. re-home and check squareness again and adjust value until machine is satisfactory square.
- 6.) Proper Shut down: "Park" the machine tool near the home position before powering off using the G53 command. This leaves the gantry in the squared position and the axes near the home position ready to home out for when the next time power is applied.

To setup a Park position, use G53 to command a move to a location just about an inch from home. For example: G53 X1Y1Z-1 L100 this will park the machine 1" away from the HOME position (for our example the machine travel away from the X and Y home switch is positive and away from the Z switch is negative) moving at 100 ipm (inch per minute). While not necessary its nice to mark the Park position so its easy to see if the gantry is square prior to homing before subsequent homing cycles. In CNC12 v4.14 and higher the CNC12 Park Button (found in the F10 Shutdown menu) can be edited with the Wizard and the user can easily customize the functionality of the Park button to the machine tools requirements. For example the park button can easily be edited to run this command. G53 X1Y1Z-1 L100

Subsequent Auto Homing and Auto Squaring procedure.

- 1.) Power on the Acorn CNC Controller and press Cycle Start to Home the machine, the machine will seek out the home switches, square the gantry automatically and then set home automatically, the machine is then homed and square ready to use.

Discussion: Auto Home and Auto Axis Squaring with Software Pairing will automatically home and square a machine tool with a paired axes. Auto Home with Auto Axis Squaring is the most reliable and accurate way to home and square a machine tool with paired axes. While initially more work to setup than other methods the pay back in saved time exceeds the initial setup effort in a short amount of time. For example: If the machine was moved out of square for any reason (bumped when off, lost steps, power loss during operation etc) To recover from such events, the operator simply power cycles the machine or presses "reset home" on the VCP and the machine tool will Automatically square the paired axis and re find home just by pressing Cycle Start. No need for the operator to manually realigns the gantry axis to be square before homing like with the other methods shown in this document.

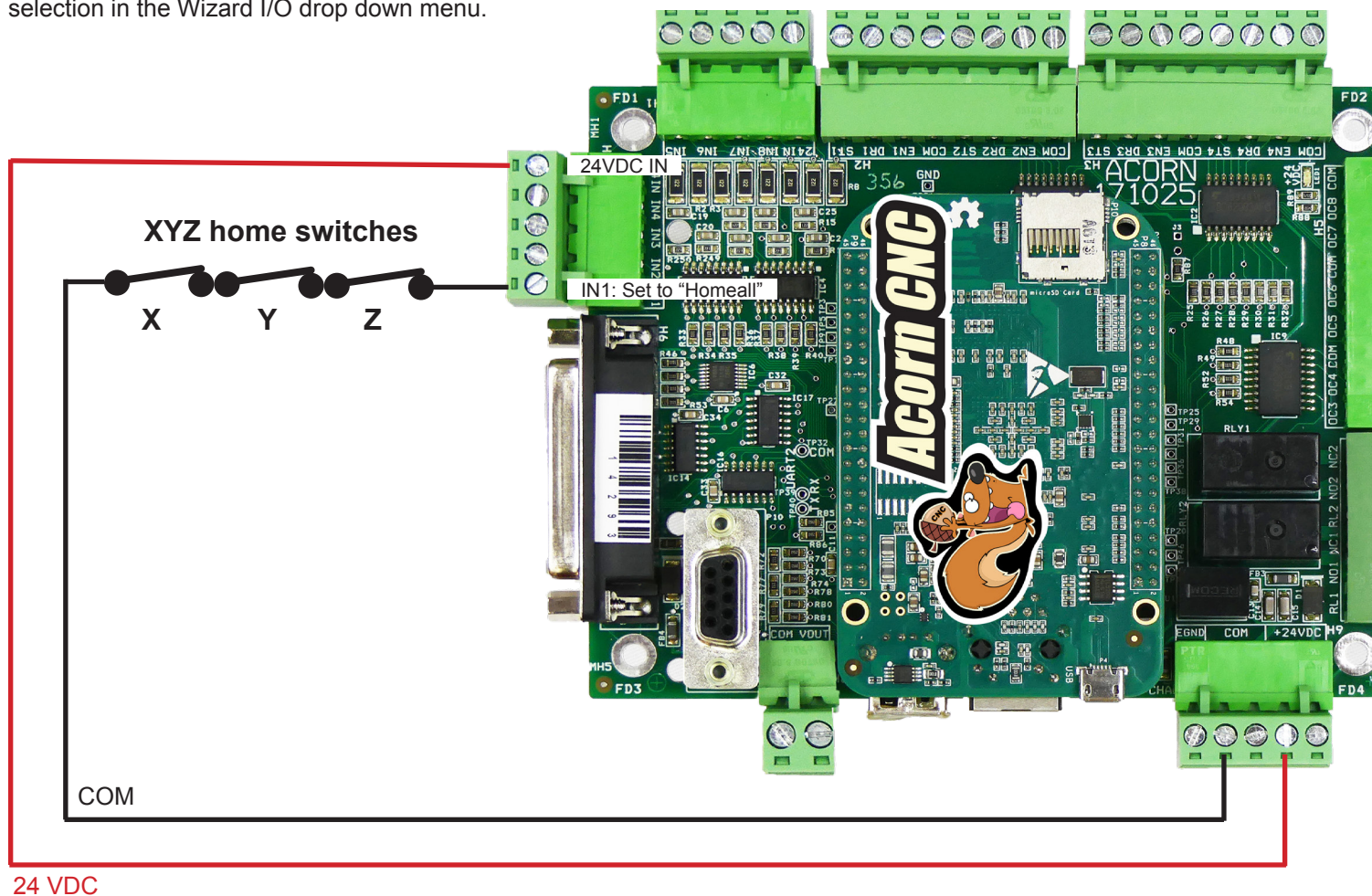
Notes:

- 1.) The Master Axis Squaring/Alignment Distance can be used to fine tune the Gantry squareness by trial and error. During initial setup by entering a value to get the machine in the ballpark square, then home out, sweep a dial indicator on a large square or do a test cut and checking for square and then make adjustments to the Master Axis Squaring/Alignment Distance based on the check for square results..re-home, etc... Then after a few go arounds you can tweak in the squaring distance so that the machine home out square every time. Obviously if either the gantry axis home switches are moved then the squaring distance would have to be redetermined.
- 2.) Type of Home switches. Most any reliable and repeatable mechanical or NPN proximity switches can be used as a home switch. One consideration is that to pick a configuration that allows the machine to over-travel the switch without damaging the switch. Good quality roller plunger switches and proximity switches allow the machine to over travel the switch without damaging the switch. Its is common to install a hard rubber/polyurethane bumper on the machine mechanicals so that if the switch has been over-traveled the machine will not be damaged. Remember the home location repeatability is only as good as the home switches themselves so use high quality switches if the machine requires precise repeatable homing.
- 3.) While not required, "LimitAll" can be used in conjunction with "HomeAll" and "SlavedHomeInput" if the machine tool is equipped with over-travel limit switches and it is desired to put them to use. Limit Switches are NOT used to home off of or use in Auto Squaring. They are used solely for gross over-travel as a last ditch effort to stop an axis drive runaway. Normal travel limits are handled by Acorn Software Travel limits.

Homing and Squaring with Software Pairing

Auto Homing and Manual Squaring with Software Pairing wiring of home switches

Requirements: Three Home Switches for Axes 1,2,3 typically wired into one input called “HomeAll”. In this example Axes 1,2,3 are labeled X,Y,Z respectively. Wire all home switches to input 1 (or any input of your choosing) using the “HomeAll” selection in the Wizard I/O drop down menu.



Choose “Home to Switch” in the Acorn Wizard homing menu and configure Homing Directions, Sequence and Travel Limits.

Acorn Integrated Inputs 1-8		
NC	NO	Definition
1	IN1	HomeAll
2	IN2	
3	IN3	
4	IN4	

Axes Pairing

CNC12 Pro, Ultimate, or Ultimate+ is required for Software Axes Pairing. A restart of CNC12 is required for changes to take effect.

Axis to pair with 4th axis

Axis 4 paired to Axis 2 ▼

* Requires a Pro, Ultimate, or Ultimate Plus License

Reverse direction of 4th axis motor relative to the paired axis?

Yes

Paired Axes Homing

Paired axes squaring/alignment

Manual Axis Squaring/Alignment ▼

Master Axis squaring/alignment distance

0.025

Feedrate of homing movements

20

Home switch Deadband Distance

0.005

Master Axis Home Switch PLC Input =

HomeAll, Input 1*

Slave Axis Home Switch PLC Input =

* Defined in the I/O table in the Primary Configuration Menu

Note: When Auto Squaring is selected, the Auto Square Homing Sequence defaults to:
1: Z axis, 2: non paired Axis, 3: Paired Axes.

[Axes Pairing and Homing Manual \(PDF\)](#)

Axis to Pair with 4th Axis: In our example Axis 2 is the Y axis and the 4th axis is paired to the Y

Reverse direction of 4th axis motor?: Depends on machine mechanical configuration. Typically a rack and pinion paired gantry requires a direction reversal of the paired motor as seen in our example since the motors are facing each other. In other cases such as a ballscrew driven gantry axis direction reverse would not be required.

Paired Axis Alignment type? : Choose “Manual Axis Squaring/Alignment” and the home program will square up the machine automatically.

Master Axis Squaring/Alignment Distance: Not used with manual axis squaring. grayed out, un-editable.

Feedrate of Homing Movements: The Speed in which the home program will move each axis to seek the home switches

Home Switch Deadband Distance: Not used with manual axis squaring.

Master Axis Home Switch PLC Input: A courtesy display to show the user which input they have set for HomeAll

Slave Axis Home Switch PLC Input: Not used with manual axis squaring.

Note: After pressing “Write Settings to CNC Control Configuration” in the wizard, CNC12 requires a restart when changing Axis Pairing Settings

Auto Homing and Manual Squaring with Software Pairing

Auto Homing and Manual Squaring with Hardware Pairing requires the operator to square the gantry/paired axis manually before running the Automatic homing cycle. The Auto Homing cycle moves each axis of the machine tool to their respective Home switches, backs off to clear the switch and sets home at that location. The home program can be automatically generated by the Wizard or customized by the user/installer. In this example we are using the Wizard generated home program using the settings shown.

Auto Homing with Manual Squaring with Hardware Pairing Procedure.

First time setup or in the event of power failure during movement or lost steps

- 1.) With the power off, manually move the gantry axis to square up the gantry axis to the axis that it sits on. Once the square position is determined, place marks on the machine tool so that it is easy to realign the gantry axis manually to the square position in the future.
- 2.) Power up the Acorn CNC controller. (using software pairing, the gantry motors are paired on power up so the gantry motors move in unison, in this example the Y axis is the gantry axis with two software paired motors)
- 3.) Jog all axes close to home switches and press cycle start to seek the home switches automatically. Acorn will trigger each of the three home switches one axis at a time, back off to clear the switch and set home for all three axis at that position. The machine is ready to use.
- 4.) Proper Shut down: "Park" the machine tool near the home position before powering off using the G53 command. This leaves the gantry in the squared position and the axes near the home position ready to home out for when the next time power is applied.

To setup a Park position, use G53 to command a move to a location just about an inch from home. For example: G53 X1Y1Z-1 L100 this will park the machine 1" away from the HOME position (for our example the machine travel away from the X and Y home switch is positive and away from the Z switch is negative) moving at 100 ipm (inch per minute). While not necessary its nice to mark the Park position so its easy to see if the gantry is square prior to homing before subsequent homing cycles. In CNC12 v4.14 and higher the CNC12 Park Button (found in the F10 Shutdown menu) can be edited with the Wizard and the user can easily customize the functionality of the Park button to the machine tools requirements. For example the park button can easily be edited to run this command. G53 X1Y1Z-1 L100

Subsequent homing procedure .

- 1.) Verify machine is at the Park position and gantry is square.
- 2.) Power on the Acorn CNC Controller and press Cycle Start to Home the machine, the machine will seek out the home switches and set home automatically, the machine is then homed and square ready to use.

Discussion: Auto Home and Manual Axis Squaring using Software pairing. Has the convenience of Auto Homing but still requires the operator to make sure the paired axis is square before starting the homing cycle. Auto Home with Manual Axis Squaring can be quite reliable and accurate enough for most wood working/plasma/flame machine tools. The only con with this method is that it is up to the operator to remember to make sure the paired axis is square before homing the machine. If the machine was moved out of square for any reason (bumped when off, lost steps , power loss during operation etc) its no big deal, To recover from such events, the operator powers off, manually realigns the gantry axis to be square using the marks made in the first time setup, powers back up and presses cycle start to seek the home switches, then machine will auto reset the home position and the machine is ready to use.

Pitfalls: Estop, Cycle Cancel, ESC, Reset during the homing cycle.

If it is necessary to cancel the homing cycle while the homing cycle is running and depending on the point in which the homing cycle was canceled it may be necessary for the operator to “Re-pair” the axes. This is especially important since when the axes are not paired it is possible to cause damage to the machine when jogging since only one motor on the paired axis will be responding to the axis jog button. For example, If Estop, Cycle Cancel, ESC, or RESET is pressed during the independent axis movement stage of the homing cycle the two axis motors will be left UNPAIRED even after the Estop condition is cleared. It is up to the operator to Re-pair the axes before jogging! (Note: Re-running home program by pressing “Reset Home” will automatically re-pair the axis.) We have made this as simple as possible by adding a “re-pair axes” button on the VCP. To re-pair the two motors press the “Re-pair Axes” button and the LED goes Green to confirm pairing is active.



Push to “Re-Pair” the axes after an Estop condition during homing cycle before jogging the gantry!!

LED turns green and label changes to let you know that the axes are paired.



Travel Limit values after Estop condition during independent master/slave movement stage.

Another side effect of pressing Estop, Cycle Cancel, ESC, or RESET during the homing cycle independent master/slave axis movement stage will result in the loss of the Software Travel Limit settings. Be sure to re-enter the software travel limit values in the Wizard (or CNC12 menu) for each axis after an Estop condition during a homing cycle. Alternatively “Restore Report” can be used to restore the Travel Limit values (if of course a good report.zip file is available) Restore report is preferred as it takes less keystrokes to recover the lost travel limit values. While this is mildly annoying during the setup and testing of the auto square switches it is not that common once the machine is configured and running properly. That being said, we are planing to add the ability for CNC12 to recover the travel limit values during an Estop condition in the upcoming next release of CNC12.

	Axis 1	Axis 2	Axis 3	Axis 4
Homing direction	-(M91) ▾	-(M91) ▾	+(M92) ▾	-(M91) ▾
Homing sequence	3	2	1	4

Travel Limits

	Axis 1	Axis 2	Axis 3	Axis 4
Travel Limit (+)	48	96	0	0
Travel Limit (-)	0	0	-8.5	0

Machine Parking

Override default park behavior? Yes ▾

Re-enter Travel limit values or use “restore report” in CNC12 utility menu to restore values automatically after an Estop condition during the master/slave axis independent movement stage.

Home programs and Axis Squaring Sub Programs

CNC12 uses a text file call “cncm.hom” for mills. The Acorn setup Wizard automatically generates the “cncm.hom” Home Program (and the corresponding PLC program) based on the Wizard homing and pairing settings chosen by the user/integrator.

cncm.hom is located in the c:\cncm directory and is simply a G&M code program and is editable. While most users will find the automatically generated cncm.hom file works for them perfectly. In rare cases users may want to modify the home program for special applications and circumstances. In the case of a user edited cncm.hom file, the Acorn Wizard can be set to not overwrite the cncm.hom file each time that the user presses “Write Settings to CNC control configuration” in the Wizard. This allows the user to make use of the Wizard to make other changes not related to the home file while not overwriting the custom home file the user has created.

A cncm.hom Auto Homing with Auto Squaring Home program is built out of subprograms m-codes. Each subprogram handles a distinct section of the auto home and auto squaring cycle. This aids in organization and programming debugging.

The Auto Square home program M-code has a debug mode which displays more information during the auto squaring cycle to help the integrator setup the switches correctly. To activate debug mode edit “mfunc74.mac” and on line 10 and set #102 equal to 1. Save. Set = 0 to turn off debug mode. Once up and running the time to display message #101 can be reduced as well. Keep it at least 1 second or longer.

```
mfunc74.mac
1 ;-----
2 ; Filename: mfunc74.mac - Paired Axes Auto Home/Squaring (Used in Paired Axes Auto Squaring)
3 ; M74 macro
4 ; Description: Automatically Home and Square the paired axes
5 ; Notes:
6 ;-----
7
8 #100 = 0 ; Time to display M225 message in seconds. 0 = Wait for Cycle Start
9 #101 = 3 ; Time to display temporary messages
10 #102 = 1 ; Debug mode. Set to 1 to enable debugging messages and features.
11 #104 = 0 ; = 1 = Master tripped
12 #105 = 0 ; = 1 = Slave tripped
13 ;#120 ; Previous Axis 1 plus limit
14 ;#121 ; Previous Axis 1 minus limit
15 ;#122 ; Previous Axis 2 plus limit
16 ;#123 ; Previous Axis 2 minus limit
17 ;#124 ; Previous Axis 3 plus limit
18 ;#125 ; Previous Axis 3 minus limit
19 ;#126 ; Previous Axis 4 plus limit
```

Notes on Home and Limit Switches:

1.) While both “normally open” and “normally closed” home switches are supported.

Using normally open switches is NOT recommended for a number of reasons.

- Normally Open switches leave the system susceptible to noise and false triggers which stops the job or homes in the wrong location.
- Normally Open switches don't offer any protection when wiring fails and leaves the machine vulnerable to crashing. Use Normally Closed Switches for both home and limit switch applications for reliable CNC machine tool operation.

2.) Individual axis home inputs (FirstAxisHomeOk, SecondAxisHomeOk, ThirdAxisHomeOk, FourthAxisHomeOk) for each axis home switch is also supported with Autosquaring, this setup is much more commonly used on AcornSix than Acorn since AcornSix has onboard 16 inputs, most Acorn user combined the switches to use “HomeAll” to save on inputs.

3.) While not required, “LimitAll” can be used in conjunction with “HomeAll” and “SlavedHomeInput” if the machine tool is equipped with over-travel limit switches and it is desired to put them to use. Limit Switches are NOT used to home off of or use in Auto Squaring. They are used solely for gross over-travel as a last ditch effort to stop an axis drive runaway. Normal travel limits are handled by Acorn Software Travel limits and do a great job of preventing an axis from overtravel as long as the axis motor drive is functional properly. Limit switches are used to prevent crashes in the case where the axis motor drive malfunctions and runs away.