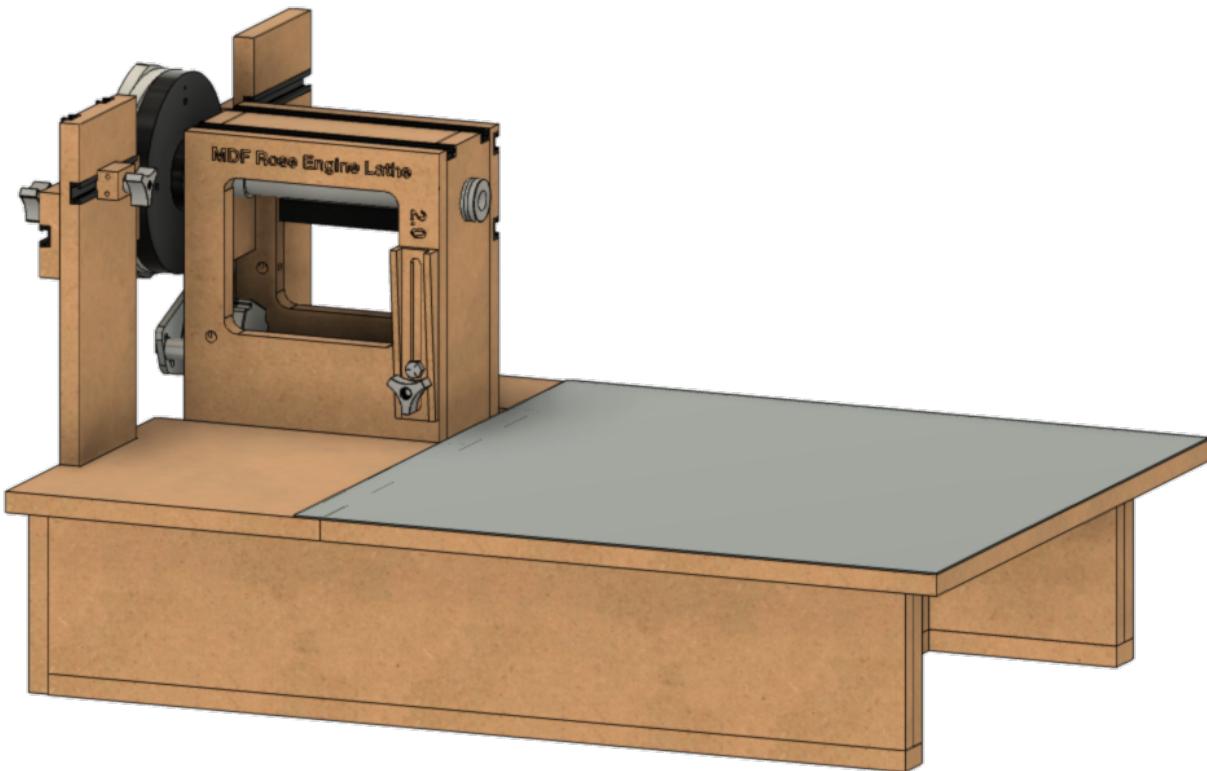


MDF Rose Engine Lathe 2.0 with Stepper Motor Drive



Instructions for Building Control System for Spindle Stepper Motor

**Version 1.0
22 January 2021**

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

This document is intended to help one unfamiliar with the MDF rose engine to build one easily. It is designed to go with the kit you can purchase from www.ColvinTools.com.

There are some variations from the ideas documented by Jon Magill at www.rogueturner.com. Where this is the case, we have tried to document such changes and provide the reason for the change.

This document is also designed to use a stepper motor for driving the spindle.

If you have any questions, please contact us at ColvinTools@Gmail.com.

Good luck.

Rich Colvin & Jack Zimmel

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

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Build Instructions – Control System for Spindle Stepper Motor

Getting Started

As you get started with building this machine, please consider making the machine according to the outlined instructions. There are a boatload of ways you can modify this, and, quite frankly, the MDF rose engine encourages experimentation. But it is best to attempt those modifications after understanding how it works. Some ideas which sound grand may not appear so after understanding how the machine works (we speak from experience).

If you have any questions on the terminology in this document, check out the “Ornamental Turning Book of Knowledge” (www.OTBoK.info).

This document outlines the approach for wiring this machine using a Pololu Tic 36v4 High-Power Stepper Motor Controller.

Advantages	Disadvantages
<ul style="list-style-type: none">The cost is significantly lower than the full system design (which uses the Nextion display and Rose Engine Controller Spindle and Three Axes V002c PCB).The Pololu Tic is small and can be placed pretty much anywhere (it is only 1.05" x 1.5").This is simpler to implement.If the implementer chooses to upgrade to the full controls system later, there is little investment which is lost (it is only the Pololu Tic and the rotary encoder).	<ul style="list-style-type: none">This design can only control the spindle's stepper motor.It could be duplicated for a 2d stepper motor; however, the two would not be synchronized.

Standards are outlined in a companion document and are used for the compilation of this document.

Cautions

- Do not perform any changes to this system when the system is powered on.** Power down and unplug the system before attempting any work.
- If your local electrical code requires for any differences from what is documented here, those requirements take precedence over this document.
- If you feel uncomfortable with anything in these instructions, consider having a licensed electrician perform the work.

Please also note: Permission is not granted to manufacture these for sale.

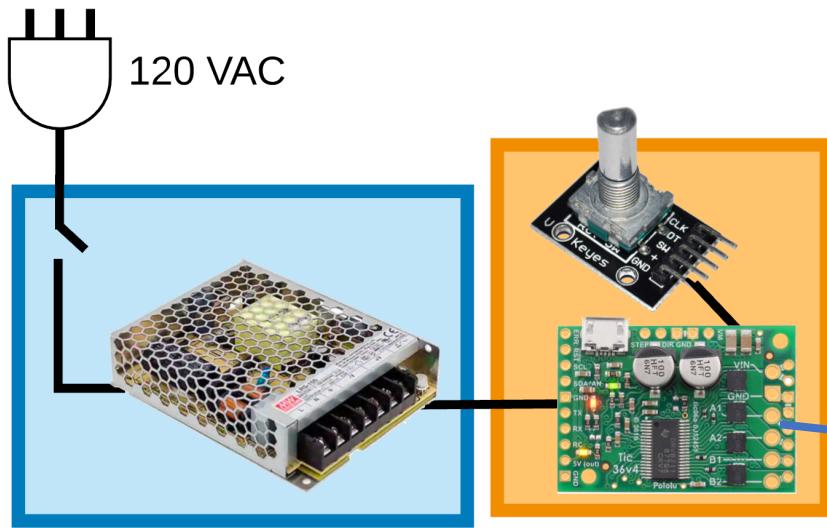
MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Overview of Connections

The whole system is shown in the picture to the right.

It is shown with two boxes, one blue and another orange. This is because these components are probably separated into separate boxes or locations.



The system consists of these items:

Blue Box

1. Power switch
2. 24 V power supply

Orange Box

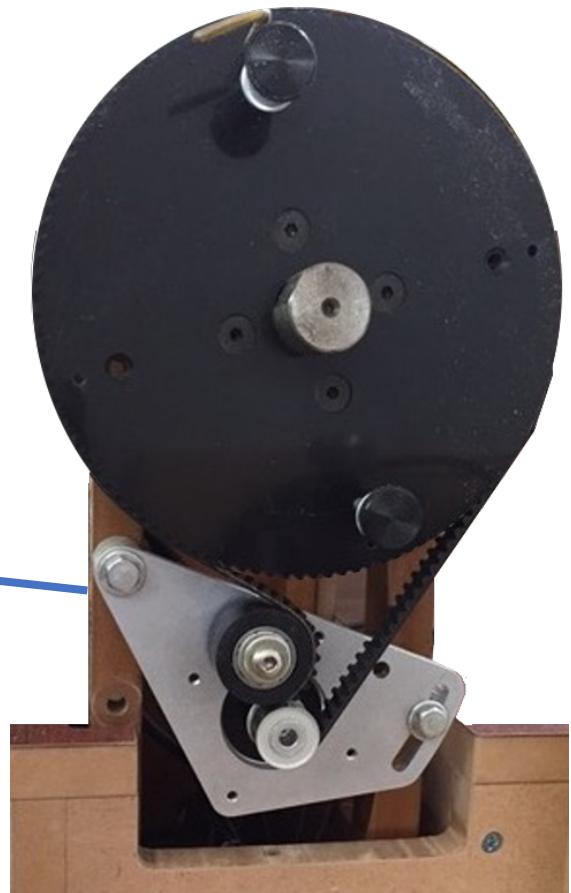
3. Pololu Tic 36v4 High-Power Stepper Motor Controller
4. Rotary encoder

Not Shown

5. Stepper motor
6. Bracket and parts to mount the stepper motor in the headstock
7. Drive gears and belt

This control system can be used on:

- MDF Rose Engine Lathe
- MDF Rose Engine Lathe 2.0



Stepper Motor on the Spindle of an Original MDF Rose Engine Lathe

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

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Bill of Materials

Parts required for building this are below. The item numbers are shown in the following drawings using an orange, circled number like the one to the right. For consistency with the full, multiple stepper motor system, those item numbers are retained; however, they are deleted from this list. That is why there are gaps in the numbers.

Quantities that are based on the option selected are shown with the respective option.

Common Materials for All Options					
Item #	Item	Qty	Source	Source Part Number	Comments
Electrical Items					
109	Tic 36v4 High-Power Stepper Motor Controller	1	Pololu.com	3140	Tic 36v4 with connectors soldered
110	Rotary Encoder	1	Amazon		Cylewet 5Pcs KY-040 Rotary Encoder Module with 15×16.5 mm with Knob Cap for Arduino (5 pcs) CYT1062
Electrical Items					
201	AC/DC Power Supply - LRS-100-24	1	Digi-Key	1866-3314-ND	
205	Power Switch	1	Amazon		SPST Toggle
209	Utility box cover, 1 gang		Amazon	Hubbell-Raco 861	
210	Utility box cover, 1 gang		Amazon	Hubbell-Raco 860	
211	3/8 in. Twin-Screw Cable Clamp Connectors		Local hardware store		
213	Stepper Motor	1	StepperOnline	23HS30-30045	For the spindle drive NEMA 23 bipolar 1.8° 1.9 Nm, 2.8A, 3.2V 57 x 57 x 76 mm
Cables					
302	Cabling – 20 AWG/4, stranded				

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Common Materials for All Options					
Item #	Item	Qty	Source	Part Number	Comments
303	Cabling – 20 or 22 AWG/2				Used for DC power connection.
304	Cabling – 16 AWG/3, stranded				Used for AC power connection. Can cut off the female end of a grounded extension cord.
305	Crimp Connector Housing, 1x5	2	Pololu.com	1904	0.1" (2.54mm) Crimp Connector Housing: 1x5-Pin (5-pack)
306	Wires with pre-crimped terminals	5	Pololu.com	1803	Wires with Pre-Crimped Terminals 50-Piece, 10-Color Assortment F-F 12"
Screws, etc.					
408	Particle Board Screws, #6, 5/8" long, flat head	12	McMaster-Carr	90252A246	Used to affix the utility box covers in place (replaces the screws that may come with the plates)
Spindle Drive Parts					
501	Timing Belt	1	MiSUMI	GBN655EV5GT-90	GT3 5mm pitch 131T / 655mm long 9mm wide
502	Spindle Pulley	1	Colvin Tools		Attached to the spindle via the flange.
503	Stepper Motor Pulley	1	Stock Drive Products (www.sdp-si.com)	A 6A55-012DF0908	5 mm (GT2) Pitch, 12 Teeth, 0.25" Bore, 2 Flanges / With Hub, Aluminum Alloy Timing Pulley for .354 (9mm)" Wide Belt
504	Stepper Motor Attachment Bracket & Parts	1	Colvin Tools		Includes: <ul style="list-style-type: none"> • Bracket with Idler • Mounting bolts, nuts, and spacers to attach to headstock • Mounting screws to attach stepper motor

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Use Standard Electrical Plates for Connectors

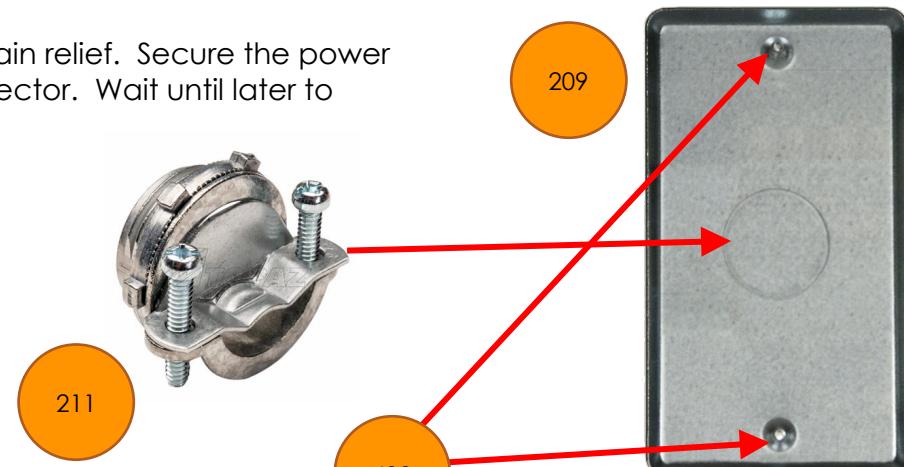
Power Infeed

Use a 1-gang plate with the hole punched out for the cable strain relief. Secure the power cable in place using the 3/8 in. Twin-Screw Cable Clamp Connector. Wait until later to tighten the screws holding the power cable into place.

Option 1: Mount to the box designed for a full system

Option 2: Use one for the 120 VAC power infeed, and a separate one for the 24 VDC power outfeed. Mount to the back of the base.

Option 3: Mount to the back of the base.



Power Switch

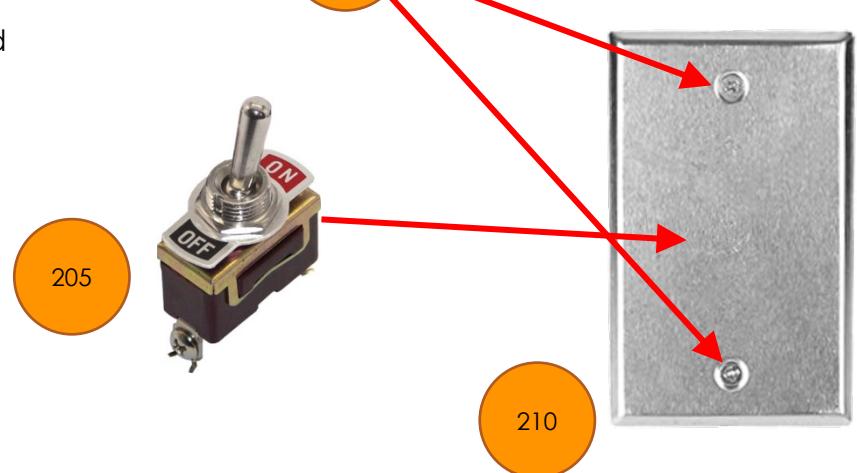
Use a 1-gang plate which is blank. Drill a 1/2" hole in the center and secure the power switch to it.

If you choose to put all the controls in the case of the machine then this would be mounted to the front.

Option 1: Mount to the box designed for a full system

Option 2: Mount to the front of the base.

Option 3: Mount to the front of the base.



MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Where to Put the Controls

There are some good options about where to put the

- Pololu Tic 36v4 High-Power Stepper Motor Controller (which is small – 1.05" x 1.5") and
- 24 V power supply

The best options are:

1. Use the box designed for the full system (see also, "Instructions for Building the Stepper Controls") – pg. 10.
2. **Use a different, smaller box – pg. 15** ↗ This is the recommended approach
3. Place all parts inside the lathe's base – pg. 18

Regardless of the option chosen,

1. The rotary encoder and the power switch, both need to be easily accessible, and
2. The power infeed and power switch should be implemented as shown on the prior page.

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Option 1: Use the Box Designed for the Full System

One consideration for building the enclosure is for using the controls box as outlined for the full controls system. This may be a bit of over-kill on space utilization, but it accommodates upgrading later to the full system if that is what is desired.

Building the box is outlined in a separate document, "Instructions for Building: Control System for Multiple Stepper Motors".

With this option, the spindle stepper motor should be connected to the controls box using a GX-16/4 plug as outlined below.

Bill of Materials for Option 1

Parts required for building this option are below. These are in addition to the items listed on pg. 6.

Materials for Option 1					
Item #	Item	Qty	Source	Source Part Number	Comments
206	Electrical Items				
206	GX-16/ 4 Socket	1	Amazon		May come as a pair of sockets and plugs (i.e., including #214)
208	Utility box cover, 2 gang	2		Hubbell-Raco 804C	
209	Utility box cover, 1 gang	1	Amazon	Hubbell-Raco 861	
210	Utility box cover, 1 gang	1	Amazon	Hubbell-Raco 860	
211	3/8 in. Twin-Screw Cable Clamp Connectors	1	Local hardware store		
214	GX-16/ 4 Plug	1	Amazon		May come as a pair of sockets and plugs (i.e., including #206)
401	Screws, etc.				
401	Nylon Spacer (Unthreaded) for #8 screw – 1/4" OD, 1/4" length	2	McMaster-Carr	94639A293	Used to add space below the Pololu Tic when affixing it to something.
406	Sheet Metal Screws, #4, 3/4" long, round head	2	McMaster-Carr	90935A137	Used to hold the Pololu Tic in place. These work acceptably in the MDF for the purposes they are designed to be used.

Option 1

MDF Rose Engine Lathe 2.0

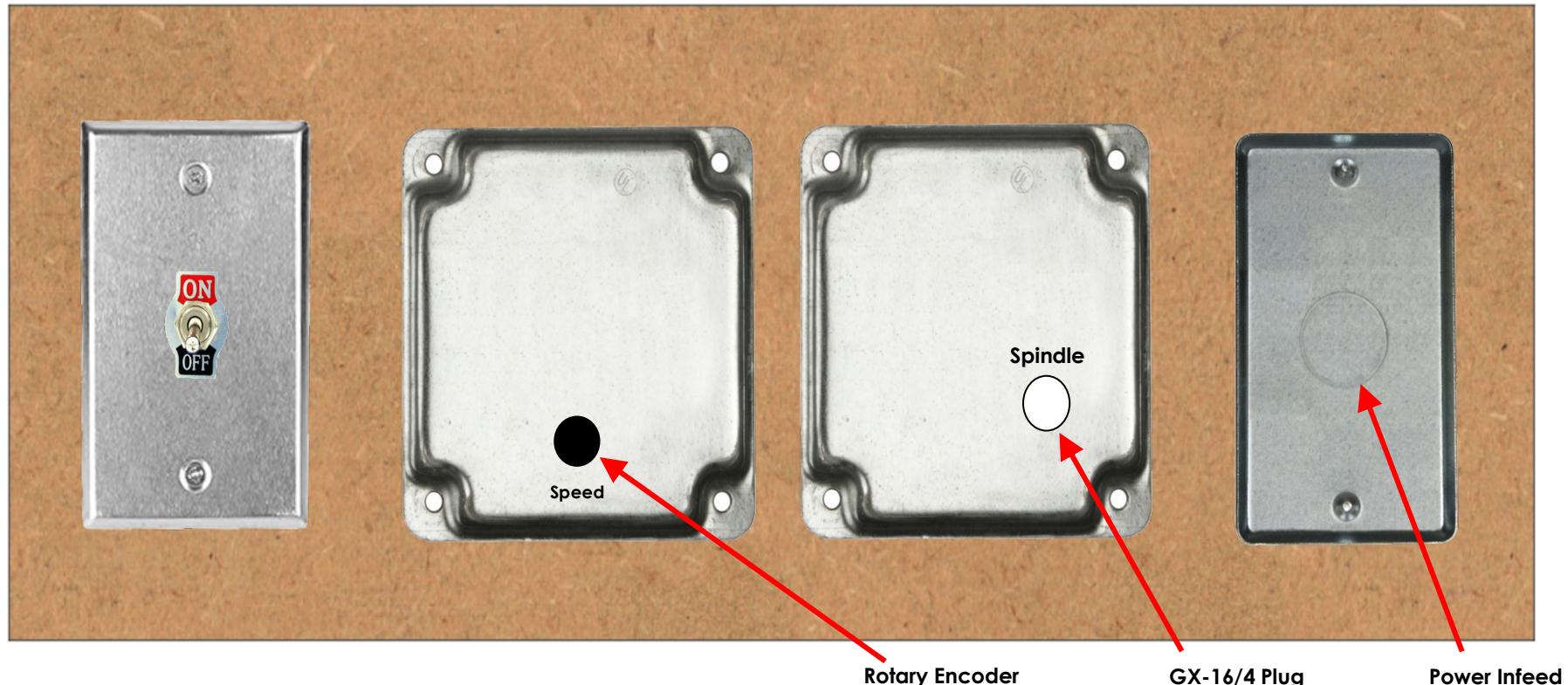
Build Instructions – Control System for Spindle Stepper Motor

Materials for Option 1					
Item #	Item	Qty	Source	Source Part Number	Comments
407	Particle Board Screws, #6, 3/4" long, round head	20	McMaster-Carr	91555A115	Used to hold the case pieces together (i.e., to affix the 1/4" MDF sides to the 3/4" MDF top and bottom)
408	Particle Board Screws, #6, 5/8" long, flat head	12	McMaster-Carr	90252A246	Used to affix the utility box covers in place (replaces the screws that may come with the plates)

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

A recommended layout for the front is shown below.



MDF Rose Engine Lathe 2.0

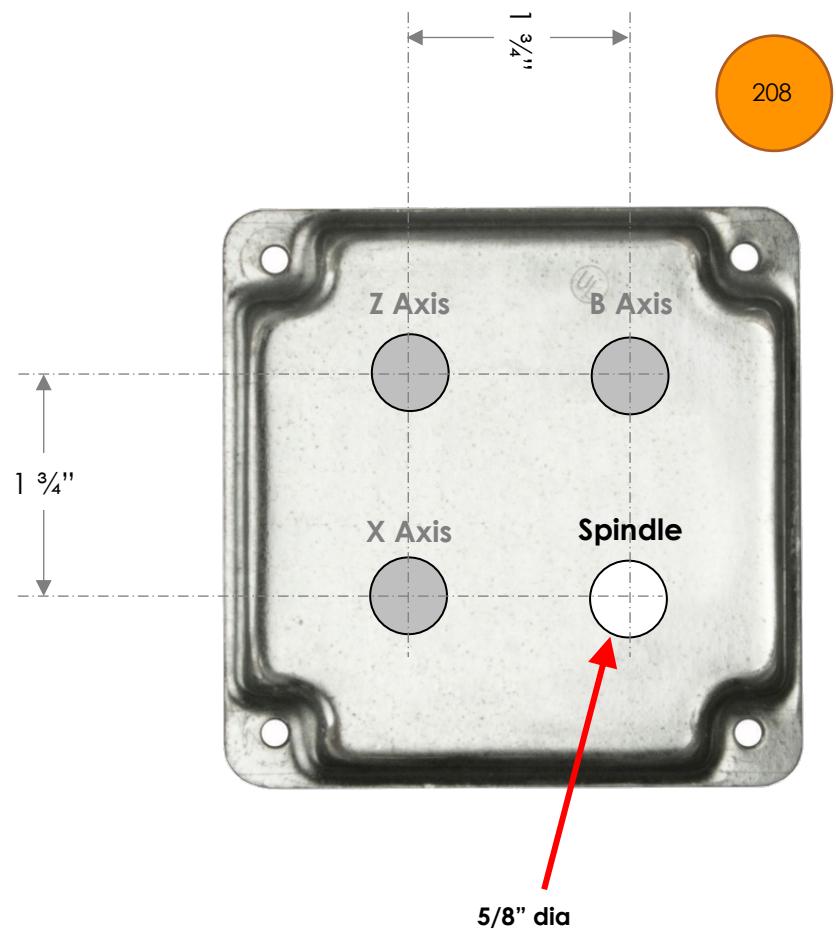
Build Instructions – Control System for Spindle Stepper Motor

Stepper Motor Plugs

Use a 2-gang plate which is blank. If you are planning to upgrade later, consider going ahead and drilling all 4 holes. They are each $5/8"$ diameter.

Even if you choose to not drill the holes, go ahead and mark them with a punch for drilling later (it is much easier to do that now).

Label the spindle plug.



MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Other Plugs

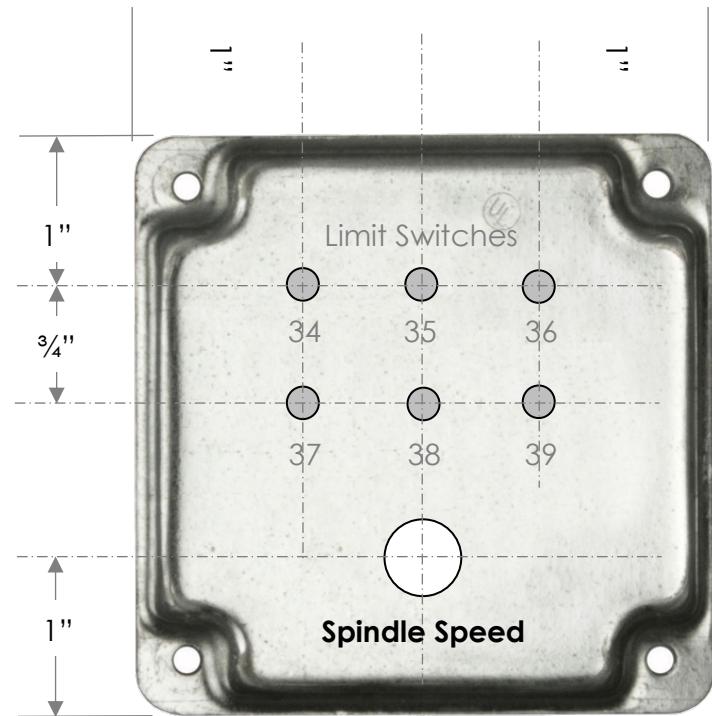
Use a 2-gang plate which is blank.

If you are planning to upgrade later, consider going ahead and drilling the 6 holes which are each $\frac{15}{64}$ " diameter. Label these as:

- Limit Switches
 - 34
 - 35
 - 36
 - 37
 - 38
 - 39

Even if you choose to not drill the holes, go ahead and mark them with a punch for drilling later (it is much easier to do that now).

For the rotary encoder, drill 1 hole that is the diameter necessary for the rotary encoder. Center it left to right and 1" from the outer edge. Label it as "Spindle Speed".



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MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Option 2: Use a Different, Smaller Box

This is the recommended approach, especially if you want to add this capability to one of the original MDF rose engine lathe (upgrading your lathe to the MDF rose engine lathe 2.0 is not required).

Option 2

Bill of Materials for Option 2

Parts required for building this option are below. These are in addition to the items listed on pg. 6.

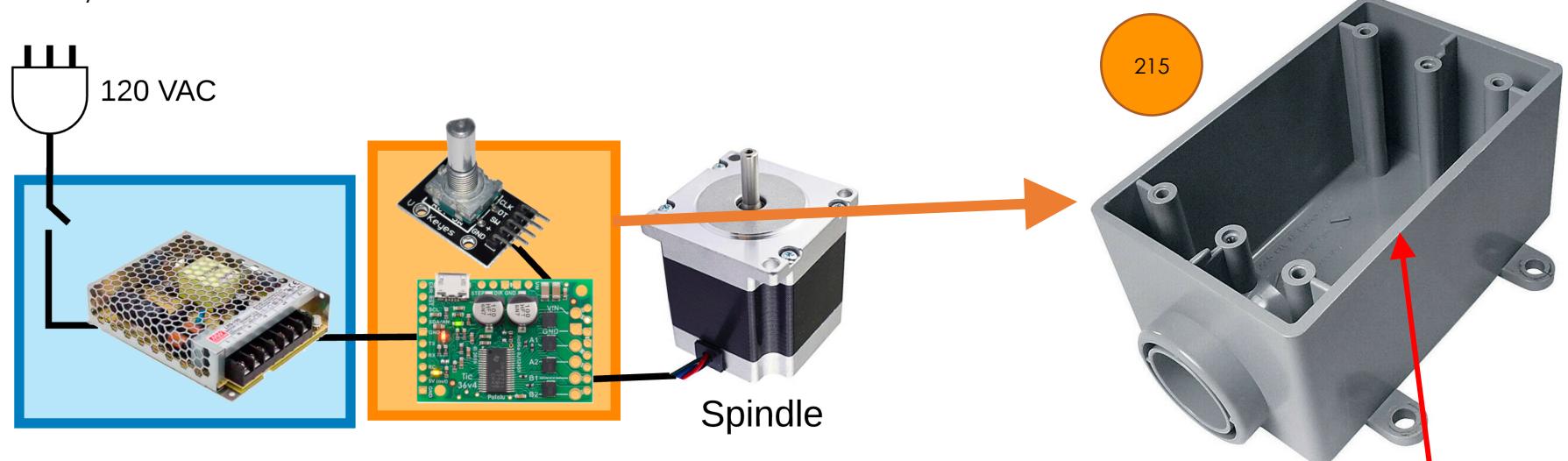
Materials for Option 2					
Item #	Item	Qty	Source	Source Part Number	Comments
206	Electrical Items				
206	GX-16/ 4 Socket	1	Amazon		May come as a pair of sockets and plugs (i.e., including #214)
211	3/8 in. Twin-Screw Cable Clamp Connectors	1	Local hardware store		
214	GX-16/ 4 Plug	1	Amazon		May come as a pair of sockets and plugs (i.e., including #206)
215	Watertight Utility Box, 1 Gang	--	Ace Hardware (or similar source)	32033	I use the Cantex 2-3/4 in. Rectangle PVC 1 gang Outlet Box Gray
216	Box Cover, 1 Gang	--	Ace Hardware (or similar source)	33368	I use the Cantex Rectangle PVC 1 gang Electrical Cover For Single Gang FS Type Box
	Screws, etc.				
408	Particle Board Screws, #6, 5/8" long, flat head	12	McMaster-Carr	90252A246	Used to affix the utility box covers in place (replaces the screws that may come with the plates)

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

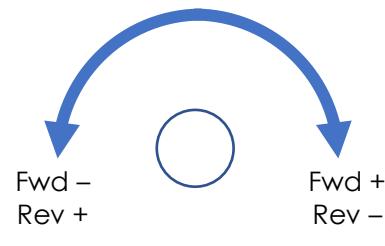
For the stuff in the orange box, I recommend using a water-tight box like the one shown to the right below. It has space inside for the Pololu Tic, and the rotary encoder can be mounted in the lid. Being water-tight, it will also be good at keeping dust out.

The cabling to the spindle stepper motor can still use the GX-16/4 socket, and this will make it easier if you want to later swap this out with the more feature-rich multiple stepper motor controls (the one running on a Teensy controller and with a Nextion touch screen).



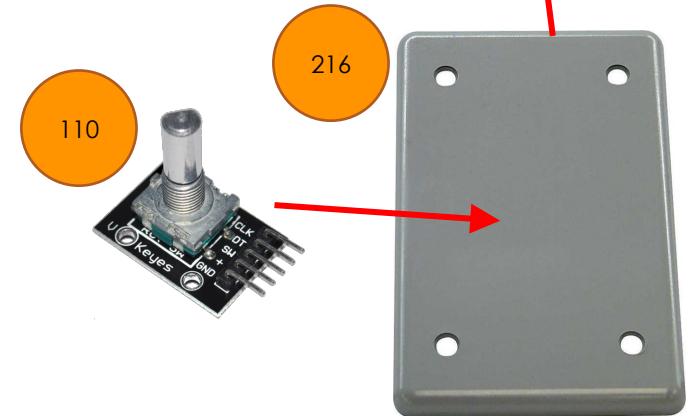
Rotary Encoder Speed Control

A blank plate (#216) could be used. Labelling on this should be something like:



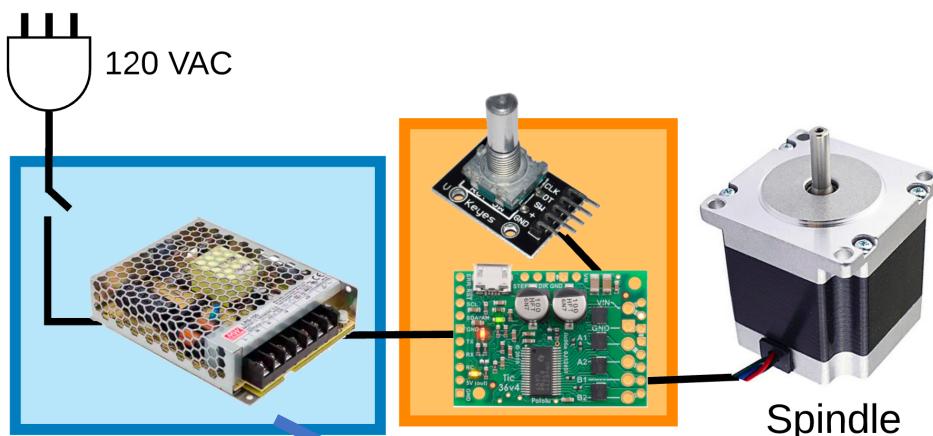
Spindle Speed

Connection of the electronics continues with **Connecting the Electronics**, starting on pg. 20.

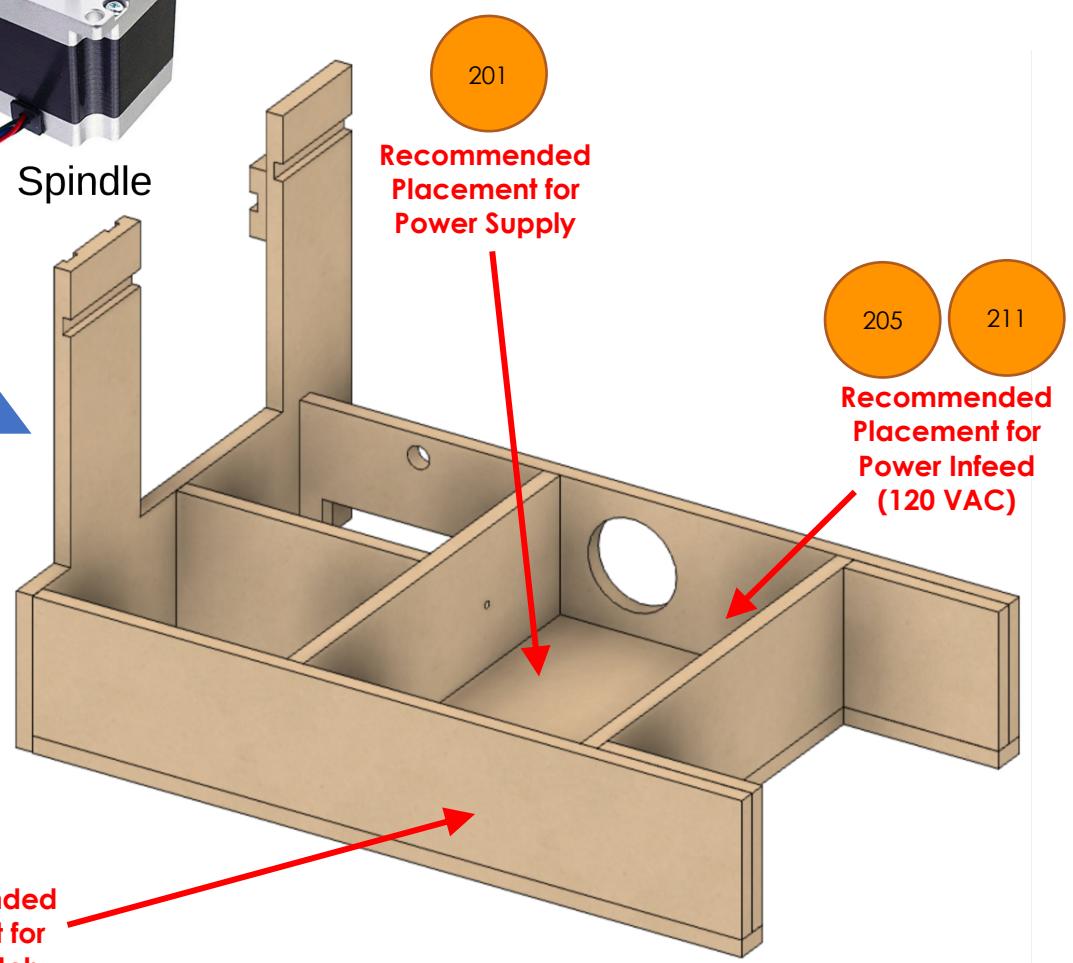


MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor



All the stuff in the blue box can easily be put into the lathe's bed. The power supply does not take up much space, so the bed is a really good place to put it. The diagram below shows where it could be put in the MDF rose engine lathe 2.0, but a similar location could be used for the original MDF rose engine lathe.



MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Option 3: Place all Parts Inside the Lathe's Base

A last option for consideration is to put all the stuff that is in the blue box and the orange box into the lathe's bed. The power supply does not take up much space, so that is a really good place to put it.

The diagram on the next page shows places where it could be put in the MDF Rose Engine Lathe 2.0, but a similar location could be used on the original MDF rose engine lathe.

Option 3

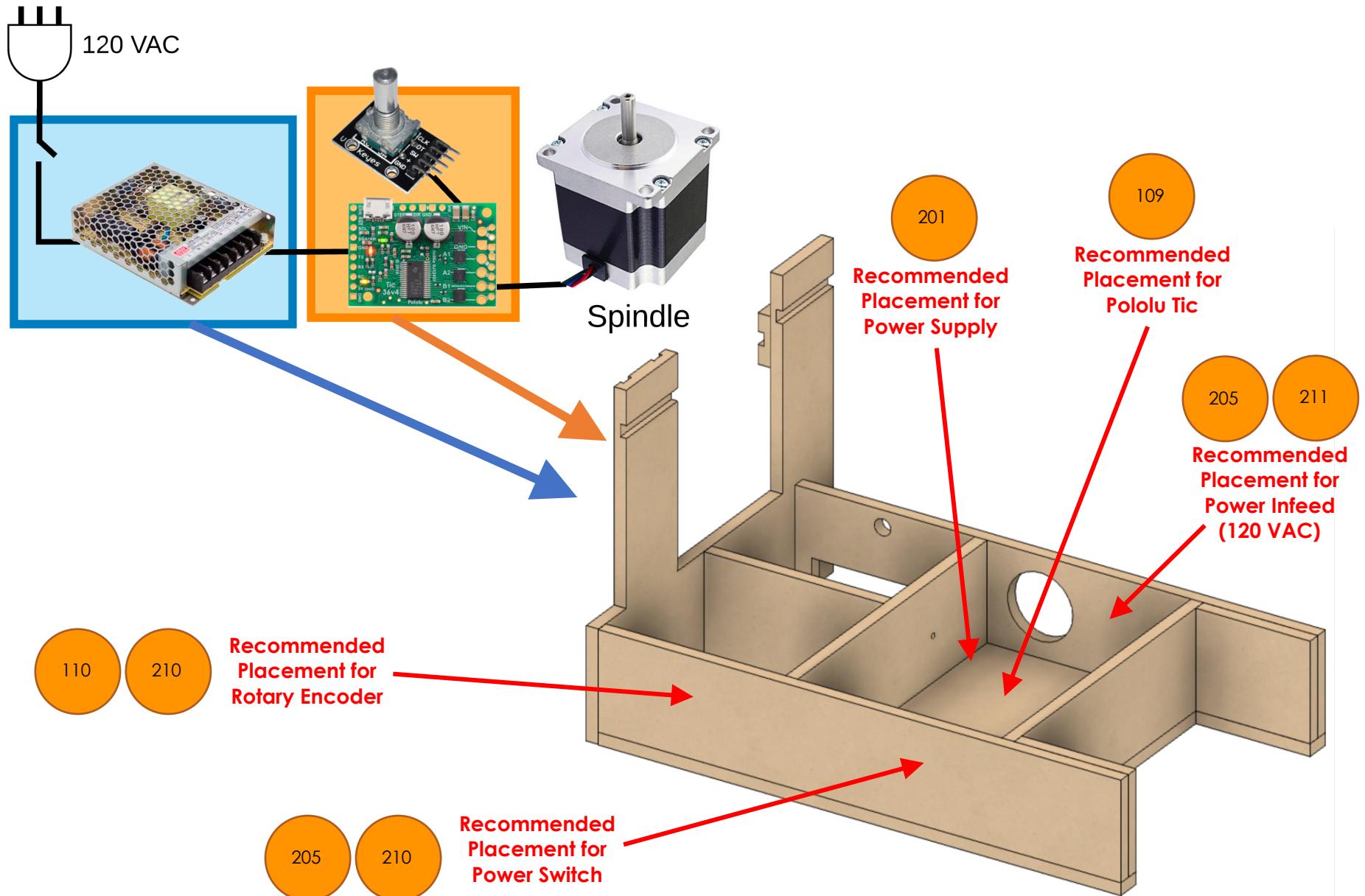
Bill of Materials for Option 3

Parts required for building this option are below. These are in addition to the items listed on pg. 6.

Materials for Option 3					
Item #	Item	Opt 3	Source	Source Part Number	Comments
Electrical Items					
211	3/8 in. Twin-Screw Cable Clamp Connectors	1	Local hardware store		
Screws, etc.					
401	Nylon Spacer (Unthreaded) for #8 screw – 1/4" OD, 1/4" length	2	McMaster-Carr	94639A293	Used to add space below the Pololu Tic when affixing it to something.
406	Sheet Metal Screws, #4, 3/4" long, round head	2	McMaster-Carr	90935A137	Used to hold the Pololu Tic in place. These work acceptably in the MDF for the purposes they are designed to be used.
408	Particle Board Screws, #6, 5/8" long, flat head	4	McMaster-Carr	90252A246	Used to affix the utility box covers in place (replaces the screws that may come with the plates)

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor



MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Connecting the Electronics

Attach the parts to the **Pololu Tic** using the instructions below.

Wiring – Power Supply (LRS-100-24)

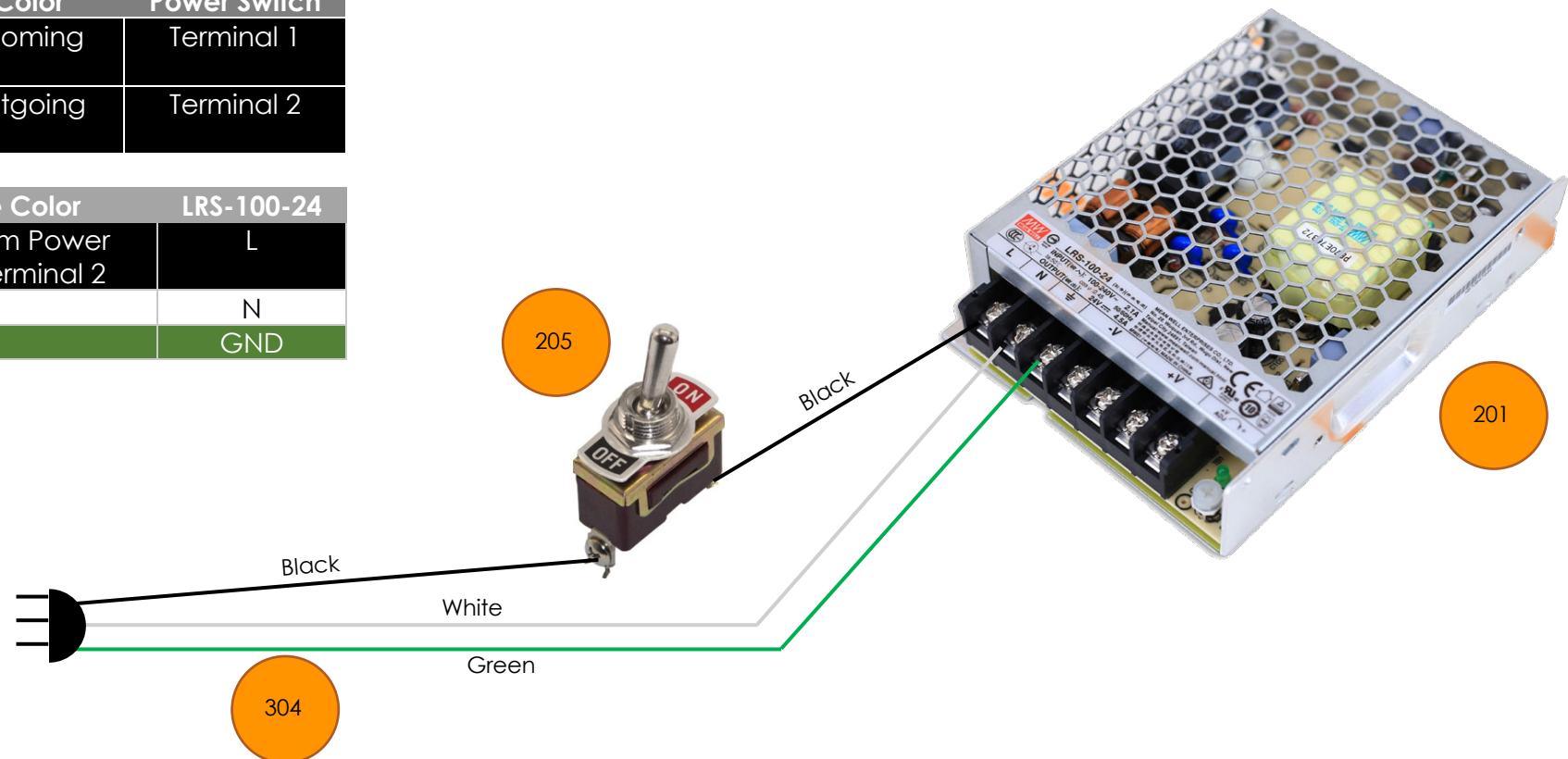
Power Infeed

The power infeed is connected as:

Wire Color	Power Switch
Black Incoming Power	Terminal 1
Black Outgoing Power	Terminal 2

Wire Color	LRS-100-24
Black from Power Switch Terminal 2	L
White	N
Green	GND

Conductor Type	Stranded copper
Conductor Size	16 AWG (min)
Cable Size	3 conductors / cable



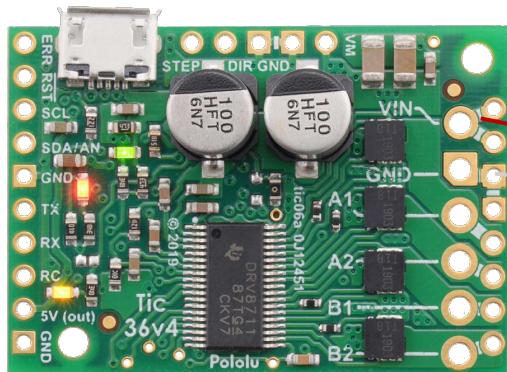
MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Power Outfeed

The Pololu Tic is powered by the LRS-100-24.

Pololu Tic	Wire Color	LRS-100-24
VIN	Red	V+
GND	White (or black)	V-



VIN
GND

303



V-
V+

201

109



On the Tic with the soldered connectors, these are connected to the end with the screw-down block.

The two connections shown towards the top are for power.

MDF Rose Engine Lathe 2.0

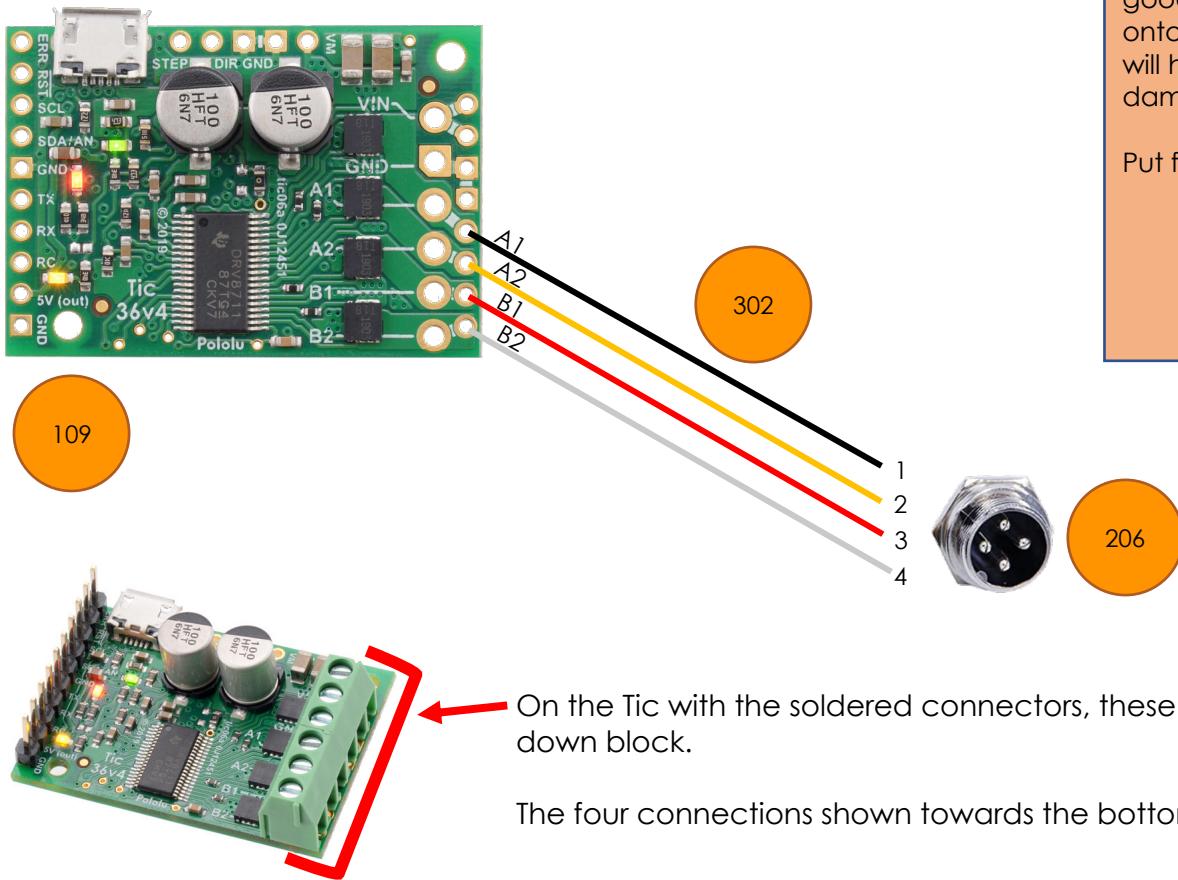
Build Instructions – Control System for Spindle Stepper Motor

Signal Wiring –Stepper Motor Drivers to GX-16/4 Jacks (4)

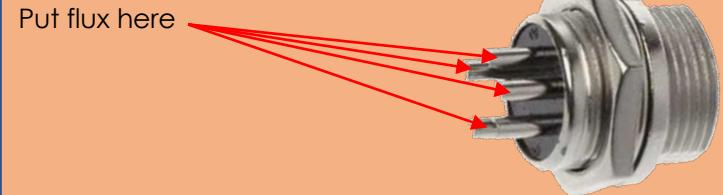
Each of the 4 stepper motors is connected to the stepper motor drivers via GX-16/4 Jacks.

Pololu Tic	Wire Color	GX-16/4 Pin
A1	Black	1
A2	Yellow	2
B1	Red	3
B2	White	4

Conductor Type	Stranded copper
Conductor Size	20 AWG
Cable Size	4 conductors / cable
Cable Length	6 to 8"



NOTE: When soldering wires to the GX-16 jack, it is a good practice to put a small dab of soldering flux onto the terminal before beginning the soldering. This will help it happen faster, minimizing the chance for damage to the jack.



MDF Rose Engine Lathe 2.0

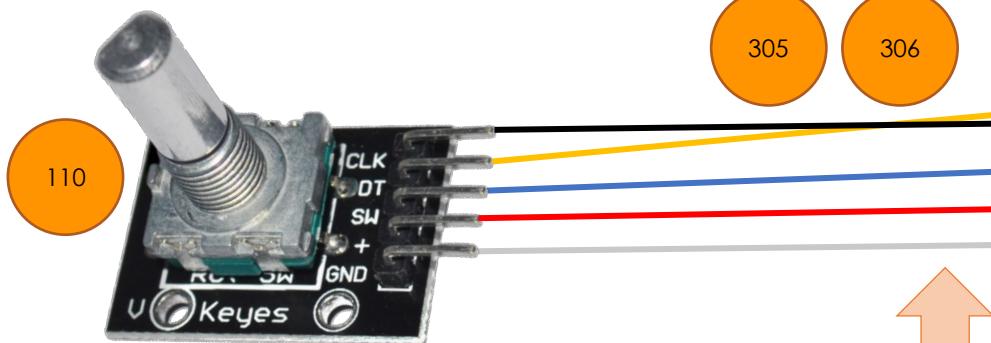
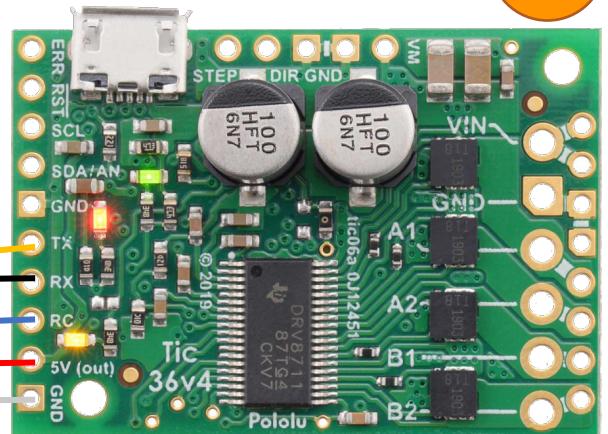
Build Instructions – Control System for Spindle Stepper Motor

Signal Wiring – Pololu Tic to Rotary Encoder

The rotary encoder is used to start the spindle, set its speed, and stop it.

Rotary Encoder	Wire Color	Pololu Tic	Purpose
CLK	Black	RX	Encoder Channel A
DT	Yellow	TX	Encoder Channel B
SW	Blue	RC	Stop / Reset
+	Red	5V (out)	VCC
GND	White	GND	GND

109



Pin	Configuration
CLK	Output A
DT	Output B
RC	Active low push button switch output. When the knob is pushed, the voltage goes LOW.
+	
GND	

Colors of these wires are not critical. However, it is recommended that 5 separate colors be used.

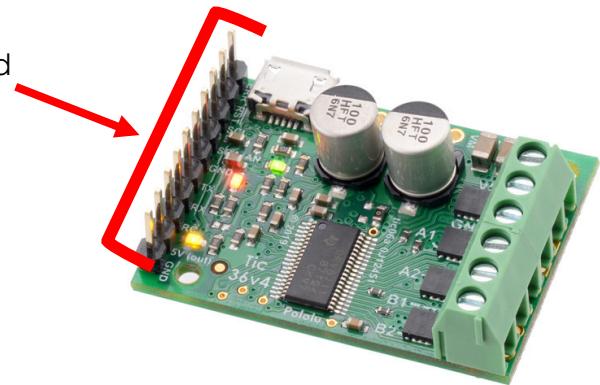
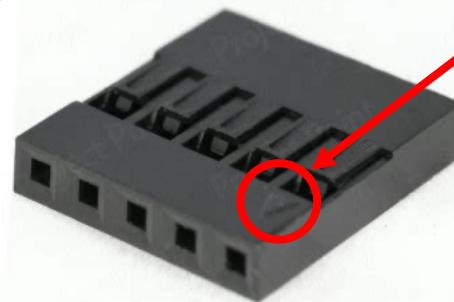
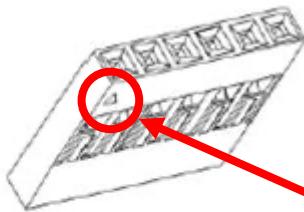
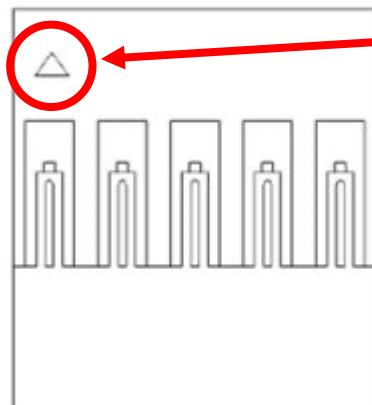
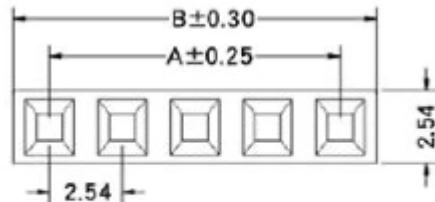
Pin	Configuration
TX	Encoder Input (B)
RX	Encoder Input (A)
RC	Kill Switch
5V (out)	
GND	

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

On the Tic with the soldered connectors, this is connected to the end with the soldered header pins.

Only the 1st 5 pins are used for this design.



When connecting the rotary encoder to the Pololu Tic, the wires are inserted into a 1x5 Crip Connector. That connector has an **arrow indicator** (▼) on it.

My practice is to insert the GND wire in the arrow indicator position. Whatever your practice is, be sure to do it the same on both ends.

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Using the Rotary Encoder

The rotary encoder is used to start the spindle, set its speed, and stop it. The way it works:

Action on the Rotary Encoder	Activity on the Spindle	What Happens
Rotate clockwise	Spindle stopped	Spindle begins rotating in the "forward" direction
	Rotating in the "forward" direction	Spindle speed increases in the "forward" direction
	Rotating in the "reverse" direction	Spindle speed decreases in the "forward" direction
Rotate counter-clockwise	Spindle stopped	Spindle begins rotating in the "reverse" direction
	Rotating in the "reverse" direction	Spindle speed increases in the "reverse" direction
	Rotating in the "forward" direction	Spindle speed decreases in the "reverse" direction
Push (and then release) the button	Spindle stopped	(nothing)
	Rotating in either direction	Spindle rotation stops

If your lathe direction is the opposite of this, then swap the wires on CLK and DT.



Pin	Configuration	
CLK	Output A	Output B
DT	Output B	Output A

MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Configuration Settings

The Pololu Tic must be configured properly to work.

Step 1 – Install the Tic software

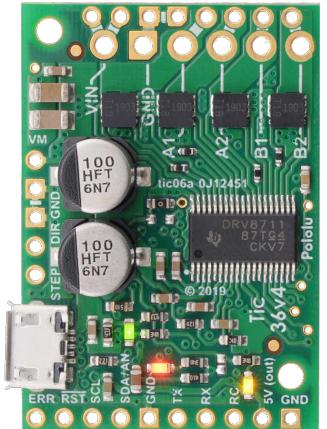
It is available from <https://www.pololu.com/product/3140/resources>.

Step 2 – Connect the Pololu Tic to the computer

- The cable end connected to the Pololu uses a MicroUSB connector.
- The Pololu's jack is noted in the picture to the right.

Notes:

Be sure you have a good MicroUSB cable. Some are only used for charging a device (and they are usually longer). These will often not work.



Step 3 – Update the firmware on the Pololu Tic

The version needed is **1.07ce**. There is a link to this firmware upgrade ([tic-v1.07ce.fmi](https://www.pololu.com/file/107ce.fmi)) in the item posted by David E Grayson.

This information about this can be obtained at <http://forum.pololu.com/t/polite-stop-kill-reset-for-tic825/18718>.

1. Save the firmware upgrade onto a location where you have the Tic software installed.
2. Open the Tic software
3. Click **Device** and then **Upgrade firmware ...**
 - a. Click **OK** to confirm you wish to proceed
4. The Firmware file is the file you downloaded.
5. Ensure the devices is the Tic you plugged in.
6. Click **Program** to begin
 - a. Click **OK** to confirm you wish to proceed
 - b. If this times out, swap the cable with another. The microUSB cable you are using is not available to be used.

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Build Instructions – Control System for Spindle Stepper Motor

When it completes, the opening screen should show you the correct firmware version has been installed.

Connected to: 36v4 

Status Input and motor settings Advanced settings

Device info

Name: Tic 36v4 High-Power Stepper Motor Controller
Serial number: 00331950
Firmware version: 1.07ce
Last reset: Software reset (bootloader)
Up time: 0:01:05

Inputs

Encoder position: 0	VIN voltage: 0.1 V
Input state: Not ready	Operation state: Reset
Input after averaging: N/A	Energized: No
Input after hysteresis: N/A	Homing active: No
Input before scaling: N/A	Last motor driver error: None
Input after scaling: 0	Target: No target
Limit switches active: N/A	Current position: 0 Uncertain: Yes
	Current velocity: 0 (0.0000 pulses/s)

Operation

<input checked="" type="radio"/> Set position	<input type="radio"/>
<input type="radio"/> Set velocity	-200
0	Set target position
200	

Set target when slider or entry box are changed

Return slider to zero when it is released

0 Set current position (will halt motor) Decelerate motor Halt motor

Errors

	Stopping motor?	Count
Intentionally de-energized	Yes	1
Motor driver error	No	-
Low VIN	Yes	1289
Kill switch active	No	-
Required input invalid	No	-
Command timeout	Yes	1289
Safe start violation	Yes	1289
ERR line high	No	-
Serial errors:	No	-
Framing		-
RX overrun		-
Format		-
CRC		-
Encoder skip		-

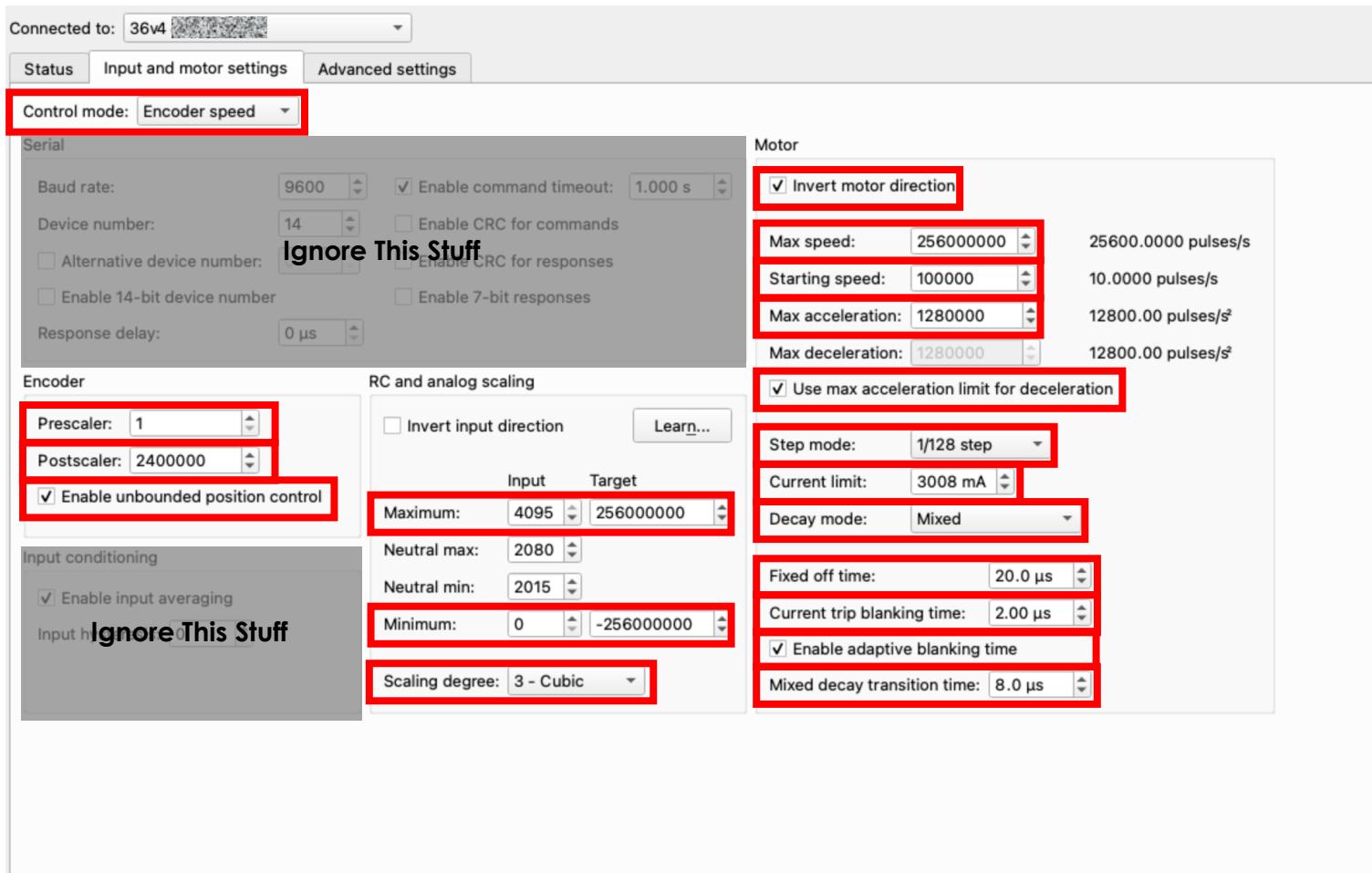
Reset counts

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Build Instructions – Control System for Spindle Stepper Motor

Step 4 – Set the options on the Pololu Tic

Use the Tic software and set the options as noted below. Comments regarding these selections are in the table, below each screen.



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Build Instructions – Control System for Spindle Stepper Motor

Option	Set to	Comments
Control Mode	Encoder Speed	This sets the Tic up for using a rotary encoder to control the speed. If you want to do it differently, consult the Polulu Tic Stepper Motor Controller User's Guide .
Encoder		
• Prescaler	1	Every time the rotary encoder is changed by this number of detents, the # of post scaler changes is applied to the speed.
• Post Scaler	40,000	<p>This is in pulses / millisecond. Therefore, each rotation by one indent changes the output from the controller to be 40 pulses / sec.</p> <p>This setting is key for setting how many rotations of the rotary encoder are req'd to get to max speed. At this setting, it is just under 1.5 full rotations to get up to full speed (from stopped).</p>
• Enable Unbounded Position Control	<input checked="" type="checkbox"/>	
RC & Analogue Scaling		
• Invert input direction	<input type="checkbox"/>	This makes the motor rotate in the correct direction so that the spindle rotates counterclockwise when in "forward". This is the standard for lathe spindles.
• Maximum Target	25,600,000	This is in pulses / millisecond, which equates to 25,600 pulses / second.
• Minimum Target	-25,600,000	This is also in pulses / millisecond. This is the reverse speed.
• Scaling Degree	3 – Cubic	
Motor		
• Max Speed	25,600,000	
• Starting Speed	0	
• Max Accel	400,000	
• Use Max Accel for Deceleration	✓ (checked)	
• Step Mode	1/128 step	
• Current Limit	3,008 mA	
• Decay Mode	Mixed	

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Build Instructions – Control System for Spindle Stepper Motor

Connected to: 36v4

Status Input and motor settings Advanced settings

Pin configuration

SCL:	Default	<input type="checkbox"/> Pull-up	<input type="checkbox"/> Active high	<input type="checkbox"/> Analog
SDA/AN:	Default	<input type="checkbox"/> Pull-up	<input type="checkbox"/> Active high	<input type="checkbox"/> Analog
TX:	Encoder input	(always pulled up)	<input type="checkbox"/> Active high	<input type="checkbox"/> Analog
RX:	Encoder input	(always pulled up)	<input type="checkbox"/> Active high	<input type="checkbox"/> Analog
RC:	Kill switch	(always pulled down)	<input type="checkbox"/> Active high	

Soft error response

De-energize
 Halt and hold
 Decelerate to hold
 Go to position: 0

Use different current limit during soft error:
3008 mA

Miscellaneous

Disable safe start
 Ignore ERR line high
 Automatically clear driver errors
 Never sleep (ignore USB suspend)
 Enable unrestricted current limits

VIN measurement calibration: 0

Homing

Enable automatic homing
Automatic homing direction: Reverse
Homing speed towards: 1000000 100.0000 pulses/s
Homing speed away: 500000 50.0000 pulses/s

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Build Instructions – Control System for Spindle Stepper Motor

Option	Set to	Comments
Pin Configuration		
• SCL		(left at default)
• SDA/AN		(left at default)
• TX	Encoder Input	Channel B
• RX	Encoder Input	Channel A
• RC	Kill Switch	
Soft Error Response	Decelerate to Hold	

For the stepper motor:

$$Max\ Stepper\ Motor\ Speed = \frac{25,600 \frac{pulses}{sec} * 60 \frac{sec}{min}}{128 \frac{pulses}{step} * 200 \frac{steps}{rotation}}$$

$$Max\ Stepper\ Motor\ Speed = 60\ rpm$$

And, as translated to the spindle:

$$Max\ Spindle\ Speed = 60\ motor\ rpm * \frac{12\ motor\ pulley\ teeth}{108\ spindle\ pulley\ teeth}$$

$$Max\ Spindle\ Speed = 6.7\ rpm$$

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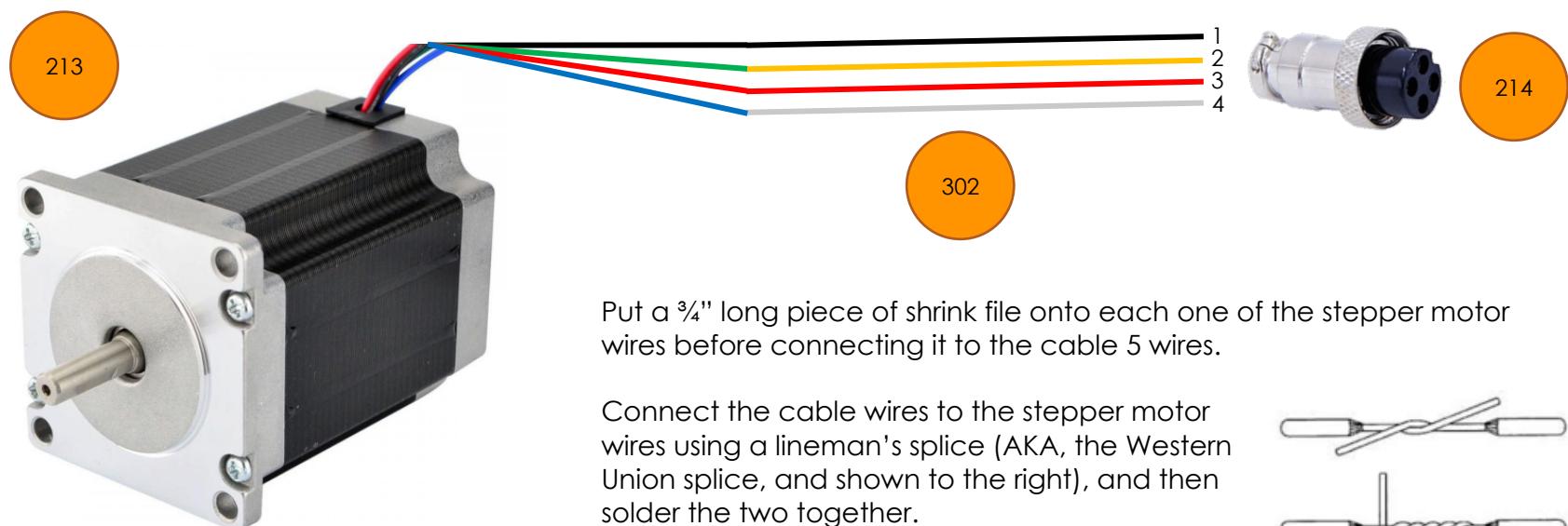
Build Instructions – Control System for Spindle Stepper Motor

Motor Connections

The spindle stepper motors is connected to the Pololu Tic via a GX-16/4 plug. For the spindle drive, a 3-foot cord is recommended. Stepper motor wire colors shown are for the StepperOnline motors. Check that the one you use matches for the connection needed.

Stepper Motor	Stepper Motor Wire	Cable Wire Color	GX-16/4 Pin
A+	Black	Black	1
A-	Green	Yellow	2
B+	Red	Red	3
B-	Blue	White	4

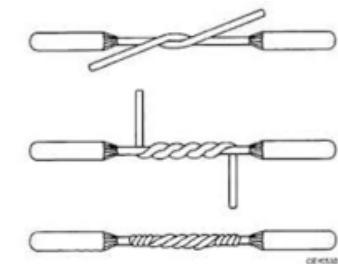
Conductor Type	Stranded copper
Conductor Size	20 AWG
Cable Size	4 conductors / cable



Put a $\frac{3}{4}$ " long piece of shrink file onto each one of the stepper motor wires before connecting it to the cable 5 wires.

Connect the cable wires to the stepper motor wires using a lineman's splice (AKA, the Western Union splice, and shown to the right), and then solder the two together.

Heat the shrink file tubing around each of the joints to insulate it from the other things it could touch.



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Build Instructions – Control System for Spindle Stepper Motor

Alternatively, you can add a back cover to the stepper motor. This gives a secure way to attach the signal wires to the motor. These are available from a number of sources, and they can even be 3D printed. Look for one online using the term “stepper motor back cover”.

In this case, connect the stepper motor to the GX-16/4 jack as:

Stepper Motor	Stepper Motor Wire	GX-16/4 Pin
A+	Black	1
A-	Green	2
B+	Red	3
B-	Blue	4



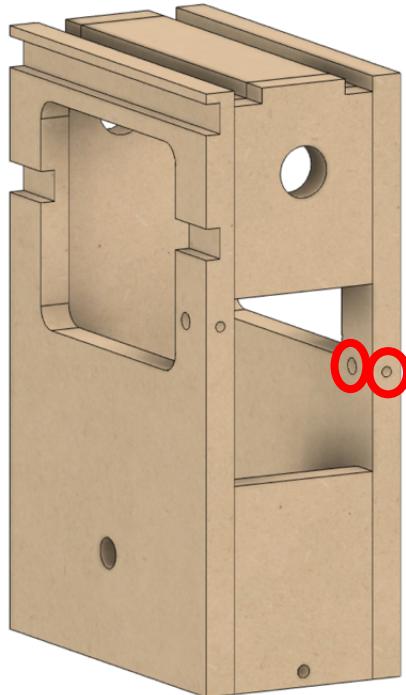
MDF Rose Engine Lathe 2.0

Build Instructions – Control System for Spindle Stepper Motor

Attaching the Stepper Motor to the Headstock

Step 1 - Ensure the bracket is ready to attach to the headstock

The stepper motor attaches to the headstock as shown in the picture to the right.



If you purchased the kit we supply, the holes on the left and right of the headstock are already set properly.

If you built it yourself, you will now need to drill the holes for the screws on the right side of the headstock. As noted in the case building instructions, these need to be set based on the alignment of the bracket.



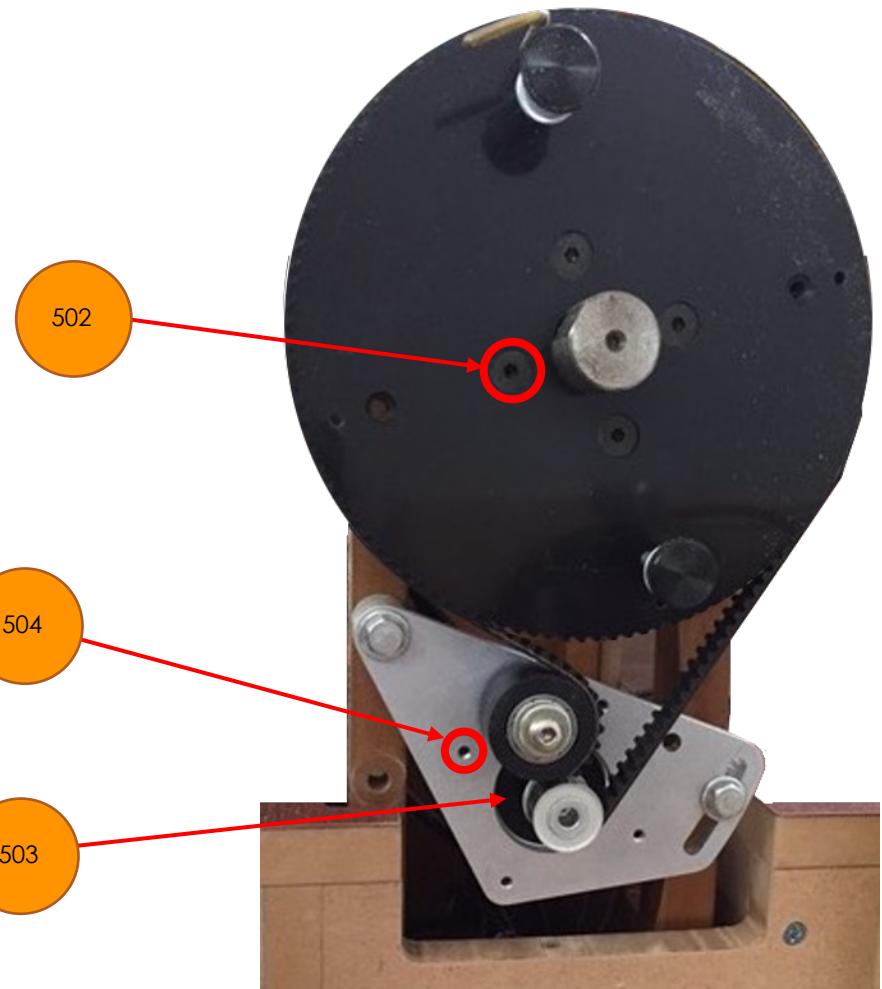
NOTE: The picture on the right is of the assembly on the original MDF rose engine lathe. On version 2.0, there is no need for the cutout in the base to accommodate the bracket.

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Build Instructions – Control System for Spindle Stepper Motor

Step 2 – Attach the spindle pulley to the spindle flange

Attach the spindle pulley to the spindle flange. There are 4 screws (#502) for this. One is indicated here.

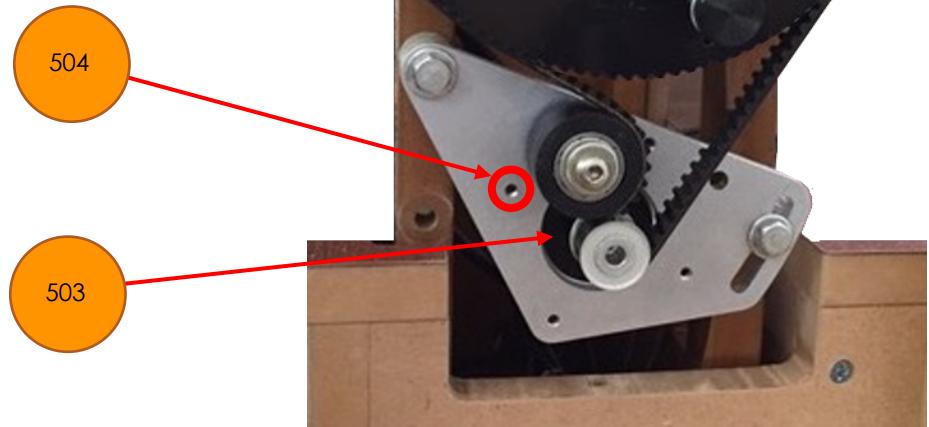


Step 3 – Attach the spindle motor to the bracket

Attach the stepper motor to the bracket using 4 screws (#504). One is indicated here.

Step 4 – Attach the motor drive pulley to the stepper motor

Secure the 12-tooth drive pulley to the stepper motor's spindle.



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Build Instructions – Control System for Spindle Stepper Motor

Step 5 – Attach the spindle motor bracket to the headstock

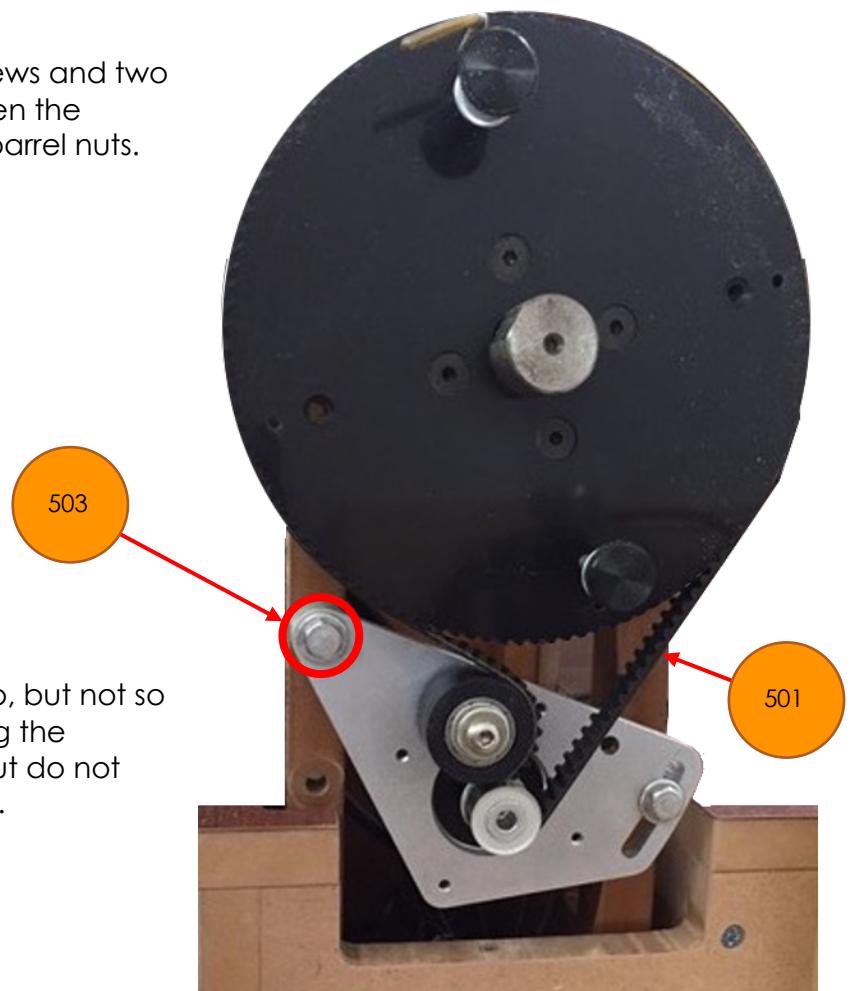
Attach the bracket to the headstock on both sides. There are two screws and two spacers (they look like thick washers). The spacers are installed between the bracket and the headstock. They are held onto the headstock using barrel nuts. Do not tighten them just yet.

Step 6 – Install the timing belt

Install the timing belt (item #501).

Step 7 – Tighten it down

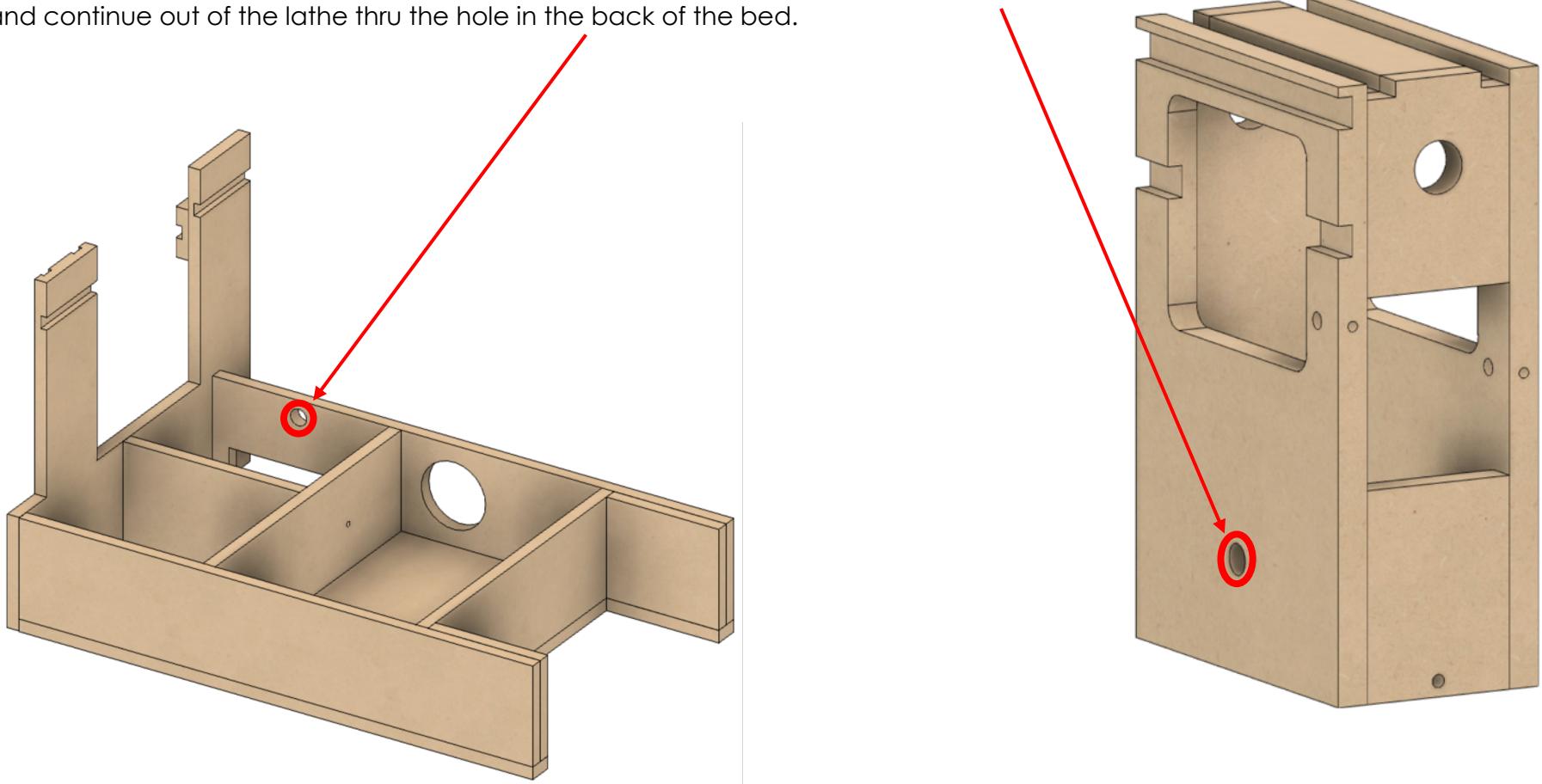
Snug the bracket so that the timing belt is tight enough that it won't slip, but not so tight that it stretches. Once it is set, tighten the two bolts (#503) holding the bracket to the headstock. They need to be tight enough to not slip, but do not over tighten them as that will cause the barrel nuts to pull thru the MDF.



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Build Instructions – Control System for Spindle Stepper Motor

The stepper motor's cable needs to be fed thru the hole in the back of the headstock, and continue out of the lathe thru the hole in the back of the bed.



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Build Instructions – Control System for Spindle Stepper Motor

Document Version History

Ver	Date	Comment
1.0	22 January 2021	Initial document

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