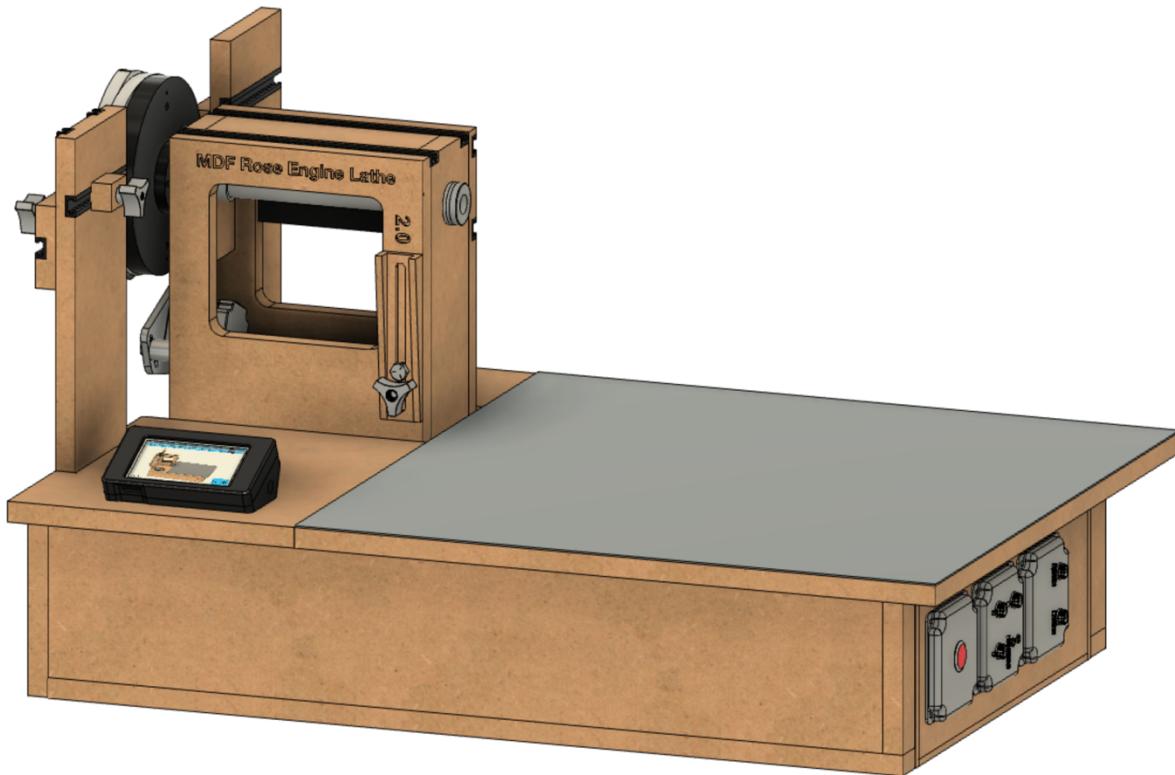


# MDF Rose Engine Lathe 2.0

## with Stepper Motor Drive



## Instructions for Building Control System for Multiple Stepper Motors

### Part 3 – Electronics

Version 3.2  
18 November 2021

# **MDF Rose Engine Lathe 2.0**

## **Build Instructions – Control System for Multiple Stepper Motors**

Permission is not granted to manufacture these for sale.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

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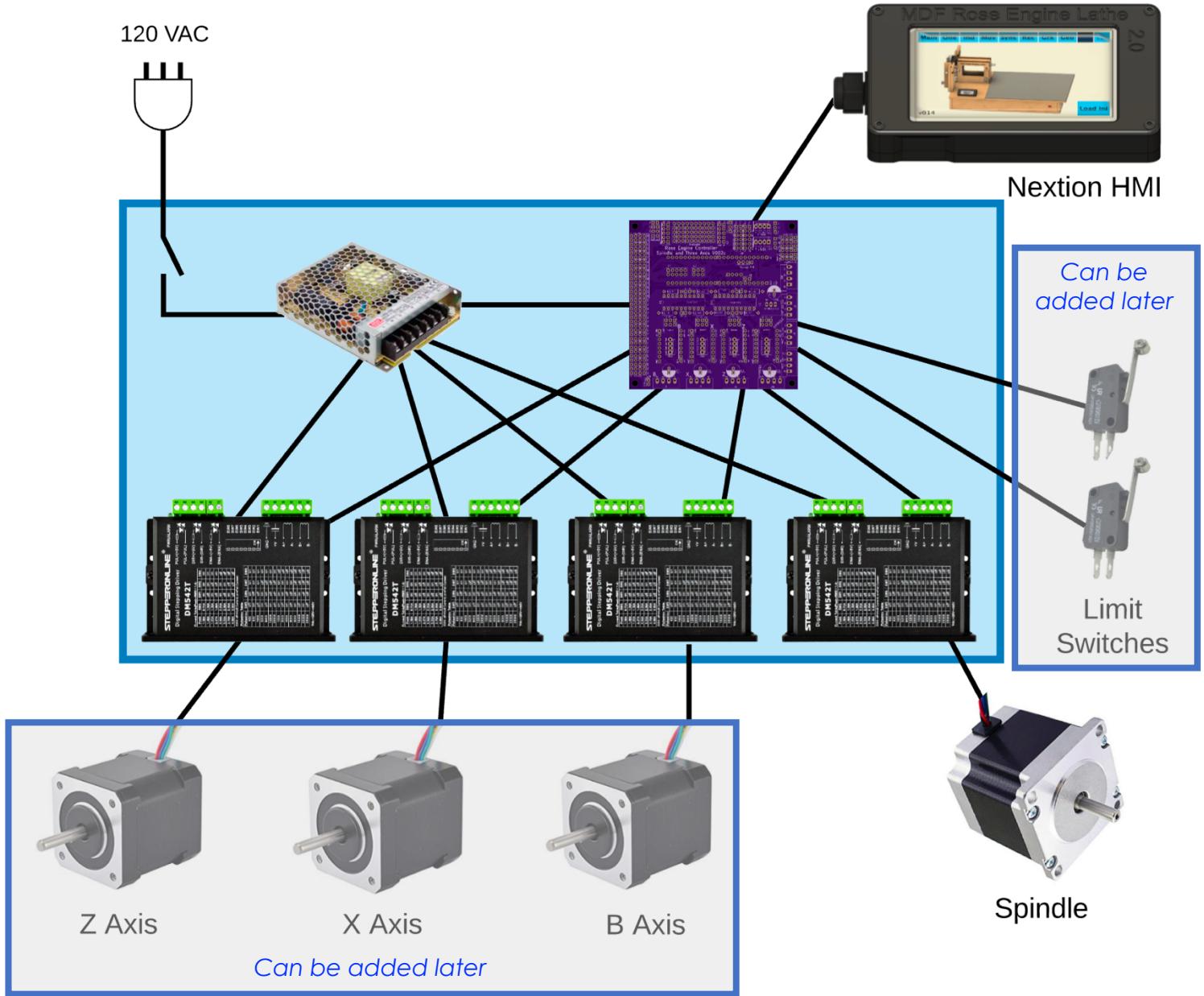
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# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Overview of Connections

The whole system is shown in the picture below.



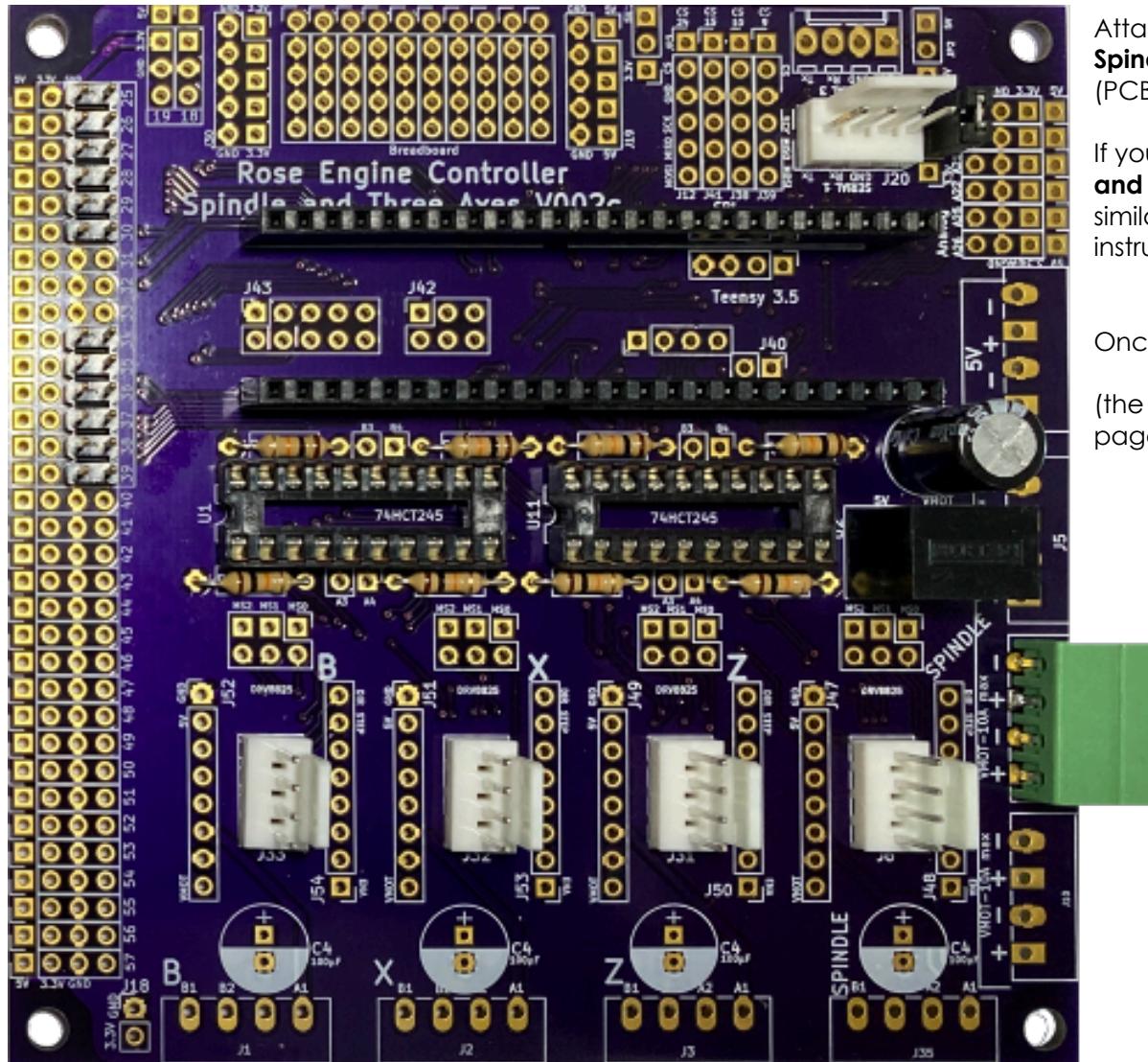
The details for how we are building the one you can buy are below. These are documented for our use to ensure consistency, and we are publishing them for anyone who wishes to build their own.

The sequence of activities follows the layout of this document. That was done consciously. Changes to the sequence should be considered strongly before making changes.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 1 – Printed Circuit Board

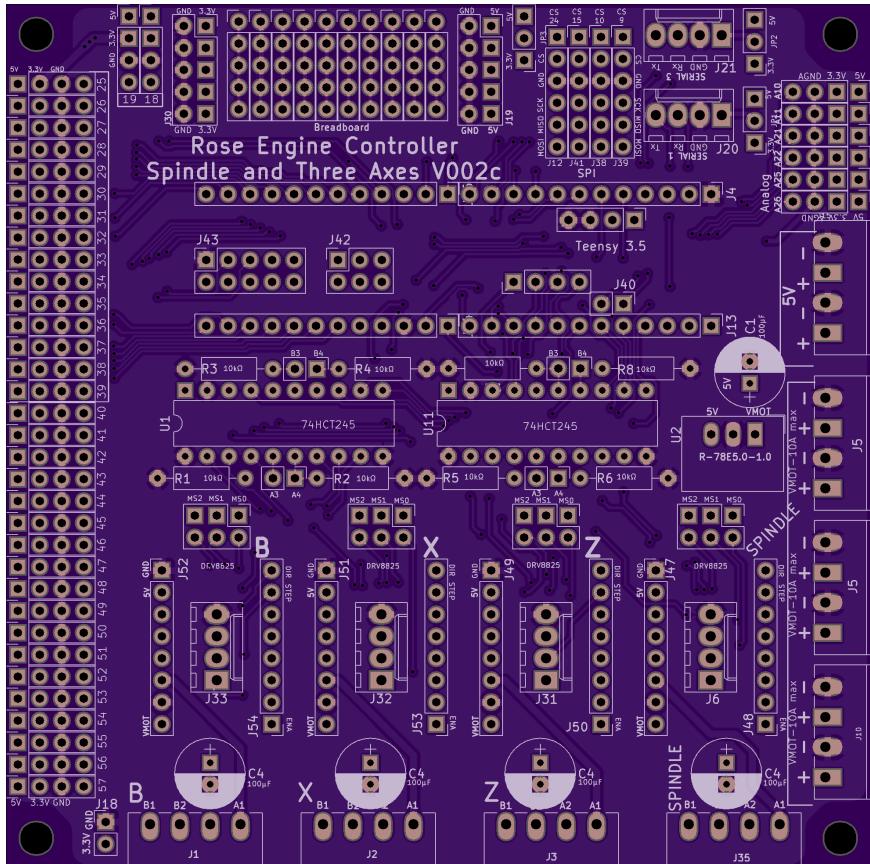


# MDF Rose Engine Lathe 2.0

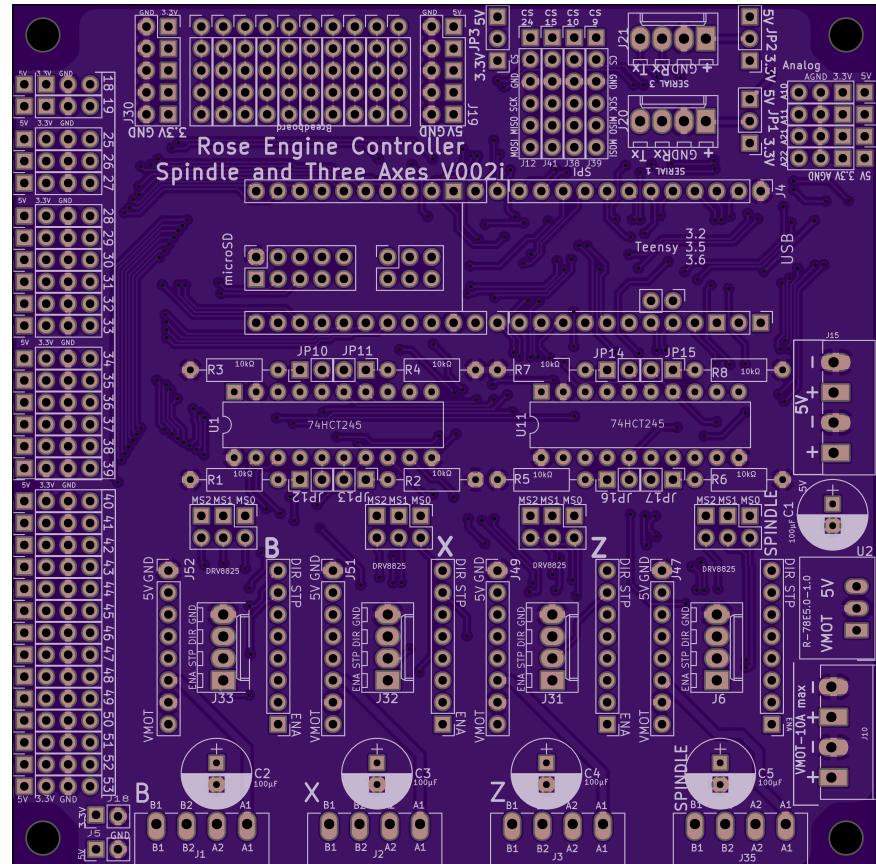
## Build Instructions – Control System for Multiple Stepper Motors

## Printed Circuit Board (PCB) versions

# Version 002c



Version 002i

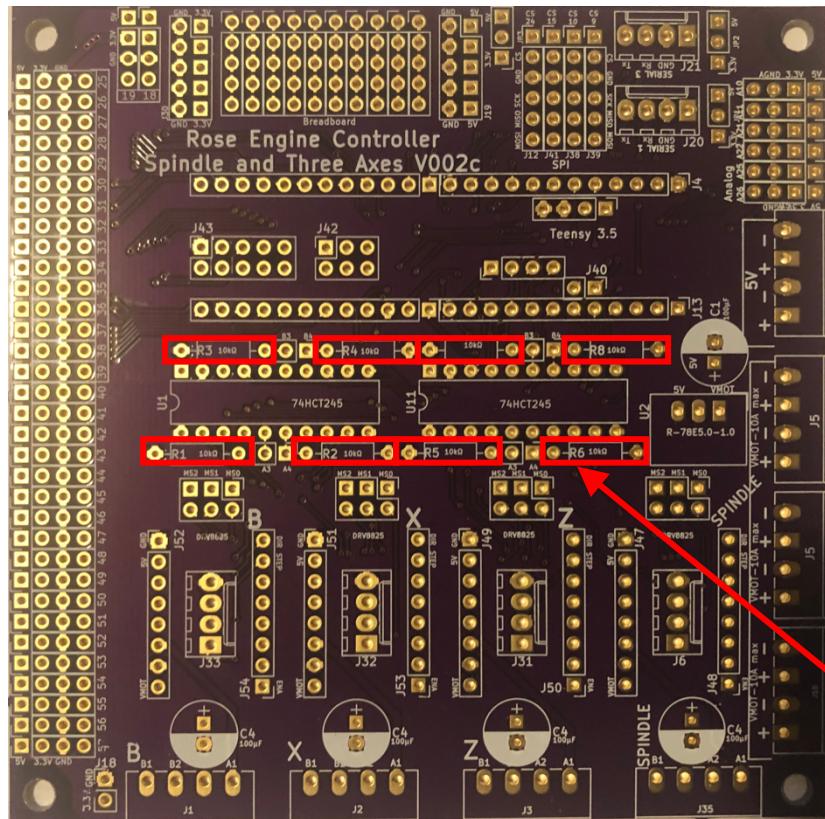


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Through-Hole Components, part 1

Solder in the resistors as noted below.



101

**NOTE 1:** If you will be using a Nextion Intelligent display (i.e., the 7" one), then the four (4) resistors on the right (R5, R6, R7, & R8) should not be added.

**NOTE 2:** the direction in which these are installed is not critical, but I solder them in place the same for each side. Makes it look more dress-right-dress. (My SGT would be happy.)

10 KΩ resistors (8)

104

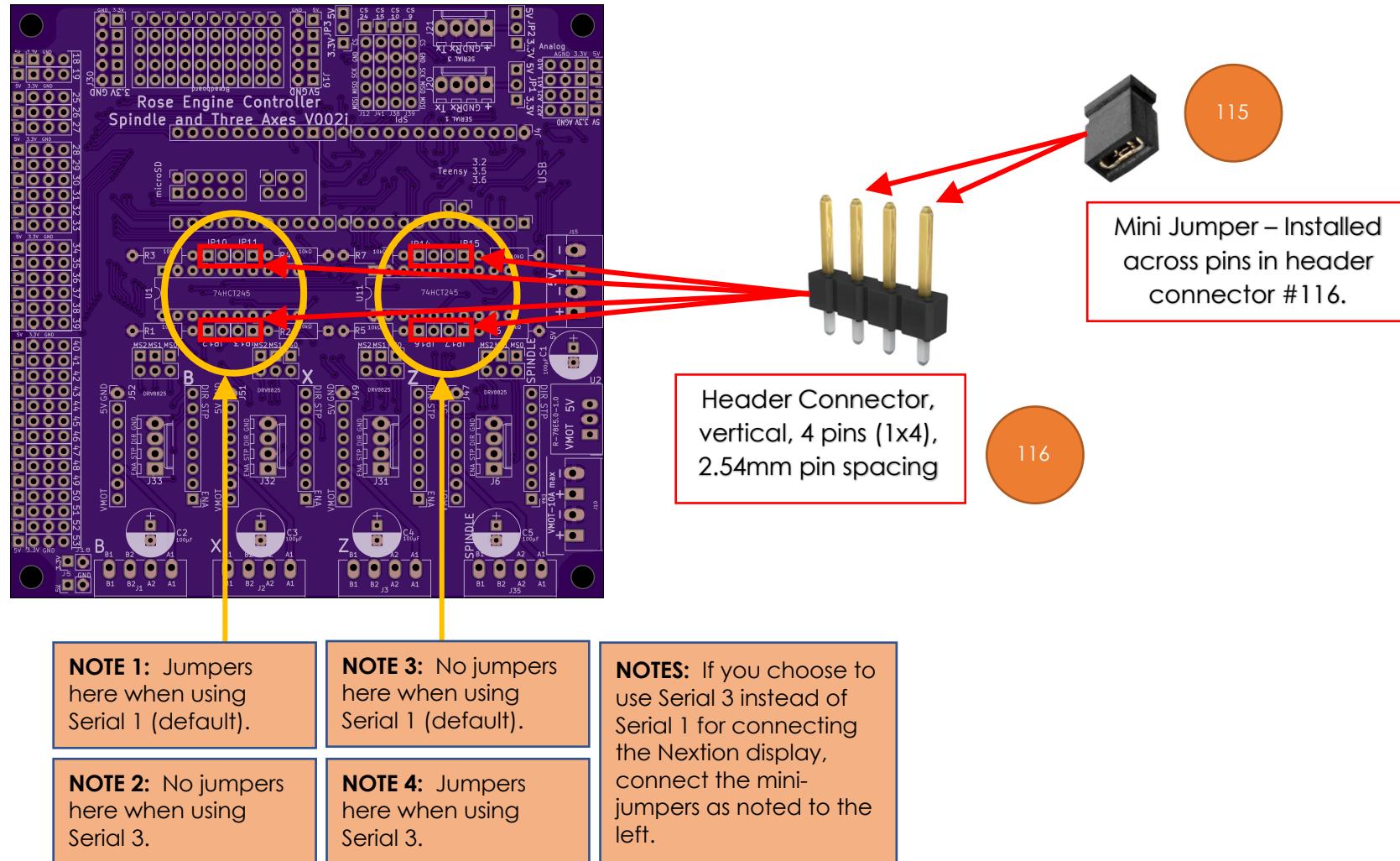


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

If you are using the version 002i PCB, follow these instructions; otherwise, continue to the next page.

Solder in the 4 headers for bypassing the resistors. These are installed for JP10 – JP17. Add mini-jumpers for JP10, JP11, JP12, & JP13 (for the 74HCT245 on the left side of the board).

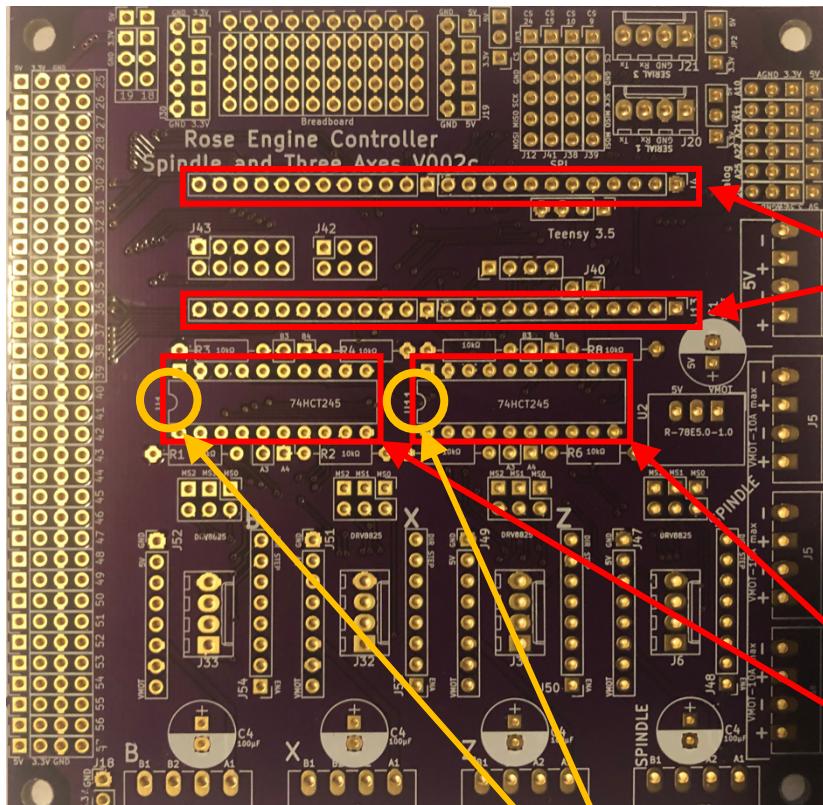


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Headers for Integrated Circuits

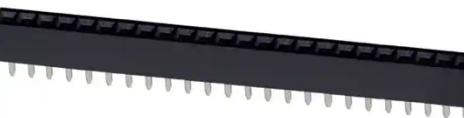
Solder in the 2 headers for the Teensy, and the 2 DIP sockets for the integrated circuits.



**NOTE:** The headers must be at 90° to the circuit board. It is necessary to ensure that they remain perpendicular or the Teensy's pins will not fit into the header pin holes.



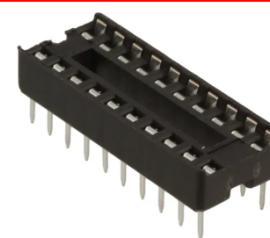
102



20-pin DIP sockets (2)  
for 74HCT245s

103

**NOTE:** Both sockets have direction indicators on them. Ensure they match the direction indicators on the board (the little curved part of the marking on the board). This is to ensure the 74HCT245s are inserted correctly.

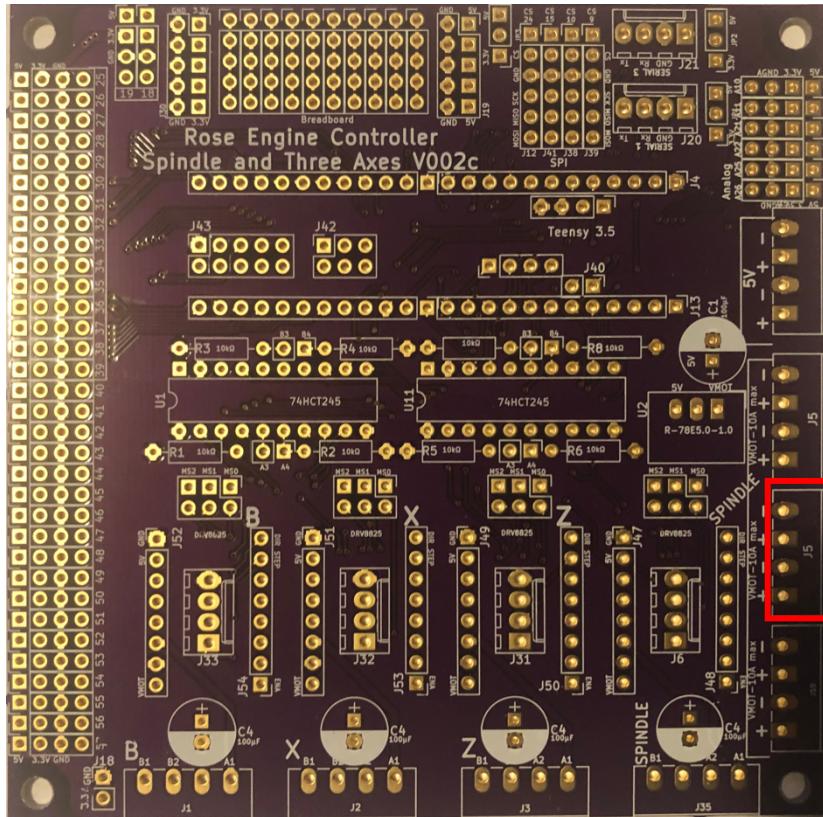


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Power Header Connector

Solder in the power connector as noted below.

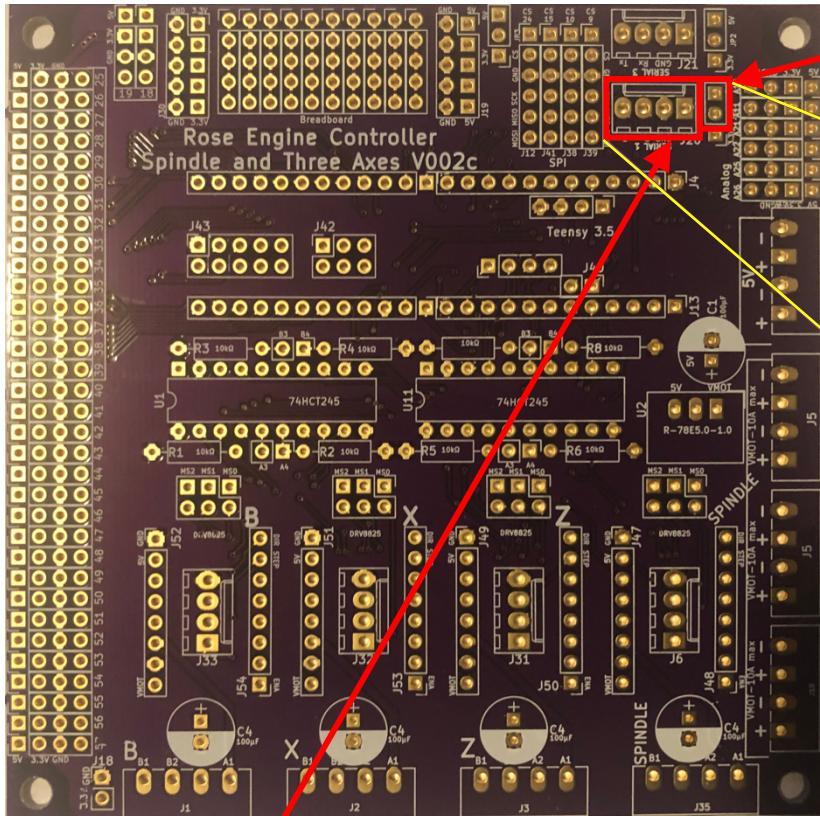


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Nextion Display Header Connectors

Solder in the power and signal connector for Serial 1 as noted below.



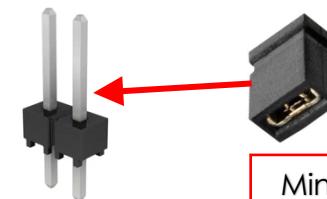
Header Connector,  
vertical, 4 pins,  
2.54mm pin spacing

111



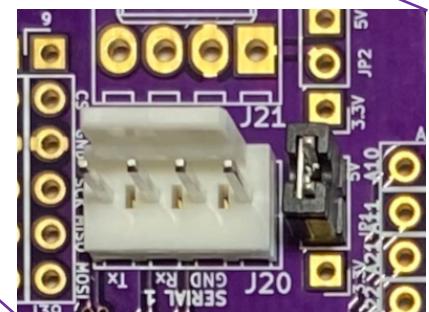
Header Connector,  
vertical, 2 pins,  
2.54mm pin spacing

114



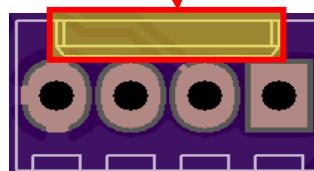
115

Mini Jumper –  
Installed across  
pins in header  
connector  
#114.



As Installed

**NOTE 1:** The plastic tab projecting up from the connector should be aligned with this marking on the PCB.



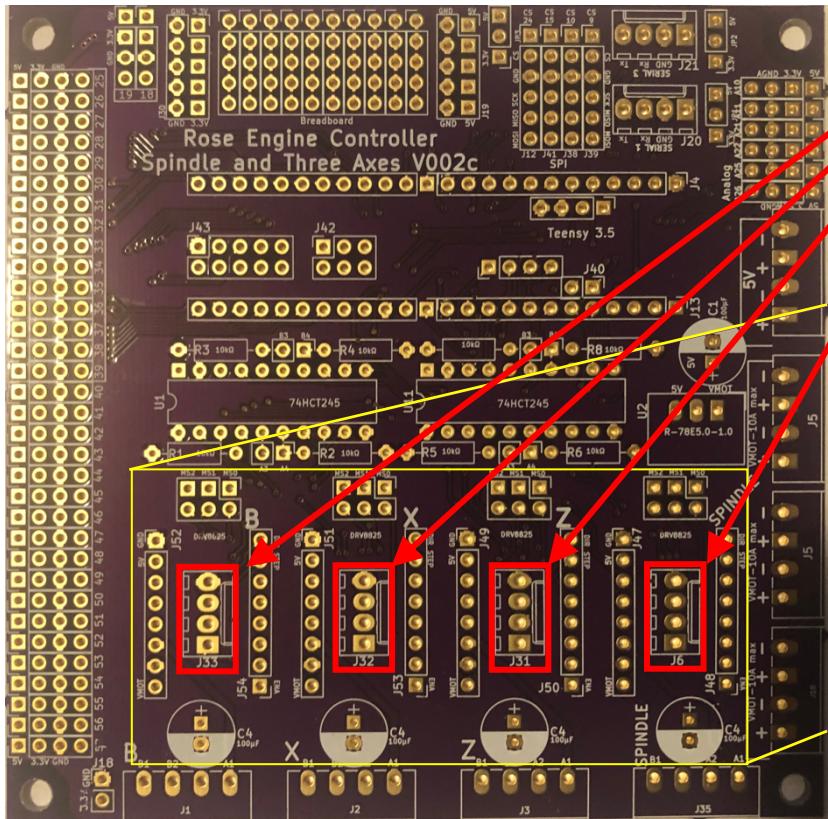
**NOTE 2:** If you are using The V002c PCB, a Teensy 3.6, and a Nexion Intelligent display (or plan to do so), these two connectors are not needed; proceed to the next step.

# MDF Rose Engine Lathe 2.0

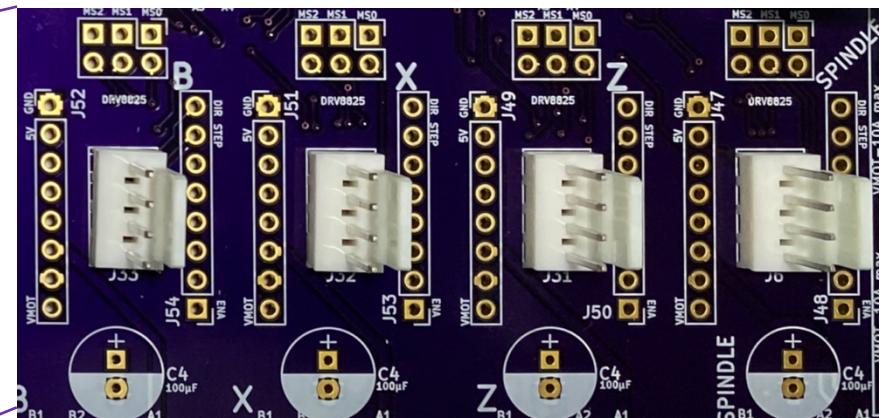
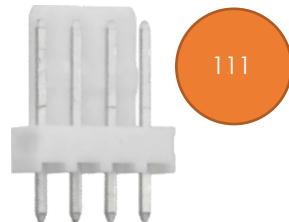
## Build Instructions – Control System for Multiple Stepper Motors

### Stepper Motor Driver Header Connectors

Solder in the stepper motor driver connectors as noted below.

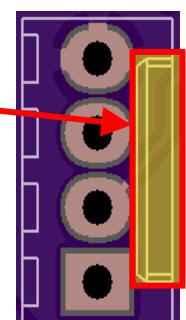


Header Connector,  
vertical, 4 pins,  
2.54mm pin spacing



As Installed

**NOTE:** The plastic tab projecting up from the connector should be aligned with this marking on the PCB.



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Limit Switch Header Connectors

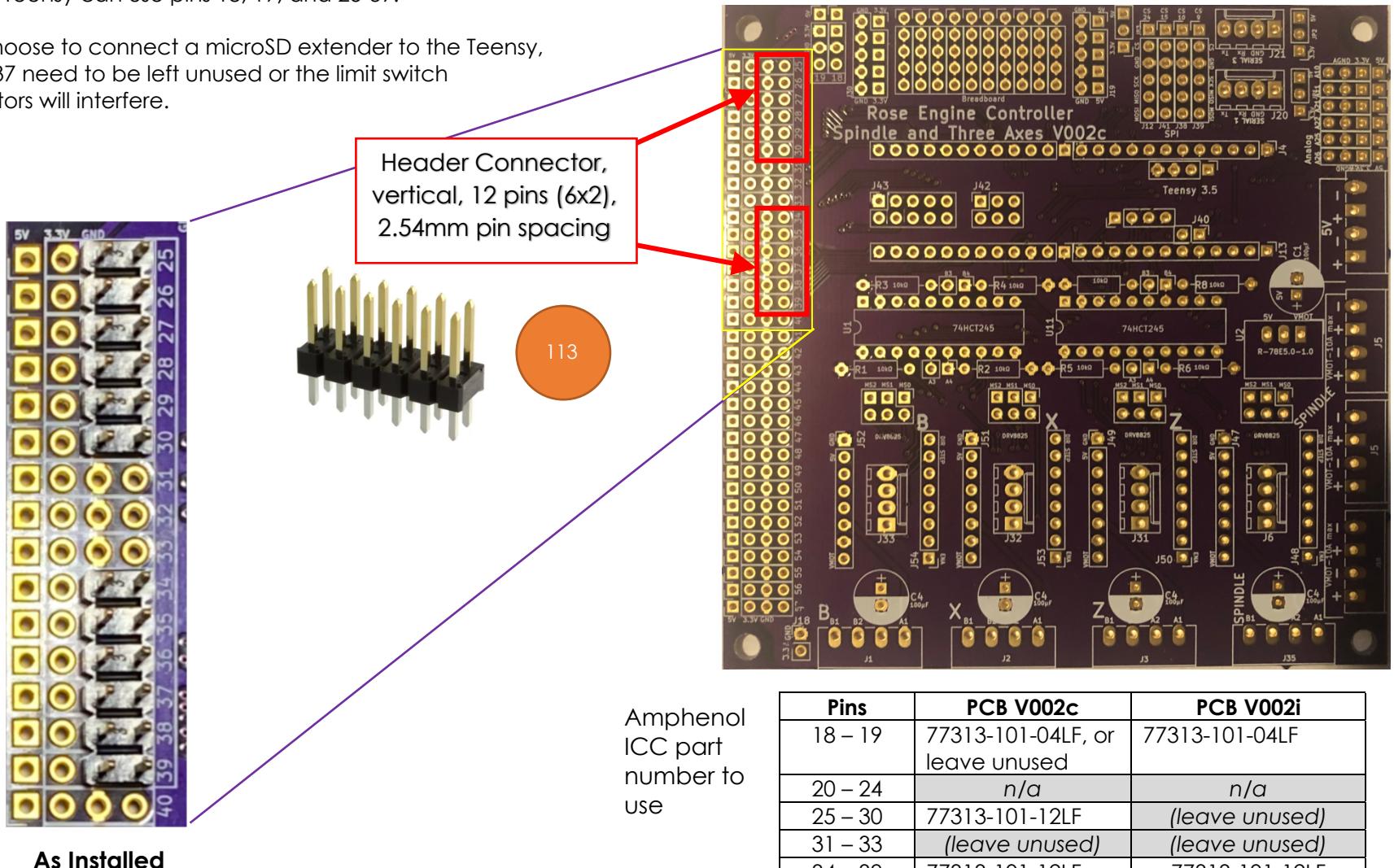
Solder in the limit switch connector pins as noted below.

The original design only used pins 34-39; however, this board and the Teensy can use pins 18, 19, and 25-39.

If you choose to connect a microSD extender to the Teensy, pins 29-37 need to be left unused or the limit switch connectors will interfere.

**NOTE1 :** One connector is used on pins 25-30.

**NOTE 2:** A second connector is used on pins 34-39.

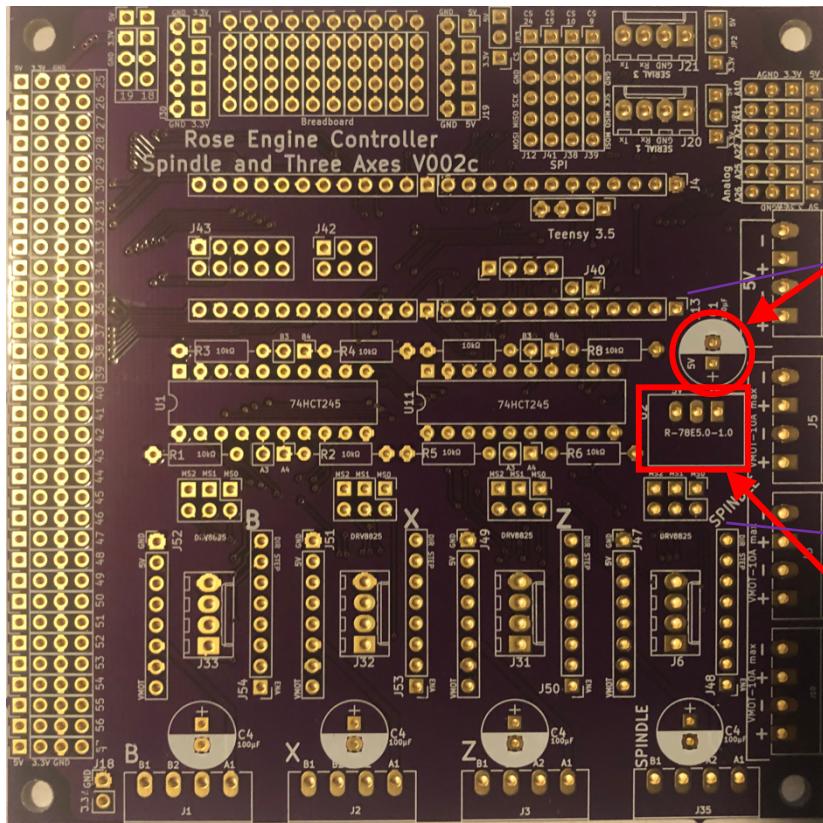


# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Through-Hole Components, part 2

Solder in the components noted below.



**NOTE 3:** On the V002i PCB, the placement on the board is slightly different, but is marked similarly none-the-less.



**NOTE 1:** Be sure the capacitor is set correctly. The negative (-) side goes in the area shaded white.

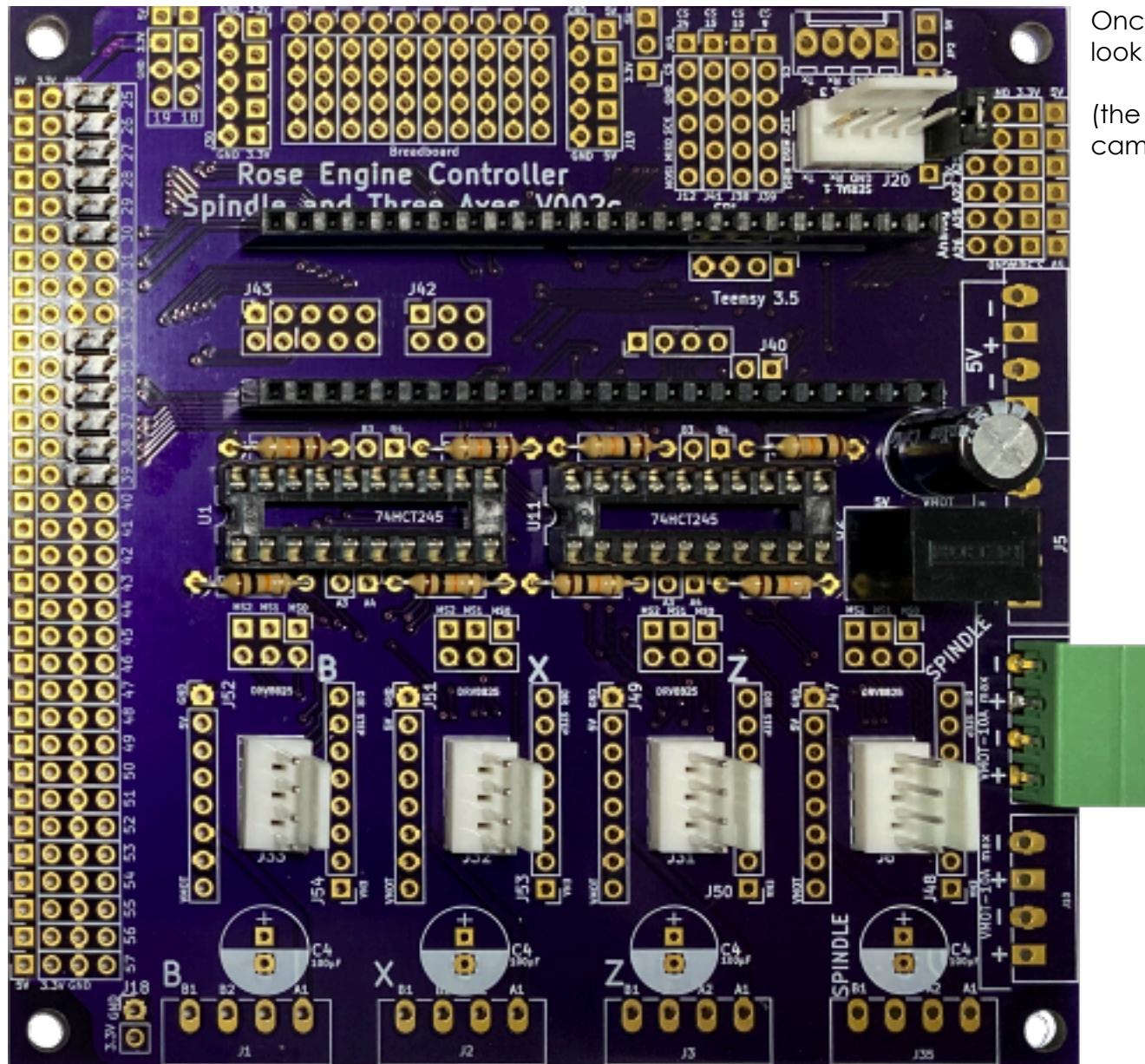


107

**NOTE 2:** The DC converter should fit over the box printed for it on the board.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors



Once all the parts are in place, it will look like this.

(the color difference is due to the camera flash on my iPhone)

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 1 Addendum - Nextion Intelligent Display and Teensy 3.6

When using the **Teensy 3.6** with a **Nextion Intelligent** series display, there is a concern that the Nextion HMI could supply 5V back to the Teensy. The Teensy 3.5 can handle 5V; however, the Teensy 3.6 can only handle 3.3V so some additional wiring is needed.

Based on the printed circuit board & Nextion display you are using, additional wiring may be needed. The decision table below shows you how to decide.

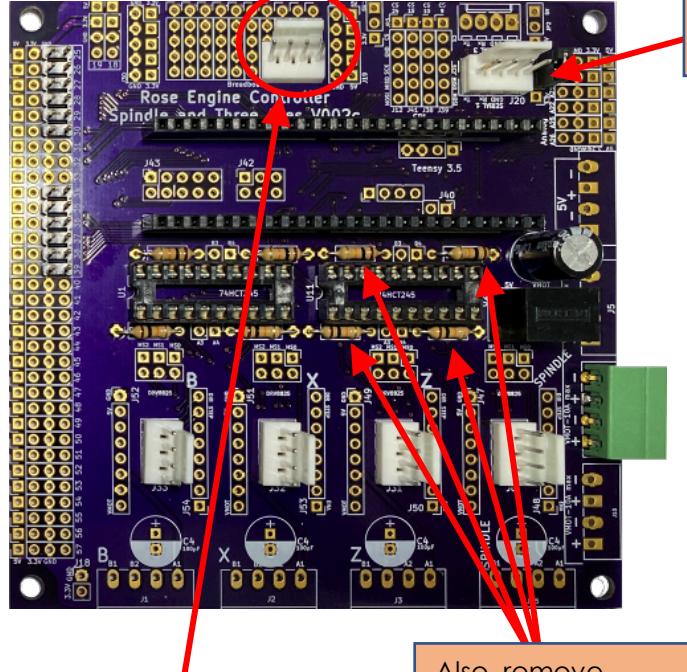
	PCB version V002c	PCB version V002i
Nextion Enhanced Series Display	No change needed – proceed to Section 2	No change needed – proceed to Section 2
Nextion Intelligent Series Display	Follow the directions on the following pages.	No change needed – proceed to Section 2

The purple boards shown are from OSH Park. Boards from Seed Studio may be a different colour.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

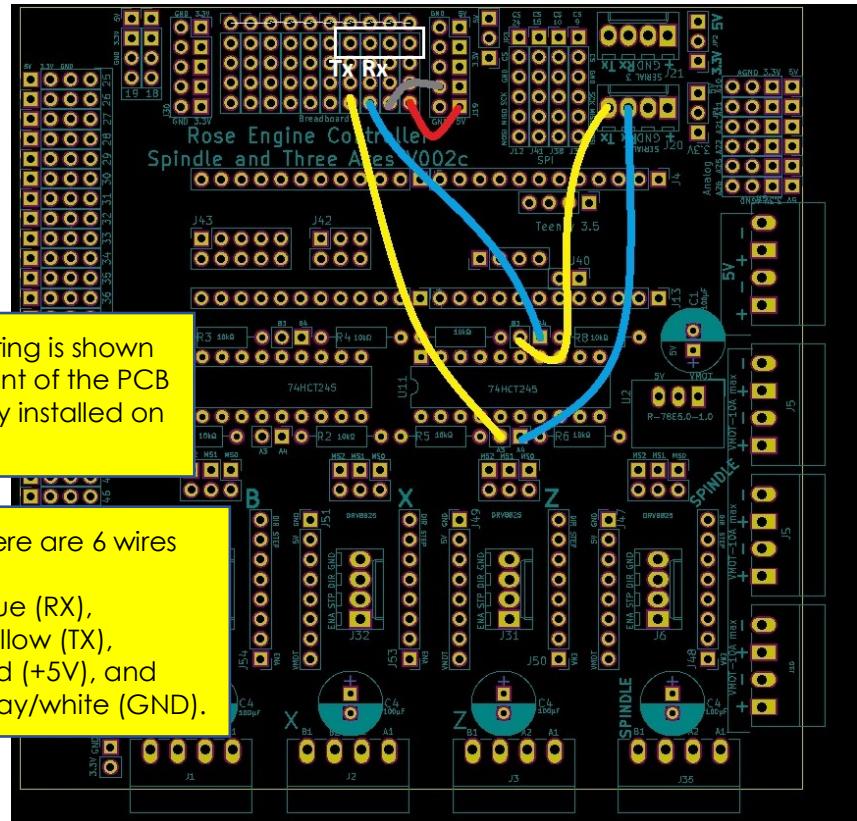
If that is the approach you are using, an additional header connector and additional wiring is recommended on the PCB as noted below. This is for use of Serial 1. If you use Serial 3, then the wires should be connected to the PCB in the area that is appropriate.



Recommend removing this header connector.

Also, remove these 4 resistors.

Add a new header connector at this location for connecting the Nextion Intelligent display to the PCB. These are breadboard wiring locations, and each vertical row is connected in the PCB.



**NOTE 1:** Wiring is shown from the front of the PCB but is usually installed on the back.

**NOTE 2:** There are 6 wires shown:

- 2 blue (RX),
- 2 yellow (TX),
- 1 red (+5V), and
- 1 gray/white (GND).

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

The basis for this wiring is that the data bus transceiver (74HCT245) can be used to ensure the Teensy is not overloaded by the Nextion's transmissions.

The configuration used with this PCB is to have data transmitted from Bus B to Bus A (see also function table to the right).

DIRECTION	1 •	20	V <sub>CC</sub>
A1	2	19	OUTPUT ENABLE
A2	3	18	B1
A3	4	17	B2
A4	5	16	B3
A5	6	15	B4
A6	7	14	B5
A7	8	13	B6
A8	9	12	B7
GND	10	11	B8

**74HCT245 Pin Assignments**

**74HCT245 Function Table**

Control Inputs		Operation
Output Enable	Direction	
L	L	Data Transmitted from Bus B to Bus A
L	H	Data Transmitted from Bus A to Bus B
H	X	Buses Isolated (High-Impedance State)

The resistors are also not needed on these pins for this bus transceiver. The pins had been unused previously, so the resistors were needed to ensure the voltages were kept low.

As the 2 input and 2 output pins are now being used, the resistors need to be removed.

The full [datasheet for the 74HCT245](#) can be seen at DigiKey.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 2 – Power Cables

#### Wiring – Power Supply (LRS-100-24)

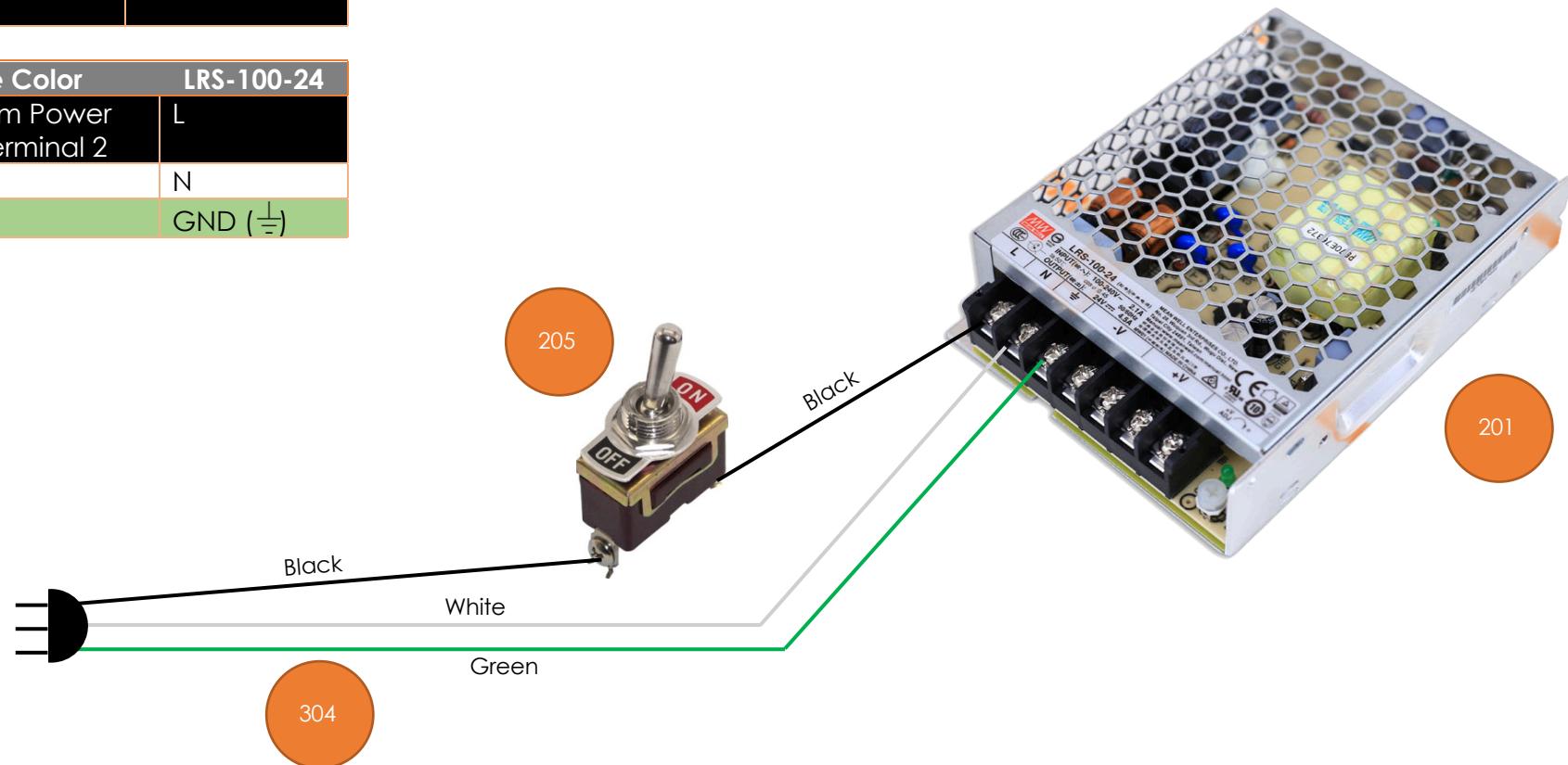
##### *Power Infeed*

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 ( $\frac{1}{3}$ )

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 Multiple Stepper Motors

### Power Outfeed

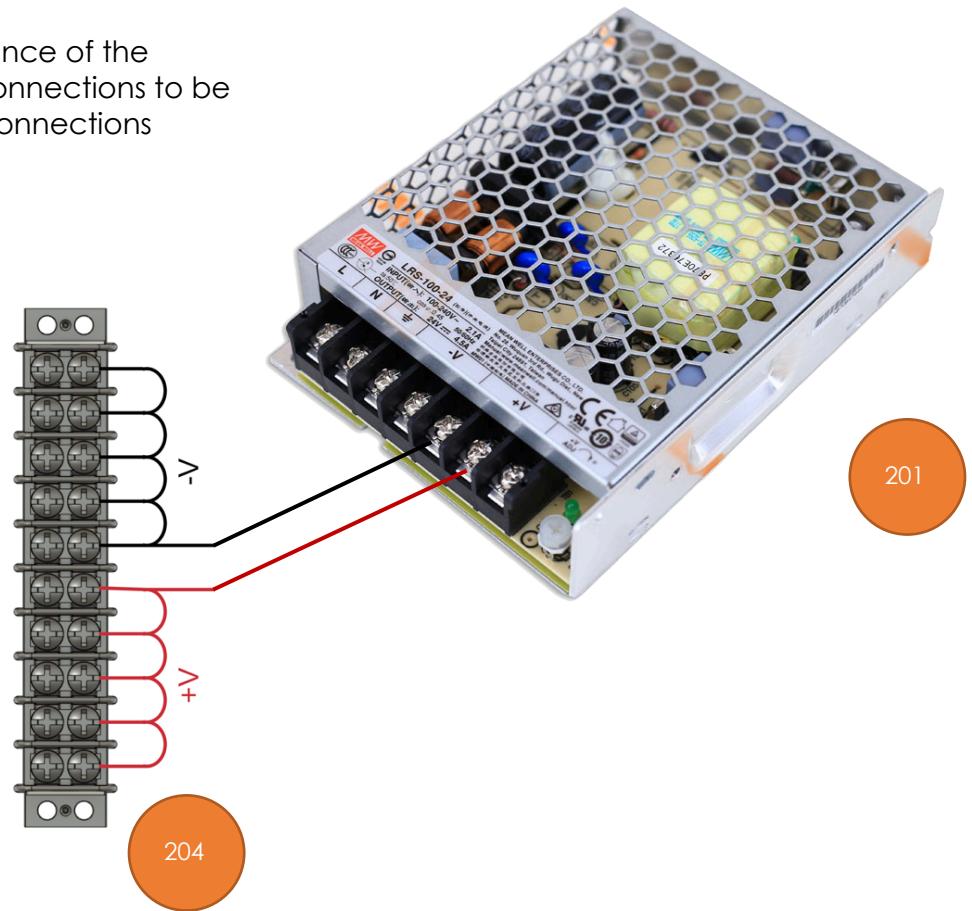
terminal block is used to make the installation and maintenance of the system's components easier. Using a terminal block allows connections to be added, changed, or removed without the risk of any other connections loosening.

Conductor Type	Stranded or solid copper
Conductor Size	20 or 22 AWG
Cable Size	2 conductors / cable

304

One of the power supply's **+V** outfeeds, and one of the **-V** outfeeds is connected up to the terminal block where the power will be distributed.

1. **-V** is connected to the other side of the terminal block using a white or black wire. That same colour wire is then used to cascade the **-V** side of the power to the next 4 terminals.
2. **+V** is connected to one side of the terminal block using a red wire, and then that same colour wire is used to then cascade the **+V** side of the power to the next 4 terminals.



# MDF Rose Engine Lathe 2.0

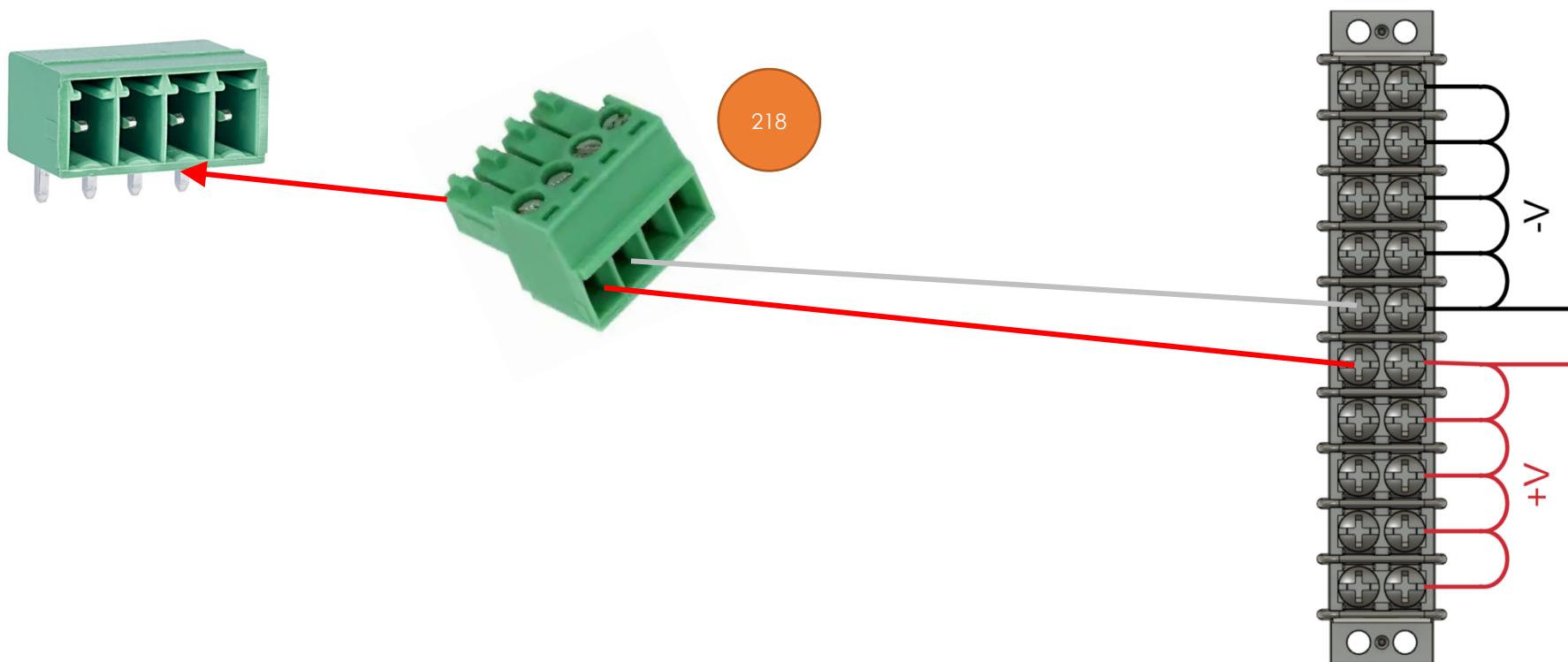
## Build Instructions – Control System for Multiple Stepper Motors

### Power Cable – 24V Power Supply to PCB

Screw the power cable wires into the terminal block plug as noted below.  
Ensure the wire is long enough to reach the PCB when installed.

This is plugged into the power header connector (#112) installed on the PCB (above).

Terminal Block	Wire Color	PCB
+V terminal	Red	O +24V
-V terminal	White	O -24V



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Power Wiring – DM542T Stepper Motor Drivers (4)

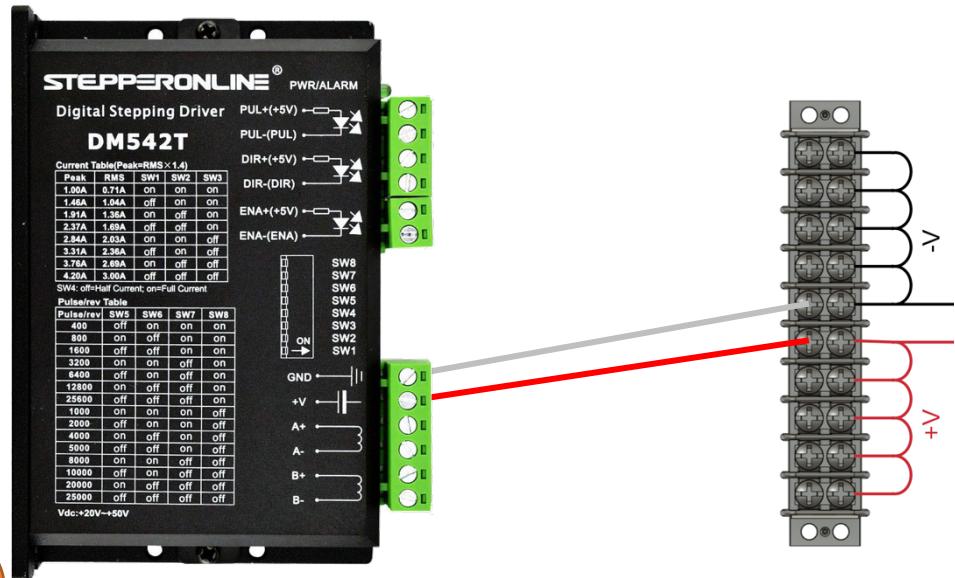
Each of the 4 DM542T stepper motor drivers is connected to the terminal block for power.

Terminal Block	Wire Color	DM542T
+V terminal	Red	+V
-V terminal	White	GND $\perp$

Conductor Type	Stranded or solid copper
Conductor Size	20 or 22 AWG
Cable Size	2 conductors / cable

303

202



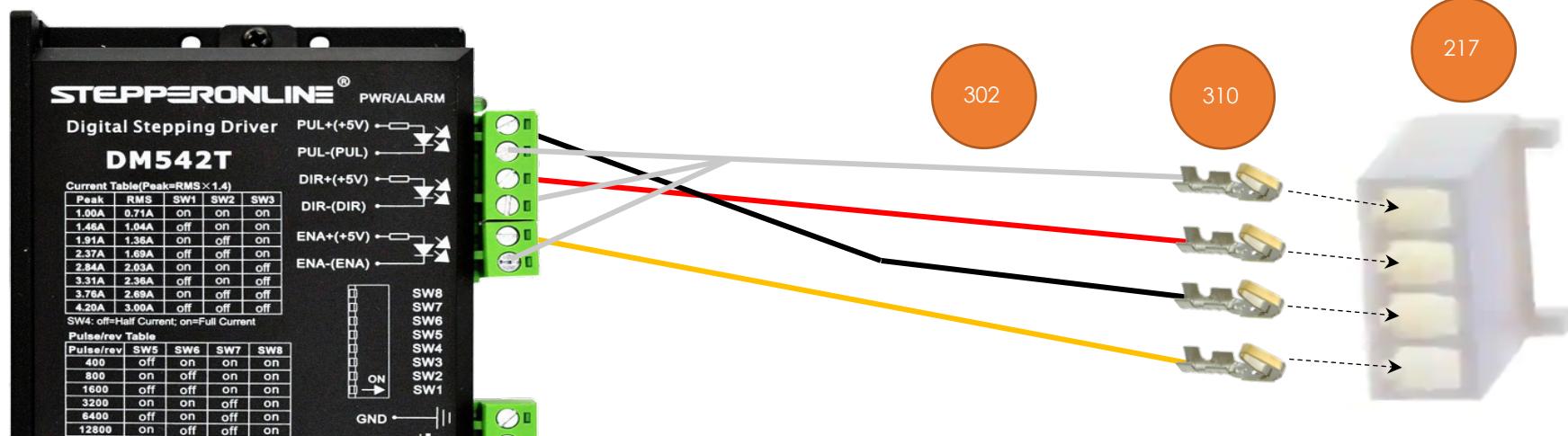
# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 3 – Stepper Motor Driver Signal Cables

#### Signal Cables – PCB to DM542T Stepper Motor Drivers

Install the pre-crimped ends of the wires into the housing. The other end is connected to the stepper driver as shown below. There are 4 of these.



A ratcheting/crimping plier for terminal pins makes the attachment of the terminal ends (#310) much easier.

The one I use is made by [IZOKEE](#).

DM542T	Wire Color	PCB
Pulse +	Black	O STEP/PUL
Direction +	Red	O DIR
Enable +	Yellow	□ ENA
Pulse -	White (GND) *	O GND
Direction -	White (GND) *	
Enable -	White (GND) *	

\* GND wires tied / bonded together.

# MDF Rose Engine Lathe 2.0

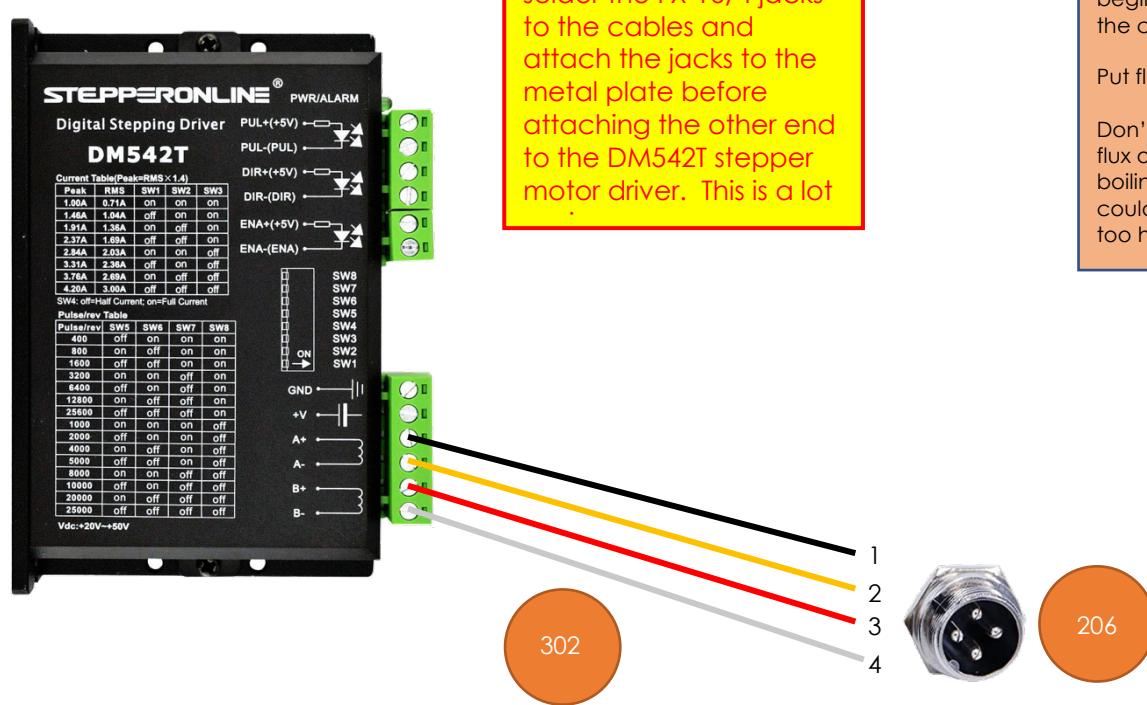
## Build Instructions – Control System for Multiple Stepper Motors

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

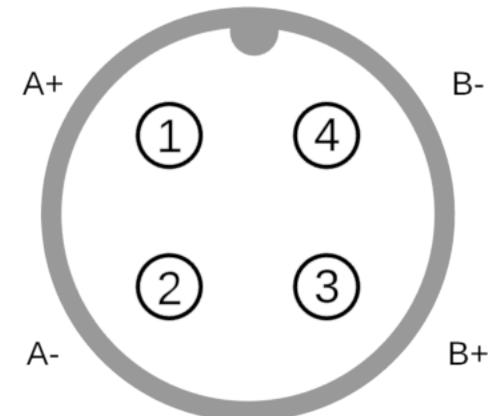
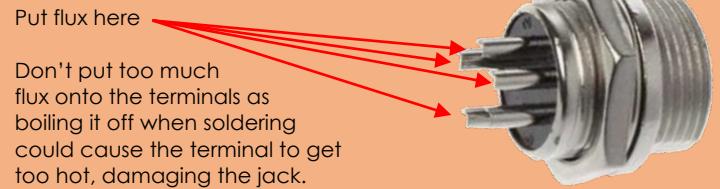
Each of the 4 stepper motors is connected to the stepper motor drivers via GX-16/4 Jacks.

DM542T	Wire Color	GX-16/4 Pin
A+	Black	1
A-	Yellow	2
B+	Red	3
B-	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 Multiple Stepper Motors

### Switch Settings

Set the switches on the DM542Ts as:

Purpose	Set to	Switch	Setting
Current	2.8A Peak 2.03A RMS	1	ON
		2	ON
		3	OFF
	Half Current	4	OFF
Pulses / Rev	6400	5	OFF
		6	ON
		7	OFF
		8	ON

The current could be set higher with this driver; however, the selected NEMA 23 stepper motor does not need that, so it is set thusly.



**NOTE:** switch settings in the picture are not correct – this is a stock photo from the Internet. Use the settings in the table above.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 4 – Nextion Display Signal Cable

#### Why use a Separate Jack Type for the Nextion Display?

It is a really good idea to have a different connector for the stepper motors than the Nextion touch screen display.

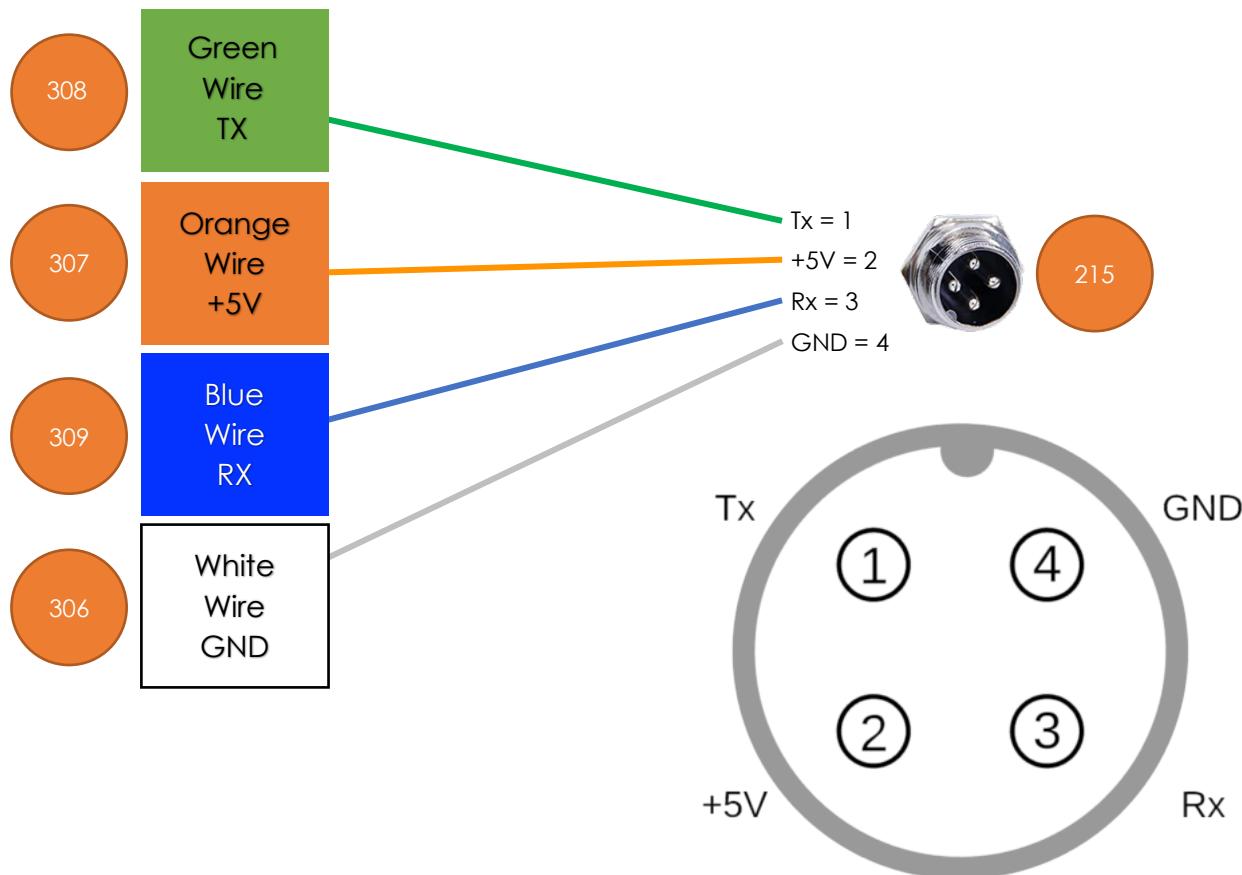
	Nextion Touch Screen Display	Stepper Motors
Cable Use	<ul style="list-style-type: none"><li>Serial communications</li><li>Power to the display</li></ul>	<ul style="list-style-type: none"><li>Motor stepping, but at a higher voltage</li></ul>
Risk if Hooked Up Wrongly	<ul style="list-style-type: none"><li>The higher voltages will probably cause the display to fail.</li></ul>	<ul style="list-style-type: none"><li>The motors will certainly work</li><li>May damage the motor.</li></ul>
Recommended Connector	<ul style="list-style-type: none"><li>GX-12/4<ul style="list-style-type: none"><li>Being 12mm in diameter makes the plug not able to connect to the GX-16/4 jack.</li></ul></li></ul>	<ul style="list-style-type: none"><li>GX-16/4<ul style="list-style-type: none"><li>Being 16mm in diameter makes the plug not able to connect to the GX-12/4 jack.</li></ul></li></ul>
Optional Connectors	<ul style="list-style-type: none"><li>Could use a GX-16 with more than 4 connectors (e.g., GX-16/5). The additional pins will just be unused, but this would prevent plugging the plug into the wrong jack.</li><li>RJ-45</li></ul>	<ul style="list-style-type: none"><li>n/a</li></ul>

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Signal Cable – PCB to Nextion Display

The Nextion touch screen is connected to the PCB via GX-12/4 connector.



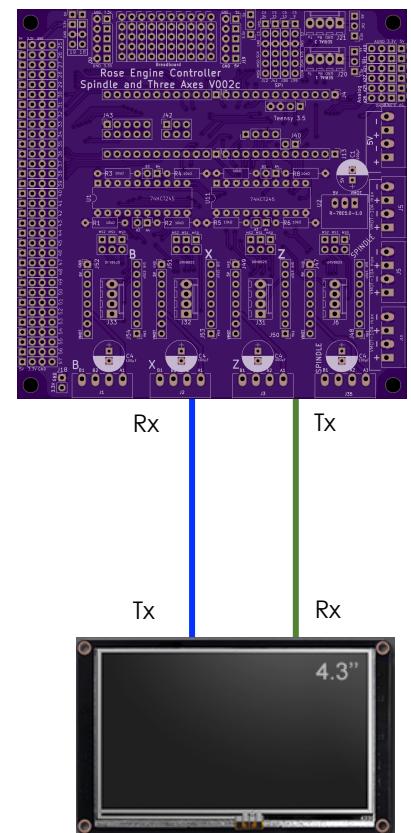
#### NOTE:

- Tx on the PCB is connected to Rx on the Nextion HMI display.
- Rx on the PCB is connected to Tx on the Nextion HMI display

**KEY POINT:** It is best to

1. Solder the jack to the cables
2. Install the jack into the 2-gang plate.
3. Once that is in place, then insert the pre-crimped ends into the housing.

This is a lot easier.

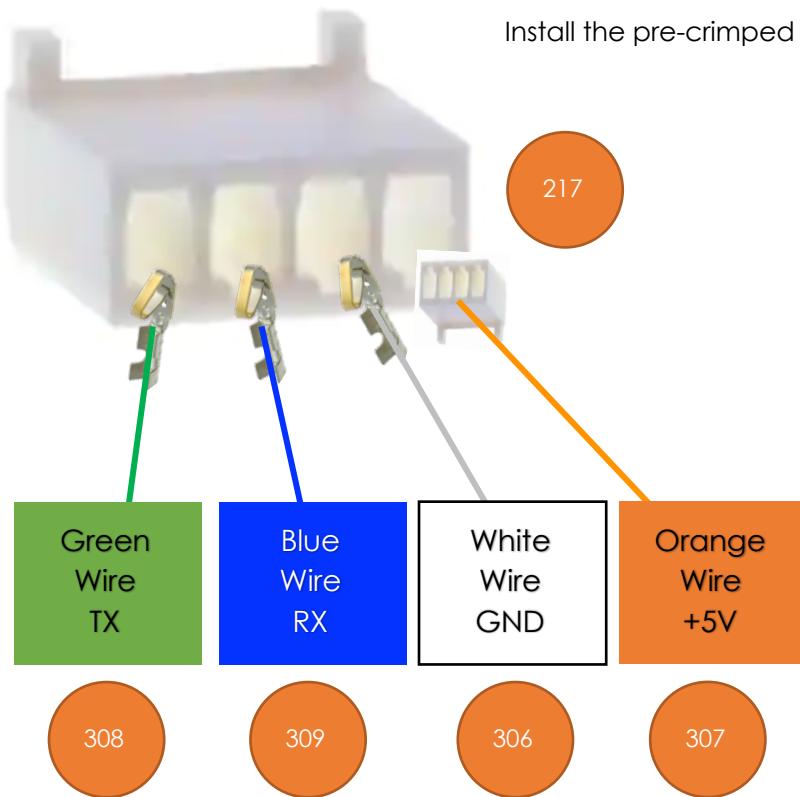


Nextion HMI Display

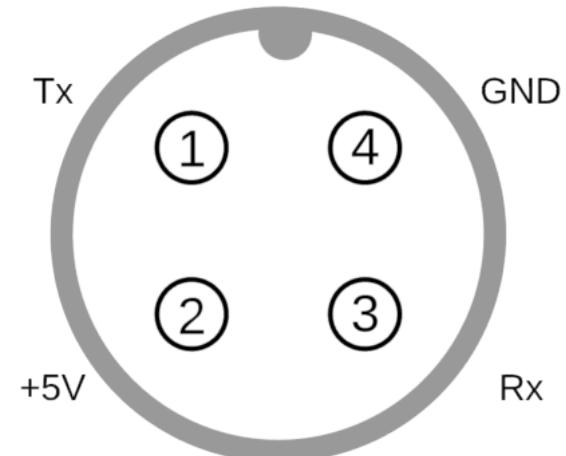
# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Signal Cable – PCB to Nextion Display



Install the pre-crimped wires into the housing. There are 4 of these.



**NOTE:** It is a very good practice to perform a continuity test to ensure the pins are wired correctly (i.e., pin 1 in the GX-12 jack should be connected to the left wire as shown in the picture to the right).

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

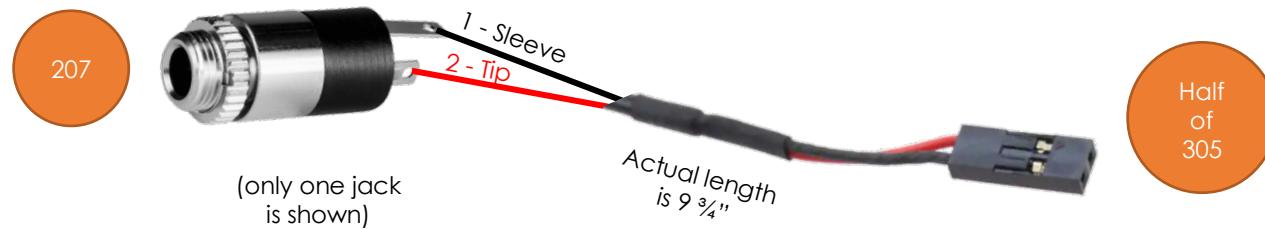
### Section 5 – Limit Switch Signal Cables

#### Signal Wiring – PCB to 3.5mm Audio Jacks for Limit & Home Switches

The limit switches are connected to the PCB via a 3.5mm (1/8") audio female jack. 6 pins on the Teensy are used (one for each limit switch). These can be any of the pins between 25 and 39.

The cable used is half of part #305.

PCB	Wire Color	Audio Jack
O pin #	Red	Tip / pin 2
O GND	Black (or White)	Sleeve / pin 1



**KEY POINT 1:** The sleeve must be connected to ground (GND). Typically, this is pin 1, but check based on the jack you are using.

**KEY POINT 2:** It is a really good idea to label each cable with the pin it is used for.

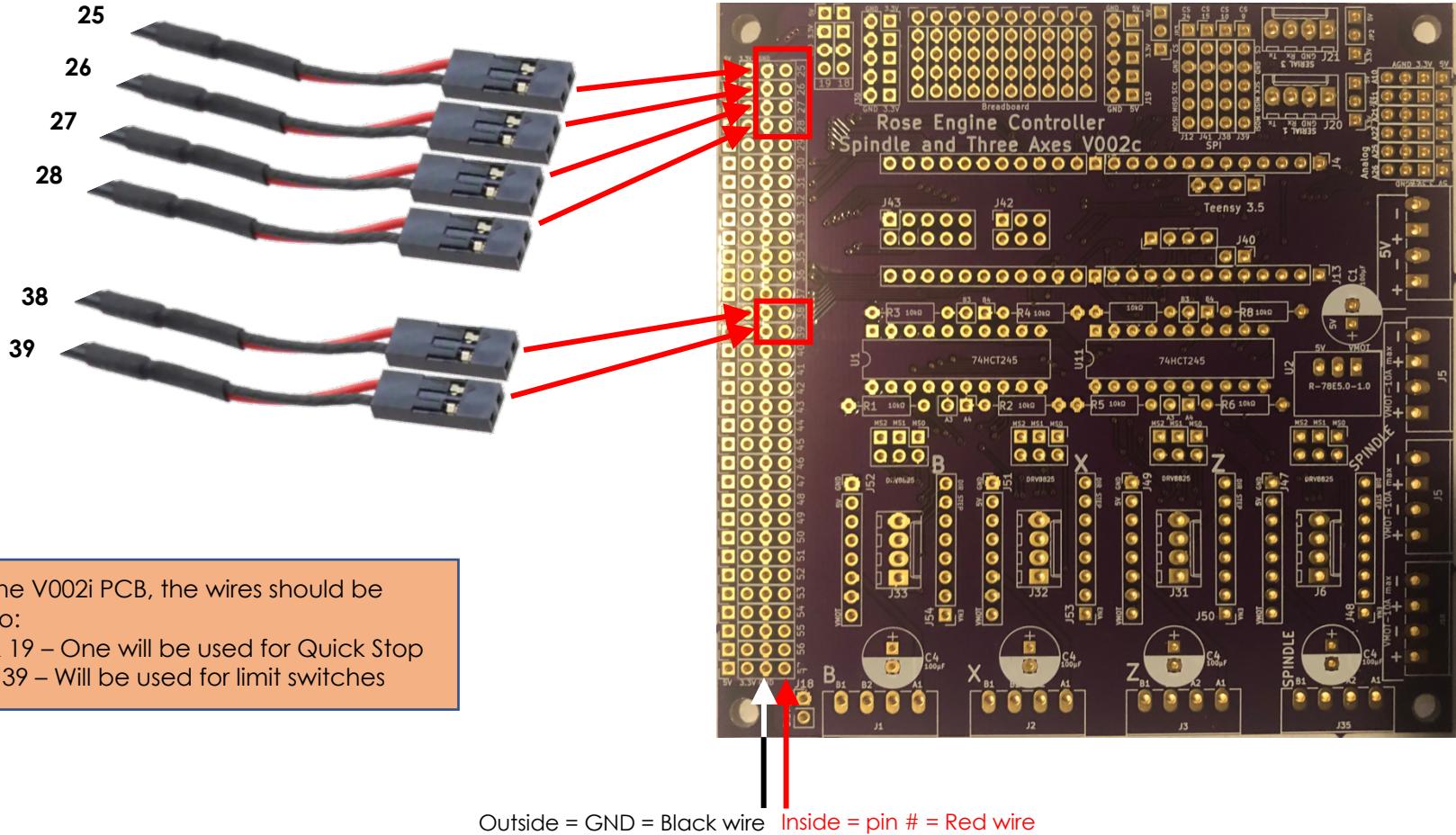
#### NOTES:

1. Most audio jacks that are available are stereo with 3 connectors. Only 2 are needed, so the 3<sup>rd</sup> one will go unused.
2. Experience has shown that it is a good practice to ensure a mono plug will work correctly for the way you have soldered the connections.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

Connect the cables to the header pins. The recommended pins are noted below, but any between 25 and 39 can be used.



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Section 6 – Final PCB Steps

#### Mounting the PCB to the MDF Board

The Teensy microcontroller is installed onto the PCB as shown in the picture to the right.

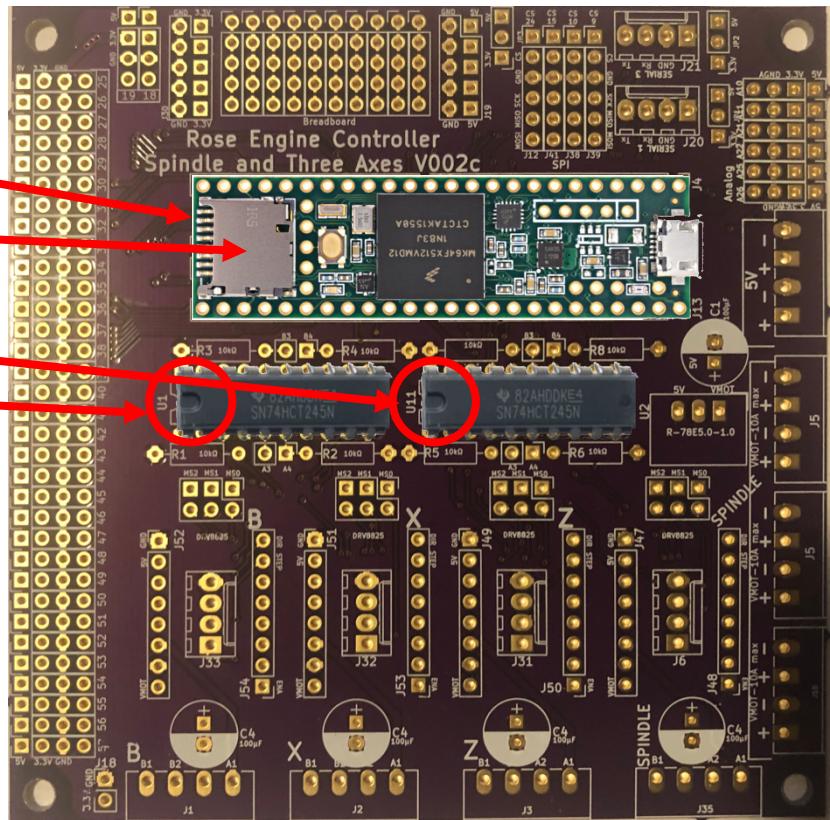
**NOTE:** Recommend using a Sharpie to write on the top of this area what type of Teensy is being used (e.g., 3.5 or 3.6). That will be helpful when upgrading later.

The two 74HCT245 integrated circuits are installed as shown in the picture to the right. Note that the indicating mark should be on the left side as shown here.



MicroSD Extension Cable

A microSD extension cable, 8 to 12 inches long, is useful. The male end can be put into the Teensy's microSD slot, and the female end can then be hung out of the case. This makes it easier to access files for the screens where that function is possible.



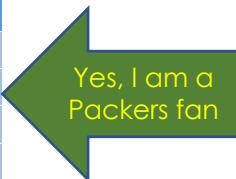
# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

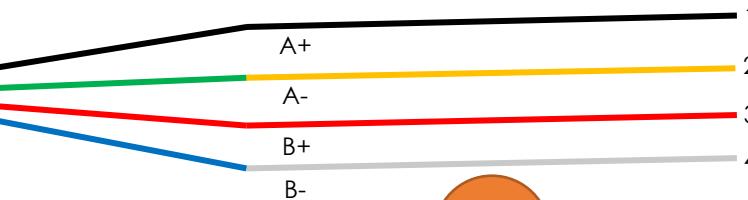
### Section 7 – Stepper Motor Cables

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



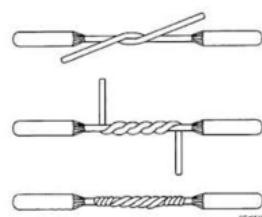
Conductor Type	Stranded copper
Conductor Size	20 AWG
Cable Size	4 conductors / cable
Cable Length	
Spindle	4 ft
Others	3 ft, or as desired



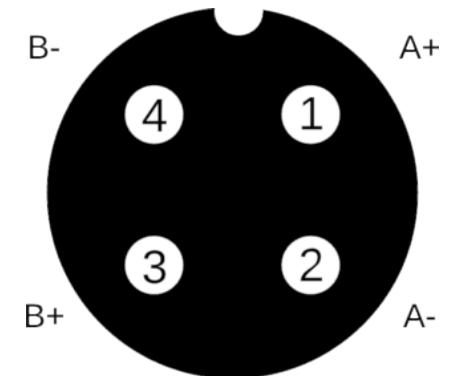
GX-16/4



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 left), and then solder the two together.



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

**NOTE:** Wires can change colors and positions from time to time. It is a very good practice to perform a continuity test to ensure the pins are wired correctly (i.e., pin 1 in the GX-16 plug should be connected to the A+ wire from the stepper motor).

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

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

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



# MDF Rose Engine Lathe 2.0

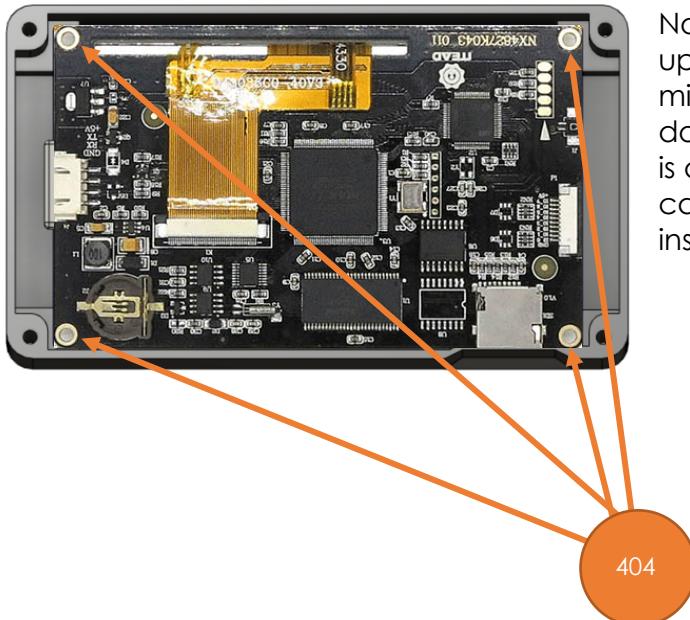
## Build Instructions – Control System for Multiple Stepper Motors

### Section 8 – Assembly of the Nextion touch screen Box

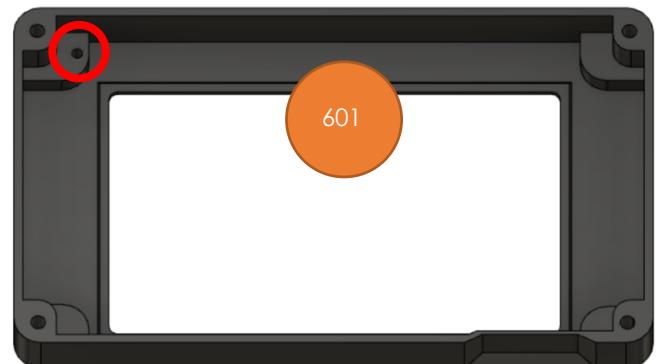
#### Attach Nextion Display to the Bezel

One hole is printed into the back side of the bezel for attaching the Nextion touch screen (circled in red to the right). That one needs to be enlarged using a #39 drill to a depth of 1/8".

Attach one corner of the Nextion touch screen using an M3 Thread Forming Screw, then center the HMI. Drill the other 3 corners, and then attach the display using the remaining M3 Thread Forming Screws.



Note that the Nextion is inserted upside down. This is because the microSD card slot is then pointed down. And the microSD card slot is accessible so that upgrades can be done without having to disassemble the whole system. (The slot for inserting the microSD card is in the base, not the bezel.)



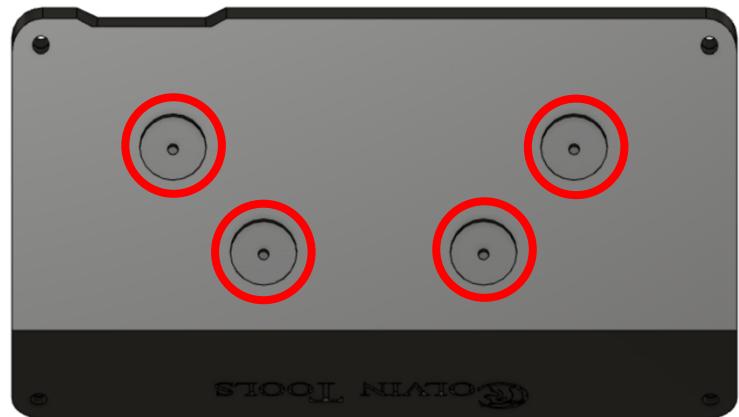
# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Attach Parts to the Base

Attach the 4 magnets to the base's bottom. There are 4 insets in the base for these.

If the screws protrude into the base, take some efforts to grind or file those sharp points down.



### Insert the Heat-Set Inserts

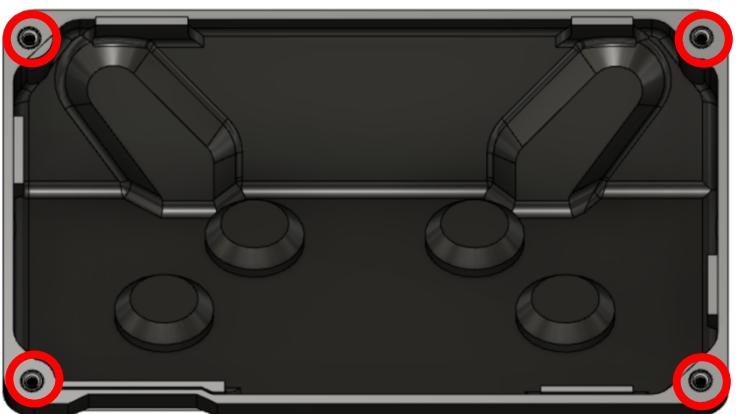
There are two options here:

1. Using a heat gun, insert each of the heat-set inserts into the corners of the base. These would then be used to attach the top of the case using the 4-40 screws (#403).

If you plan to disassemble the box and reassemble it quite a bit, this is probably the way to go. Otherwise, take option #2 (it is much easier.



2. Do nothing at this point, and attach the top using thread forming screws (#410)



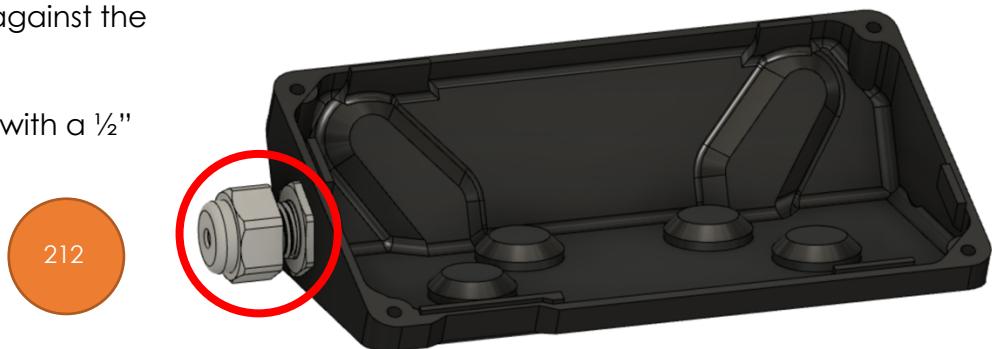
# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Add Wire Cord Grip

The cord grip is used to ensure the signal wire does not pull against the Nextion display.

Depending on the printing, you may need to drill the hole with a  $\frac{1}{2}$ " bit to ease the installation.



### Signal Wiring – PCB to GX-12/4 or RJ-45 Plug for Nextion Display

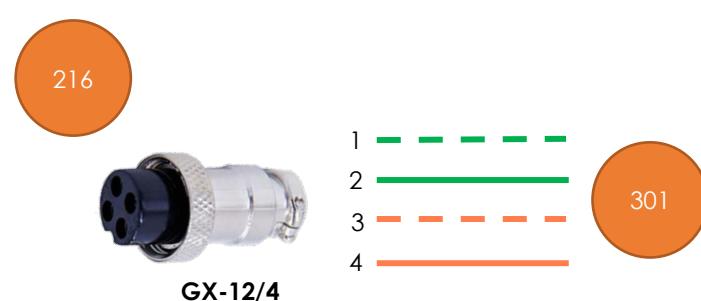
The Nextion touch screen is connected to the main box via a GX-12/4 or RJ-45 connector.

Using a piece of CAT 5 (or greater) wire, 8 feet long, make the connections to the HMI's connector (supplied by the vendor) as shown to the right.

**NOTE 1:** Be sure to put the cable thru the cord grip (#212) before attaching both ends.

**NOTE 2:** Be sure to add a short piece of shrink tubing to the CAT 6/5 wire before finishing the soldering to the GX-12/4 plug (#216) This shrink tubing is needed to secure the plug to the Wire (#301).

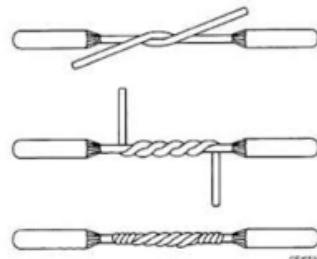
Nextion Connection	Nextion Wire Color	CAT 5 Wire Color	GX-12/4 Pin	RJ-45 Pin
RX	Yellow	White/Green	1	1
+5V	Red	Green	2	2
TX	Blue	White/Orange	3	3
		Blue	4	4
		White/Blue	5	5
GND	Black	Orange	4	6
		White/Brown	7	7
		Brown	8	8



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

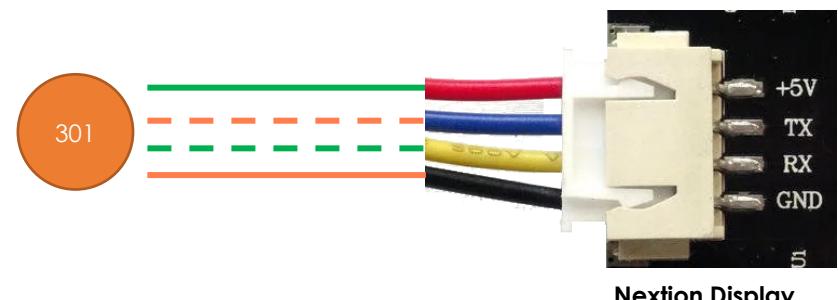
Put a  $\frac{3}{4}$ " long piece of shrink file onto each one of the Nextion wires before connecting it to the CAT 5 wires.



Lineman's Splice

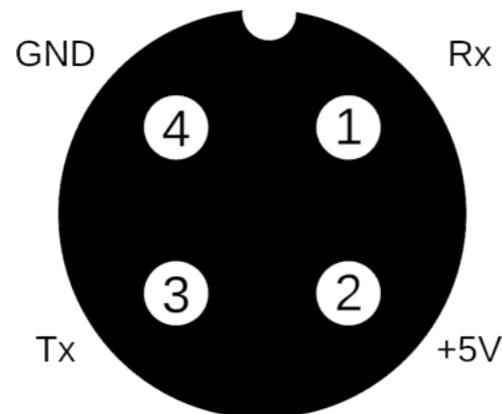
Connect the CAT 5 wire to the Nextion wires using a lineman's splice (AKA, the Western Union splice, and shown to the right), and then solder the two together.

Heat the shrink file tubing around the joint to insulate it from the other things it could touch.



Nextion Display

**NOTE:** Wires can change colors and positions from time to time. It is a very good practice to perform a continuity test to ensure the pins are wired correctly (i.e., pin 1 in the GX-12 jack should be connected to the Rx pin on the Nextion).



# MDF Rose Engine Lathe 2.0

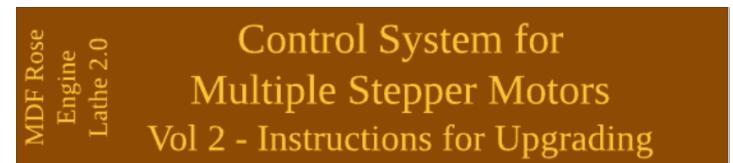
## Build Instructions – Control System for Multiple Stepper Motors

### Section 9 – System Setup and Program Loading

Use the web page noted below to load the programs into the Teensy and the Nextion, and then load the initial configuration into the Teensy.

<https://mdfre2.colvintools.com/NextionUserGuide-Upgrading.html>

If you are looking for that book on the MDF Rose Engine Lathe 2.0 Library, it is just like the book shown to the right.



### Section 10 – Finishing It Up

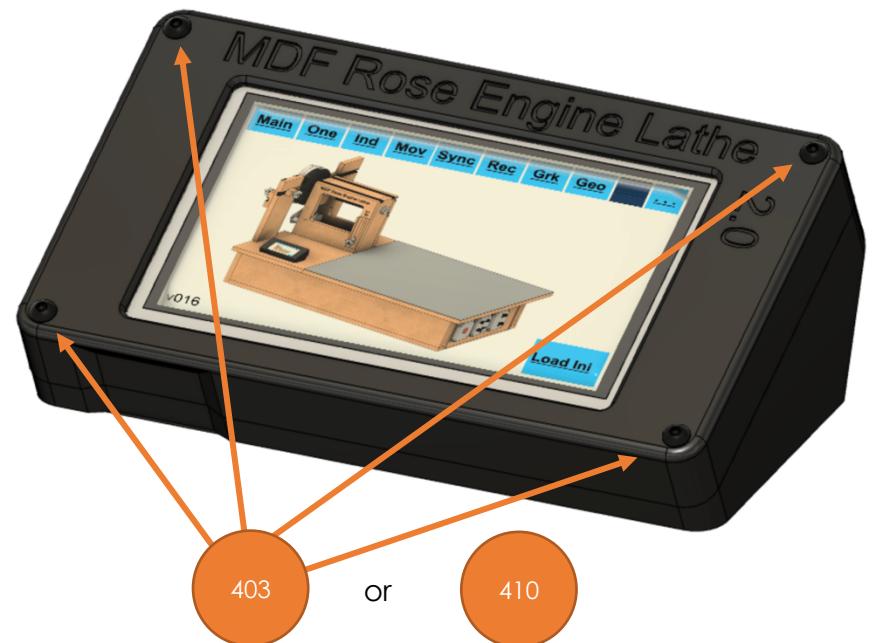
Before screwing the bezel to the base, check to be sure everything works. To do that, you will need to use the instructions in the next section to load the programs into all the pieces.

If it works, screw the two pieces together.

If you took the option to use the heat set inserts back on pg. 35, then attach the lid using four #4-40,  $\frac{3}{4}$ " long screws (#403).

Otherwise, attach it using 4 thread-forming screws (#410).

When finished and powered on, it will look like the picture to the right.



# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Optional Configurations

If you wish to change the designs built into this system, options are outlined below. **We do not support systems with such changes, so the user must be aware that they will be responsible for their own technical support.** These options are only provided for the sake of completeness and transparency.

#### Option 1: Less Functional Model

Some have expressed the desire to build a system which is not as fully functional as outlined in this document. For example, they only want to drive the spindle.

That is very doable but is not an option we will be providing. The components which can be left out when building the system are outlined in the table below.

Component	Configuration			
	Spindle Drive Only	+ Z Axis	+Z & B Axes	+Z, X, and B Axes
10 KΩ Resistors	4	4	8	8
74HCT245s & 20-pin DIP sockets	1	1	2	2
DM542T Stepper motor drivers & GX-16/4 Jacks	1	2	3	4

Regarding limit switches, none are truly required. These can be added later as desired. If not used, the 3.5mm audio jacks are not needed.

#### Recommendation

Except for the DM542T Stepper Motor Drivers, there really is not any significant cost advantage to taking this approach. So, if you do desire to make such a change, consider populating the Printed Circuit Board fully (8 resistors and two 74HCT245s). The DM542Ts can be added when you later want to expand to use them.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Option 2: Alternative Stepper Motor Drivers

The printed circuit board was developed to use either

- the DM542T external drivers outlined above, or
- the Pololu DRV8825 stepper motor drivers which would be attached to the board using header sockets.

#### Advantages to Using the Pololu DRV8825

1. DRV8825s are about 1/3 the cost of an external driver (i.e., the DM542T).
2. Having the DRV8825s mounted to the printed circuit board makes for a smaller physical footprint, enabling it to be installed easily inside the lathe's bed carcass.
3. The power draw for this configuration is lower, so a different (& potentially less expensive) power supply is possibly available.
4. There is less cabling to be done.

#### Disadvantages of Using the Pololu DRV8825

1. DRV8825 chips are limited to a max 1.5 A (vs. 4.2 A for the DM542T drivers).
  - a. This can necessitate the need for different, more expensive stepper motors. The cost of these different motors can erode the savings for not using the external stepper motor drivers (DM542T).
  - b. It is easy to overload the DRV8825 chips and cause them to fail.
  - c. It is easy to overload the DRV8825 chips and they in turn can cause other components to fail (e.g., the Teensy).
2. DRV8825 chips get hot when used, so fans must be attached to them to ensure they do not overheat. And the user will need to replace the fans when they fail.
3. Future deliverables (e.g., a curvilinear slide and a spherical slide) for the MDF Rose Engine Lathe 2.0 will be tested to ensure compatibility with the design from above. If the add-on devices do not work with the changed configuration, the owner/builder will be responsible for accommodating the necessary changes.

#### Recommendation

Unless you are an electrical / automation engineer or have substantial experience in this space, the design outlined with external stepper motor drivers (DM542Ts) will be easier to implement over the long term.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Option 3: Different Microcontroller

The printed circuit board was developed to use either

- the Teensy 3.5 outlined above, or
- the Teensy 3.6.

The Teensy 3.6 is 50% faster than the 3.5; however, it will only accommodate 3.3V whilst the Teensy 3.5 will accommodate 5V. Using the 3.5 helps ensure you don't burn out the microcontroller.

As for Teensy 4.0 or 4.1, the library of functions needed to control the stepper motor drivers is not yet complete for those boards. We will re-evaluate those over time.

### Recommendation

Unless you are an electrical / automation engineer or have substantial experience in this space, the design outlined with a Teensy 3.5 is recommended.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Option 4: Different Display

The control system was designed for a 4.3" Nextion display. We provide the code for these displays:

- 4.3" Enhanced display,
- 5" Intelligent display, and
- 7" Intelligent display.

These all have the same resolution (800 x 600), so the screens can be displayed with no re-programming.

That said

1. The Intelligent displays require re-wiring the PCB (if you are using the V002c board and are using the Teensy 3.6), and
2. We do not have a 3D printable case for the 5" or 7" displays at this time.

### Recommendation

Use the Nextion 4.3" Enhanced display.

# MDF Rose Engine Lathe 2.0

## Build Instructions – Control System for Multiple Stepper Motors

### Document Version History

Ver	Date	Comment
<b>3.2</b>	18 Nov 21	<ul style="list-style-type: none"><li>Added diagrams to better elucidate the GX jacks and plugs. This is to help with troubleshooting.</li></ul>
<b>3.1</b>	19 Oct 21	<ul style="list-style-type: none"><li>Added support for the new <b>Rose Engine Controller Spindle and Three Axes V002i</b> printed circuit board.</li></ul>
<b>3.0</b>	19 Aug 21	<ul style="list-style-type: none"><li>Original document split into 3 parts to allow for different case configurations to be handled easily.</li></ul>
<b>2.1</b>	14 Aug 21	<ul style="list-style-type: none"><li>Changed pins used for limit switches</li><li>Added information regarding different Teensy and Nextion displays.</li></ul>
<b>2.0</b>	13 Jun 21	<ul style="list-style-type: none"><li>This document incorporates changes to the way cables are attached to the PCB. It now shows how to use connectors in lieu of soldering the wires directly to the board.</li></ul>
<b>1.4</b>	10 Mar 21	<ul style="list-style-type: none"><li>Reorganized a few steps to follow better flow of work.</li><li>Added notes on using GX-12/4 connector for Nextion display.</li><li>Updated instructions for loading software to reference web site.</li><li>Also added a few minor other tweaks.</li></ul>
<b>1.3</b>	01 Jan 21	<ul style="list-style-type: none"><li>Added item numbers for optional build using a Pololu Tic (this is a separate document).</li><li>Renamed Document</li></ul>
<b>1.2</b>	15 Dec 20	<ul style="list-style-type: none"><li>Added parts to the bill of materials</li><li>Added details on the installation of the 3.5mm phono jacks.</li></ul>
<b>1.1</b>	10 Dec 20	<ul style="list-style-type: none"><li>Added details for optional configurations.</li><li>Added information for attaching the stepper motor to the headstock</li></ul>
<b>1.0.2</b>	07 Dec 20	<ul style="list-style-type: none"><li>Updated p/n for item #204; also updated p/n &amp; qty for item #102.</li><li>Added note on soldering on 3.5mm jacks first.</li></ul>
<b>1.0.1</b>	05 Dec 20	<ul style="list-style-type: none"><li>Updated commentary about stepper motor needed.</li><li>Added information about stepper motor mount, pulleys, and belt.</li><li>Updated drawing dimensions.</li></ul>
<b>1.0</b>	01 Dec 20	Initial document

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