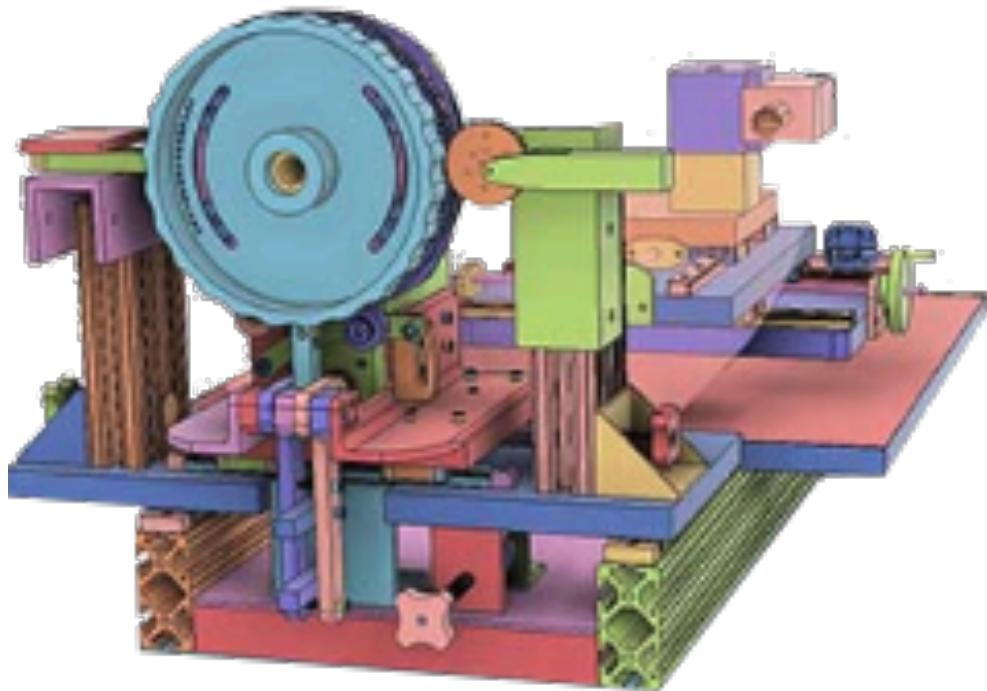


MDF Rose Engine Lathe 2.0 with Stepper Motor Drive



Instructions for Building ELFOS

Part 1 – General Information & Bill of Materials

**Version 4.2
01 April 2024**

MDF Rose Engine Lathe 2.0

Build Instructions – ELFOS

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.ColinTools.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 designed to use a stepper motor for driving the spindle.

NOTE: This has been split into separate parts to accommodate some variations.

Part 1 General Information & Bill of Materials

Part 2 Case – as there are many options, this is being split out to separate documents for each case option.

2a MDF Case – You build yourself

Part 3 Electronics, including

- Soldering of the parts to the PCB
- Soldering of wires to the jacks & plugs
- Wiring the components together

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

Good luck.

Rich Colvin

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Build Instructions – ELFOS

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:

1. Rose Engine Controller Spindle and Three Axes Voo3 printed circuit board
2. Nextion 7" HMI Display
3. Teensy 3.5 Microcontroller
4. DM542T Stepper Motor Drivers

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

Cautions

1. **Do not perform any changes to this system when the system is powered on.** Power down and unplug the system before attempting any work.
2. If your local electrical code requires for any differences from what is documented here, those requirements take precedence over this document.
3. 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.

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.

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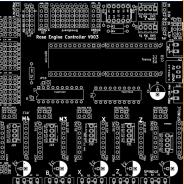
Bill of Materials

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.

3

This is the complete BOM for all sections. It is provided completely here to allow for purchasing the parts. Other documents in this set show only the parts used in that respective document.

NOTE: Pictures shown in the table below are to help with identification. Sizes shown are not representative of the actual size.

Item #	Item	Qty	Source	Source Part Number	Comments
101 v3	Printed Circuit Board Assembly Printed Circuit Board (PCB) 	1	Seeed Studios	Rose Engine 5 axes controller V3	https://www.seeedstudio.com/Rose-Engine-5-axes-controller-V3-g-1388793
102	Header Sockets 	2	Digi-Key	S7022-ND	24 pins each Mfgr p/n PPTC241LFBN-RC
103	20-pin DIP sockets 	2	Digi-Key	ED3054-5-ND	
104	10 KΩ resistors 	1	Digi-Key	CF14JT10KoCT-ND	
105	100 µF electrolytic capacitor 	1	LCSC	C59414	Mfgr p/n KM101M050F115A
106	74HCT245 Octal Bus Transceiver, 3-state 	2	Digi-Key	296-1612-5-ND	

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Item #	Item	Qty	Source	Source Part Number	Comments
107	R-78E5.0-1.0 DC/DC Converter	1	Digi-Key	945-2201-ND	
108	Teensy 3.5	1	PJRC	Teensy 3.5 pins	Be sure to get the one with the pins already soldered into place. Alternatively, a Teensy 3.2 or 3.6 may be used.
109	(Unused for this design)				
110	(Unused for this design)				
111	Header Connector, Vertical, 4 pins, 2.54mm pin spacing	6	Digi-Key	WM4113-ND	Used to connect the PCB to: <ul style="list-style-type: none">• Stepper motor drivers (5)• Nextion Display (1) Molex p/n 0022272041
112	(Unused for this design)				
113	Header Connector, Vertical, 12 pins (6x2), 2.54mm pin spacing	1	Digi-Key	609-5695-ND	Used to connect jacks for limit switches to the PCB. Amphenol ICC p/n 77313-101-12LF
114	Header Connector, Vertical, 2 pins, 2.54mm pin spacing	1	Digi-Key	SAM12303-ND	Used for setting the power selection for the Nextion touch screen. Samtec p/n TSW-102-24-T-S
115	Mini Jumper	1	Digi-Key	68786-302-ND	Used for setting the power selection for the Nextion touch screen. Amphenol p/n 68786-302. NOTE: original part, Amphenol p/n G89011020023DEU, is now obsolete.
116	(Unused for this design)				
117	Header Connector, Vertical, 4 pins (2x2), 2.54mm pin spacing	1	Digi-Key	609-5691-ND	Optional: Can be used to connect jacks for limit switches to the PCB. Amphenol ICC p/n 77313-101-04LF.
118	Logic Level Shifter, 4-Channel, Bidirectional	1	Pololu	2595	

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Item #	Item	Qty	Source	Source Part Number	Comments
119	Header Connector, 90 degree, 2 pins, 3.50mm pin spacing	1	Digikey	277-2416-ND	
120	Header Sockets	1	Digikey	S6103-ND	5 pins each Mfgr p/n PPTC051LFBN-RC. Used to hold the Pololu 2959 onto the PCB.
121	Header Socket	1	Digikey	S7004-ND	6 pins each Mfgr p/n PPTC061LFBN-RC. Used to attach a microSD card reader to the board. Needed when using a Teensy 3.2.

Item #	Item	Qty	Source	Source Part Number	Comments
Electrical Items					
201	AC/DC Power Supply - LRS-100-24	1	Digi-Key	1866-3314-ND	
202	DM542T Stepper Driver	5	StepperOnline	DM542T	
203	(Unused for this design)				
204	Terminal Block, 10 circuits, low profile	1	ouser	538-39100-1910	Used to distribute power from the LRS-100-24 (#201) to the other parts in the box. Molex p/n 39100-1910
205	Power Switch	1			SPST Toggle
206	GX-16/ 4 Socket	5	Amazon		Used to connect stepper motors to stepper motor drives. May come as a pair of sockets and plugs (i.e., including #214)

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Item #	Item	Qty	Source	Source Part Number	Comments
207	3.5mm Audio Jack, Female	6			Used for connecting limit switches. NOTE: #220 is a very good alternative to use in lieu of this part.
208	(Unused for this design)				
209	Utility box cover, 1 gang	1		Hubbell-Raco 861	
210	(Unused for this design)				
211	3/8 in. Twin-Screw Cable Clamp Connectors	1			Used for the AC power cable.
212	Cord Grip	1	McMaster-Carr	69915K47	Used for the cable to the 3D-printed case for the Nextion display. If hard wiring the cable to the main box, a 2d one of these is needed.
213	Stepper Motor	1	StepperOnline	23HS30-30045	For the spindle drive: NEMA 23 bipolar 1.8°, 1.9 Nm, 2.8A, 3.2V, 57mm x 57mm x 76 mm
214	GX-16/ 4 Plug	1	Amazon		Used for stepper motors. May come as a pair of sockets and plugs (i.e., including #206)
215	GX-12/ 4 Socket	1	Amazon		Used for the Nextion touch screen display. May come as a pair of sockets and plugs (i.e., including #216)
216	GX-12/ 4 Plug	1	Amazon		Used for the Nextion touch screen display in lieu of RJ-45 connectors. May come as a pair of sockets and plugs (i.e., including #215)
217	Connector Housing Receptacle, 2.54mm pin spacing	5	Digi-Key	WM2002-ND	Used to connect the PCB to: <ul style="list-style-type: none">• Stepper motor drivers (4)• Nextion Display (1) Molex p/n 0022013047
218	(Unused for this design)				
219	Controls Face Plate, 3D printed	1	Colvin Tools		3D printing designs are at https://mdfre2.colvintools.com/3DPrint.html . <ul style="list-style-type: none">• Use version 2 with #207 3.5mm audio jacks• Use version 3 with #220 3.5mm audio jacks

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Item #	Item	Qty	Source	Source Part Number	Comments
220	3.5mm Audio Jack, Female	5	Digi-Key	839-1410-ND	<p>Use these with the #219 Controls Face Plate (use version 3 of the templates the holes for this jack are bigger).</p> <p>They are significantly better quality than the generic ones I've found on Amazon or elsewhere. Bit more expensive too.</p> <p>Tensility p/n 54-00080.</p>
221	Nextion 7" Intelligent HMI	1	ITEAD.cc	NX8048P070-011R	<p>If that model is not available, select the replacement which has:</p> <ul style="list-style-type: none"> • Resistive touch (vs. capacitance) • Flash data storage space: 128 MB or more • EEPROM: 1024 bytes or more • RAM: 512 KB or more • Resolution: 800×480 pixels <p>Use this with #602.</p> <p>Use this in lieu of #203 (4.3" model).</p>
222	Terminal Block Plug, 2 pins, Screw Terminals, 3.50mm pin spacing	1	Digikey	277-9008-ND	Used to connect power to the PCB. Phoenix Contact p/n 1840382

Item #	Item	Qty	Source	Source Part Number	Comments
Cables					
301	Cabling – CAT 5 or higher				Used for the Nextion touch screen.
302	Cabling – 20 AWG/4, stranded				Used for signaling for the stepper motors and the stepper motor drivers.
303	Cabling – 20 or 22 AWG/2, stranded or solid core				Used for low voltage, DC power.
304	Cabling – 16 AWG/3, stranded				Used for AC power. Can cut off the female end of a grounded extension cord.
305	Cable with Connector, 2 pin, 2.54mm pin spacing, 500mm long (19 1/2")	3	Digi-Key	1175-1261-ND	<p>Used for limit switches. Both ends have connectors, so cable will be cut in the center to make two each.</p> <p>CNC Tech p/n 810-10053-00050</p>
	Cable, pre-crimped on one end for Molex connector (#217), 10" long, 28 AWG,				Used to connect the PCB to the GX-12/4 socket for the Nextion touch screen.
306	• White	1	Digi-Key	0008500113-10-W8-ND	Molex p/n 08500113-10-W8

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Item #	Item	Qty	Source	Source Part Number	Comments
307	• Orange	1	Digi-Key	0008500113-10-A8-ND	Molex p/n 08500113-10-A8
308	• Green	1	Digi-Key	0008500113-10-G8-ND	Molex p/n 08500113-10-G8
309	• Blue	1	Digi-Key	0008500113-10-L8-ND	Molex p/n 08500113-10-L8
310	Crimp Terminal	16	Digi-Key	WM2312-ND	Used to connect the PCB to the DM542T stepper motor drivers. Molex p/n 08550102

Item #	Item	Qty	Source	Source Part Number	Comments
Screws, etc.					
401	Nylon Spacer (Unthreaded) for #8 screw – 1/4" OD, 1/4" length	4	McMaster-Carr	94639A293	Used to raise the PCB up off the MDF.
402	(Unused for this design)				
403	(Unused for this design)				
404	M3 Screws, Thread Forming	4	McMaster-Carr	96817A300	Used to attach the Nextion touch screen display to the 3D printed case.
405	Magnets	4	McMaster-Carr or Amazon	5862K14	1/2" outside diameter with hole in center for attaching to an object via a screw. Used on bottom of the 3D-printed enclosure for the Nextion touch screen display
406	Sheet Metal Screws, #4, 3/4" long, round head		McMaster-Carr	90935A137	These work acceptably in the MDF for the purposes they are designed to be used.
407	Particle Board Screws, #6, 3/4" long, round head		McMaster-Carr	91555A115	
408	Particle Board Screws, #6, 5/8" long, flat head		McMaster-Carr	90252A246	Used to attach #208, #209, and #210 to the MDF.
409	Sheet metal screws, #4, 5/16" long, flat head		McMaster-Carr	90065A107	Used to attach #405 magnets to the 3D-printed enclosure for the Nextion touch screen display.

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Item #	Item	Qty	Source	Part Number	Comments
410	Torx Round Head Thread-Forming Screws for Plastic, #4, 7/8" long	1	McMaster-Carr	96001A217	If you take option #2 as outlined in part 2, you should use these. If not, they are not needed.

Item #	Item	Qty	Source	Part Number	Comments
Spindle Drive Parts					
501	Timing Belt	1	MiSUMi	GBN655EV5GT-90	<ul style="list-style-type: none"> • GT3 5mm pitch • 131T / 655mm long • 9mm wide
502	Spindle Pulley	1	Colvin Tools		<p>Attached to the spindle via the flange.</p> <p>This can be 3D printed using the the designs at https://mdfre2.colvintools.com/3DPrint.html; however, this is provided for convenience only. We recommend a machined one like the one we provide.</p>
503	Stepper Motor Pulley	1	Stock Drive Products (www.sdp-si.com)	A 6A55-012DF0908	<p>Aluminum Alloy Timing Pulley for .354 (9mm)" Wide Belt</p> <ul style="list-style-type: none"> • 5 mm (GT2) Pitch • 12 Teeth • 0.25" Bore • 2 Flanges / With Hub <p>Attached to the stepper motor</p>
504	Stepper Motor Attachment Bracket & Parts	1	Colvin Tools		<p>Includes:</p> <ul style="list-style-type: none"> • Bracket with Idler • Mounting bolts, nuts, and spacers to attach to headstock • Mounting screws to attach stepper motor

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Item #	Item	Qty	Source	Source Part Number	Comments
601	3D printed Nextion case (Unused for this design)				
602	Touch Screen Case for 7.0" Nextion Display, 3D printed	1	Colvin Tools		<p>This can be 3D printed using the designs at https://mdfre2.colvintools.com/3DPrint.html</p> <p>The 3D printed case is also available from Ed French on GitHub https://github.com/elfren/RoseEngine_SpindleAndAxis/tree/master/Nextion/Enclosure_7i/7i_Enclosure_o3a. Ed also has a design on GitHub with a rotary switch opening on the right. This rotary switch is used in Ed's design to control the overhead drive's speed.</p> <p>If you cannot 3D print this yourself, look at online services to do it. One recommended site is www.PCBway.com.</p>

Item #	Item	Qty	Source	Source Part Number	Comments
Optional Parts					
901	Limit switch	Up to 6	McMaster-Carr	7779K13	Needs to be normally off with a momentary on.
902	Magnetic base stand with Noga style arm		Amazon		<p>For holding the limit switch. Clockwise Tools MGBR-01 is a good one to consider.</p> <p>There is a bracket available in the 3D Printed Parts book which can be used to attach the limit switch to this (https://mdfre2.colvintools.com/3DPrint.html).</p>
903	microSD extender		Amazon		<p>Needs to provide a male jack to plug into the Teensy, and a female jack for inserting the microSD card.</p> <p>Recommend one with a cable which is 10" to 12".</p> <p>There is a bracket available in the 3D Printed Parts book which can be used to attach this to a panel. It is in the parts for the <i>Control System for Multiple Stepper Motors</i> (https://mdfre2.colvintools.com/3DPrint.html).</p>

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Item #	Item	Qty	Source	Source Part Number	Comments
904	Multilayer Ceramic Capacitor, 0.1 μ F	1	Amazon		<p>This is used to debounce the limit switch. It is recommended to attach one across the two leads at the limit switch (#901).</p> <p>These criteria are not critical, but the data listed at Amazon for these is: Capacitance Tolerance = $\pm 20\%$; Voltage = AC 50V; Lead Spacing = 5.08mm/ 0.2"; Temperature Range = +10C to +85C; Overall Size(Each) = 13x 5.7x 3mm/ 0.51" x 0.22" x 0.12"(L*W*T)</p>
905	microSD card	1	Microcenter		32 GB is a good size. Do not get larger storage (e.g., 64 GB), but less is OK.
906	Cable Assembly, 3.5mm Plug	1	Digi-Key	839-1039-ND	<p>Use this to connect the limit switch to a plug. The pre-made cable makes this a whole lot easier.</p> <p>Vendor p/n 10-00344</p>
907	microUSB / USB Cable	1			Need this to program the Teensy. Needs to handle both power and data.
908	1 Channel DC 3V/3.3V Relay Power Switch Module with Optocoupler Relay Module Isolated Drive Control Board	1	Amazon		Used with the Auxiliary Pin.

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Build Instructions – ELFOS

Document Version History

Ver	Date	Comment
4.2	01 Apr 24	<ul style="list-style-type: none">Had to restore item 602
4.1	17 Mar 24	<ul style="list-style-type: none">Pared down to only cover the 5-axis board for ELFOSMoved Motor attachment instructions from this document to part 3
4.0	01 Aug 22	<ul style="list-style-type: none">Added parts #118, #119, #120, #222, and #907.Updated information regarding Nextion 5" & 7" displays.
3.2	22 Jan 22	<ul style="list-style-type: none">Added parts #219, #220, #221, #602, #905, and #906.Updated commentary on #207.
3.1	30 Nov 21	<ul style="list-style-type: none">Updated BOM to only be in this document. Also added pictures.
3.0	19 Aug 21	<ul style="list-style-type: none">Original document split into 3 parts to allow for different case configurations to be handled easily.
2.1	14 Aug 21	<ul style="list-style-type: none">Changed pins used for limit switchesAdded information regarding different Teensy and Nextion displays.
2.0	13 Jun 21	<ul style="list-style-type: none">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.
1.4	10 Mar 21	<ul style="list-style-type: none">Reorganized a few steps to follow better flow of work.Added notes on using GX-12/4 connector for Nextion display.Updated instructions for loading software to reference web site.Also added a few minor other tweaks.
1.3	01 Jan 21	<ul style="list-style-type: none">Added item numbers for optional build using a Pololu Tic (this is a separate document).Renamed Document
1.2	15 Dec 20	<ul style="list-style-type: none">Added parts to the bill of materialsAdded details on the installation of the 3.5mm phono jacks.
1.1	10 Dec 20	<ul style="list-style-type: none">Added details for optional configurations.Added information for attaching the stepper motor to the headstock
1.0.2	07 Dec 20	<ul style="list-style-type: none">Updated p/n for item #204; also updated p/n & qty for item #102.Added note on soldering on 3.5mm jacks first.
1.0.1	05 Dec 20	<ul style="list-style-type: none">Updated commentary about stepper motor needed.Added information about stepper motor mount, pulleys, and belt.Updated drawing dimensions.
1.0	01 Dec 20	Initial document

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The layout of the Printed Circuit Board (PCB) is copyright Ed French and is used with his permission.

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