**MDF Rose Engine Lathe 2.0**

**with Stepper Motor Drive**

**A colorful machine with a black background

Description automatically generated**

**Instructions for**

**Building ELFOS**

**Part 1 – General Information**

**& Bill of Materials**

**Version 4.2**

**01 April 2024**

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](http://www.ColvinTools.com).

There are some variations from the ideas documented by Jon Magill at [www.rogueturner.com](http://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](mailto:ColvinTools@Gmail.com).

Good luck.

Rich Colvin

Table of Contents

[Getting Started 4](#_Toc161564565)

[Bill of Materials 5](#_Toc161564566)

[Document Version History 14](#_Toc161564567)

# 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](https://www.otbok.info/)).

This document outlines the approach for wiring this machine using:

1. Rose Engine Controller Spindle and Three Axes V003 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.

|  |
| --- |
| 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.

**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 |
| --- | --- | --- | --- | --- | --- |
|  | **Printed Circuit Board Assembly** |  |  |  |  |
| 101 v3 | A picture containing text, electronics, battery  Description automatically generatedPrinted 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 | CF14JT10K0CT-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 |  |
| 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:   * 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 |  |
| 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 | Mouser | 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 | A close up of a device  Description automatically generatedGX-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) |
| 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 | A close up of a speaker  Description automatically generatedUtility 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 | A close up of a device  Description automatically generatedGX-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:   * 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>.   * Use version 2 with #207 3.5mm audio jacks * Use version 3 with #220 3.5mm audio jacks |
| 220 | 3.5mm Audio Jack, Female | 5 | Digi-Key | 839-1410-ND | Use these with the #219 Controls Face Plate (use version 3 of the templates the holes for this jack are bigger).  They are significantly better quality than the generic ones I’ve found on Amazon or elsewhere. Bit more expensive too.  Tensility p/n 54-00080. |
| 221 | Nextion 7” Intelligent  HMI | 1 | ITEAD.cc | NX8048P070-011R | If that model is not available, select the replacement which has:   * 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   Use this with #602.  Use this in lieu of #203 (4.3” model). |
| 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 ½”) | 3 | Digi-Key | 1175-1261-ND | Used for limit switches. Both ends have connectors, so cable will be cut in the center to make two each.  CNC Tech p/n 810-10053-00050 |
|  | 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 |
| 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 – ¼” OD, ¼” 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 | ½” 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. |
| 410 | Torx Round Head Thread-Forming Screws for Plastic, #4, 7/8” long |  | 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 | Source  Part Number | Comments |
| --- | --- | --- | --- | --- | --- |
|  | **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.  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. |
| 503 | Stepper Motor Pulley | 1 | Stock Drive Products ([www.sdp-si.com](http://www.sdp-si.com)) | A 6A55-012DF0908 | Aluminum Alloy Timing Pulley for .354 (9mm)" Wide Belt   * 5 mm (GT2) Pitch * 12 Teeth * 0.25" Bore * 2 Flanges / With Hub   Attached to the stepper motor |
| 504 | Stepper Motor Attachment Bracket & Parts | 1 | Colvin Tools |  | Includes:   * Bracket with Idler * Mounting bolts, nuts, and spacers to attach to headstock * Mounting screws to attach stepper motor |

| Item # | Item | Qty | | Source | | | | Source  Part Number | Comments | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **3D printed Nextion case** |  | |  | |  | | | |  | |
| 601 | (Unused for this design) | |  | |  | |  | | | |  |
| 602 | Touch Screen Case for 7.0” Nextion Display, 3D printed | 1 | | Colvin Tools | | | |  | This can be 3D printed using the the designs at <https://mdfre2.colvintools.com/3DPrint.html>  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\_03a](https://github.com/elfren/RoseEngine_SpindleAndAxis/tree/master/Nextion/Enclosure_7i/7i_Enclosure_03a). 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.  If you cannot 3D print this yourself, look at online services to do it. One recommended site is [www.PCBway.com](http://www.PCBway.com). | | |

| 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 |  | For holding the limit switch. Clockwise Tools MGBR-01 is a good one to consider.  There is a bracket available in the [3D Printed Parts](https://mdfre2.colvintools.com/3DPrint.html) book which can be used to attach the limit switch to this (<https://mdfre2.colvintools.com/3DPrint.html>). |
| 903 | A picture containing text, container  Description automatically generatedmicroSD extender |  | Amazon |  | Needs to provide a male jack to plug into the Teensy, and a female jack for inserting the microSD card.  Recommend one with a cable which is 10” to 12”.  There is a bracket available in the [3D Printed Parts](https://mdfre2.colvintools.com/3DPrint.html) book which can be used to attach this to a panel. It is in the parts for the *Control System for Multiple Stepper Motors* (<https://mdfre2.colvintools.com/3DPrint.html>). |
| 904 | A picture containing icon  Description automatically generatedMultilayer Ceramic Capacitor, 0.1 μF |  | Amazon |  | This is used to debounce the limit switch. It is recommended to attach one across the two leads at the limit switch (#901).  These criteria are not critical, but the data listed at Amazon for these is: Capacitance Tolerance = ± 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) |
| 905 | microSD card |  | 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 |  | Digi-Key | 839-1039-ND | Use this to connect the limit switch to a plug. The pre-made cable makes this a whole lot easier.  Vendor p/n 10-00344 |
| 907 | microUSB / USB Cable |  |  |  | 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. |

# Document Version History

|  |  |  |
| --- | --- | --- |
| Ver | Date | Comment |
| 4.2 | 01 Apr 24 | * Had to restore item 602 |
| 4.1 | 17 Mar 24 | * Pared down to only cover the 5-axis board for ELFOS * Moved Motor attachment instructions from this document to part 3 |
| 4.0 | 01 Aug 22 | * Added parts #118, #119, #120, #222, and #907. * Updated information regarding Nextion 5” & 7” displays. |
| 3.2 | 22 Jan 22 | * Added parts #219, #220, #221, #602, #905, and #906. * Updated commentary on #207. |
| 3.1 | 30 Nov 21 | * Updated BOM to only be in this document. Also added pictures. |
| 3.0 | 19 Aug 21 | * Original document split into 3 parts to allow for different case configurations to be handled easily. |
| 2.1 | 14 Aug 21 | * Changed pins used for limit switches * Added information regarding different Teensy and Nextion displays. |
| 2.0 | 13 Jun 21 | * 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 | * 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 | * Added item numbers for optional build using a Pololu Tic (this is a separate document). * Renamed Document |
| 1.2 | 15 Dec 20 | * Added parts to the bill of materials * Added details on the installation of the 3.5mm phono jacks. |
| 1.1 | 10 Dec 20 | * Added details for optional configurations. * Added information for attaching the stepper motor to the headstock |
| 1.0.2 | 07 Dec 20 | * 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 | * 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 |

To the extent that material may appear to be infringed, we assert that such alleged infringement is permissible under fair use principles in U.S. copyright laws. If you believe material has been used in an unauthorized manner, please contact me at [ColvinTools@Gmail.com](mailto:ColvinTools@Gmail.com).

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

Permission is not granted to manufacture these for sale.