

Rose Engine Controller Setup

Connecting, Installing & Upgrading the Rose Engine Controller Board

2 Axis, 4 Driver Controller

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The Rose Engine Controller board system is designed to drive the spindle and a second motor, to create a variety of ornamental patterns. The system is technically a two-axis, four motor control system. The controller board is combined with a Nextion touchscreen which enables selecting and using one or two motors, of up to four motors that can be controlled by the system. The user interface enables selecting from a variety of modes, running the motors individually or in combinations to produce complex patterns associated with ornamental turning.



The “brains” of the controller is a Teensy 3.5 made by PJRC ([https:// www.pjrc.com](https://www.pjrc.com)). The Teensy version 3.5 features a 32 bit 120 MHz ARM CortexM4 processor with floating point unit.

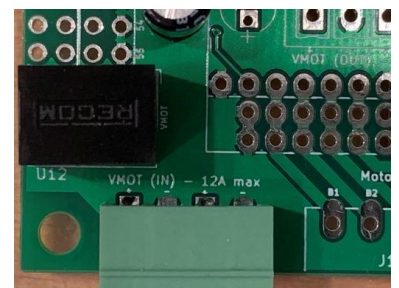
The user interface for the system is based on an enhanced version a Nextion 4.3” touchscreen. The touchscreen is powered by, and communicates with the Teensy.

The controller board was designed to be very flexible in how it is adapted to each individual installation, so there are many options that will be discussed throughout this document. Choose the options best for your specific lathe and application.

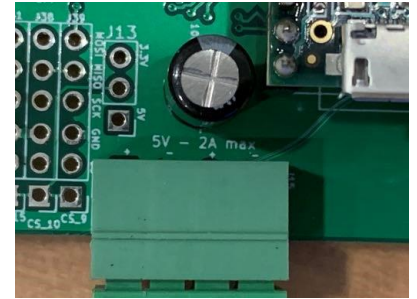
Connections

Power — Some form of power must be provided to the controller board, which in turn also supplies power to the Nextion touchscreen. There are xx options:

- 1) Supply 24V to the V_{mot} (IN) connector at the edge of the board. 24V is suggested, but your driver selection may determine a lower or higher voltage. The onboard DC-DC converter will accept 8V-42V and convert anything in that range to the 5V required for the Teensy and Nextion. Do not exceed 12 amps (12A) maximum. This is the preferred connection if onboard drivers are used, as the V_{mot} will be passed through the board to the drivers (and motors) and also power the Teensy and Nextion.



- 2) Supply 5V directly to the edge connector. 2 amps maximum. This connection option is provided for those who will be using external (off board) drivers, and eliminates the need for a DC-DC converter to be installed on the controller.
- 3) Supply 24V to V_{mot} and then out of V_{mot} to an external DC-DC converter, then back to the 5V input.



Touchscreen — The Nextion touchscreen needs to get power from the controller board, and communicate with the Teensy. This is done by connecting a four wire connector from the Serial3 port, near the USB end of the Teensy. Because the Nextion requires 5V to power the display, there is a 3-position jumper adjacent to the serial port, which allows selecting 3.3V or 5V. A jumper needs to connect the center pin with the pin closest to the outer edge of the board to provide 5V to the Nextion. This may also be a soldered (permanent) jumper wire.

The interconnect wire must have the “red” wire oriented towards the outside edge of the controller board. The other end is connected to a polarized socket on the underside of the Nextion touchscreen.



Stepper Drivers – One of the main goals of the controller board design was to accommodate a variety of stepper driver usage scenarios. Small, low-current drivers can be added on board, while larger current drivers can be mounted externally and connected back to the controller board. Any combination of drivers can be connected to the controller. There are two options.

- 1) Onboard DRV8825 drivers – There are four locations for sockets to be added to the controller board that can accept Pololu DRV8825 drivers (<https://www.pololu.com/product/2982>). One to four drivers can be installed and used in any combination with external drivers. The DRV8825 drivers can be used with stepper motors up to 1.5A with no heatsink, and up to 2.2A with heatsinks and fan cooling. See the Pololu documentation for current setting and use of jumpers for microstepping settings.

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If V_{mot} is brought into the controller board, then the motor edge connectors (Motor 1, Motor 2, etc.) can be used for direct connection and output to stepper motors from the board (maximum of 12A combined).

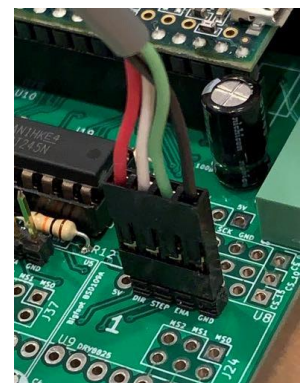
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- 2) External “industrial style” drivers – There are four header locations on the controller board to provide signals out to external “industrial style” stepper drivers. These are typically used for higher current motors, or for the convenience of selecting the motor current settings via DIP switches on the drivers. External drivers are connected using a “common ground” scheme, where the “–” terminals on the driver are connected to the GND (ground) pin on the controller, and the “+” terminals are connected to the individual signals (ENA = enable, DIR = direction and PUL = pulse or step).

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Typically “black” colored wires will be used for ground (GND) connections. Note the polarity of the header connector, with the black wire going to the GND pin on the board.


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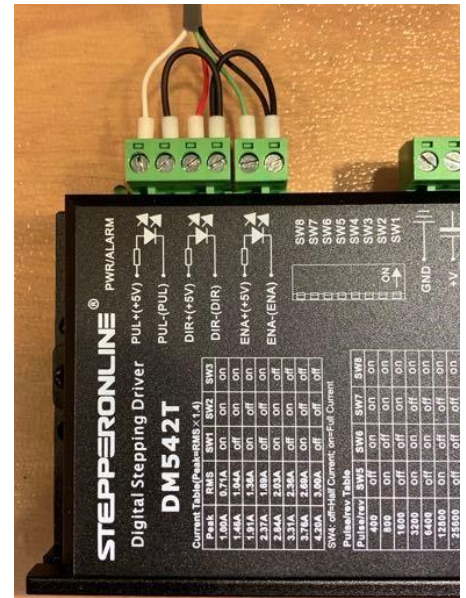
Onboard Bigfoot drivers – The controller was originally designed to accommodate a mid-size driver that allowed using motors up to 3A, the Bigfoot BSD109A drivers (http://www.panucatt.com/product_p/bsd109a.htm). This was never successfully tested, and has been eliminated from future designs.

[SEP]

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Stepper Motors – If onboard drivers are used, connect the appropriate pairs of motor wires to the onboard connectors. 

External Driver Connections – If using external drivers, connect the “–” terminals on the driver to the black (GND) wire and jumper to all three signals, ENA (enable), DIR (direction), and PUL (aka Step).



Teensy Pin and Breadboard Connections – The controller has numerous connection options for accessing the unused pins of the Teensy 3.5. These might be used for limit switches, other peripherals, and communications to other devices in the future. There is also a “breadboard” provision on the controller board to allow user additions and modifications for user-specific purposes. There are numerous locations to access 3.3V and 5V power, as well as GND connection near all the pins, allowing for easy button or other uses in conjunction with Arduino-style “pinMode(xx, INPUT_PULLUP)” mode.

Installing Software

In order to use the system, software must be installed on both the Teensy 3.5 and the Nextion touchscreen. The repository for the project software, RoseEngine_SpindleAndAxis is located on Github at https://github.com/elfren/RoseEngine_SpindleAndAxis.

Teensy 3.5 – There is a .hex file for the Teensy 3.5 in the Teensy directory, in a sub-directory names Teensy35. The .hex file (currently named 4Rose_Vxxx.hex) can be loaded onto the Teensy 3.5 using the Teensy Loader utility <https://www.pjrc.com/teensy/loader.html> (which requires prior installation of the Arduino IDE <https://www.arduino.cc/en/Main/Software> and Teensyduino extension https://www.pjrc.com/teensy/td_download.html ... not for the faint of heart ...

Nextion – Similar to the Teensy, the Nextion touchscreen needs to have software installed on it as well. The software for the Nextion is in the Nextion directory, in the Four_Axes subdirectory, named RoseEngin_Nxx.tft. This file needs to be copied to a microSD card and inserted into the Nextion’s card slot. Either connected to the controller board, or using the Nextion supplied USB adapter board and a USB Micro B cable, supply power to the touchscreen. It will detect and install the .tft file. After installation, remove the microSD card to run the system.

First Use Initialization

Prior to first use, numerous values need to be initialized via the Teensy and values stored in the Nextion. To make this easier a file named 4Axes.ini is at the top level of the repository. This file needs to be copied to a microSD card and inserted into the card slot on the Teensy 3.5. When the system is powered on, the “splash screen” on the Nextion will have a button in the lower right corner that will allow the .ini file to be read and values stored. After the file has been copied successfully, shut down, remove the card and re-boot the system.

Mounting

When mounting the Nextion touchscreen, note that the microSD card slot is oriented towards the bottom edge in our configurations. This is intended to minimize the possibility of any dust contamination when being used on the lathe.

Cautions

- Never disconnect a stepper motor from a stepper driver when the system is powered.
- All components and boards are sensitive to static electricity. Use precautions when handling.