

Power Supply, Arduino MEGA 2560, and Stepper Motors Connections

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Abstract: Arduino MEGA 2560 is required for this project to control the movement of the 3D printer axis and its extruder. It must be powered using a suitable power supply in order to function appropriately. A RAMPS is essential as link between Arduino and the other electrical components. This application note is intended to demonstrate the connections between the Arduino MEGA 2560, the stepper motors and the power supply.

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Keywords

Arduino MEGA, RAMPS, Power supply, Stepper motor, Extruder, Stepper driver.

Introduction

Arduino MEGA 2560 is an open-source physical computing platform predicated on a simple input/output board and a development environment that implements the Processing/Wiring language. The board based on ATmega2560 microcontroller. It contains 54 input/output pins, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button (Arduino). Thus, it is needed for the project to control the movement of the 3D printer axis and the extruder through stepper motors. To power the system a 12V 10A power supply is used since the recommended input voltage is between 7-12V. The board may be unstable with low input voltage and could be damaged with high input (Arduino).

Therefore, using the precise power supply and accurate connections are required to guarantee preferable outcomes.

Objective

Explain the connection between all the electrical parts in the 3D printer to assure they work as expected and to avoid damaging.

Hardware Needed

- Arduino MEGA 2560
 - [Datasheet](#)
 - [Schematic](#)
 - [PinMapping](#)
- RepRap Arduino Mega Pololu Shield
 - [RAMPS 1.4](#)
- 12V 10Amp power supply
- Stepper motors
 - [Datasheet](#)
- Wires

Getting Started

The Arduino board is the link between the power supply and stepper motors. Thus, it is important to understand the input/output pins of the microcontroller. As shown in figure 1 below, the Arduino board contains a 2.1mm power jack for external 7-12V power source. There is also a USB interface that can power the board by connect it to the computer. It has a total of 54 input/output pins that can operate at 5V and they can provide or receive a maximum of 40mA. They are split to 14 used as PWM outputs, 16 analog inputs, and 4 UARTs hardware serial ports (Arduino).

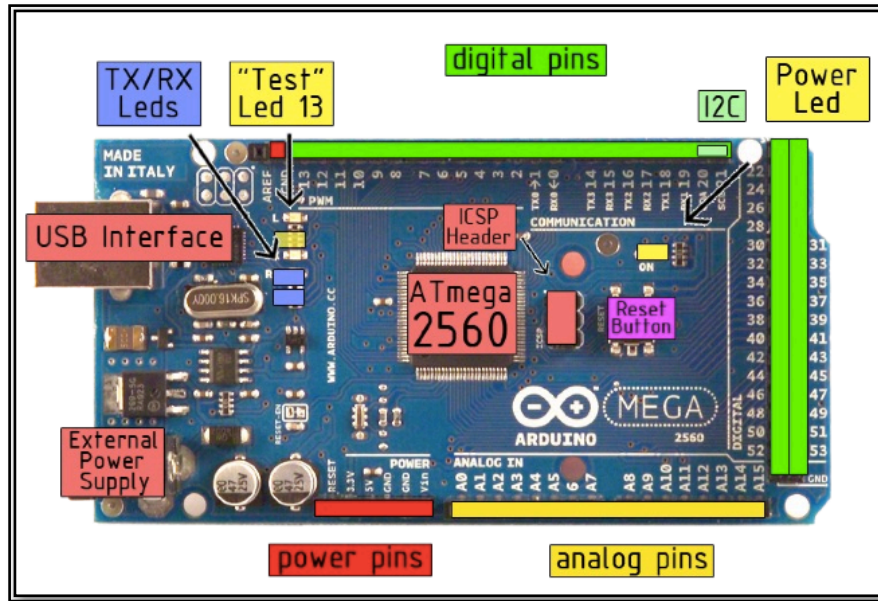


Figure 1: Arduino board

Moreover, a RepRap Arduino MEGA Pololu Shield, which is called RAMPS (see figure 2), is needed for the stepper motors and extruder connection. The RAMPS is provided with 3 PWM controlled MOSFET powered outputs, heated bed control with 11A fuse, three thermistor circuits, five Pololu Stepper Driver sockets, six sets of Digital Pins in headers with VCC and GND for endstops, uses pluggable screw terminal block for power connection, fused at 5A for additional safety and component protection, and Extra pins broke out: PWM, digital, serial, SPI, I2C and analog (Arduino).

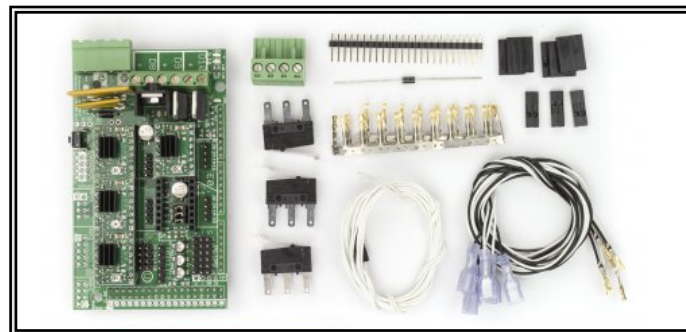


Figure 2: RepRap Arduino MEGA Pololu Shield

First step is to carefully plug the RAMPS into the Arduino without pinning any pins. Figure 3 is shown the Arduino as it connected to the RAMPS.

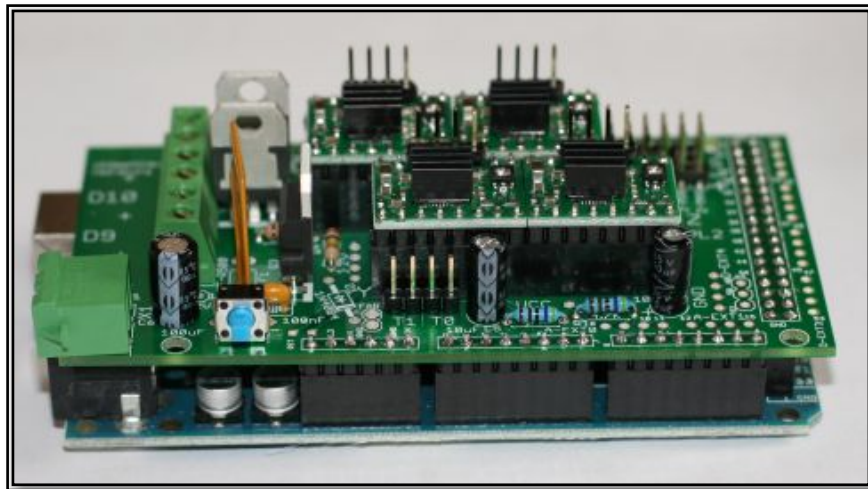


Figure 3: RAMPS plugged into Arduino

Stepper Motors and Arduino MEGA 2560 Connections

After the RAMPS and Arduino are plugged together, stepper motors need to be connected to the RAMPS. There are two types of stepper motors each with different driver circuit board. The first type is the bipolar motor, which is the strongest type of stepper motor. The motor moves by energies two coils inside and changing the direction of the current within those coils (see figure 4). It could have four or eight leads (RepRap). Second type is the unipolar stepper that has also two coils inside with a center tap in each one (see figure 4). The unipolar motor has the possibility to drive six or eight lead unipolar if the center tap wires is ignored. This type has less torque than bipolar motors since the center tap is used to energies only half of each coil at a time (RepRap).

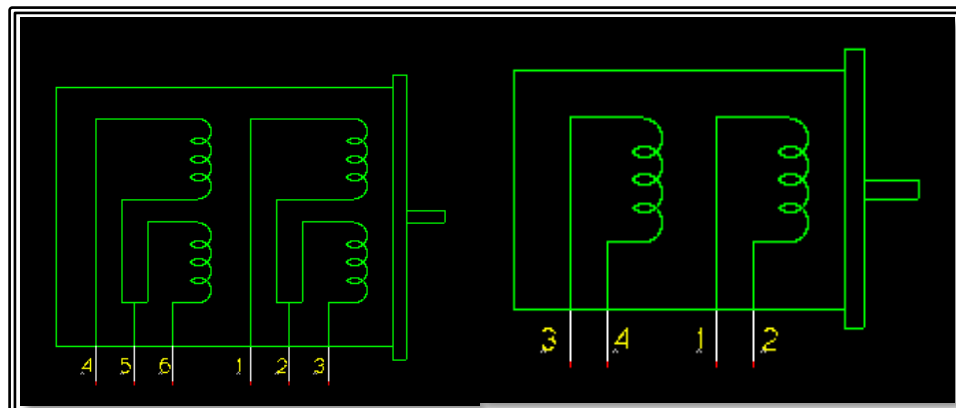


Figure 4: The two coils of a unipolar motor, each with a center taps to the left part. And the two coils of a bipolar motor to the right side.

For the 3D printer, the team decided to use the bipolar stepper motor that has four leads (see figure 5). It is very important to find the two pairs of wires, which are connected to each of the two coils. One way to do that is by using an ohmmeter by measuring the resistance of pairs of wires. The pair wires resistance should be less than 100ohm (RepRap). Figure 6 shows the wires end in the stepper motor to be connected to the RAMPS.

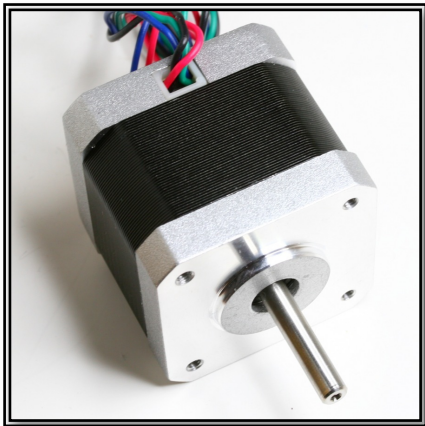


Figure 6: Bipolar stepper motor

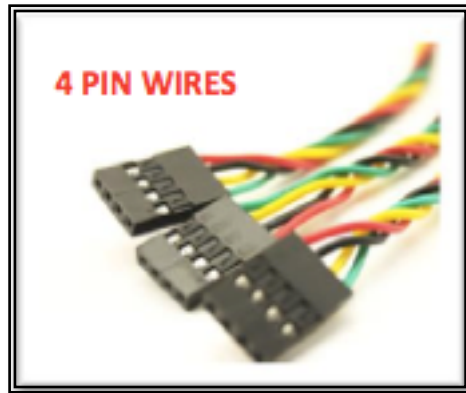


Figure 5: Stepper motor 4 pin wires

Before wiring the stepper motors to the RAMPS, the stepper driver for each axis and the extruder should be connected first to the RAMPS as shown in figure 7 and figure 8. After knowing the color code of stepper wires, simply connect the wires of the axis stepper motor to the RAMPS (see figure 9). Then connect the stepper motor in the extruder into the RAMPS as well as the hot end thermistor that inside the extruder to T0 in the RAMPS as shown in figure 10 (Note 1 – RAMPS KIT WIRES).

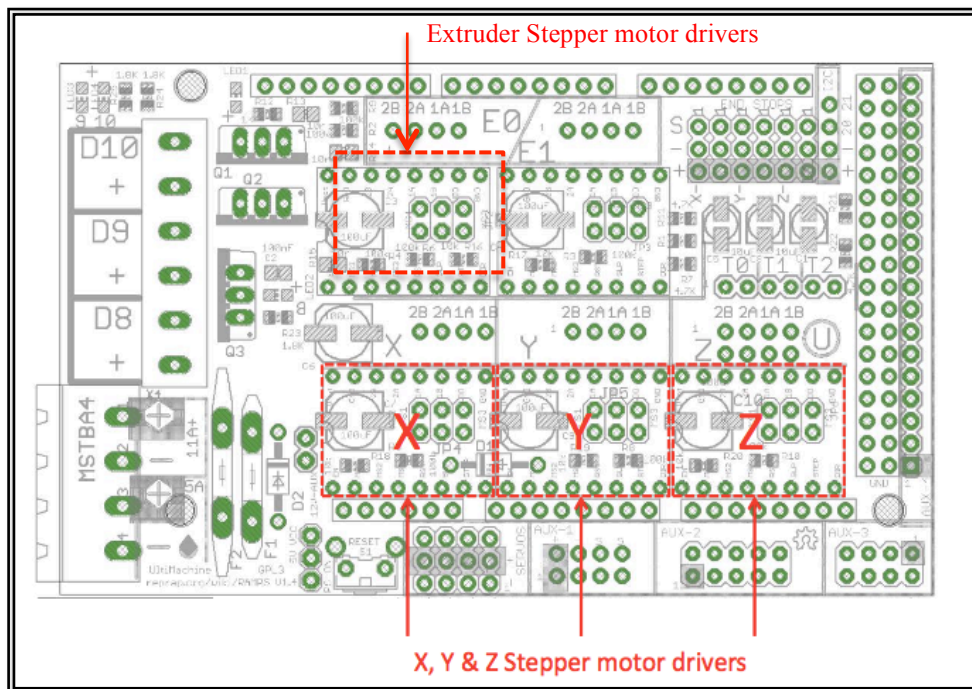


Figure 7: RAMPS schematic

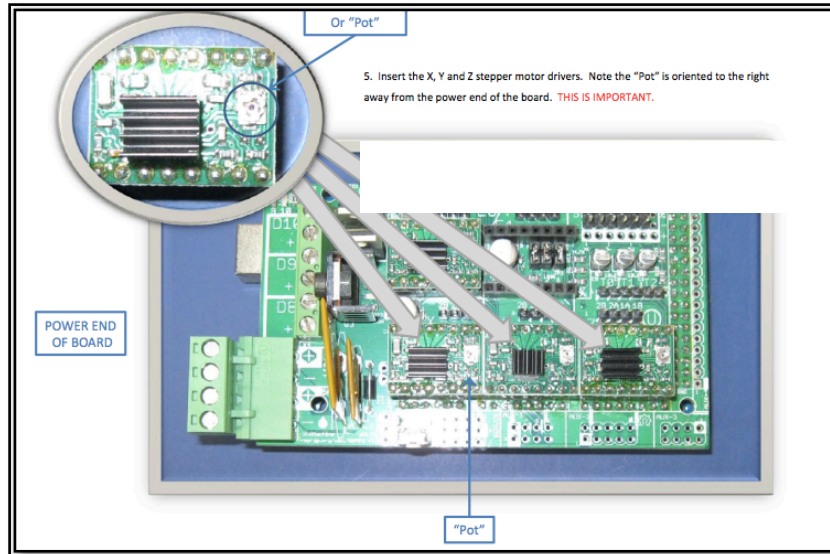


Figure 8: RAMPS and stepper driver connection

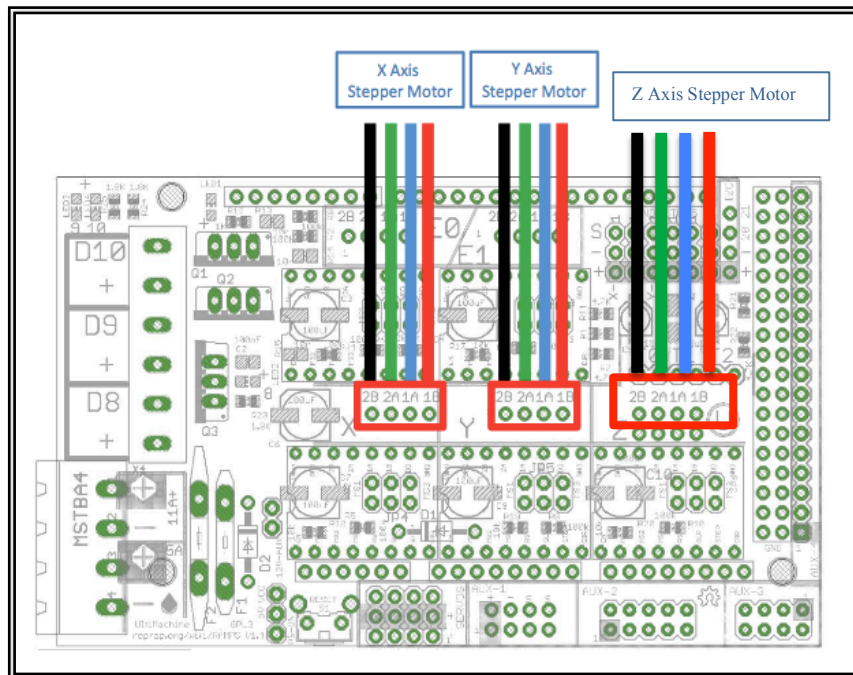


Figure 9: X, Y, and Z axis wire connections

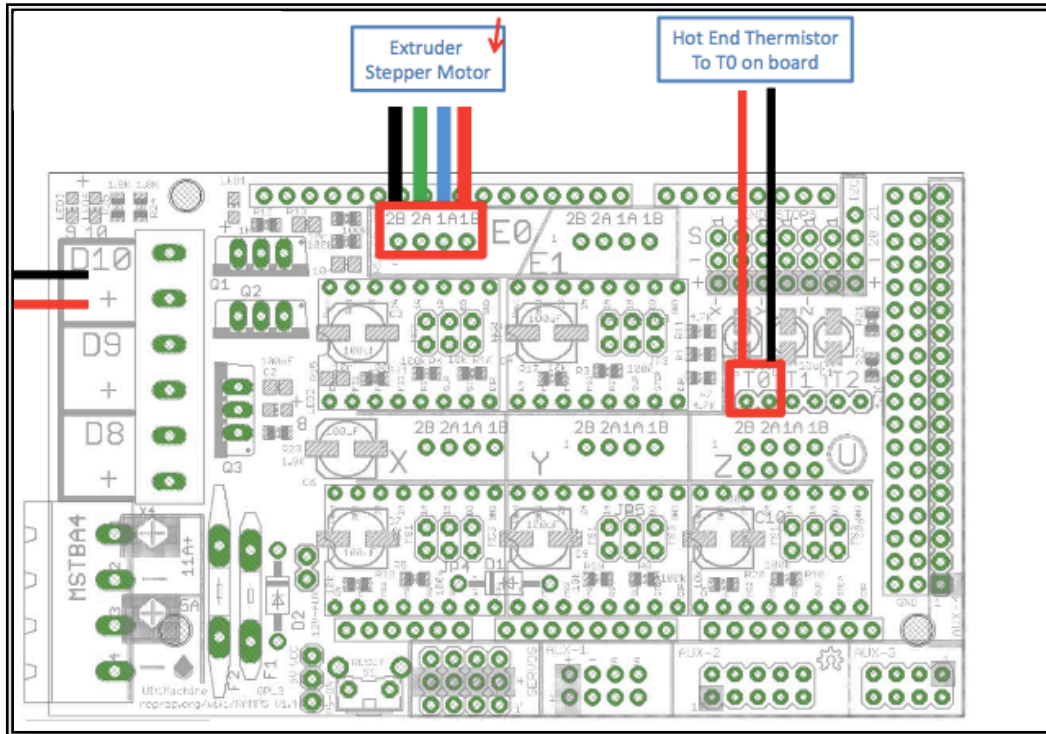


Figure 10: Extruder and thermistor connections

Arduino MEGA 2560 and Power Supply Connections

It is better to use the universal color code to connect the RAMPS to the power supply as the red wire is direct current positive and the black wire is direct current negative. To get the full potential of the RAMPS, it used a 12V power supply that can output 5A or greater (RepRap). Thus, it should be connected to the bottom pair of connector marked as 5A (see figure 11). The other connector is used to power the heated bed, which is not used in the project.

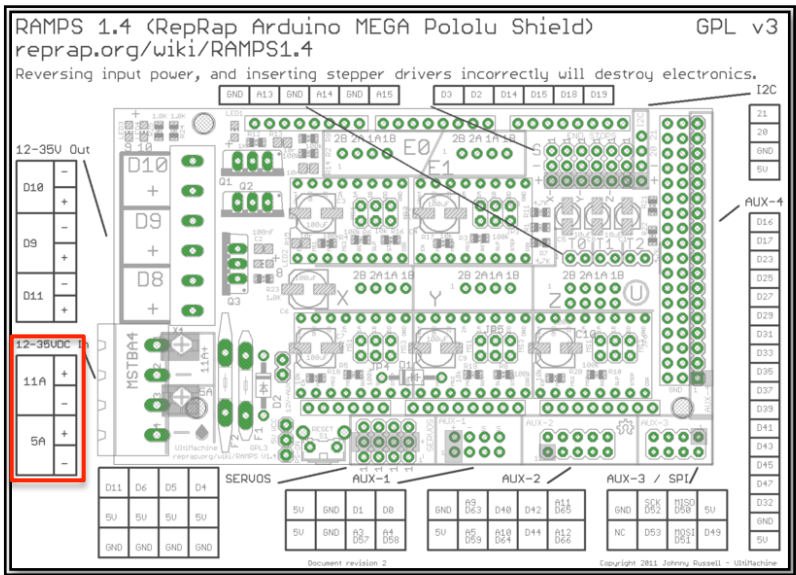


Figure 11: Power supply connectors

Conclusion

This document contains an explanation for connecting the electrical parts of the 3D printer. Each section covers brief description of each component and its schematic that would help understanding the appropriate wiring without causing damage.

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