VORON

Assembly/Setup Guide

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Introduction

Thank you for downloading the unofficial VORON CoreXY 3D printer assembly and setup guide! This guide was developed with the 3D printing newcomer in mind to ensure better understanding of the concepts of the printer, regardless of your level of experience.

This guide will walk you through every stage of the VORON setup process, explaining concepts as they become necessary to understand. It is important that you read each page in its entirety to ensure that you configure everything exactly as described, especially once you get to the electronics layout. **Failure to follow instructions with electronic components can lead to catastrophic failure of your equipment, with shorted equipment at best, and electrical shock/fires at worst.**

Take note that the VORON CoreXY 3D printer is an open source platform, under the lead of Maksim Zolin, and this guide may be outdated by the time you read it. To ensure that you have the most up to date set of instructions, please visit one of the official VORON sites:

MZBot Website
http://mzbot.us/

VORON Reddit Community
https://www.reddit.com/r/voroncorexy/

VORON GitHub Repository
https://github.com/mzbotreprap/VORON

In addition to these pages, a VORON Facebook group has been started to ensure better coverage across the community.

This manual will cover VORON up through 1.5. The primary differences between VORON 1.0 and VORON 1.5 are within the gantry and X-carriage components.

Screenshots used in this manual will be from both macOS and Windows systems. If the software used on one operating system is laid out substantially different from its counterpart on another operating system, these differences will be accounted for.

List of Changes

Because this is a living document, changes will continue to be made as the VORON evolves and the community submits improvements/advice.

Date	Change Description	Author
12/23/16	Completed RAMPS Board Setup	Terrance S.
11/26/16	Guide created	Terrance S.

Conventions Used in This Guide

Throughout this guide, there will be various icons to indicate helpful tips, as well as cautionary or warnings to be followed to the fullest extent possible. Where applicable, here are the meanings behind these indicators:

This is an informational block (e.g., a *note*), and provides insight to the surrounding text that you may find useful.

This is a warning block, and will mention any particular hazards that could be fatal to your equipment (or yourself), and should be heeded absolutely.

Bill of Materials (BOM)

The parts shown here within the bill of materials (BOM) have been copied from those on the official VORON CoreXY GitHub page. The primary difference here is that these components have links provided to vendors that will reduce shipping costs and overall wait for the VORON components. That being said, Amazon is extensively used due to the fact that they have the vast majority of parts required for the built at relatively competitive prices.

Where possible, links have been provided to the vendor pages for easier ordering. **Please ensure you read the notes, as this BOM has been modified from the official VORON BOM due to Amazon components being substituted, among other changes/notes.**

For the quantities of each of these components, bear in mind that these *exact* quantities are required to complete the build. As such, you may want to procure spares of certain items—screws, DuPont, and MicroFit3 connectors, for example—to ensure that you have more on hand in the event you make a mistake and damage them.

To reiterate one final time: This BOM encompasses all the parts listed from the official BOM, but with a heavier lean on Amazon for the procurement of the parts. Bear in mind that some of these parts may be inferior to those specified in the official BOM; where applicable, user ratings have been taken into consideration when selecting these components.

Frame

Description	MZBot Part #	Supplier	Supplier Part #	Qty
2020 Extrusion – Black – 370mm	VB-FR-01-EXT1	Misumi	HFSB5-2020-370	12
Cube Corner Bracket	VB-FR-01-CB1	*OpenBuilds	Link	8
Cube Corner Bracket		*Misumi	HBLCR5-B	8

As of November 25, 2016, Misumi is offering 30% off all orders within 30 days of creating your account.

*For the corner brackets, you can opt to use either OpenBuilds or Misumi for the source. OpenBuilds' product is roughly $2.00 cheaper in comparison, but their shipping can also be arguably slower.

You can also opt to have Misumi tap the ends of the extrusions for you. Note that this option will add a pretty substantial fee on to the extrusions (price of extrusions *without* tapping as of this writing: $3.25/ea; price of extrusions *with* tapping (selecting **Both Ends Tapped (TPW)**): $6.85.

Linear Motion

Description	MZBot Part #	Supplier	Supplier Part #	Qty

Description	MZBot Part #	Supplier	Supplier Part #	Qty
Linear Shaft – 8mm – Hardened – 320mm	VB-LM-01-LS1	Misumi	PSFJ8-320	8
Linear Bearing (Single)	VB-LM-01-LB1	Misumi	LM8UU	2
Linear Bearing (Double)	VB-LM-01-LB2	Misumi	LMUW8	6
GT2 belt – 6mm x 2mm pitch 1.5M	VB-LM-01-GTB1	Amazon	Link	2
GT2 pulley – 20 tooth – 2mm pitch	VB-LM-01-GTP1	Amazon	Link	2
NEMA 17 Linear Stepper TR8x8 300mm (with nut)	GB-EL-01-LSM1	Amazon	Link	2
F695ZZ – Flanged Ball Bearing	VB-LM-01-BBF1	Amazon	Link	16

Electronics

Description	MZBot Part #	Supplier	Supplier Part #	Qty
NEMA 17 Stepper	VB-EL-01-SM1	Amazon	Link	2
Arduino MEGA2560 R3	VB-EL-01-AM3	Amazon	Link (RAMPS Kit)	1
RAMPS 1.4 SP	VB-EL-01-RSP	Amazon		1
LCD Controller Full Graphics	VB-EL-01-LCD	Amazon		1
DRV8825 Drivers (set of 5)	VB-EL-01-DRV	Amazon	Link	1
Endstop Microswitch (KW10 series, hole distance 6.5mm)	VB-EL-01-ESS1	Amazon	Link	2
12V PSU 16.7A	VB-EL-01-PSU1	OMC StepperOnline	S-201-12	1
250V 10A 3pin IEC320 C14 Inlet w/ fuse and switch	VB-EL-01-ISW1	Amazon	C14	1
Bed Thermistor – M3 Hex Stud – EPCOS	VB-EL-01-TB1	eBay	Link	1
Bed Harness Connector – Molex	VB-EL-01-BHC1	Mouser	538-76650-0065 (2-pack)	1
Silicone Heater 110V 250W	VB-EL-01-BH1	Omega	SRFG-505/10-P	1
110V SSR – Omron	VB-EL-01-SSR1	Mouser	653-G3A-210B-DC5	1
2-pin DuPont jumper wire (12V supply for Fan Expansion Board)	VB-EL-01-FXW1	eBay	Link	1
RAMPS Fan Expansion Board	VB-EL-01-RFX1	eBay	Link	1
DuPont Connector Kit	N/A	Amazon	Link	1
Molex MicroFit3 3-pin plug housing	VB-EL-01-MLX-H3	Mouser	538-43640-0301	1

Description	MZBot Part #	Supplier	Supplier Part #	Qty
Molex MicroFit3 3-pin receptacle	VB-EL-01-MLX-R3	Mouser	538-43645-0300	1
Molex MicroFit3 2-pin plug housing	VB-EL-01-MLX-H2	Mouser	538-43640-0201	7
Molex MicroFit3 2-pin receptacle	VB-EL-01-MLX-R2	Mouser	538-43645-0200	7
Molex MicroFit3 female pin (20-24AWG)	VB-EL-01-MLX-FP1	Mouser	538-43030-0007	4
Molex MicroFit3 female pin (26-30AWG)	VB-EL-01-MLX-FP2	Mouser	538-43030-0010	13
Molex MicroFit3 male pin (20-24AWG)	VB-EL-01-MLX-MP1	Mouser	538-43031-0007	4
Molex MicroFit3 male pin (26-30AWG)	VB-EL-01-MLX-MP2	Mouser	538-43031-0010	13
Spade connector (female)	VB-EL-01-SPC-F	Amazon	Link	8
Spade connector (male)	VB-EL-01-SPC-M	Amazon	Link	1
20AWG wire (black) 9'	VB-EL-01-W20-B	Amazon	Link	1
20AWG wire (red) 9'	VB-EL-01-W20-R	Amazon		1
20AWG wire (white) 9'	N/A	Amazon	Link	1
20AWG wire (green) 3'	VB-EL-01-W20-G	Amazon	Link	1
CAT5e stranded patch cable wire (6')	VB-EL-01-CAT5	Amazon	Link	1
80x80x10 case fan 12V	VB-EL-01-F802	Amazon	Link	1
40x40x20 blower fan 12V	VB-EL-01-F302	Amazon	Link	1
Inductive Proximity Sensor	VB-EL-01-IPS1	Amazon	LJ12A3-4-Z/BX	1
2M Ohm resistor (for inductive sensor)	VB-EL-01-R2M	Amazon	Link	1
USB Cable	VB-EL-01-USB	Amazon	Link	1
C14 Power Cable (US)	VB-EL-01-PC-US	Amazon	Link	1

⚠️ **The bed heater in this instance must be suitable to the task. You can use an alternate supplier for this component, but you must ensure you meet the 110V 250W requirement at a <u>minimum</u>.**

Electronics (Optional)

Description	MZBot Part #	Supplier	Supplier Part #	Qty

LED strip	VB-EL-01-LED1	Amazon	[Link](#)	1
Thermal protection fuse (120°C)	VB-EL-01-TPF1	Amazon	[Link](#)	1

Extrusion

Description	MZBot Part #	Supplier	Supplier Part #	Qty
E3D Chimera and/or E3Dv6 Kit	VB-EX-01-DHK1	Filastruder	[Link](#)	1
NEMA 17 Stepper	VB-EL-01-LSM1	Amazon	[Link](#)	2
VORON Belted Extruder – Bowden	VB-BX-HW-KIT2	MZBot	(see separate BOM for parts)	2

Build Plate

Description	MZBot Part #	Supplier	Supplier Part #	Qty
Aluminum tooling plate MIC-6 9"x9"x0.25"	VE-B-AL-9	Midwest Metal Warehouse	[Link](#)	1
PEI sheet 9"x9"x0.04"	VE-B-PEI-9	Amazon	[Link](#)	1
3M 468MP 12"x12"	VE-B-3-M468-12	Amazon	[Link](#)	1

Hardware (KIT4)

Description	MZBot Part #	Supplier	Supplier Part #	Qty
10mm M5 cap socket screw	VB-HW-CSS-M5-10	McMaster Carr	91239A224	36
30mm M5 cap socket screw	VB-HW-CSS-M5-30	McMaster Carr	91239A236	6
20mm M3 hex socket screw	VB-HW-HSS-M3-20	McMaster Carr	91290A123	9
30mm M3 hex socket screw	VB-HW-HSS-M3-30	McMaster Carr	91290A130	5
40mm M3 hex socket screw	VB-HW-HSS-M3-40	McMaster Carr	91290A136	2
16mm M3 hex socket screw	VB-HW-HSS-M3-16	McMaster Carr	91290A120	19
8mm hex socket screw	VB-HW-HSS-M3-8	McMaster Carr	91290A113	25
12mm hex socket screw	VB-HW-HSS-M3-12	McMaster Carr	91290A117	2

6mm M4 cap socket screw	VB-HW-HSS-M4-6	McMaster Carr	91239A138	4
M3 hex nut	VB-HW-HN-M3	McMaster Carr	90591A250	14
M3 hex lock nut	VB-HW-HLN-M3	McMaster Carr	90576A102	4
M5 hex nut	VB-HW-HN-M5	McMaster Carr	98676A300	2
M5 steel washer	VB-HW-WST-M5	McMaster Carr	98269A440	2
No. 6 neoprene washer	VB-HW-WNP-M3	McMaster Carr	90133A005	16
M3 steel washer	VB-HW-WST-M3	McMaster Carr	98269A420	4
Plastics screw No. 1 7/16"	VB-HW-PS-1	McMaster Carr	92470A056	4
1" L spring 0.408" OD	VB-HW-SPB-1	McMaster Carr	9657K311	4
M3 pressfit threaded insert	VB-HW-PFTI-M3	McMaster Carr	94510A030	3
M5 drop-in T-slot nuts	VB-FR-01-TSN2	Amazon	Link	36
Phillips #10-24 5/8" thread-rolling screws	VB-FR-01-PTS1	Fastenal	145017	24

For the thread-rolling screws (VB-FR-01-PTS1): These are for actually connecting your extrusions together. **Note: This is an incredibly time-intensive process and will require patience and care to avoid damaging the aluminum extrusions.**

(i) You can also bypass this requirement by opting to have Misumi tap the ends of the extrusions for you. Note that this option will add a pretty substantial fee on to the extrusions (price of extrusions *without* tapping as of this writing: $3.25/ea; price of extrusions with *with* tapping (selecting **Both Ends Tapped (TPW)**): $6.85.

Yet another option would be to purchase a 10-24 thread tapping drill bit if you own a drill; this will substantially reduce the amount of effort it requires to complete this phase of assembly.

Tools

Description	MZBot Part #	Supplier	Supplier Part #	Qty
Ball-end Allen wrenches		Brondhus		1
SuperLube 21030 synthetic lube with PTFE		Amazon	Link	1

Tools (Optional)

Description	MZBot Part #	Supplier	Supplier Part #	Qty
DuPont crimper		Amazon	Link	1

Printed Components

In addition to the components outlined in the BOM, you must also obtain the printed components. MZBot has provided the STL files required for this within the VORON GitHub repository, and each filename specifies the quantity of parts you will need. Additionally, they are listed here for completeness.

Within the GitHub repository, you can find these files located within **STLs > VORON** and **STLs > VORON Belted Extruder**. In the event that you want to choose an alternate form of extruder (for example, a flexible filament extruder, check out the corresponding folder).

Component Breakdown

	Part	Part Name	Qty
☐		a_idler_lower	1
☐		a_idler_upper	1
☐		a_motor_mount	1
☐		b_idler_lower	1
☐		b_idler_upper	1
☐		b_motor_mount	1
☐		bed_support_carriage_a_x2	2
☐		bed_support_carriage_b_x2	2
☐		bed_support_carriage_midsection_x2	2
☐		belt_clip_x2	2
☐		blower_fan_duct	1
☐		carriage_end_a	1

☐		carriage_end_b	1
☐		hotend_mount_chimera_bottom	1
☐		hotend_mount_chimera_top	1
☐		hotend_mount_e3d_v6_x2	2
☐		lcd_case-back_cover	1
☐		lcd_case-jog	1
☐		lcd_case-main	1
☐		lcd_case-stop_button	1
☐		power_box	1
☐		psu_upper_brace	1
☐		ramps_case-body	1
☐		ramps_case-door	1
☐		ramps_case-fan_guard	1
☐		spool_holder	1*
☐		xy_bearing_retainer_a_x2	2
☐		xy_bearing_retainer_b_x2	2
☐		xy_idler_block_x2	2

☐		y_rod_retainer_x2	2
☐		z_motor_mount_x2	2
☐		z_sensor_mount	1
☐		z_shaft_support_lower_x4	4
☐		z_shaft_support_upper_x4	4

Component Sources

If you do not already have a 3D printer with which to print these components, you can either go to a 3D printing service such as 3D Hubs or even check out the RepRapPIF community on reddit. This community is made up of people that are willing to provide their printer's time to forward the 3D printing hobby in exchange for various things, with a roll of filament and cost of shipping being a recurring theme.

Alternatively, you can touch bases with someone from the VORON community, of course, and they may be willing to provide their time and printer to help you with this.

Initial Preparation

Before beginning assembly, it may be a good idea to test your electronic components to ensure that the RAMPS assembly and the stepper motors are in good working order. To that end, you will begin with some initial preparation to ensure that your computer system is in working order to move forward as you progress through the guide.

Download the Arduino IDE

Arduino is an open-source system that allows you to control physical components through a computer interface. Before you can do this with your own Arduino MEGA2560 board (a component of the overall RAMPS assembly), you will need to download and install the Arduino IDE (Integrated Development Environment).

1. Go to the Arduino IDE download page at https://www.arduino.cc/en/Main/Software.

2. Download the Arduino software for your platform (Windows/Mac/Linux).

3. Once downloaded, install the software; install drivers if prompted to do so.

Download Pronterface

Pronterface is one of many programs that can be used to interface with the control boards in 3D printers. Though it is not as full-featured as many of the higher end programs, its strengths are in its expandability, as well as that it is free for use.

1. Go to the Printrun GitHub repository at https://github.com/kliment/Printrun.

2. Scroll down the page until you see "GETTING PRINTRUN". You will see links to a page that has the Windows and Mac binaries (executables and their dependencies), as well as steps for Linux users. Download the binaries and extract them if necessary. You are done here for now, but remember the location of your Pronterface executable.

Download and Configure Cura

Cura is software developed by the Ultimaker company, creators of a high-end desktop 3D printer. Cura's function in the 3D printing space is that of the *slicer*: a program that takes a 3D model and "slices" it into the many, many layers that a 3D printer can understand. The output from a slicer is either sent directly to the printer via wifi or USB connection, or saved as GCode.

1. Go to the Cura download website at https://ultimaker.com/en/products/cura-software/list.

2. Scroll down if necessary and select the most recent version 15 release. As of the time of this writing, that is version 15.04.6 (released on 06/07/16). Version 2 of Cura brings with it a lot of extra bells and whistles, but may not work correctly with the provided VORON Cura profile.

3. A window will pop up asking for your usage of the software. You can choose to answer the question (and its follow-on questions) or you can select "I don't want to share any information". Either way, download the software.

4. Once downloaded, install Cura. During the setup of Cura, one of the options provided is to install Arduino drivers. Unless you skipped installation of those drivers when you installed the Arduino IDE, you can skip it (uncheck the option) now.

5. Once installation is completed, go ahead and run Cura to get the basic VORON profile set up.

   a. One of the first things you should see when you run Cura for the first time is the **Configuration Wizard**. If you don't, cancel out of any window you're in to access the main Cura Interface, and select **Machine > Add new machine...**. You should see a window that looks similar to the following.
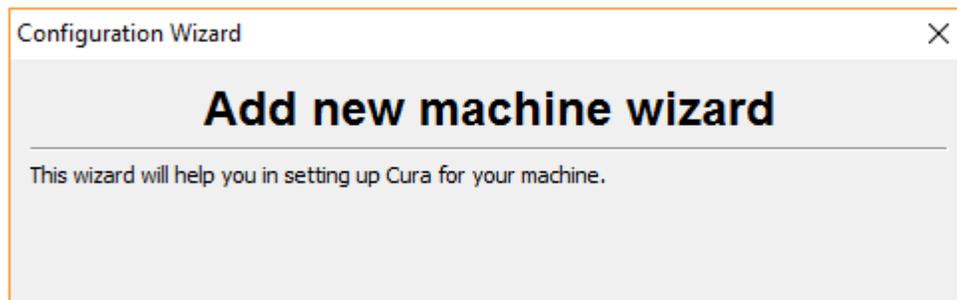
The Cura Configuration Wizard.

   b. Click **Next**.

   c. On the **Select your machine** screen, select **Other (Ex: RepRap/Makerbot/Witbox)**, and then click **Next**.

   d. On the **Other machine information** screen, leave **Custom...** selected and click **Next**.

   e. Use the following settings in the **Custom RepRap Information** screen:

   Machine Name: VORON

   Machine Width X (mm): 230

   Machine Depth Y (mm): 230

   Machine Height Z (mm): 230

   Nozzle size (mm): 0.4

   Check **Heated Bed**

Leave **Bed center is 0, 0, 0 (RoStock)** unchecked (this is used for delta-style 3D printers; on the VORON printer, the bed center is at **115, 115, 10**)

f. Click **Finish**.

g. This will return you to the main Cura interface. All that remains now is to load the VORON Cura profile.

     i. Download the VORON Cura profile here, or using the following link: https://syrinathos.com/files/cura_profile.ini.

     ii. Back in Cura, click **File > Open Profile...**.

     iii. Select the profile you downloaded in step i, and click **Open**. The VORON configuration settings are now loaded into Cura for use later.

h. Cura configuration is now complete. You can quit Cura until later.

RAMPS Board Setup

Getting your RAMPS (RepRap Arduino MEGA Polulu Shield) board set up is straightforward, but can seem daunting to first-time 3D printer users. Depending on the route you chose for sourcing the parts, you may end up needing to perform soldering to get your board up and running; this is why a RAMPS kit has been recommended for the modified BOM within this guide.

The photos shown here may reference the A4988 drivers, whereas the VORON utilizes DRV8825s. So long as you read this portion carefully, you will be able to follow these instructions for either stepper driver.

Ensure that you follow the instructions provided here with zero deviation. Failing to do so could lead to electrical shock, fire, or bodily harm; as well as (most definite) damage to your electronic components.

Unpack your kit

The first thing that you'll want to do is unpack your kit (cannot recall how many times I've advocated this route at this point, but it's the easiest way to get into this path). You should have the following items:

Specifically, your kit should come with the following items at a minimum:

- RAMPS board (current version in most kits these days is 1.4)
- Arduino MEGA2560 board (most kits will sell clones of the authentic Arduino board)
- A4988 stepper drivers with heatsinks (5)
- Jumper pins (15 is the minimum, you may receive spares)
- LCD smart controller with the smart controller adapter and cables
- USB A cable (all kits I have purchased have included insanely short cables; I'd recommend getting your own with at least a 6' length, but your mileage may vary)

A breakdown of the critical components (minus the LCD controller) are shown below. Make sure that you familiarize yourself with the terminology, as it's not going anywhere.
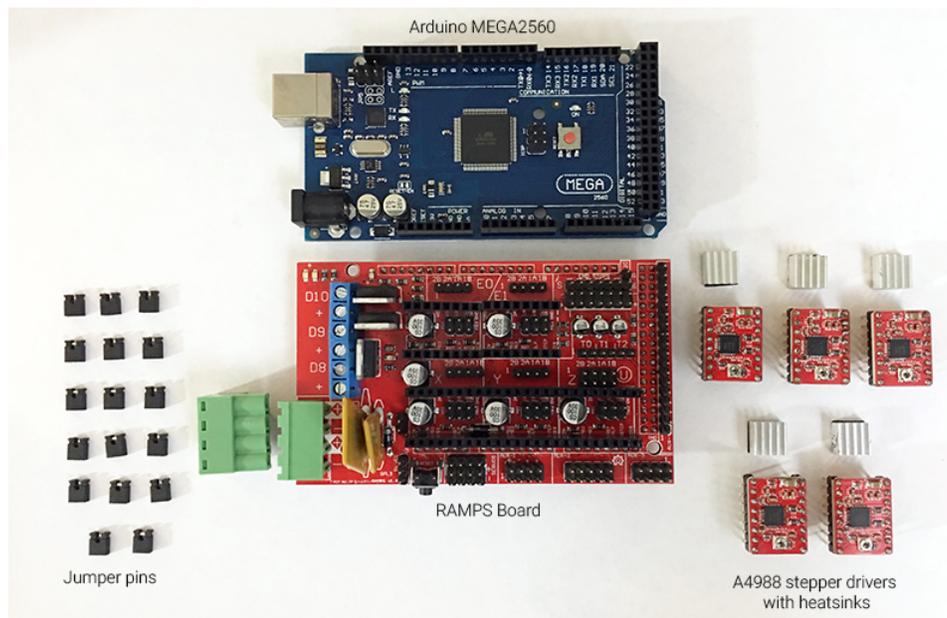
Inspect your kit

The MEGA2560 board will factor very little into the overall assembly process as far as we're concerned, but inspect the board and make sure that there are no bent pins/connectors to ensure you won't have any issues going forward.

And on the note of inspection, you'll most definitely want to inspect your RAMPS board itself for any and all bent pins. It can and does happen, and there's no real say as to whether that happens in transit from the vendor to you, or from the manufacturer to the vendor.

You may run into a situation where your RAMPS kit has bent pins, either on the underside where you install it onto the MEGA2560 board, or the topside where you connect your various motors and other components.

This is not a fatal issue: Using needlenose pliers or a similar tool, gently bend them straight.
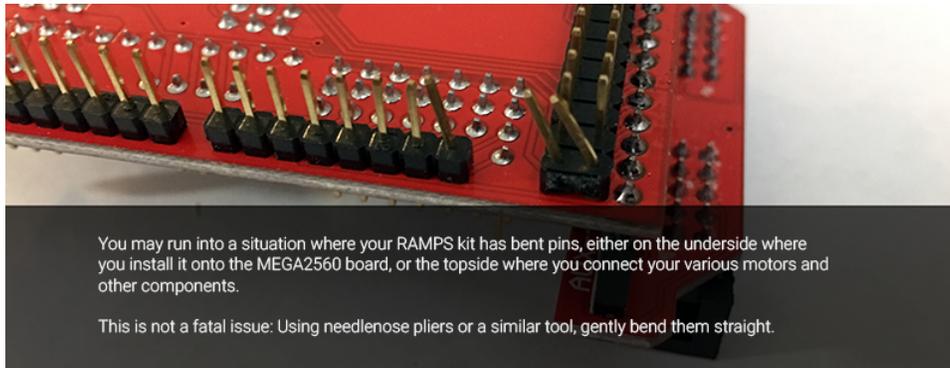
The positive note here is that the problem is easily remedied with some pliers (I'd recommend needlenose pliers because… well, they've got finer tips and are less likely to bend surrounding pins as you fix the issue.

As promised: with some pliers and a steady hand, you can easily bend the pins back into their straight and desirable layout.

Remember: Be sure to do this very carefully, as they can be broken if you use too much force, and you will have to solder in new DuPont connectors to replace them.
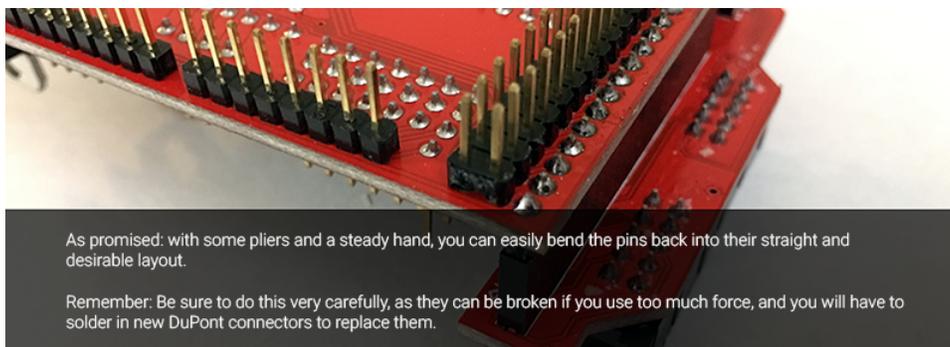
Before you proceed *any* further, look at the actual board itself and familiarize yourself with the pin assignments. This will become **crucial** later on when you start installing your stepper motor drivers.

This is the RAMPS board that you will receive in a typical RAMPS kit. The color of the board may vary from vendor to vendor, but generally—if not always—the pin layouts will remain consistent.

Highlighted here are the areas where you will need to install the included jumper pins. You will use 15 of them (you may receive spares) to modify the settings the RAMPS board uses to control the stepper drivers.

Regardless of the driver used, the jumpers will be installed in the same manner on the same pins.

Shown in the photo above, you can see the RAMPS board from the Kuman kit with each individual section of pins labeled in a pretty minimalist way. Without having to think about it too hard, though, you can see areas marked off as **E0**, **E1**, **X**, **Y**, and **Z**. These are where we will be installing the stepper motor drivers later on, but for now pay attention to the areas marked 1 through 5.

1. Jumpers for **Extruder 0**
2. Jumpers for **Extruder 1**
3. Jumpers for **X axis**
4. Jumpers for **Y axis**
5. Jumpers for **Z axis**

In addition to the jumpers, look at the pin assignments inscribed on the board surrounding each block. You'll see words like **GND**, **DIR**, and so on. When you go to install your steppers, these will need to be taken into account to ensure you don't short your equipment, or hurt yourself/others. **This point will be re-stated throughout this portion of the manual as you can easily hurt yourself, others, or your damage your electronics.**

Install the jumpers

The jumpers you received will need to be installed to set the appropriate step settings for the stepper drivers that will be installed immediately after. It is important to note that RAMPS boards are very specifically labeled with regards to what goes where, and this will help immensely for this and subsequent tasks. For jumper installation, you will want to inspect the RAMPS board and look at the pins labeled **MS1**, **MS2**, and **MS3**.

Depending on the drivers you end up using (either the VORON-recommended DRV8825 or the kit-included A4988), you will be using a 1/16 microstep setting for your VORON system. The table below illustrates the jumper settings to use dependent on your driver selection:

Driver	MS1	MS2	MS3
A4988	Yes	Yes	Yes
DRV8825	No	No	Yes
TMC2100	No	No	No

As each jumper can cover a maximum of two pins, a **Yes** shows that you will install a jumper covering both pins for either **MS1**, **MS2**, or **MS3**, whereas a **No** indicates that you will not install a driver in that slot.

That aside, let's go ahead and take those jumpers and install them in place. Remember, you'll be using 5 of them in total across the five areas shown in the last photo (1 jumper per area). When it's all said and done, you should have something resembling the following:

The RAMPS board with all 15 jumpers installed. Note that these jumpers must be installed before the stepper drivers, as they are located between the rails (female DuPont connectors) that the drivers will be installed in.

Note that this configuration covers the X, Y, and Z axes as well as a maximum of two extruders.
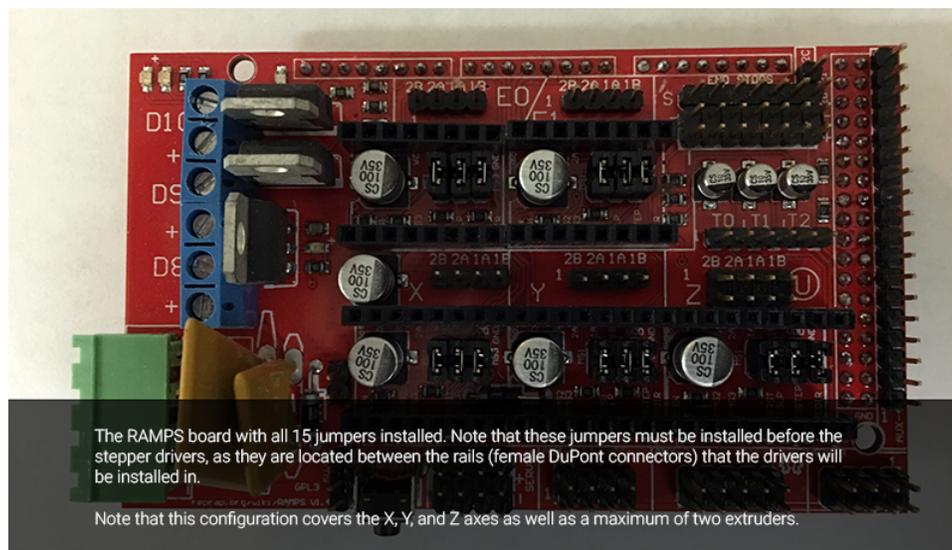
This illustration depicts the jumper settings when using a DRV8825 stepper driver in slot **E0**. Refer to the preceding chart for the jumper settings for the stepper drivers you selected to use for your build.

Using the depicted jumper settings when using a DRV8825 driver will configure that driver for 1/32 microstepping, which will require you to double the step values within Marlin's Configuration.h file later on.

Trim some pins

Next up is installing the RAMPS board onto the MEGA2560. Before you can do this, though, there is a concern worth note: the power supply pins from the RAMPS board run a bit long on one side and end up causing issues with proper seating between the two boards:

With the RAMPS board stacked on the MEGA2560 board, you can see that the pins from the RAMPS power input port would press firmly against the power input to the MEGA2560 board.

This would not cause a short (as the MEGA2560's power input is surrounded by plastic), but will lead to an improper fit between the two boards.

Your options are to clip the excess pin length from the RAMPS board on the two left-most pins, or remove the MEGA2560's power input via soldering iron (as it is not used in this configuration).

As stated in the above illustration, you have two options that you can pursue and both are completely viable:

- You can clip the longer pins so they don't prevent proper seating of the boards.
- You can remove the MEGA2560 power input connector since you won't be using it.

Of the two options, it is recommended to clip the connectors: This way you can reuse the MEGA2560 board for other purposes down the road without having to re-solder the power connector should that become a requirement. What's more: most people will have something they can use to clip the pin excess (e.g., nail clippers, wire cutters, etc.) than are likely to have a soldering iron.

Once your pins have been clipped, you will have something resembling the following:

With the RAMPS board power input pins clipped (using wire cutters or similar tool), you have a much better fit with the RAMPS and MEGA2560 boards.

An alternative solution would be to use a soldering iron and remove the power input port from the MEGA2560, but clipping the pins on the RAMPS board is a faster, simpler solution.
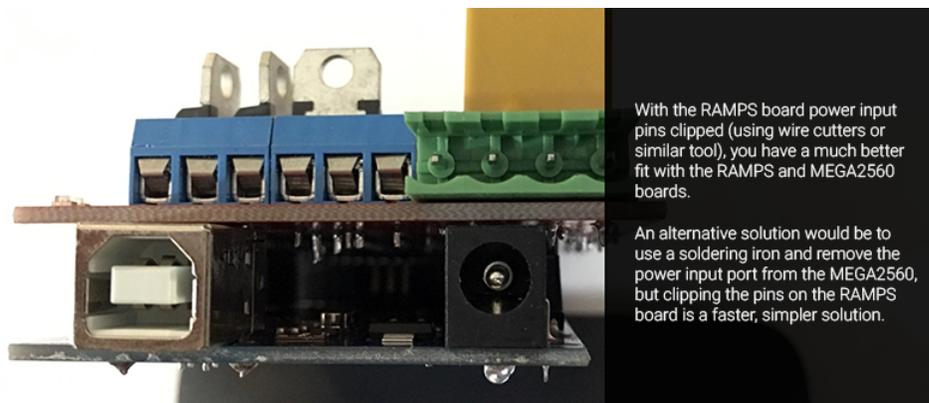
Clipped pins on the RAMPS board leads to a substantially better fit.

That photo was a bit out of order with the flow of things, but I wanted to show what the boards should look like from that end before proceeding.

Assemble the RAMPS/MEGA2560

With your pin issue resolved (regardless of which route you chose), you can now sandwich the boards together and have the following setup:

The RAMPS board installed on the Arduino MEGA2560 board. There is only one way that the RAMPS board will fit on the MEGA2560; use the end furthest from the USB/power connections on the MEGA2560 as a reference.

When properly installed, the power input on both the RAMPS and MEGA2560 boards should be more or less flush.
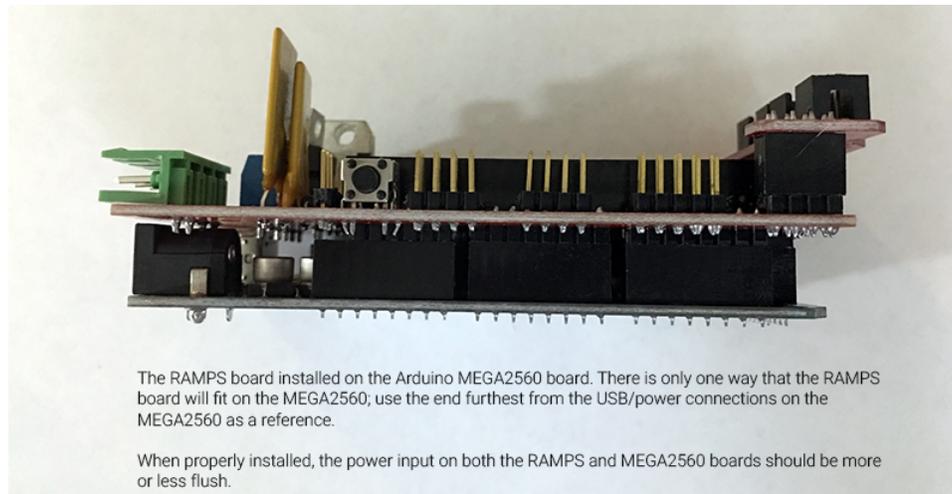
The stacked RAMPS/MEGA 2560 assembly.

As you can see in the photo, both boards are installed correctly with the closest fit possible between the male DuPont connectors of the RAMPS board and the female DuPont receptacles of the MEGA2560. As stated earlier, there's only one way for these two boards to fit together (correctly, that is); as long as you use the end opposite the power supply end as a guide, you'll be good to go.

Also remember that single button that you see next to the DuPont connectors: that's your **emergency reset button**, and in the event that your print goes horribly awry or your carriage decides to crash through the build plate on what should be a routine maneuver, you'll be able to stop the evolution **immediately**.

With the RAMPS/MEGA2560 assembly complete, we can move on to the final parts of the puzzle: the stepper drivers. Before we actually install them on the board, though, we're going to look at the differences between the top two drivers in use these days: the A4988 and the DRV8825 drivers (used in the VORON).

Stepper drivers

Stepper drivers are the components that actually drive the stepper motors. Specifically, RepRap.org has this to say about them:

"These chips keep the power that drives the motors separate from the power that is on the arduino. The arduino can't provide enough juice to power the stepper motors directly. This is why you have to use separate chips to sort of act as valves that control how the motor spins."

As mentioned before, there are two drivers that are predominantly used in 3D printing with RAMPS: the A4988 and DRV8825 drivers.
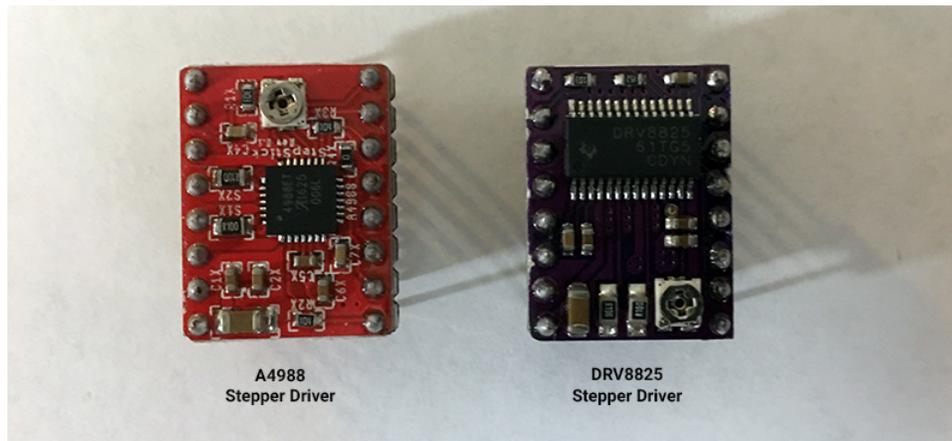
The A4988 and DRV8825 stepper drivers.

The primary difference between these two driver options is in how precisely they can control your stepper motors, as well as how quietly they operate. You can find more information on the RepRap comparison page, but in summary: the DRV8825 will give you much finer control over the microsteps that your motors can make.

The important takeaway from the above illustration is that the orientation of the drivers is intentional. The potentiometer (the metal disc with a Phillips indentation) is actually flipped on these two drivers, as highlighted here:

Note that the potentiometers (used to control voltage throughput on the drivers) are on different sides of the drivers when viewed from the top side.

Potentiometer location should **never be used for orientation** of the drivers when installed on the RAMPS board!
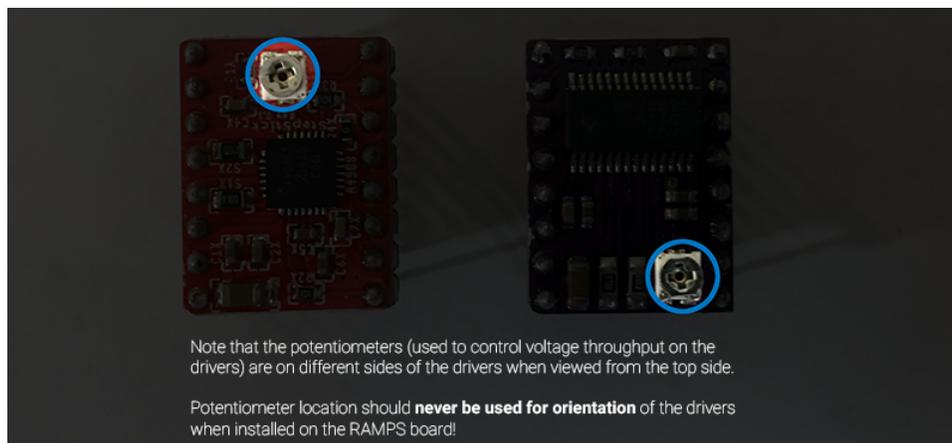
Potentiometer location on the A4988 (left) vs the DRV8825 (right).

The reason that this distinction is made (here and many times throughout this section of the guide) is because there are instructions available online that use the potentiometer as a means of orienting the stepper drivers on the RAMPS board. And though this (usually) works for the

A4988 driver, **using this point of reference with the DRV8825 driver instead will lead to disastrous consequences**.

Though the writing is tiny, you can easily make out on the RAMPS board which pins go where, and with the DRV8825, you actually flip the orientation of the potentiometer. Bear in mind that this is also a sweeping generalization, and you are **highly recommended to read the pin assignments inscribed on the drivers and RAMPS board you have on hand**.

This may not seem like such a big deal at first, but if you flip those same drivers over, you'll see that even with the potentiometers on different sides, we have nearly the same pin assignments underneath:

In this view, you can see that the A4988 (left) and DRV8825 (right) have Direction, Ground, Step, Sleep, Reset, and VMOT pins. The other pins may vary from driver to driver, but these pins—specifically those pertaining to power—must be properly aligned when installed on your RAMPS board.
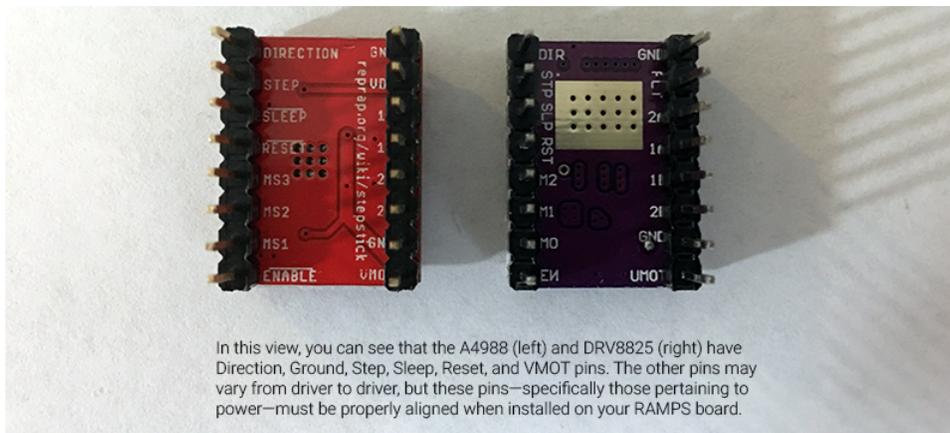
A4988 (left) vs DRV8825 pin assignments when flipped over (potentiometers on opposite ends).

Though there are some *slight* differences between the inscribed pin assignments, they are the same where it counts. The **DIR** and **GND** pins along the top edge are identical, as well as the **STEP**, **SLP**, and **RESET** pins on the left edge, and **ENABLE** and **VMOT** pins along the bottom edge; as well as the other **GND** pin just above the **VMOT** pin.

If you opt for the standard A4988 setup, you can install it on the board like so:

When installing the stepper drivers (regardless of whether you are using the A4988 or DRV8825, ensure that you have your GND pins properly oriented with their RAMPS-board counterparts.

Failure to do this could lead to electrical problems, shorting your board/drivers in the best case scenario, or electrical shock/fires in the worst.
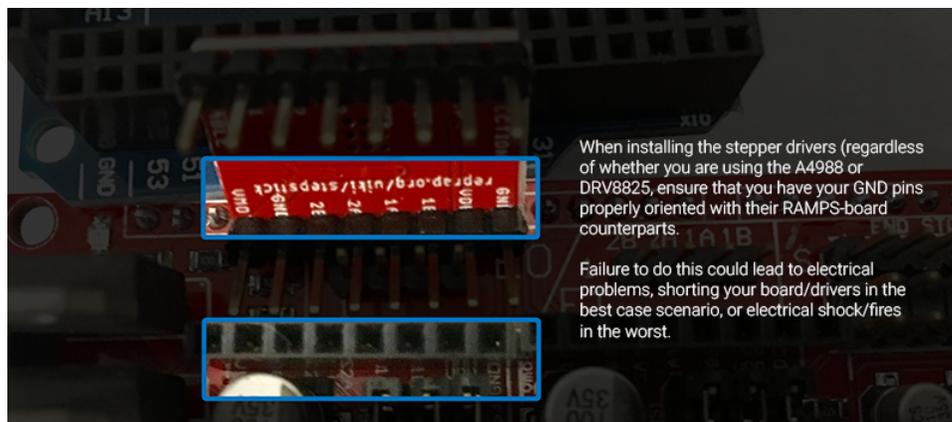
The A4988 (above) and RAMPS board (below) showing proper alignment.

Or if using the recommended DRV8825 stepper drivers:

As with the A4988 drivers, ensure that the pins on your DRV8825 driver align with their RAMPS counterparts prior to installation.

Do not use the potentiometer orientation as a guide to correct installation!
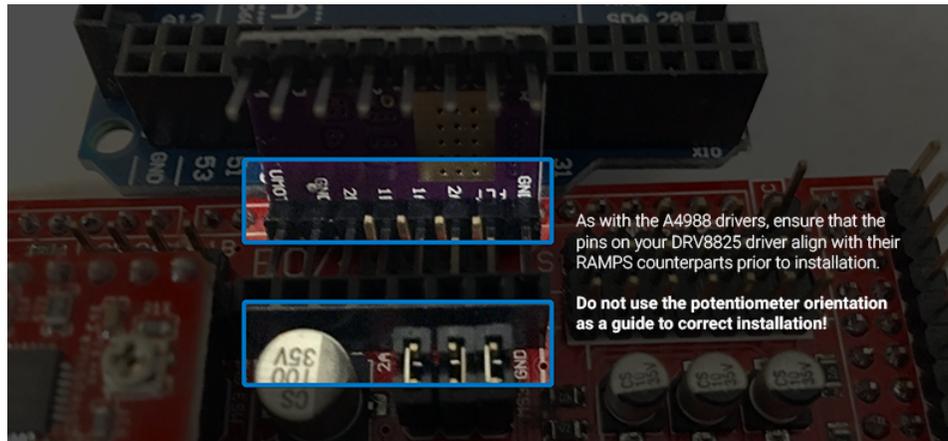
The DRV8825 driver (above) properly lined up with the RAMPS board (below).

Whichever stepper driver you choose, make sure that you find a point of reference on the driver and line it up with the correct pins on the board. **Double, triple, and quadruple check that these match before supplying power to the board**. If it seems like I'm overkilling this particular warning, well… deal with it. Or skip past it; it's really your call, but after spending more money than I needed to because I wasn't paying attention, I'm trying to do you a solid here.

Mixing stepper drivers

Also worth mentioning is that you can, in fact, mix different stepper drivers on the same board. Just make sure that you don't let the potentiometers trick you into installing one or more of them on backwards:
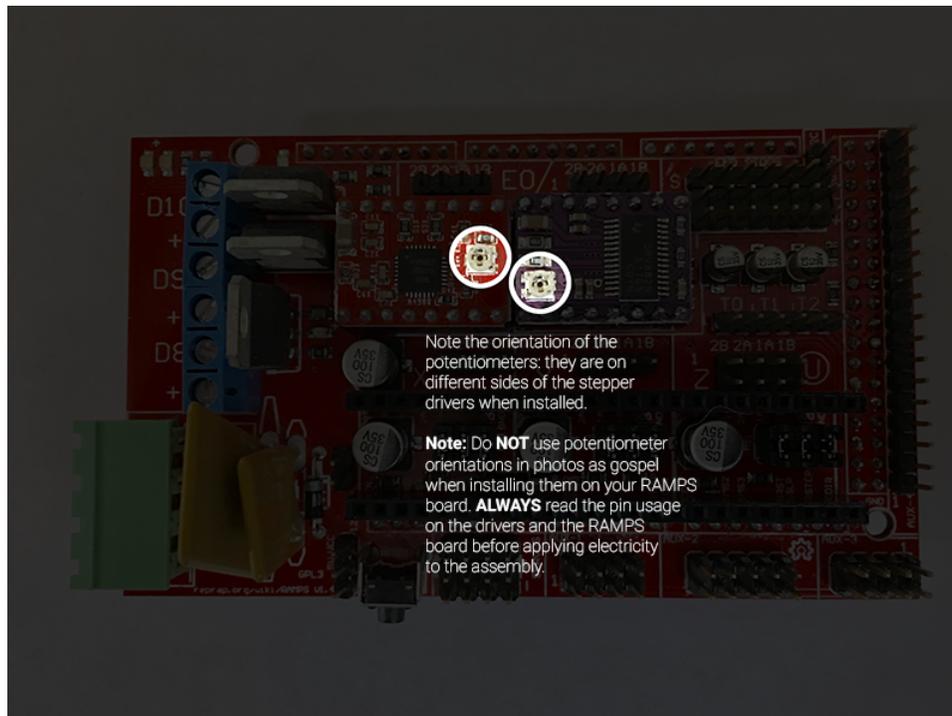
Do <u>not</u> use potentiometers as an orientation aid.

Go ahead and grab your LCD controller smart adapter and install it on the board (again, it can only fit one correct way), and you should see something somewhat similar to this:
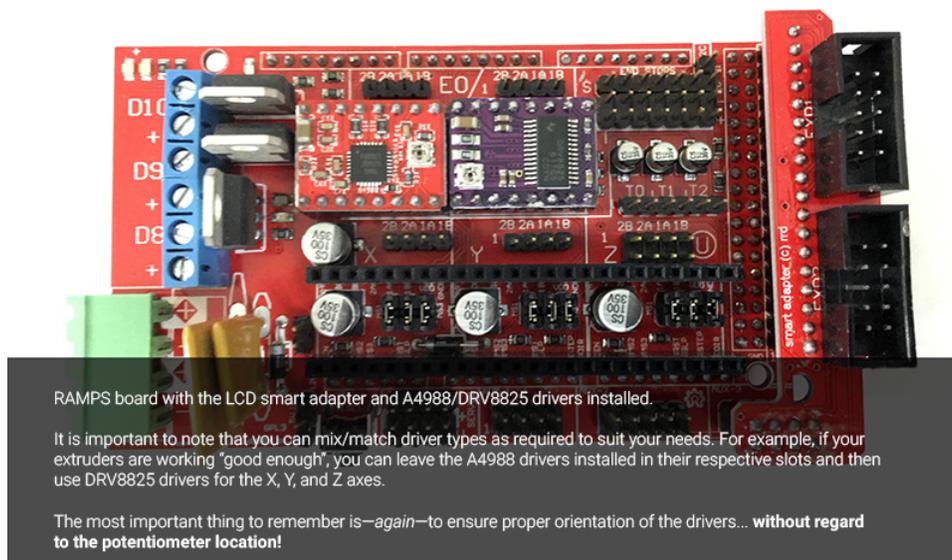
LCD controller smart adapter and A4988/DRV8825 drivers installed.

Once again, notice that the potentiometers are on opposite ends of the drivers. A closeup of the LCD controller smart adapter installed:
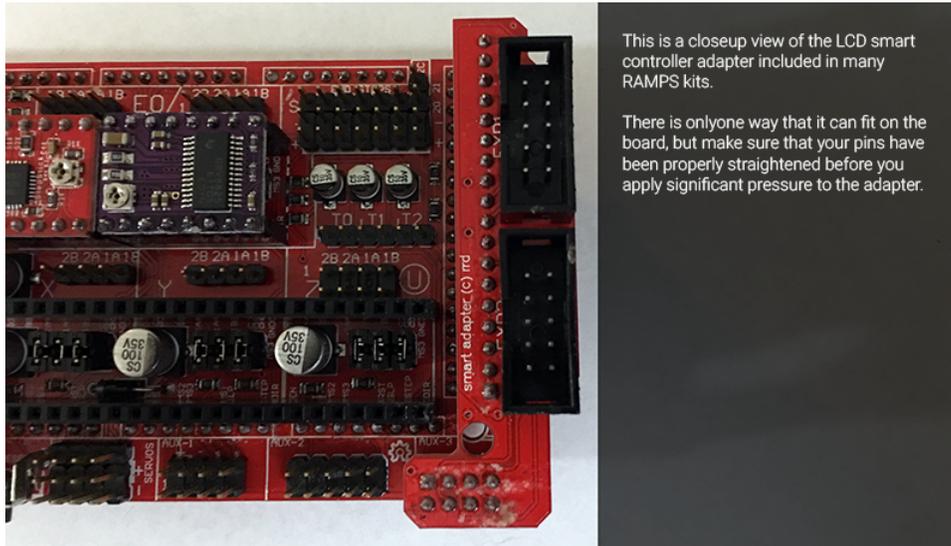
This is a closeup view of the LCD smart controller adapter included in many RAMPS kits.

There is onlyone way that it can fit on the board, but make sure that your pins have been properly straightened before you apply significant pressure to the adapter.

Closeup view of the LCD controller smart adapter installed on the RAMPS board.

Back to the actual drivers, you should end up with something similar if you went with DRV8825 drivers:
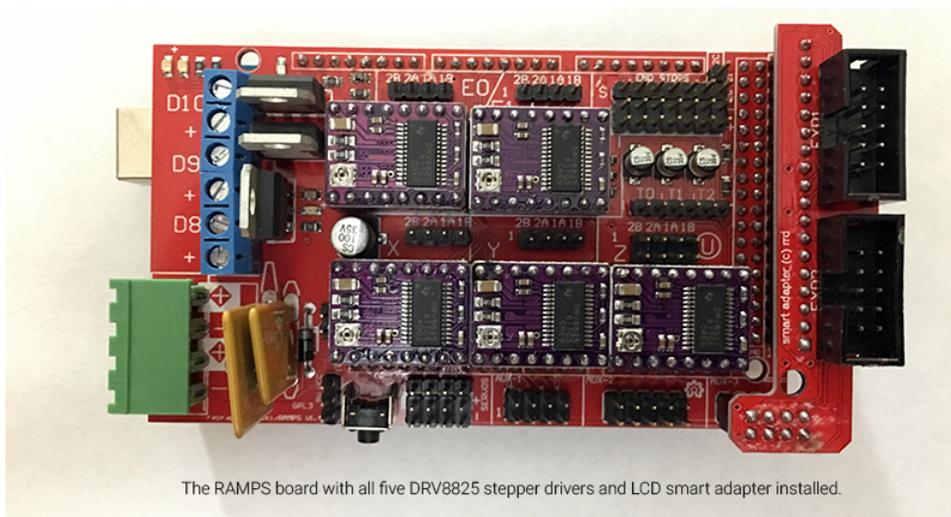
The RAMPS board with all five DRV8825 stepper drivers and LCD smart adapter installed.

All five DRV8825 drivers installed on the RAMPS board.

We're almost done with the drivers; all that remains now are the heatsinks. These are the small pieces of aluminum with the 3M double-sided adhesive, and you'll mount them to the chips on the driver boards as shown:
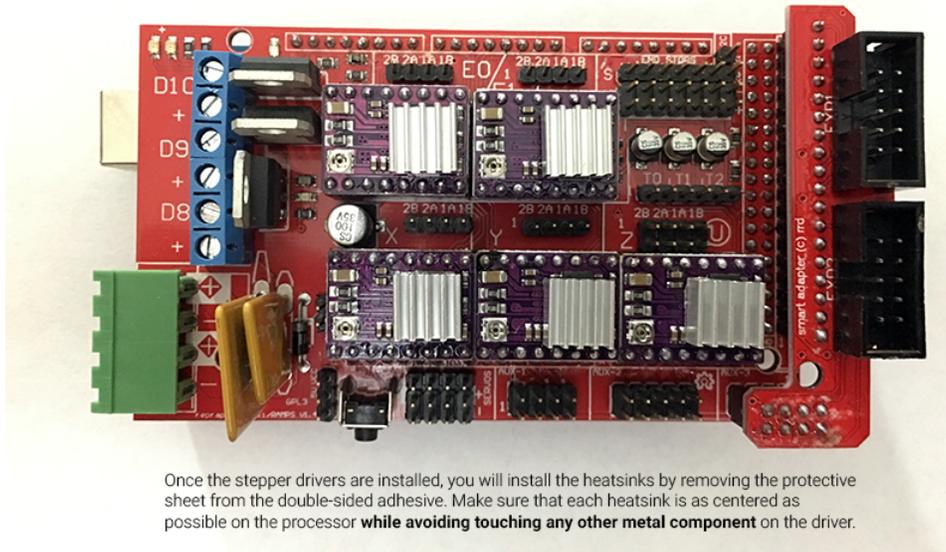
Once the stepper drivers are installed, you will install the heatsinks by removing the protective sheet from the double-sided adhesive. Make sure that each heatsink is as centered as possible on the processor **while avoiding touching any other metal component** on the driver.

DRV8825 drivers with heatsinks installed.

As mentioned in the photo above, it's important to ensure that the heatsinks do not make contact with any other metal components of the driver:
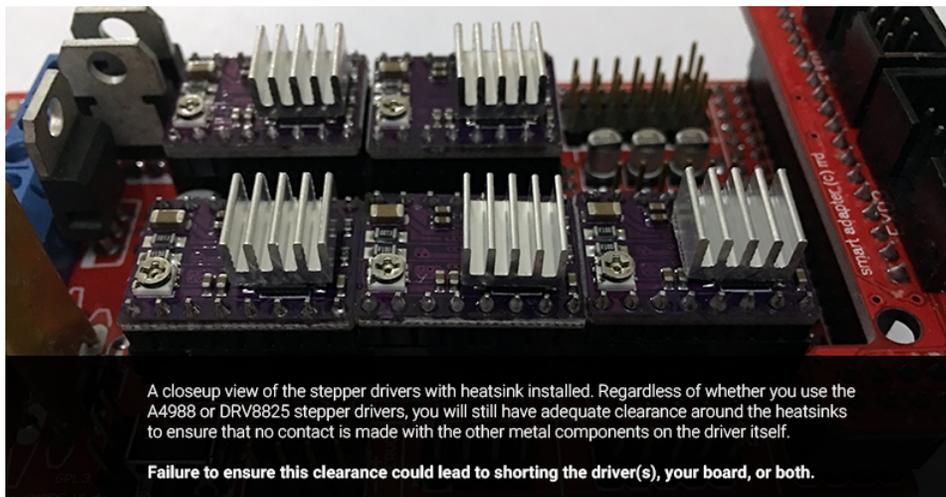
A closeup view of the stepper drivers with heatsink installed. Regardless of whether you use the A4988 or DRV8825 stepper drivers, you will still have adequate clearance around the heatsinks to ensure that no contact is made with the other metal components on the driver itself.

Failure to ensure this clearance could lead to shorting the driver(s), your board, or both.

They are somewhat large pieces compared with the chips on the drivers, but in my experience, you will always have sufficient clearance on all edges without contacting any other part of the driver. This becomes a bit more difficult if the heatsink(s) you received had double-sided foam adhesive as opposed to just a typical "sticker-type" adhesive, but do your best to work with what you have.

Power supply inputs and final wrap-up

That's actually it for the RAMPS assembly. Everything else is relatively plug-and-play with regards to your connections to your motors and other components, but before we move on to the software, let's take a closing look at the power inputs/outputs.
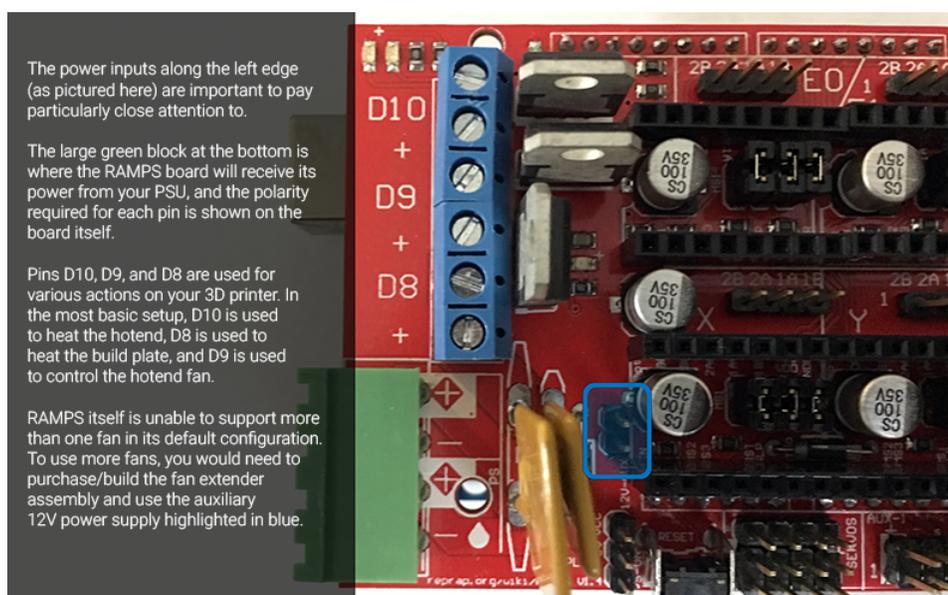
A quick and dirty breakdown of the power supply situation on your RAMPS board.

On the left edge of your RAMPS board (as shown above), you have all the power inputs that you'll need to concern yourself with for a RAMPS-enabled 3D printer.

The large green block is the power *input* from your Power Supply Unit (PSU), and will not be covered in this section of the guide.

Pins **D10**, **D9**, and **D8** are actually assigned within Marlin (and can be reassigned as needed), and provide the actual power *output* to the different components of your 3D printer. Specifically, however, these are what the different pins/receptacles provide on your standard RAMPS configuration:

- **D10** is used to provide power to the hotend (that is, the part that melts the plastic filament)
- **D9** is used to power your hotend's cooling fan to help reduce the chance of a nozzle/hotend clog
- **D8** is used to provide power to the build plate (that is, the platform onto which plastic is extruded)

Though the assignments above are for RAMPS configurations for many other printers, VORON utilizes pins **D10** and **D9** for each individual hotend (when using the Chimera for dual extrusion) and **D8** for the RAMPS case fan. The build plate for the VORON will receive its power from the SSR, external to the RAMPS board.

In addition to the pins discussed here, the illustration also shows the pins used for the auxiliary 12V power source that will be used by the RAMPS fan extender board during the later build section of the guide.

Arduino Setup and Marlin Configuration

Introduction

This section of the guide will walk you through the setup and configuration of Arduino and Marlin. If you are new to 3D printing, it is recommended that you read through this section in its entirety before committing to the steps given.

For those that are new to 3D printing: Arduino is an open-source framework that allows for the control of physical devices. When paired with your RAMPS board, it is the primary driving force behind everything that your 3D printer actually does.

To go along with your Arduino and RAMPS board is the software: Marlin is the firmware being used (default recommendation) for the VORON due to its robust feature set and ease of use. Currently, the version that is supported by the VORON community as of **December 23, 2016** is:

Marlin v1.1.0 RC8

This can be downloaded on its GitHub repository.

Getting it Done

1. Go to the Marlin GitHub repository and download the latest VORON-supported version of Marlin (from the link provided, click **Clone** or **download > Download ZIP**). Extract the files and navigate to the **Marlin** folder (you should see around 76 files or so, including **Configuration.h** and **Configuration_adv.h**).

2. From the VORON repository's **Marlin-VORON** folder, copy and paste the files below into the folder you're in from step 1:

    a. Configuration.h

    b. _Bootscreen.h

    c. pins.h

    d. pins_RAMPS_VORON.h

    e. ultralcd.cpp

3. Using the USB cable provided in your RAMPS kit, connect your RAMPS board to your computer (you don't need to have power supplied to the board via the PSU; your computer will provide all you need for this step) and launch the Arduino IDE you installed earlier by double-clicking the Marlin.ino file within the Marlin firmware directory you unzipped the firmware to earlier (step 1).

4. Before doing *anything* else, you'll need to configure the Arduino IDE to know which port and board you're working on. For the RAMPS setup I recommended, these are the options you'll choose for the port: Select **Tools > Port >** *Port*, where *Port* is the port being used by your operating system to detect your printer. When selecting your port, Arduino *may* automatically show you the specific type of board it has picked up on any given port.
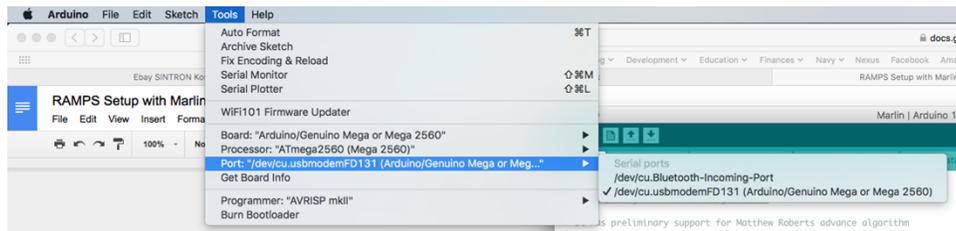
You'll want to choose the port that specifically lists your Arduino board; in this case, the MEGA 2560.

   a. Take note that Windows doesn't necessarily tell you what's running on a port, and will be represented by COM*X*, where *X* is any given port number available to Arduino.

5. And then the board. Select **Tools > Board >** *Board*, where *Board* is the particular board you will be using for your setup. For this manual's purposes, **Arduino/Genuino Mega or Mega 2560** is the board type to select.
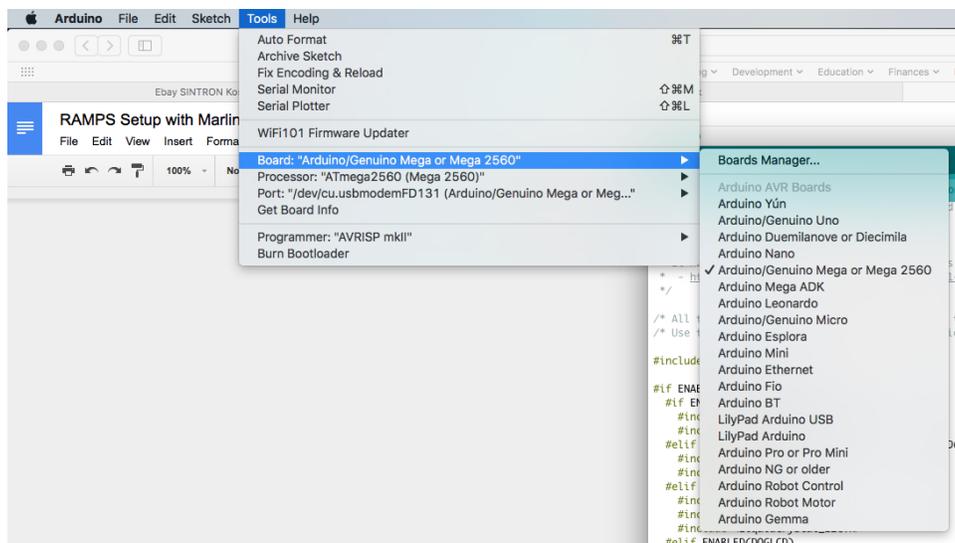
Select the Arduino/Genuino Mega or Mega 2560 option.

6. From here on out, you'll only need to worry about two parts in the Arduino interface: **Verify** and **Upload**. **Verify** is shown in the following screenshot as a checkmark, and **Upload** as the right-facing arrow.

The Arduino IDE interface.

7. The other part of note for Arduino is the multitude of tabs at the top. Arduino source code is collectively saved as a "sketch file", with the *.ino* file extension. When uploading the Marlin firmware, you may get an error at one point or another where it says that the file must be located within a directory named Marlin. If you get this, cancel the upload and rename the root directory (that is, the directory with Marlin.ino, Configuration.h, Configuration_adv.h, etc.) to Marlin and try again.

8. Back to the tabs: Each tab represents a specific file within the Arduino sketch. You can see in this screenshot that the tabs spill off the edge of the window, but you'll also see that there's a downward-facing arrow on the very right. Clicking this will give you a scrollable menu of all the tabs/files in your sketch:

There are many files in your sketch, but they're all within reach.

9. Click the **Upload** button in Arduino to upload your settings to your board. If everything is configured properly, you should be good to go with a decent baseline.

Again, please note: This guide and the provided files assumes you're running an Anet A8 3D printer. Though the A8 is just one of *many* Prusa i3 clones on the market today, there are differences in builds (mostly the build sizes and offsets which must be taken into account within

your Configuration.h file), and if they're not properly addressed can lead to some horrendous noises at best, and damaged hardware at worst.

VORON Build Preparation

Before commencing with the build, take the time to go through and verify that all of your components have been sorted out. As mentioned in the BOM section, the BOM itself as it stands with regards to quantity is very exact, and as such, is very unforgiving.

Executing the Build

This portion of the manual is currently under construction. Please refer to the official VORON Manual within the GitHub repository for assembly instructions.

Glossary

Term	Definition
Build plate	See also *Heatbed*
Cartesian (Printer)	A Cartesian printer is one in which the X, Y, and Z axes are all mapped out in a logical means and are moved via stepper motors to build the 3D model
Control board	The "motherboard" of a 3D printer that accepts and performs commands send to it via control/slicing software
Control software	Software used to send commands to the 3D printer for execution (e.g., Pronterface)
CoreXY	A unique take on the typical Cartesian 3D printer platform where the Z axis moves vertically as opposed to horizontally. The VORON is a CoreXY system
FDM	Fused Deposition Modeling is a trademarked term for the process used by most consumer-grade 3D printers that create prints via melting filaments.
FFF	Fused Filament Fabrication is an alternative term for the process used by most consumer-grade 3D printers that create prints via melting filaments.
GCode	The instruction code send to 3D printers for execution
Heatbed	The headed area where the melted filament is extruded, layer by layer, to build the model
Hotend	This is the part of a 3D printer that melts the plastic filament for extrusion
Slicer	Software used to "slice" a provided 3D model into various layers that can be used by the 3D printer
Stepper driver	An electronics board used to control the flow of current to the stepper motors to accurately position the printing components of the printer
Stepper motor	The actual motors used to move about the X, Y, and Z axes
STL (File type)	STL files are the common de facto standard used for 3D models available from model repositories such as Youmagine, Pinshape, and Thingiverse
STL (Process)	Stereolithography is a 3D printing process which involves the curing of resin in various layers for creating 3D prints.
RAMPS	RepRap Arduino MEGA Polulu Shield is the collective term used to describe the control board for many community-sourced 3D printers

References

Arduino Mega Polulu Shield
http://reprap.org/wiki/Arduino_Mega_Pololu_Shield

A4988 vs DRV8825 Chinese Stepper Driver Boards
http://reprap.org/wiki/A4988_vs_DRV8825_Chinese_Stepper_Driver_Boards

Resources

Acknowledgements

Primary thanks, of course, goes to Maksim Zolin for his incredible work on the VORON CoreXY printer system. As well, all the contributors of the RepRap community as a whole are to thank for their dedication and hard work.