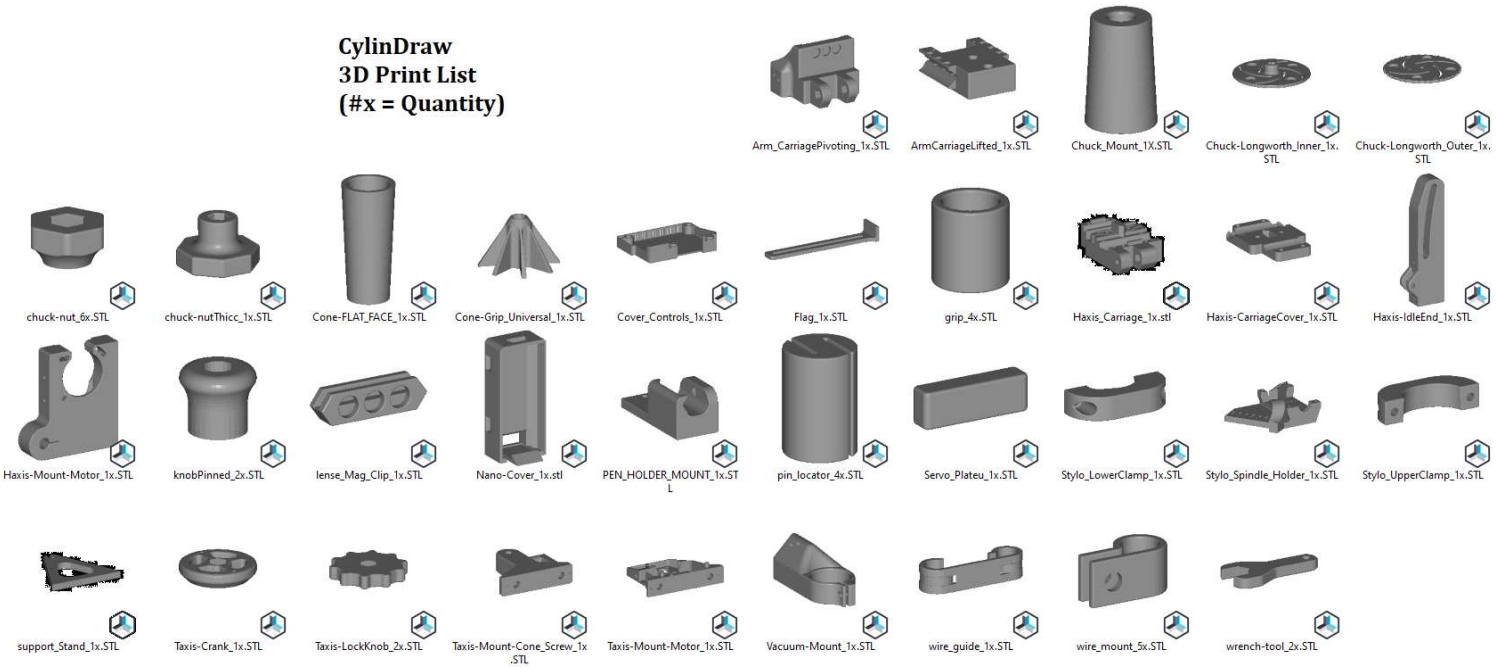
Group	Item Description	Unit Qty in Kit
TOOLS + LONGS	linear rods 8mm	2
TOOLS + LONGS	hex Key, micro	1
TOOLS + LONGS	hex key, med	1
TOOLS + LONGS	hex key, large	1
TOOLS + LONGS	Screwdriver phillips	1
TOOLS + LONGS	Marker, permanent fineliner	1
TOOLS + LONGS	Ruler, 30cm metric	1
TOOLS + LONGS	wrenches	2
TOOLS + LONGS	threaded rod 5/16" x 12"	1
SOFT PARTS	buzzer	1
SOFT PARTS	Wire harness	1
SOFT PARTS	9g servo	1
SOFT PARTS	servo extension wire	1
SOFT PARTS	Jumper Wires	5
SOFT PARTS	limit switch	1
SOFT PARTS	rubber feet stick on	6
SOFT PARTS	cable ties	25
SOFT PARTS	sticky tack	4
SOFT PARTS	timing belt GT2	1
MOTOR BAG	stepper motor, nema 17 with cable	2
MOTOR BAG	motor cork mount	2
IN BOX	Bed Plate	1
IN BOX	ALL 3D PRINTS	1
HARD PARTS	heatsink	1
HARD PARTS	linear bearing 8mm	3
HARD PARTS	shoulder bolt 8mm dia	2
HARD PARTS	hex bolt 5/16"x 1.5" fully threaded	1
HARD PARTS	shoulder bolt 6mm dia	2
HARD PARTS	linear bearing 6mm	2
HARD PARTS	pulley toothed driving	2
HARD PARTS	pulley idler GT2	1
HARD PARTS	plastite screws short	25
HARD PARTS	plastite screws long	4
HARD PARTS	3mmx18mm cap screw	12
HARD PARTS	3mm nut	12
HARD PARTS	3mm x 30mm cap screw	1
HARD PARTS	3mm x10mm flat head screw	4
HARD PARTS	nut standard 5/16	7
HARD PARTS	nut nylock 5/16	1
HARD PARTS	spring compression	1
HARD PARTS	magnets	6
CABLES	USB Extension Cable for arduino	1
CABLES	Power Supply Wall Wart	1
CABLES	On/Off Switch Cable	1

CylinDraw
3D Print List
(#x = Quantity)



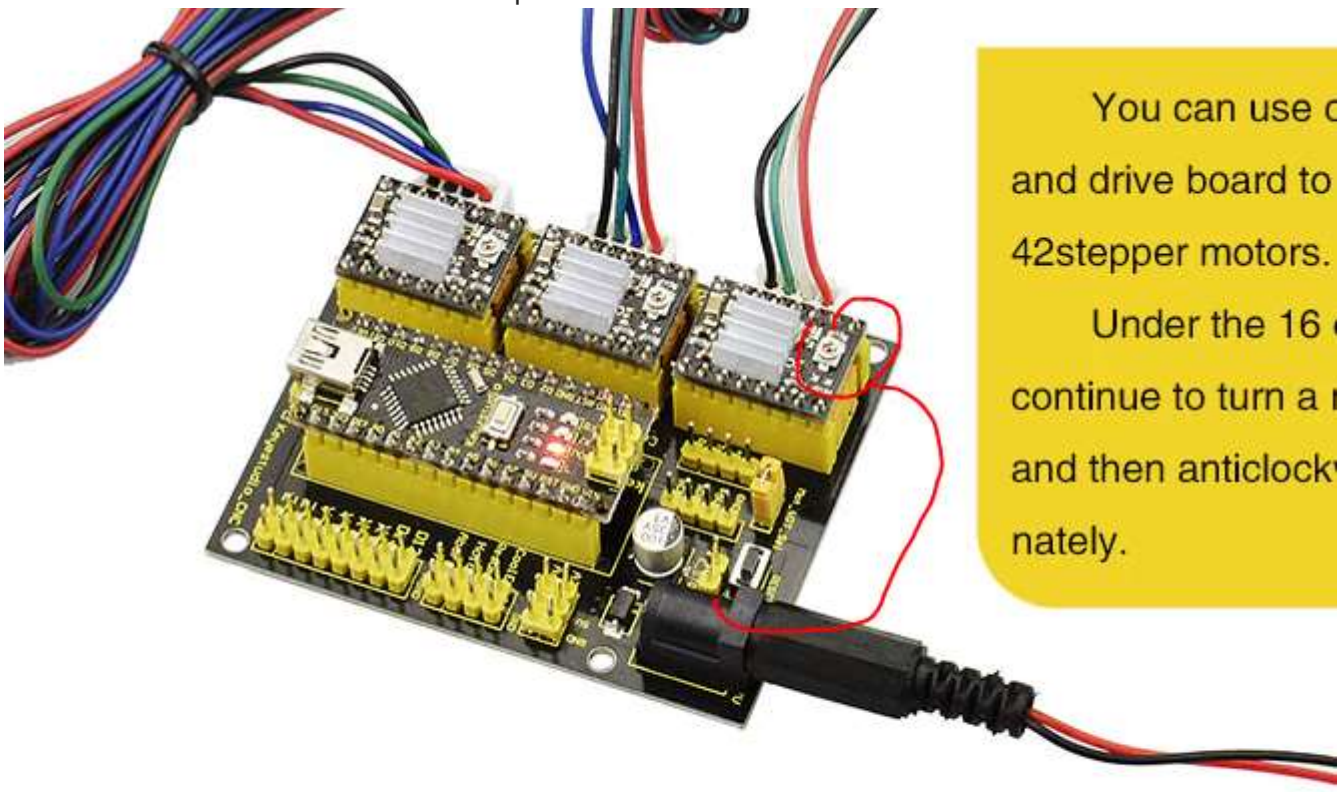
Group	Item Description	Unit Qty in Kit
ENGRAVER	6x magnets	6
ENGRAVER	shield Transparent	1
ENGRAVER	longer Screw for plastic	1
ENGRAVER	Shorter screw for plastic	4
ENGRAVER	engraver Bit ball end diamond	5
PCB IN CUP	arduino Nano CNC Kit	1
PCB IN CUP	USB-B to USB-C short cable	1
PCB IN CUP	Paper Cup 8 oz	1
SPARE PARTS	disc magnet 8x3mm	2
SPARE PARTS	Shorter screw for plastic	4
SPARE PARTS	longer Screw for plastic	1
SPARE PARTS	3mmx18mm screw	1
SPARE PARTS	3mm nut	2
SPARE PARTS	3mm x 30mm screw	1
SPARE PARTS	3mm x10mm flat head screw	1
SPARE PARTS	nut 5/16 standard	1
SPARE PARTS	sticky foot	2
SPARE PARTS	cable ties	25
SPARE PARTS	jumpers	5
SPARE PARTS	super glue	1
SPARE PARTS	Printed (Knob round + knob hex + grip + cable mount)	1
SPARE PARTS	sticky tack	4
SPARE PARTS	servo 9g	1
SPARE PARTS	Sticker, CylinDraw Logo, 4"x2"	1

The following information is for reference only. Be aware that Graham Research LLC makes the potentiometer adjustment for you in all of our kits and you do not need to do this! We mark the potentiometer with a marker.

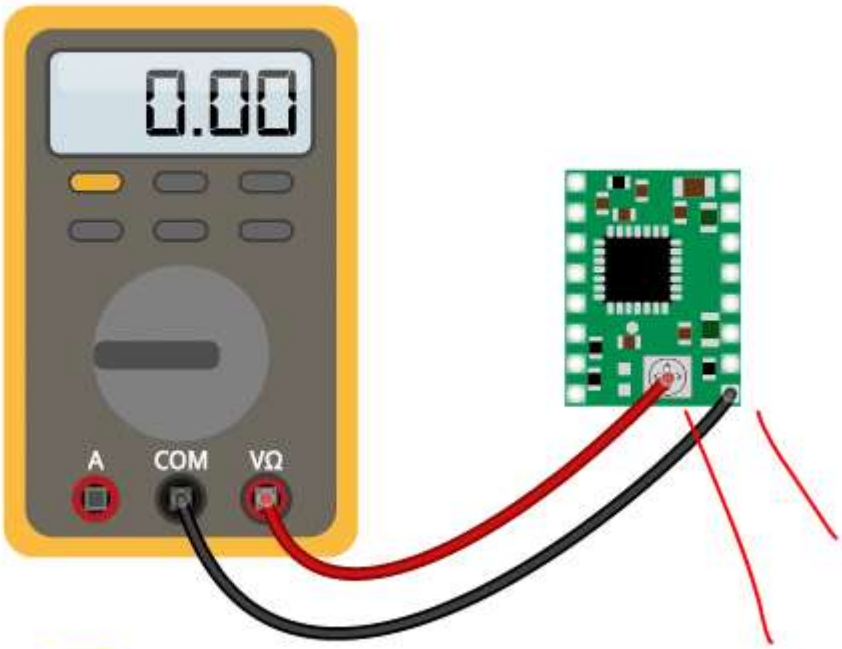
Adjusting Drive current

- Step one is connect motors, drivers, & Arduino, then power it on.
- Never disconnect the stepper motor cable while the power is connected.
- A4988 = stepper motor driver. We need to set **VREF,** the voltage between the potentiometer and GND as measured with a potentiometer on the next page.
- The calculation formula of the current upper limit is **I=VREF/(8*Rs)**
- **Rs** is the reference resistor; the reference resistor for this module is 0.05Ω. **VREF=I*8*0.05=0.4*I**
- The current limit of our motors is 1.5A (so **VREF=1.5*0.4**, that is, 0.6V MAX, so we target 0.55V for a safety factor.)
-
- Bonus info: When using the driver in full-step mode, the current through each coil is limited to approximately 70% of the set current limit. This means that you would need to set the current limit 40% higher or 1.4 A in full-step mode. When using microstepping, the formula above applies.

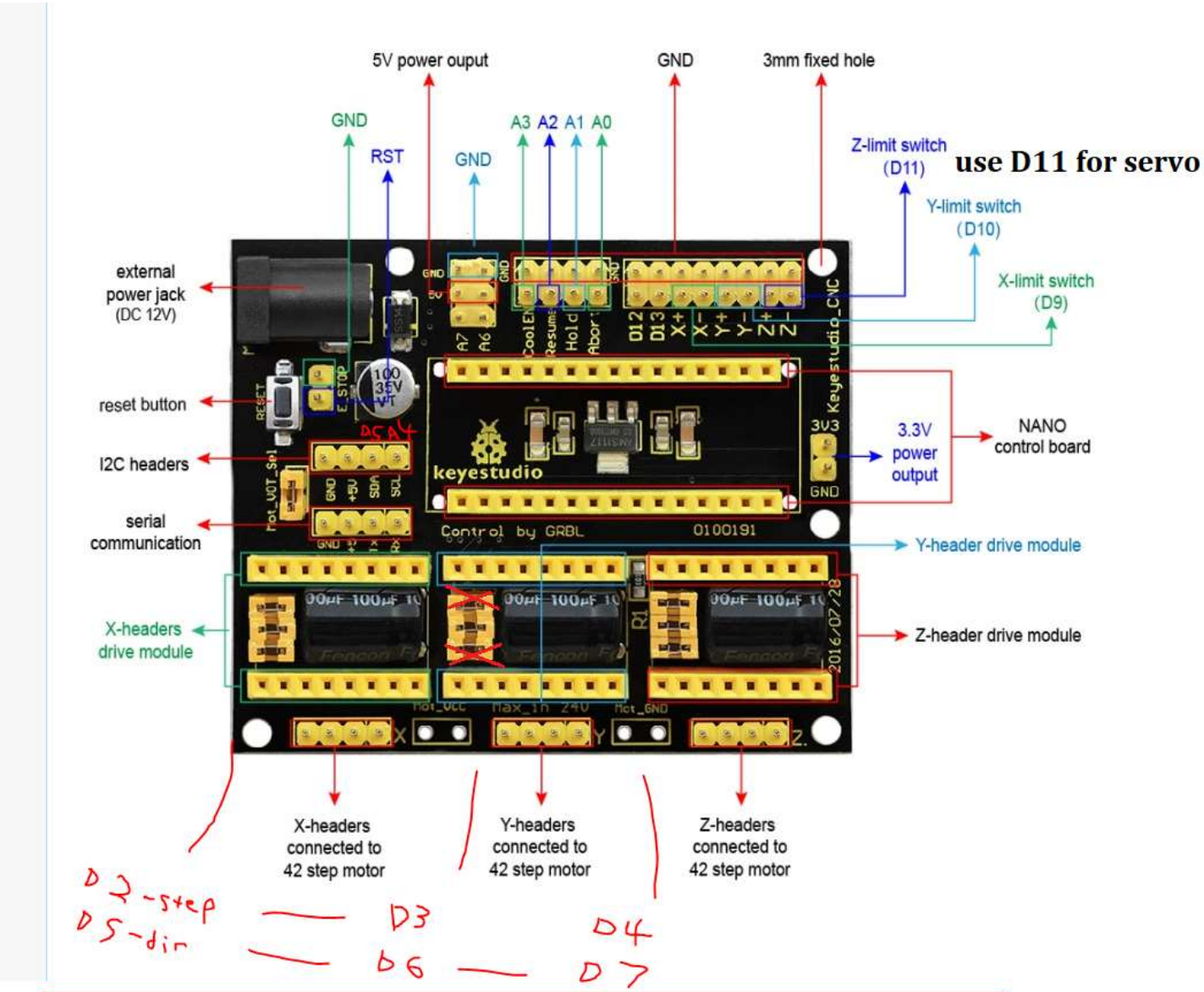
Note orientation of drivers & nano on the pcb!



Now you will need to measure the reference voltage (Vref) between the two points marked on the picture below (GND and the potentiometer) and adjust it to the value you calculated.



Vref probe points (GND and potentiometer).



Rotary X-axis: All jumpers present (1/16 step)
Linear Y-axis: Only Center jumper Present (1/4 step)

Note we use X axis for the rotational axis and Y axis for the linear axis. Z axis driver is left open.

Stuff we do for you: The servo motor is connected to a 3-wire ribbon cable extension, and then that extension is connected to 3 individual jumper wires. We also tune the resistance trimmers on the stepper drivers to supply the appropriate current, then superglue them in place & mark them with a line. (we do this for you in all our kits because the consequences of doing this wrong can be disastrous)

-The jumpers underneat the stepper drivers configure the microstepping steps per rotation. The rotational axis (x-axis) will keep all 3 jumpers. The Linear axis (y-axis) ONLY keeps the center jumper. (The reason is to tradeoff some resolution we don't need to get more speed we do need!)

- A0 (abort)= unconnected
- A1 (hold)= unconnected
- A2 (resume)= unconnected
- A3(cool) = unconnected
- A4 (SDA)= unconnected
- A5 (SCL) = unconnected
- A6 = unconnected
- A7 servo2 = unconnected
- D0 (RX) =unconnected
- D1 (TX) = unconnected
- D2 (Xstep)= (part of drivers)
- D3~(Ystep)= (part of drivers)
- D4 (Zstep)= unconnected
- D5~(Xdir) = (part of drivers)
- D6~(Ydir)= (part of drivers)
- D7 (Zdir)= unconnected
- D8 (enable) = (part of drivers)
- D9~ (X+,X-) = unconnected
- D10~ (Y+ & Y-)= Limit switch red wire (normally closed leg)
- D11~(Z- & Z+) = Servo Yellow wire (sig)
- D12 = Buzzer+
- D13 = Arduino Embedded LED
- GND = Buzzer-, Servo Brown Wire, Limit switch black center wire.

5V = Servo Red (Center wire) (I use the available 5v pin next to A6)