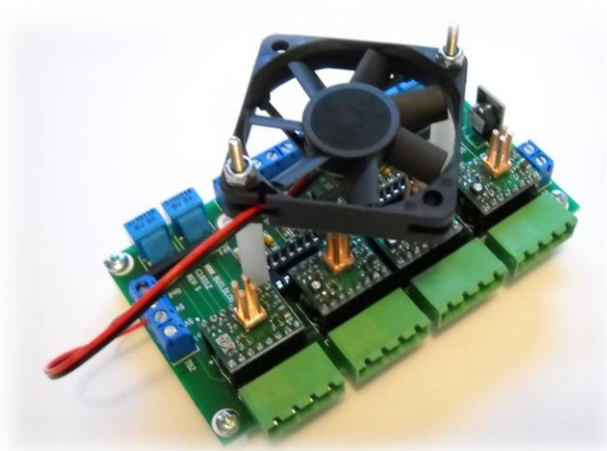# Buildlog.net 4 Axis Stepper Driver (p/n C16013)

User Guide Rev 2

Safety & Disclaimers

This stepper driver board is designed for experienced technicians only. The schematic should be studied to see if it will safely work in your system before installing or using the board. Improper use in CNC or other machines could cause personal injury or damage expensive equipment.

No circuit can be truly fail-safe. Even with properly connected interlocks and safety switches, there is always the chance for unintended motion of the motors or engagement relays.

The user is the sole person responsible for the safety of the system. If at any time you are concerned about the suitability of this circuit for safe operation you can return it for a refund.

Unless otherwise specified in the document, no connections should be made to this board while the board is powered. Remove power and wait for the voltage to reach 0 before making changes.

Do not assume anything. Please ask if anything is unclear. Orientations and connection order are very important and might not be what you assume from previous experiences or assumed "standards".

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Features

1. Sockets for standard Pololu and StepStick stepper drivers.
2. Integral Cooling Fan.
3. On board logic power supply (5V or 3.3V by special order)
4. Rotary switch selectable microstep resolution (Full,2x,4x,8x,16x).
5. Step and direction control connection via 'D' connector or terminal block.
6. Electrical noise filtering on all step and direction signals
7. Motor enable/disable control.

Assembly

If assembly is required….Use the Bill Of Materials (BOM) section near the end of this document to determine the parts.   Here are some tips to make assembly easier.

- I find it easiest to assemble the shortest parts first because they can be inserted and the board flipped over and placed on a table.
- The parts in the pink, gray or mylar bags are static sensitive. Use a wrist strap or ground yourself when handling these.
- Note the orientation of the U1. The large inductor goes away from the edge of the board. The silkscreen on the board shows the rough outline.
- An assembled stepper driver PCB can be used to hold the mating connectors properly aligned while soldering.
- I use a little dab of super glue to hold the terminal blocks in place while soldering. This makes it easier to solder them straight. Be sure no glue flows onto the solder pads.
- Many parts are polarized other otherwise orientation sensitive.
    - The large capacitors have a minus sign printed on the device. The negative side of the capacitor goes towards the middle of the PCB. The positive side has a square solder pad on the board.
    - The Schmitt trigger must be oriented with pin 1 towards the end with the notch in the silkscreen.
    - The resistor arrays (RP1-3) is bussed, meaning all the resistors share a common pin. This pin (pin 1) must be placed correctly. It goes towards the edge of the PCB. The silkscreen outline of the part rounds it off on the pin 1 end and the solder pad is square on pin1. The part is poorly marked, but the text starts at the pin 1 end. Pin 1 to any other pin will measure 10k. Any other pin to pin will measure 20k.

J1 Control Connector "D'

The step, direction and enable pins are routed to a dual part pattern. You can use a standard 25 pin male 'D' connector or terminal blocks. The parts occupy the same space so once the choice is made, you cannot switch back.

| J1 (Control input connector)	
Pin #	Function (goes to)
1	Not used
2	X Step
3	X Dir
4	Y Step
5	Y Dir
6	Z Step
7	Z Dir
8	A Step
9	A Dir
10-15	Not used
16	Motor disable
17	Not used
18-25	Ground
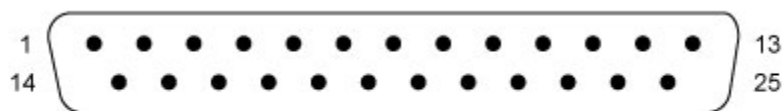
DB-25P (Male Plug Front View)

TB3, TB4, TB5, TB6 Control Connections (Terminal blocks)
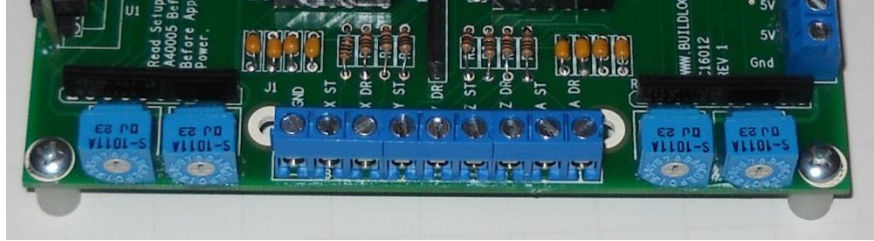
The blocks are individually numbered on the schematic TB8-TB11, but they link together on the board to form one long terminal block. The terminals are labeled on the slikscreen behind the terminal blocks. The table shows them as they are labeled from left to right.

TB3	
1	Gnd (used for all axes)
2	X Step
3	X Dir
TB4	
1	Y Step
2	Y Dir
TB5	
1	Z Step
2	Z Dir
TB6	
1	A Step
2	A Dir

TB1 Power
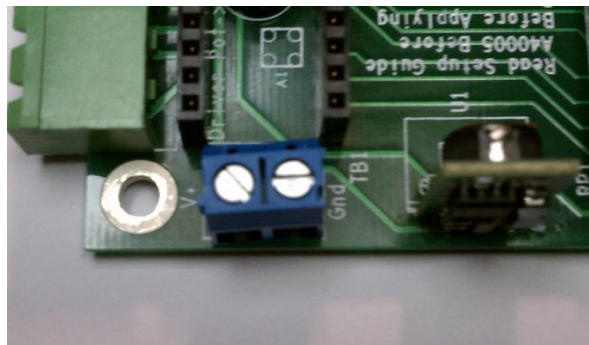
This connector is for the motor power. This should be limited to the range of 8V-30V. The terminals are labeled on the silkscreen. Ground is on the right and V+ is on the left as shown in the view above. Hooking up power in any other way will destroy the drivers and other parts on the board.

TB1, TB2, TB3, TB4 Stepper Motor Connections
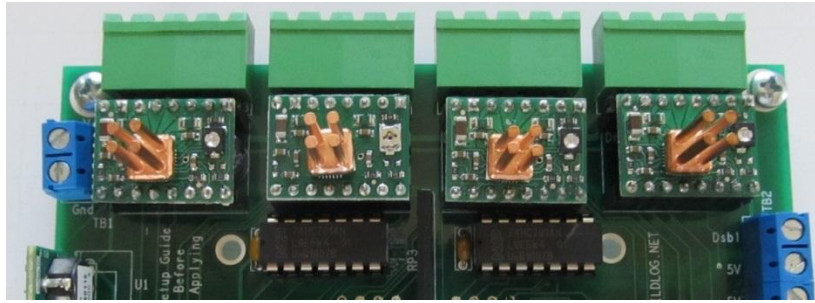
Pin 1 and 2 are for one winding and pins 3 and 4 are for the other winding

The Pololu drivers must be installed in the orientation shown. Any other orientation will destroy the drivers and other circuitry. Make sure all the pins go in the sockets and you are not offset by one hole and overhang the end.

There drivers are shown with heatsinks installed. These help cool the driver chip. These are supplied when drivers are purchased from Buildlog.net. They are attached using small (blue) adhesive tape squares (provided).

The current is set using the potentiometer on the driver board. You adjust the pot until the correct voltage is measured on the very little point shown below. The voltage is calculated using the following formula. For 1.5A you would set the voltage to 0.6V.

$$V = I * 0.4$$

Note:

Never disconnect a stepper motor with the board powered. It will destroy the stepper drivers. Make sure the wires are securely fastened in the terminal blocks to prevent accidental disconnect. The use of heatsinks on the drivers is suggested. Heatsinks are attached with special heatsink tape.

TB2
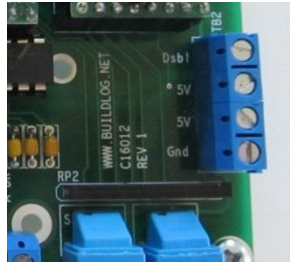
This terminal block has (2) functions. The first is to provide power to the fan. Use the lower (2) connections (Gnd & 5V) to power the fan.

Do not over tighten the fan. It just needs to be snug. If you put excessive pressure on the fan housing it may distort and cause the fan to bind. This may cause permanent damage.

The second function of the terminal block is for the motor disable function. If you connect Dsbl to 5V, the motor drivers will disable and the motors can be turned by hand. The drivers will enable by default and do not need a connection.

Stepper Resolution Switches.

The rotary switches control the stepper motor resolution on the Pololu A4983/A4988 driver boards. The control bit scheme follows a binary progression except for the highest resolution. The positions are decoded below. Other switch positions will result in some resolution, but probably should be avoided. Resolution can be changed while the system is powered.

Encoder Position	Resolution (bit pattern)
0	Full Steps 0,0,0
1	1/2 Step 0,0,1
2	1/4 Step 0,1,0
3	1/8 Step 0,1,1
7	1/16 Step 1,1,1

Noise Filtering

The PCB has some noise filtering features using a RC filer and a Schmitt trigger. The RC filter frequency is high enough that 1uS step pulses should work. Other factors can effective add more filtering which could cause extremely fast pulses to

be missed.   If you controller allows you to adjust this, it is recommended that you use longer, 5uS pulses.

Bill Of Materials

Designator	Qty	Description	Part Number
A1, A2, A3, A4	8	8 Pin socket Headers	Generic
C1,C2	2	0.1uF Capacitor	Panasonic ECE-A1AKA221
C3-C10	8	100pF 100V 5% Ceramic Cap	AVX SA102A101JAR
C11-C14	4	220uF Capacitor	Generic
J1 (optional)	1	Connector, D 25 Pin Male 90 Deg	FCI 10090097-P254VLF
R1-R8	8	10 Ohm 1/4W Resistor	Generic
RP1-RP3	3	10K Resistor Array	
S1-S4	4	Rotary Dip Switch	Stewart SS-6488S-A-NF
TB1	1	Terminal block 5mm x 2 Pluggable	On Shore Tech OSTOQ027151
TB2	1	Terminal Block 5mm x 4	
TB9,TB10,TB11 (optional)	3	Terminal block 5mm x 2	
TB3,TB4,TB5,TB6	3	Terminal block 5mm x 4 Pluggable	On Shore Tech OSTOQ047151
TB8 (optional)	1	Terminal block 5mm x 3	Panasonic TQ2H-5V
U1	1	5VDC DC-DC P/S	Murata OKI-78SR-5/1.5-W36-C
U2,U3	2	Hex Schmitt Trigger	74HC7014
	2	14 Pin Dip Socket	
	2	Spacer .25 OD .115 ID 1.50Lg	McMaster 94639A209
	2	Screws high-low #4-20 x 3/4	McMaster 90380A120
	2	Screws high-low #4-20 x 3/8	McMaster 90380A108
	2	Nylon Washers #4 Nylon	McMaster 90295A360
	1	Blower 5V	Sunon KDE0505PFV1.11.MS.A.GN
	4	Terminal block plug 5mm x 4	On Shore Tech OSTTJ047150
	1	Terminal Block plug 5mm x 2	On Shore Tech OSTTJ027150

Troubleshooting Section

Steppers run backwards. If you swap any two wires on the same motor poll you will fix this. You can often change it in software too.

Steppers do not run or lock when powered. Make sure the polls are wired correctly. If you are unsure about what wires go to what polls try shorting two stepper motor wires together on the motor. If it is harder to turn the motor, they belong to the same poll. Is the enable circuit working?

Stepper Motors Step or Move by Themselves. This is likely a noise issue. CNC machines and lasers are noisy environments. Review all wiring to see if good noise reduction techniques are used. Try running the circuit away from other electronics to determine if it is a noise issue.

The motors whine when enabled. This is often the case for this type of motor driver.

Test Procedure

Start with no drivers installed.

Visually check orientation of all parts.

Visual inspect all solder joints.

Apply Power to PCB and make sure it is not drawing and current.

Check 5V power supply on TB2 fan terminal block.

Turn off power.

Install a stepper driver in the X axis position. Use Mach3 to test.

Repeat for Y,Z and A Axes.