



## 3 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

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Thank you for purchasing our 4 axis HobbyCNC PRO kit. The following information and the step-by-step instructions will assure complete success and satisfaction. Please read through the following before beginning any construction to get familiarized with the process. **NOTE:** Machinery driven with this device can and will start without warning and may cause injury or even death. The builder of this device assumes sole responsibility for its use! **IF YOU DO NOT AGREE WITH THIS RETURN THE KIT FOR FULL REFUND, LESS SHIPPING AND HANDLING FEE, BEFORE STARTING ASSEMBLY.**

### Specifications:

- 3 Axis Unipolar Chopper control. Individual OR simultaneous control of 2/4 Phase Stepper Motors.
- Accepts 5, 6, or 8 wire stepper motors. 4 wire types are not usable.
- 42 VDC maximum input voltage, 12VDC minimum input voltage.
- 3.0 Amps Maximum per Phase, 500ma (.5A) minimum. Individually adjustable throughout this range.
- 1/1, 1/2, 1/4, 1/8, and 1/16 Micro stepping.
- Step and Direction Control.
- Idle Current Reduction to 50% when idle for 10 seconds. Can change this time delay.
- Built In Protection Circuit to help against blown chips on stepper motor short or open connections.
- Power On Reset.
- On board voltage regulation for 5-volt logic with 24VDC cooling fan from motor power supply.
- On board connections for home and limit switches with 10K pullup resistor provided to each.
- Minimum of components to make assembly fast and easy.

### Tools Required For Assembly:

- 15-25 Watt soldering pencil
- 1/32" Rosin core solder
- Side cutters
- Pliers
- Voltmeter

### Construction Step by Step:

1. Insert the (6) 10K (R1,R2,R3,R4,R5,R6 Brown Black Black Red Brown) resistors. Simply bend the leads over to fit the PCB holes (typically .400") and solder in. We ALWAYS use an Ohmmeter to verify values before soldering in place. Trim the leads. **Do not install R7,R8.**
2. (3) 100K resistors (R9,R10,R11 Brown Black Yellow Gold) are next. This value gives approximately 10 seconds delay before going into idle current reduction. You can change this delay by substituting a different value. Expect a 1-second difference for every 10,000 Ohms. 50K would be 5 seconds, 150K would be 15 seconds etc. 30 seconds (300K seems the limit) Trim the leads. **Do not install R12.**
3. (2) 249R resistors (R13,R14 Red Yellow White Black Brown) are now installed. Trim the leads.
4. Install (1) 6.04K (R15 Blue Black Yellow Brown Brown) resistor. Trim the leads.
5. Install (1) 750R (R16 Violet Green Black Black Brown) resistor. Trim the leads.



### 3 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

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6. Install (6) .1uF (C1,C2,C3,C5,C6,C7) Capacitors. These have NO orientation. Trim the leads. **Do not install C4.**
7. Solder in (4) 10K Resistor Networks (RN1,RN2,RN3,RN5). **Orient** the dot with the PCB silkscreened dot. Trim the leads. **Do not install RN4.**
8. Solder in (6) BS250P Mosfets (Q1,Q2,Q3,Q4,Q5,Q6) **Orient** the case as shown on the PCB silkscreen. Spread the leads apart to fit the PCB holes. Trim the leads. **Do not install Q7,Q8.**
9. (3) Capacitors 10uF 50V (C8,C9,C10) solder in now. **Orient** the longest lead into the hole marked "+". The body has "-" marked on it to help identify the proper orientation. Trim the leads. **Do not confuse with C15-C17. Do not install C11.**
10. (3) Capacitors 100uF 16V (C15,C16,C17) solder in now. **Orient** the longest lead into the hole marked "+". The body has "-" marked on it to help identify the proper orientation. Trim the leads. **Do not install C18.**
11. Install (3) Potentiometers (VR1,VR2,VR3) now. Trim the leads. **Do not install VR4.**
12. Solder the 2 X 4 (J1,J2,J3,J4) Header Pins in now. (Installing the Jumper/Shunts onto the pins makes holding them in place easier!) Refer to the PCB Connections drawing for proper orientation. Only 3 jumper shunts maximum are required for each 2 X 4 pin header to satisfy all stepping modes.
13. Solder P1 DB25 Male connector in now. Take your time as many pins are close together. We also solder the mounting lugs for an even more robust mounting.
14. The 6 Position Terminal Blocks (TB1,TB2,TB3,TB5) solder in now. **Orient** the holes for the wires facing "out". **Do not install TB4.** These may require a little extra heat to flow the solder as a lot of copper is present.
15. Install the 2 Position Terminal Blocks (TB6,TB7) next. **Orient** the holes facing "out". These may require a little extra heat to flow the solder as a lot of copper is present.
16. The LM317HV (U7), **NOT the LM317**, is next to be soldered in place. **Orient** the tab towards R15. The PCB silkscreen shows this as a wide white band. Trim the leads.
17. The LM317 (U5) goes in now. **Orient** the tab towards R13. The PCB silkscreen shows this as a wide white band. Trim the leads.
18. The 7824 (U6) goes in now. **Orient** the tab towards C6. The PCB silkscreen shows this as a wide white band. Trim the leads.
19. Install (3) 680uF Capacitors (C12,C13,C14) now. **Orient** the long lead into the hole marked "+". Again the body is marked with "-" to help with orientation. Trim the leads.

This completes the basic construction. DO NOT INSTALL U1,U2,U3,U4,U8 and U9 UNTIL THE FOLLOWING TEST IS MADE! To make sure no errors were made, apply at least 12VDC BUT less than 42VDC to TB6 labeled + and -. With a voltmeter verify that +5.0VDC to 5.2VDC is present at the pad labeled +5VDC. The black test lead touches the "-" on TB6. If not, review all the above steps and correct them. Failure to insure



## 3 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

that +5.0VDC--5.2VDC is present will BLOW the driver chips! (U5, R13, and R16 control the +5VDC voltage.) Go no further until +5VDC is achieved with this test.

- 20. Install (2) MM74HC14N Hex Inverters (U8, U9). Orient the notch as shown in the PCB silkscreen. Trim the leads.
- 21. Install (4) 23 pin Driver Chips (U1,U2,U3,U4) only after the above test is successful. They can only go one way. Trim the leads.
- 22. Clean the PCB with alcohol or a flux remover and inspect all solder connections with a MAGNYFING glass to assure against any solder bridges. These will cause ALMOST ALL failures!

### Interfacing With the Printer Port

This section explains the connections the driver board makes to your computers parallel port. This is where the printer plugs into. The pinouts cannot be changed. These are as follows:

Pin	Function	Pin	Function
2	X direction	6	Z direction
3	X step	7	Z step
4	Y direction	8	A direction (for reference only)
5	Y step	9	A step (for reference only)

- 10,11,12,13 and 15 are pulled up with a 10K resistor and are used for home/limit functions. Consult your software as to the type of switches needed. (N.O. or N.C. types)
- 1,14,16 and 17 are not pulled up and are available as needed. Our driver board plays no role other than to provide convenient access to these pins.
- 18-25 Ground

Refer to your software for your specific requirements.

Be sure to use a DB25M to DB25F ALL lines wired straight thru parallel port cable.

### Current Adjustment MOST IMPORTANT!

The stepper motor current **MUST be adjusted before connecting any steppers** to the driver board. Each axis can be adjusted to a different value. Current MUST be 500ma up to 3A per coil. With power applied to TB6 (12VDC min, 42VDC max) use a voltmeter with the black lead connected to TB6 terminal "minus" and the red lead touching the axis pad to the left of VR1, VR2, VR3, VR4. Clockwise movement increases the voltage, counter clockwise decreases the voltage. **IDLE CURRENT REDUCTION MUST BE DISABLED (J4 jumper ON) WHILE SETTING Vref.** The following voltage MUST be set to achieve the correct amperage:

- 500ma = .070VDC (seven hundredths of a volt)
- 1A= .14VDC (fourteen hundredths of a volt)
- 1.5A= .21VDC (twenty-one hundredths of a volt)
- 2A= .28VDC (twenty-eight hundredths of a volt)
- 2.5A= .35VDC (thirty-five hundredths of a volt)
- 3A= .42VDC (forty-two hundredths of a volt)



## 3 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

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For any amperage not shown use the following formula: desired amps times .14 equals Vref. Again, Idle current reduction **MUST** be disabled when setting the Vref values. We recommend fan (24VDC) cooling and heat sink at 2A or more. The wiring diagram has a suggested heat sink from 1/8" aluminum flat stock.

### Stepper Motor Hookup

This driver board will accept 5, 6 and 8 wire stepper motors rated at 500ma to 3A per coil. Over 2A per coil we recommend a heat sink and fan cooling. (4) wire BIPOLAR motors are not usable! The PCB silkscreen identifies which coil connects where. The coil commons connect to the 2 positions labeled "COM". Leads from "A" and "a" coil connect to positions labeled so. Likewise for "B" and "b". Simply reverse "A" for "a" and "a" for "A" connections to reverse the stepper motor direction. Most software allows for direction reversing. "Ballast" resistors are NOT required. Stepper motor leads should be kept as short as possible. 22ga stranded cabling will be fine for most applications. Never connect or disconnect any wiring with ANY voltage present as this will ensure blown driver chips! Measure for under .1VDC at TB6 before making any connections or disconnections. Be very careful when tightening the terminal screws so as NOT to twist the terminal block. This MAY cause the soldered pins to fracture causing intermittent operation.

### Microstepping

The driver board allows (5) different modes of driving your stepper motors. These can be set differently between each axis if desired. As a side note, 1/8 and 1/16 stepping MAY require quite a lot of computer process power! The Microstepping is set as follows:

- 1/1 step=J1 ON J2 ON J3 OFF
- 1/2 step=J1 ON J2 OFF J3 OFF
- 1/4 step=J1 OFF J2 ON J3 ON
- 1/8 step= J1 OFF J2 ON J3 OFF
- 1/16 step= J1 OFF J2 OFF J3 ON

We recommend using 1/2 or 1/4 step. This produces almost full power and usually avoids any resonance issues. The finer the micro step the less power you'll have. Don't use microstepping to increase the "precision" of your machine.

For reference, the driver chip steps best with a "low to high" transition signal.

### Idle Current Reduction

Jumper J4 controls this function on each axis. This allows the current to be reduced to @50% after no movement for approximately 10 seconds on that axis. This may reduce stepper motor heating. Each axis is individually settable. **Remove J4 jumper to enable** this function. **Install jumper on J4 to disable it**. A word of caution is in order. Idle current reduction MAY cause lost steps IF your software settings are very aggressive for the start rate and accel rate. It takes a few microseconds to restore full power when commanded to move from an idle current reduced condition. Experiment a bit with this.

As an alternate to the 50% reduction, substituting R2,R4,R6,R8 with a 4.7K value (not included) will allow only @30% current reduction. (3A down to 2A for example). This may allow more aggressive software setups. Note that 20K would allow @75% current reduction.

### Synchronous and Asynchronous Mode

Asynchronous function is active for all stepping modes. Approximately 10 seconds after last movement the stepper driver will automatically switch to synchronous mode. This helps prevent stepper "hiss" when not



## 3 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

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moving. The time delay is directly related to the idle current delay resistors (100K) installed in step #2. This function is always active and is independent of idle current enable/disable J4 jumper setting.

### Stepper Power Supply

The stepper power supply **MUST** be capable of providing 50% of the TOTAL current draw of the steppers. A 2.5A stepper will draw 5 Amps! For example: 4 steppers rated at 2.5A will draw a total of 20Amps. Adequate fusing must be used on both the AC and DC side.

### Stepper Fault Protection

We recommend never to connect or disconnect the stepper motors with power applied. **Wait a few minutes for the capacitors to completely discharge before removing any stepper wires.**

The driver chips have a built in feature (PAT PEND) to help prevent blowing the chip if a stepper motors wiring becomes open or shorted. This feature is available only during stepping. Use extreme caution when connecting or disconnecting ANY wires to and from the driver board. If the driver does enter fault protect mode, then cycling the power off and on again will reset the chip. Wait a full minute before turning back on. Find the fault and correct it.

Steppers will get warm. Also the chopper frequency can be heard in the steppers. This is normal.

We welcome your comments and suggestions. Be sure to check our FAQ page [hobbycnc.com/faq](http://hobbycnc.com/faq) first. **All** customer support is handled thru our Yahoo support group. A link was provided at the time of your order.

Please join and share the experience!

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