HobbyCNC®

CNC for the desktop machinist and hobbyist.

3 Axis

HobbyCNC® PRO Rev2

Chopper Driver Board Kit

Assembly Instructions

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Thank you for purchasing our 3 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 Enable signal is low (Pin 1).
- 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 and 24VDC for cooling fan (not provided) 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
- Side cutters
- Voltmeter
- 1/32" Rosin core solder
- Pliers

Construction Step by Step:

1. Compare all the parts against the parts list on page 11.

2. Insert the (7) 10K (R1, R2, R3, R4, R5, R6, R9. Brown Black Black Red Brown) resistors. Simply bend the leads over to fit the PCB holes (0.40") and solder in. ALWAYS use an Ohmmeter to verify values before soldering in place. Trim the leads.

3. Install (1) 6.04K (R10. Blue Black Yellow Brown Brown) resistor. Trim the leads.

4. Install (1) 249R resistors (R11. Red Yellow White Black Brown). Trim the leads.

5. Install (6) .1uF (C1, C2, C3, C5, C6, C7) Capacitors. These have NO orientation. Trim the leads.

6. Install (4) 10K Resistor Networks (RN1, RN2, RN3, RN5). Orient the dot on the part with the PCB silkscreened dot.

7. Install (3) BS250P MOSFETs (Q1, Q2, Q3) Orient the case as shown on the PCB silkscreen. Spread the leads apart to fit the PCB holes. Trim the leads.

8. Install (3) Capacitors 10uF 50V (C8, C9, C10). Orient the longest lead into the hole marked "+". The body of the capacitor has "-" marked on it to help identify the proper orientation. Trim the leads.

9. Install (3) Potentiometers (VR1, VR2, VR3).

10. Install (3) 2x4 Header Pin (P2, P3, P4). Short leads go into the PC Board, longer leads point 'up'.
   Note: Only 3 jumper shunts maximum are required for each 2x4 pin header to satisfy all stepping modes. (See Microstepping, page 8)

11. Install P1 DB25 Male connector. Take your time as many pins are close together. Solder the two mounting lugs for an even more robust mounting.

12. Install (4) 6-Position Terminal Blocks (TB1, TB2, TB3, TB5). **Orient** the holes for the wires facing "out". These may require a little extra heat to flow the solder as a lot of copper is present.

13. Install (2) 2-Position Terminal Blocks (TB6, TB7). **Orient** the holes facing "out". These may require a little extra heat to flow the solder as a lot of copper is present.

14. Install LM317HV (U7). **Orient** the tab towards R10. The PCB silkscreen shows this as a wide white band. Trim the leads.

15. Install 7805 (U5). **Orient** the tab towards C5/C6. The PCB silkscreen shows this as a wide white band. Trim the leads.

16. Install 7824 (U6). **Orient** the tab towards U5. The PCB silkscreen shows this as a wide white band. Trim the leads.

17. Install (3) 680uF Capacitors (C12, C13, C14). **Orient** the long lead into the hole marked "+". The capacitor body is marked with "-" to help with orientation. Trim the leads.

This completes the basic construction. DO NOT INSTALL U1, U2, U3 or U8 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, the **black** test lead touches the "-" on TB6 (indicated with a purple circle on page 7) and the **red** lead touches the pad labeled +5VDC (highlighted in red on page 7). Verify that +4.9 to 5.2VDC is present.

If not, review all the above steps and correct them. Failure to insure that +4.9 to 5.2VDC is present will BLOW the driver chips!

Go no further until +5VDC is achieved with this test.

18. Install (1) 74HC14N Hex Inverter (U8). **Orient** the notch as shown in the PCB silkscreen.

19. Install (3) 23 pin Driver Chips (U1, U2, U3) only after the above test is successful. They can only go one way.

   a. Leave the leads as long as possible by inserting the chips just far enough through the board to solder them (about 3/32").

   b. It is recommended to attach the heatsink **before** soldering the driver chips to avoid stress on the leads (see page 10 for heatsink design)

20. 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 resolve ALMOST ALL failures!

Interfacing With the Printer Port

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

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
1	Enable*	6	Z direction
2	X direction	7	Z step
3	X step	8	A direction
4	Y direction	9	A step
5	Y step		

- 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 via P6. See section **P6 Unused Pins**, page 8.
- 18-25 Ground

  * Pin 1 can be jumper-selected (J1) to become an Enable signal (active high). This allows the software to put the motors in a lower power idle state. If jumpered, Pin 1 will be pulled-up with a 10k resistor (R9). See **Idle Current Reduction** on page 8.

Refer to your CAM software for your specific requirements to configure pin 1 as "enable active-high".

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 nothing connected to P1, apply power to TB6 (12VDC min, 42VDC max) use a voltmeter with the **black** lead connected to TB6 terminal "minus" (indicated with a purple circle on page 7) and the **red** lead touching the axis pad to the lower left of VR1, VR2, VR3 (highlighted in green on page 7).

Clockwise rotation increases the voltage, counter clockwise decreases the voltage.

Vref		Motor Current
500ma	=	0.070VDC (seven hundredths of a volt)
1A	=	0.14VDC (fourteen hundredths of a volt)
1.5A	=	0.21VDC (twenty-one hundredths of a volt)
2A**	=	0.28VDC (twenty-eight hundredths of a volt)
2.5A**	=	0.35VDC (thirty-five hundredths of a volt)
3A**	=	0.42VDC (forty-two hundredths of a volt)

For any amperage not shown, use the following formula:

<u>desired amps times .14 equals Vref</u>

**A fan (24VDC) and heat sink are recommend for cooling at motor currents of 2A or more. Page 10 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. Four (4) wire BIPLOAR 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.

Stepper motor leads should be kept as short as possible. 22 gauge stranded cabling will be fine for most applications.

> Never connect or disconnect the stepper motors with power applied as this will ensure blown chips. Wait a few minutes for the capacitors to completely discharge before removing any stepper wires.

<u>Measure for under 0.1VDC at TB6 before making any connections or disconnections</u>.

<u>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.</u>
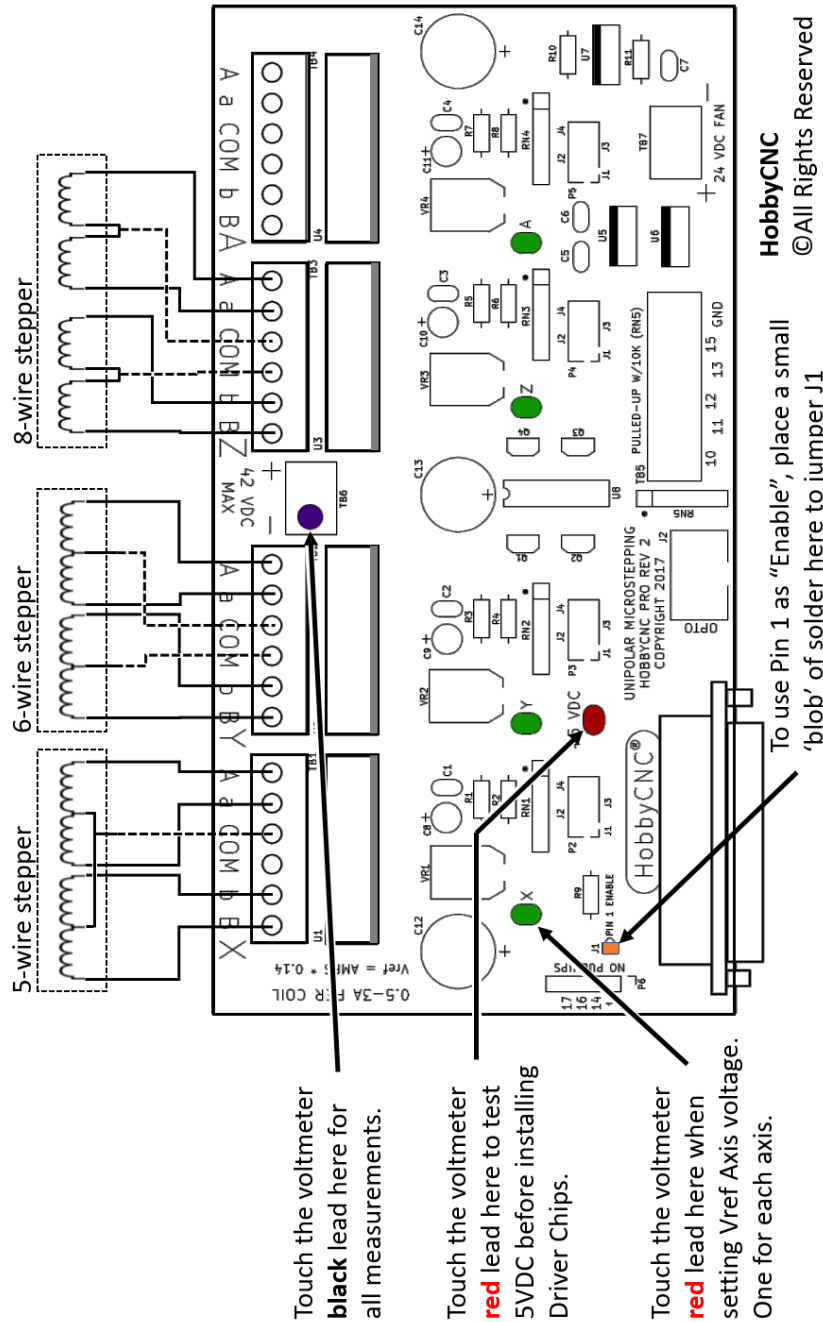
HobbyCNC Stepper Motor Wiring

23-130-DS8
23-205-DS8
23-305-DS8
23-305-DS8A
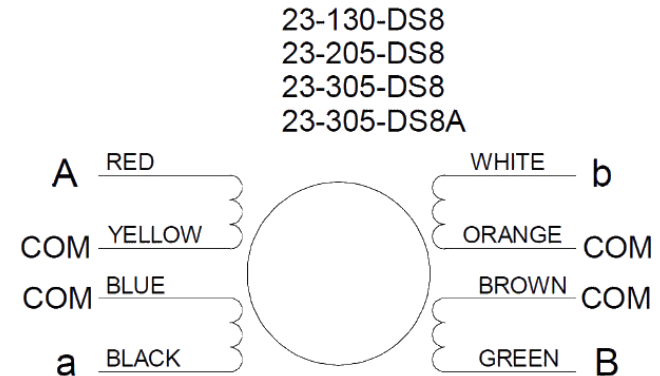
www.HobbyCNC.com

For non HobbyCNC motors, consult the motor vendor for wiring diagram and wire colors.

Board Diagram

(board diagram labels)

8-wire stepper
6-wire stepper
5-wire stepper

A a COM b B A
A a COM b B Z
A a COM b B Y
A a COM b B X

42 VDC MAX

24 VDC FAN

UNIPOLAR MICROSTEPPING
HOBBYCNC PRO REV 2
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PULLED-UP w/10K (RN5)
10 11 12 13 15 GND

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5 VDC

Vref = AMPS * 0.14
0.5–3A PER COIL

PIN 1 ENABLE

NO PULL-UPS

To use Pin 1 as "Enable", place a small 'blob' of solder here to jumper J1

Touch the voltmeter **black** lead here for all measurements.

Touch the voltmeter **red** lead here to test 5VDC before installing Driver Chips.

Touch the voltmeter **red** lead here when setting Vref Axis voltage. One for each axis.

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 via P2 through P5 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

Pin 1 can be jumper-selected (J1) to become an Enable signal (active high). This allows the software to put the motors in a lower power idle state.

To use Pin1 of the D connector as the Enable signal, take a small amount of solder and make a small "blob" to short the two pads together (marked in orange on page 7). If J1 is jumpered, Pin 1 will be pulled-up with a 10k resistor (R9).

On an axis-by-axis basis you can select to keep that axis enabled regardless of the state of Pin 1. Place a jumper on J4 of the 2x4 pin header (P2, P3, P4 or P5) for that axis to keep it enabled all the time.

Remove J4 jumper stepper motor current reduction controlled by Pin 1. **Install J4 jumper** to keep that axis constantly enabled regardless of Pin 1.

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). Note that 20K would allow @75% current reduction.

P6 Unused Pins

Four output pins from the 25 Pin D connector can be used to control relays or other devices. These pins are available at P6. A 6-pin 0.1" header (not included) can be soldered in to facilitate access to these signals. Pins 1 and 6 are ground. Our driver board plays no role other than to provide convenient access to these pins.

Stepper Power Supply

The stepper power supply MUST be capable of providing the TOTAL current draw of the steppers as set in the section *Current Adjustment* on page 5).

For example, if you set Vref to 0.42V (3 Amps) for all 4 motors, then you should have at least a 12A power supply. Adequate fusing must be used on both the AC and DC side of the power supply.

Support

Helpful assembly videos: hobbycnc.com/hobbycnc-videos
Frequently Asked Questions: hobbycnc.com/faq
Support Forum: hobbycnc.com/forums/forum/hobbycnc-pro

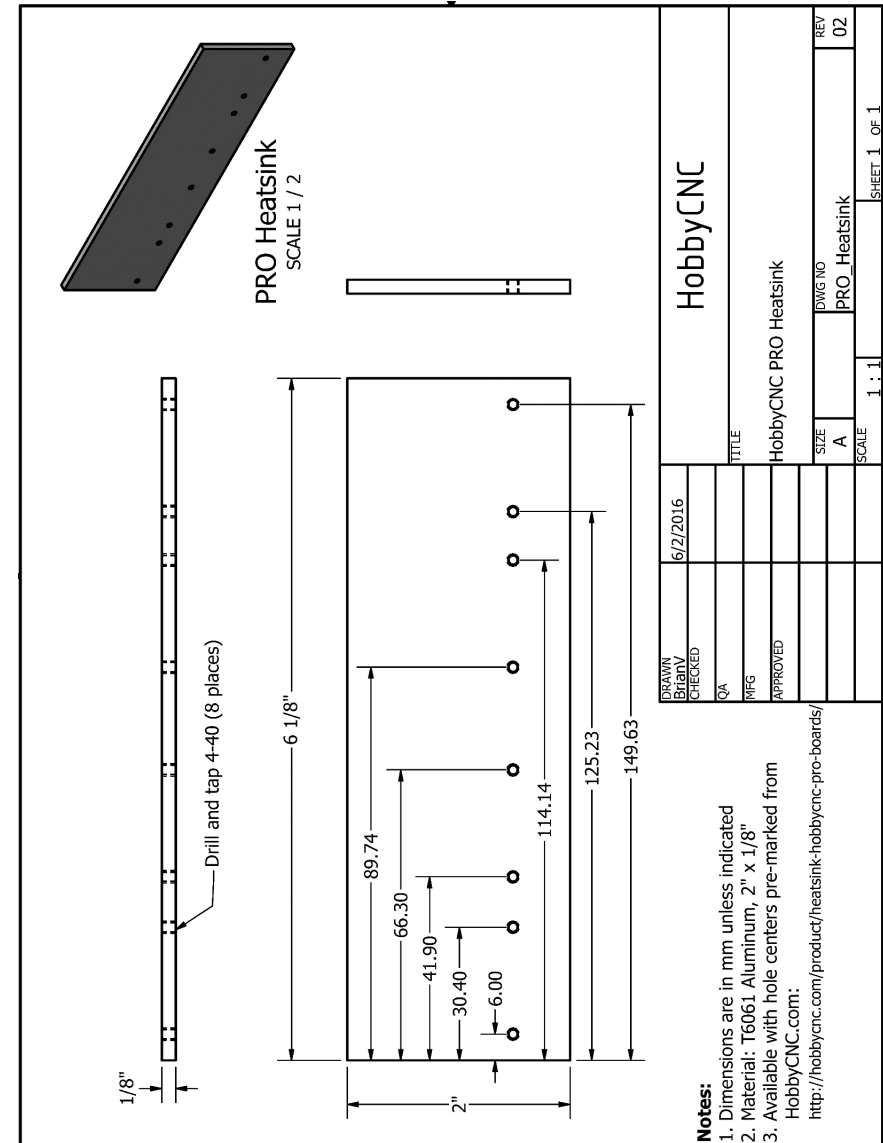We welcome your comments and suggestions.

Stepper Fault Protection

Never 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 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.

HobbyCNC PRO heatsink

It is recommended to attach the driver chips to the heatsink **before** soldering the driver chips.

PRO Heatsink
SCALE 1 / 2

Drill and tap 4-40 (8 places)

6 1/8"
89.74
66.30
41.90
30.40
6.00
114.14
125.23
149.63
1/8"
2"

Notes:
1. Dimensions are in mm unless indicated
2. Material: T6061 Aluminum, 2" x 1/8"
3. Available with hole centers pre-marked from HobbyCNC.com:
http://hobbycnc.com/product/heatsink-hobbycnc-pro-boards/

DRAWN BrianV
CHECKED
QA
MFG
APPROVED
6/2/2016

HobbyCNC

TITLE HobbyCNC PRO Heatsink

SIZE A
DWG NO PRO_Heatsink
REV 02
SCALE 1 : 1
SHEET 1 OF 1

The HobbyCNC PRO heatsink is available pre-marked for easy drilling-and-tapping. Includes screws and heatsink paste (hobbycnc.com/product/5865).

Parts List

Quantity	Reference	Part
6	C1,C2,C3,C5,C6,C7	0.1uF 50v Capacitor
3	C8,C9,C10	10uF 50V Electrolytic Capacitor
3	C12,C13,C14	680uF 50V Electrolytic Capacitor
7	R1,R2,R3,R4,R5,R6,R9	10k 1/4 W 1% (Brown Black Black Red Brown)
1	R10	6.04k 1/4 W 1% (Blue Black Yellow Brown Brown)
1	R11	249 1/4 W 1% (Red Yellow White Black Brown)
4	RN1,RN2,RN3,RN5	10k 6 Pin SIP Resistor Network
3	VR1,VR2,VR3	1k 1/2 W Potentiometer
3	U1,U2,U3	23 Pin Motor Driver Chip
1	U5	7805 5V Voltage Regulator
1	U6	7824 24V Voltage Regulator
1	U7	LM317HV Adjustable Voltage Regulator
1	U8	74HC14 Hex Inverter
3	Q1,Q2,Q3	BS250 PNP MOSFET
4	TB1,TB2,TB3,TB5	6 Position Terminal Block
2	TB6,TB7	2 Position Terminal Block
1	P1	DB25 90 Degree Male Connector
3	P2, P3, P4	2 X 4 Pin Header (Short ends solder into the PCB)
9	J1,J2,J3,J4	Jumper Shunts (Only 3 required for each 2 x 4 header)
1	RoHS compliant lead-free solder	PCB 2 Layer with Top Silkscreen and Plated Thru Holes, Rev 2
1		Step by Step Instructions & Kit Contents List

Stepper Motors and Power Supply Not Included

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