4 axis HobbyCNC PRO Rev1 Chopper Driver Board Kit

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:
4 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 (8) 10K (R1,R2,R3,R4,R5,R6,R7,R8 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.

2. (4) 100K resistors (R9,R10,R11,R12 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.

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.

6. Install (7) .1uF (C1,C2,C3,C4,C5,C6,C7) Capacitors. These have NO orientation. Trim the leads.

7. Solder in (5) 10K Resistor Networks (RN1,RN2,RN3,RN4,RN5). **Orient** the dot with the PCB silkscreened dot. Trim the leads.

8. Solder in (8) BS250P Mosfets (Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8) **Orient** the case as shown on the PCB silkscreen. Spread the leads apart to fit the PCB holes. Trim the leads.

9. (4) Capacitors 10uF 50V (C8,C9,C10,C11) 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-C18.**

10. (4) Capacitors 100uF 16V (C15,C16,C17,C18) 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.

11. Install (4) Potentiometers (VR1,VR2,VR3,VR4) now. Trim the leads.

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.

13. Solder P1 DB25 Male connector in now. Take your time as many pins are close together.

14. The 6 Position Terminal Blocks (TB1,TB2,TB3,TB4,TB5) solder in now. **Orient** the holes for the wires facing "out".

15. Install the 2 Position Terminal Blocks (TB6,TB7) next. **Orient** the holes facing "out".

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 that +5.0VDC-+5.2VDC is present will BLOW the driver chips! **(U5, R13, and R16 control the +5VDC voltage.)**

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
2	X direction
3	X step
4	Y direction
5	Y step

6   Z direction
7   Z step
8   A direction
9   A step

10,11,12,13,15 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)

1,14,16,17 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)

For any amperage not shown use the following formula: <u>desired amps times .14 equals Vref</u>. Again, Idle current reduction <u>MUST</u> 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 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. "Ballast" resistors are NOT required. Stepper motor leads should be kept as short as possible. 22ga stranded cabling will be fine for most applications.

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 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. **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!

Dave Rigotti
Hobby CNC

Quantity	Reference	4 Axis HobbyCNC PRO Rev1 Driver Board Kit
		Part
7	C1,C2,C3,C4,C5,C6,C7	.1uF 50v Capacitor
4	C8,C9,C10,C11	10uF 50V Electrolytic Capacitor
3	C12,C13,C14	680uF 50V Electrolytic Capacitor
4	C15,C16,C17,C18	100uF 16V Electrolytic Capacitor
8	R1,R2,R3,R4,R5,R6,R7,R8	10K 1/4 W 1% (Brown Black Black Red Brown)
4	R9,R10,R11,R12	100K 1/4 W 5% (Brown Black Yellow Gold)
2	R13,R14	249 1/4 W 1% (Red Yellow White Black Brown)
1	R15	6.04K 1/4 W 1% (Blue Black Yellow Brown Brown)
1	R16	750 1/4 W 1% (Violet Green Black Black Brown)
5	RN1,RN2,RN3,RN4,RN5	10K 6 Pin SIP Resistor Network
4	VR1,VR2,VR3,VR4	1K 1/2 W Potentiometer
4	U1,U2,U3,U4	23 Pin Driver Chip
1	U5	LM317 Adjustable Voltage Regulator
1	U6	7824 24V Voltage Regulator
1	U7	LM317HV Adjustable Voltage Regulator
2	U8,U9	74HC14 Hex Inverter
8	Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8	BS250 PNP Mosfet
5	TB1,TB2,TB3,TB4,TB5	6 Position Terminal Block
2	TB6,TB7	2 Position Terminal Block
1	P1	DB25 90 Degree Male Connector
4	J1,J2,J3,J4	2 X 4 Pin Header
12	J1,J2,J3,J4	Jumper Shunts
1	RoHS compliant lead-free solder	PCB 2 Layer with Top Silkscreen and Plated Thru Holes
1		Step by Step Instructions
1		Kit Contents List

VARIOUS STEPPER HOOKUPS

TYPE	A	a	COM	COM	b	B
HOBBYCNC 8 Wire 130, 205, 305	RED	BLACK	YELLOW BLUE	ORANGE BROWN	GREEN	WHITE
HOBBYCNC 8 Wire 127, 200	BLUE	GREEN	RED YELLOW	ORANGE BLACK	WHITE	BROWN
HOBBYCNC 6 Wire	BLACK	GREEN	YELLOW	WHITE	BLUE	RED
Vexta PH PK 6 Wire	BLACK	GREEN	YELLOW	WHITE	BLUE	RED
Vexta PK 8 Wire	BLACK	GREEN	YELLOW ORANGE	WHITE BROWN	BLUE	RED
Vexta PH 8 Wire	BLACK	ORANGE	BLK/WHT ORG/WHT	RED/WHT YEL/WHT	YELLOW	RED
Japan Servo, SKC Superior 6 Wire	WHT/RED	RED	BLACK	WHITE	WHT/GRN	GREEN
Superior 8 Wire	WHT/RED	RED	WHITE BLACK	WHT/BLK ORANGE	WHT/GRN	GREEN
SKC 6 Wire	BROWN	ORANGE	BLACK	WHITE	RED	YELLOW
SKC 8 Wire	BLACK	GREEN	BLK/WHT GRN/WHT	RED/WHT BLU/WHT	BLUE	RED
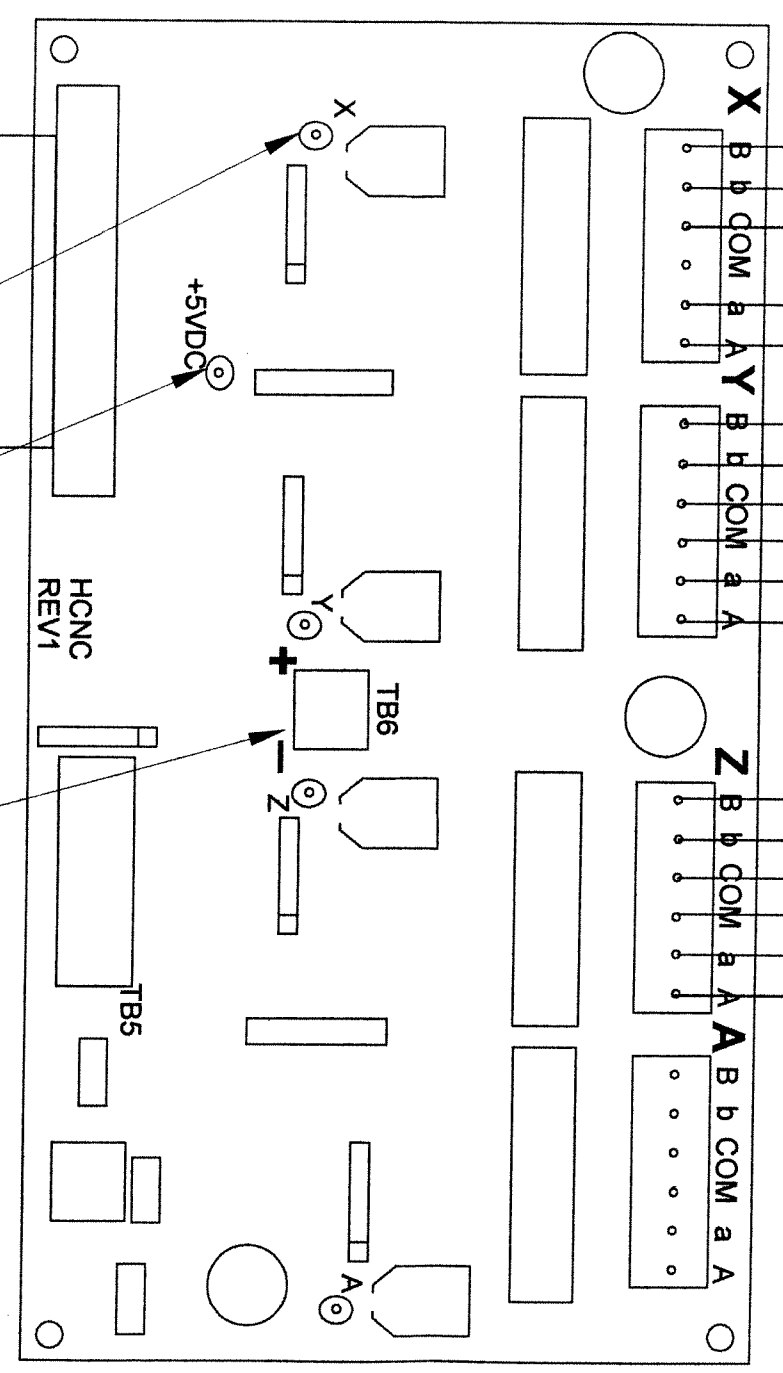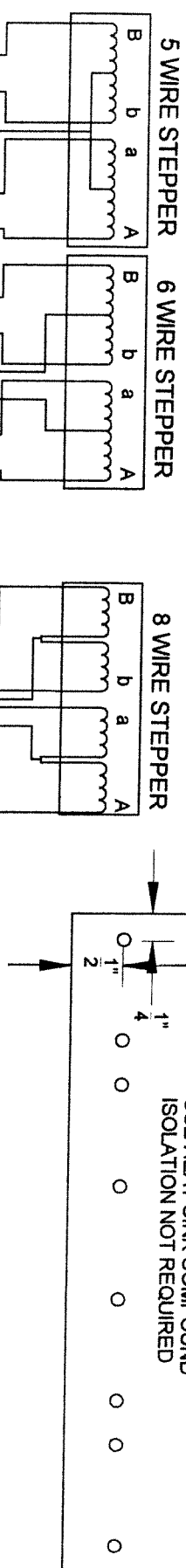
TOUCH VOLTMETER RED LEAD
HERE WHEN SETTING Vref AXIS
VOLTAGE. TYP FOR EACH AXIS

TOUCH VOLTMETER RED LEAD HERE
TO CHECK FOR +5VDC BEFORE
INSTALLING THE DRIVER CHIPS

TOUCH VOLTMETER BLACK
LEAD HERE FOR ALL
MEASUREMENTS

+5VDC

X

+5VDC

Y

HCNC
REV1

TB6

+

−

Z

A

TB5

X

5 WIRE STEPPER

B   b   COM   a   A

Y

6 WIRE STEPPER

B   b   COM   a   A

Z

8 WIRE STEPPER

B   b   COM   a   A

A

B   b   COM   a   A

HEAT SINK 1/8 X 2 X 6 1/8 ALUM
LOCATE HOLES FROM CHIPS TAP #4-40

1/2"
1/4"

USE HEAT SINK COMPOUND
ISOLATION NOT REQUIRED

HOBBY CNC