

# Easy to build CNC Mill Stepper Motor and Driver circuits

by **Tom McWire** on August 26, 2007

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## intro: Easy to build CNC Mill Stepper Motor and Driver circuits

This is a follow up to the [Easy to Build Desk Top 3 Axis CNC Milling Machine](#) Once you get the machine all put together its time to make it go.

So it's time to drive the motors. And here I've put together a circuit that I think is the absolute cheapest and easiest way to control stepper motors with step and direction signals. It works with many of the free or low cost softwares that produce step and direction signals through the parallel printer port. I'll explain how it works but for those of you who just want to get on with it... [The\\_Next\\_Step](#)

But I would suggest for those of you who are unfamiliar with circuits to do it on a bread board (see pictures). This way you can easily correct any mistakes and try different things.

This schematic is just to control one motor so for the milling machine you need 3 of these circuits and 3 motors.

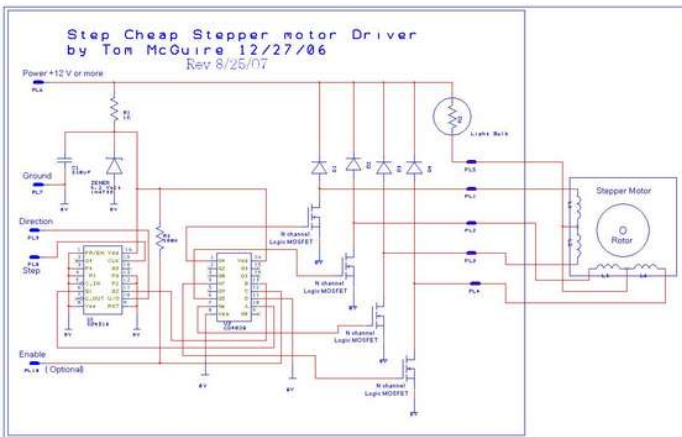
From Left to right and top to bottom. I try to draw schematics so that positive voltages are toward the top and ground or negative volge is toward the bottom. Inputs are to the left and outputs to the right. First off the voltage that you are going to use to run the motor needs to be stepped down and regulated for the logic chips. I used a 6.2 volt Zener to do this because it's low enough for the logic chips to receive the signals from your printer port and high enough for the outputs to drive many of the standard power FETs, so you may not have to use logic FETs like the schematic shows. So the resistor R1 drops the voltage, the Zener diode regulates it to 6.2 volts and the capacitor C1 filters out any noise from the motor, and this voltage powers the two IC's.

The first IC (CD4516) is called an up/down counter. One signal from the printer port will tell the counter if it will count up or down and the other signal, called step, will increment or decrement the counter by one count. Now were only going to use two outputs from the counter Q1 and Q2. With this binary counting method there are only 4 combinations of output from the counter: 00, 01, 10, and 11. These lines are fed to the A and B inputs of the other IC (CD4028) which decodes these combinations to 4 separate outputs.

I did a trick here using the C input to work as an Enable input. If the Enable(optional) is connected to the parallel port and the computer tells it to shut off all of the outputs to the FETs will go low(Off). So the four outputs of the decoder drive the FET transistors and the FETs drive the four poles of the motor.

Now everybody wants to know what the light bulb is for. Its not so much whether you use a bulb or a resistor, its that a bulb comes with a socket. You can get these wedge base light bulbs from 1 watt to 20 watts. Start with may be a 4 watt bulb and if you find you need a little more beef you just pull it out and put in a 10 watt bulb. It's really handy. And I found it's good to have some voltage drop there as kind of a ballast for the motor windings. The diodes catch some of the current that comes out of the motor each time the FET transistors turn off. The diode feeds this current back to the supply.

When you get the circuit up and running find a power supply that puts out more voltage than you really need and then change out light bulbs till you get it running smoothly. Some of my stepper motors are 5 or 6 volt and some are 12 volt but it all works out.



Pin	I/O	ADDRESS	BIT	STATE	STEPPER CONTROLS
1	O	PORT+2	0	INVERTED	SPINDLE RELAY
2	O	PORT	0	NORMAL	X-STEP
3	O	PORT	1	NORMAL	X-DIR
4	O	PORT	2	NORMAL	X-ENABLE
5	O	PORT	3	NORMAL	Y-STEP
6	O	PORT	4	NORMAL	Y-DIR
7	O	PORT	5	NORMAL	Y-ENABLE
8	O	PORT	6	NORMAL	Z-STEP
9	O	PORT	7	NORMAL	Z-DIR
10	I	PORT+1	6	NORMAL	NU
11	I	PORT+1	7	INVERTED	X-HOME SWITCH
12	I	PORT+1	5	NORMAL	Y-HOME SWITCH
13	I	PORT+1	4	NORMAL	Z-HOME SWITCH
14	O	PORT+2	1	INVERTED	Z-ENABLE
15	I	PORT+1	3	NORMAL	NU
16	O	PORT+2	2	NORMAL	M CODE FUNCTION
17	O	PORT+2	3	INVERTED	M CODE FUNCTION
18-25					GROUND

## File Downloads

[C:\Projects\Milling\Mill\\_Drive\StepCheap1.pdf](#) (37 KB)  
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\Milling\Mill\_Drive\StepCheap1.pdf']

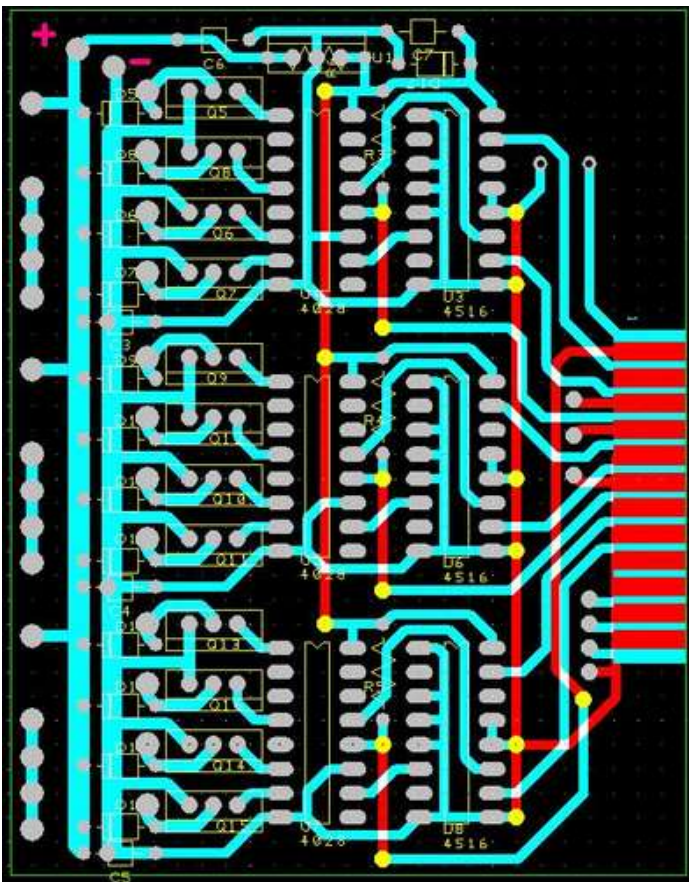
[C:\Projects\StepCheap3D\\_PCB\\_GodeC.zip](#) (34 KB)  
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\StepCheap3D\_PCB\_GodeC.zip']

[C:\Projects\StepCheapPartsList.rtf](#) (2 KB)  
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\StepCheapPartsList.rtf']

## step 1: The Circuit Board of Appeals

OK here's what your all looking for. I made a simple PC board layout that includes 3 motor driver circuits connected to a 25 pin D sub Parallel printer port connector. Here's a picture of the layout. At the top of the picture you see a place for a voltage regulator. You can use that or you can put a resistor and Zener Diode in its place(like the schematic shows). On the right edge is a place for the 25 pin D-sub connector that connects to the parallel printer port. You just jam the PC board between the two rows of pins and solder it.

On the left side are places for the lamp sockets. You need to look over the schematic to see where some of the parts go but it's all there.



## File Downloads



C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3D.zip (16 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3D.zip']



C:\Documents and Settings\Tom\Desktop\StepCheap3DBOT.pdf (30 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Documents and Settings\Tom\Desktop\StepCheap3DBOT.pdf']



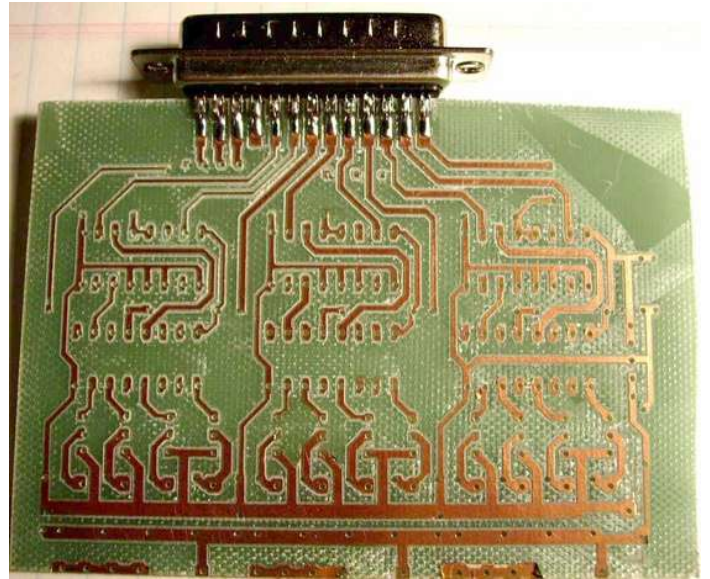
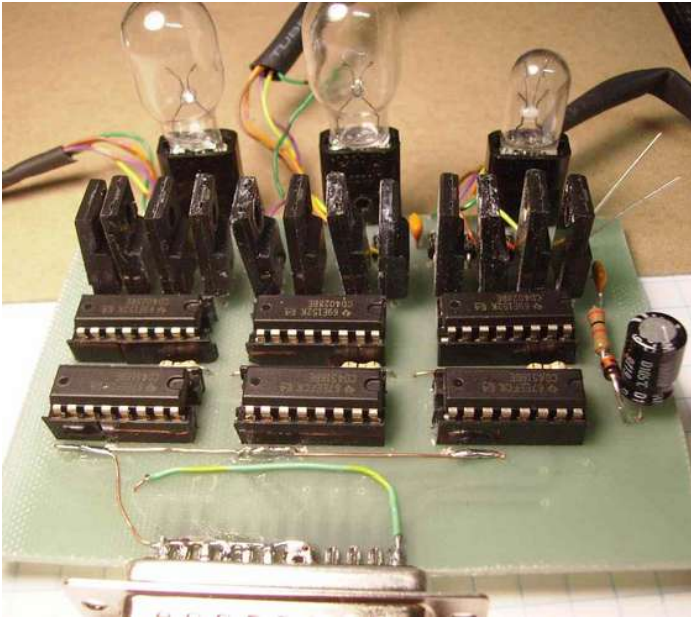
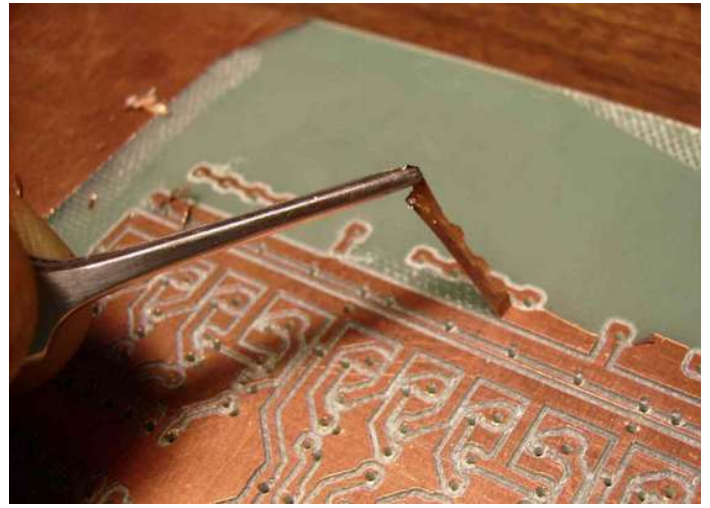
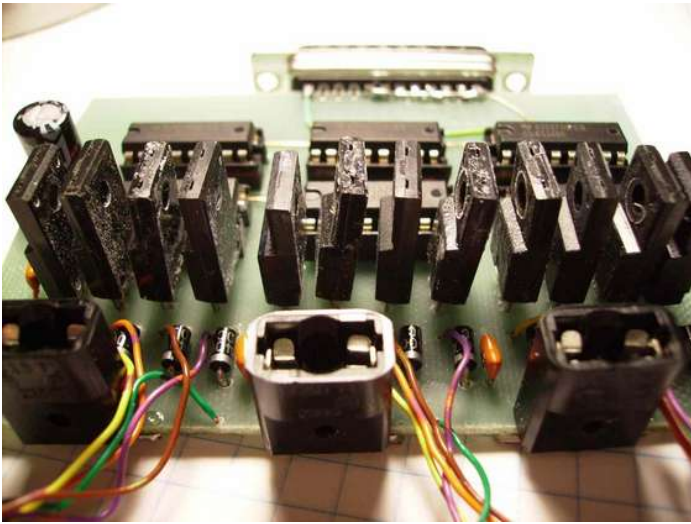
C:\Projects\StepCheap3D\_PCB\_GodeC.zip (34 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\StepCheap3D\_PCB\_GodeC.zip']

## step 2: Circuit Cloning

If you have a time machine you can go to the future and ask yourself to make the circuit board with the finished machine and then bring it back and finish building the machine. After a couple of tries I got the board to come out pretty good. The machine routes what are called isolation paths which means it separates the copper that is associated with a conductive path from all the other copper around it. This leaves some areas of the board that are not associated with a path still covered with copper. You could leave this extra copper on there but when your soldering it is easy to get solder bridges across the isolation paths and short circuit something. So I take the soldering iron and touch it on the excess copper and peel it up off the board. It makes the board more like what you would get if you chemical etched it or bought it from a board house(see below).

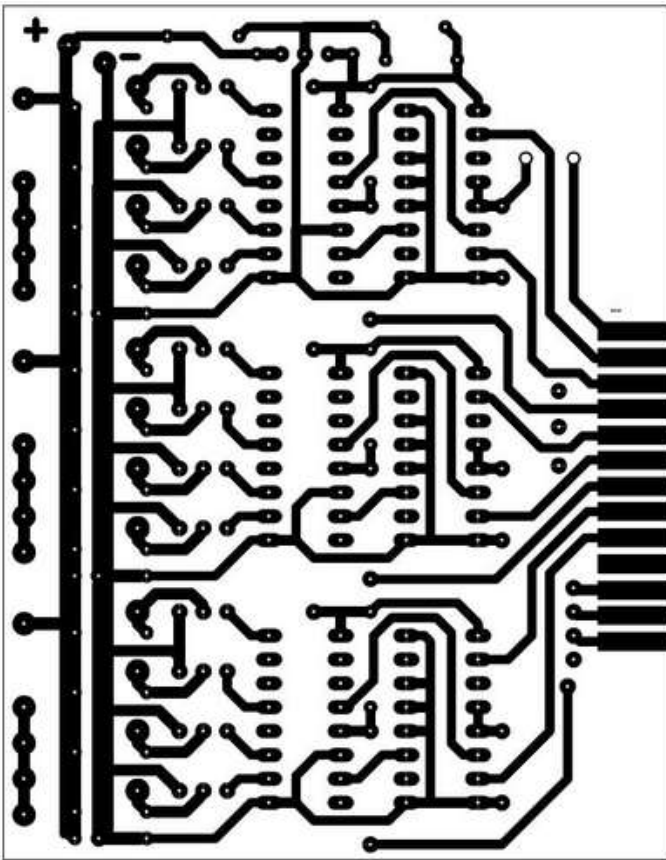
Anyway look over the schematic and place the parts accordingly. I added a few capacitors along the power lines just for general principals. There were so few traces on the top side of the board I didn't bother milling it. I just used jumper wires. See the pictures below of the populated board. All the little FETs lined up like marching soldiers.



### step 3: Photo Etching a Driver Board

OK, For all you chemistry majors who want to do something a little more professional here are some .pdf files you can print out and iron on or what ever you do to make an etched PC board. There's a Top Silk (just for reference), Top Copper, and Bottom Copper.

If you want to go easy Just do the Bottom Copper. There's not that much on the top and you can just solder jumpers where you need to.



## File Downloads



C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3Dsilk.pdf (9 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3Dsilk.pdf']



C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3DTop.pdf (28 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3DTop.pdf']



C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3DBot.pdf (30 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'C:\Projects\Milling\Mill\_Drive\Schem-PCB\StepCheap3DBot.pdf']

### step 4: TESTING..1..2..3

Don't be nervous. It's just a little electricity. First off it would be good to load up the KCAM (or what ever you plan on using) in your computer. Then when you feel comfortable that all the parts are in the right place plug the parallel port connector into the driver board(as shown below) and put a low wattage bulb in the socket for the motor. In this case I'm using middle, the Y axis driver.

For power I like to use one of these universal power adapters with selectable voltage output. They're cheap and they don't put out a lot of current so if something goes wrong it's less likely to damage your circuit. Set the voltage low and see if you have some voltage on the power pins(16) of the CD4516 and the CD4028. If you don't have a volt meter just take an LED and tie a 10K(BRN,BLK,ORN) resistor to the positive(the long leg) and wire to ground tied to the negative(the short leg). Now you can use this as a probe to see where you have voltage. It will be very dim but we don't want to draw too much current away from the circuit.

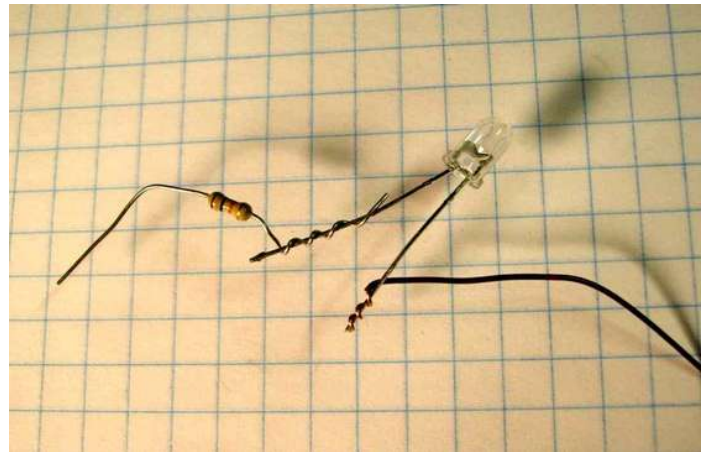
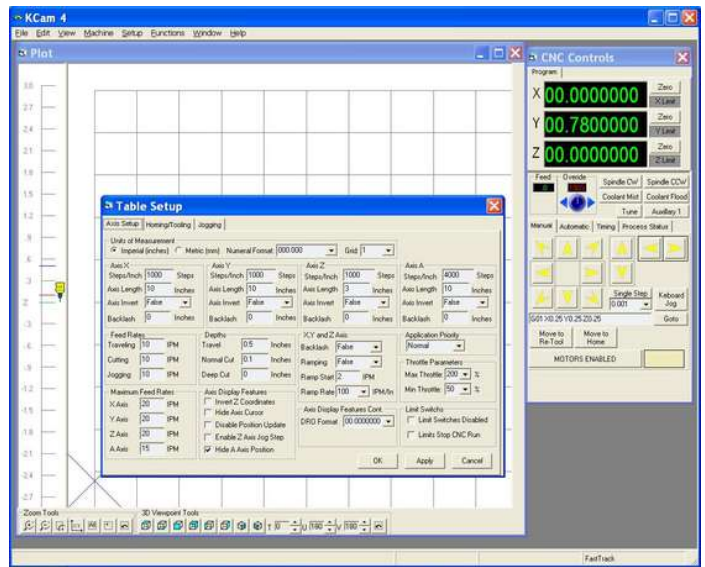
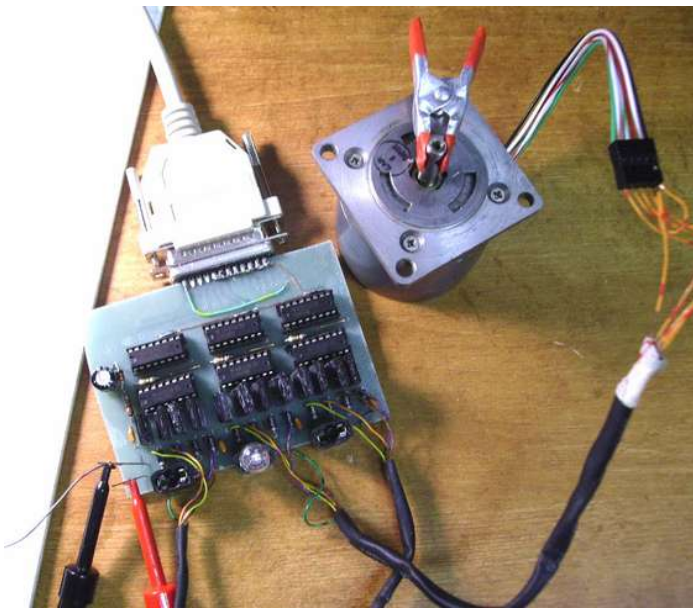
Now go into the computer program and find the Setup Table. Set the steps per inch to 1000. Then open the CNC control and set the single step for .001 inch and activate the single step mode. Now each time you click the yellow arrows (up and down for the Y axis) the computer will output one pulse to the stepper motor driver circuit.

Put your LED probe on pin 10 of the CD4516. This is the up down input. When you click the up arrow the input will be low(LED off) and when you click the down arrow the input will be high(LED on). Pin 15 is the step input you will see a very short blink each time you click a up or down arrow on this pin. Pin 6 is the Q1 output. It will change state(high/low) each time you click an arrow. And Pin 11 is the Q2 output. It will change state every other time you click an arrow.

On the output side of things we should see some activity on the CD4028 chip. Putting your probe on any of the output pins 1,4,6,or 7. These outputs drive the FETs. You should see the output go high every 4th time you click the up or down arrow.

If this all makes sense so far it's time to get the motor running. The common wire or wires of the motor which are the center tap of the windings should be connected to the light bulb. The other four wires should go to the four FETs on the circuit. If you are really lucky you will get the combination just right in the first couple of tries. Other wise just keep switching the wires around until the motor steps in the same direction each time you click the arrows.

Watch the video in the next step. It may give you a better idea what to do.



**step 5: Let's Watch it on TV**

I just like watching a video better than doing a bunch of reading. Hope this is helpful. Good luck with your projects. If the movie doesn't show past this link into your browser.

<http://www.youtube.com/watch?v=ZUyqscxLJ4k>



## step 6: Linux Users

I'm not a Linux user yet but I have played with it enough to be dangerous. But for you Linux users Chaddcurtis has contributed some setup files and information to help you use Linux CNC with the parallel port and this circuit board layout. Thanks a lot Chad and more power to you.



## File Downloads



Linux\_stepper.zip (7 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'Linux\_stepper.zip']

## Related Instructables



**Make your own cnc controller**  
by charcoal999



**Make a CNC Hot Wire Foam Cutter from parts available at your local hardware store**  
by tbarnea



**CNC Stomp Pad Project | CNC Programming | G-Code Programming | CNC Plasma Cutting**  
by ivanirons



**How to Make a Three Axis CNC Machine (Cheaply and Easily)**  
by Stuart.Mcfarlan



**CO2 laser that cuts sheet metal**  
by owwhite



**Homebrew Laser Cutter made by Zach Radding**  
by TimAnderson



**stepper motor - use it cheapest and easiest**  
by usmiv40



**3 Axis CNC Router - 60"x60"x5" - JunkBot**  
by russaanderson



## Comments

50 comments [Add Comment](#)

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**WILLIAM BOON** says:

I HAVE A PROBLEM FROM PARTS LIST, I HAD BOUGHT PARTS LIST EXCEPT CAPACITOR 10 VOLT & 4 MOSFET N-CH 100V 12A TO-220AB ARE NOT AVAILABLE, CAN YOU GIVE ME A SUBSTITUTE OF CAPACITOR & MOSFET. THANKS.

Oct 18, 2008. 8:14 PM [REPLY](#)




**h11ayw** says:


Today I had a same problem. The dealer of fairchild told me that IRF 530A is suitable. It is 100V, 19A. Sooner or later the name will be changed to FQP19N10 which means 19A, N ch, 100V. More understandable. And Capacitor voltage is not that critical if it is higher, so 220uF 50V(or 35) is easily available.

Nov 19, 2008. 4:27 AM [REPLY](#)


Patrick from Seoul

 **Sousa** says: Nov 9, 2008. 1:12 PM [REPLY](#)  
Hello! Great tutorial. In step2, I just want to add that you don't need to buy a time machine. Since is too expensive you can test the circuit on a breadboard and, by the way, connect it to the mill motors and build it's own pcb! ;)


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 **Riddell** says: Nov 13, 2008. 5:28 PM [REPLY](#)  
Good idea, use plenty of 0.01 and 0.1 ceramic caps sprinkled around the boards btwn pos and neg runs and keep wires as short as possible.


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 **vijaycira** says: Nov 13, 2008. 7:51 AM [REPLY](#)  
Hi tom this is vijay from india and i m really fascinated with the idea of making a cnc machine. i have been going through your pages past couple of days and understood lots of things. have already gone to the local electronic market and inquired about the stuff i would need. I would like to know if my choice of a 12 volt 1.8 step stepper motor is good enough for running a wood router machine. will the motor be able to take the load. and as per your plan i understand that this is a unipolar motore will the unipolar motors are good enough for this purpose. please advise before i buy all the stuff and start assembly.


---

 **chucketn** says: Nov 13, 2008. 6:57 AM [REPLY](#)  
Great instructable, both the Desktop Mill and the stepper controller.  
Any updates as to kits for the stepper controller? I would be interested in purchasing such a kit. It's hard to find the circuit components locally.  
Also, any info on USB to Parallel adapters that will work for those of us with no parallel ports?  
contact me chunk07@comcast.net  
Chuck in E. Tennessee


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 **Chris\_Stringer** says: Nov 9, 2008. 4:22 PM [REPLY](#)  
Hi, Has anyone used this Circuit with Mach3. Im having real trouble getting my motors to move, I set all the pin outs correct, Im not sure if Mach3 is sending the right signals to the board. Also on Kcam I cant get my motors to move fast even with no load on them, they just start jittering once the speed picks up, there quite strong motors 1.4nNm. Any Ideas?  
  
Cheers

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 **Odin49** says: Nov 5, 2008. 12:42 PM [REPLY](#)  
Hi, is there any way I can get the Parallel Port's pinout. I would like to know where each pin connects to. Thank you.


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 **itstuck3r** says: Oct 7, 2008. 4:05 PM [REPLY](#)  
is there any way i can test the circuit with my breadboard? i have 2 breadboards with the circuits placed on them but is there any way to test only 1 circuit so i can make sure my circuit is correct before i go and solder them on the board?

---

 **Riddell** says: Nov 5, 2008. 3:17 AM [REPLY](#)  
Use a NE555 as a clock source.


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 **mox** says: Nov 1, 2008. 4:16 AM [REPLY](#)  
Hi I'm also trying to build the drivers. The only problem is I don't know enough to read the diagrams. Can you send me a picture of your placement of the components on the breadboard so I can try it as well (with links etc.)  
You can mail the pic to : marcokruger@vodamail.co.za  
I also don't have the bulb fittings (will it still work?)  
  
Thanks  
  
Marco

---

 **rahmansaid** says: Nov 18, 2008. 10:22 PM [REPLY](#)  
I also cannot find the bulbs. What are my alternatives?

---

 **Tom McWire** says: Oct 9, 2008. 8:24 PM [REPLY](#)  
Sure. If you have the resistors, Zener diode, and capacitors in place go ahead and plug it in. It will run one channel just fine without the others hooked up.  
Tom

---

 **Chris\_Stringer** says: Oct 26, 2008. 8:03 PM [REPLY](#)  
Alright Fellas,  
Quick question: Will this circuit support an 8 lead Stepper Motor?  
Also what sort of current will this circuit handle?  
  
Cheers Guys

---





**imprez55** says:

Oct 29, 2008. 6:02 PM **REPLY**

Yes it will support 8 wire steppers. 8 wire steppers can be wired unipolar and bipolar (both parallel and series). The default wiring for this circuit is unipolar. If you take bazoooka\_mx's advice (i think) you could wire it as bipolar, taking the full advantage of an 8 wire stepper.

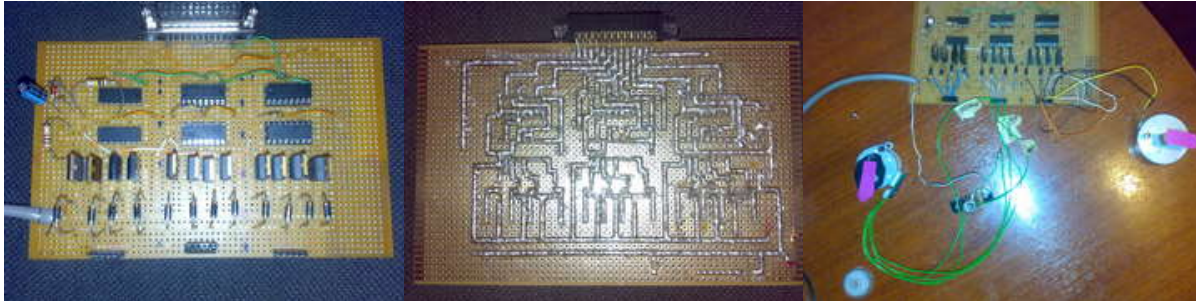
I do not know the max current as I have not built this circuit. Someone else will have to chime in here.



**RAVENEXTREME** says:

Oct 24, 2008. 5:22 AM **REPLY**

Hi there. Tom until now i was relly exited about your project and tried to build it myself and untill now everything was just fine. ya untill now cause now i have one small but big problem with my ciscuit or my configuration. The problem is that wen i connect one motor in the ( Y ) drive it wrks fine but, when i connect it on other drive ( X ) or ( Z ) it doesn't work fine. I tried vairous connections with the wires and still nothing. Just simply movos on various directions at the same step or does not rotate on the desired direction. I wil try to post the pic of my circuit ( it is on bread board cause i dont have much experience and for a prototype it should be nice ) I understand that there are other conditions for the drives to work with stepper motors because of the especificatios of the motros like for ex if they are unipolar or bipolar. At my test i used a uniplolar from a HP printer. But i have two othr ones. However they are bipolar. As i could see Bazzoka posted a solution for the motors conversion and i think that i wiil try it later :). But now :( my problem is that i cant solve the main problem :( the motor doesn't work correctly on the ( X ) and ( z ) drives :(((( HELP PLS ...



**Firefart\_1st** says:

Oct 25, 2008. 5:08 AM **REPLY**

RAVENEXTREME

também sou de Portugal e já resolvi o problema dos motores rodarem para todo o lado menos em circulo xD (liguei todas as entradas livres do 4028 à massa) e outro problema é quando o oscilador ou pc a que ligas tem uma saída "ruidosa" e ele dá mais do que um passo. se tiveres pouca corrente no motor também tens passos que ele não dá e salta(escorrega) algum passo e não anda. mas primeiro todas as saídas têm que contar bem. liga as entradas (entradas mesmo!) livres do 4028 e isso resolve-se. se quiseres ajuda manda-me uma PM ou responde com um mail. gostava só de saber quais mosfets usaste porque eu tenho medo de escolher uns e chegar à dimofel em lisboa e não haver... queria só mesmo um guide-line para mosfets standart.

for the other users that upper part is in Portuguese and It's going to be translated and shortened here!

I tried this circuit in a breadboard and had the same problem. seems like some cmos have different tolerances and I had to ground all the free inputs of the 4028 for it to decode the right output at the right pulse.

on the other hand.. I need help to find a standard mosfet in order to get the right one in my solar electronics shop. I really appreciate it if anyone gives me a mosfet reference.

my motors are about 5V (or 2.5V) 1A. (about 9W when pushed really hard)  
thanks

really nice instructable



**rhorton** says:

Oct 29, 2008. 5:58 PM **REPLY**

The closest match I could find in the local electrical components shop was part number IRF532



**RAVENEXTREME** says:

Oct 25, 2008. 9:57 AM **REPLY**

Boas ;)  
os I should say hello,

Anyway i thik my problem is major than that but i will try your solution for my case. Thanks Firefart:1st. I dont have much experience on all of this and all i say here can be corrected by more experiented friends. I hope so ;) Ok for the noise problem that you have i think it as something about the configuration on Kcam at the table setup ( correct me if i'm wrong ) i aldo had some prblems ate the movements and the noise on my (Y) axe but i solved it changing the "Maximum Fedd rates" on Kcam. Or at least after that the motor was just fine and moves in the desired direction with no noise and smoth.

Abou the MOSFETS i used the IRF640 since at the Electronic Shop they didnt have the ones on the componets list. Anyway you should phone them or chech their website before you go there. ;)

Thanks for the sugestion Firefart\_1st :) I left my mail on the PM and since you have it there you can add me on msn if you have it. That way maybe we can help each other .

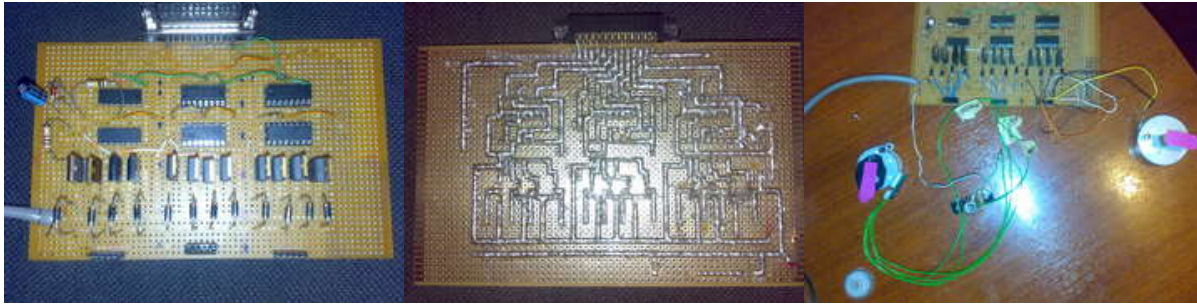
However i think we gonna nedd all the help form the others to solve our problems cause most o them had finished their machines and so they are precious help for all the ones that like us are having some problems. Becuase of that i want to say thanks for all the help im getting here and speccially to TOM for posting this instructable ;)



**RAVENEXTREME** says:

Oct 24, 2008. 5:25 AM [REPLY](#)

By the way, Im from Portugal and i work with CNC machines but for metal cutting ;) sorry about my english :s Thanks for posting your project. Its really amazing and as i could see there is lots of ppl meking really good things with it :) once again thanks



**RAVENEXTREME** says:

Oct 24, 2008. 5:43 AM [REPLY](#)

oops... i think i forgot to say something. As i said before this circuit is just a prototype one and so, the components are disposed as you can see but, they are in place. I used all the onos that you have described on the componnets list. Other thing is that as you can see in the third picture i used two motors. The left side one is the unipolar one and works really fine. The right side one is the Bipolar one witch also works but not correctly. For the last one i applied the scheme suplied by Bazooka\_mx and i can say that works bu, as i described at the first post the two motors only works at 100% on the (y ) drive :(( I hope that you understand my problem and if you coul help me i will aprecciate it ;) ) 3 posts are yo much but its my first time here and i didnt know how it works arround here. The next time will be better :) Thanks once again



**RAVENEXTREME** says:

Oct 28, 2008. 10:13 AM [REPLY](#)

Well i think that the problem i had described at this topic is solved or at least i think so. I removed the UNIPOLAR motor and applied 3 BIPOLAR motors so by this way i will have the same type of connection for all the motors. As i told before i'm using the bazooka\_mx technique and it works fine but on my case only when i have just one motor running. The problem becomes bigger when i have all the 3 motor connected and there, ok i have burned some resistors :( As i'm not experient at electronic now i dont really know witch resistor i must put there instead f the four bulbs for each motor. Can anyone help me ? I'm using a 12V power supply . Thanks guys



**itstuck3r** says:

Oct 17, 2008. 1:26 AM [REPLY](#)

one more question, i solved the random boiling hot MOSFET and now somethings going on with the stepper motor. i set the step to 1.0 to see if it would spin and it randomly goes back and forth very rapidly until it stops...any suggestions?



**rhorton** says:

Oct 29, 2008. 5:55 PM [REPLY](#)

Hey itstuck3r, I have exactly that problem - the first MOSFET is totally hot - all the rest are fine, but I am afraid to run the circuit as I don't want to burn things. What seemed to be the issue that was making the fet go so hot?



**Themachinist** says:

Oct 14, 2008. 6:24 PM [REPLY](#)

hello tom, I'm trying to build the circuit on a bread board since I don't have experience with circuits. What I don't understand is how am i going to add the parallel printer port to the circuit.You said we need one circuit for every motor...how is it that all three circuits will be connected to one single parallel port.I would appreciate your prompt answer...I'm building this for my electromechanical devices class. thank you....I admire the work you've done with this project.



**imprez55** says:

Oct 23, 2008. 12:20 AM [REPLY](#)

The breadboard is meant more for a test than to be used to run the entire mill by. If you do choose to run the machine by breadboard (again, not advised) than you will need 3 breadboards. The parallel port will just be connected by jumper wires to the boards.



**itstuck3r** says:

Oct 16, 2008. 12:46 AM [REPLY](#)

there should be a picture above with the pin numbers for the parallel port and their functions. each motor will be used to drive a certain axis (x,y,z). if you look at the second picture, this displays which wire goes where. as you said, one circuit is for one motor, so in total we need 3 for x, y, and z. i have two breadboards so i can only test two circuits at a time unless i smother 2 circuits onto one of my bread boards. also, if your wondering how to hook up the parallel port to your circuit, you need to buy or get some wire, solder the wires to the correct pins, and plug those pins into their appropriate spots on the breadboard. if you only have one circuit made, i would suggest testing it in kcam as the x-axis:

pin 2- x-step  
pin 3- x-direction  
pin 4- x-enable

be careful when soldering it to the parallel port because when you solder it pin 1 will actually be on the right side. (ie. pins go from right to left when your soldering onto them)



**mykeyb** says:

Oct 14, 2008. 11:28 PM [REPLY](#)

Machinist, look at the schmtc above,below is three pics click the middle one which will give you the pin no and settings for each pin and if you look at the parallel cable connector you will see that they are also numbered, hope this helps.



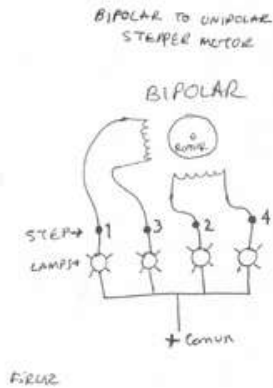
**bazooka\_mx** says:  
 Hola a todos..

Mar 25, 2008. 11:17 AM [REPLY](#)

(Bipolar to Unipolar stepper motor)

para el que quiera utilizar un motor bipolar puede usar el siguiente diagrama. Ya lo probe y si funciona. Solo hay que substituir la lampara original por las cuatro del dibujo y buscar los pasos correspondientes.

Saludos... Mexico

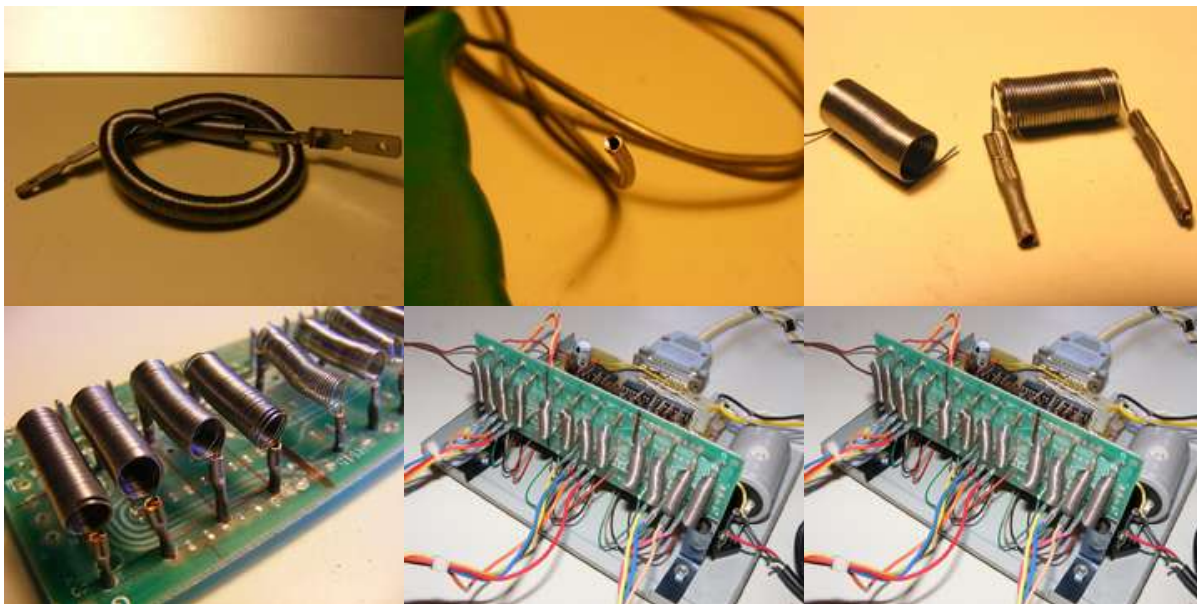


**ferxbar** says:

Oct 19, 2008. 11:20 AM [REPLY](#)

Hola BAZOOKA MX.

Gracias por tu idea para conectar motores bipolares a controladoras unipolares. Yo retire las lamparas e contrui los resistores, partiendo de resistores para calentamiento infra rojos. Funciona mui biem, gracias. Te dejo unas fotos.



**bazooka\_mx** says:

Oct 20, 2008. 7:59 AM [REPLY](#)

Hola Fexbar

Me alegra que te haya sido de utilidad la idea de las lamparas para tu proyecto, tambien habia pensado poner resistencias de alambre recubiertas de ceramica, no he hecho la prueba, pero ha de funcionar! jeje

Saludos desde Monterrey MX



**ferxbar** says:

Oct 20, 2008. 1:08 PM [REPLY](#)

Ok Bazooka assim és. Tu ideia funciona mui biem. Em buena hora, comprei em Ebay, mui baratitos los motores passo passo, bipolares, pero já tenia construida la controladora unipolar. Assim, todo marcha bien, gracias. Desculpa mi malo espanhol.



**bazooka\_mx** says:  
 Saludos y suerte!!!

Oct 22, 2008. 11:27 AM [REPLY](#)



**zorif** says:

English pls.

u mean connecting a bi-polar motor to an unipolar driver?  
pls give us some more clarification.

Mar 27, 2008. 10:21 PM [REPLY](#)

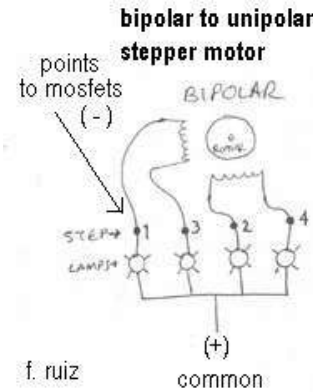


**bazooka\_mx** says:

yes zorif, I'm connecting a bipolar stepper motor on driver board of Tom. I'm using a four bulbs per motor instead of only one. Connect each out of four mosfet to points of the diagram... and works!!!

Mar 28, 2008. 9:38 PM [REPLY](#)

sorry my English is bad...



**nanoassembler** says:

**JUST REPLACE THE DIODES (in the original circuit) WITH RESISTORS.**

The resistors will dissipate the residual energy (i.e., voltage spikes), so **THE DIODES ARE NO LONGER NECESSARY**. After the resistors are in place, connect the motor like bazooka\_mx's diagram shows.

Aug 9, 2008. 9:32 PM [REPLY](#)

*Make sure to get rid of ALL the light bulbs too.*

I'm driving NMB23 bipolar stepper motors.



**rahmansaid** says:

What is the value of the resistors? Can u do an amended schematic? Thanks

Nov 19, 2008. 7:07 AM [REPLY](#)



**nanoassembler** says:

My words might sound complicated, but the real math is actually simple and fun. All you need is Ohm's law "voltage = current x resistance" and Watt's law "power = voltage x current" (combined with Ohm's law "power = (current)<sup>2</sup> x resistance"):

Nov 19, 2008. 10:54 AM [REPLY](#)

- 1.) Measure the resistance of one of the motor's coils (call it *motor resistance*).
- 2.) Calculate the *total resistance* using the *supply voltage* and *motor current* of the motor driver subcircuit:  
 $total\ resistance = (supply\ voltage) / (motor\ current)$
- 3.) Subtract the *motor resistance* (step 1) from the *total resistance* (step 2) to calculate the resistors' value:  
 $resistor\ value = (total\ resistance) - (motor\ resistance)$
- 4.) Multiply the *resistor value* times the square of the *motor current* to calculate the *resistor power*.  
 $resistor\ power = (resistor\ value) \times (motor\ current)^2$
- 5.) You will need to "derate" these calculations in order to buy real resistor. (For example, you'll never find a 7.4527 ohm resistor)

**Example:** I'm using a NMB 23KM-255U stepper motor with **12 volt supply voltage** and **1.5 amp motor current**.

- 1.) I measure the *motor resistance* to be **2.2 ohms**.
- 2.)  $total\ resistance = (12\ volts) / (1.5\ amps) = 8.0\ ohms$
- 3.)  $resistor\ value = (8.0\ ohms) - (2.2\ ohms) = 5.8\ ohms$
- 4.)  $resistor\ power = (5.8\ ohms) \times (1.5\ amps)^2 = 13\ watts$
- 5.) Digikey does not sell a 5.8 ohm, 13 watt resistor, so I derate the resistor to what is available. I'll choose a **8.0 ohm, 12 watt ceramic resistor**. It is a *big* resistor (30mm x 8mm)!!!

If you go back through the math, the *total resistance* will be 10.2 ohms, which will yield a *motor current* of 1.2 A at 11 watts (a 12 watt resistor should have no problem). Since this is not a HEAVY DUTY commercial product (just hobby), I don't care about size and a I am willing to accept a little less current and less redundancy (at least 25 watt would be the industrial choice).

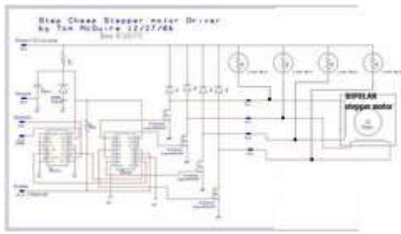
**Schematic:** Omit the light bulbs (draw a line for each one instead). Replace each diode with the resistor you calculate using the above method.

*I hope this gives you a good starting point.*



**bazooka\_mx** says:  
Diagram

Mar 29, 2008. 9:32 AM **REPLY**



**zorif** says:

Apr 2, 2008. 10:59 PM **REPLY**

now thats amazing.never heard of cncnecting a bi-polar motor to unipolar driver.are u sure its working well?  
is it able to produce enough torque to drive an axis?and what is ur motor rating? and 4 bulbs instead of one,then i think i shld use 4 resistors instead of one.

i'll be great full if u could post some video or pic f ur setup.  
\*ur english is just fine.

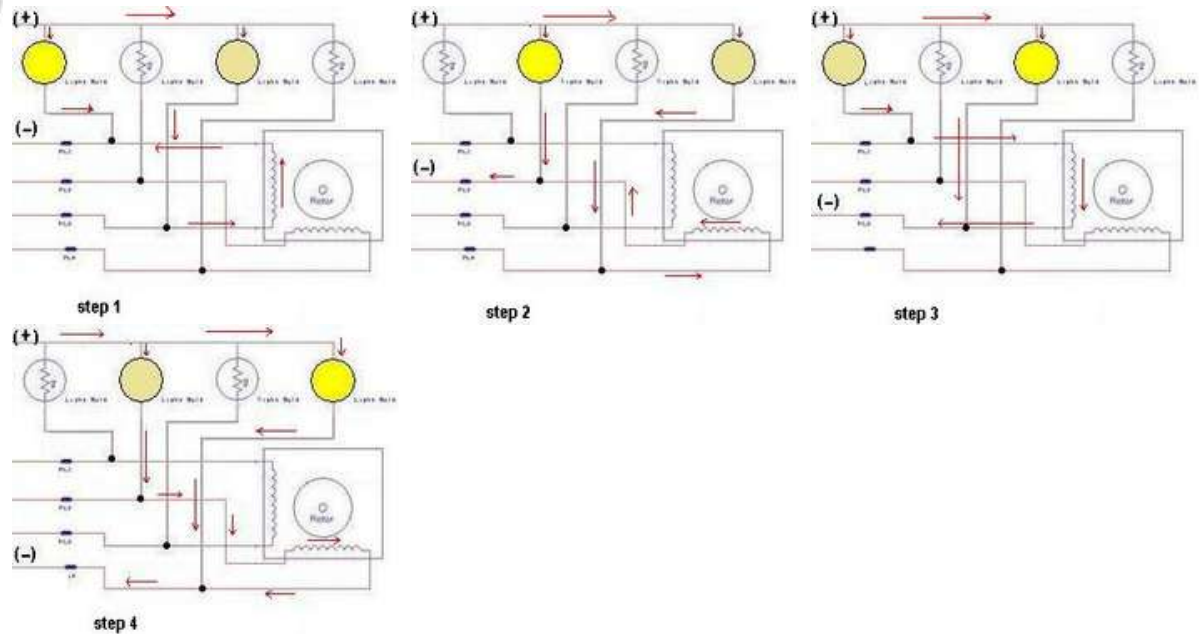
thanks for sharing.



**bazooka\_mx** says:

Apr 3, 2008. 11:15 AM **REPLY**

Only you can say that if you have the chance, try it yourself. I propose to revise the logical point by point, and do your analysis.



**Tom McWire** says:

Aug 10, 2008. 11:41 AM **REPLY**

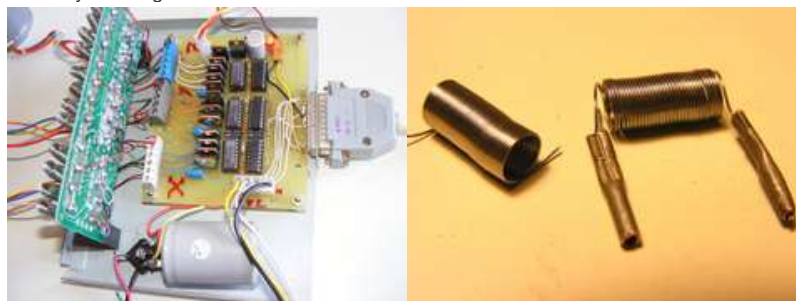
That is a great illustration and a brilliant way to convert the circuit to run 4 wire steppers. Thanks for sharing that with everyone.  
Tom

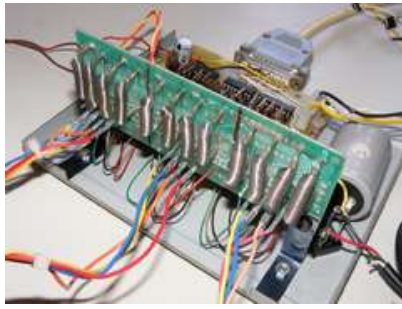


**ferxbar** says:

Oct 19, 2008. 11:43 AM **REPLY**

Hi Tom. I build your circuit and it work for the first time I connect it.  
Tank you for this beautiful technical project. I send same fotos.  
I wold like tank too Bazooka, for the ideia to drive bipolar motors with 4 lamps and a unipolar controller.  
I do 4 resistors for each motor and they work fine.  
Exc. My bad english.





**RAVENEXTREME** says:

Oct 28, 2008. 10:04 AM [REPLY](#)

Hi there guys :) OK as far i could see this technique works but now I'm having a problem :( i cant find the aproprite resitor for the motors to work when they are all connected to the circuit. As a result i have various restistors burned :( Can anyone teel me witch value are using for the resistors instead of the bulbs ? I'm using a 12V power supply. Thanks



**ferxbar** says:

Oct 28, 2008. 4:21 PM [REPLY](#)

Hi. In my case i apply the measure that I've find in the motor coil terminals (12 homs).Was this result that i have used to cut the (infra red resistor) and assemble all the 12 resistors. You can purchase the infra red resistor in any electric store. Sometimes is inside in a silica (quartz) pipe. For assemble the resistors you need a multimeter in hom scale, scissors, thin cooper pipe ( from a damaged fridge thermostat), and a nipper.



**galaxyman7** says:

Oct 22, 2008. 8:57 AM [REPLY](#)

Is it true that you cannot use a usb to parallel converter to run this? I have a laptop, and I have no idea what I will do if I can't run it with usb.



**mstenbaek** says:

Dec 15, 2007. 4:10 PM [REPLY](#)

Hi Tom,

I would like to control the Spindle (turn on/off) by the KCAM program, and using the output on pin 0 (Strobe). But it is only giving me 3.3 volt out (from the computer) when turned on, and my relay needs 9-12 volt to flip the switches.

Any idea (like a small circuit) that I could use to 'control' or feed the relay with 12V?

-

Also I would like to use HOME-switches (pin 11,12,13) with the KCAM program, but I can only get pin 11 to go 'low' by feeding it -12V. Pin 12 and 13 does not react the same...!?

KCAM setup:

11 I &H379 7 INVERTED X-HOME SWITCH

12 I &H379 5 NORMAL Y-HOME SWITCH

13 I &H379 4 NORMAL Z-HOME SWITCH

Any ideas how to 'signal' these inputs the right way?

Thanks

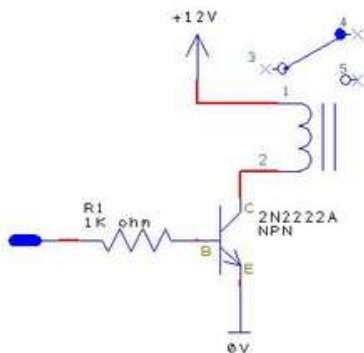
Morten



**Tom McWire** says:

Dec 16, 2007. 6:01 PM [REPLY](#)

Here's the basic how to drive a relay circuit. Just about any NPN transistor will work 2N2222, 2N3904, 2N4400. As for the home switches I don't think -12 volts is good for the parallel port (pins 11,12,13). I think it only takes 0 to 5 volts. Pull the inputs up to 5 volts through a resistor (10K ohm) and then connect the switches so when they make contact it pulls the pin to ground (0 volts).



**ferxbar** says:

Oct 19, 2008. 10:43 AM [REPLY](#)

Hi Tom. It's possible drive a 6 volts relay with this circuit?



**gus\_452000** says:

Hi Tom, on this circuit, it might be wise to add a small diode across the relays coil to stop a back surge when the coil is de-energised (very badly explained by me sorry). What do you think?

regards  
Gus

Jun 29, 2008. 3:06 AM [REPLY](#)

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[view all 406 comments](#)