

# CK1405 - UNIPOLAR STEPPERMOTOR DRIVER

Stepper motors are everywhere in electronics these days. There are two main types of stepper motors:

1. Bipolar motors. These have two coils and are controlled by changing the direction of the current flow through the coils in the proper sequence. These motors have only **four wires** and **cannot** be connected to this kit. See our Kit 1406 for a Bipolar Stepper driver Kit.
2. Unipolar motors. These have two center-tapped coils which are treated as four coils. These motors can have **five, six or eight wires**. Five-wire motors have the two center-taps commoned internally and brought out as one wire (Fig 1). Six-wire motors bring out each center-tap separately. The two center-taps need to be commoned externally (Fig 2). Eight-wire motors bring out both ends of each coil. The four “center-taps” are joined externally to form one wire. In each case the center-tap(s) are connected to a positive motor power supply. Unipolar motors may be connect as bipolar ones by not using the ‘+’ wires.

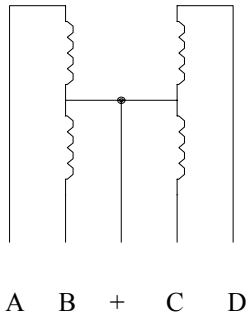


Fig 1. Five-wire stepper motor

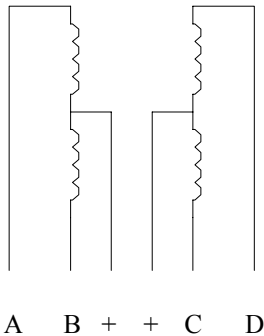


Fig 2. Six-wire stepper motor

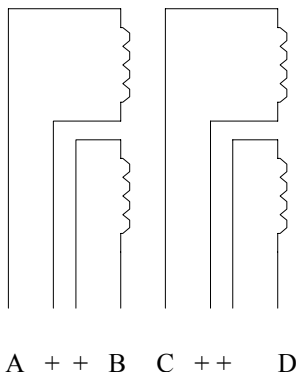


Fig 3. Eight-wire stepper motor

A stepper motor has no brushes or contacts. It is basically a synchronous motor with the magnetic field electronically switched to rotate the armature magnet around.

The Internet is where to get all the explanation about steppers. Just google ‘stepper motor’ and you will find tens of sites. In particular, look for ‘Jones on Stepper motors’ (it comes up top of the list when I did it just now) and read it. If you look at the other references you will find that the circuit in this kit has been around for many years in various forms. The latest publication was in *Silicon Chip*, 5/2002, and I have based this kit on it.

## CIRCUIT DESCRIPTION

This controller works in either free-standing or PC controlled mode.

**In free-standing mode** an internal square-wave oscillator based on IC2:B of the 4093 supplies timing pulses to the OSC output. The frequency of these pulses and thus the speed of the stepper motor is controlled by the trimpot VR1 (100K.) A series 1K resistor controls the maximum frequency. You may increase the value of this resistor for your own needs. These pulses are fed into the STEP input which is buffered and inverted by IC2:D. This helps prevent false triggering. Similarly, IC2:C buffers and inverts the DIRection input. A SPDT taking the input to +5VDC or ground controls the direction of rotation.

IC3:C and D (4030 or 4070 exclusive OR gates) invert the outputs available at Q and /Q outputs of each of the flip-flops (FF) IC4:A and IC4:B. The incoming step-pulses clock the FF, thus toggling the Q & /Q outputs and this turns the MOSFET's on and off in sequence. The IRFZ44's have a low on-resistance and can deliver up to 6A each without needing a heatsink.

Power to the stepper motor is connected to V+ and GND terminals as shown on the overlay. There is a separate power supply, KITV, to the 78L05 to power the IC's. 9V – 12VDC will be sufficient. R2/C2 form a low-pass filter to filter fast-rise switching transients from the motor.

Note that some stepper motor texts say to use a 4070 instead of a 4030. We have not worked out why this is. Certainly our testing with the 4030's showed no problems. I would like to hear from anyone who knows why this advice is sometime given.

**In computer-controlled mode** use the three pads with pins DIR, STEP and GND. Switch the SPDT switch to EXTERNAL. The direction SPDT has no effect in external mode.

## ASSEMBLY

Note that after further testing we have changed the values of the trimpot and R1 from that shown on the PCB overlay.

Put the resistors and 4 links in first. Use the cutoff lengths from the resistors for the links. Add the other components as shown on the overlay. The IRFZ44 are placed back to

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back. The metal tabs are indicated by the bars on the overlay pattern. Slide the 3 terminal blocks together before inserting and soldering.

If you need to use a heatsink for the MOSFET's then you will need insulating washers and bushes on each one to make sure they are electrically isolated from each other.

## CONNECTING THE MOTOR

It is always fun connecting the motor correctly. Usually the motor has some indication of which wires are which. If not then use a multimeter to measure the resistance between pairs of wires and determine the layout. Connect the wires to the terminal block. Apply power. Make sure the SPDT switch is set to INTERNAL. See if the motor is turning. If not then swap M1B & M2B wires only and check again. Now it should be turning. VR1 will vary the stepping speed.

## EXTERNAL CONTROL

Google 'Stepper Motor Software' and will see a range of controller freeware available. Also go to

<http://www.metalworking.com/>

<http://www.kellyware.com/>

<http://www.thegallows.com/stepster.htm>

Depending on the software used up to 6 motors (with 6 Kit 179 boards) can be controlled just by connecting the stepper drivers to the printer port of your PC.

## COMPONENTS

Resistors 5%, 1/4W, carbon

1K brown black red	R1	1
100R brown black black	R2	1
10K brown black orange	R3	1

100K Koa pot	VR1	1
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100uF 16V ecap	C3	1
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100u 35V	C2	1
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100n mono 104	C1 C4	2
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1uF/50V mini	C5	1
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Metal pins		3
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SPDT switch		2
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3 pole terminal block		3
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IRFZ44	Q1 Q2 Q3 Q4	4
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78L05	IC1	1
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4013	IC4	1
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4030	IC3	1
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4093	IC2	1
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14 pin IC socket		3
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K179 PCB		1
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See our website at [www.ElectronicKits.com](http://www.ElectronicKits.com)

Documentation: july 26, 2003. Corrected schematic.

