

QUASAR CODE 3179 - UNIPOLAR STEPPERMOTOR DRIVER

General Guidelines for Electronic Kits and Assembled Modules

Thank you for choosing one of our products. Please take some time to carefully read the important information below concerning use of this product. The assembly and operating instructions are on the following pages.



WEEE Directive (Waste Electrical and Electronic Equipment)

Notice To All European Union Citizens. Important environmental information about this product.

The crossed out wheeled bin symbol on this product, package or documentation indicates that disposal of this product after its lifecycle could harm the environment. Do not dispose of this product (or batteries if used) as unsorted municipal waste. It should be disposed by a specialized company for recycling.

The unit should be returned to your distributor or to a local recycling service. Please respect the local environmental rules. If in doubt contact your local authorities about waste disposal rules.

Safety: General rules concerning safe use of our Kits or Modules.

To ensure your safety, please observe these safety measures. In no way are these complete. As safety requirements vary, please check with your local authorities, in order to comply with local requirements. If in doubt, seek the help of a qualified person.

Battery or wall-adaptor operated devices are safe devices. They do not require special attention unless mains voltage is connected to an output e.g. a relay.



To ensure electrical safety, and also protection from fire or personal injury, make sure your mains operated equipment complies with these safety hints:

- Use a suitable plastic enclosure. If a metal enclosure is used, make sure it is properly earthed.
- Use a power switch if the device consumes more than 10W. Use a double pole switch for mains operated, transformer-less kits.
- Mount a fuse in series with the mains switch. Use a slow blow (T) 50mA fuse for transformers up to 10W and a 100mA fuse for transformers up to 20W.
- Use a mains input connector, or a robust power cord with a clamp.
- Internal wiring carrying mains voltages must have a minimum cross-sectional area of 0.5mm².

If supplied, attach the power rating label near the power cord of the device and fill-out the mains voltage, frequency, power consumption and fuse values.

Troubleshooting and Support

90% of non working kits are due to poor soldering.

We operate a Get-You-Going service for non-working kits but there is a charge based on the time and components needed to complete the repair. Quite often it is not economically viable for us to repair and it is cheaper to supply a new ready made product at full cost.

Disclaimer

Quasar Electronics reserves the right to change product specifications or to discontinue products without notice. Quasar Electronics cannot be held responsible for any loss or damage, direct or indirect, which might occur from the use of a product. Quasar Electronics Kits or Modules are intended for educational and demonstration purposes only. They are not intended for use in commercial applications. If they are used in such applications the purchaser assumes all responsibility for ensuring compliance with all local laws. In addition, they are not suitable for use as or as a part of life support systems, or systems that might create a hazardous situation of any kind.

General Guidelines for Motor Controllers

Thank you for choosing one of our motor controllers. Please take some time to carefully read the important information below concerning use of this product.

WARNING

Please read and follow the product manufacturers instructions. Mains powered motor controller must only be fitted by a suitably qualified person. Please ensure all relevant local health and safety standards are observed and implemented. This information is not exhaustive.

Please also note the following points:

- A suitable value safety fuse should be fitted to the motor supply**
- Mains motor controllers must be housed in a suitable enclosure**
- Ensure adequate ventilated to avoid overheating and component damage**
- The motor controller should have a capacity of at least 25% above the motors peak power requirement. Please do NOT rely on motor rating plates for power consumption figures as they are often quote average not peak power. Before connecting the motor controller you should use a meter to verify the motors actual peak power at start-up and under full load.**

Failure to observe these points may lead to equipment damage or personal injury. If in doubt please seek help from a suitably qualified person.

If you are unsure about any aspect of the use of this product please contact our Support Team before proceeding.

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QUASAR CODE 3179 - 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 3158 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.

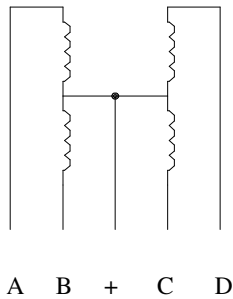


Fig 1. Five-wire stepper motor

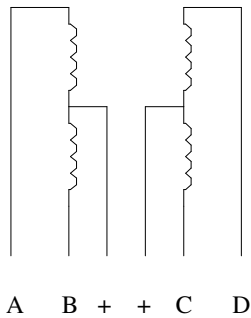


Fig 2. Six-wire stepper motor

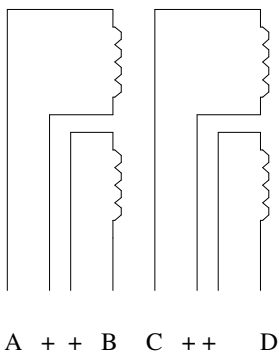


Fig 3. Eight-wire stepper motor

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. For some good tutorials go to

<http://www.stepperworld.com/>
<http://www.ams2000.com/stepping101.html>

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. 8V - 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. Note if the STEP input is left floating the high impedance to the cmos logic gate might pick up noise and false step. Either connect to a PC or ground via a 10K resistor.

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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 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 and non-freeware available. Also see <http://www.metalworking.com/>
<http://www.kellyware.com/>
<http://www.thegallows.com/stepster.htm>
<http://www.stepperworld.com/>
<http://www.ams2000.com/>

Depending on the software used up to 6 motors (with 6 Kit 3179 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
100uF 16V ecap	C3	1
100u 35V	C2	1
100n mono 104	C1 C4	2
1uF/50V mini	C5	1
Metal pins		3
SPDT switch		2
3 pole terminal block		3
IRFZ44	Q1 Q2 Q3 Q4	4
78L05	IC1	1
4013	IC4	1
4030	IC3	1
4093	IC2	1
14 pin IC socket		3
3179 PCB		1

Email us at support@quasarelectronics.com if you have problems.

Documentation: Corrected schematic October 21, 2010.

You cannot connect 3179 to the serial port on a PC. The serial port voltages are +/-12V but 3179 inputs can only handle TTL logic level signals

