ONESTEP

C R H Electronics Design

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SELF CONTAINED MICROPROCESSOR CONTROLLED 2.5A STEPPER MOTOR CONTROL UNIT

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Specifications

- Microprocessor controlled compact hand held unit.
- Backlit LCD display of motor step position.
- Simple 3 button control of backwards, forwards and reset.
- Single step with automatic repeat and acceleration of motor speed.
- Includes thermal shutdown and automatic power reduction circuit.
- 1/8, 1/4, 1/2 or full Step selectable output.
- 1, 1.5, 2 & 2.5Amp switch selectable max stepper current
- Optional, Step, Direction, Enable output pins without driver stage.
- Single supply input from (12V - 30V DC regulated supply)
- Soft grip hand held unit.
- Available with or without 2.5A stepper driver ready built or in kit form.

Manual V1.0 Aug 08
Hardware V1.1 Aug 08

The Onestep hand held motor controller is a stand alone unit that can drive 2 phase stepper motors up to 2.5 amperes rating directly with a single power supply. An LCD display indicates the exact number of steps made to the motor giving precise control of positioning.

Onestep controls

There are three buttons used to control operation. They are individually colour code for ease of use. Green is step down (think of green grass down on the ground). Blue is step up (think of blue sky up above) and Red is reset.
One powering up the unit, you are greeted with a Onestep message indicating the current software revision. After a few seconds the display will clear leaving a four digit display with plus or minus indication. A single short press of the green or blue buttons will increment the motor by a single step either clockwise or anticlockwise. Holding the button for longer periods will initiate an auto increment that increases the frequency of steps to over 100 steps per second. Releasing the button will cease movement instantly. If you overshoot your desired position it is a simple mater of hitting the reverse button to step backwards until the exact readout is obtained. Pressing the red reset button at any time will reset the display back to zero without stepping the motor. The stepper motor driver incorporates an automatic current reduction circuit. While positioning the motor either fast or slow the motor receives the full current set by the dip switch settings. After a second of inactivity the motor will receive a reduced holding current keeping the Onestep unit and stepper motors from unnecessary heating. After about a minute and a half of inactivity the unit will go into standby mode switching off power to the motor.

Connector

At the base of the unit is a green six way connector. Four of the pins are used to drive the motor and the remaining two for power to the unit. The connectors are like terminal blocks allowing easy fitting of connection wires. Plugs supplied with the unit are a 4 way and a two way so the power supply and the motor can all be easily separated from the main unit. Alongside the connector are 4 dip switches for altering step and current settings. Combinations of these settings are shown below.

Dip switch settings

MS2 & MS1 Adjust Step rate.
(MS2 on MS1 on) Full Step
(MS2 on MS1 off) ½ Step
(MS2 off MS1 on) ¼ Step
(MS2 off MS1 off) 1/8 Step

It should be noted that if the step setting is less than full step then the number of steps required to rotate the motor will increase accordingly.
Example: ¼ step will require 800 steps for a full rotation of the shaft on a standard 200 step motor.

C1 & C2 Control maximum stepper current

(C1 on C2 off)	1A
(C1 on C2 on)	1.5A
(C1 off C2 off)	2A
(C1 off C2 on)	2.5A

Power Input

Maximum input voltage 35V, recommended regulated voltage 24-30V DC but can be used down to minimum of 12V.

If using an unregulated power supply, check peak voltage across output before connecting the Onestep unit. Power is supplied to the board via a two pin none reversible connector to the main terminal block.

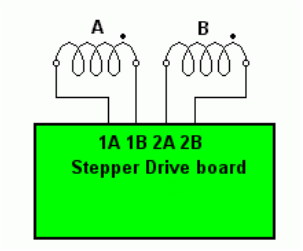
Stepper motor connections

The following diagrams show typical connections for a range of different motors. If your motor rating is in excess of the 2.5A maximum current limit then you should use the windings in serial connection for maximum efficiency.

4 leads - Bipolar Drive

4 Leads
The standard connection for a four lead motor.

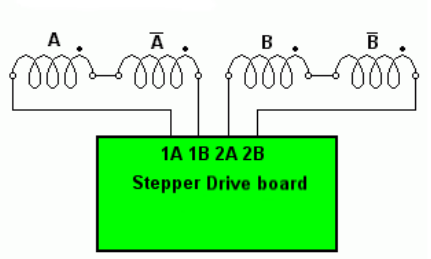
This is the standard connection for a bipolar drive. There are still four windings and, depending on motor type, they are in series or parallel. Most manufacturers makes two models with the same winding, but one time connected is series and one time in parallel.



Bipolar Drive - Serial Connection

6 Leads
The windings are connected in serial. Since most 6 lead motors are wound bifilar - link -, so the inductance will be quadruple of the single winding value.

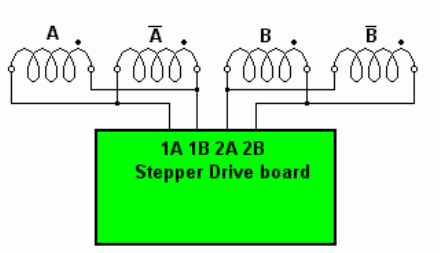
8 Leads
The windings are connected in serial. Since most 8 lead motors are wound monofilar - link -, then the inductance will be double. If the motor was wound bifilar - link -,the inductance will be quadruple .



Bipolar Drive- 8 leads - Windings Parallel

8 Leads
This is the standard high speed connection for an eight lead motor.

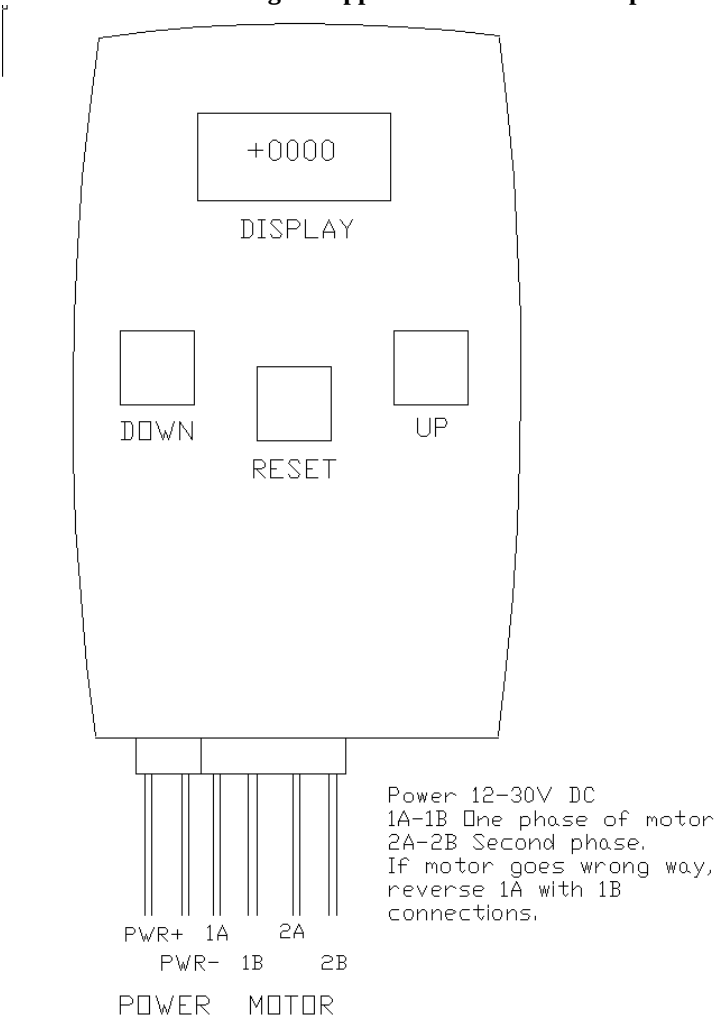
With the windings in parallel, the motor current can be higher whilt the inductance is lower. This is a typical connection for a motor that need to run at a high speed..



IMPORTANT:
Double check that connections are correct before applying power to the board, windings connected out of phase may cause damage to the board. Do not connect or disconnect wires with the power on. It is a good idea to set the current switch settings to minimum, to limit the current if you are in any doubt of the connections.

The PCB Stepper outputs on the Onestep board are marked 1A &1B this represents one winding. Outputs 2A & 2B are the other winding.

Controls and connecting a Stepper motor to the Onestep unit



For users of the Onestep without driver components the following output pins of the connector are used to connect to an external driver board.

2B Unused
2A Step
1B Direction
1A Enable (Active low)
Power and ground are unchanged.

KIT CONSTRUCTION

Building the Onestep board kit should take less than one hour. You will need a good soldering iron, preferably temperature controlled and set to 400-450 degrees. The solder provided is lead free with a mild active flux. This helps it to flow easily but you need an extra 50 degrees higher temperature compared to lead solders. As the driver chip is a surface mount device the PCB is supplied with it ready mounted into position. With reference to the board layout diagram, start by placing the components with the longest leads that will need cropping after soldering. I find that the best way is to push the component through the holes until it is in contact with the board and then bending the leads at 45 degrees on the underside to stop the component moving while soldering. Using this technique you can place several components before soldering. The 0.18 ohm resistors will need there leads bent close to the body and positioned a couple of millimetres away from the board. After soldering and cropping the long leaded components next place the small capacitors which have fairly short leads. The LCD assembly connects to the main PCB via a 16 way connector this effectively lowers the position of the display so that it mates up with the case. Solder the connector to the main pcb first using the short side of the pins ensuring that the plastic spacer is flush with the PCB. Double check that it is flat and straight before soldering the pins. Then insert the Display module over the connector to the PCB, once again ensuring that it is flush to the plastic spacer, see Fig3 for detail. Tack one pin and check that it is aligned correctly before soldering the remaining pins. There is a small modification needed to be added to the board and that is to link two pins together (pins 9&10) on the processor socket. This is due to the fact that the processor data sheet is incorrect and an alternative output pin had to be used. The 7805 regulator needs the centre leg bending slightly forward before bending all the legs back and fitting a bolt though the metal tag to secure. Fit the DIP Switch and the six way connector block. If available you could clean up the flux residue with a proprietary flux cleaner when complete. I have found the SERVISOL DE-FLUX 160 flux remover / PCB cleaner is very effective.
Notes:

- Position power resistors R8 and R9 so they are a couple of millimetres away from the PCB
- K4 is a ground link and must be present on all versions.

- K1, K2 & K3 is a wire link used to couple the step direction and enable signals to the output connector. (Only used without stepper driver chip)
- Long lead on electrolytic caps is positive (goes to square pad)
- Link pins 9&10 on processor socket. (Use discarded component lead)

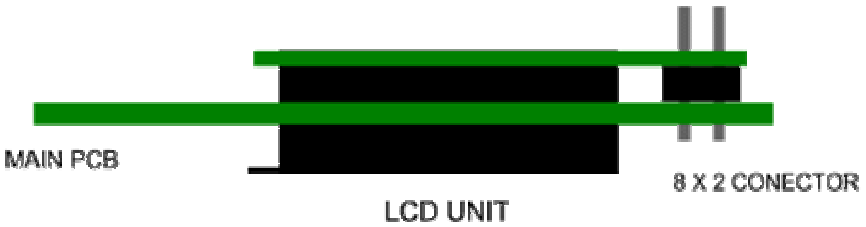
Component parts list for ONESTEP.

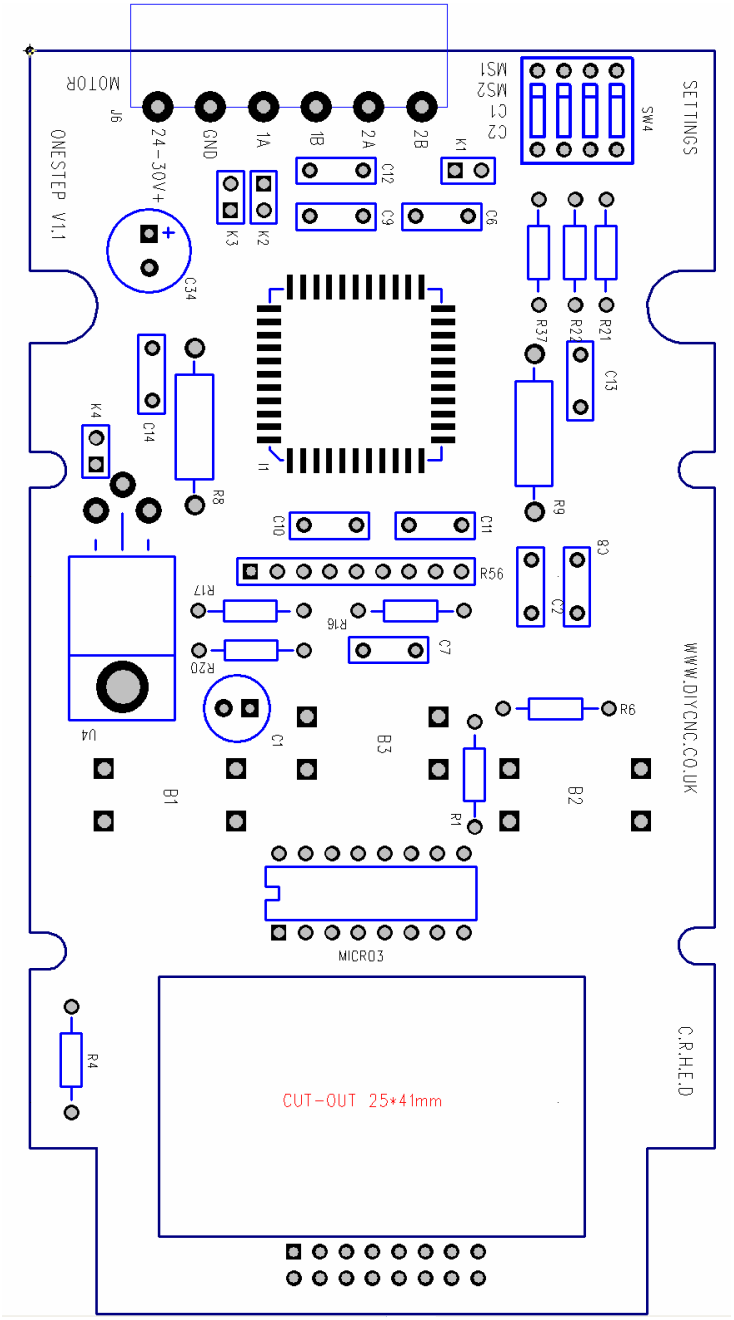
C2, C7, C8, C13, C14	0.1uF 100V
C6, C9, C12	0.22uF 63V
C10, C11	1nF 100V
C1	100uF 50V
C34	100uF 16V
R16, R17,	22k 5% 1/4W
R6	15K 5% 1/4W
R1	2.2k 5% 1/4W
R4	220 5% 1/4W
R8, R9	0.18ohm 5% 2W
R56	10k Network
R21	5.6K 5% 1/4W
R22	12K 5% 1/4W
R20, R37	1K 5% 1/4W
I1	A3977SED I'C
D1	LCD8
U4	7805 5V Regulator
SW4	DIP SWITCH 4 WAY
MICRO3	MC908QY1

8 X 2 row connector 0.1 pitch
Onestep PCB, Hand held case, 3 mm Nut & Bolt

Contact Details
J Harding 12 Herm Close, Seabridge, Newcastle-under-Lyme. ST5 3LL. England
Email roy@diycnc.co.uk

FIG 3




MOTOR
J6
24-30V+
GND
1A
1B
2A
2B
K1
MS1
MS2
C1
C2
SW4
SETTINGS
ONESTEP V1.1
K3
K2
C12
C9
C6
C34
R37
R22
R21
C13
K4
C14
R8
U1
C10
C11
R56
R17
R16
C7
C3
C2
R20
U4
C1
B3
R6
B1
B2
R1
MICRO3
WWW.DIYCNC.CO.UK
R4
CUT-OUT 25*41mm
C.R.H.E.D