NOTE
Make sure that you read these notes from start to finish before atempting any construction of any of the kits.
These notes may contain last minute warnings and/or changes.

CAUTION
When connected to any machine unexpected movements that may be dangerous may occur. To minimise this possibility always turn off your CNC equipment while your computer is booting or not directly involved with controlling your CNC equipment.

INTRODUCTION TO OUR CNC KITS
This series of kits K142A, K142B, K142C and K142D are designed to control machinery via a computer using up to 4 stepper motors.
This system can be used to manufacture one or many items extremely accurately & can be retro fitted to existing milling machines or lathes etc.

BASIC PROCEDURE
Depending on the software chosen, usually an item is drawn, the drawing file is then converted to a Gcode file. The Gcode is then read by your CNC software that in turn controls your machine.
Gcode can also be written with a text editor like Notepad etc.

APPLICATIONS
Some common applications include: milling, turning, engraving, drilling, hot wire foam cutting and animation camera control.

SOFTWARE
You will have to consider to best software for your application. Some of the software available include KCAM, STEPSTER, DANCAD and EMC (Enhanced Machine Controller). Some is freeware, some shareware and some is commercial.
Note:
There are many different types of software that are available, for that reason it is impossible for Oatley Electronics to advise on how to use your software. To use this kit your software should be the STEP & DIRECTION type (this is the most common type). Most software also has configure-able pin connections to match the connections required by the our kits.

DRIVING STEPPER MOTORS
The major problem is as a stepper motor's speed increases the current drawn by the motor and it's power output slowly drop until it reaches a certain speed (this point varies greatly with motor type) then suddenly the current and power drop to almost nothing, making the motor almost useless at anything other than low speeds. This is caused by insufficient time for each coil's field to break down before the next step. Different systems are often employed to increase the speed of stepper motors like ballast resistors or chopper drives.

BALLAST RESISTORS
To help overcome the lack of performance high wattage resistors are connected in series with the motor coils and a power supply higher than the motor's rated voltage is used.

CHOPPER DRIVES
Chopper drives or PWM (pulse width modulated) drives turn on and off (at high speed) a power supply higher than the motor's rated voltage. This technique is a linear response to a non-linear problem.

CONSTANT CURRENT DRIVES
This type of drive maintains motor current and power by incensing the voltage to the motor as the motor speed rises. Constant current drives force each coil's field to collapse quicker allowing the motor to run much faster.

Our new (K142C) Constant Current Source systems sense the drop in current and increase the voltage to the motor and thus the current and power is maintained with higher speeds.
A common motor we tested gave similar torque at around 300 RPM as at 1 or 2 RPM (this is as FAST as we tested with a 200 step motor). Because of the wide voltage output range of the constant current source we had to re-design our (K142) CNC Stepper Motor Driver Kit to cope.

There are a number of cheep ripoff copies of our K142B kit but most don't allow for the wide voltage range produced by ballast resistor, chopper or constant current system drives.

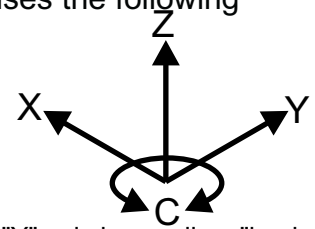
BASIC KIT DESCRIPTION

K142A is a PC interface that helps to simplify wiring, it also provides 2 relays that are controlled by your PC and can be used to switch just about anything.

CONNECTIONS

Most of the software available uses or can be configured to use the same connections of the printer port. K142A uses the following connections.

PC Pin	Function
2	X axis step
3	X axis direction
4	Y axis step
5	Y axis direction
6	Z axis step
7	Z axis direction
8	C axis step
9	C axis direction
18-25	GND



The "Y" axis is usually a "back and forth" movement, The "X" is usually "left and right" movement and the "C" axis is usually a rotary axis around the "Z" axis but it can also be used as a fourth axis in a foam wing cutter.

The other pins not shown here are often used for limit and home switches and will vary depending on the software you choose to use. In some cases they may not be needed at all or they can be disabled.

The power supply in connection is required for the relays and 12VDC output. We recommend 9VAC or 12VDC from a power adaptor or other similar supply. The power supply 12VDC output is used to supply the logic (ICs etc.) of each of the K142B or K142D kits.

The axis outputs supply step and direction signals to each of the K142B or K142D kits. The AUX I/O terminals can generally be connected to things like switches etc. that are placed at the limits of the movement of your CNC machine. This is to stop you machine from moving too far. These connections will vary depending on the software you use, check the documentation that comes with your software..

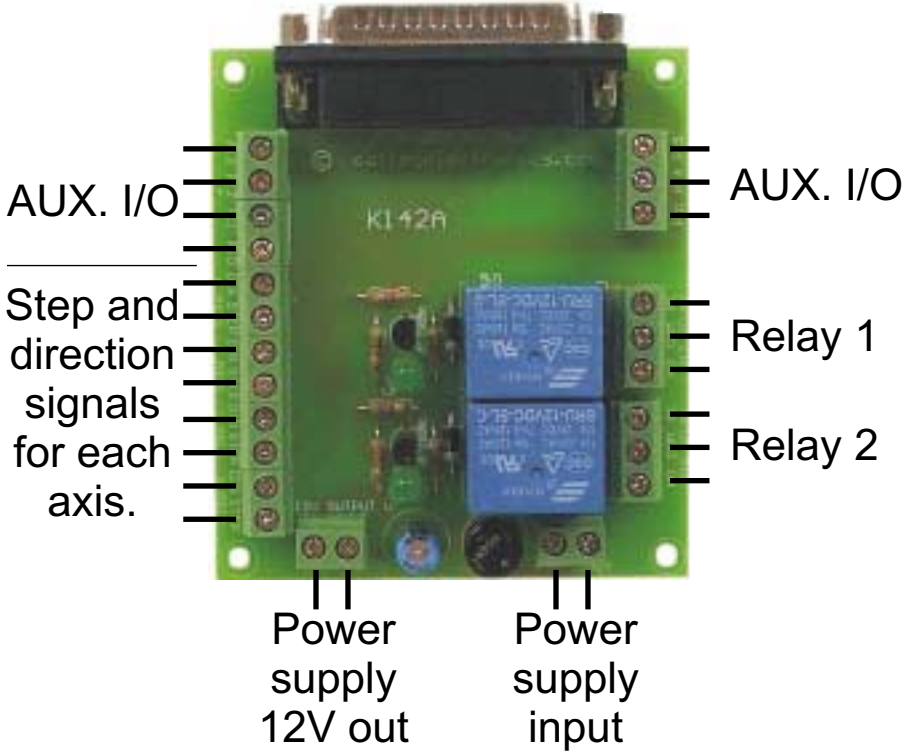
CAUTION:

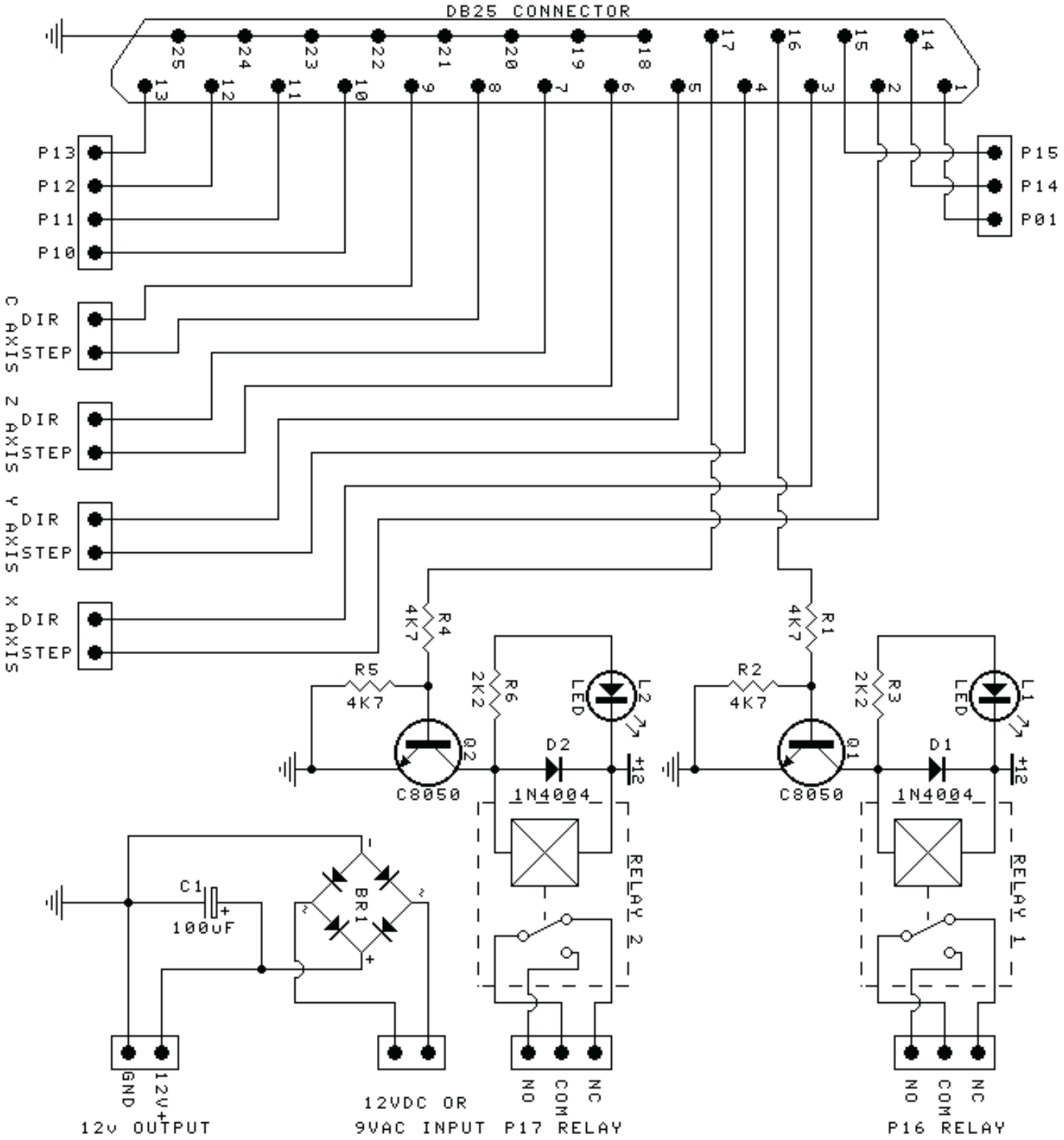
Although the relays used in this kit are mains rated we do not recommend that they be connected to mains power as it may be dangerous and result in electric shock.

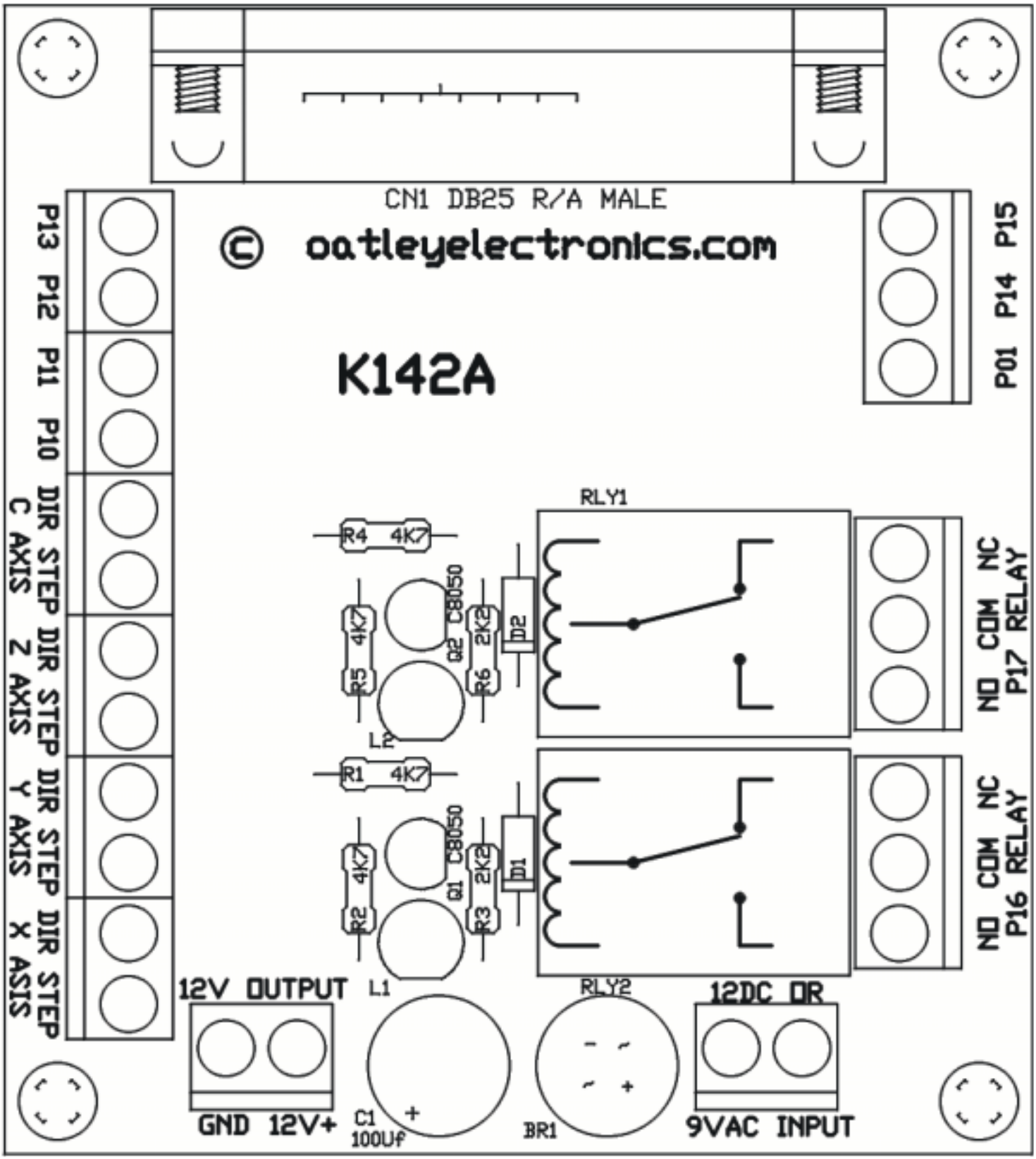
The relays can be used to switch on or off auxiliary items such as your machine's spindle motor, coolant, hot wire, drill, dust extractor or vacuum cleaner, just about anything you can think off. Relay1 is controlled by pin17 and Relay2 is controlled by pin16 of your PC.

The power supply **IN** connection is required to power the relays and 12VDC output. The power supply 12VDC output is used to supply the logic (ICs etc.) of each of the K142B kits. We recommend 9VAC or 12VDC from a power adaptor or other similar supply and should have these in stock for less than $10.

The axis outputs supply step and direction signals to each of the K142B or K142D kits. The AUX I/O terminals can generally be connected to things like switches etc. that are placed at the limits of the movement of your CNC machine. This is to stop you machine from moving too far, in some cases may not be needed at all. These connections will vary depending on the software you use, check the documentation that comes with your software.

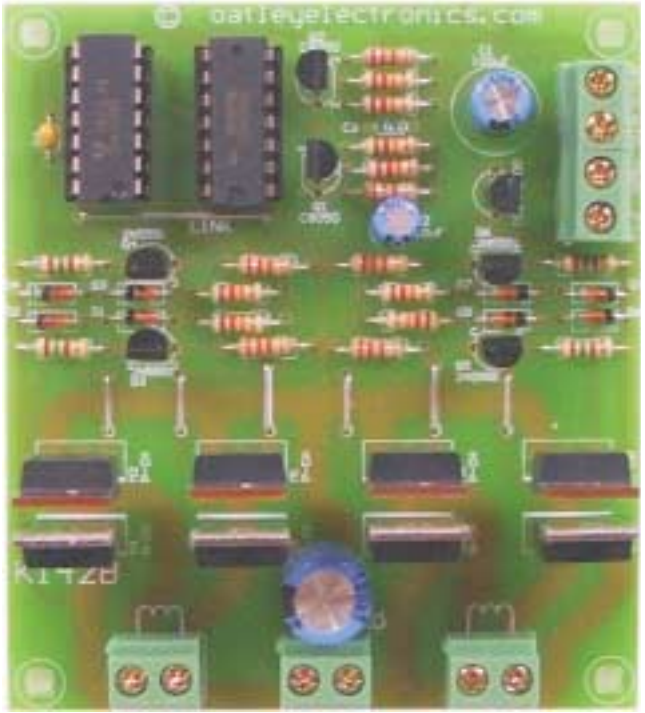



DB25 CONNECTOR
25 24 23 22 21 20 19 18 17 16 15 14
13 12 11 10 9 8 7 6 5 4 3 2 1
P13
P12
P11
P10
P15
P14
P01
C AXIS
DIR
STEP
Z AXIS
DIR
STEP
Y AXIS
DIR
STEP
X AXIS
DIR
STEP
R4 4K7
R5 4K7
R6 2K2
L2 LED
Q2 C8050
D2 1N4004
+12
R1 4K7
R2 4K7
R3 2K2
L1 LED
Q1 C8050
D1 1N4004
+12
C1 100uF
BR1
GND
12V+
12v OUTPUT
12VDC OR
9VAC INPUT
RELAY 2
NO COM NC
P17 RELAY
RELAY 1
NO COM NC
P16 RELAY


CN1 DB25 R/A MALE
© oatleyelectronics.com
K142A
P13 P12 P11 P10 DIR STEP DIR STEP DIR STEP DIR STEP
C AXIS Z AXIS Y AXIS X ASIS
P01 P14 P15
RLY1
R4 4K7
R5 4K7
Q2 C8050
R6 2K2
D2
L2
R1 4K7
R2 4K7
Q1 C8050
R3 2K2
D1
NO COM NC
P17 RELAY
NO COM NC
P16 RELAY
12V OUTPUT
L1
RLY2
12DC OR
GND 12V+
C1
100Uf
BR1
9VAC INPUT

K142B BASIC KIT DESCRIPTION

K142B is a stepper motor controller that interprets the step and direction signals from the PC into the output sequences required by the stepper motors.

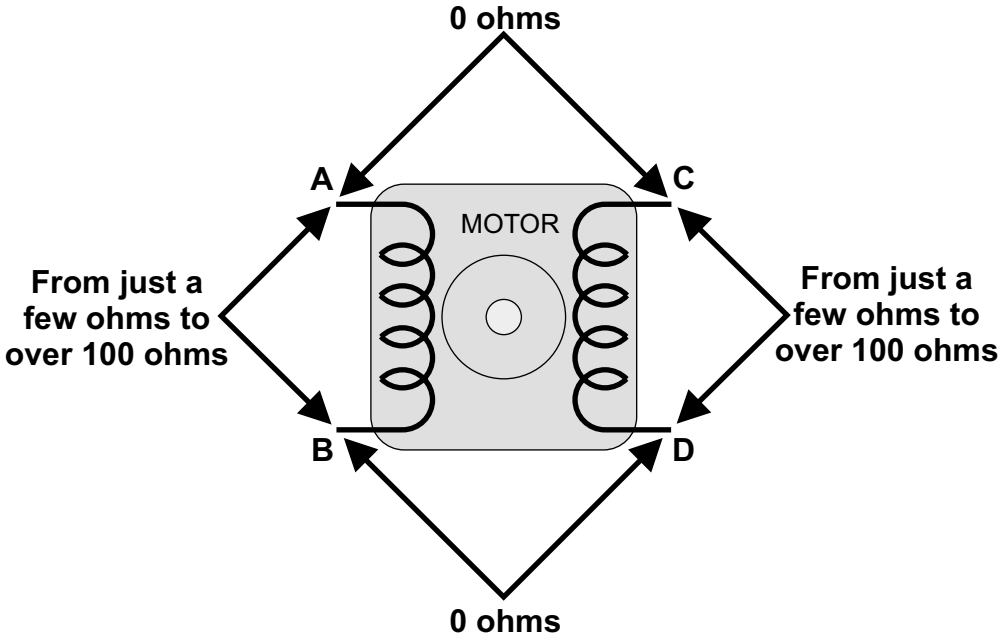


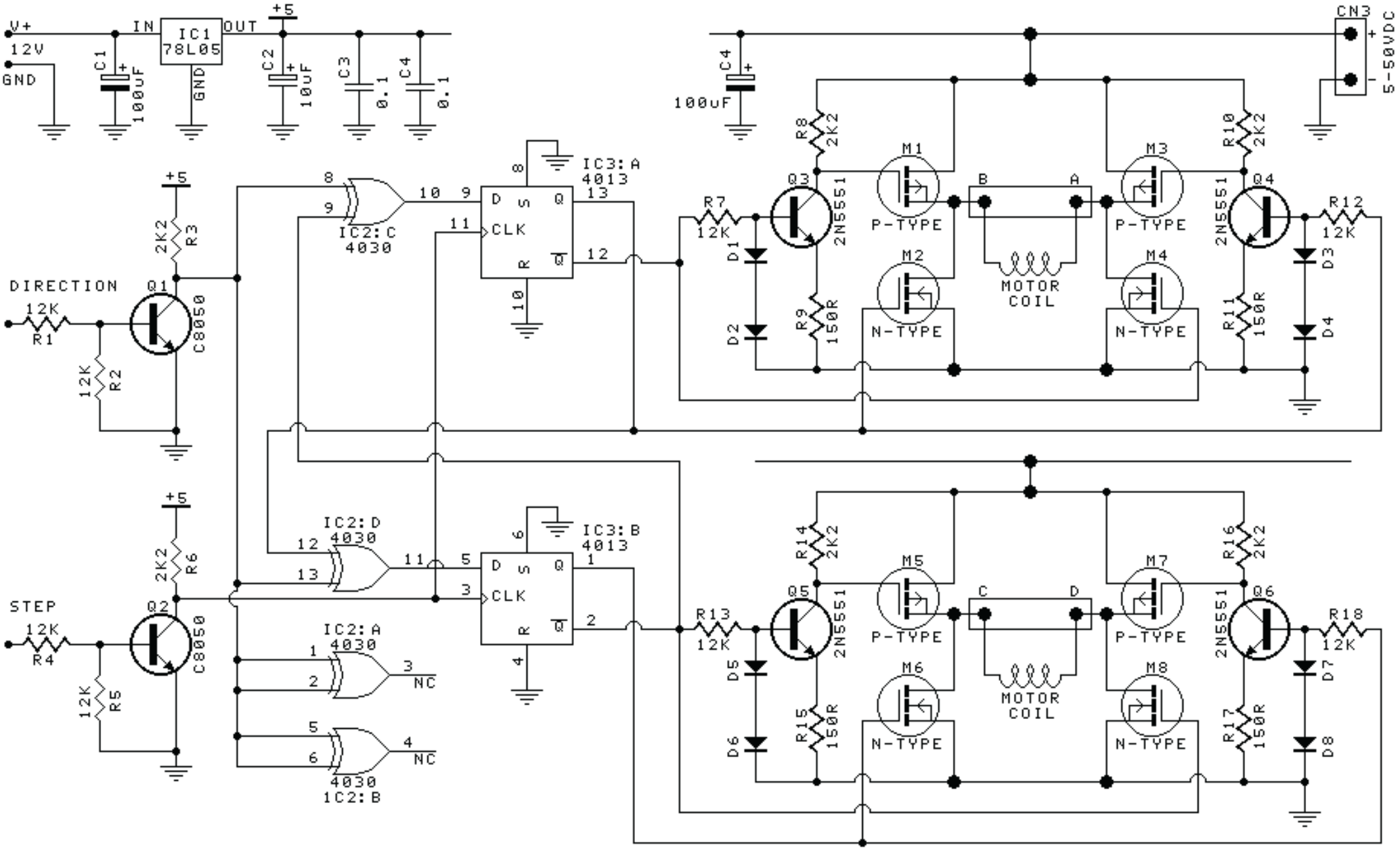
HEATSINKING

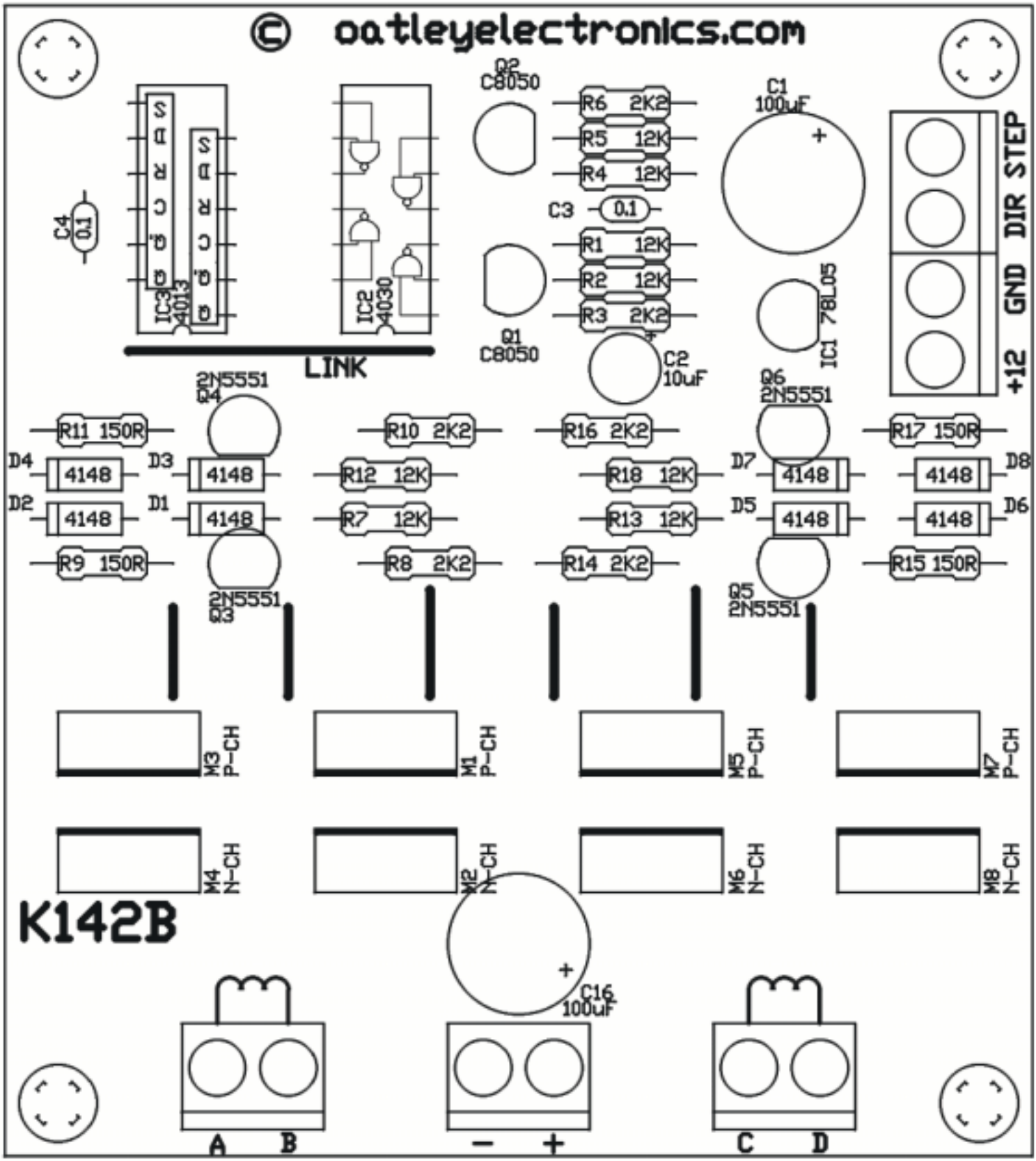
If heatsinking is required and only one heatsink is used for all MOSFETS insulation will need to be fitted to each of the MOSFETS. If four separate heat sinks are used (one heatsink fitted between each back to back pair) no insulation is required.

MOTOR CONNECTIONS

To find your correct motor connections measure the resistance of the motor coil wires. If when running your motor vibrates instead of rotating swap connection "A" with "B" or "C" with "D".

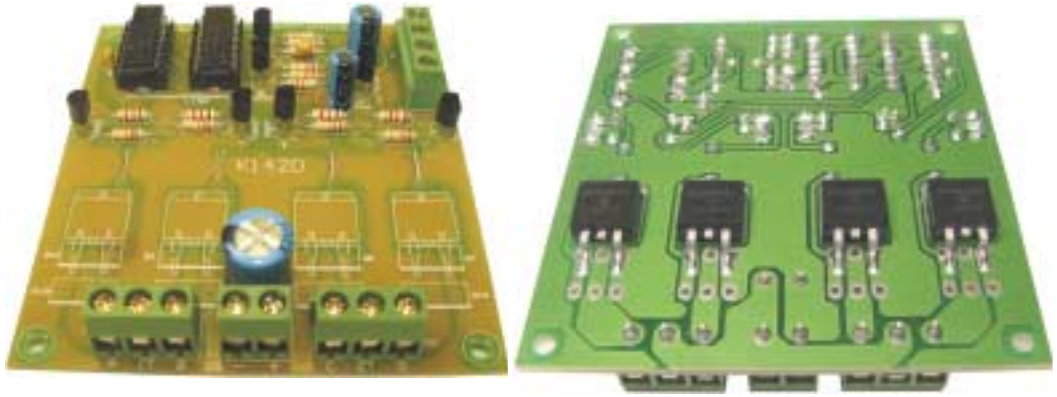



V+
12V
GND
IC1
78L05
IN
OUT
GND
C1
100uF
C2
10uF
C3
0.1
C4
0.1
+5
C4
100uF
CN3
5-50VDC
DIRECTION
STEP
R1
12K
R2
12K
R3
2K2
R4
12K
R5
12K
R6
2K2
Q1
C8050
Q2
C8050
IC2:C
4030
IC2:D
4030
IC2:A
4030
IC2:B
4030
NC
NC
IC3:A
4013
IC3:B
4013
D
S
Q
CLK
R
Q
R7
12K
R8
2K2
R9
150R
R10
2K2
R11
150R
R12
12K
R13
12K
R14
2K2
R15
150R
R16
2K2
R17
150R
R18
12K
Q3
2N5551
Q4
2N5551
Q5
2N5551
Q6
2N5551
M1
P-TYPE
M2
N-TYPE
M3
P-TYPE
M4
N-TYPE
M5
P-TYPE
M6
N-TYPE
M7
P-TYPE
M8
N-TYPE
MOTOR
COIL
MOTOR
COIL
B
A
C
D
D1
D2
D3
D4
D5
D6
D7
D8


© oatleyelectronics.com
Q2
C8050
R6 2K2
R5 12K
R4 12K
C3 0.1
R1 12K
R2 12K
R3 2K2
C1
100uF
+12 GND DIR STEP
C4
0.1
IC3
4013
IC2
4030
Q1
C8050
C2
10uF
IC1
78L05
LINK
Q4
2N5551
Q6
2N5551
R11 150R
R10 2K2
R16 2K2
R17 150R
D4
4148
D3
4148
D7
4148
D8
4148
D2
4148
D1
4148
D5
4148
D6
4148
R12 12K
R18 12K
R7 12K
R13 12K
R9 150R
R8 2K2
R14 2K2
R15 150R
Q3
2N5551
Q5
2N5551
M3
P-CH
M1
P-CH
M5
P-CH
M7
P-CH
M4
N-CH
M2
N-CH
M6
N-CH
M8
N-CH
K142B
C16
100uF
A
B
−
+
C
D

K142D BASIC KIT DESCRIPTION

K142D is a stepper motor controller that interprets the step and direction signals from the PC into the output sequences required by the stepper motors.



NOTE:

The MOSFETs supplied with this kit are suitable for a maximum supply voltage of 30VDC. If you wish to use the maximum recommended supply voltage for the K142 system you will need to change the MOSFETs to IRFZ44Z (TO220 type) or simalar, (see out website for pricing etc.). You will require either 4 or 8 depending on the current drawn by your motors.

HEATSINKING

If you use TO220 type MOSFETS you can use additional heatsinking. If heatsinking is required and only one heatsink is used for all MOSFETS insulation will need to be fitted to each of the MOSFETS. If four separate heat sinks are used (one heatsink fitted between each back to back pair) no insulation is required.

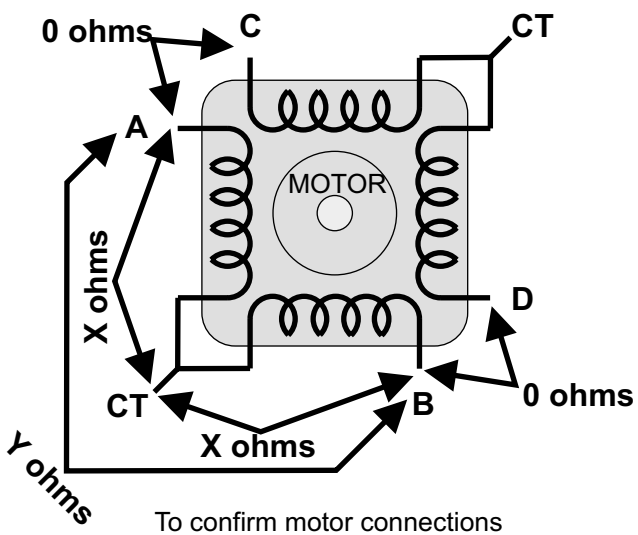
ASSEMBLY

Assembly is relatively simple, even the (Surface Mount Devices) SMD MOSFETs are easy to fit. Start by holding a MOSFET in place with a washing peg or similar, then solder the 2 legs of the MOSFET. Next solder the back of the MOSFET to the PCB, this must be done as it forms one of the connections required as well as providing heatsinking.

MOTOR CONNECTIONS

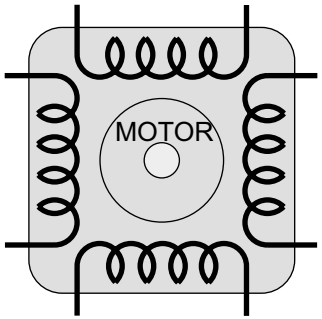
To find your correct motor connections measure the resistance of the motor coil wires. If when running your motor vibrates instead of rotating swap connection "A" with "B" or "C" with "D".

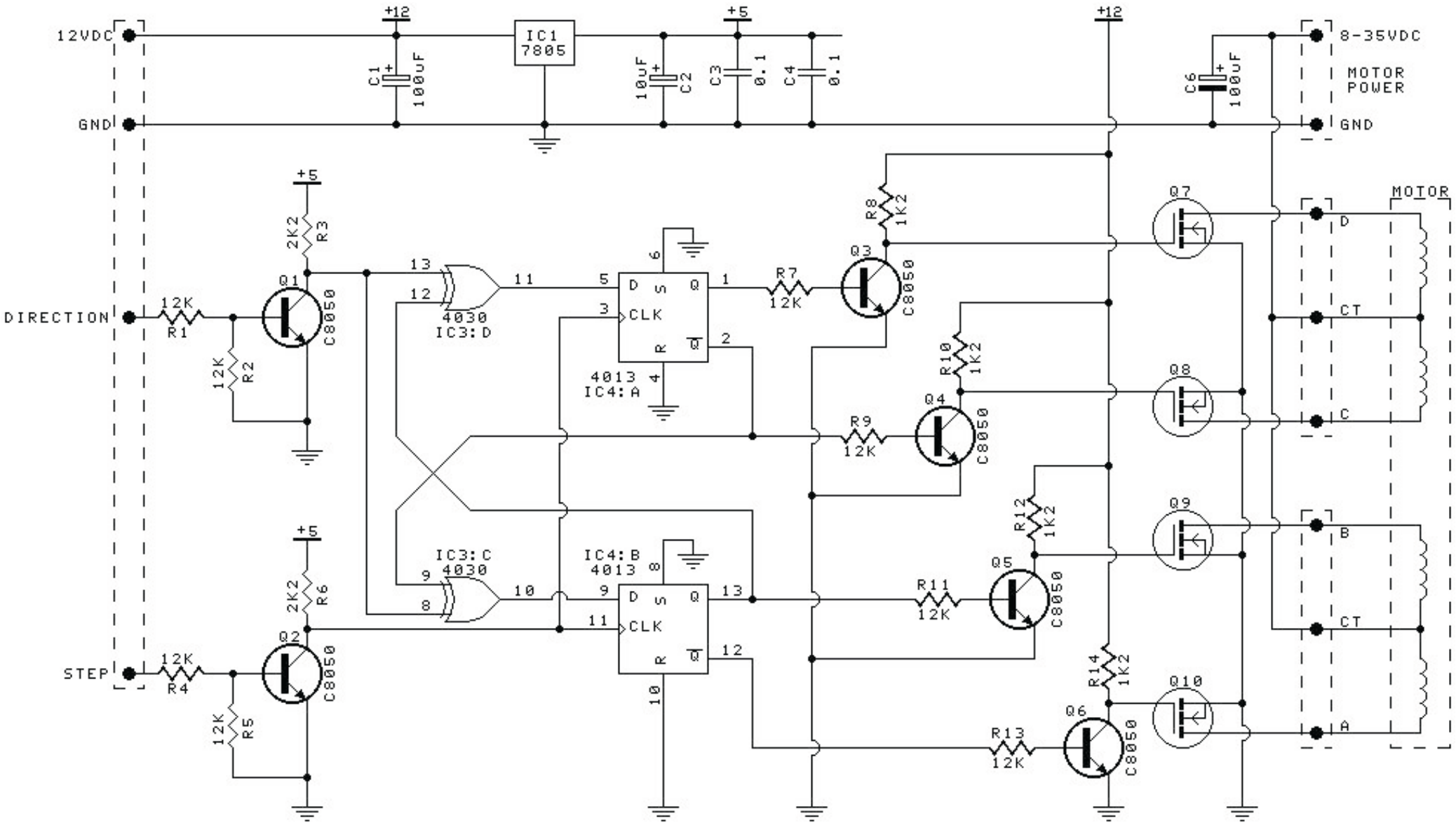
6 WIRE MOTOR DIAGRAM



To confirm motor connections use a multi-meter and measure the resistance of the coils.
Y ohms = 2 * X ohms

8 WIRE MOTOR DIAGRAM




12VDC
GND
+12
C1
100uF
IC1
7805
10uF
C2
+5
C3
0.1
C4
0.1
+12
C6
100uF
8-35VDC
MOTOR
POWER
GND
MOTOR
D
CT
C
B
CT
A
DIRECTION
STEP
+5
2K2
R3
Q1
C8050
12K
R1
12K
R2
13
12
4030
IC3:D
11
5
D
S
Q
1
3
CLK
R
Q
2
6
4
4013
IC4:A
R8
1K2
Q3
C8050
R7
12K
R10
1K2
Q4
C8050
R9
12K
Q7
Q8
+5
2K2
R6
Q2
C8050
12K
R4
12K
R5
IC3:C
4030
9
8
10
IC4:B
4013
8
9
D
S
Q
13
11
CLK
R
Q
12
10
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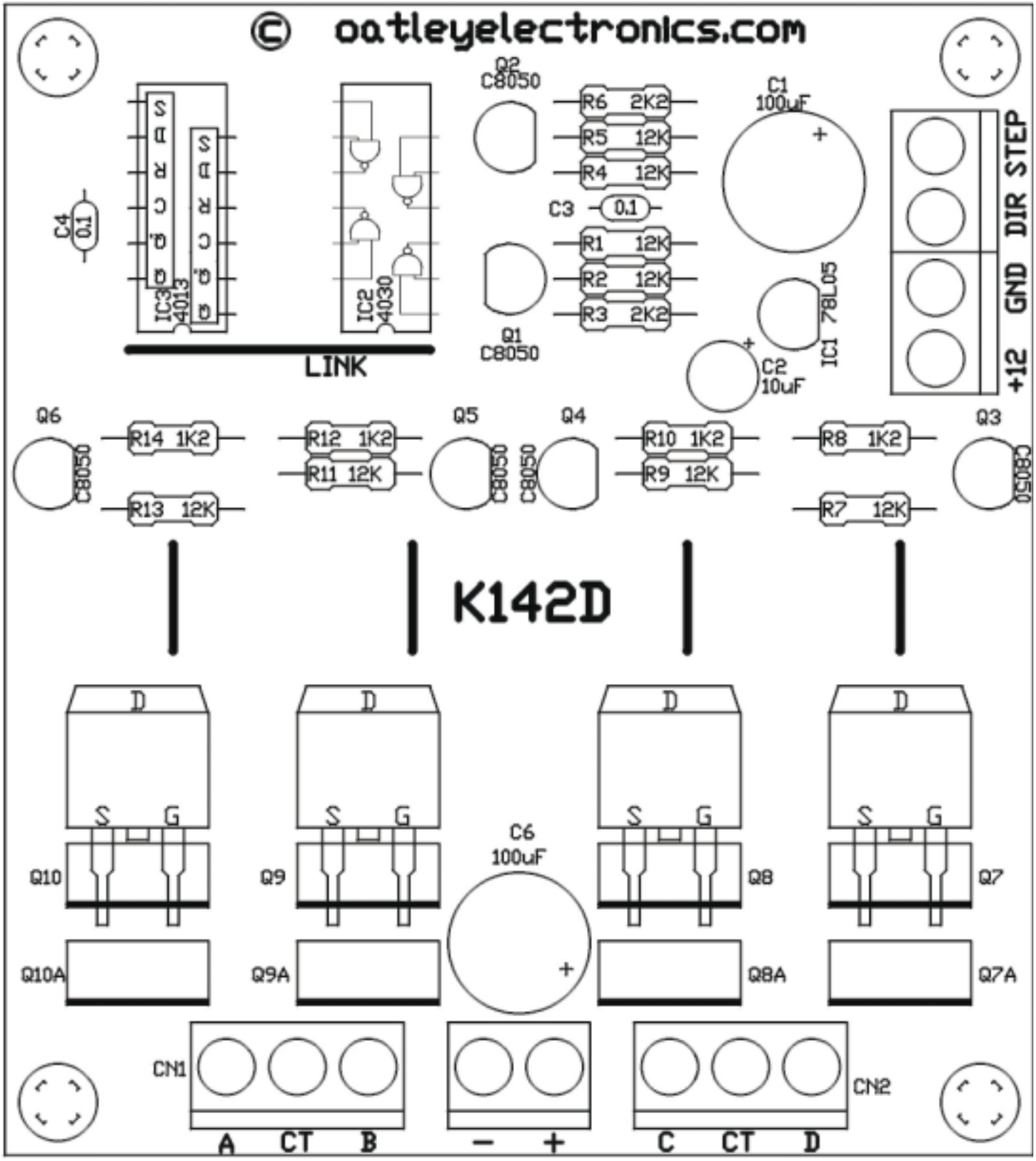
C8050
R11
12K
R14
1K2
Q6
C8050
R13
12K
Q9
Q10


© oatleyelectronics.com
Q2
C8050
R6 2K2
R5 12K
R4 12K
C3 0.1
R1 12K
R2 12K
R3 2K2
Q1
C8050
C1
100uF
+
C2
10uF
IC1 78L05
+12 GND DIR STEP
C4
0.1
IC3
4013
IC2
4030
LINK
Q6
C8050
R14 1K2
R13 12K
R12 1K2
R11 12K
Q5
C8050
Q4
C8050
R10 1K2
R9 12K
R8 1K2
R7 12K
Q3
C8050
K142D
D
S
G
Q10
Q9
Q8
Q7
C6
100uF
+
Q10A
Q9A
Q8A
Q7A
CN1
A CT B
− +
C CT D
CN2

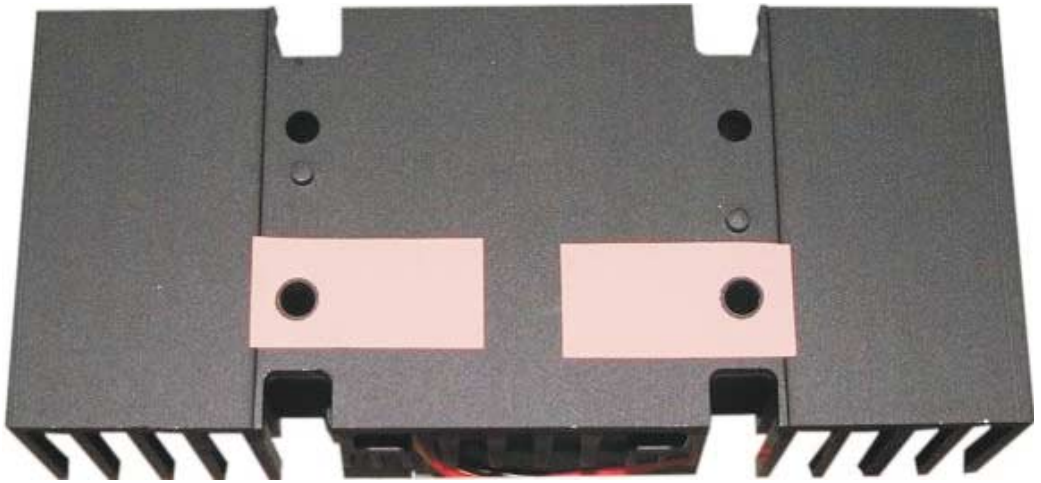
K142C BASIC KIT DESCRIPTION

K142C is a constant current power supply that is used to supply the correct current to the stepper motors to maintain higher performance.

This kit is recommended for use with a 15-34V power supply and low voltage motors. The ideal situation would be a 33-34V supply with 2-4V motors. The K142C is adjustable to suit motors from around 0.5A to 2.5A. By changing the values of R6 and/or R7 lower and higher ranges can be achieved. See construction notes for details.

CONSTRUCTION

Fit the transistors and the regulators to the PCB as shown but do not solder them in place. Remove the insulating pad from the heatsink, cut it in half and punch a hole in one end of each piece as shown. These insulators are used between the LM317 regulators and the heatsink but are not required for the transistors. Remove the regulators and transistors from the PCB and attached them to the heatsink, Make sure to fit the insulating washer to the screw that holds IC1, do not tighten the screws. Now fit the heatsinkand it's components to the PCB. Make sure that the components are flat against the circuit board and solder them in to the PCB. Now tighten the screws.



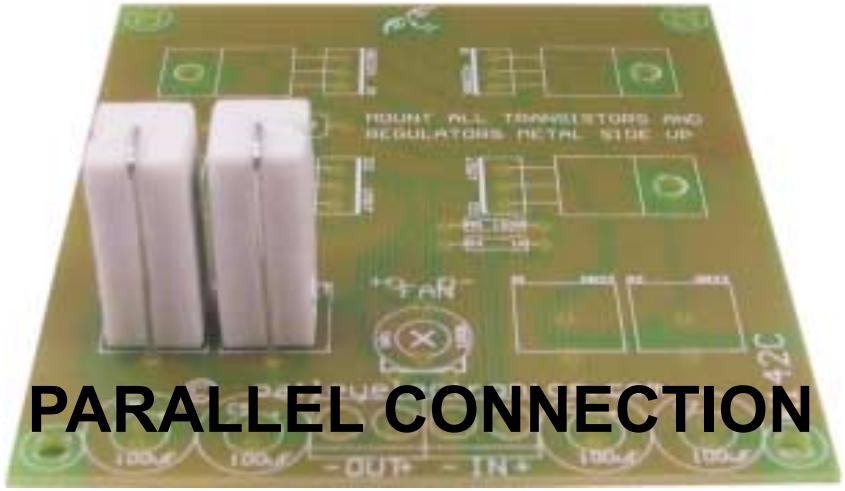
To change the current adjustment range select a new resistance for R6 and R7 using the calculation bellow. Remember that this will set the minimum current, you should select a minimum current below what is required so to allow for adjustment above and below the required current.

1.25 / Amps out = Ohms

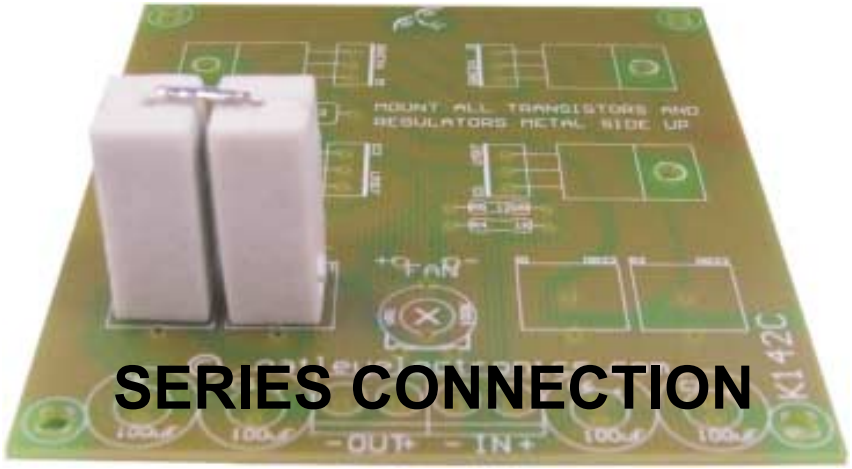
1.25 divided by the required minimum current = resistance in ohms

You may need to place resistors in parallel or series to obtain the resistance needed as shown in the next image. Note that the top connections of R6 and R7 are connected together for series connection.

To set the current apply your power supply to the input terminals of the k142C, connect an amp meter or multi-meter to the output terminals and adjust VR1 to set the desired current.

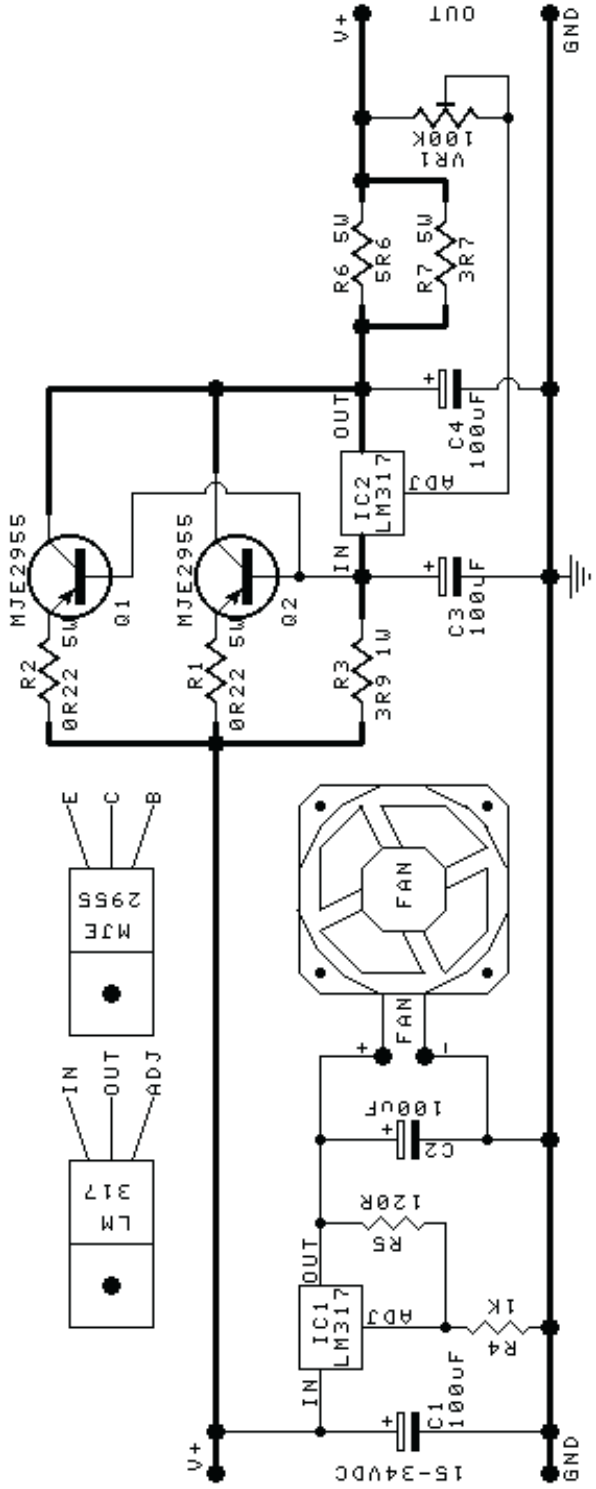


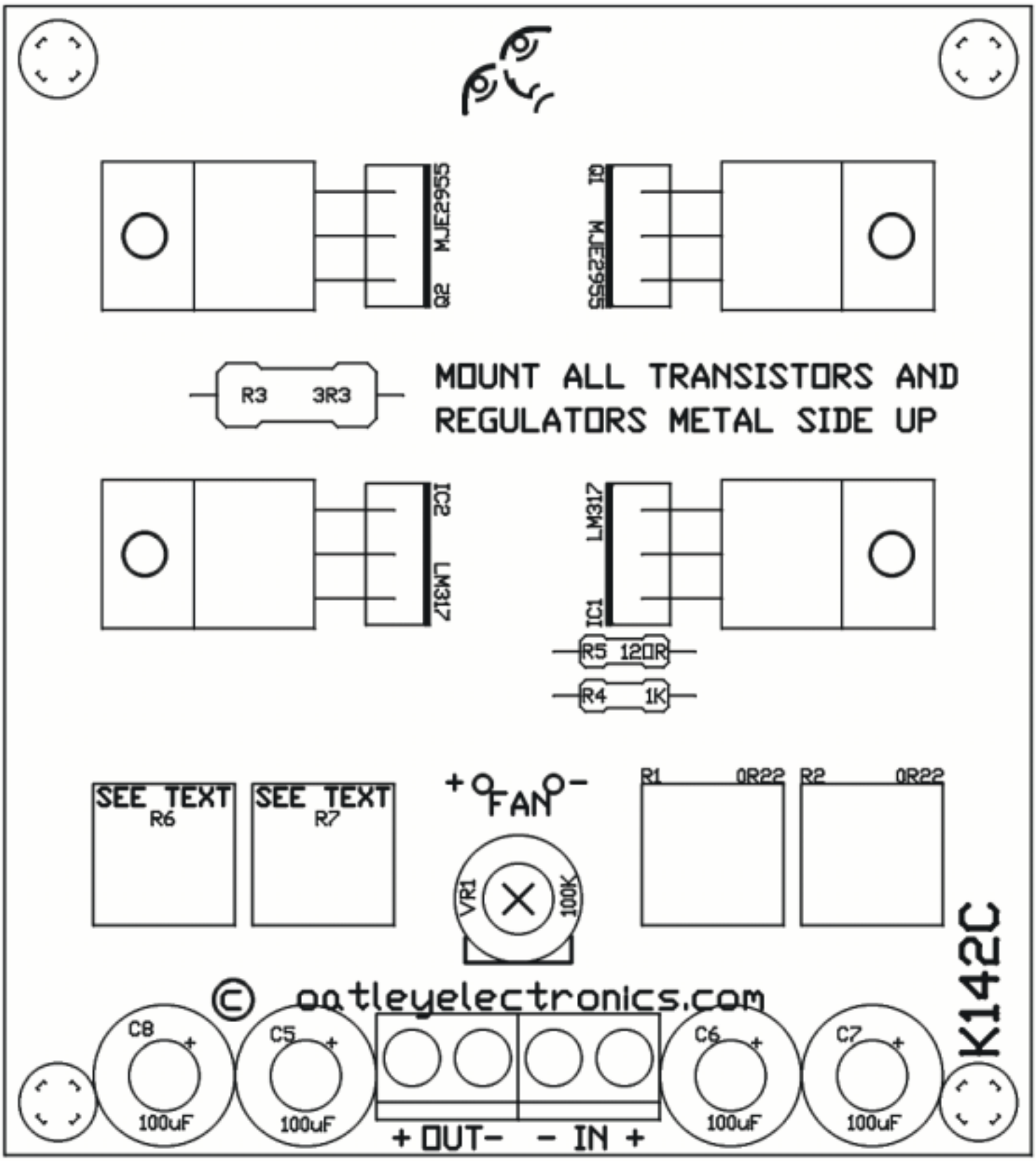
PARALLEL CONNECTION



SERIES CONNECTION

NOTE:
Some circuit boards may have incorrect output labeling.
The correct terminal connections are as shown in the component layout image on the next page .





NOTE:

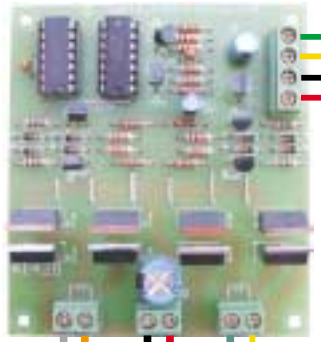
Some circuit boards may have incorrect output labeling. The correct terminal connections are as shown here.

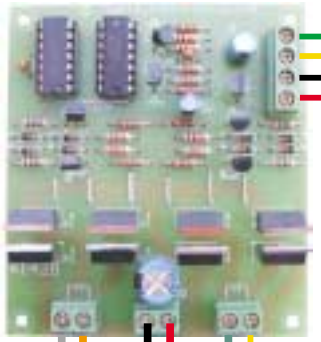
Wiring diagram for a full 3 axis system using K142B kits for 4 wire motors

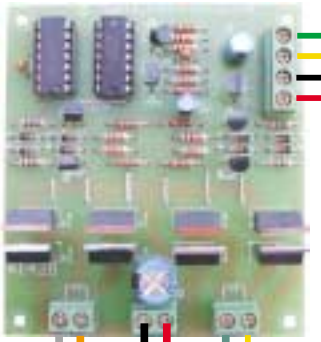
STEPPER MOTOR POWER SUPPLY

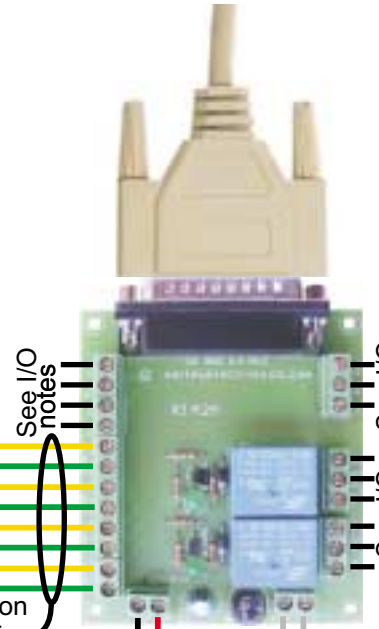
To PC parallel (printer) port

To "C" or fourth axis step & direction if used.









See I/O notes

See I/O notes

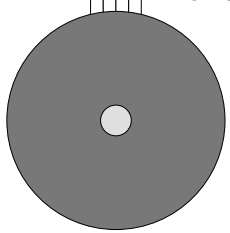
See I/O notes

Step & direction connections for each axis.

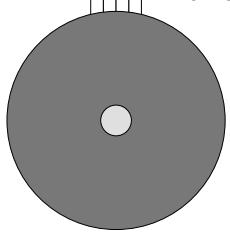
12VDC OUT

9VAC or 12VDC

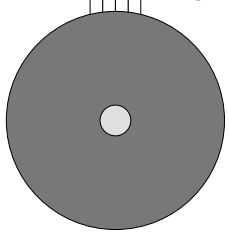
"Z" axis stepper motor



"Y" axis stepper motor



"X" axis stepper motor

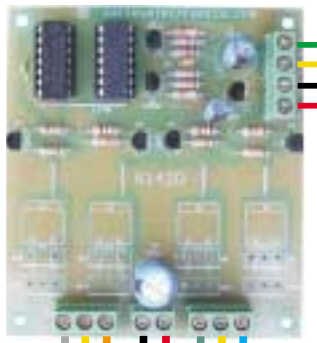


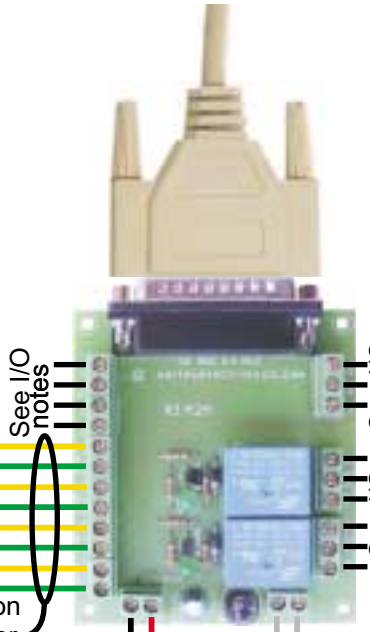
Wiring diagram for a full 3 axis system using K142D kits for 8, 6, and 4 wire stepper motors

STEPPER MOTOR POWER SUPPLY

To PC parallel (printer) port

To "C" or fourth axis step & direction if used.





See I/O notes

See I/O notes

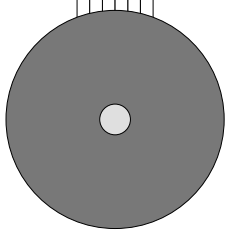
See I/O notes

Step & direction connections for each axis.

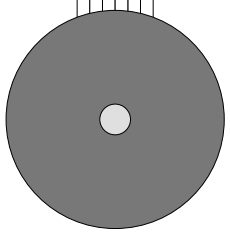
12VDC OUT

9VAC or 12VDC

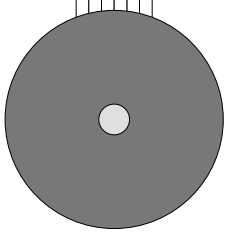
"Z" axis stepper motor



"Y" axis stepper motor



"X" axis stepper motor



NOTE!
Due to an error in the design of this circuit board a small track was omitted. This track should have been between the large pad behind each MOSFETs and the track that passes between the legs of each MOSFET. The metal tag of each MOSFET is also connected to the stump of the middle leg of each MOSFET. To fix this error simply solder a short wire link as shown in the diagram.