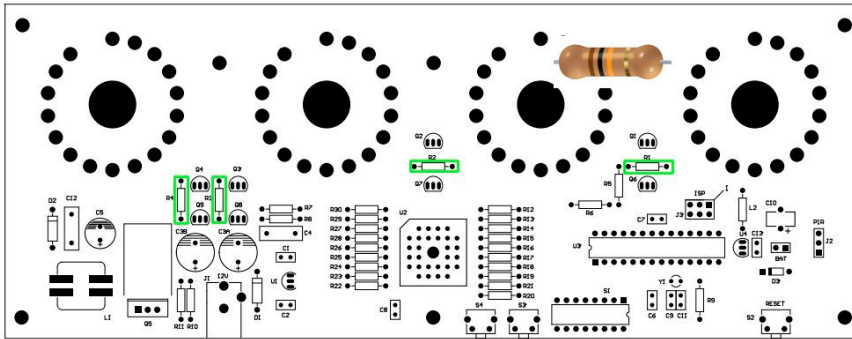


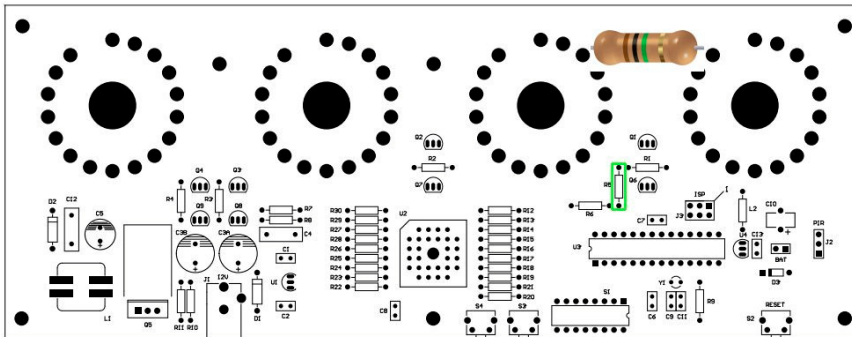
Four Letter Word – Build Instructions

All of the electronic components go on one side of the board – this will be the BOTTOM when the board is finished. The tube sockets go on the other side – this will be the TOP when finished.

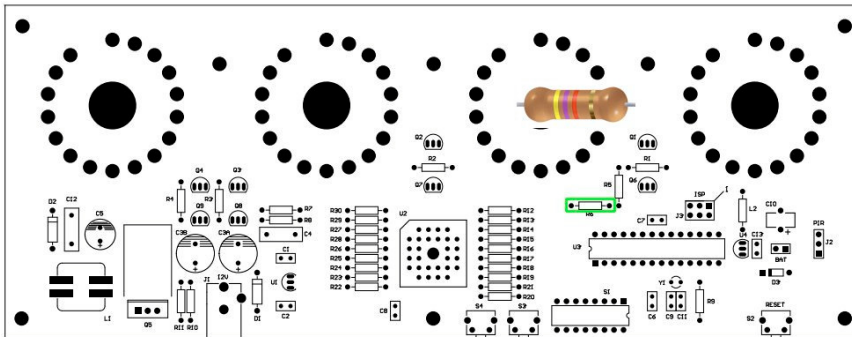
Start with the resistors.



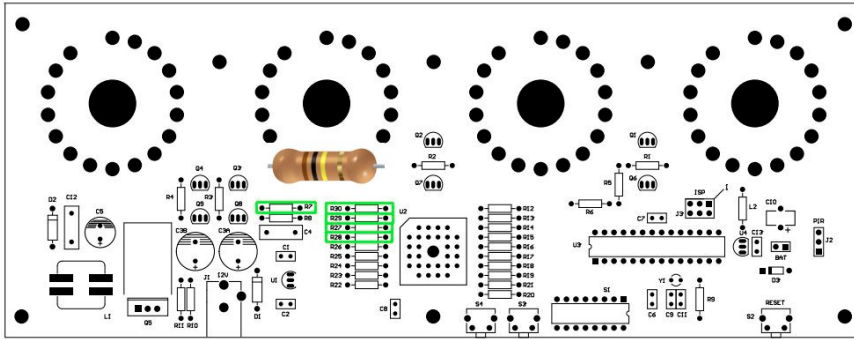
R1, R2, R3, R4 – 10k, brown-black-red, 4 positions.



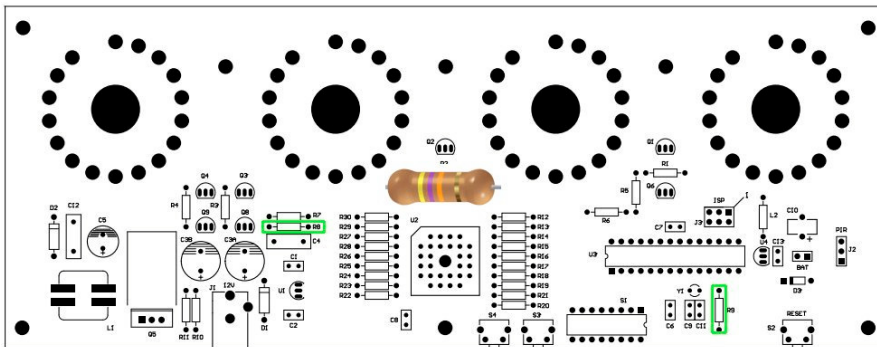
R5 - 1M, brown-black-green, 1 position



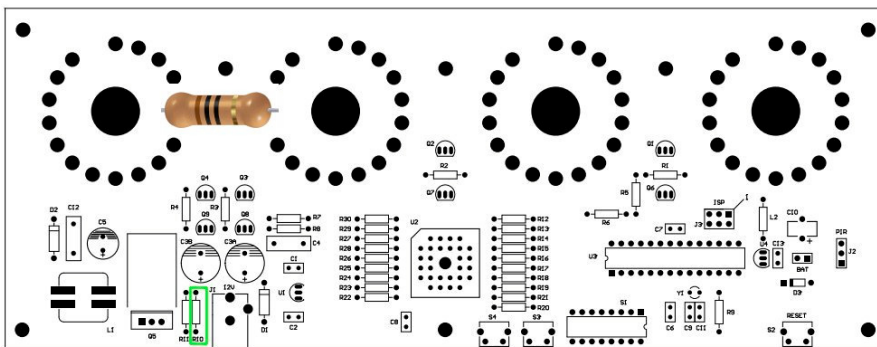
R6 – 4.7k, yellow-violet-red, 1 position



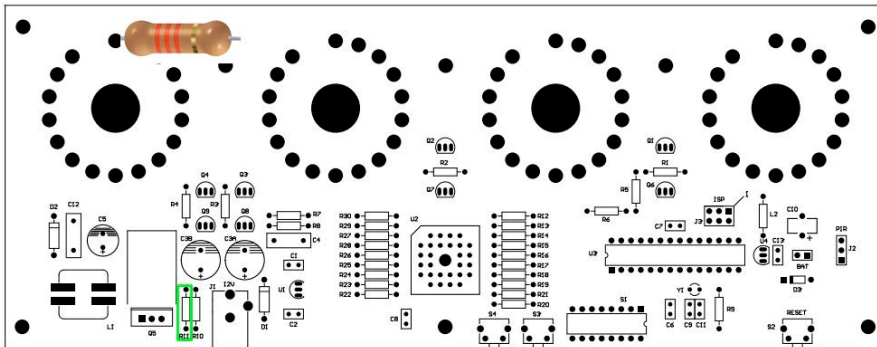
R7, R27, R28, R29, R30 – 100k, brown-black-yellow, 5 positions



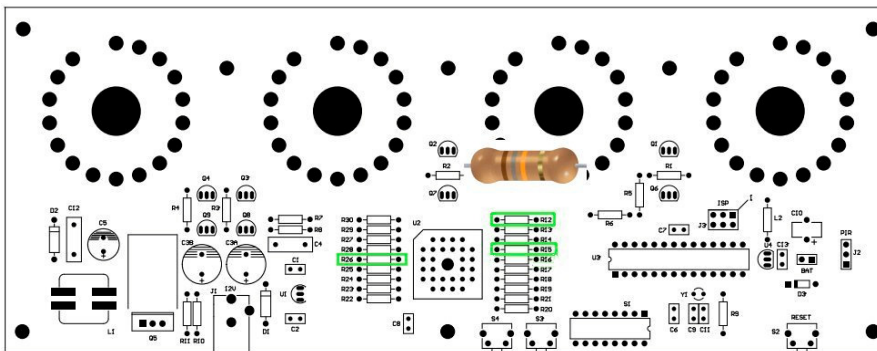
R8, R9 – 47k, yellow-violet-orange, 2 positions



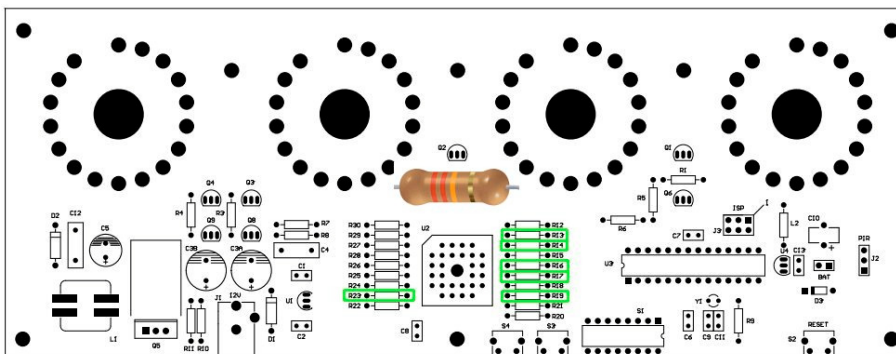
R10 – 10R (10 ohms), brown-black-black, 1 position. Do not confuse this with inductor L2, which has the same markings but is slightly smaller.



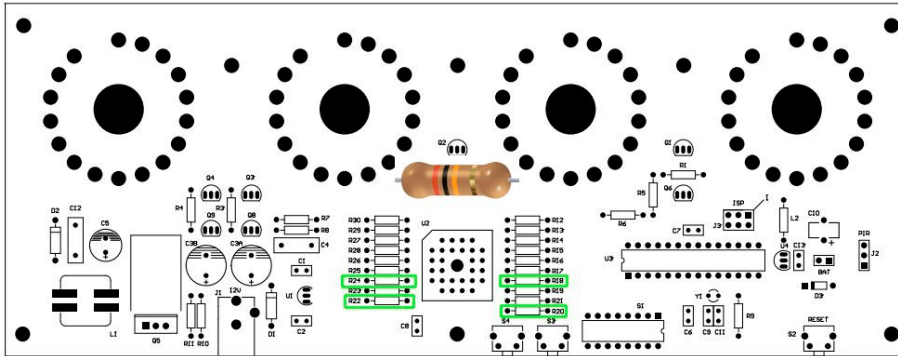
R11 – 2.2k, red-red-red, 1 position



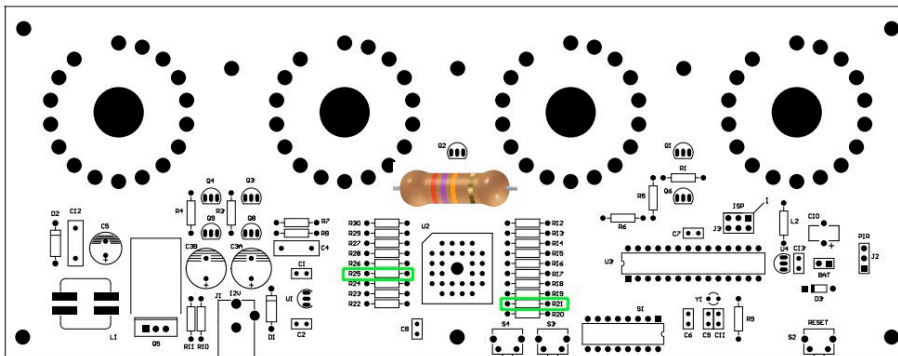
R12, R15, R26 – 18k, brown-gray-orange, 3 positions



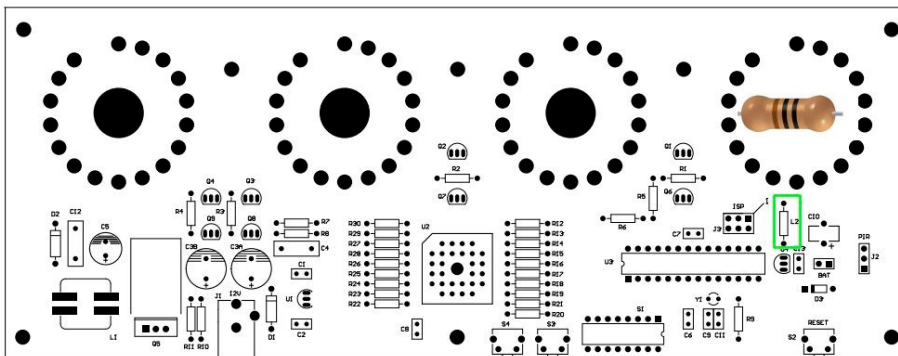
R13, R14, R16, R17, R19, R23 – 22k, red-red-orange, 6 positions



R18, R20, R22, R24 – 20k, red-black-orange, 4 positions

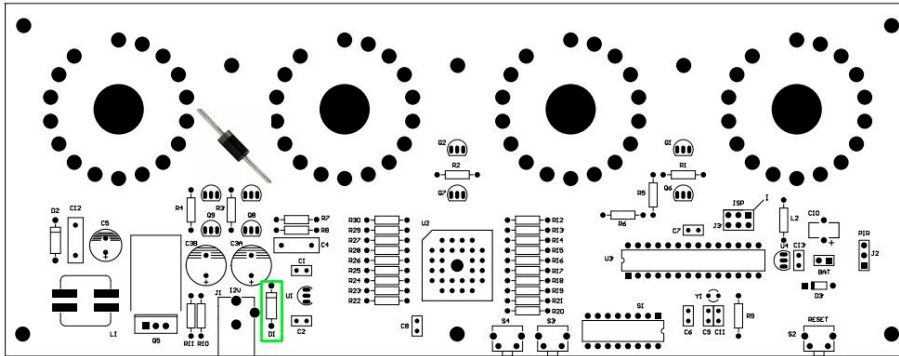


R21, R25 – 27k, red-violet-orange, 3 positions

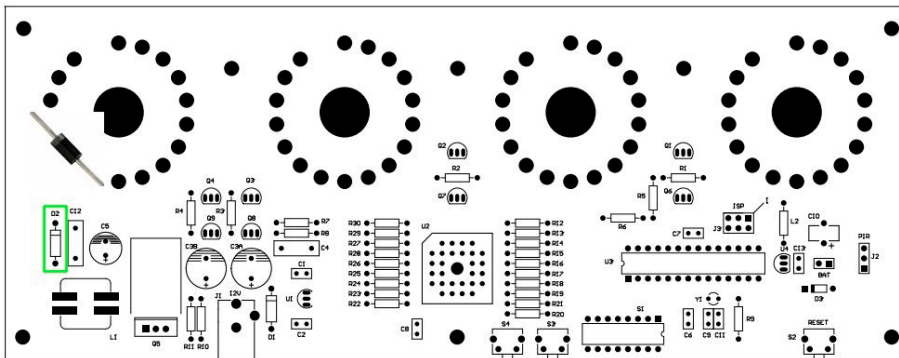


Next install the choke L2 – 10uH (10 microhenry), brown-black-black. This is not a resistor even though it looks like one. It isolates a sensitive section of the microprocessor from electrical noise.

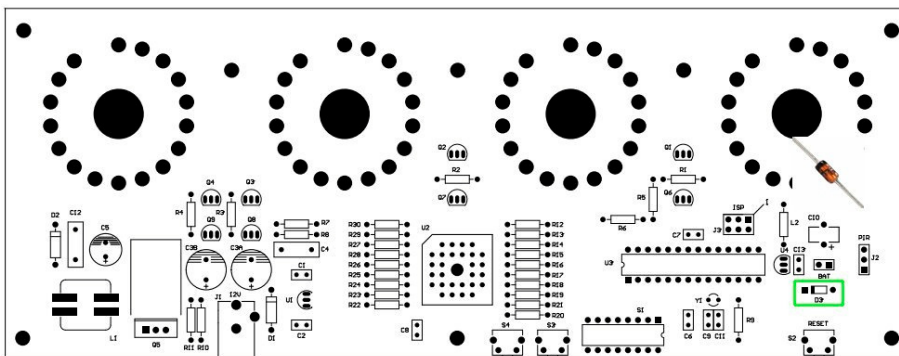
Continuing with the low-profile components, install the three diodes. The diodes have a polarity band at one end, and must be inserted the right way round. D1 and D2 look similar - do not get them mixed up, as they are different electrically. The board may still work, but it will be inefficient and will get hot.



D1, 1N4003. This is a protection against connecting the power supply backwards.

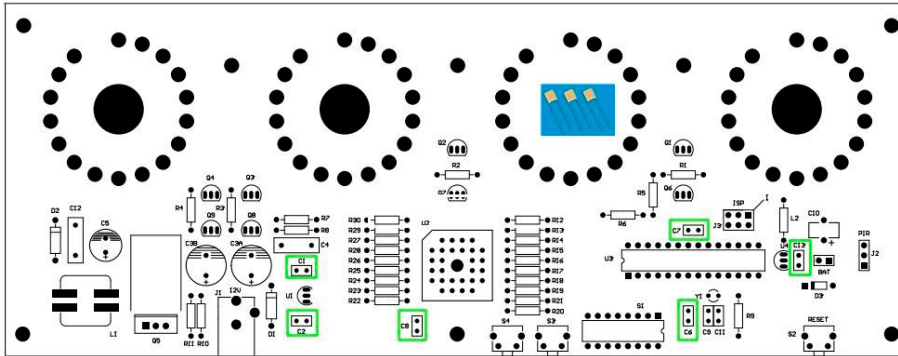


D2, UF4004. This is the high voltage rectifier. It is an ultra-fast recovery type.

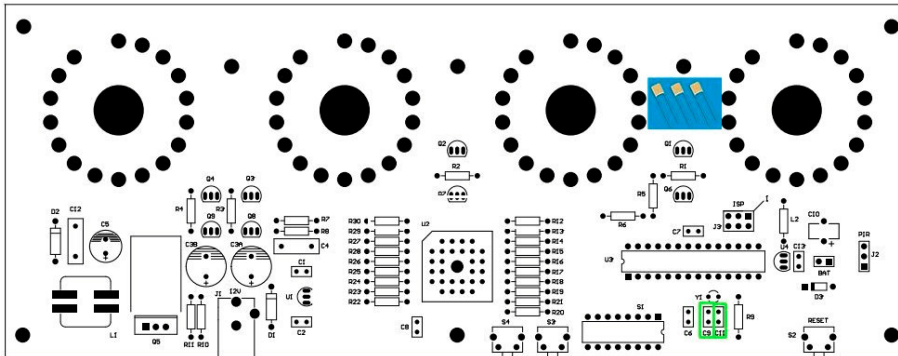


D3, 1N4148 or 1N914 (they are equivalent). This diode isolates the supercap C10 from the rest of the circuit when the power is disconnected.

Next install the small capacitors.

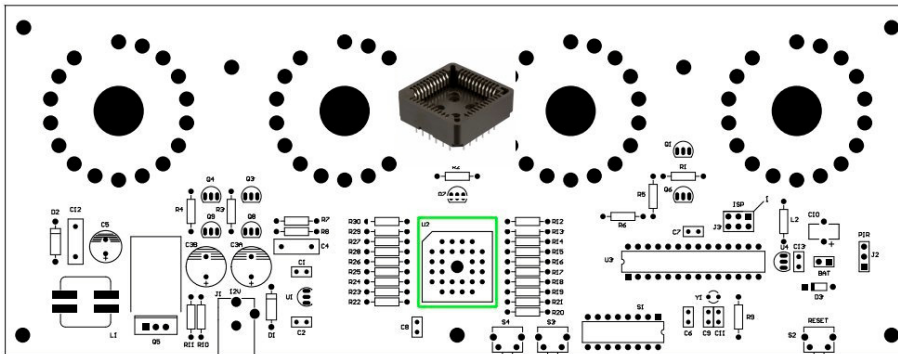


C1, C2, C6, C7, C8, C13 – 0.1uF (100nF), six places. These are decoupling capacitors, to reduce noise on the 5V supply.

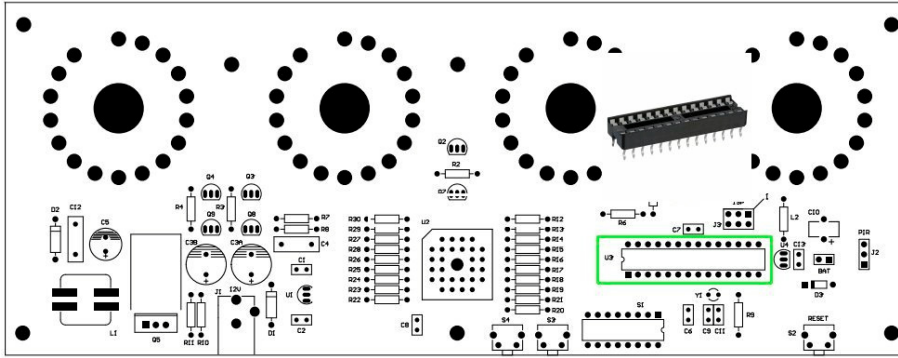


C9, C11 – 18pF, 2 places. These are ballast capacitors for the small crystal Y1.

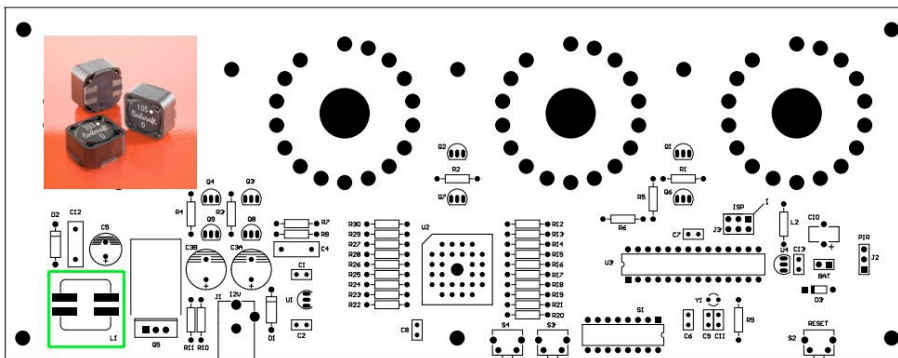
Continuing with the low profile parts, install the IC sockets next. These have an orientation mark that needs to be lined up with the marking on the PCB.



Pin 1 of U2 lies in the center of one side, and corresponds with a mark molded on the socket. It may be easier to locate this mark than to identify which corner is angled. Pin 1 goes toward the center of the board – up, in the picture. BE VERY CAREFUL! U2 will only fit in the socket one way, and if you mount the socket wrong it is nearly impossible to remove it and try again. Also, the pins are quite thin and it is easy to bend one over without noticing, so that it doesn't go through the board. DOUBLE CHECK, then check again, before soldering all the pins.

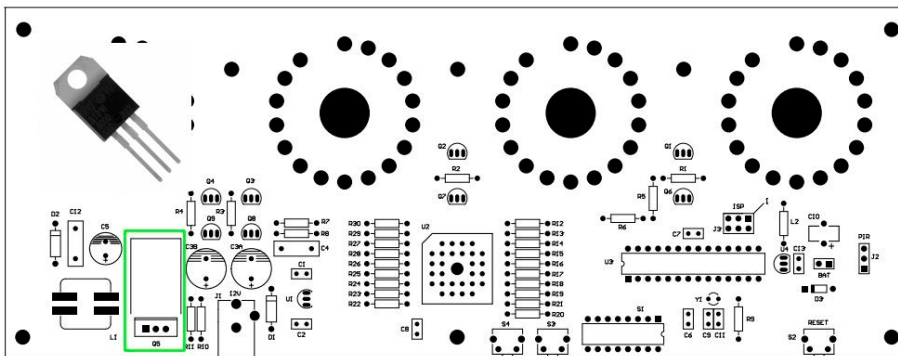


The socket for U3 has a notch at one end, which must line up with the notch on the PCB marking. This is to the left in the drawing above. Again. Make sure all the pins go through the board and none are bent over.

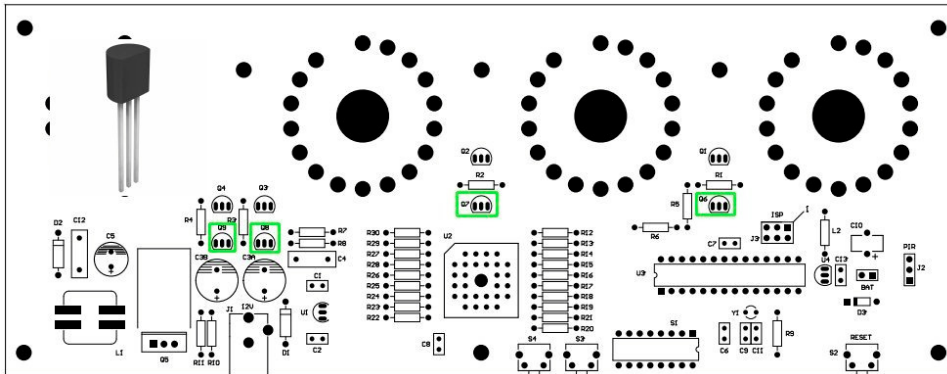


Inductor L1 is a surface mount part. It has four connections, two on each side, and it goes either way around. Line these up with the tracks on the PCB and solder it in place by heating each track in turn and letting solder run underneath by capillary action. Take care not to allow the solder to short circuit the pads.

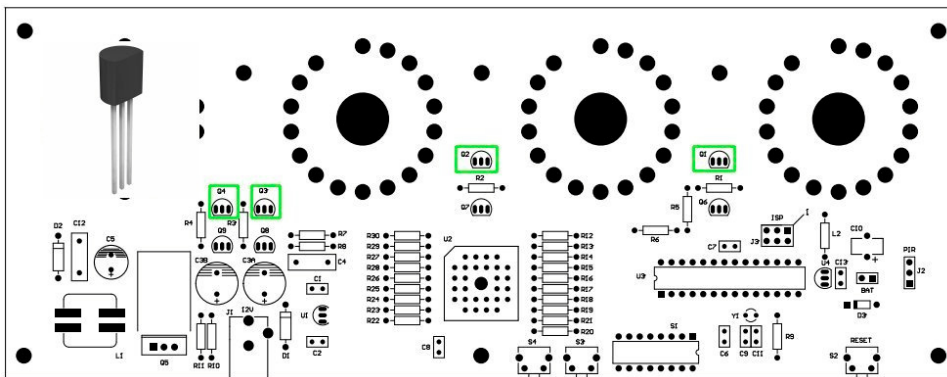
Note! L1 should be installed before power transistor Q5, to allow access to the pads on both sides.



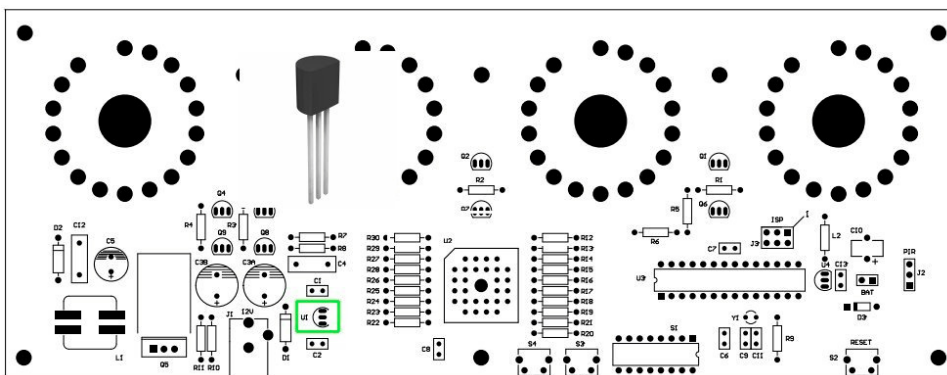
To install the power FET Q5, first bend its leads down at a right angle at the point where they change from thick to thin. Then mount it with the metal tab flush down on the PCB, inside its outline.

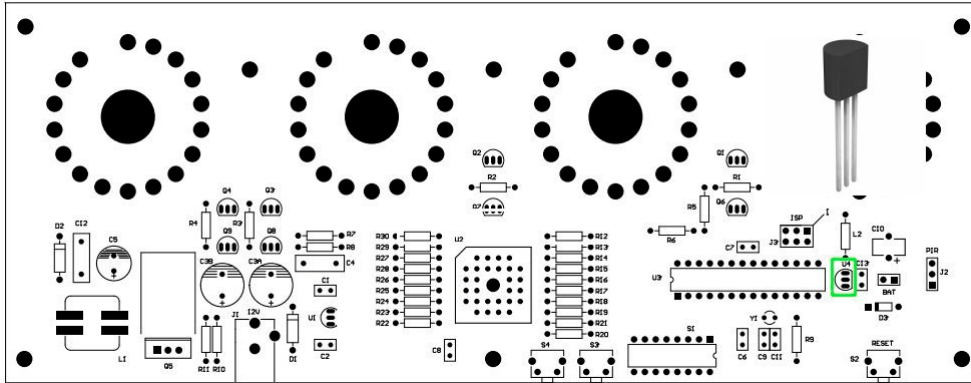


Mount the high voltage NPN transistors MPSA42 next (4 places). Insert them so that the D shaped package corresponds with the D shaped outline on the board. These transistors have very close lead spacing and carry a high voltage, so be neat and tidy with the solder.

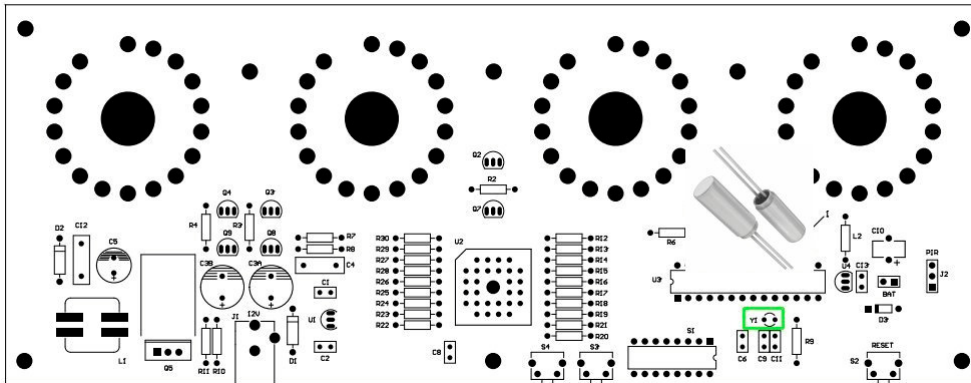


Continue with the high voltage PNP transistors MPSA92 (4 places). Insert them so that the D shaped package corresponds with the D shaped outline on the board. These transistors also have very close lead spacing and carry a high voltage, so be neat and tidy with the solder.

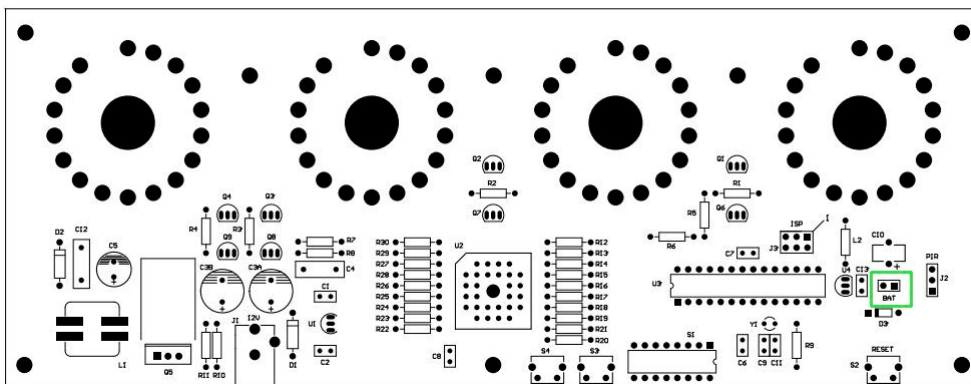




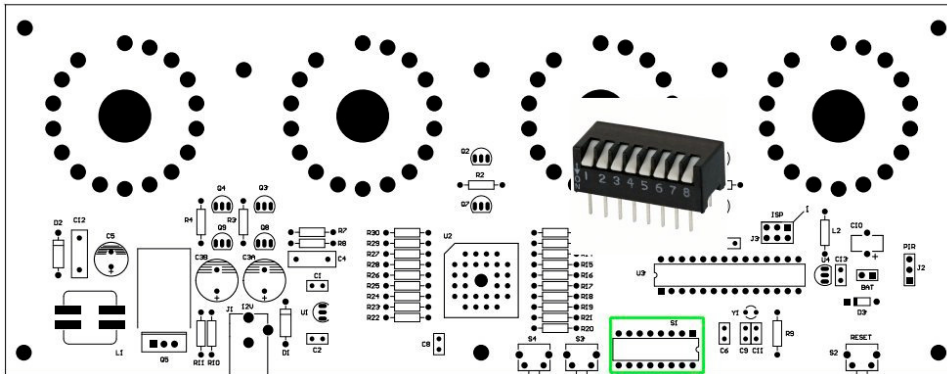
Mount U4, the MCP130 voltage supervisor. The purpose of this device is to give the processor U3 an early warning when power is turned off. Again, its D shaped package must line up with the D shaped outline on the PCB.



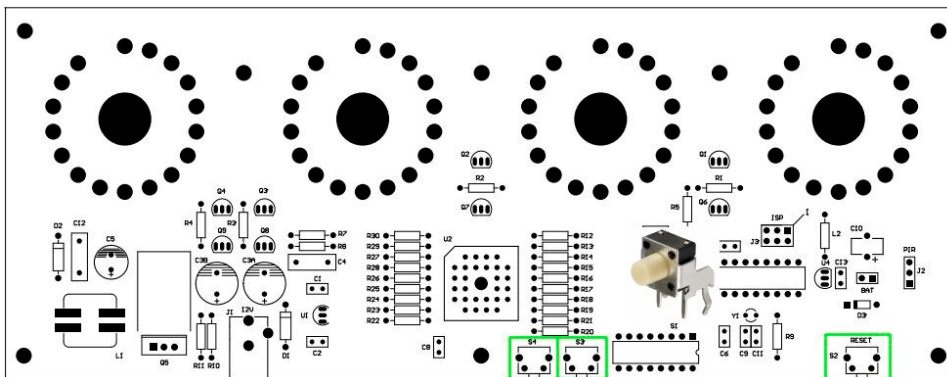
Mount the watch crystal Y1. This is the main time-keeping component for the clock.



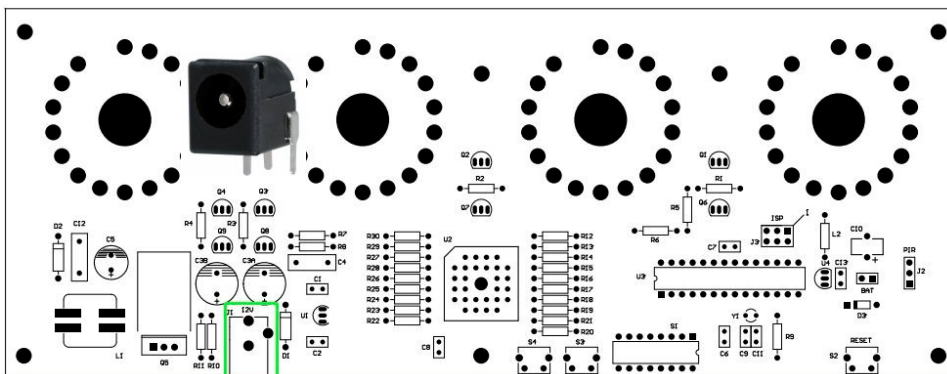
Mount the 2-pin battery jumper JP1. Place the link on the pins after you solder it.



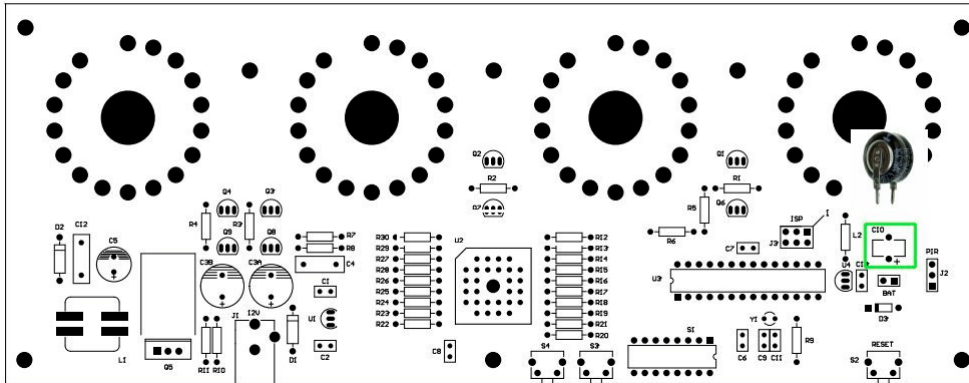
Mount the DIP switch S1. The plastic tape on it is to seal it against solvents, and can be removed after assembly.



Mount the push button switches S2, S3, S4 (3 positions).



Mount the power jack J1. Nearly finished!



Mount the super capacitor C10. This is polarized and must be mounted the right way round. The markings are rather difficult to see, but there is a small ‘-’ stamped on one lead, and arrows on the plastic sleeve point to that end, which is also domed slightly (the other end is flat). This is the negative terminal, which goes toward the center of the board (up in the picture).

This leaves two component positions empty on this side of the board – the blanking connector J2, and the programming connector J3. These are not supplied in the kit as most people have no use for them. If you know how to use them, you have no need of instruction how to mount them.

This is a good time to install some half-inch (12mm) standoffs in the corner mounting holes, as the remainder of the assembly is on the other side of the board and the standoffs will make it a level surface.

Turn the board over and insert the socket pins on the other side. The best way to do this is to drop the pins into one circle at a time and solder them from the TOP. If you fill all the circles at once, odds are 100 to 1 you will knock the board at some stage and half of them will jump out.

Place the tip of the soldering iron to touch the outside rim of the socket and the PCB circle, let it heat for a moment and apply a small amount of solder. You should see the solder run around the socket by capillary action. Remove the iron and it's done. You don't need a lot of solder, as it wicks down through the plated hole and holds the socket quite firmly. BE CAREFUL not to get any solder INSIDE the socket, as this will solder up the gold spring insert and make it useless. If this happens by accident, pull it out and throw it away. There are a couple of spares in the kit just in case, and since pin 11 on each tube has no connection, you can liberate four more by not placing pins in that position. Pin 11 is the 11th hole counting anti-clockwise from the arrow.

When everything is complete, insert U2 and U3 in their sockets if you haven't already. U2 will only go in one way. It has a slight chamfer along one edge and a molded dot in the center of that edge. This goes towards the center of the board. If you get the chip stuck or need to remove it for some reason, push it out from below through the hole underneath. U3 has a notch at one end, this goes towards the center of the board. Take care that none of its pins miss the socket and bend underneath.

You can now fire it up if you wish, without the tubes, and check the high voltage. The power supply should be 12 to 18 volts DC, center pin positive, at 250mA – larger is ok. You should measure round about 175V at the cathode (striped) end of D2 – the frame of any of the push button switches is a suitable ground for the meter. After you remove the power it takes a while for the high voltage to leak away, so handle with care!