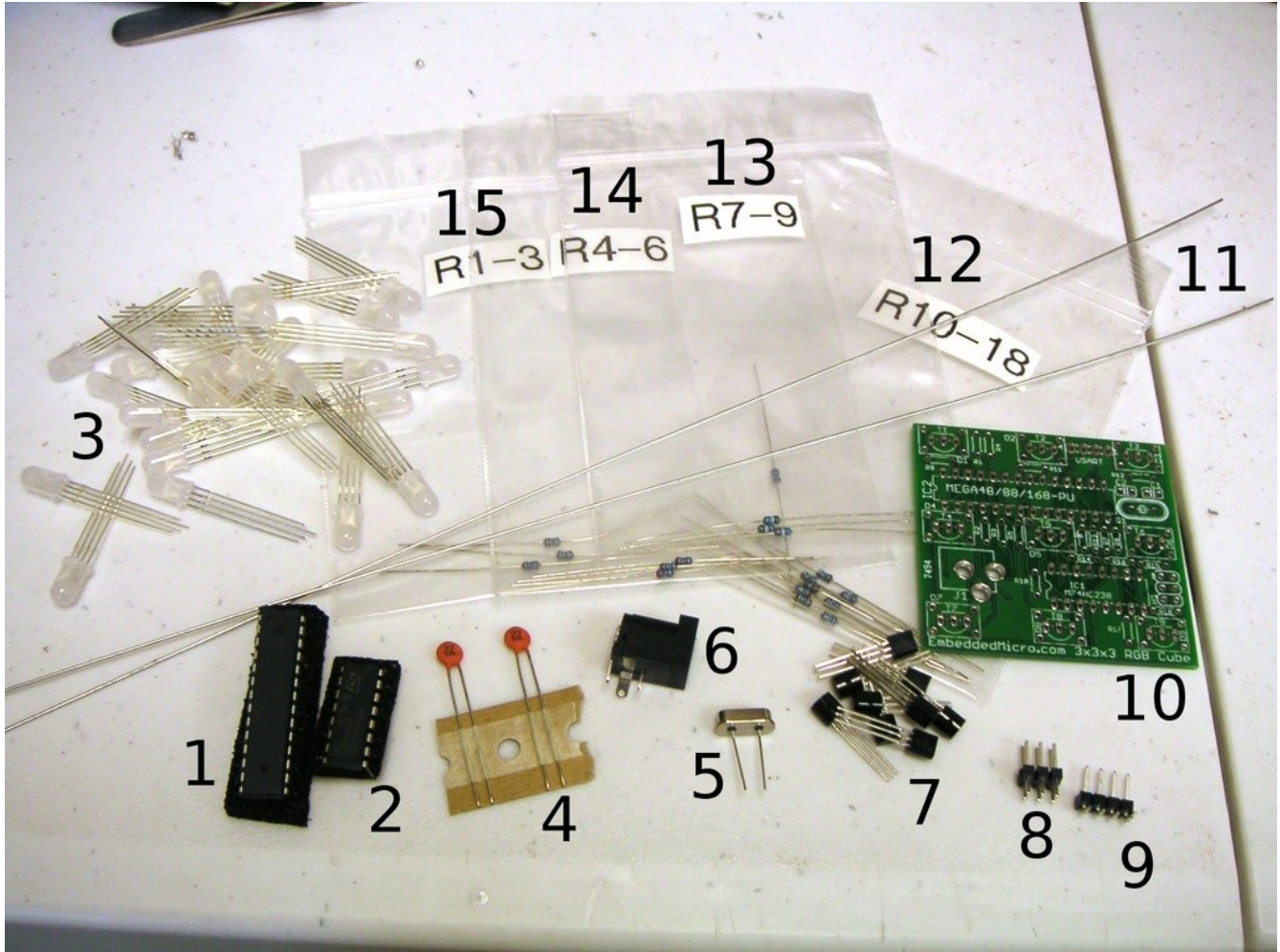# Embedded Micro.com

3x3x3 RGB LED Cube Kit V04

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Kit Contents

1. Atmega168 (pre-programmed)
2. M74HC238
3. 27 RGB LED (common cathode)
4. 22pf capacitors
5. 20MHz crystal
6. 2.1mm DC jack
7. 9 NPN transistors
8. 2x3 0.1" header (optional)
9. 1x4 0.1" header (optional)
10. 3x3x3 cube PCB V04
11. 2 12" straight wires
12. 9 1K ohm resistors
13. 3 169 ohm resistors
14. 3 200 ohm resistors
15. 3 100 ohm resistors

PCB Soldering

If you how done any PCB work before this should be easy, if not take your time, it's not difficult. The PCB is all thru-hole which makes it easier to build. Read through all of the instructions before starting.

Resistors

Find the bag labeled "R1-3" (#15). Bend the leads of the resistor at 90 degree angles as close as possible to the body of it.
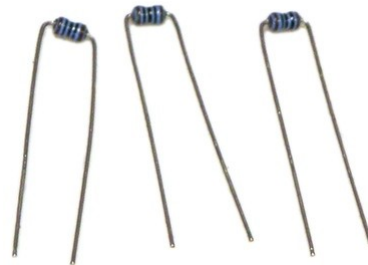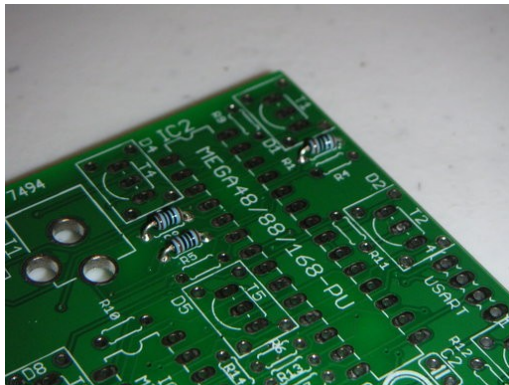

Illustration 1

Illustration 2

Insert the resistors in to the places marked R1, R2, and R3. Orientation of resistors is not important, but if they face the same way it looks cleaner. Solder the resistors in place and trim the excess wire.

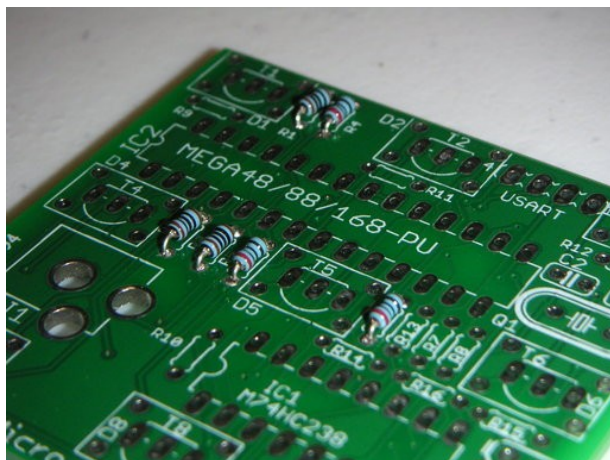Do the same for the resistors in R4-6(#14) and R7-9(#13).

Illustration 4

Illustration 3

And again for R10-18(#12). Once done it should resemble illustration 5. Mixing up the locations of the resistors could result in poor color mixing, or possible damage to the LED.

Transistors

Find the 9 NPN transistors (#7). Look at the flat and curved side, that lines up with the silk screen on the PCB. The orientation of the transistors in
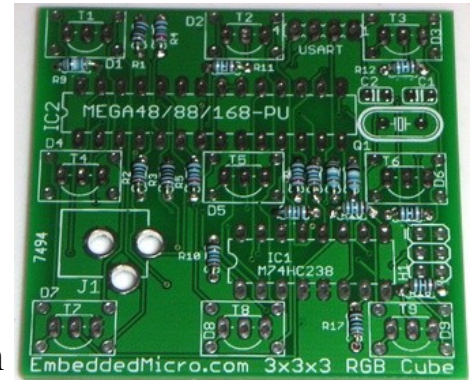
Illustration 5

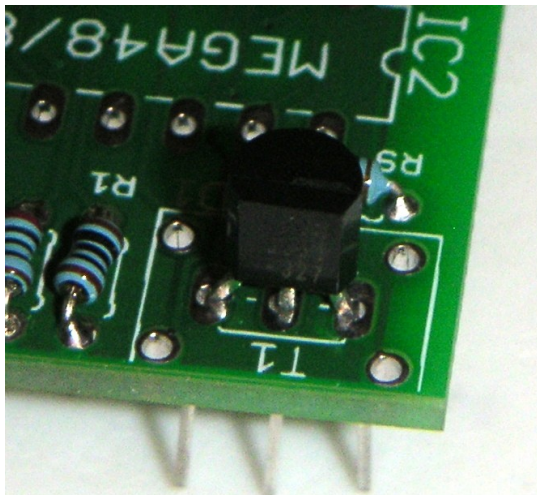important. The illustration 6 shows the correct placement.

To insert the transistor, simply line up the pins and push it in until it is snug. Then flip the PCB over, solder it, and cut off the extra wire.
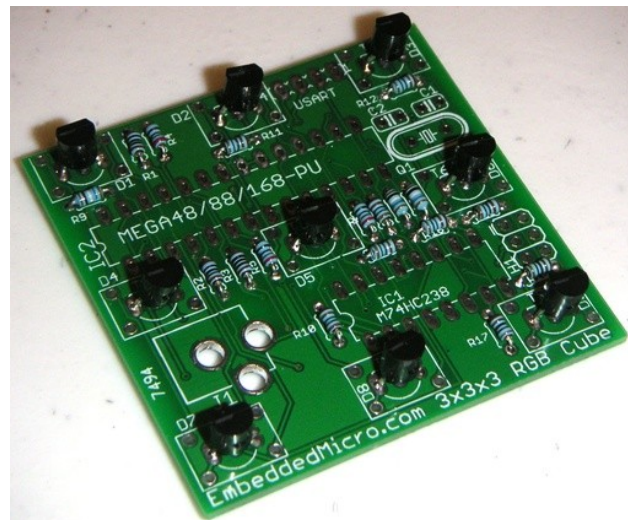
Illustration 6

Do this for the other 8.

Illustration 7

Crystal

For this section the 20MHz crystal (#5) and the two 22pf capacitors (#4) are needed. The orientation of the crystal and capacitors is not important, but again it looks better if they face the same way.

Solder the capacitors into C1 and C2 and the crystal into Q1.

Illustration 8

Integrated Circuits

Here the two IC, the Atmega168 (#1) and the M74HC238 (#2), will be soldered in place. Orientation is extremely important with both IC. If they are accidentally flipped, they are a very difficult to remove.
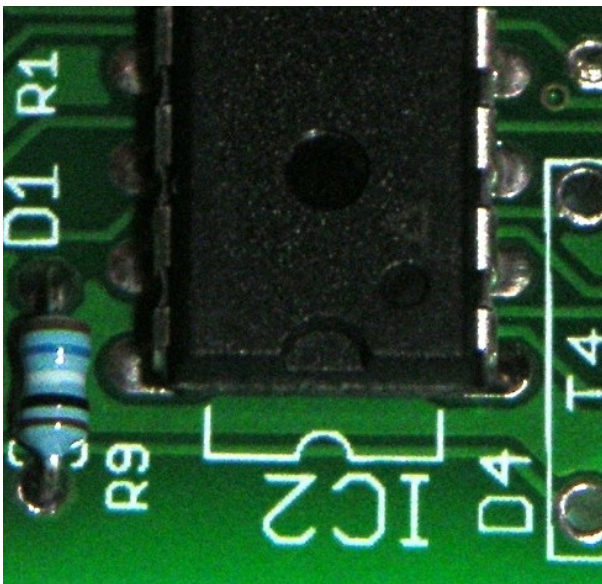

Illustration 9

To indicate the orientation the IC have a little notch in them that corresponds the PCB as shown in illustration 9. The Atmega168 goes into the IC2 space and the M74HC238 goes into IC1. It may be necessary to bend the pin in slightly to make them fit.

When soldering the pins in jump around, solder a pin on one side then the other. This prevents the IC from over heating.

Headers (optional)

This section is optional and is not needed to make the cube work correctly. It is only if you would like to have access to the ISP pin of the Atmega168 to re-program it, or to access the serial port features.
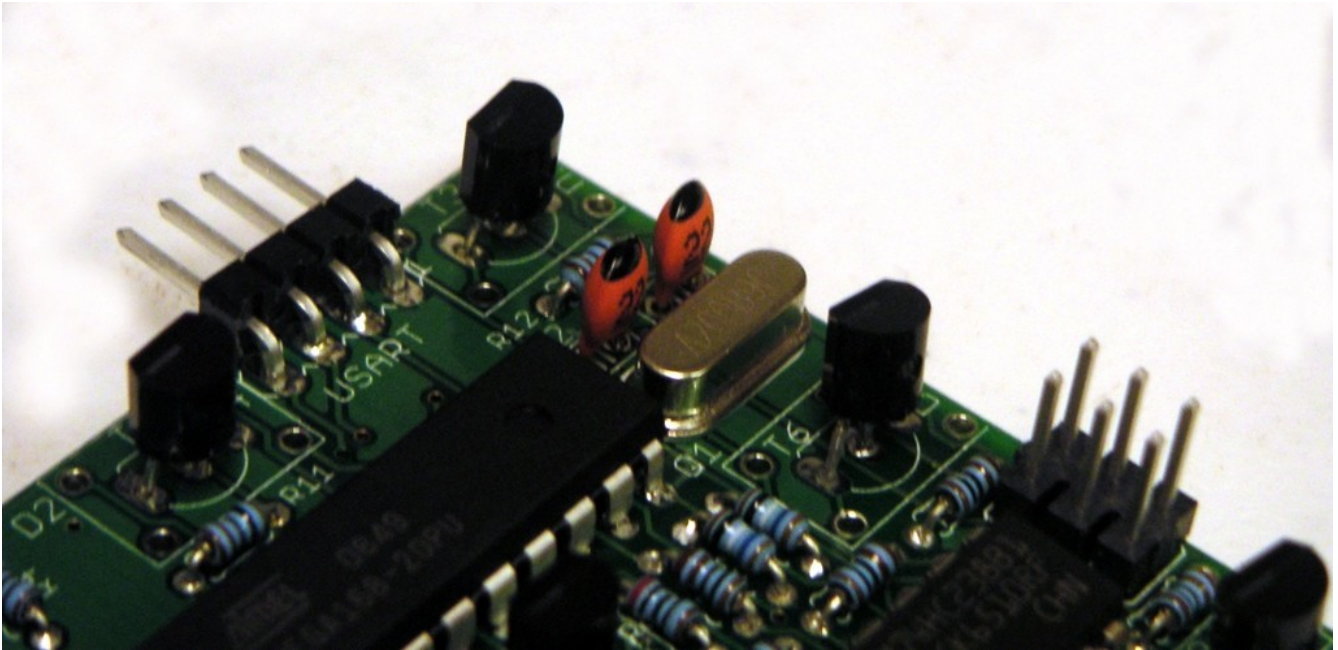

Illustration 10

The ISP header is the 2x3 header (#8). Solder this into H1. The best way to do this is to solder one pin, get the alignment perfect, then solder the rest. This header allows you to program the Atmega168 with an AVRISP mkII or compatible programmer.

The serial port header is the 1x4 header (#9). This goes into the 4 holes labeled "USART". This allows you to connect to the cube over serial and control it.

DC Power Jack

Solder the DC power jack (#6) into the space labeled J1. Make sure to fill in the three holes entirely to make a good solid connection.

Congratulations! The PCB is now done. The next part will take a while, so taking a break is recommended.
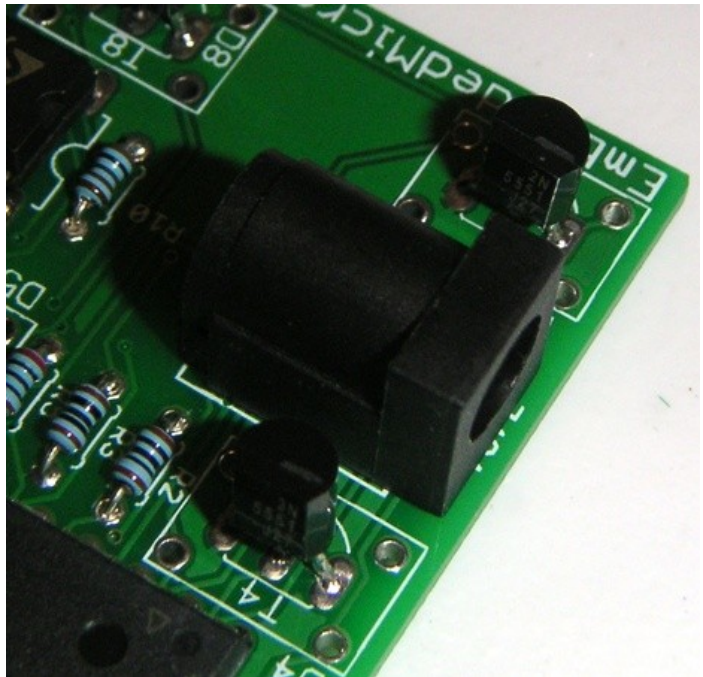

Illustration 11

Building the LED Matrix

This is the most difficult and time consuming part of the cube. Your ability to make the LED matrix even and clean will greatly affect the aesthetics of your cube, so take your time. It is recommended that you read through this entire section before proceeding and obtain an understanding of what you are doing.

Bending the Leads

For this step I highly recommended the use of hemostats or something similar.

First take a LED (#3) and grab it like illustration 12. Notice the little flat spots about ¼" away from the LED, grab it so about ½ of the flat spot is still showing. Also make sure to grab it so that the blue pin on the outside, it makes bending it easier.
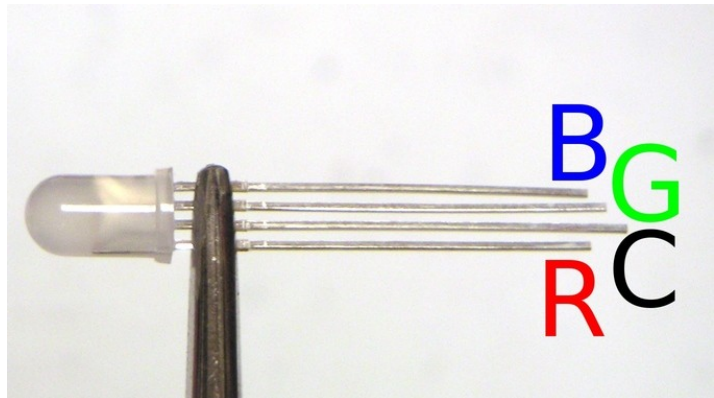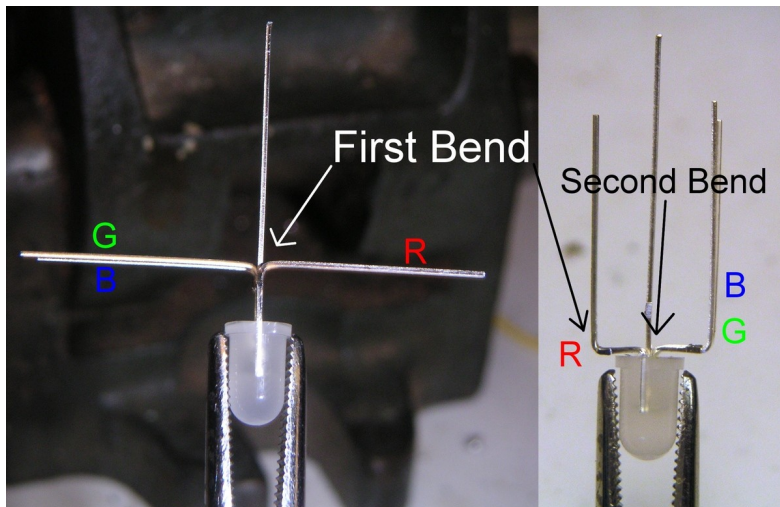

Illustration 12

Illustration 13

Use your fingers to bend it like the left picture in illustration 13. Try to keep the pins parallel. Do this for all 27 LED.

With that done, take each LED and bend each pin so they face down again. Try to keep them as parallel as possible and keep the bend close to the LED. The LED should look like the right picture in illustration 13.

Then take the green pin and bend it away from the blue one. It should be bent at around a 45° angle.

Illustration 14

Assemble the Rows

The LED now need to be assembled into rows of three. To do this they need something to hold them evenly. I use a jig that is just a small piece with three holes held by a small vice. The holes should be the right size to hold the LED snug, but still be able to easily pull it out. A 5mm in diameter drill bit works
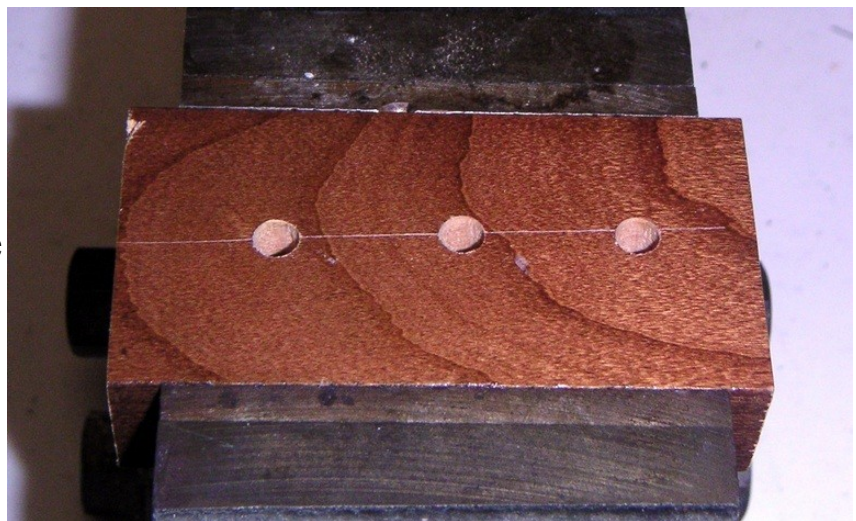

Illustration 15

well. From center to center, the holes are 0.8" apart.

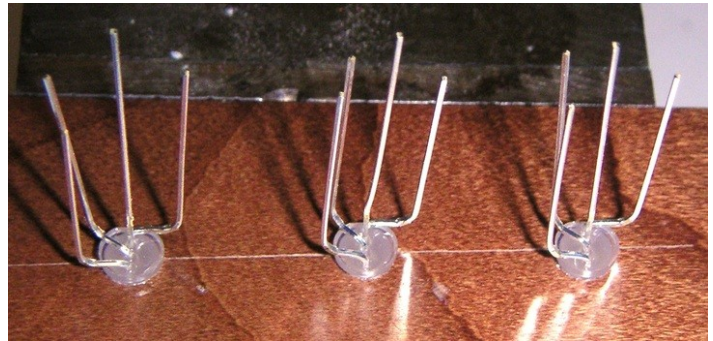To build the first row, insert the three LED so that the side with the blue and green pins is to the left.

Illustration 16

Illustration 17
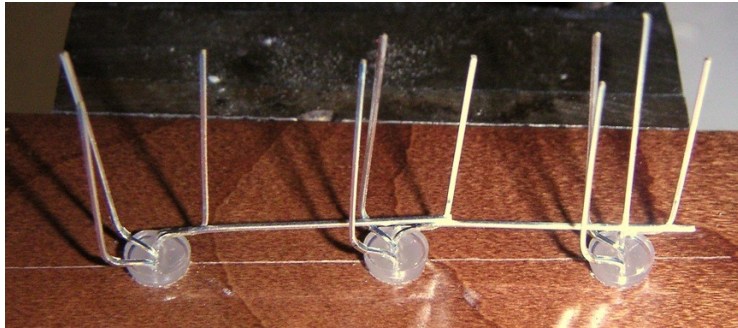
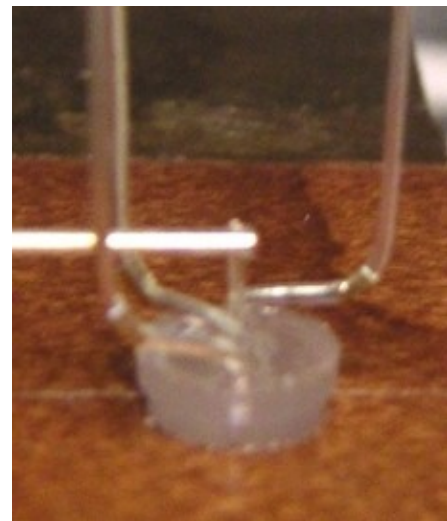Take the common pin and bend the first and second ones to the right. Don't bend the last one.

Cut off the extra wire on the last pin so it looks like illustration 18.

Illustration 18

Illustration 19

Solder it all together. Do this 5 more times so there are 6 rows like this.
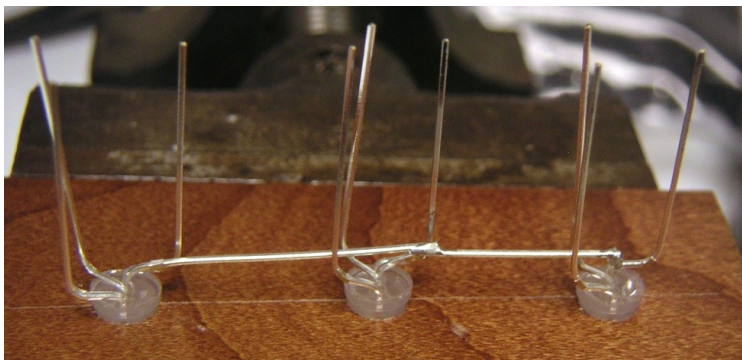
The last three rows are a little different. First take three LED and bend the common pin so it looks like illustration 20. The common pin is the bottom right pin.
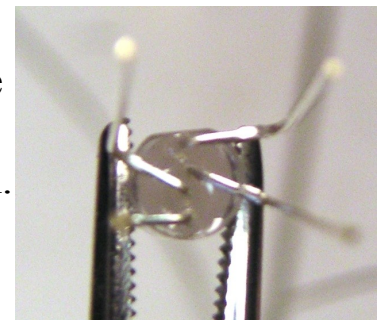
Illustration 20

Place two regular LED in the two left holes, just like before, and place one of the specially bend LED in the right hole. Bend the two common pins over, like before, so they overlap. The right LED should look like illustration 21. Trim the extra wire off and solder it together. Do this two more times so there are 3 of these rows.
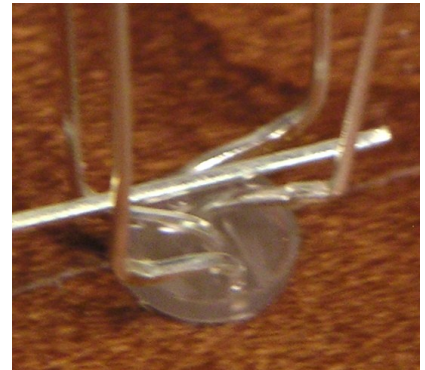

Illustration 21

Assemble the Sheets

This part is not too difficult but it is very important to do it evenly for each sheet, again for looks.
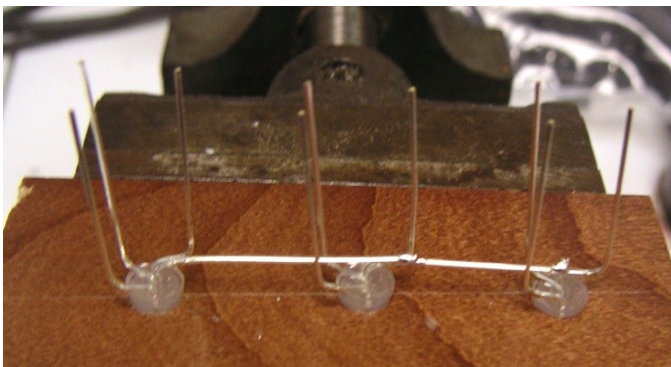

Illustration 22

To assemble a sheet, take one of the six regular rows and insert it into the jig.

Illustration 23

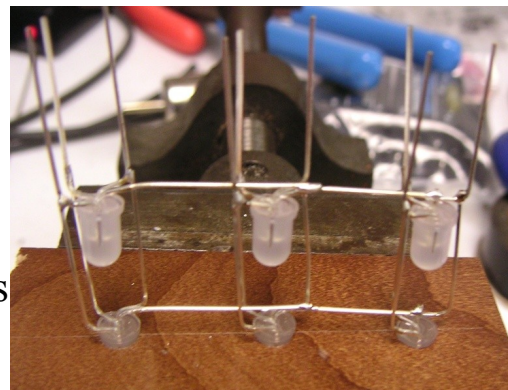Take another regular row and solder the ends of the pins onto the corners of the other row. Try to keep them even.
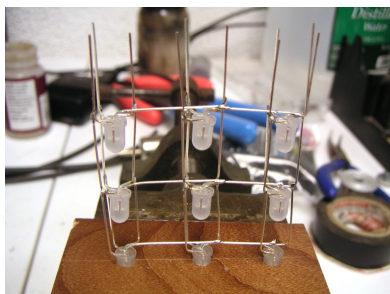

Illustration 24

Do the same thing again but with one of the special rows. One sheet is done, make two more.

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Putting it all Together

Take one of the sheets and insert it in the spots marked D1, D2, and D3. The orientation is important here. The middle and right columns should not have a pin going into the bottom left hole.
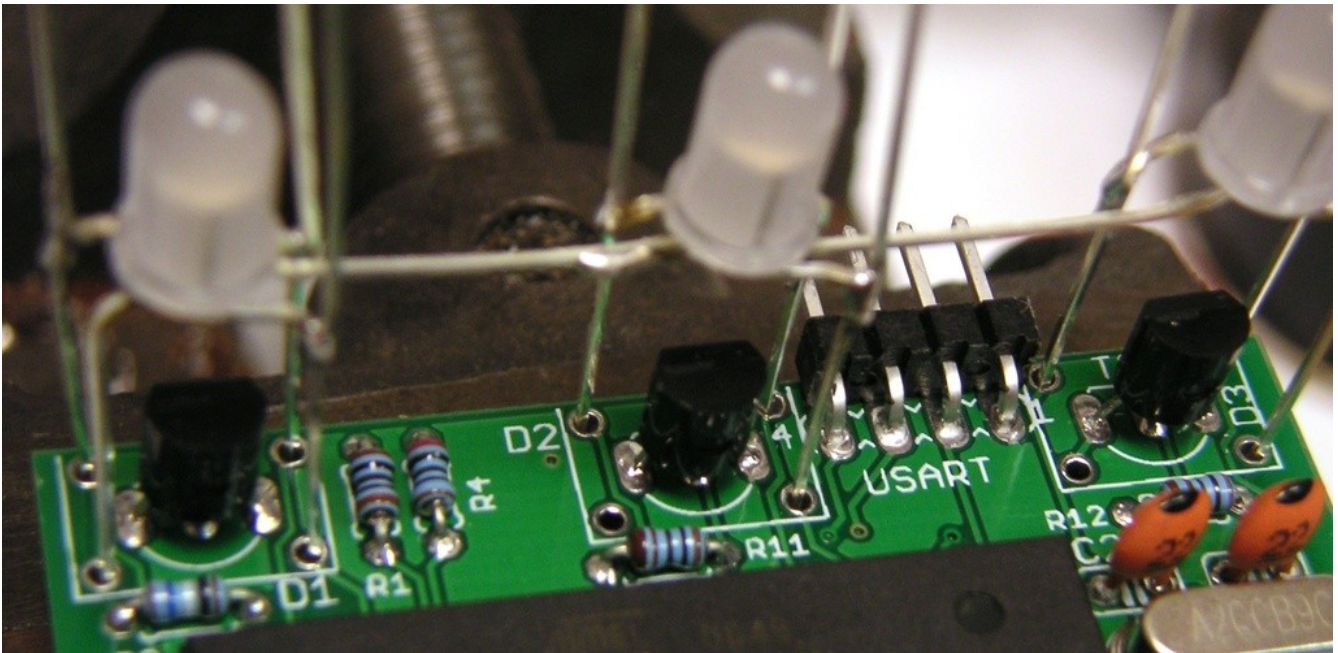

Illustration 25

Get the sheet as perpendicular the the PCB as possible then solder it.

Connect the common cross bars from the second and top rows to the two bottom holes. This is where the straight wire (#11) is used. Cut a piece 2.5-3" long and bent one end to a right angle as shown in illustration 26.
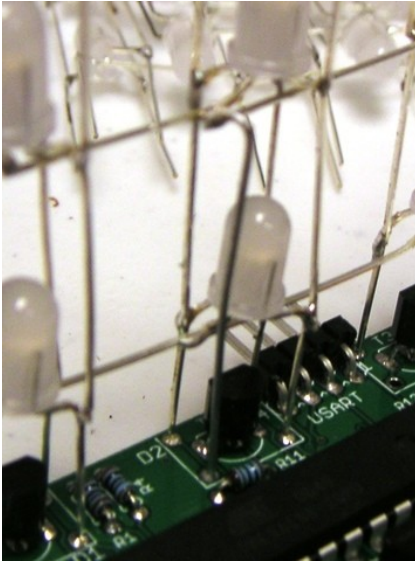

Illustration 26

Illustration 27

Solder the bent part of the wire to the middle cross bar where the two pins are connected. Solder the other end into the the PCB.

Do the same thing with the top cross bar, except it will need a wire 3-3.5" long.

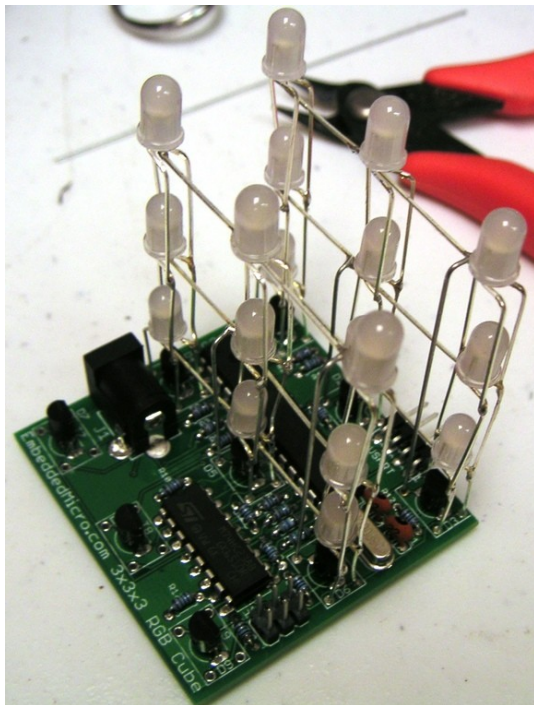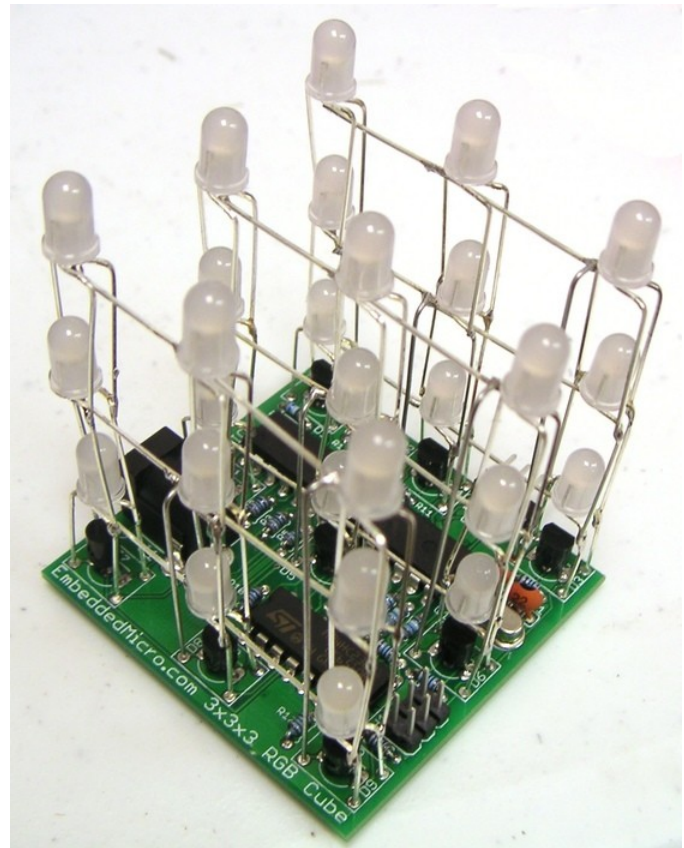That is it for the first sheet. Do the same thing for the next two.
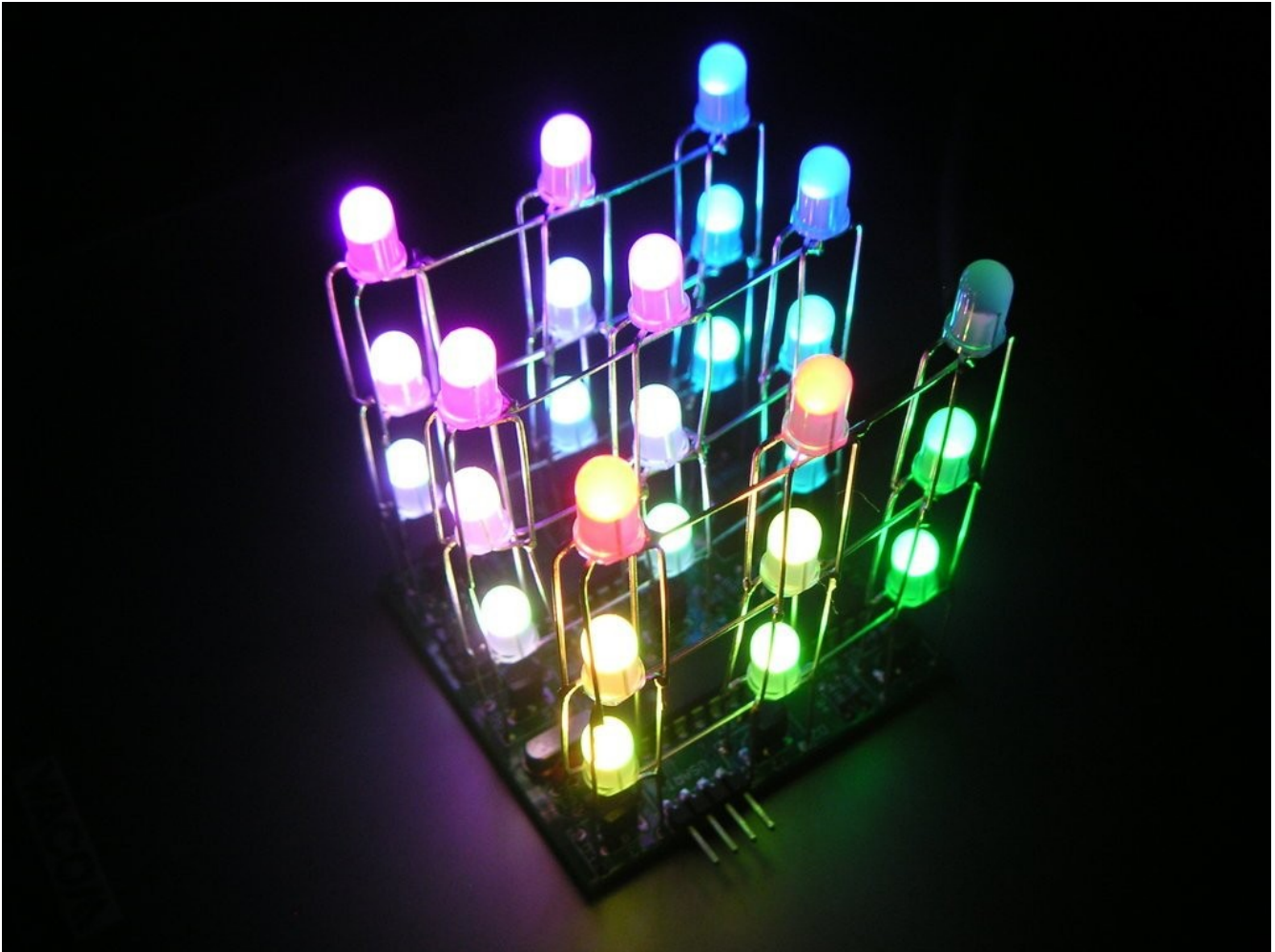

Illustration 28

Illustration 29

The cube is complete! To start using it it needs 5V applied to the DC jack. The center of the jack is positive and the outside is negative. It works great off power from a USB port. USB power cables may be available in the future.

When it is powered it should show the test pattern above for ½ a second before it starts the animations. One top corner should not be lit. The opposite corner should be full white.