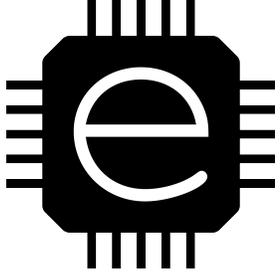


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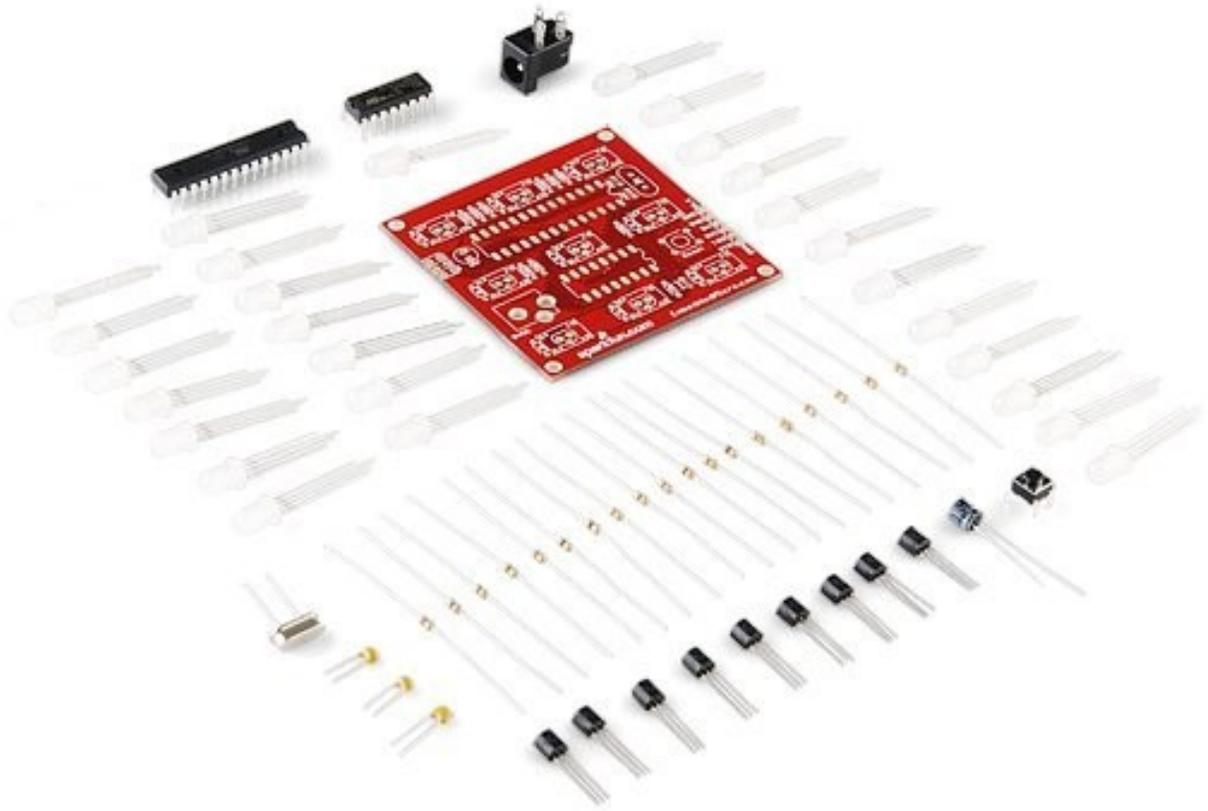
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<http://embeddedmicro.com>

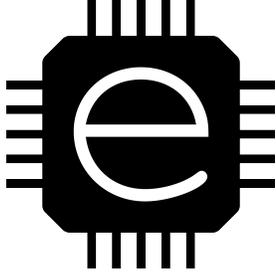


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Kit Contents



1. 1x Atmega328 (preprogrammed)
2. 1x 74HC238
3. 1x LED Cube PCB
4. 27x RGB Diffused LEDs
5. 2x 22pf Ceramic Capacitors
6. 1x 0.1uF Ceramic Capacitor
7. 1x 10uF Electrolytic Capacitor
8. 9x 1k Ω Resistors
9. 1x 10k Ω Resistor
10. 1x 16MHz Crystal
11. 1x 2.1mm DC Barrel Jack
12. 9x 220 Ω resistors
13. 9x NPN 2N3904 Transistors



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PCB Soldering

If you have 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

Locate the 9 220 ohm resistors. They have two red stripes, a brown stripe, and a gold stripe as shown in illustration 1. Bend the leads of the resistor at 90 degree angles as close as possible to the body of it.



Illustration 1

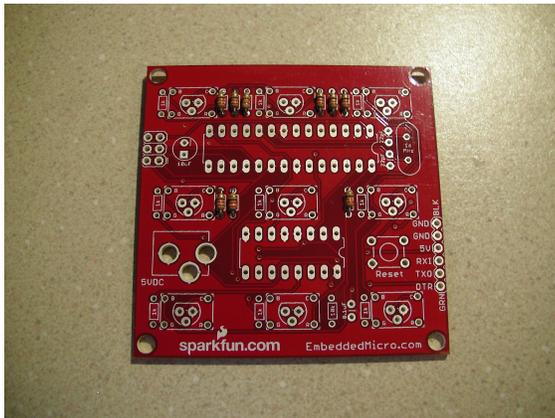


Illustration 2

Insert the resistors in

to the places marked 220. 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 9 1K ohm resistors (brown, black, red, and gold stripes).

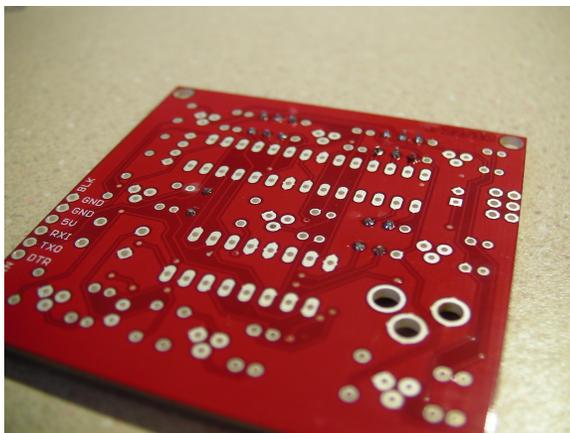


Illustration 3

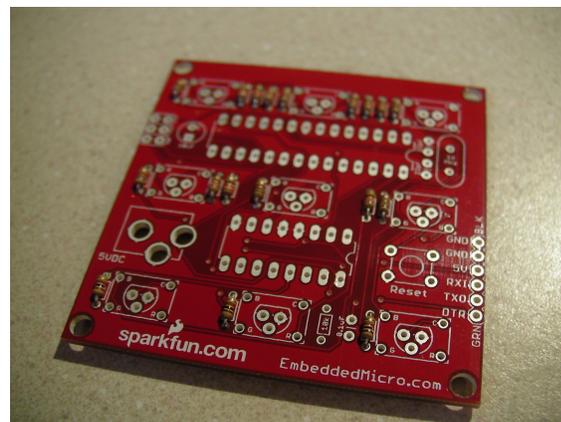
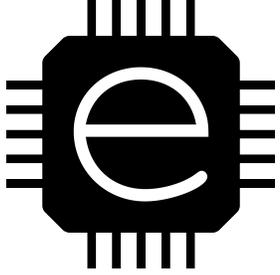


Illustration 4



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Finally find the 10K ohm resistor (brown, black, orange, gold stripes) and solder it in as shown.

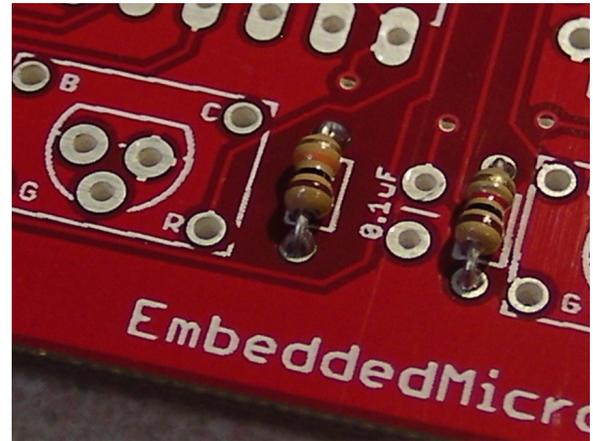


Illustration 5

Capacitors

Find the 0.1uF capacitor. It has the number 104 written on the front. Solder it into the spot labeled 0.1uF. The orientation does not matter.

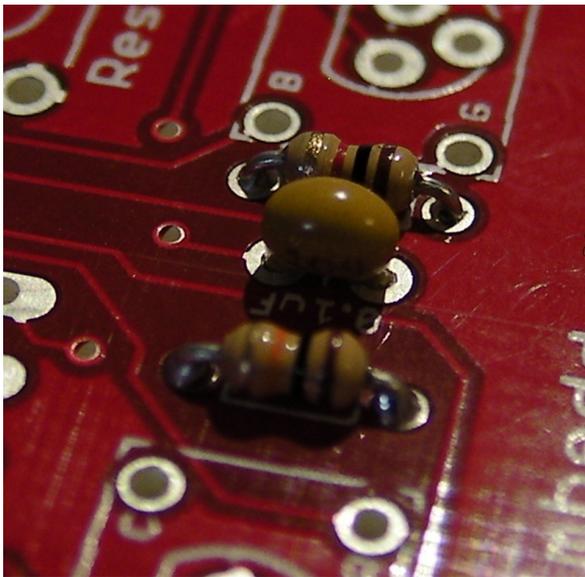


Illustration 6

Next find the 22pF capacitors (220 written on the front) and solder them in as shown.

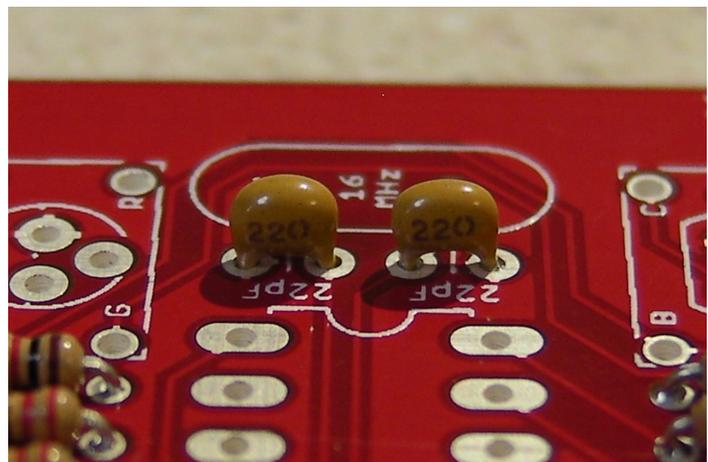


Illustration 7

Find the 10uF and solder it in.

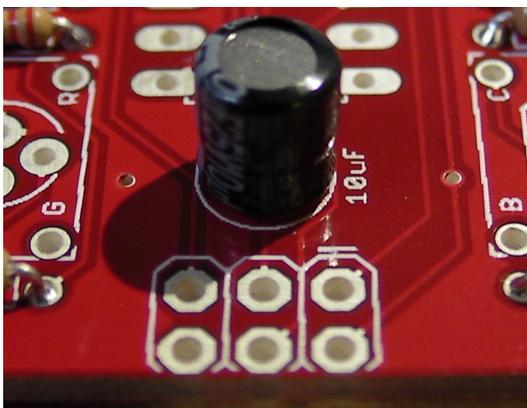
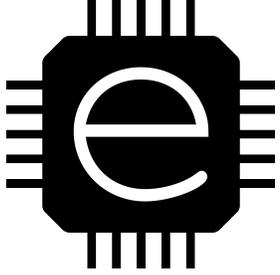


Illustration 8



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Crystal

Find the 16MHz crystal. It is a metal oval with 16.000N printed on the top. Solder it in near the 22pF capacitors. The orientation does not matter.

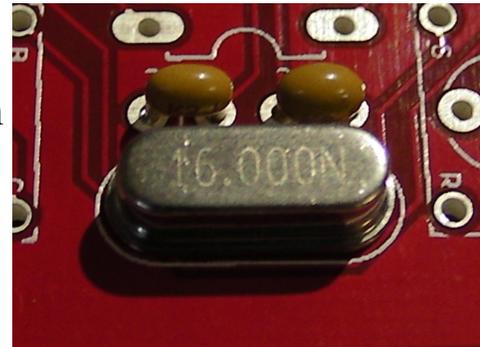


Illustration 9

Reset Button

Find the reset button and solder it in as shown. Note that the button is not a square and the pins should come out of the sides when viewed as in illustration 10.

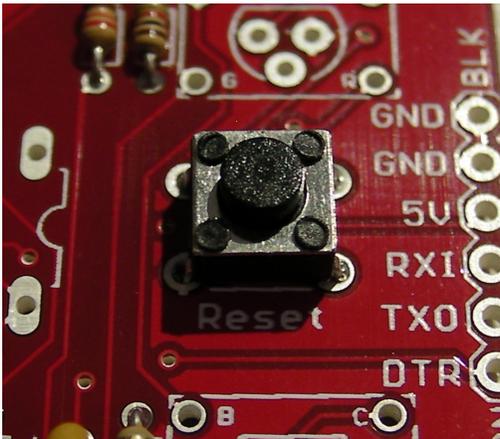


Illustration 10

Integrated Circuits

Here the two IC, the Atmega328 and the 74HC238, will be soldered in place. Orientation is extremely important with both IC. If they are accidentally flipped, they are a very difficult to remove.

To indicate the orientation the IC have a little notch in them

that corresponds the PCB as shown in illustration 11. 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.

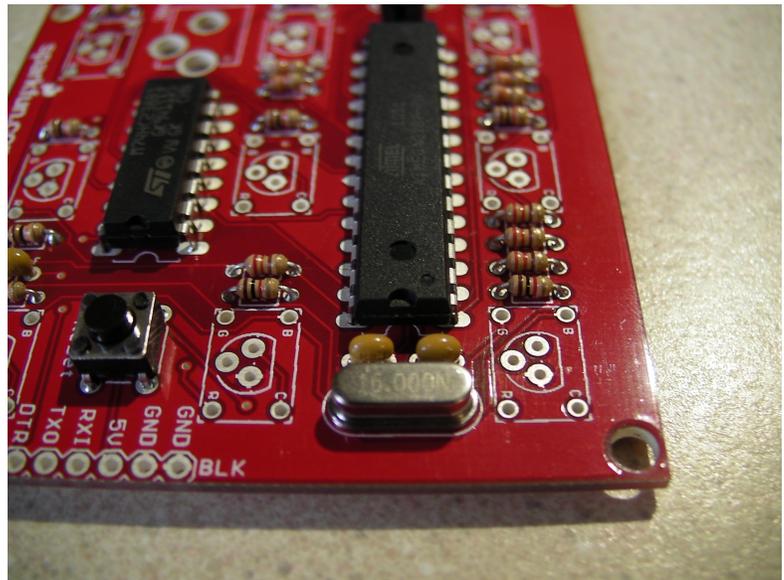
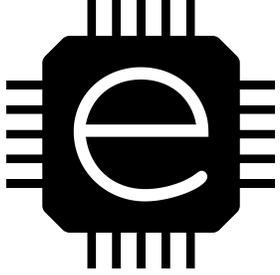


Illustration 11



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Transistors

Find the 9 NPN transistors. Look at the flat and curved side, that lines up with the silk screen on the PCB. The orientation of the transistors is important. The illustration 16 shows the correct placement.

To insert the transistor, simply line up the pins and push it in until it is snug. You will have to bend the middle pin back a little to get it to line up with the holes. Flip the PCB over, solder it, and cut off the extra wire.

Do this for all nine.

DC Power Jack

Solder the DC power jack into the space labeled 5VDC. Make sure to fill in the three holes entirely to make a good solid connection.

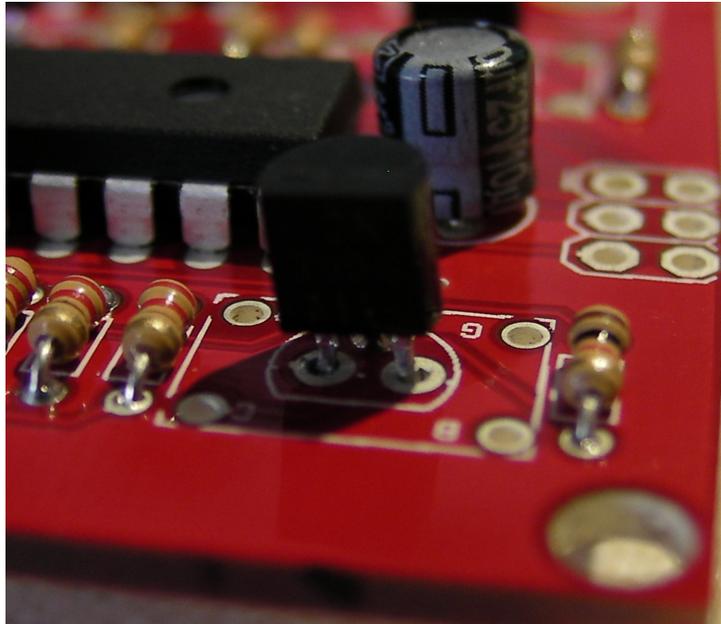


Illustration 12

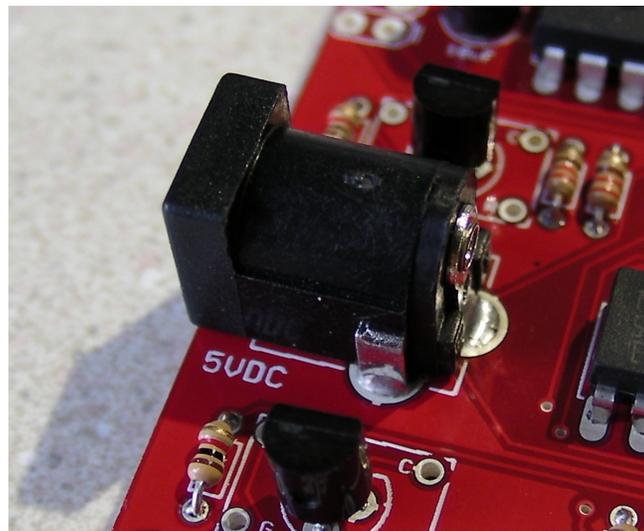
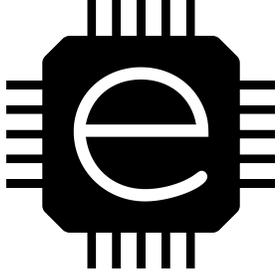


Illustration 13



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Headers (optional)

This section is optional and is not needed to make the cube work correctly. The headers do not come in the kit and must be ordered separately. It is only if you would like to have access to the ISP pin of the Atmega328 to re-program it, or to access the serial port features and boot-loader.

The ISP header is the 2x3 header. The best way to solder this is to solder one pin, get the alignment perfect, then solder the rest. This header allows you to program the Atmega328 with an AVRISP mkII or compatible programmer.

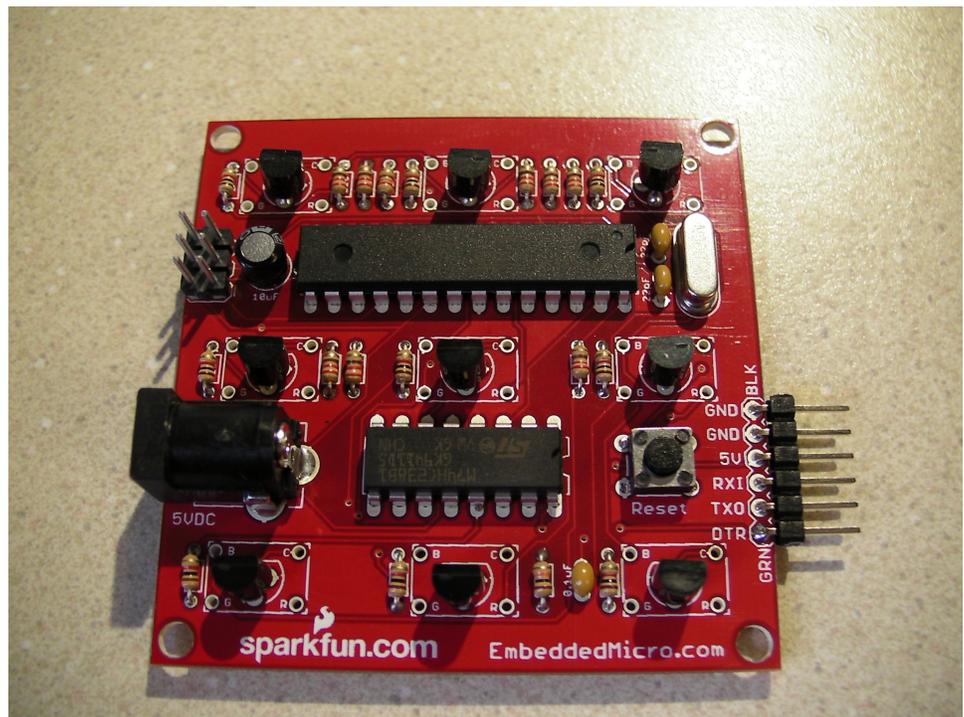
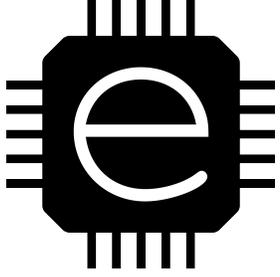


Illustration 14

The serial port header is the 1x6 header. This goes into the 6 holes on the right hand side of the board. This allows you to connect to the cube over serial and control it as well as program it with the boot-loader.

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



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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 and grab it like illustration 15. Notice the little flat spots about $\frac{1}{4}$ " away from the LED, grab it so about $\frac{1}{2}$ 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.

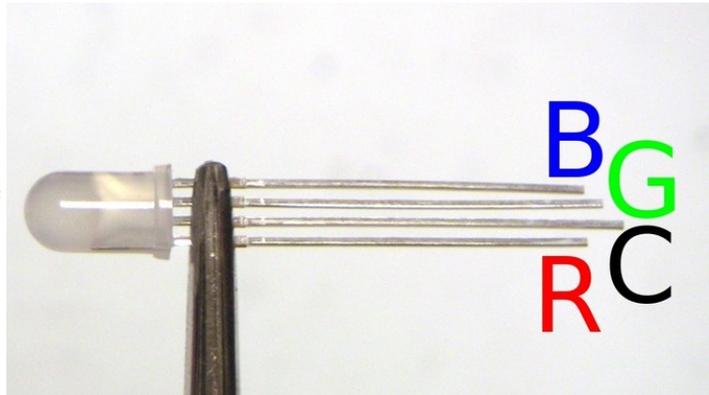


Illustration 15

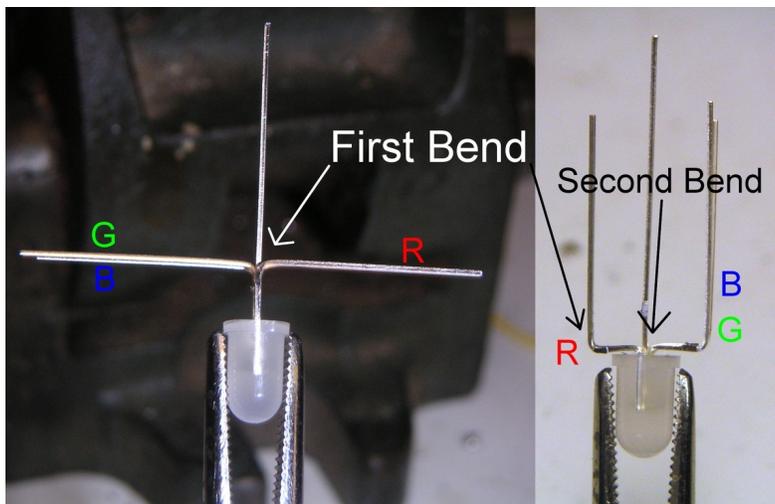
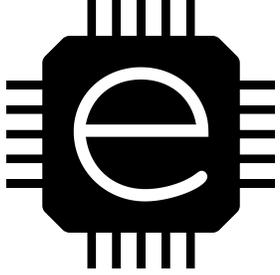


Illustration 16

Use your fingers to bend it like the left picture in illustration 16. 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 16.



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



Illustration 17

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

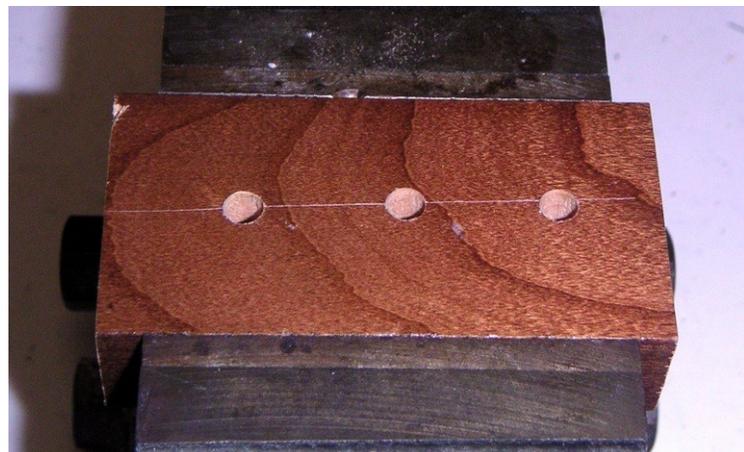
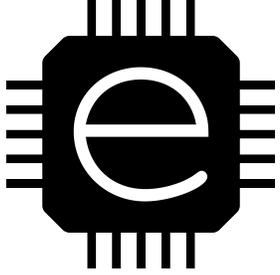


Illustration 18

It is also possible to use the box the kit comes in by using a knife to cut three X's into the top and pushing the LEDs into them.



Illustration 19



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

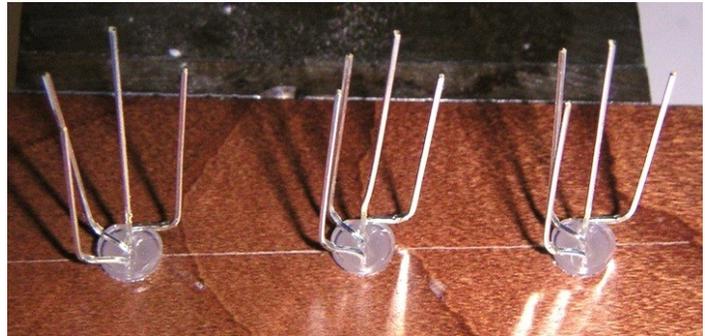


Illustration 20

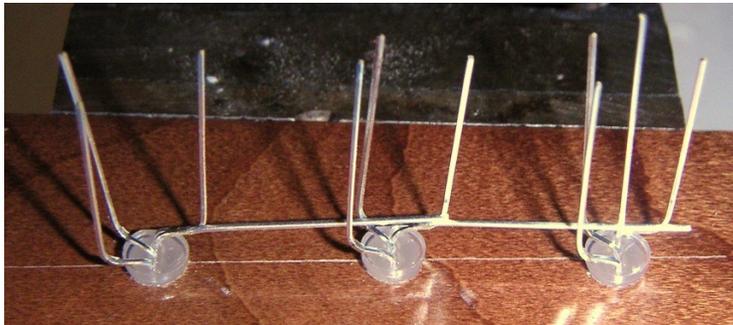


Illustration 21

Cut off the extra wire on the last pin so it looks like illustration 22.

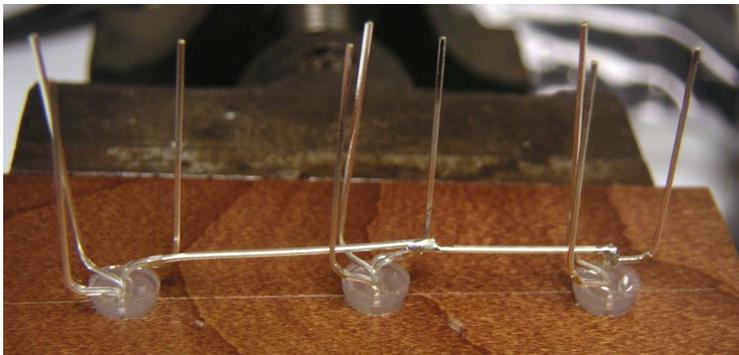


Illustration 23

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

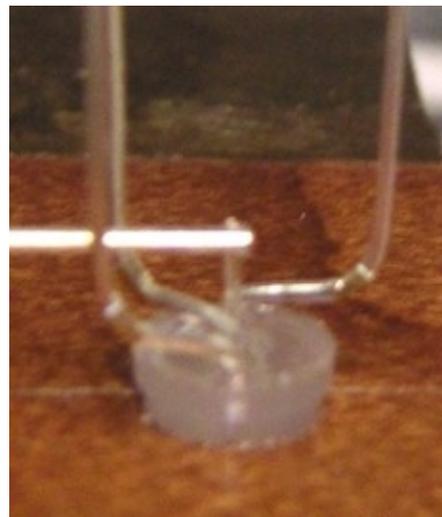


Illustration 22

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 24. The common pin is the bottom right pin.

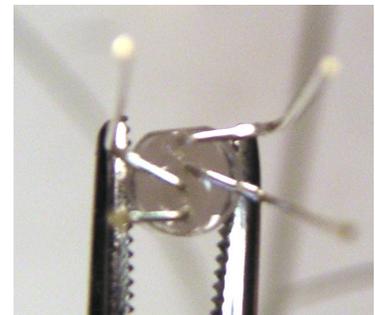
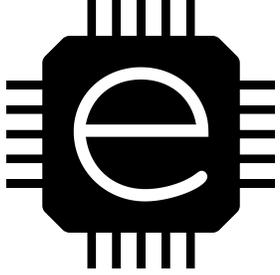


Illustration 24



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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 25. Trim the extra wire off and solder it together. Do this two more times so there are 3 of these rows.

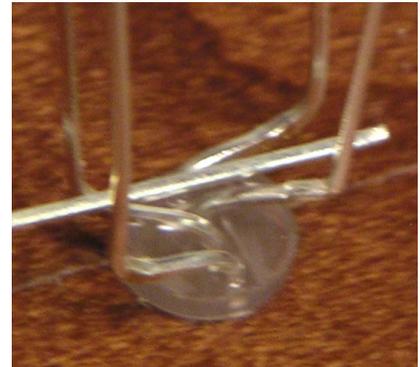


Illustration 25

Assemble the Sheets

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

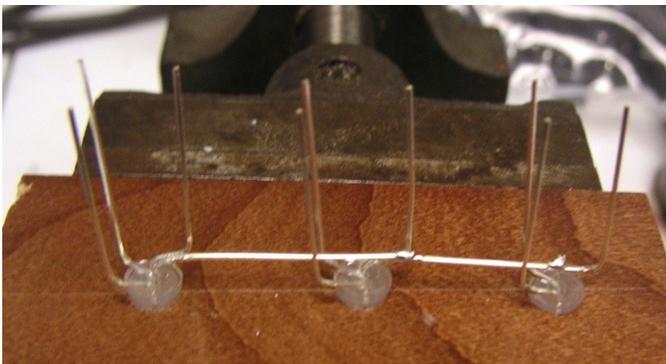


Illustration 26

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

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

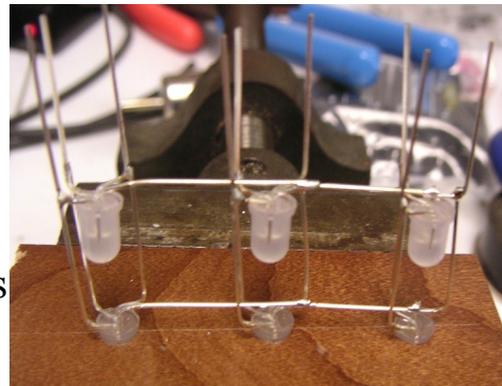


Illustration 27

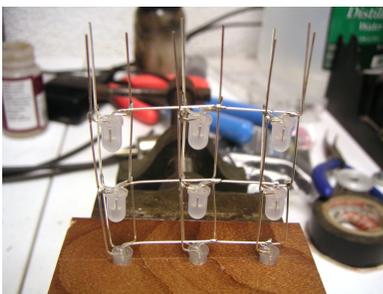
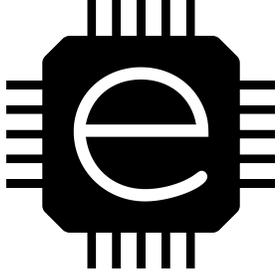


Illustration 28

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 on the side with the logos. The orientation is important here. The middle and right columns should not have a pin going into the hole labeled C.

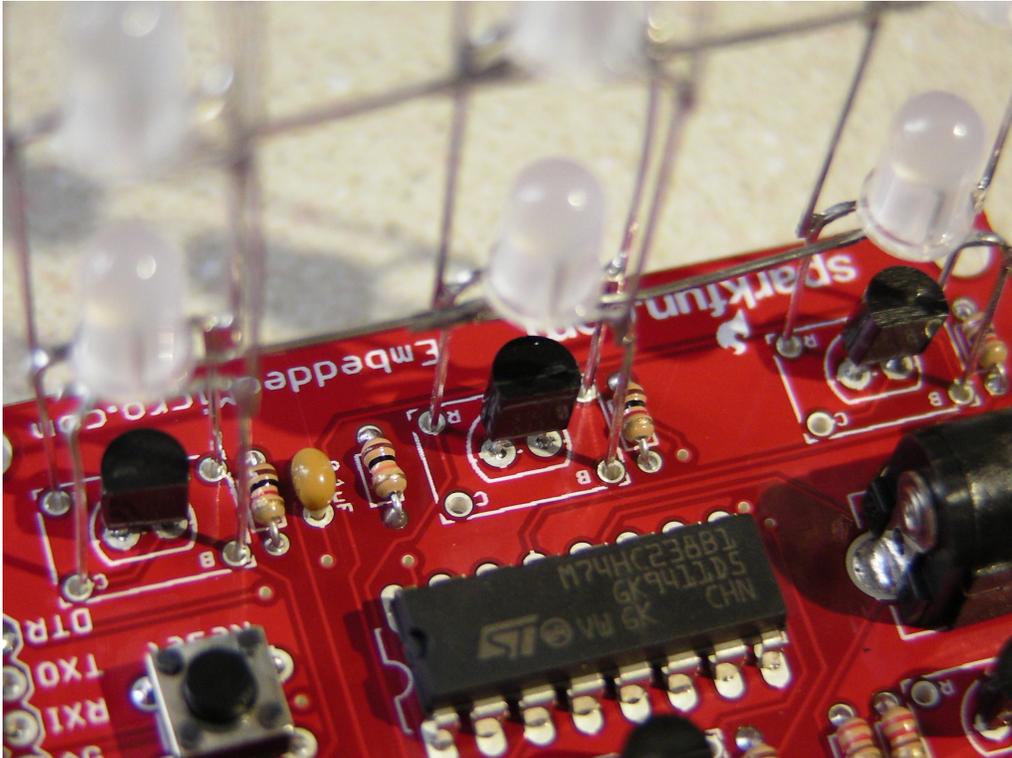


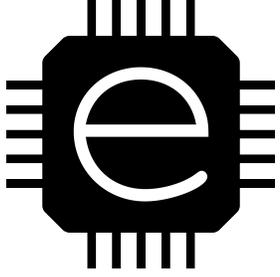
Illustration 29

Get the sheet as perpendicular to 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 wire is used. Cut a piece 3-3.5" long and bent one end to a right angle as shown in illustration 30.



Illustration 30



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Solder the bent part of the wire to the top cross bar. Solder the other end into the the PCB.

Do the same thing with the middle cross bar, except it will need a wire 2.5-3" long.

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

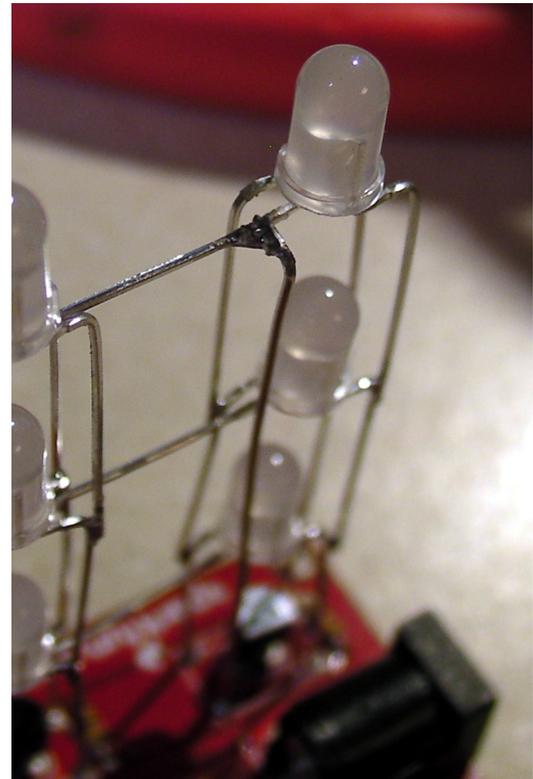


Illustration 31

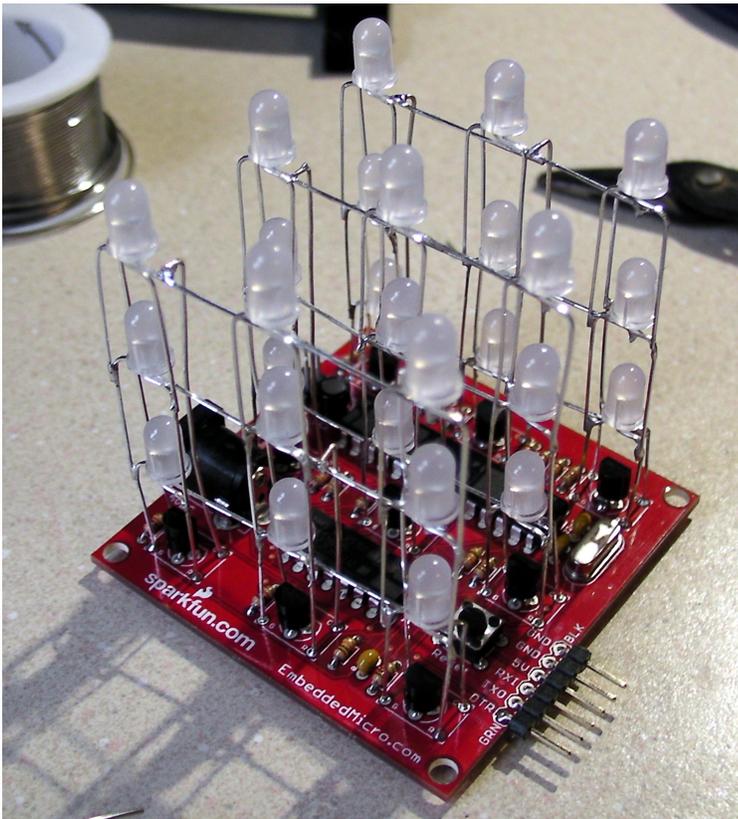
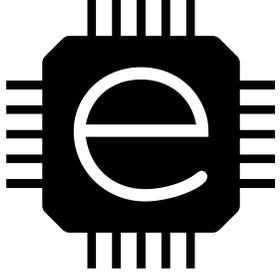
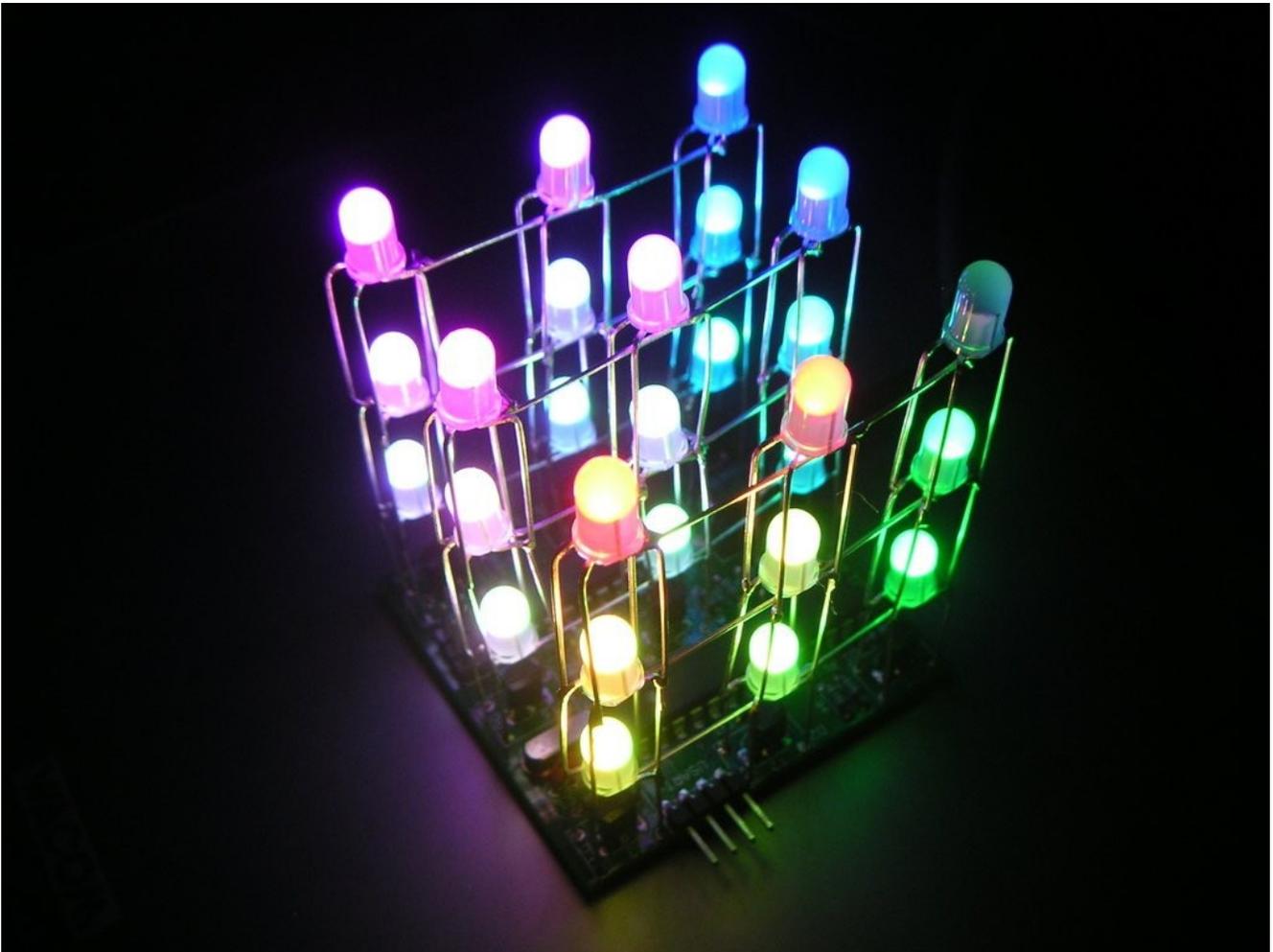


Illustration 32



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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 the power from a USB port.



When it is powered it should show the test pattern above for $\frac{1}{2}$ a second before it starts the animations. One top corner should not be lit. The opposite corner should be full white.