BLUESAT Dice Kit

Please ensure your soldering kit includes all the listed components. Do not start soldering until indicated by the lab demonstrators and carefully listen to all their instructions and advice.

Please read the safety information below and the useful placement and soldering tips.

Safety Information:

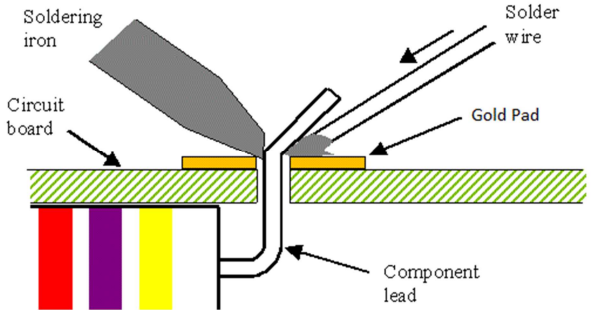
- ✓ **Always wash hands after soldering.**
- ✓ **Take care while using the soldering iron, do not touch the tip – it is extremely hot.**
- ✓ **Always wear your safety glasses while working.**
- ✓ **Aim wires towards the table while cutting them – they can fly off.**

Components List:

1x Printed Circuit Board (PCB)
1x 74HC4017 Decade Counter 16-pin Dual Inline Package (DIP)
1x NE555 Timer 8-pin Dual Inline Package (DIP)
2x BC557 PNP Bipolar Junction Transistor (BJT)
3x BC547 NPN Bipolar Junction Transistor (BJT)
1x 22nF Ceramic Capacitor (labelled 223; yellow)
1x 470nF Ceramic Capacitor (labelled 474; blue)
1x 1kΩ Resistor
7x 10kΩ Resistor
1x 330kΩ Resistor
2x 4.7MΩ Resistor
7x Light Emitting Diode (LED)
1x CR2032 Lithium 3.0V Battery
1x 20mm Surface Mount Battery Clip

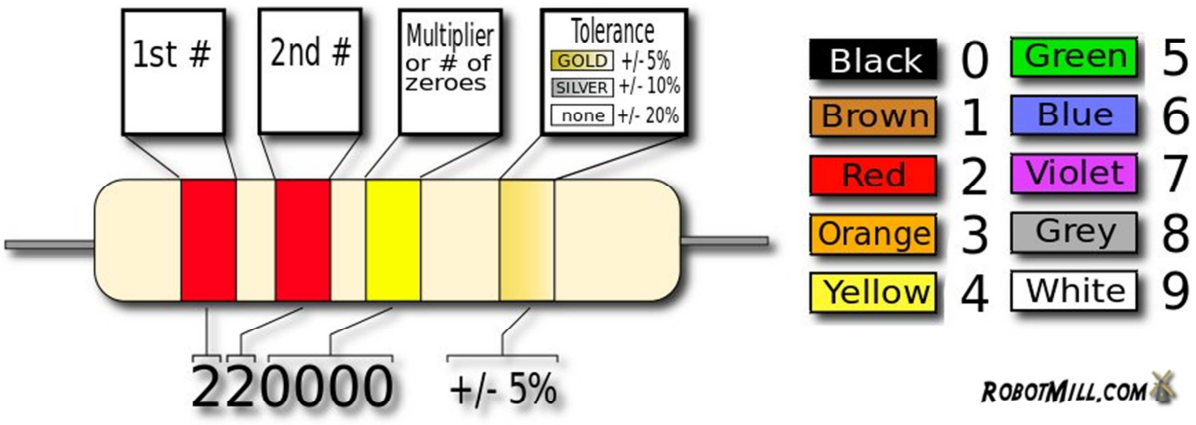
Through-hole Soldering Tips:

- ✓ Do not apply solder directly onto the tip of the iron. Instead, touch the tip of the iron to both the component lead and the pad (the shiny gold plate). Hold for a couple of seconds to heat the pad and then apply solder to the opposite side of the iron.
- ✓ Start with the battery clip – It is the most difficult part to solder and is easier to do so at the start.
- ✓ Place the smallest components first, this will make it easier to solder - a good order would be resistors first, followed by the IC's and the remainder in any order.

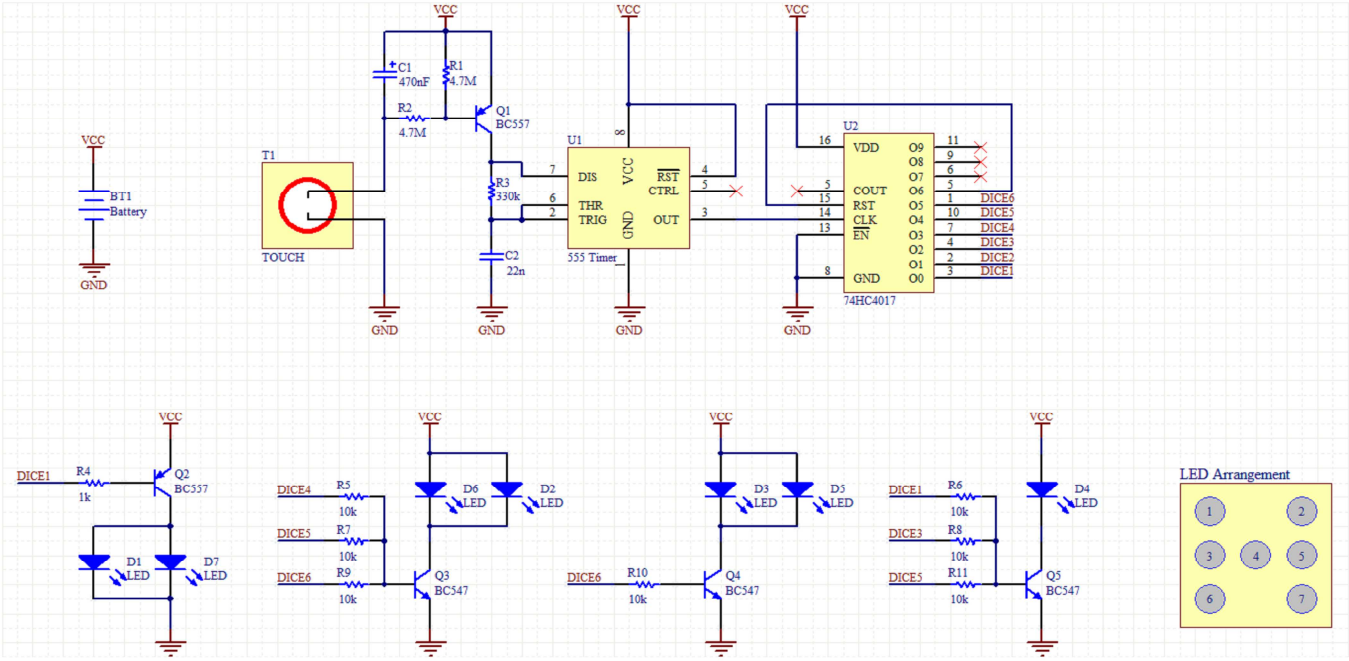


Placement Tips:

- ✓ Component orientation must be correct:
  - o Integrated Circuit orientation is indicated by a notch on one end.
  - o Bipolar Junction Transistor and Light Emitting Diode orientation is indicated by a flat edge.
  - o Resistors and Ceramic Capacitors can be placed in either direction.
- ✓ Do not confuse the BC557 PNP transistors and the BC547 NPN transistors; they are not the same.
- ✓ Take care reading the resistor colour chart. Ask if you are confused, this is where the most mistakes are made!
- ✓ Do not insert the battery until you are finished soldering.



Circuit Diagram



How Does it Work?

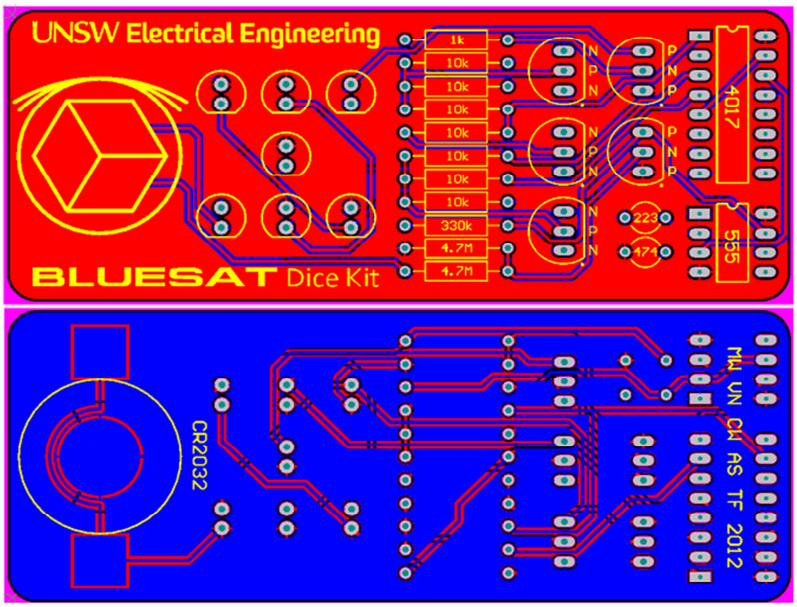
When you touch the BLUESat logo, your finger completes a circuit connecting a power source to a capacitor (the blue one). Capacitors are components which store charge. As this capacitor charges, current flows into the 555 timer (the smaller IC).

This flowing current then causes the output of the 555 to alternate between “high” and “low” voltages at a certain rate; the rate depends on the voltage in the capacitor (ask why).

Next, the decade counter (the larger IC) uses this alternating voltage (we call it a waveform) to cycle through the six dice values. For each dice value, one output pin of the counter is set to a high voltage. This turns on the lights to display that face of the die.

Finally, when you remove your finger from the logo, the capacitor is no longer connected to the battery, and begins to discharge. Hence the voltage across the capacitor drop and so the waveform’s frequency also decreases. Eventually the die stops rolling completely, settling on its final value.

Remember, if you have any questions never hesitate to ask for more details.



Printed Circuit Board

To make this dice circuit we used a CAD (computer aided design) package called Altium to draw the circuit schematic and produce a design. The design was made by PCBCart in China.

The top and bottom layers of the design are displayed on the red and blue pictures to the left.

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