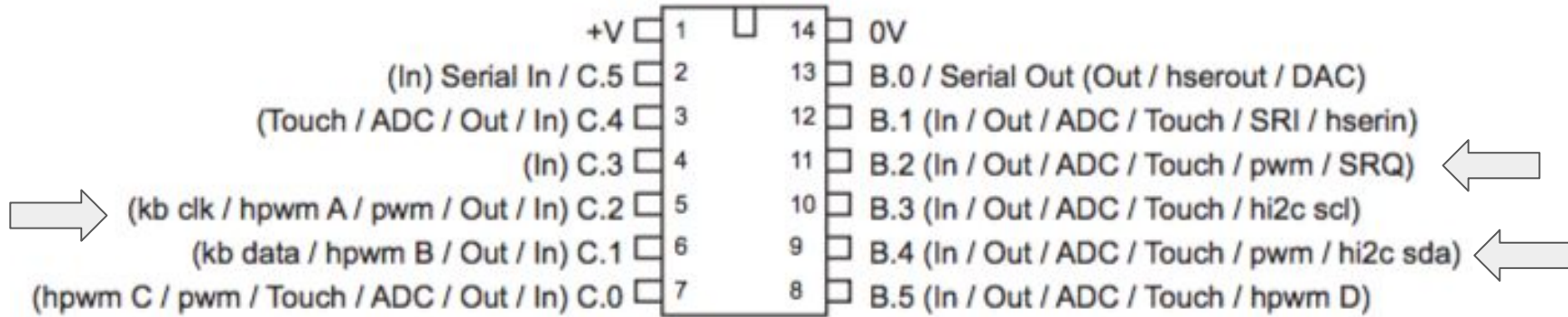


# Mood Light with Pulse Width Modulation (PWM)

This guide shows how to complete the assembly of the mood light and circuit board. The mood light has six led's (green, red and blue) that pulse their light outputs, using a microcontroller to programme and control the led's.

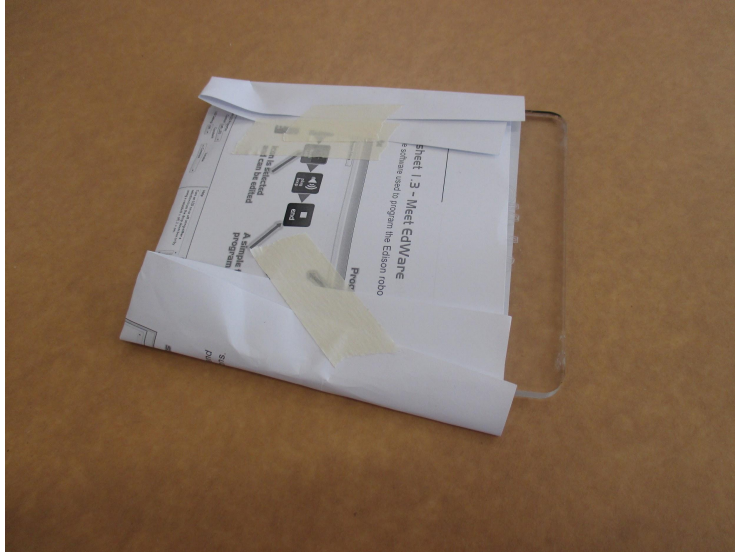
You must use equal numbers of each colour led's - i.e, 2 x green, 2 x blue, 2 x red

## PICAXE-14M2

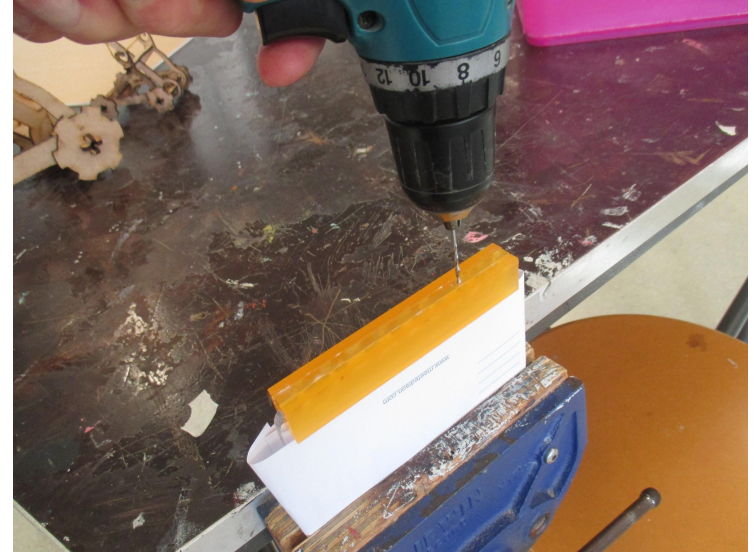


The picaxe 14M2 microcontroller. The three output pins used are c.2. b.4 and b.2

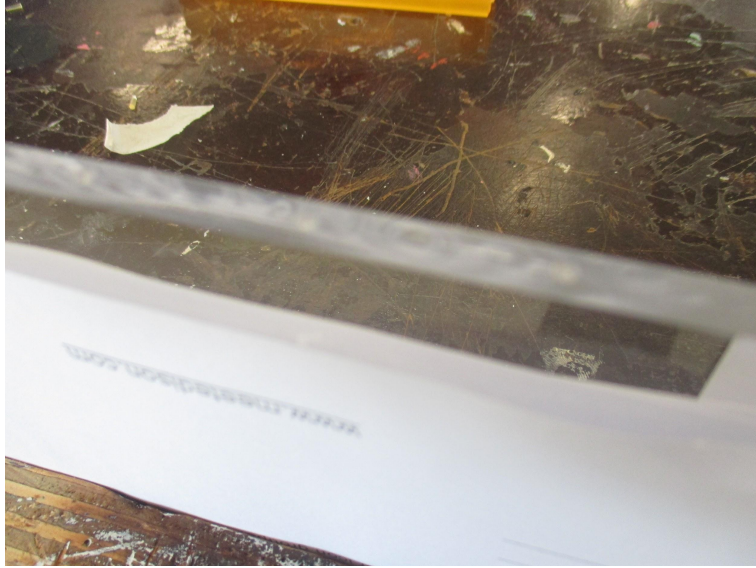
You can see the pwm alongside each of the pins being used. PWM stands for pulse width modulation which means very small 'pulses' of power can be sent out of these pins and an led or motor connected to these pins can have its light output or speed controlled. This pwm process is widely used to control modern appliances so it's important to experience how it can be used in coding and controlling components. The led's in the mood light will be controlled using PWM



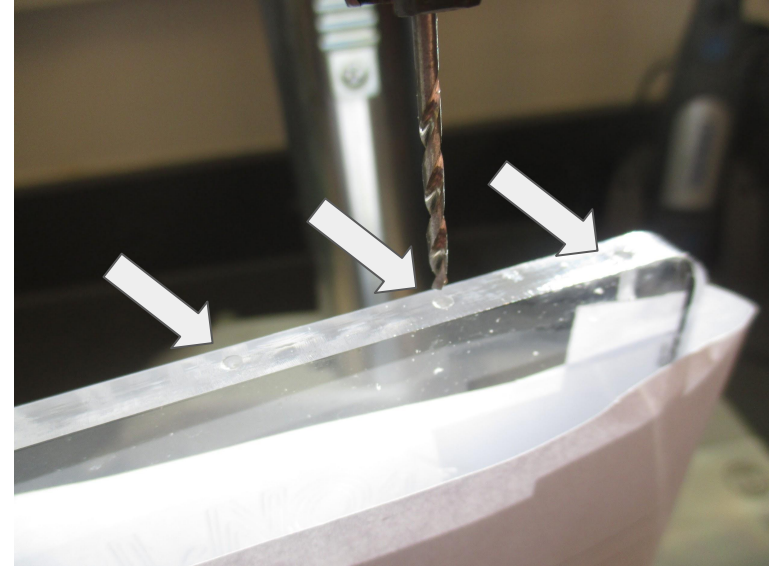
After the moodlight has been laser cut and engraved wrap the piece of acrylic in a sheet of paper folded to fit the size, this will prevent scratches and marks on the surfaces during the assembly process.



Secure the acrylic using a vice to hold it firmly. Place a hole drilling jig on the bottom edge of the acrylic, this will be used to mark the six equally spaced 5mm holes which will hold the led's, a piece of tape can be used to hold the jig in the centre. Place the jig in the centre of the width of the bottom face Use a 2mm drill to mark the six hole positions, the 2mm drill is only used to mark the holes so that a 5mm drill can be used for the final size so do not drill deeper than 1mm into the acrylic.



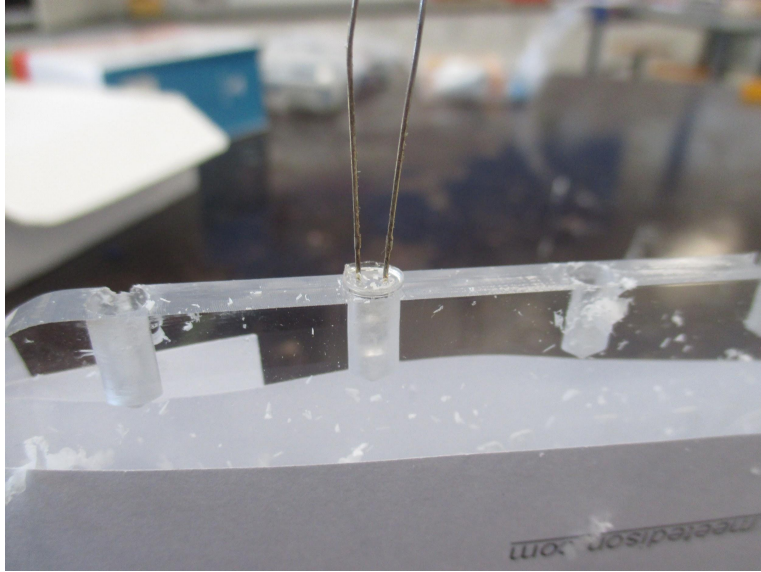
This photo shows the edge with the holes marked by the 2mm drill (the photo does not show the marks clearly as they are quite small)



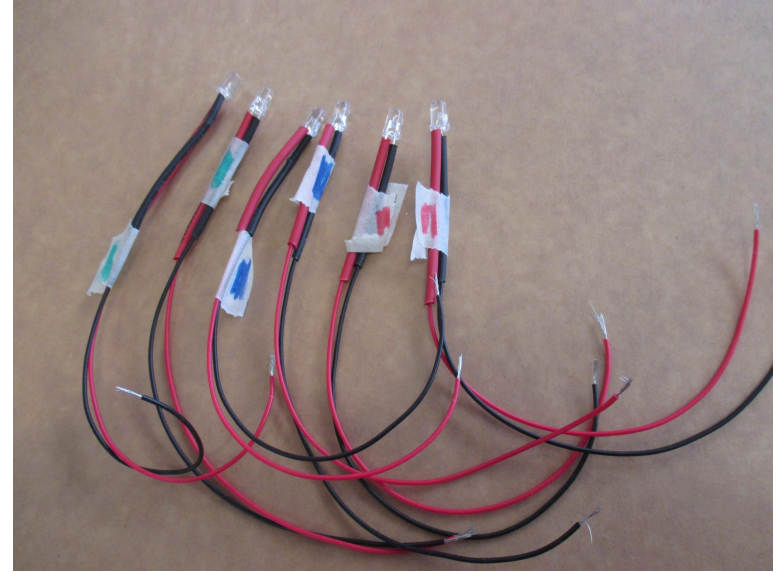
Secure a 2mm drill bit into the machine drill. Hold the acrylic firmly in the machine vice, the edge should be horizontal and level

The 2mm drill can be used to mark the hole positions a little deeper so that the 5mm drill has a clear place to begin drilling. The arrows point to three of the small drill marks.





The 5mm holes should be drilled just deep enough so that an led fits flush with the edge of the acrylic, the machine drill can be set so that it drills to a specific depth. The rotational speed of the drill should be set to 700 revs per minute. Adjust the speed control dial until the display shows 700 rpm.

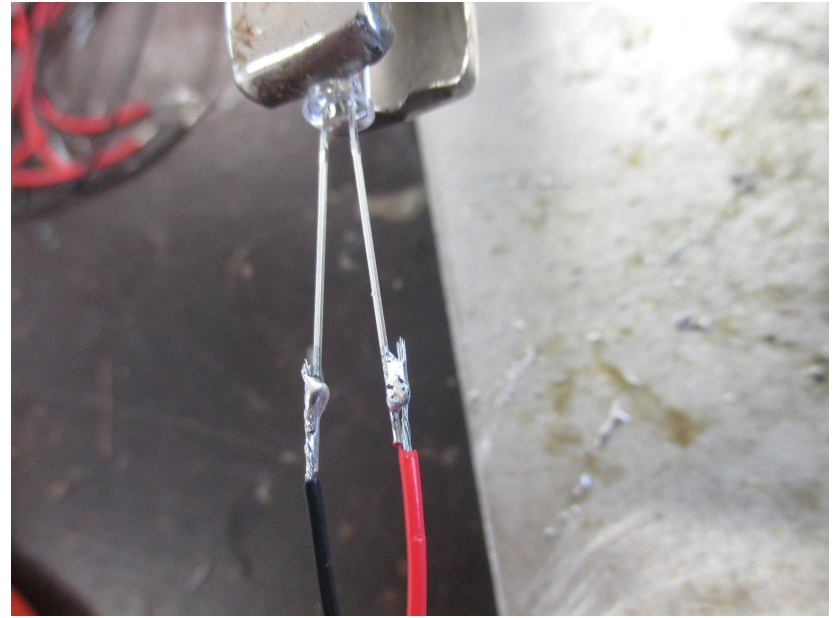


Make six led's (2 x green 2 x red and 2 x blue) the wire must be stranded/flexible type

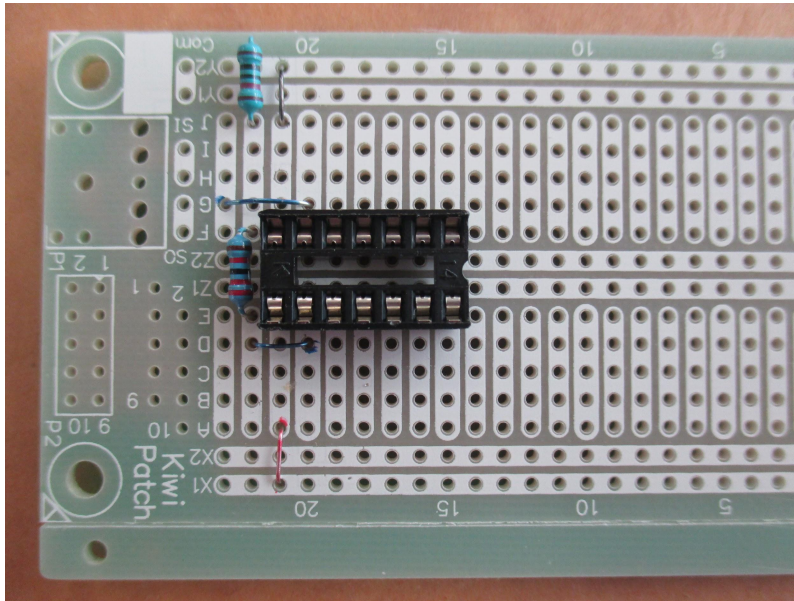
- Cut to 150mm long, strip 10mm of insulation from each end, solder to the led's
- Add shrink tube then test each led before marking the colour on each one.



Add a spot of solder to the end of each led lead



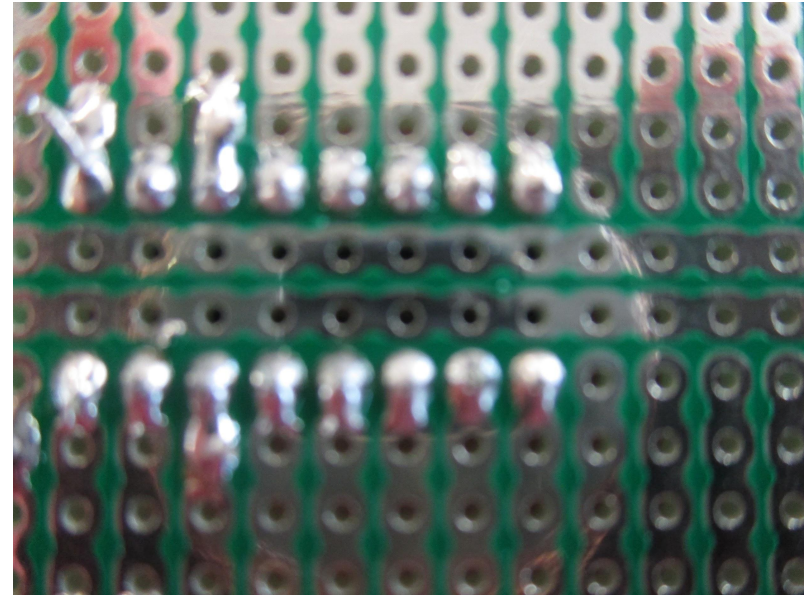
Solder each wire to the led leads, there is no need to add solder, just hold the 10mm end of the wire parallel with the lead running the tip of the iron slowly along the joint.



Insert the 14 pin insert, 22k resistor above the insert and the 10K resistor in the same row to -ve. The other wire connectors are:

- Pin1 to +ve
- Pin 14 to -ve
- Pin 2 to the 22K resistor
- Pin 13 to the row above the resistors

Look at the example circuit if you need clarification

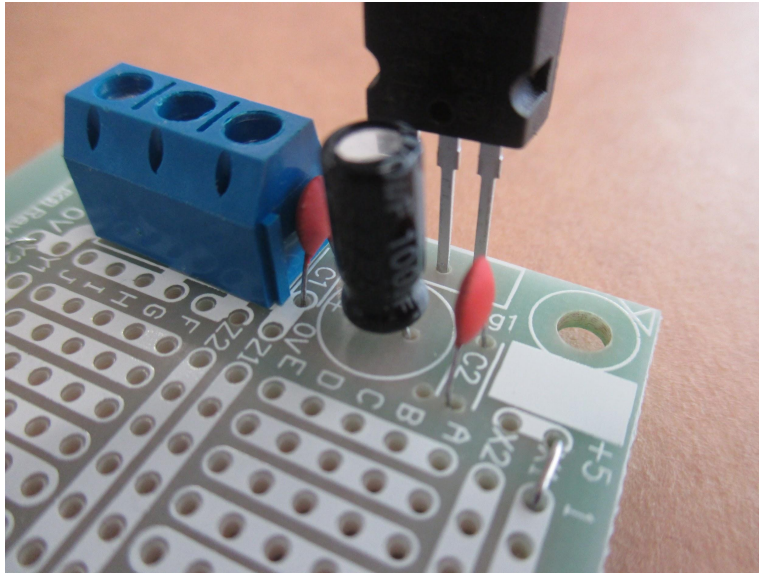


Solder joints must be absolutely perfect, the solder completely around the lead, smooth and shiny, no cross connections

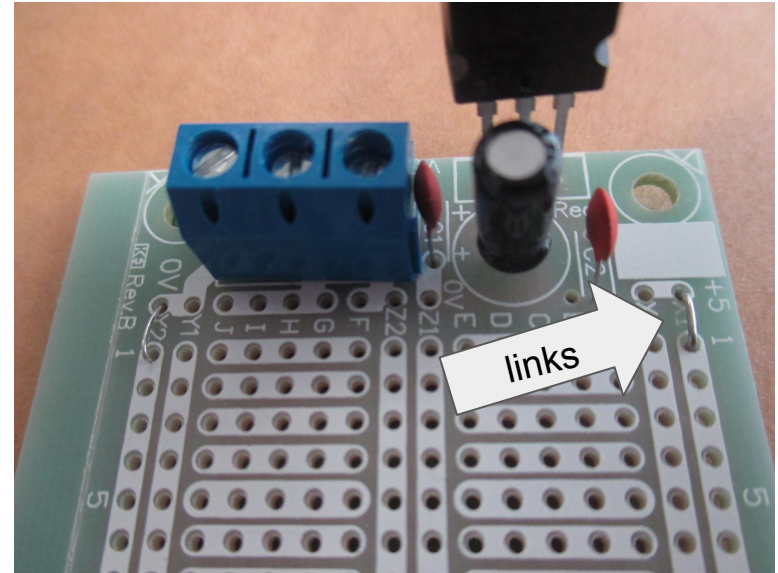
- Apply the tip to the joint
- Count to to four
- Apply solder to the very point of the tip
- NEVER apply solder to the tip before connecting to the joint

**NO SECOND CHANCES!**

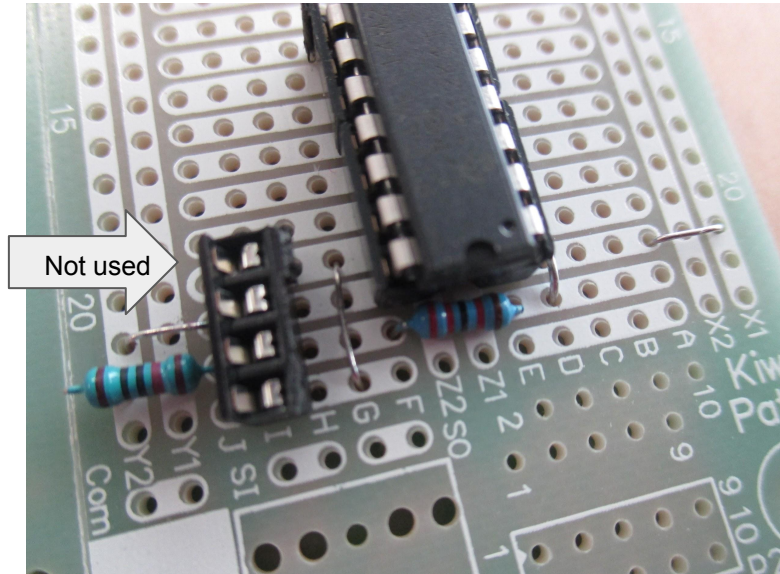




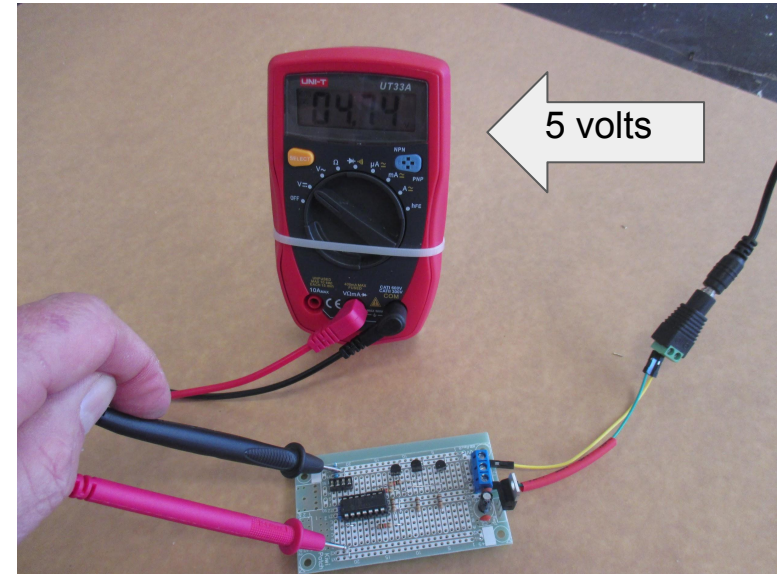
The power supply of the circuit board.  
 The blue connector block is the incoming 12 volt connection  
 The capacitor is a 100uf electrolytic type, the board shows the +ve lead on the left and -ve on the right so it MUST be placed correctly  
 The two small ceramic capacitors each side are not polarised and can go any way round  
 The large black component with 3 leads is the voltage regulator, it takes the incoming 12 volts and reduces it to 5V, note its orientation, with the flat side towards the edge!



The voltage regulator leads are pushed through the circuit board only 1 - 2 mm for soldering.  
 There are two small wire links, one each side that connect the circuit board +ve and -ve rails to the power supply, note where they are positioned, they can be made from surplus resistor leads.

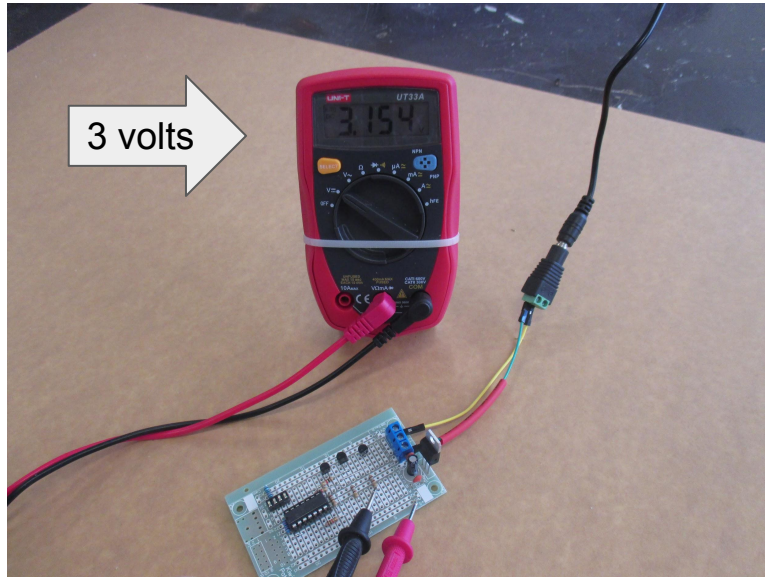


This view shows the picaxe 14M2 with its download connections and also its +ve and -ve connections to the outer rails on the circuit board, check by looking at the example circuit board to make sure you get all the links in the correct places. Only the top three holes nearest the top on the download insert are used.

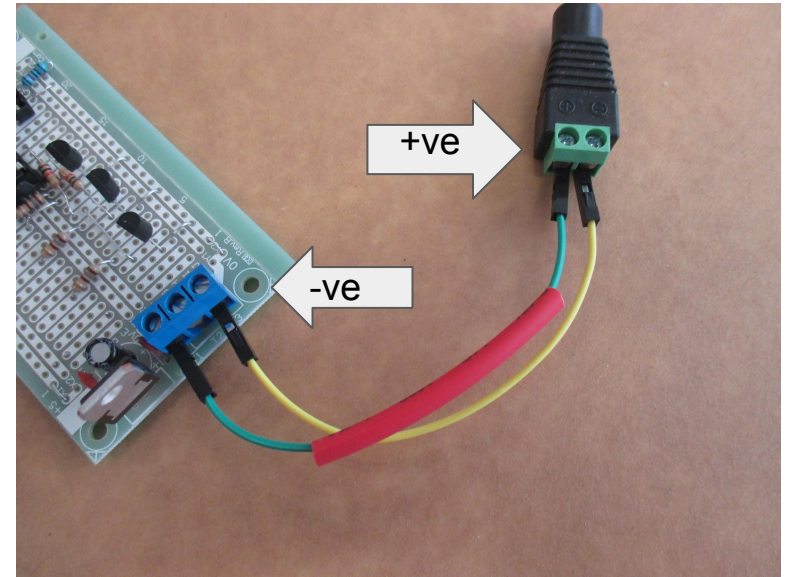


When the power supply and picaxe have been soldered you MUST check that you have the correct voltage supplied to the circuit board. Connect the power supply socket to two hook-up wires, these hook-up wires are multi coloured so use a piece of red shrink tube to identify the +ve wire, plug in the 230 volt power supply and connect to the socket. Use a multimeter set to measure DC voltage. Across the +ve and -ve rails you should see very close to 5 volts



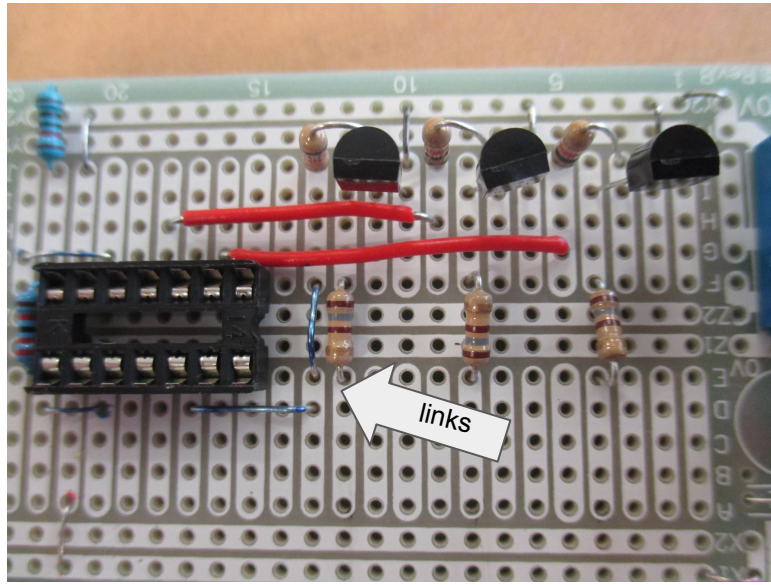


Next, check the voltage between the 3 x 180 ohm resistors which are connected to the transistor collector leads. Place the -ve lead on the resistor lead and the +ve lead on the connector wire that connects the power supply to the +ve rail, the multimeter should show around 3 volts, which is the correct voltage that the two led's need to run

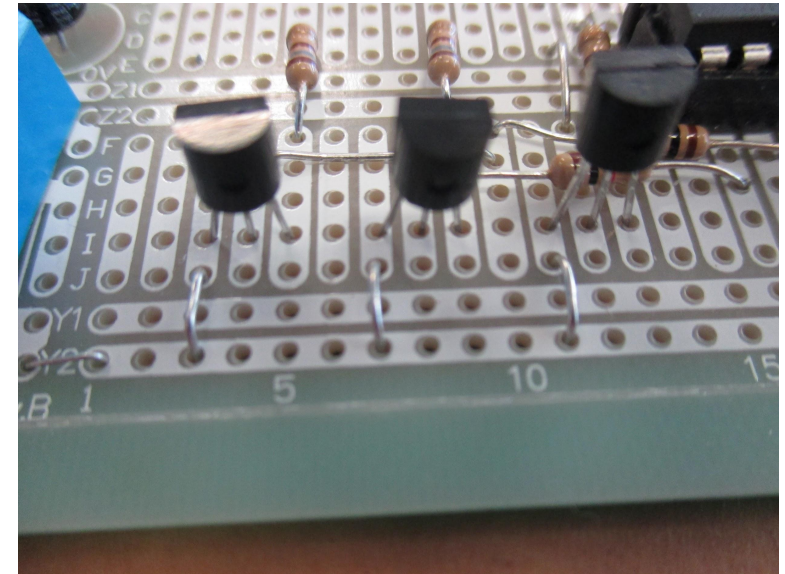


This photo shows the completed circuit board with the 12 volt power supply socket. The positive wire has the piece of red shrink tube to identify it as the hook-up wires are multi coloured.

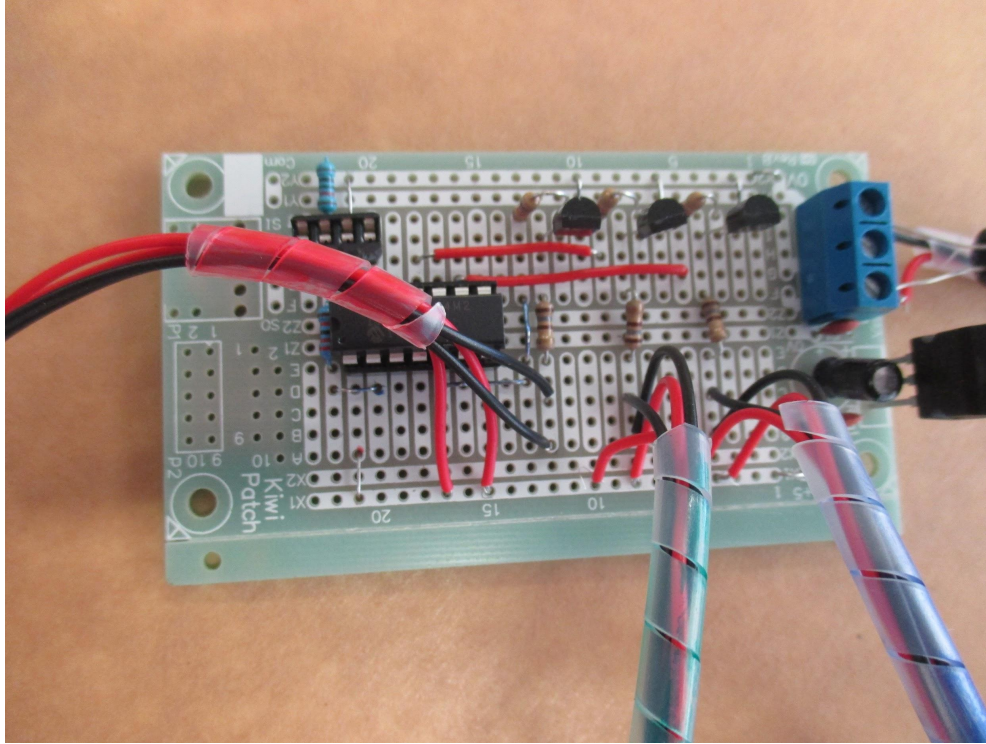
If the wires are connected with the positive and negative leads the wrong way then the picaxe and transistors may be destroyed and the circuit board ruined, so take great care to check the connections!



This photo shows the 3 x transistors  
 The picaxe pins used are c.2, b.2 and b.4  
 1 K resistors are connected between the picaxe output pins  
 and the transistor base leads  
 180 ohm resistors are connected to the transistor base  
 leads, across the centre of the board  
 Wire links connect pin c.2 with transistor 1 nearest the  
 14M2  
 The red wires connect pins b.2/ b.4 to transistors 2 and 3



This photo shows the transistors. Each transistor has a  
 connector link between its emitter lead and the negative rail.  
 The link wire at the bottom left of the photo is connecting  
 the negative rail to the negative of the power supply block  
 (blue)

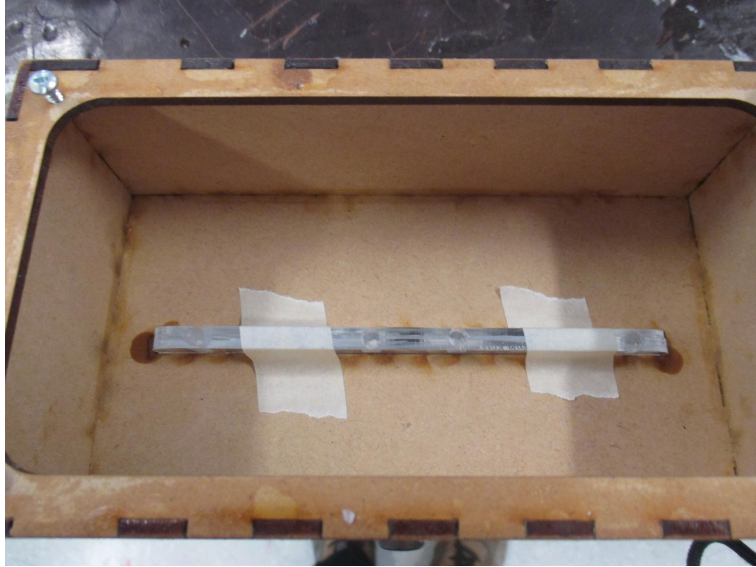


The completed circuit board with the 6 led's inserted. The led's must be in pairs, red, green and blue, the photo shows the colours marked on the coils around each pair of led's

The negative leads connect to the 180 ohm resistors which you can see in the centre of the board

The positive led wires all connect to the positive rail along the side of the board





Assembling the acrylic moodlight to the case.

The case for the moodlight is made by the laser cutter and assembled using PVA glue

Place the acrylic plate in the vice

Insert the case slot over the acrylic, the 5mm led holes must be fully inside the case, pieces of tape can be used to locate the position, make sure the plate is level inside the case

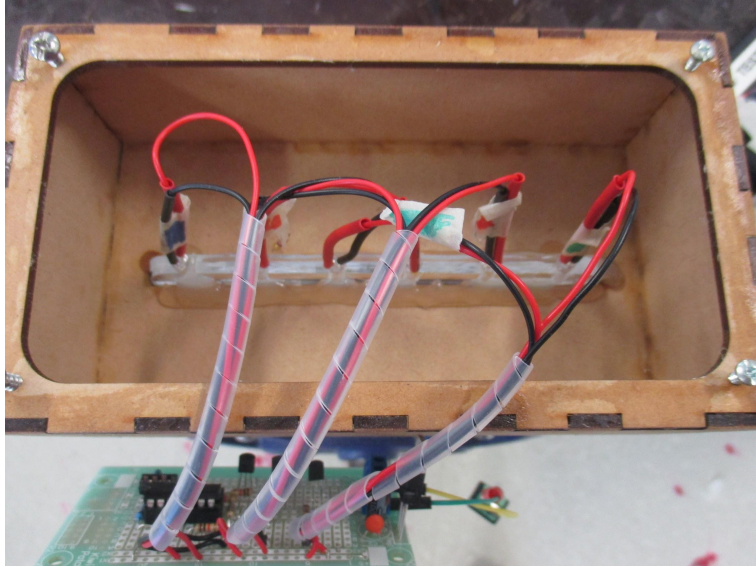
On each end of the acrylic plate place a blob of hot melt glue to locate the plate in place before fully gluing



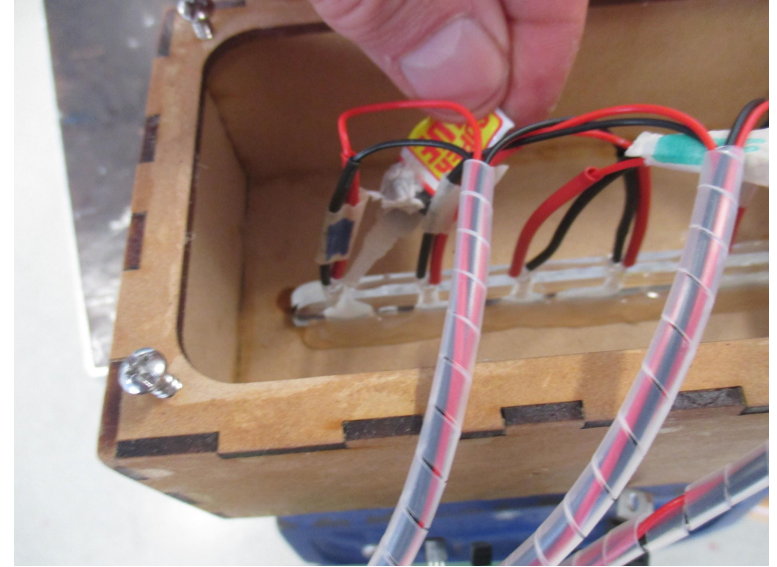
When the position of the plate has been checked, fully glue the plate by running hot glue along each side of the plate to the case.

Allow 10 minutes for the glue gun to fully heat up and 5 minutes for the glue to set before moving.

Do not get glue on the edge where the led's will be inserted, make a neat job of the gluing by running an even bead of glue along both sides of the plate

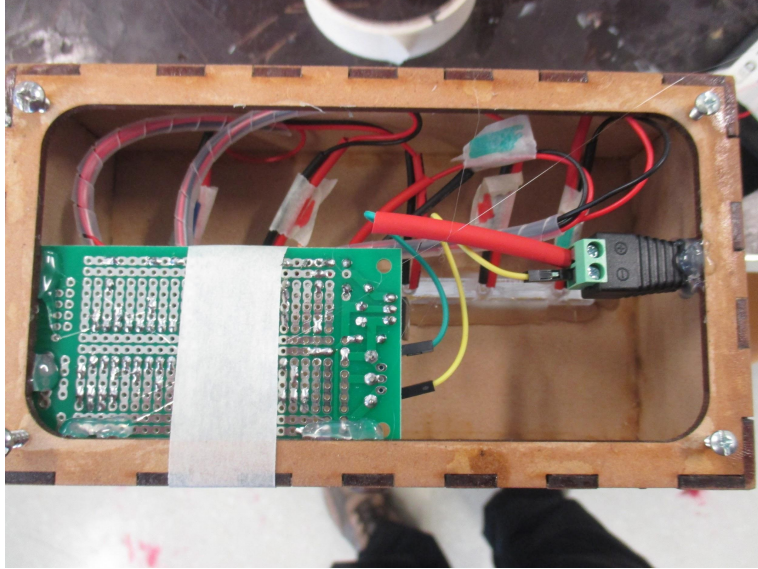


The led's are inserted into the edge of the acrylic plate in the order of green, red, blue, green, red, blue. The led's must be fully pushed into the holes

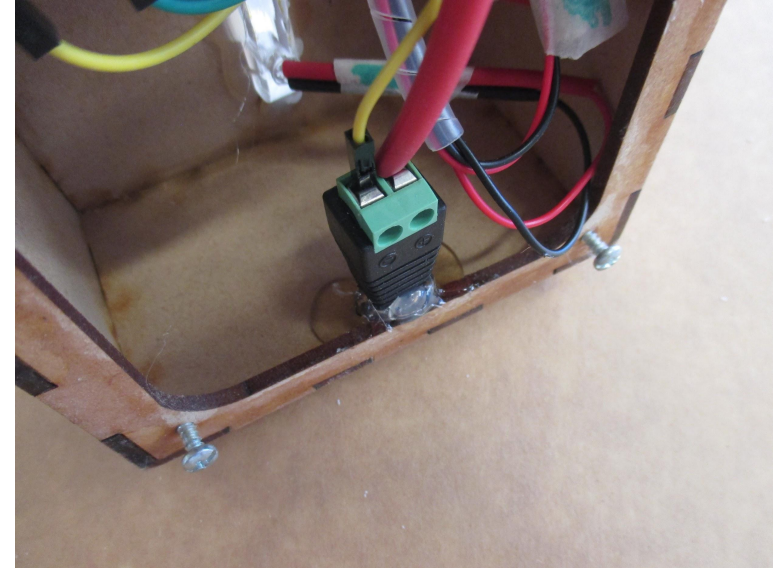


Add a drop of super glue to the top of each led where it meets the acrylic and let it set for 5 minutes. Be very careful when using super glue, it will instantly glue skin together and should not come into contact with skin, eyes and clothes. If it contacts your skin then Acetone is the only chemical that will melt it, your teacher will deal with this.





This photo shows the circuit board and the 12 volt power socket inserted into the case.  
After the led's have been glued into the acrylic, carefully bend the leads towards the inside edge of the case.  
Place the circuit board inside the case as shown  
Add small blobs of hot glue at the outer edges and in the corner, tape should be used to hold it in place until the glue hardens



After drilling an 8mm hole in the case side, glue in place the 12 volt power socket. A small blob is used on the edge of the case to hold it in place then check the position is OK before adding glue inside the case each side of the socket.

