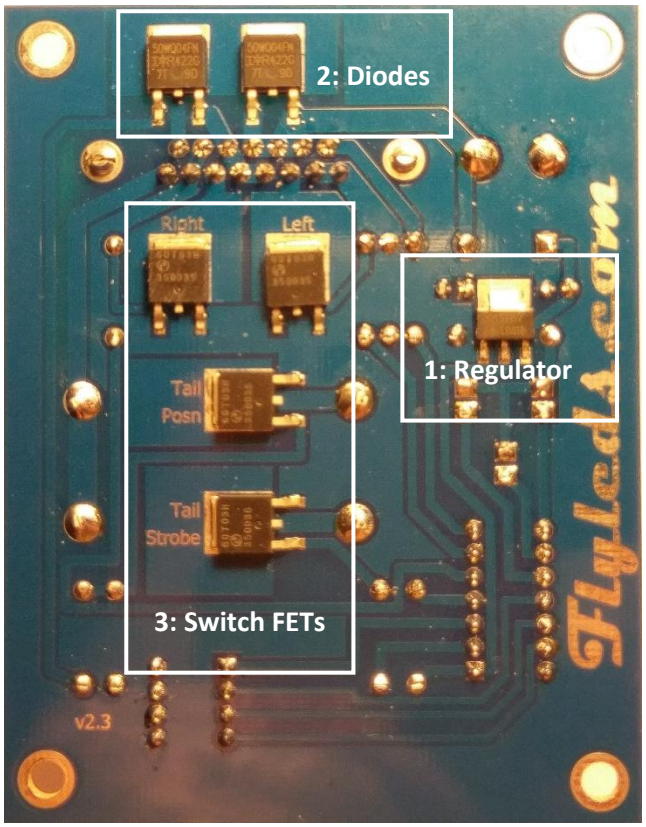
Part 2: Building the Controller Board

Congratulations for making it this far! The controller board uses smaller components than the wing boards, which means that everything is actually easier to solder.

Surface mount components

We supply the controller board with the surface mount components already reflow soldered onto the PCB. For your reference the components are:

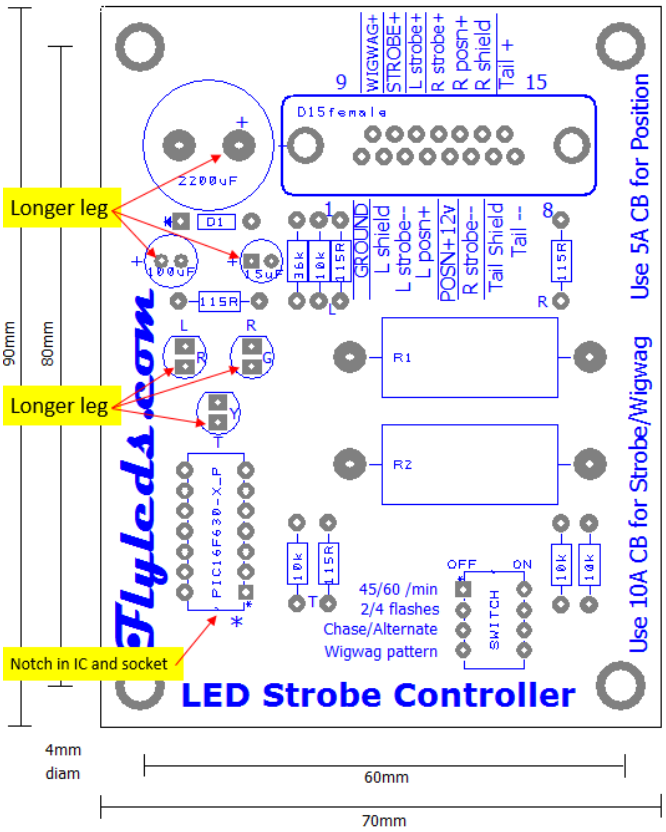


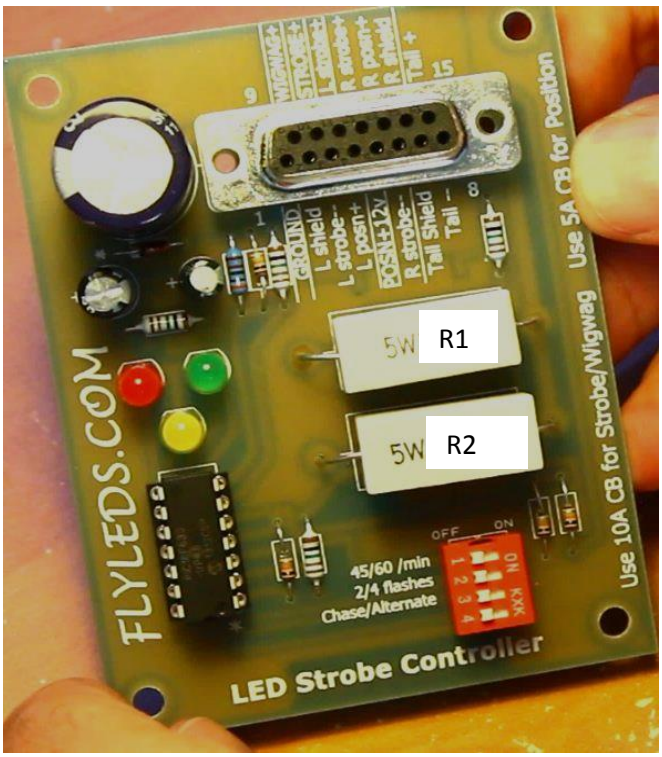
1: AMS1117 5 volt regulator. Converts the incoming 14 volt supply down to 5 volts for the microcontroller.

2: Two **50WQ04FN** diodes. These are part of the circuit that allows the tail LED to act as a strobe and a position light.

3: Four **60T03H** N-channel power MOSFETs. These little miracles will switch 45 amps of current all day long, and have an "on" resistance of only 0.02 ohms. In this circuit, they only switch ~5-6 amps for the strobe flash duration, so they generate very little heat. In years gone by, this control circuit would have required large switching transistors that came in steel bodies, all mounted on a large and heavy heatsink.

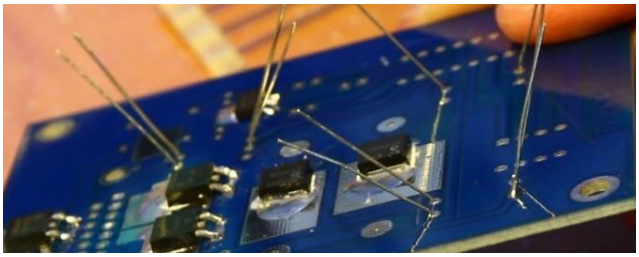
Component side





With circuit board construction, it is easier to start off with the smaller components, and work your way up in size.

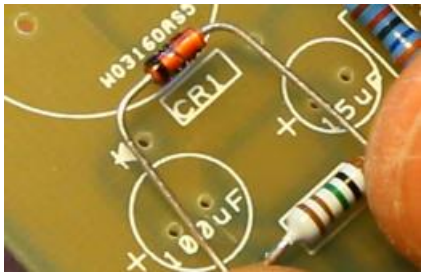
1: Resistors



- Begin by inserting the 4x **10kΩ** (ohm) resistors (Brown/Black/Orange/ Gold – small, brown body).

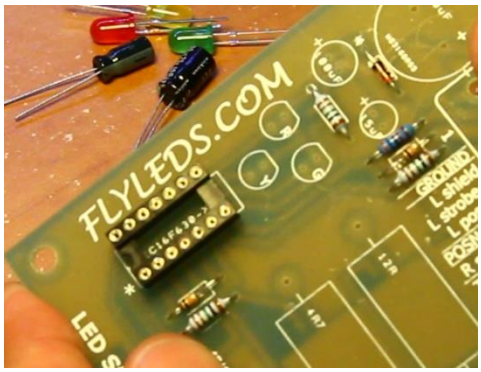
Bend their legs apart slightly as shown so that the resistor stays in place tight to the board when you solder them in.

- Next insert the 4x **115Ω** resistors (Brown/Brown/Green/Black/ Brown – light blue body)
- The last resistor to insert is the **36kΩ** resistor (Orange/Blue/Black/Red/ Brown - dark blue body)



2: Insert the **1N4148 diode**, CR1. **Note** that the diode has a **black band** around one end. This must be mounted with the black band to the left, otherwise there will be no blinking lights!

3: At this point you can solder all of these components. Let the tip of the iron touch both the circuit board and the component leg, and after a few seconds introduce some solder. A few seconds for each one and you should have a nice smooth looking joint around each leg.



4: You can now mount the **IC socket** for the microcontroller. One end of the socket has a notch taken out of it, which aligns with the asterisk (*) on the PCB. Solder one leg first, then check that the socket is still mounted flush to the board. Reheat the joint if necessary to let it sit properly.

Continue to solder the rest of the legs in place, as you would tighten up a cylinder head on a car… that way if you're still a bit slow with your soldering still, the heat build-up won't melt the plastic socket!

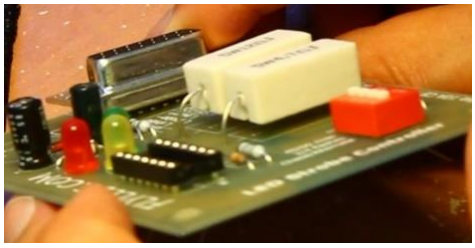
5: Mount and solder the four-way **DIP switch**, checking that it is oriented as pictured on page 1.

6: Insert the red, green and yellow **LEDs**. The *longer* leg of the LED mounts in the hole closest to the IC socket.

7: Mount the two smaller **capacitors**. 100uF on the left or outside of the board, 15uF on the right. Note the orientation as per the diagram, and the + on the silkscreen on the PCB. The *longer* leg of the capacitors is the **+** terminal. (The body printing highlights the – terminal, just to keep you on your toes!)

8: You can now fit the **15 pin D connector**. The screw holders on each end are a tight fit, but they do push in!

9: Mount the **ceramic power resistors** for the tail strobe. Leave a few millimetres of air gap under them to allow for heat dissipation. The values used depends on the kind of tail light you were supplied with:

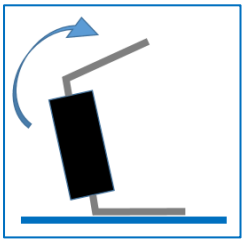


Tail LED resistors	3x LEDs (XML)	1x LED (XHP)
R1: (Position)	22 ohm	12 ohm
R2: (Strobe)	1.2 or 1.5 ohm	0.22 ohm

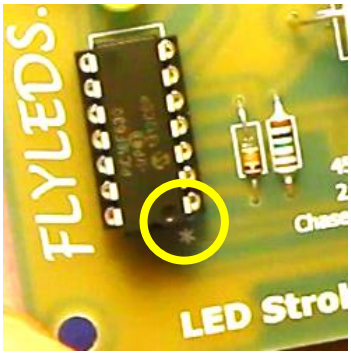
If you purchased the Stand-Alone Tail Strobe (**#15045**) with its own PCB and custom flash patterns, you can omit these resistors. Wire it directly to the strobe and power switches, and ground it locally.

10: Mount the **2200uF** capacitor, by observing the + sign on the silkscreen and inserting the longer leg of the capacitor there. Double check this one before soldering it in!

11: The **PIC16F630** microcontroller can now be inserted into the IC socket, however the legs are usually spread too wide to fit straight into the socket. Hold the body of the chip so that one side of legs is against your workbench, and gently "roll" the chip forward so that the legs are *almost* 90° to the body. Turn the chip over and make the legs on the other side parallel with the first.



You can now carefully insert the controller IC into the socket. The IC is held in by a friction fit, and does not need to be soldered to the socket.



Note the small detent and/or notch in the chip, which marks pin 1, and corresponds with the (*) on the PCB.

That's it! You're done!

The Blink Test

Using your square 9 volt battery, you can connect the battery+ to **STROBE+** (pin 10) and battery– to **GROUND** (pin 1). Configure the switches and you will see the different flash patterns in action with the on-board LEDs. Hours of fun!

To enable the WigWag mode, you need to connect *both* WIGWAG+ (pin 9) *and* STROBE+ (pin 10) to the positive + terminal of the 9v battery. Switch 4 adds an extra wiggle (what else could we call it?!) to the wigwag pattern.

You can check your board and soldering skills by setting your multimeter to the *continuity/beeper* function.

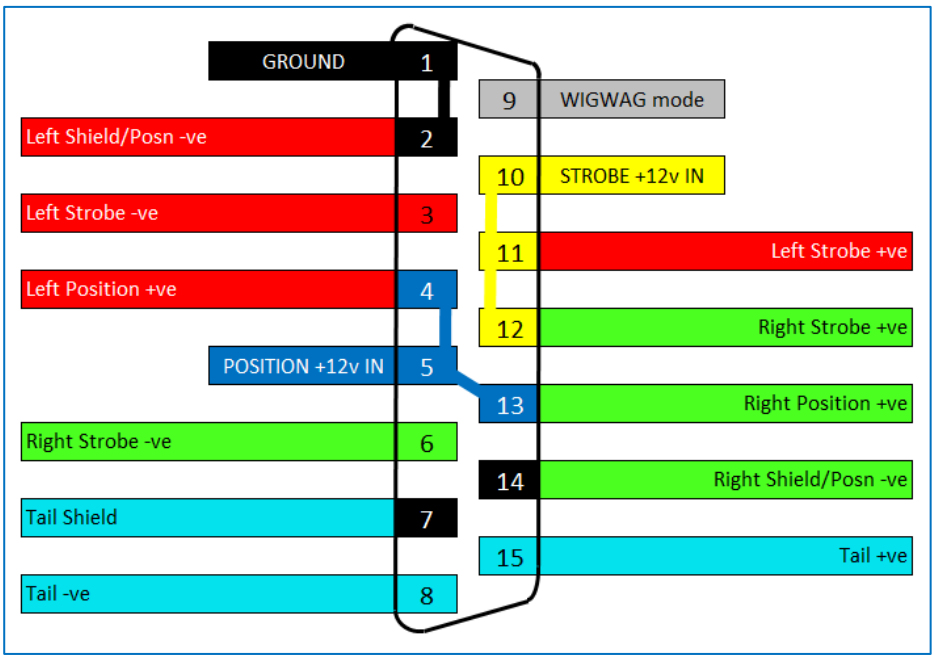
- Firstly, check that your meter *beeps* when you short the test leads together.
- Check for a periodic beep in time with the flashing LEDs between any ground connection, eg pin 1 or 2, and then pin 3 (left), pin 6 (right).
  It's likely that the same test *won't* work with pin 8 (tail), as the ceramic resistors may be seen as a "high resistance" to your meter. And if you've left the resistors off the board, then it definitely won't work!

If everything beeps as expected here, that's it, you're good to go!

Another possible test is to wire a ~5 watt automotive turn signal or interior light bulb in place of the strobes. Connect one side of the globe to pin 11 or 12, and the other to pin 3 (left), pin 6 (right), pin 8 (tail). Be aware that your 9 volt battery might be starting to run out of steam by now!

Connector pinout

The label colours shown at right describe the wire groups and functions.



- The red labels are the four connections to the left wing.
- The green labels are the four connections to the right wing.
- The blue labels are the + and - connections, plus shield, to the tail LED.
- Airframe Ground is connected to Pin 1, which then connects to pin 7 for tail light wire shielding, and to pins 2 and 14 for the ground return for the wing position LEDs.
- **Position** light power is applied to pin 5 "POSITION +12v IN", which then feeds +12v *out* to the red and green position LEDs on pins 4 &13.
- **Strobe** power is applied to pin 10 "STROBE +12v IN", which then feeds +12v *out* directly to the strobe LEDs on pins 11 & 12.
- The strobe LEDs on the wings and tail flash when the switching MOSFETs switch the ***negative*** side of each light circuit to ground. This is why the strobe negative wires must come back to the controller board.