ESC for MGF/TF HEATER FAN with AIRCON

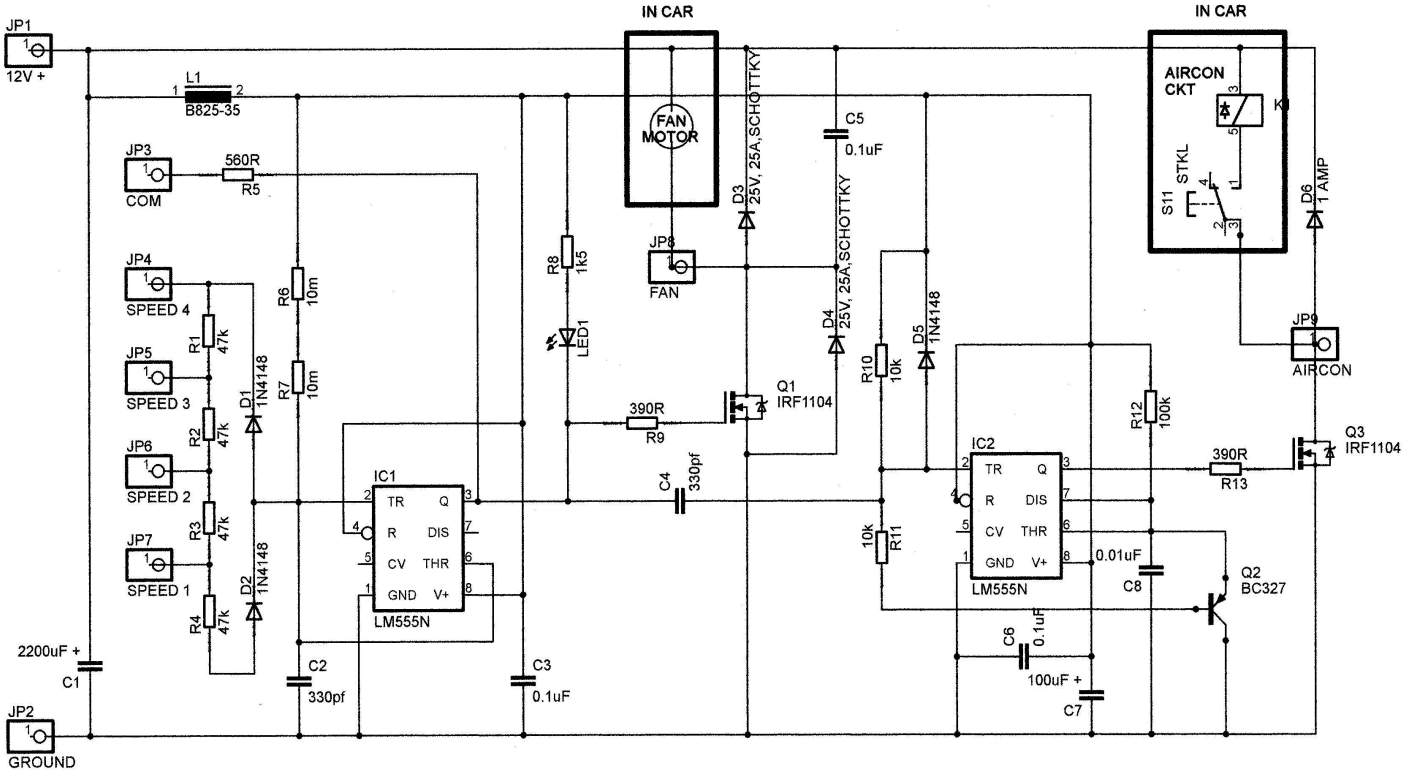
Many of you will know of the problem with the failure of the oem resistor pack causing loss of blower motor (heater fan) speeds 1 & 2. This is easily replaced or repaired unless, of course, your F/TF has air conditioning. To access the resistor pack will then necessitate the removal of the aircon unit.

THIS IS A BIG JOB.

To get around this problem, I have constructed an electronic speed controller (ESC) that bypasses the resistor pack and thus alleviate the headache of the aircon unit removal. The harness to the blower motor switch is unplugged from the switch and all leads are removed from the connector with only the lead to the **motor, aircon** and **ground** being transferred to the ESC, the remaining wires (from the resistor pack) being taped up out of the way. The change means that the double ground circuit within the switch cannot now be used I had to devise a way of adding a new ground feed for the aircon circuit.

CIRCUIT OPERATION

To this end we will be using two 555 timer chips, one to control the blower motor speeds and the other to control the ground route of the aircon system. Capacitor C2, resistors R1 – R5, diodes D1 & D2 together with IC1 (a 555 timer chip) generate output pulses at pin 3 of IC1 that drive the "gate" of the MOSFET semiconductor Q1. This semiconductor in turn controls the blower motor speed. Capacitors C1, C5 & C7 together with inductor L1 (choke) and resistor R9 keep the 12 volt supply reasonably noise free. This is electrical noise generated by Q1 switching on and off at a high frequency. Diode D3 protects the electronics from back e.m.f. from the blower motor, diode D4 giving additional protection to the MOSFET Q1.



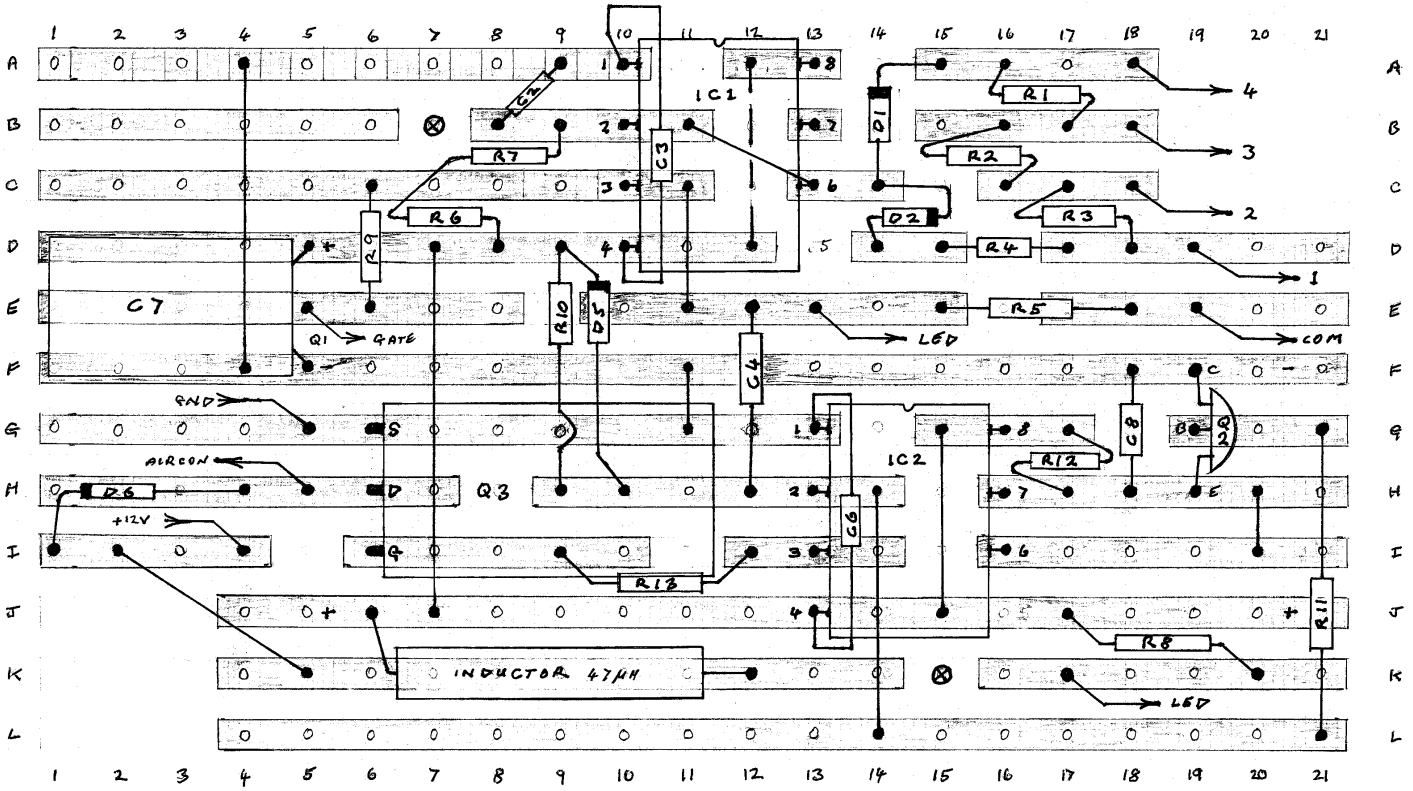
The output from IC1 is also sent to the base of transistor Q2 and the other 555 timer, IC2, through capacitor C4. The timer IC2 is used as a "lost pulse detector", so, as long as there is a string of pulses coming from IC1, the output pin 3 of IC2 will hold MOSFET Q3 fully switched on completing the ground circuit to the aircon system. Transistor Q2 is continually switched on by timer IC1 and as it's wired parallel to capacitor C8, capacitor C8 is repeatedly clamped to 0.7 volt preventing it to charge up to 2/3rds supply voltage and hence reset IC2. Capacitor C8 and resistor R12 control the switch off time of IC2 when IC1 is turned off. Resistors R6 & R7 are needed to stabilise IC1 when the blower motor is switched off .

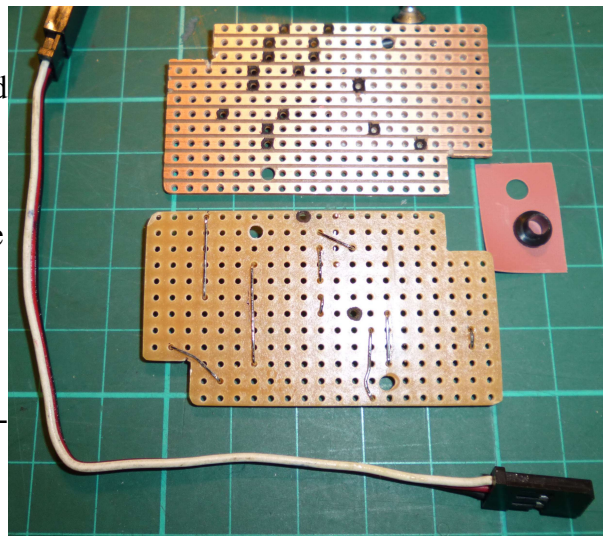
BUILDING THE ELECTRONIC SPEED CONTROLLER

Referring to the circuit overlay drawing you will see that there are 10 jumper wires and 19 cuts in the "Veroboard" strip-board. The **CUTS** are made at:- **A-11 & 14**; **B-7, 12 & 14**; **C-12 & 15**; **D-13 &16**; **E-9 & 16**; **G-14 & 18**; **H-8 & 15**; **I-5, 11 & 15**; **K-15**. I use a drill bit and a no.11 scalpel blade to cut and trim the breaks in the copper strips.

B-7 and K-15 are the mounting hole positions and the holes will need to be drilled 2mm. A round needle file will also be required to carefully align the holes to the mounting pillars in the case .

The **JUMPER WIRES** are from:- **I-2 to K-5; A-4 to F-4; D-7 to J-7; C-11 to E-11; F-11 to G-11; B-11 to C-13; A-12 to D-12,** note this jumper wire is made on the copper side of the strip-board (Veroboard); **H-14 to L-14; G-15 to J-15; H-20 to I-20.** The jumper wires are offcuts from components. See attached photos.





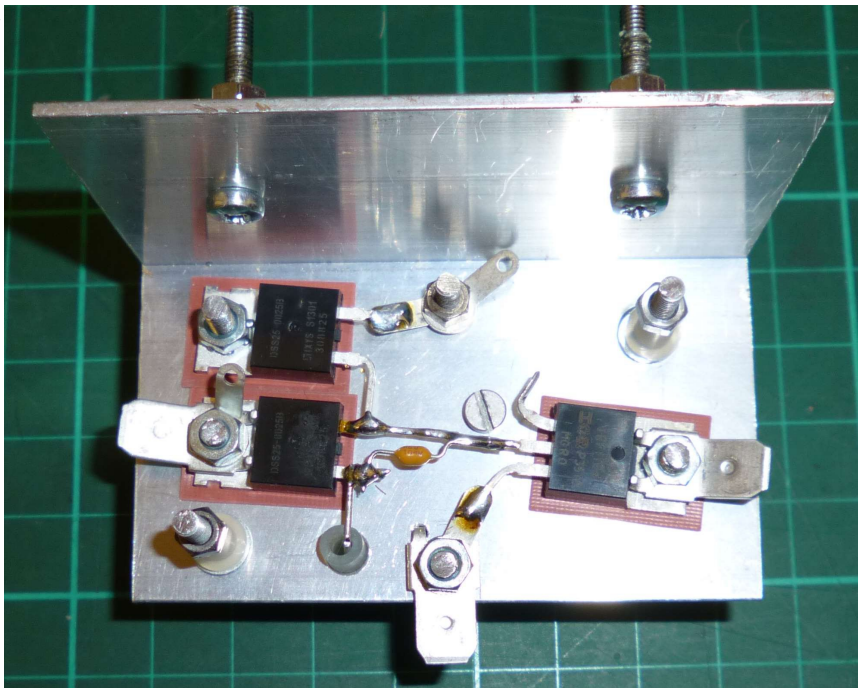
To facilitate the build, I mark position 1 for each IC with a slight countersink and black felt pen mark. I've also highlighted the cuts on the copper side for the photos. Capacitors C3 and C6 are soldered to the IC sockets. I also cut off pins 5 of the ICs and their sockets. A Stanley knife blade makes a clean flush cut on the ICs. Important for the IC2 position. Note there is a mark indicating pin 1 of the 555 timer ICs. You are also cutting off pin 5 of the IC sockets for extra assurance.

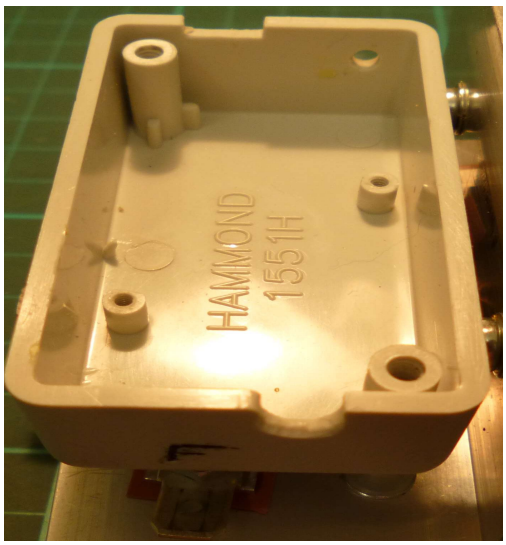
You will probably need to slightly enlarge the holes on the board at positions D-9, C-13 and H-5 for the aircon lead, and G-6, H-6 & I-6 to accommodate Q3.
Note how the leads of Q3 are bent 90 degrees to allow it to fit inside the case.
The same for capacitor C7. Diode D6 needs to be flat against the board as the 4 leads exit the case above it.
Round nosed pliers are the best to bend wires this tightly to reduce stress in the wires.

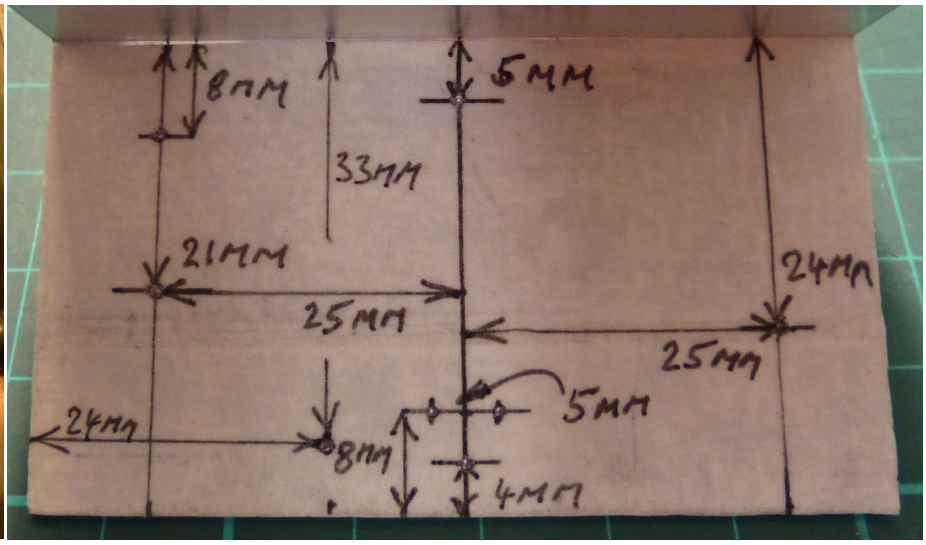
The photo above shows diode D6 on the extreme left with the aircon lead & the other three leads above it. Note the silicone tubing used as a grommet.

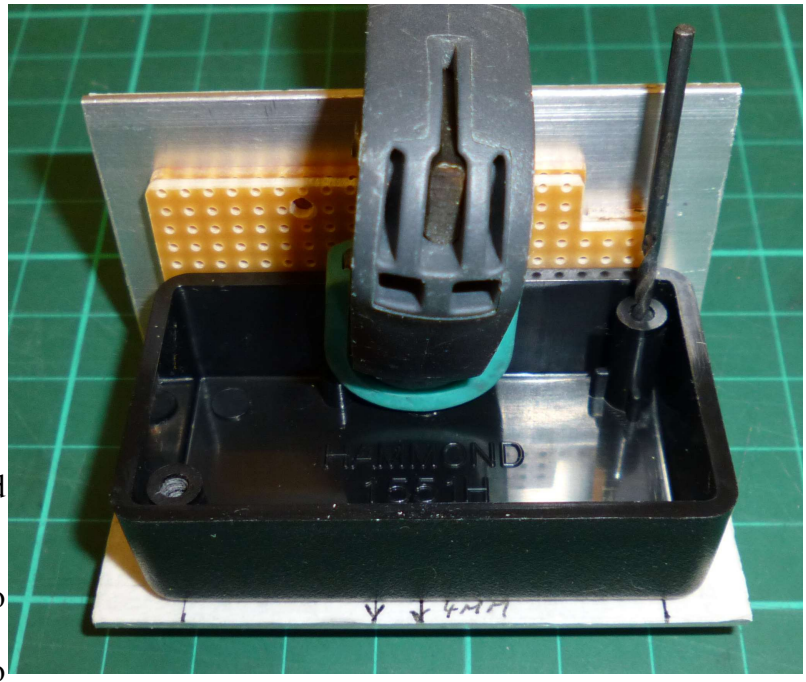
You will need a 18-25 watt iron using a small tipped soldering bit. The board is a tight fit within the "Hammond" box and you will need to trim quite a bit off of the strip of copper at position “L”.

See how I've modified the 1/4 spade terminals fitted to Q1, D3 and the ground terminal on the alloy plate. These are drilled 3mm to clear 3mm (or) 6ba screws. MOSFET Q1 and diodes D3 & D4 are insulated from the alloy plate which is at ground (-ve). A new lead (330mm long) is required to supply +12 volts to the unit and this is connected to D3. **This must come from the 12 volt supply to the blower motor.** **If the supply is taken from another source and this fuse blows then diode D3 will be out of the circuit and you will destroy the unit.** The motor is now connected to Q1. The ground lead that you removed from the switch is fitted to the ground terminal on the alloy plate. A short fly lead output from the box is the aircon lead, so connect the aircon lead removed from the switch here. MOSFET Q1, diodes D3 &D4 with capacitors C1 & C5 are fitted on the alloy heatsink/mount. MOSFET Q3 and the rest of the electronics are soldered to a strip-board and mounted in a small box that is screwed to the alloy plate using spacers to clear Q1, D3 and D4. The alloy plate is a 70mm length of 40mmx40mm angle. **See attached photos.** See how C5 is soldered to D3 which is at the bottom left of the photo. Q1 is on the right. The positive lead from C1 is through the hole below D3. The 3 leads from the circuit board (ground, positive and signal) with ground being soldered to the earth tag in the top middle of the photo, the positive lead is soldered to the tag on D3 while the gate signal is soldered to the top terminal of Q1 in the photo. The screw length for mounting the semiconductors are 12.7mm. The two that fit the unit to the car are 21mm long. The unit needs to be 9.5mm (+) away from the locating position so as not to interfere with the footwell light assembly.



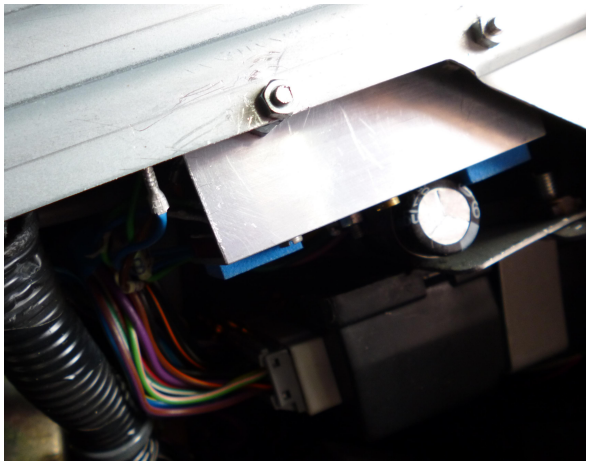


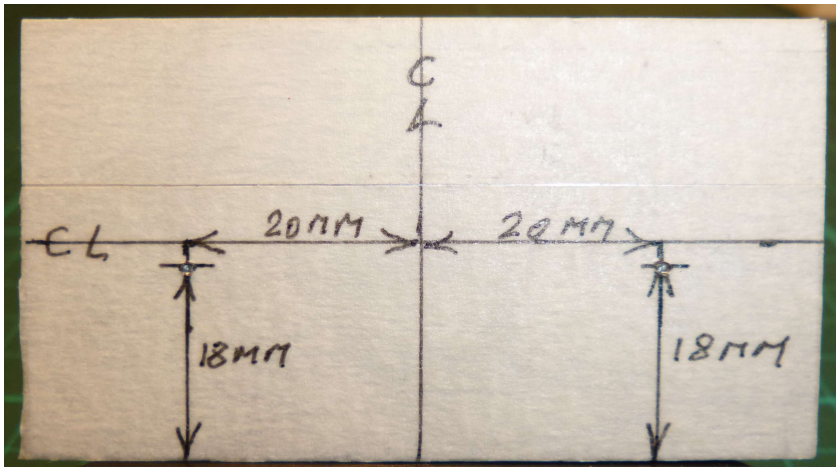




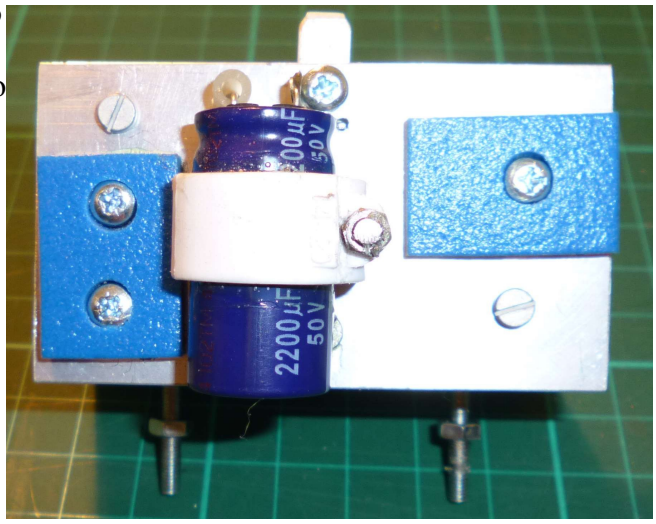
Use some masking tape on the alloy mount so that you can easily mark out where to drill the holes to mount the devices and solder tags. The semiconductors need a 3.5mm hole drilled to accept the through hole “top hat” insulator. Other holes are drilled 3mm. I drill 2 x 1.6mm holes to prevent the earth connector from rotating. A lock washer then solder tag is put onto the screw that clamps the earthing connector. The solder tag is for connecting the negative terminal of capacitor C1 to ground. After pushing the screw through the alloy plate a thick washer is added before the ground terminal and another solder tag is fitted. Q1 and D3 are fitted close enough for the “anode” of the diode to be soldered to the “Drain” terminal (centre one) of Q1. Just finger tighten these two components so that you can solder them together and also the “Source” terminal of Q1 to the earth tag. This will stop things moving when fully tightening up these components.Make sure the rectangular (TO22 style body) insulator is still correctly positioned underneath in each case, as in the photo above. When you fit the semiconductors, first push the “top hat” insulator through the hole, add the TO22 style insulator and when adding the semiconductor make sure you don't crush the “top hat”. Insert the screw from below and add a lockwasher to the top of the semiconductor. Now add the modified ¼ blade connector and nut to both Q1 and D3. Diode D4 is fitted again so that it can be soldered to D3 without additional hookup wire. Note an additional solder tag is added to D3 to make life easy connecting the power lead from the circuit board. A double solder tag (ground) is fitted close to D4 which again eases assembly. The photo above shows how these components are mounted and wired up. Leave a gap of between 3.5mm and 4mm for the plastic case so that it clears the heads of the alloy plate mounting screws. The photo shows using two thicknesses of circuit board. Centre and clamp the case as shown and drill through using a 2mm drill. Open up the hole in the alloy to 3mm so that you can use 3mm or 6ba screws to fit the case above the components fitted to the alloy plate.

If you are fitting this unit to a TF with the Pektron BCU then you will need to fit the mounting screws below the centre line so that capacitor C1 will clear the metal plate to which the BCU is screwed. 2mm below centre would probably be ok.



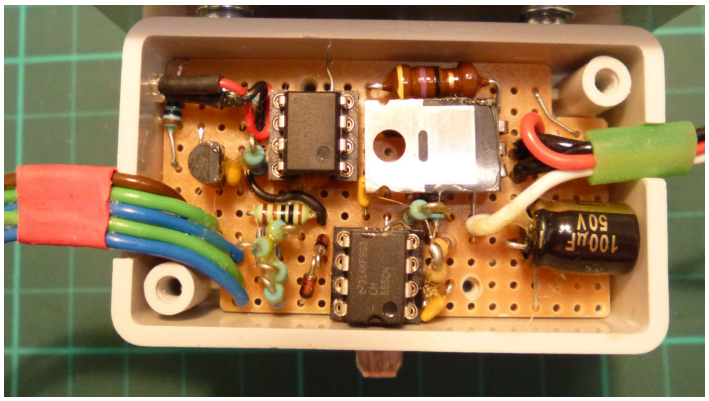


Capacitor C1 is fitted to the underside of the alloy mount so slide a “P” clip onto capacitor C1 and carefully measure where you need to drill a clamping hole for the clip and also a hole to pass the positive terminal of C1 so that you can solder it to diode D3. Make sure you sleeve the wire. I used a short piece of silicone tubing from my modelling supplies. The blue neoprene pads shown below are from a double glazing firm and just add a little extra protection to the three screws that are insulated from the alloy plate. Here I am using a plumbing pipe “P” clip modified to hold capacitor C1 (2200uF,50 volt) with the negative terminal being soldered to the earth solder tag.

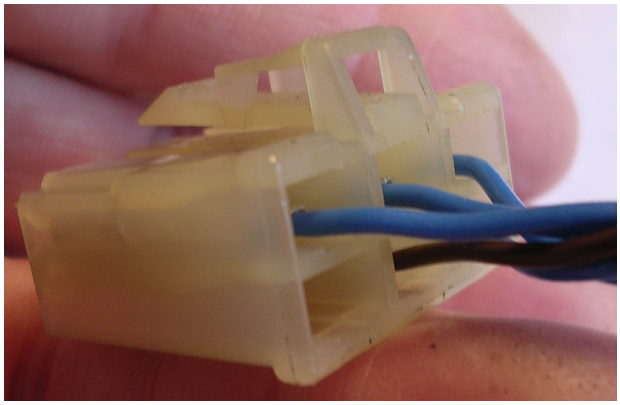


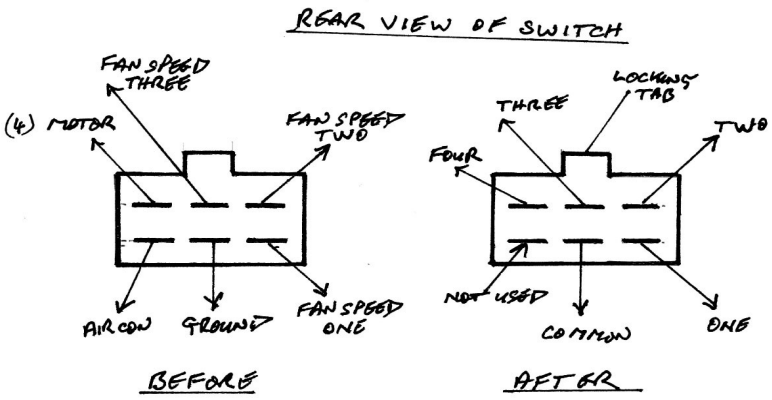
I have listed all parts that I have used to make the units. The bulk of components are from RS Components but a lot of these come in quantities - some large. I've used servo lead wire to connect the circuit board to the components on the alloy plate. These leads are much better than using ribbon cable. You could use servo extension leads for both the power to the circuit board and the leads to the blower switch. This will give you the convenience of easily plugging everything together. Readily available from any good model shop. I show an extension lead in the photo on page 2 with the circuit boards showing cuts and jumper wires.

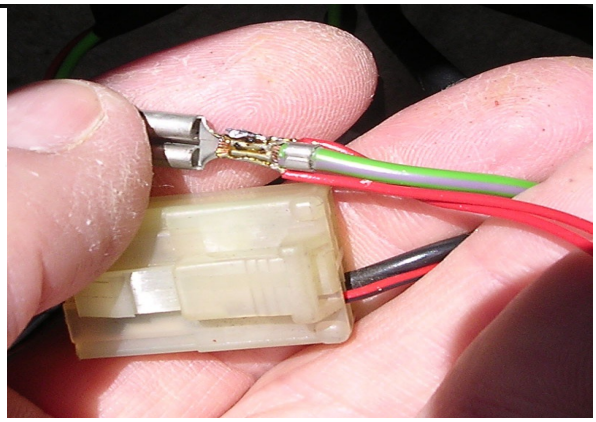
This is how it looks inside the case



Leads into the back of the switch connector







Connecting to the blower motor power supply

I attach additional photos so that you can see how things go together.

If you're not comfortable with building electronics, hopefully you will know of someone in your club willing to help. I have written separate instructions for fitting a built unit.

However, if you need further details, clarification or help, then don't hesitate to "PM" me via the MGF Register website.

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