



SAAB-96 1973

Replacing Fuel Sender Unit



Introduction

- The fuel gauge on my SAAB read full when newly filled, within 3 miles it read half full where it remained (bouncing up and down violently occasionally) until it read empty.
- For general information on fuel sender replacement please see Scandix site:
<https://www.skandix.de/en/documents/installation-guide/fuel-gauge-sender-unit/3000411/>
- A quick diagnostic test showed that the gauge and wiring was fine and the fault lay with the sender unit.
- After some calculations a new unit was selected and fitted.
- A new circuit was required for the low fuel indicator light.
- Result one was satisfactory – not quite full reading when full but empty OK.
- Circuit for low-fuel gauge reading fried when ignition started! (think it needs some suppression!)
- New improved circuit designed

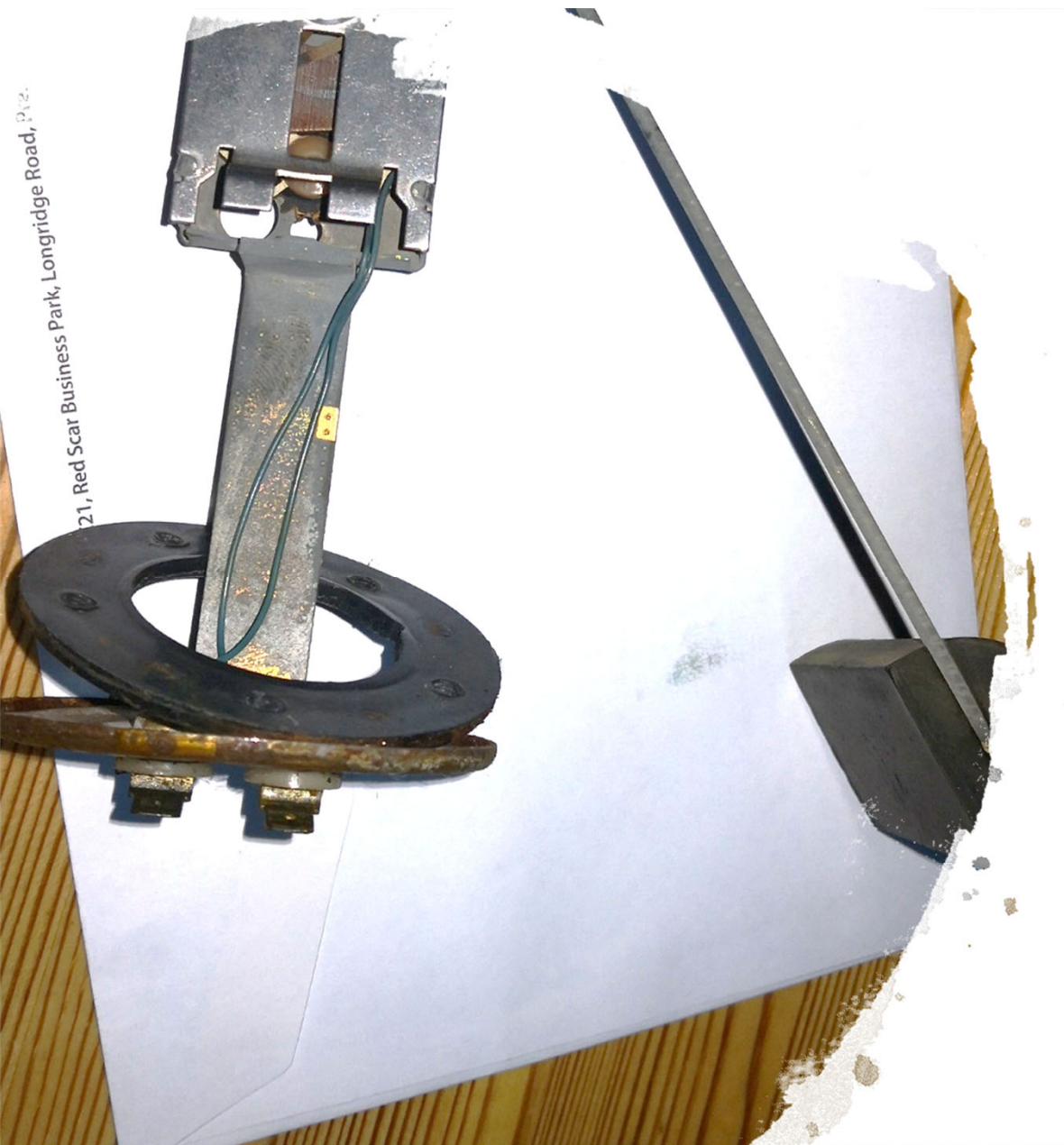
Reccomendation

- Don't bother with the fuel-warning light unless you're a pedant like me. It's not really necessary.



Wiring of the fuel sender

- The fuel level sender top is shown here (looking down on the petrol tank looking from rear seat).
- There are two wires
 - Wire 1 is the level sensor: grey with a red sleeve, to the left of the photo
 - Wire 2 is the low-level warning light sensor.
- Wire 1 works as a variable resistor to ground going from high resistance (at full) to low resistance (at empty).
- Wire 2 works as a switch – open circuit when the light is out, and connected to ground when the fuel runs low. This completes a circuit for the warning light to turn on.



The original sender unit

I extracted the sender unit and there was very little contact pressure between the wiper arm and the wound resistance wire shown. I opened the case and the contents sprung out (there is a spring in there!).

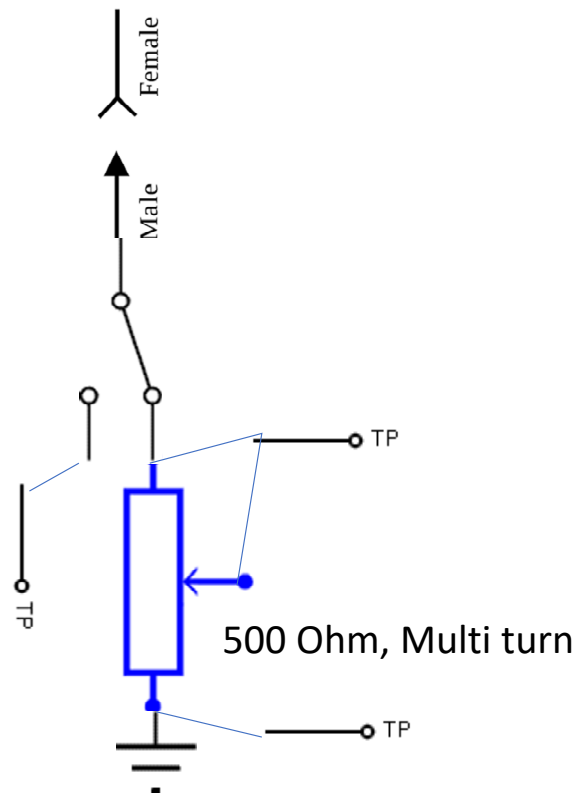
I cleaned the contacts and tried to increase pressure, but it was still very flaky and inconsistent on the bench.

I think I also lost the wiper arm for the low fuel sensor contact (which is a wiper on a carbon track located behind the wound component). I couldn't find it on the garage floor – so if it ever existed, I lost it.



Measurements

- A quick circuit was built to simulate the fuel sender unit. Disconnect the cable to the fuel sender at the fuel sender end and insert this unit connecting the yellow wire to the disconnected sender wire and the black wire to ground. Turn on ignition and check calibration.

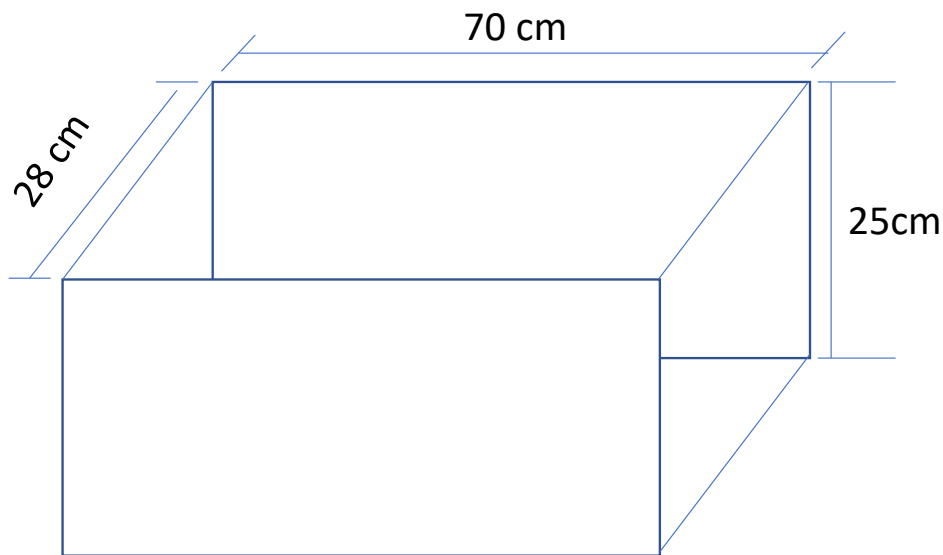


Measured Results

Gauge Reading	Voltage (volts)	Resistance (Ohms)	Current Flowing (ma)
Open Circuit, Full Pegged Meter	7.6	N/A	N/A
Full	5.3	208	25
$\frac{3}{4}$	4.5	120	38
$\frac{1}{2}$	3.5	70	50
Red line	1.4	19	74
Empty	0.02	0.2	88
Short Circuit	N/A	N/A	90

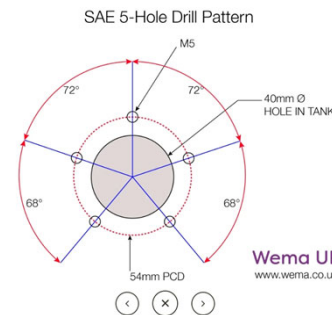
Conclusion: A fuel sender unit with resistance range 10-180 Ohms will work reasonably well, though will not go to fully full (but will be well above $\frac{3}{4}$ and won't go to fully empty – but will be well into red area.

Fuel Tank Dimensions



Volume: $0.28 \times 0.7 \times 0.25 = 0.049$ cu Meters
Equivalent 49 Litres.

Adjusting for measurement inaccuracy, rounded corners, volume taken by sender unit fitting and gap between filler and top of the tank, any internal structure etc. Seems reasonable dimensions for tank specified to hold 38 litres.



The sender mounting is 5 hole SAE pattern as shown here.

Selected a magnetic reed relay sender unit with 20cm depth. This will Probably read empty before the tank is really empty, but that's a good thing.

Purchased a reed switch sender unit.

8 inch long 10-180 Ohms.
This should run the main gauge OK, but will not activate the low fuel warning light (10-200 Ohm would have been better but couldn't find one)

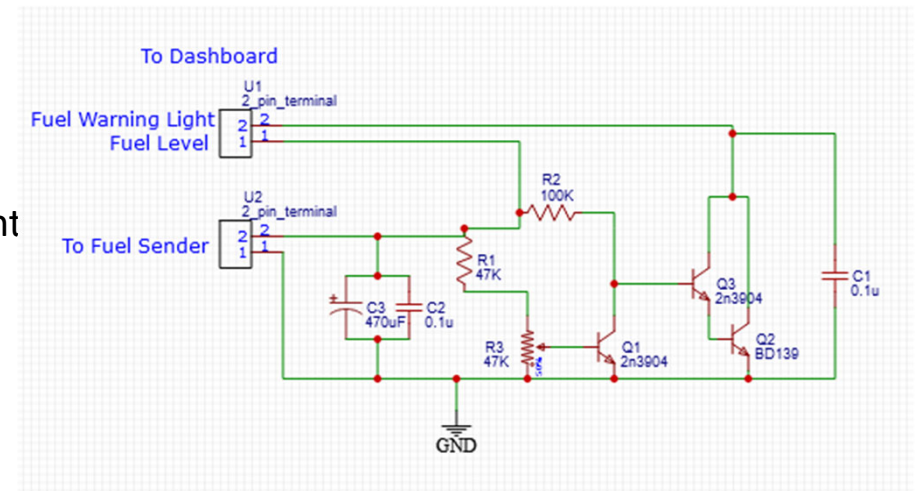
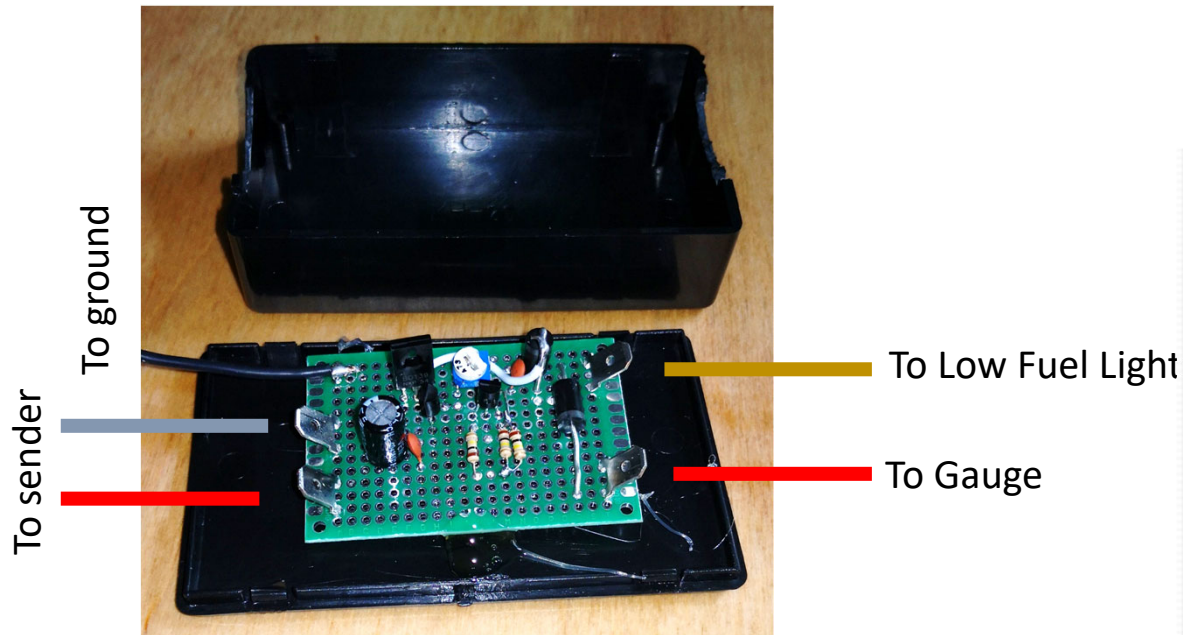
<https://www.ebay.co.uk/item/Fuel-Tank-Tube-Level-Sender-Length-8-200mm-Resistance-10-180-ohm-UK-Reed-Switch/373145938309>



Fuel Warning Light Trigger as built

Used 2 x 2n3904 and the final transistor as a BD139. In practice required the base dropper resistor to be 47KOhm to get the unit in the correct trigger range.

Set on the bench for the light to come on at 1.38v across the level sender. The light remains on until the voltage drops 0.99V at which time there is not enough residual voltage to run the light circuit. This means as the tank approaches "really empty" the light turns off again.



Installation Results

The circuit for the warning light was hard wired and then insulated with gaffer tape.



Result:

The gauge reads approximately slightly lower on a tank which has 13 Litres remaining.

Full tank reading with the new gauge is not full but slightly over $\frac{3}{4}$ full.

The original low-fuel light circuit worked perfectly with the ignition on and without the engine running. Starting the engine fried the circuit (this is the second piece of electronics that has been destroyed in the car). I think there may be a suppression issue coming from the ignition coil.

New design made with transient suppression diodes fitted.

Original Gauge (Left) at 13 litre remaining vs. New Gauge



New reading with full tank



Design notes fuel level trigger

SAAB-96 1973

Original Design

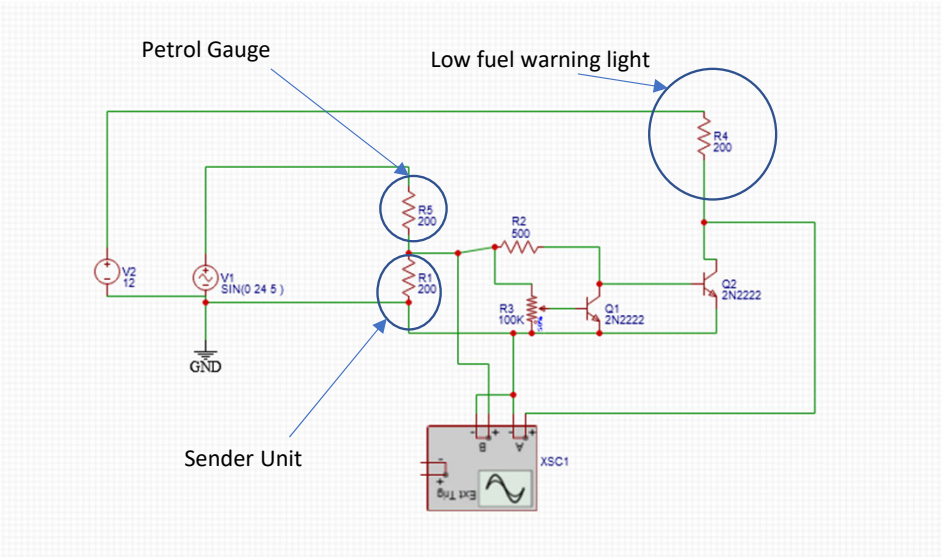
This has now been updated, see later.

This design is a simple two transistor circuit that seems to give the required performance.

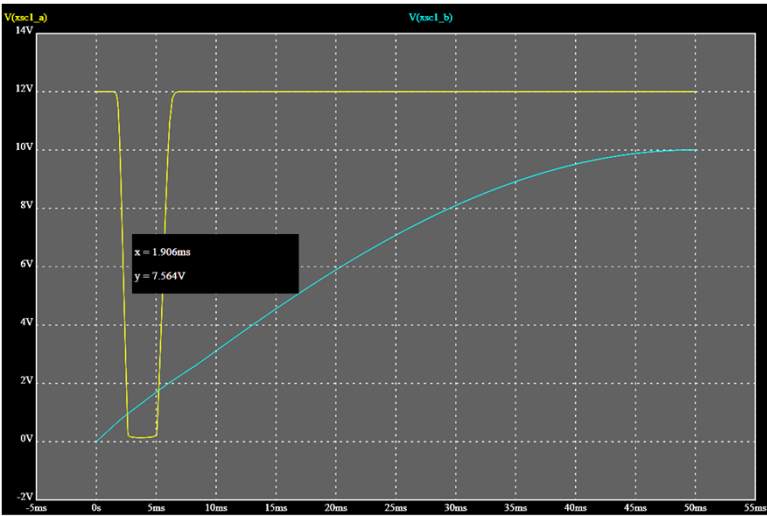
There is some distortion to the output as it's impedance input is only 3x that of the unit on full.

Wired and tested out of tank and it performed as expected.

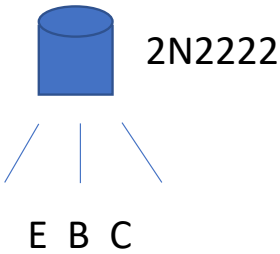
However when the light came on the fuel gauge kicked more empty than before it went on. But functionally OK.



Shows region light is on

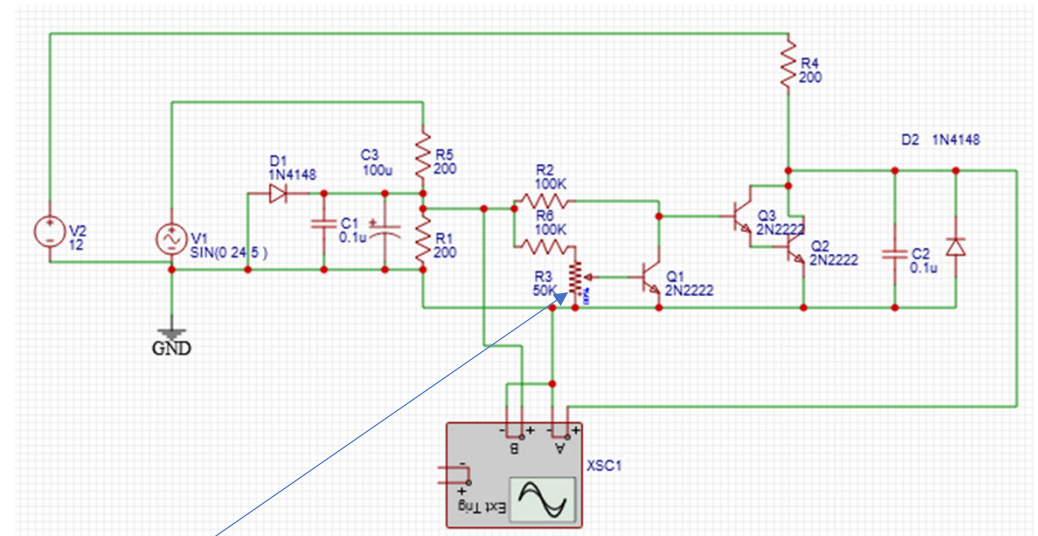
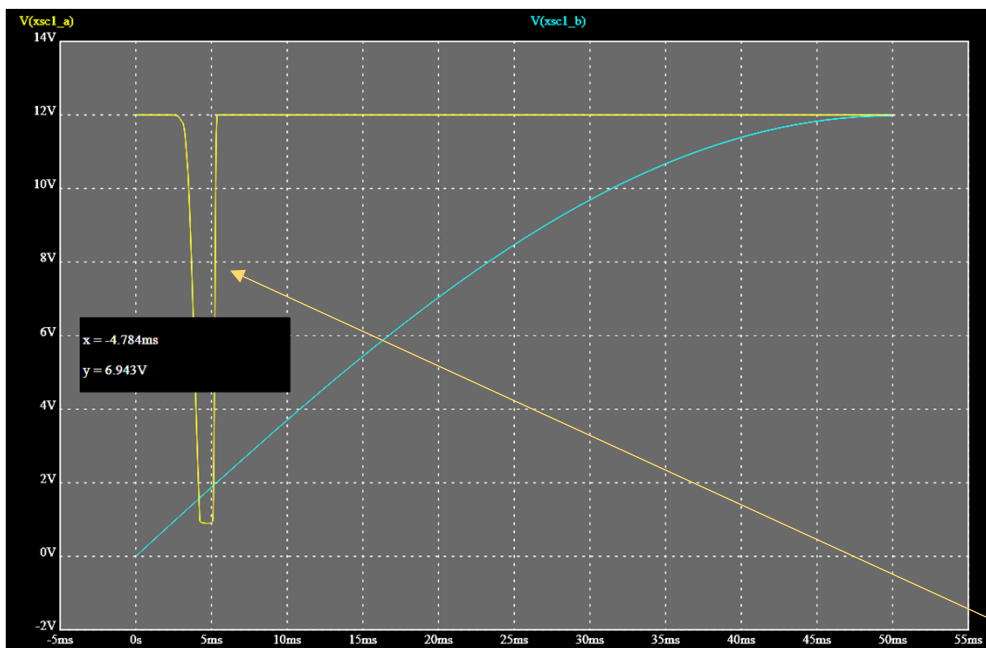


Simulation result



Improved design for low fuel warning light

The raised impedance of R2 (now 100K, was 0K5) is accomplished by using a Darlington pair Q2 and Q3. This means the distortion to the gauge reading will be much reduced. Fitting a suppression diode and decoupling capacitor across Q2 and R1 reduces chance of destroying the circuit with transient spikes. C3 is used to slow the response of the gauge needle to remove needle bouncing. Diodes are 1.5KE30A transient suppression diodes.



Variable resistor varies the cut-off point for light on, adjust off-line with a trigger at a shade under 1.4V (as per test= redline)

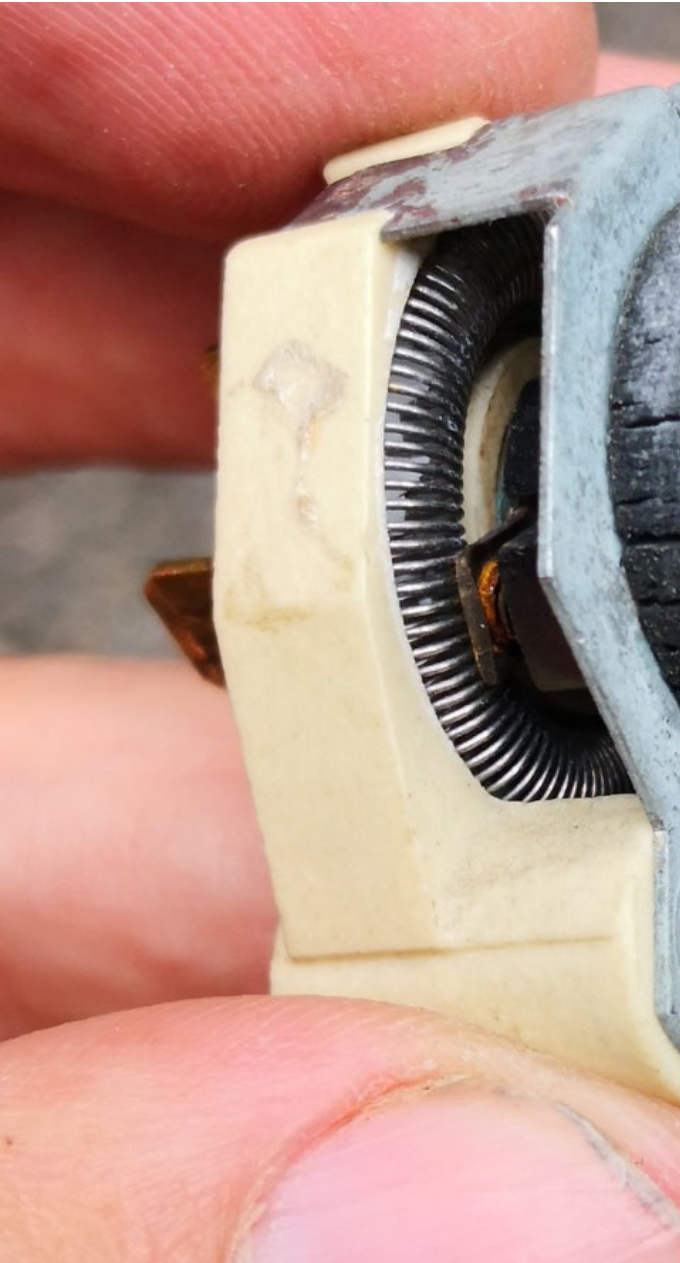
Other jobs while I'm at it

SAAB-96 1973

The boot lining had water ingress and had delaminated. Time to create new ones. Birch ply and a bit of routing.

Routed out an
inset over the
sender unit to
increase
clearance





Dashboard dimmer

Also discovered that this fellow was so dusty that the dashboard lights were not on! Removed the dimmer and sprayed with Servisol switch cleaner. All good now.