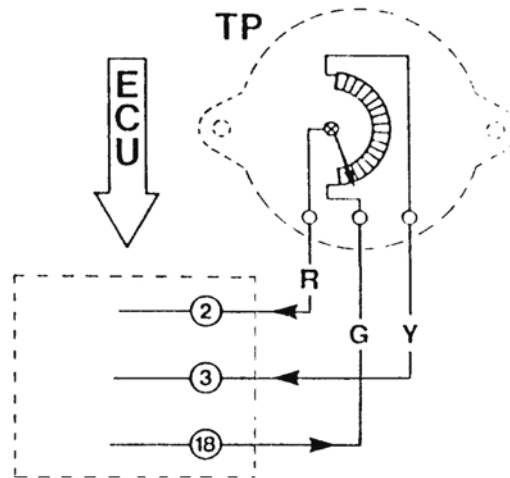


Rover SD1 Vitesse and Vdp Efi Throttle Potentiometer

Description and purpose

- The throttle potentiometer (TP) is connected to the spindle of the throttle butterfly. Its purpose is to advise the ECU of the driver's accelerator pedal position and its rate of change.
- When the throttle is operated, the wiper moves over the resistance to vary the voltage and the appropriate signal sent to pin 2 of the ECU. In this way throttle movement is sensed.



- The ECU detects the rate of change of the voltage across the potentiometer connections (pins 2, 3 & 18), and when appropriate, triggers the acceleration enrichment circuits.
- At full throttle the ECU detects the appropriate signal to provide full load fuel enrichment.

Adjustment

- The position of the throttle potentiometer is adjustable and if either the position of the throttle butterfly, or any of its linkages have been disturbed, then it will probably need to be checked and if necessary, adjusted as described below.
- NOTE. For adjustment of the throttle potentiometer either a digital or analogue meter can be used but the meter MUST be set to voltage. For testing it is better to use an analogue meter as it is easier to observe any faulty symptoms.
- The potentiometer and/or the ECU may be adversely affected if the meter is set to ohms (An ohmmeter uses an internally generated voltage to measure resistance).

- To check the adjustment, switch on the ignition and with the engine NOT running, connect the meter between the red and green leads at the potentiometer electrical plug and note the voltage. It should read 0.325 ± 0.025 volts.
- If the reading is incorrect, slacken the securing screws and rotate the potentiometer one way or the other until the reading is correct. Tighten the securing screws and re-check the voltage reading.

Testing

- Check the integrity of the potentiometer, preferably using an analogue meter.
- SLOWLY operate the throttle mechanism by hand and watch the voltage reading go smoothly to a maximum of 4.3 volts.
- If it proves impossible to get near the maximum voltage with the throttle fully open then inspect the throttle quadrant and throttle assembly, the cruise control quadrant (especially because it can foul its own mounting bracket), accelerator pedal, driver's side floor carpet and automatic transmission kick down cable.
- Correct any faults at these locations as they can prevent full throttle opening.
- Whilst not desirable, some set-ups may fall slightly short of the full voltage, say 3.7 to 4.1 volts, but it does not affect the system operation during normal driving. However, full load driving (i.e. throttle wide open) may be adversely affected.
- If the reading is erratic or unstable causing the meter needle to flicker or vary sharply then the potentiometer is probably faulty and will need to be replaced.

System response to normal and fault conditions

- Providing the voltage change is slow and smooth the injectors may be heard firing or clicking just once as the assembly approaches full throttle. If the prior maximum voltage measurement is undesirably low then, obviously, this function cannot take place and the above mentioned full load fuel enrichment is denied.
- Open the throttle RAPIDLY and the injectors fire much sooner during rotation.
- This simulated fast acceleration, triggers supplementary injector firing to provide extra fuel needed as soon as possible during the period of acceleration demand.
- However if the voltage rise is erratic it is very likely that the injectors will be heard firing randomly or in sympathy with the sharply varying voltage reading even when slowly operating the throttle.

- This is because the erratic voltage signal fools the ECU into thinking the throttle is moving swiftly when it is not, triggering unwanted fuel enrichment under casual driving conditions resulting in a randomly unstable fuel/air mixture leading to very lumpy engine performance with gross adverse affect on fuel consumption.
- This random injection of extra fuel may not occur when the car is cruising at constant speed with the throttle not moving. However even casual acceleration or deceleration can cause havoc with mixture control.
- Alas, the potentiometer is prone to wear at the point where it is most used at normal driving speed so the effects on normal driving are at their most noticeable.
- As already mentioned the erratic voltage readings are observed more readily with an analogue voltmeter.
- It is possible to prolong the life of the throttle potentiometer a couple of ways. It can also be substituted with a readily available alternative.
- Original work on repair/replacement of a throttle potentiometer was researched by Carl Heinlein. A copy of his detailed instructions is appended to this essay.

Repairing a Throttle Potentiometer

- Anecdotal evidence indicates these items last about 60-80K miles before they start to fail. This is a gradual process and the above symptoms provide sufficient clues to suggest a possible faulty component and trigger the appropriate diagnosis.
- Any number of worn, original items might be found to provide a useful stock for repairs but new replacement items have long been unavailable and given the age of the cars it is unlikely that many serviceable second-hand units would be found.
- Even a serviceable S/H unit may have a limited remaining lifetime thus repairing a faulty unit offers a good possibility of extending its useful life.
- Remove the throttle potentiometer from the plenum chamber and using a small instrument screwdriver or spike, dig out the epoxy filler on the rear face covering three small screws. Undo them and the unit comes into two bits.
- Inside one half is a carbon covered substrate. The other half has a butterfly arrangement of beryllium springs and contacts connected to the input shaft. Clean the carbon track very lightly with lint-free material and a smear of alcohol.
- The carbon resistive track wears through to the white substrate and is easily observed. There are two methods of repair.

Method 1

- With a small flat screwdriver, very carefully ease up the butterfly type springs to increase their upward tension towards the carbon track when reassembled.
- Find or buy a very fine small diameter (1/8" to 3/16" approx) compression spring similar but finer to those found in a biro pen. Snip off 1 1/4 turns of the spring thus producing a small sprung spiral ring of fine wire.
- Place this spring ring onto the conical end of the locating spigot with a dot of "copper ease" grease and reassemble the potentiometer ensuring the spring ring does not dislocate from its conical home. There is sufficient end float in the assembly to accommodate this trick and once in position the spring will not migrate. Smear a trace of silicon oil on the carbon track prior to final assy.
- If the wire is too thick it is not possible to close the two halves of the potentiometer properly. Look for a finer spring and try again.
- What this does is to increase the distance between the stationary track and the rotating wiper base, allowing the re-tensioned butterfly springs to alter their touchdown position on the carbon track, inside of, but away from the worn area.
- The success, or otherwise of the new contact relationship between the beryllium springs and the carbon track can be measured by connecting an ohm meter across red/green wires and rotate the spindle. The resistance change should now be smooth. If it doesn't work first time, keep trying as it can take a while to get the beryllium spring contact adjustment and the small additional spring coil just right.

Method 2 (Short description)

- Careful inspection of the fixing of the butterfly type beryllium springs shows that they are located on minute plastic spigots moulded on the base plate.
- With a sharp thin blade slice through the spigots and remove all trace of them.
- With some very small machine screws and a matching drill bit, re-attach the springs 1/16" of an inch down and away from their original location.
- Alternatively clamp the springs in their new position, carefully drill new holes, re-attach the springs with minute plugs of araldite and allow it to cure.
- The desired effect is to create a new tracking line 1/16" beyond and away from the worn area of carbon. Re-assemble and test as above.
- When satisfied that the repaired unit is functioning correctly the two halves can be reassembled with their original screws.

Conclusion

- According to feedback received from owners who have tried both these repairs, on balance, method 2 is the best option but both methods call for care, dexterity and patience. Perhaps only qualified watchmakers should attempt it!
- Even so, both methods do work and whilst a repaired unit may not live for another 60-80K miles, personal experience with method 1 had a repaired item last for over 11K miles without any sign of failure before I opted for a substitute.

Implications of fitting a substitute throttle potentiometer

- Because the original throttle potentiometer is no longer available fitting an electrically similar substitute is a viable option but has some associated problems.
- The item concerned is available from Radiospares/Electromail (Tel 01536 204555) and is described in their catalogue as a “Rotary Position Sensor”, 5000 ohm, P/N 319-310.
- The unit is mechanically different so an alternate mounting plate is required.
- It has a rotary deflection of 105 versus 90 degrees for the original so the maximum voltage achieved at full throttle is approximately $4.3 \times 90 / 105 = 3.7v$.
- This is not a serious problem and performance of the SD1 Efi system under normal conditions is unaffected, unless for some reason full throttle rotation is other-wise restricted by a mechanical fault.
- However full load fuel enrichment (i.e. throttle wide open) may be denied due to the maximum voltage limitation.

Fitting a substitute throttle potentiometer

- After fitting replacement units to two Efi cars both had a relatively short life until I discovered they are not hermetically sealed so the vacuum present at the throttle shaft drew dirty air into the unit which contaminated the carbon track. A patch of sticky tape over the hole in the outer casing and three small washers on the screws behind the mounting plate to nullify the vacuum, fixed the problem.
- Under normal; driving conditions there is no difference in the performance of the system, and because one rarely if ever drives at full throttle it is unlikely that the lack of full load enrichment would be noticed.
- The Rover SD1 Club used to sell replacement kits but these are no longer available so owners now have to consider the necessary DIY home mechanics to solve the problem. Carl Heinlein’s definitive processes are appended below.

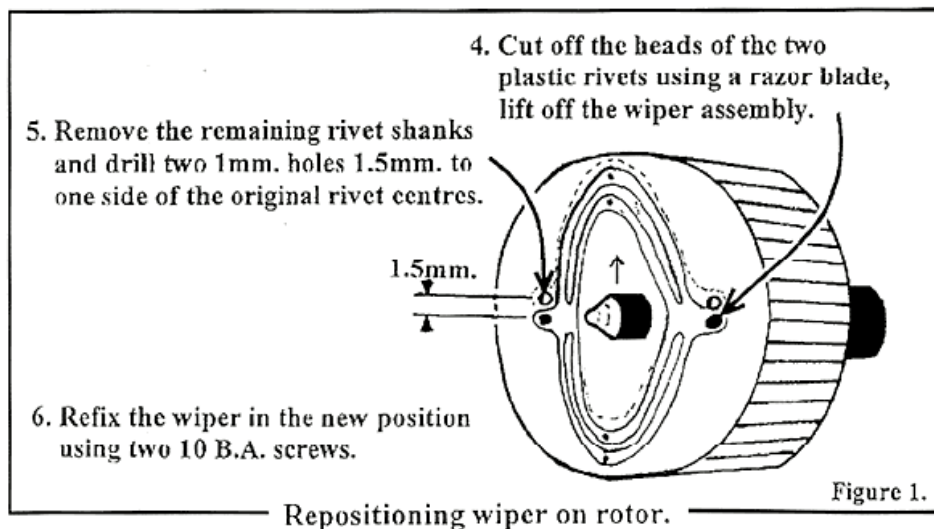
Throttle Potentiometer Repair.

Now that there are no more new throttle potentiometers, it is essential that we do not throw any faulty throttle pots away, the following suggestion will usually enable a pot to be repaired twice with hopefully as long a life as the original on both occasions.

When the potentiometer fails to operate properly, the fault is usually caused by the wiper wearing through the resistance track. So if the wiper could be moved laterally until it ran on a fresh part of the resistance material the potentiometer would have a new lease of life.

This is how to do it. -

1. Remove the circlip surrounding the spindle.
2. With the aid of a sharp instrument, such as a small screwdriver, pick out the sealing compound concealing the heads of the three fixing screws holding the cover, clean their slots and remove the screws.
3. Remove the cover and take out the rotor, taking care not to damage or bend the wiper assembly.



4. The wiper is heat riveted to the rotor. Remove the heads of the two plastic rivets using a scalpel or a razor blade and carefully lift off the wiper assembly.
5. Cut off the remaining shank of each rivet, but make sure that you can still see where they were and using a 1mm. drill make a hole 1.5mm. to one side of each rivet marking so that the wiper assembly may be refitted in a position 1.5mm. to one side of its original position and thus contact new segments of track.
6. Two 10 BA x ¼" screws (obtainable from model shops) should be used to refix the wiper to the rotor (they will cut their own threads into the plastic.).
7. Make sure that every part is clean then apply one small drop of silicon oil to each of the two resistance tracks. (DOT 5 brake fluid is silicon oil.)
8. Reassemble everything in reverse order then test the unit using an appropriate Ohms range of your multimeter. The reading that will be obtained between the **Green** and **Red** wires should vary smoothly between a low reading of a few ohms and a high one of about 5,000 ohms. The same result will be obtained between the **Yellow** and **Red** wires but in the reverse rotation.
9. Reseal the three lid screws to complete the job.

Replacement for Efi throttle potentiometer.
(ERC 3619 and ETC 4483)

You will need the following items to make the new throttle pot assembly:

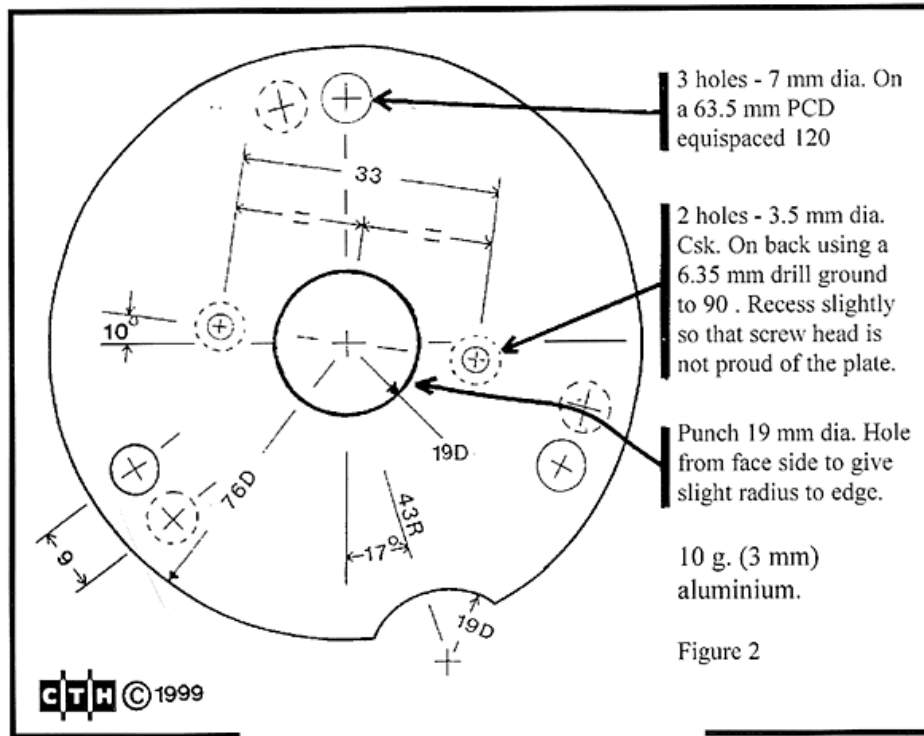
1. 5,000 ohms rotary position sensor. (Obtainable by mail order from Electromail Tel. No. 01536 204555) Part number 319-310 (Total cost £22.03 including vat & post.)
2. 2 x 4 BA (or 3.5 mm) countersunk screws.]
3. 2 x 4 BA plain washers.] Try your local
4. 2 x 4 BA spring washers.] hardware or
5. 2 x 4 BA full nuts.] model shop
6. 3 x ¼" plain washers.] for all these
7. 3 x ¼" spring washers.] parts.
8. 1 x 3 pin connector moulding. Rover part No. AFU 1439
9. 1 x keeper bar. Rover part No. AFU 1470
10. 3 x terminal pins. Rover part No. ADU 7058
11. Aluminium adapter plate made to the drawing (Figure 2) on the next page., to replace the original potentiometer mounting plate.

There is less lateral play between the rotor and the case in the new type of potentiometer so it is essential that the adapter plate is made accurately. The three fixing holes in the adapter plate are made deliberately slightly large so that, when the assembly is fitted to the plenum, the plate may be centred to ensure free rotation of the spindle before final tightening of the three screws.

(Note: Items 8, 9 & 10 are used on unit ETC4483 for the later cars with T.T.S. connectors, I do not know the part numbers of the connector parts used on earlier potentiometer ERC

3619, but the pins will fit the earlier in line moulding if their anti rotational tabs are cut off.)

Throttle Potentiometer Adapter Plate



The original prototype was made with a triangular plate, but at the suggestion of **Ramon Alban Mem. No. 1064** this was made circular as shown. It is much cheaper to make on a computerised press.

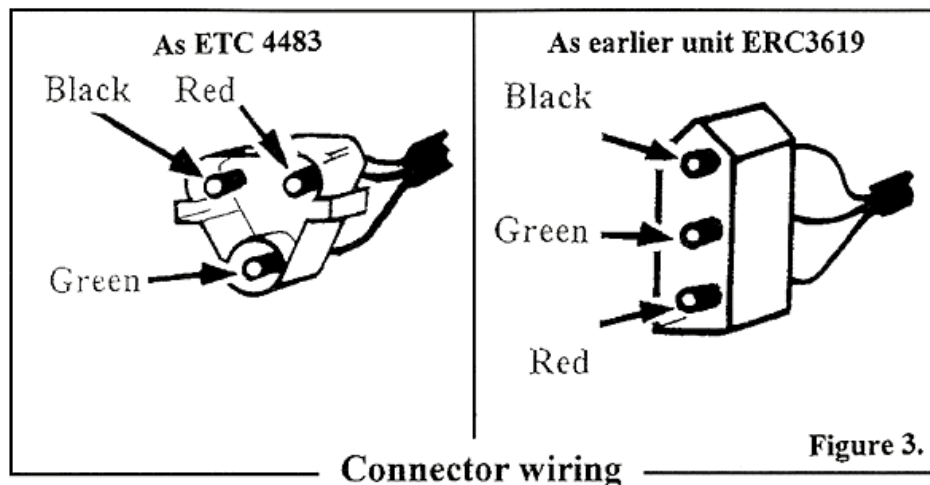
Note – The adapter plate drawing as shown is suitable for **single plenum use only**. For some reason known only to the twin plenum designers, the angle between the throttle spindle flat and the three 1/4" UNC fixing screws has changed by about 15°. To overcome this, **twin plenum owners** must drill or punch the three 7mm. fixing holes in a position that is 9mm. anticlockwise from the single plenum holes as shown dotted in the drawing. Unless the centre steel bush in the plenum face can be removed, it will be necessary to place two or three packing washers under the three fixing screws, but no more than absolutely necessary and keep the spacing equal.

This is how to do it:-

1. Mount adaptor plate using the three original ¼"UNC x ½" screws and new washers (items 6 & 7) These plain and spring washers are essential for ease of alignment.
2. Make sure that the 'D' shaped hole through the rotor shaft is **not** a tight fit to the throttle spindle, - if it is tight then file the hole 'flat' carefully until it is a free sliding fit on the spindle using a suitable needle file. (File the 'flat', not the diameter, - the diameter has adequate clearance and **do not be tempted to file the brass spindle**, - it is much harder to replace than the pot.)

There is a hole right through the potentiometer allowing the vacuum that escapes along the throttle spindle to draw rubbish into the potentiometer casing unless the exposed hole is covered over. - **This is essential.**

In order to relieve the vacuum still further it is a good idea to place a washer between the adapter plate and the plenum face when fitting the three ¼" screws, but make sure that the three washers are of the same thickness.



3. Having fitted the potentiometer assembly and plugged it in, turn on the ignition but do not start the engine. Connect a multimeter on a low D.C. voltage range to the **Black** (-) and **Green** (+) wires at the connector and (having slackened the two nuts holding the potentiometer to the adapter plate slightly) rotate the potentiometer to a position that gives a voltage reading between **0.300** and **0.350** volts.

4. Tighten the two fixing nuts and turn off the ignition. **Check that the throttle spindle rotates freely.** (See also page T77 of issue 45 but note that the wire colours of the new unit are different.)

| | | | | |
|---------------------------|--------|--------|-------|-----------------|
| Original pot. wire colour | Yellow | is now | Red | on new version. |
| " | Green | " | Black | " |
| " | Red | " | Green | " |

Note; - The three terminal pins listed at 10 in the above parts list will fit the earlier moulding if their anti-rotation tabs are removed.

Carl Heinlein

Ramon

Website: <http://www.vintagemodelairplane.com>

Blog: <http://uk.blog.360.yahoo.com/maureen9235>