www.OdometerGears.com

Merkur Scorpio Odometer Repair Instructions

http://www.bitsprings.com/gearinst.pdf

Please read through these instructions completely once before proceeding. It is important to understand that in attempting this repair it is possible to cause additional damage to the speedometer/odometer assembly. Wires and delicate parts can get broken. If there are bad solder joints on the speedometer circuit board, the manipulation needed to remove it to affect this repair can cause them to break. However, if you work slowly, carefully, and do not attempt to apply too much force to components, most persons with some mechanical experience should be able to successfully complete this repair. You are responsible for your own work and these instructions are intended to just provide some assistance.

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Please read the first few steps carefully as these are our most common questions we receive after a client has performed a repair and the odometer still does not work.
The reason the original gear or gears have failed is that they are made of urethane and lubricated with petroleum grease. This combination breaks down the urethane into a waxy substance which flakes and breaks away. This will also leave a waxy film and deposits on the shafts, gears, housing and peg on the pods.

* Work smart, meaning have a clean area to work and the proper tools to perform the repair. General tools that will be needed depending on the vehicle are small standard screwdriver, small Phillips screwdriver, assortment of torx drivers, diagonal cutters (dikes), 1/4" socket set are just a few of the items that may be needed.

* No grease is needed with the new gears. Our gears are made using Celcon® which has graphite mixed into the material and does not require any additional lubricant.

* Make sure that you have blown the speedometer and odometer assembly clean with high pressure compressed air. ***Even if you think that you have found all of the broken pieces you still need to perform this step.***

* Wipe the area around the gears, any shaft or shafts that the gears may ride on, the motor shaft and the peg on the pod that the small gear spins on clean, using a clean cloth and rubbing alcohol. Any residue left over from the old gears can allow the new gears to stick and not allow the odometer to work.

* On units that use a gear and pod combination: install the gears into the housing first and then install the motor assembly. Before installing the screws that secure the motor and circuit board use a small standard screw driver and rock the tenths digit of the odometer up and down. This will help to seat the gears into place and allow the motor assembly to seat fully.

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Step Zero: Overview
The 1988-89 Merkur Scorpio uses an electronic speedometer/odometer unit manufactured by VDO for Ford. Many other European cars of its era used similar or identical VDO mechanisms. The odometer drive spur gears in this unit were made of a very soft plastic that commonly fail with age. If the speedometer appears to be working fine, but the odometer has stopped operating, a stripped gear is the most likely cause. The small 20-tooth planetary gear used in these units is particularly failure prone.

The “right way” to make this repair involves removing the speedometer/odometer assembly from the faceplate. However, this necessitates pulling off the speedometer needle and printed speedometer fascia to access three small screws. Attempting to extract the needle from the spindle frequently results in a broken spindle. Some shops do not even attempt this any longer since they cannot get new speedometer assemblies from VDO. The alternate repair described here is a work around that many professional shops are currently using.


Picture 1

Tools Required:
- Philips screwdrivers
- Small straight-slot screwdriver (blade < 3/16” wide)
- 7mm nut driver or socket
- Needle-nose pliers or tweezers
- Electric drill
- 3/16” drill bit (must be sharp)

Optional Tools:
- Volt/ohm/frequency meter
- 12-volt power supply
- Function generator capable producing a sine wave in the frequency range of 20-200 Hz
- Jumper leads

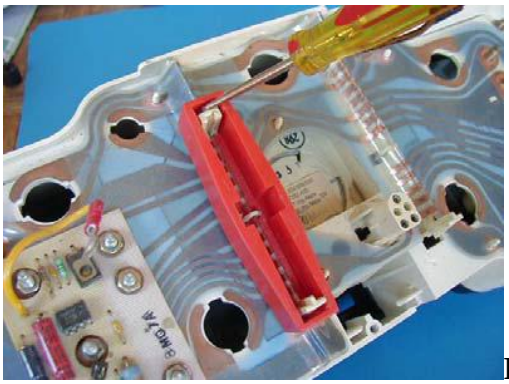
Step One: Remove Instrument Cluster
Note: The step order outlined here may be slightly different than that described elsewhere, but is the easiest procedure we have found in removing many Scorpio instrument clusters. **Tip:** Before removing the instrument cluster check for any malfunctioning light bulbs. Now would be a good time to replace them.

1) Adjust steering column position as far down as possible.
2) Remove four screws retaining instrument cluster bezel. Carefully pull bezel free and disconnect the panel illumination connectors. One connector is located on each side of the bezel.
3) Remove four screws holding instrument cluster to dash and pull cluster towards the steering wheel. Do this gently and only far enough to allow your hand to reach behind the left side of the cluster. It may be necessary to tip the top of the cluster toward you as you pull it free of the dash.

4) Carefully disconnect all the wiring connectors on the back of the instrument cluster. **Note:** The connector to the vehicle status display has a locking tab in the center of the connector. Pull the locking tab first to remove the connector.
5) Remove cluster from dash.

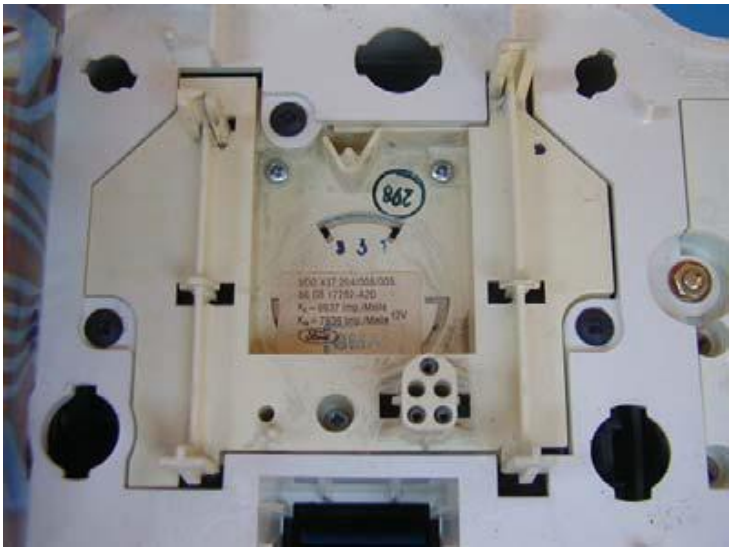
Step Two: Remove Speedometer Assembly

1) Gently pull the trip meter reset button straight out from the front of the cluster.
2) Remove the clear lens assembly from front of the instrument cluster. This is secured with three tabs at the top and two metal clips at the bottom. **Note:** The tabs break easily so be careful.
3) Remove all the bulbs from the rear of the cluster that are to the right of the anti-slosh circuit board.
4) Remove the red and green connector locks by gently prying upward inside the top of the lock with a small screwdriver to release it (*Photo 2*). Spread the lock slightly to allow it to slide over the center locking tab then disengage it from the lower locking tab.


Picture 2

5) Remove the three nuts and copper washers from the threaded studs at the right of the cluster.
6) Gently peel back the flexible circuit film, disengaging it from the locating studs, to expose the back of the speedometer assembly in the center of the cluster.
7) Remove the three larger screws holding the speedometer assembly into the cluster (*Photo 3*). **Note:** Be careful as you remove the last screw, as the speedometer will want to fall out the front of the cluster.
8) Carefully slide the speedometer out the front of the cluster.

Caution: Always be careful to not lay the speedometer on its face in such a way that you will put any pressure on the needle or shaft. A lack of care can result in a broken needle and/or speedometer spindle. Always rest the assembly on its side or back and hold it securely while performing the remainder of the repair procedure.


Picture 3

Step Three: Diagnose Malfunction (Optional)
With the speedometer assembly removed from the cluster, it is now possible to narrow down the cause of the malfunction. By bench testing now you may save yourself some unnecessary work. However, you need a couple additional tools that may not be available to everyone. I have had two repair technicians who work on VDO instruments tell me that 90% of these malfunctions are caused by a broken gear. Even if you do this test, you have a high probability of still having to replace the gear.

What we want to be able to do is simulate the signal sent from the speed sensor on the transmission to the speedometer while the car is moving. To do this we hook up our sine wave generator to the signal input of the speedometer/odometer to see if the stepper motor is operating. If the motor is working, but the odometer wheels are not turning, then you have a stripped gear.
To perform this test, you need a function generator that can produce an adjustable frequency sine wave in the range of 20 Hz to 200 Hz. Radio Shack sells these for under $60. Circuit Specialists also sells a kit with all the parts needed t0 build a small function generator for $8.95 that is perfectly adequate for performing this simple test on our speedometers. **(Note:** If you don't want to build this kit yourself let me know and I can assemble one for you for a nominal charge. I also have an assembled unit that I might be persuaded to loan out for the cost of two-way shipping with a refundable deposit.)


Diagram 1
Black= Ground / Red = 12 Volts / Yellow= Signal

Hook up test equipment to the speedometer as shown in the *Diagram 1*. You should see the speedometer register a speed in miles/hour that is approximately one-half the frequency. The speedometer tends to be less accurate at lower speeds, but you should see about 60 mph when supplying a 120 Hz signal. Look through the clear plastic window on the stepper motor case to see if the rotor is turning. Proper operation is indicated by a continuous series of little “ticks” much like a second hand on some analog clocks. Naturally, the faster the speed, the more frequently the stepper motor should “tick”. If the motor works, but the odometer wheels do not turn, go to **Step Four**.
If the stepper motor does not operate, check you have everything hooked up properly and try again. If the motor still does not turn, then the motor or circuit board is at fault. Sometimes resoldering the connections on the circuit board will fix this problem. If that does not work, then the only solution is to get a salvaged speedometer assembly or circuit board. Replacing the gears will not help anything if the motor does not operate.

Step Four: Odometer Disassembly

1) Remove the three small silver screws from the back of the speedometer assembly (*Photo 4*).
2) Gently pull the plastic mounting bracket and connector assembly clear of the speedometer and set it to the side. Be careful not to pull on the three wires connected to the speedometer circuit board.
3) Carefully drill a hole using a 3/16” bit in the clear plastic light conduit at the location where it obstructs access to one of the screws that secure the circuit board**.** See *Photos 5* and *6* for the location of this hole. **Caution:** Drill slowly and carefully to avoid the bit striking the circuit board when it breaks through the plastic. If your 3/16” bit is not sharp, it may help to first drill a smaller pilot hole.
4) Using a small straight slot screwdriver, remove the two screws that secure the circuit board (*Photos 5 and 7*).

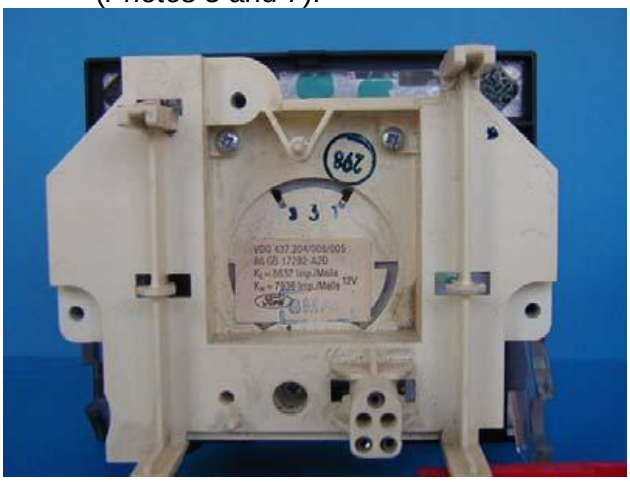


Photo 4

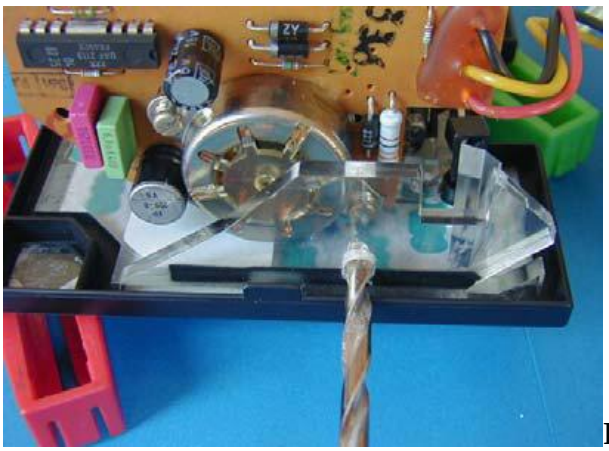


Photo 5

Photo 6

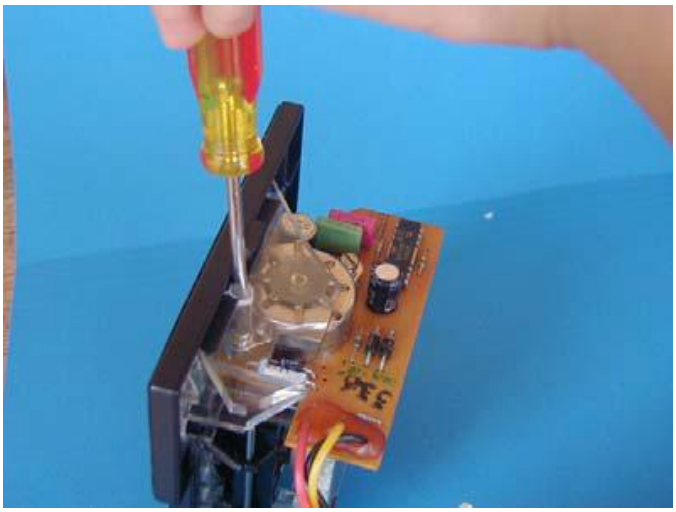


Photo 7

5) Working carefully and slowly, flex the circuit board slightly to allow it to be freed from the plastic pins that the screws were threaded into. You need to get the board far enough away from the odometer assembly that the motor shaft will disengage the white plastic gear armature and clear the transparent plastic odometer frame. Holding the stepper motor rotor into its housing and slightly flexing the clear plastic frame will allow the motor shaft to clear the ring gear. **Caution:** Two small wires run from the circuit board to the speedometer assembly. Do not try to pull the board up or to the side too far as you may break these wires**. Tip:** During this manipulation, it may help to extract the gear armature assembly so that it is not in the way. With a little prodding, it can be made to drop out of the ring gear cavity even before the circuit board is completely removed.

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6) When the circuit board is clear, you should be able to remove the stepper motor rotor and shaft assembly from the stator on the board (*Photo 8*).
7) If the white plastic armature and gear assembly has not fallen out by now, go ahead and remove it from inside the ring gear in the transparent plastic frame at this time.

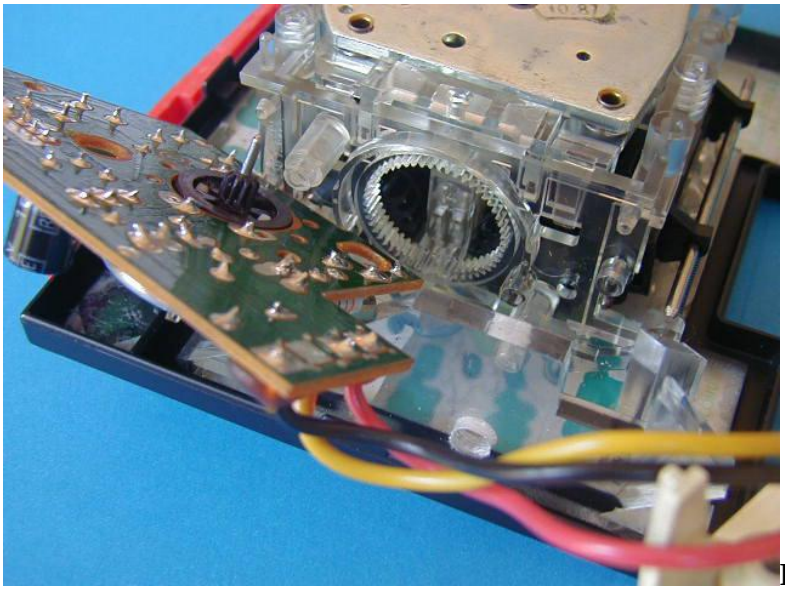
Photo 8

Step Five: Cleanup and Examination

1) Examine the ring gear cavity and the odometer wheel drive gears for any damage or pieces of a broken gear. Gently brush out any debris found.
2) Use a wooden or plastic toothpick and gently attempt to rotate the odometer and trip-meter gears to ensure they rotate freely. These gears can be seen and accessed through the ring gear hole. If these gears bind at all, there is probably still some debris interfering.
3) Look inside the stepper motor stator and carefully remove any dirt or debris found there.
4) Examine the rotor and pinion gear for any damage, dirt, or debris.
5) Do NOT apply any lubricant to any part of the speedometer/odometer assembly. The plastics used do not require lubrication and the use of the wrong lubricant can cause damage. Even the right lubricant used in excess can attract dirt and cause more harm than good.
6) Check the small planetary spur gear on the armature (*Photo 9*). This gear just slides off its mounting shaft. It should have 20 teeth all of which should be regular in shape and evenly spaced.

Make sure the gear disk is not cracked. Usually damage to this gear will be obvious. Mount the gear armature with the planetary gear in place onto the rotor shaft (*Photo 10*). While holding the armature, rotate the rotor. The planetary gear should turn freely and continuously through 360° on its stub shaft. If it stops turning, it means there is one or more teeth missing or rounded off.

7) Examine the 16-tooth drive gear mounted on the armature for any broken teeth or cracks (*Photo 11*). This gear is semi-permanently mounted on the armature and no attempt should be made to remove it unless it is damaged.


Photo 9


Photo 10


Photo 11

Step Six: Planetary Gear Replacement

1) To remove the 20 tooth planetary gear, just slide it off its shaft on the armature.
2) Slip the new gear onto the stub shaft noting that it is properly oriented.

Step Seven: Reassembly

1) Stand the speedometer assembly on its side so that the ring gear cavity is facing up.
2) Replace the armature and gear assembly into the ring gear in its original position. Orient the armature so that the planetary gear is at about the 7 o'clock position (*Photo 12*). This will keep it out of the way as you replace the rotor.

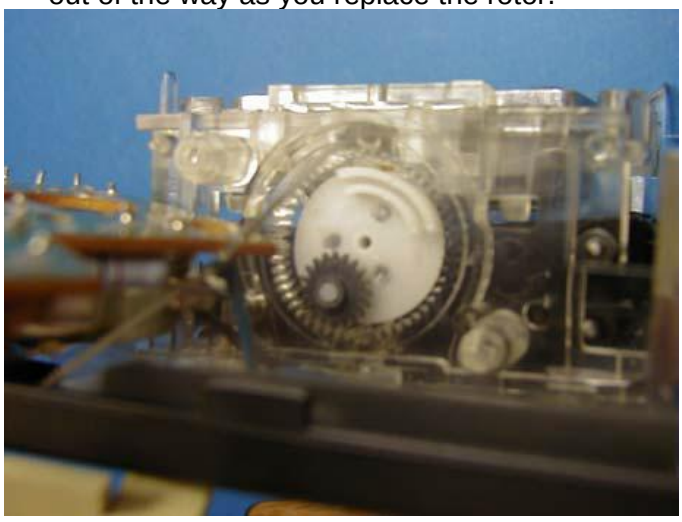
Photo 12

3) Replace the rotor into the stepper motor stator with the shaft and pinion gear facing out of the stator.

4) Carefully move the circuit board into its original position while holding the rotor in place. It may be necessary to gently flex the circuit board and speedometer housing near the ring gear very slightly to allow the rotor shaft to slide into the armature hub. A pair of tweezers might assist in guiding the shaft into its hole in the armature.
5) Position the two holes in the circuit board over their mounting pins.
6) Gently push the circuit board onto the pins while ensuring that the rotor and armature remain in their proper position.
7) Replace the two screws that hold the circuit board to the speedometer housing. **Tip:** Use the needle-nose pliers to position and hold the obstructed screw in place as you screw it into place through the hole you drilled.
8) Test the speedometer as you did in **Step Three**. The odometer and trip-meter should now operate properly.
9) Replace the bracket and connector assembly you removed in **Step Four** (*Photo 4*) and secure it with the three silver screws. There are small locating pins on the back of the speedometer housing that assist in proper positioning. **Note:** Ensure that the three wires running from the connector to the circuit board are tucked into the slot in the bracket.
10) Slide the speedometer assembly back into the instrument cluster housing and secure with the three screws removed in **Step Two** (*Photo 3*).

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11) Replace the flexible circuit film, connector locks, nuts and washers on studs, and light bulbs removed in **Step Two**.
12) Replace the clear plastic lens on the front of the cluster securing it at the bottom with the clips.
13) Gently press the trip-meter reset button into its position.
14) Reinstall the cluster into the dash. **Tip:** After you have all the electrical harnesses reconnected on the back of the cluster, turn on the ignition and ensure all the gauges, bulbs, etc. are operating properly before you push the cluster back into its final position.

Congratulations, you are done! Enjoy your working Scorpio odometer.

If you have any corrections, suggestions, or comments regarding these instructions or the procedure described, please let me know. Send email to jim@bitsprings.com.

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