Components of the Overdrive Electrical Circuit

The Laycock de Normanville overdrive used on all Austin-Healeys is engaged by physically sliding a gear assembly within the overdrive case from the normal position to the overdrive position. An internal clutch is used to lock the assembly in position, actuated with pistons moved by oil at 400 psi pressure. There is a ball valve that allows the oil to be diverted to the operating pistons, and this is controlled by a lever and linkage that is operated by an electric solenoid located on the overdrive unit itself.

This solenoid is the linking point between the electrical system and the mechanical system. If there is electric power to the solenoid, then overdrive will be engaged. If the electric power is interrupted, then the unit shifts back out of overdrive.

The overdrive wiring circuit is designed not only to operate the solenoid, but also to limit the conditions when it can be engaged or disengaged. The discussion that follows will describe how the various electrical components relate to each other to engage or disengage the overdrive. But more importantly, it should help you understand how the system works as the dash switch is turned on or off, as you operate the throttle, and as you shift gears. This understanding will make it easier for you to troubleshoot, should problems arise.

Though it might seem logical to start exploring the overdrive circuitry with the switch on the dashboard, in fact that component isn’t always involved in determining whether the overdrive is engaged or disengaged, so we’ll start from the other end with the overdrive solenoid.

Overdrive Solenoid — The solenoid is mounted on the side of the overdrive. The pictures on this page illustrate the solenoid on the overdrive unit. On many — including the late BN1s through the 100-Sixes — you can see the operating lever (upper photograph). Starting with the 3000 BN7/BT7 and continuing through the BJ8, this lever was enclosed in a box (lower photograph) that is cast as part of the overdrive side cover. All the operating components remained the same — they just were now enclosed. (Early 100s also had an enclosed design.) The change points for all these design variations are given in Service Parts Lists by overdrive unit numbers, not car chassis numbers, so it is hard to tell exactly where the changes occurred during car production.

Note: This discussion applies to the circuitry as installed on the BN2 through BJ8. The BN1 has some slight differences, addressed in a separate sidebar.
Inside the solenoid are wire coils that create a magnetic field that draws an iron plunger up and then holds it in place. As the plunger rises, the bottom end pulls up the lever underneath that, through a linkage inside the overdrive case, actuates the ball valve to divert oil, under high pressure, to the operating pistons. Everything in the electrical circuitry is designed to eventually cause this lever to move up and down to coincide with the driver’s desire to be in an overdrive gear, while at the same time safeguarding the mechanical components of the drive train.

Since more force is required to draw the plunger up into the solenoid than to hold it there, the solenoid contains two internal coils. One has low resistance, about two ohms, and this provides the strong actuating magnetic field. The top of the solenoid cavity the plunger actuates a switch which disconnects the low resistance coil, leaving only the high-resistance – about 11 ohms (and thus drawing less current) – holding coil functioning, which creates a lesser, but sufficient, magnetic field to hold the plunger up.

The most frequent cause of solenoid failure occurs when the solenoid is improperly adjusted, and the low-resistance actuating coil doesn’t disconnect, causing the solenoid to burn out. The Workshop Manual provides the procedure to adjust the lever to which the solenoid is connected. It is critical that you check that the coil resistance changes when the plunger is pressed to the top of its stroke and make sure that after removing the 3/16-inch setting dowel (as described in the shop manual) the lever is free to move upwards a bit more and thus is not restricting upward movement of the plunger.

Gear Switch – The gear switch can be seen in the bottom picture on the opposite page, on the side of the gearbox housing. On 3-speed BN1 gearboxes it is located on the right side of the case, while on MkII and MkIII center-shift transmissions it is on the casting that supports the gear lever. Regardless of location, these switches are quite similar in appearance.

The purpose of this switch is to allow current to the overdrive solenoid only when the transmission is in the top two gears. In particular, it prevents the overdrive from being engaged when the transmission is in reverse, since some components of the overdrive are designed to operate in only one direction. Should this switch fail or be overridden, allowing the overdrive to remain engaged when the car is driven in reverse, catastrophic damage to the overdrive can result.

The gear switch closes when the gearshift is in the three-fourth slot on 4-speed gearboxes, and opens when the gearshift is moved over into the one-two or reverse slots. The electrical circuit connects the gear switch to the C2 post on the overdrive relay box.
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The overdrive relay is not depressed, creating a circuit that keeps the overdrive relay energized even if the dash switch has been flipped to NORMAL. As the throttle is pressed, a lever connected to the throttle linkage rotates a cam in the switch case that opens the points and breaks the circuit, de-energizing the overdrive relay. If the lever is properly adjusted, the points will remain closed at less than about quarter throttle, and open when the throttle pedal is pressed more than one-quarter.

**Dashboard Overdrive Switch** – The final component in the overdrive circuit is, of course, the dash-mounted toggle switch. While necessary to initiate operation of the overdrive, as we’ve just noted, depending on throttle position, the solenoid may remain engaged even if this switch is opened, and by the same token, the gear position will determine whether closing this switch will cause the solenoid to engage.

How all this works might best be understood by considering several different situations.

**Operation and Basic Trouble-shooting**

With some assistance from our schematic circuit diagram, we can examine how the overdrive electrical circuit looks under various scenarios. This is also a good procedure to use for checking operation of the electrical system in the event the overdrive isn't working.

As shown in Diagram B, with the ignition on, the engine not running, and the gear lever in third or fourth (second or third on BN1 3-speed gearboxes), when the dash switch is moved from NORMAL to OVERDRIVE, you should hear a distinct click from the overdrive solenoid. If you don’t hear the click, then some component of the electrical system is faulty, and you’ll need to check each component in turn as discussed below. (Note: on 3-speed BN1s there is an additional component, the centrifugal switch, which prevents shifting into overdrive below about 40 mph. Because of this you cannot perform the above test on the BN1 cars.)

If you do hear the click, but the overdrive doesn’t work when the car is driven, then the problem is in the overdrive itself, which will have to be checked by a qualified specialist.

Diagram C illustrates what happens when the throttle pedal is less than one-quarter pressed. The throttle switch points are closed, keeping the relay coil energized and the relay points closed, and keeping the overdrive engaged.

If the throttle pedal is pressed more than one-quarter through the drive train, so if the overdrive were to disengage, the consequent increase in engine rpm would cause the drivetrain to jerk and could cause harm to the engine.

**Throttle Switch** – The throttle switch is contained in a box mounted on the firewall. The throttle switch ensures that, when the overdrive is being transmitted from the rear wheels for construction. Inside the case is a set of switches that are closed when the throttle pedal is less than about quarter throttle, and open when the throttle pedal is pressed more than one-quarter.

If the overdrive switch is left on, but the car is shifted down into second, first, or reverse, the overdrive will disengage, but will re-engage when the transmission is shifted back into third.

You can use this feature to anticipate downshifting out of overdrive. For example, if you are driving on fairly level ground, you can flip the dash switch to NORMAL and still maintain your speed using only a very light throttle. The overdrive will remain engaged. When you are ready to shift out of overdrive, merely depress the throttle about one-quarter and the transmission will immediately down-shift out of.
overdrive. This procedure can be handy when exiting a freeway, as it only takes a light “blip” of the throttle as you enter the off ramp to drop out of overdrive.

To check the throttle switch adjustment, with the engine off and the ignition turned on, flip the overdrive switch on. Then, with your foot off the throttle, flip the switch to NORMAL. Now flip the switch back on again. You should not hear the overdrive solenoid click, as it should not have been de-energized when the switch was flipped off. Next, repeat this above sequence, except this time depress the throttle about one-quarter before flipping the switch on for the second time. You should now hear the solenoid energize, as depressing the throttle should have opened the throttle switch points.

A more accurate and direct way to check the throttle switch setting is to disconnect the two wires and put an ohmmeter across the terminals. The reading should go from zero ohms (throttle less than one-quarter depressed – switch points closed) to infinite when the points open.

To adjust the throttle switch, loosen the clamp bolt on the lever arm. The throttle switch has an internal spring which helps in setting it. With the shaft free to be positioned by this spring, the cam should be oriented so that the points are closed.

You can check this by using a screwdriver to rotate the shaft by its slot. Turning an equal amount clockwise and then counterclockwise you should find a position in each direction where the resistance becomes infinite – the points are now open. Position the shaft about half way between these extremes, tighten the arm clamp, and use this as a starting point for adjustment. Observe the throttle position when the resistance changes from zero, and make adjustments to the shaft position until this occurs at about one-quarter throttle.

Diagram E illustrates what happens if the transmission is shifted down into second or first, as for example if you have to slow down on the highway in a traffic jam. In this case, there is still power flowing through relay coil and consequently through the C1 and C2 points but the overdrive solenoid circuit is open at the gear shift switch, preventing the power from getting to the solenoid coil. As soon as you shift back into third, the overdrive will re-engage.

Further Electrical Trouble-shooting

The gear shift switch operation can be checked as follows. Disconnect the ground wire from terminal W2 on the overdrive relay and connect a jumper wire (with alligator clips at both ends) from terminal A3 on the fuse block to C2 on the overdrive relay. Switch on the ignition (but do not start the engine) and move the gear shift lever back and forth from the three-four slot to the first-second slot. Each time the lever is moved over to the three-four position, you should hear the solenoid click as the plunger is pulled up. If you don’t hear that click, then the throttle switch is faulty. Before continuing with the following additional tests remove the jumper wire and reconnect the ground wire to W2.

If the gear lever switch is working properly, to check the overdrive relay, turn on the ignition and shift the transmission into third or fourth gear. In the engine compartment, attach one end of a short jumper wire from terminal W1 of the relay and touch the other end to fuse post A3. If you don’t hear the relay respond, the internal coil is bad. You can also sense operation of the relay by feeling the cover for vibration.

If you verify the relay is working, then go listen for the overdrive solenoid to click while someone else touches the jumper wire to the terminals. If the solenoid doesn’t operate, then the relay points could be dirty or damaged and not making good electrical contact.

Once you have verified that all the other components are working properly, you can check the dash toggle switch. With the engine off, ignition turned on, gear lever in one of the top two gears, and throttle pedal released, flip the toggle to OVERDRIVE. You should hear the solenoid click. Flip the switch back to NORMAL and turn the ignition switch off (to de-energize the solenoid even if the throttle switch is not set correctly). Re-test by turning the ignition switch on followed by the toggle switch.

If the overdrive should start operating while you’re out on the road and you can determine that it’s an electrical problem rather than a problem within the overdrive itself, it may be tempting to bypass the offending component(s). However, since these components are designed to protect the overdrive, this may not be a good idea, since it can be considerably more expensive to replace the overdrive should that fail as a consequence of one of the override switches not working.

Your engine can quite effectively handle highway speeds even without overdrive. Though the higher rpm may be a little wearing on driver and passenger, the car will get you to a place where you can trouble-shoot the system properly and properly replace a failed electrical component.