

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion. The shift valves (solenoids) are On-Off solenoids and are powered up by the TCM with a 12-volt power source and are internally grounded in the transmission. The Torque Converter Clutch (TCC) and Pressure Control (PC) solenoids are also powered up by the TCM and internally grounded in the transmission but are pulse with modulated (PWM) . PWM measurable voltage varies depending on percentage of modulation requested by the TCM.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

- Increase the amount of current applied to the coil or
- Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired

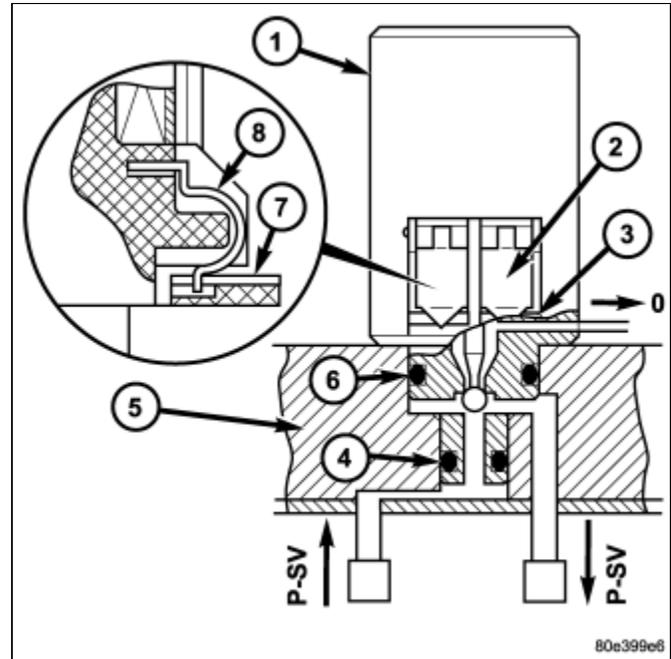
position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

UPSHIFT/DOWNSHIFT SOLENOID VALVES

The solenoid valves (1) for upshifts and downshifts are located in the shell of the electric control unit and pressed against the shift plate with a spring.

The solenoid valves (1) initiate the upshift and downshift procedures in the shift plate.

The solenoid valves (1) are sealed off from the valve housing of the shift plate (5) by two O-rings (4, 6). The contact springs (8) at the solenoid valve engage in a slot in the conductor tracks (7). The force of the contact spring (8) ensures safe contacts.

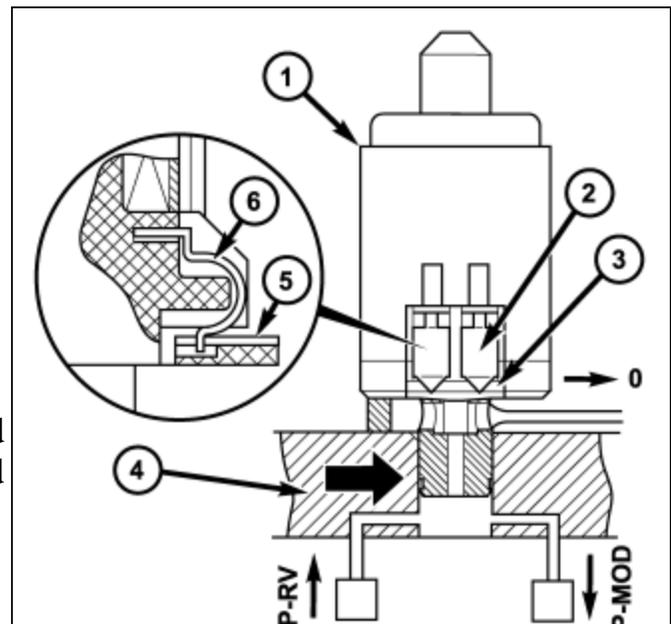


MODULATING PRESSURE CONTROL SOLENOID VALVE

The modulating pressure control solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

Its purpose is control the modulating pressure depending on the continuously changing operating conditions, such as load and gear change.

The modulating pressure regulating solenoid valve (1) has an interference fit and is sealed off to the valve body of the shift plate (4) by a seal (arrow). The contact springs (2) at the solenoid valve engage in a slot in the



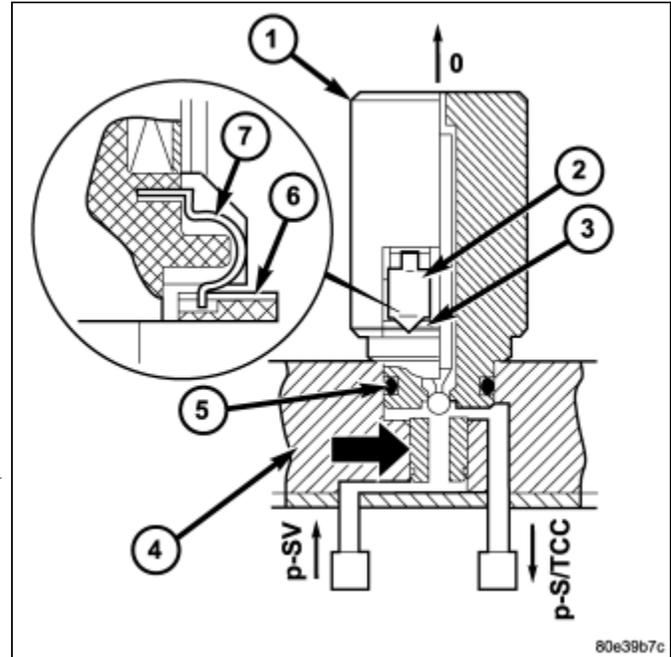
conductor tracks (3). The force of the contact springs (2) ensures secure contacts.

TORQUE CONVERTER LOCKUP CLUTCH PWM SOLENOID VALVE

The torque converter lockup clutch PWM solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

The PWM solenoid valve (1) for the torque converter lockup controls the pressure for the torque converter lockup clutch.

The torque converter lockup PWM solenoid valve (1) is sealed off to the valve body of the shift plate (4) by an O-ring (5) and a seal (arrow). The contact springs (2) at the solenoid valve engage in a slot in the conductor tracks (3). The force of the contact springs (2) ensures secure contacts.

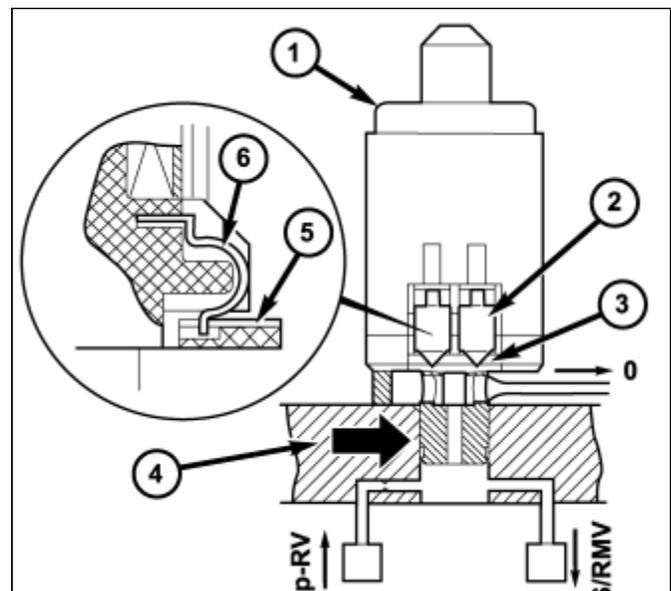


SHIFT PRESSURE CONTROL SOLENOID VALVE

The shift pressure control solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

Its purpose is to control the shift pressure depending on the continuously changing operating conditions, such as load and gear change.

The shift pressure regulating solenoid valve (1) has an interference fit and is sealed off to the valve body of the shift plate (4) by a seal (arrow). The contact springs (2) at the



solenoid valve engage in a slot in the conductor tracks (3). The force of the contact springs (2) ensures secure contacts.