Simple Electronic Transmission

Matthew Whitten
Brookhaven College

Basically a Hydraulic System

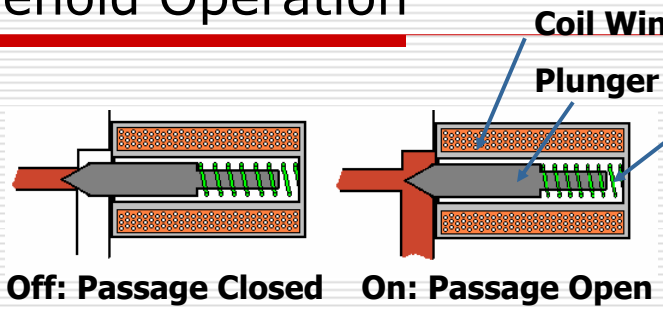
An electronic transmission is a hydraulically-operated unit that has solenoids controlling valve operation. The solenoids control:

1. Shift timing, when the shift occurs.

2. Shift quality, how firm or soft the shifts are. This is done by changing boost pressure at the regulator valve.

3. Torque converter clutch application.

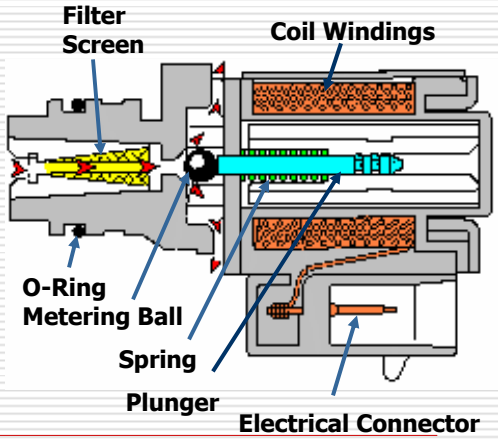
Solenoid Operation



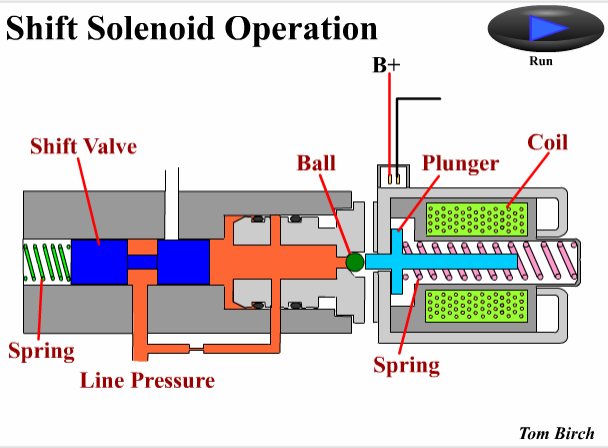
When the solenoid is off, the spring moves the plunger to close the passage. When the solenoid is turned on, electrical current flows through the windings. This creates a magnet that pulls the plunger into the solenoid and opens the passage.

Shift Solenoids

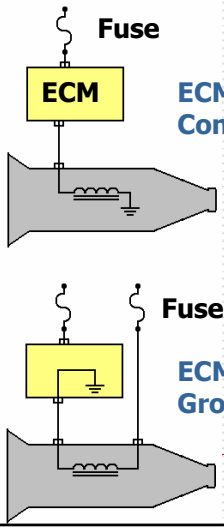
A solenoid has a coil of wires that becomes a magnet when current flows through the windings. When magnetized, the plunger will move to the right and allow the metering ball to move off its seat. This will allow fluid to flow through the filter screen and out the exhaust.



Shift Solenoid Animation



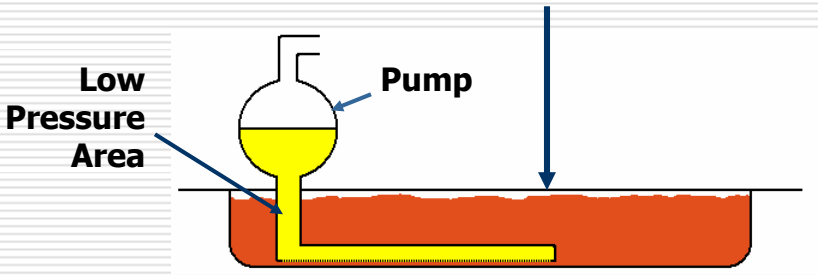
Solenoid B+ & Ground



A one-wire solenoid is connected directly to ground by its mount and switched to B+ by the ECM to turn it on.

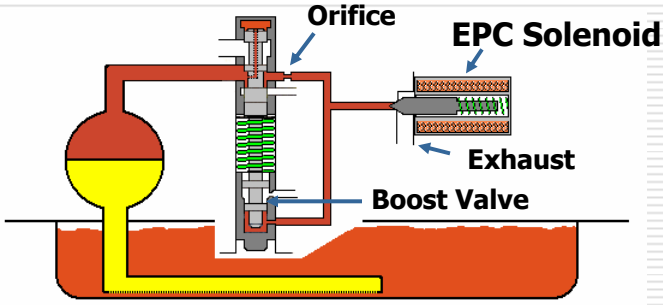
Most two-wire solenoids are connected to B+ through a fuse and the ECM controls the ground to turn it off or on.

Pump



Fluid supply starts out the same as a non-electronic transmission. The pump is driven by the torque converter and pumps enough fluid to supply the transmission's needs. Pump output volume increases as engine speed increases. Pump operation creates a low pressure that draws in fluid.

Electronic Pressure Control (EPC)



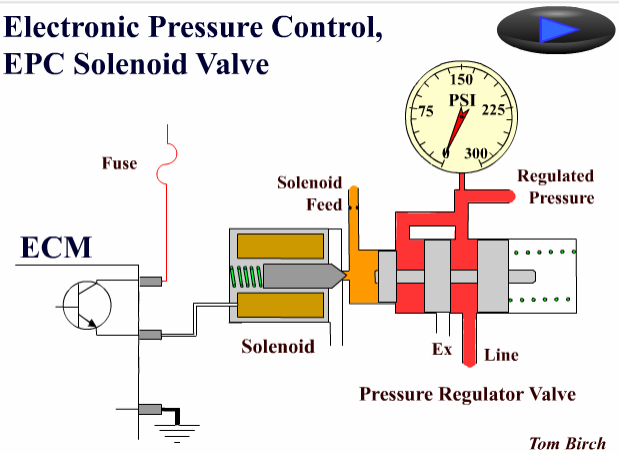
When the EPC solenoid is off, boost pressure will increase, and this will raise mainline pressure. Turning the solenoid on, opens the exhaust passage to drop boost and line pressure. The orifice prevents too much fluid loss through this circuit.

EPC Solenoid

The EPC solenoid is very busy, constantly opening and closing to maintain the proper line pressure. It is also called a force motor, variable force solenoid (VFS) or pulse width modulated (PWM) or MOD.

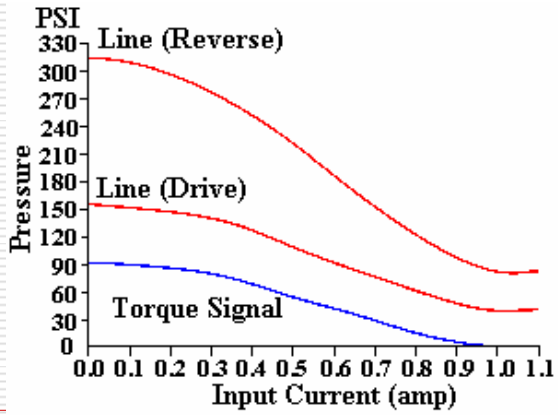
A similar solenoid is sometime used to control converter clutch apply and release.

EPC Animation



Fluid Pressure Control

Increasing the current flow to this pressure control solenoid/force motor will reduce line pressure. No current flow produces the highest pressure for the firmest or strongest shifts.

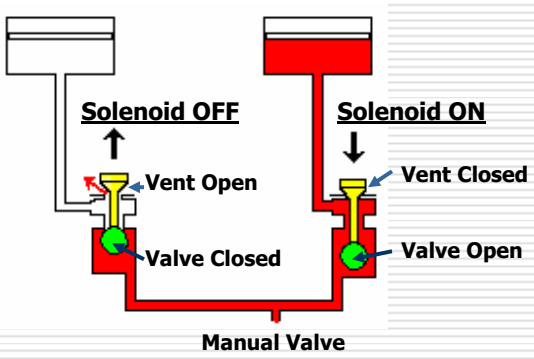


Shift Solenoids

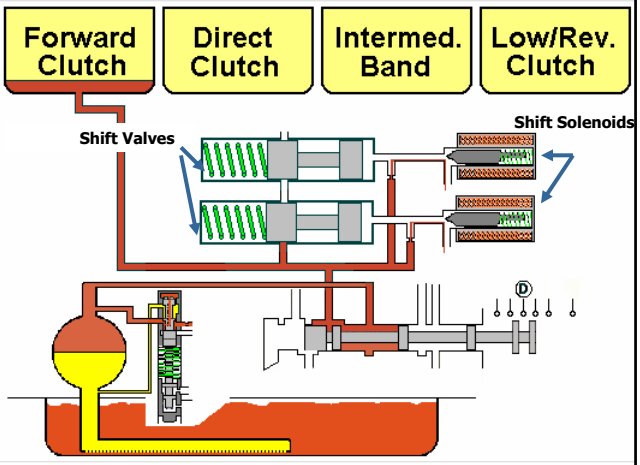
A shift solenoid is either on or off, and it strokes once to make an upshift or downshift. Some 4-speed transmissions use two shift solenoids that are both on, both off, or one open at one time. One modern 6-speed transmission uses 8 solenoids: 6 shift solenoids, an EPC solenoid, and torque converter clutch (TCC) solenoid.

Direct Solenoid Operation

In this transmission, the solenoid stems (yellow) act on the check ball/ valve. The taper on the stems opens or closes a vent. When the solenoid is off, the stem is upward, opening the vent and closing the valve.



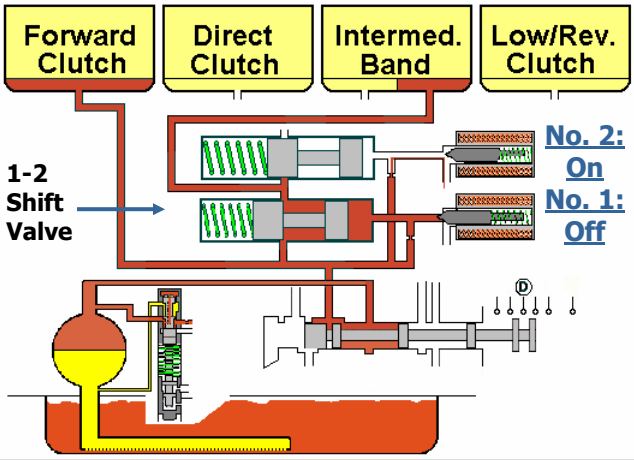
Drive, First/Low Gear



Both shift solenoids are on so both shift valves are down-shifted. Shift valve pressure is exhausted at the solenoids.

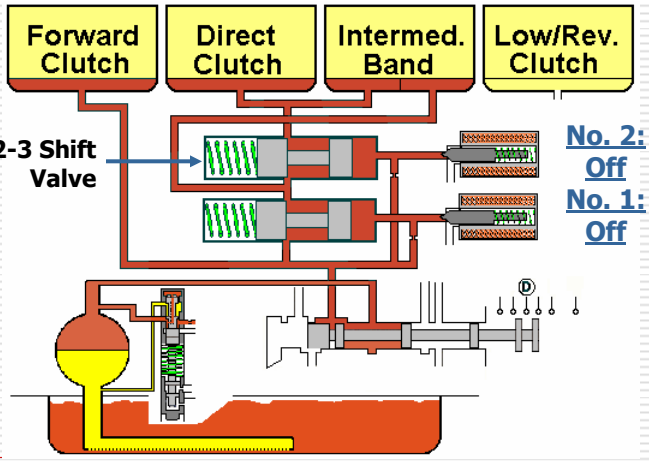
Drive, Second Gear

Turning Solenoid No. 1 off causes a pressure increase that moves the 1-2 shift valve to upshift. This applies the intermediate band to make the shift to 2nd gear.



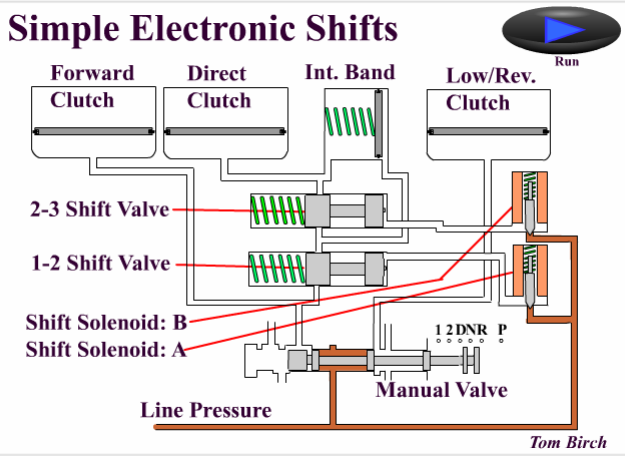
Drive, Third/High Gear

Turning solenoid No. 2 off will move the 2-3 shift valve to upshift. This will release the band and apply the direct clutch for 3rd gear.



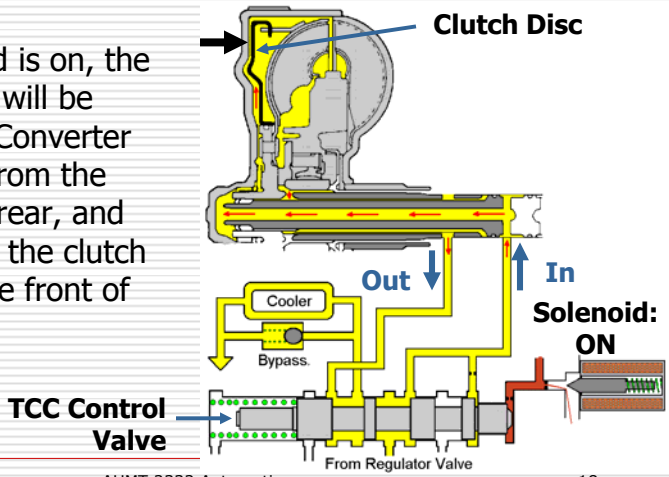
Animation: Simple Electronic Shifts

Simple Electronic Animation



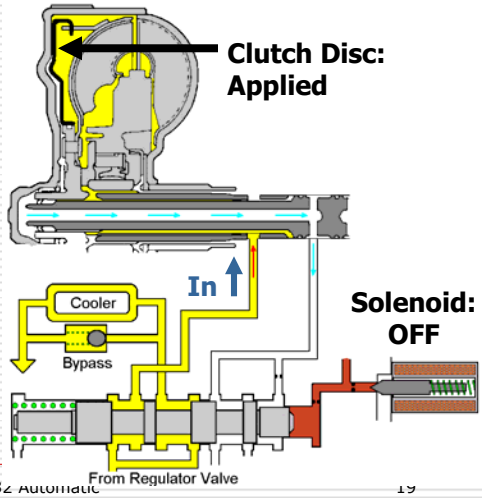
Torque Converter Clutch (TCC)

When the solenoid is on, the TCC control valve will be toward the right. Converter fluid flow will be from the front (left) to the rear, and this flow will push the clutch disc away from the front of the converter.



TCC Applied

Switching the solenoid off produces a pressure increase at the right side of the TCC Control valve. This moves the valve to the left. Valve movement sends fluid into the rear of the converter which applies the TCC.



TCC Control

This solenoid is cycled at a 25 to 50% duty cycle during torque converter clutch (TCC) apply. This produces a much smoother TCC apply and release.