Antilock Brake Systems

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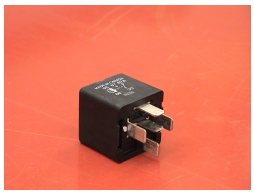
Antilock Brakes

- ABS prevents brake lockup during by modulating brake system hydraulic pressure to the brakes
- Two types of antilock brake system are commonly used
  - Three channel
  - Four channel

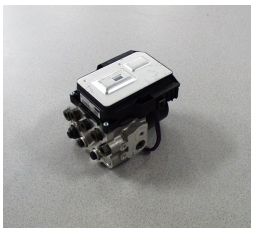
ABS Power Relay

- Provides power to the:
  - ABS module
  - Hydraulic pump
  - Inlet solenoids
  - Outlet solenoids



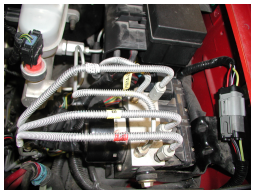
ABS Module

- Calculates wheel speed
- Estimates vehicle speed
- Determines wheel lockup
- Activates antilock brake system
- Utilizes self-diagnostics and fail-safe systems
- Stores service codes in its memory



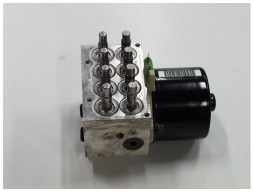
Hydraulic Control Unit

- Converts electrical signals from the ABS control module into hydraulic actions
- Normally contains
  - Inlet and outlet valves
  - Accumulator
  - Hydraulic pump
- Normally serviced as a complete unit
- Sometimes combined with the ABS control module



Inlet and Outlet Valves

- Energizing the inlet solenoid closes the inlet valve, separating the wheel cylinder or caliper from the hydraulic system
- Energizing the outlet solenoid opens the outlet valve, allowing hydraulic pressure to bleed from the wheel cylinder or caliper



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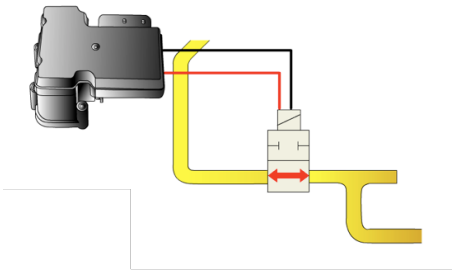
Inlet Solenoid Operation



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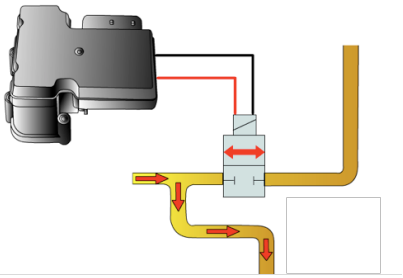
Outlet Solenoid Operation



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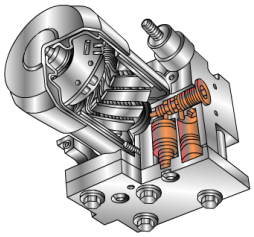
Brake Fluid Pump

- Normally internal to the HCU
- Driven by the motor to provide fluid movement under high pressure
- Produces the pressure needed to send the brake fluid from the accumulator to the master cylinder
- Pump operation may be felt in brake pedal



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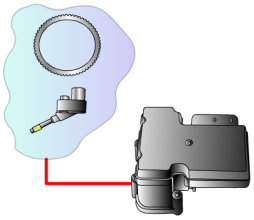
Wheel Speed Sensor

- Monitors each ABS controlled hydraulic channel
- ABS module "counts the teeth" of the sensor ring as they pass the wheel speed sensor allowing the module to determine the rotation speed of the wheel
- May be passive or active type sensors



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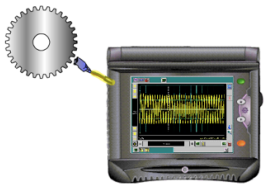
Passive Wheel Speed Sensor

- Variable reluctance sensor
- Creates an AC signal pulse as each tooth of the antilock sensor ring passes
- As the speed of the wheel increases, the frequency of the AC signal increases



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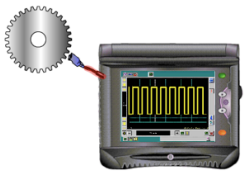
Active Wheel Speed Sensor

- Reluctance sensor and an analog to digital converter to convert the signal to a digital square wave
- Digital signal toggles between approximately 0.9 and 1.9 volts



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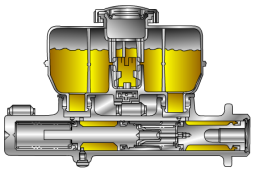
Brake Fluid Level Indicator

- When the fluid reaches a predetermined level, the magnet causes the reed switch to close
- Provides a ground for the red brake warning indicator
- On some ABS systems, this also grounds a circuit of the ABS control module, ceasing anti-lock operation and illuminating the ABS lamp



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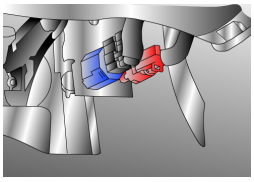
Brake Pedal Switch

- The Brake On/Off (BOO) switch closes when the brake pedal is depressed and a 12-volt signal is sent to the ABS control module
- A Brake Pedal Position (BPP) sensor is used on some vehicles provide the ABS with module brake pedal position



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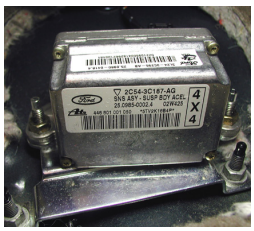
Longitudinal Accelerometer

- When driving a 4-wheel drive truck in 4x4 mode, all four wheels are mechanically linked
- If one wheel locks up all the wheels stop and the ABS control module could mistake this condition for a stationary vehicle
- The G-switch is a mercury switch that detects when the vehicle is accelerating or decelerating to prevent this condition



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ABS Warning Lamp

- The ABS warning lamp comes on or stays on to indicate a failure in the ABS
- The lamp has a prove-out cycle during initial vehicle startup
- The lamp may also be used to retrieve DTCs

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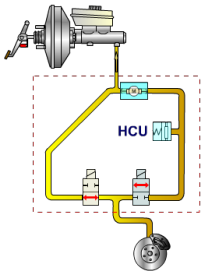
Normal Operation

- During normal braking when the brakes are applied, fluid is forced from the brake master cylinder outlet ports to the normally open inlet ports of the HCU
- The brake fluid then travels to the braking units just like in a conventional brake system



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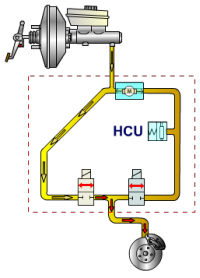
Pressure Holding

- The ABS control module uses wheel speed sensor input to determine which wheel is locking up
- The ABS control module activates the inlet solenoid for the wheel that is in danger of lock-up
- The normally open inlet valve closes, preventing any more hydraulic pressure from reaching the wheel



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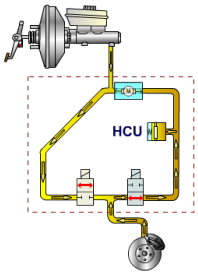
Pressure Decrease

- If the wheel is still decelerating too quickly, the module sends a signal to the outlet solenoid for that wheel
- The normally closed valve dumps pressure to the accumulator
- Once the affected wheel returns to an acceptable speed the valves are returned to their normal positions
- The valves may cycle as many as 12-15 times per second



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Brake Fluid Return

- Since brake fluid is released each time the outlet valve is opened, there must be a way to replenish the brake fluid to the system
- The pump motor is energized by the ABS module and brake fluid stored in the accumulator is pumped back to the master cylinder
- The driver may notice the pedal moving as the brake fluid is returned