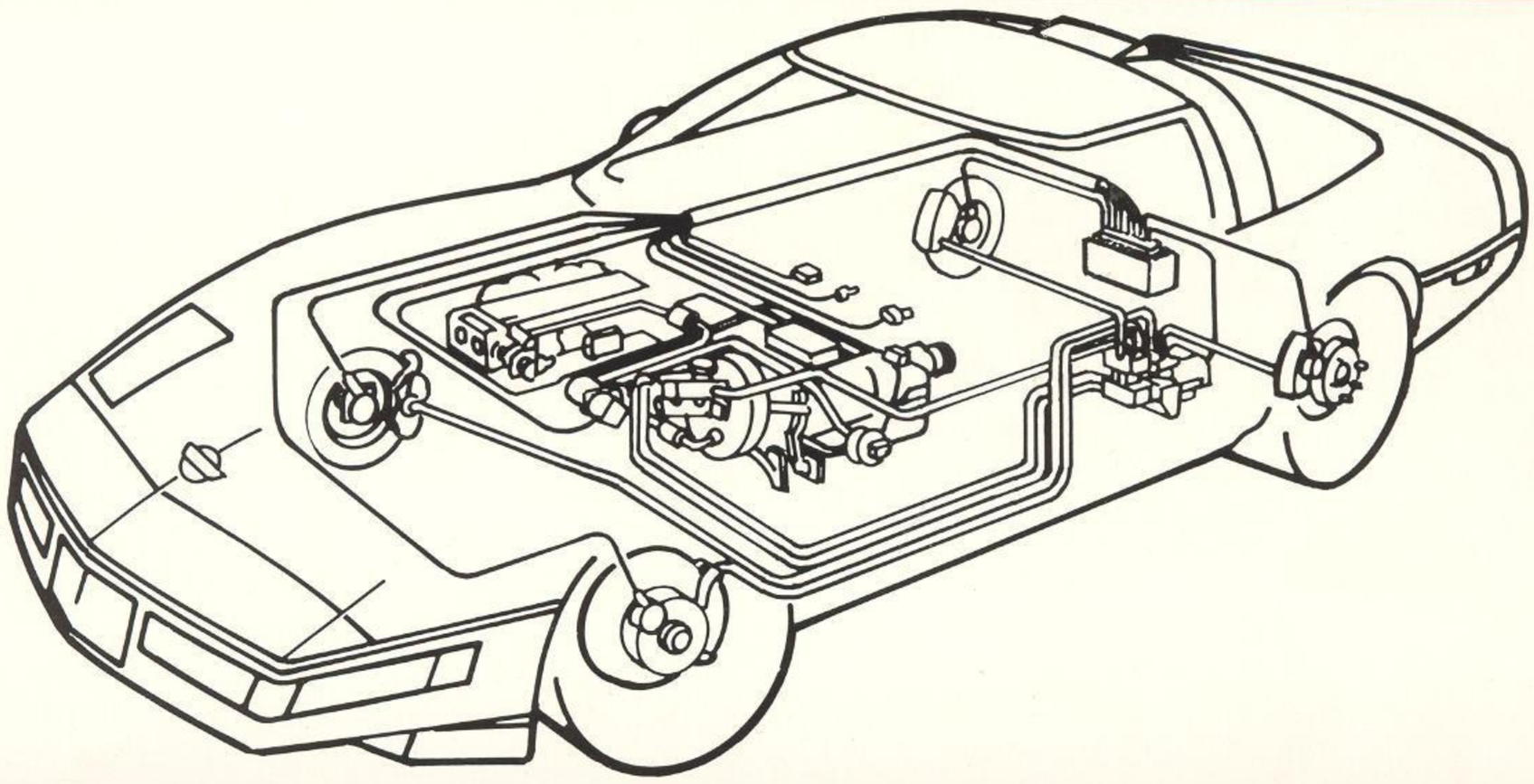
Corvette ABS/ASR Operation and Diagnosis

Antilock Brake System / Acceleration Slip Regulation



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CORVETTE ABS/ASR

Foreword

While this booklet will serve as an excellent review of the extensive program presented in the training center session, it is not intended to substitute for the various service manuals normally used on the job. The range of specifications and variations in procedures between model years requires that the model year service publications be referred to, as necessary, when performing these operations.

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1. System Overview

Beginning in the 1992 model year, Chevrolet features both an Antilock Brake System (ABS) and an Acceleration Slip Regulation (ASR) system as standard equipment on the Corvette (figure 1-1), regardless of engine:

- LT1 (VIN P) Corporate 5.7L (350 CID)
- LT5 (VIN J) DOHC 32-valve 5.7L (350 CID)

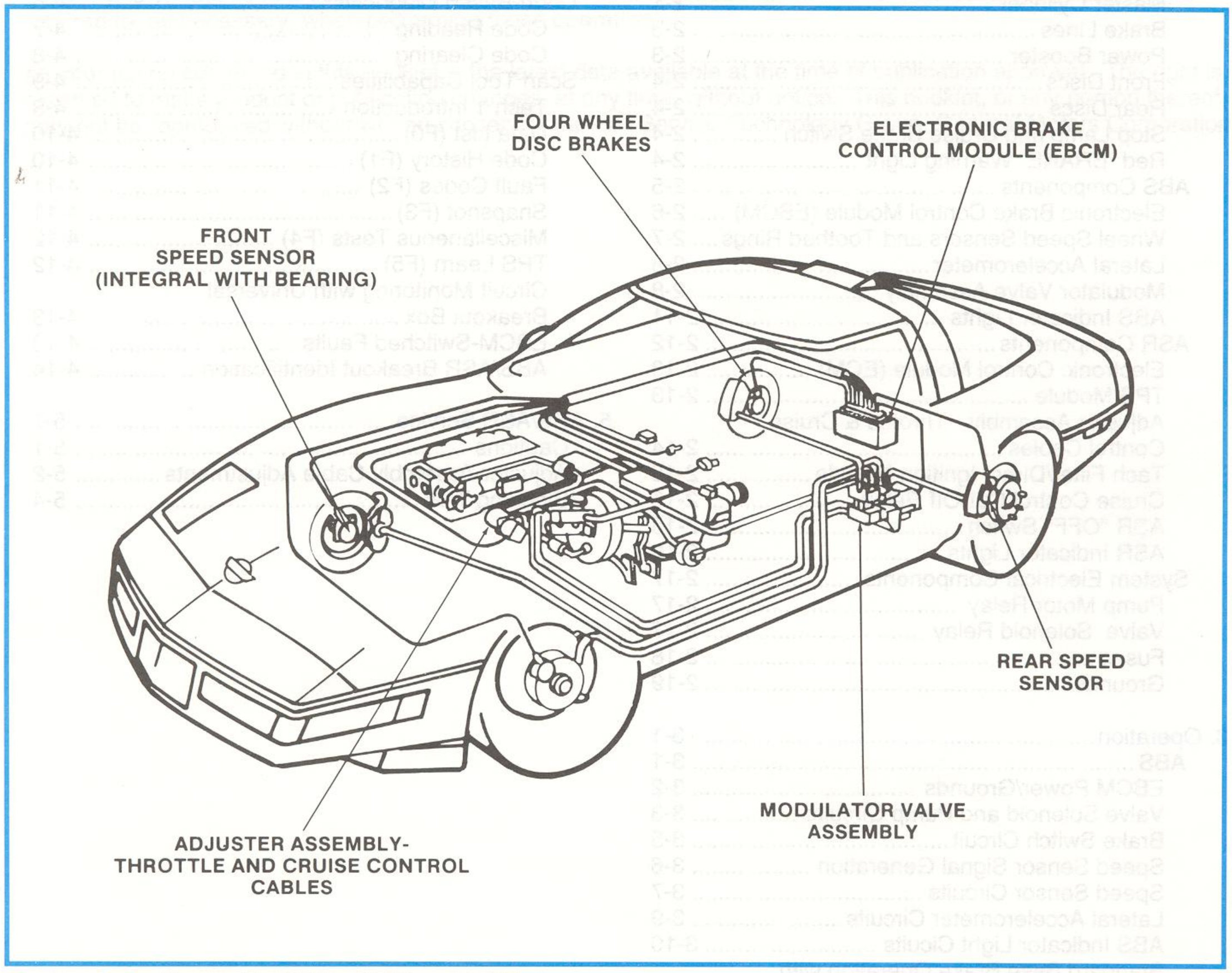


Figure 1-1, Corvette With ABS and ASR

ABS and ASR are integrated and controlled by the same Electronic Brake Control Module (EBCM).

In the case of ABS, the EBCM looks at wheel speed data to regulate wheel slip during an impending lockup situation for increased braking effectiveness.

For ASR, the EBCM looks at wheel speed data to determine whether wheel slip is occurring during acceleration. With Corvette ASR, brake intervention as commanded by the EBCM is one of three methods to control rear wheel slip. Spark retard and throttle close-down are also used to help regulate slip on acceleration.

ABS/ASR GOALS

The Bosch ABS/ASR system for the Corvette is considered a non-integral system. The design is downstream of the conventional brake booster and master cylinder, ahead of the four disc brake assemblies.

In essence, ABS/ASR is merely added to the existing Corvette power-assisted base brake system. Power-assisted braking is not affected when ABS and/or ASR are disabled.

ABS will provide the average driver with:

- Enhanced directional stability during an impending lockup condition.
- Enhanced steering control by enabling the vehicle to move in a driver-controlled direction during an impending lockup condition.
- Enhanced braking performance by reducing vehicle speed in potentially the shortest possible distance during impending lockup conditions on most driving surfaces.

ASR will provide the average driver with:

- Reduced wheel slip during acceleration when compared to similar rear-wheel drive vehicles.
- Enhanced directional control during acceleration on normal or marginal driving surfaces.
- Potentially improved straight-line and cornering maneuverability on most driving surfaces when compared to similar rear-wheel drive vehicles.

WHEEL SLIP

ABS/ASR on Corvette controls both negative and positive wheel slip to provide an average driver better vehicle control during aggressive braking and marginal traction conditions.

We refer to a wheel slipping negatively when a driver applies too much brake force and causes the wheel to lock-up. The tire slides or slips on the road surface, increasing stopping distances and reducing vehicle control and handling quality.

We refer to a wheel slipping positively when a driver applies too much acceleration effort for the tire-to-road traction conditions. The driving wheels spin (slip), which wastes energy and impairs the directional control and forward motion of the vehicle.

2. Components

ABS/ASR for Corvette is a non-integral system, as mentioned before. Components for this system can be divided into three sub-systems:

- Base brakes (also known as foundation brakes)
- ABS
- ASR

BASE BRAKE COMPONENTS

The base brake components of the Corvette ABS/ASR system are similar to those that have been on Corvette for years:

- Master cylinder
- Power booster
- Disc brakes at all four wheels
- Brake lines
- Stop lamp switch
- Red "BRAKE" warning light

Master Cylinder

The aluminum and plastic composite master cylinder features dual pressure chambers (figure 2-1). The primary piston supplies pressure to the front brakes, while the secondary piston supplies the rear brakes. Included in the master cylinder are the proportioning valve and the combined pressure differential sensor/warning switch.

The master cylinder features a Positive-Opening Center Valve, which opens when the secondary piston returns to the rest position. This valve provides pressure relief in case excess fluid is being pumped back to the master cylinder. This helps prevent pump damage in a case when the driver applies maximum braking force at the same time the ABS pump is returning excess fluid to the master cylinder.

The plastic baffled reservoir has a common fluid reserve with three chambers (figure 2-2):

- The primary chamber
- The secondary chamber
- The ABS/ASR modulator valve assembly chamber (feeds the ABS/ASR prime pipe)

The reservoir cap is vented, and although it looks similar to other reservoir caps, always be sure the correct vented cap is specified when replacement is required. This venting design is critical to proper ABS/ASR operation.

A float-type fluid level switch is found in the reservoir. When brake fluid is approximately 33 mm (1 5/16") below the top of the neck for the cap, the red "BRAKE" warning light illuminates and the EBCM:

- Disables ABS/ASR operation
- Turns "ON" the "SERVICE ASR" light
- Turns "ON" the "SERVICE ABS" light

1. Reservoir Cap
2. Reservoir Cap Diaphragm
3. Reservoir Body
4. Reservoir O-Ring
5. Secondary Piston Stop Pin
6. Cylinder Body
7. Secondary Return Spring
8. Secondary Spring Retainer
9. Center Valve Spring
10. Center Valve Plunger
11. "L" Type Cup Seal
12. Secondary Piston Assembly
13. Primary Cup Retaining Ring
14. Recuperating Type Cup Seal
15. Recuperating Guide
16. Primary Piston
17. Retaining Ring
18. End Plug
19. End Plug O-Ring
20. Electrical Bias Spring
21. Proportioning Valve/Pressure Differential Assembly (do not disassemble)
22. Proportioning Valve Spacer
23. Proportioning Valve O-Ring
24. Pressure Differential Warning Switch Assembly (do not disassemble)
25. Reservoir Retainer Screw
26. Fluid Level Switch Assembly (do not disassemble)

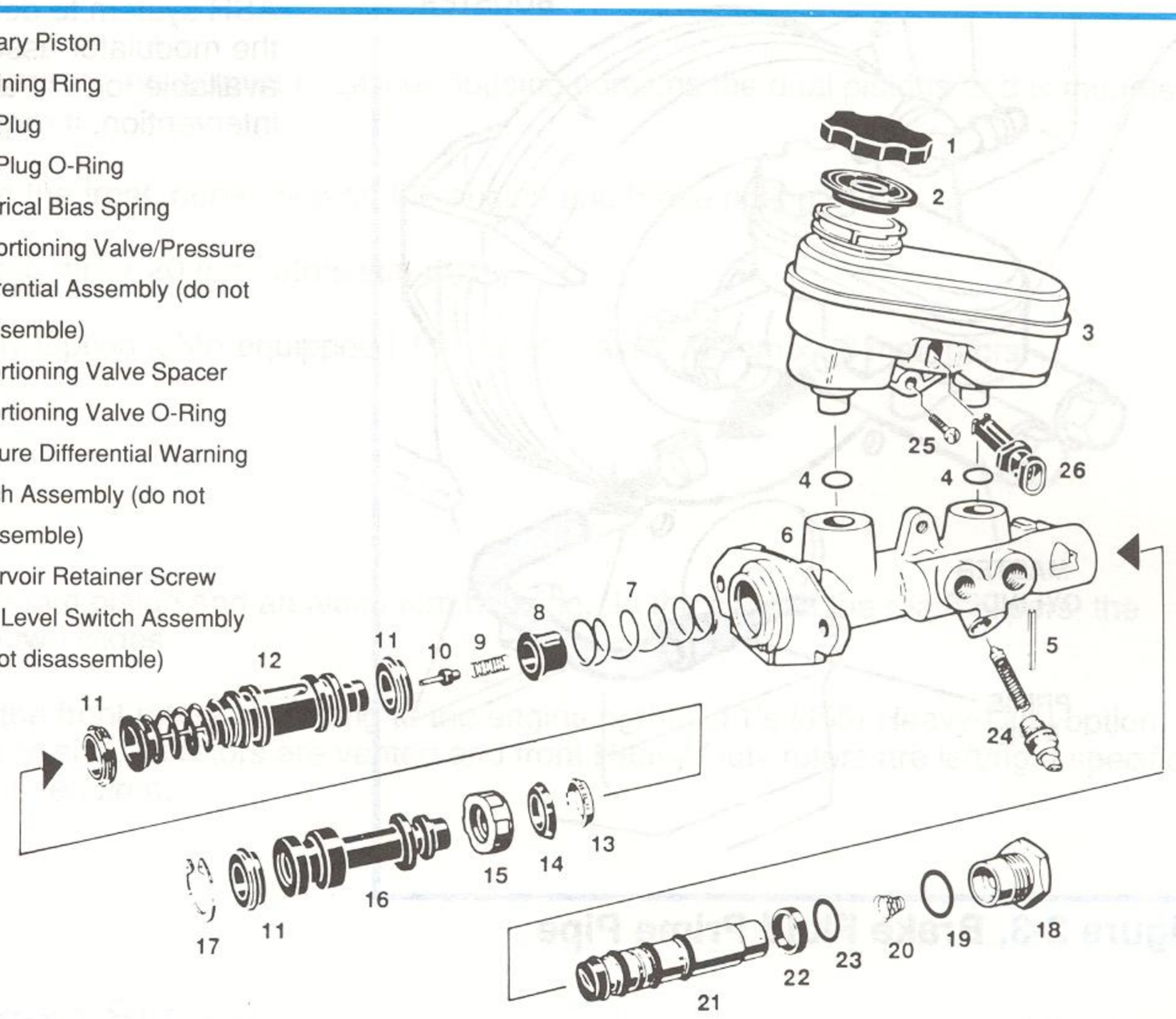


Figure 2-1, Master Cylinder

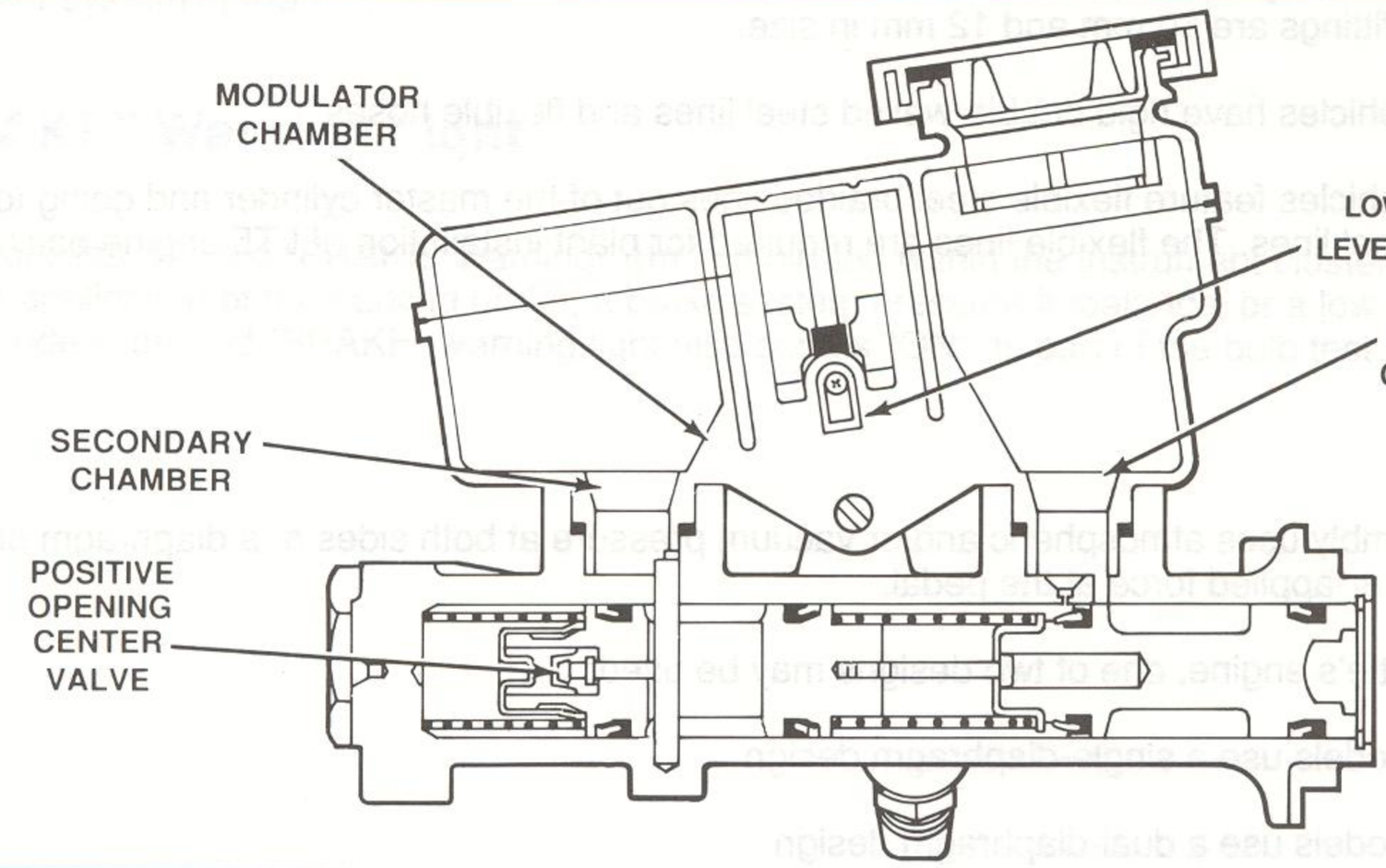


Figure 2-2, Fluid Reservoir

2. Components

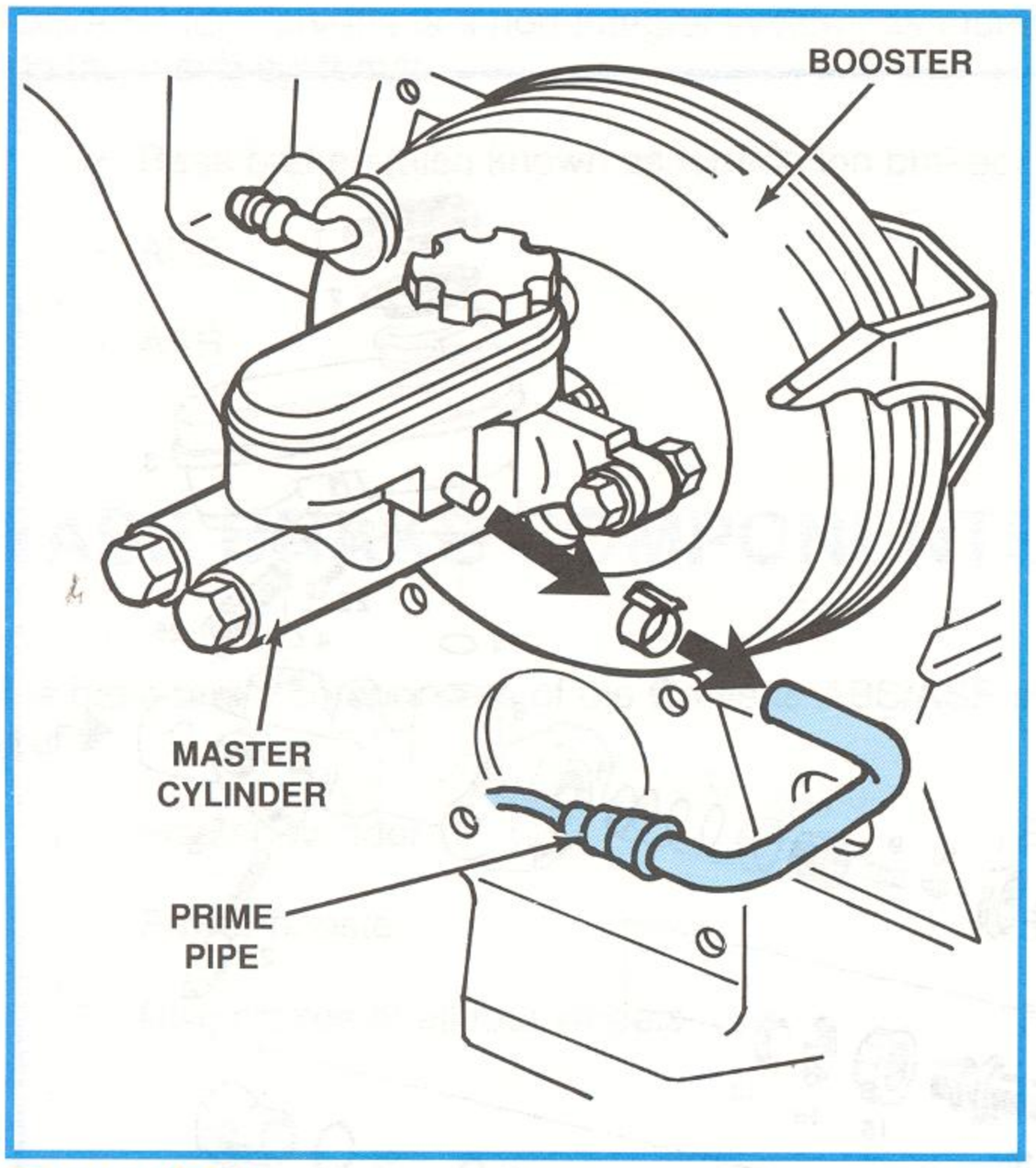


Figure 2-3, Brake Fluid Prime Pipe

A 6 mm brake fluid prime pipe is added for the ABS/ASR system to deliver fluid from the master cylinder to the modulator assembly (figure 2-3). This fluid is only available for use at the rear wheels for ASR brake intervention, if required.

Brake Lines

Brake line routing has been redesigned for 1992. Two lines route master cylinder front and rear fluid to the ABS/ASR Modulator Valve Assembly mounted behind the driver's seat. From the assembly, four lines take fluid to each of the four wheels. The fittings are 10 mm and 12 mm in size.

- LT1-equipped vehicles have rigid double-walled steel lines and flexible hoses.
- LT5-equipped vehicles feature flexible steel braided lines out of the master cylinder and going to the frame-mounted rigid steel lines. The flexible lines are required for plant installation of LT5 engine packaging.

Power Booster

The power booster assembly uses atmospheric and/or vacuum pressure at both sides of a diaphragm or diaphragms to enhance driver-applied force at the pedal.

Depending on the Corvette's engine, one of two designs may be used:

- LT1-equipped models use a single-diaphragm design
- LT5-equipped models use a dual-diaphragm design

The dual-diaphragm design is required for LT5 underhood packaging.

Front Discs

The front calipers have dual 38 mm pistons. An aluminum caliper housing contains the dual pistons and is mounted on the steering knuckle.

Two different sized rotors are used on the front, depending on the engine and brake option:

- LT1-equipped models have 305 mm x 20 mm rotors standard.
- LT5-equipped and Heavy Duty Option (J55)-equipped LT1 models have 330 mm x 28 mm rotors.

Rear Discs

The rear calipers feature a single 40.5 mm piston and an aluminum housing. In the case of the rear calipers, the housing is mounted on a bracket with two slides.

The rear rotors match up in size with the front rotors according to the engine or the LT1's (J55) Heavy-Duty option. However, realize that regardless of rotor size, all rotors are vented and front Heavy-Duty rotors are left/right specific for proper venting when replacement is required.

Stop Lamp and Cruise Brake Switch

As with any brake system, there is a switch at the brake pedal bracket to activate the vehicle's rear stop lamps whenever brakes are applied by the driver. This switch is also an input to the EBCM and proper adjustment is critical to proper system operation.

Red "BRAKE" Warning Light

As on other vehicles, the red "BRAKE" warning light is mounted within the instrument cluster. The red "BRAKE" light identifies application of the parking brake, a brake system pressure imbalance, or a low reservoir fluid level. As on other models, the red "BRAKE" warning light also comes "ON" as part of the bulb test.

ABS COMPONENTS

ABS components (figure 2-4) added to the base brake system are the same as on previous Corvettes:

- EBCM
- Speed sensors at each wheel
- Lateral accelerometer
- Modulator Valve Assembly
- ABS indicator lights
- Brake switch input to EBCM

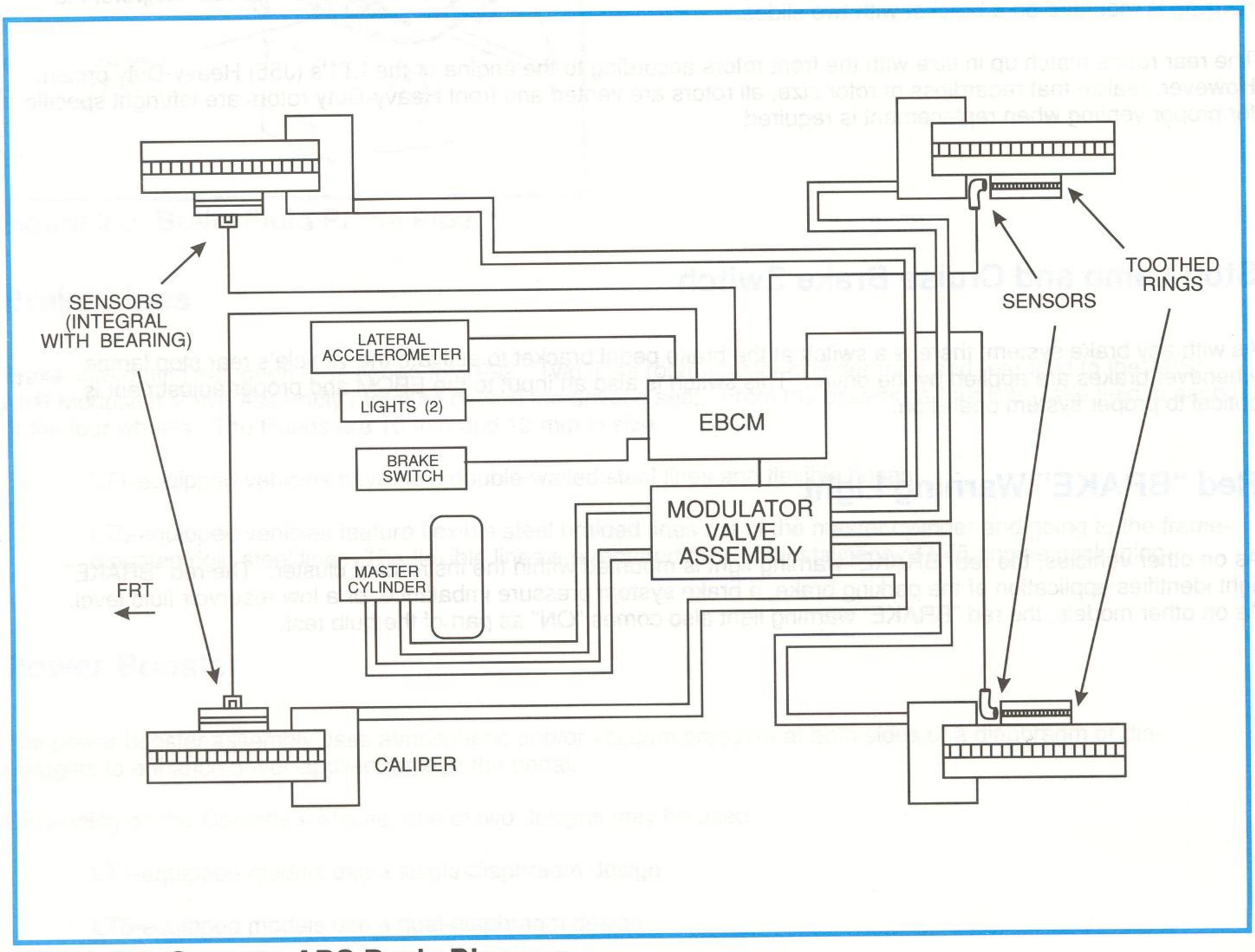


Figure 2-4, Corvette ABS Basic Diagram

Electronic Brake Control Module (EBCM)

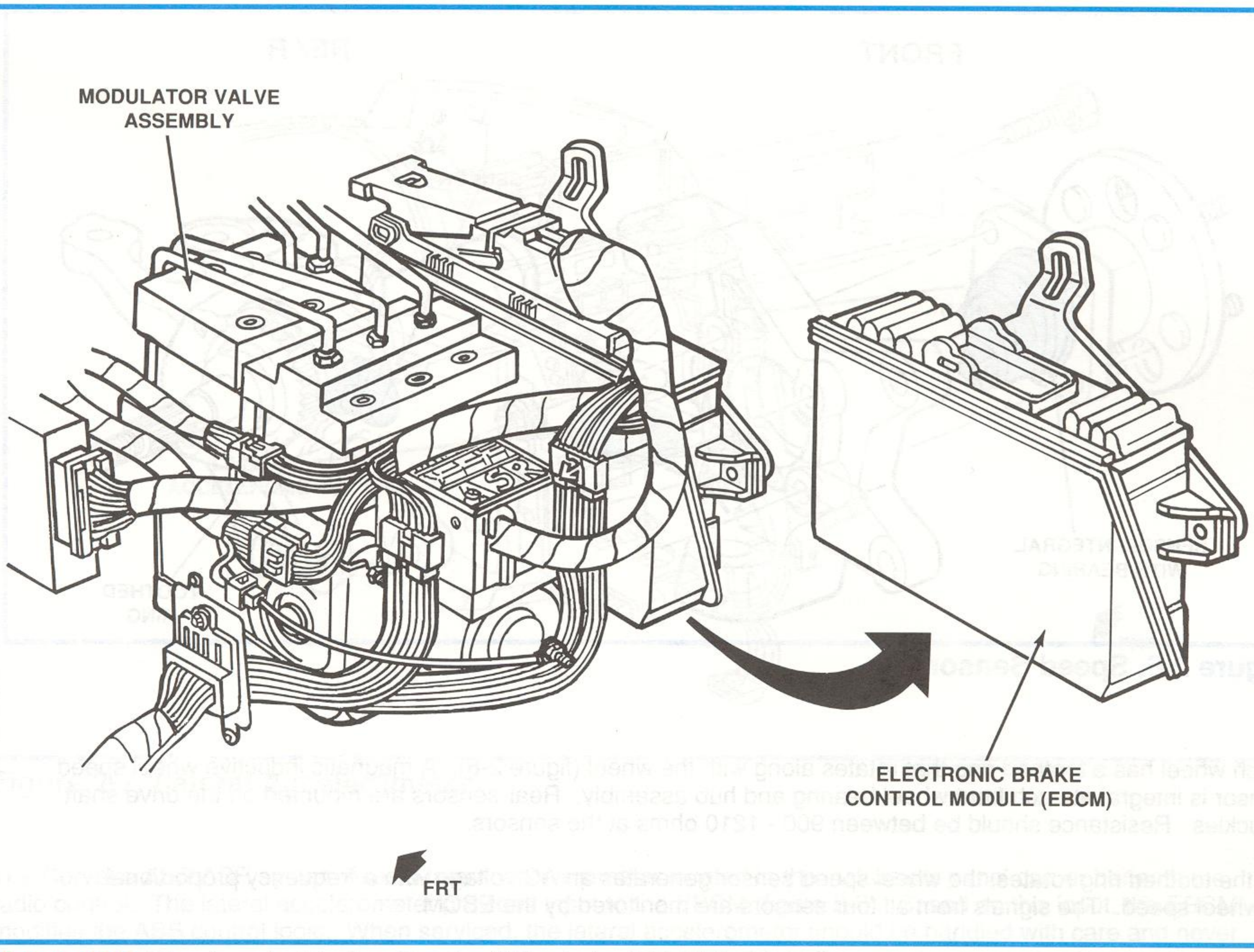


Figure 2-5, Electronic Brake Control Module (EBCM)

The Electronic Brake Control Module (EBCM) provides management of both ABS and ASR functions (figure 2-5).

The EBCM is located behind the driver's seat in the rear storage compartment, near the Modulator Valve Assembly.

The EBCM is larger in appearance than the previous Bosch EBCM on Corvette. The connector is a 55-way. Not all cavities are used.

2. Components

Wheel Speed Sensors and Toothed Rings

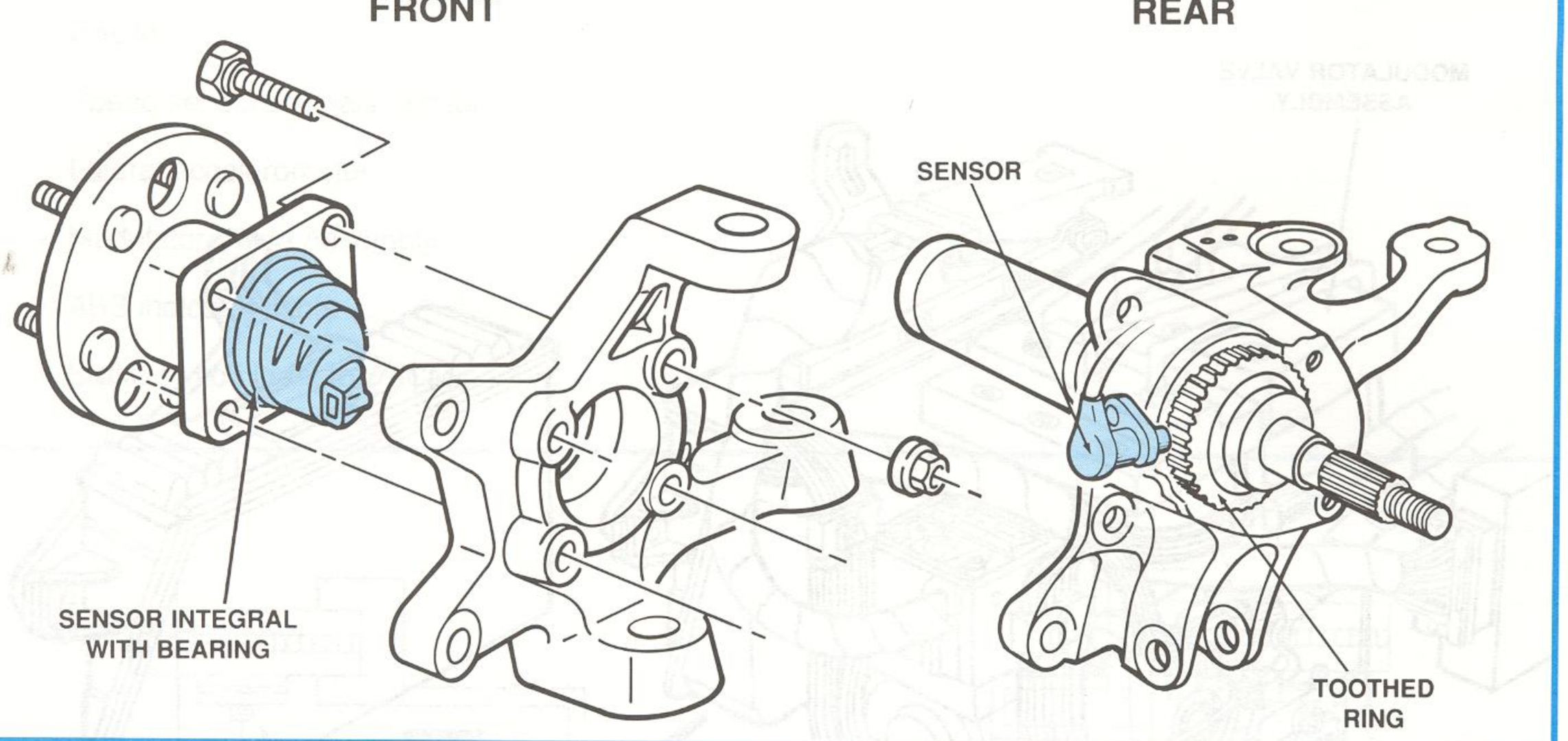


Figure 2-6, Speed Sensors

Each wheel has a toothed ring that rotates along with the wheel (figure 2-6). A magnetic inductive wheel speed sensor is integral at each front wheel bearing and hub assembly. Rear sensors are mounted on the drive shaft knuckles. Resistance should be between 900 - 1210 ohms at the sensors.

As the toothed ring rotates, the wheel speed sensor generates an AC voltage with a frequency proportional to wheel speed. The signals from all four sensors are monitored by the EBCM.

Air gap at front and rear sensors is non-adjustable.

—NOTICE—

It is important that the vehicle only be equipped with original equipment tire sizes. Changing tire size could affect system sensitivity. Refer to the Owner's Manual for correct tire size applications.

Lateral Accelerometer

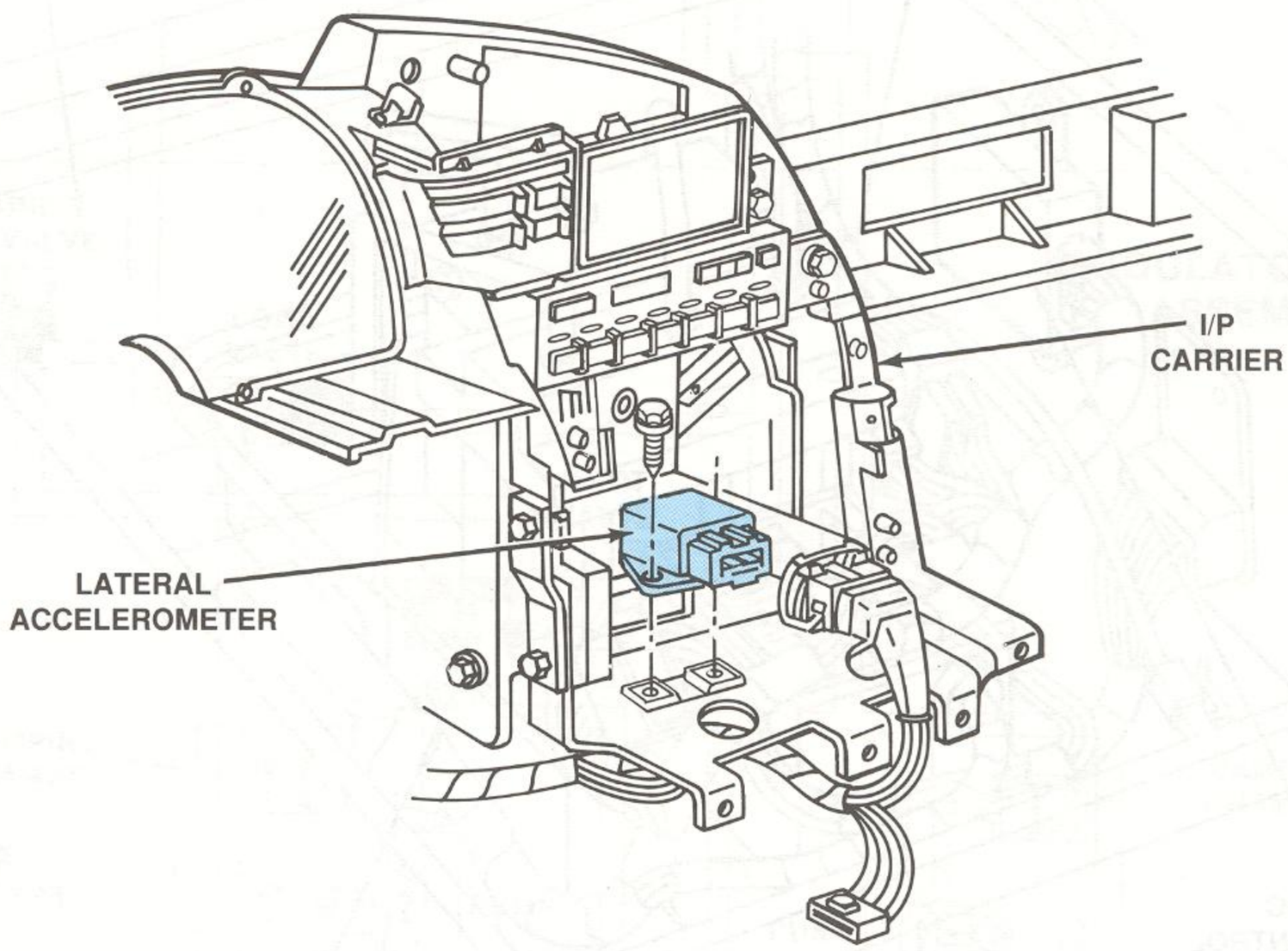


Figure 2-7, Lateral Accelerometer

The Corvette ABS/ASR system uses a lateral accelerometer located in the instrument panel carrier beneath the radio control. The lateral accelerometer provides input to the EBCM (figure 2-7). Based on this input, the EBCM modifies the ABS control logic. When serviced, the lateral accelerometer should be handled with care and never dropped.

Modulator Valve Assembly

The Modulator Valve Assembly executes hydraulic pressure control for ABS and ASR functions (figure 2-8). The assembly is located behind the driver's seat in the rear storage compartment. Its electrical connector is a 14-way.

The assembly contains a DC motor-driven recirculation pump with separate front and rear circuits. The pump:

- Transfers fluid from the calipers back to the master cylinder for ABS "pressure reduce".
- Transfers fluid from the master cylinder to the rear calipers during an ASR "brake apply" event.

Whenever the Modulator Valve Assembly is inspected or serviced, always be sure to properly position the insulation pad to "isolate" pump noise from the interior.

2. Components

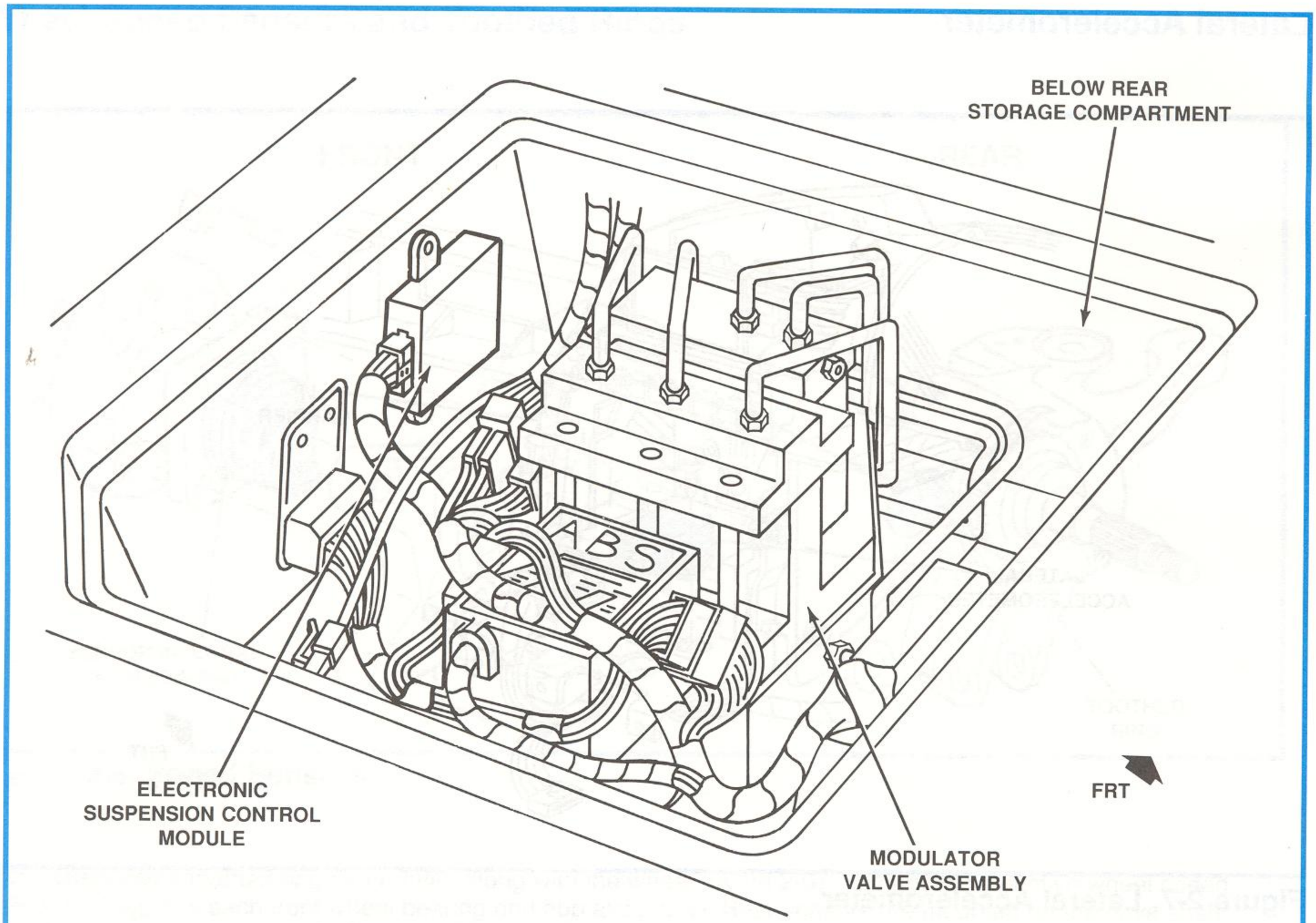


Figure 2-8, Modulator Valve Assembly

The Modulator Valve Assembly also contains two hydraulically controlled valves and five electronically controlled solenoid valves (figure 2-9):

- **The Load Valve** (hydraulically operated) isolates the line from the modulator to the master cylinder reservoir during brake apply. It is spring loaded to the open position. This prevents the pump from taking fluid from the reservoir during ABS operation, and also allows pump recirculation during ASR.

- **The Pressure Limiting Valve** (hydraulically controlled) regulates pump pressure by allowing excess fluid to pass back to the master cylinder via the prime pipe. This only occurs during ASR.

- **The Pilot Valve** (electronically controlled) isolates the master cylinder from the pump during ASR functions. This valve closes when the pump directs fluid for rear circuit ASR operation. Excess fluid passes through the pressure limiting valve.

- **The Wheel Circuit Solenoid Valves (4)** individually control fluid pressure at each front wheel and at the rear wheels together (using the "Select Low" principle) for ABS operation. Each valve has three positions: "pressure hold", "pressure decrease", and "pressure increase". The valves are spring loaded to the "pressure increase" (or neutral) position.

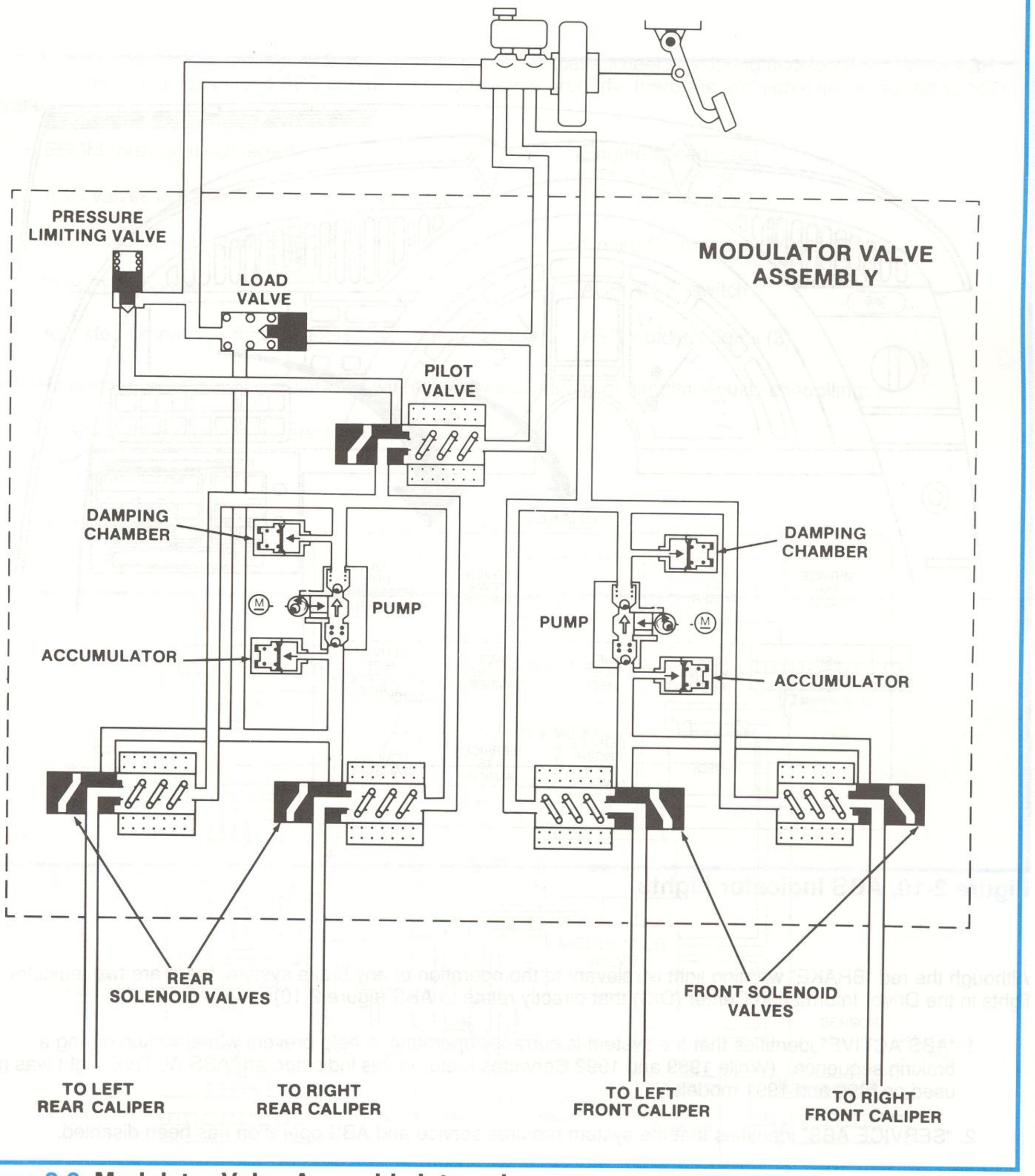


Figure 2-9, Modulator Valve Assembly Internals

2. Components

ABS Indicator Lights

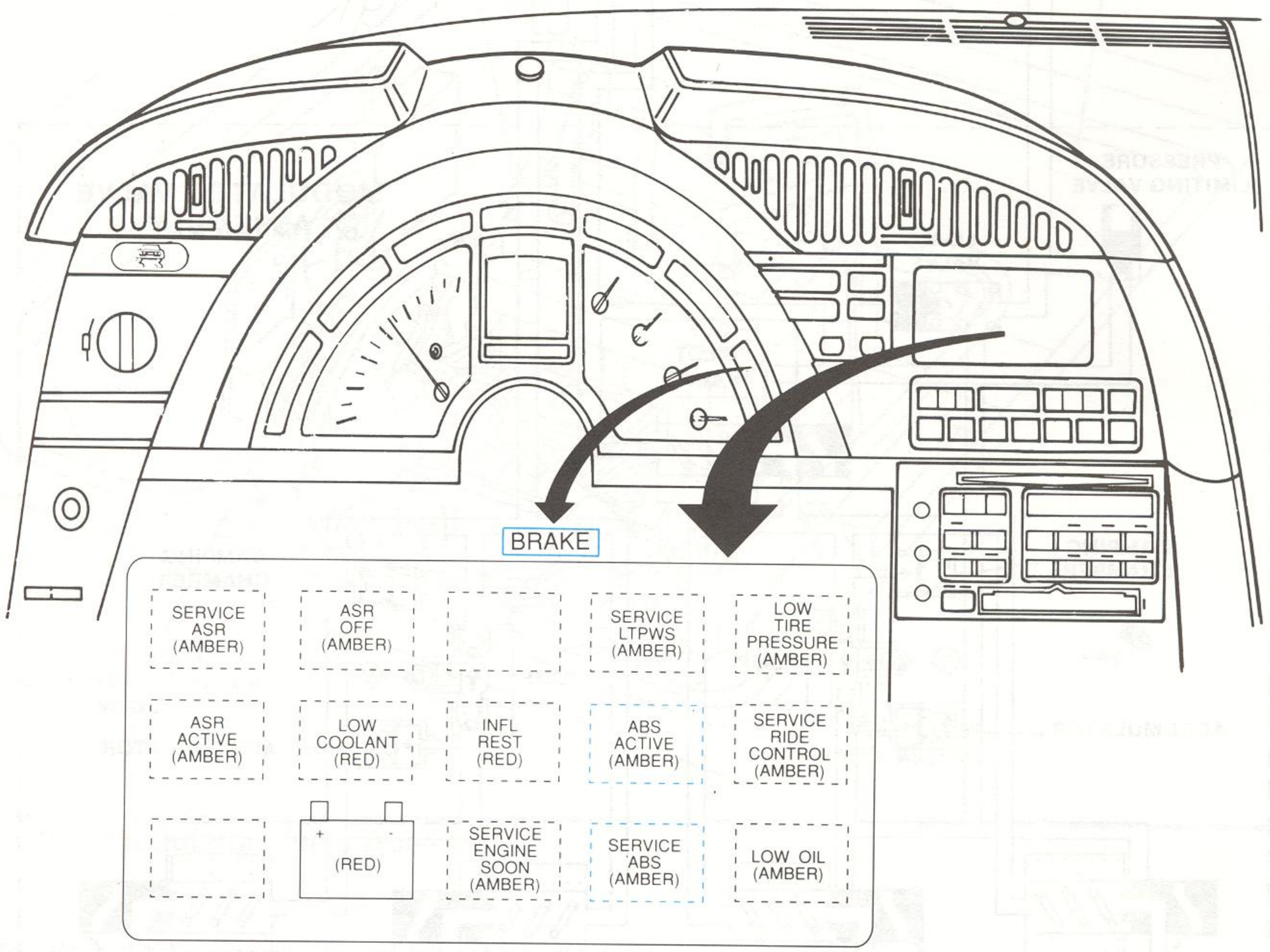


Figure 2-10, ABS Indicator Lights

Although the red "BRAKE" warning light is relevant to the operation of any brake system, there are two indicator lights in the Driver Information Center (DIC) that directly relate to ABS (figure 2-10):

1. "ABS ACTIVE" identifies that the system is currently operating to help prevent wheel lockup during a braking sequence. (While 1989 and 1992 Corvettes featured this indicator, an "ABS ACTIVE" light was not used on1990 and 1991 models.)

2. "SERVICE ABS" identifies that the system requires service and ABS operation has been disabled.

ASR COMPONENTS

The ASR portion of the system (figure 2-11) works to prevent excess wheel slip during acceleration. While ASR requires the previously described ABS components to function properly, there are additional items related to ASR operation:

- EBCM (previously covered)
- ASR valves in modulator (previously covered)
- Electronic Control Module (ECM)
- TPS/TPS module
- Adjuster Assembly - throttle and cruise control cables
- Engine speed input
  LT1 - Tach Filter
  LT5 - Ign. Module
- Cruise Control Cut-Off relay
- ASR "OFF" switch
- ASR indicator lights (3)

The ASR system can help limit acceleration wheel slip by individually or simultaneously controlling:

1. Spark retard (timing advance reduction)
2. Throttle close-down
3. Rear brake intervention

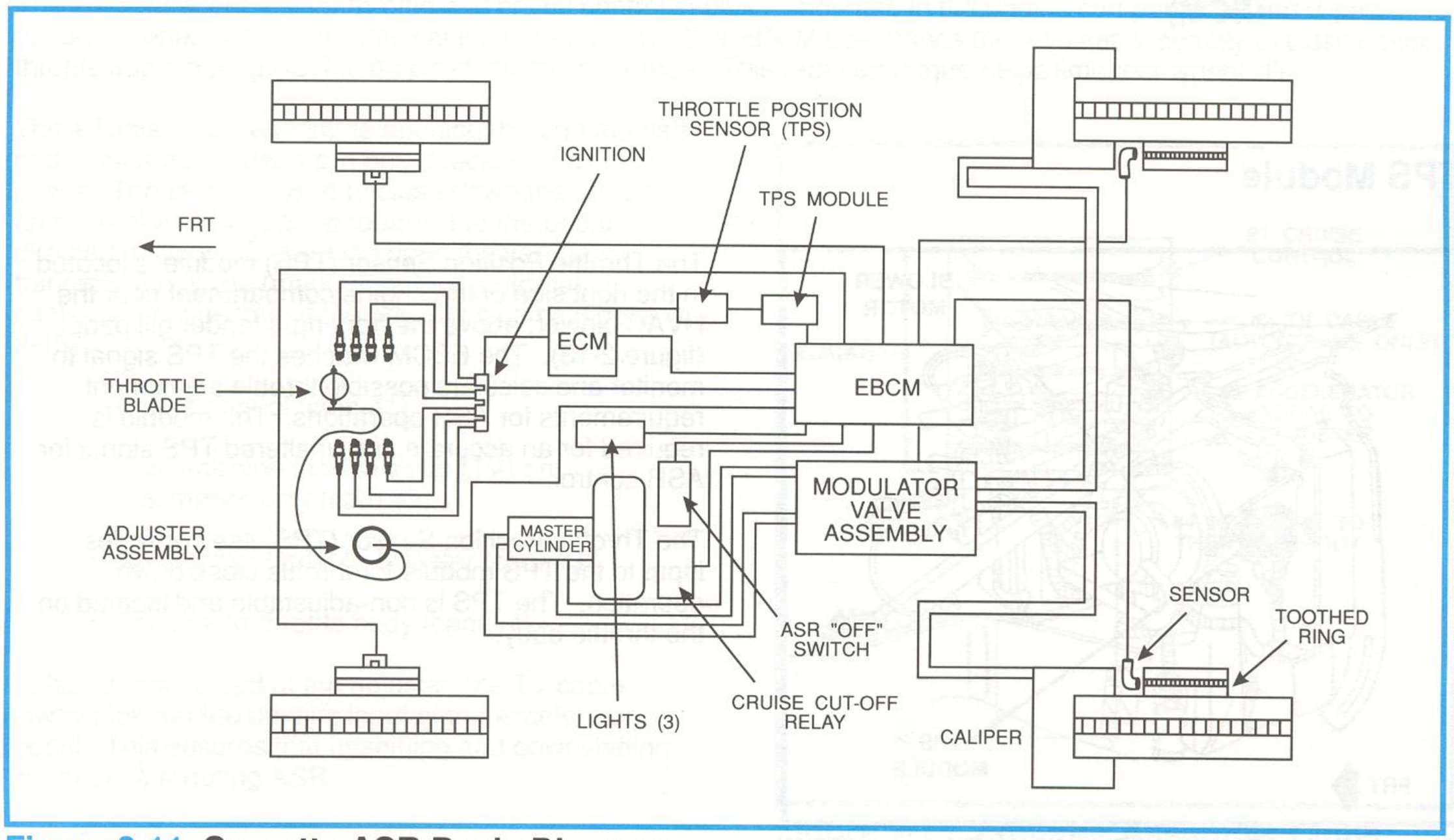


Figure 2-11, Corvette ASR Basic Diagram

2. Components

Electronic Control Module (ECM)

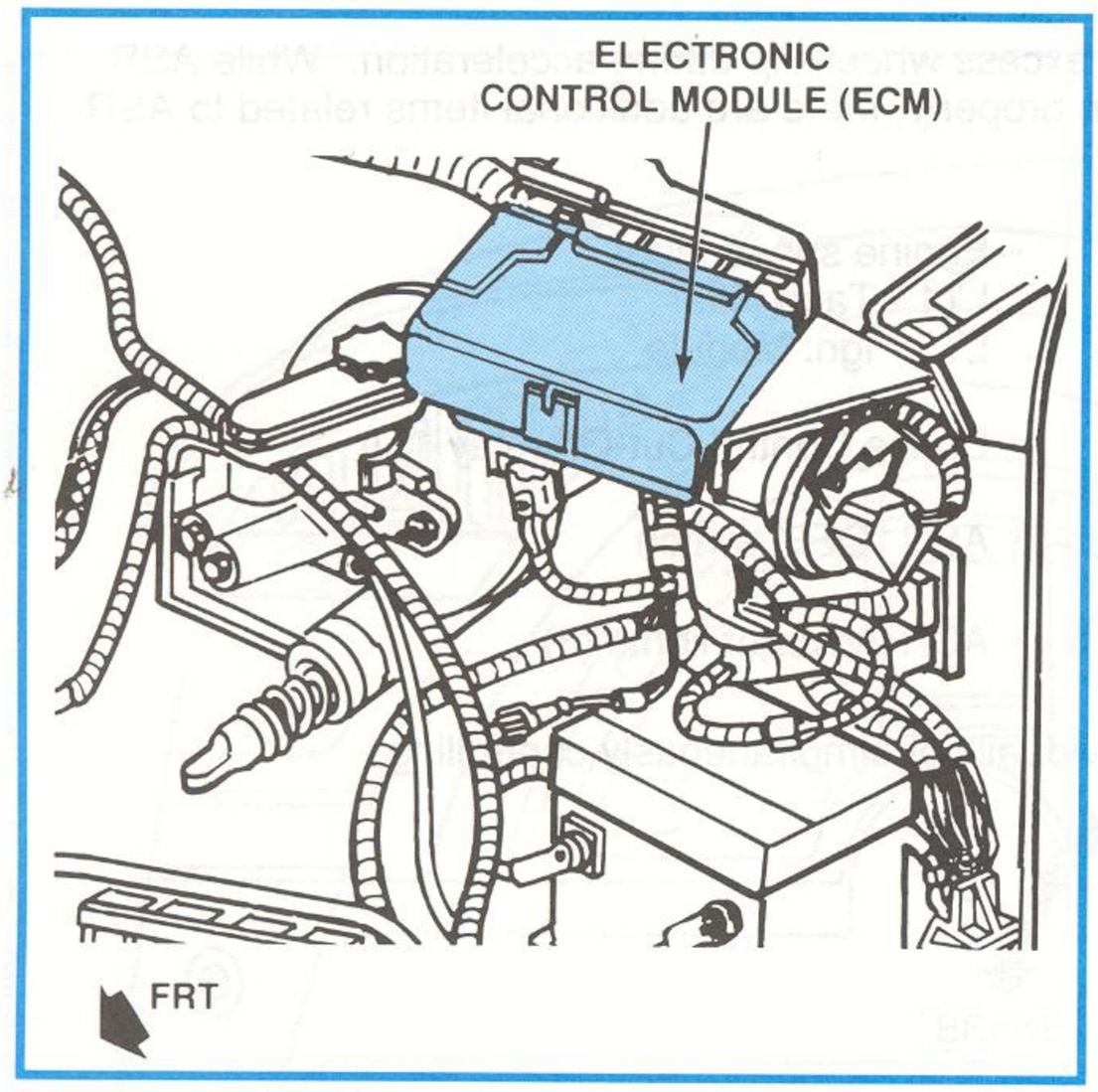


Figure 2-12, Electronic Control Module (ECM)

The engine Electronic Control Module (ECM) is also part of ASR operation (figure 2-12). The ECM is located at the rear left of the engine compartment above the battery. The EBCM requests the ECM to reduce ignition timing advance, as required, for ASR intervention. The ECM also monitors TPS and disables the Torque Converter Clutch (TCC).

TPS Module

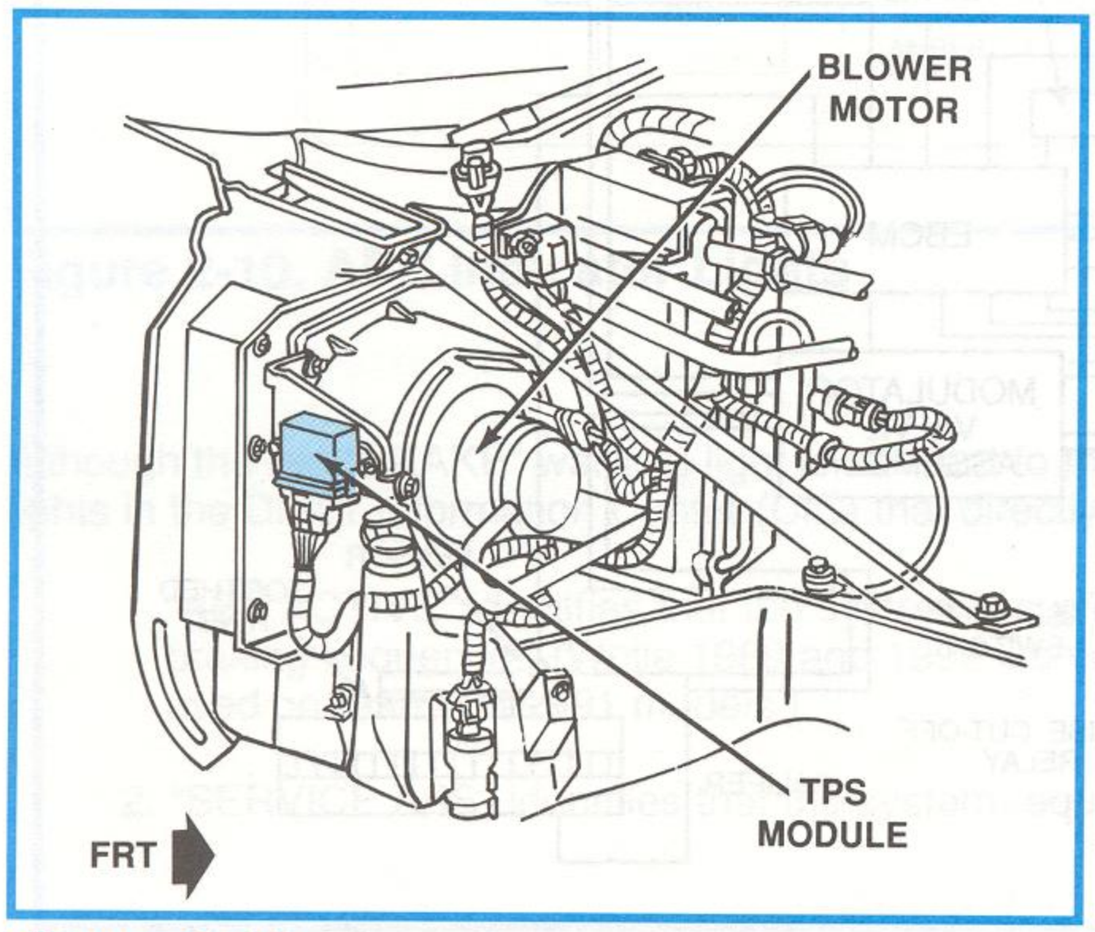


Figure 2-13, Throttle Position Sensor (TPS) Module

The Throttle Position Sensor (TPS) module is located in the right side of the engine compartment near the HVAC blower, above the front right fender gill panel (figure 2-13). The EBCM watches the TPS signal to monitor and calculate possible throttle adjustment requirements for ASR operations. The module is required for an accurate and unaltered TPS signal for ASR control.

The Throttle Position Sensor (TPS) itself provides input to the TPS module for throttle close down operation. The TPS is non-adjustable and located on the throttle body.

Adjuster Assembly - Throttle & Cruise Control Cables

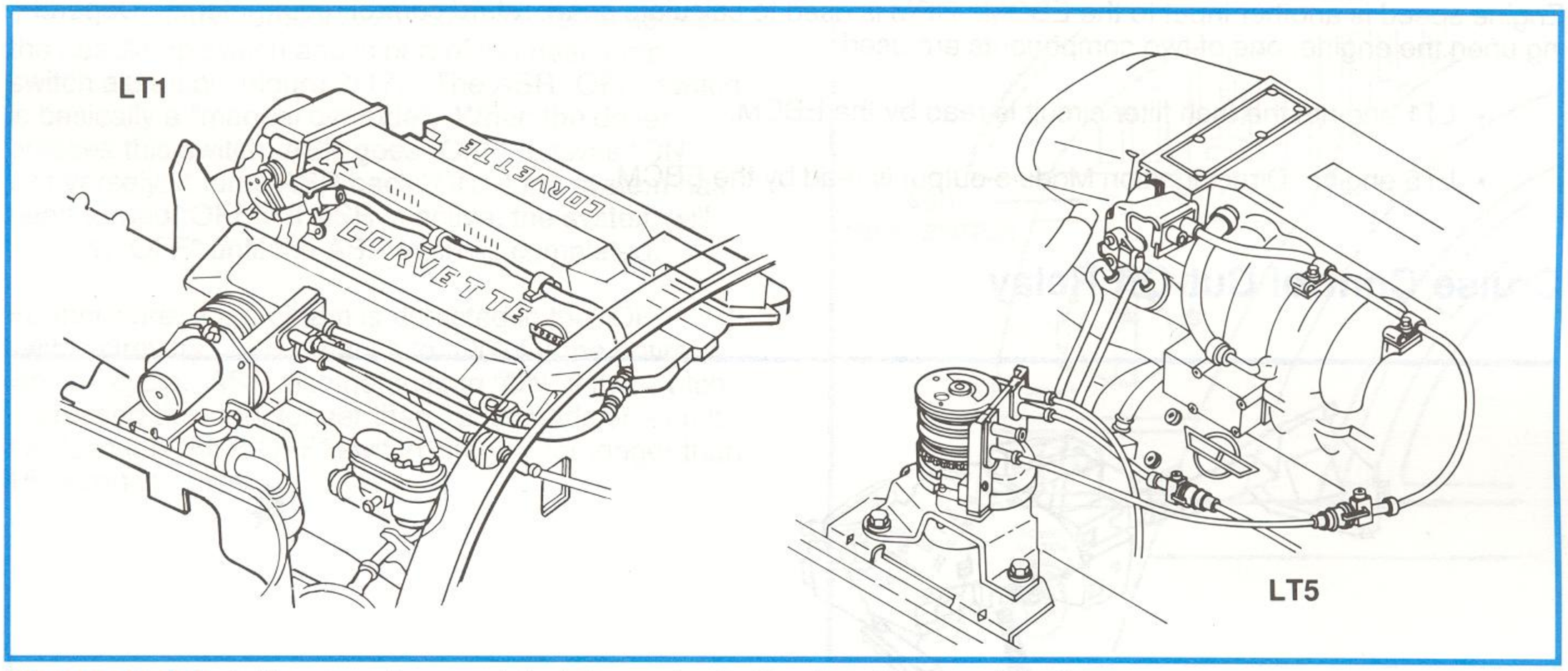


Figure 2-14, Adjuster Assembly-Throttle & Cruise Control Cables

The adjuster assembly for throttle and cruise control cables is mounted in the engine compartment and is positioned in series with the throttle cables (figure 2-14). The EBCM commands the adjuster assembly to close down throttle angle during ASR to help reduce engine torque. This reduced torque helps limit rear wheel slip.

The adjuster reduces throttle opening through the use of a unidirectional (works in one direction only) DC motor. The motor is used to close down the throttle; an internal adjuster spring returns it to the pedal-directed position. Depending upon the vehicle's transmission, three (manual) or four (automatic) cables are connected at the adjuster's cams (figure 2-15):

- Cruise control (cam #1)
- Transmission throttle valve (TV) on automatics only (cam #2)
- Accelerator pedal to adjuster (cam #3)
- Adjuster to throttle body (cam #4)

Although connected at the adjuster, the TV cable always follows the driver's input at the accelerator pedal. This ensures that upshifting and downshifting will not occur during ASR.

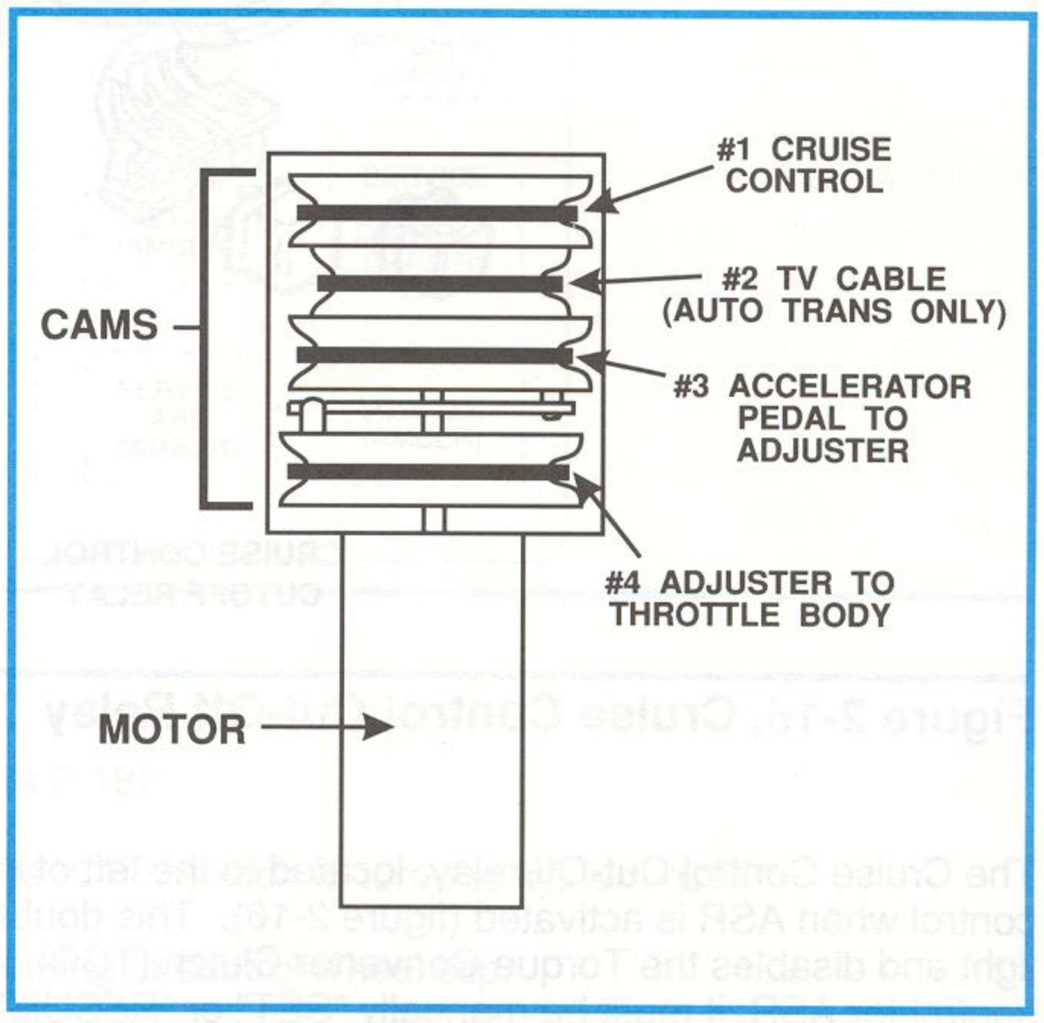


Figure 2-15, Adjuster Assembly Cams

2. Components

Tach Filter/Direct Ignition Module

Engine speed is another input to the EBCM. RPM is used to calculate spark retard control requirements. Depending upon the engine, one of two components are used:

- LT1 engine: the tach filter circuit is read by the EBCM.
- LT5 engine: Direct Ignition Module output is read by the EBCM.

Cruise Control Cut-Off Relay

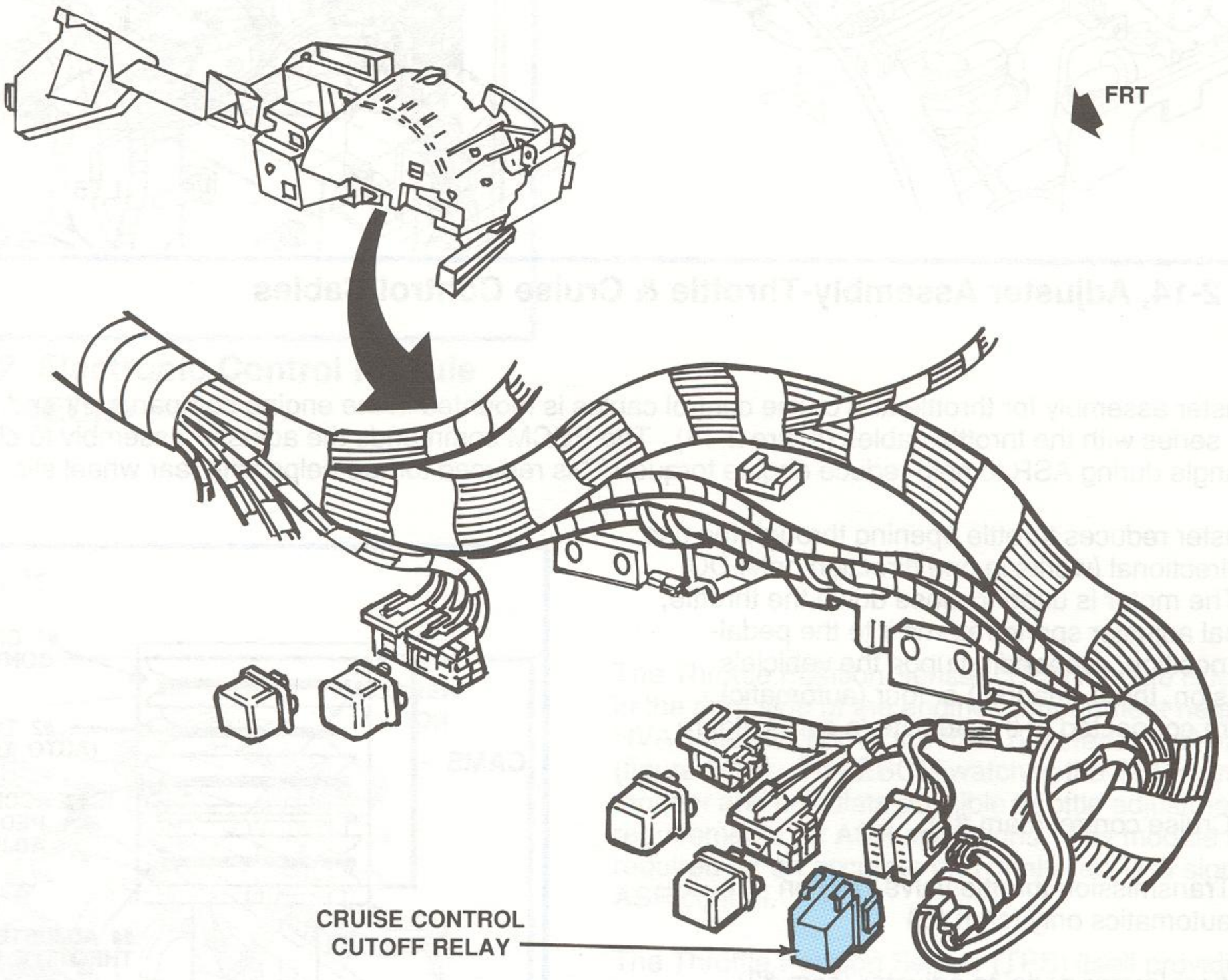


Figure 2-16, Cruise Control Cut-Off Relay

The Cruise Control Cut-Off relay, located to the left of the steering column in the instrument panel, disables cruise control when ASR is activated (figure 2-16). This double-throw relay also turns "ON" the "ASR ACTIVE" indicator light and disables the Torque Converter Clutch (TCC), if so equipped. Once the EBCM has disengaged the cruise control for ASR, it must be manually "SET" or "RESUMED" by the driver.

ASR "OFF" Switch

The momentary-contact ASR "OFF" switch is above the headlamp switch and is part of the headlamp switch assembly (figure 2-17). The ASR "OFF" switch is basically a "manual override". When the driver presses this switch, ASR goes "OFF" if it was "ON". Conversely, it turns ASR back "ON" if the system has been turned "OFF". If ASR is active, the system will not turn "OFF" until the ASR event is completed.

Furthermore, if a problem is detected in the "OFF" switch circuitry, ASR defaults to "ON" for the entire ignition cycle. ASR also defaults to "ON" if the switch is pressed down for longer than 15 seconds or a fault exists in the "ASR OFF" switch circuitry for longer than 15 seconds.

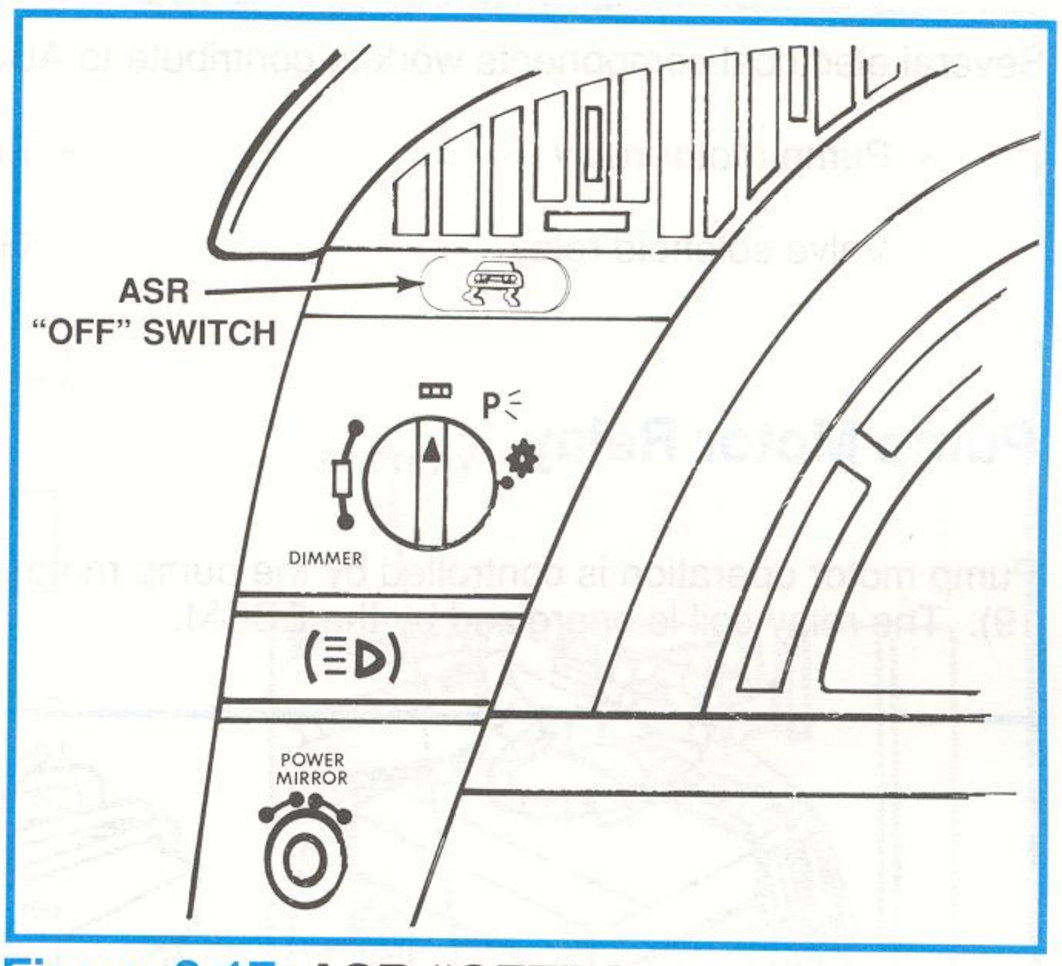


Figure 2-17, ASR "OFF" Switch

ASR Indicator Lights

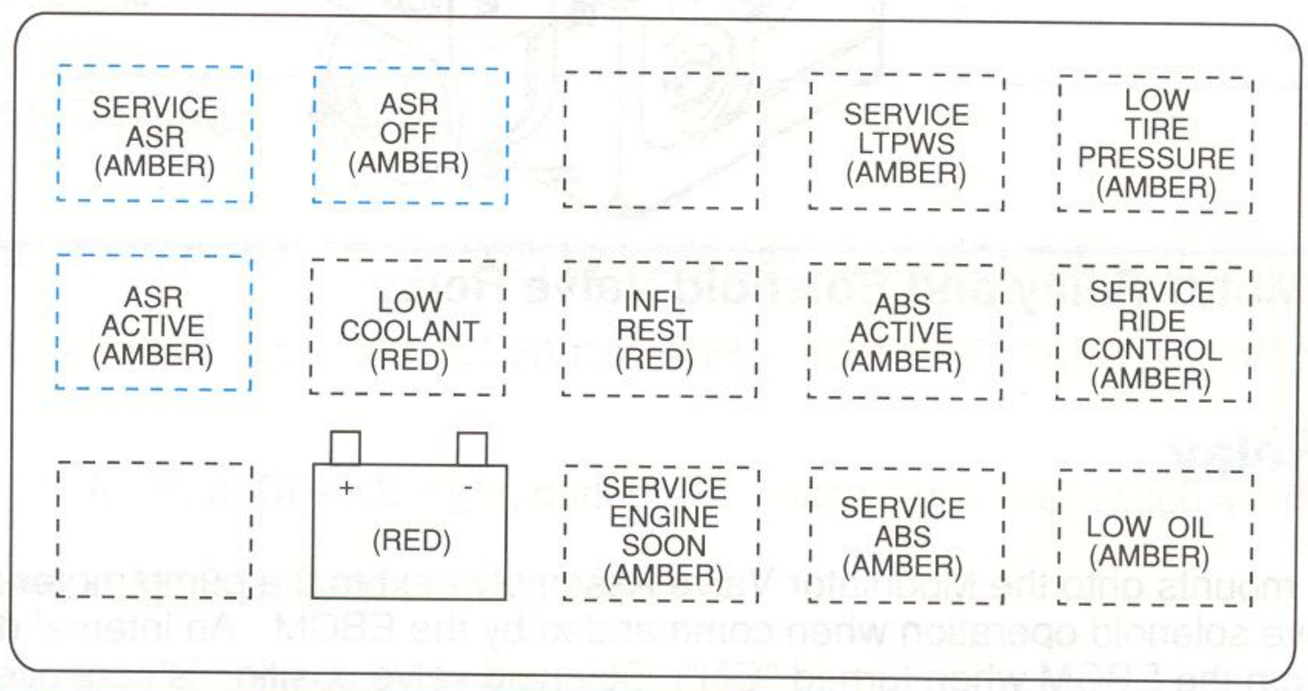


Figure 2-18, ASR Indicator Lights

Three indicator lights in the DIC relate to ASR operation (figure 2-18):

1. "ASR OFF" illuminates whenever the driver toggles the "OFF" switch to turn the system "OFF".
2. "ASR ACTIVE" illuminates to identify the system is working to control wheel slip.
3. "SERVICE ASR" illuminates to tell the driver the system requires service.

SYSTEM ELECTRICAL COMPONENTS

Several electrical components work to contribute to ABS/ASR operation:

- Pump motor relay
- Valve solenoid relay
- Fuses
- Grounds

Pump Motor Relay

Pump motor operation is controlled by the pump motor relay mounted on the Modulator Valve Assembly (figure 2-19). The relay coil is energized by the EBCM.

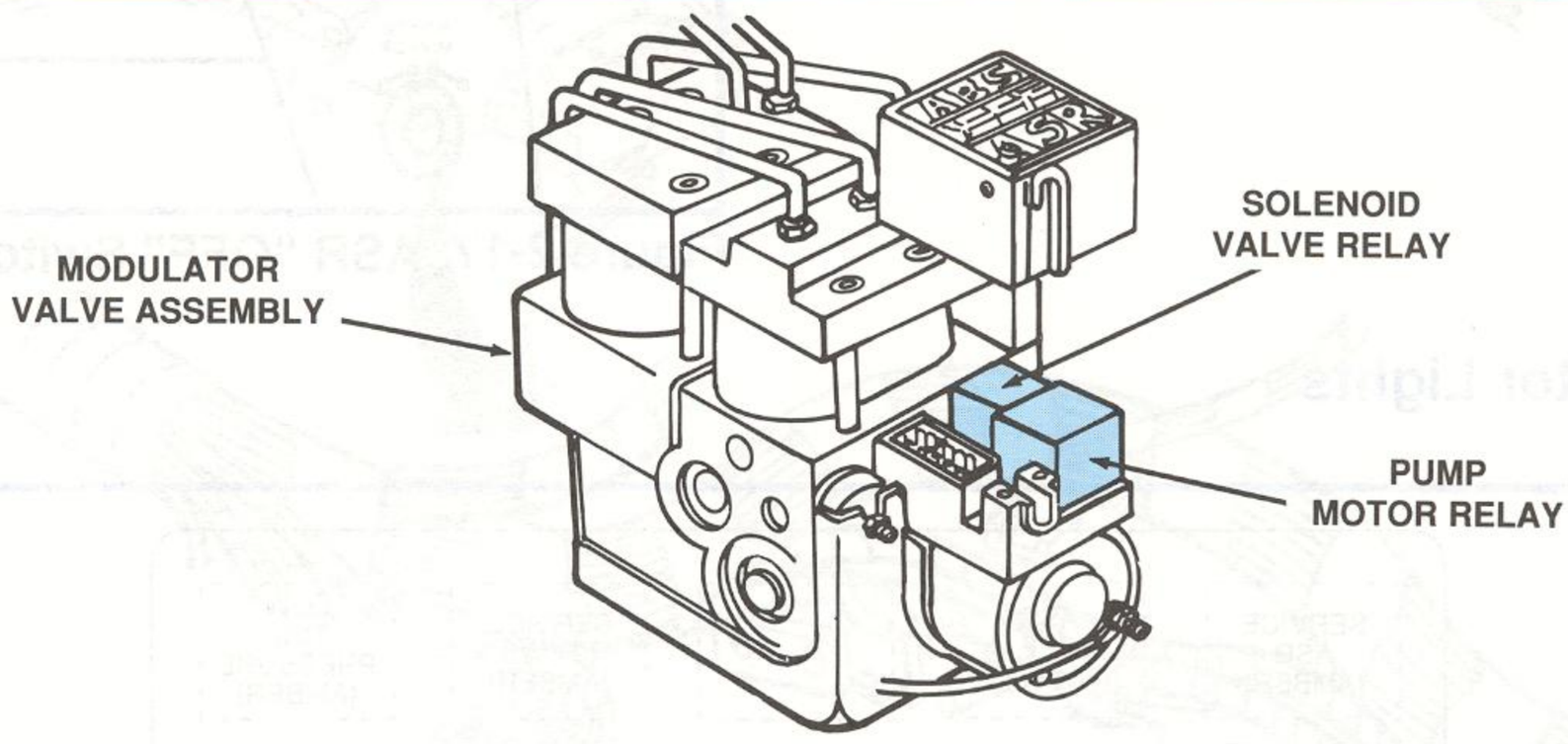


Figure 2-19, Pump Motor Relay and Solenoid Valve Relay

Valve Solenoid Relay

The valve solenoid relay mounts onto the Modulator Valve Assembly next to the pump motor relay. It provides voltage for ABS/ASR valve solenoid operation when commanded by the EBCM. An internal diode prevents the relay from applying B+ from the EBCM when turned "ON". Solenoid valve position is controlled by the EBCM providing varying levels of resistance to ground. The valve solenoid relay also provides a ground to the “SERVICE ABS” indicator lamp if the relay loses power or ground.

Fuses

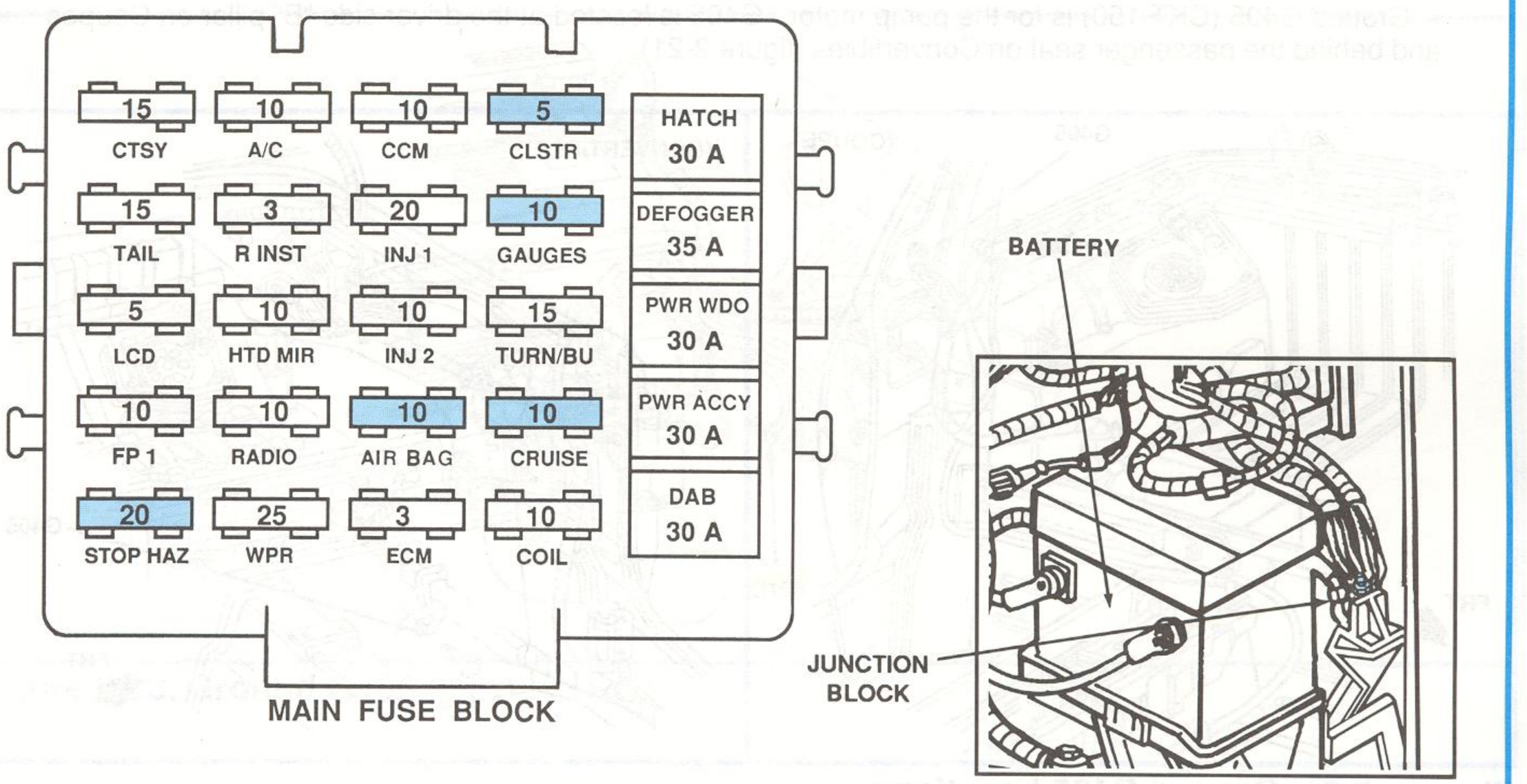


Figure 2-20, ABS/ASR Fuses

Power for ABS/ASR related components is supplied by five fuses and two fusible links (figure 2-20):

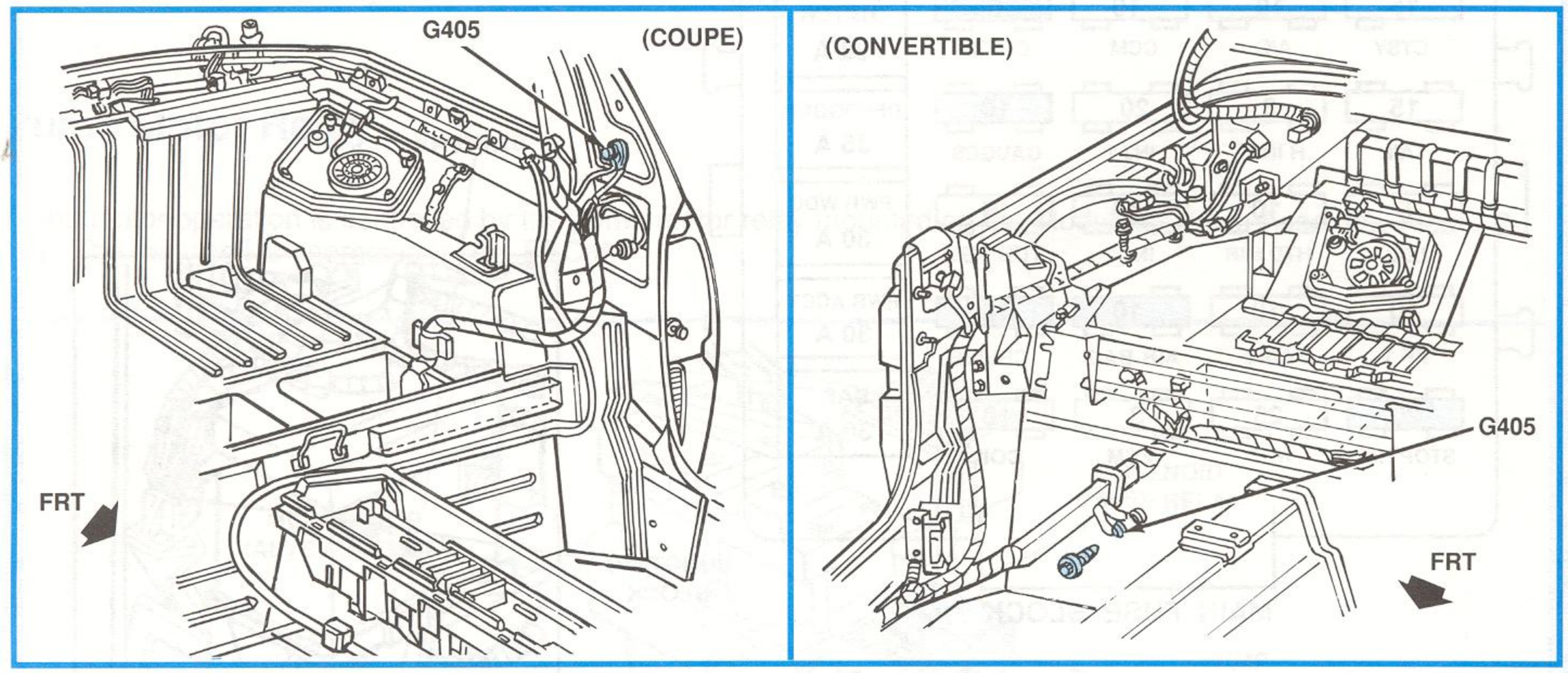
- "CLSTR" fuse (5A): "SERVICE ABS", "SERVICE ASR", "ASR OFF", "ASR ACTIVE" and "ABS ACTIVE" lights
- "AIR BAG" fuse (10A): Red "BRAKE" light, park brake switch, fluid level switch, ignition "ON" input
- "STOP/HAZ" fuse (20A): Stop lamp switch
- "GAUGES" fuse (10A): TPS module ignition "ON" input
- "CRUISE" fuse (10A): Cruise control system
- Fusible link "J": Power for Modulator Valve Assembly
- Fusible link "L": Power to EBCM

2. Components

Grounds

Several grounds relate to ABS/ASR operation:

- Ground G405 (CKT 150) is for the pump motor. G405 is located at the driver side "B" pillar on Coupes and behind the passenger seat on Convertibles (figure 2-21).



Figures 2-21, Ground G405 Locations

- Ground G201 (CKT 150) is for the Cruise Control Cut-Off relay. G201 is located at the left-hand kick panel under the instrument panel (figure 2-22).

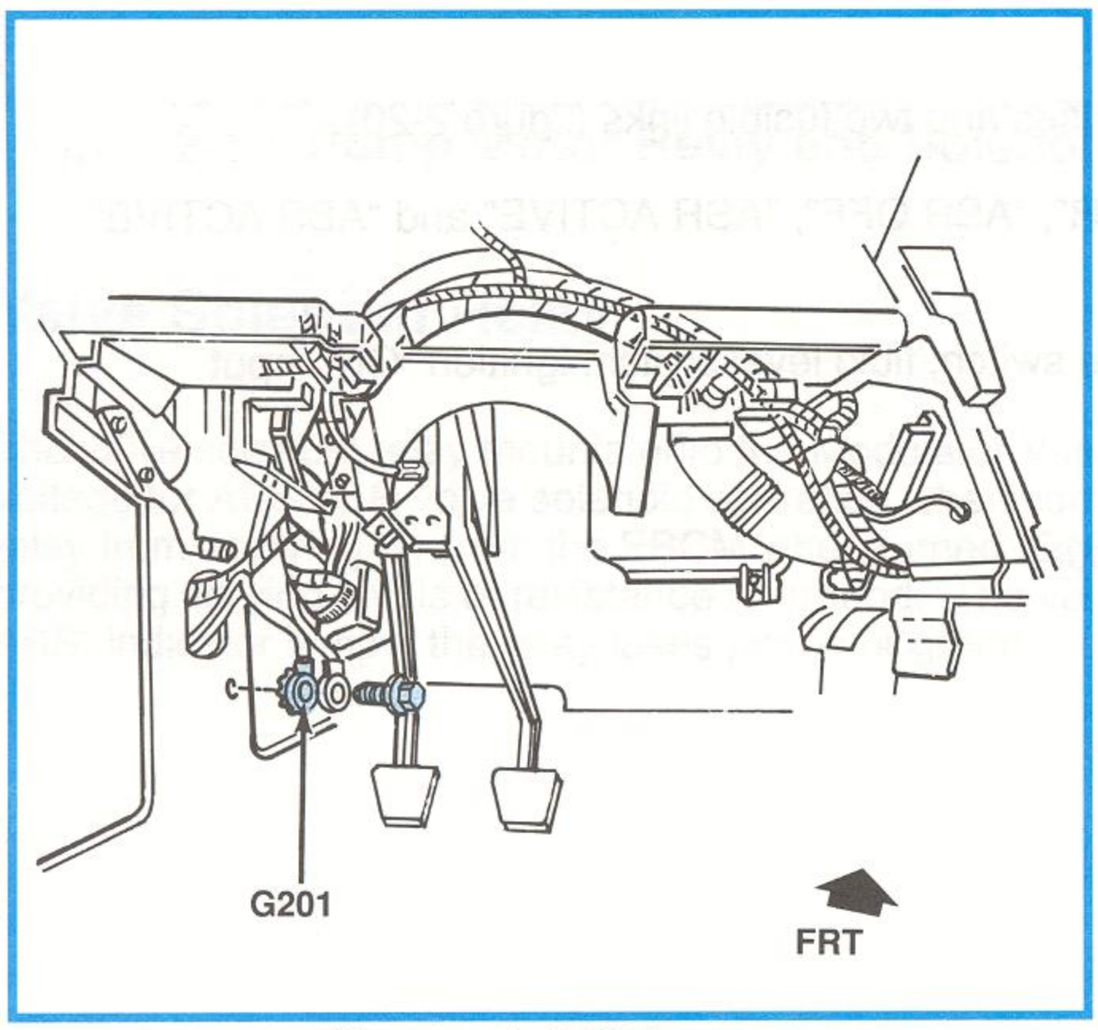


Figure 2-22, Ground G201

- Ground G106 (CKT 801) handles both the TPS module and EBCM valve solenoid control. On LT1- equipped vehicles, G106 is next to the oil filter (figure 2-23). With the LT5, G106 is at the right bell housing bolt (figure 2-24). Ground G106 (CKT 803) is for the brake fluid level switch and is an engine ground.

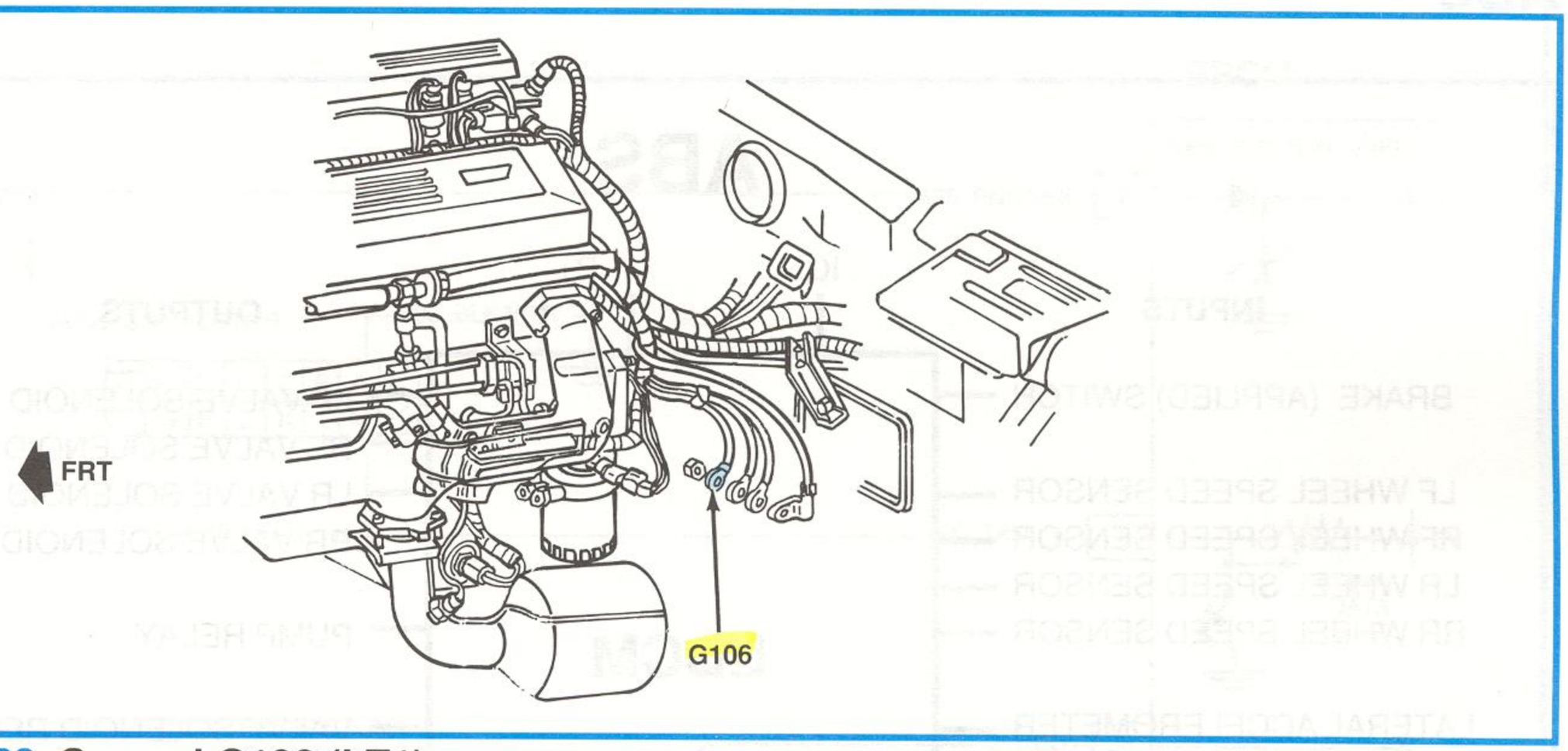


Figure 2-23, Ground G106 (LT1)

As with other electrical systems, good ground connections are critical to proper circuit operation.

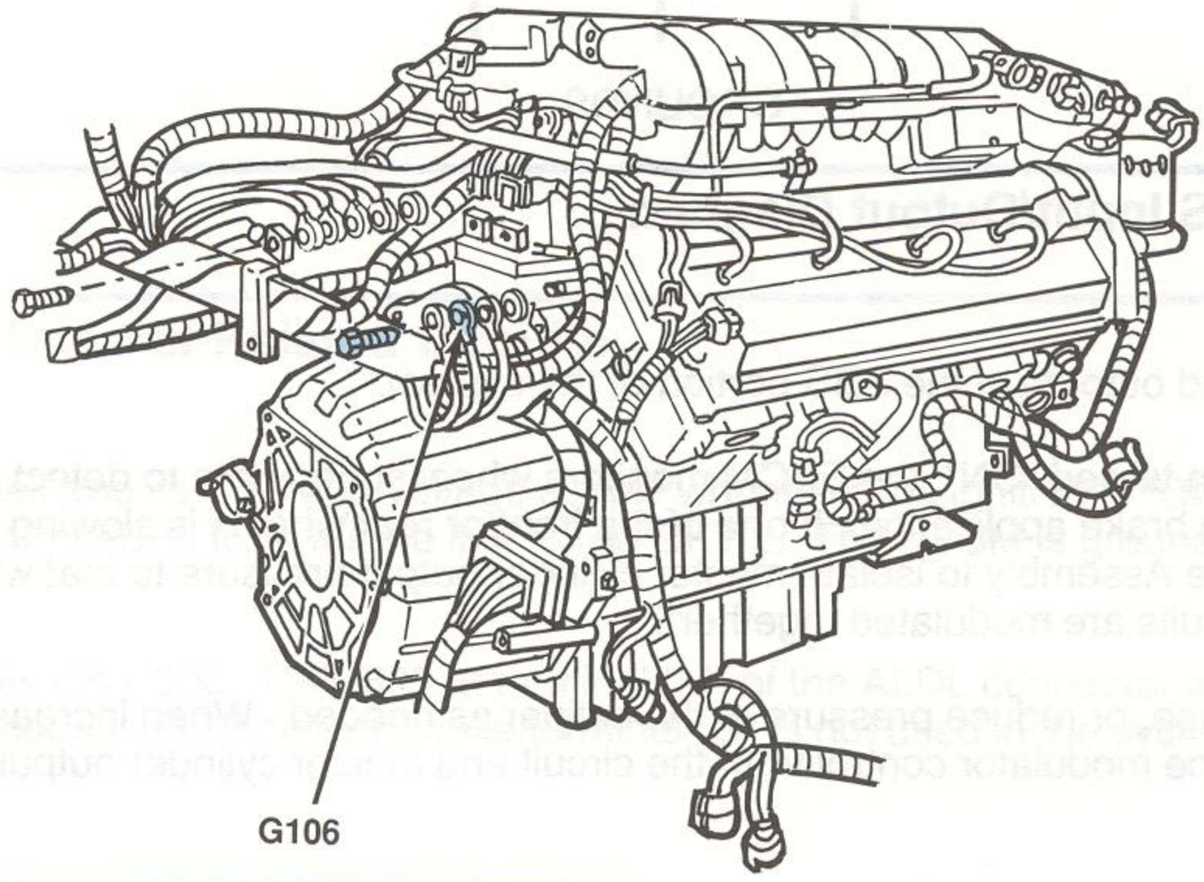


Figure 2-24, Ground G106 (LT5)

3. Operation

Both ABS and ASR rely on the EBCM for control.

ABS

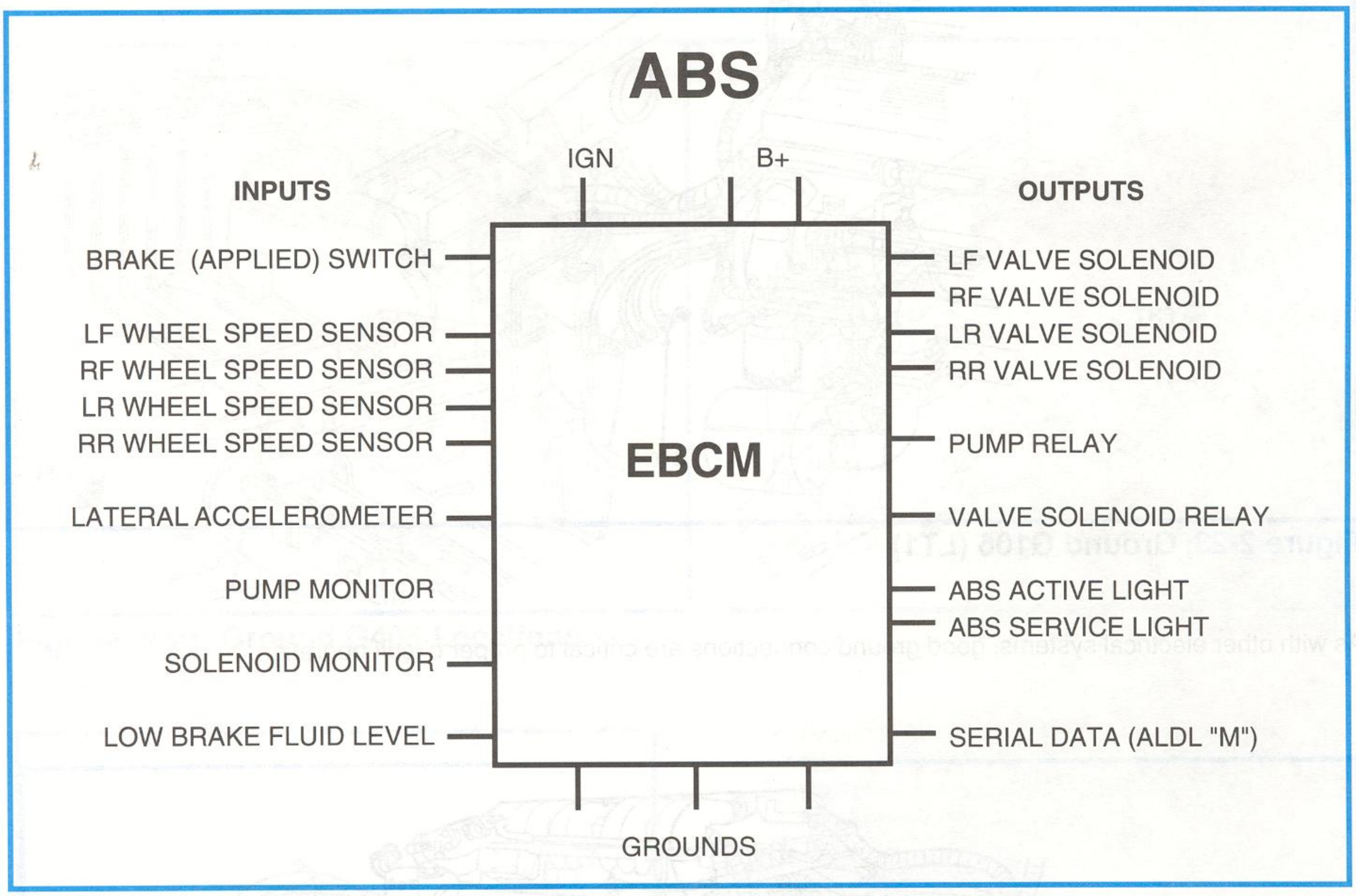


Figure 3-1, Corvette ABS Input/Output Diagram

Figure 3-1 shows the inputs and outputs of the ABS portion of the system.

Whenever the ignition has been turned “ON”, the EBCM monitors wheel speed data to detect any evidence of impending wheel lockup during brake application. If one of the front or rear wheels is slowing too rapidly, the EBCM commands the Modulator Valve Assembly to isolate master cylinder output pressure to that wheel (front circuits are controlled individually, rear circuits are modulated together).

The modulator can hold, increase, or reduce pressure at the caliper as needed. When increased pressure is required, the EBCM removes the modulator control from the circuit and master cylinder output pressure applies the caliper.

As implied, the modulator cannot apply pressure beyond that of the driver-controlled master cylinder.

EBCM Power/Grounds

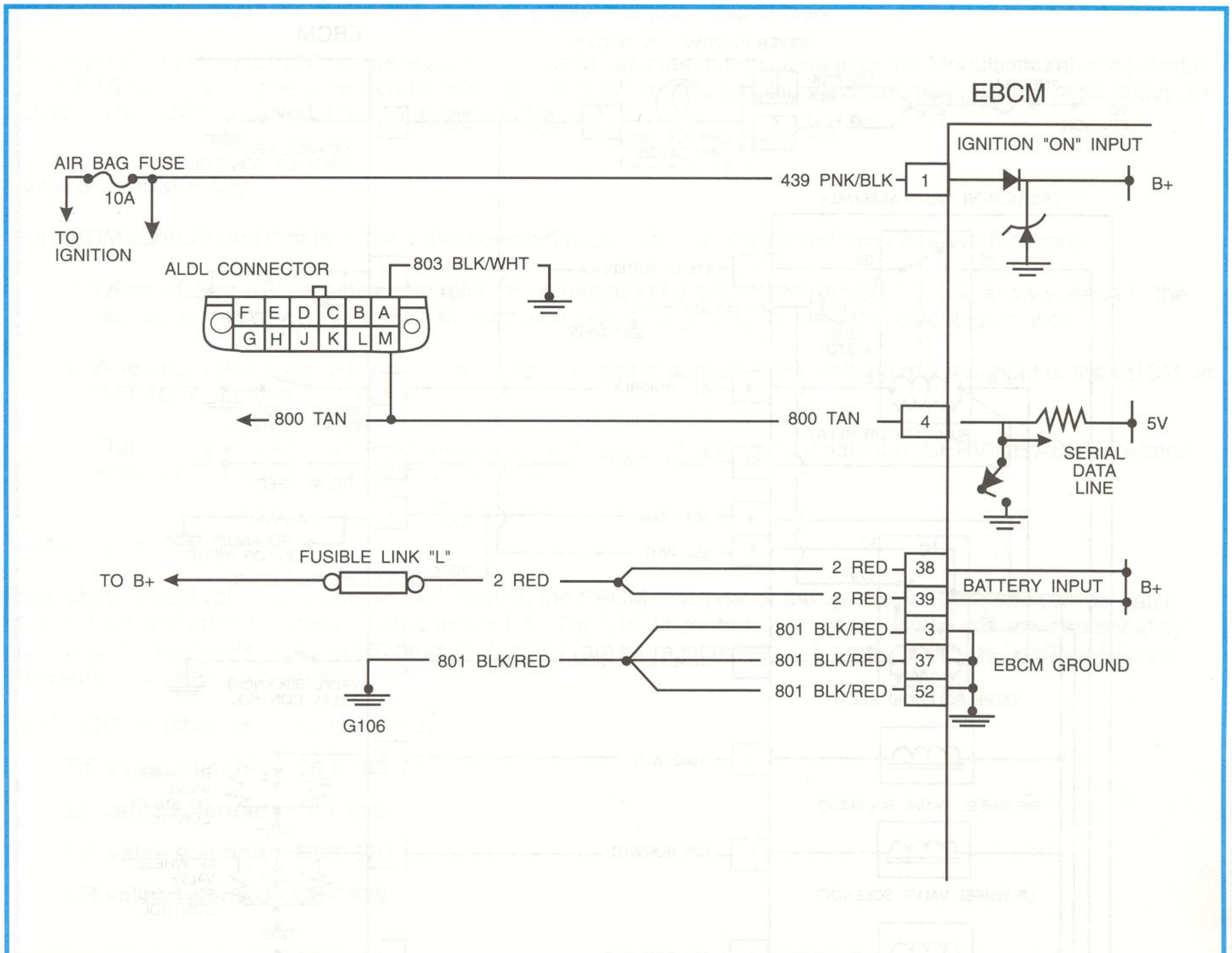


Figure 3-2, EBCM Internal-Related Circuits

The EBCM monitors itself and its CKT 439 voltage supply whenever the ignition is “ON” (figure 3-2). Battery positive for the EBCM is received from fusible link "L" on CKT 2. The EBCM is grounded via CKT 801 at terminals 3, 37 and 52.

The EBCM also monitors CKT 800. CKT 800 at terminal "M" of the ALDL connector is not used as on past systems to generate flash codes. Furthermore, while terminal "G" is not used in the system it is used for CCM diagnostics.

3. Operation

Valve Solenoid and Pump Circuits

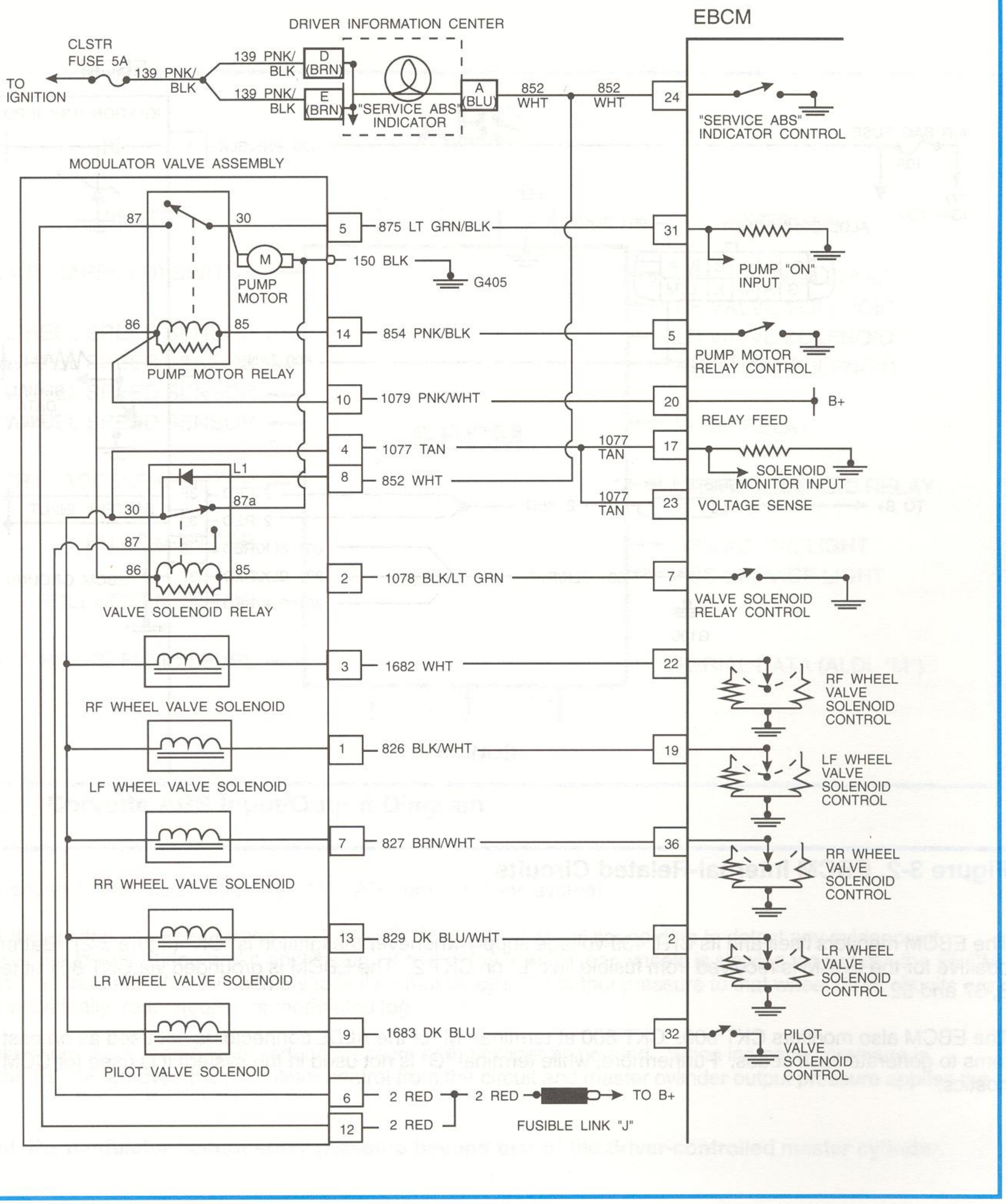


Figure 3-3, Valve Solenoid and Pump Circuits

Valve solenoid operation in the Modulator Valve Assembly is controlled and monitored by the EBCM (figure 3-3).

Battery positive is supplied to the Modulator Valve Assembly from fusible link "J". The voltage is carried on CKT 2 and enters at terminals 6 and 12 of the Modulator Valve Assembly. This voltage is routed to the the pump and valve solenoids by the pump motor relay and valve solenoid relay respectively.

Whenever the ignition is "ON", terminal 20 at the EBCM supplies battery voltage to the Modulator Valve Assembly on CKT 1079. This voltage is spliced to both the pump motor relay and the valve solenoid relay. These relays are controlled by EBCM supplied grounds discussed below.

Valve Solenoid Relay

The EBCM controls and monitors the valve solenoid relay. The valve solenoid relay has two functions:

1. When ABS or ASR is active, the relay is commanded by the EBCM on CKT 1078 to allow voltage to the valves. In these cases, the EBCM must also provide a ground for the valve solenoids to work.

2. When the valve solenoid relay is energized, voltage is applied to the voltage monitor input of the EBCM on CKT 1077, terminals 23 and 17.

3. The valve solenoid relay also provides a ground on CKT 852 to illuminate the “SERVICE ABS” indicator whenever the relay loses power or ground.

Wheel Valve Solenoids

Each of the wheel valve solenoids is controlled by the EBCM. Whenever the ignition is “ON”, each wheel valve solenoid is supplied with battery voltage on CKT 2. The EBCM controls current amount at the valve solenoid by providing various levels of ground to produce 0 amps (pressure increase), 2.5 amps (pressure hold), or 5 amps (pressure decrease) as required.

The EBCM-switched ground circuits are:

RF valve solenoid - CKT 1682

LF valve solenoid - CKT 826

RR valve solenoid - CKT 827

LR valve solenoid - CKT 829

Pilot Valve Solenoid

The pilot valve solenoid is controlled by the EBCM and receives battery voltage on CKT 2 whenever the ignition is “ON”. However, unlike the three-position wheel valve solenoids, the EBCM only commands the pilot valve to be either “ON” or “OFF” by supplying a ground on CKT 1683.

Pump Motor

When required, the EBCM turns the pump motor "ON" by grounding the pump motor relay via CKT 854. Battery voltage is always supplied to the pump motor relay on CKT 2. The EBCM uses CKT 875 to monitor motor operation. The EBCM looks for battery voltage within 60 milliseconds of the "PUMP ON" command to the relay, which is energized for the entire ABS or ASR event.

3. Operation

Brake Switch Circuit

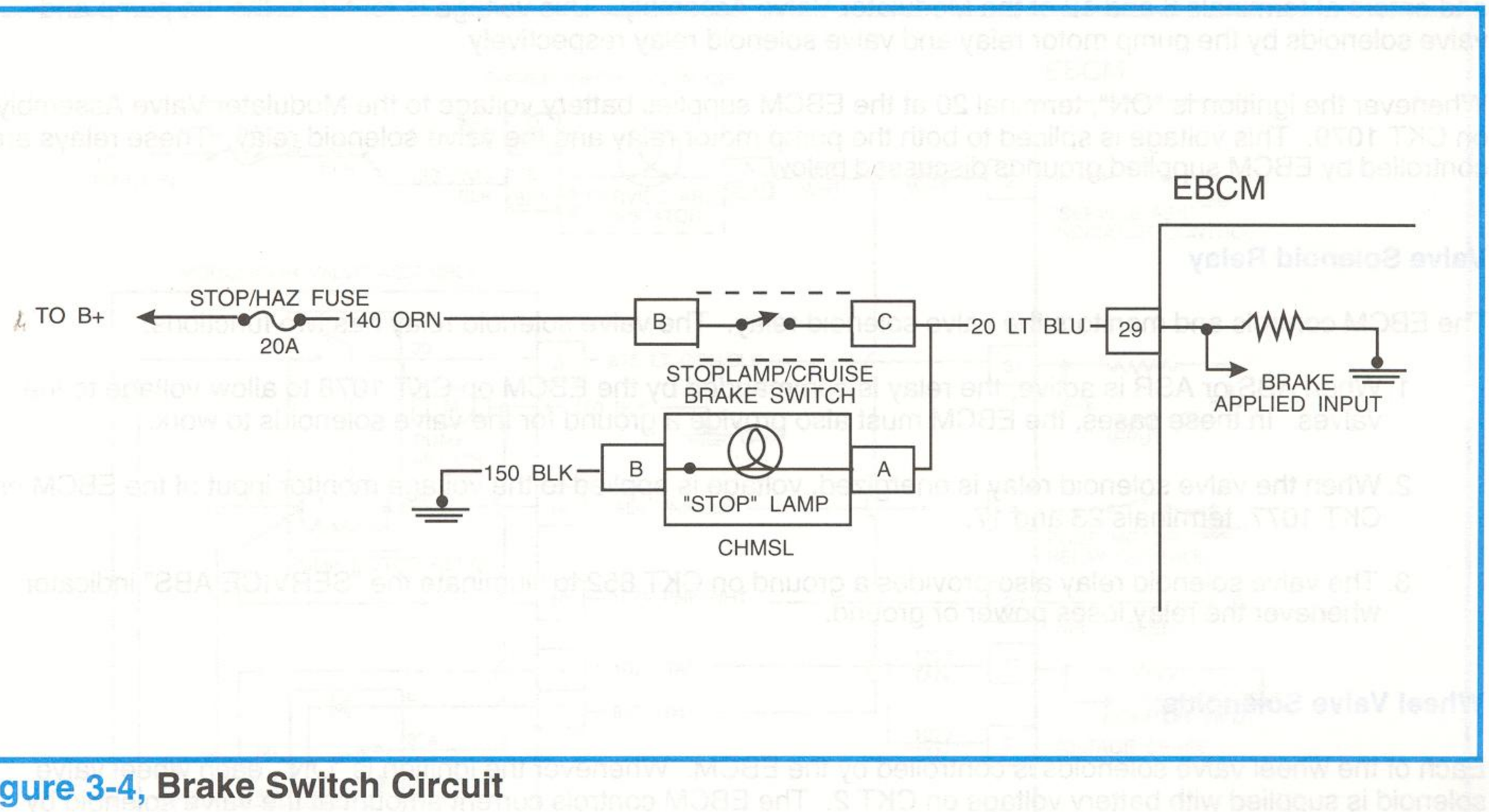


Figure 3-4, Brake Switch Circuit

The brake switch provides input to the EBCM on CKT 20 (figure 3-4) and also turns "ON" the center high mounted stop lamp.

Power goes to the switch through the "STOP/HAZ" 20-amp fuse on CKT 140 and is "hot" at all times. When the normally open brake switch is closed, voltage is applied at the EBCM terminal 29.

If the brake applied input is not seen at the EBCM, the "SERVICE ABS" light does not come "ON" and no code is set.

Speed Sensor Signal Generation

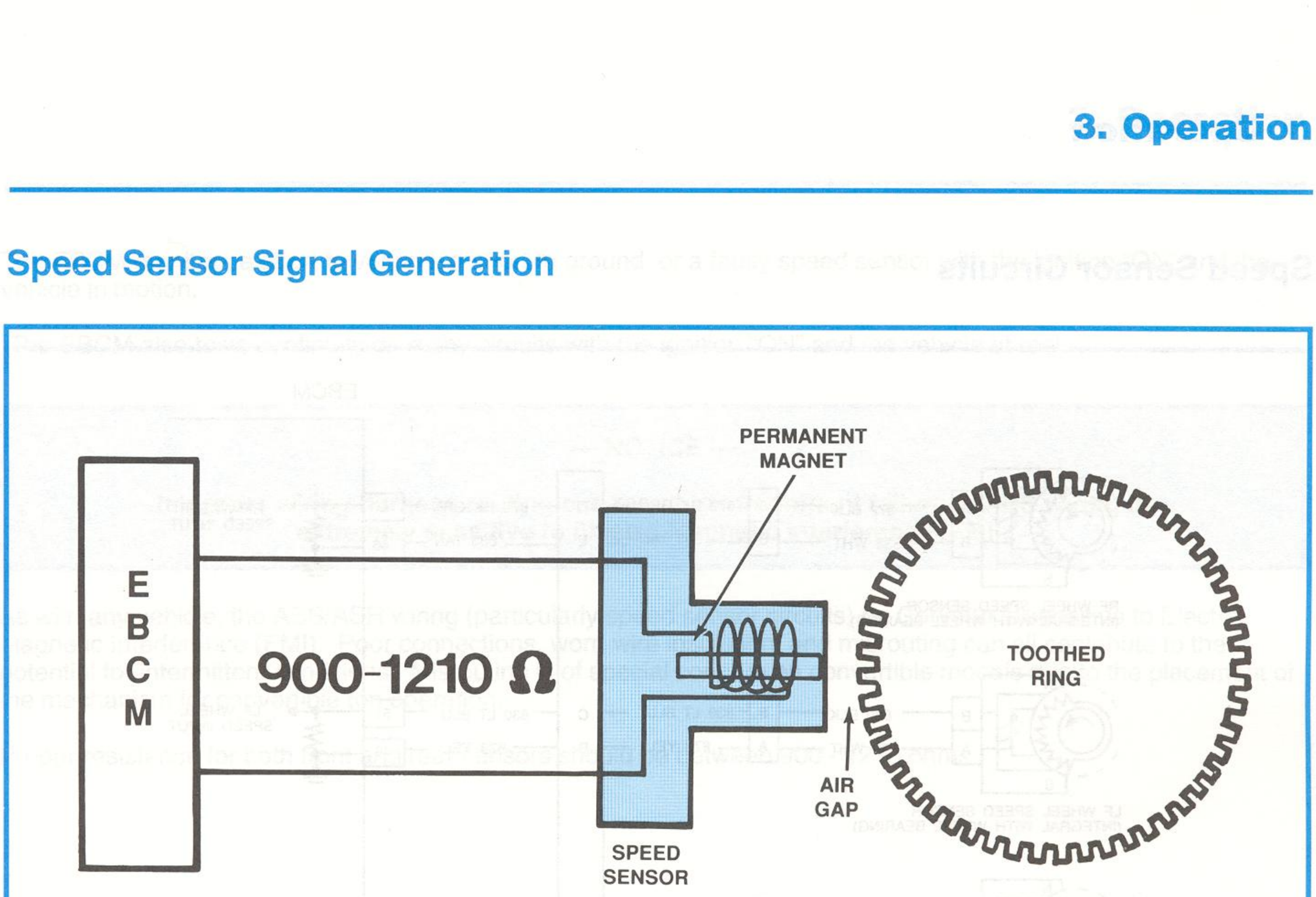


Figure 3-5, Speed Sensor Signal Generation

As the vehicle begins to move, wheel speed sensors come into play (figure 3-5). Sensors are a magnetic inductive type, consisting of three components:

- coil
- magnet
- reluctor (toothed wheel)

As the toothed wheel rotates at tire speed, the teeth disrupt the magnetic field. The pulsing magnetic field induces an AC voltage into the surrounding coil winding. This AC voltage has a frequency proportional to wheel speed.

- The EBCM uses wheel speed signals to determine vehicle reference speed and when antilock control is required. Specifically, the EBCM uses wheel speed sensor signals to determine whether one or more of the wheels are decelerating too rapidly and lockup is about to occur.
- Input from the wheel sensors is also used by the EBCM to determine when ASR is required. In the case of ASR, the EBCM looks for a rear wheel that is accelerating too rapidly compared to the front, non-drive wheels. This indicates positive wheel slip is occurring.
- Actual EBCM use of wheel speed data differs slightly between ABS and ASR operation. For ABS, the EBCM controls the rear wheels together using the “Select Low” principle. In these cases, the wheel with the least traction determines the level of control at both rear wheels. For ASR, rear wheels are controlled individually.

3. Operation

Speed Sensor Circuits

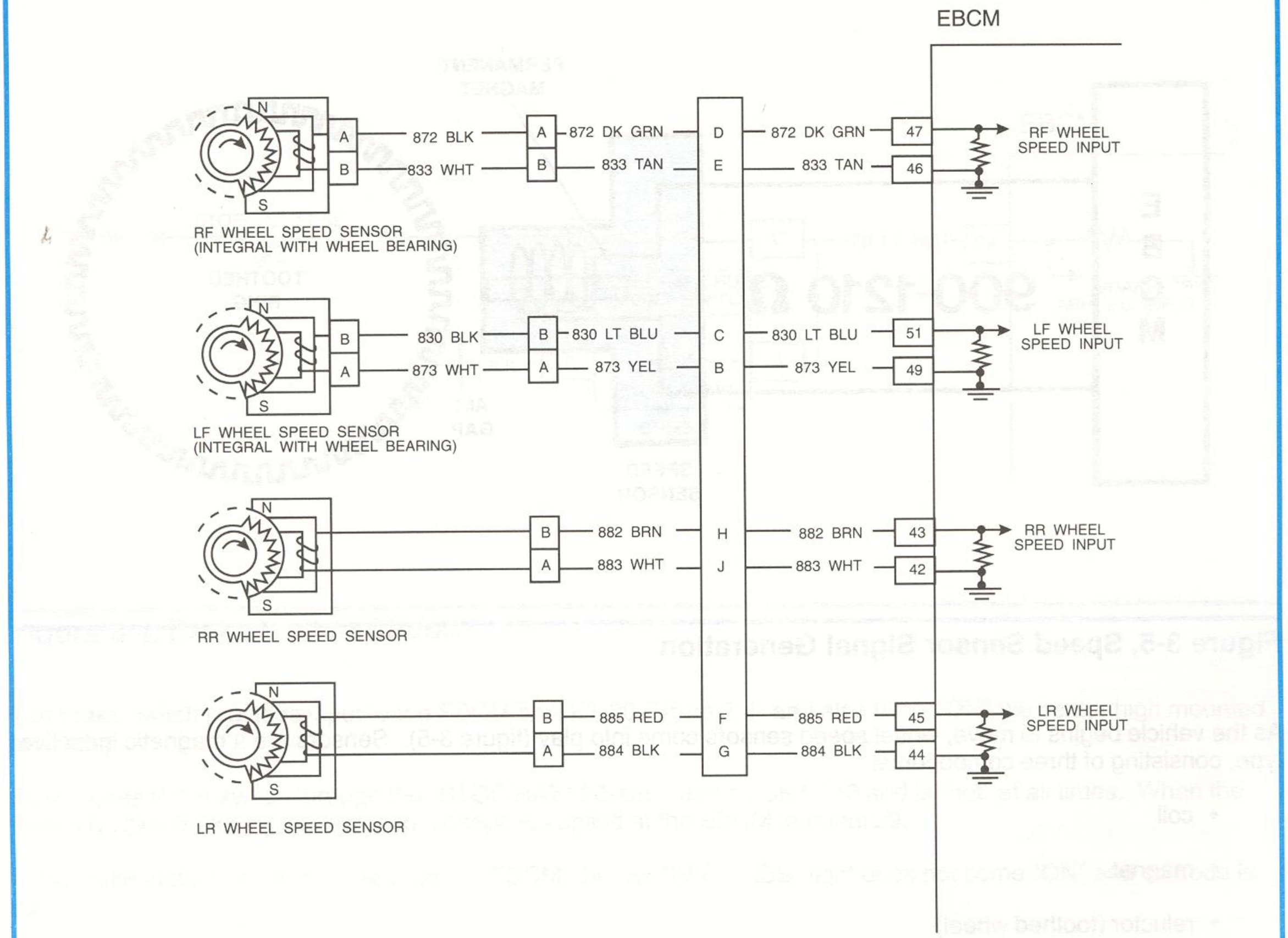


Figure 3-6, Speed Sensor Circuits

The EBCM monitors voltage pulses that are generated each time a “tooth-gap-tooth” event series occurs at a wheel speed sensor (figure 3-6). This speed sensor signal depends on:

- Air gap at the sensor/toothed wheel (non-adjustable)
- Wheel speed
- Condition of the sensor, tooth wheel, and the circuit (i.e., damage, wire misrouting, toothed wheel-sensor alignment)

Also be aware of a condition known as "sensor shock". Although rare, sensor shock is where a vehicle vibration could cause generation of a false sensor signal and modulator valve activation.

The EBCM monitors a short to voltage, a short to ground, or a faulty speed sensor with the ignition "ON" and the vehicle in motion.

The EBCM also tests continuity on many circuits with the ignition "ON" and the vehicle at rest.

— NOTICE —

Improper wiring harness routing can result in intermittent failures. ABS wiring is extremely sensitive to Electro-Magnetic Interference (EMI).

As with any vehicle, the ABS/ASR wiring (particularly speed sensor circuits) on Corvette is sensitive to Electro-Magnetic Interference (EMI). Poor connections, worn wire insulation, and misrouting can all contribute to the potential for intermittent conditions. Misrouting is of special concern on convertible models due to the placement of the mechanism for convertible top operation.

Proper resistance for both front and rear sensors should be between 900 - 1210 ohms.

3. Operation

Lateral Accelerometer Circuits

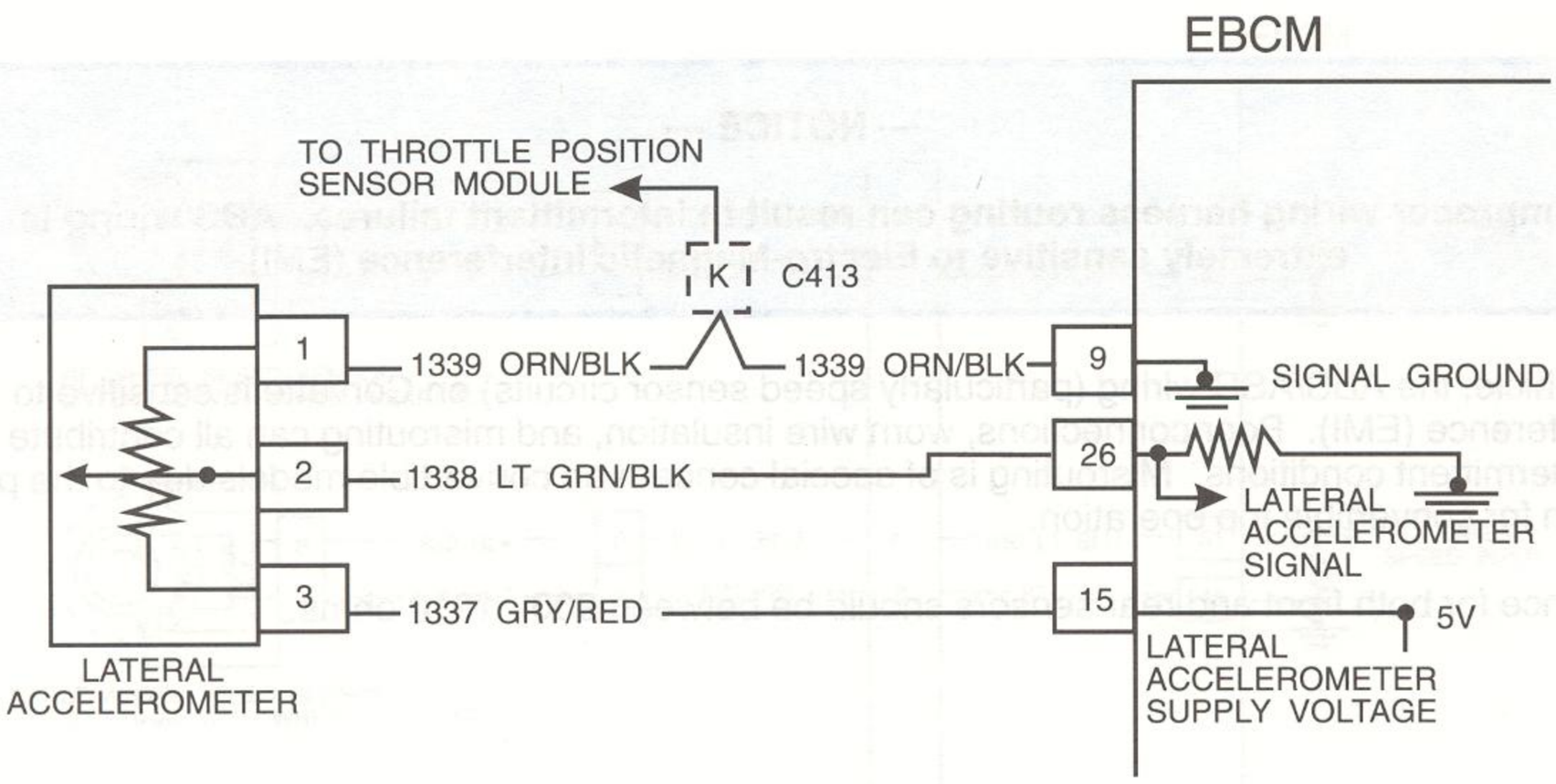


Figure 3-7, Lateral Accelerometer Circuits

The EBCM uses the lateral accelerometer to adjust brake application calculations whenever the vehicle is performing a severe turning or cornering maneuver (i.e. "yaw" forces) at 30 miles-per-hour or higher (figure 3-7). If the vehicle experiences significant rear-end "yaw" (oversteer), ASR events can be commanded by the EBCM to help prevent further "yaw" and help correct the oversteer.

Minor brake pulsations while driving could be caused by a bad lateral accelerometer.

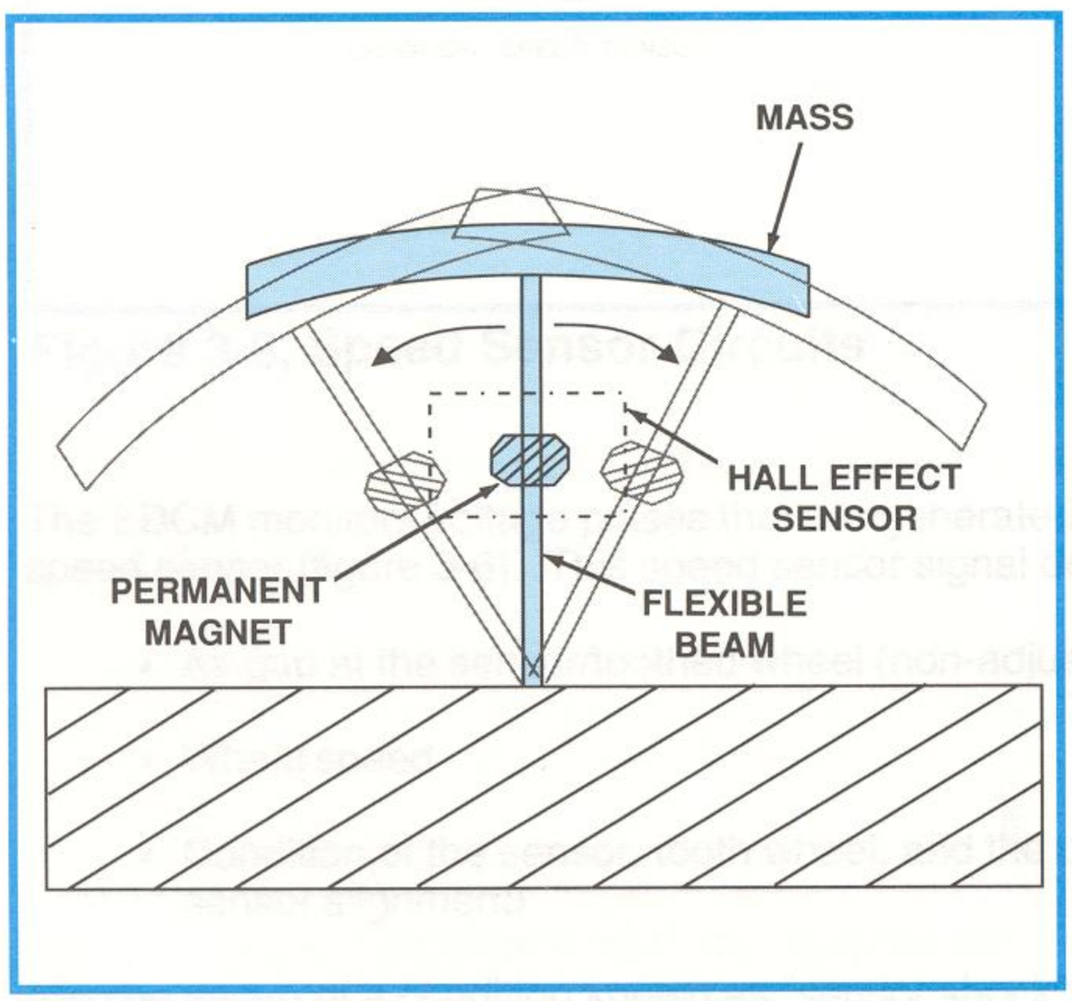


Figure 3-8, Lateral Accelerometer Internal

The EBCM supplies a five volt signal to the lateral accelerometer on CKT 1337 and a ground on CKT 1339. Actual accelerometer input is sensed on CKT 1338. During diagnosis, it may be helpful to note that the accelerometer ground on CKT 1339 is a shared ground for the throttle position module as well.

The lateral accelerometer is a Hall effect design, similar to the Hall effect switches used in General Motors distributorless ignition systems.

Inside the accelerometer, a mass attached to the end of a flexible beam is forced away from its center position by cornering forces (figure 3-8). As the mass moves, the beam flexes and moves a permanent magnet away from the Hall sensor. These actions change the analog output of the lateral accelerometer to the EBCM.

ABS Indicator Light Circuits

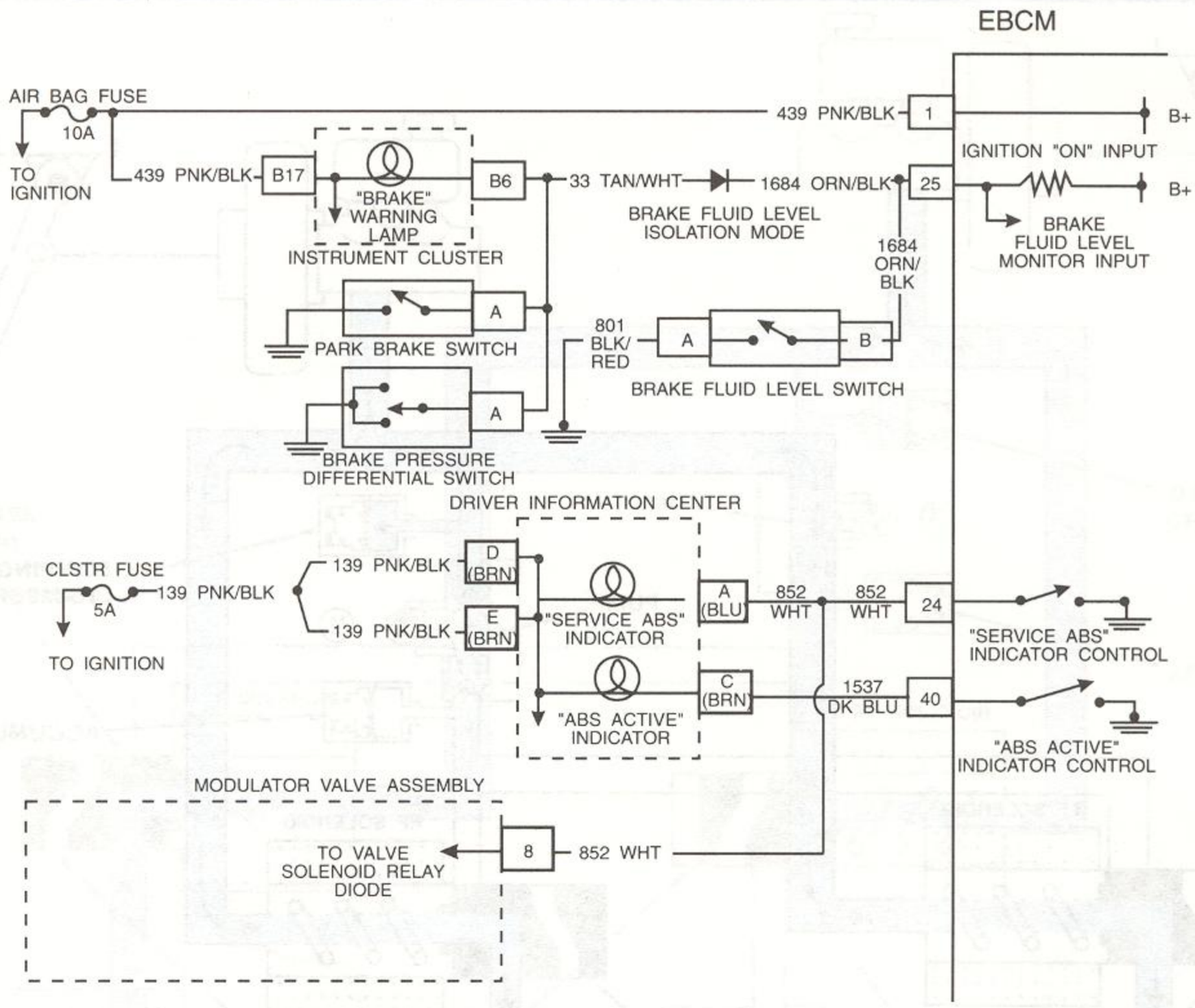


Figure 3-9, ABS Indicator Light Circuits

Three indicator lights relate to ABS operation (figure 3-9).

The red "BRAKE" warning lamp is spliced in CKT 439, EBCM ignition "ON" input. The red "BRAKE" lamp is turned "ON" by:

- a ground through the park brake switch
- a ground through the brake pressure differential switch
- a ground through the brake fluid level switch (monitored by the EBCM at terminal 25 to disable the system when fluid level is low).

The diode in the circuit for fluid level monitoring at terminal 25 isolates all other switch actions from the brake fluid level switch input.

Both the "ABS ACTIVE" and "SERVICE ABS" indicators receive power from the "CLSTR" fuse (5A) on CKT 139:

- "ABS ACTIVE" is grounded by the EBCM at terminal 40.
- "SERVICE ABS" is grounded through the valve solenoid relay at terminal 8 of the modulator valve assembly. This occurs until the relay is powered up.
- "SERVICE ABS" can also be grounded by the EBCM terminal 24 whenever a fault exists.

3. Operation

Standard Base Brake Operation with Power Assist

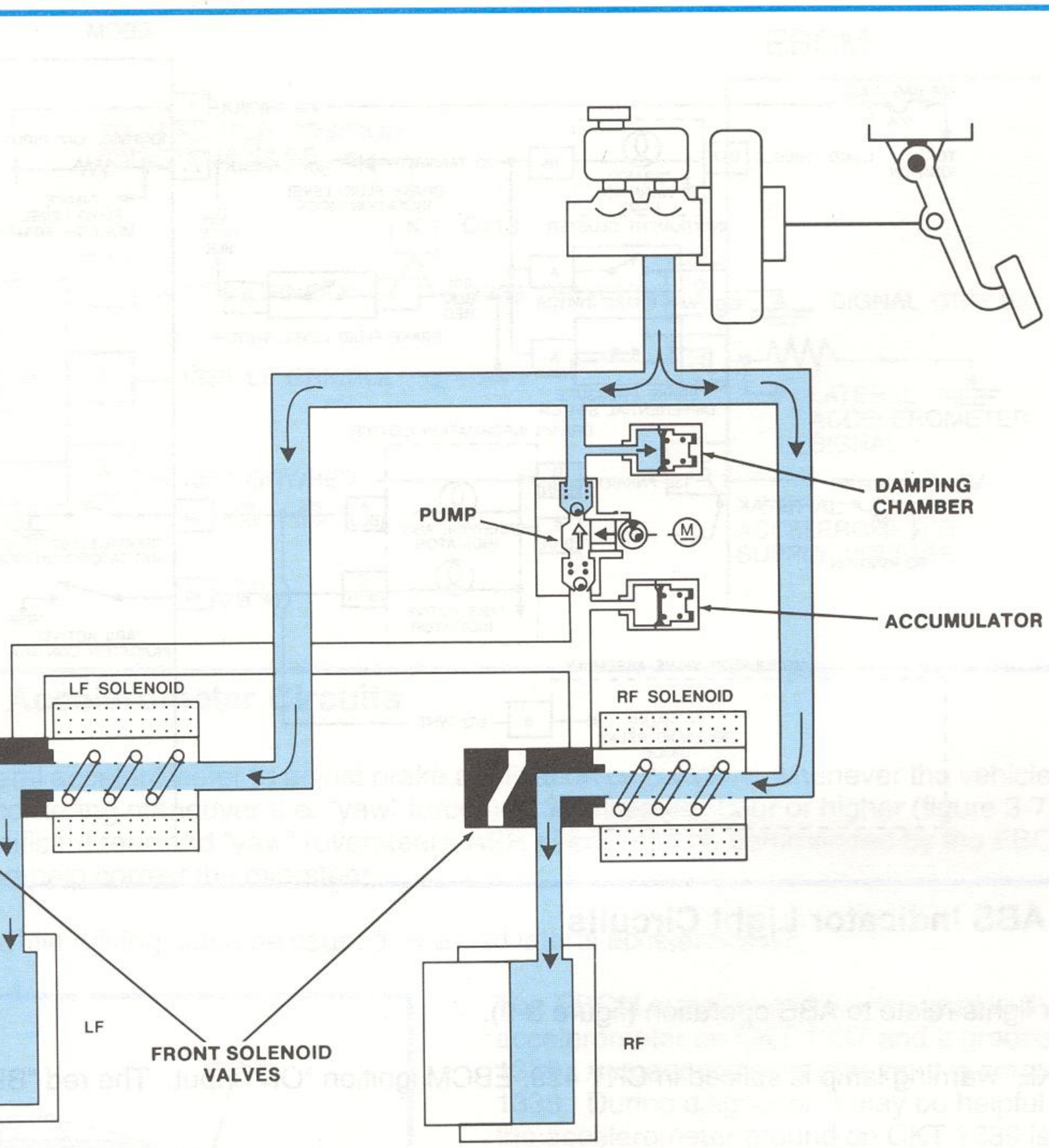


Figure 3-10, Hydraulic Flow Without ABS Intervention

Under most braking conditions, the antilock system functions similar to a conventional brake system. Brake fluid pressure is provided by the booster-assisted master cylinder (figure 3-10).

For non-antilock braking, hydraulic pressure is applied to the wheel cylinder and calipers without any intervention from the ABS. The modulator valve assembly maintains a two-way fluid path from the master cylinder to the wheel circuits.

Non-antilock braking occurs when the wheel sensors do not detect wheel lockup tendencies. However, even though the ABS is passive during non-ABS power-assist braking, the EBCM constantly watches for rapid changes at any of the wheels or a signal from the brake switch. Rapid wheel deceleration when not braking could turn "ON" the "ABS ACTIVE" indicator and cause the pump to run for a short time. This is normal.

ABS Stop: Pressure Hold

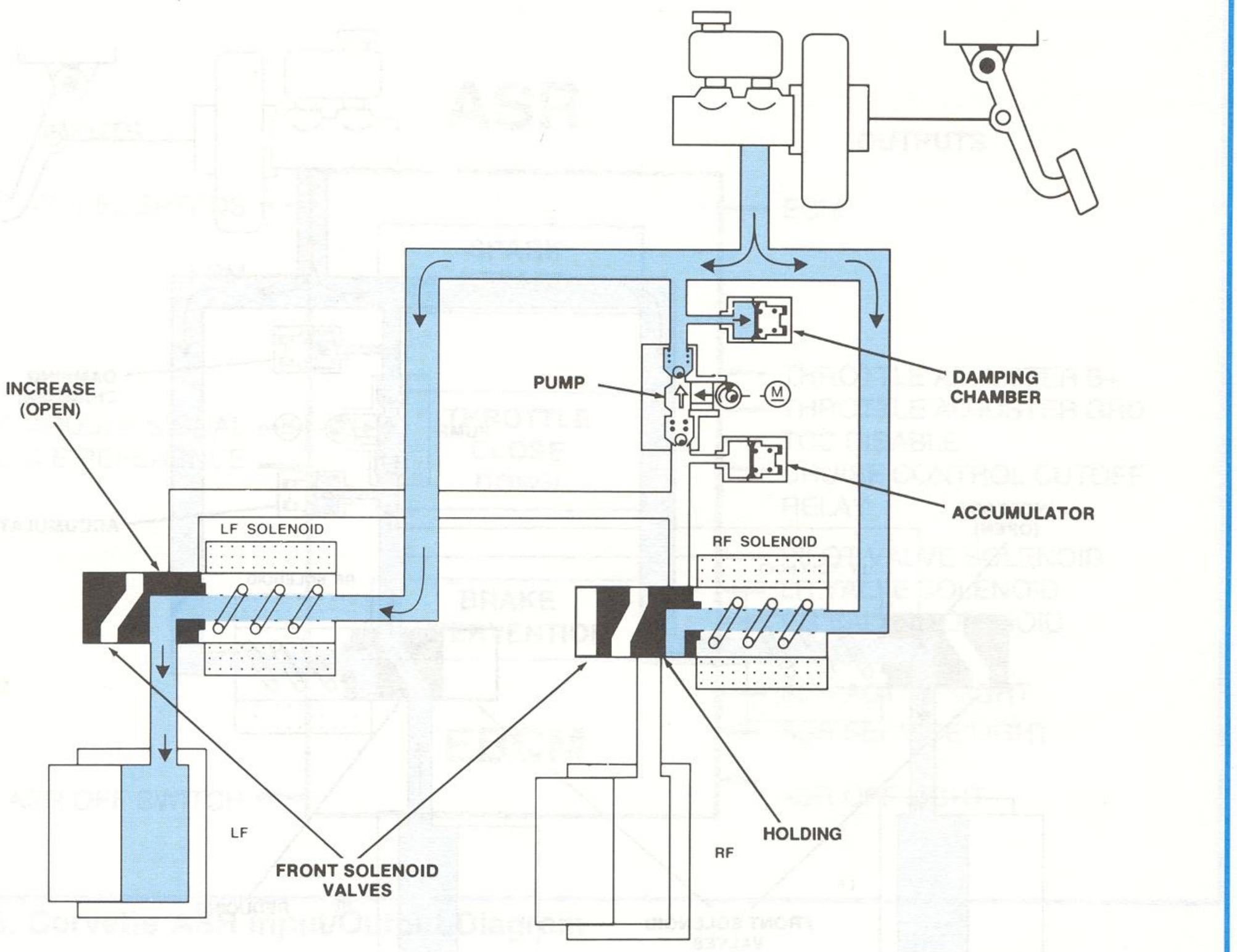


Figure 3-11, ABS: Pressure Hold

When an impending lockup is determined by the EBCM, the ABS solenoid valve for that wheel circuit is positioned to block additional fluid pressure from entering the specific wheel circuit (figure 3-11). Positioning the solenoid valve in the "hold" position requires the EBCM to provide an appropriate resistance ground to that valve solenoid (current at 2.5 amps).

ABS Stop: Pressure Decrease

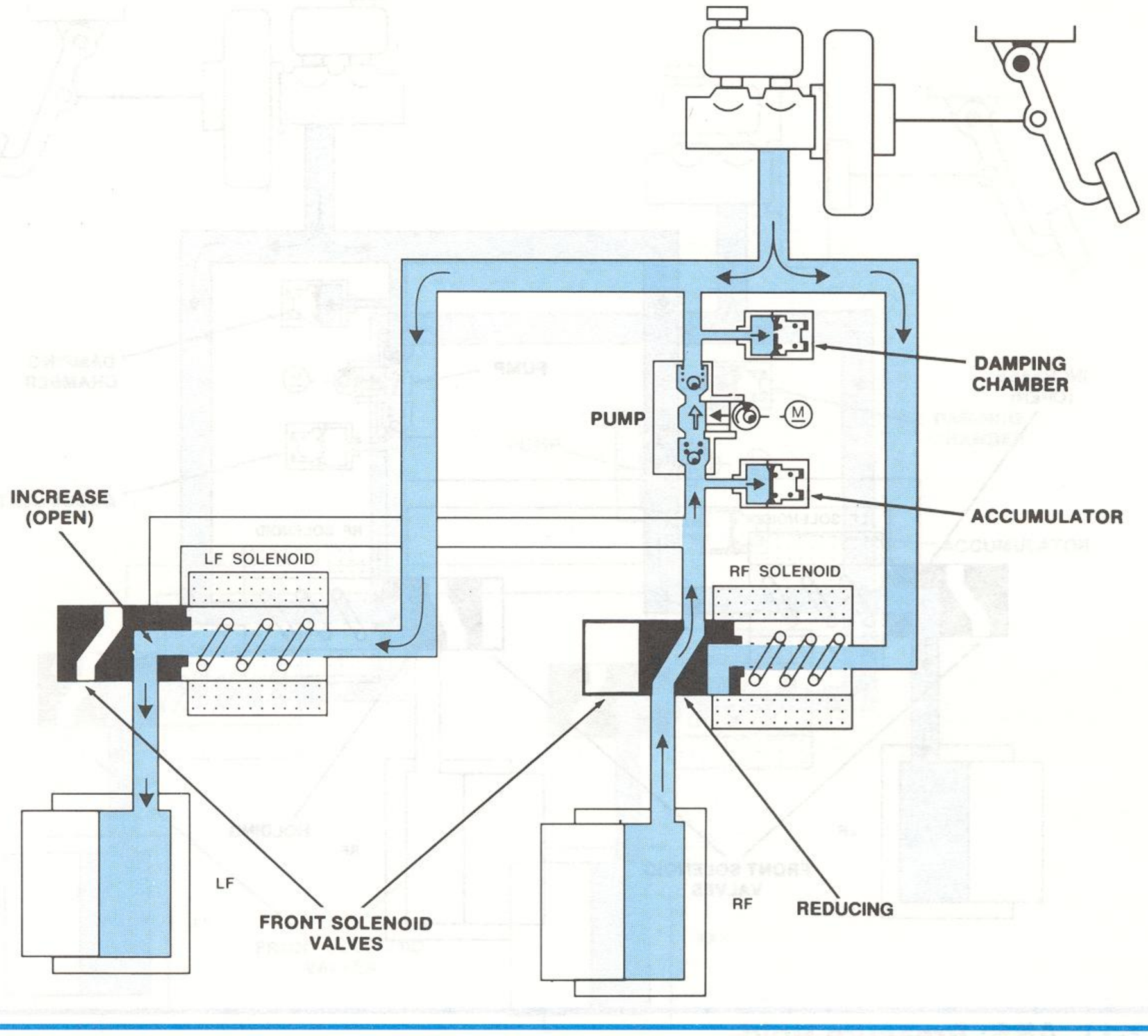


Figure 3-12, ABS: Pressure Decrease

If the EBCM determines from wheel sensor signals that wheel lockup is still occurring after "holding" pressure, it will provide 5 amps to advance the solenoid valve to the pressure decrease position (figure 3-12). In this position, the wheel caliper circuit is connected to the pump. Pressurized fluid is directed back to the solenoid valve input. Depending on the road surface coefficient, this action reduces wheel slip. The EBCM reads wheel speed many times a second and adjusts pressure as required.

ABS Stop: Pressure Increase

In order to reapply the brakes, the EBCM will command the appropriate wheel circuit solenoid valve to return to the open, or at rest position. The EBCM deenergizes all solenoids and the pump. Now, master cylinder fluid pressure reapplies the brakes as shown previously in figure 3-10.

ASR

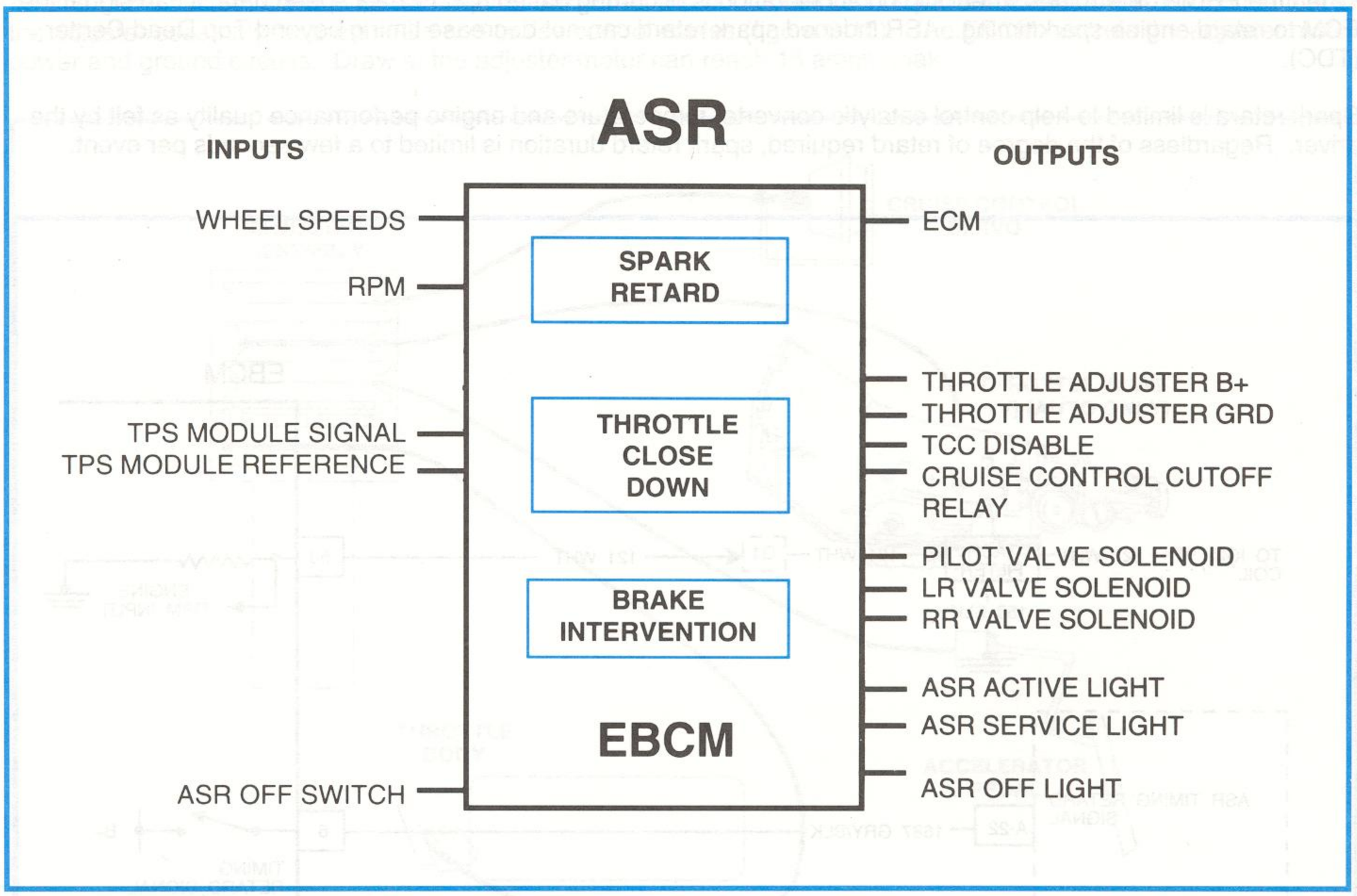


Figure 3-13, Corvette ASR Input/Output Diagram

Unlike ABS, which is entirely dedicated to brake system control, ASR involves brake operation as only one of three ways to control positive wheel slip (figure 3-13). If the EBCM sees that positive wheel slip is occurring at a rear wheel, it will:

1. Command the ECM to retard spark advance.
2. Close throttle blade position.
3. Apply brake pressure, if required, at the rear wheel(s) that is(are) losing traction.

The EBCM can combine one, two, or all three of these actions to minimize slip on acceleration. Note, however, that brake intervention will never precede the other actions; it is done only along with or after retarding spark advance or throttle close-down. In fact, brake intervention is relatively slow and less effective at engine torque control than spark retard and/or throttle close-down. Brake intervention is, however, effective at slower speeds during excess wheel spinning. As a result, EBCM-directed brake intervention occurs only below 80 kph (50 mph). Above 80 kph (50 mph), ASR uses spark retard and throttle close-down only.

When ASR rear brake intervention is required, the EBCM commands the pump and Modulator Valve Assembly to apply brake pressure to the caliper of the rear wheel that is slipping. When the wheel slip is controlled, the EBCM discontinues rear brake intervention.

3. Operation

ASR Spark Retard

When the EBCM determines wheel slip on acceleration is occurring based upon wheel speed data, it can signal the ECM to retard engine spark timing. ASR induced spark retard can not decrease timing beyond Top Dead Center (TDC).

Spark retard is limited to help control catalytic converter temperature and engine performance quality as felt by the driver. Regardless of the degree of retard required, spark retard duration is limited to a few seconds per event.

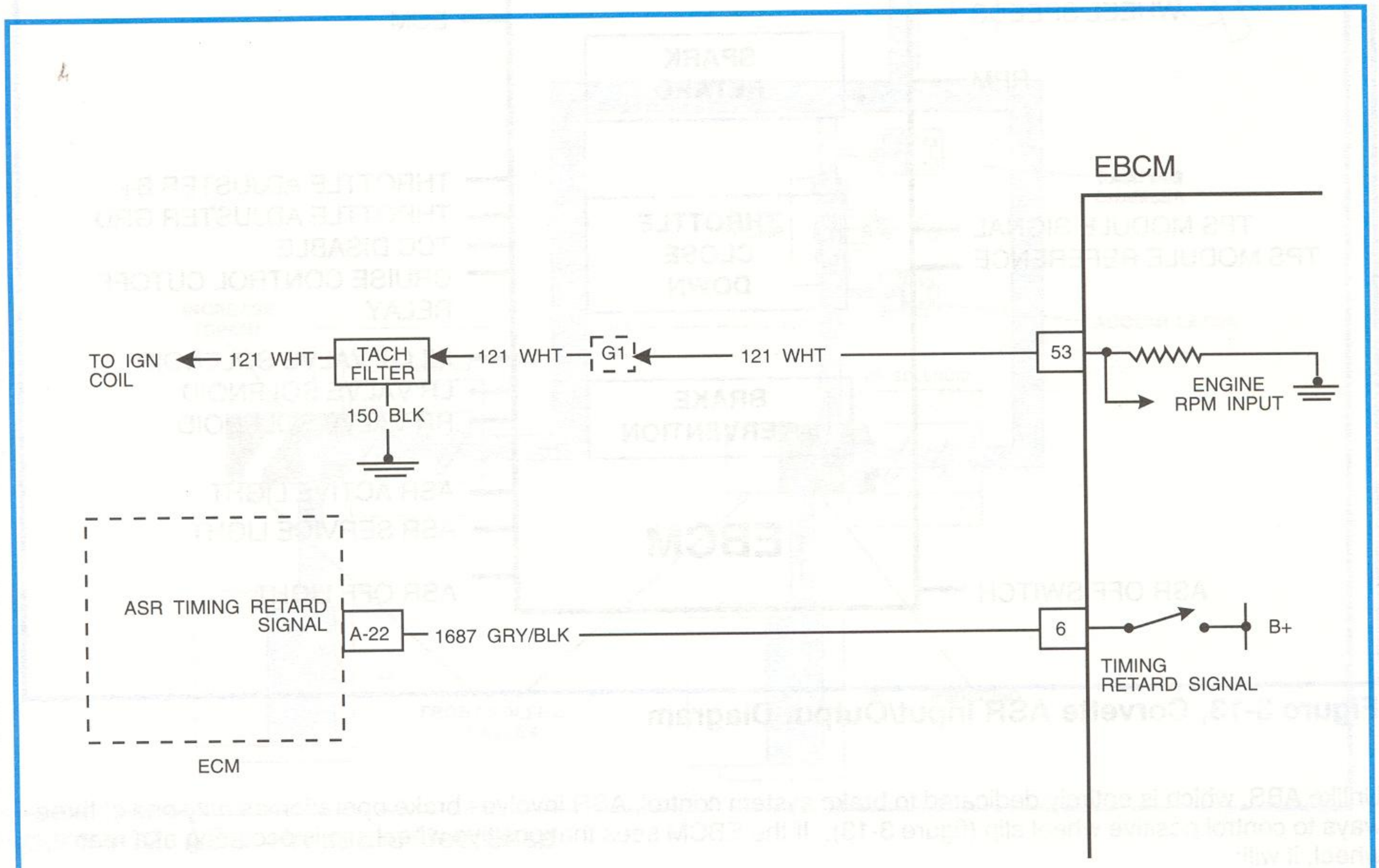


Figure 3-14, ECM-Related Circuits (LT1 Shown)

The EBCM monitors engine rpm on CKT 121 from the tach filter and requests ignition retard on CKT 1687 to the ECM (figure 3-14).

ASR Throttle Close-Down

Another ASR system method for minimizing rear wheel slip on acceleration is throttle close-down through the use of the adjuster assembly for the throttle and cruise control cables (figure 3-15). The EBCM controls the adjuster motor power and ground circuits. Draw at the adjuster motor can reach 16 amps peak.

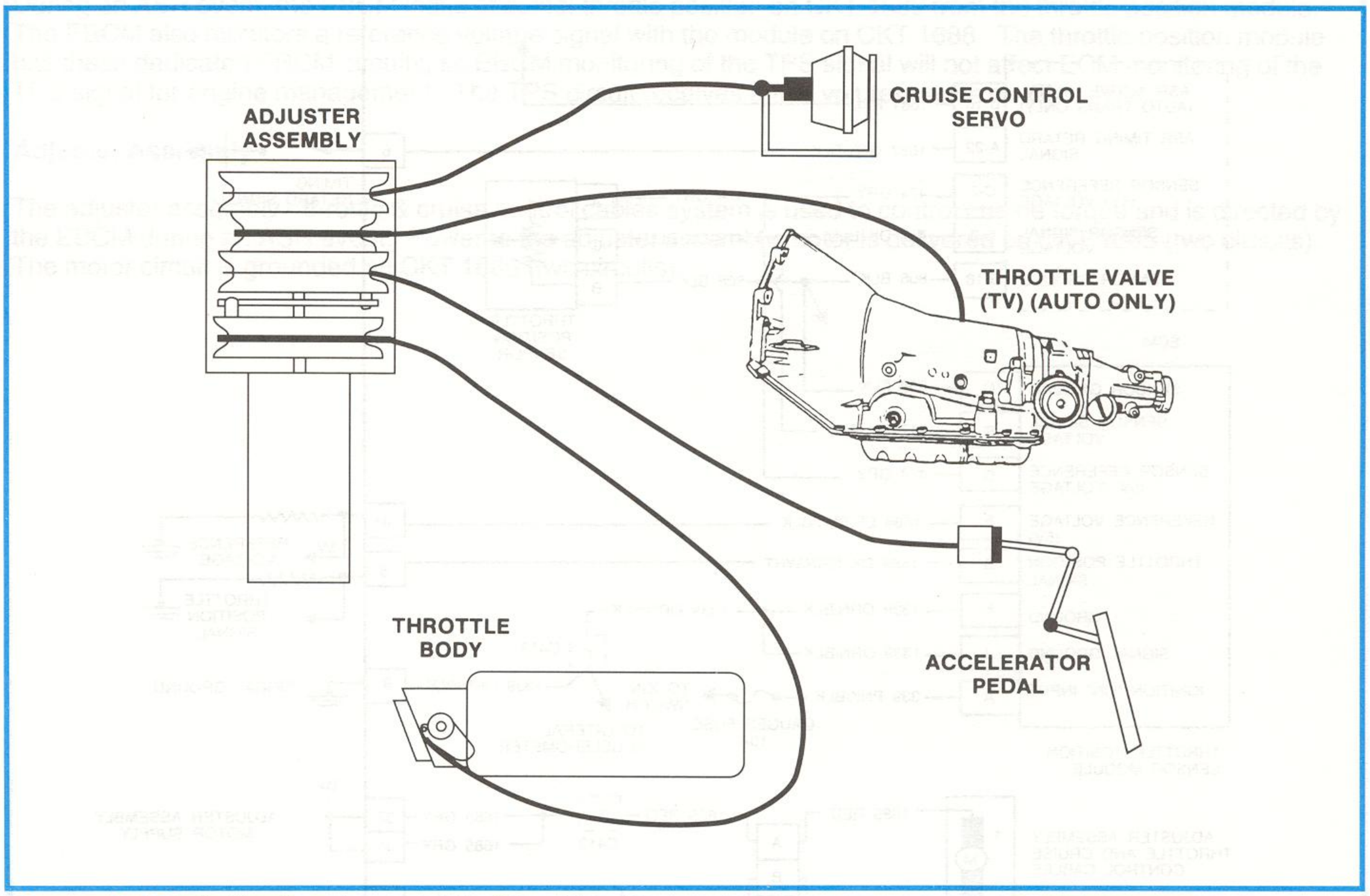


Figure 3-15, Adjuster Assembly Throttle Close-Down

When it is required, driver-controlled throttle position can be reduced by the adjuster assembly, regardless of accelerator pedal position. However, the TV cable is not affected by the adjuster position.

3. Operation

Adjuster Assembly Circuits

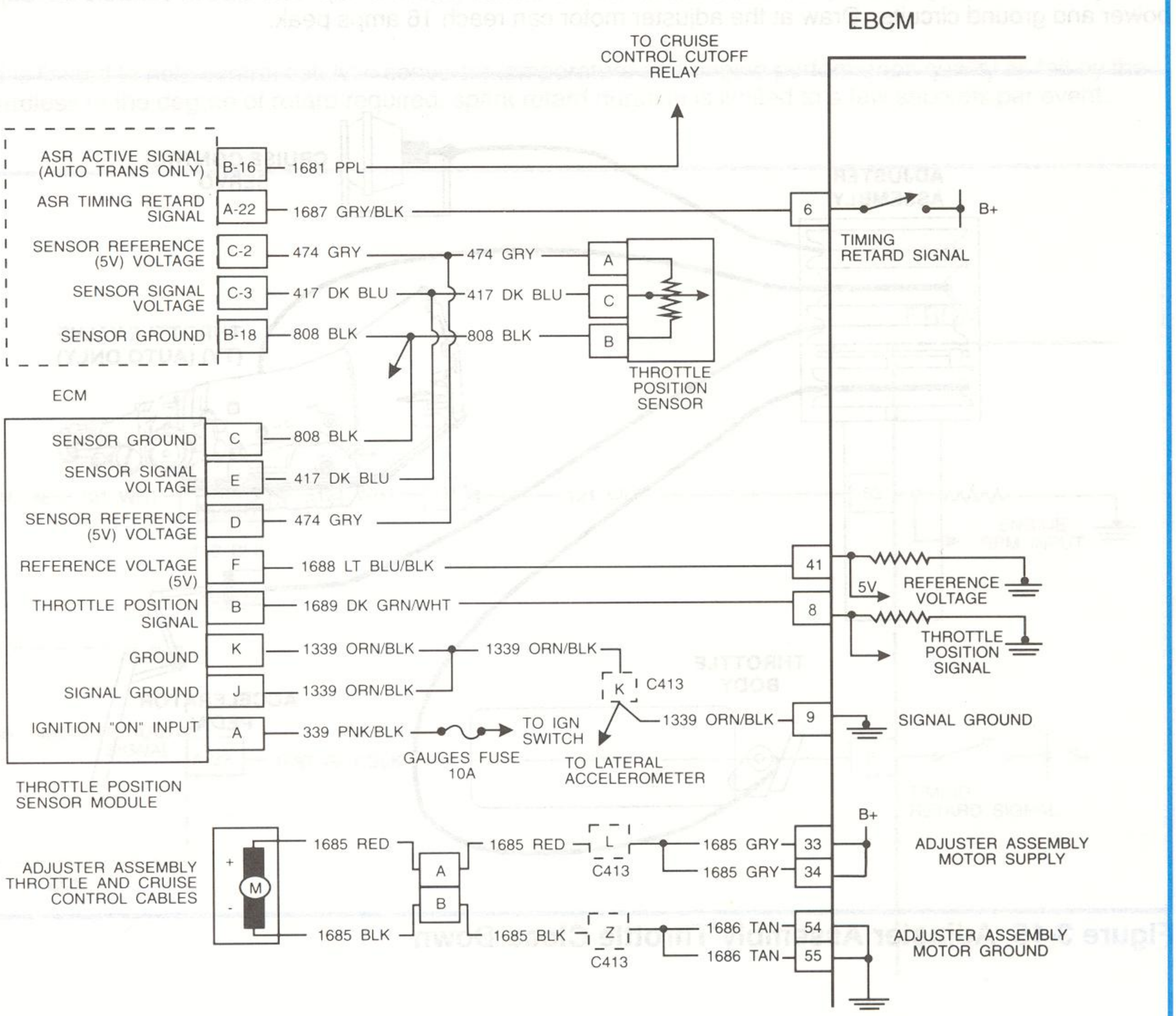


Figure 3-16, Adjuster Assembly Circuits (LT1 Shown)

When ASR is active, the EBCM can request adjustment of throttle position by looking at the throttle position sensor module and command the closing of the throttle opening to decrease engine torque (figure 3-16).

EBCM Internal Adjuster Assembly

The EBCM contains two internal microprocessors related to ASR operation. One microprocessor handles ASR calculations and functions, and the other handles calculations and functions for the adjuster assembly.

Throttle Position Signal

During an ASR event, the EBCM looks at actual throttle position on CKT 1689 from the throttle position module. The EBCM also monitors a reference voltage signal with the module on CKT 1688. The throttle position module has these dedicated EBCM circuits, so EBCM monitoring of the TPS signal will not affect ECM monitoring of the TPS signal for engine management. The TPS circuit receives a five volt reference on CKT 474.

Adjuster Assembly

The adjuster assembly - throttle & cruise control cables system is used to control engine torque and is directed by the EBCM during an ASR event. Power to the adjuster assembly motor is delivered on CKT 1685 (two circuits). The motor circuit is grounded on CKT 1686 (two circuits).

Cruise/TCC Disable

During ASR operation, cruise control and Torque Converter Clutch (TCC) operation are disabled (figure 3-17).

- Cruise control is disabled at the cruise control module via circuit interruption by the cruise control cut-off relay.
- TCC (if equipped with an automatic transmission) is disabled via a signal from the EBCM to the ECM.

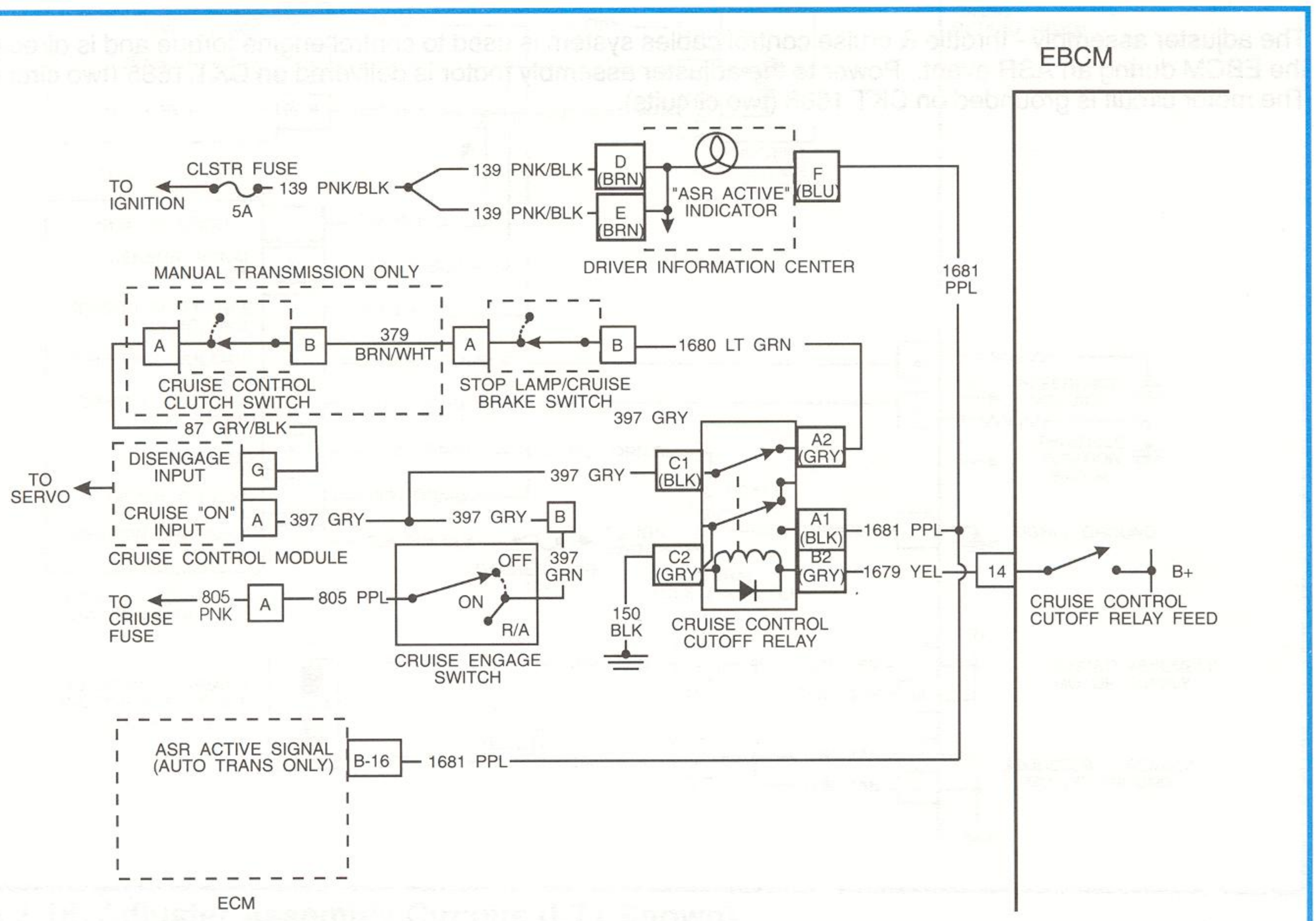


Figure 3-17, Cruise Output Circuits (LT1 Shown)

When cruise control is “ON” and ASR is not active, the cruise control circuit is completed across normally closed terminals C1 and A2 in the “Cruise Control Cut-Off” relay. When ASR is active, the EBCM energizes the relay coil via CKT 1679. This pulls the C1 terminal from A2, interrupting cruise engagement. Also, terminal C2 is connected with A1 which provides a ground for the “ASR ACTIVE” indicator on CKT 1681. CKT 1681 also goes to the ECM (identifying that ASR is active) to request TCC disable on vehicles with automatic transmissions. The cruise control switch is part of the clutch pedal vacuum release valve assembly and is open with the clutch pedal depressed on vehicles with manual transmissions. This disables cruise control.

ASR Indicator Light Circuits

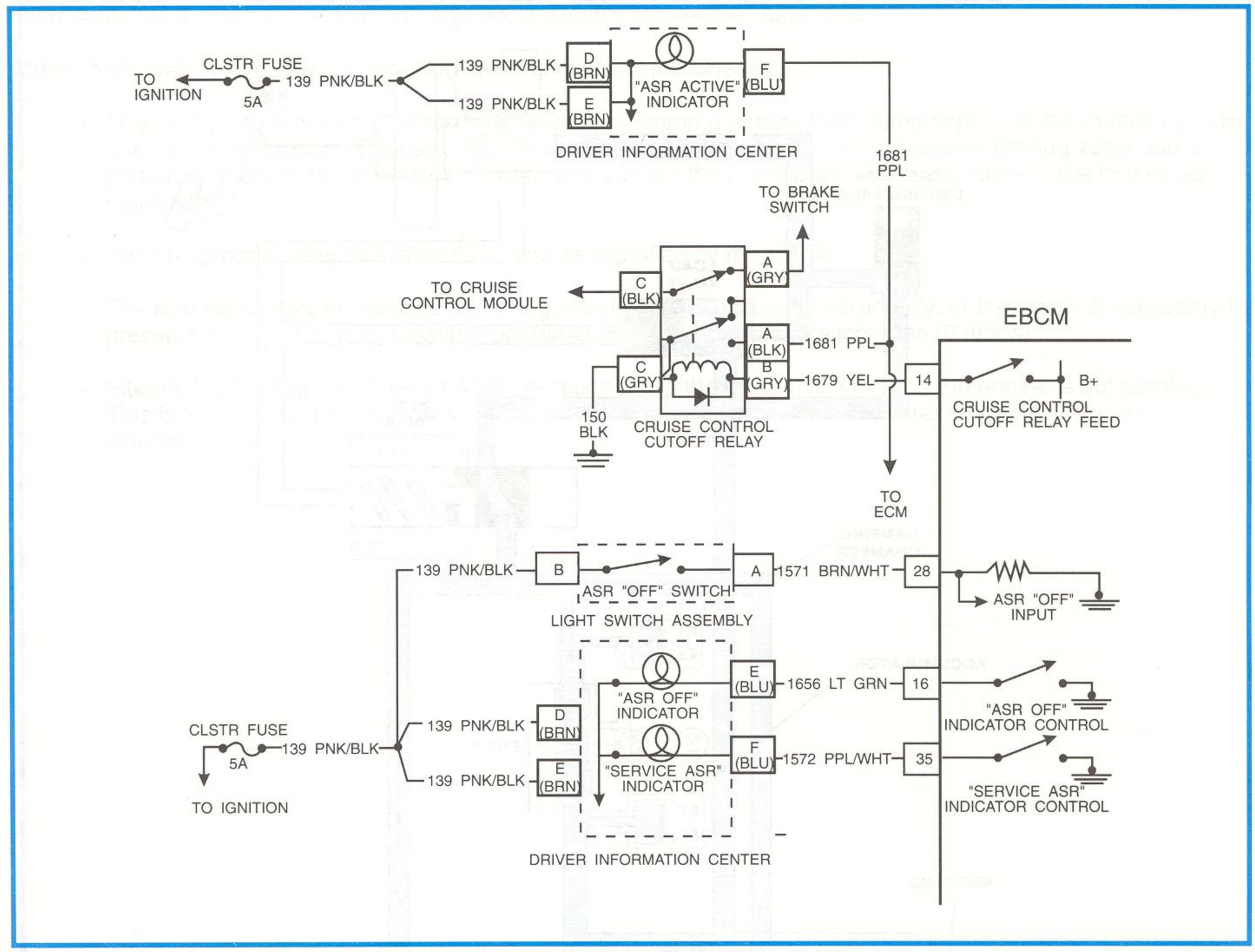


Figure 3-18, ASR Indicator Light Circuits

Three indicator lights relate to ASR operation (figure 3-18):

- The "ASR ACTIVE" indicator receives voltage from the "CLSTR" fuse 5A on CKT 139. The indicator is grounded on CKT 1681 by the double-throw cruise control cutoff relay as it disables cruise control for ASR operation.

- "ASR OFF" indicator also receives voltge from the 5 amp "CLSTR" fuse. This indicator can be turned "ON" by the ASR "OFF" switch or the EBCM at terminal 16. As mentioned earlier, the "ASR OFF" switch is a "manual override" sensed at terminal 28 of the EBCM. Pressing the switch turns the system "OFF". Pressing it again turns it back "ON". If the EBCM sees a fault in this circuit for longer than 15 seconds or the switch is depressed for more than 15 seconds, the system defaults to "ON" for the entire ignition cycle.

- "SERVICE ASR" indicator is turned "ON" by the EBCM supplying a ground at terminal 35, CKT 1572. As with the other ASR indicators, voltage is provided by the 5 amp "CLSTR" fuse.

ASR Brake Intervention

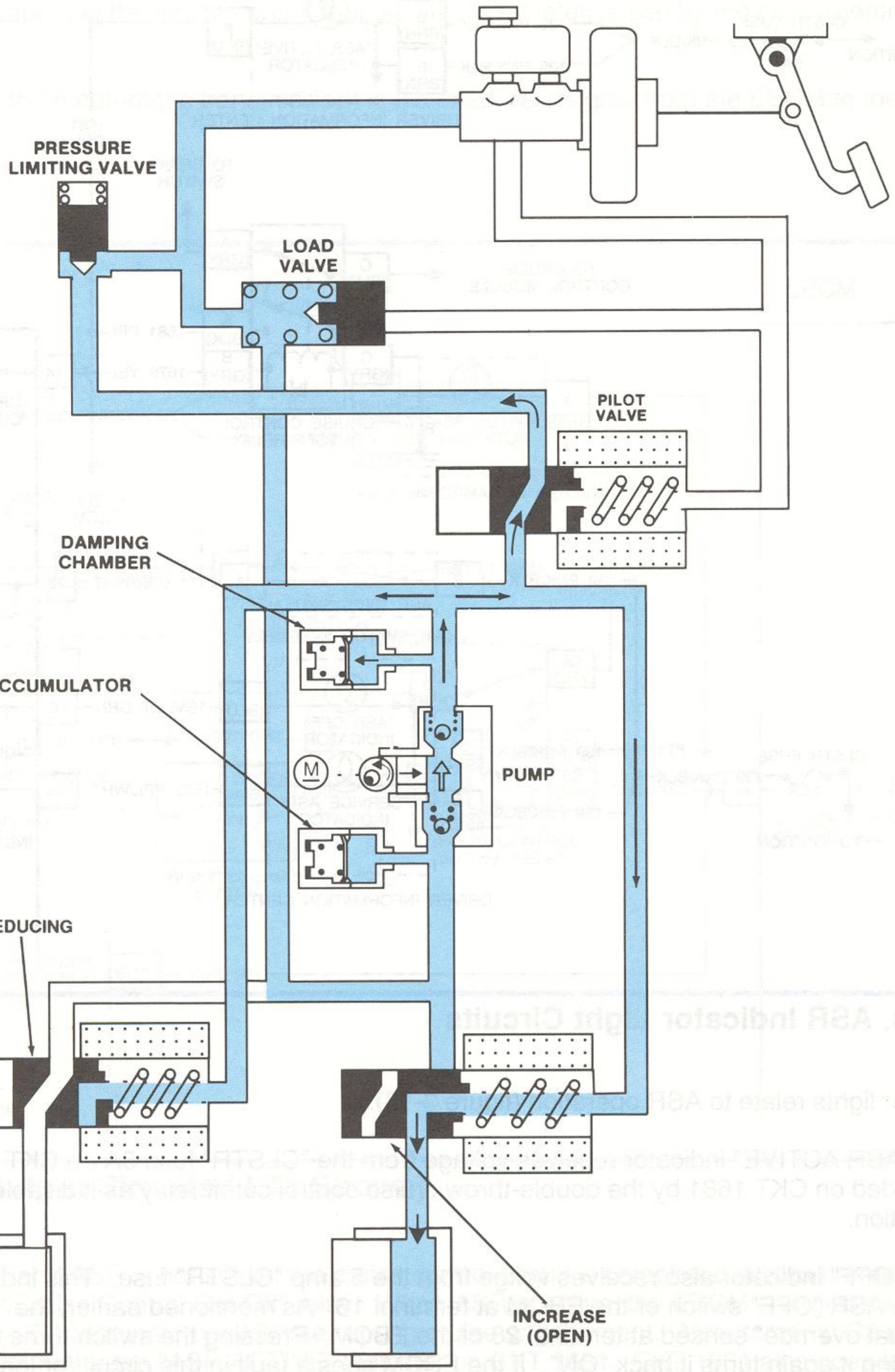


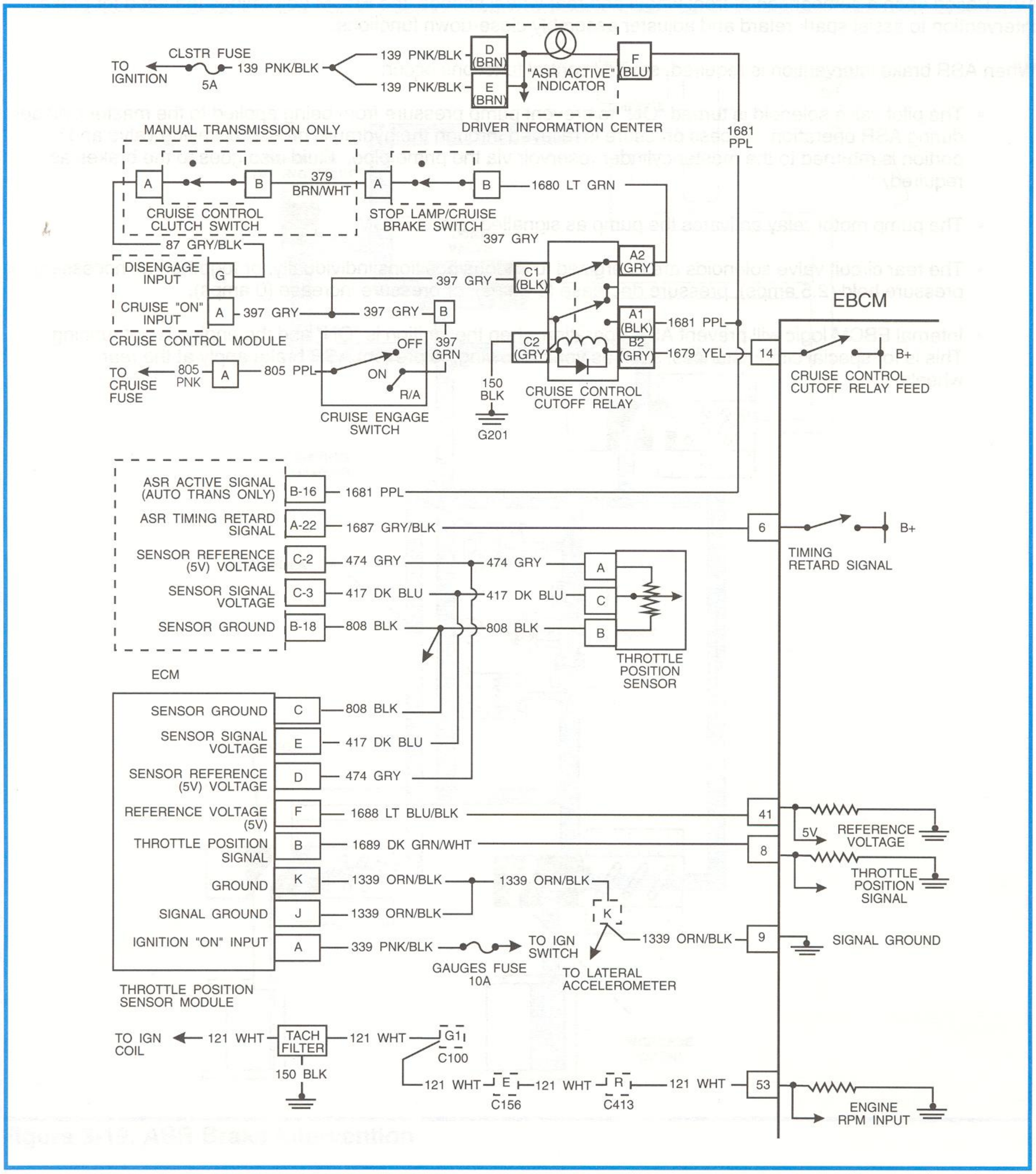
Figure 3-19, ASR Brake Intervention

When the EBCM determines brake intervention is required to minimize positive rear wheel slip, it signals the Modulator Valve Assembly to apply and release brake pressure at one or both rear circuits as necessary (figure 3-19). Based upon a comparison of front wheel and rear wheel speeds, the EBCM determines the need for brake intervention to assist spark retard and adjuster assembly close-down functions.

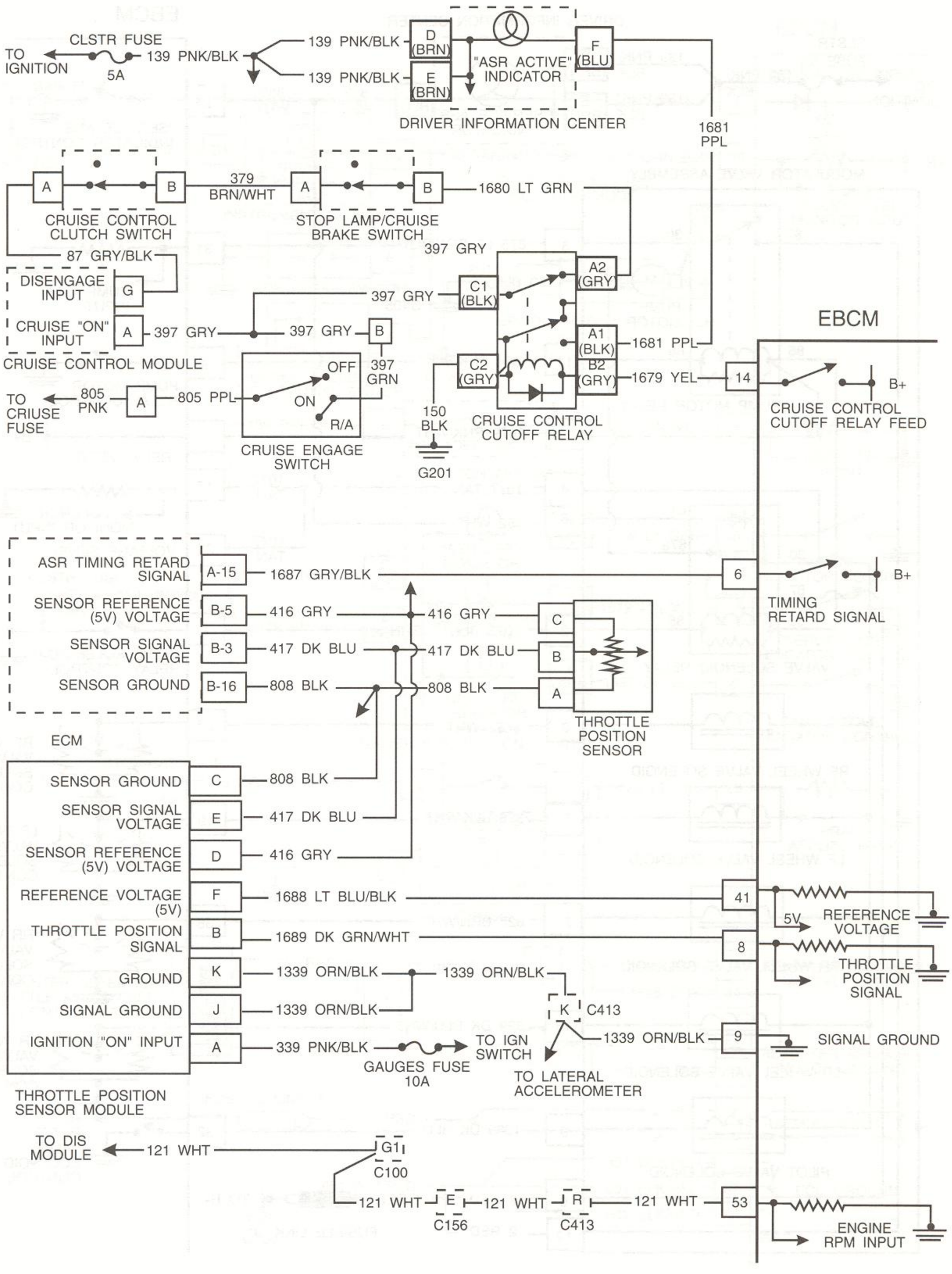
When ASR brake intervention is required, several control functions occur:

- The pilot valve solenoid is turned "ON" to prevent pump pressure from being applied to the master cylinder during ASR operation. Excess pressure is relieved through the hydraulic pressure limiting valve and a portion is returned to the master cylinder reservoir via the prime pipe. Fluid also goes to the brakes as required.
- The pump motor relay activates the pump as signalled by the EBCM.
- The rear circuit valve solenoids are energized to various positions individually, or together, as necessary for pressure hold (2.5 amps), pressure decrease (5 amps), or pressure increase (0 amps).
- Internal EBCM logic will prevent ASR operation when the ignition is "ON" and the engine is not running. This is for special circumstances, such as vehicle towing, to prevent ASR brake apply at the rear wheels.

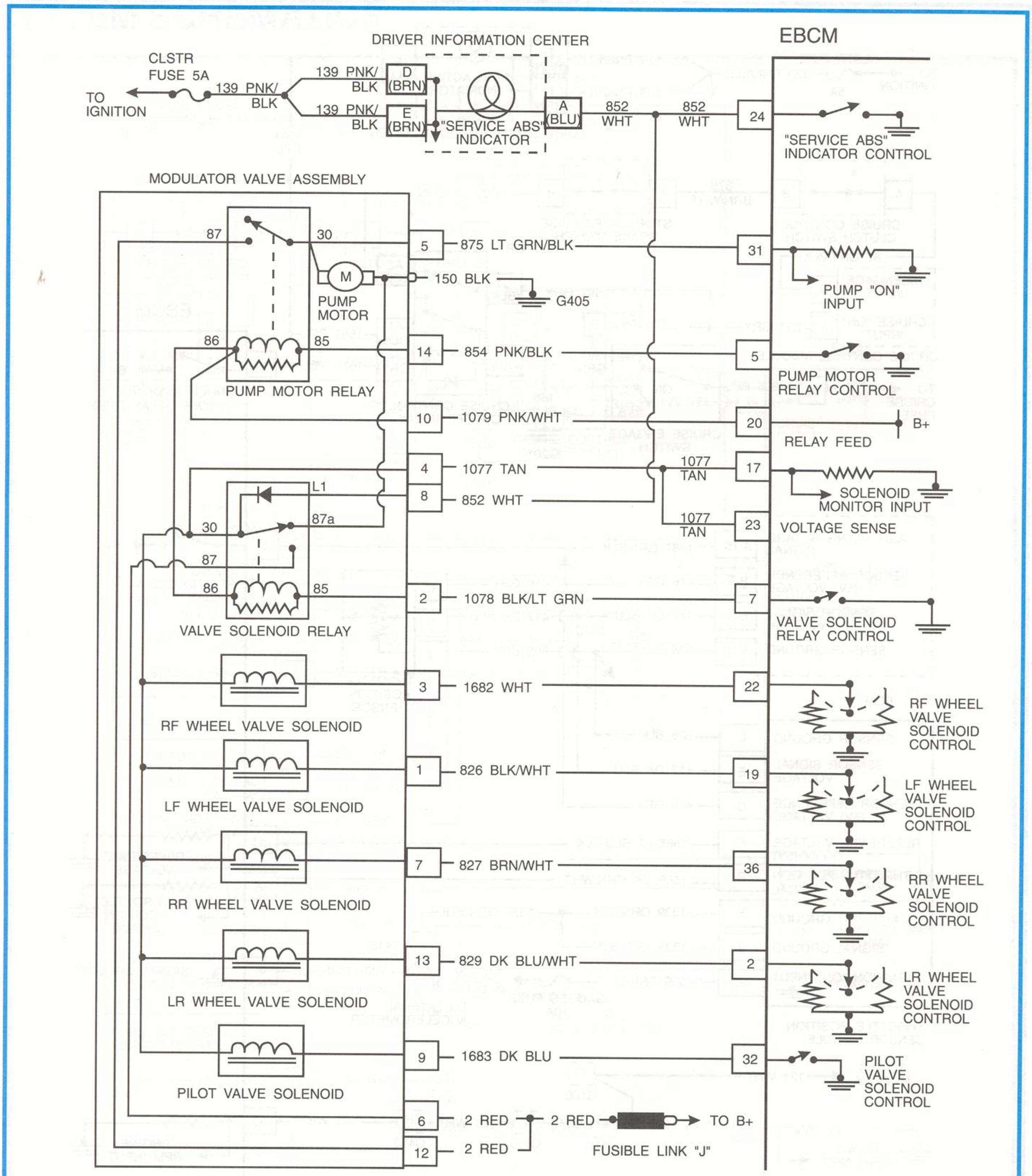
SYSTEM SCHEMATICS



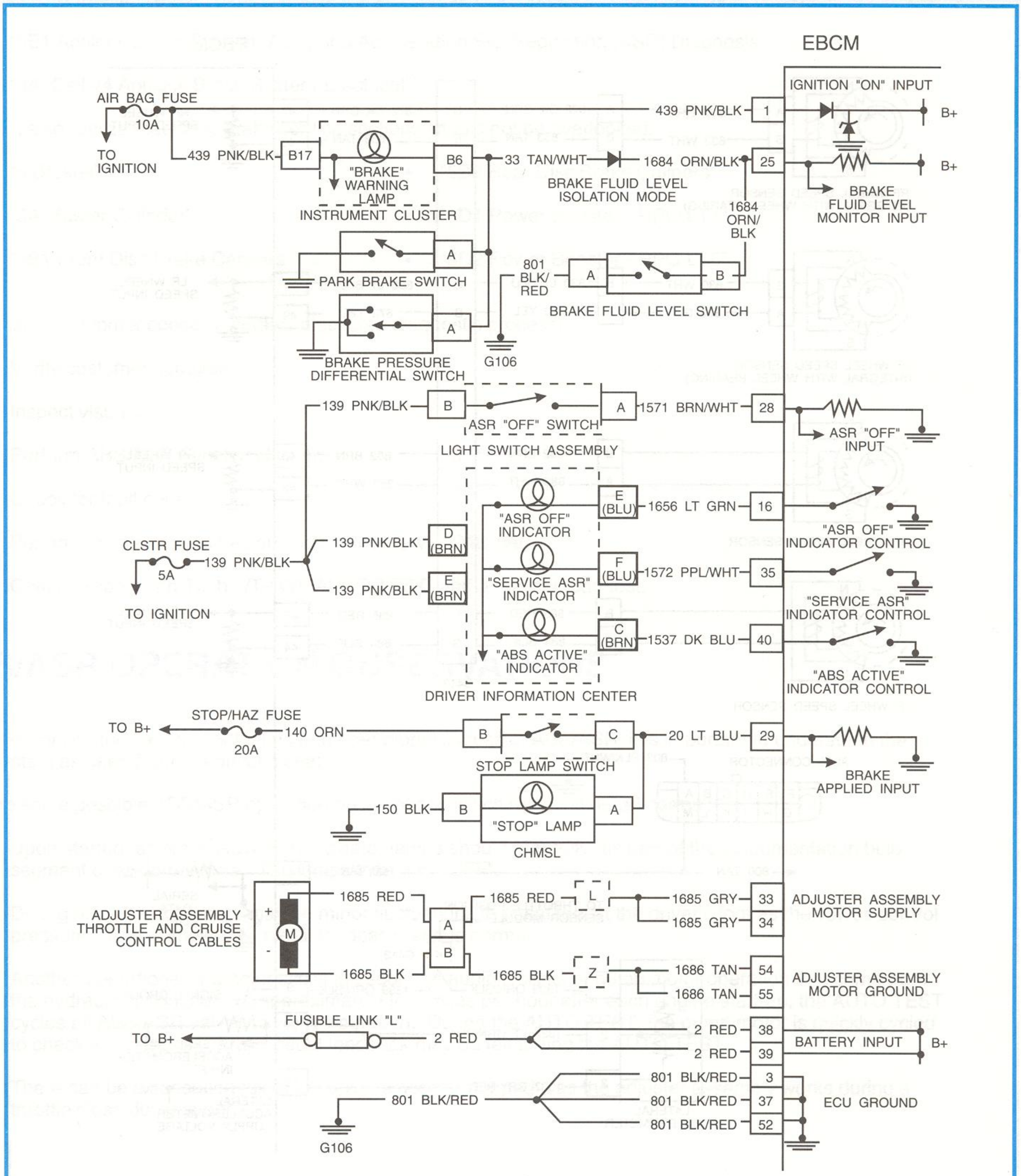
ABS/ASR Wiring Diagram (LT1 only) 1 of 5



ABS/ASR Wiring Diagram (LT5 only) 2 of 5

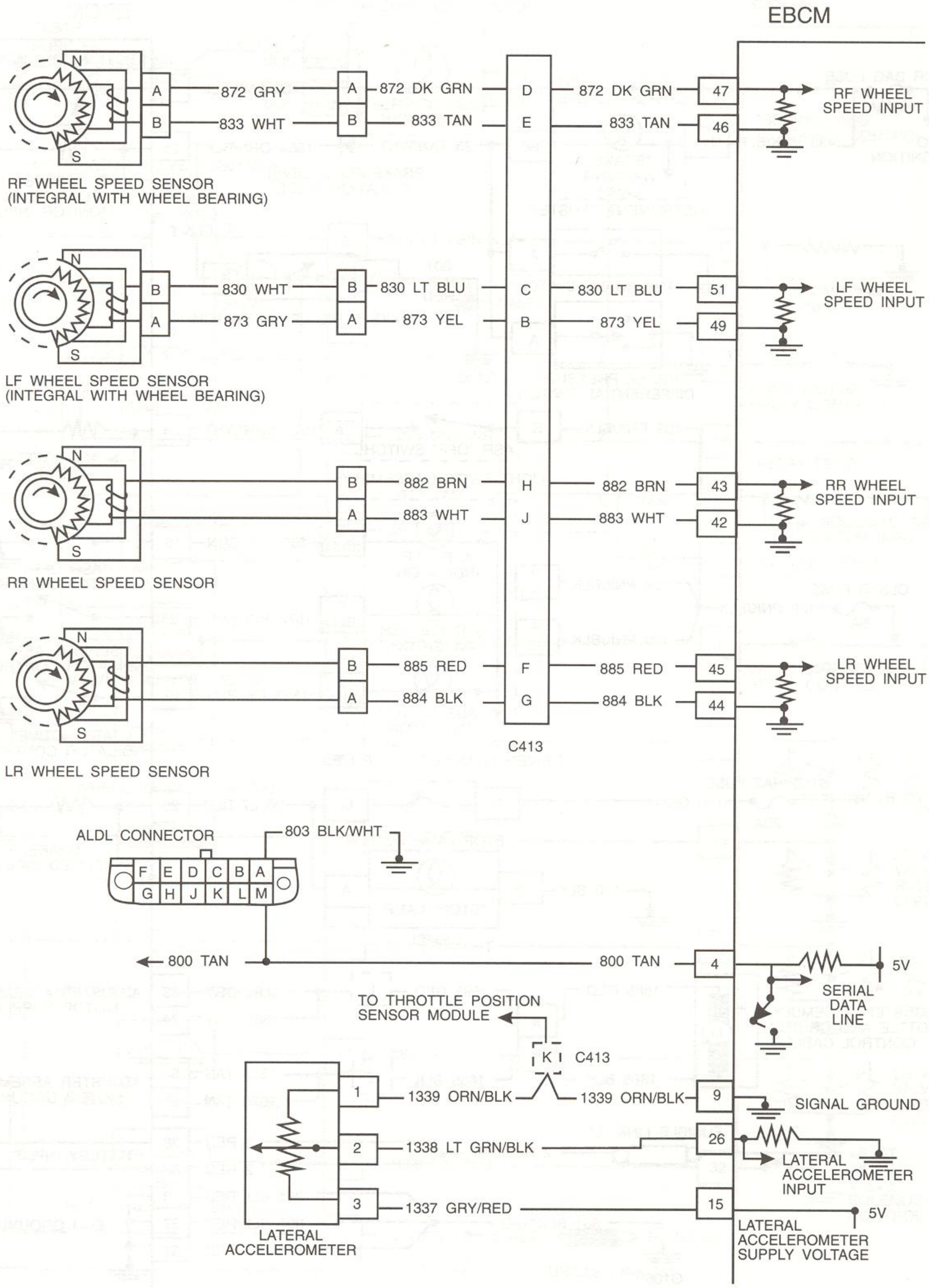


ABS/ASR Wiring Diagram (3 of 5)



ABS/ASR Wiring Diagram (4 of 5)

3. Operation



ABS/ASR Wiring Diagram (5 of 5)

4. ABS/ASR Diagnosis

Diagnosis for Corvette ABS/ASR is best done by referring to the appropriate service manual section:

- “5E1 Antilock Brake System (ABS) and Acceleration Slip Regulation (ASR) Diagnosis”
- "8A, Cell 44 Antilock Brake System-Electrical"

However, also realize that basic brake service sections should not be overlooked:

- “5 Brakes”
- “5A Master Cylinder”
- “5B1 Front Disc Brake Calipers”
- "5B2 Rear Disc Brake Calipers"
- "5D1 Power Booster - RPO LT1"
- "5D2 Power Booster - RPO LT5"

Addressing a customer concern requires a six-step diagnostic process:

1. Verify customer complaint
2. Inspect visually
3. Perform ABS/ASR Functional Check
4. Check for fault codes
5. Perform tests and repair as outlined in the Service Manual.
6. Confirm repair with Tech 1/T-100 "AUTO TEST" and a vehicle road test.

ABS/ASR OPERATION OBSERVATIONS

Before examining the various controlling and operational circuits of ABS/ASR, it is important to understand the basic system as seen from the driver’s seat.

Here are some possible ABS/ASR operation observations which are considered normal:

- Upon startup, all brake/ABS/ASR indicator lamps should turn “ON” as part of the instrumentation bulb segment check procedure. The lamps then turn "OFF".
- During an ABS stop, there may be minor fluctuations in pedal feel at the driver’s foot as the valves control pressure. This is known as “pedal feedback” and is normal.
- Another operational characteristic is the sound of audible clicks or pump motor operation that come from the hydraulic modulator. At approximately four miles per hour after each engine start-up, the AUTO TEST cycles all ABS/ASR valves to verify operation. During the AUTO TEST, the pump motor is quickly cycled to check its operation. Brake pedal feedback may be felt during the AUTO TEST.
- There can be a sensation felt at the driver's accelerator pedal as the adjuster assembly works during a throttle close down event.

4. ABS/ASR Diagnosis

TEST DRIVING

Some ABS/ASR conditions require a test drive because several codes will not set unless the vehicle is moving. The purpose of the test drive is to duplicate the condition experienced by the customer and reset the fault code.

Before test driving a brake complaint vehicle (especially if the red “BRAKE” warning light is illuminated), test the brakes at low speed to be sure that the car will stop safely.

The following procedure should be used to test drive ABS/ASR vehicles in for service.

1. Making sure the Tech 1 is not connected, turn ignition to the "RUN" position without starting the engine and wait until the red “BRAKE” light and ABS/ASR lights turn “OFF”. This bulb test should occur within 5 seconds.

2. Start the vehicle and wait for the displays to complete the “bulb test” mode before proceeding.

3. With transmission in PARK or NEUTRAL, slowly depress brake pedal and release. Be sure to use a high force pedal stroke. If the red “BRAKE” warning light was previously “OFF” but comes “ON” when the pedal is depressed, check for a hydraulic malfunction.

4. Find a safe area and drive vehicle a short distance. Be sure the vehicle achieves at least 40 kph (25 mph). Brake to at least one complete stop and accelerate slowly to a minimum speed of 40 kph (25 mph).

5. Rapidly perform an ABS stop and observe for proper operation.

6. Accelerate to induce an ASR event and note indicator light operation.

7. If at any time during the test drive, the “BRAKE” light comes “ON” and/or the”SERVICE ABS” or “SERVICE ASR” indicators come “ON”, check for codes.

VISUAL INSPECTION

Always start by verifying the customer’s concern. Then, continue with a visual inspection. It can save time by uncovering an obvious fault:

1. Check the parking brake for full release and brake light operation. Verify that the switch, diode in the circuit, and release system are working properly. Adjust or repair as required.

2. Check the brake fluid level. Fill as necessary, but be sure to find the cause of any fluid loss and correct it.

3. Inspect the modulator valve assembly for leaks and proper connections.

4. Check the "CLSTR", “GAUGES”, “AIR BAG”, “STOP/HAZ” and "CRUISE" fuses. Replace as necessary. Locate and repair the cause of failure.

5. Verify ignition is "OFF". Check all ABS/ASR-related electrical connectors and wiring. However, only manipulate connectors and harnesses after a function check. This will help you avoid eliminating an intermittent fault without exact circuit identification.

ABS/ASR FUNCTIONAL CHECK

- ENGAGE PARKING BRAKE.
- IGNITION "ON".
  DOES "BRAKE" WARNING LAMP COME "ON" STEADY?

YES

- DISENGAGE PARKING BRAKE.
  DOES "BRAKE" WARNING LAMP GO "OFF"?

NO

REFER TO SERVICE MANUAL, SECTION 8A-41.

YES

- IGNITION "OFF".
- WHILE OBSERVING "SERVICE ABS" INDICATOR TURN IGNITION "ON."

NO

REFER TO SERVICE MANUAL, SECTION 8A-41.

INDICATOR COMES "ON" STEADY FOR ABOUT 2 SECONDS, THEN GOES "OFF."

- IGNITION "OFF."
- WHILE OBSERVING "SERVICE ASR" INDICATOR TURN IGNITION "ON."

INDICATOR DOES NOT COME "ON" OR FLICKERS VERY BRIEFLY.

GO TO APPROPRIATE CHART AS INDICATED BY "ABS/ASR SYMPTOM TABLE" IN SERVICE MANUAL, SECTION 5E1.

INDICATOR COMES "ON" AND STAYS "ON."

INDICATOR COMES "ON" STEADY FOR ABOUT 2 SECONDS, THEN GOES "OFF."

- IGNITION "OFF."
- WHILE OBSERVING DIC TURN IGNITION "ON".
  DO "ABS ACTIVE," "ASR ACTIVE", AND "ASR OFF" INDICATORS COME "ON" STEADY FOR ABOUT 2 SECONDS, THEN GO "OFF"?

INDICATOR DOES NOT COME "ON."

GO TO APPROPRIATE CHART AS INDICATED BY "ABS/ASR SYMPTOM TABLE" IN SERVICE MANUAL, SECTION 5E1.

INDICATOR COMES "ON" AND STAYS "ON."

YES

- ROAD TEST VEHICLE, VEHICLE REACHING AT LEAST 40 KPH (25 MPH).
  DID "SERVICE ABS" AND/OR "SERVICE ASR" INDICATOR(S) COME "ON"?

NO

GO TO APPROPRIATE CHART AS INDICATED BY "ABS/ASR SYMPTOM TABLE" IN SERVICE MANUAL, SECTION 5E1.

NO

DID VEHICLE BRAKES EXHIBIT ANY SYMPTOMS OF IMPROPER OPERATION THAT MAY BE MECHANICAL IN NATURE AND/OR DID "BRAKE" WARNING LAMP COME "ON"?

YES

- INSTALL TECH 1 WITH '88-'92 BRAKE CARTRIDGE.
- REQUEST EBCM FAULT CODE DISPLAY, RECORD ALL CODES ON REPAIR ORDER.

NO

SYSTEM IS FUNCTIONAL AND FREE OF FAULTS*. NO FURTHER DIAGNOSIS IS REQUIRED.

YES

REFER TO SERVICE MANUAL, SECTION 5.

CODES PRESENT.

GO TO "ABS/ASR FAULT CODE TABLE" IN SERVICE MANUAL, 5E1.

NO CODES PRESENT.

GO TO "ABS/ASR SYMPTOM TABLE" IN SERVICE MANUAL, SECTION 5E1 FOR APPROPRIATE CHART TO DIAGNOSE INDICATOR "ON" WITH NO CODES SET.

* IF CUSTOMER CONCERN MAY STILL EXIST, CHECK FOR HISTORY CODES AND/OR INTERMITTENTS.

SERVICE MANUAL CHARTS

When fault codes are present, always diagnose them according to the corresponding charts in the service manual, beginning with the "ABS/ASR Functional Check". Within the service manual, you will find that each code is covered by at least a two-page spread for diagnosis.

—CAUTION—

To help avoid accidental air bag deployment and personal injury, when servicing a vehicle which requires repair of the SIR system and another vehicle system, it is recommended that the SIR system be repaired first.

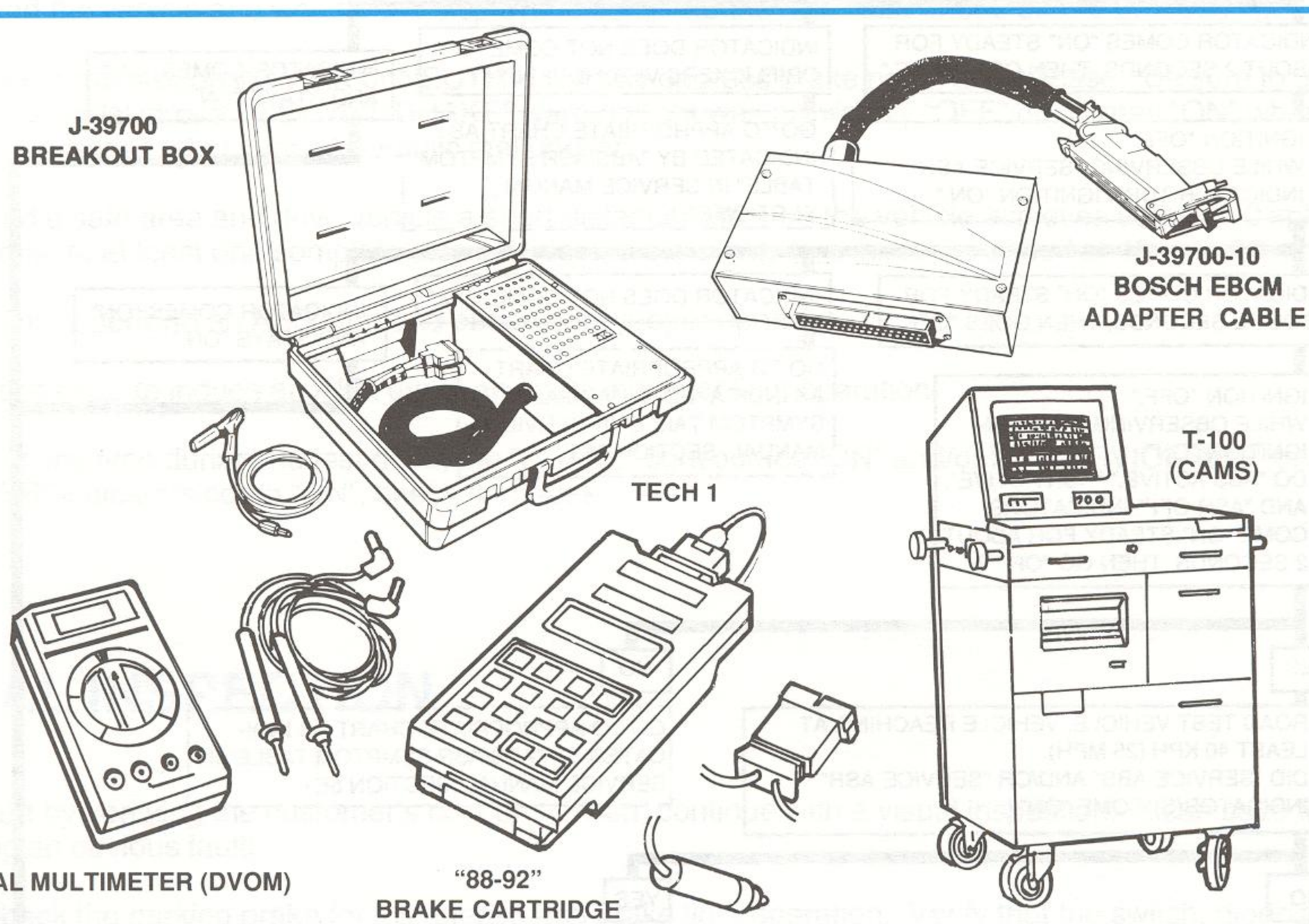


Figure 4-1, Diagnostic Tools for ABS/ASR

Special tools for troubleshooting ABS/ASR include (figure 4-1):

- High Impedance Digital Multimeter (DVOM), J-34029-A or equivalent
- Universal Breakout Box J-39700 with J-39700-10 Bosch EBCM Adapter Cable
- Scan Tool — Handheld Tech 1 Diagnostic Computer with "88-92 BRAKE" cartridge (#TK03030B) or T-100 (CAMS)

CODE-BASED DIAGNOSIS

There are 29 fault codes relating to ABS/ASR diagnosis.

Code	Description	Disable
21	RF Wheel Speed Sensor Fault	ABS/ASR
23	RF Wheel Speed Sensor Continuity Fault	ABS/ASR
25	LF Wheel Speed Sensor Fault	ABS/ASR
27	LF Wheel Speed Sensor Continuity Fault	ABS/ASR
28	Wheel Speed Sensor Frequency Error	ABS/ASR
31	RR Wheel Speed Sensor Fault	ABS/ASR
33	RR Wheel Speed Sensor Continuity Fault	ABS/ASR
35	LR Wheel Speed Sensor Fault	ABS/ASR
37	LR Wheel Speed Sensor Continuity Fault	ABS/ASR
41	RF Valve Solenoid Fault	ABS/ASR
44	Pilot Valve Solenoid Fault	ABS/ASR
45	LF Valve Solenoid Fault	ABS/ASR
51	RR Valve Solenoid Fault	ABS/ASR
55	LR Valve Solenoid Fault	ABS/ASR
57	Cruise Control Output Monitoring Fault	ASR
58	EBCM Internal Adjuster Assembly Fault	ASR
61	Pump Motor or Pump Motor Relay Fault	ABS/ASR
62	Tach Pulses Fault	ASR
63	Valve Solenoid Relay Circuit Fault	ABS/ASR
64	Throttle Position Signal Fault	ASR
65	Adjuster Assembly Fault	ASR
66	Adjuster Assembly Control Fault	ASR
71	EBCM Internal Fault	ABS/ASR
72	Serial Data Link Fault	ASR
73	Spark Retard Monitoring Fault	ASR
74	Low Voltage	ABS/ASR
75	Lateral Accelerometer Wiring Fault	ABS/ASR
76	Lateral Accelerometer Signal Out of Range	ASR
83	Brake Fluid Level Low	ABS/ASR

4. ABS/ASR Diagnosis

ABS/ASR FAULT CODE PARAMETERS

DESCRIPTION	CODE NUMBER(S)	PARAMETERS
SPEED SENSOR FAULTS	21, 25, 31, 35	• Circuit or sensor problem with ignition "ON" and vehicle in motion.
SPEED SENSOR FREQUENCY FAULT	28	• Error as above, but individual sensor or circuit not identified.
SPEED SENSOR CONTINUITY FAULTS	23, 27, 33, 37	• Circuit or sensor problem with ignition "ON" and vehicle at rest.
VALVE SOLENOID FAULTS	41, 45, 51, 55	• Solenoid position not as commanded.
PILOT VALVE SOLENOID FAULT	44	• Solenoid position not as commanded.
CRUISE CONTROL OUTPUT MONITORING FAULT	57	• Cruise control cutoff relay not as commanded.
EBCM INTERNAL ADJUSTER ASSEMBLY FAULT	58	• Loss of microprocessor communication inside EBCM.
PUMP MOTOR OR PUMP MOTOR RELAY FAULT	61	• Voltage at relay without EBCM command or voltage not at relay within 60 milliseconds of command.
TACH PULSES FAULT	62	• Engine RPM input lost.
VALVE SOLENOID RELAY CIRCUIT FAULT	63	• Voltage at relay not correct as commanded.
THROTTLE POSITION SIGNAL FAULT	64	• TPS signal not present or out of range.
ADJUSTER ASSEMBLY FAULT	65	• Circuits to motor open or shorted.
ADJUSTER ASSEMBLY CONTROL FAULT	66	• Current at motor too high (over 16 amps for 3 seconds) before reaching commanded position.
EBCM INTERNAL FAULT	71	• Internal problem detected in self-testing.
SERIAL DATA LINK FAULT	72	• 3 consecutive data link transmission errors.
SPARK RETARD MONITORING FAULT	73	• Open or short in ignition retard request circuit to ECM.
LOW VOLTAGE	74	• EBCM power input below 9.0 volts.
LATERAL ACCELEROMETER WIRING FAULT	75	• Open or short on any of the lateral accelerometer circuits.
LATERAL ACCELEROMETER SIGNAL OUT OF RANGE	76	• Reading greater than 0.6g for an extended period of time.
BRAKE FLUID LEVEL LOW	83	• Fluid level sensor or circuit indicates low fluid.

Code Reading

The EBCM can display fault codes only when it is in the ABS/ASR Diagnostic mode. ABS/ASR diagnostic fault codes can be read two ways:

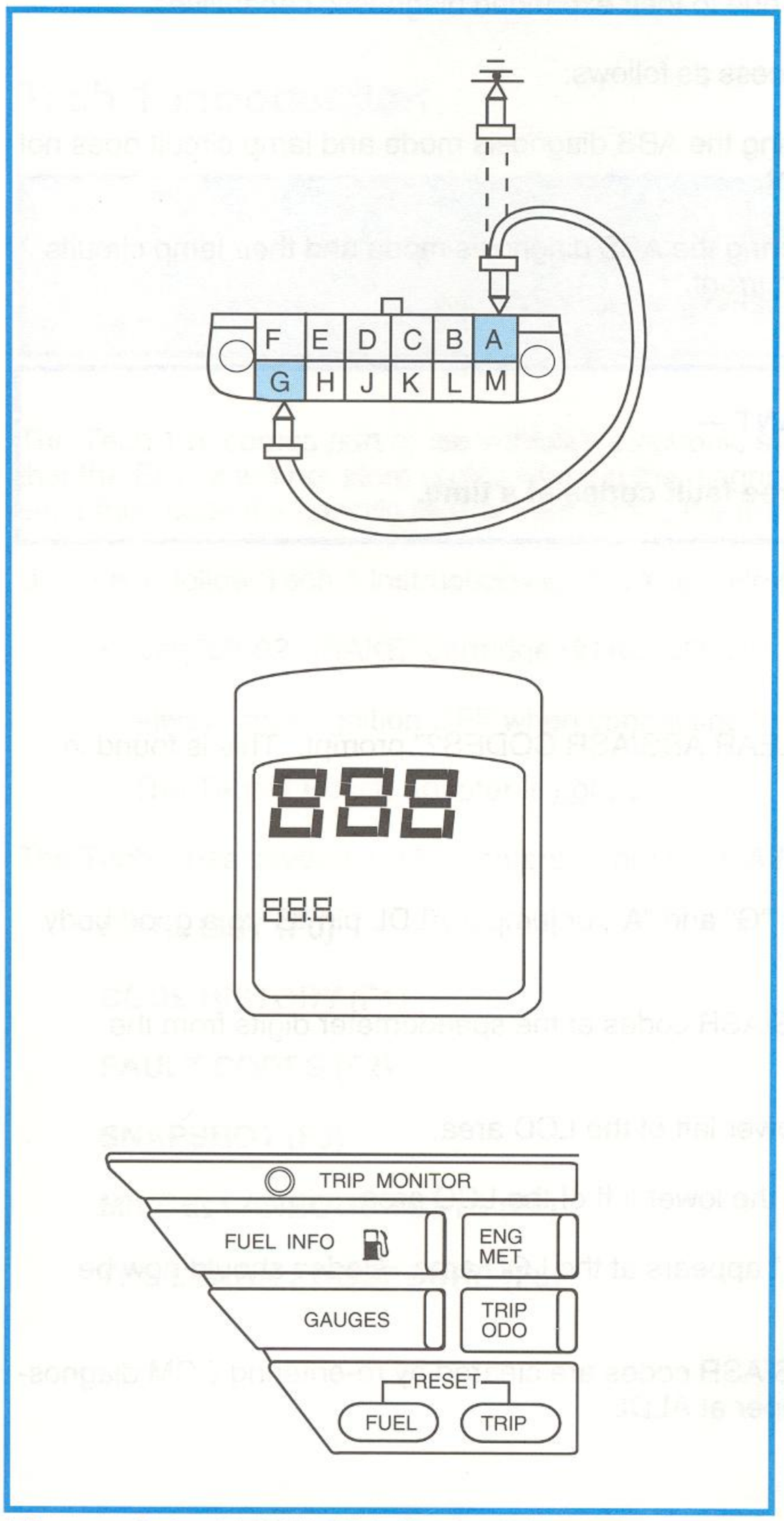


Figure 4-2, ABS/ASR Code Display Through the CCM

1. View the ABS/ASR codes at the speedometer digits from the Central Control Module (CCM) (figure 4-2). Codes do not flash at the ABS light as was found on previous systems. To view codes through the CCM, when a scan tool is not readily available:

   a. Verify ignition is "OFF".

   b. Jumper ALDL pins “G” to “A” (or "G" ground).

   c. Turn the ignition to the “ON” (“RUN”) position.

   d. If entering the diagnostic mode was successful, the CCM will automatically display fault codes for:

      - #1 CCM module
      - #4 ECM module
      - #9 EBCM (ABS/ASR) module

   The module numbers (1, 4, 9) appear in the lower left of the speedometer LCD area. Fault codes are displayed with the speedometer digits.

   e. Manual diagnosis follows automatic diagnosis. However, pressing any of the DIC control switches during automatic diagnosis will prompt the CCM into manual diagnosis. In manual diagnosis, the only ABS/ASR tests possible are:

      - 9.0 ABS/ASR system ready
      - 9.1 Display ABS/ASR fault codes
      - 9.7 Clear ABS/ASR fault codes

   Pressing “TRIP ODO” lets you move to the next test.

f. To end CCM diagnostics, turn the ignition "OFF" and disconnect the jumper at the ALDL.

g. Complete CCM information is available in your 1992 Service Manual and CCM course #19010.05.

2. Use a scan tool such as the handheld Tech 1 Diagnostic Computer or the T-100 (CAMS). It is important to note that these scan tools are preferred for diagnosis due to their expanded diagnostic capabilities.

The ABS/ASR codes may be used to assist the diagnosis process as follows:

- If the ABS and/or ASR lights is/are “ON” before entering the ABS diagnosis mode and lamp circuit does not have a fault, at least one of the stored codes is current.
- If the ABS and/or ASR lights is/are “OFF” before entering the ABS diagnosis mode and their lamp circuits are known to be good, none of the stored codes are current.

— IMPORTANT —

The system can store up to three fault codes at a time.

Code Clearing

1. At the Tech 1/T-100, merely answer “YES” to the “CLEAR ABS/ASR CODES?” prompt. This is found in Fault Codes - F2 from the MAIN MENU.

2. ABS/ASR codes can also be cleared at the CCM.

   a. With the ignition “OFF”, jumper between ALDL pins “G” and “A”, or jumper ALDL pin “G” to a good body ground.

   b. Turn the ignition switch to “RUN”, and view the ABS/ASR codes at the speedometer digits from the Central Control Module (CCM).

   c. Press the "TRIP" button until "9.0" appears in the lower left of the LCD area.

   d. Press the “TRIP/ODO” button until “9.7” appears in the lower left of the LCD area.

   e. Press the “ENG/MET” button and hold it until “_ _ _” appears at the LCD area. Codes should now be clear.

   f. Turn the ignition “OFF” and “ON” again. Verify ABS/ASR codes are cleared by re-entering CCM diagnostics. If cleared, turn ignition “OFF” and remove jumper at ALDL.

3. Codes will also clear if ignition is cycled 100 times.

It is best to also perform an "AUTO Test" with the Tech 1 and a road test (with the Tech 1 disconnected) to verify that no new fault codes are set to confirm a proper repair.

SCAN TOOL CAPABILITIES

Both the Tech 1 Diagnostic Computer and T-100 (CAMS) can be used to aid diagnosis of ABS/ASR conditions on the Corvette. We will review the data and testing available on scan tools using the Tech 1.

Tech 1 Introduction

— NOTICE —

ABS/ASR is not available when Tech 1 is being used.

The Tech 1 becomes part of the vehicle's electronic system when plugged into the ALDL connector. Please realize that the EBCM will not store codes when in the diagnostic mode. The only exception is the "AUTO Test" which will set a fault code if a specific fault occurs during the test.

Be sure to follow Tech 1 instructions for hook-up. However, you must:

- Use "88-92 BRAKE" cartridge (#TK03030 B)
- Always have ignition OFF when connecting the Tech 1
- The Tech 1 Bosch Adapter is not used.

The Tech 1 has several modes (entered from the MAIN MENU) to investigate ABS/ASR conditions:

DATA LIST (F0)

CODE HISTORY (F1)

FAULT CODES (F2)

SNAPSHOT (F3)

MISCELLANEOUS TESTS (F4)

TPS LEARN PROCEDURE (F5)

4. ABS/ASR Diagnosis

DATA LIST (F0)

When F0 is selected from the Tech 1 MAIN MENU, ABS/ASR system data is listed in pairs. These pairs can be mixed and matched to any two data items on the screen for simultaneous viewing.

DATA INFORMATION	
PARAMETER	**READING**
Front Wheel Speed Sensors (L/R)	0 - 128 KPH/0 - 80 MPH
Rear Wheel Speed Sensors (L/R)	0 - 128 KPH/0 - 80 MPH
Brake Switch	OFF/ON
Brake Fluid	OK/LOW
ASR Switch State	ON/OFF
Pump Monitor	OFF/ON
Lateral Accelerometer	-0.8 - +0.8g/0 - 5 VOLTS
Valve Relay	0 - 11.7 VOLTS (MINIMUM)
Engine Speed	0 - 7650 RPM
Throttle Angle	0 - 100%
ECU ID	

CODE HISTORY (F1)

Code history information is available when F1 is pressed from the Tech 1 MAIN MENU. Up to three code occurrences can be stored with system status information present at the time the code occurred.

CODE HISTORY INFORMATION	
PARAMETER	**READING**
Code Set	Code Number
Ignition Cycles Since Code Set	0 - 99
Speed	0 - 300 KPH/0 - 186 MPH
Brake Switch	OFF/ON
ABS State	INACTIVE/ACTIVE
ASR State	INACTIVE/ACTIVE
ASR Switched	ON/OFF

FAULT CODES (F2)

Pressing F2 from the Tech 1 MAIN MENU reviews up to three stored fault codes. If more fault codes were stored, only the latest three remain accessible. Within this mode, stored codes can be read and cleared. In addition, certain diagnostic information at the time of code setting is also available.

FAULT CODE INFORMATION	
PARAMETER	**READING**
Code	Description
Ignition Cycles Since Code Set	0 - 99
Vehicle Speed	0 - 300 KPH/0 - 186 MPH
Brake Switch	OFF/ON
ABS State	INACTIVE/ACTIVE
ASR State	INACTIVE/ACTIVE
ASR Switched Off	NO/YES
Clear Trouble Codes	NO/YES

SNAPSHOT (F3)

Taking system snapshots during operation can be particularly helpful in diagnosing intermittent conditions. Snapshot options are found when F3 is pressed from the Tech 1 MAIN MENU.

Four snapshot options are available:

- F0 “Replay data” allows data obtained by the snapshot to be reviewed.
- F1 “Manual trigger” is used to capture data at a point commanded by the technician.
- F2 “Automatic trigger” captures data when operation information deviates from normal parameters. (This can be set to trigger for a specific code as well.)
- F9 “Trigger Point” is used to select the timeframe for the snapshot.

When performing a snapshot, realize that there are three snapshot “trigger point” timeframes available:

- A “beginning” snapshot (F0) captures data starting at the trigger point.
- A “center” snapshot (F1) captures data in equal amounts before and after the trigger point.
- A “end of data” snapshot (F2) stops capturing data at the trigger point.

4. ABS/ASR Diagnosis

MISCELLANEOUS TESTS (F4)

The "Scan" tools have several programmed miscellaneous functional tests that can be used to verify ABS/ASR operation. On the Tech 1, these tests are available after pressing F4 from the MAIN MENU and are completely described in Section 5E1 of the Service Manual.

With all these tests, the Tech 1 is used to cause certain aspects of system operation. Based upon observations during testing, diagnosis is performed. Possible ABS/ASR tests are:

SOLENOID TEST (F0).	This test allows you to verify exact operation of the solenoids as commanded. The test requires the wheels be raised and can spin freely. As you apply the solenoids for either "pressure hold" or "pressure reduce", an assistant verifies expected operation of the brakes by attempting to turn the specific wheel. Separate tests are used for ABS and ASR diagnosis.
AUTO TEST (F1).	This test basically performs the EBCM's AUTO TEST described earlier. Each of the solenoids, as well as the pump motor, are cycled to verify proper operation.
LAMP TEST (F2).	This test allows you to cycle each of the ABS/ASR indicator lamps to verify operation.
PILOT VALVE TEST (F3).	This test verifies the pilot valve is capable of blocking pump motor pressure to the master cylinder during an ASR event.
ASR TEST (F4).	This test runs the pump and applies pressure for the rear circuits. The previously mentioned "Pilot Valve Test" must always be performed prior to the "ASR Test" because the "ASR Test" assumes the Pilot Valve is good.

TPS LEARN (F5)

Pressing F5 from the Tech 1 MAIN MENU lets you perform the "TPS Learn" procedure. This procedure must be performed any time the TPS or throttle body is replaced so the EBCM can "see" and "know" (therefore "learn") the TPS idle position voltage. EBCM replacement does not require this procedure.

Circuit Monitoring With Universal Breakout Box

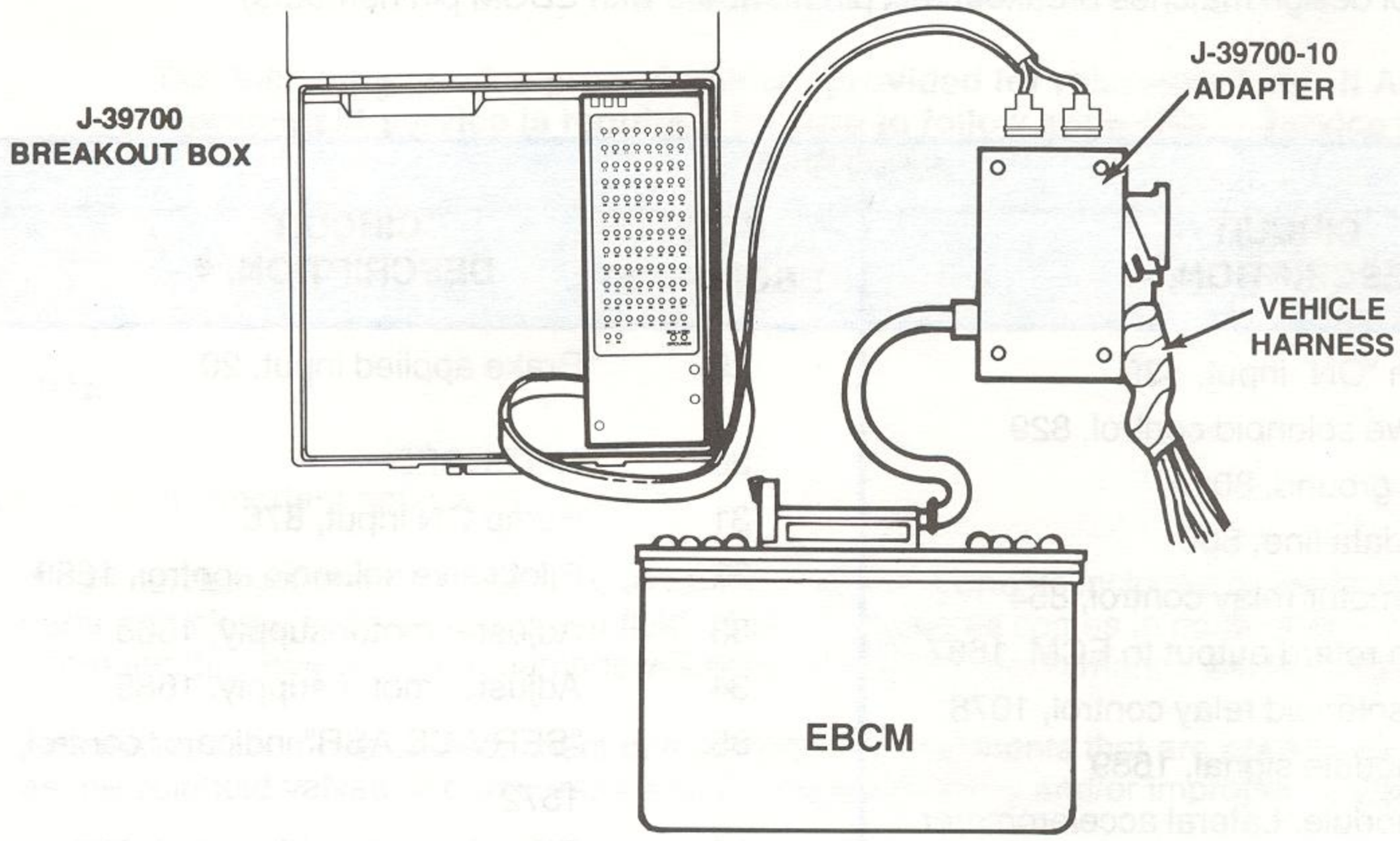


Figure 4-3, Breakout Box Installation

Universal breakout box J-39700 and Bosch EBCM adapter cable J-39700-10 are used on the Corvette ABS/ASR system to monitor circuits as required by the fault code diagnostic chart procedures (figure 4-3). The breakout box features 100 pinouts and must always be connected at the EBCM with the ignition "OFF". Both the breakout box and adapter cable have a one amp draw limitation and should not be used to activate circuits.

— CAUTION —

Never disconnect the breakout box from the EBCM with the ignition "ON".

EBCM - Switched Faults

Sometimes diagnosis will point to a short to battery voltage or ground. Since the EBCM provides power or ground on many circuits when powered up and operational, it is helpful to eliminate the EBCM to pinpoint the short. To do this:

1. Turn ignition "OFF".
2. Disconnect Breakout Box J-39700 from the EBCM, leaving the tool connected to the harness.
3. Repeat the test. (With ignition "ON", if directed by test.)

If the short is no longer present, it is probably EBCM-switched. Check the harness or connectors and repair as needed.

If the short remains, it is not EBCM-switched and the source is not an EBCM-switched circuit.

ABS/ASR BREAKOUT IDENTIFICATION

(Tool design matches breakout box pin numbers with EBCM pin numbers)

BOX/ EBCM PIN#	CIRCUIT DESCRIPTION, #
1	Ignition "ON" input, 439
2	LR valve solenoid control, 829
3	EBCM ground, 801A
4	Serial data line, 800
5	Pump motor relay control, 854
6	Ignition retard output to ECM, 1687
7	Valve solenoid relay control, 1078
8	TPS module signal, 1689
9	TPS module, Lateral accelerometer signal ground, 1339
10	NOT USED
11	NOT USED
12	NOT USED
13	NOT USED
14	Cruise cutoff (ASR ACTIVE) relay supply, 1679
15	Lateral accelerometer supply, 1337
16	"ASR OFF" indicator control, 1656
17	Solenoid monitor input, 1077
18	NOT USED
19	LF valve solenoid control, 826
20	Pump motor relay feed, 1079
21	NOT USED
22	RF valve solenoid control, 1682
23	Solenoid voltage sense, 1077
24	"SERVICE ABS" indicator control, 852
25	Brake fluid level monitor control, 1684
26	Lateral accelerometer input, 1338
27	NOT USED
28	"ASR OFF" input, 1571

BOX/ EBCM PIN#	CIRCUIT DESCRIPTION, #
29	Brake applied input, 20
30	NOT USED
31	Pump ON input, 875
32	Pilot valve solenoid control, 1683
33	Adjuster motor supply, 1685
34	Adjuster motor supply, 1685
35	"SERVICE ASR" indicator control, 1572
36	RR valve solenoid control, 827
37	EBCM ground, 801
38	Supply voltage, 2
39	Supply voltage, 2
40	"ABS ACTIVE" indicator control 1537
41	TPS module reference voltage, 1688
42	RR wheel speed ground, 883
43	RR wheel speed input, 882
44	LR wheel speed ground, 884
45	LR wheel speed input, 885
46	RF wheel speed ground, 833
47	RF wheel speed input, 872
48	NOT USED
49	LF wheel speed ground, 873
50	NOT USED
51	LF wheel speed input, 830
52	EBCM ground, 801
53	Engine rpm input, 121
54	Adjuster motor ground, 1686
55	Adjuster motor ground, 1686
56-100	NOT USED

5. ABS/ASR Service

Servicing Corvette ABS/ASR is similar to other ABS systems.

— IMPORTANT —

The following service procedures are provided for reference only. If ABS/ASR component service is required, be sure to follow appropriate Service Manual procedures.

Cautions

There are several important notes and cautions.

- When servicing Corvette ABS/ASR, always use all components included in repair kits. Lubricate rubber parts with clean, fresh DOT 3 brake fluid. Also, if engine oil comes in contact with the system or any ABS components, severe system damage will occur and brake performance will be decreased.
- Attempting to remove or disconnect certain system components that are not intended to be serviced, such as the solenoid valves or pump, may result in personal injury and/or improper system operation.
- Bolts connecting caliper mounting brackets to the knuckles must be replaced any time they are loosened or removed.
- If welding work is to be performed with an electric welding unit, turn ignition “OFF” and disconnect the EBCM connector.
- During painting work, the EBCM may be subjected to a maximum of 85°C (185°F) for approximately two hours.
- Do not use a fast charger for starting the engine.
- Disconnect the negative battery cable when fast charging.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Make sure that all connectors of the wiring harness are securely connected.
- Always note the routing, position, mounting, and location of all the components, wiring, connectors, clips, brackets, brake pipes, etc., when performing service on ABS/ASR. Speed sensor wiring, routing, and retention is especially important to help prevent false signals due to electrical noise picked up by the wiring. Proper operation of the system can only be achieved if the system is restored to its original equipment (OEM) condition.

ADJUSTER ASSEMBLY CABLE ADJUSTMENTS

Whenever the adjuster assembly is removed and replaced, the cables must be adjusted to ensure correct system operation (figure 5-1).

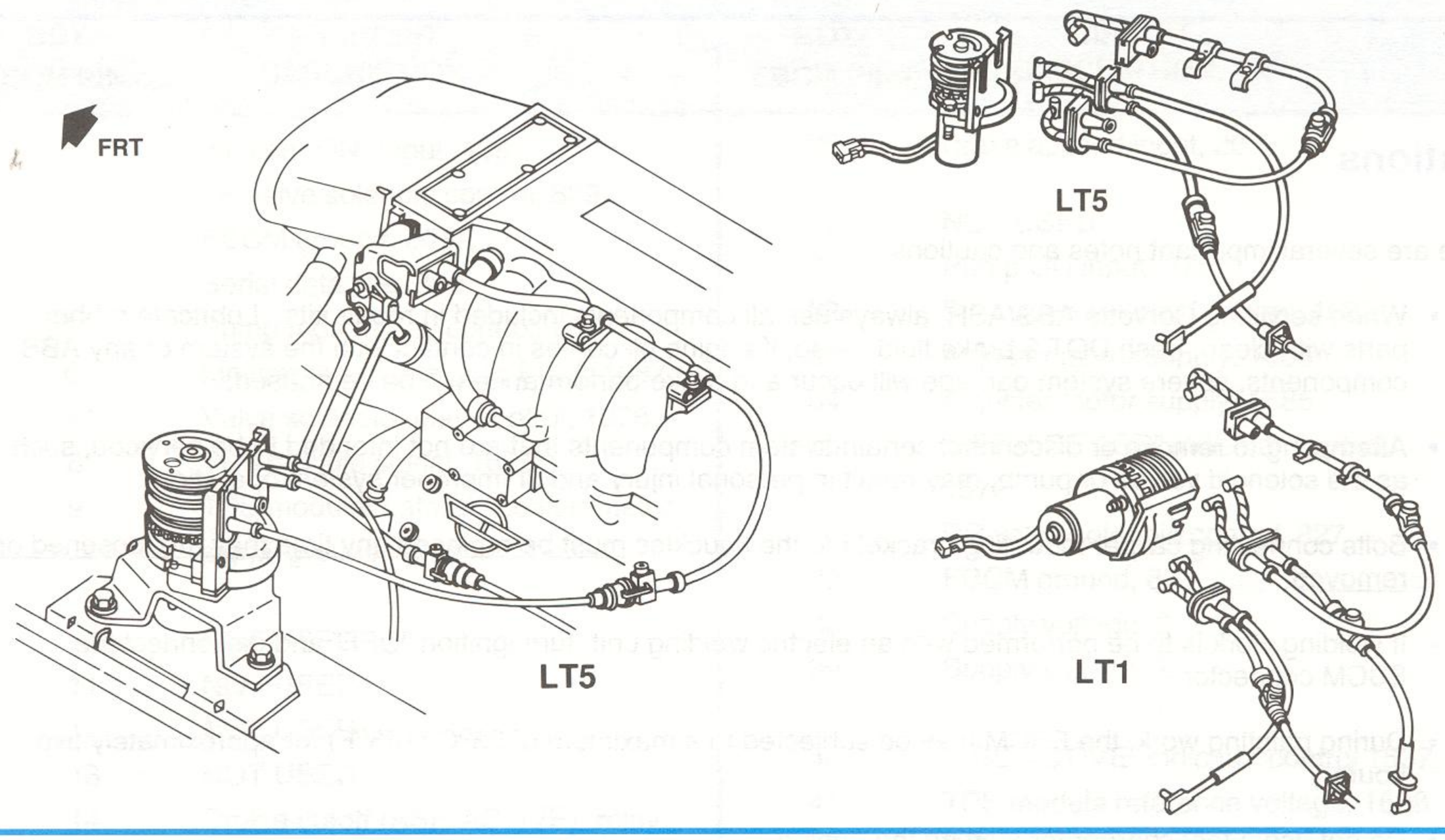


Figure 5-1, Adjuster Assembly

Cable adjustment for all cables connecting to the accelerator control adjuster assembly is critical. Proper adjustment ensures that Wide-Open Throttle (WOT) at the throttle body, adjuster, and accelerator pedal all match, as well as that TV cable adjustment on models with automatic transmissions is also properly set. Improper adjustment will affect ASR system performance.

1. The first step is to position the cables to their non-adjusted configuration. This ensures the proper length at the control adjuster. This configuration is where the cable's external conduit is at its longest, and the actual internal cable is at its shortest.

   On all cables (except TV), merely press the button on the adjuster and pull the conduit out of the adjuster. Then, release the button.

   On the TV cable, flip up the swivel lock on the adjuster to depress the adjuster button. A spring inside the adjuster automatically holds the conduit at its longest position.

2. Next, the cables are attached to the adjuster's cams with slugs.

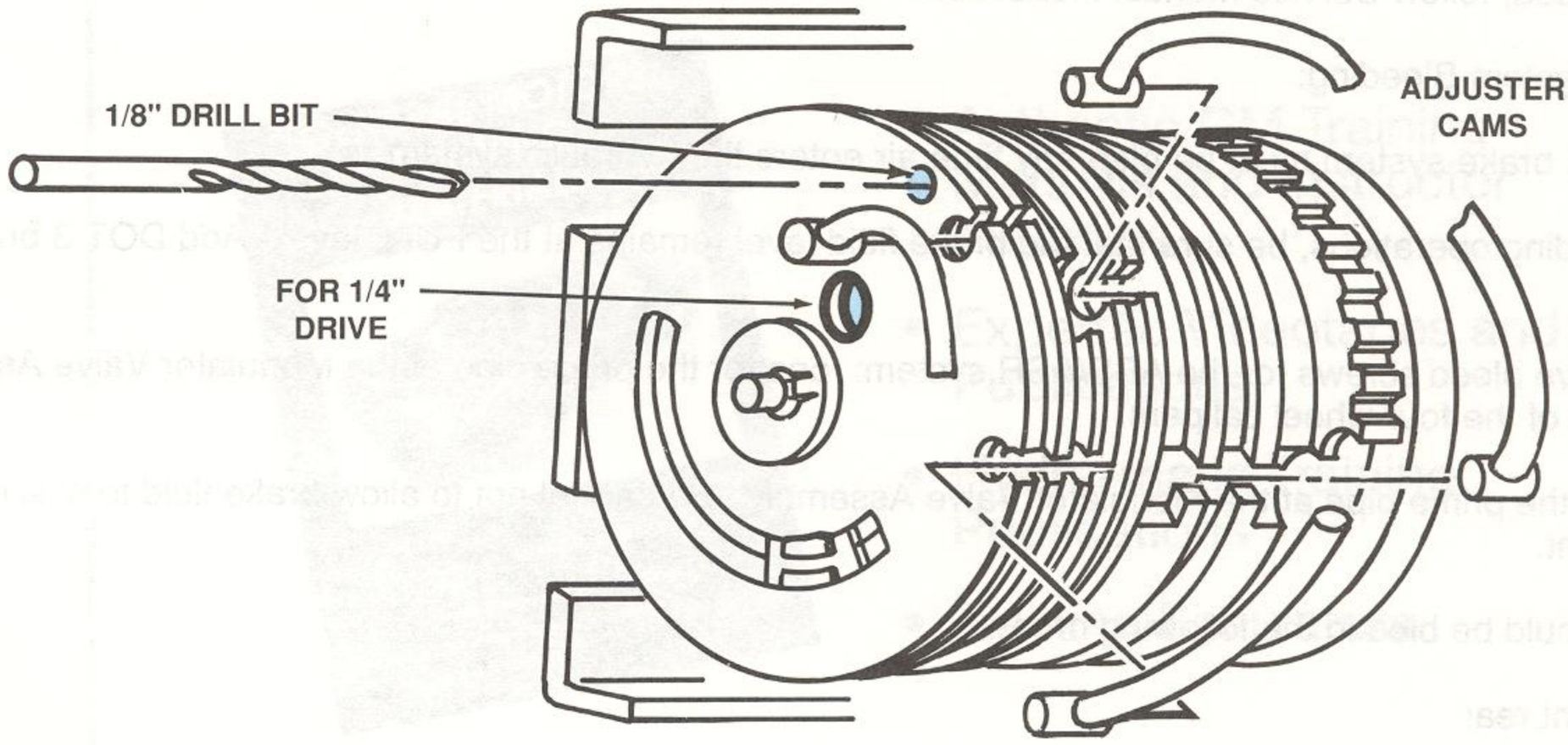


Figure 5-2, 1/8-Inch Drill Bit Locks Cams Together

3. With the cables attached to the cams, but the cruise cable unattached at the cruise servo, the throttle and TV cable must be adjusted. Lock the adjuster cams together with a 1/8 inch drill bit (figure 5-2).

4. With a 1/4 inch drive (inch-pound) torque wrench and extension, rotate the cams clockwise until 8 N-m (72 lb.in.) is measured. The "clicking" sound indicates that adjustment is occurring. At the TV cable cam, when the torque has been reached, the swivel lock is released to lock in the setting.

5. Remove the torque wrench, extension, and drill bit.

6. Slowly depress the accelerator pedal to WOT. Two or three clicks of the pedal cable may be heard. If more than five occur, the TV cable may be misadjusted and W.O.T may not be able to be obtained.

7. Adjust the cruise cable at the cruise servo by removing slack in the system and inserting the cable pin in the servo paddle. Add retainer clip.

8. Finally, use a Tech 1 to check the throttle opening position by pressing the accelerator pedal. Fully depressing the pedal should show a minimum throttle opening of 98%. Releasing the pedal should show 0%.

BLEEDING TIPS

The Corvette ABS/ASR system may be bled using manual, pressure, or vacuum procedures. Regardless of the technique used, follow Service Manual instructions.

Notes On System Bleeding:

The antilock brake system must be bled any time air enters the hydraulic system.

During bleeding operations, be sure that the brake fluid level remains at the FULL level. Add DOT 3 brake fluid as required.

There are five bleed screws for the ABS/ASR system: one for the prime pipe at the Modulator Valve Assembly and one at each of the four wheel calipers.

First, bleed the prime pipe at the Modulator Valve Assembly. Be careful not to allow brake fluid to spill into the tub compartment.

Calipers should be bled in the following order:

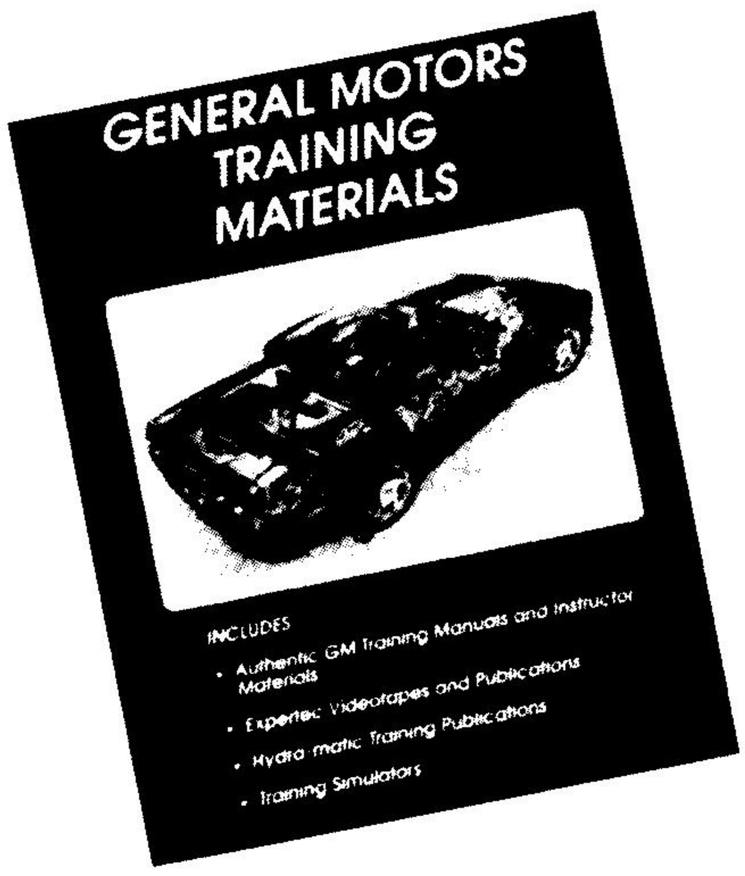
- Right rear
- Left rear
- Right front
- Left front

Any of three bleeding techniques may be used:

- manual
- pressure
- vacuum

If pressure bleeding is used, it is necessary to use the pressure bleeder adapter (J-35589, or its equivalent).

GENERAL MOTORS TRAINING MATERIALS



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