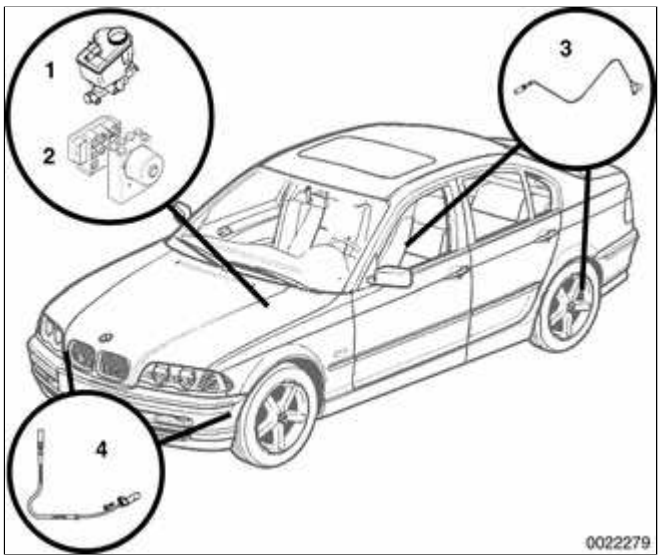
Electronic Brake and Stability Control Systems

All E46 vehicles are equipped with an Antilock Braking System (ABS). Early production models featured ABS with Automatic Stability Control (ABS/ASC). Later models came equipped with ABS and Dynamic Stability Control (ABS/DSC). DSC builds upon the existing ABS/ASC system to provide electronic control of drive and braking systems to insure vehicle stability.

This manual will refer to these systems as ABS. ASC or DSC will be specified when necessary. See the accompanying illustrations for individual system identification.

E46 Electronic braking and stability control systems

ASC



1999 - 2000 Automatic Stability Control Teves MK 20 ASC

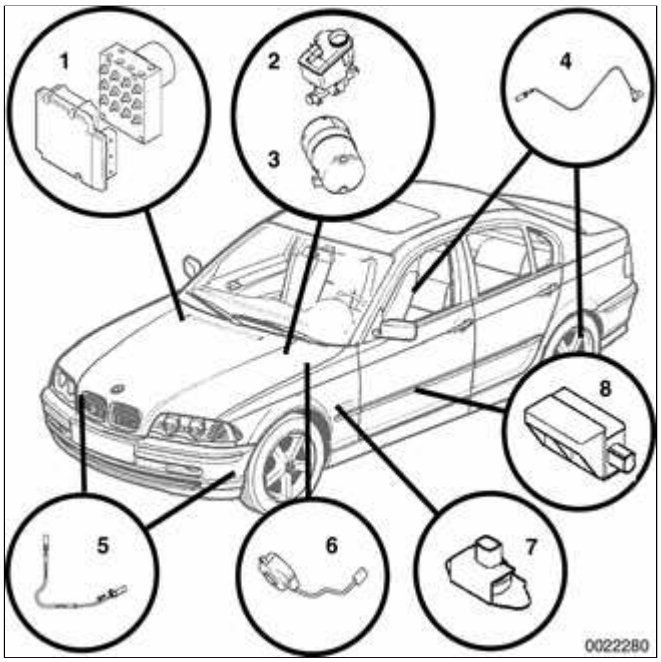
1 - Brake master cylinder and fluid reservoir, left rear of engine compartment

2 - ASC control module and hydraulic unit, left rear of engine compartment under master cylinder

3 - Rear wheel speed sensor, at each rear wheel hub

4 - Front wheel speed sensor, at each front steering arm

DSC



- 1999 - 2000 Dynamic Stability Control Teves MK 20 DSC

1 - DSC control module and hydraulic unit, right rear of engine compartment

2 - Brake fluid reservoir, master cylinder and DSC brake pressure sensors, left rear of engine compartment

3 - DSC precharge pump, left rear of engine compartment, under brake master cylinder

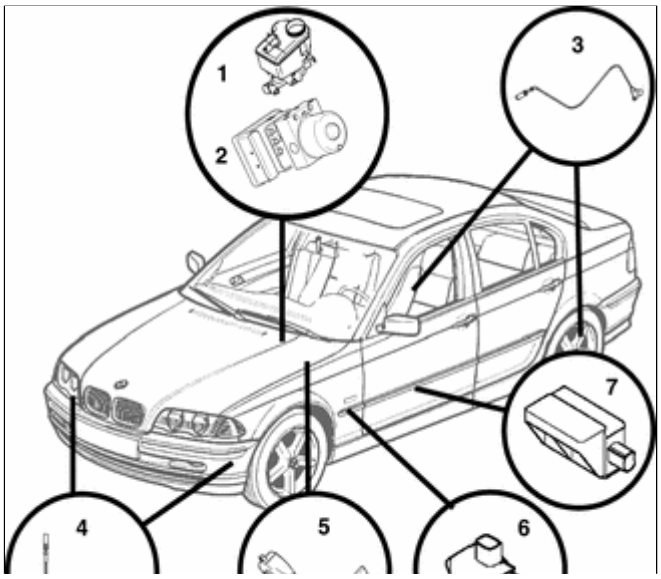
4 - Rear wheel speed sensor, at each rear wheel hub

5 - Front wheel speed sensor, at each front steering arm

6 - Steering angle sensor, at base of upper steering column

7 - Lateral acceleration sensor, behind driver's kickpanel

8 - Rotational acceleration (yaw) sensor, under driver's seat, underneath rug



- 2001 rear wheel drive Dynamic Stability Control Teves MK 60 DSC

1 - Brake fluid reservoir and master cylinder, left rear of engine compartment

2 - DSC control module and hydraulic unit, left rear of engine compartment, under brake master cylinder

3 - Rear wheel speed sensor, at each rear wheel hub

4 - Front wheel speed sensor, at each front steering arm

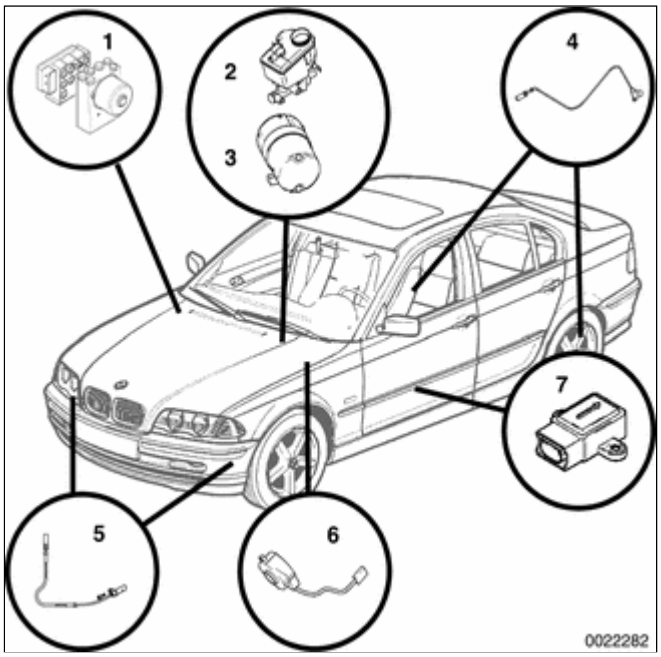
5 - Steering angle sensor, at base of upper steering column

6 - Lateral acceleration sensor, behind driver's kickpanel

7 - Rotational acceleration (yaw) sensor, under driver's seat, underneath rug

Note:

There is no precharge pump in this system.



2001 all wheel drive Dynamic Stability Control Bosch DSC III 5.7

1 - DSC control module, hydraulic unit and DSC brake pressure sensor, right rear of engine compartment

2 - Brake fluid reservoir and master cylinder, left rear of engine compartment

3 - DSC precharge pump, left rear of engine compartment, under brake master cylinder

4 - Rear wheel speed sensor, at each rear wheel hub

5 - Front wheel speed sensor, at each front steering arm

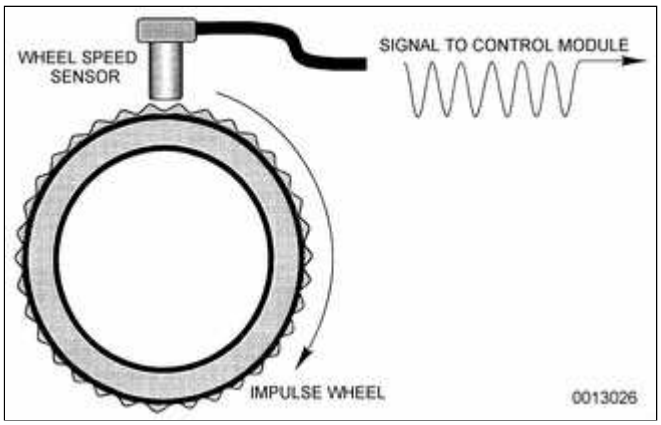
6 - Steering angle sensor, at base of upper steering column

7 - Lateral acceleration sensor and rotational acceleration (yaw) sensor, under driver's seat, underneath rug

ABS system description

The electronically controlled ABS maintains vehicle stability and control during emergency braking by preventing wheel lock-up. ABS provides optimum deceleration and stability during adverse conditions. It automatically adjusts brake system hydraulic pressure at each wheel to prevent wheel lock-up.

The system's main components are the wheel speed (pulse) sensors, the ABS/ASC or ABS/DSC control module, and the hydraulic control unit.



The wheel speed sensors continuously send wheel speed signals to the control module. The control module compares these signals to determine, in fractions of a second, whether any of the wheels are about to lock. If any wheel is nearing a lock-up condition, the module signals the hydraulic unit to maintain or reduce pressure at the appropriate wheel(s). Pressure is modulated by electrically-operated solenoid valves in the hydraulic unit.

Automatic Stability Control (ASC)

The Automatic Stability Control (ASC) system works in conjunction with the Antilock Brake System (ABS) and the engine management system to enhance vehicle control. The main function of the ASC system is to maintain the rolling contact between the tires and the road surface under all driving conditions. This is achieved through exact application and management of braking and drivetrain forces.

Note:

The traction control system referred to as ASC (Automatic Stability Control)

may also be referred to as ASC+T (Automatic Stability Control+Traction).

The ASC system improves traction by electronically applying the rear brakes when the rear drive wheels are spinning at a faster rate than the front wheels. The combined ABS/ASC control module, operating through the ABS hydraulic control unit, modulates braking force at the rear wheels.

In addition, ASC will deactivate individual fuel injectors and override the motor driven throttle to reduce engine torque and maintain vehicle traction. Because the throttle is controlled electronically the driver cannot increase the engine power output during ASC intervention regardless of how far the accelerator pedal is pushed.

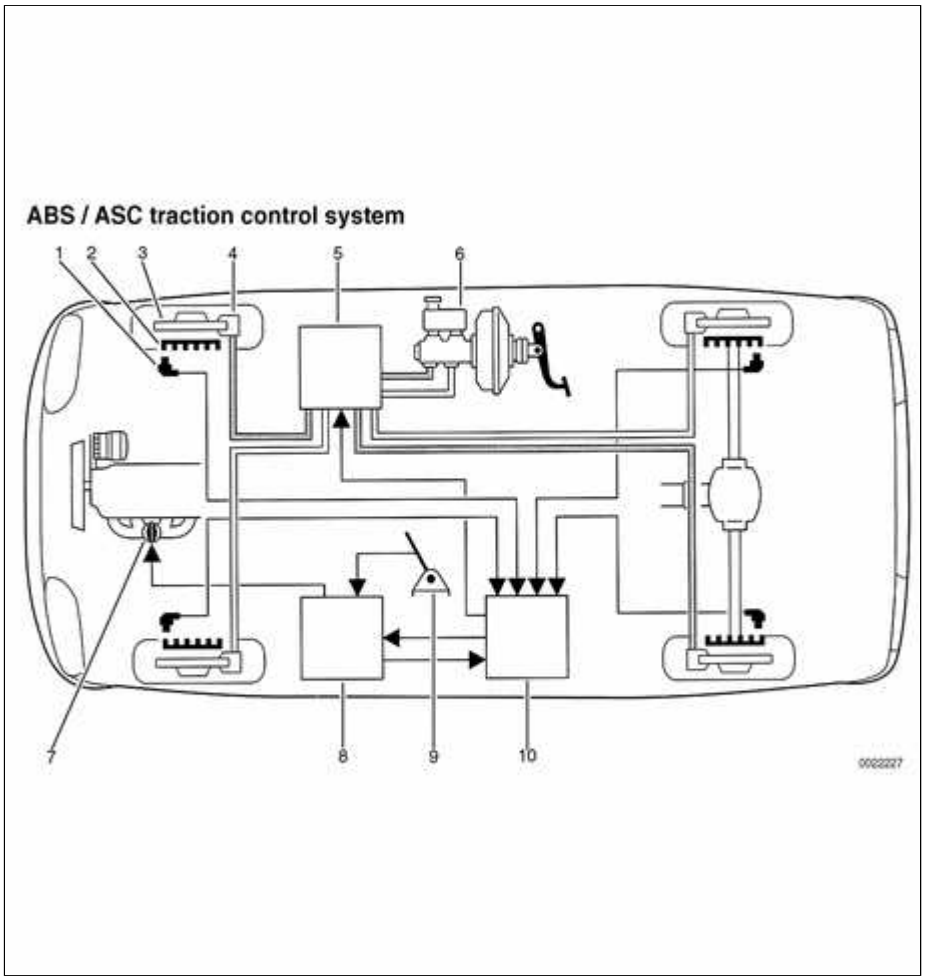
The components that comprise the ASC system also function to replace the limited slip differential available in previous models. Even with the ASC system turned off, if the ASC control module senses a difference in wheel speed (one wheel spinning) the control module will apply modulated braking force to the slipping wheel until traction is regained, but will not override fuel injection function.

Traction control also comes into operation during deceleration. Decelerating on snowy or icy road surfaces can lead to rear wheel slip. If a rear wheel starts to drag or lock up, the ASC system can limit the problem by adjusting throttle, fuel injection and ignition timing.

- A switch on the center console is used to toggle the ASC on or off.

The ASC system is designed to be maintenance free. There are no adjustments that can be made. Repair and troubleshooting of the ASC system

requires special test equipment and knowledge and should be performed only by an authorized BMW dealer. ⇒ Table c. ASC indicator lamp function lists the conditions indicated by the ASC indicator light in the instrument cluster.



ABS/ASC traction control system

1 - Wheel speed sensor

2 - Wheel speed pulse wheel

3 - Brake disk

4 - Brake caliper

5 - ABS/ASC hydraulic unit

6 - Brake master cylinder

7 - Throttle valve

8 - Engine control module

9 - Accelerator pedal

10 - ABS/ASC control module

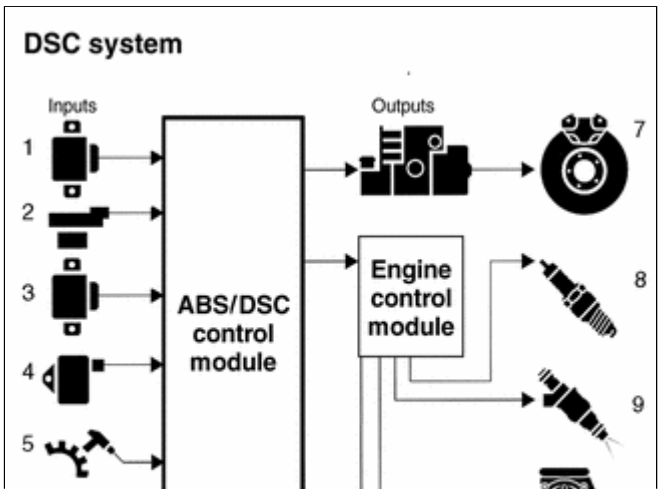
Table c. ASC indicator lamp function

Indicator lamp	Condition	Action / Use
Light on	Normal ASC start-up	Automatic ASC self-test

Indicator lamp	Condition	Action / Use
Light off	ASC monitoring mode	Automatic ASC operation
Press ASC button, light comes on	ASC off (disabled)	Rocking the car to get out of snow or other loose surface Driving with snow chains
Press ASC button, light goes out	ASC monitoring mode	Automatic ASC operation
Light flashes	ASC active mode	Normal ASC operation as it controls wheel speed
Light stays on after start up or comes on while driving	Defect in ASC	Consult BMW dealer for diagnosis/repair (vehicle operation remains normal)

Dynamic Stability Control (DSC)

Dynamic Stability Control (DSC), standard in 2000 and later E46 models, utilizes many principles and components of the ASC traction control system. DSC is active throughout the driving experience, unlike ASC which is only active during acceleration and braking. DSC helps stabilize the vehicle in cornering and avoidance maneuvers by adjusting engine controls such as throttle, ignition, fuel injection and the application of brake pressure to the wheels individually.



The DSC control module uses various inputs to determine vehicle instability during braking, cornering, or reduced traction situations. Based upon these inputs the ABS/DSC control module sends outputs to the engine control module and the ABS/DSC hydraulic unit to activate torque reduction protocols and braking intervention.

Inputs

1 - Lateral acceleration sensor

2 - Steering angle sensor

3 - Rotational rate (yaw) sensor

4 - Brake pressure sensor

5 - ABS wheel speed sensors

6 - Engine control module

Outputs

7 - ABS/DSC hydraulic system

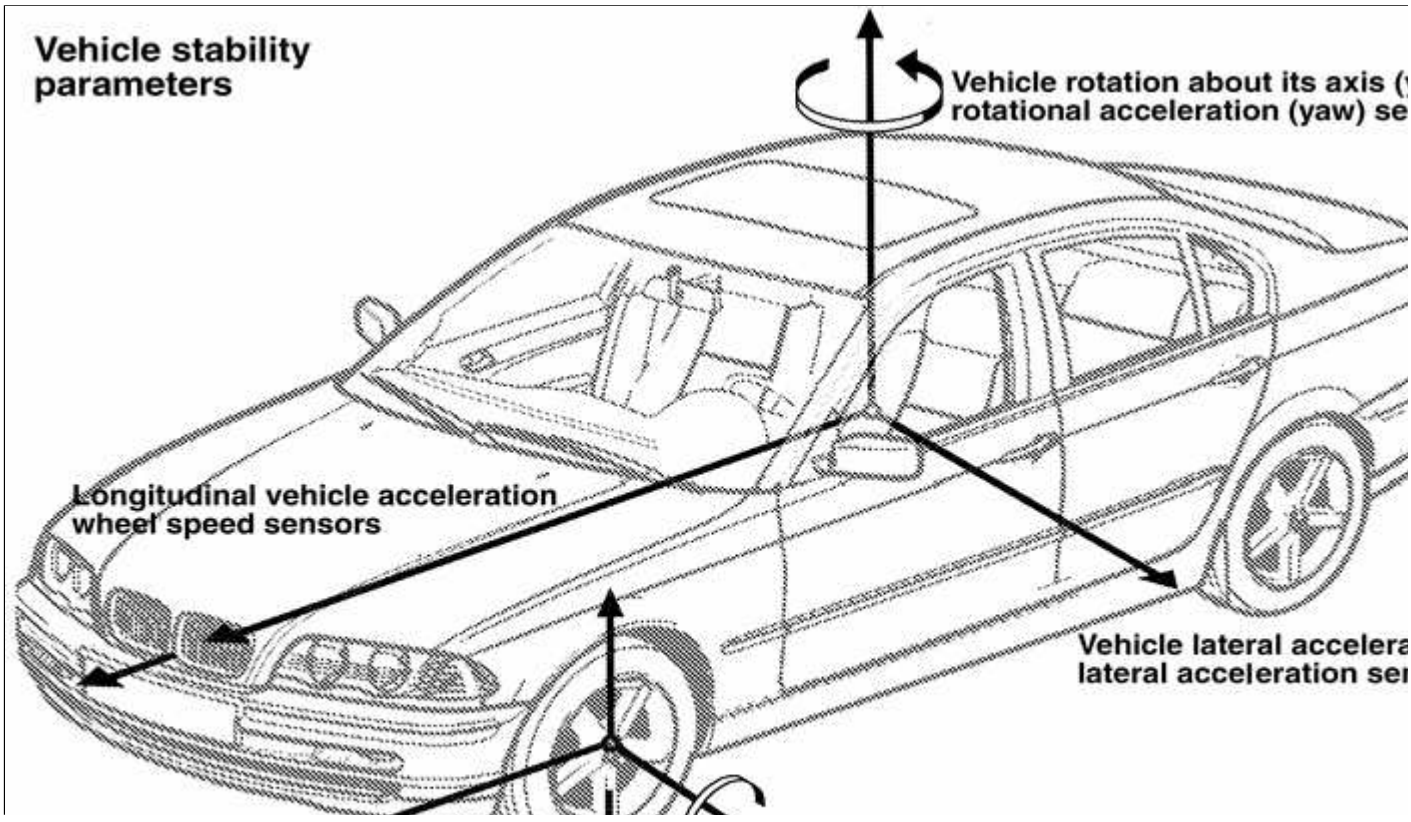
8 - Ignition (spark)

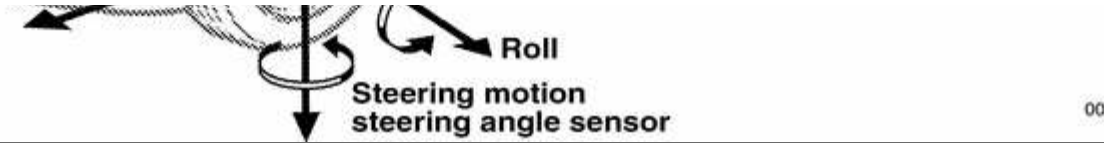
9 - Fuel injection

10 - Throttle valve

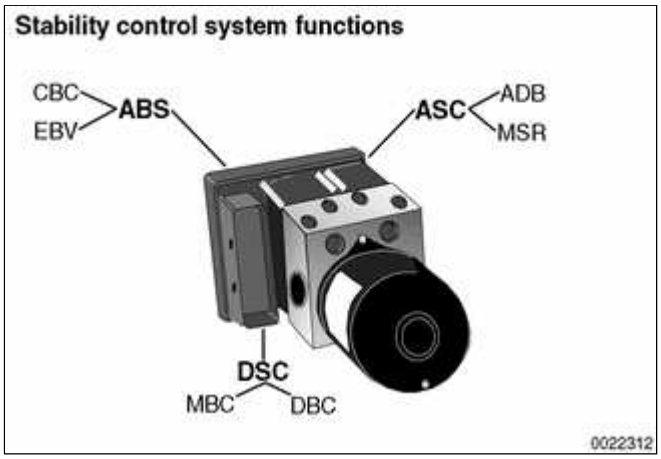
The DSC system can be toggled on and off by a switch mounted on the center console. Turning off the DSC system does not disable ABS or ASC functions.

Vehicle stability parameters





System functions



Each of the electronic braking and stability control systems include sub-systems which use the hydraulic unit/control module and sensors to carry out additional system functions. The foundation of the stability control systems is Antilock Braking System (ABS) with the following basic functions:

- Cornering brake control (CBC)
- Electronic brake proportioning (EBV)

The Teves MK 20 ASC system functions as a basic ABS system, but adds additional system functions:

- Brake intervention (ADB)
- Drag torque reduction (MSR)

All of the dynamic stability control systems are based on the ABS/ASC system, but add DSC system functions

- Dynamic brake control (DBC)
- Maximum brake control (MBC)

Cornering brake control (CBC)

Cornering brake control reduces brake pressure build up on the inside rear

wheel brake circuit during cornering if activation threshold values are exceeded.

Electronic brake proportioning (EBV)

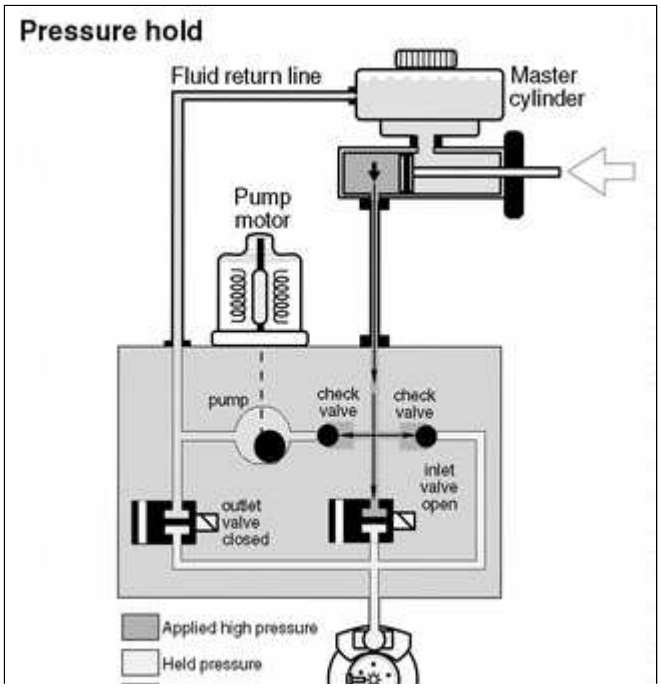
Electronic brake proportioning adjusts braking force to the rear wheels based upon the vehicle's loading, front to rear, to maximize the vehicle's braking power.

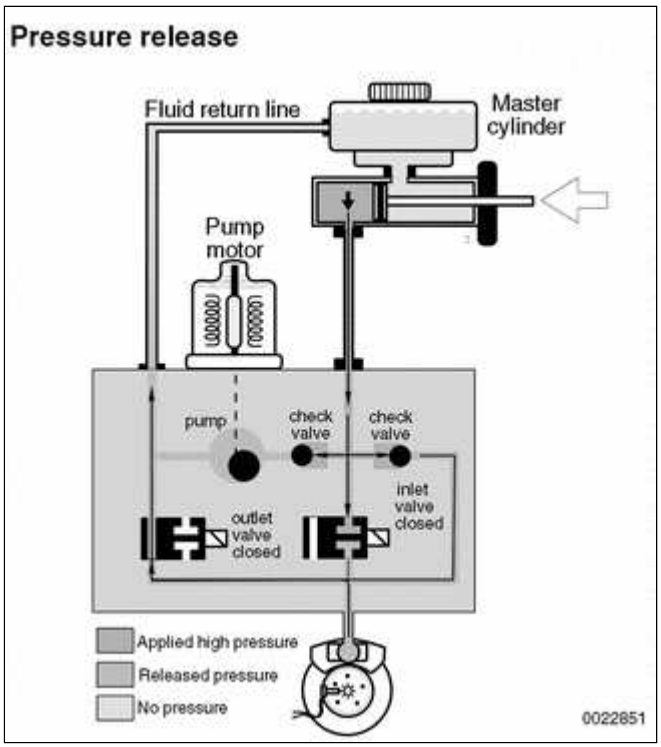
Using wheel speed sensors, the control module compares individual wheel deceleration rates as the brakes are applied. If the difference in wheel speeds exceeds the programmed threshold values, EBV is activated. EBV activation modulates inlet valves to the rear wheels to regulate braking force.

Brake intervention (ADB)

Brake intervention is applied to the individual drive wheel which is losing traction by activating the rear brake calipers in three phases:

- Pressure build
- Pressure hold





- Pressure release

When intervention is necessary:

- The changeover valve in the hydraulic unit energizes and closes inlet valves for the two front wheels and the rear wheel with traction.
- The rear brake circuit intake valve is energized and opened to rear wheel without traction.
- Return/pressure pump is activated and draws in brake fluid from the master cylinder and delivers pressurized brake fluid to wheel without traction.
- Pressure hold and pressure release cycles are run by cycling inlet and outlet valve to rear brake caliper without traction.

Drive torque reduction

In low traction conditions, the ABS control module request is sent to the engine control module (ECM) via the CAN-bus. The ECM accomplishes torque reduction by implementing the following measures:

- Reducing throttle opening angle
- Retarding ignition
- Cutting off individual cylinder fuel injectors