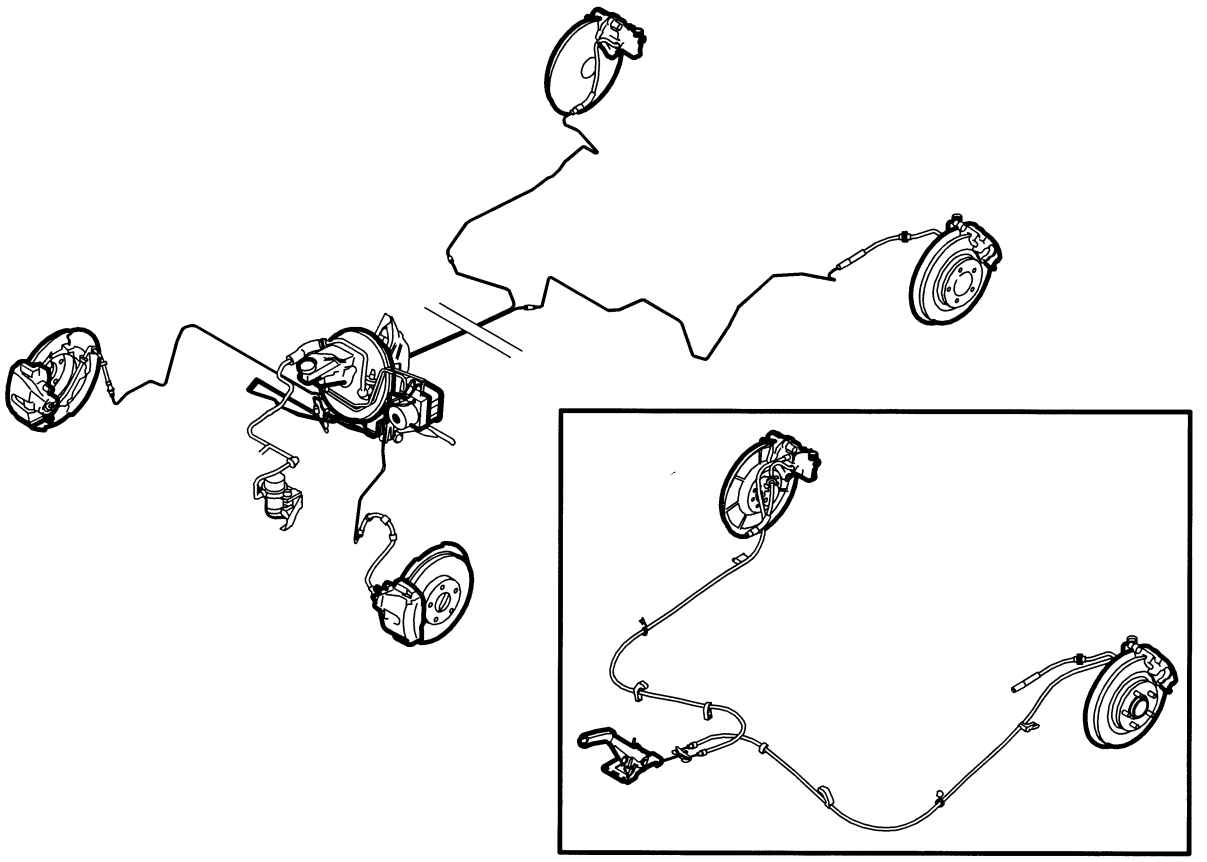


BRAKE SYSTEM

OVERVIEW

GENERAL

The brake system is a dual circuit, diagonally split system with disc brakes front and rear.

The power brake booster (servo) is single acting and has an integrated mechanical function for Emergency Brake Assist (EBA). The power brake booster is connected to the engine's intake manifold and to a vacuum pump. Cars with gasoline engines have an electrical pump, while diesel engined cars have a mechanical pump.

The parking brake is mechanical with a lever and mechanical cables. The brakes act on the rear wheels via a mechanism integrated with the rear brake callipers.

BRAKE CONTROL SYSTEM

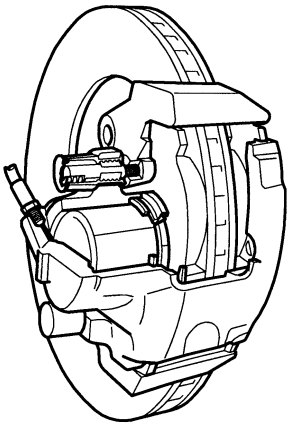
The brake control system is a Mark 60 with integrated ABS and EBD functions.

As an option, the system can be factory fitted with STC or DSTC.

Mark 60 is similar to the Mark 25 ABS system on the P2 platform, but is adapted for the smaller and lighter P1 platform.

WHEEL BRAKES

FRONT WHEEL BRAKE

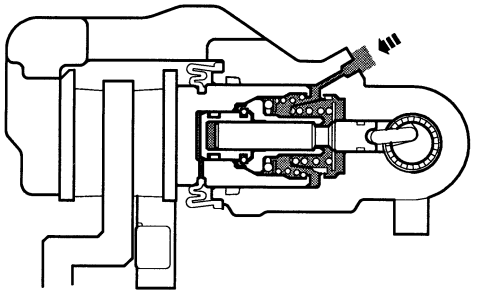


Ventilated brake discs and floating brake callipers with one piston are made of cast iron.

The diameter of the brake discs vary depending on the car variant. The brake callipers and pads are the same but the calliper holders vary depending on disc size based on vehicle configuration.

16 inch wheels - 300 mm rotors
17 inch wheels - 320 mm rotors

REAR WHEEL BRAKE

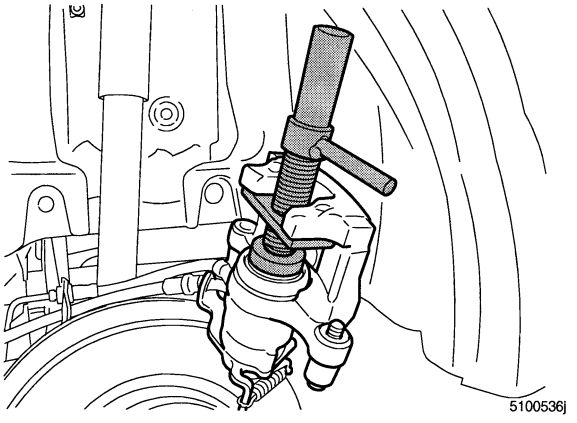


Solid brake discs and floating brake callipers with one piston are made of aluminium.

The rear brake calliper is supplied as a replacement part filled with brake fluid. This makes bleeding the brakes after replacement easier.

The parking brake mechanism is integrated with the rear brake callipers.

The mechanism is self-adjusting and compensates for wear to the brake pads and disc. The adjustment occurs in conjunction with use of the footbrake.

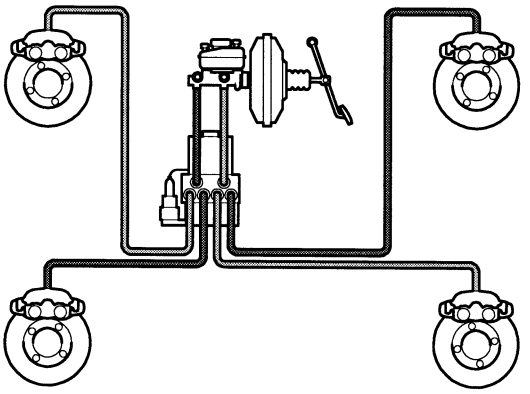


When brake pads are replaced, the mechanism must be reset manually.

Resetting is performed using special tools (999 5782 and 999 7091).

HYDRAULIC SYSTEM

CIRCUITS

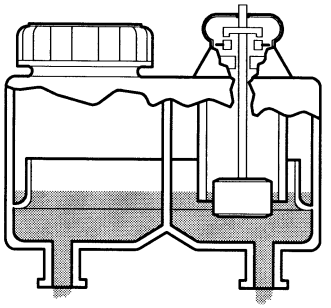


The system has dual circuits and is split diagonally (X-split).

The primary circuit covers the first section of the master cylinder and the right front and left rear brakes.

The secondary circuit covers the second section of the master cylinder and the left front and right rear brakes.

BRAKE FLUID RESERVOIR

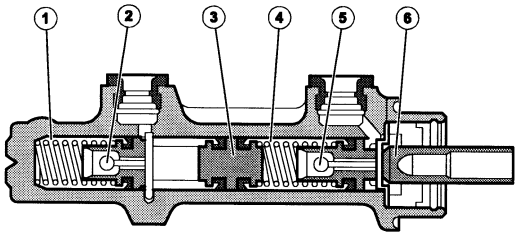


The brake fluid reservoir has two chambers, one per brake circuit, and an integral level sensor.

The level sensor is attached to the Central Electronic Module (CEM).

The brake warning lamp in the combined instrument panel (DIM) will light if the brake fluid level is too low.

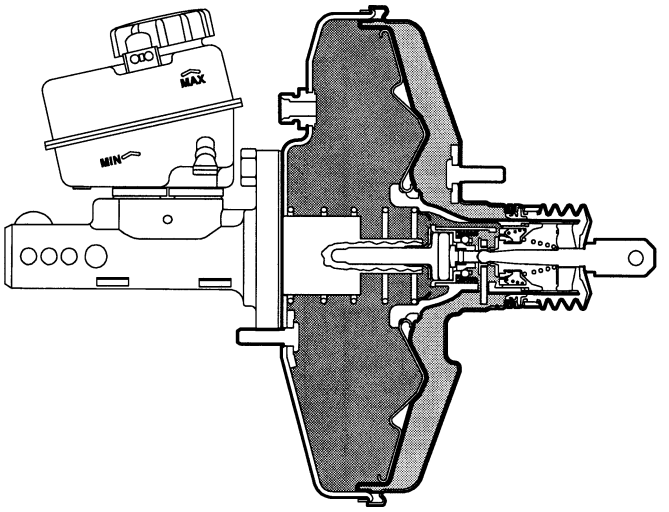
MASTER CYLINDER



The master cylinder is tandem type, with two pistons - one per circuit. There are check valves in the pistons which close during braking and open when the brakes are released.

1. Secondary circuit chamber
2. Check valve in the secondary piston
3. Secondary piston
4. Primary circuit chamber
5. Check valve in the primary piston
6. Primary piston/push rod (one unit)

POWER BRAKE BOOSTER (SERVO)



The power brake booster is located in the engine compartment against the bulkhead.

The brake control module (BCM) with hydraulic unit is always located in the engine compartment on the left-hand side at the bulkhead.

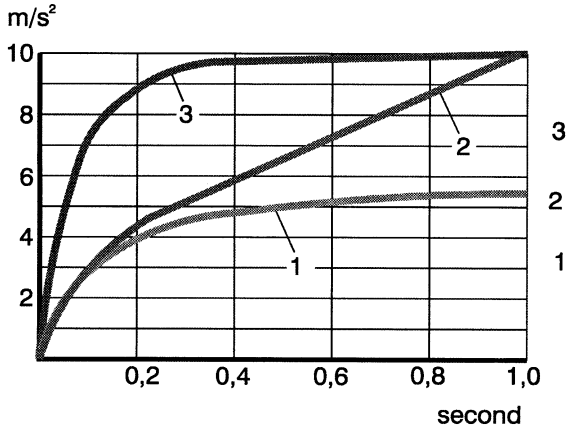
The illustration displays the power brake booster in partial braking position, brake release.

The power brake booster (servo) is single acting (one membrane) and has an integrated mechanical function for EBA (Emergency Brake Assist).

EBA General

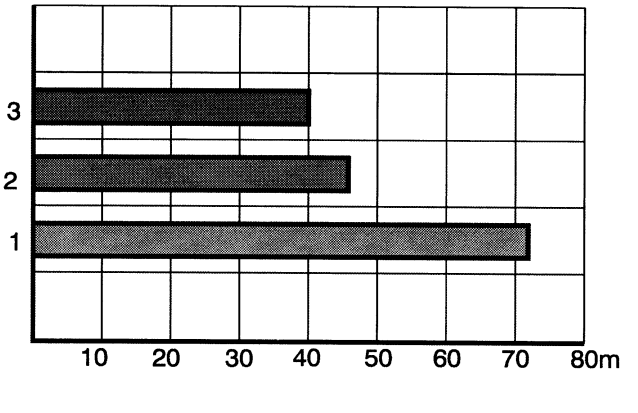
EBA is activated when the driver presses the brake pedal sufficiently hard and fast. Full servo effect is applied and the ABS function controls the brake effect depending on the circumstances.

NOTE: The values in the diagrams below are not specific to any one model. They are only used as examples of differences between cars with and without EBA.



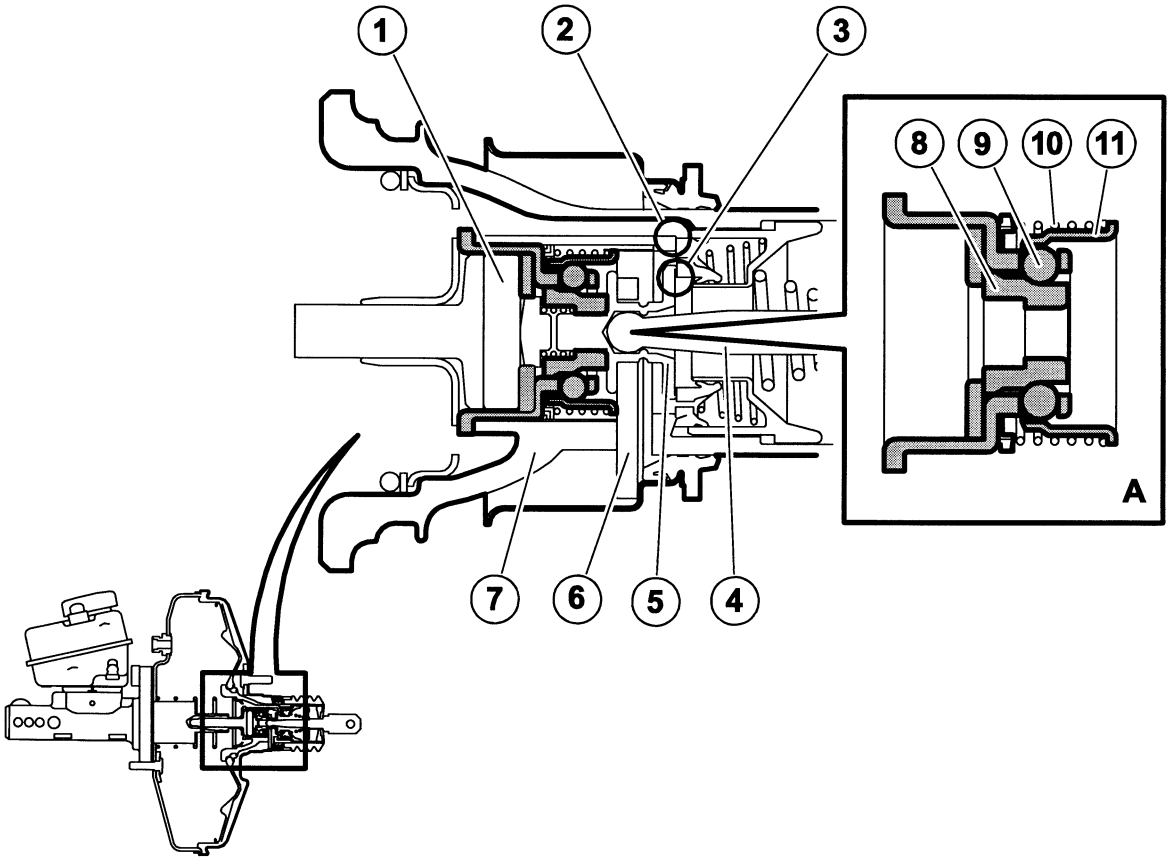
Braking characteristics with and without EBA

1 = insufficient driver reaction
2 = hesitant driver reaction
3 =with EBA



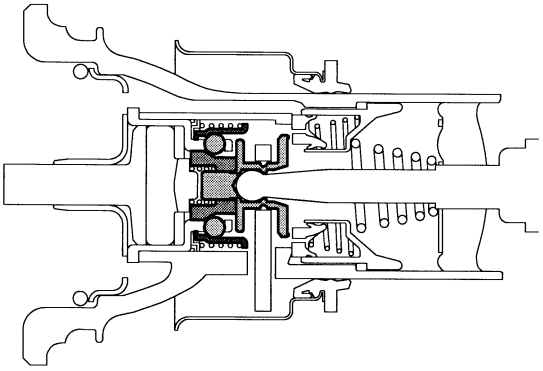
Braking distance from 100 km/h with and without EBA

1 = insufficient driver reaction
2 = hesitant driver reaction
3 =with EBA



A - MECHANICAL VERSION, COMPONENTS AND FUNCTION

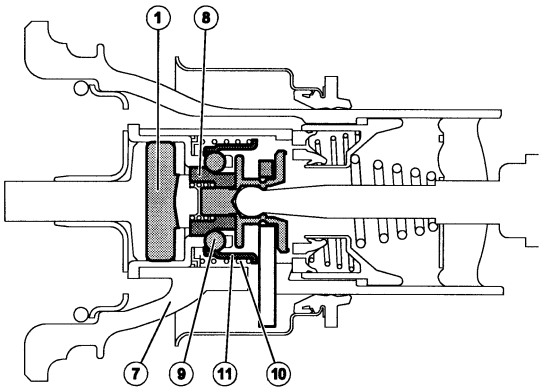
1	Reaction disc	7	Guide housing
2	Valve, vacuum	8	Ball sleeve
3	Valve, atmospheric pressure	9	Balls
4	Push rod	10	Spring
5	Valve piston	11	Locking sleeve
6	Mounting bracket	A	EBA unit



Braking without emergency brake assistance

The EBA unit is designed to be activated in certain conditions.

During normal braking these conditions are not met and the EBA unit remains in 'passive' mode and the power brake booster functions as normal.

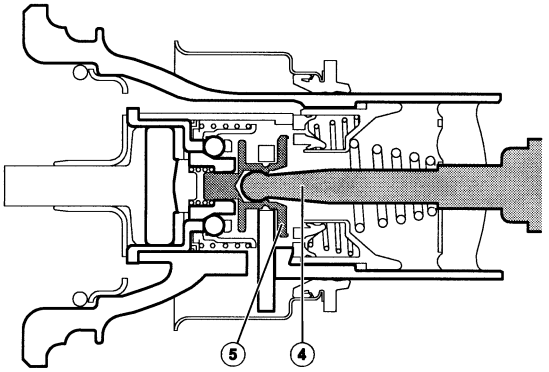


Braking with emergency brake assistance

If the driver presses the brake pedal sufficiently hard and fast, the ball sleeve (8) moves faster (further to the left in the illustration) than the guide housing (7).

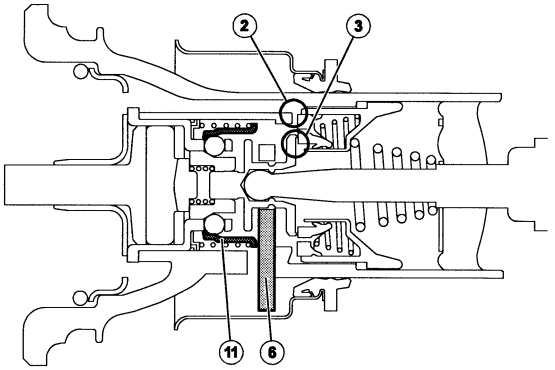
The spring (10) affects the locking sleeve (11) which depresses the balls (9) on the ball sleeve ramp and locks them in this position.

The EBA unit is now activated.



When the EBA unit is activated, the brake pedal/push rod (4) are in principle disconnected from the valve piston (5).

The driver can therefore depress the brake pedal without any more physical effort.



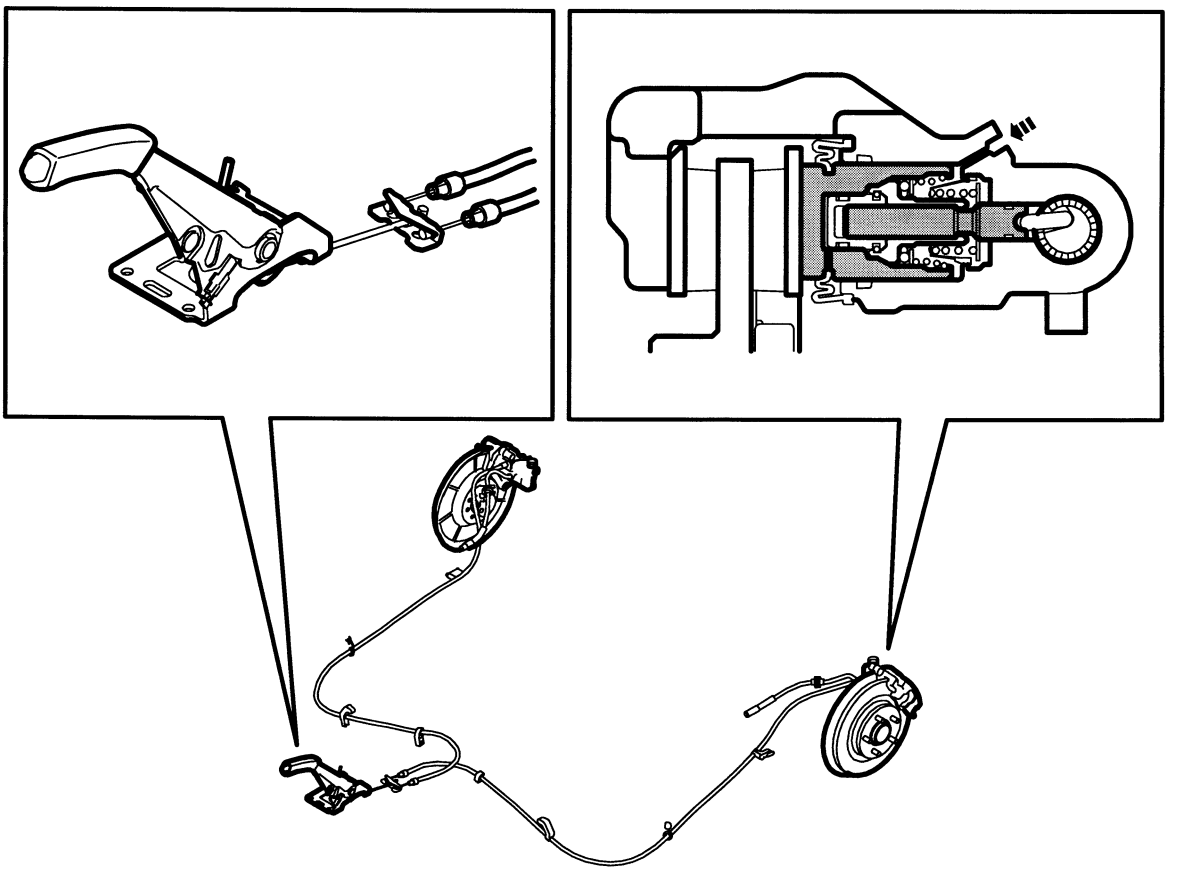
Releasing the brake after braking with emergency brake assistance

The driver controls the pressure reduction through pedal movement.

Reduction occurs in the normal way, that is the valve piston closes the valve (3) for atmospheric pressure and opens the vacuum valve (2).

The EBA unit remains in the activated position during pressure reduction.

Just before standby position is reached the locking sleeve (11) comes into contact with the mounting bracket (6). The locking sleeve is pushed back to its original position and the EBA unit is returned to 'passive' mode.



PARKING BRAKE

GENERAL

The parking brake operates on the rear brake calipers. The brakes are mechanical with handbrake lever, mechanical cables and a mechanism integrated with the rear brake callipers.

The mechanism in the brake callipers is self-adjusting, but the mechanism must be reset manually when the brake pads are replaced.

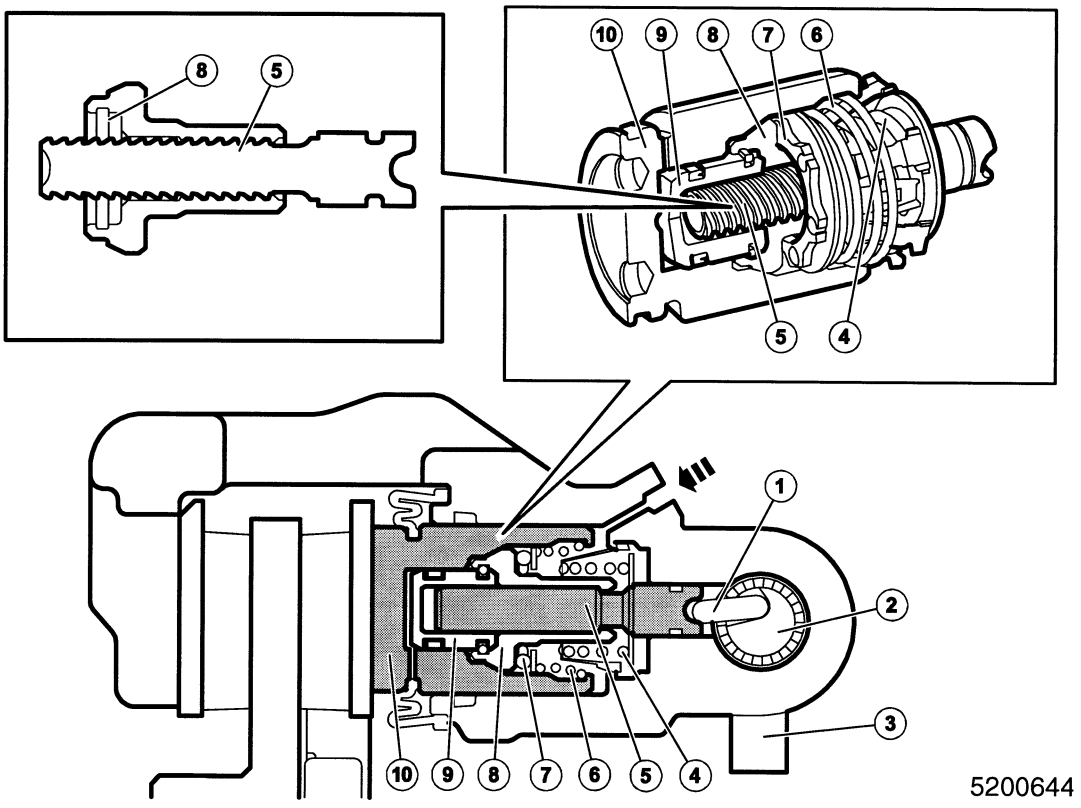
Lever, Switch, Mechanical Cables

The handbrake lever is located between the front seats. There is a switch on the handbrake console which indicates the handbrake is applied. The switch is connected to the Central Electronic Module (CEM).

A mechanical cable runs from the handbrake lever to a distributor link.

Two wires run from the distributor link - one to each rear brake calliper. The mechanical cables are routed diagonally for less acute bends.

The adjustment mechanism for the cables is located by the lever under the rubber boot.



COMPONENTS AND FUNCTION

1	Arm	6	Control spring
2	Eccentric	7	Bearing
3	Lever	8	Adjuster nut
4	Return spring	9	Seal and guide
5	Adjuster screw	10	Brake piston

Applying the Parking Brake

The parking brake cable pulls the lever (3). The movement is transferred via the eccentric (2) to the arm (1) which presses the adjuster screw (5). The force is transferred from the adjuster screw (5) via the adjuster nut (8) to the brake calliper piston (10) and the brake pads are applied.

When the parking brake is released the components return to the resting position.

Self-adjustment

Adjustment occurs when braking, using the footbrake.

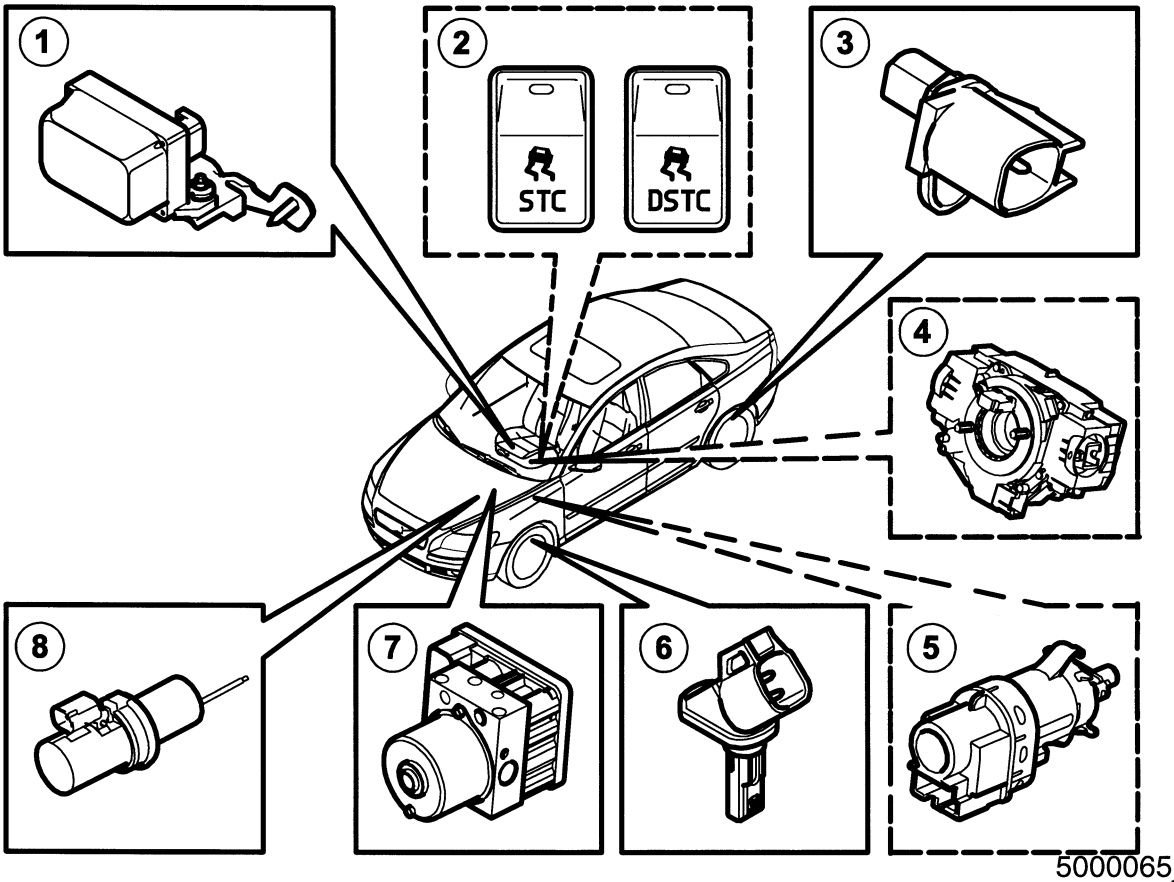
Adjustment is determined by the play in the threads between the adjuster screw (5) and the adjuster nut (8).

When the brake pedal is depressed the hydraulic pressure forces the brake piston out (10). The adjuster nut (8) and the adjuster screw (5) follow this movement.

When the brake pedal is released the brake piston is pushed slightly back by the tension in the piston seal.

The adjuster nut (8) is pressed against the piston of the control spring (6), at the same time as the return spring (4) presses the adjuster screw (5) against the arm (1).

If the relative movement exceeds the play in the thread, the adjuster nut will be twisted to a new position further out on the adjuster screw.



1	BSC (Body sensor cluster) Only on cars with DSTC	5	Brake light switch Connected to the ECM via the CEM
2	STC or DSTC switch Connected to the CCM	6	Wheel sensor, front wheel
3	Wheel sensor, rear wheel	7	BCM and hydraulic unit
4	Steering wheel module (SWM)	8	Pedal position sensor

BRAKE CONTROL SYSTEM - MARK 60

GENERAL

The brake control system is a Mark 60 type with integrated ABS and EBD functions.

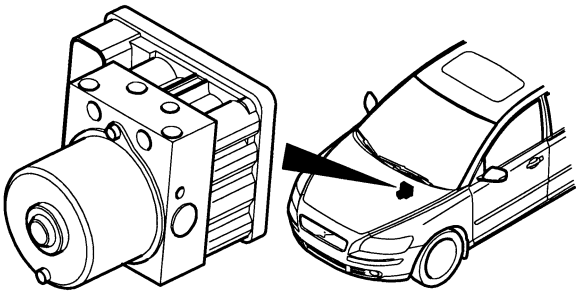
As an option the system can be factory fitted with STC or DSTC.

In principle the Mark 60 has the same design as earlier systems-for example the 'Mark 25' in the XC90.

The main differences are:

- Adapted for lighter cars - software, algorithms etc.
- Lower weight and smaller dimensions.
- The brake pressure sensor for the AYC function is integrated in the hydraulic unit.
  AYC regulation only starts the pump, the power brake booster is not activated, which is different for the Mark 25, where both the pump and the power brake booster are activated.

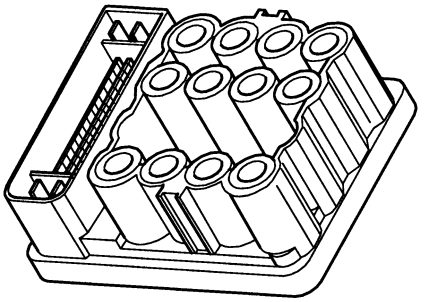
COMPONENTS



Brake Control Module (BCM) and Hydraulic Unit
The unit is located in the engine compartment on the left-hand side against the bulkhead.

The control module processes the input signals and controls the hydraulic unit (pump and valves) depending on the prevailing driving conditions.

There are different versions of the control module and hydraulic unit depending on whether the car has STC/DSTC or not.



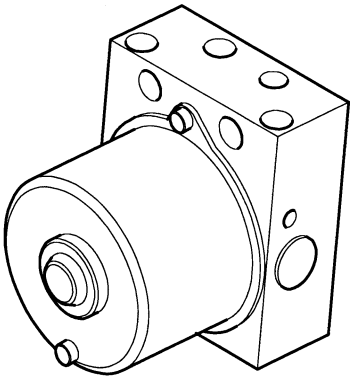
Control module
The control module has double micro processors which operate and perform calculations in parallel.

The control module for cars with ABS/EBD has 8 valve coils for the hydraulic valves, 4 inlet and 4 outlet valves.

Cars with STC and DSTC have an additional 4 valve coils. Cars with DSTC also have an additional terminal for the brake pressure sensor in the hydraulic unit.

Note: On cars with DSTC the control module must be calibrated after replacement.

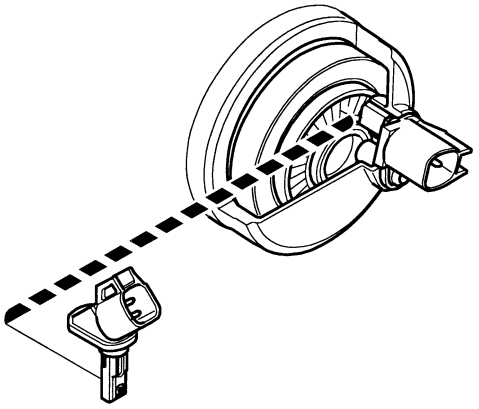
The illustration shows the control module for cars with STC.



Hydraulic Unit
The hydraulic unit contains:

- Hydraulic valves - 8 for cars without STC/DSTC and 12 for cars with STC/DSTC.
- Accumulators and check valves.
- Pump motor.
- Brake pressure sensor - only for cars with DSTC.

The hydraulic unit is supplied as a replacement part filled with brake fluid. This makes it easier to bleed the system when the unit has been replaced.



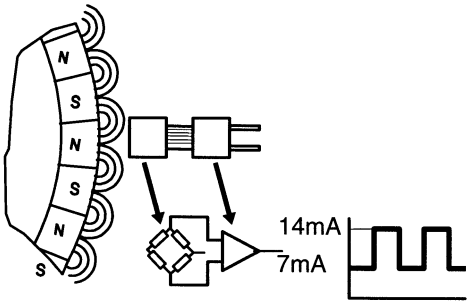
Wheel Sensors

The sensors are the active sensor type and are affected by magnetic rings with 88 permanent magnets, alternatively North and South poles.

The sensors are mounted in the stub axles.

The magnetic rings are integrated with the inner wheel bearing seals.

Install the seal/bearing in the correct position when replacing them. This is to ensure the distance between the sensor and magnetic ring is correct.



Signal Description Wheel Sensor

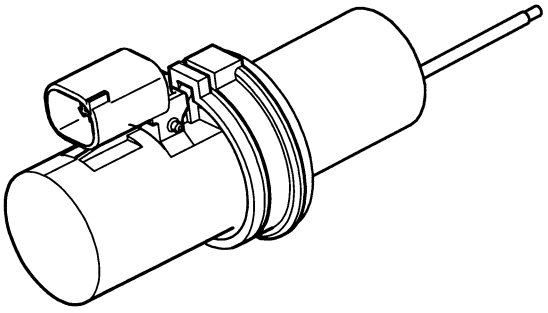
The sensor is supplied with 12V from the BCM.

The sensor contains resistors whose resistance is affected by the magnetic field from the magnetic ring.

The change in resistance means the sensor power consumption varies. The consumption varies between 7 mA and 14 mA depending on the position of the magnetic ring.

The sensor generates a signal as a quadratic wave with a fixed pulse ratio but the frequency increases with wheel speed.

Front wheel bearing and magnetic ring are integrated.

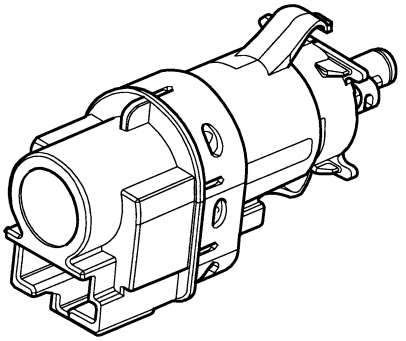


Pedal Position Sensor

The sensor is located in the power brake booster and reads off the position of the membrane in the power brake booster.

The sensor is a sliding potentiometer.

The sensor is supplied with 5V from the BCM. The output signal is a voltage that varies between approximately 0.15 V - 4.85 V depending on the position.

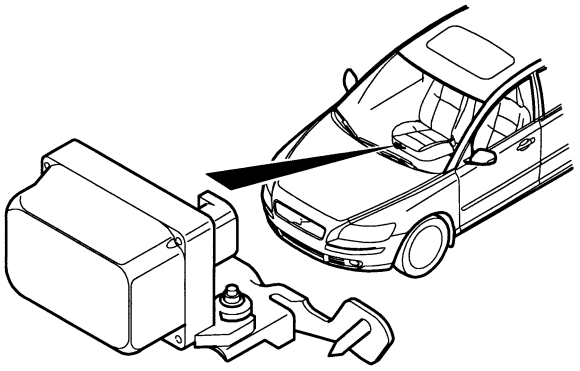


Brake Light Switch
The brake light switch is located by the brake pedal lever. The switch is self-adjusting during installation.

The switch is open when the brake pedal is unaffected and closes when the brake pedal is depressed.

The switch is supplied with 12 V via 30 V at the ignition switch and the output signal is connected to the ECM via the CEM.

The BCM receives information about the switch position via the CAN.



Body Sensor Cluster (BSC)
Cars with DSTC only

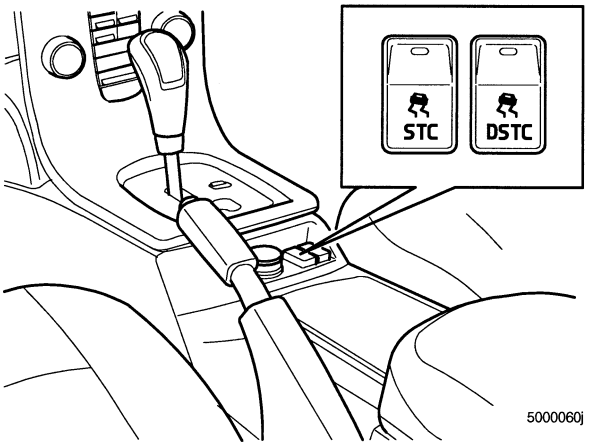
The sensor is positioned under the right front seat.

The sensor must be installed correctly to function. The BCM must be calibrated after replacing the sensor.

The sensor contains:

- A sensor which measures the yaw angle of the car in ° /s (yaw angle = the rotation of the car around the vertical axis).
- A sensor which measures the lateral acceleration of the car in m/s^2.

The sensor is a slave module for the BCM. Communication between the sensor and BCM is through an adapted CAN protocol.



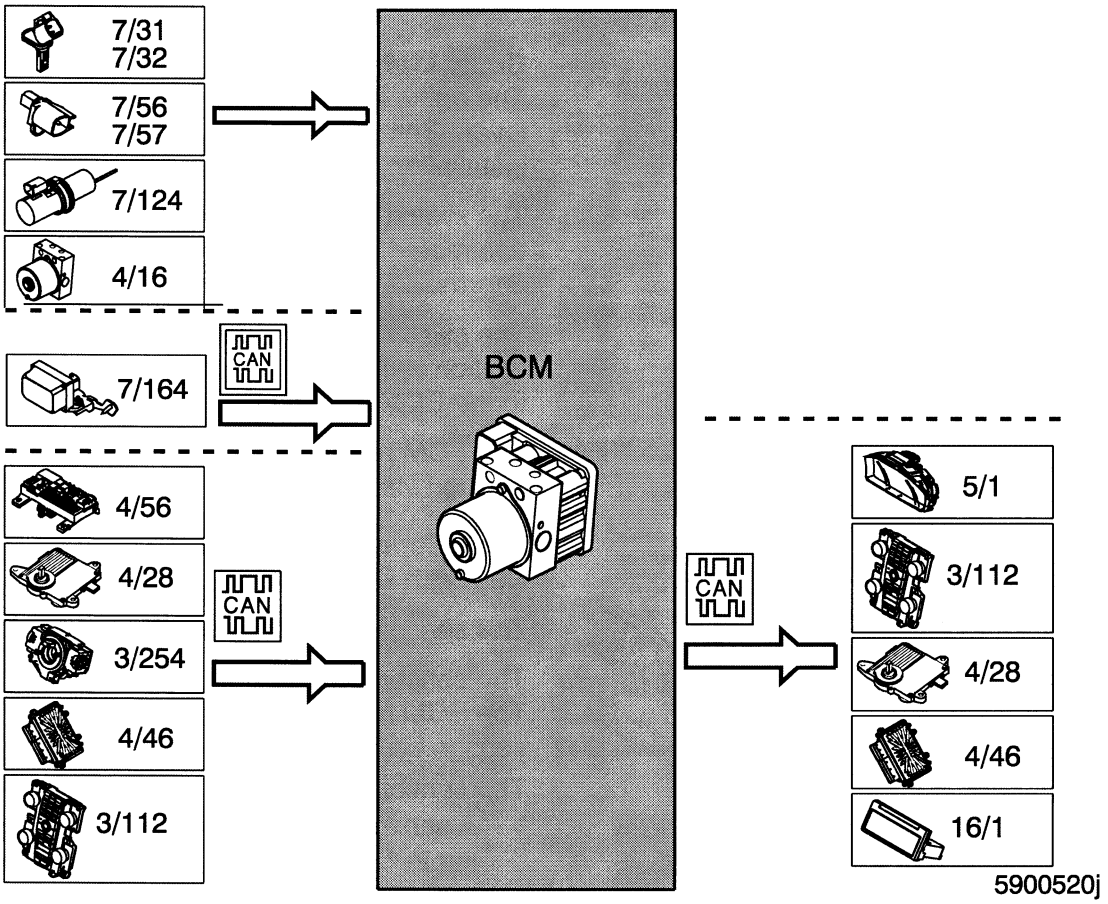
Switch for STC or DSTC
The switch is located in the center console between the front seats.

The STC/DSTC function is always activated when the ignition is switched on. This is indicated by the LED on the button lighting.

The function can be reduced and reactivated by pressing the switch for at least half a second.

Reduction means the SC (stability function) is switched off and the AYC enters 'Wideslip mode'.

This is indicated by the LED on the button going out and the DIM displaying the system status.



SIGNAL SPECIFICATION

INPUT SIGNALS, DIRECTLY CONNECTED

Component	Information, signal specification
Wheel sensors (7/31, 7/32, 7/56, 7/57)	The wheel speed, acceleration and deceleration. Quadratic wave (the current varies between 7 and 14 mA) with a fixed pulse ratio, frequency varies with wheel speed.
Pedal position sensor (7/124)	Brake pedal position (the position of the membrane in the power brake booster). Variable voltage between 0.15 and 4.85 V.
Brake pressure sensors, integrated in the ABS hydraulic modulator (4/16) Cars with DSTC only	Actual brake pressure. Cannot be measured, directly connected from the ABS hydraulic modulator to the BCM.

INPUT SIGNALS VIA CAN COMMUNICATION

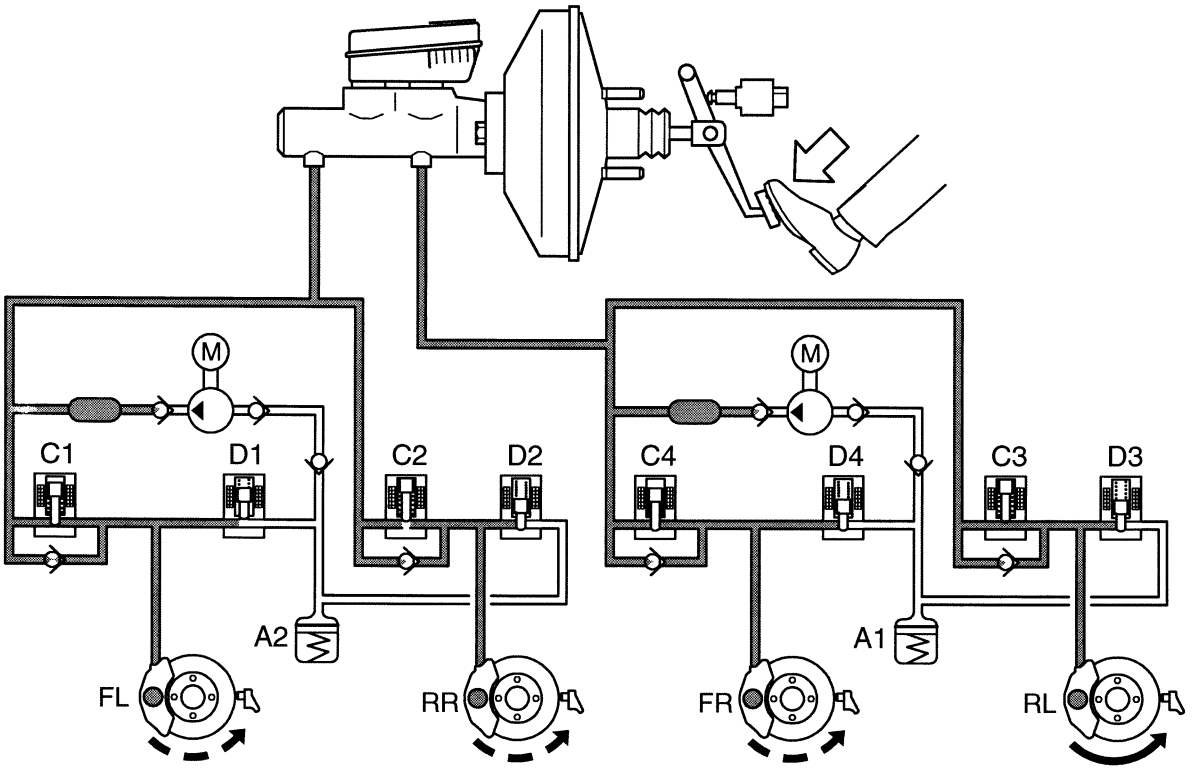
Component	Information
BSC (7/164) Cars with DSTC only	Yaw rate speed in degrees/s and lateral acceleration in m/s^2.

INPUT SIGNALS VIA CAN COMMUNICATION

Component	Information
CEM (4/56)	Vehicle configuration. Reverse gear engaged or not (manual transmission). This information is used by the BCM to disable the AYC function when reverse gear is engaged.
TCM (4/28)	Reverse gear engaged or not. This information is used by the BCM to disable the AYC function when reverse gear is engaged. Actual gear, next gear and lock-up status.
SWM (3/254) Cars with DSTC only	Steering wheel signal status - OK or not OK. Steering wheel position, at what speed the steering wheel is being turned to the left or to the right.
ECM (4/46)	Engine status engine running or not. Actual engine speed (RPM) and torque. Brake light switch status - closed or open. This information is used by the BCM to diagnose the brake pedal position sensor function.
CCM (3/112)	Switch position STC/DSTC full or reduced function.

OUTPUT SIGNALS VIA CAN COMMUNICATION

Component	Information
DIM (5/1)	Vehicle speed. Request to light the information lamp, warning lamps and display text message in the text window.
CCM (3/112)	Request to light/switch off the LED in the switch for STC/DSTC.
TCM (4/28)	Vehicle speed. Pedal position sensor position. Request to delay a gearshift in the event of excessive speed difference between the front wheels.
ECM (4/46)	Vehicle speed. Pedal position sensor position. Whether ABS, SC or TC control is active. Request for torque limiting during SC control.
ICM (16/1)	For cars with RTI number of front wheel rotations and total distance traveled.



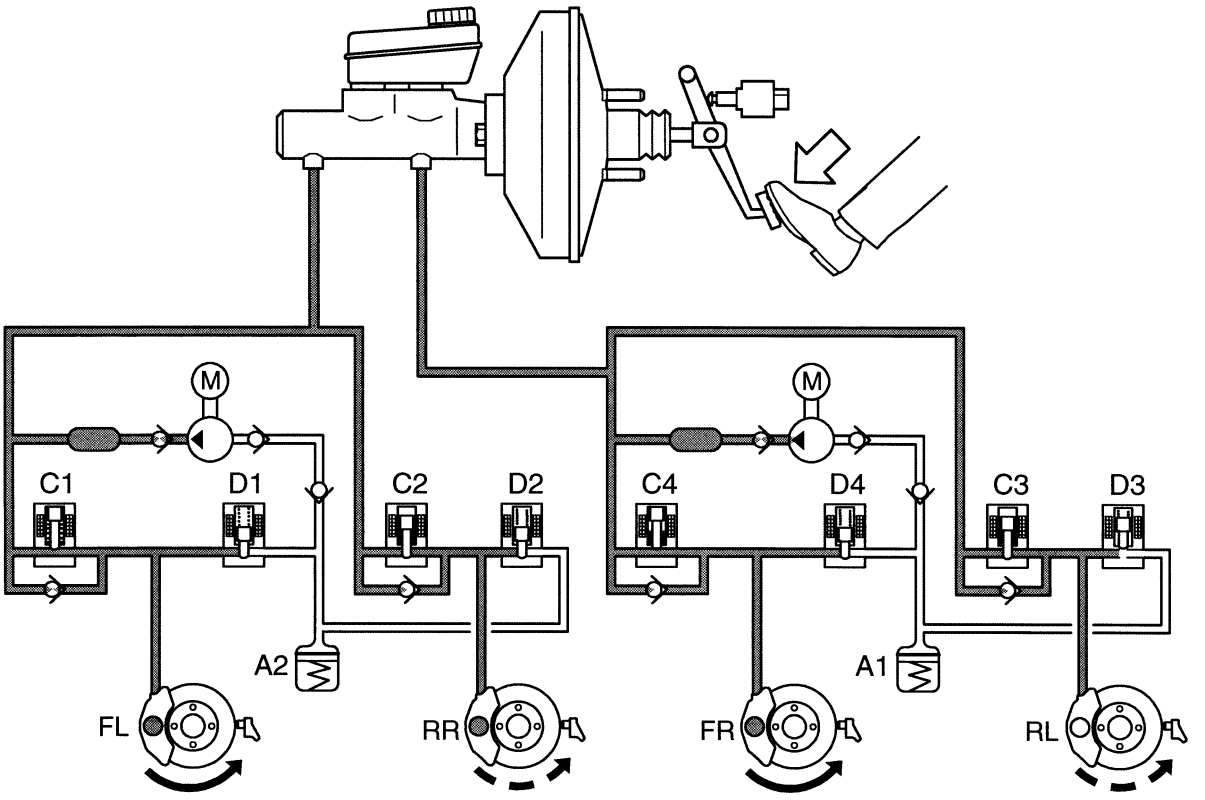
ABS - CONTROL

ABS Control functions in the same way as other similar systems.

During control, the hydraulic pump runs and inlet/outlet valves switch between pressure increase, pressure maintenance and pressure dumping depending on the acceleration and deceleration of the wheels.

Some facts:

- The brake force is controlled so the greatest possible brake force is transferred to the road surface. This occurs when the wheels rotate with 15 - 20 % slippage against the road surface.
- The ABS function is only active at speeds above 7 km/h.
  At speeds below 7 km/h the wheels may lock, but this has no practical effect on driving stability or braking distance.



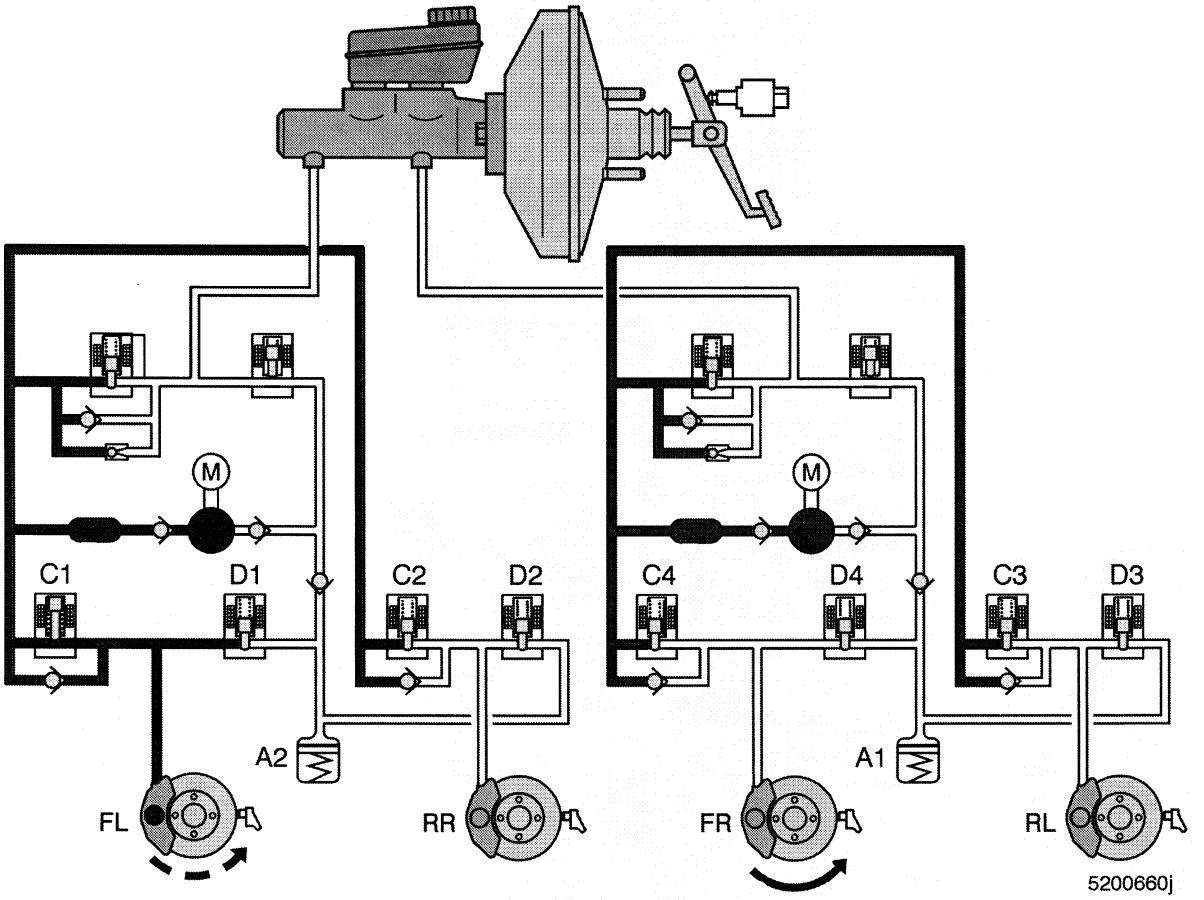
EBD CONTROL

EBD Control functions in the same way as other similar systems.

During control, the inlet/outlet valves for the rear wheels switch between pressure increase, pressure maintenance and pressure dumping depending on the acceleration and deceleration of the wheels. The hydraulic pump does not start, the fluid volume returned from the rear wheel brakes is taken up by the accumulators (A1-A2).

Some facts:

- The brake effect is controlled so rear wheel slippage is less than the front wheel slippage.
- The rear wheels tendency to slippage is dependent on the pressure on the rear wheels - the pressure is affected by factors such as the load in the vehicle. The function is consequently load dependent.



STC

Additional Components

For cars with STC the following components are added (1 per circuit):

1	SV (Separation Valve)	3	Overflow valve
2	ESV (Electronic Shuttle Valve)	4	Check valve

STC Control

The STC function consists of two components:

- SC (Stability Control).
- TC (Traction Control).

SC Control

SC Control functions in the same way as other similar systems.
During control the BCM transmits a request to the ECM to reduce engine torque.

Some facts:

- SC functions between 0 km/h and top speed.

Traction Control

IC functions in the same way as other similar systems.

During control:

- It shuts the SV and the ESV opens.
- The inlet valve for the wheel which is not spinning closes.
- The pump starts and takes brake fluid from the brake fluid reservoir via the ESV valve.
- The inlet and outlet valves for the wheel which is spinning are controlled so the wheel is braked. The drive force is transferred to the driving wheel on the other side.
- The pump supplies more fluid/flow than is required for TC control. The excess is returned via the ESV to the master cylinder and/or the pump.

Some facts:

- TC is mainly intended for use when moving off on slippery surfaces at speeds up to approximately 60 km/h (37 mph).

  At speeds between 60 -100 km/h TC control has a limited function.

  The TC function is not active at speeds above 100 km/h (62 mph).

- For the TC to be activated there must be a speed difference between the wheels.

  The speed difference required varies depending on the car type, driving situation and vehicle speed.

  In principle, the higher the speed of the car the greater the difference in speed between the wheels must be for TC to be activated.

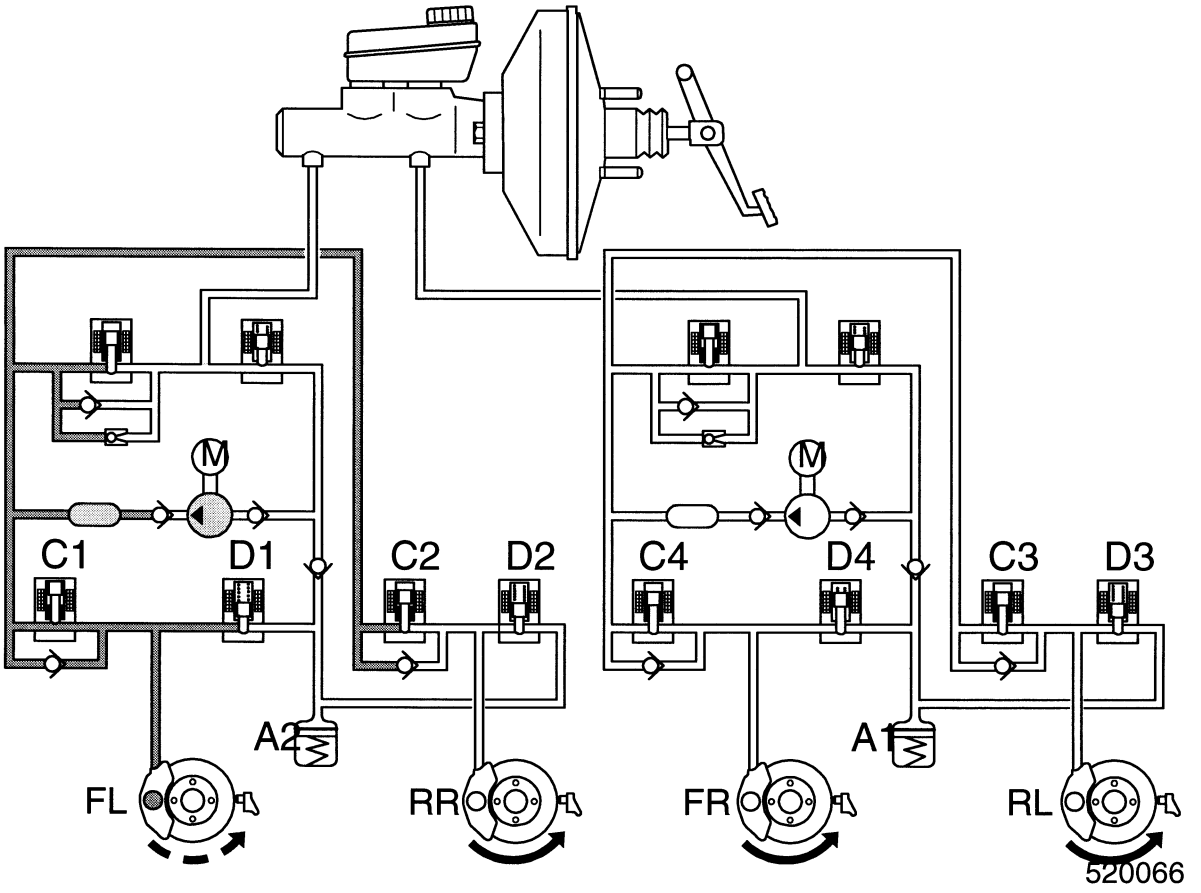
- The BCM continuously calculates how much the brakes are used and calculates the temperature of the brake discs of the front wheels.

  If the calculated temperature exceeds approximately 450°C, TC is shut off to prevent the brakes overheating. A DTC is stored in the BCM, the general warning lamp lights and a text message is displayed in the DIM.

  The function is reactivated and the warning lamp in the DIM goes out when the temperature falls below 300°C.

  Note that high brake temperature can also be caused by hard use of the brake system, for example extended braking when driving with a trailer on long downhill stretches.

- TC is disactivated when the brake pedal is depressed.



DSTC

General

The DSTC function consists of three components:

- SC (Stability control).
- TC (Traction control).
- AYC (Active Yaw control).

Additional Components

The BCM and the hydraulic unit are the same as for cars with STC except for:

- Tailored software.
- Brake pressure sensor integrated in the hydraulic unit.

SC and TC - Control

Functions in the same way as other cars with STC.

Automatic Yaw Control

AYC control functions in the same way as other similar systems.

As on the S60, the hydraulic pump starts with AYC regulation, however the power brake booster is not activated. It is not required because the S40/V50 is a lighter vehicle and pressure is built up by the pump sufficiently and quickly without help from the power brake booster.

The BCM continuously monitors:

- Steering wheel angle, the speed at which the steering wheel is being turned (to the left or to the right).
- Engine torque.
- Vehicle speed.
- The vehicle yaw rate and lateral acceleration.

AYC is activated if the difference between the driver's intended direction and the behavior of the vehicle exceeds a certain limit.

First the BCM requests that the ECM adapt the engine torque and that the TCM adapt the gearshifts.

During the second stage, the brake system is activated by the BCM:

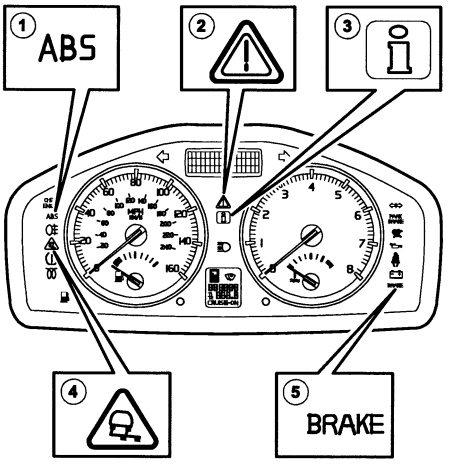
- Shuts the SV and opens the ESV.
- Starting the hydraulic pump (the brake pressure sensor in the hydraulic unit provides the BCM with information about the actual brake pressure).
- Activating the inlet and outlet valves so the correct wheel is braked to counteract under or oversteer.

Some facts:

- If the driver presses the brake pedal during AYC, the BCM will use the pressure applied by the driver in its calculations.
- AYC function diminishes at low speeds. The function is not noticeable at or below speeds of 6- 10 mph.

INFORMATION/WARNING LAMPS

The brake system uses five information/warning lamps and the DIM. The text displayed depends on the information/fault.



1	ABS warning lamp	4	STC/DSTC lamp
2	General warning lamp	5	Brake warning lamp
3	General information lamp		

In the event of a fault, the lamps light in different combinations depending on the fault. In certain cases a text message is also displayed in the DIM (Refer to table under Diagnostics on the next page).

No lamps are lit during normal function.

Note that the STC/DSTC lamp flashes during TC, SC and/or AYC control.

DIAGNOSTICS

When the ignition is switched on, all the information / warning lamps in the dashboard light up for 2 seconds.

When the car is started and driven, the BCM checks the signals from the wheel sensors.

When the car reaches 12 mph (25 mph if the brake pedal is depressed), the BCM checks the hydraulic pump and the function of the hydraulic valves by activating the components. Some noise may occur. This is normal.

While the car is being driven, the BCM continuously checks all internal functions and the input and output signals.

If the BCM detects any faults, a request is transmitted to DIM, to light the general information / warning lamps and for certain faults to display a text message in the text window.

Which lamps are lit and if text message is shown depends on the fault - Refer to the table below.

At the same time, the BCM stores a diagnostic trouble code (DTC) and stores the frozen values (the conditions when the DTC was stored).

Faulty function/lamp, text		Brake fluid level	ABS	EBD	STC/DSTC
ABS lamp			X	X	
General warning lamp				X	
General information lamp			X		X
Brake warning lamp		X		X	
Text message		X	X	X	X