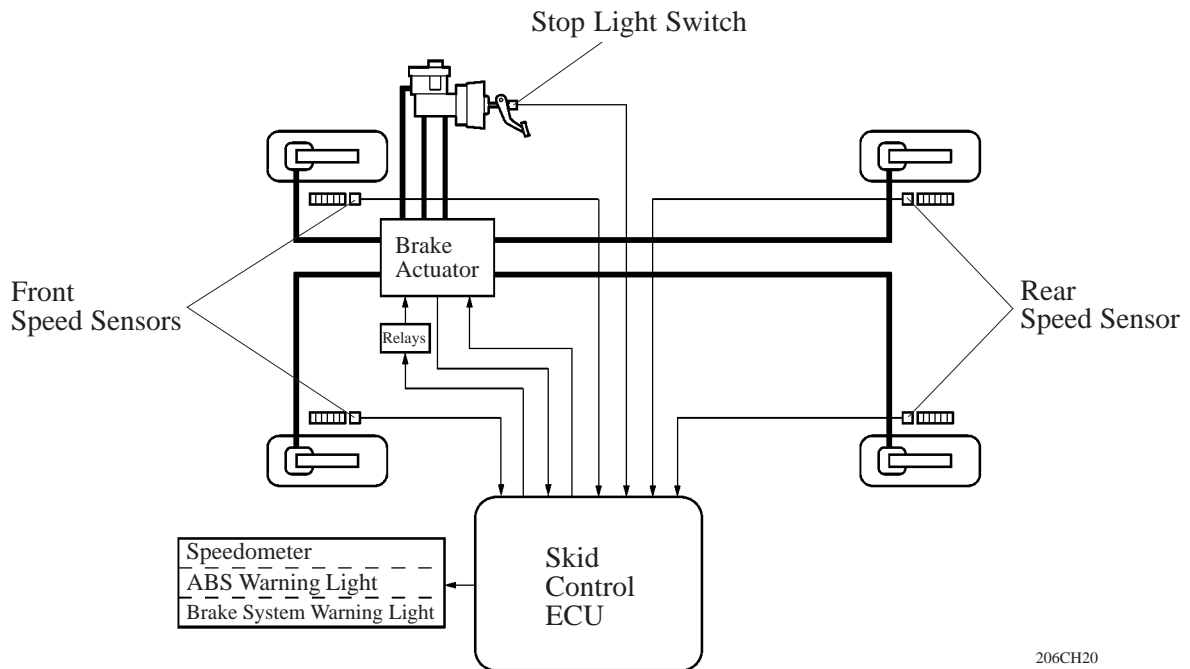


■ ABS with EBD & BRAKE ASSIST SYSTEM

1. General

- The ABS helps prevent the wheels from locking when the brakes are applied firmly or when braking on a slippery surface.
- The EBD control utilizes ABS, realizing the proper brake force distribution between front and rear wheels in accordance with the driving conditions.
In addition, during cornering braking, it also controls the brake forces of right and left wheels.
- The primary purpose of the Brake Assist system is to provided an auxiliary brake force assist to the driver who cannot generate a large brake force during emergency braking, thus maximizing the vehicle's brake performance.

2. System Diagram



206CH20

3. Outline of EBD Control

General

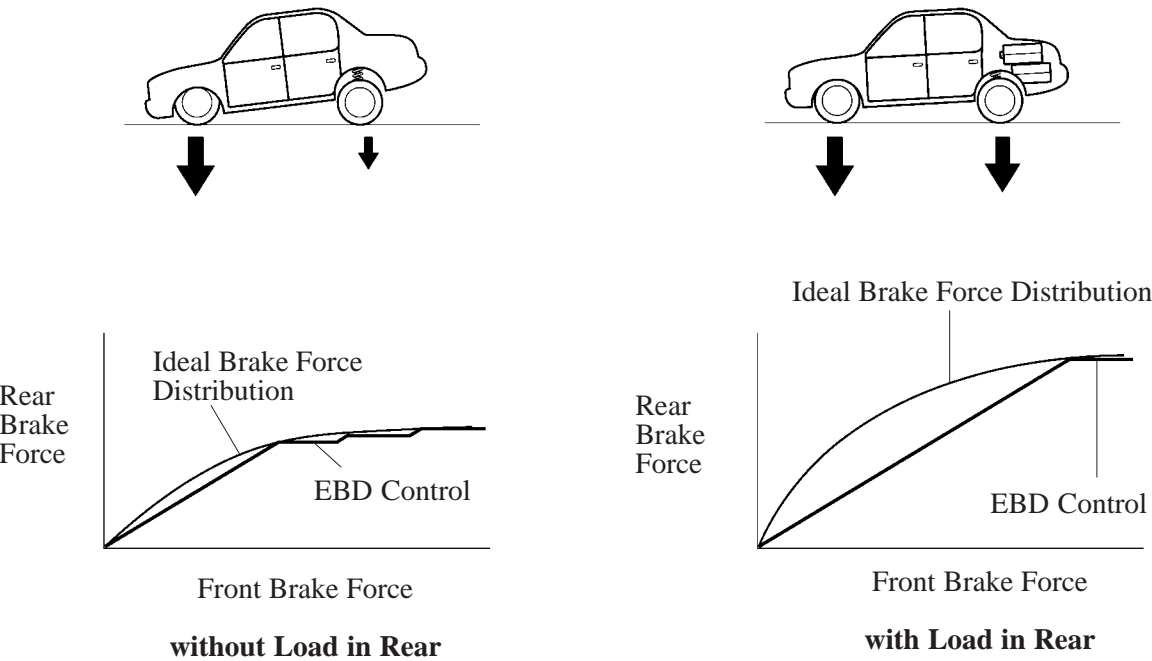
The distribution of the brake force, which was performed mechanically in the past, is now performed under electrical control of the skid control ECU, which precisely controls the braking force in accordance with the vehicle's driving conditions.

Front/Rear Wheels Brake Force Distribution

If the brakes are applied while the vehicle is moving straight forward, the transfer of the road reduces the load that is applied to the rear wheels. The skid control ECU determines this condition by way of the signals from the speed sensor, and the brake actuator regulates the distribution of the brake force of the rear wheels to optimally control.

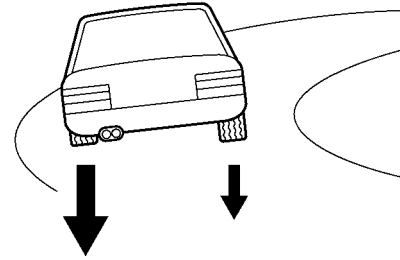
For example, the amount of the brake force that is applied to the rear wheels during braking varies whether or not the vehicle is carrying a load. The amount of the brake force that is applied to the rear wheels also varies in accordance with the extent of the deceleration. Thus, the distribution of the brake force to the rear is optimally controlled in order to effectively utilize the braking force of the rear wheels under these conditions.

► EBD Control Concept ◀



Right/Left Wheels Brake Force Distribution (During Cornering Braking)

When the brakes are applied while the vehicle is cornering, the load that applied to the inner wheel decreases while that to the outer wheel increases. The skid control ECU determines this condition by way of the signals from the speed sensor, and the brake actuator regulates the brake force in order to optimally control the distribution of the brake force to the inner wheel and outer wheel.



181CH56

4. Outline of Brake Assist System

CH

Brake Assist system interprets a quick push of the brake pedal as emergency braking and supplements the braking power applied if the driver has not stepped hard enough on the brake pedal.

In emergencies, drivers, especially inexperienced ones, often panic and do not apply sufficient pressure on the brake pedal.

Brake Assist system measures the speed and force with which the brake pedal is pushed to determine whether the driver is attempting to brake rapidly, and applies additional pressure to maximize braking performance. A key feature of Brake Assist system is that the timing and the degree of braking assistance are designed to ensure that the driver does not discern anything unusual about the braking operation.

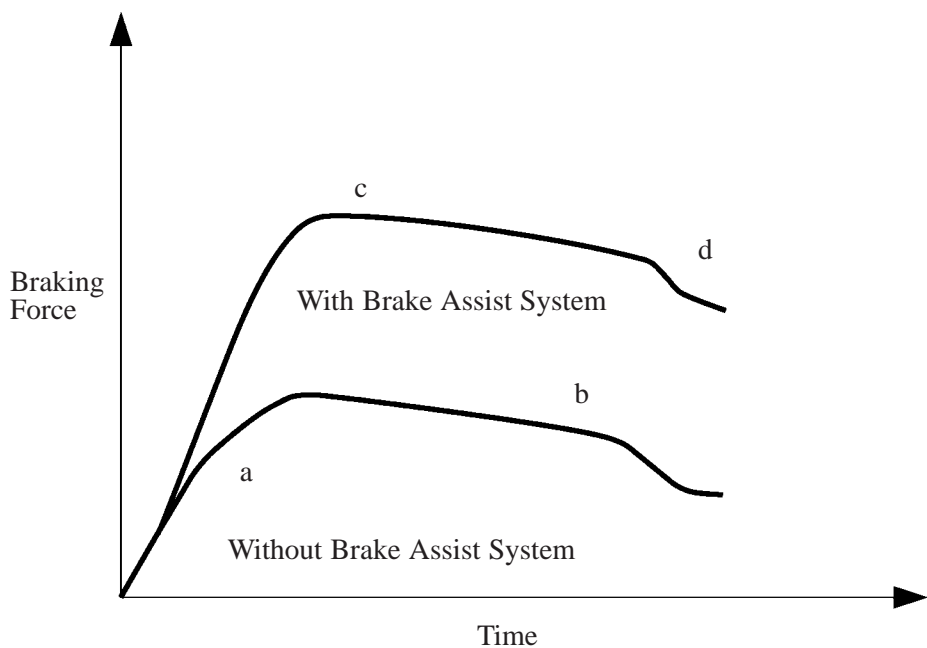
When the driver intentionally eases up on the brake pedal, the system reduce the amount of assistance it provides.

— REFERENCE —

Effectiveness of the Brake Assist Operation:

- During emergency braking, an inexperienced driver, or a driver in a state of panic might not be able to firmly depress the brake pedal, although driver can depress it quickly. As a result, only a small amount of brake force is generated.
- The pedal effort of this type of driver might weaken as time passes, causing a reduction in the braking force.
- Based on how quickly the brake pedal is depressed, the Brake Assist operation assesses the intention of the driver to apply emergency braking and increases the brake force.

- d. After the Brake Assist operation, if the driver intentionally release the brake pedal, the assist operation reduces the amount of Brake Assist in order to reduce the feeling of uneasiness.

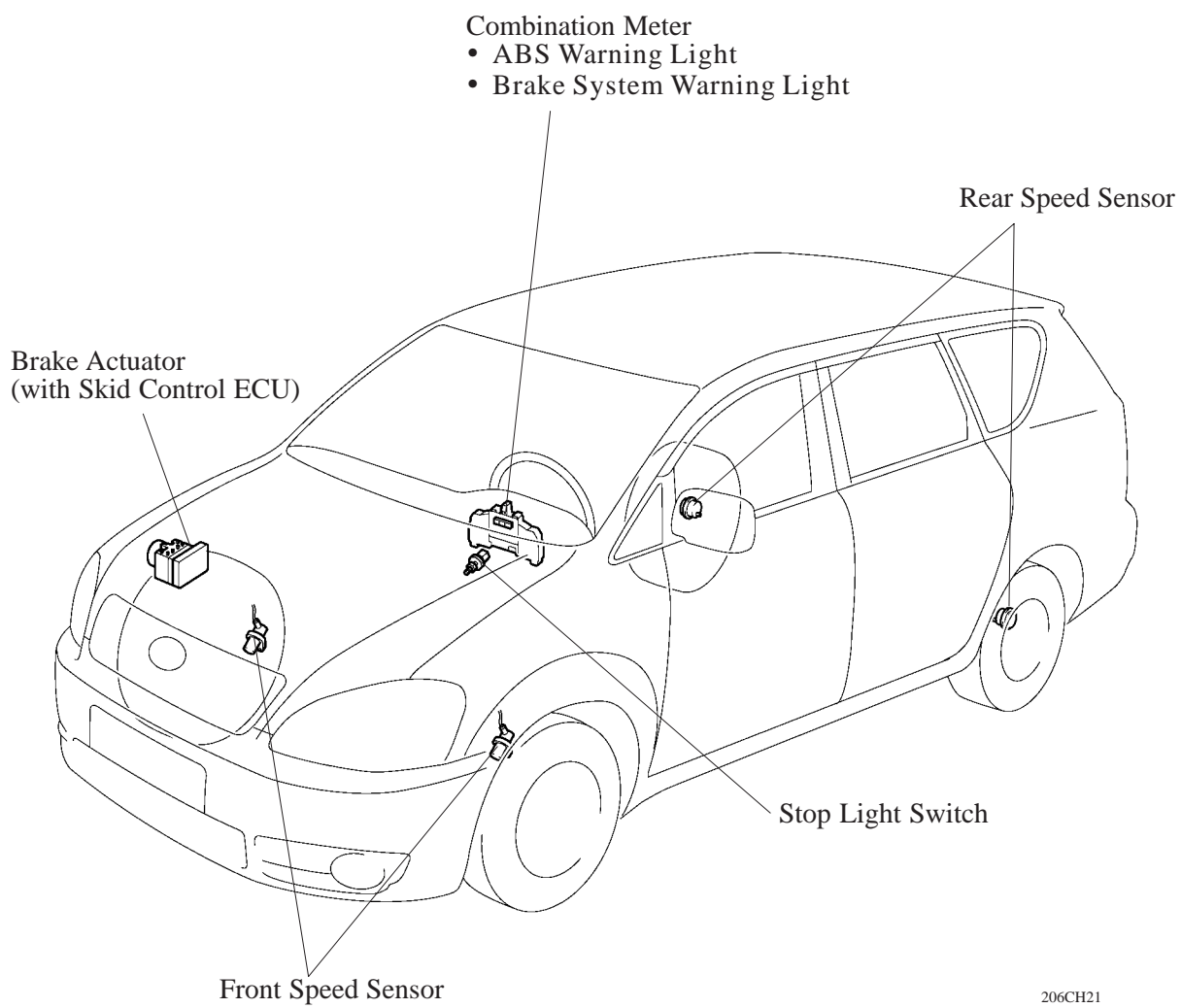


170CH18

Service Tip

When this system is activated, the brake pedal could shudder, which is a normal occurrence of the system in operation and should not be considered a malfunction.

5. Layout of Component



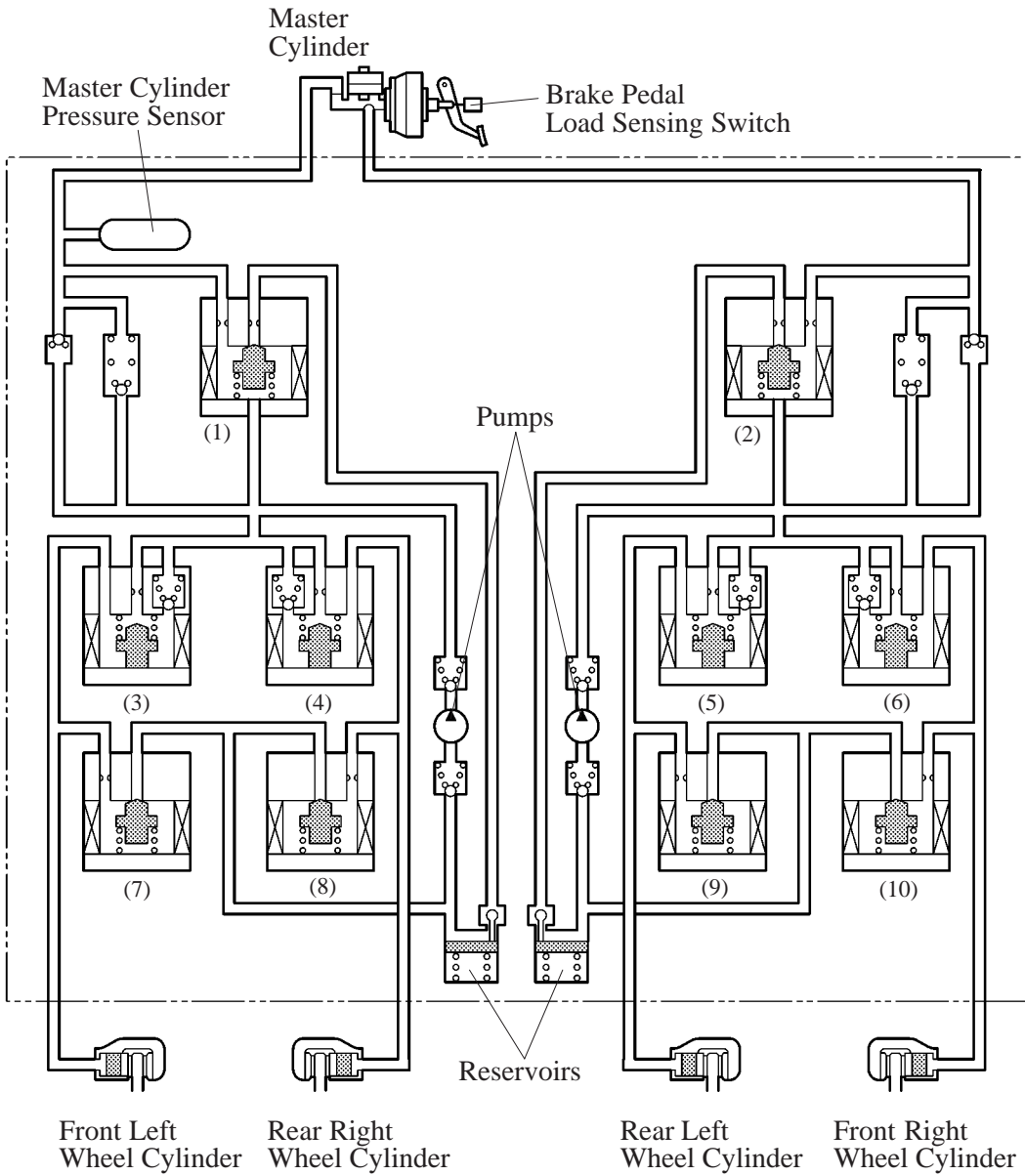
CH

6. Function of Components

Components		Function
Warning Light	ABS Warning Light	Lights up to alert the driver when the ECU detects the malfunction in the ABS or Brake Assist system.
	Brake System Warning Light	Lights up together with the ABS warning light to alert the driver when the ECU detects the malfunction not only in the ABS but also in the EBD control.
Skid Control ECU		Judges the vehicle driving condition based on signals from each sensor, and sends brake control signal to the brake actuator.
Brake Actuator		Changes the fluid path based on the signals from the skid control ECU during the operation of the ABS with EBD & Brake Assist system, in order to control the fluid pressure that is applied to the wheel cylinder.
	Master Cylinder Pressure Sensor	Assembled in the brake actuator and detects the master cylinder pressure.
Control Relay	Pump Motor Relay	Supply power to the pump motor in the actuator.
	Solenoid Relay	Supply power to the solenoid valves in the actuator.
Speed Sensor		Detects the wheel speed of each of four wheels.
Stop Light Switch		Detects the brake depressing signal.

7. Brake Actuator

Hydraulic Circuit

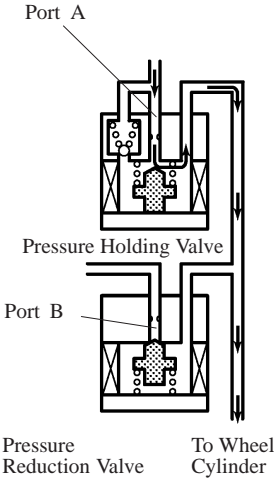
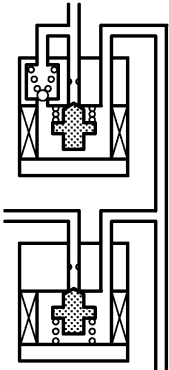
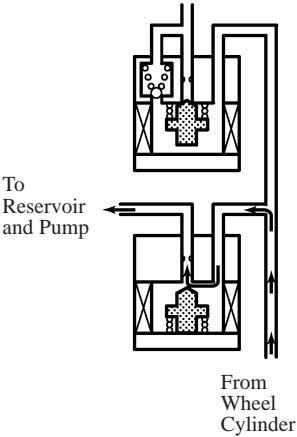


206CH23

Type	10 two-piston solenoid valves, 1 motor 2 pumps, 2 reservoirs, and master cylinder pressure sensor
(1), (2)	Brake Assist Switching Solenoid Valve
(3), (4), (5), (6)	Pressure Holding Valve
(7), (8), (9), (10)	Pressure Reduction Valve

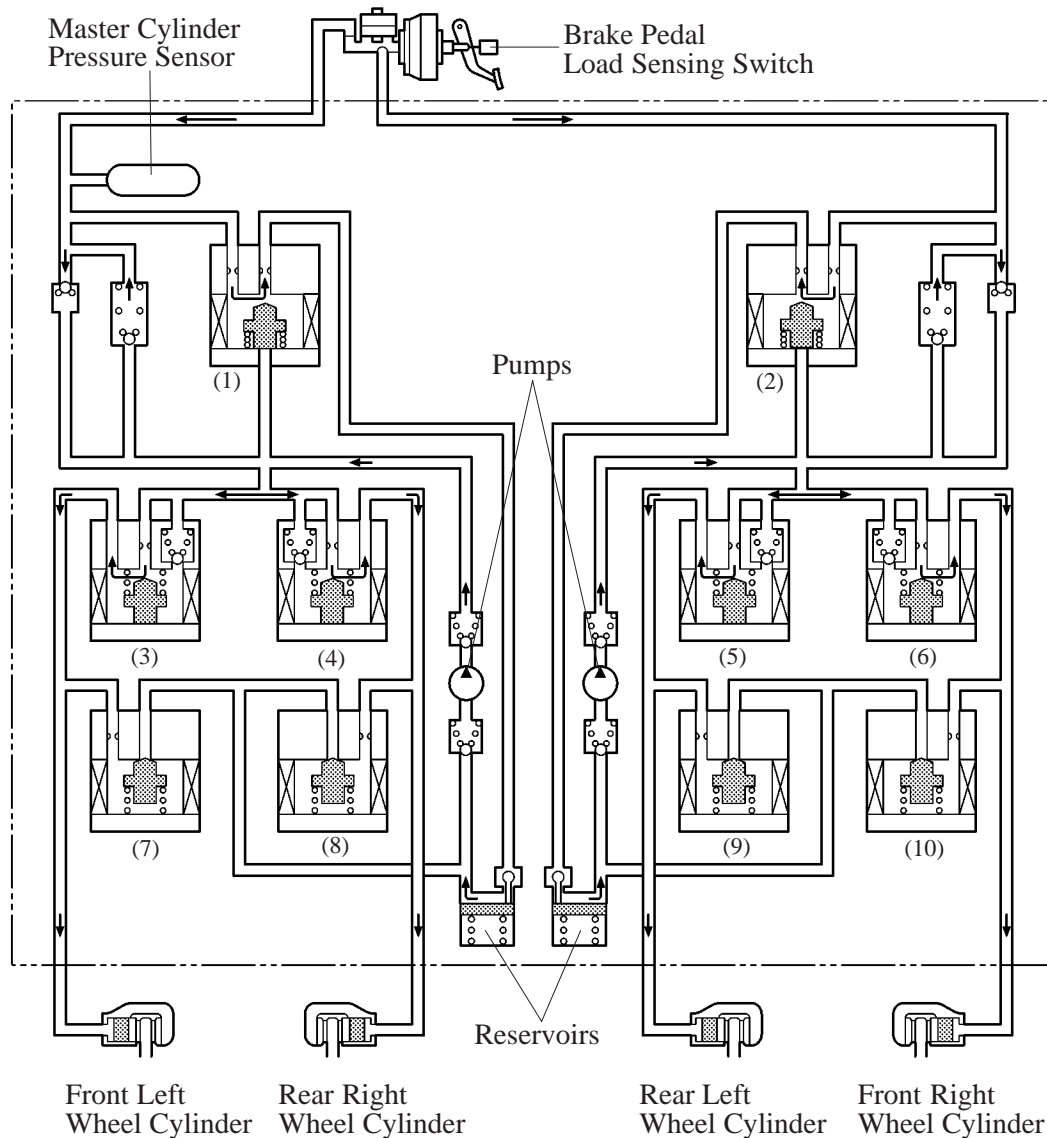
ABS with EBD Operation

Based on the signals received from the 4 wheel speed sensors, the skid control ECU calculates each wheel speed, and checks wheel slipping condition. And according to the slipping condition, the ECU controls the pressure holding valve and pressure reduction valve in order to adjust the fluid pressure of each wheel cylinder in the following 3 modes: pressure reduction, pressure holding, and pressure increase modes.

Not Activated	Normal Braking	—	—
Activated	Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
Hydraulic Circuit	 169CH54	 169CH55	 169CH56
	Pressure Holding Valve (Port A)	OFF (Open)	ON (Close)
	Pressure Reduction Valve (Port B)	OFF (Close)	ON (Open)
	Wheel Cylinder Pressure	Increase	Hold

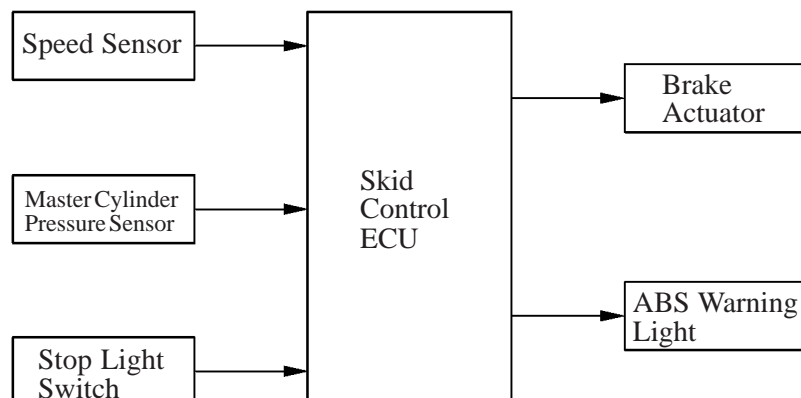
Brake Assist Operation

The fluid pressure that has been generated by the pump in the brake actuator is directed to the wheel cylinders. By applying a greater fluid pressure than the master cylinder, a greater braking force is achieved.



206CH24

► System Diagram ◀



206CH30

Item		Brake Assist Not Activated	Brake Assist Activated
(1)	Brake Assist Switching Solenoid Valve	OFF (Close)	ON (Open)
(2)	Port: (A), (B)		
(3), (4)	Pressure Holding Valve	OFF (Open)	OFF (Open)
(5), (6)	Port: (C), (D), (E), (F)		
(7), (8)	Pressure Reduction Valve	OFF (Close)	OFF (Close)
(9), (10)	Port: (G), (H), (I), (J)		

8. Skid Control ECU

Initial Check

After the ignition switch is turned ON, and the vehicle attains an approximate speed of 6 km/h (4 mph) or more only at first time, the skid control ECU performs an initial check.

The functions of each solenoid valve and pump motor in the actuator are checked in order.

Self-Diagnosis

- If the skid control ECU detects a malfunction in the ABS with EBD and Brake Assist system, the warning light that corresponds to the function in which the malfunction has been detected lights up, as indicated in the table below, to alert the driver of the malfunction.

○: Light ON —: Light OFF

Item	ABS	EBD	Brake Assist
ABS Warning Light	○	○	○
Brake System Warning Light	—	○	—

- If the skid control ECU detects a malfunction in this system, it illuminates the warning light to alert the driver. At the same time, the DTCs (Diagnostic Trouble Codes) are stored in memory. The DTCs can be read by connecting the SST (09843-18040) between the TC and CG terminals of DLC3 and observing the blinking ABS warning light, or by connecting a hand-held tester.
- This system has a sensor signal check function. The operation method of this function is the same as of the above.
- For details on the DTCs that are stored in skid control ECU memory and DTCs that are output through the sensor signal check function, see the Avensis Verso/Picnic Chassis & Body Repair Manual (Pub. No. RM864E).

Fail-Safe

In the event of a malfunction in the skid control ECU turns on the ABS warning light and prohibits the ABS and Brake Assist. In the case of the malfunction that the EBD control can not be carried out, the ECU also turns on the brake system warning light and prohibits the EBD control.