■BRAKE CONTROL SYSTEM (ABS with EBD)

1. General

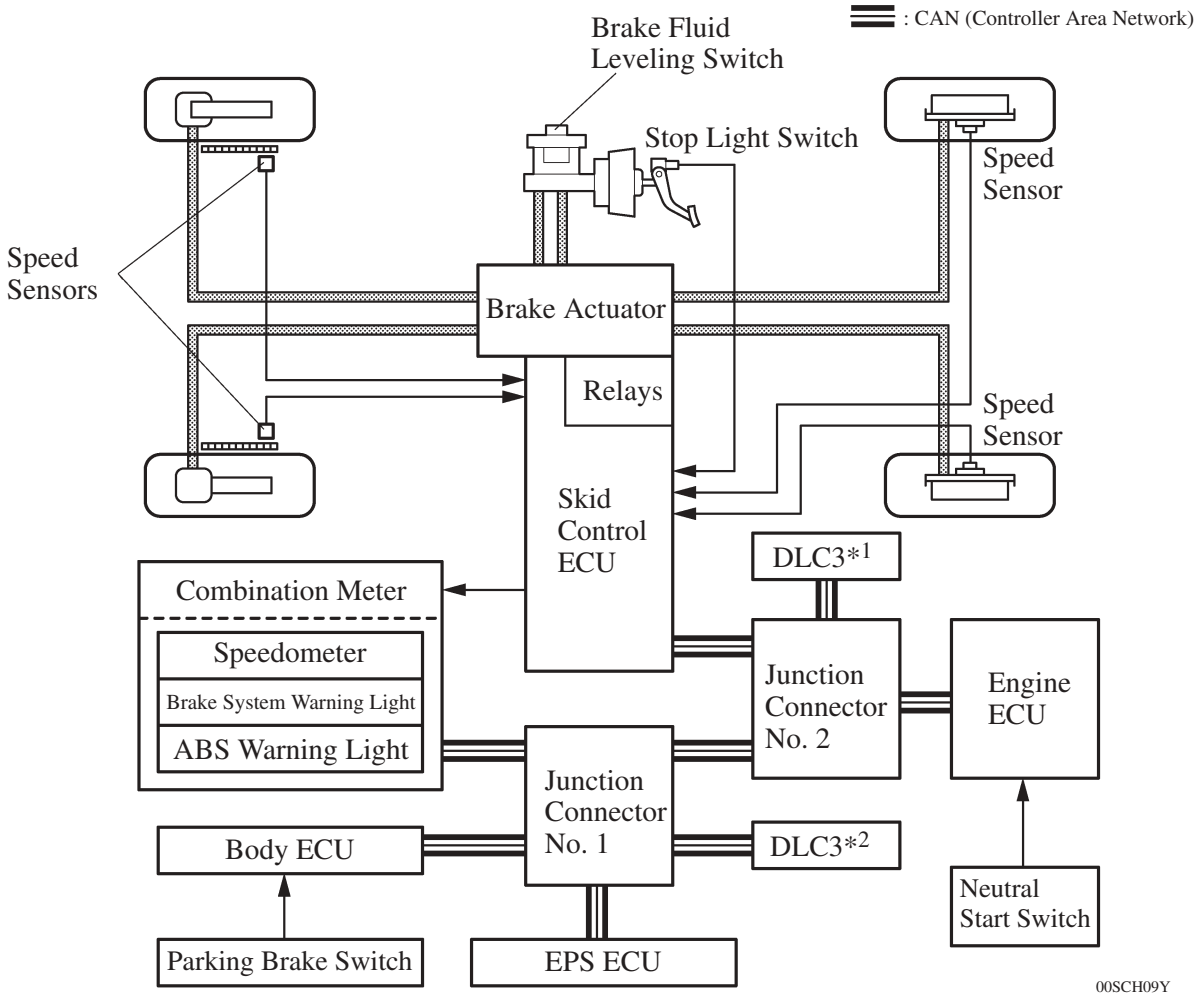
The brake control system (ABS with EBD) of the new models has the following functions:

Function	Outline
ABS (Anti-lock Brake System)	The ABS helps prevent the wheels from locking when the brake is applied firmly or applied on a slippery surface.
EBD (Electronic Brake force Distribution)	The EBD control utilizes the ABS, realizing the proper brake force distribution between the front and rear wheels in accordance with the driving conditions. In addition, during cornering braking, it also controls the brake forces of the right and left wheels, helping to maintain the vehicle behavior.
Brake Assist (Mechanical Type)	The primary purpose of the Brake Assist is to provide an auxiliary brake force to assist the driver who cannot generate a large brake force during emergency braking, thus helping draw the vehicle's brake performance.

Service Tip

When brake control system (except Brake Assist) is activated, the brake pedal could shudder, which is a normal occurrence of the system in operation and should not be considered as a malfunction.

▶ System Diagram ◀



*1: LHD Models *2: RHD Models

2. Outline of EBD

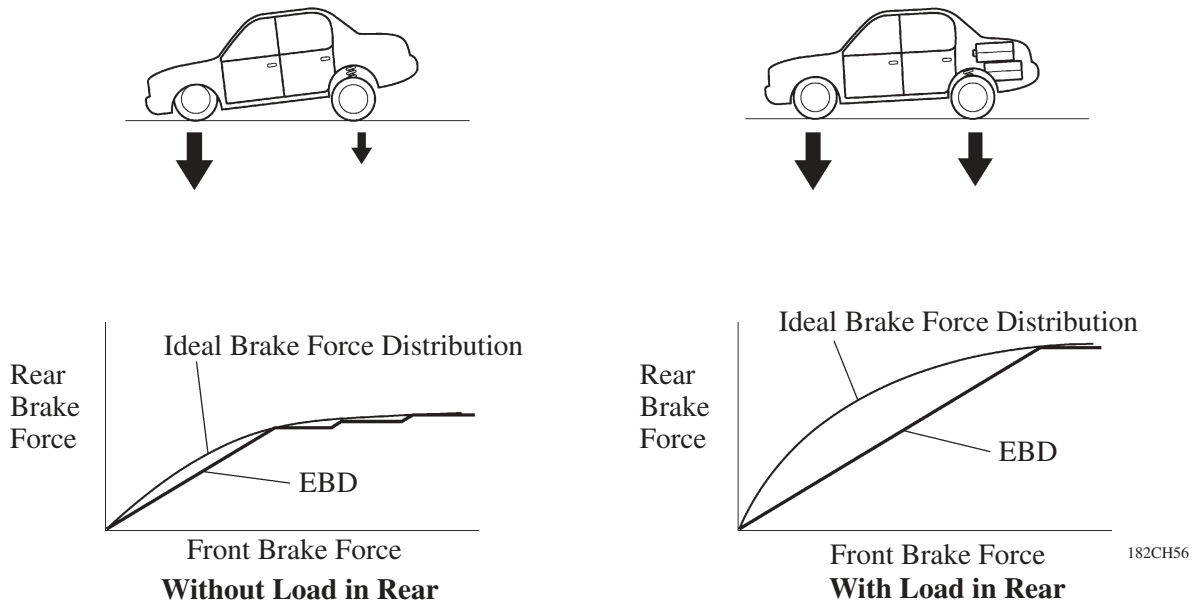
General

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 controls the braking force in accordance with the vehicle's driving conditions.

Front / Rear Wheels Brake Force Distribution

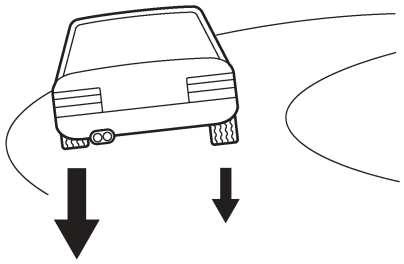
If the brakes are applied while the vehicle is moving straight forward, the transfer of the load reduces the weight that is applied to the rear wheels. The skid control ECU determines this condition by way of the signals from the speed sensor, and the brake actuator regulates the distribution of the 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 depending on whether the vehicle is carrying load or not. 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 Concept ◀



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

When the brakes are applied while the vehicle is cornering, the load that is applied to the inner wheel decreases as the load 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.

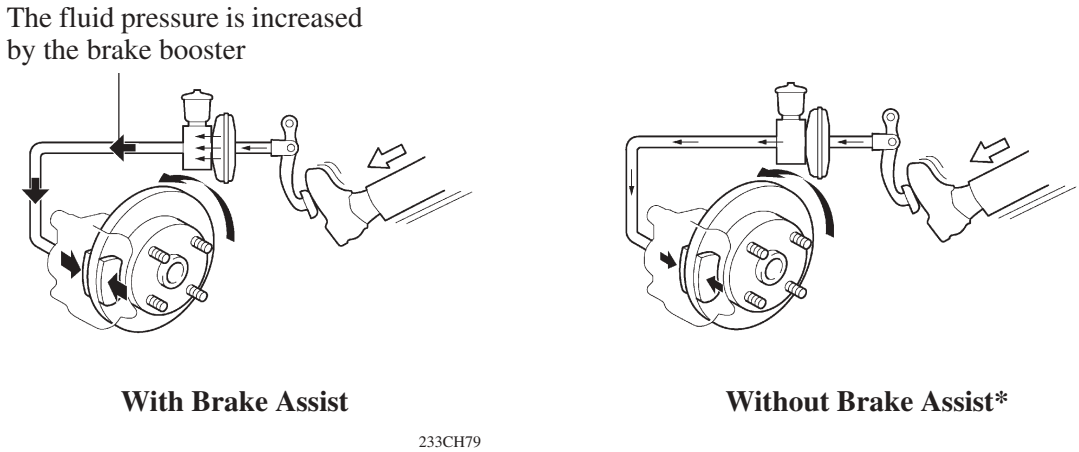


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3. Outline of Brake Assist (Mechanical Type)

- The Brake Assist in combination with the ABS helps ensure the vehicle's brake performance.
- The Brake Assist interprets a quick push of the brake pedal as emergency braking and supplements the brake force applied if the driver has not depressed hard enough the brake pedal. In emergencies, drivers, especially inexperienced ones, often panic and do not apply sufficient pressure on the brake pedal.
- A key feature of Brake Assist is that the timing and the degree of braking assistance are designed to help ensure that the driver dose not discern anything unusual about the braking operation.
  When the driver intentionally eases up on the brake pedal, the system reduces the amount of assistance it provides.
- The mechanical type Brake Assist uses the brake assist mechanism in the brake booster to mechanically activate the brake booster function in order to increase the brake force. For details, see page CH-87.

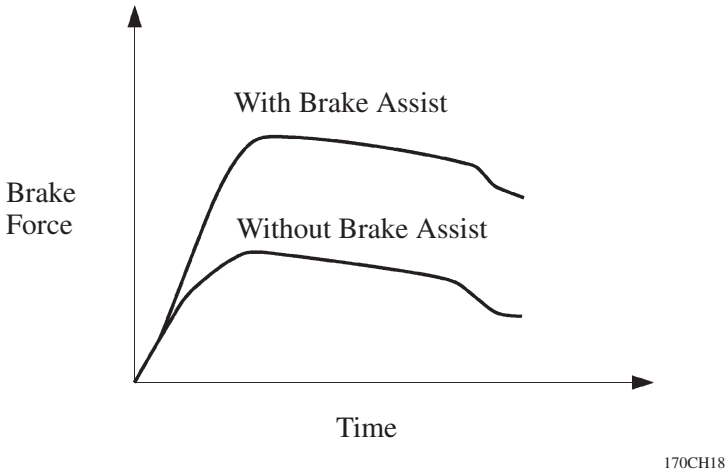
▶ In case that the driver's depressing force is small when emergency braking is applied ◀



With Brake Assist **Without Brake Assist***

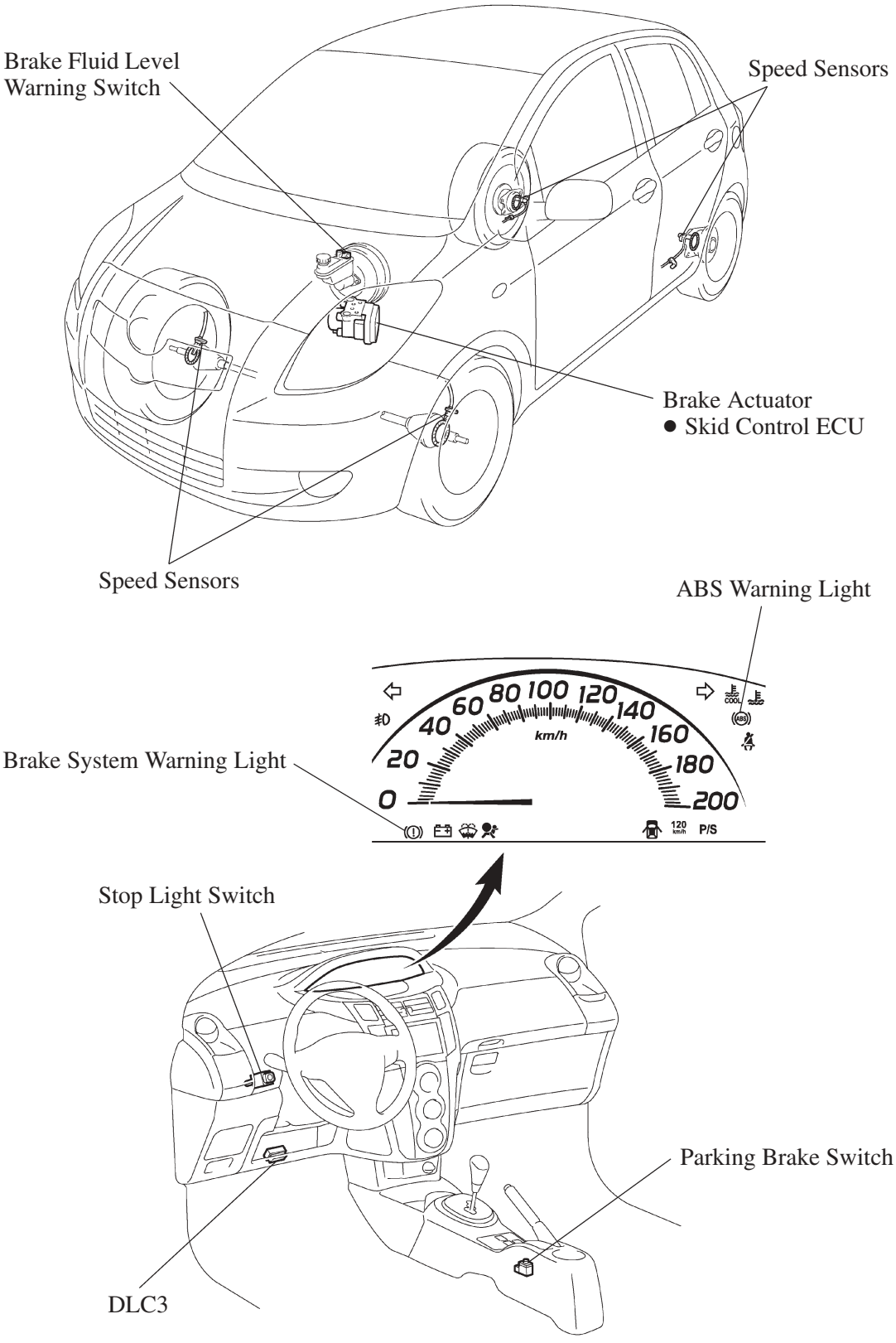
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*: The basic performance of the brake is the same as of the models with the brake assist system



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4. Layout of Main Components



TMC 5-door Hatchback LHD Models

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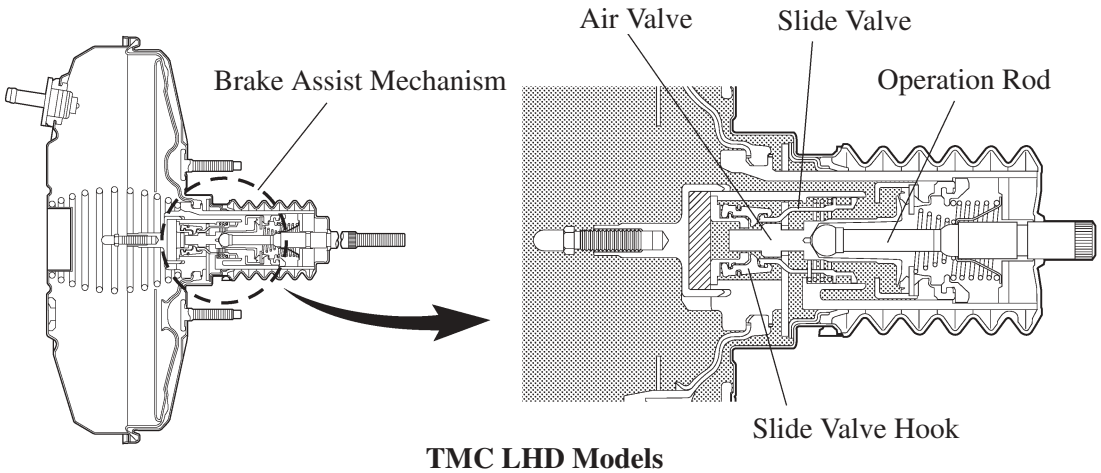
5. Function of Main Components

Component		Function
Combination Meter	Brake System Warning Light	● Lights up to alert the driver when a malfunction occurs in the EBD or skid control ECU. ● Lights up to alert the driver when the brake fluid level is low. ● Lights up to intorm the drive when the parking brake lever is pulled up.
	ABS Warning Light	Lights up to alert the driver when the skid control ECU detects a malfunction in the ABS.
Brake Fluid Level Warning Switch		Detects the brake fluid level.
Stop Light Switch		Detects the brake pedal depressing signal.
Parking Brake Switch		Detects when the parking brake lever is pulled up.
Speed Sensor (4)		Detects the wheel speed of each of 4 wheels.
Brake Booster		● Increases the brake pedal effort. ● Operates the brake assist mechanism to mechanically activate the brake assist.
Brake Actuator	Actuator Portion	Changes the fluid path based on the signals from the skid control ECU during the operation of the ABS with EBD, in order to control the fluid pressure that is applied to the wheel cylinders.
	Skid Control ECU	Judges the vehicle driving condition based on the signals from each sensor, and sends brake control signals to the brake actuator.
	Motor Relay	Supplies or cuts off power to the motor in the brake actuator.
	Solenoid Relay	Supplies or cuts off power to the solenoid valves in the brake actuator.
Engine ECU		Sends the signals from neutral start switch etc., to the skid control ECU.

6. Brake Booster (with Brake Assist Mechanism)

General

This brake booster consists of the conventional type brake booster to which a brake assist mechanism has been added. During a normal brake operation, the function of the brake booster is the same as that of the conventional type. The major difference in construction between this booster and the conventional type one is that the slide valve and the slide valve hook are added in the air valve in this booster.



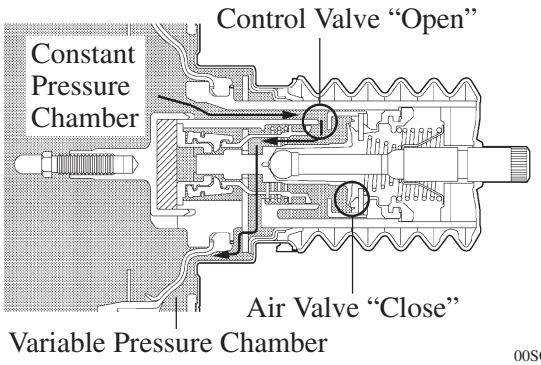
TMC LHD Models

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Operation

1) No Braking Condition

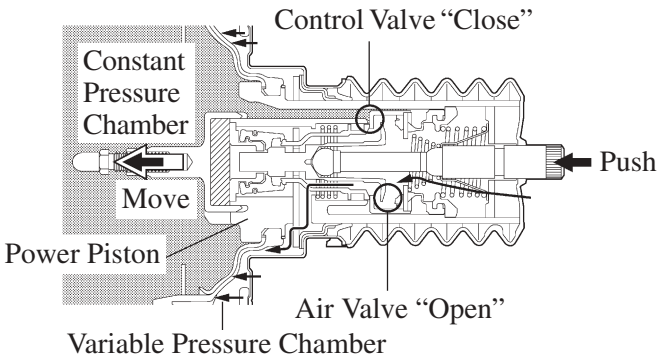
The air valve closes, the control valve opens, and the pressure is the same in the variable pressure chamber and the constant pressure chamber.



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2) Normal Braking Condition (Operation Rod Speed = Power Piston Speed)

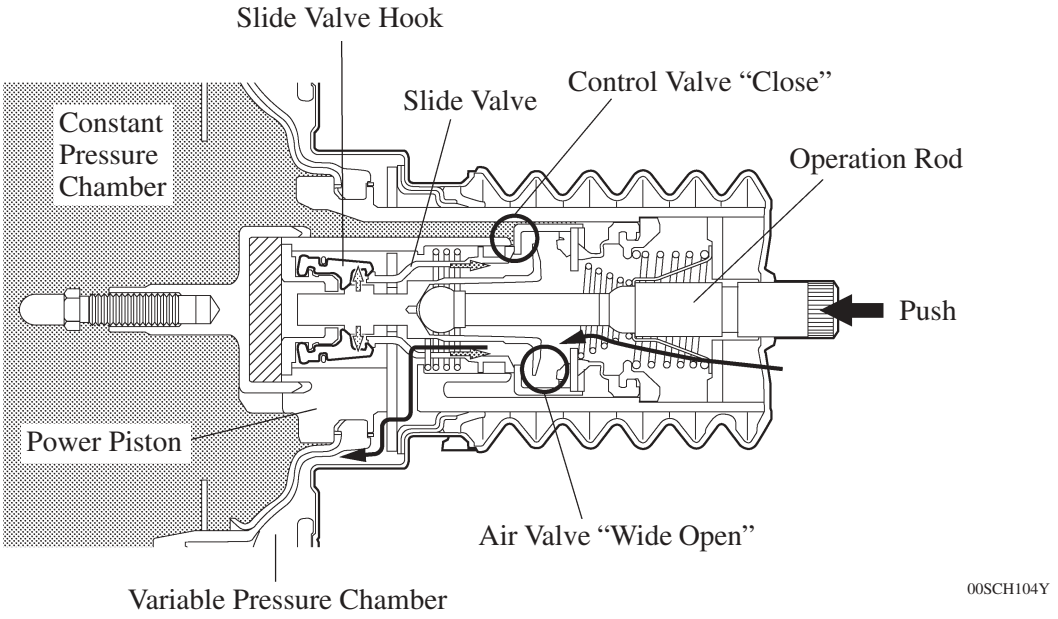
During normal braking, the air valve opens and the control valve closes to activate the brake booster function.

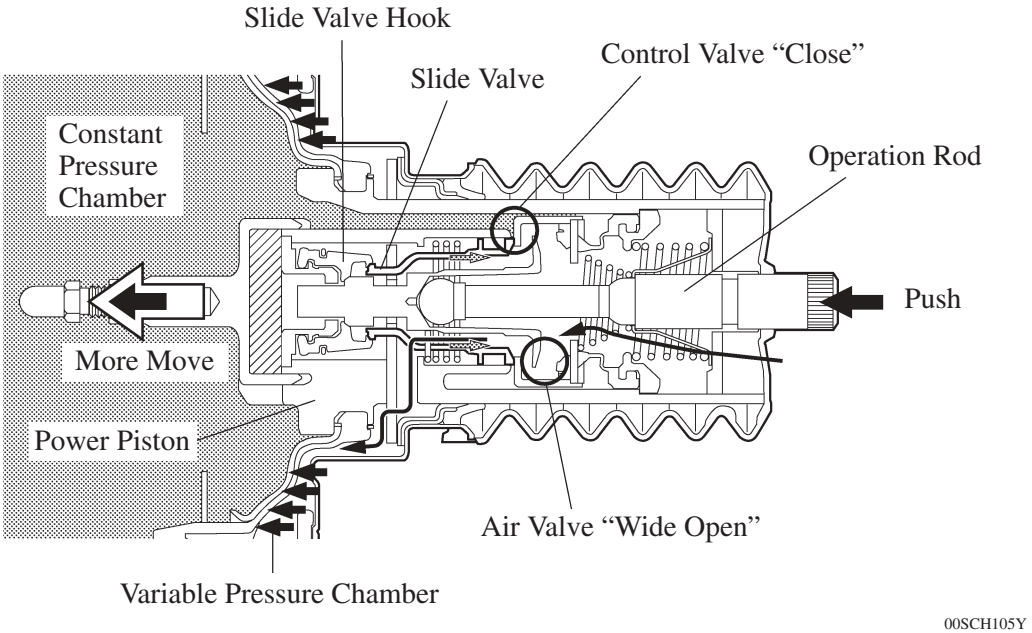


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3) Brake Assist Condition
(Operation Rod Speed > Power Piston Speed)

When the operation rod speed is faster than the power piston speed, the air valve pushes the slide valve hook. Consequently, the slide valve separates from the slide valve hook, the spring pushes the control valve, and the control valve closes. Thus, the opening of the air valve becomes enlarged and the air volume that is introduced increases. This results in a brake assist force to powerfully push the power piston.

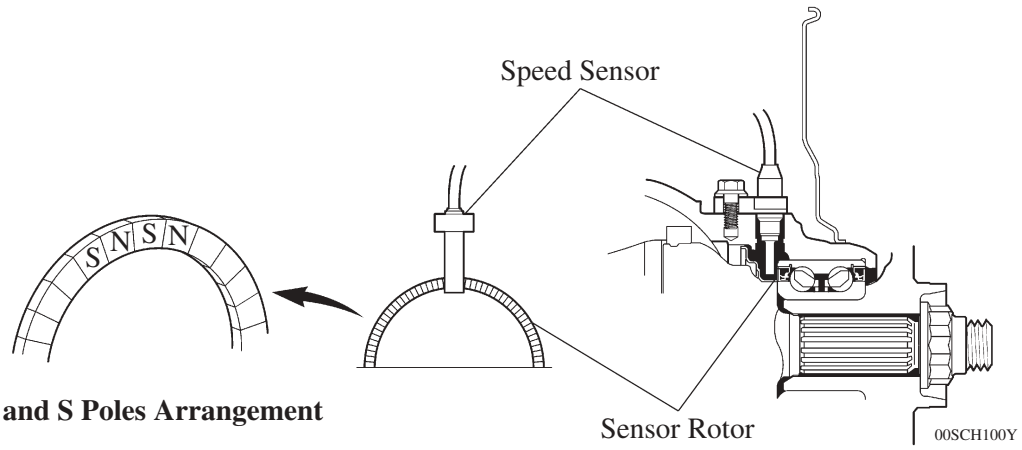




7. Speed Sensor

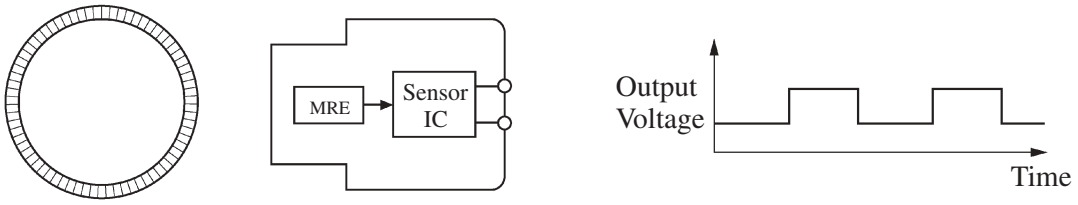
General

- An active type speed sensor is used. A Hall IC is used in the sensing portion of this sensor.
- The sensor rotor, which consists of N and S poles that are arranged in a circle, is integrated with the hub bearing inner race.



N and S Poles Arrangement

▶ Active Type Speed Sensor ◀

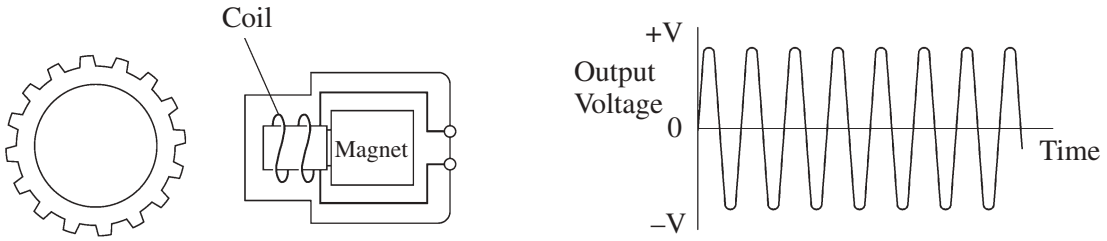


Sensor Rotor (Hub Bearing Inner Race)

Forward and Backward

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▶ Passive Type Speed Sensor ◀



Sensor Rotor (Drive Shaft or Axle Shaft)

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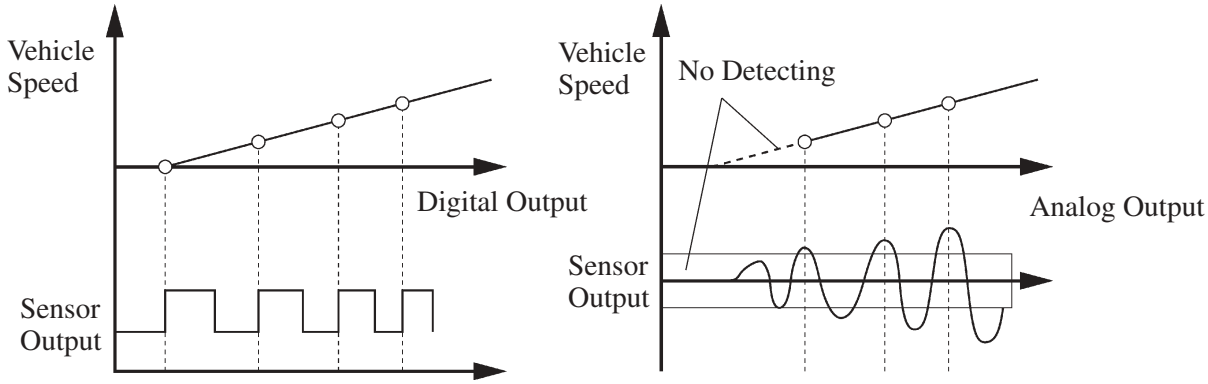
Forward and Backward

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Operation

- Along with the rotational movement of the magnetic rotor, the N and S poles of the magnetic rotor pass alternately near the sensing portion of the speed sensor. This speed sensor outputs magnetic flux as a current value. The skid control ECU detects the changes in the output current to determine the wheel speed.
- Unlike the passive type speed sensors used on conventional models that output analog pulses, the active type speed sensor outputs digital pulses. Therefore, it can start detecting vehicle speeds at approximately 0 km/h.

▶ Comparison between Active Type and Passive Type Output Waveform Image ◀



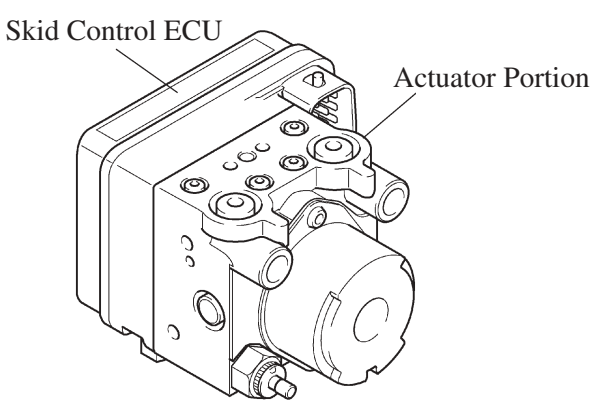
Active Type **Passive Type**

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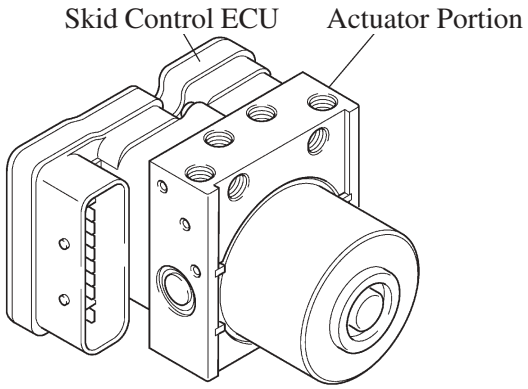
8. Brake Actuator

General

- The brake actuator consists of the actuator portion, skid control ECU, ABS solenoid relay, and ABS motor relay.
- The 2 relays are built into the skid control ECU.



TMC Models 00RCH18Y

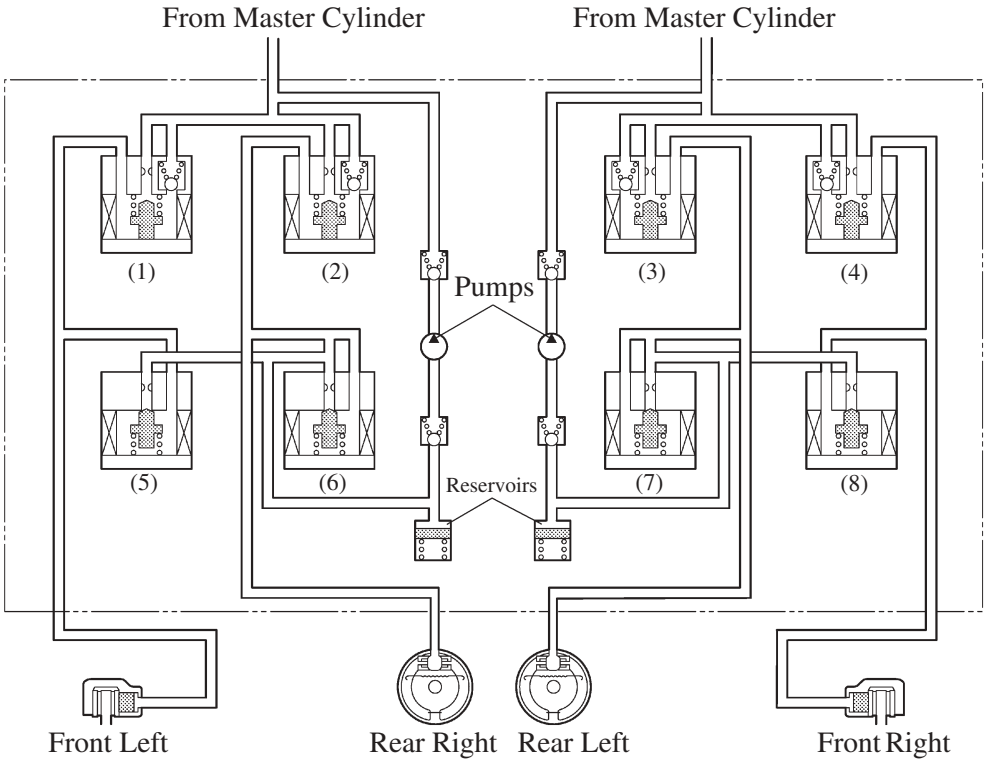


TMMF Models 00SCH18Y

Actuator Portion

The actuator portion consists of 8 two-position solenoid valves, 1 motor, 2 pumps and 2 reservoirs. The 8 two-solenoid valves consist of 4 pressure holding valves [(1), (2), (3), (4)] and 4 pressure reduction valves [(5), (6), (7), (8)].

▶ Hydraulic Circuit ◀

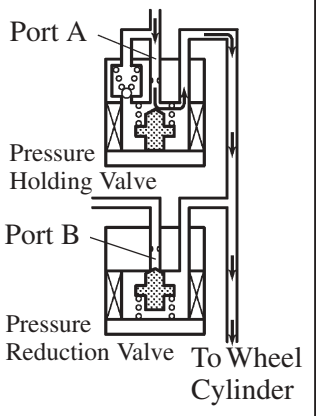
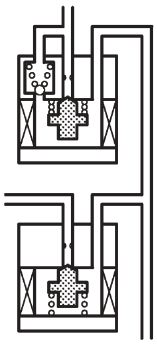
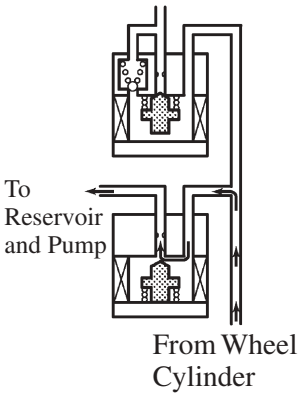


TMC LHD Models 00RCH19Y

9. System Operation

ABS with EBD Operation

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

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

Initial Check

After the power source mode is selected to IG-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 the initial check.
The functions of each solenoid valve and pump motor in the brake actuator are checked in order.

*: TMMF Models: 20 km/h (12 mph) or more

Self-diagnosis

- If the skid control ECU detects a malfunction in the brake control system (ABS with EBD), the ABS and brake system warning lights that correspond to the function in which the malfunction has been detected indicate or light up to alert the driver of the malfunction as indicated in the table below.

○: Light ON —: Light OFF

Item	ABS	EBD	Skid Control ECU
ABS Warning Light	○	○	○
Brake System Warning Light	—	○	○

- At the same time, the DTCs (Diagnostic Trouble Codes) are stored in the memory. The DTCs can be read by connecting an intelligent tester II, or by connecting the SST (09843-18040) to the TC and CG terminals of DLC3 and observing the blinks of the ABS warning light.
- This system has a sensor signal check (test mode) function. This function is activated by connecting an intelligent tester II or by connecting the SST (09843-18040) to the TS and CG terminals of the DLC3.
- If the skid control ECU detects a malfunction during a sensor signal check (test mode), it stores the DTCs in its memory. These DTCs can be read during a sensor check operation by connecting an intelligent tester II or by connecting the SST (09843-18040) to the TC and CG terminals of the DLC3 and observing the blinking of the ABS warning light.

For details of the DTCs that are stored in skid control ECU memory and the DTCs that are output through the sensor signal check (test mode) functions, see the Yaris Repair Manual (Pub. No. RM00S1E).

Fail-safe

- In the event of a malfunction in the ABS, the skid control ECU prohibits the ABS operation.
- In the event of a malfunction in EBD control, the skid control ECU prohibits EBD control. Thus, the brake will be operated in the same condition as the brake system without the ABS with EBD.