■ DIFFERENTIAL

1. General

- A differential gear ratio has been changed on the 2JZ–GE engine model.
- A Helical gear type torque–sensing LSD (Limited Slip Differential) is available as an option on the SJZ–GE engine model and 2JZ–GTE engine with automatic transmission model.
- As in the ’96 model, a worm gear type torque–sensing LSD is used on the model with the SJZ–GTE engine and manual transmission.

▶Specifications◀

Model		’97 Model				’96 Model			
Engine Type		2JZ–GE		2JZ–GTE		2JZ–GE		2JZ–GTE	
Transmission Type / Item		Manual	Automatic	Manual	Automatic	Manual	Automatic	Manual	Automatic
Differential Gear Ratio		4.803	←	3.133	3.769	4.272	←	3.133	3.769
No. of Teeth	Drive Pinion	12	←	15	13	11	←	15	13
	Ring Gear	49	←	47	49	47	←	47	49
Ring Gear Size mm (in.)		205 (8.07)	←	222 (8.74)	205 (8.07)	←	←	222 (8.74)	205 (8.07)
No. of Differential Pinion		2,8*1, 3	←	6*2	2,8*1, 3	2,6*2, 3	←	6*2	←

*1 : Models with Helical Gear Type Torque–Sensing LSD

*2 : Models with Worm Gear Type Torque–Sensing LSD

*3 : Option

2. Helical Gear Type Torque–Sensing LSD

Characteristics

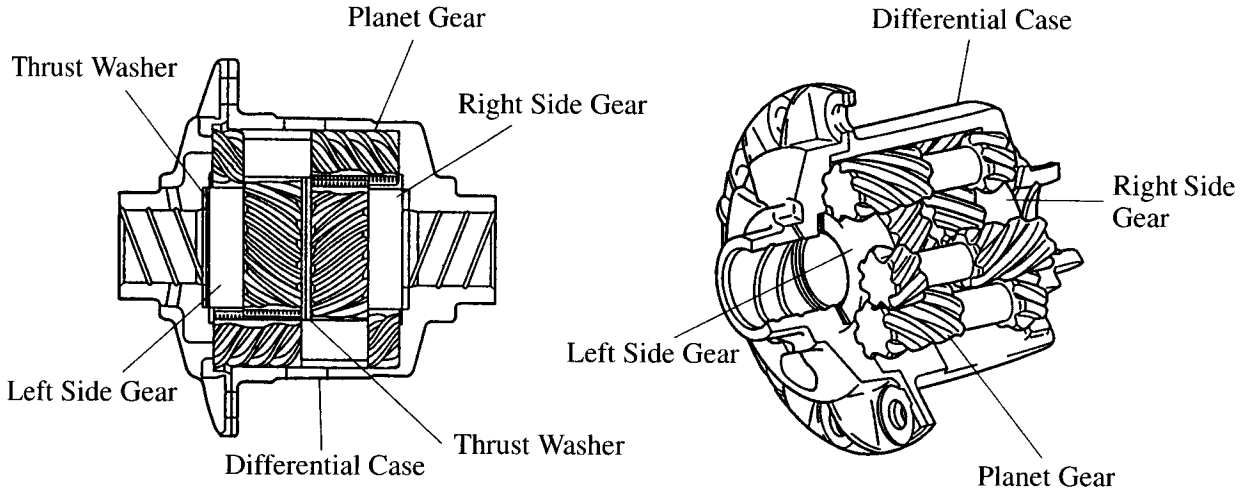
- Good traction of high bias ratio design is obtained through the utilization of two types of friction: One is the friction that is generated between the planet gear’s tooth tips and the differential case’s inner wall. The other is the friction that is generated between the side gear end face and the thrust washer.
- Quick response and minimum time lag until differential limiting force is generated.
- The bias ratio sustains minimal changes due to aging and maintains a stable performance.
- A simple, compact, and lightweight differential configuration has been achieved through the use of the helical gear.
- Ordinary differential oil must be used; do not use special LSD oil.

Construction

The helical gear type torque–sensing LSD consists of a differential case, 9 planet gears, 2 side gears and 4 thrust washers.

Planet gears mesh with one another as a pair, and each gear of the pair meshes with the side gear on its right or left side.

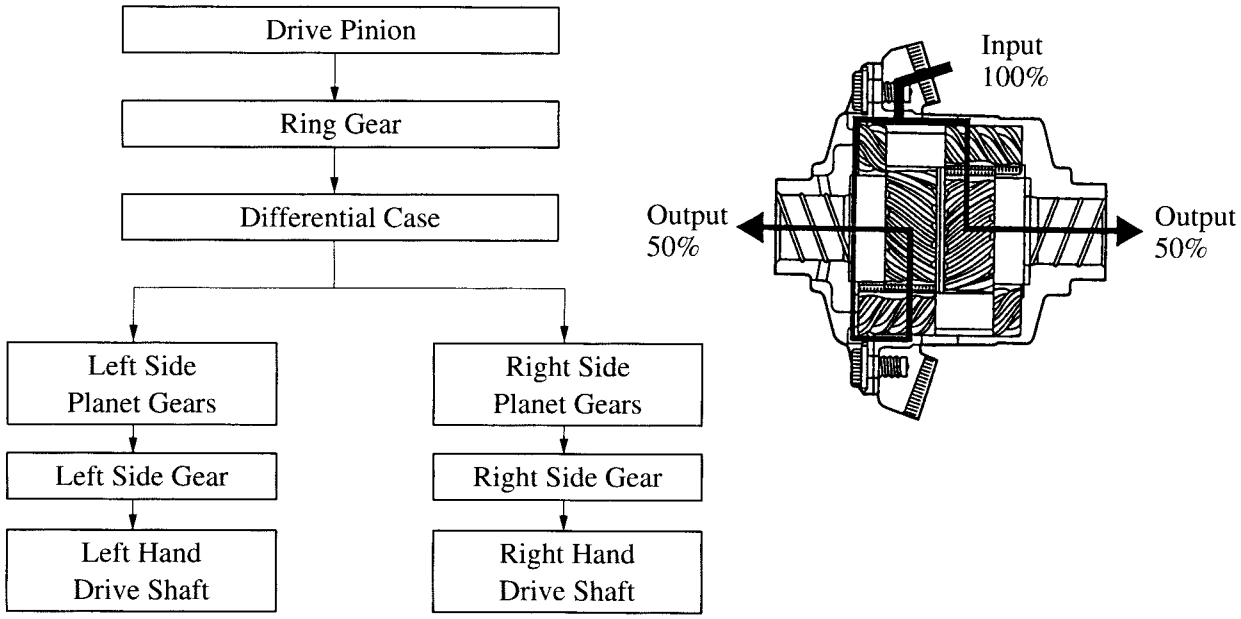
The planet gears are supported by the hole that is provided in the differential case. They are constructed so that they revolve while rotating over the side gear.



Operation

1) Straight–Ahead Operation

Since side gears (left and right) and planet gears are rotating together with the differential case as a unit when the vehicle is running straight–forward, the driving force is transmitted from the ring gear to the differential case, planet gears and side gears.

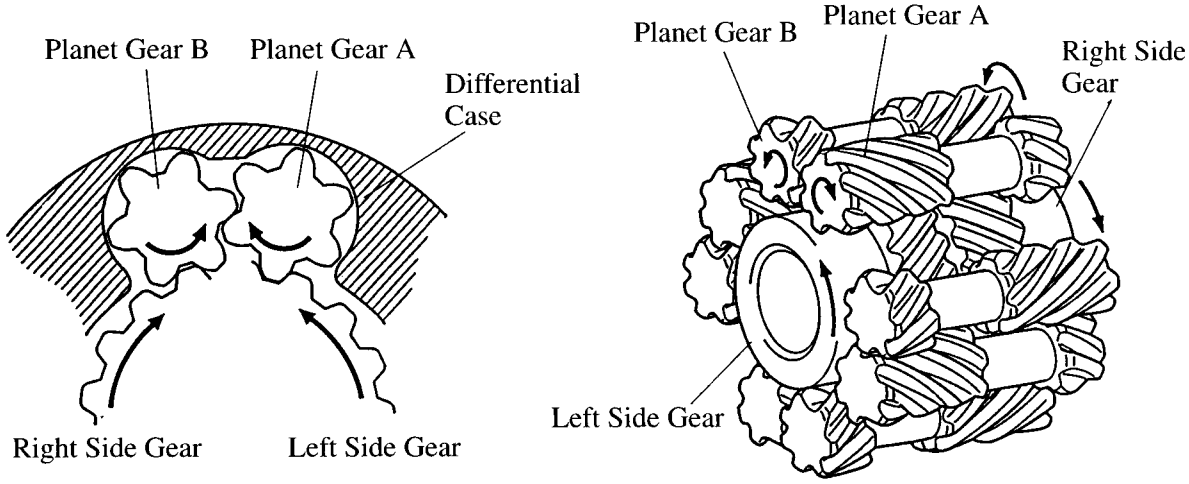


2) Cornering

Supposing that the differential case is not moving, rotating the left side gear counterclockwise, causes planet gear A (which meshes with the left side gear) to rotate clockwise.

Furthermore, planet gear B, which is paired with planet gear A, rotates counterclockwise, causing the right side gear (which meshes with planet gear B) to rotate clockwise.

Therefore the left and right side gears rotate in the opposite direction each other, thus accomplishing a motion differential.

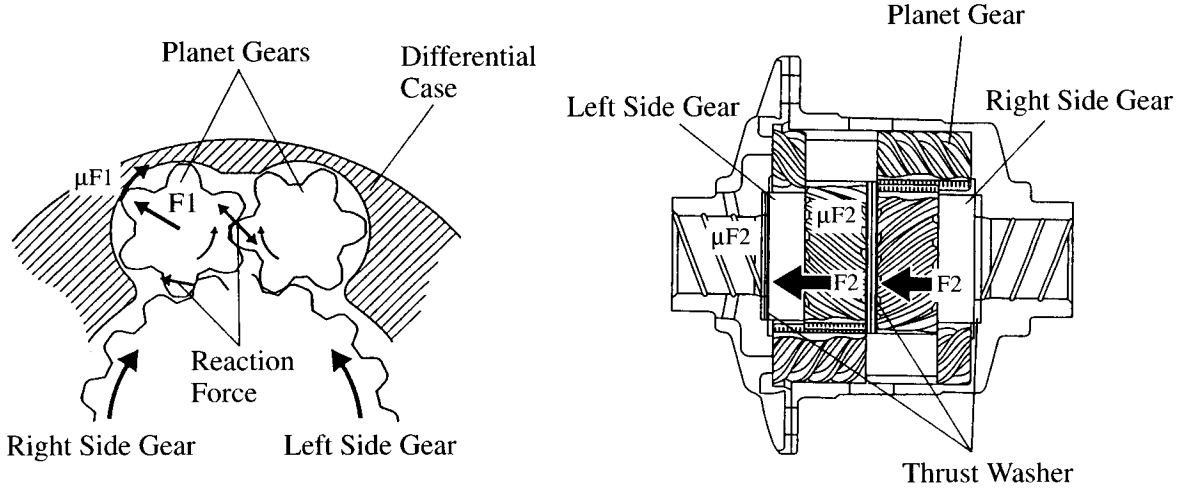


3) Limited Slip Differential Operation

Limited slip is accomplished primarily b the friction that is generated between the planet gear's tooth tips and the differential case's inner wall, and the friction that is generated between the side gear end face and the thrust washer.

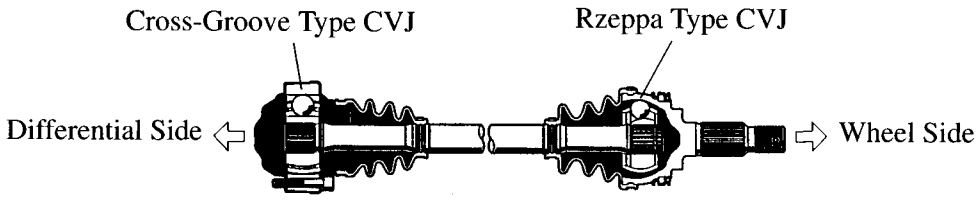
The principle of limited slip enables the resultant reaction force F1 (which is created by the meshing reaction of the planet gear and the side gear and the meshing reaction of the planet gears themselves) to push the planet gear in the direction of the differential case in proportion to the input torque.

Due to the reaction force F1, the friction force u F2 (which is generated between the side gear end face and the thrust washer) applies a force to cancel out the rotational difference between the side gears themselves as well as between the side gear and the differential case.



■ DRIVE SHAFT

- The drive shaft outboard joint of the 2JZ–GE engine model has been changed from the cross–groove type CJV (Constant–Velocity Joint) to the Rzeppa type CVJ.
- As in the ’96 model, the 2JZ–GTE engine model uses the drive shaft consisting of cross–groove type CVJs for both the inboard and outboard joints.



2JZ-GE Engine Model

■ BRAKES

1. General

- The size of the master cylinder for the 2JZ–GTE engine model has been increased to realize excellent brake feeling.
- The ABS actuator has been changed from the conventional three–position solenoid valves to a combination of compact two–position solenoid valves, thus achieving a compact and lightweight configuration.
- 3–channel type ABS with 4–speed sensor is used on the 2JZ–GE engine model.
- 4–channel type ABS with 4–speed sensors and linear type deceleration sensor is used on the 2JZ–GTE engine model.

▶Specifications◀

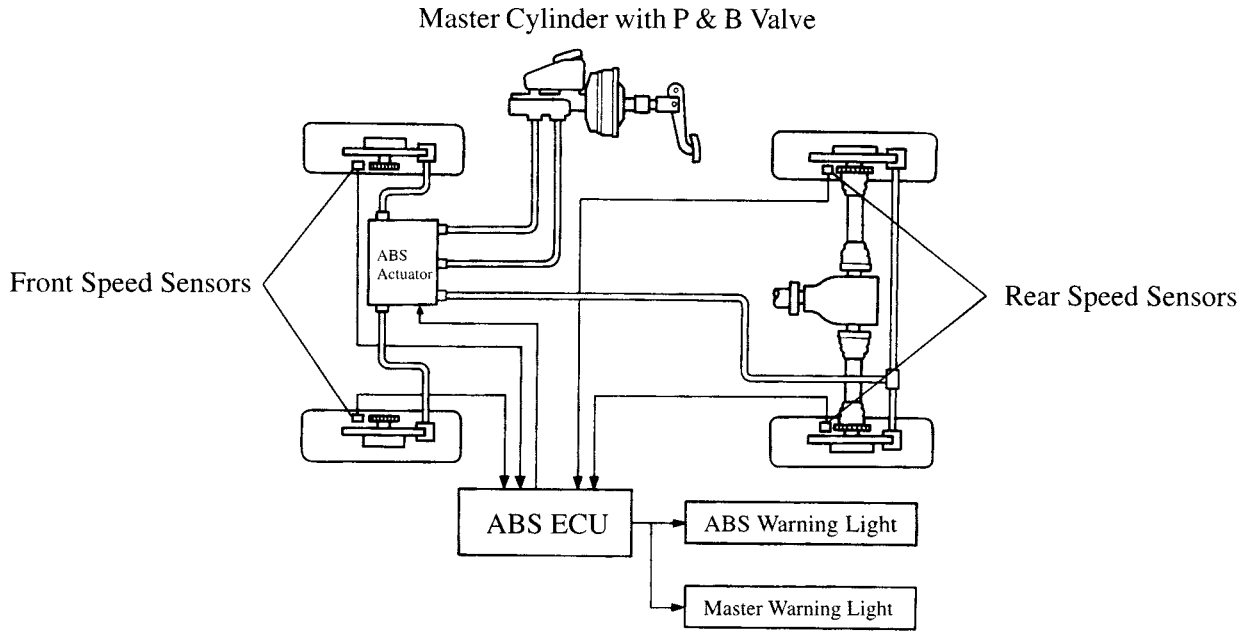
Model		’97 Model		’96 Model	
Engine Type		2JZ–GE	2JZ–GTE	2JZ–GE	2JZ–GTE
Item					
Master Cylinder	Type	Tandem	←	←	←
	Dia. mm (in.)	25.4 (1.00)	26.9 (1.06)	25.4 (1.00)	←
ABS Type		3 Channel Type ABS with 4–Speed Sensors	4 Channel Type ABS with 4–Speed Sensors and Linear Type Deceleration Sensor	4–Channel Type ABS with 4–Speed Sensor and Lateral Acceleration Sensors	←
ABS Type Actuator		6 Two Position Solenoid Valves	8 Two Position Solenoid Valves	4 Three Position Solenoid Valves	←

2. ABS

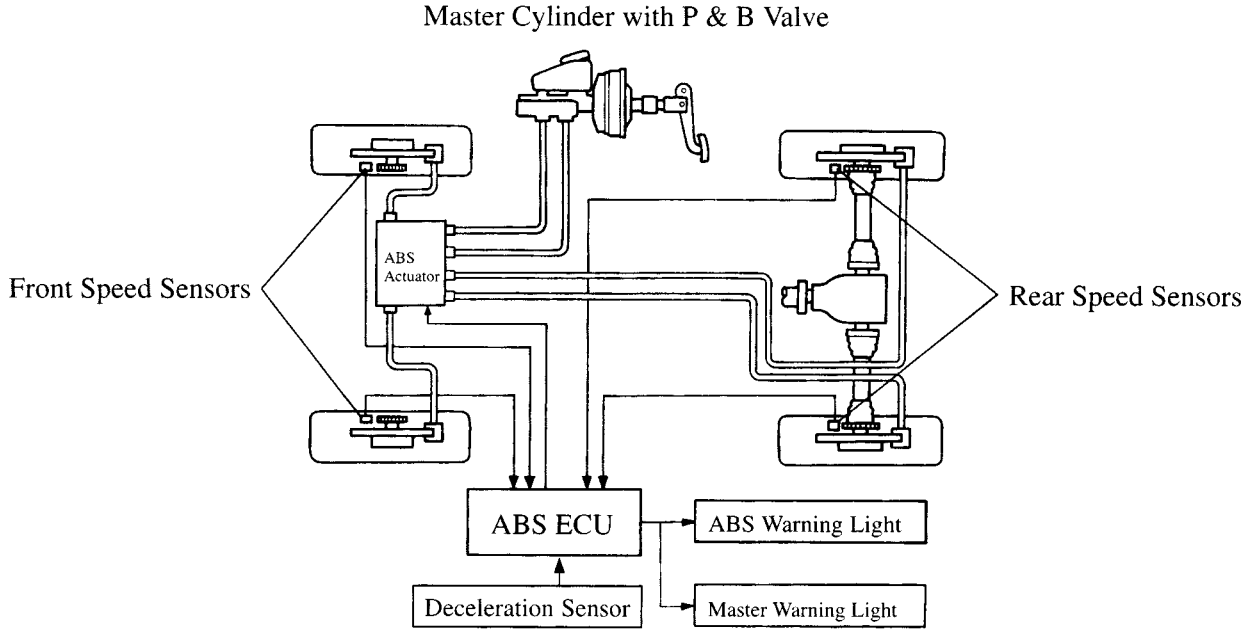
General

The ABS (Anti–Lock Brake System) is designed to control the brake fluid pressure of the brake wheel cylinder to help prevent wheel lock–up in instances of panic braking, and thus maintaining vehicle directional stability and control.

System Diagram

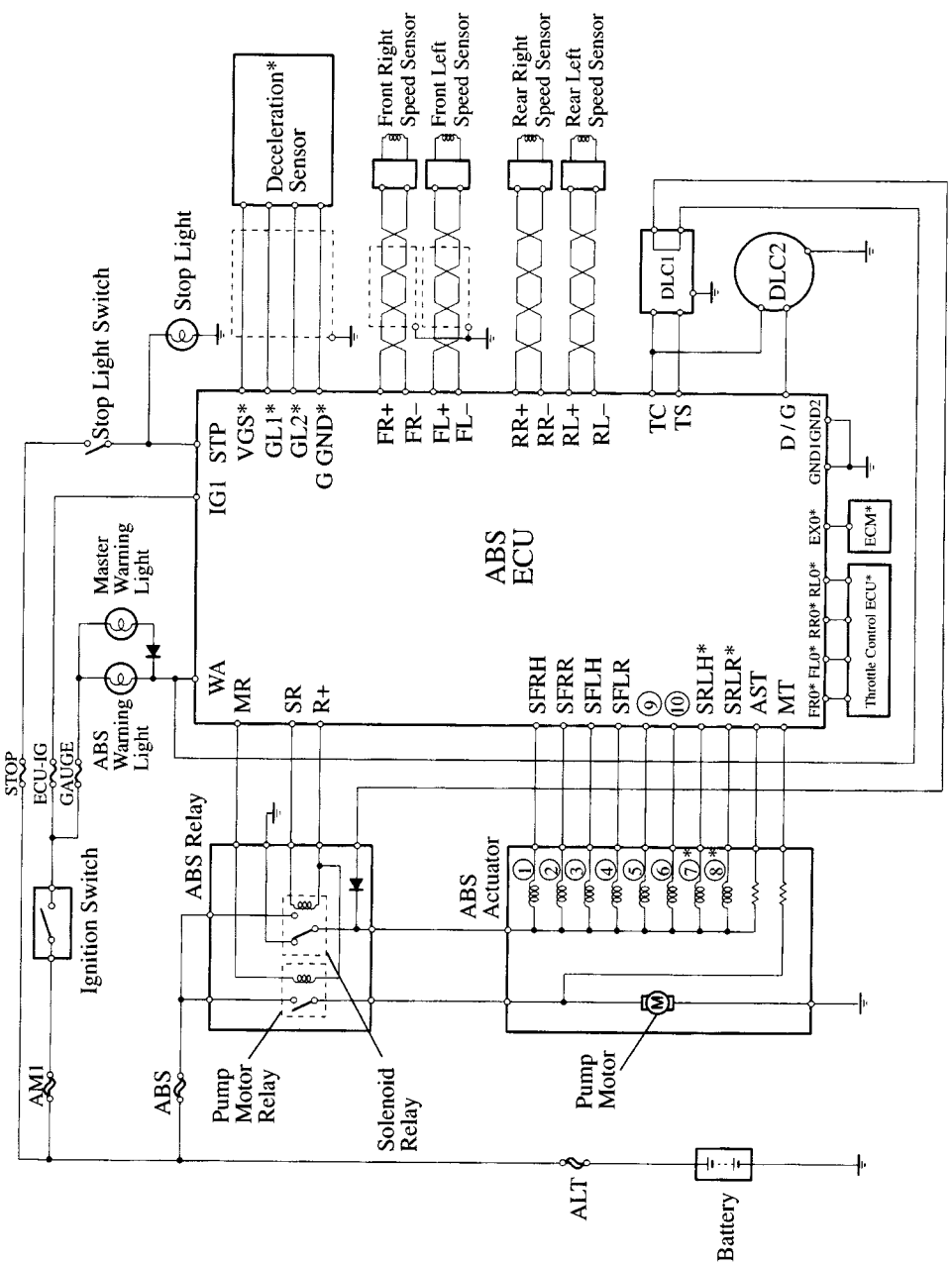


2JZ-GE Engine Model



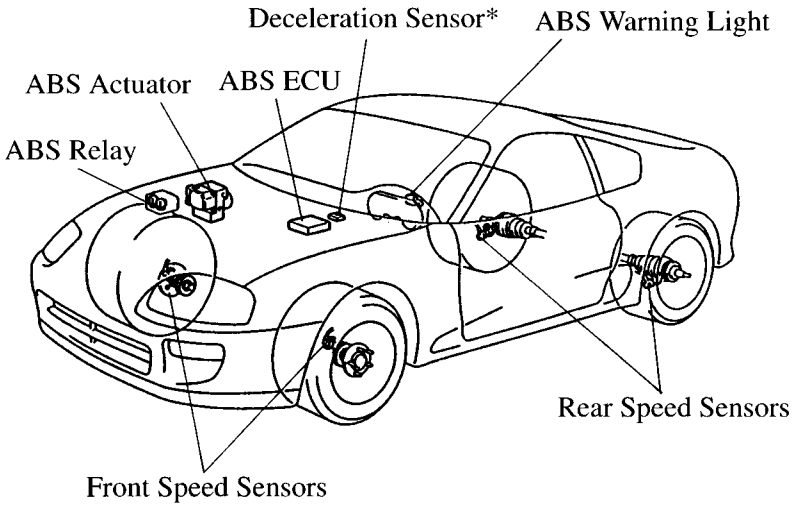
2JZ-GTE Engine Model

Wiring Diagram



① Front Right Pressure Holding Valve
② Front Right Pressure Reduction Valve
③ Front Left Pressure Holding Valve
④ Front Left Pressure Reduction Valve
⑤ 2JZ-GE : Rear Pressure Holding Valve
2JZ-GTE : Rear Right Pressure Holding Valve
⑥ 2JZ-GE : Rear Pressure Reduction Valve
2JZ-GTE : Rear Right Pressure Reduction Valve
⑦ Rear Left Pressure Holding Valve
⑧ Rear Left Pressure Reduction Valve
⑨ 2JZ-GE : SRH, 2JZ-GTE: SRRH
⑩ 2JZ-GE : SRR, 2JZ-GTE: SRRR
*: Only 2JZ-GTE Engine Model

Layout of Components



*: Only 2JZ-GTE Engine Model

Construction and Operation

1) Deceleration Sensor

The 2JZ–GTE engine model uses a linear type deceleration sensor to detect the deceleration rate in the vehicle's longitudinal direction and the acceleration rate in the vehicle's lateral direction.

Accordingly, the ABS in able to determine the vehicle's cornering condition and various road surface conditions to achieve a finely cornering control.

The basic construction and operation are the same as those of the '97 RAV4 4WD 2–door model. For details, see '96 RAV4 New Car Features (Pub. No. NCF124U), page 70.

2) ABS Actuator

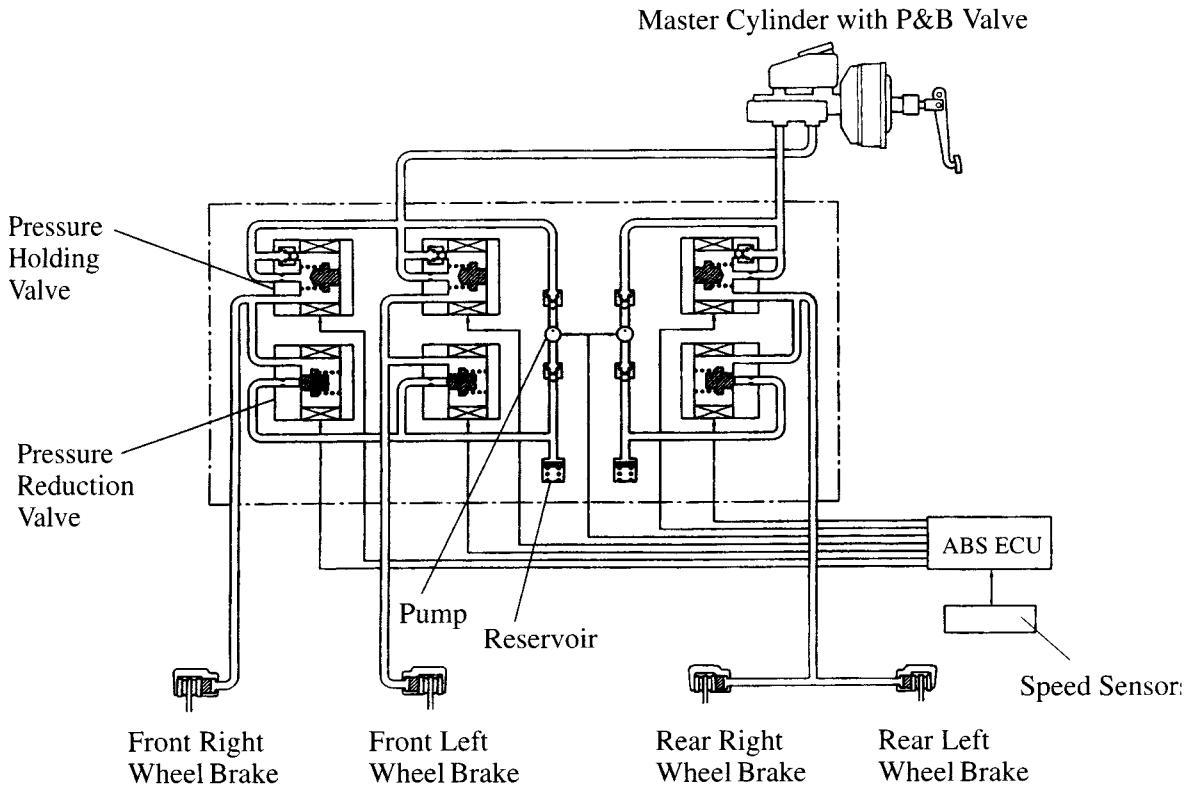
a. General

The ABS actuator consists of 6 or 8 two–position solenoid valves, 2 pumps, 2 reservoirs and a motor. The table below compares the actuator against that of the '96 model.

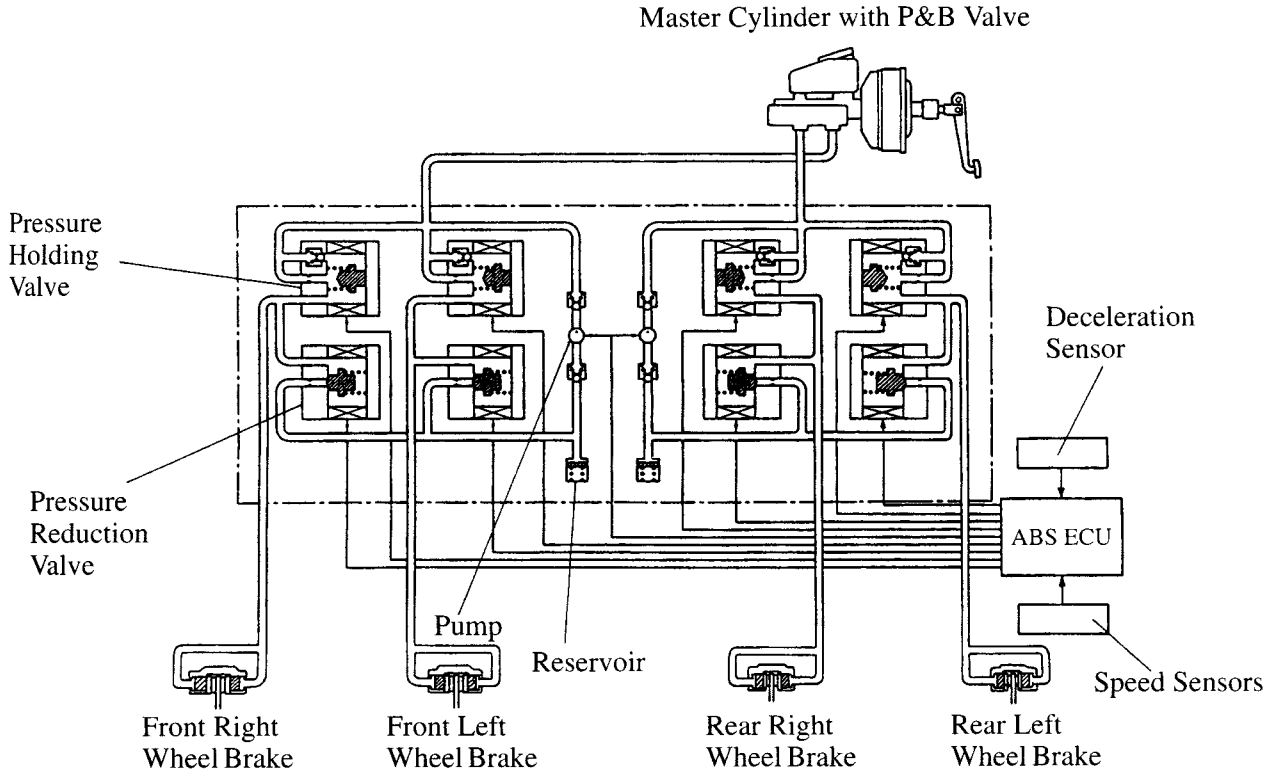
▶Comparison of ABS Actuators◀

Model	'97 Model		'96 Model
Engine Type	2JZ–GE	2JZ–GTE	2JZ–GE, 2JZ–GTE
Actuator Type	2–Position	2–Position	3–Position
Component	Solenoid Valves	Solenoid Valves	Solenoid Valves
Control Unit	6 Two–Position Solenoid Valves (3 pressure holding valves and 3 pressure reduction valves)	8 Two–Position Solenoid Valves (4 pressure holding valves and 4 pressure reduction valves)	4 Three–Position Solenoid Valves

b. Hydraulic Circuit



2JZ-GE Engine Model



2JZ-GTE Engine Model

c. Operation

The hydraulic system of the ABS has 3 or 4 circuits. Although the hydraulic circuit described below has 1 circuit, it is applicable to other circuits as well.

i) During Normal Braking (ABS not Activated)

During normal braking, the ABS is not activated and the ECU dose not send control signal.

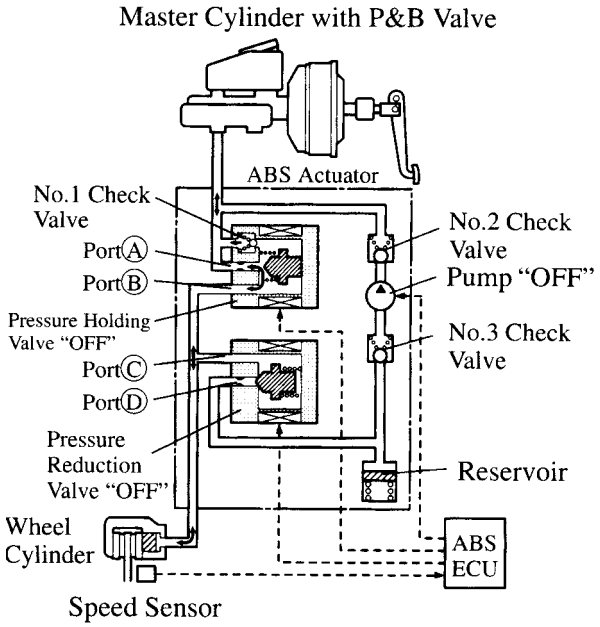
When the brake pedal is depressed, the fluid passes from port **A** to port **B**, and then flows to the brake wheel cylinder.

When the brake pedal is released, brake fluid returns from the brake wheel cylinder to the master cylinder through port **B** to port **A** and No. 1 Check Valve.

▶Condition of Actuator◀

Part Name	Signal from ABS ECU	Operation	
Pressure Holding Valve	OFF	Port A	Open
Pressure Reduction Valve	OFF	Port B	Closed
Pump Motor	OFF	Rotating	

▶Hydraulic Circuit◀



ii) During Emergency Braking (ABS Activated)

• Pressure Reduction Mode

When the wheel about to lock , the control signal from the ECU causes port **A** to close and port **D** to open, thus engaging the pressure reduction mode.

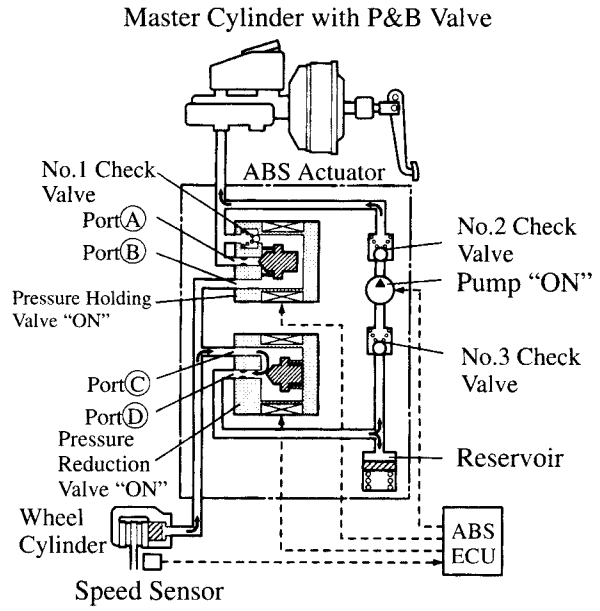
At this time the brake fluid flows from the wheel cylinder, through ports **C** and **D**, to the reservoir reducing the wheel pressure.

At the same time the brake fluid is pumped and returned to the master cylinder.

▶Condition of Actuator◀

Part Name	Signal from ABS ECU	Operation	
Pressure Holding Valve	ON	Port A	Closed
Pressure Reduction Valve	ON	Port D	Open
Pump Motor	ON	Rotating	

▶Hydraulic Circuit◀



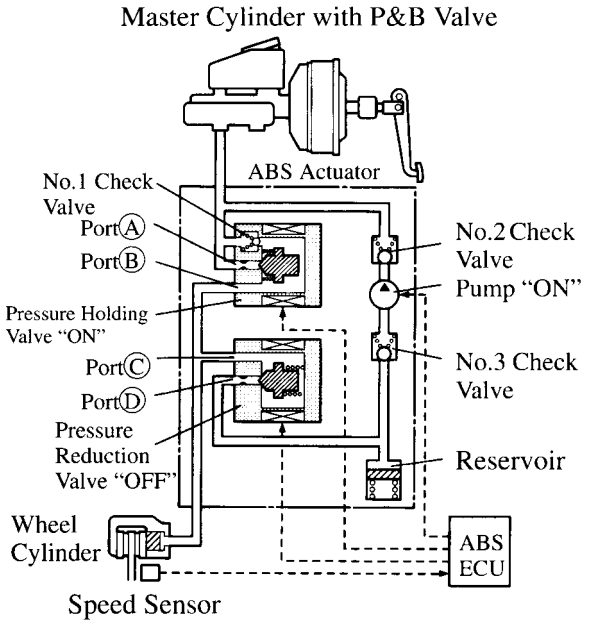
• Pressure Holding Mode

After the fluid pressure in the wheel cylinder is reduced or increased to the required pressure, a control signal from the ECU causes ports **A** and **D** to close. As a result, the system engages in the pressure holding mode to maintain the fluid pressure in the wheel cylinder.

▶Condition of Actuator◀

Part Name	Signal from ABS ECU	Operation	
Pressure Holding Valve	ON	Port A	Closed
Pressure Reduction Valve	OFF	Port D	Closed
Pump Motor	ON	Rotating	

▶Hydraulic Circuit◀



• Pressure Increase Mode

When the fluid pressure in the wheel needs to be increased in order to apply more braking force, a control signal from the ECU causes port **A** to open, port **D** to close, thus engaging the increase mode.

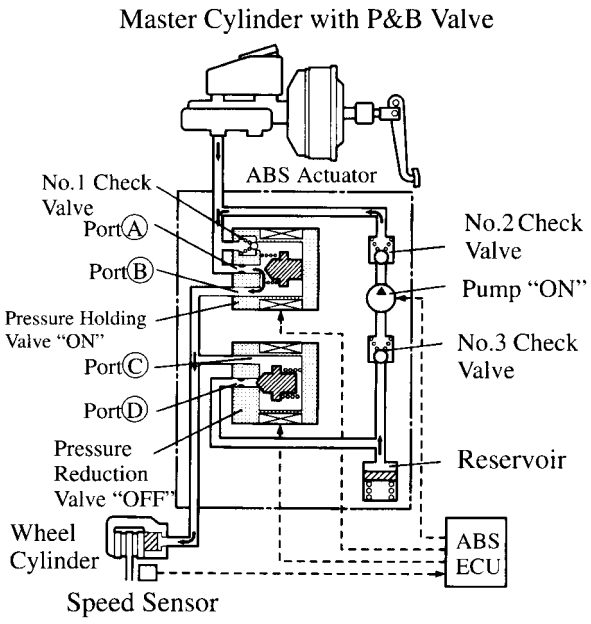
Accordingly, the circuit will be in the same state as in normal braking, in which the brake fluid is sent from the master cylinder to the wheel cylinder to increase the fluid pressure in the wheel cylinder.

The fluid pressure increase rate is controlled by repetition of the pressure increase and pressure holding mode.

▶Condition of Actuator◀

Part Name	Signal from ABS ECU	Operation	
Pressure Holding Valve	OFF	Port A	Open
Pressure Reduction Valve	OFF	Port D	Closed
Pump Motor	ON	Rotating	

▶Hydraulic Circuit◀



3) ABS ECU

a. Wheel Speed Control

The ECU constantly receives signals form the 4–speed sensors and a deceleration sensor (2JZ–GTE engine model), and estimates the speed and deceleration rate of the vehicle by calculating the speed and deceleration rate of each wheel.

b. Initial Check

An initial check is carried out every time once after the engine has started and the initial vehicle speed exceeds 6 km/h (4 mph).

c. Self–Diagnosis

If the ABS ECU detects a malfunction in the ABS, the ABS warning light and a master warning lights in the combination meter will light up and alert the driver that a malfunction has occurred. The ECU will also store the codes of the malfunctions.

■ SUSPENSION

1. General

- The shock absorber of the 2JZ–GTE engine model with manual transmission has been changed from the mono–tube, gas–filled shock absorber to the twin–tube, gas–filled shock absorber, which is the same type that is used on the 2JZ–GE engine model.
- The same rubber–integrated ball bushing that is used on the 2JZ–GTE engine model is used for the upper arm bushing of the rear suspension of the 2JZ–GE engine model.
- The brace rod of the rear subframe has been relocated to realize excellent riding comfort, in addition, this provides excellent stability, an controllability.