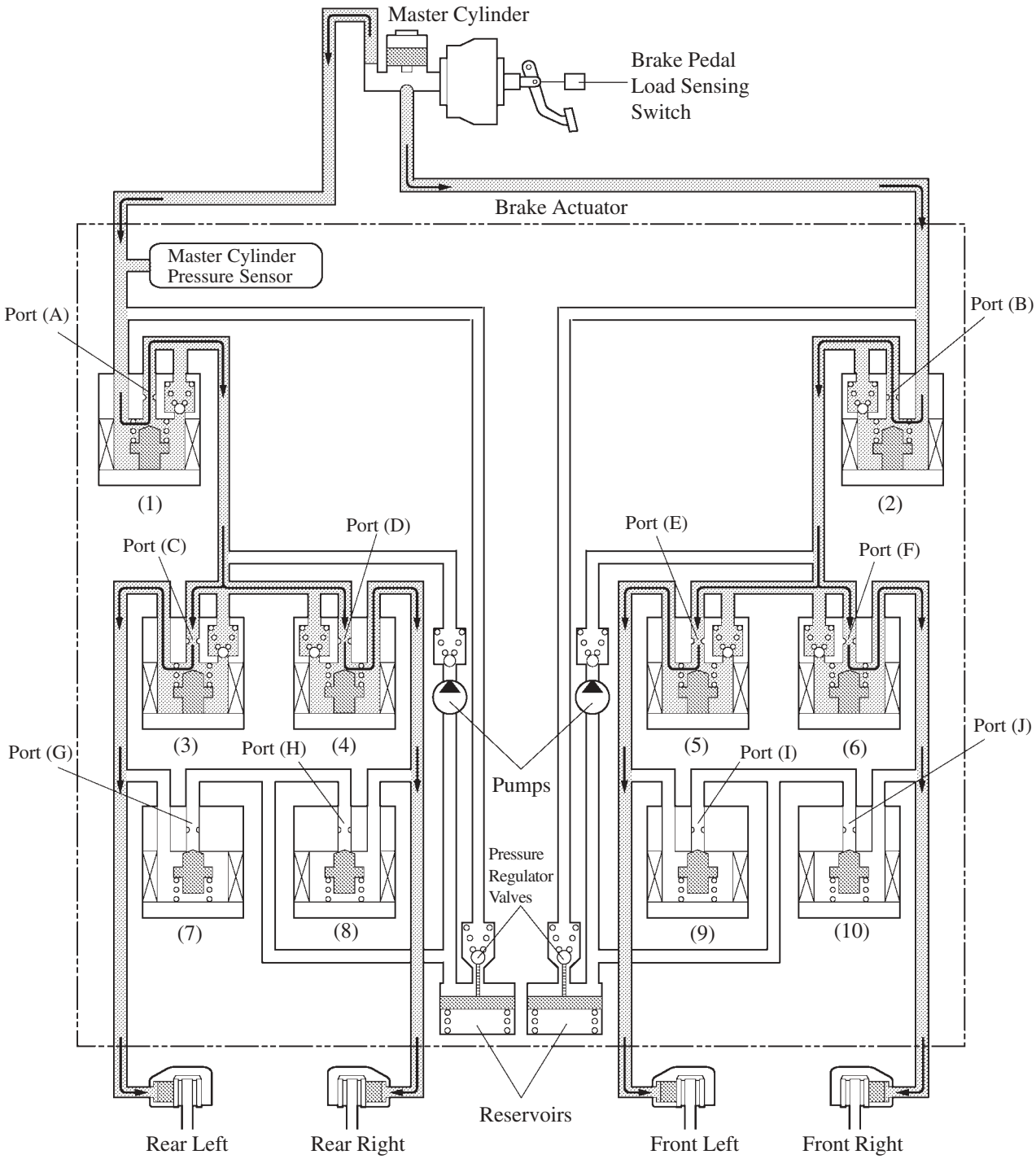
4. System Operation

Normal Braking Operation

During normal braking, all solenoid valves are remained OFF.



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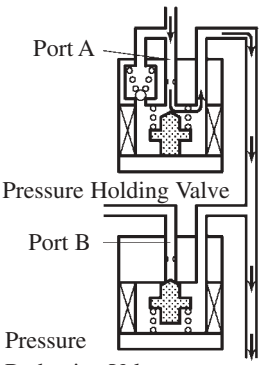
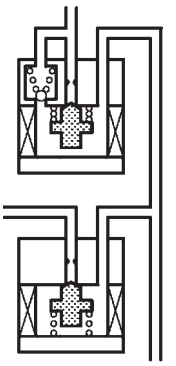
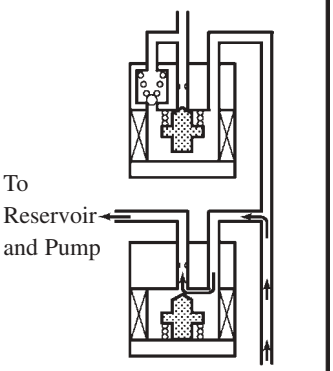
ABS with EBD Operation

Based on the signals received from the 4 wheel speed sensors and yaw rate & deceleration sensor, the skid control ECU calculates each wheel speed and deceleration, and checks wheel slipping condition. 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.

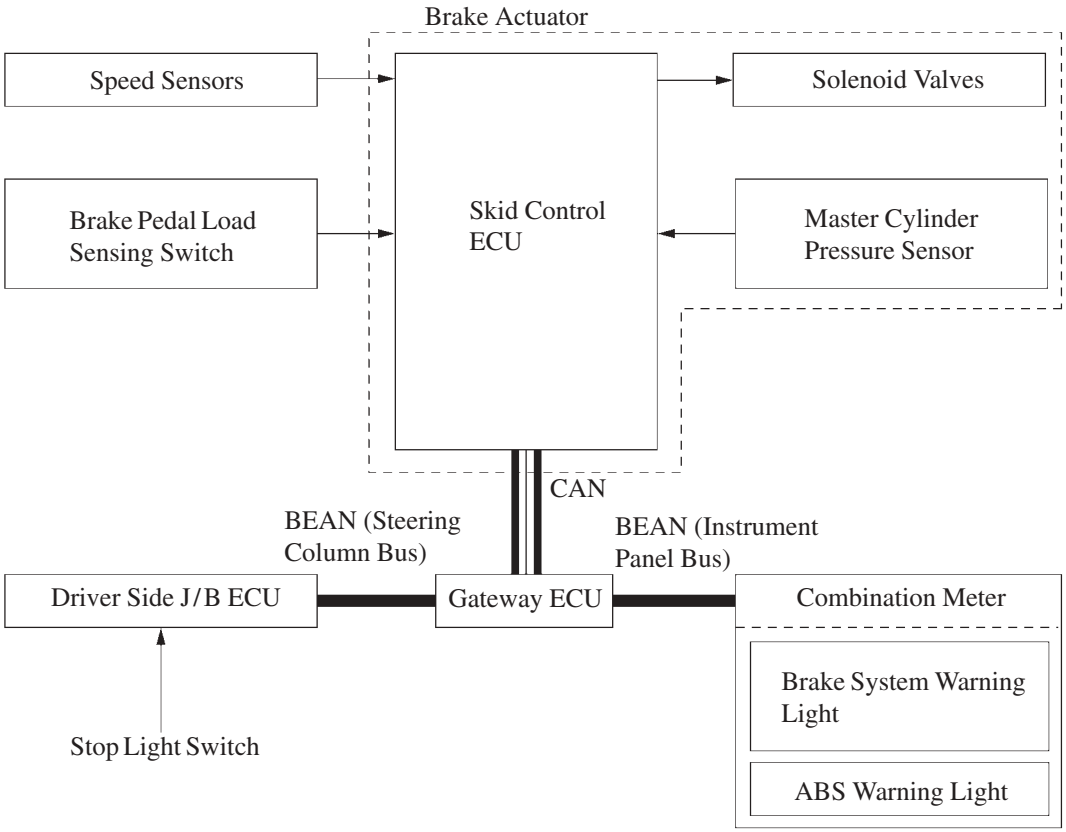
Not Activated	Normal Braking	—	—
Activated	Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
Hydraulic Circuit			
Pressure Holding Valve (Port A)	OFF/Open	ON/Close	←
Pressure Reduction Valve (Port B)	OFF/Close	←	ON/Open
Wheel Cylinder Pressure	Increase	Hold	Reduce

Brake Assist Operation

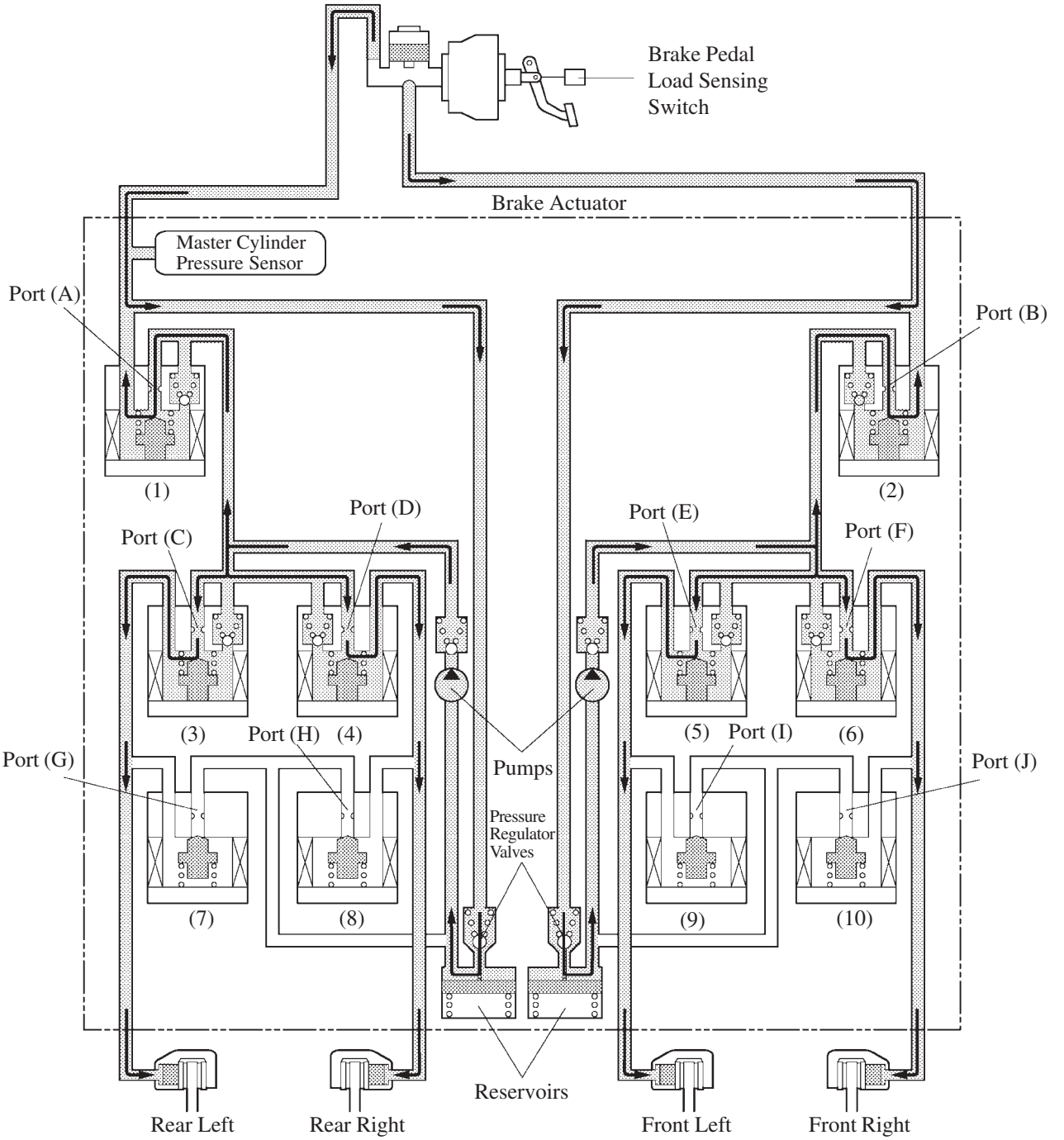
In the event of emergency braking, the skid control ECU detects the driver's intention based on the speed of the pressure increase in the master cylinder determined by the pressure sensor signal. If the ECU judges the need for additional brake assist, pressure is generated by the pump in the actuator and directed to the wheel cylinder to apply a greater fluid pressure than the master cylinder.
Also in the following cases, the system provides brake assist.

- When greater braking force is needed than normal, such as when the vehicle is fully loaded and downhill driving, etc., the skid control ECU judges the need for brake assist using the master cylinder pressure sensor.
- In the event of a brake booster failure, the skid control ECU judges the failure using the brake load sensing switch and master cylinder pressure sensor signals.

▶ System Diagram ◀



259LSK36



Brake Assist Activated

259LSK37

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

*: The solenoid valve controls the hydraulic pressure between "open" and "close" according to the operating condition by adjusting continually.

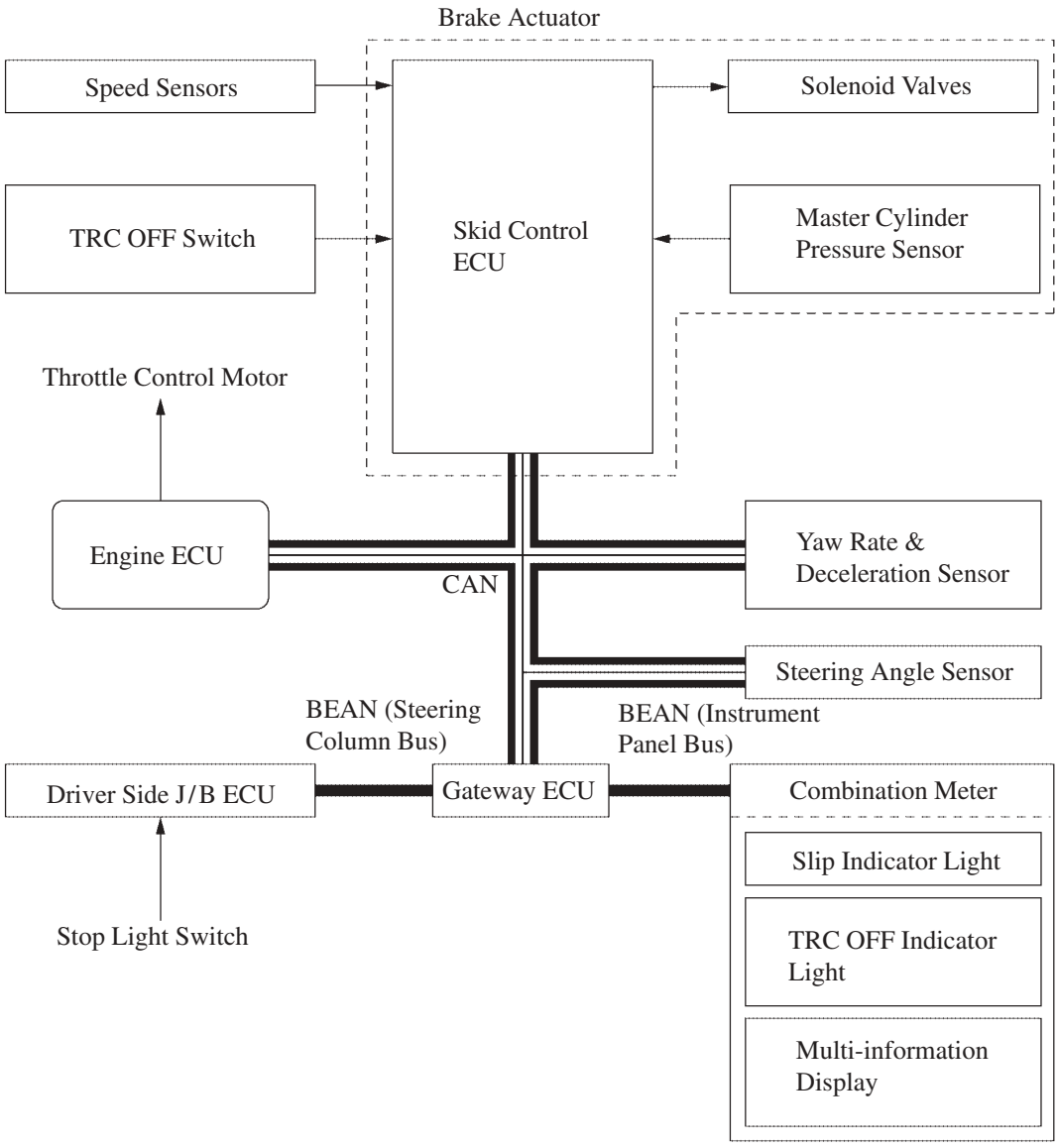
TRC Operation

The fluid pressure generated by the pump is regulated by the master cylinder cut solenoid valve to the required pressure. Thus, the wheel cylinders of the drive wheels are controlled in the following 3 modes: pressure reduction, pressure holding, and pressure increase modes, to control the slippage of the drive wheels.

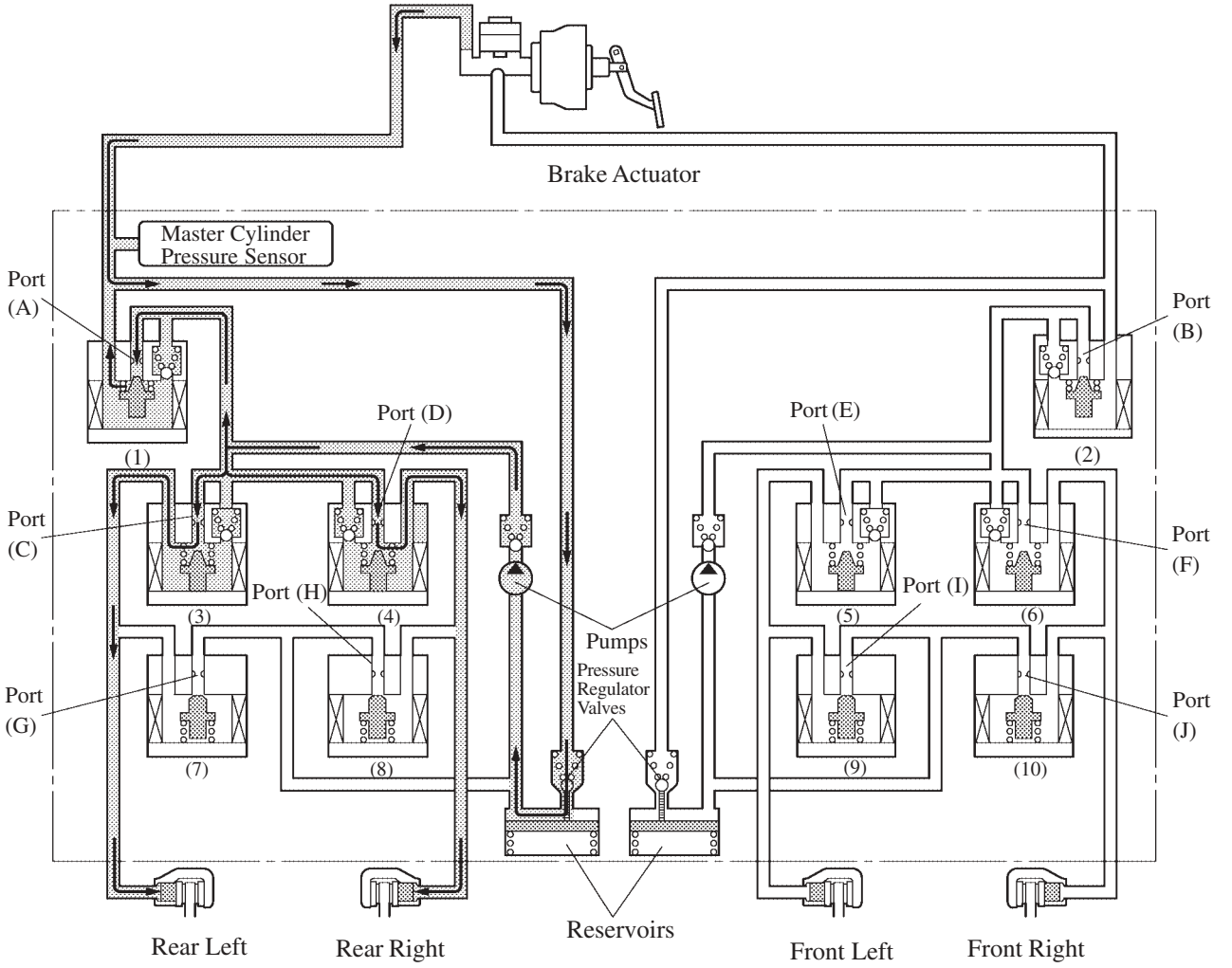
The diagram below shows the hydraulic circuit in the pressure increase mode when the TRC system is activated.

The pressure holding valve and the pressure reduction valve are turned ON/OFF according to the ABS operation pattern described on the previous page.

▶ System Diagram ◀



259LSK38



Pressure Increase Mode

259LSK39

Item			TRC not Activated	TRC Activated		
				Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
(1)	Master Cylinder Cut Solenoid Valve		OFF/Open	ON*	←	←
	Port: (A)					
(2)	Master Cylinder Cut Solenoid Valve		OFF/Open	←	←	←
	Port: (B)					
Front Brake	(5), (6)	Pressure Holding Valve	OFF/Open	←	←	←
		Port: (E), (F)				
	(9), (10)	Pressure Reduction Valve	OFF/Close	←	←	←
		Port: (I), (J)				
	Wheel Cylinder Pressure		—	—	—	—
Rear Brake	(3), (4)	Pressure Holding Valve	OFF/Open	←	ON/Close	←
		Port: (C), (D)				
	(7), (8)	Pressure Reduction Valve	OFF/Close	←	←	ON/Open
		Port: (G), (H)				
	Wheel Cylinder Pressure		—	Increase	Holding	Reduce

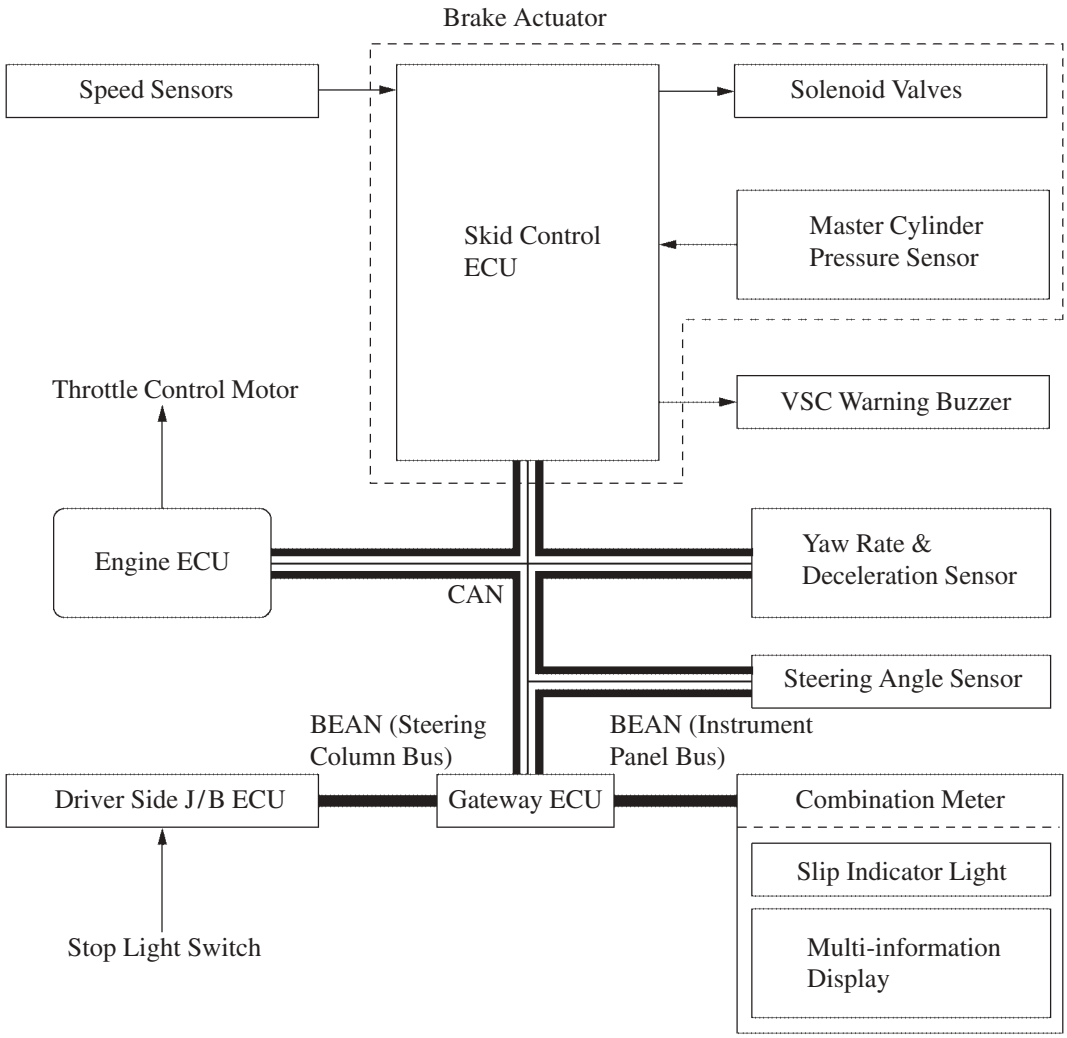
*: The solenoid valve controls the hydraulic pressure between "open" and "close" according to the operating condition by adjusting continually.

VSC Operation

1) General

The VSC system, by way of solenoid valves, controls the fluid pressure that is generated by the pump and applies it to the brake wheel cylinder of each wheel in the following 3 modes: pressure reduction, pressure holding, and pressure increase modes. As a result, the tendency to front wheel skid or rear wheel skid is controlled.

▶ System Diagram ◀

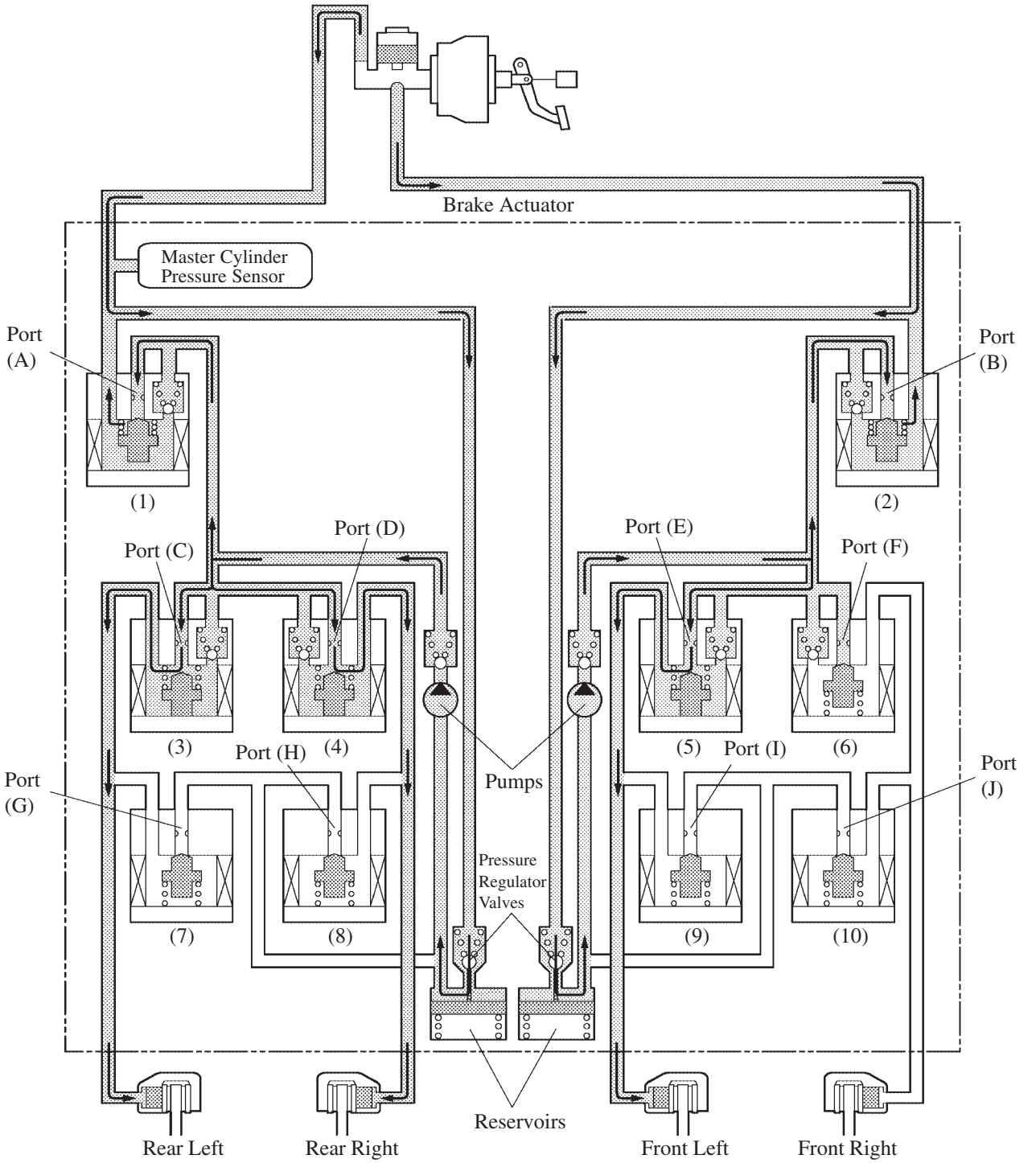


259LSK40

2) Front Wheel Skid Restraining Control (Turn to the Right)

In the front wheel skid restraining control, the brakes of the front wheel of the outer side of the turn and the rear wheels are applied. Also, depending on whether the brake is ON or OFF and the condition of the vehicle, there are circumstances in which the brake might not be applied to the wheels even if those wheels are targeted for braking.

- The diagram below shows the hydraulic circuit in the pressure increase mode, as it controls the front wheel skid condition while the vehicle makes a right turn.
- In other operating modes, the pressure holding valve and the pressure reduction valve are turned ON/OFF according to the ABS with EBD operation pattern.



Pressure Increase Mode

259LSK41

Item			VSC not Activated	VSC Activated		
				Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)		OFF/Open	ON*	←	←
Front Brake	(5)	Pressure Holding Valve Port: (E)	OFF/Open	←	ON/Close	←
	(6)	Pressure Holding Valve Port: (F)	OFF/Open	ON/Close	←	←
	(9)	Pressure Reduction Valve Port: (I)	OFF/Close	←	←	ON/Open
	(10)	Pressure Reduction Valve Port: (J)	OFF/Close	←	←	←
	Wheel Cylinder Pressure	Right	—	—	—	—
		Left	—	Increase	Holding	Reduce
Rear Brake	(3)	Pressure Holding Valve Port: (C)	OFF/Open	←	ON/Close	←
	(4)	Pressure Holding Valve Port: (D)	OFF/Open	←	ON/Close	←
	(7)	Pressure Reduction Valve Port: (G)	OFF/Close	←	←	ON/Open
	(8)	Pressure Reduction Valve Port: (H)	OFF/Close	←	←	ON/Open
	Wheel Cylinder Pressure	Right	—	Increase	Holding	Reduce
		Left	—	Increase	Holding	Reduce

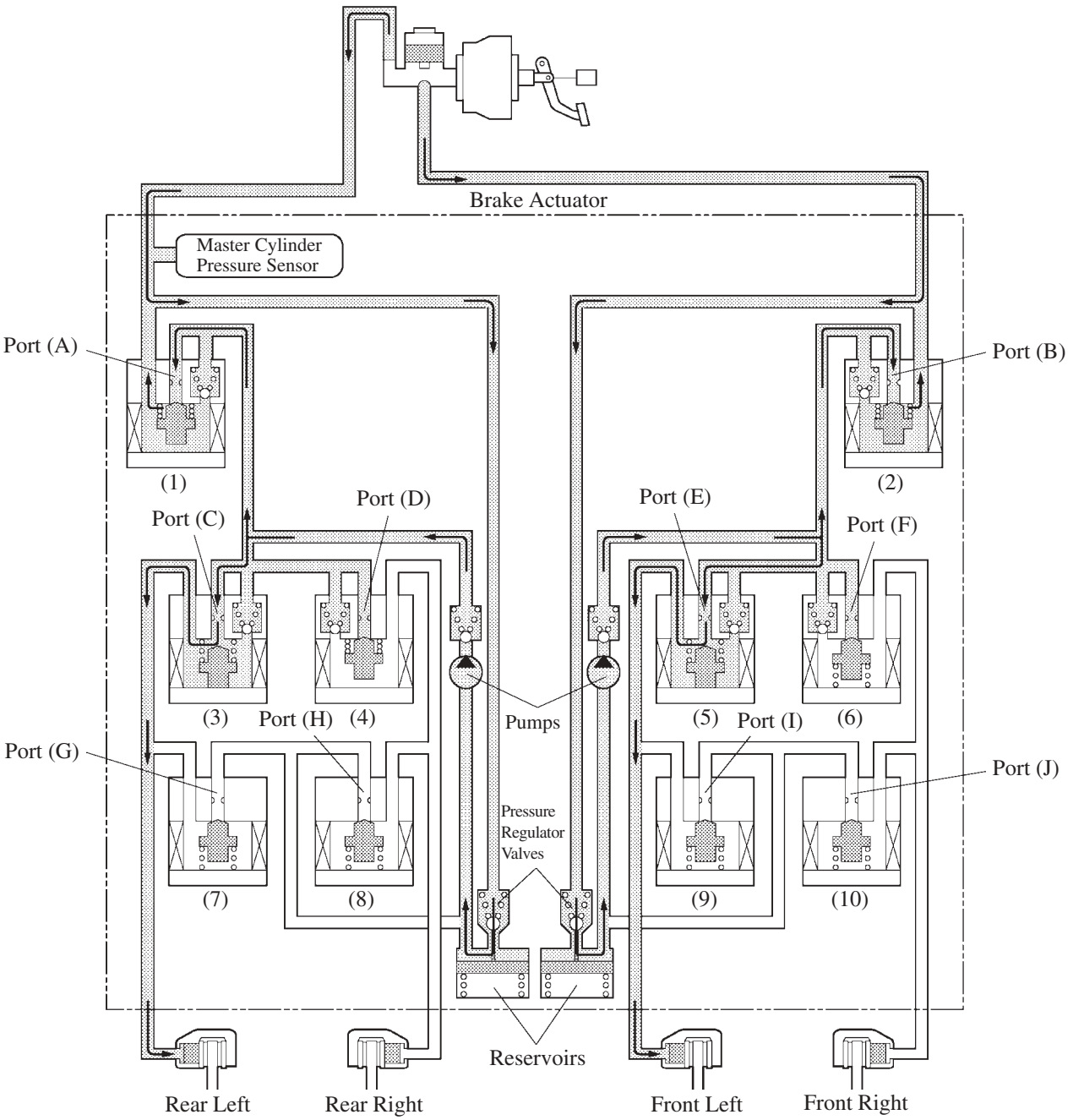
*: The solenoid valve controls the hydraulic pressure between “open” and “close” according to the operating condition by adjusting continually.

3) Rear Wheel Skid Restraining Control (Turn to the Right)

In the rear wheel skid restraining control, the brake of the front and rear wheels of the outer side of the turn is applied. Also, depending on whether the brake is ON or OFF and the condition of the vehicle, there are circumstances in which the brake might not be applied to the wheels even if those wheels are targeted for braking.

- The diagram below shows the hydraulic circuit in the pressure increase mode, as it controls the rear wheel skid condition while the vehicle make a right turn.
- In other operating modes, the pressure holding valve and the pressure reduction valve are turned ON/OFF according to the ABS with EBD operating pattern.

However, in rear wheel skid control, the pressure holding valve is turned ON and blocks the hydraulic passage to the front inner wheel in order to prevent applying the brake to the front inner wheel.



Pressure Increase Mode

259LSK42

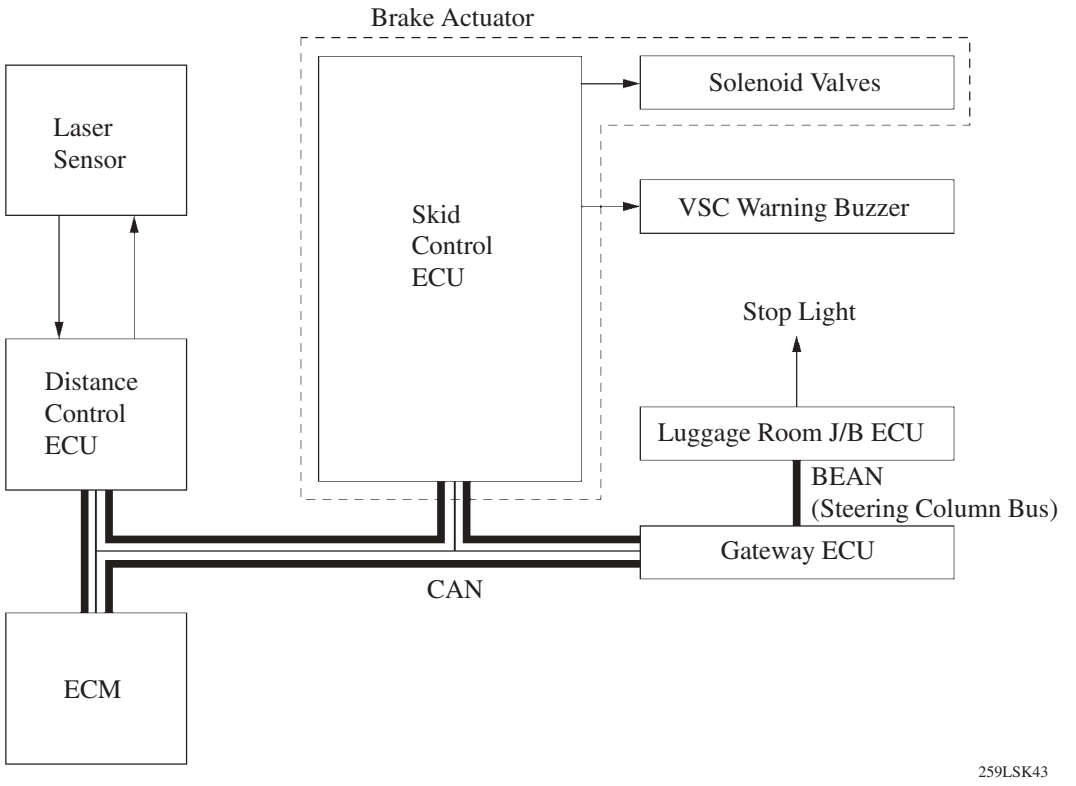
Item			VSC not Activated	VSC Activated		
				Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)		OFF/Open	ON*	←	←
Front Brake	(5)	Pressure Holding Valve Port: (E)	OFF/Open	←	ON/Close	←
	(6)	Pressure Holding Valve Port: (F)	OFF/Open	ON/Close	←	←
	(9)	Pressure Reduction Valve Port: (I)	OFF/Close	←	←	ON/Open
	(10)	Pressure Reduction Valve Port: (J)	OFF/Close	←	←	←
	Wheel Cylinder Pressure	Right	—	—	—	—
		Left	—	Increase	Holding	Reduce
Rear Brake	(3)	Pressure Holding Valve Port: (C)	OFF/Open	←	ON/Close	←
	(4)	Pressure Holding Valve Port: (D)	OFF/Open	ON/Close	←	←
	(7)	Pressure Reduction Valve Port: (G)	OFF/Close	←	←	ON/Open
	(8)	Pressure Reduction Valve Port: (H)	OFF/Close	←	←	←
	Wheel Cylinder Pressure	Right	—	—	—	—
		Left	—	Increase	Holding	Reduce

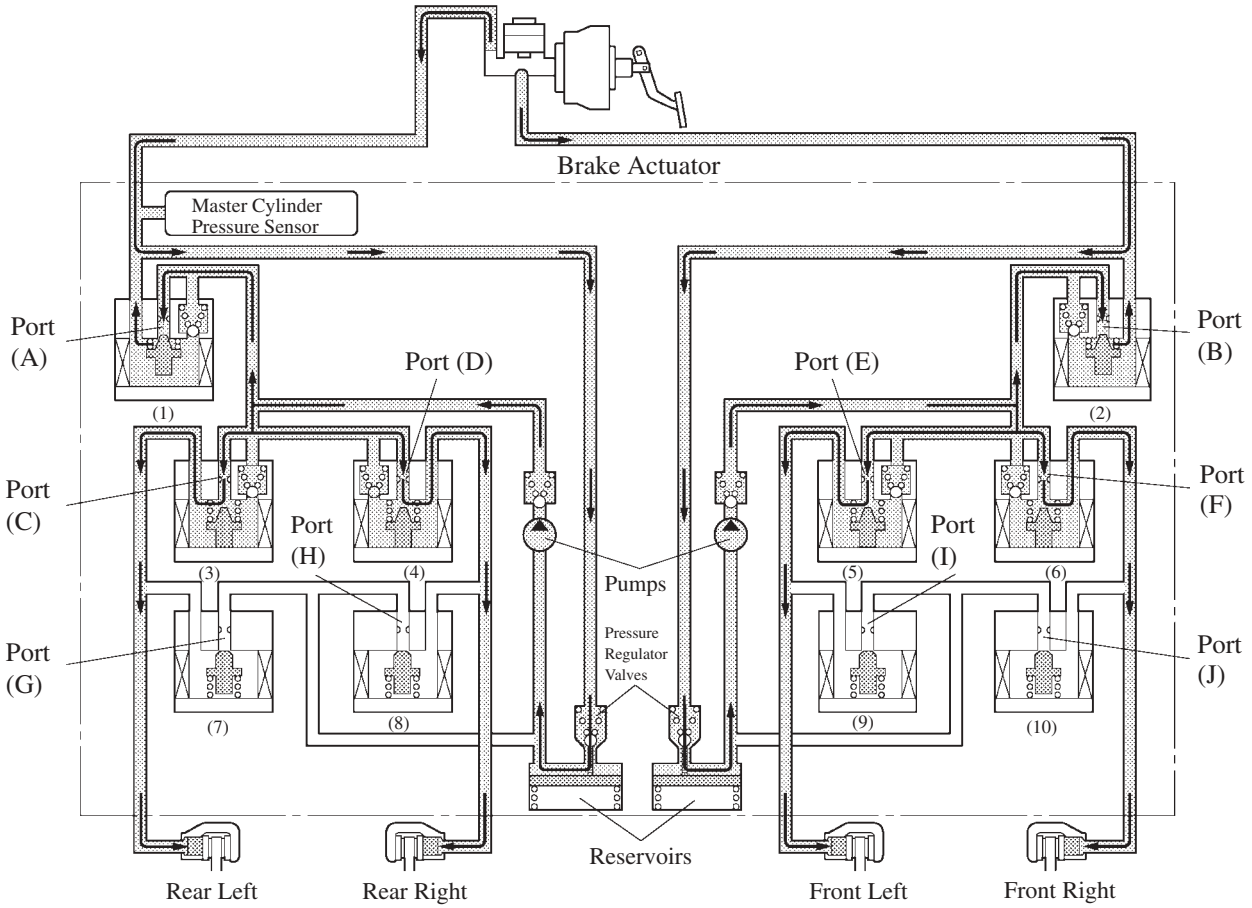
*: The solenoid valve controls the hydraulic pressure between “open” and “close” according to the operating condition by adjusting continually.

Brake Control Operation of Dynamic Laser Cruise Control System

The fluid pressure that has been generated by the pump in the brake actuator is directed to the wheel cylinders.

▶ System Diagram ◀





Brake Control Actuated

259LSK44

Item			Brake Control Not Activated	Brake Control Actuated
(1), (2)	Master Cylinder Cut Solenoid Valve		OFF/Open	ON*
	Port: (A), (B)			
Front Brake	(5), (6)	Pressure Holding Valve	OFF/Open	←
		Port: (E), (F)		
	(9), (10)	Pressure Reduction Valve	OFF/Close	←
		Port: (I), (J)		
Rear Brake	(3), (4)	Pressure Holding Valve	OFF/Open	←
		Port: (C), (D)		
	(7), (8)	Pressure Reduction Valve	OFF/Close	←
		Port: (G), (H)		

*: The solenoid valve controls the hydraulic pressure between “open” and “close” according to the operating condition by adjusting continually.