

## 8. System Operation

### Vehicle Height Control

- The vehicle height control controls the vehicle height over 5 levels in accordance with the manual switch operation or the driving conditions.
- The vehicle height control has the following functions:

Function	Outline
Vehicle Height Selection Function (See Page CH-100)	Enables the selection of 3 levels of vehicle height by operating a switch.
Automatic Leveling Function	This function maintains the vehicle height constant regardless of the load conditions such as the number of occupants or the weight of the cargo under the prescribed loading condition. It effects constant control so that the vehicle height is maintained at a prescribed value.
Extra HI Mode	<ul style="list-style-type: none"> <li>• While driving on an unpaved road with the transfer shifted in the L4 range and the vehicle height set to the HI position, if one of the wheels freewheels, the vehicle is raised up to the Extra HI position, 20 mm (0.8 in.) higher than the HI position.</li> <li>• When the CRAWL function of the brake control system is in operation and the vehicle height adjustment request signal for switching to the Extra HI position is input from the skid control ECU to the suspension control ECU, the vehicle is raised up to the Extra HI position.</li> </ul>
Vehicle Speed Sensing Function (See Page CH-104)	The vehicle height will be automatically adjusted in accordance with the vehicle speed and selected vehicle height.
Easy Access Control (See Page CH-106)	For convenient in-and-out access, this function effects vehicle height control in conjunction with the engine switch when the easy access mode is set to ON.
Vehicle Height Adjustment Prohibition Control	When the vehicle is raised on a jack or is being towed, the vehicle adjustment can be prohibited by operating the height control switch.* However, the prohibition control cancels automatically when the vehicle speed becomes higher than approximately 80 km/h (50 mph) at the Normal position, or higher than approximately 30 km/h (19 mph) at the HI or LO position.

\*: This control is available only when the vehicle is stopped [the vehicle speed is 5 km/h (3.1 mph) or less].

### 1) Vehicle Height Selection Function

The following three types of vehicle heights can be selected by operating the switch: normal vehicle height (Normal), low vehicle height (LO), and high vehicle height (HI).

Selected Height Position		LO	Normal	HI
Vehicle Height	Front	Approximately –60 mm (–2.4 in.)	Standard Vehicle Height	Approximately +50 mm (+2.0 in.)
	Rear	Approximately –40 mm (–1.6 in.)	Standard Vehicle Height	Approximately +60 mm (+2.4 in.)
Vehicle Height Adjustment Speed* <sup>1</sup>	Up	LO to Normal Approximately 11 to 16 seconds		
	Down	Normal to LO Approximately 2 seconds* <sup>2</sup>		

\*<sup>1</sup>: Vehicle height control speed differs depending on the loaded condition.

\*<sup>2</sup>: Approximately 5 seconds when the shift lever is in N.

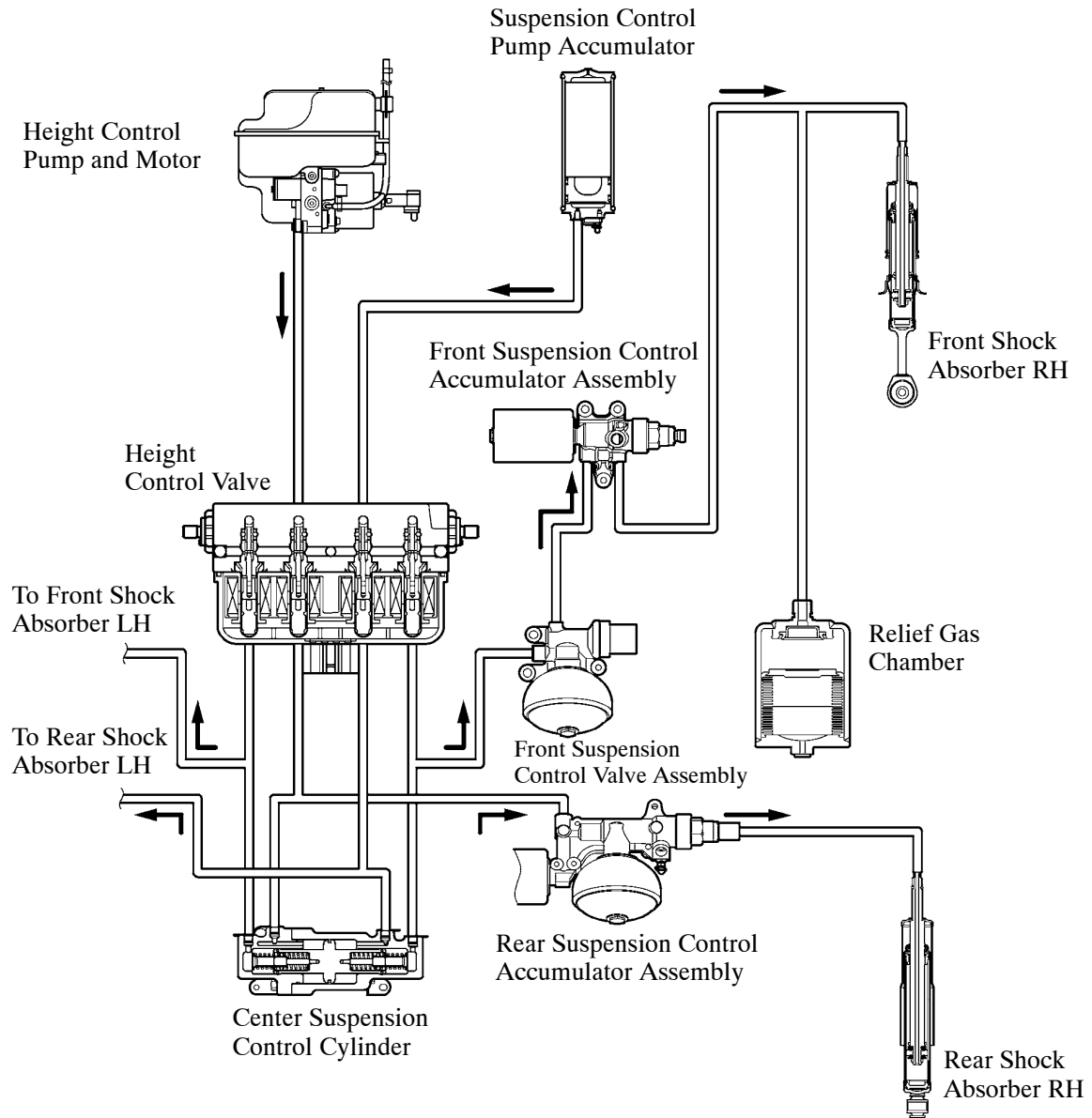
#### NOTE

When a load exceeding the following axle weight limitations is applied to the vehicle, it causes the vehicle not to stay at the Normal height. At times like this, it might not be possible to raise the vehicle height even by operating the switch.

- In Normal mode: Front axle weight: 1460 kg (3212 lb)/Rear axle weight: 1800 kg (3960 lb)

**a. Raising Vehicle Height (Manual Operation)**

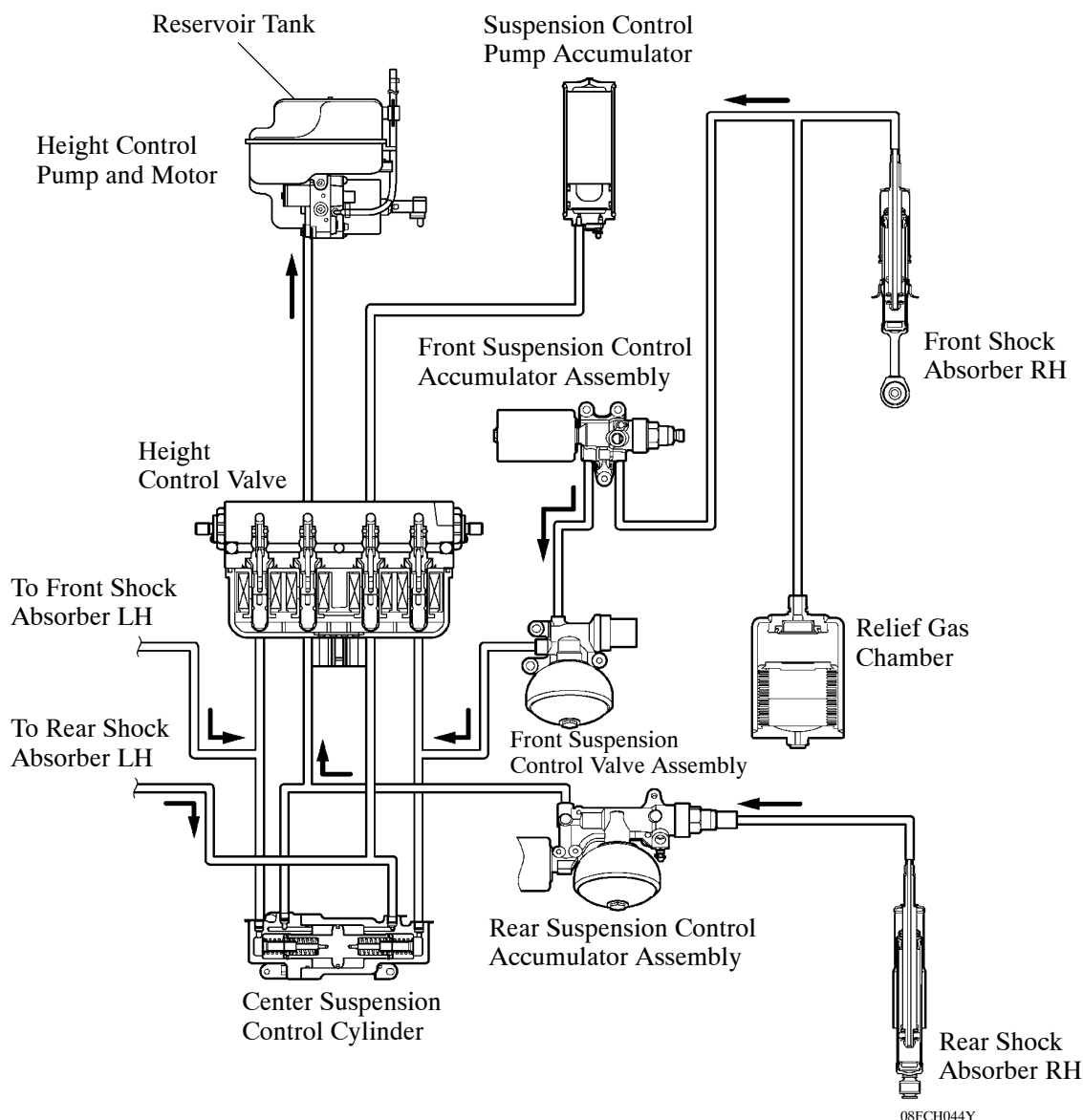
When the height select switch is operated to raise the vehicle height, the suspension control ECU opens the leveling valves for each of the wheels arranged inside the height control valve. This allows the fluid to flow from the pump into the shock absorber and gas chamber and results in an increase in the vehicle height. Simultaneously, the accumulator valve opens, guiding the fluid into them from the suspension control pump accumulator, thereby raising the vehicle height.



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**b. Lowering Vehicle Height (Manual Operation)**

When the height select switch is operated to lower the vehicle height from the HI to the Normal position, or from the Normal to the LO position, the suspension control ECU opens the front and rear leveling valves. As a result, the fluid in the gas chambers and the shock absorbers arranged for each of the wheels returns into the reservoir tank, thereby lowering the height of the suspension. However, if the rear side is expected to become lower more quickly due to the load condition, and the difference between the lowering of the front side and the rear side becomes greater than a prescribed value, the rear leveling valve closes once, allowing only the vehicle height to become lowered at the front side. This feature prevents the headlights from being aimed upward.

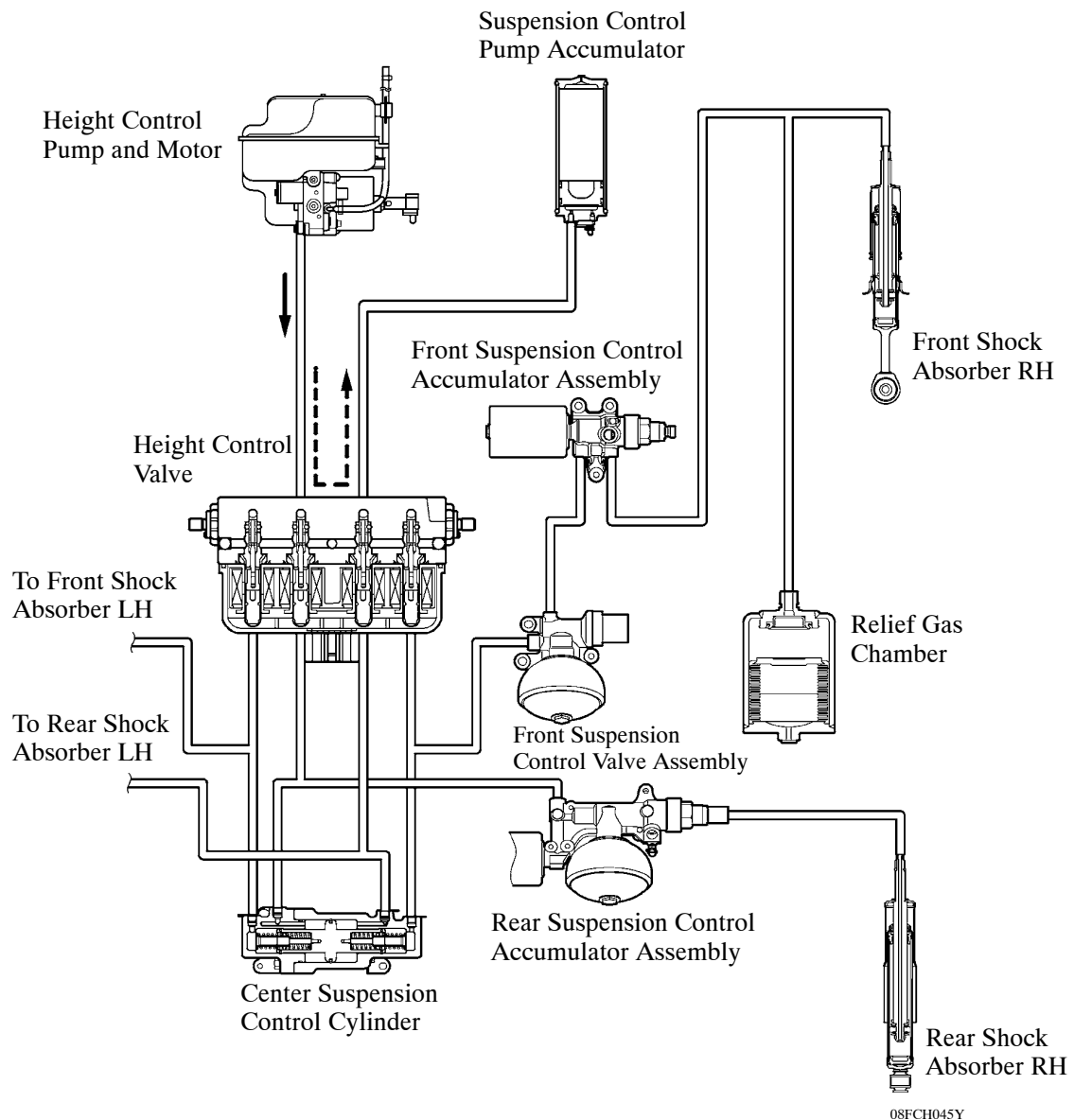


### c. Fluid Stored in Height Control Accumulator

Normally, the suspension control pump accumulator stores only the amount of fluid that is equivalent that used in raising the vehicle height once. Therefore, after the vehicle has been raised from the LO position to the Normal position, or from the Normal position to the HI position, it is necessary to replenish the fluid in the suspension control pump accumulator.

At this time, the pump motor is operated to rotate the pump, the leveling valves are closed, the accumulator valve of the height control valve is opened, and the fluid is stored in the suspension control pump accumulator.

When the vehicle height is raised while the fluid that is stored in the suspension control pump accumulator has not reached a prescribed pressure, only the fluid that is discharged by the pump is used for raising the vehicle height, without using the fluid in the suspension control pump accumulator.

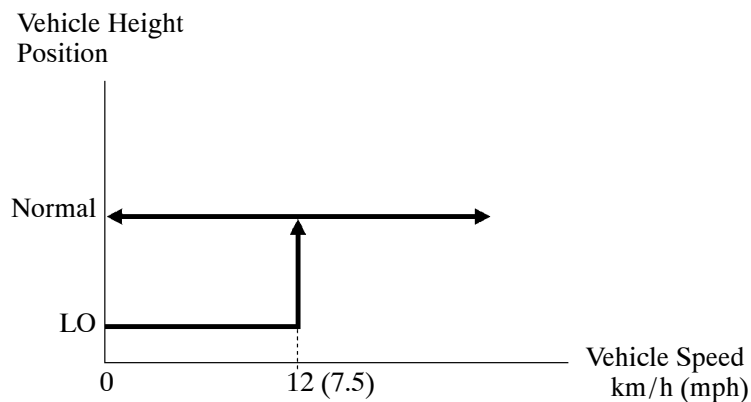


## 2) Vehicle Speed Sensing Function

This function automatically adjusts the vehicle to any of the six levels of the height positions depending on vehicle speeds and vehicle conditions. The values of each height position are as follows:

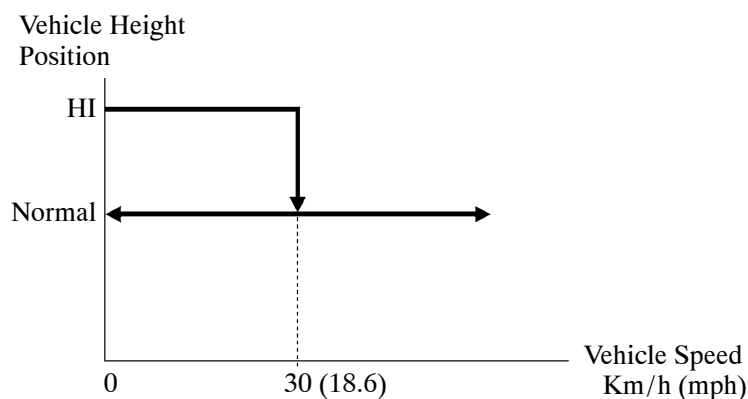
Height Position	Front Suspension Adjustment Value	Rear Suspension Adjustment Value
Extra HI	70 mm (2.8 in.)	80 mm (3.1 in.)
HI	50 mm (2.0 in.)	60 mm (2.4 in.)
L4 Range HI	25 mm (1.0 in.)	25 mm (1.0 in.)
Normal	0 mm (0 in.)	0 mm (0 in.)
High Speed LO	-20 mm (-0.8 in.)	-15 mm (-0.6 in.)
LO	-60 mm (-2.4 in.)	-40 mm (-1.6 in.)

- If the vehicle speed exceeds approximately 12 km/h (7.5 mph) when the vehicle height is set to the LO position, the vehicle height will be automatically adjusted to the Normal position.



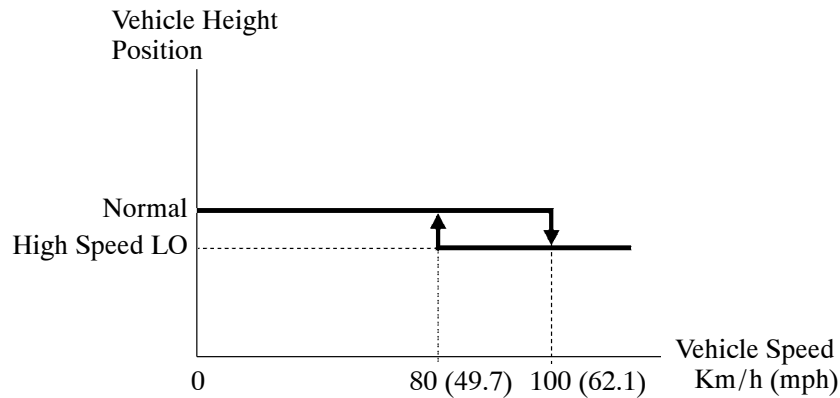
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- If the vehicle speed exceeds approximately 30 km/h (18.6 mph) when the vehicle height is set to the HI position, the vehicle height will be automatically adjusted to the Normal position.



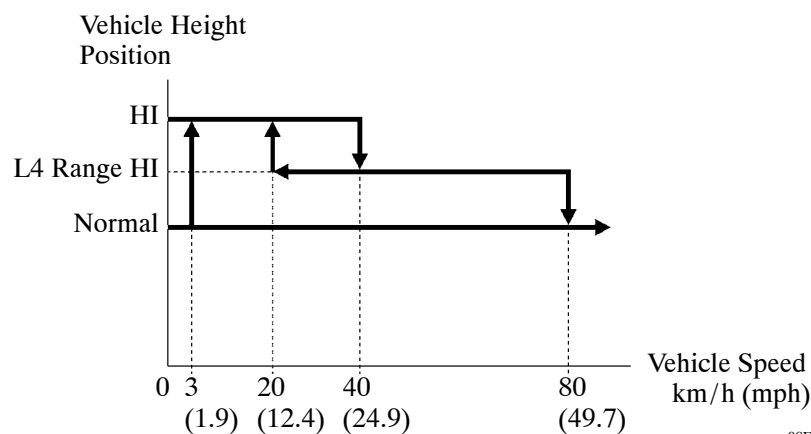
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- If the vehicle speed exceeds approximately 100 km/h (62.1 mph) when the vehicle height is set to the Normal position, the vehicle height will be adjusted to the High Speed LO position. If the vehicle speed is decreased to approximately 80 km/h (49.7 mph) or less while this is in effect, the vehicle height will be automatically adjusted to the Normal position.



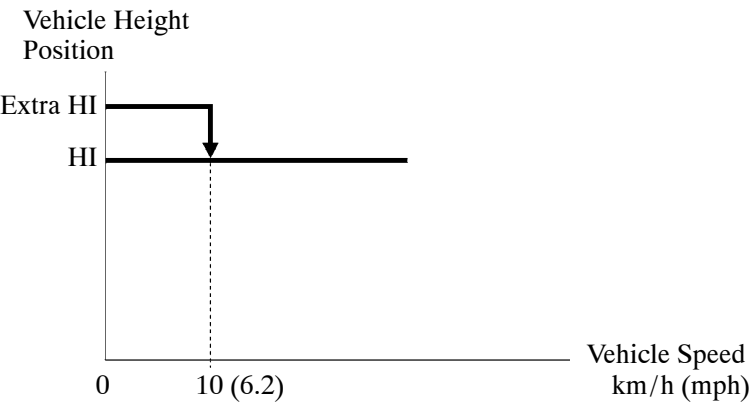
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- When the transfer is set in the L4 range, the following control is performed.
  - If the vehicle speed exceeds approximately 3 km/h (1.9 mph) when the vehicle height is set to the Normal or LO position and a rough road condition is detected, the vehicle height will be automatically adjusted to the HI position.
  - When the vehicle speed exceeds 40 km/h (24.9 mph), the vehicle height will be adjusted to the L4 Range HI position. If the vehicle further accelerates in this condition and the vehicle speed exceeds 80 km/h (49.7 mph), the vehicle height will be automatically adjusted to the Normal position. On the other hand, if the vehicle decelerates and the vehicle speed is decreased to 20 km/h (12.4 mph) or less, the vehicle height will be automatically adjusted to the HI position.



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- If the vehicle speed exceeds approximately 10 km/h (6.2 mph) when the vehicle height is set to Extra HI position, the vehicle height will be automatically adjusted to the HI position.

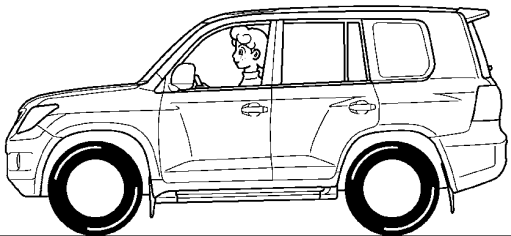


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3) Easy Access Control

This function effects vehicle height control in conjunction with the engine switch when all of the following conditions have been met.

Condition	Function
<ul style="list-style-type: none"><li>● Easy access mode switch is ON</li><li>● Vehicle height is Normal</li><li>● Shift lever is in P position</li><li>● Vehicle speed is 0 km/h (0 mph)</li><li>● Engine switch is turned OFF</li><li>● Vehicle is on flat road</li></ul>	<ul style="list-style-type: none"><li>● The vehicle height is changed from the Normal position to the LO position.</li><li>● The wireless door lock buzzer sounds.</li><li>● The easy access mode indicator light is changed from illuminating condition to blinking condition.</li></ul>
<ul style="list-style-type: none"><li>● Easy access mode switch is ON</li><li>● Engine switch is turned ON (IG)</li><li>● Vehicle speed is 12 km/h (7.5 mph) or more</li></ul>	<ul style="list-style-type: none"><li>● The vehicle height is changed from the LO position to the Normal position.</li></ul>



Normal Position



LO Position

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## Damping Force Control

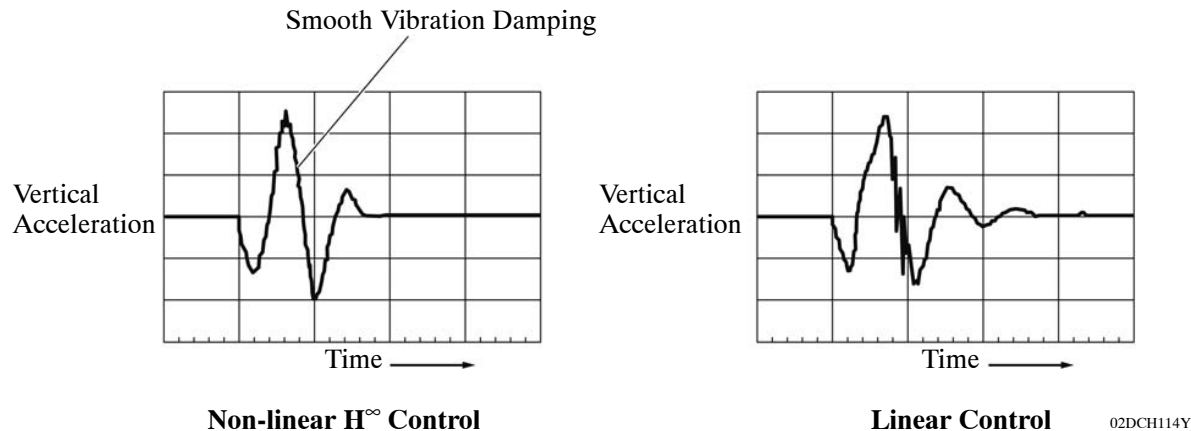
The damping force control has following functions:

Control	Function
Non-linear $H^\infty$ Control (See Page CH-108)	Smoothly changes the damping force to a target value in accordance with the changes in the road surface or driving conditions. Thus, excellent ride comfort has been realized while a high level of vibration damping performance is ensured.
Thumping Sensitive Control	Controls the shock absorbers so that the damping force for the shock absorbers will not increase while driving on a rough road.
Large-amplitude Control	When the suspension control ECU detects any large fluctuation in the wheel stroke when driving at low speeds, the damping force is adjusted to a firmer variable range for a predetermined time, to decrease the spring vibration.
Roll Posture Control (See Page CH-108)	Changes the damping force to control the vehicle posture during cornering. As a result, excellent stability and controllability have been realized during cornering.
Anti-dive Control	During braking, this function makes the damping force firmer to restrain the body dive, thus ensuring excellent stability and controllability.
Anti-squat Control	During acceleration, this function makes the damping force firmer to minimize the changes in the vehicle body posture.
High Speed Control	This function varies the variable range of the damping force according to vehicle speed in order to realize a soft and comfortable ride and a stable driving condition. The damping force is controlled in a softer variable range at low speeds, and in a firmer variable range at high speeds.
Absorber Control	The damping mode select switch enables the driver to select a desired damping force from the 3 modes.
L4 Range Control	The damping force is normally controlled in 16 steps. However, when the transfer is set in the L4 range, it is controlled in the intermediate 8 steps*, thereby ensuring riding comfort during off-road driving.

\*: It is controlled in 3 steps when the vehicle speed is 55 km/h (34.2 mph) or less, and 8 steps when the vehicle speed is more than 55 km/h (34.2 mph).

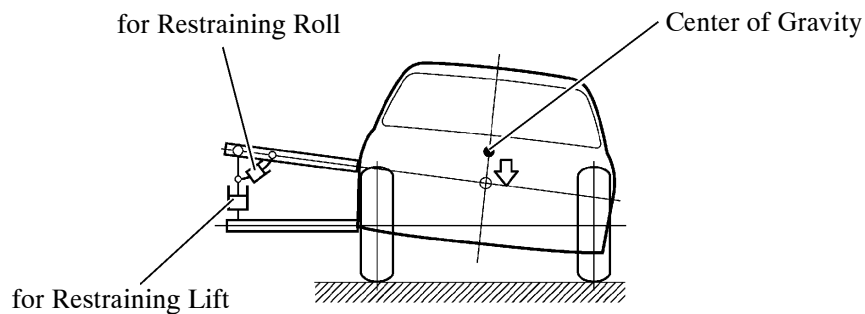
### 1) Non-linear $H^\infty$ Control

This control uses 3 acceleration sensors to detect the vertical acceleration rate that corresponds to the bumps on the road surface and applies the non-linear  $H^\infty$  control to calculate the target damping force. Unlike linear control which linearly changes the damping force proportional to the sprung acceleration rate, non-linear  $H^\infty$  control achieves a higher level of vibration damping performance. As a result, superior riding comfort is ensured on any road surface or under any driving conditions.



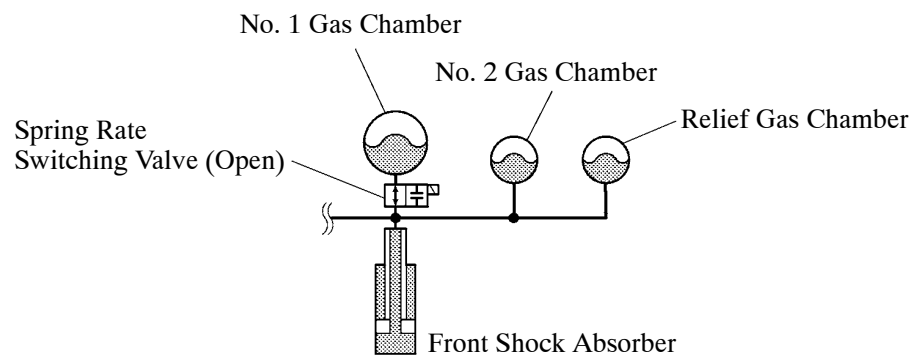
### 2) Roll Posture Control

- This control changes the damping force to control the vehicle posture during cornering. As a result, excellent stability and controllability have been realized during cornering. This control assumes that two types of shock absorbers (one for restraining roll and the other for restraining lift) are provided at an imaginary point on the inside of the turn of the vehicle. The function of these shock absorbers is to prevent the center of gravity of the vehicle from rising. The damping force of the front and rear shock absorbers is controlled in order to control the vehicle's posture as in this imaginary condition.
- To effect this control, the suspension stroke information is calculated based on the information from the 3 acceleration sensors and a steering angle sensor. Thus, the driving conditions of the vehicle are detected.



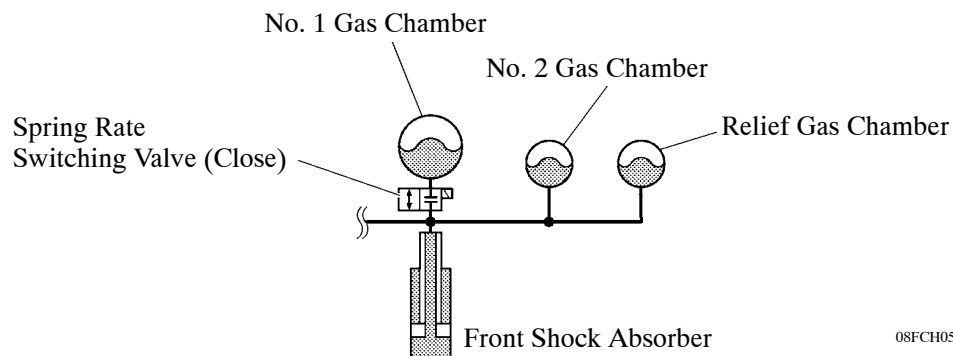
### Spring Rate Control

- The front shock absorber includes No. 1 and No. 2 gas chambers. These gas chambers are automatically selected in accordance with the driving conditions, and this ensures both driving comfort and steering stability.
- Under normal driving conditions, the suspension control ECU opens the spring rate switching valve and allows the gas chambers to operate, thereby reducing the spring rate and ensuring ride comfort.
- If the vehicle speed exceeds a predetermined speed while cornering or when the brake pedal is depressed, the suspension control ECU closes the spring rate switching valve and allows only the No. 2 gas chamber to operate, thereby increasing the spring rate to control the vehicle posture and improve the steering stability.



**Normal Driving Condition**

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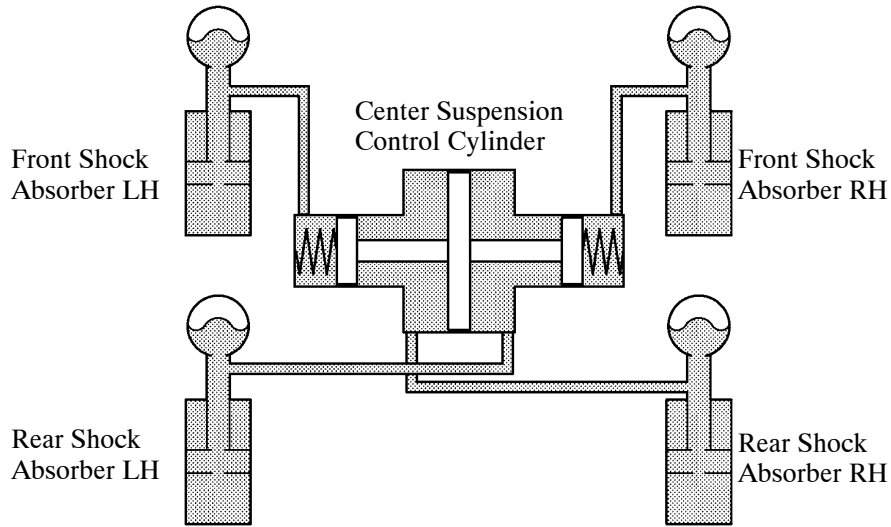
**During Cornering or while Brake Pedal is being Depressed**

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## 4-wheel Related Control

### 1) General

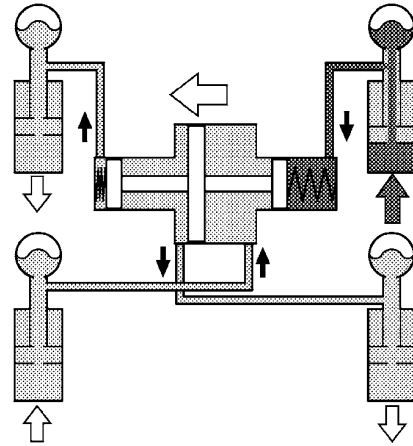
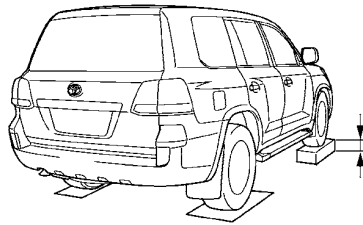
When a hydraulic pressure of one of the shock absorbers has changed because of changes in driving conditions, the 4-wheel related control adjusts the hydraulic pressure for the other shock absorbers through the center suspension control cylinder which is connected to all shock absorbers to stabilize the vehicle posture. When the vehicle is cornering, braking or driving on rough roads, the center suspension control cylinder operates differently through the center suspension control cylinder structure and shock absorber connection method, thereby achieving the optimum on-road and off-road driving performance.



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## 2) Driving under Rough Road Conditions (When an impact force is applied to only one wheel)

When an impact is only applied to the front right wheel during on-road driving, the piston placed inside the center suspension control cylinder moves to the left in accordance with increase in the wheel pressure. This movement prompts the other shock absorbers to expand or contract as shown in the illustration, thereby improving the grounding performance.

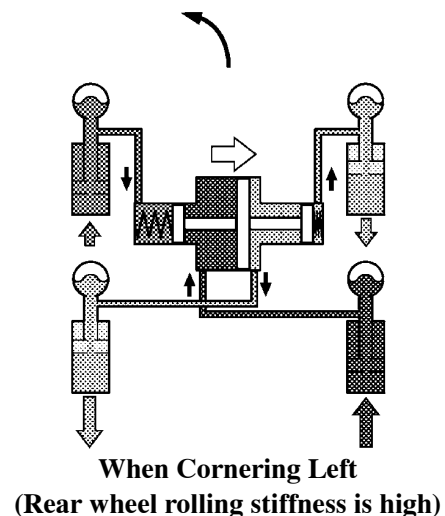
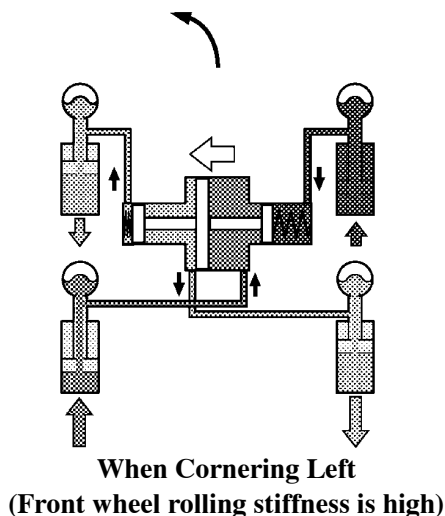


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## 3) While Cornering

As shown in the illustration, when a small load is applied to the rear of the vehicle and the rolling stiffness of the suspension for the front wheels is high, the hydraulic pressure of the front right absorber is high. Then, the piston inside the center suspension control cylinder moves to the left in accordance with changes in the hydraulic pressure balance for each of the wheels. As a result, the pressure is applied to the rear right absorber, and the rear suspension is caused to move in the opposite direction from that of the front suspension.

On the other hand, when a large load is applied to the rear of the vehicle and the rolling stiffness of the suspension for the rear wheels is high, the hydraulic pressure of the rear right absorber is high. Then, the piston inside the center suspension control cylinder moves to the right in accordance with changes in the hydraulic pressure balance for each of the wheels. This optimizes the rolling stiffness distribution regardless of load quantity and improves the steering stability.



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## 9. Fail-safe

- If the suspension control ECU detects a malfunction in the active height control suspension system, the ECU illuminates the master warning light, indicates the warning message “Check 4-WHEEL AHC System” on the multi-information display, and sounds the buzzer to inform the driver of the malfunction.
- When a vehicle can still be driven even if a system malfunction occurs, the vehicle height is automatically returned to the Normal position at a speed of 30 km/h or more.

## 10. Diagnosis

If a system malfunction occurs, DTC (Diagnostic Trouble Code) is stored in memory of the suspension control ECU. This DTC can be read by the following two methods.

- The 5-digit DTC can be read by connecting a Techstream to the DLC3.
- The 2-digit DTC can be read by connecting the SST (09843-18040) between the TC and CG terminals of the DLC3.

For details, see the 2008 LEXUS LX 570 Repair Manual (Pub. No. RM08F0U).

## 11. Active Test

Vehicle height control and damping force control operation in the suspension system can be checked through either of the following two methods:

- Vehicle height and damping force of each wheel can be operated by connecting a Techstream to the DLC3.
- Vehicle height of each wheel can be operated by connecting the terminals of the height control connector.

For details, see the 2008 LEXUS LX 570 Repair Manual (Pub. No. RM08F0U).