

SUSPENSION AND AXLE

■ SUSPENSION

1. General

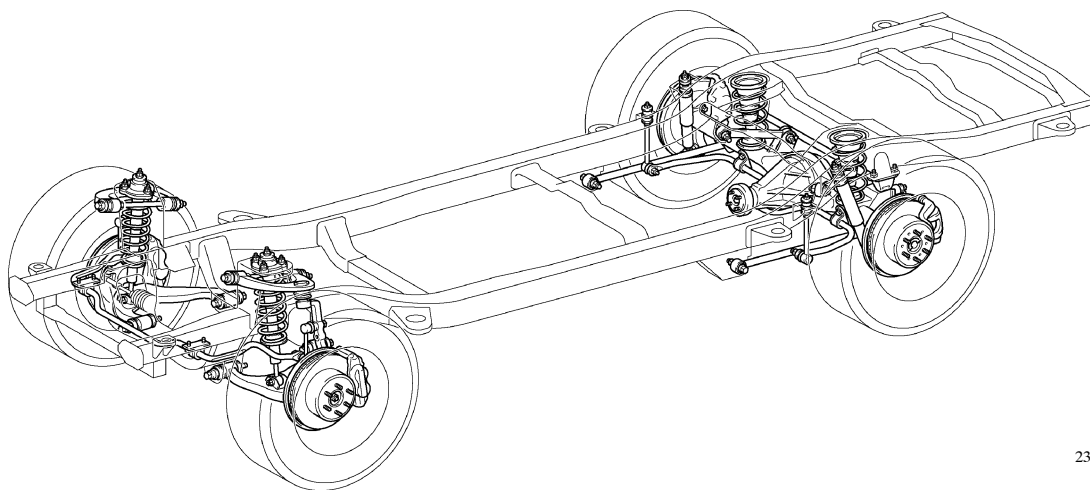
As in the previous Land Cruiser/ Land Cruiser Prado, the double-wishbone independent suspension for front and the 4-link coil spring with lateral rod type suspension for rear are used on the new Land Cruiser/ Land Cruiser Prado. However, these front and rear suspensions have been newly developed in order to ensure the off-road drivability, controllability, and ride comfort of the new Land Cruiser/Land Cruiser Prado.

- Some models for Europe, General Countries, and Australia with the brake control system are available with TEMS (Toyota Electronic Modulated Suspension) and rear air suspension as optional equipment.
- The new Land Cruiser/ Land Cruiser Prado has a suspension with the following equipment:

Destination		Europe	Australia		G.C.C. Countries	General Countries		
Engine Type		1KD	3RZ	1KZ	3RZ	3RZ	5L	1KZ
Suspension	Basic	STD	←	←	←	←	←	←
	TEMS and rear air suspension	OPT*1	—	OPT*2	—	—	—	OPT*2

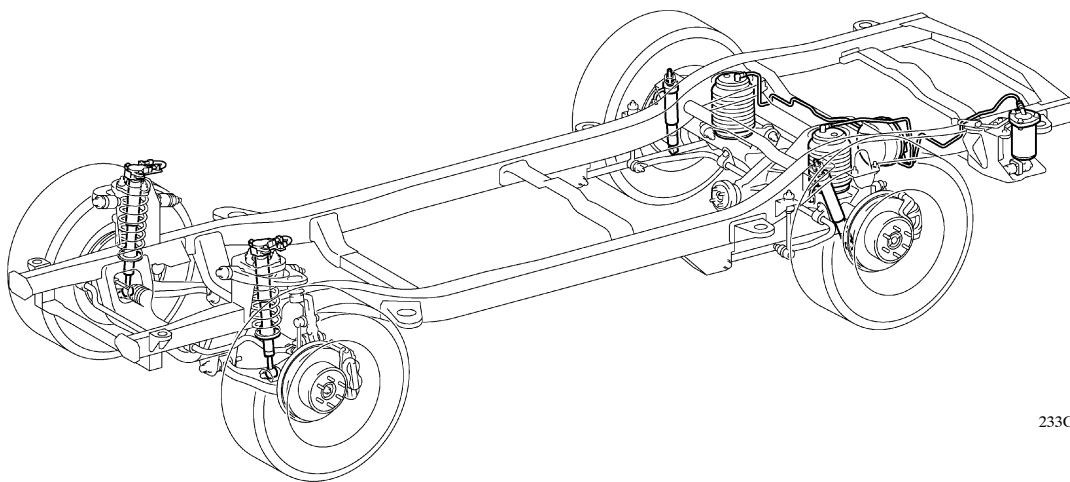
*1: Only for 5-Door model with brake control system

*2: Only for with brake control system models



232CH04

Basic Suspension



233CH53

TEMS and Rear Air Suspension

► Specification ◀

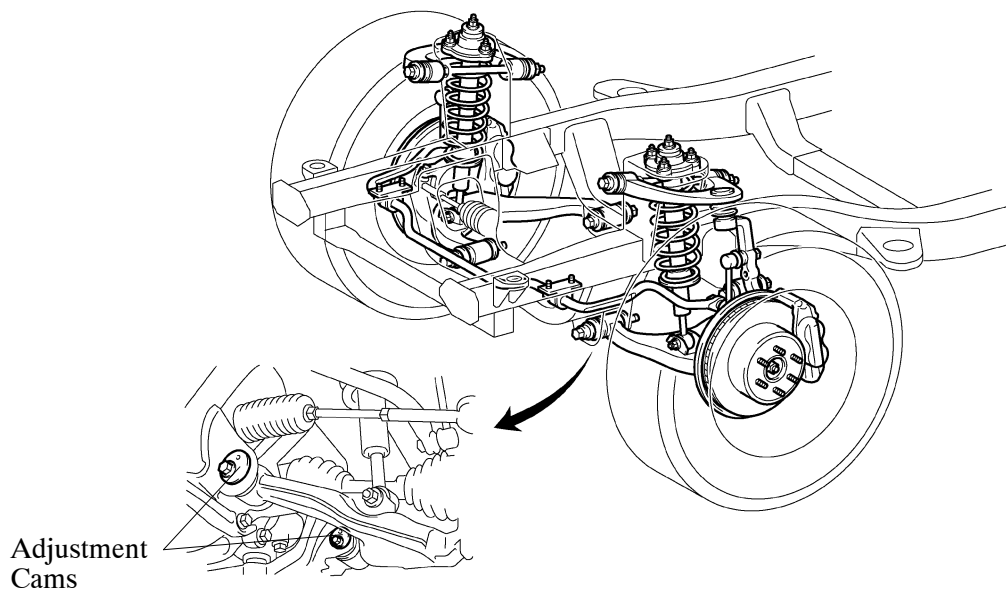
Body Type			3-Door	5-Door
Tread	Front and Rear mm (in.)	225/70 R17 (STD)	1535 (60.4)	←
		265/65 R17 (OPT)	1575 (62.0)	←
Front Wheel Alignment*	Caster degree	Rear Coil Spring	2°41'	2°40'
		Rear Air Suspension	—	2°56'
	Camber degree	Rear Coil Spring	0°16'	0°19'
		Rear Air Suspension	—	0°19'
	Toe-In mm (in.)		1 (0.04)	2 (0.08)
	King Pin Inclination degree	Rear Coil Spring	12°14'	12°11'
		Rear Air Suspension	—	12°11'

*: Unloaded Condition

2. Basic Front and Rear Suspension

Through the optimal allocation of components, and the front and rear suspensions realizes excellent riding comfort, controllability, and off-road drivability.

► Front Suspension ◀

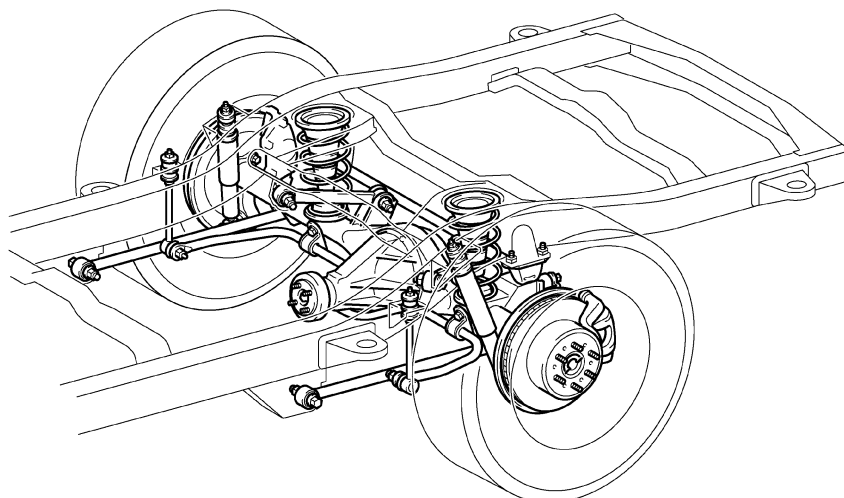


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Service Tip

The camber and caster of the front suspension are adjusted at the adjustment cams of the lower arms, and the toe-in is adjusted by changing the lengths of the tie-rod ends. The basic adjustment procedure is the same as the previous Land Cruiser/ Land Cruiser Prado. For details, refer to Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

► Rear Suspension ◀



232CH07

3. TEMS and Rear Air Suspension

General

Although the TEMS and the rear air suspension are controlled by the suspension control ECU, these systems are independent from each other.

However, these systems share some of the input signals (wheel speed signal, engine speed signal, and stop light switch signal).

TEMS	<ul style="list-style-type: none"> • Through electronic control, TEMS automatically controls the damping force of the shock absorbers, thus realizes excellent riding comfort and controllability. • The TEMS is a semi-active type of suspension. Its suspension control ECU estimates the vehicle conditions based on the signals from the sensors and the absorber control switch. Then, the ECU actuates the actuators of the shock absorbers, vary the flow of the oil, and control the damping force. • Non-linear H^∞ control has been adopted for the basic control of the damping force. • By operation absorber control switch, the driver can select 4 types of damping forces of the shock absorbers.
Rear Air Suspension	<ul style="list-style-type: none"> • This system uses pneumatic cylinders instead of the coil springs that are used in a conventional rear suspension. The suspension control ECU analyzes the information based on the switches, sensors, and input signals, operates the compressor & motor with dryer, and uses the solenoid valves to control the vehicle height. • The suspension control ECU detects, via the 2 height control sensors, the changes in the rear vehicle height that results from the number of occupants or the amount of the load. Then, the suspension control ECU controls the height control solenoid valves and the compressor & motor with dryer in order to automatically adjust the rear vehicle height to a constant (normal) vehicle height. • Furthermore, 3 vehicle heights can be selected by operating the height control switch: HI, Normal, and LO. The HI vehicle height ensures the vehicle's drive-through performance on rough roads. The LO vehicle height facilitates the entry and exit of the occupants and the loading and unloading of cargo. The Normal vehicle height helps realize excellent controllability and riding comfort during normal driving.

— Reference —

- To summarize, H^∞ control is a theory for designing a controller that meets the control specifications that are represented by the H^∞ norm (a unit of measurement of the transfer function of the system). When this is expanded into a non-linear system, it is called “non-linear H^∞ control”.
- The “H” is the initial letter of the mathematician named Hardy (who studied the stability of control systems) who advocated the mathematical space that is handled by this control theory. The “ $^\infty$ ” represents the “ $^\infty$ norm”, which is one of the mathematical units used for measuring the size of the signals.

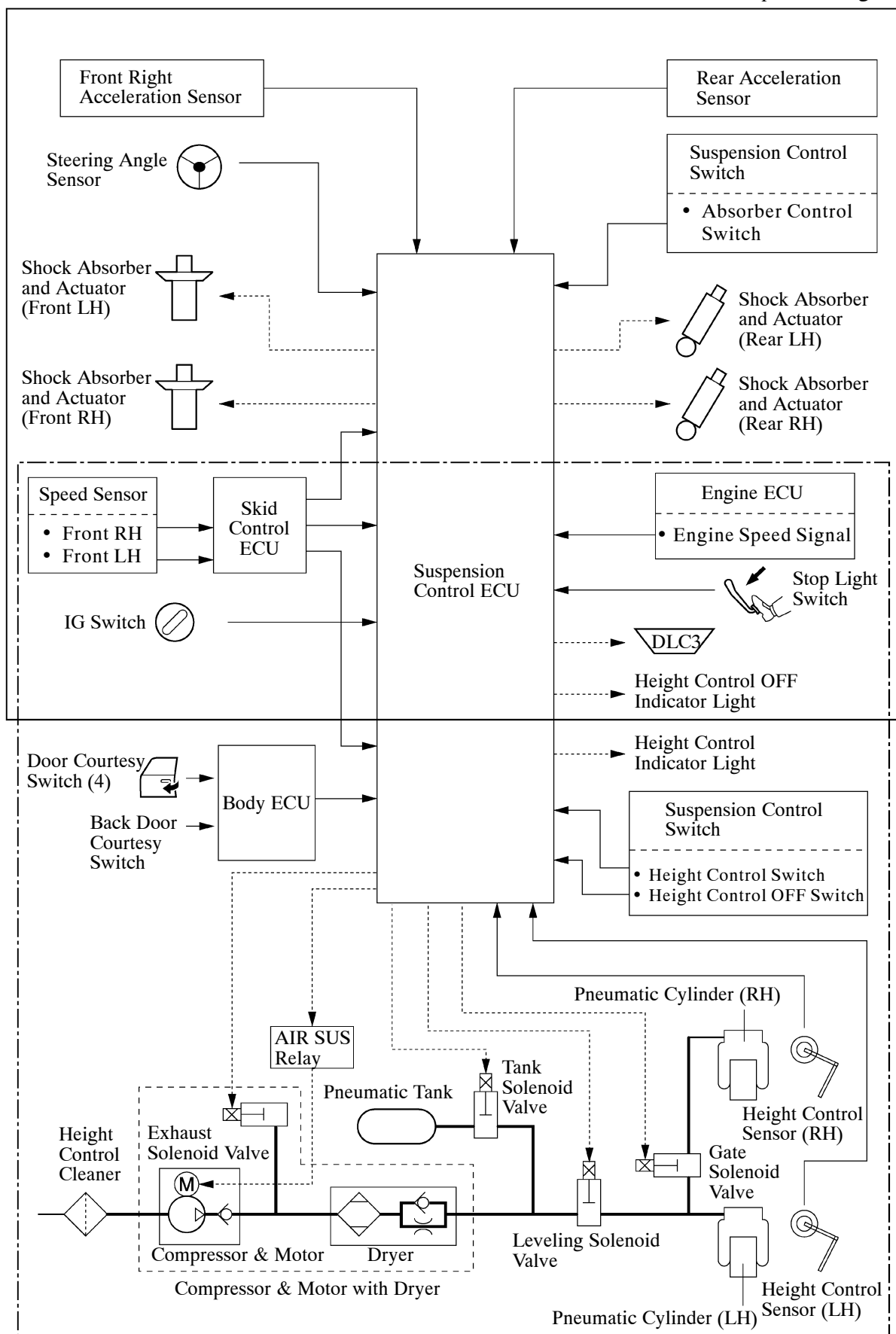
CAUTION

Before raising the vehicle on a jack or hoist, make sure to press the height control OFF switch to prohibit height control.

► System Diagram ◀

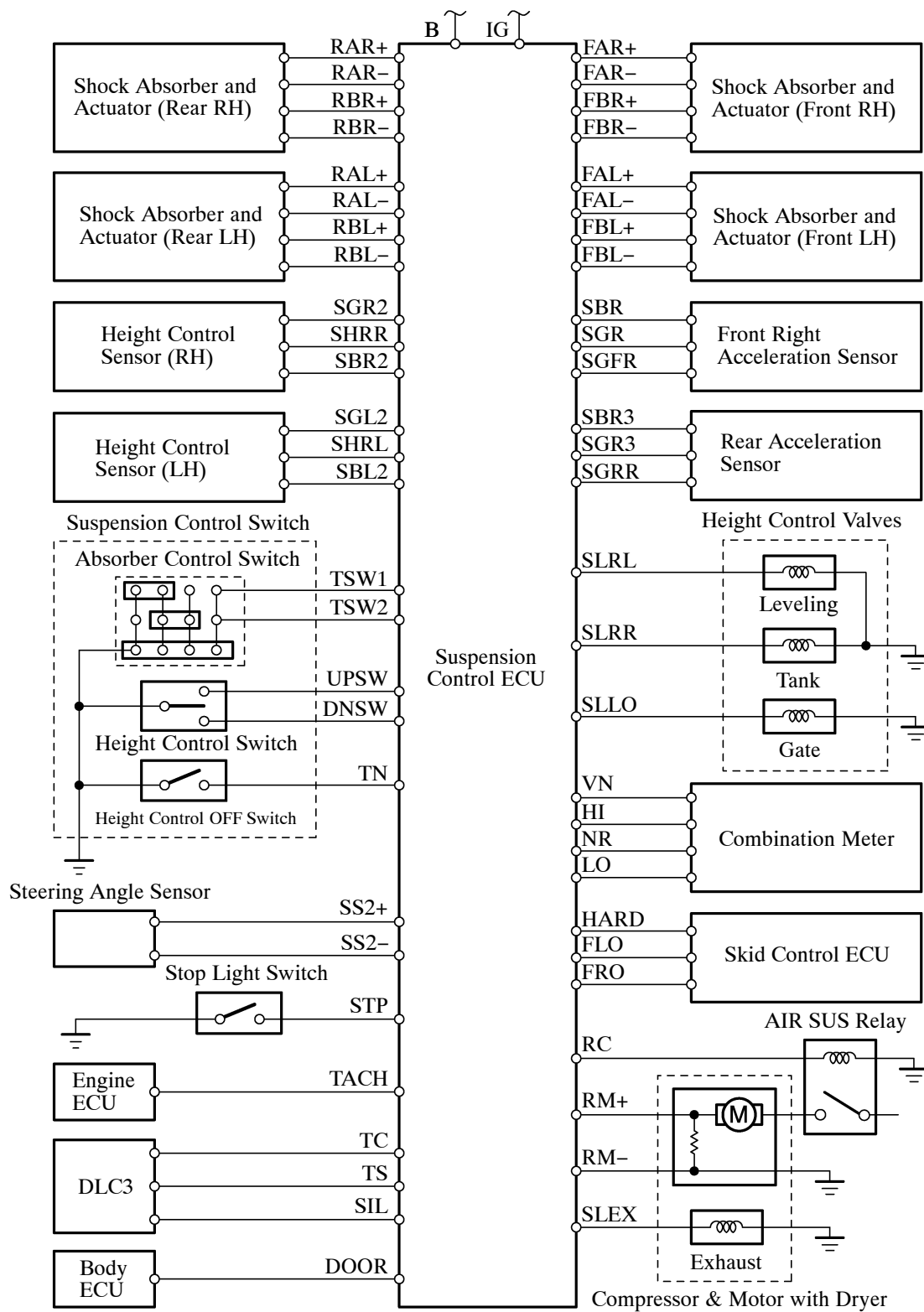
TEMS

*: VSC Operation Signal

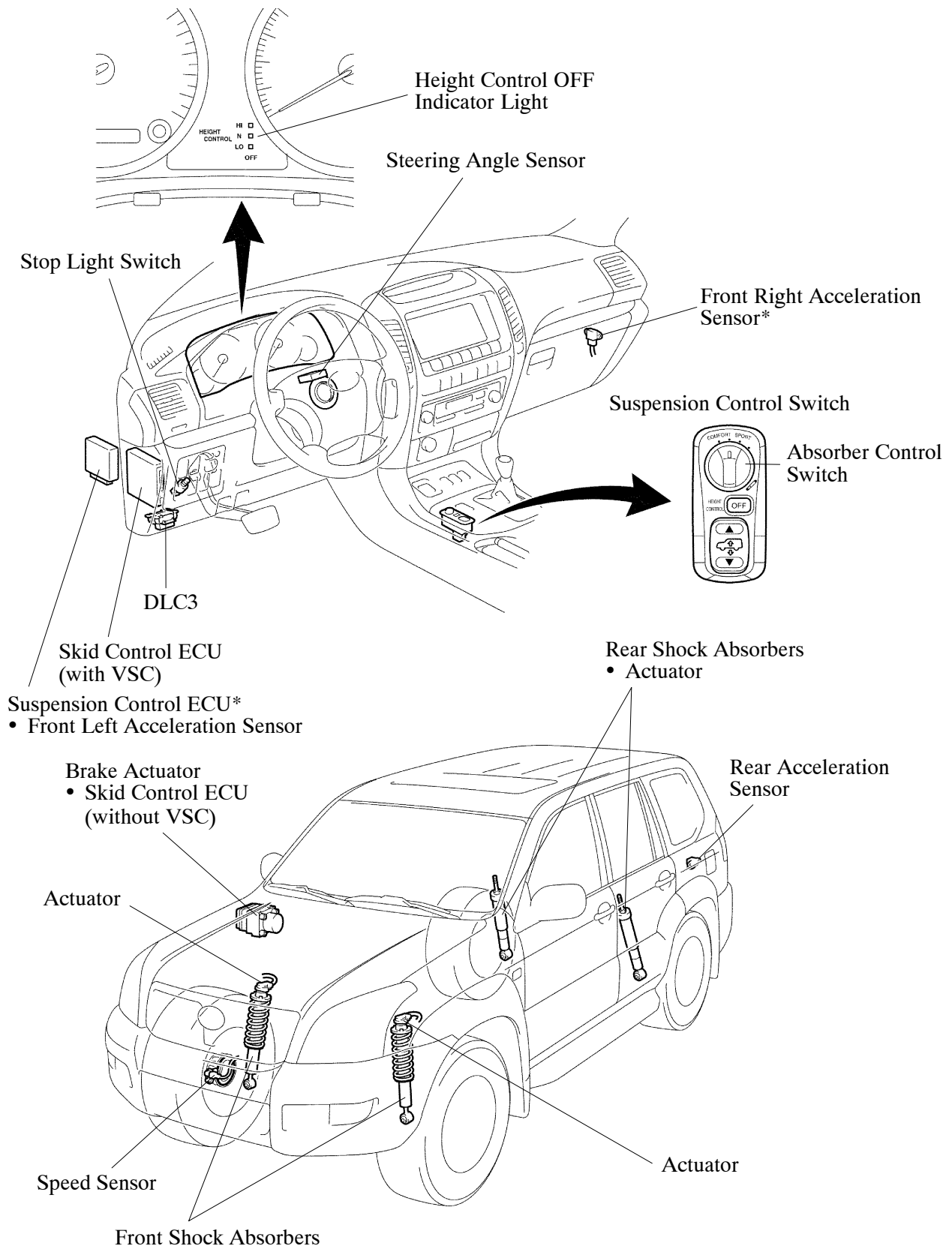


Rear Air Suspension

Wiring Diagram



Layout of Component in TEMS



*: These installation positions remain unchanged on the RHD model.

Function of Component in TEMS

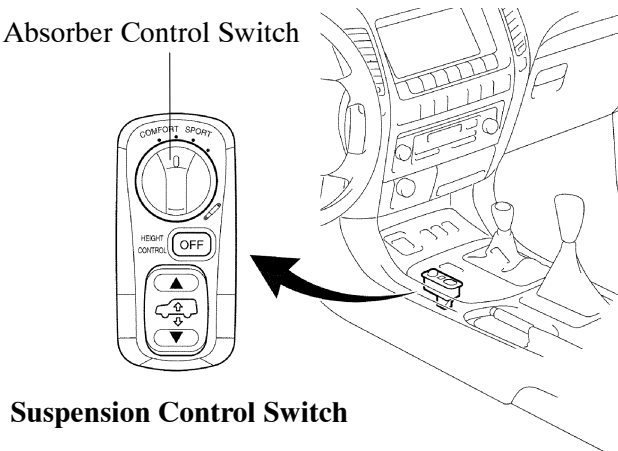
Component		Function
Suspension Control Switch	Absorber Control Switch	Selects the damping force of the shock absorber.
Combination Meter	Height Control OFF Indicator Light	Indicate the DTCs (Diagnostic Trouble Codes) of the TEMS.
Front Right Acceleration Sensor		Detects the vehicle's vertical (front right side) acceleration rate.
Rear Acceleration Sensor		Detects the vehicle's vertical acceleration rate.
Steering Angle Sensor		Detects the steering direction and angle of the steering wheel.
Front Shock Absorber and Actuator		Changes the damping force of the front shock absorber by the suspension control ECU signal.
Rear Shock Absorber (Built in actuator)		Changes the damping force of the rear shock absorber by the suspension control ECU signal.
Engine ECU		Receives the signal of the crankshaft position sensor and sends it to the suspension control ECU.
Skid Control ECU		<ul style="list-style-type: none"> • Receives the signal of the front right speed sensor and sends it to the suspension control ECU. • Sends the VSC operation (front or rear skid condition) signal to the suspension control ECU. (with VSC models)
Front Right Speed Sensor		Detects the wheel speed of the front right wheel.
Stop Light Switch		<ul style="list-style-type: none"> • Detects the brake condition. • Detects the brake pedal depressed to clear of the DTCs.
Suspension Control ECU		<ul style="list-style-type: none"> • Determines the condition of the vehicle based on the signals received from the sensors and switches and sends a control signal to the actuator located in the shock absorber. • Blinks the height control OFF indicator light to output the DTCs (Diagnostic Trouble Codes) of the TEMS.
	Front Left Acceleration Sensor	Uses an internal acceleration sensor to detect the vehicle's vertical (front left side) acceleration rate.

Construction and Operation of Component in TEMS

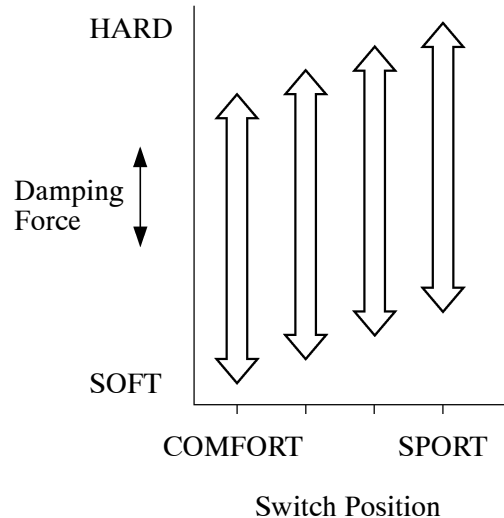
1) Absorber Control Switch

The absorber control switch is integrated in the suspension control switch. This absorber control switch is used a rotary type switch. By operating this switch, the driver can select 4 type of damping forces of the shock absorbers.

Absorber Control Switch



Suspension Control Switch



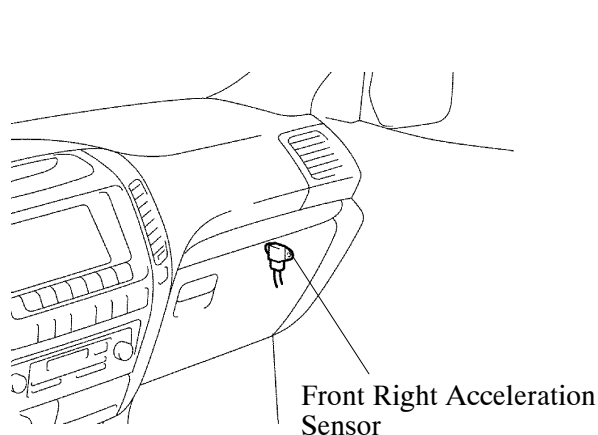
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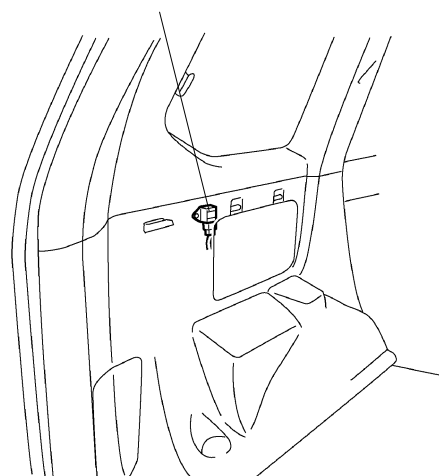
2) Acceleration Sensor

- The front left acceleration sensor is built into the suspension control ECU.
- The front right acceleration sensor is fitted to the instrument panel reinforcement.
- The rear acceleration sensor is fitted to the right roof side inner.
- These sensors are piezoresistive type. When the vehicle accelerates, a piezosistive sensor deflects, thus changing its resistance. The resistance is then converted into an electrical signal in order to output a voltage that is proportionate to the accelerate rate.

Rear Acceleration Sensor



Front Right Acceleration Sensor



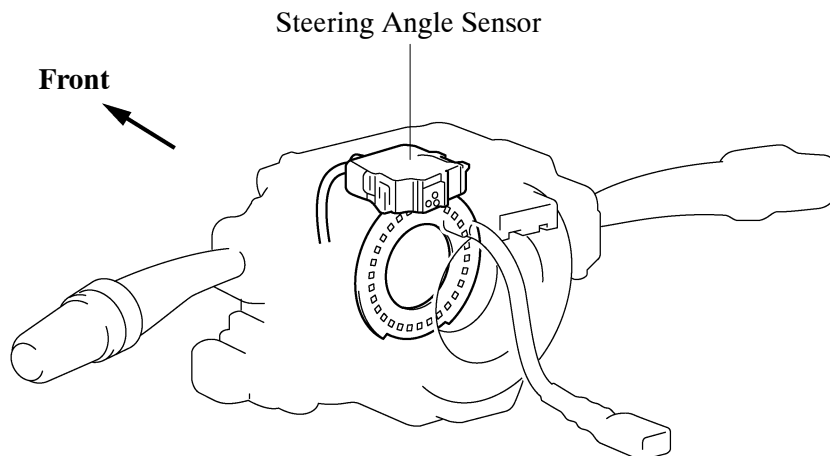
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233CH59

3) Steering Angle Sensor

This sensor contains 3 photo interrupters with different phases, and a slotted disc interrupts the light to the photo transistor turning it ON and OFF to detect the steering direction and angle.

This steering angle sensor is the same steering angle sensor as used for the brake control system (ABS with EBD, A-TRC, VSC, DAC, HAC).

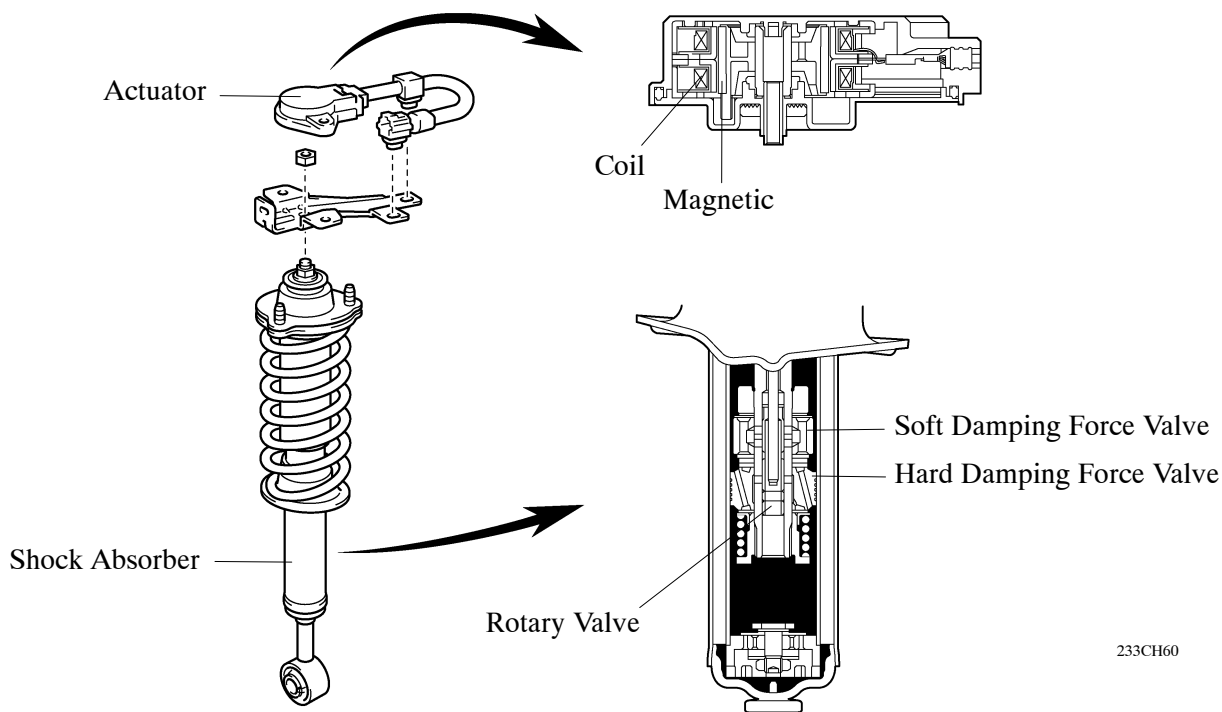


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4) Shock Absorber

Front Shock Absorber and Actuator

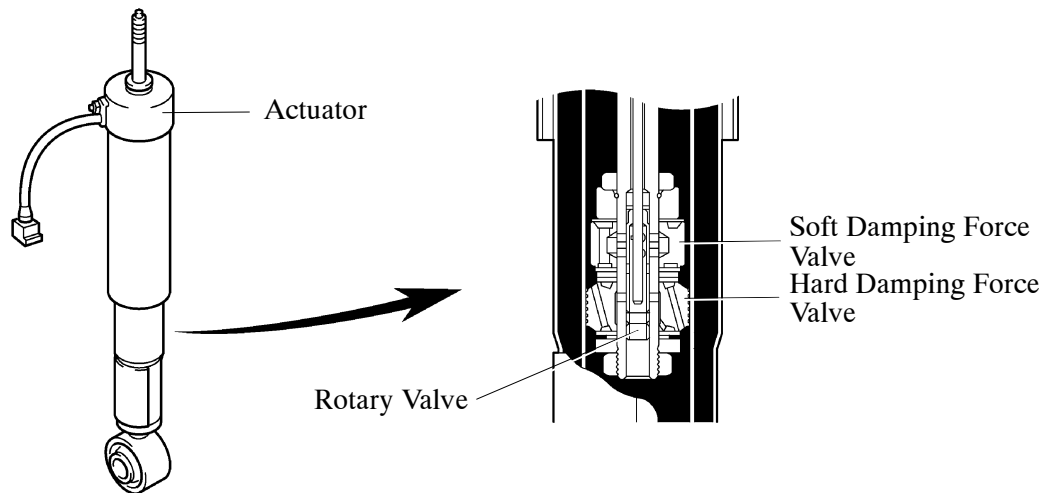
The front shock absorber is equipped with an external actuator. This actuator consists of a step motor and a screw mechanism (which converts the rotational movement to a linear movement). Also, the piston rod is equipped with a rotary valve, a soft damping force valve and a hard damping force valve.



233CH60

Rear Shock Absorber (built-in Actuator)

The piston rod of the shock absorber is equipped with an internal actuator. This actuator consists of a step motor and a screw mechanism (which converts the rotational movement to a linear movement). Also, the piston rod is equipped with a rotary valve, a soft damping force valve and a hard damping force valve.



233CH61

TEMS Control

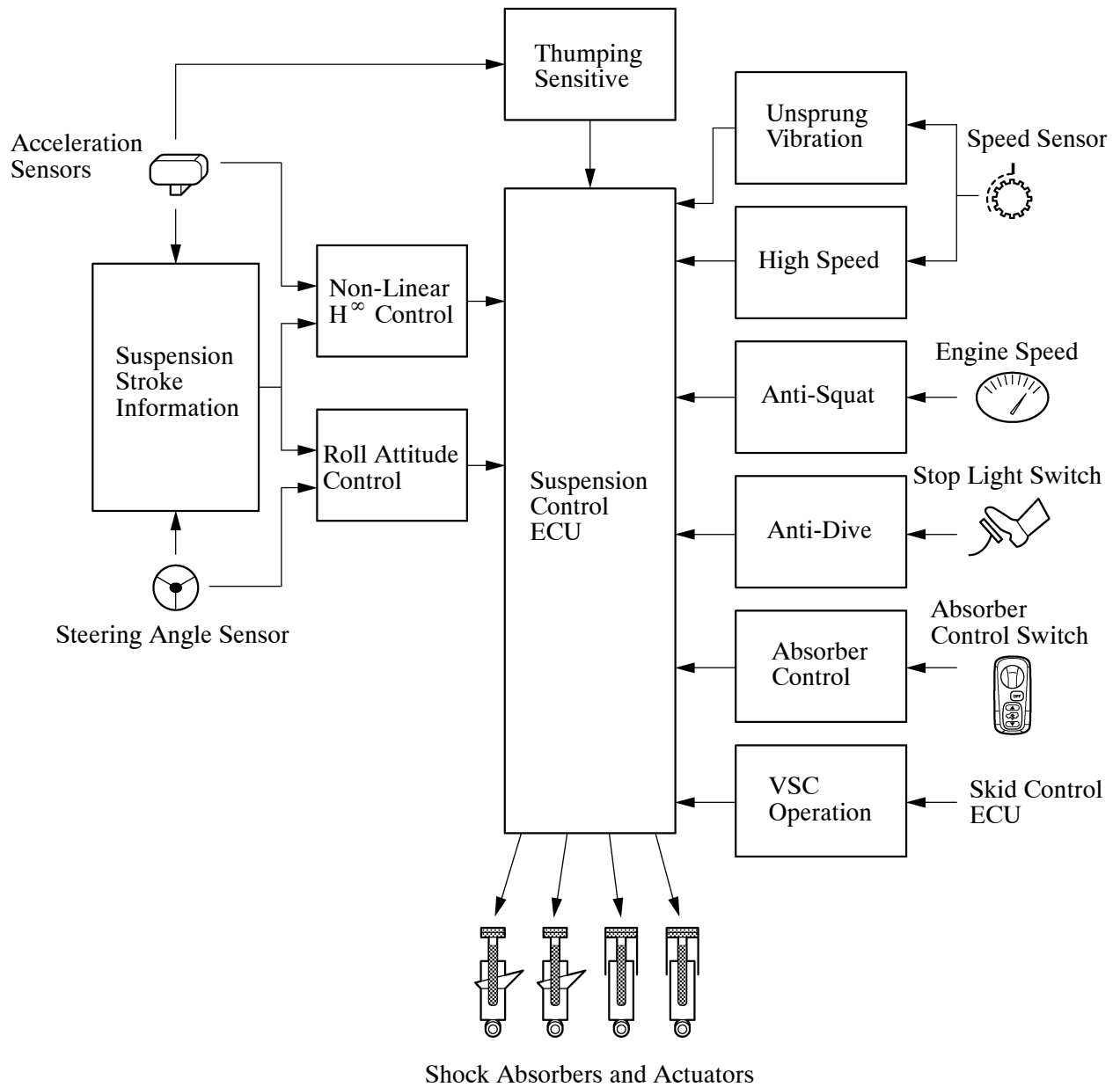
1) General

The TEMS has the following controls:

Control	Function
Non-Linear H^∞ Control	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 ensuring a high level of vibration damping performance.
Thumping Sensitive Control	When the road surface condition does not require a damping force, this function controls the shock absorbers so that their damping force will not increase.
Unsprung Vibration Control	If unsprung resonance is detected, this function controls so that the damping force will not decrease below a certain level, in order to reduce the unsprung resonance.
Roll Attitude Control	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 at a softer variable range at low speeds, and at a firmer variable range at high speeds.
Absorber Control	The absorber control switch enables the driver to select a desired damping force from the 4 modes.
VSC Operation Control*	Changes the damping force to control the vehicle posture during VSC operation (front or rear skid). As a result, road-holding performance has been realized during VSC operation.
Fail-Safe	When the suspension control ECU detected a malfunction, the control of the damping force will be limited.
Diagnosis	When the suspension control ECU detects a malfunction, the suspension control ECU makes a diagnosis and memorizes the failed section.

*: Only for with VSC model

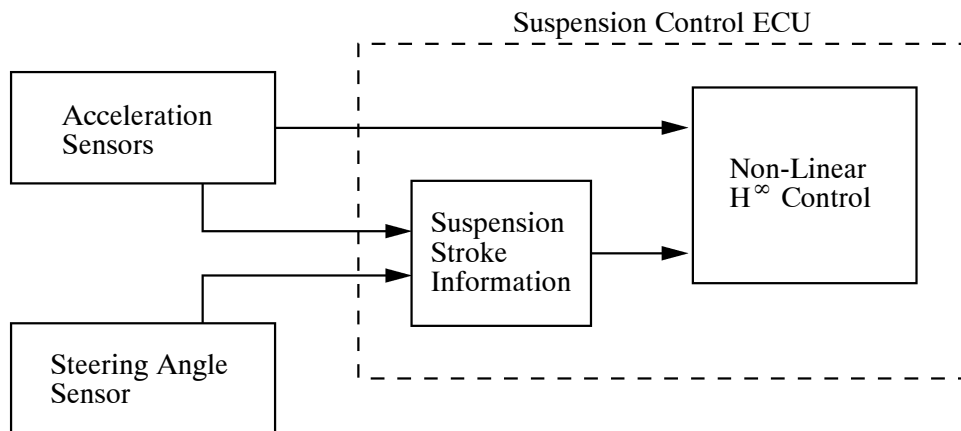
2) Control Diagram



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3) Non-Linear H^∞ Control

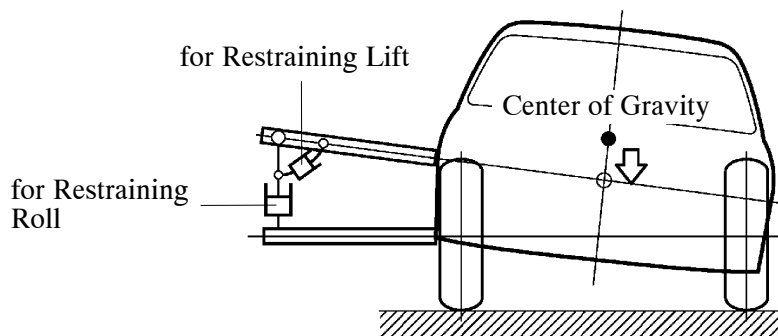
- This control smoothly changes the damping force to a target value in accordance with the changes in the road surface or driving conditions. Thus, excellent ride comfort has been realized while ensuring a high level of vibration damping performance.
- To effect this control, the suspension stroke information is calculated based on the sprung acceleration rate from the 3 acceleration sensors and the information from the steering angle sensor. Thus the driving conditions of the vehicle are detected.



211CH46

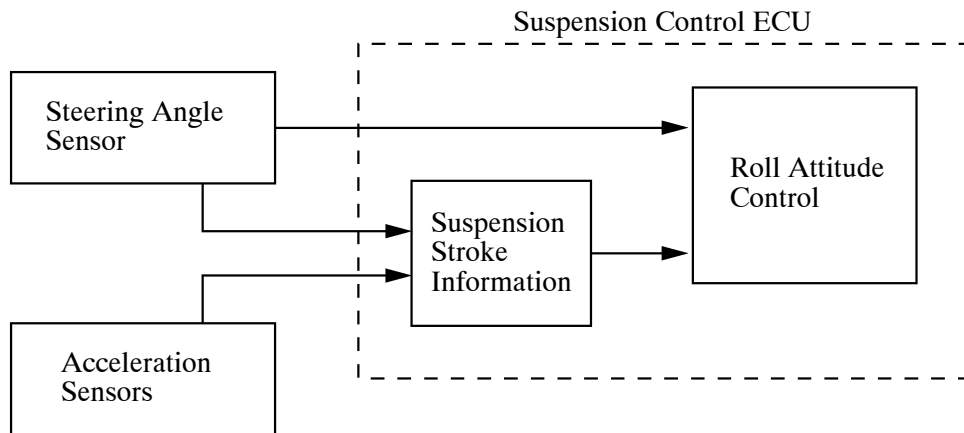
4) Roll Attitude Control

- 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 shock absorbers, (one for restraining roll and the other for restraining lift) are provided at an imaginary point on 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.



211CH54

- 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.



211CH46

5) Diagnosis

Diagnosis function has a DTC output, input signal check (test mode), active test, and fail- safe.

If the suspension control ECU detects a malfunction in this system, it blinks the height control OFF indicator light to alert the driver of the malfunction. This ECU will also store the codes of the malfunctions. The DTC (Diagnostic Trouble Code) can be accessed through the blinking of the height control OFF indicator light by connecting the SST (09843-18040) between the Tc and CG terminals of DLC3 or the use of a hand-held tester. For details, see the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

► DTC Chart ◀

DTC No.	Detection Item	DTC No.	Detection Item
C1715/ 15	Open or short circuit in right front acceleration sensor circuit	C1728/ 24	Open or short circuit in left rear absorber control actuator circuit
C1716/ 16	Open or short circuit in left front acceleration sensor circuit	C1761/ 61	ECU malfunction
C1717/ 17	Open or short circuit in rear acceleration sensor circuit	C1774/ 74	Power voltage drop
C1725/ 21	Open or short circuit in right front absorber control actuator circuit	C1776/ 76	Speed sensor circuit malfunction
C1726/ 22	Open or short circuit in left front absorber control actuator circuit	C1777/ 77	Open or short circuit in steering angle sensor circuit
C1727/ 23	Open or short circuit in right rear absorber control actuator circuit	C1779/ 79	Crankshaft position sensor circuit

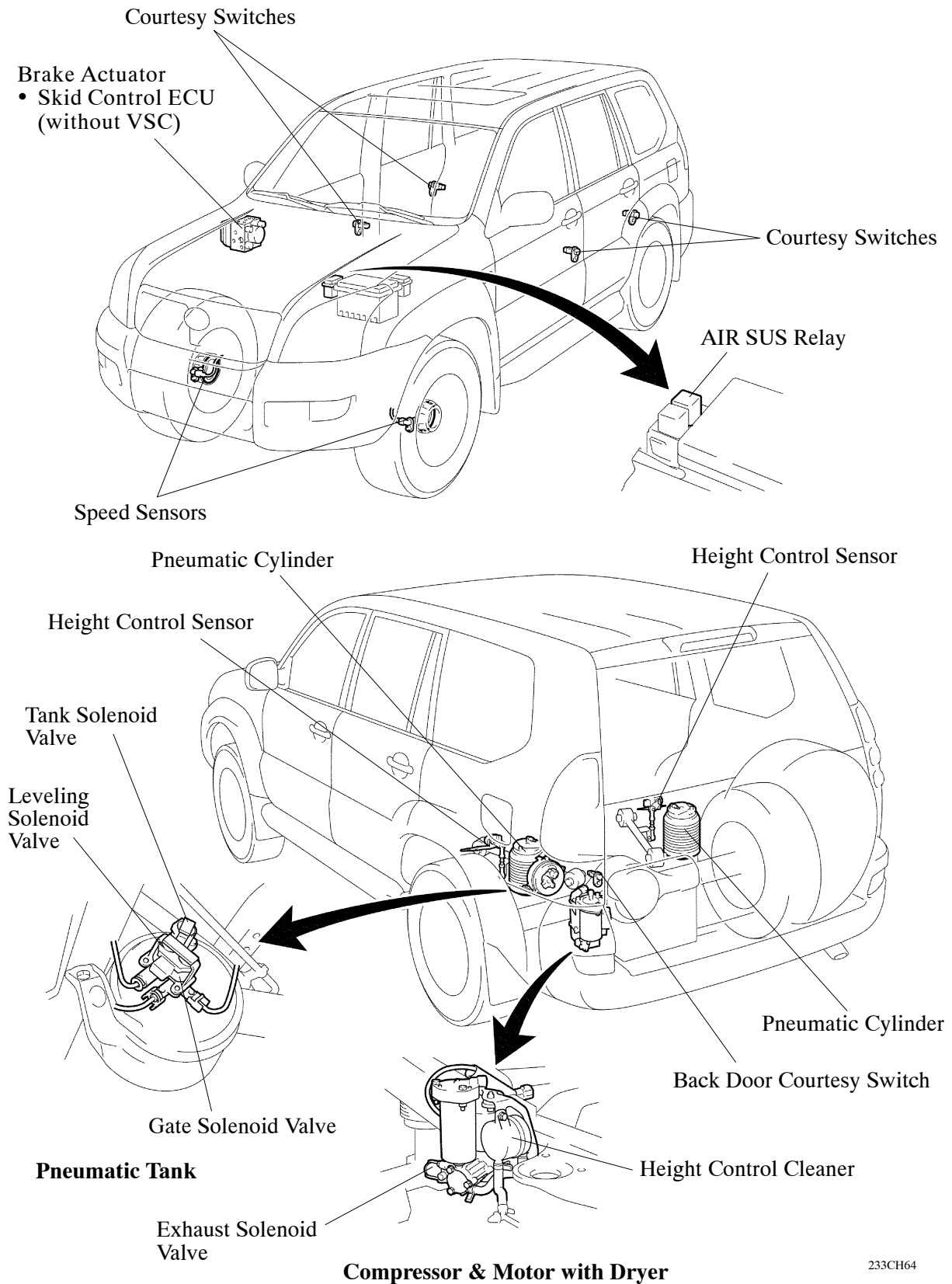
- The operation of the sensors and the switches can be inspected in the input signal check (test mode). For details, refer to the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

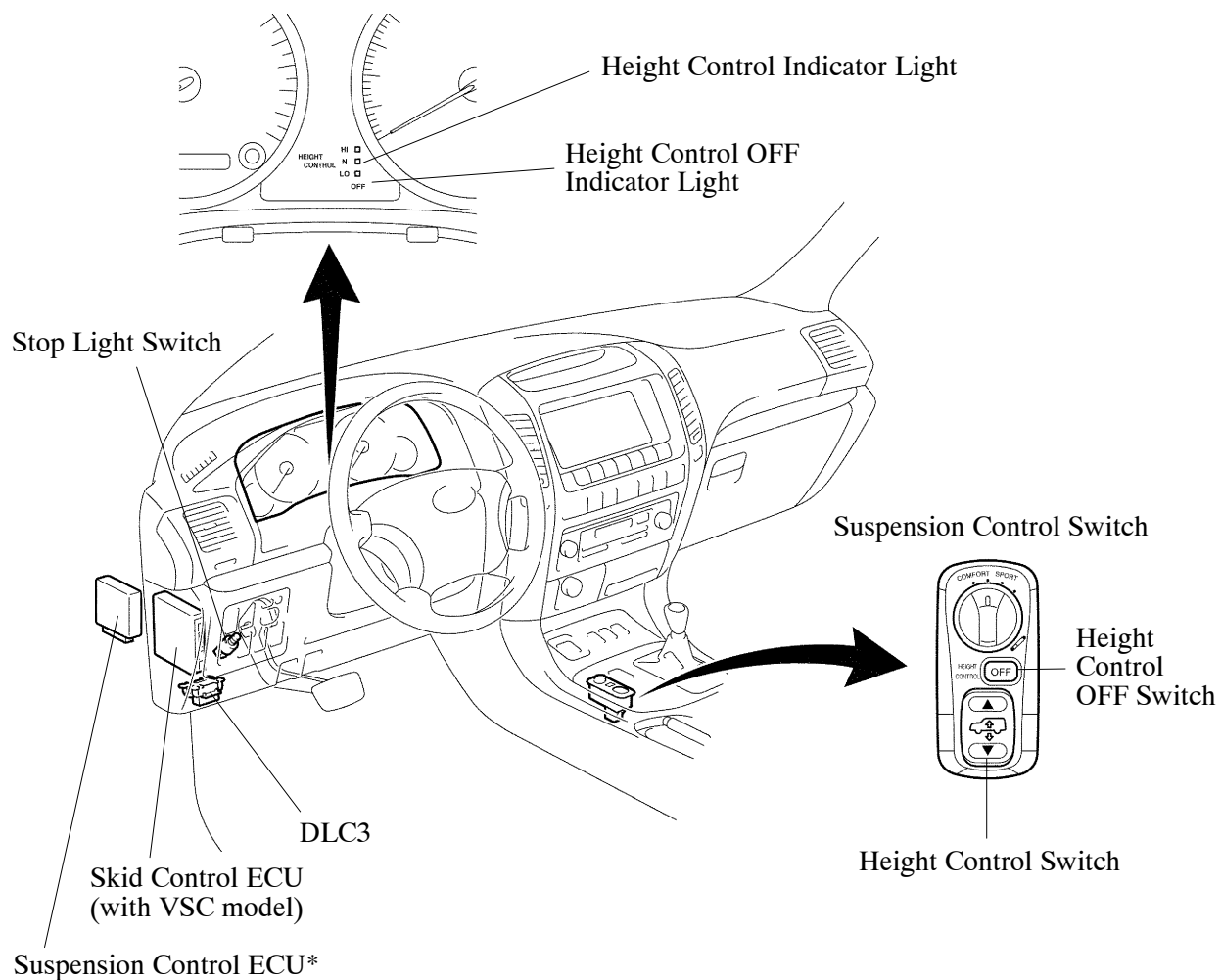
► DTC Chart of the Input Signal Check (Test Mode) ◀

DTC No.	Detection Item	DTC No.	Detection Item
C1787/ 87	Absorber control switch malfunction	C1793/ 93	Open or short circuit in rear acceleration sensor circuit
C1791/ 91	Open or short circuit in right front acceleration sensor circuit	C1794/ 94	Right front speed sensor circuit malfunction
C1792/ 92	Open or short circuit in left front acceleration sensor circuit	C1797/ 97	Crankshaft position sensor circuit malfunction

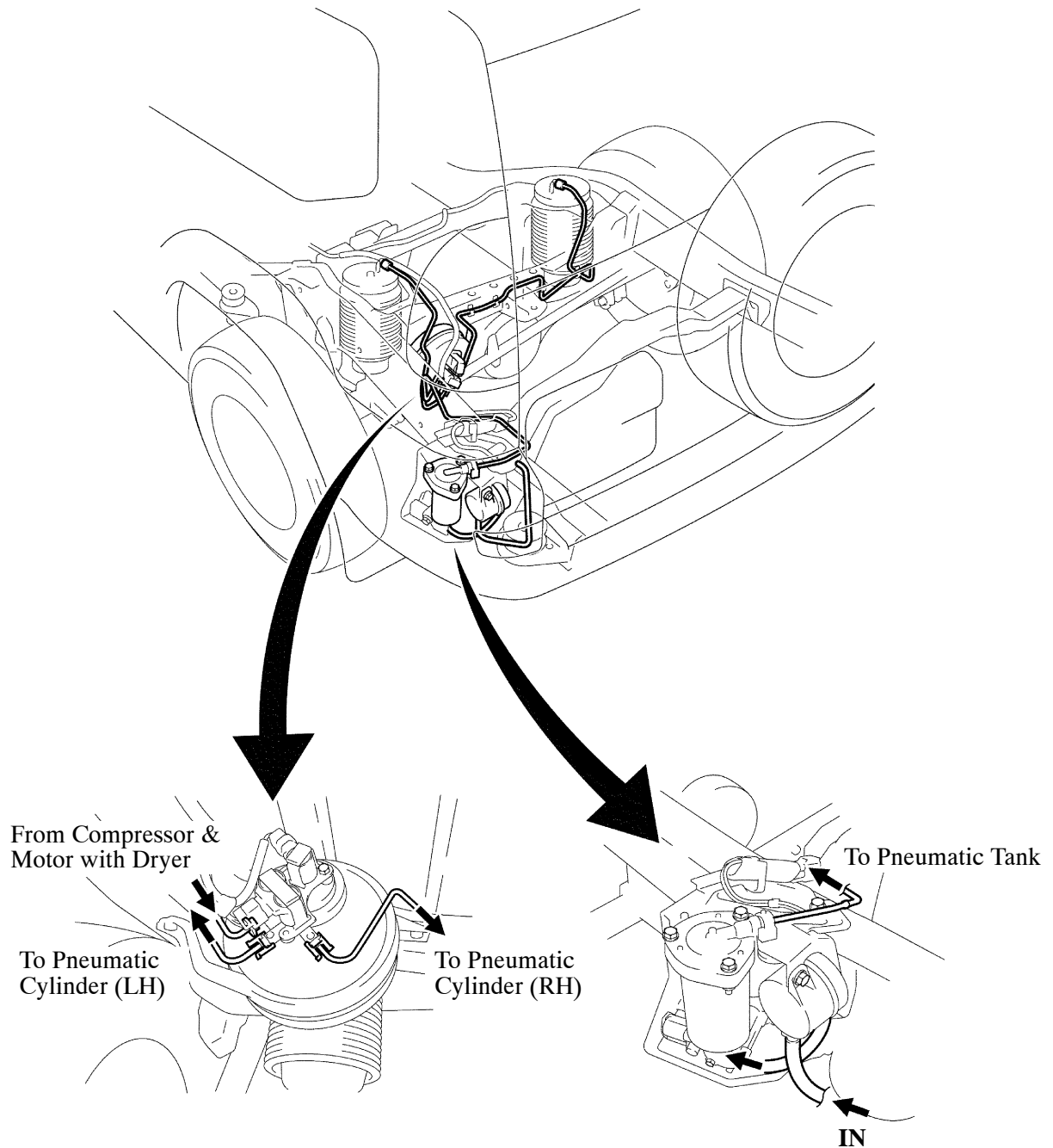
- A hand-held tester can use to activate the actuators for inspecting their operation (active test). For details, refer to the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

Layout of Main Component in Rear Air Suspension





*: This installation positions remain unchanged on the RHD model.

Air Suspension Tubing Diagram

233CH66

Service Tip

Quick joints are used for connecting the air suspension tubes. As a result, the ease of operation and service has been ensured. Make sure to use the SST (09730-00010) to disconnect the joints. For details, see the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

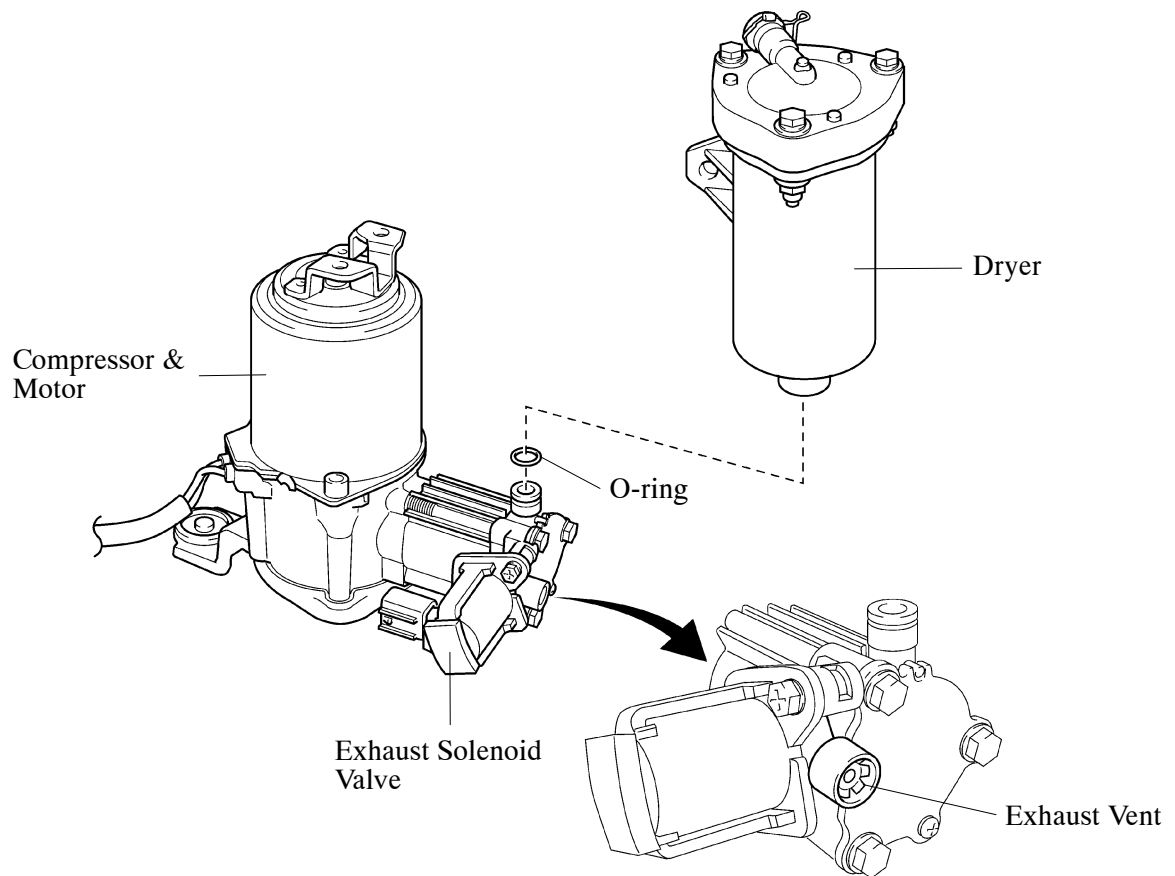
Function of Component in Rear Air Suspension

Component		Function
Suspension Control Switch	Height Control Switch	Selects the target vehicle height.
	Height Control OFF Switch	Prohibits the adjustment of the vehicle height.
Combination Meter	Height Control Indicator Light (3)	Indicates the present vehicle height condition (HI, Normal, LO).
	Height Control OFF Indicator Light	<ul style="list-style-type: none"> • Lights to inform the driver when the height control is turned OFF by the height control OFF switch. • Blinks to alert the driver when the suspension control ECU detects the malfunction in the rear air suspension. • Indicate the DTCs (Diagnostic Trouble Codes) of the rear air suspension.
Compressor & Motor with Dryer		<ul style="list-style-type: none"> • Supplies compressed air to increase the vehicle height. • Removes moisture in the compressed air.
	Exhaust Solenoid Valve	Discharges compressed air to atmosphere from pneumatic cylinder to lower the vehicle.
Height Control Cleaner		Removes dust and sand from the internal air.
Pneumatic Cylinder (2)		Supports the vehicle body and adjusts the vehicle height.
Pneumatic Tank		Temporarily stores the exhaust air during the vehicle height down operation.
	Tank Solenoid Valve	Opens/ closes the compressed air path between the pneumatic tank and right and left pneumatic cylinders.
	Leveling Solenoid Valve	Opens/ closes the compressed air path between the compressor and pneumatic cylinder.
	Gate Solenoid Valve	Opens/ closes the compressed air path between the right and left pneumatic cylinder.
Height Control Sensor (2)		Detects the vehicle height (distance between the vehicle body and road).
Door Courtesy Switch (4)		Detects the open/ close condition of the doors.
Back Door Courtesy Switch		Detects the open/ close condition of the back door.
Body ECU		Receives the signals of the 4 door courtesy switches and the back door courtesy switch sends it to the suspension control ECU.
AIR SUS Relay		Supply the electricity to the compressor & motor with dryer.
Front Right and Left Speed Sensors		Detects the wheel speeds of the front right and left wheels.
Skid Control ECU		Receives the signals of the front right and left speed sensors and sends them to the suspension control ECU.
Suspension Control ECU		<ul style="list-style-type: none"> • Controls the vehicle height according to the operation modes. • Blinks the height control OFF indicator light to alert the driver when the suspension control ECU detects a malfunction in the rear air suspension. • Blinks the height control OFF indicator light to output the DTCs (Diagnostic Trouble Codes) of the rear air suspension.

Construction and Operation of Main Component in Rear Air Suspension

1) Compressor & Motor with Dryer

- The compressor and motor are used to make the compressed air necessary for raising the vehicle height.
An exhaust solenoid valve is provided on the compressor & motor. The exhaust solenoid valve discharges compressed air from the pneumatic cylinders to the atmosphere in order to lower the vehicle.
- To protect the battery, this compressor & motor with dryer operates only when the engine is running.
- The dryer is used to eliminate the moisture in the compressed air made by the compressor and motor, and the exhaust valve to drain the compressed air out to the atmosphere from the pneumatic cylinders.



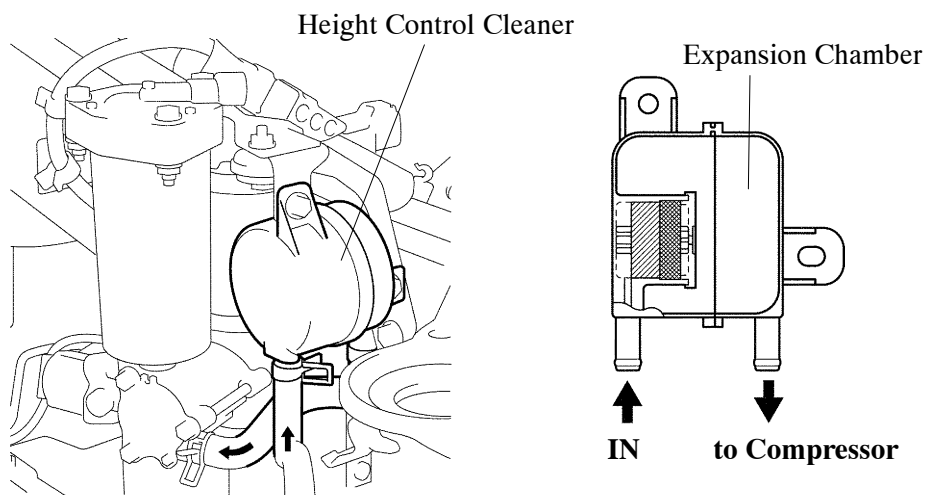
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► Specification ◀

Motor	Type	DC
	Rated Voltage	12 V
Exhaust Solenoid Valve	Rated Voltage	12 V
	Operating Voltage Range	10 – 15 V
	Resistance	10 – 14 Ω

2) Height Control Cleaner

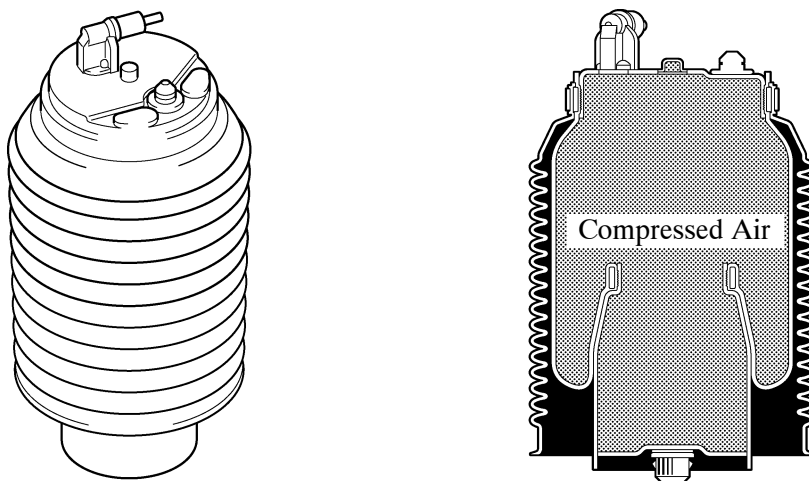
- The height control cleaner consists of a filter to remove dust and debris, and an expansion chamber to reduce the intake sound. In consideration of dusty areas, this cleaner draws air from the inside of the vehicle cabin.
- This cleaner cannot be disassembled; therefore, it is not possible to replace only the filter element.



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3) Pneumatic Cylinder

Pneumatic cylinder consists of a single type air chamber with a large compressed air capacity in order to realize excellent riding comfort.



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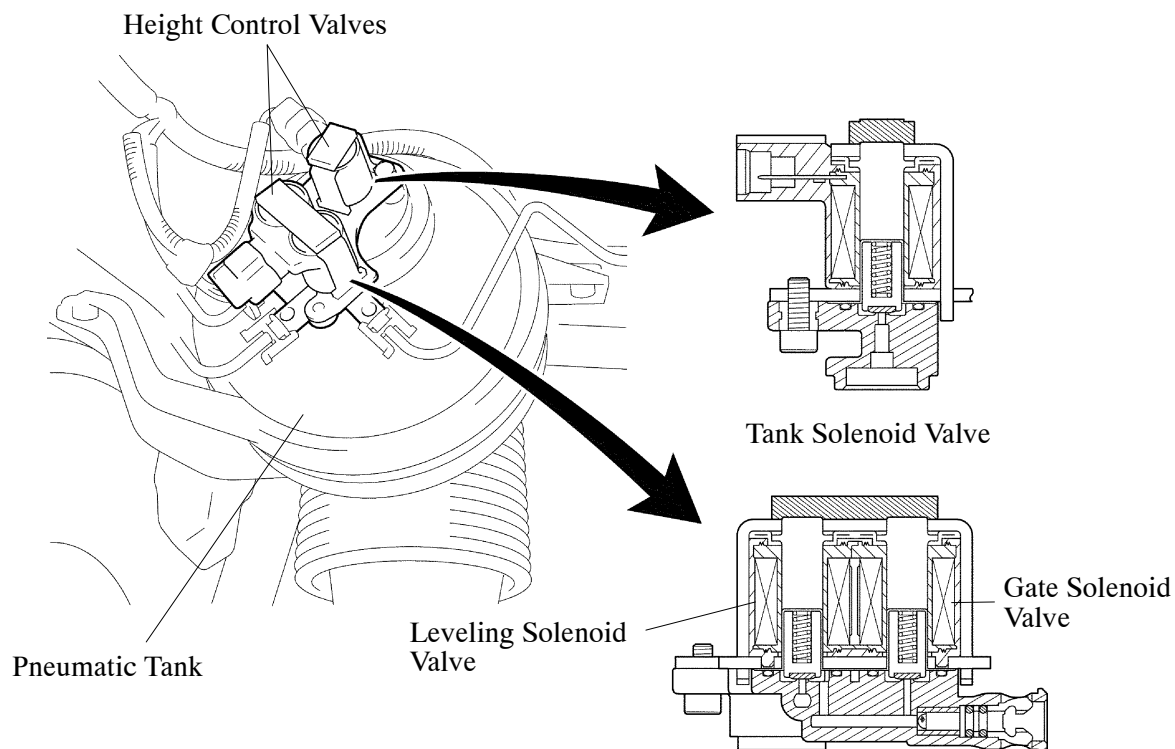
Service Tip

To remove a pneumatic cylinder, perform the operation by supporting the frame, raising the rear axle on a jack, and leaving the shock absorbers attached in place.

For details, see the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

4) Pneumatic Tank

- The pneumatic tank, which temporarily stores the exhaust air from the pneumatic cylinders, contributes in reducing the length of time that is required for lowering the vehicle height.
- The height control valve consists of a leveling solenoid valve, gate solenoid valve, and tank solenoid valve.



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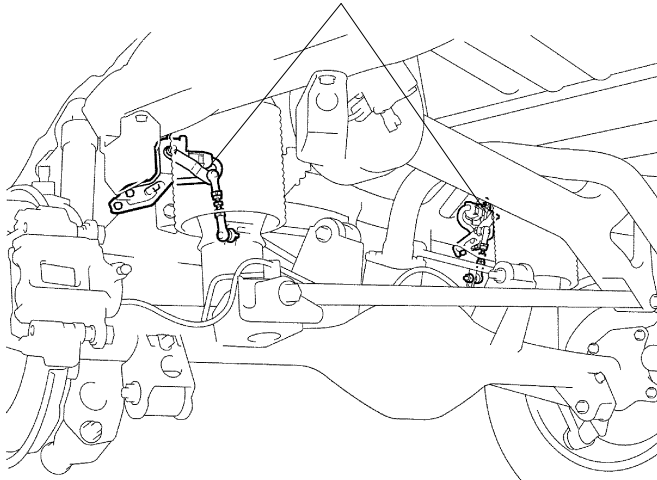
► Specification ◀

Height Control Valve	Leveling & Tank Solenoid Valve	Rated Voltage	12 V
		Operating Voltage Range	10 – 15 V
		Resistance	10 – 14 Ω
	Gate Solenoid Valve	Rated Voltage	12 V
		Operating Voltage Range	10 – 15 V
		Resistance	17.5 – 21.5 Ω

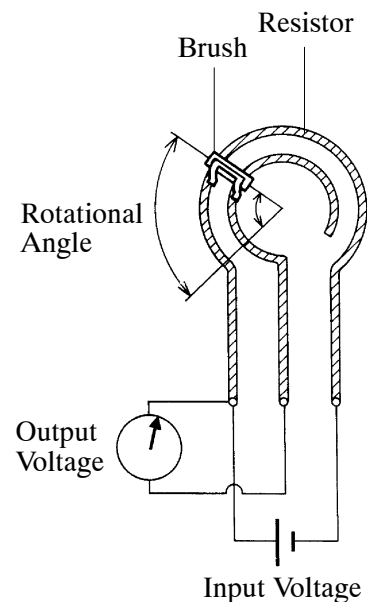
5) Height Control Sensor

The height control sensors detect the vehicle's height. There are two rear height control sensors, one for the right, and the other for the left. This sensor consists of a brush that is integrated with a shaft, which slides on the resistor that is formed on a substrate. Because the resistance value between the brush and the resistor terminal varies in proportion to the shaft's rotational angle, a prescribed amount of voltage is applied to the resistor so that a change in the rotational angle can be detected in the form of a voltage change.

Height Control Sensors



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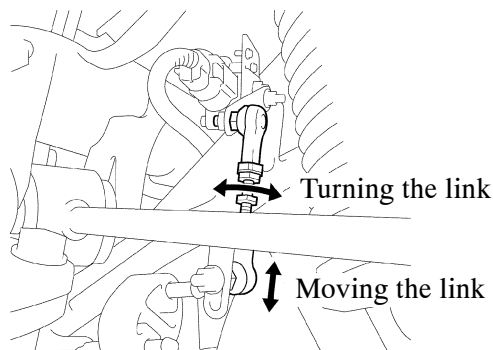
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Diagram of the Principle

Service Tip

Refer to the following factors when adjusting the link of the height control sensor:

- Vehicle height will be changed approximately 3 mm (0.12 in.) if moving both link installation positions approximately 1 mm (0.04 in.) simultaneously.
- Vehicle height will be changed approximately 6 mm (0.24 in.) if rotating both links once simultaneously.



232CH18

Rear Air Suspension Control

1) General

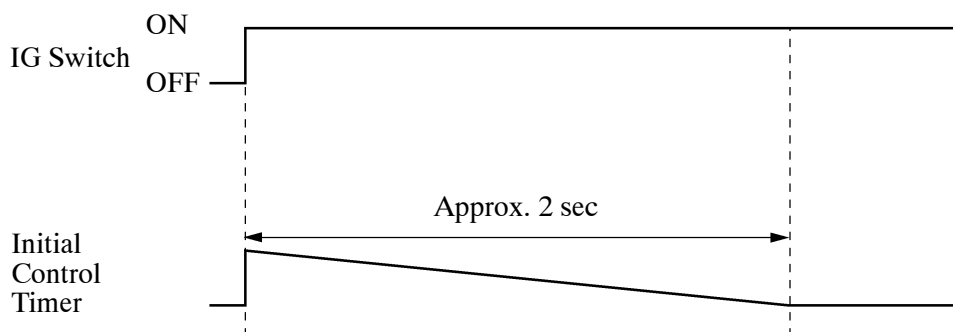
Rear air suspension control effects the following controls:

System Operation		Outline
Initial Control		To initialize the system, this control is effected each time the ignition switch is turned ON.
Reflash Control		Eliminates the difference in the compressed air pressure between the right and left pneumatic cylinders.
Exhaust Control		Automatically exhausts the compressed air that is temporarily stored in the pneumatic tank during the vehicle height down operation.
Vehicle Height Control	Automatic Height Control	Maintains a constant rear vehicle height regardless of the number of occupants or the amount of load.
	Vehicle Height Switching	The vehicle height (HI, Normal, or LO) can be set as desired by the driver by operating the height control switch.
	Vehicle Speed Sensing	Even if the vehicle height is set to HI or LO by the height control switch, this function automatically resumes to the normal vehicle height if the vehicle speed is higher than a prescribed speed [LO: 12 km/h (7 mph), HI: 50 km/h (31 mph)].
	Key OFF Operation	If an occupant exits the vehicle when the ignition key is OFF, causing the vehicle height to rise, this function corrects the vehicle height by lowering it for a prescribed length of time.
	Vehicle Height Control OFF	Pressing the height control OFF switch prohibits height control.
Suspension Control	Normal Control	Shuts off the right and left pneumatic cylinders by closing the gate solenoid valve, in order to ensure the proper rolling rigidity.
	Off-road Control	Connects the right and left pneumatic cylinders by opening the gate solenoid valve, in order to ensure the proper drive-through performance on very bumpy roads.
Diagnosis		When the suspension control ECU detects a malfunction in this system, it blinks the height control OFF indicator light to inform the driver of the malfunction.

2) Initial Control

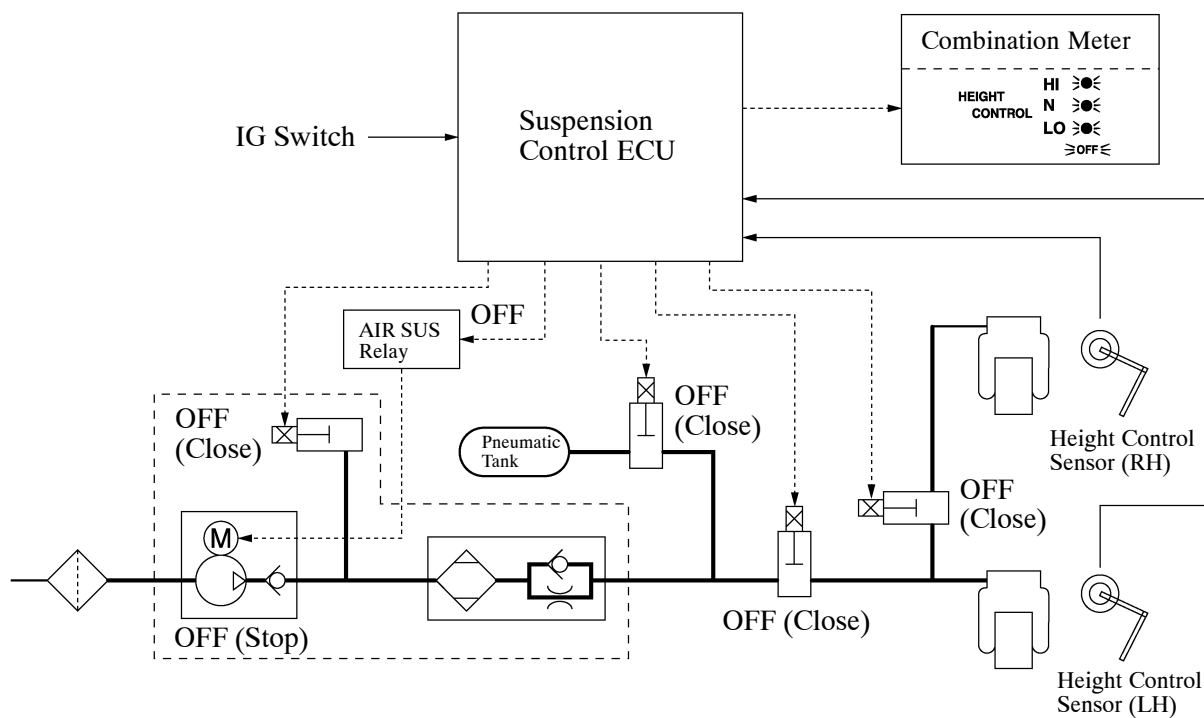
For approximately 2 seconds after each time the ignition switch is turned ON, the suspension control ECU performs the initial control in accordance with the timing chart shown below. During this control, the suspension control ECU stops all the actuators except the height control motor relay, and illuminates all the indicator lights to check their bulbs.

► Timing Chart ◀



232CH99

► System Diagram ◀



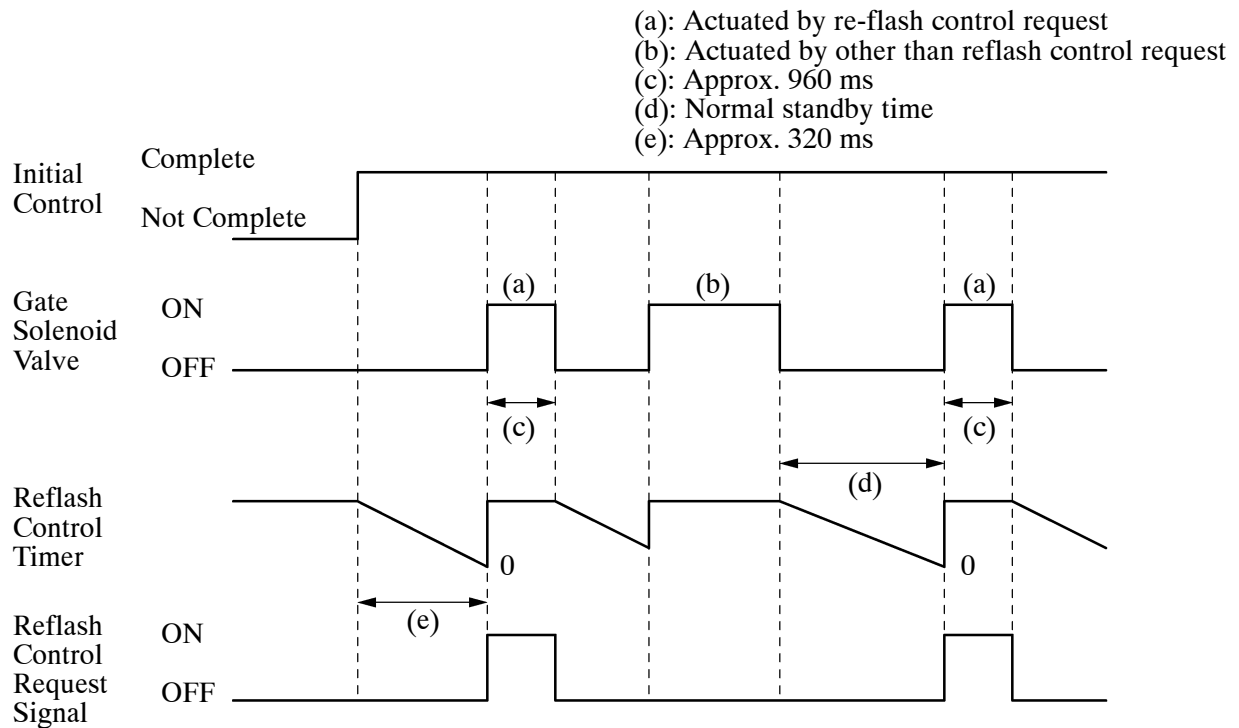
233CH67

3) Reflash Control

Reflash control is effected in order to eliminate the difference in the compressed air pressure between the right and left pneumatic cylinders.

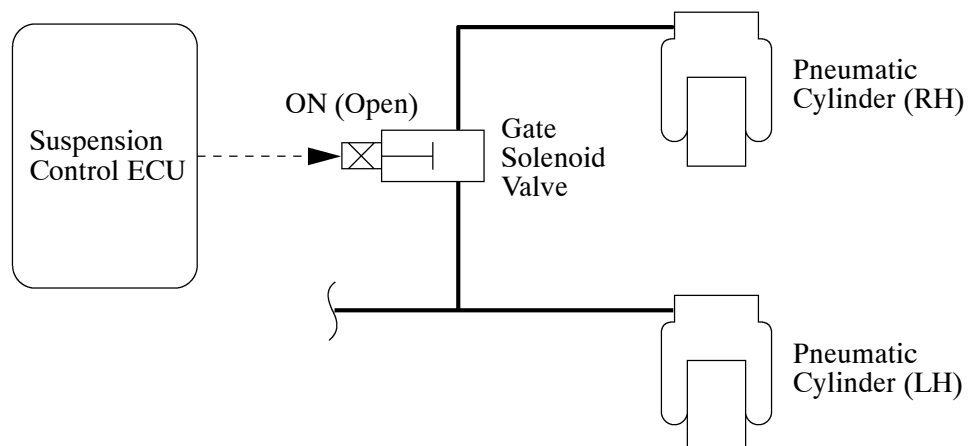
From the time the initial control is completed, the suspension control ECU turns ON (open) the gate solenoid valve in accordance with the timing chart shown below, in order to connect the right and pneumatic cylinders.

► Timing Chart ◀



232CH101

► System Diagram ◀



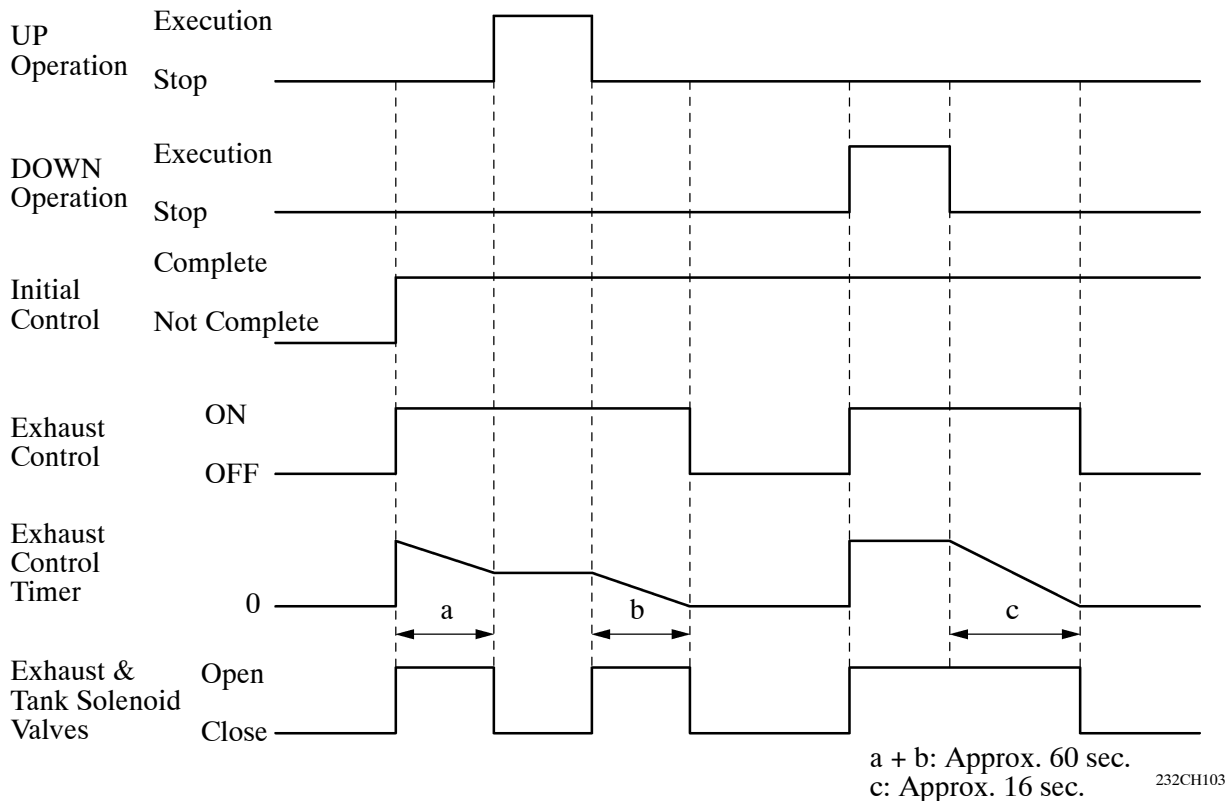
232CH102

4) Exhaust Control

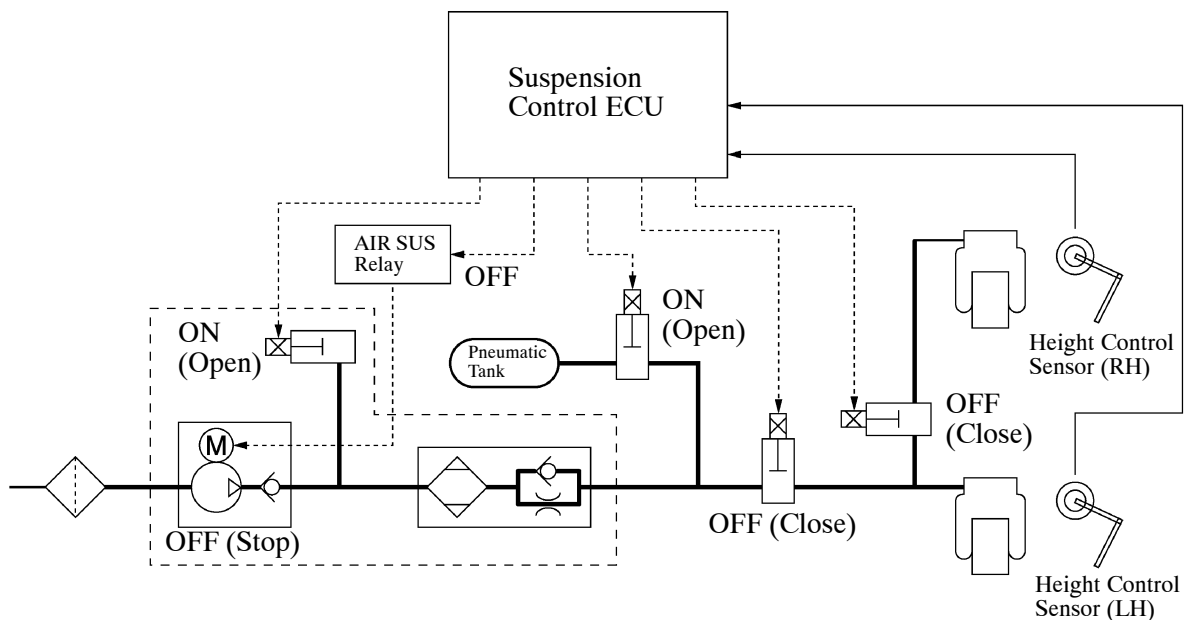
During the height control down operation, this control automatically exhausts the compressed air that is stored in the pneumatic tank.

After the completion of the initial control or the height control down operation, the suspension control ECU turns ON (open) the tank solenoid valve and the exhaust solenoid valve in accordance with the timing chart shown below, in order to exhaust the compressed air from the pneumatic tank.

► Timing Chart ◀



► System Diagram ◀



5) Vehicle Height Control

General

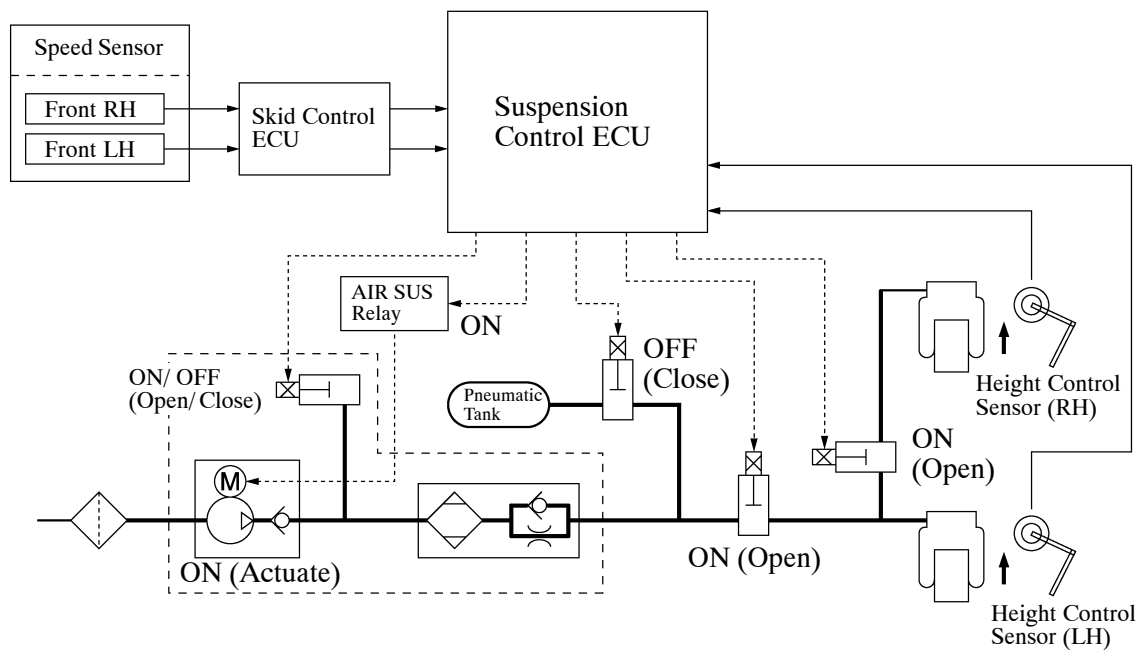
The vehicle height control consists of an automatic vehicle height control, vehicle height switching control, vehicle speed sensing control, key OFF operation control, and vehicle height control OFF control.

Automatic Vehicle Height Control

The suspension control ECU detects via the 2 height control sensors the changes in the rear vehicle height that results from the number of occupants or the amount of the load. Then, the suspension control ECU controls the height control solenoid valves and the compressor & motor with dryer in order to automatically adjust the rear vehicle height to a constant (normal) vehicle height.

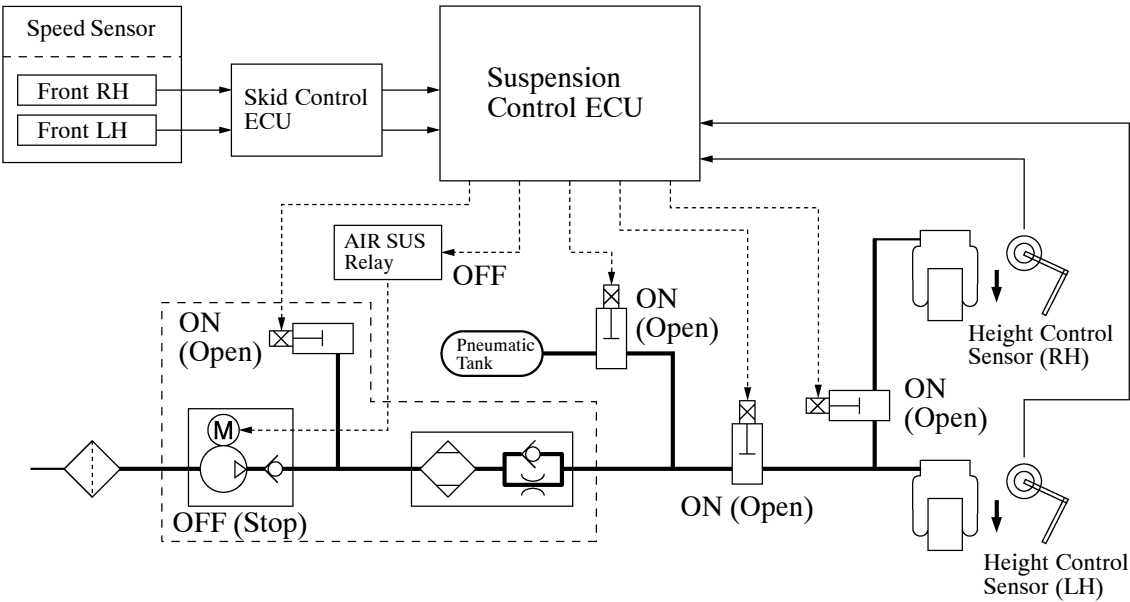
- If the vehicle height is lower than normal, the suspension control ECU raises the vehicle height by turning ON (open) the exhaust solenoid valve, leveling solenoid valve, and gate solenoid valve, and actuating the compressor & motor with dryer. The exhaust solenoid valve remains ON (open) for a prescribed length of time (approx. 0 – 1 sec or less) in order to ensure the initial operation of the compressor & motor with dryer and then closes. This length of the time is changed by power supply (+B) voltage.

► System Diagram ◀



- If the vehicle height is higher than normal, the suspension control ECU lowers the vehicle height by turning ON (open) the exhaust solenoid valve, tank solenoid valve, leveling solenoid valve, and gate solenoid valve, and stopping the compressor & motor with dryer.

► System Diagram ◀



232CH106

Vehicle Height Switching Control

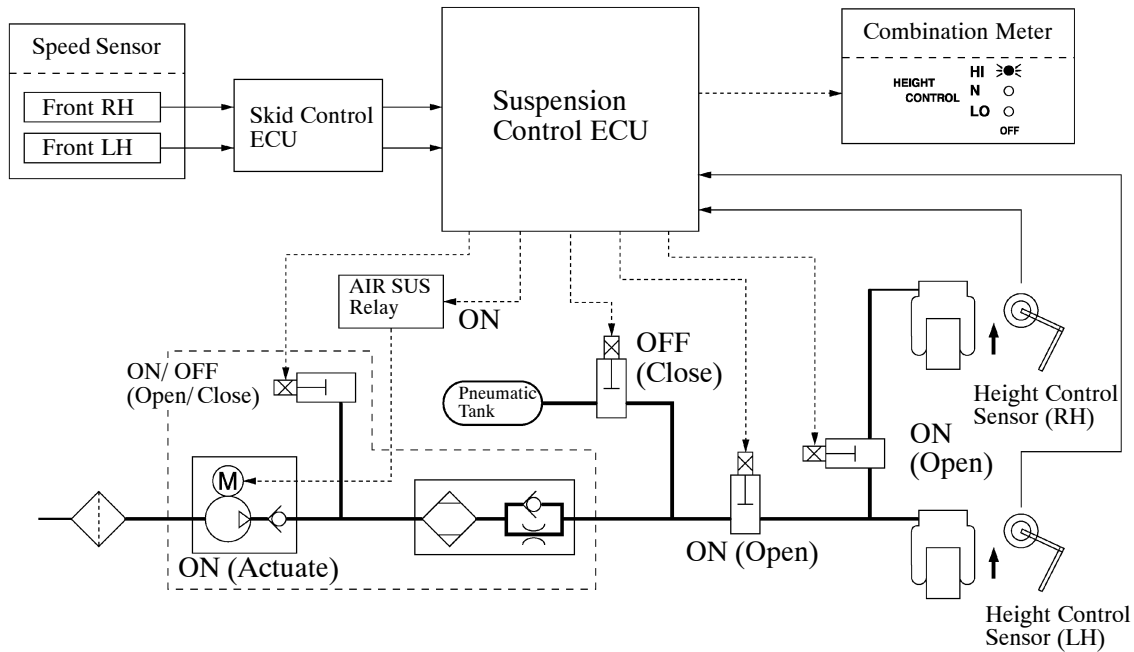
Through this control, three vehicle heights (HI, Normal, and LO) can be selected by operating the height control switch within the specified speed ranges.

► Vehicle Speed and Vehicle Height Ranges ◀

Range	Select Vehicle Height	Destination	
		Europe	Others
Vehicle Speed	Normal → HI	Less than 50 km/h (31 mph)	←
	Normal → LO	Less than 12 km/h (7 mph)	←
Vehicle Height	HI	+ 30 mm (1.2 in.)/ Approx. 15 – 20 sec.	+ 40 mm (1.6 in.)/ Approx. 15 – 20 sec.
	Normal	0	←
	LO	– 30 mm (1.2 in.)/ Approx. 10 – 15 sec.	←

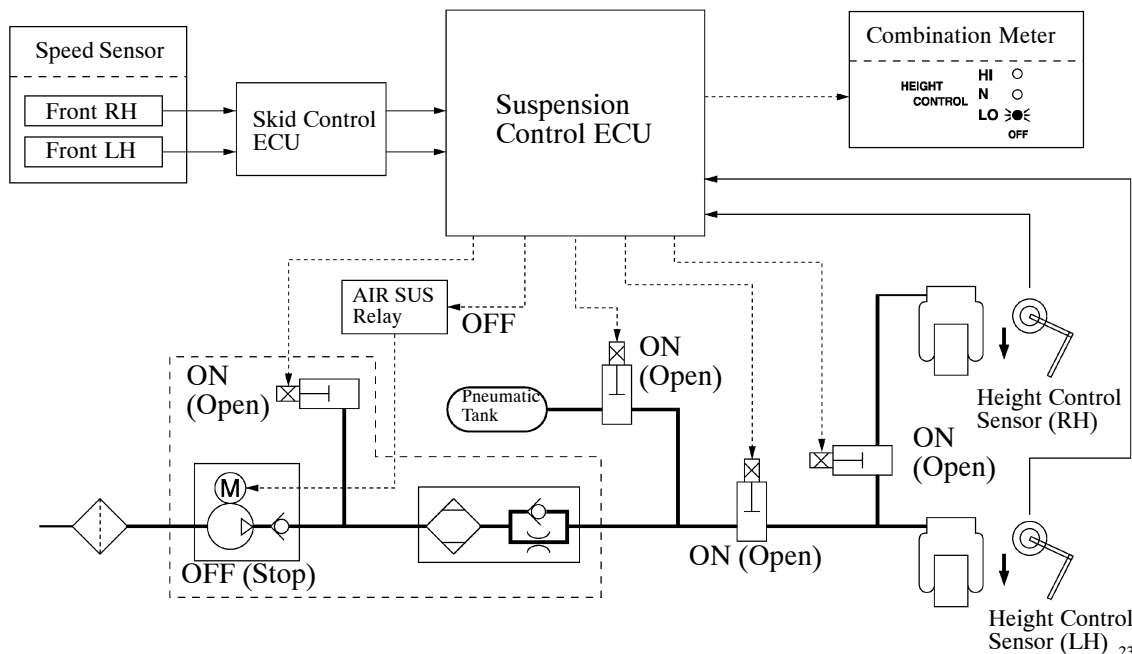
- The suspension control ECU detects the vehicle speed through the signals from the front speed sensors and the target vehicle height through the signals from the height select switch. When these signals meet the operation conditions, the suspension control ECU performs the vehicle height UP/ DOWN operation.
- Upon detecting the changes in the vehicle height through the signals from the height control sensors, the suspension control ECU blinks the selected vehicle height indicator light during the switching operation, and illuminates it after the operation has been completed.

► **Height Control Switch: Normal** → HI ◀



233CH68

► **Height Control Switch: Normal** → LO ◀



233CH69

Vehicle Speed Sensing Control

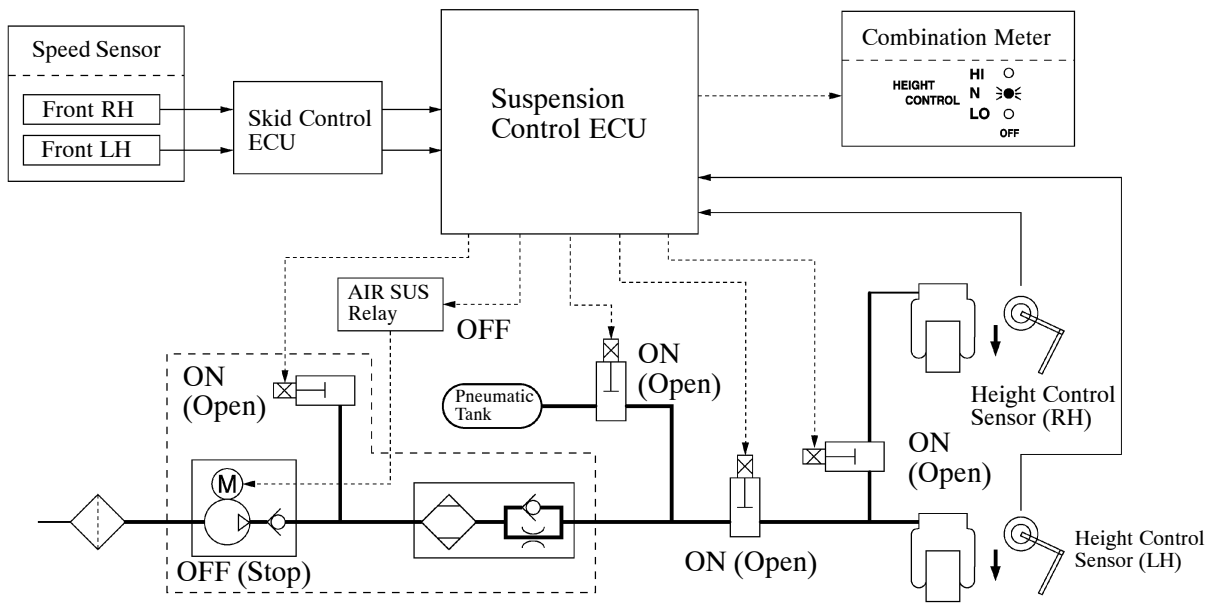
- The suspension control ECU detects the vehicle speed through the signals from the front speed sensors. When the vehicle reaches a prescribed vehicle speed or higher, this control resumes the normal vehicle height regardless of the height control switch. At this time, the suspension control ECU blinks the height control indicator (for normal) and illuminates it after height control has been completed.

► Resume Vehicle Speed ◀

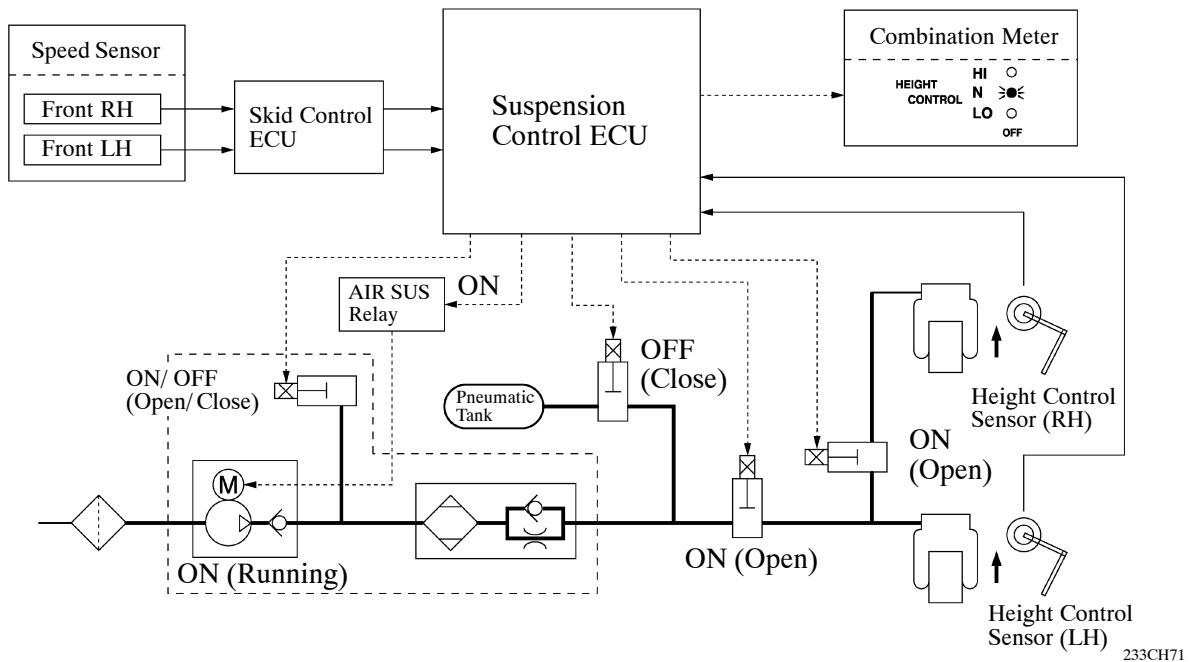
Item	Vehicle Height	Specification
Vehicle Speed	HI → Normal	50 km/h (31 mph) or more
	LO → Normal	12 km/h (7 mph) or more

- Once the vehicle resumes its normal vehicle height through this control, it is possible to select a vehicle height by operating the height control switch at a prescribed vehicle speed or below.

► Vehicle Height: HI → Normal ◀



► Vehicle Height: LO → Normal ◀



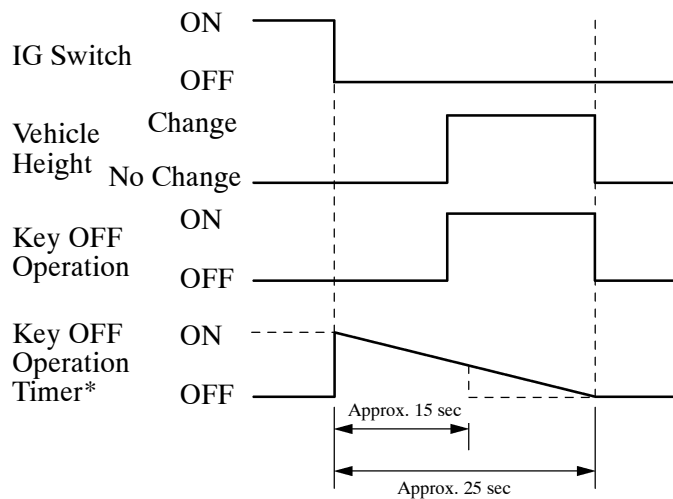
Key OFF Operation Control

If an occupant exits the vehicle or a cargo is unloaded when the ignition key is OFF, causing the vehicle height to rise, this control causes the vehicle to resume the target vehicle height only for a prescribed length of time.

- The suspension control ECU detects the OFF signal through the ignition switch, the door open/close signal from the 5 door courtesy light switches, and the vehicle height condition from the 2 height control sensors, in order to effect the key OFF operation control in accordance with the timing chart.
- There are 2 key OFF operation times depending on the vehicle height condition.

Vehicle Height Condition	Key OFF Operation Time
No change	Approx. 15 sec.
Change	Approx. 25 sec.

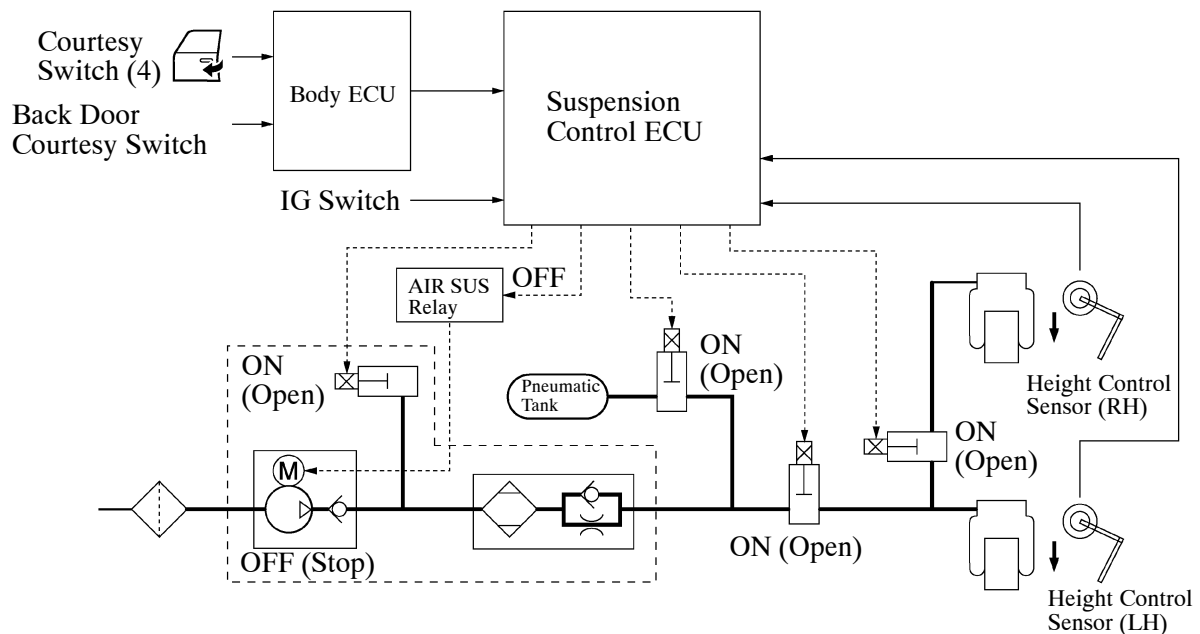
► Timing Chart ◀



*: If a courtesy light switch ON signal is input into the suspension control ECU during the key OFF operation time while the ignition switch is OFF, the operation time extends by approximately 15 seconds.

232CH111

► System Diagram ◀



233CH72

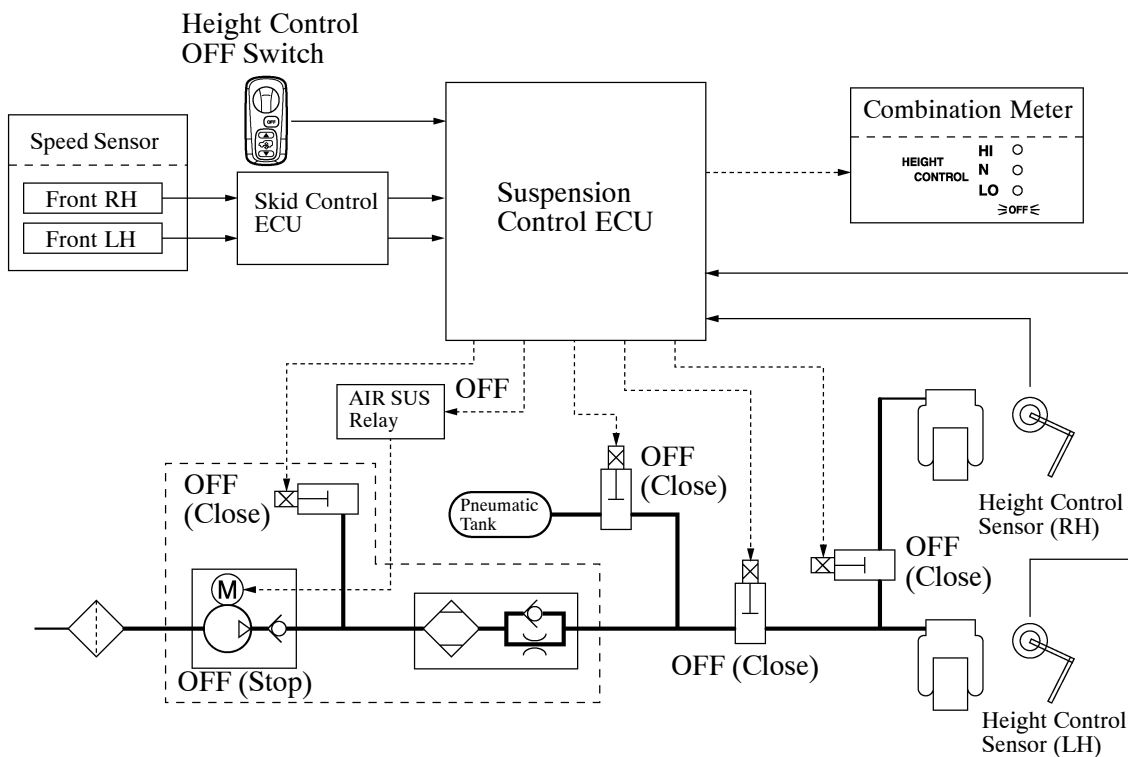
Vehicle Height Control OFF Control

When the height control OFF switch is pressed, this control prohibits vehicle height control when under the vehicle speed sensing range.

The suspension control ECU prohibits height control in accordance with the signals from the height control OFF switch and illuminates the height control OFF indicator light.

When the vehicle exceeds the vehicle speed 30 km/h (19 mph), this control releases to ensure safety and turns OFF the height control OFF indicator light.

► System Diagram ◀



6) Suspension Control

General

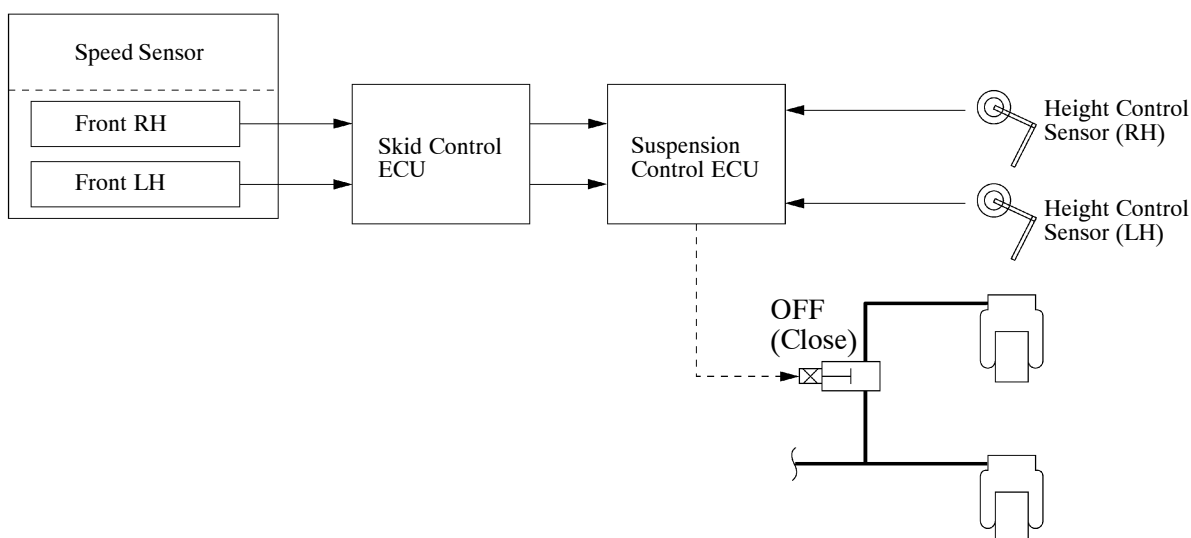
Suspension control consists of a normal control and off-road control.

- The normal control turns OFF (close) the gate solenoid valve during normal driving, in order to increase the vehicle's rolling rigidity.
- The off-road control turns ON (open) the gate solenoid valve while the vehicle is being driven on bumpy roads at low speeds, in order to ensure the proper drive-through performance.

Normal Control

Upon detecting the vehicle speed through the signals from the right and left front speed sensors, and the vehicle height through the signals from the right and left height control sensors, the suspension control ECU turns OFF (close) the gate solenoid valve in order to shut off the air path between the right and left pneumatic cylinders.

► System Diagram ◀



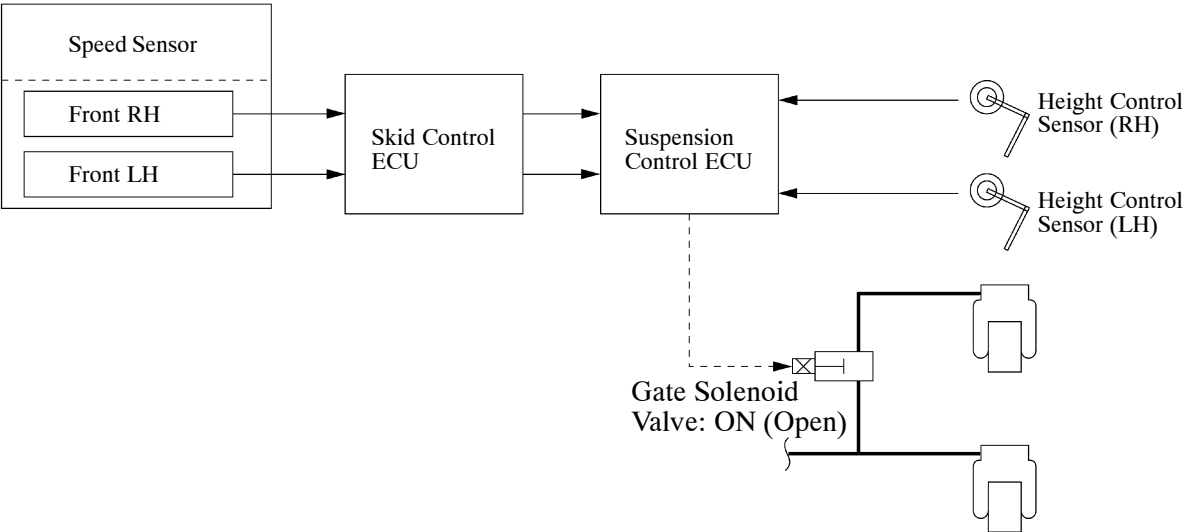
Off-road Control

- The skid control ECU detects the vehicle speed and the speed difference between the right and left wheels through the signals from the right and left front speed sensors, and the difference between the right and left vehicle height through the signals from the right and left height control sensor.
- When all of these signals have reached the following tables, the suspension control ECU turns ON (open) the gate solenoid valve to connect the right and left pneumatic cylinders.

► Set Operation Conditions ◀

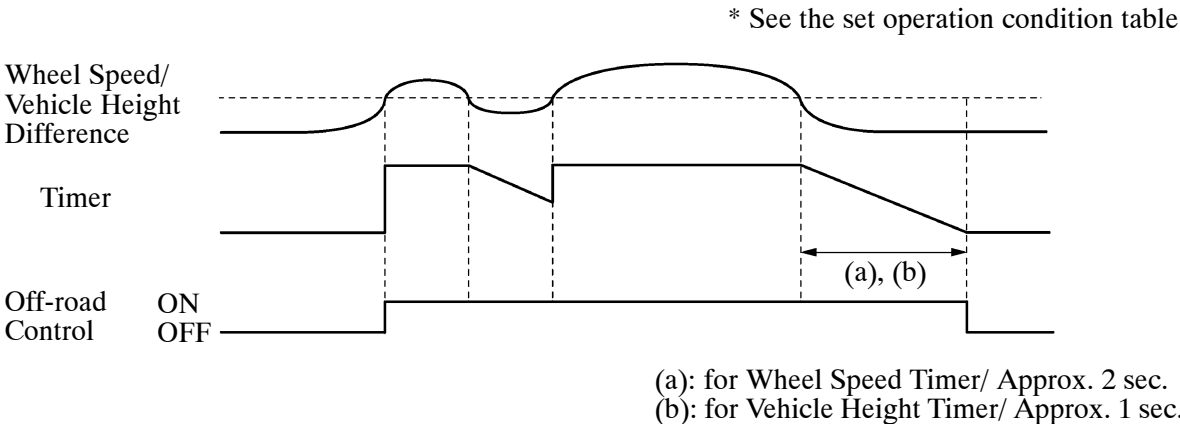
Vehicle Speed	Less than approx. 20 km/h (12 mph)
Wheel Speed Difference	More than approx. 5 km/h (3 mph)
Vehicle Height Difference	More than approx. 100 mm (3.93 in.)

► System Diagram ◀



232CH115

- A timer is provided to clear this control in order to prevent hunting.



232CH144

7) Diagnosis

Diagnosis function has a DTC output, input signal check (test mode), active test, and fail- safe.

If the suspension control ECU detects a malfunction in this system, it blinks the height control OFF indicator light to alert the driver of the malfunction. This ECU will also store the codes of the malfunctions. The DTC (Diagnostic Trouble Code) can be accessed through the blinking of the height control OFF indicator light by connecting the SST (09843-18040) between the Tc and CG terminals of DLC3 or the use of a hand-held tester. For details, see the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

► DTC Chart ◀

DTC No.	Detection Item	DTC No.	Detection Item
C1713/ 13	Open or short circuit in right rear height control sensor circuit	C1744/ 44	Open or short circuit in tank solenoid valve circuit
C1714/ 14	Open or short circuit in left rear height control sensor circuit	C1751/ 51	Continuous electric current to height control compressor circuit
C1733/ 33	Open or short circuit in gate solenoid valve circuit	C1761/ 61	ECU malfunction
C1734/ 34	Open or short circuit in leveling solenoid valve circuit	C1774/ 74	Power voltage drop
C1735/ 35	Open or short circuit in exhaust solenoid valve circuit	C1776/ 76	Speed sensor circuit malfunction
C1741/ 41	Open or short circuit in AIR SUS relay circuit	C1779/ 79	Crankshaft position sensor circuit
C1742/ 42	Lock, open or short circuit in height control compressor circuit	—	—

- The operation of the sensors and the switches can be inspected in the input signal check (test mode). For details, refer to the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

► DTC Chart of the Input Signal Check (Test Mode) ◀

DTC No.	Detection Item	DTC No.	Detection Item
C1782/ 82	Stop light switch circuit malfunction	C1794/ 94	Right front speed sensor circuit malfunction
C1783/ 83	Door courtesy switch circuit malfunction	C1795/ 95	Left front speed sensor circuit malfunction
C1786/ 86	Height control switch circuit malfunction	C1797/ 97	Crankshaft position sensor circuit malfunction
C1788/ 88	Height control OFF switch circuit malfunction	—	—

- A hand-held tester can be used to activate the actuators for inspecting their operation (active test). For details, refer to the Land Cruiser/ Land Cruiser Prado Repair Manual (Pub. No. RM990E).

- If a malfunction occurs in any of the sensors or actuators, the suspension control ECU effects the following fail-safe controls:

Item		Description Control
Height Control Sensor (2)	Malfunction on 1 sensor	<ul style="list-style-type: none"> • Height control is effected only with normal sensor. • Target vehicle height is fixed on the normal. • Height control indicator light stays on N position. • Height select switching operation is prohibited.
	Malfunction on 2 sensors	<ul style="list-style-type: none"> • Interrupts height control. • Target vehicle height is fixed on the normal. • Height control indicator light stays on N position. • Height select switching operation is prohibited.
Gate Solenoid Valve	Open/ short	<ul style="list-style-type: none"> • Interrupts height control. • Reflash control is prohibited. • Gate solenoid valve OFF (Close) • Height select switching operation is prohibited.
Leveling Solenoid Valve	Open/ short	<ul style="list-style-type: none"> • Interrupts height control • Height select switching operation is prohibited.
Exhaust Solenoid Valve	Open/ short	<ul style="list-style-type: none"> • Prohibits height control after the vehicle reaches its normal vehicle height. • Target vehicle height is fixed on the normal. • Exhaust control is prohibited. • Height select switching operation is prohibited.
Tank Solenoid Valve	Open/ short	<ul style="list-style-type: none"> • Exhaust control is prohibited.
Motor Relay Coil	Open/ short	<ul style="list-style-type: none"> • Prohibits height control after the vehicle is lowered to its normal vehicle height. • Height select switching operation is prohibited. • Vehicle height is fixed on the normal.
Compressor Motor	Lock	<ul style="list-style-type: none"> • Prohibits height control after the vehicle is lowered to its normal vehicle height. • Height select switching operation is prohibited. • Vehicle height is fixed on the normal.
	Powered continuously or excessively	<ul style="list-style-type: none"> • Prohibits height control after the vehicle is lowered to its normal vehicle height. • Height select switching operation is prohibited. • Vehicle height is fixed on the normal.
Speed Sensor (2)	Malfunction on 1 sensor	Low Speed Range
		High Speed Range
	Malfunction on 2 sensors	
Engine Speed Signal from Engine ECU		<ul style="list-style-type: none"> • Height control is effected with normal sensor, with no difference between the right and left. • Reflash control is prohibited.
		<ul style="list-style-type: none"> • Reflash control is prohibited. • Gate solenoid valve OFF (Close)
		<ul style="list-style-type: none"> • Effects height control as high speed driving. • Height select switching operation is prohibited. • Vehicle height is fixed on the normal. • Reflash control is prohibited. • Gate solenoid valve OFF (Close)
		<ul style="list-style-type: none"> • Height select switching operation is prohibited. • Vehicle height is fixed on the normal. • Reflash control is prohibited. • Gate solenoid valve OFF (Close)
		<ul style="list-style-type: none"> • Height select switching operation is prohibited. • Vehicle height is fixed on the normal. • Reflash control is prohibited. • Gate solenoid valve OFF (Close)
		Engine speed is fixed 1000 rpm