DRIVE-CONTROL COMPONENTS

CONTENTS

E9DAZAE

SUSPENSION

E9DLAAA

The front suspension is double wishbone, independent suspension which assures a comfortable ride and outstanding steering stability. The rear suspension is the 3-link coil spring type axle suspension, which assures comfortable ride and outstanding steering stability or the leaf spring type axle suspension, which features outstanding strength. In addition, remote controlled variable shock absorbers have been adopted which allow the shock absorber damping force to be changed in three stages of operation by a switch provided int.

SPECIFICATIONS

Items	V21, V23, V24, V41, V43, V44	V12, V14, V32, V34
Front suspension	Double wishbone type independent suspension	Double wishbone type independent suspension
Rear suspension	3-link coil spring type axle suspension	Leaf spring type axle suspension
Remote controlled variable shock absorber	Option	–

FEATURES

Ride comfort

1. Rubber bushing adopted for upper arm pivot <Front>
2. Larger size bushing adopted for lower arm <Front>
3. Taper coil springs adopted <Rear> (V21, V23, V24, V41, V43, V44)
4. Remote controlled variable shock absorbers adopted (Option)
5. Front wheel stroke increased

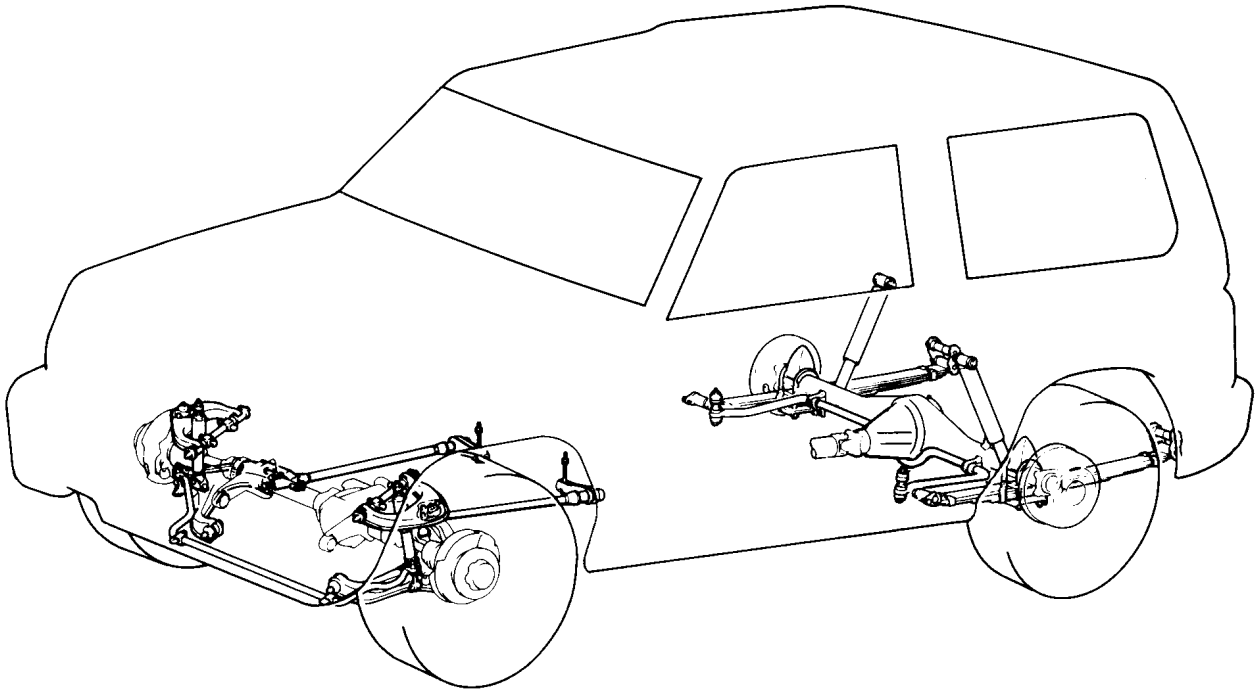
Better steering stability and rough road operation

1. Tread enlarged
2. Kingpin offset reduced
3. Straight type lateral rod adopted which offers higher lateral rigidity (V21, V23, V24, V41, V43, V44)
4. Higher roll rigidity stabilizer bar adopted
5. Shock absorber damping force optimized

Better durability and serviceability

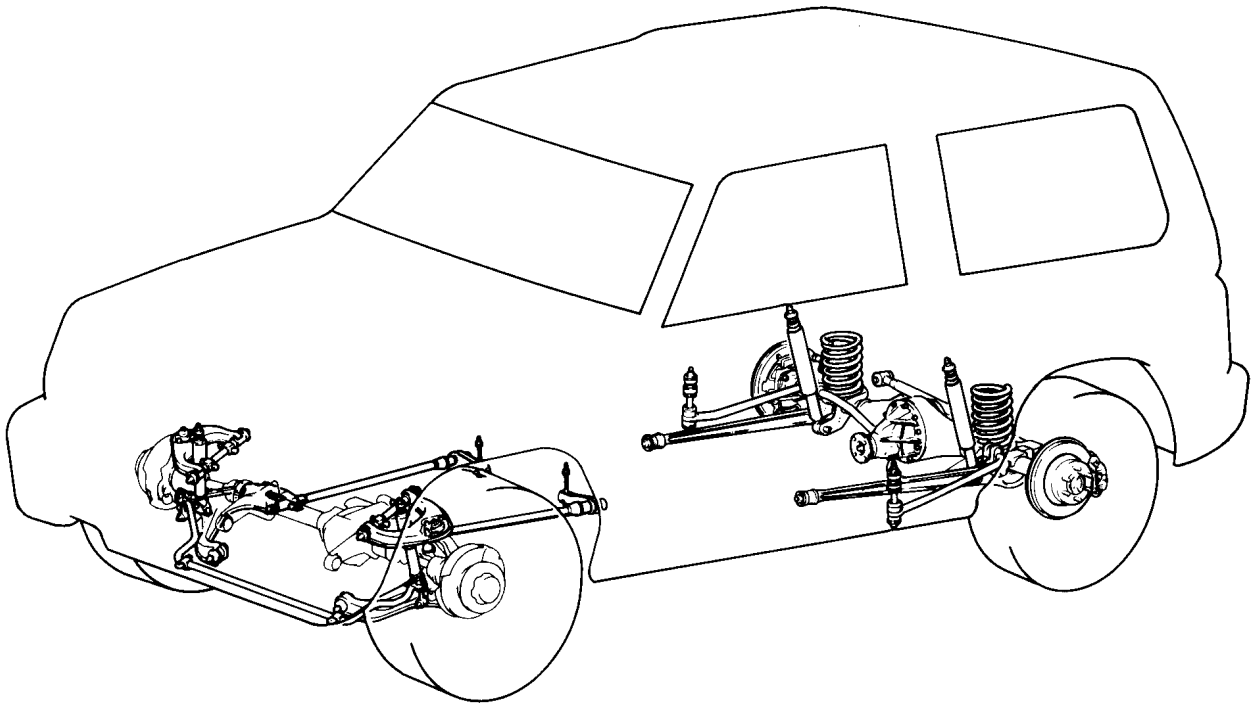
1. Forged lower arm adopted which offers higher strength and durability <Rear> (V21, V23, V24, V41, V43, V44)
2. Simpler link mechanism adopted which requires less parts <Rear> (V21, V23, V24, V41, V43, V44)

<REAR LEAF SPRING TYPE>



12E0041

<REAR 3-LINK COIL SPRING TYPE>



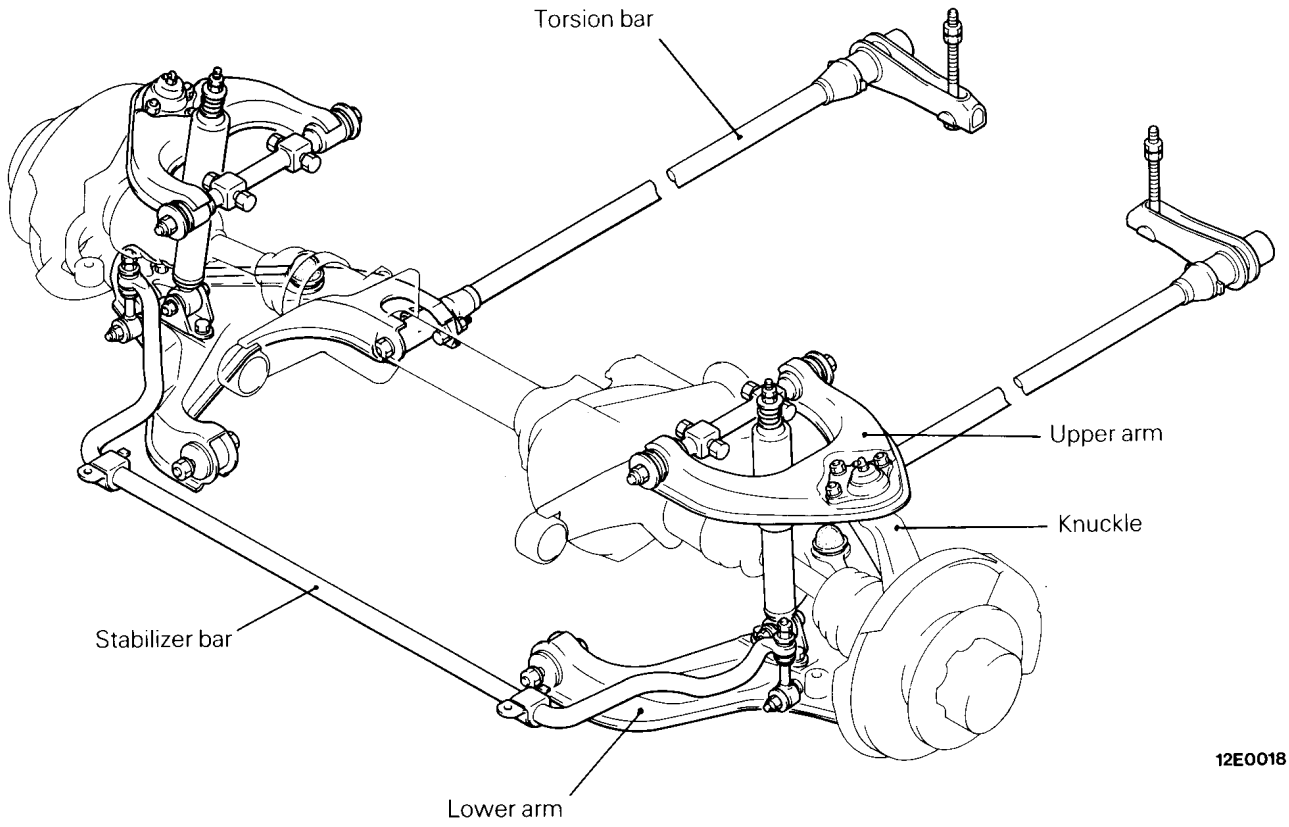
12E0040

FRONT SUSPENSION

E9DBAAF

FEATURES

- Adopts a highly rigid A-type upper arm and lower arm suitable for rough road operation.
- Sets optimum damping force characteristics for the shock absorbers.
- Adopts torsion bar springs which assure comfortable ride.

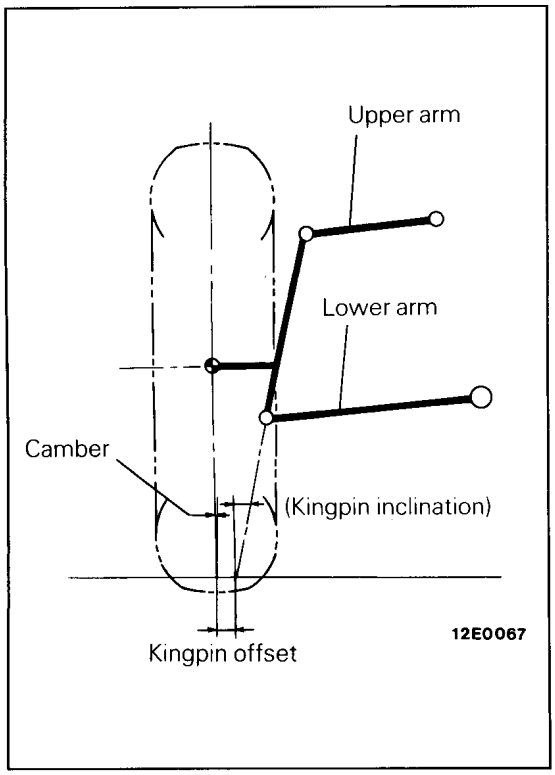


NOTE
The construction and operation of the front suspension are essentially the same as those of the 1990 PAJERO. Only the differences from the conventional PAJERO are described here.

SPECIFICATIONS

Items	Standard specification	Optional specification
Suspension system	Independent, double wishbone with torsion bar and telescopic shock absorber	Independent, double wishbone with torsion bar and telescopic shock absorber
Camber	40'±30' (difference between right and left: 30' or less)	40'±30' (difference between right and left: 30' or less)
Caster	3°±1° (difference between right and left: 30' or less)	3°±1° (difference between right and left: 30' or less)
Kingpin inclination	14°52'	14°52'
Toe-in mm (in.)	3.5±3.5 (0.14±0.14)	3.5±3.5 (0.14±0.14)
Torsion bar		
Length x O.D. mm (in.)	1,277.5 x 26.2 (50.295 x 1.031) 1,277.5 x 27.0 (50.295 x 1.062)*1	1,277.5 x 27.0 (50.295 x 1.062)
Spring constant (wheel position) N/mm (kg/mm, lbs./in.)	25 (2.5, 140), 28 (2.8, 157)*1	28 (2.8, 157)
Shock absorber		
Type	Hydraulic cylinder type double acting	Low pressure nitrogen gas filled hydraulic cylinder type double acting
Max. length mm (in.)	345 (13.6)	345 (13.6)
Min. length mm (in.)	225 (8.9)	230 (9.1)
Stroke mm (in.)	120 (4.7)	115 (4.5)
Damping force [at 0.3 m/sec. (0.9 ft./sec.)]		
Expansion N (kg, lbs.)	2,450 (245, 540)	Hard: 3,150 (315, 694) Medium: 2,350 (235, 518) Soft: 1,700 (170, 375)
Contraction N (kg, lbs.)	1,500 (150, 331)	Hard: 1,600 (160, 353) Medium: 1,250 (125, 278) Soft: 850 (85, 187)
Stabilizer bar		
Outside diameter mm (in.)	23 (0.91)*2, 25 (0.98)*3, 28 (1.10)*4	23 (0.91)*2, 25 (0.98)*3, 28 (1.10)*4
Identification colour	Red*2, White*3, Yellow*4	Red*2, White*3, Yellow*4

NOTE
*1: Australia version V32, V34
*2: V12, V14
*3: V21, V23, V24, V32, V34
*4: V41, V43, V44



DESCRIPTION OF CONSTRUCTION

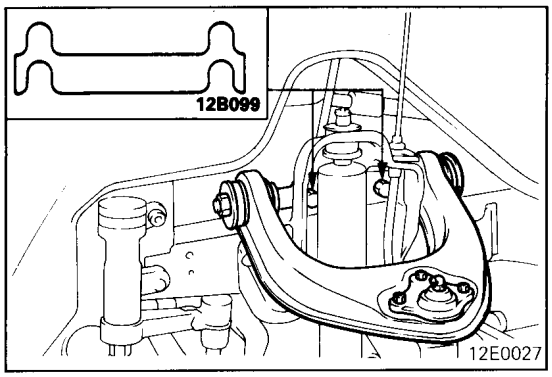
WHEEL ALIGNMENT

Camber, Toe-in

The camber has been reduced to improve the steerability.

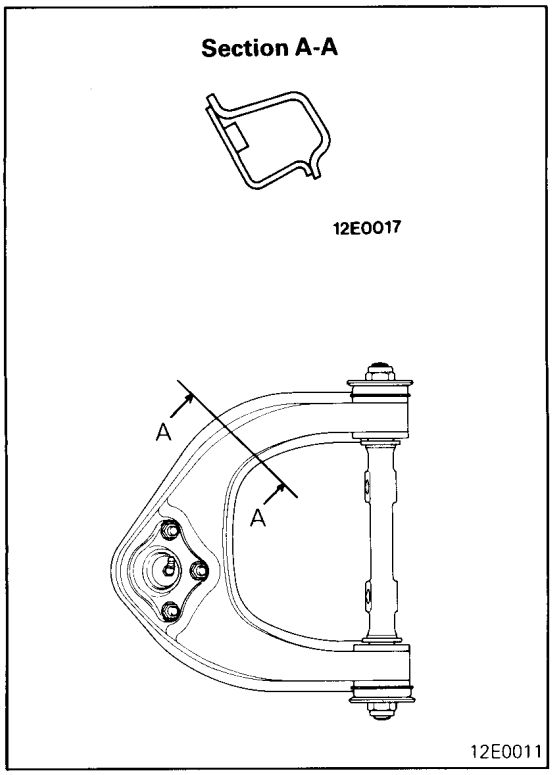
Kingpin Offset

The kingpin offset amount has been reduced for reduction of the moment around the kingpin shaft generated during braking or driving on a road where vehicles are exposed to various external forces to improve braking stability and straight ahead stability.



Wheel Alignment Adjustment

The camber can be adjusted by adding or removing shims set in the upper arm and cross member mounting portions. The caster is not possible to adjust.



UPPER ARM

The upper arm is an A-type arm of box type closed cross-sectional construction which offers high strength.
A rubber bushing has been adopted for the pivot of the upper arm for improvement of riding comfort and prevention of vibration.
The ball joint is installed on the upper arm with bolts to assure easier servicing.

REAR SUSPENSION <LEAF SPRING TYPE>

E9DCAAE

FEATURES

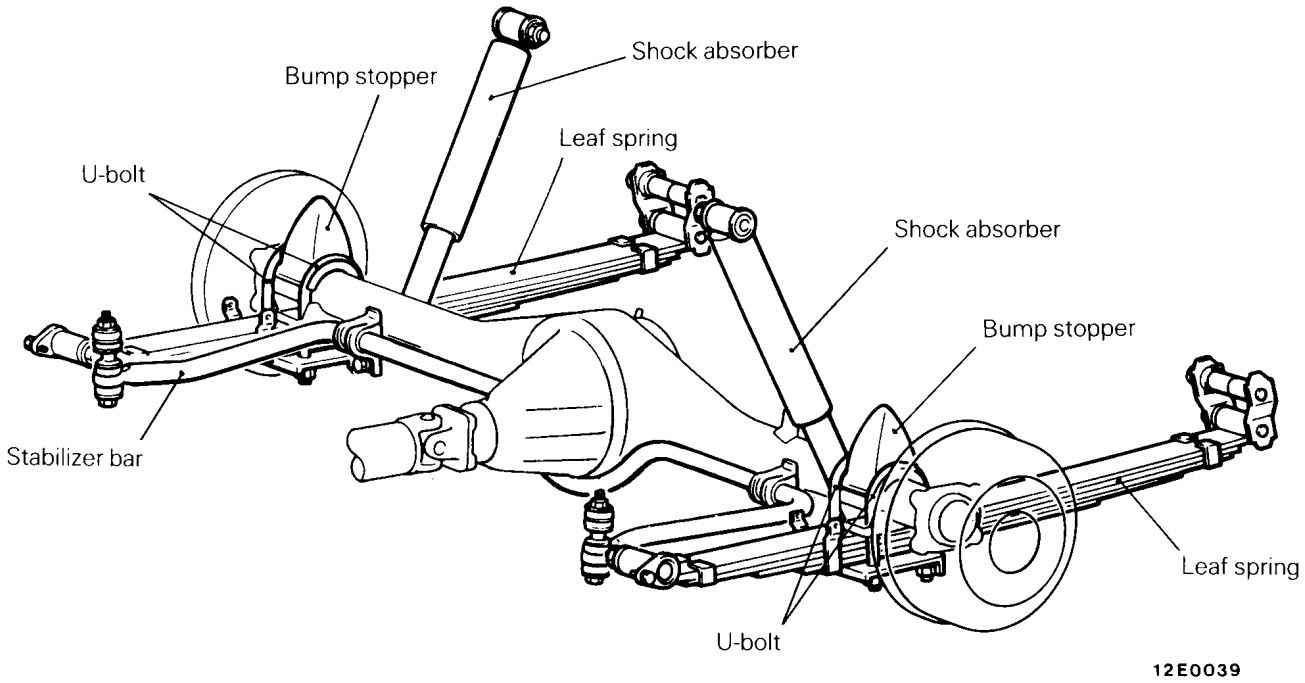
- Asymmetrical progressive leaf springs* have been adopted for improvement of riding comfort and roll rigidity and prevention of wind-up.
- Bias arrangement shock absorbers have been adopted for effective prevention of wind-up.

* Progressive leaf spring: Consists of large curvature leaves piled under an arc-shaped spring and provides a larger spring force for a larger load.

SPECIFICATIONS

Items	V12, V14	V32, V34
Suspension system	Asymmetrical semi-elliptic leaf spring type rigid axle suspension	Asymmetrical semi-elliptic leaf spring type rigid axle suspension
Leaf spring		
Number of leaf springs	4	5
Camber (unladen) mm (in.)	73 – 83 (2.87 – 3.27) [73.5 – 82.5 (2.89 – 3.25)]	Vehicles for General Export and Gulf countries 72.5 – 83.5 (2.854 – 3.287) [80.0 – 90.0 (3.15 – 3.54)] Vehicles for Australia 80.0 – 90.0 (3.15 – 3.54)
Spring constant as installed N/mm (kg/mm, lbs./in.)		
Light load	29.1 (2.91, 163) [35.0 (3.50, 196)]	Vehicles for General Export and Gulf countries 32.2 (3.22, 180) [42.4 (4.24, 237)] Vehicles for Australia 42.4 (4.24, 237)
Heavy load	73.1 (7.31, 409) [124.0 (12.40, 694)]	Vehicles for General Export and Gulf countries 61.5 (6.15, 344) [103.8 (10.38, 581)] Vehicles for Australia 103.8 (10.38, 581)
Shock absorber		
Max. length mm (in.)	548 (21.6)	558 (22.0)
Min. length mm (in.)	328 (12.9)	333 (13.1)
Stroke mm (in.)	220 (8.7)	225 (8.9)
Damping force [at 0.3 m/sec. (0.9 ft./sec.)]		
Expansion N (kg, lbs.)	1,200 (120, 265)	1,800 (180, 397)
Contraction N (kg, lbs.)	550 (55, 121)	800 (80, 176)

NOTE
Optional specifications shown in [ ]



NOTE
The construction and operation of the leaf spring type rear suspension are essentially the same as those of the 1990 PAJERO.

REAR SUSPENSION <COIL SPRING TYPE>

E9DCAAF

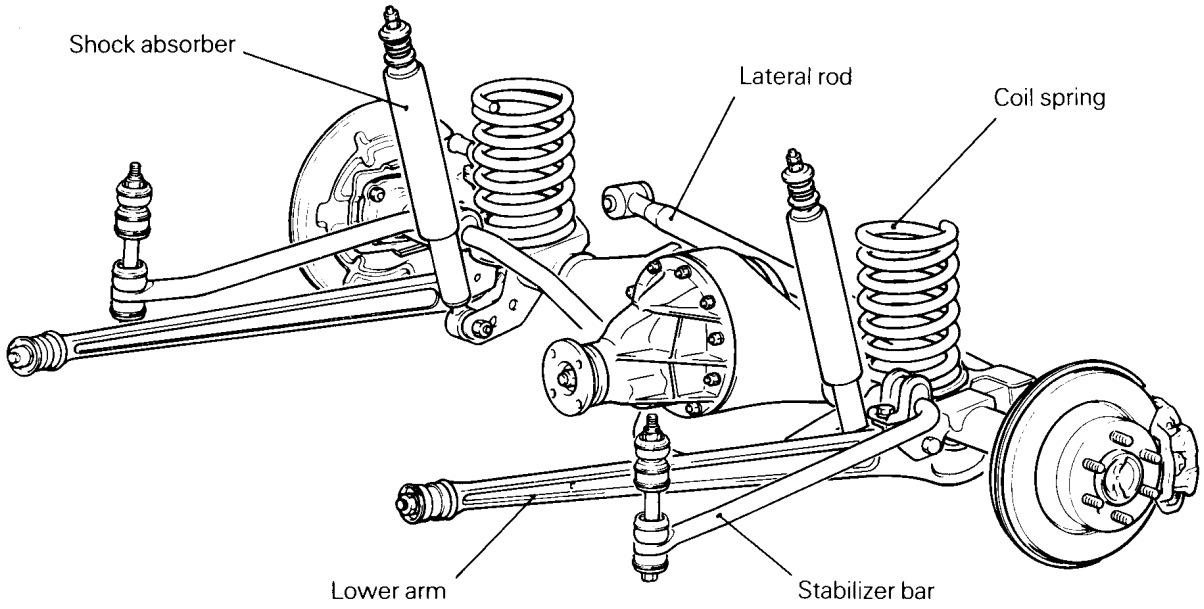
FEATURES

- Coil springs have been fitted to give passenger car ride comfort.
- A lateral rod has been adopted to assure better steering stability and rough road operation.

SPECIFICATIONS

Items	V21C, V24C	V21W, V23C, V23W, V24W	V41W, V43W, V44W
Suspension system	Coil spring type 3-link rigid axle suspension	Coil spring type 3-link rigid axle suspension	Coil spring type 3-link rigid axle suspension
Coil spring			
Wire dia. x O.D. x free length mm (in.)	13.4 to 14.5 x 159.4 to 160.5 x 422.5 (0.53 to 0.57 x 6.28 to 6.32 x 16.63) [13.4 to 15.0 x 159.4 to 161 x 391 (0.53 to 0.59 x 6.28 to 6.34 x 15.39)]	13.4 to 14.5 x 159.4 to 160.5 x 435.5 (0.53 to 0.57 x 6.28 to 6.32 x 17.15) [13.4 to 15.0 x 159.4 to 161 x 401.5 (0.53 to 0.59 x 6.28 to 6.34 x 15.81)]	14.2 to 15.8 x 160.2 to 161.8 x 404.5 (0.56 to 0.62 x 6.31 to 6.37 x 15.93) [11.8 to 16.0 x 157.8 to 162 x 396.5 (0.46 to 0.63 x 6.21 to 6.38 x 15.61)]
Coil spring identification colour	Orange x 1 [Pink x 1]	Orange x 2 [Pink x 2]	Green x 1 [Light blue x 1]
Spring constant N/mm (kg/mm, lbs./in.)	18 to 30 (1.8 to 3.0, 101 to 168) [22 to 40 (2.2 to 4.0, 123 to 224)]	18 to 30 (1.8 to 3.0, 101 to 168) [22 to 40 (2.2 to 4.0, 123 to 224)]	27 to 39 (2.7 to 3.9, 151 to 218) [27 to 45 (2.7 to 4.5, 151 to 252)]
Shock absorber			
Max. length mm (in.)	457 (18.0)	457 (18.0)	
Min. length mm (in.)	297 (11.7)	297 (11.7)	
Stroke mm (in.)	160 (6.3)	160 (6.3)	
Damping force [at 0.3 m/sec. (0.9 ft./sec.)]			
Expansion N (kg, lbs.)	2,450 (245, 540)	2,450 (245, 540) [Hard: 3,350 (335, 739) Medium: 2,450 (245, 540) Soft: 1,750 (175, 386)]	
Contraction N (kg, lbs.)	1,300 (130, 287)	1,300 (130, 287) [Hard: 1,650 (165, 364) Medium: 1,300 (130, 287) Soft: 900 (90, 198)]	

NOTE
Optional specifications shown in [ ]

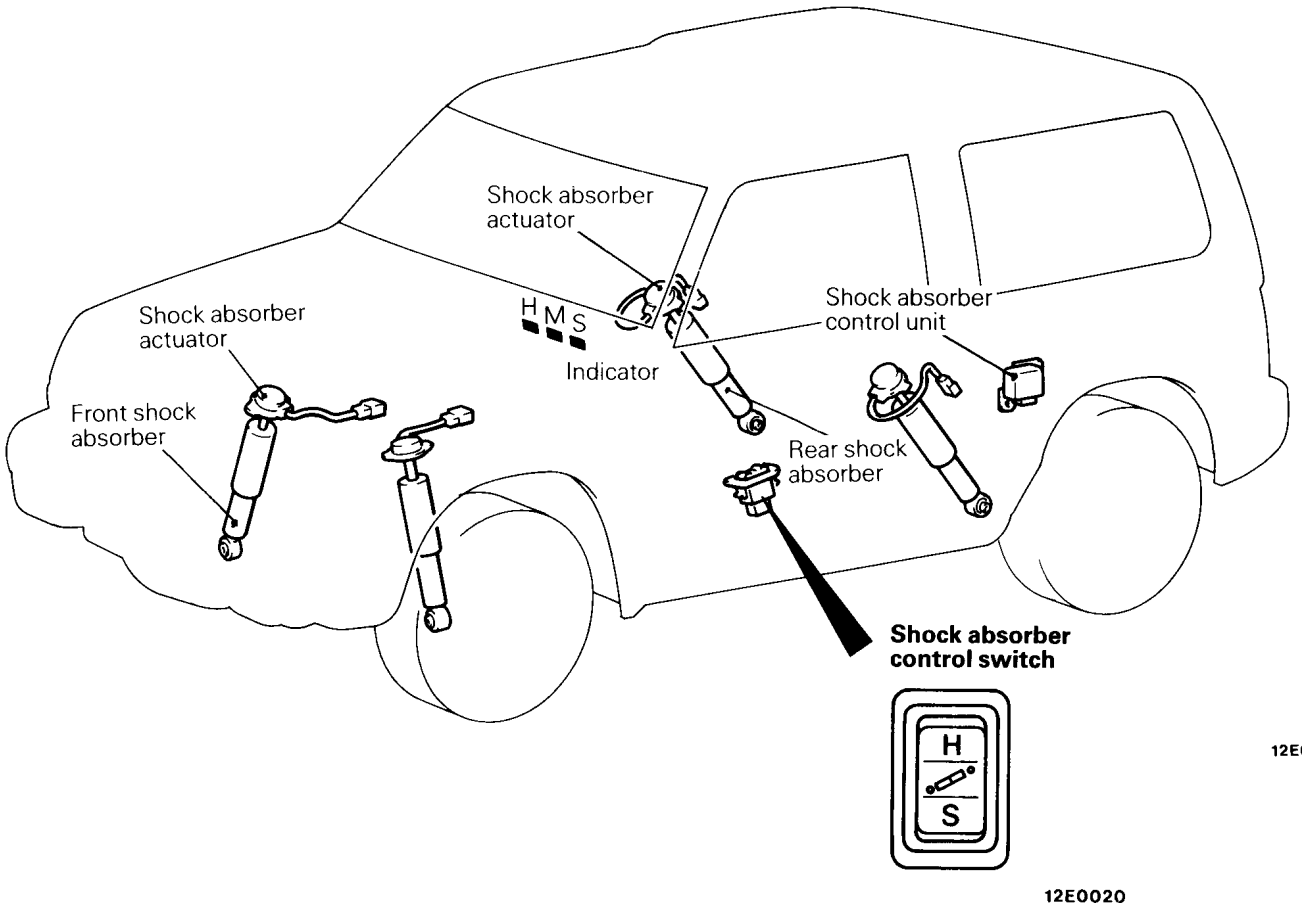


NOTE
The construction and operation of the coil spring type rear suspension are essentially the same as those of the 1990 PAJERO.

REMOTE CONTROLLED VARIABLE SHOCK ABSORBERS

E9DKAAA

The remote controlled variable shock absorbers allow the damping force to be changed in three stages by operating a three-stage switch fitted in the console. When the switch is operated, the motor-driven actuators fitted on the top of the shock absorbers rotate the control rods in the shock absorbers to change the damping force.



12E0023

12E0020

Features of individual modes

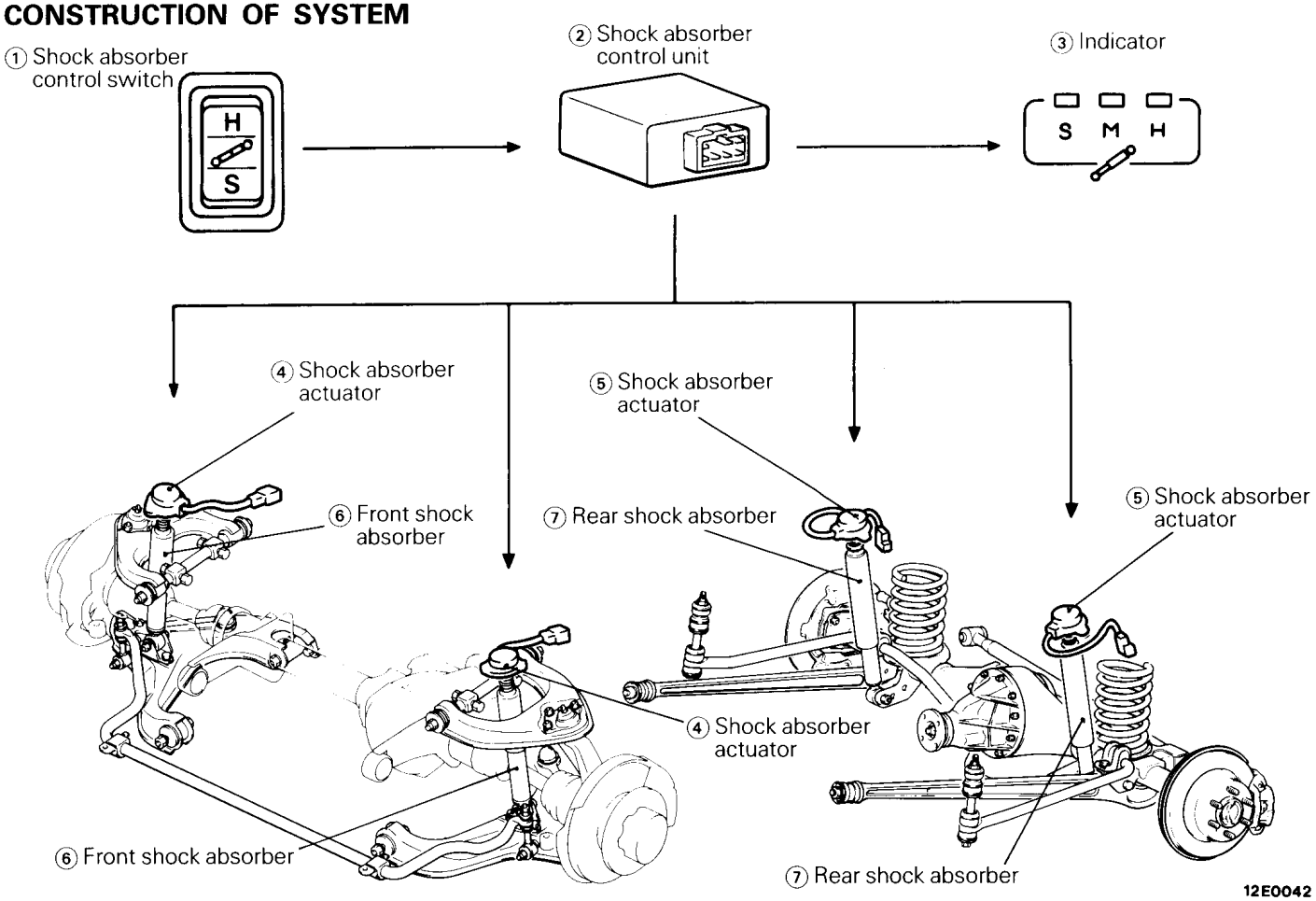
Items / Mode	Shock absorber damping force	Features
Hard	Hard setting	Outstanding steering stability and drivability on rough roads.
Medium	Standard setting	Proper suspension suitable for operation on general roads
Soft	Soft setting	Comfortable ride

SPECIFICATIONS

Items		Front suspension	Rear suspension
Type		Low pressure nitrogen gas filled hydraulic cylinder type double acting	Low pressure nitrogen gas filled hydraulic cylinder type double acting
Max. length	mm (in.)	345 (13.6)	457 (18.0)
Compressed length	mm (in.)	230 (9.1)	297 (11.7)
Stroke	mm (in.)	115 (4.5)	160 (6.3)
Damping force [at 0.3 m/sec. (0.9 ft./sec.)] N (kg, lbs.)	Expansion Hard Medium Soft	 3,150 (315, 694) 2,350 (235, 518) 1,700 (170, 375)	 3,350 (335, 739) 2,450 (245, 540) 1,750 (175, 386)
	Contraction Hard Medium Soft	 1,600 (160, 353) 1,250 (125, 276) 850 (85, 187)	 1,650 (165, 364) 1,300 (130, 287) 900 (90, 198)

DESCRIPTION OF CONSTRUCTION

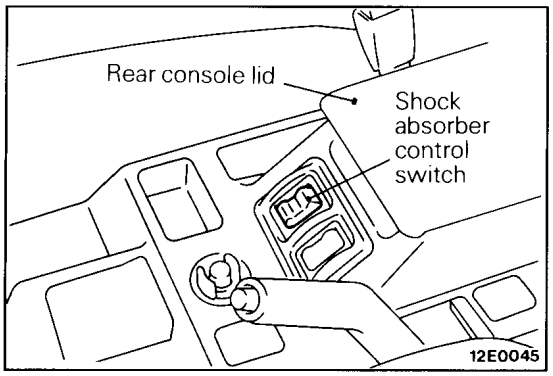
CONSTRUCTION OF SYSTEM



When the shock absorber control switch ① is operated, the shock absorber control unit ② operates the shock absorber actuators ④, ⑤ to rotate the damping force changeover rotary valves built in the front shock absorbers ⑥ and rear shock absorbers ⑦. Accordingly, the orifices which constitute the oil passages in the front and rear shock absorbers are opened or closed to alter the damping force.

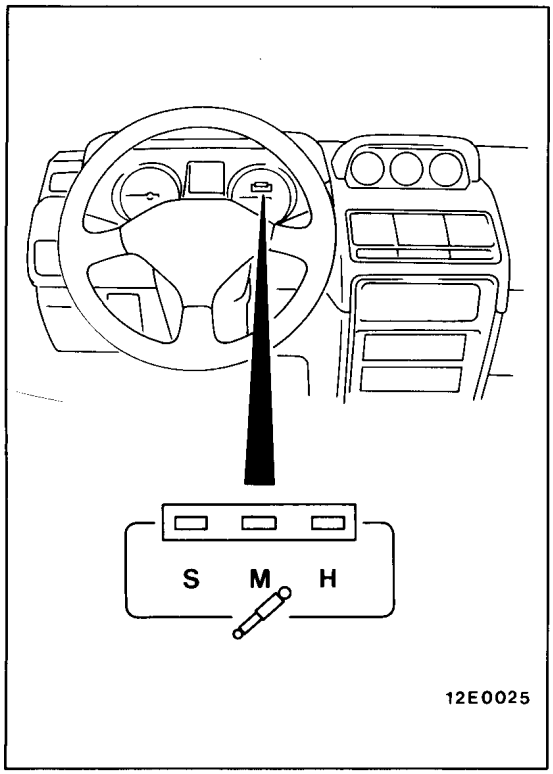
Major components

Component	Function of component
Shock absorber control switch	Mode selection switch
Indicator	Indicates the current mode to the driver.
Shock absorber actuator	Actuates the rotary valve in the shock absorber.
Front shock absorbers, rear shock absorbers	Have a built-in rotary valve constructed to make the damping force variable.
Shock absorber control unit	Actuates all the actuators according to the mode selected by the shock absorber control switch.



SHOCK ABSORBER CONTROL SWITCH

The shock absorber control switch is a rocker type 3-stage changeover switch fitted in the rear console assembly and is used to select the Hard, Medium or Soft mode.



INDICATOR

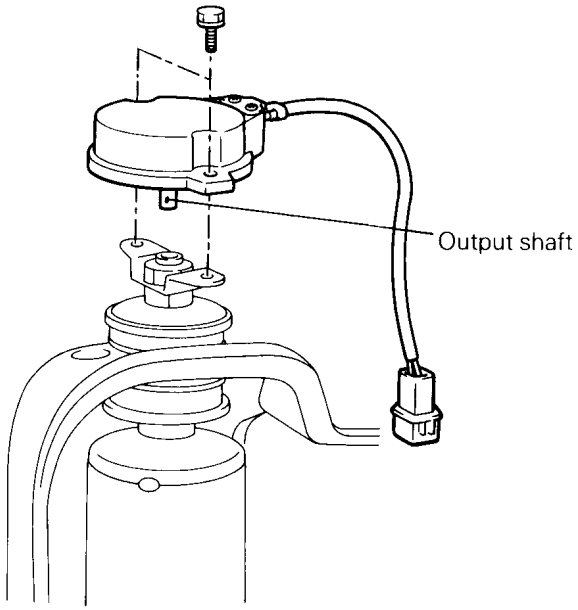
The indicator is arranged in the tachometer of the combination meter. The LED that is ON identifies the current mode.

SHOCK ABSORBER ACTUATOR

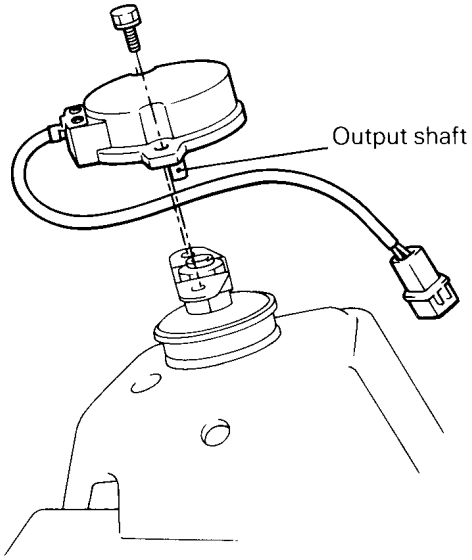
In response to a signal from the shock absorber control unit, the shock absorber actuators rotate the control rods in the shock absorbers to operate the respective rotary valves.

The actuator output shaft which rotates the control rod always rotates in a single direction for change-over of the Soft, Medium and Hard modes at intervals of 90°.

Front actuator

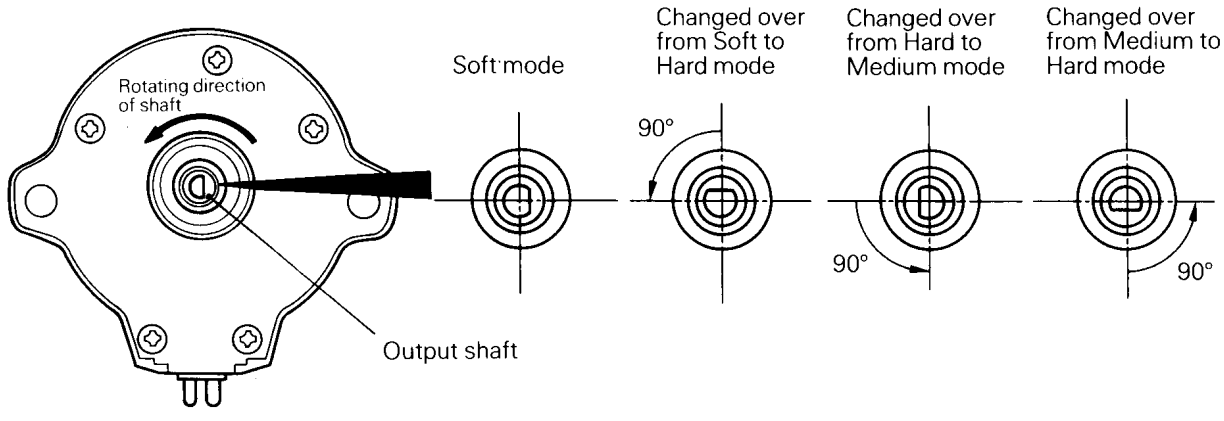


Rear actuator



12E0034

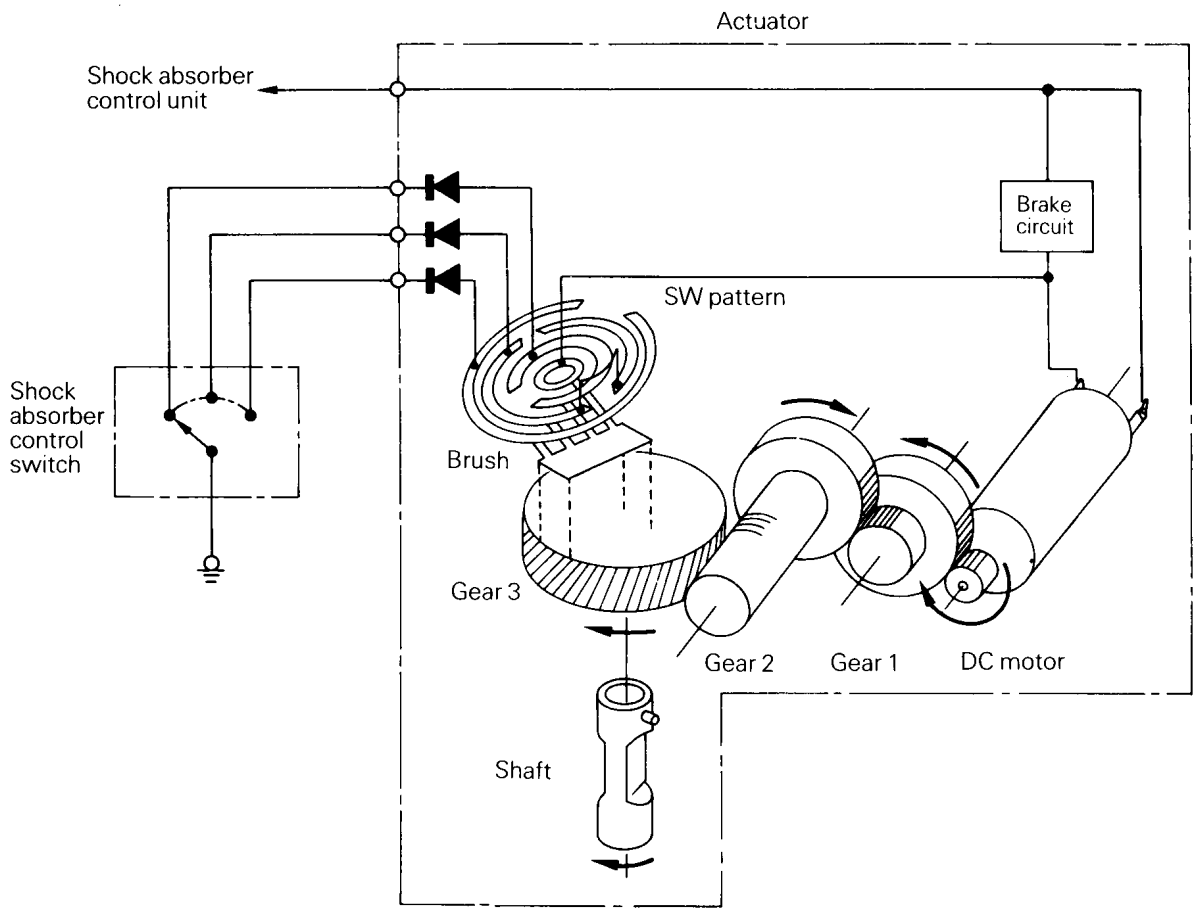
Back side of actuator



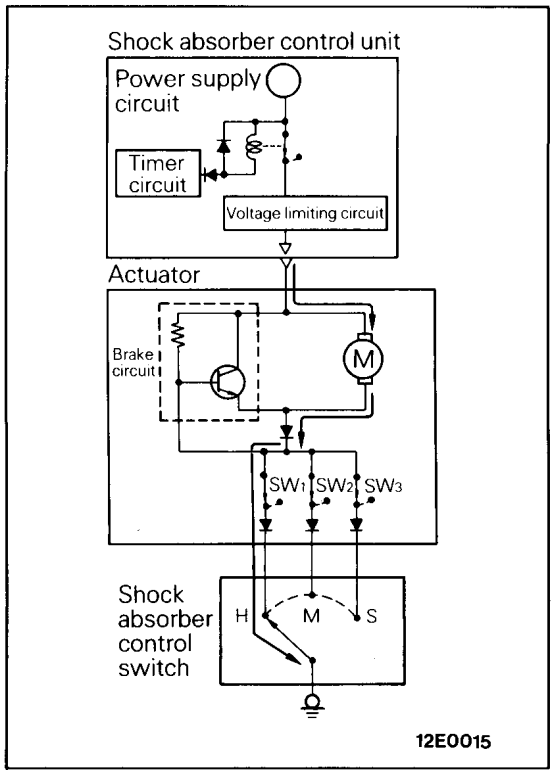
12E0006

Construction of Actuator

The actuator consists of a rotary drive section composed of a DC motor and three gears, a position detector circuit composed of a brush rotating with the output shaft in a single body and a switch pattern secured on the case, and a brake circuit which applies electric brake to the DC motor to assure locating accuracy.



12E0003



12E0015

Operation of Actuator

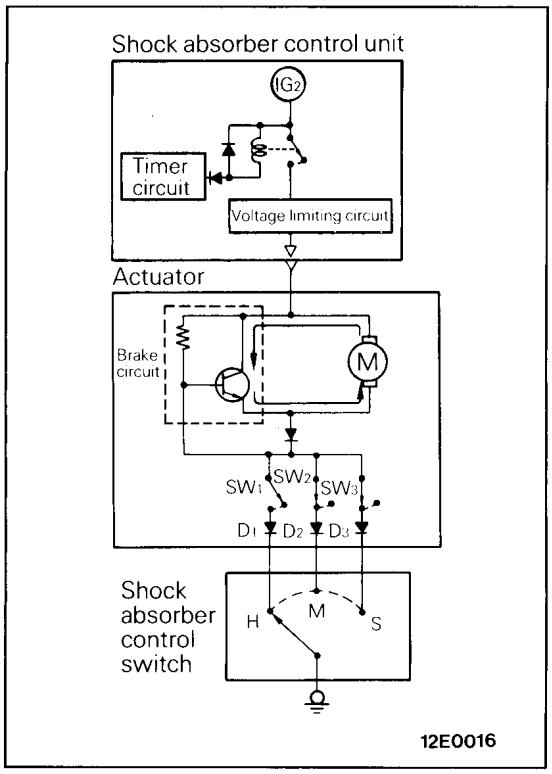
Briefly the system operates as follows when the Hard mode is selected. In the circuit diagram, the SW_1, SW_2 and SW_3 denote the contacts comprising the SW pattern and brush on the circuit board and have the following relationships with the actuator drive positions.

[Relationships between actuator drive positions and contacts SW_1, SW_2 and SW_3]

Contact	Hard	Medium	Soft
SW_1	OFF	ON	ON
SW_2	ON	OFF	ON
SW_3	ON	ON	OFF

[Operation during rotation]

The electrical circuit in the actuator is configured as shown in the illustration at the left. When the Hard mode is selected, the power is fed to the motor as indicated by the arrow. When the output shaft rotates to the position H, the SW_1 is opened and the motor cut off.

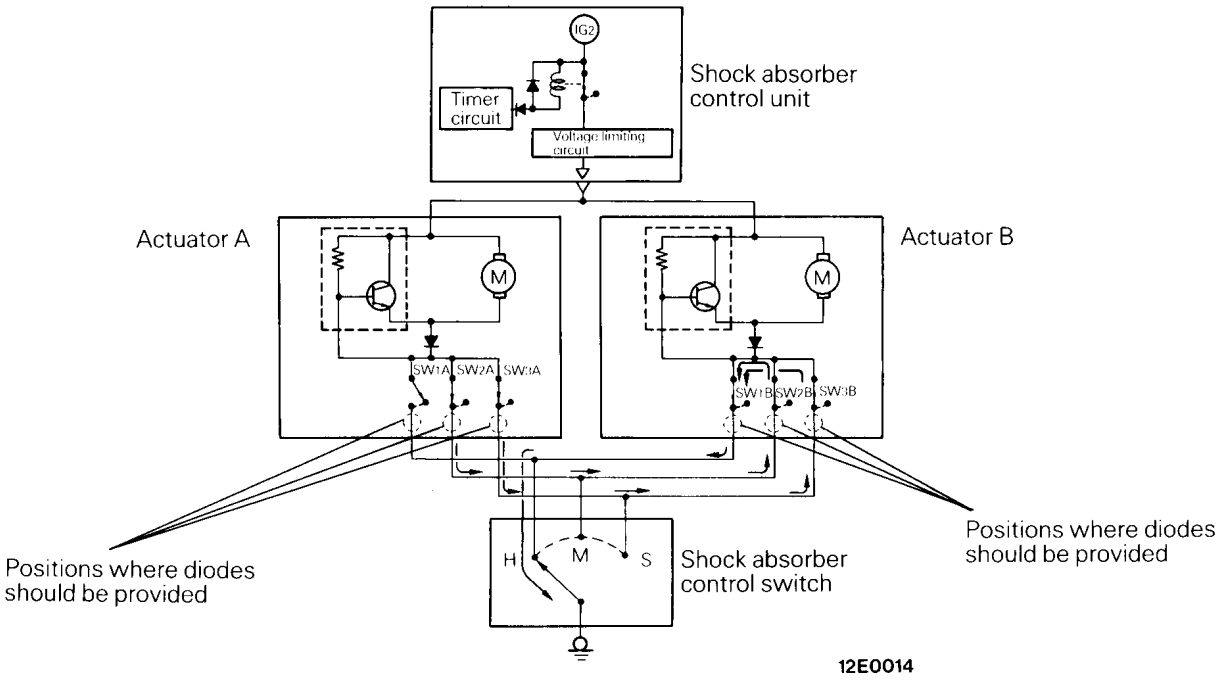


[Operation at the time of shutdown]

Even after the power supply to the motor has been stopped, the motor continues to rotate because of its inertial force, generating an e.m.f. (Electro motive force)
The e.m.f. is used to operate the brake circuit which provides a short circuit across the motor to apply abrupt brake to the motor.

[Roles of diodes D_1, D_2 and D_3]

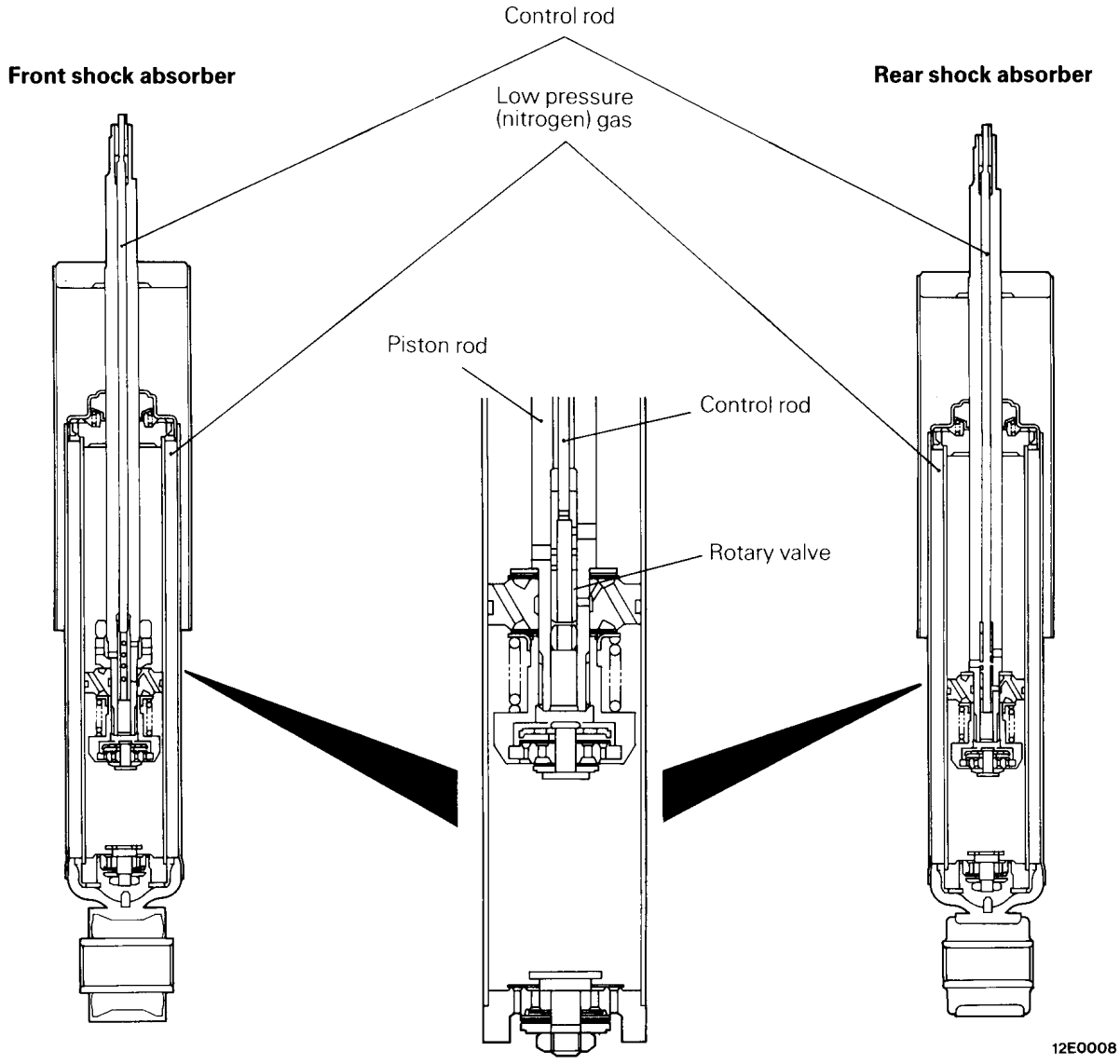
Diodes D_1, D_2 and D_3 are provided between the actuator SW_1, SW_2 and SW_3 and the shock absorber control switch respectively. The diodes are provided for the purpose of preventing problems such as the one described below that occur when multiple actuators are wired in parallel. For example, when the Hard mode is selected the motors in both actuators A and B rotate to the Hard position. In this case, if the motor in actuator A reaches the Hard position earlier, the SW_1A is forced to OFF to stop motor A. However, since the motor in actuator B does not reach the Hard position yet, the SW_1B remains ON. As a result, the ⊖ terminal of motor A is grounded via SW_2A, SW_3A → SW_2B, SW_3B → SW_1B → shock absorber control switch, and motor A cannot stop. In other words, it follows that if no diodes are provided, motors A and B cannot be stopped unless the SW_1A, SW_2B and SW_3B are simultaneously caused to be OFF.

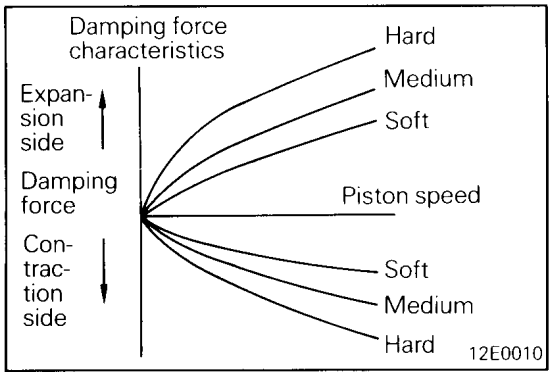


FRONT AND REAR SHOCK ABSORBERS

The front and rear shock absorbers are essentially the same in construction and operation. Both have a rotary valve with an orifice which is made to rotate to open or close the oil passage, thereby changing the damping force.

The front and rear shock absorbers are filled with a low pressure nitrogen gas to assure stable damping force characteristics.



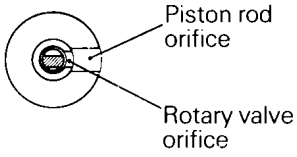
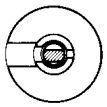
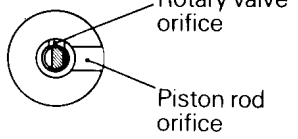
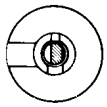
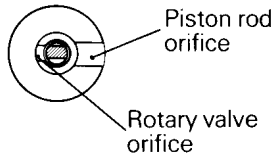
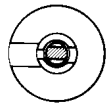
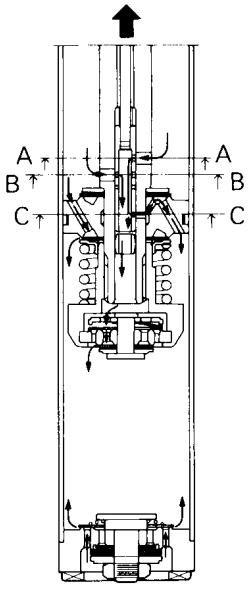
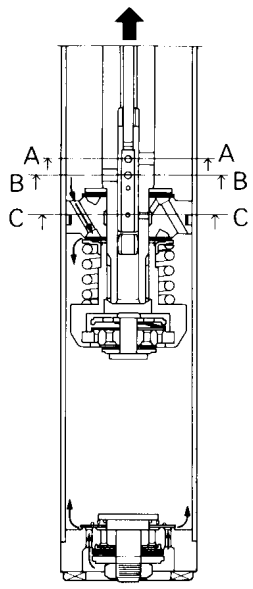
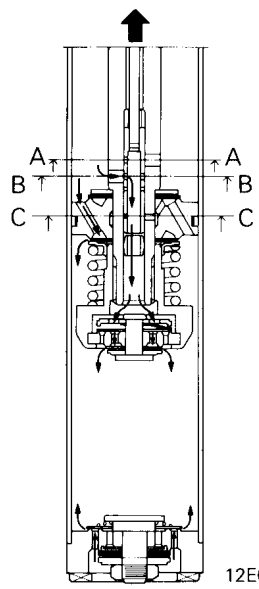
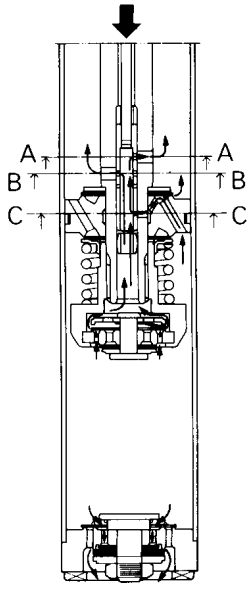
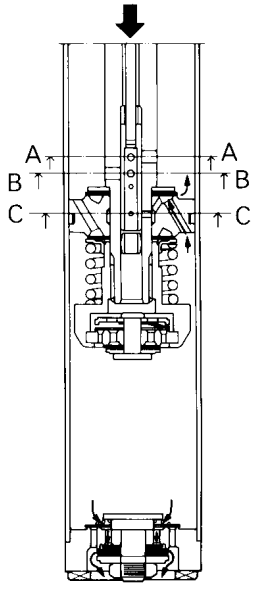
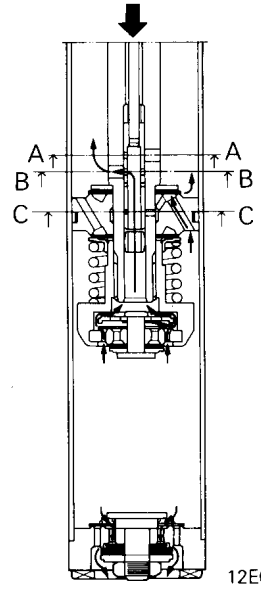


Damping Force Changing Mechanism

Both the rotary valve and the piston rod which accommodates the rotary valve have an orifice.

The two orifices are placed in the opened or closed position by rotation of the rotary valve to increase or reduce the flow passage area in the shock absorber and change the damping force in three stages.

Flow of Shock Absorber Oil

Item \ Mode	Soft mode	Hard mode	Medium mode
Positions of rotary valve orifice and piston rod orifice	**Section A-A**  **Section B-B**  **Section C-C** 	**Section A-A**  **Section B-B**  **Section C-C** 	**Section A-A**  **Section B-B**  **Section C-C**  12E0073
Flow of oil in shock absorber — Expansion stroke			 12E0071
Contraction stroke			 12E0072

WHEEL AND TYRE

E9DMAAB

On the wide fender equipped vehicles, aluminum wheels are standard equipment.
The offset amount of wheel, reduced for the wider fender installation, have contributed to wider track and better cornering performance.

SPECIFICATIONS

<Vehicles for Europe>

Items		Vehicles with wide fender	Vehicles without wide fender
Wheel			
Type		Aluminum type	Steel type Aluminum type*1
Size		15 x 7JJ	15 x 6JJ
Offset	mm (in.)	10 (0.39)	33 (1.29)
Pitch circle diameter	mm (in.)	139.7 (5.5)	139.7 (5.5)
Tyre			
Size		265/70R15 110S	235/75R15 105S 215R15 100S*1
Tyre inflation pressure	kPa (kg/cm², psi)		
When 4 passengers			
Front		180 (1.8, 26)	180 (1.8, 26)
Rear		200 (2.0, 28)	200 (2.0, 28) 210 (2.1, 30)*2
When 4 passengers to max. load or trailer towing			
Front		180 (1.8, 26)	180 (1.8, 26)
Rear		200 (2.0, 28)	220 (2.2, 31) 230 (2.3, 33)*2

NOTE
*1: Optional equipment
*2: Tire inflation pressure for optional tyres

<Vehicles for General Export>

Items	Canvas top and van		Wagon			
	GCC	Except for GCC	GCC		Except for GCC	
			With wide fender	Without wide fender	With wide fender	Without wide fender
Wheel						
Type	Steel type	Steel type	Aluminum type	Steel type	Aluminum type	Steel type
Size	16 x 5.50F 16 x 6JJ*1	16 x 5.50F 16 x 6JJ*1	15 x 7JJ	16 x 6JJ 16 x 5.50F*1	15 x 7JJ	16 x 6JJ 16 x 5.50F*1
Offset mm (in.)	33 (1.29)	33 (1.29)	10 (0.39)	33 (1.29)	10 (0.39)	33 (1.29)
Pitch circle diameter mm (in.)	139.7 (5.5)	139.7 (5.5)	139.7 (5.5)	139.7 (5.5)	139.7 (5.5)	139.7 (5.5)
Tyre						
Size	205/80R16 RF 104S 7.50–16 –6PRLT*1	205R16 RF 104Q 7.50–16 –6PRLT*1	31 x 10.50R15 6PRLT	205/80R16 RF 104S 7.50–16 –6PRLT*1	31 x 10.50R15 6PRLT	205R16 RF 104Q 7.50–16 –6PRLT*1
Tyre inflation pressure kPa (kg/cm², psi)						
Front	210 (2.1, 30) 200 (2.0, 29)*2	210 (2.1, 30) 200 (2.0, 29)*2	200 (2.0, 29)	210 (2.1, 30) 200 (2.0, 29)*2	200 (2.0, 29)	210 (2.1, 30) 200 (2.0, 29)*2
Rear	260 (2.6, 38) 240 (2.4, 35)*2	260 (2.6, 38) 240 (2.4, 35)*2	200 (2.0, 29)	260 (2.6, 38) 240 (2.4, 35)*2	200 (2.0, 29)	260 (2.6, 38) 240 (2.4, 35)*2

NOTE
*1: Optional equipment
*2: Tire inflation pressure for optional tyres

<Vehicles for Australia>

Items	Vehicles with wide fender	Vehicles without wide fender	
		With leaf spring rear suspension	With 3-link, coil spring rear suspension
Wheel			
Type	Aluminum type	Steel type	Steel type
Size	15 x 7JJ	16 x 5.50F 16 x 6JJ*	15 x 6JJ
Offset mm (in.)	10 (0.39)	33 (1.29)	33 (1.29)
Pitch circle diameter mm (in.)	139.7 (5.5)	139.7 (5.5)	139.7 (5.5)
Tyre			
Size	265/70R15 110S	205R16 RF 104Q	P235/75R15
Tyre inflation pressure kPa (kg/cm², psi)			
When not loaded			
Front	180 (1.8, 26)	210 (2.1, 29)	180 (1.8, 26)
Rear	200 (2.0, 28)	240 (2.4, 35)	200 (2.0, 28)
When loaded			
Front	180 (1.8, 26)	230 (2.3, 33)	180 (1.8, 26)
Rear	200 (2.0, 28)	260 (2.6, 38)	240 (2.4, 35)

NOTE
*: Optional equipment

STEERING

E9DEBAA

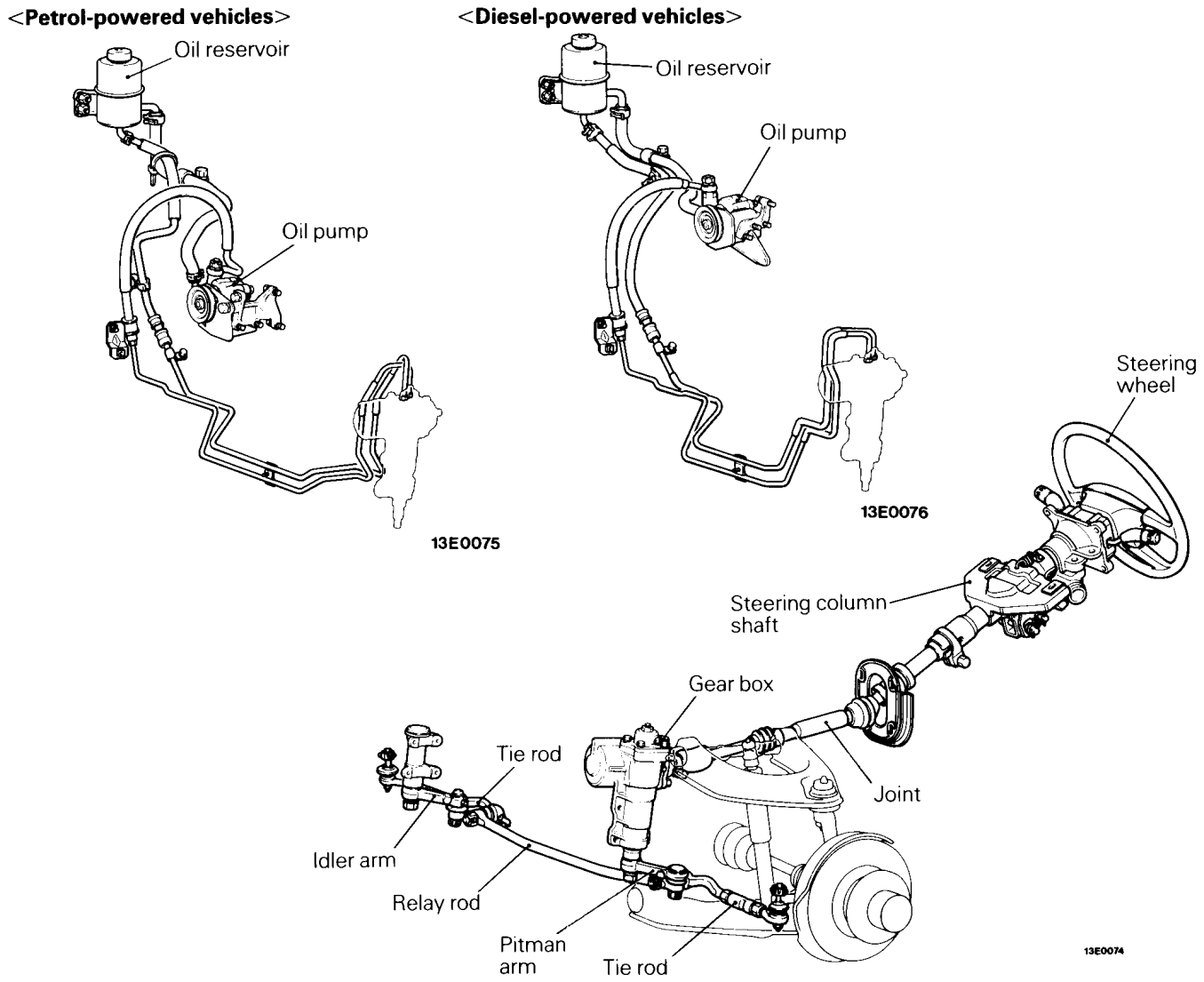
- The steering wheel is a three- or two-spoke type.
- The steering column employs an impact absorbing mechanism (Europe and GCC versions) and a tilt steering mechanism (Europe, General Export, Australia and GCC versions).
- The oil pump is a vane type oil pump with a fluid flow control system so the steering force varies according to engine speed.
- The manual steering gear box is a recirculating ball type with a variable gear ratio. (Except GCC version)
- The power steering gear box is a recirculating ball type with a rotary valve for smooth changeover of oil passages. In addition, a variable gear ratio has been adopted for less steering effort and better steering feeling.
- The steering linkage has steering angle stoppers at the pitman arm and idler arm to prevent noise when maximum steering is done. In addition, an idler arm which provides high support rigidity has been adopted for better steering feeling and reliability. On manual steering equipped vehicles, a damper has been provided for transmission of less vibration to the steering wheel.

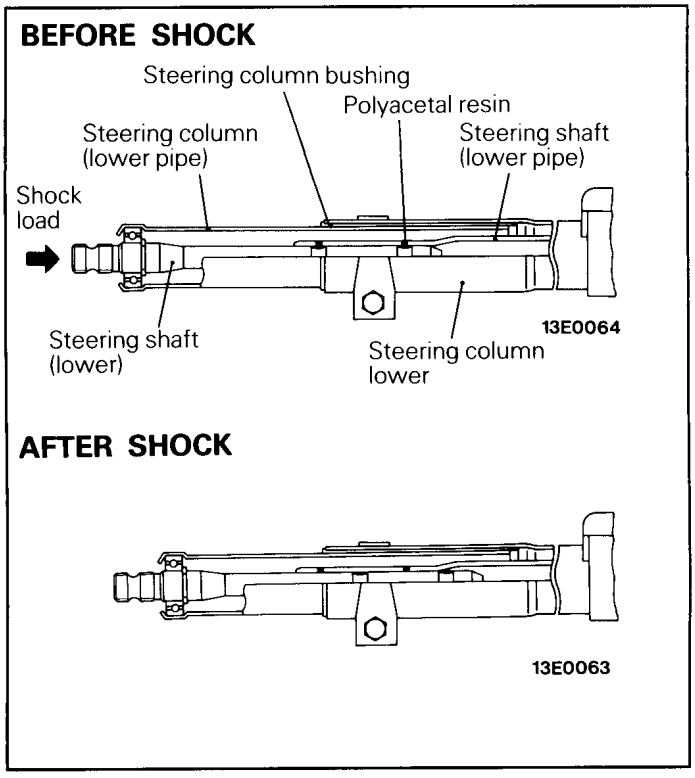
NOTE
The construction and operation of the oil pump, manual steering gear box and power steering gear box are essentially the same as those of the PAJERO.

SPECIFICATIONS

Items		Specifications
Steering wheel diameter	mm (in.)	390 (15.35)
Steering angle (vehicle in unladen)		
Inner wheel		32°40′ $^{+0°}_{-3°}$
Outer wheel		29°45′
Manual steering gear box		
Steering gear type		Recirculating ball type with variable gear ratio
Steering gear ratio		20.5–24.5
Power steering gear box		
Steering gear type		Ball and nut, torsion bar type (integral type)
Steering gear ratio		16.4–18.0
Oil pump		
Oil pump type		Vane type
Displacement	cm^3/rev. (cu.in/rev.)	9.6 (0.59)
Damper assembly		
Type		Hydraulic, cylindrical, double-acting type
Maximum length	mm (in.)	534 (21.0)
Compressed length	mm (in.)	361 (14.2)
Stroke	mm (in.)	173 (6.8)

CONSTRUCTION DIAGRAM



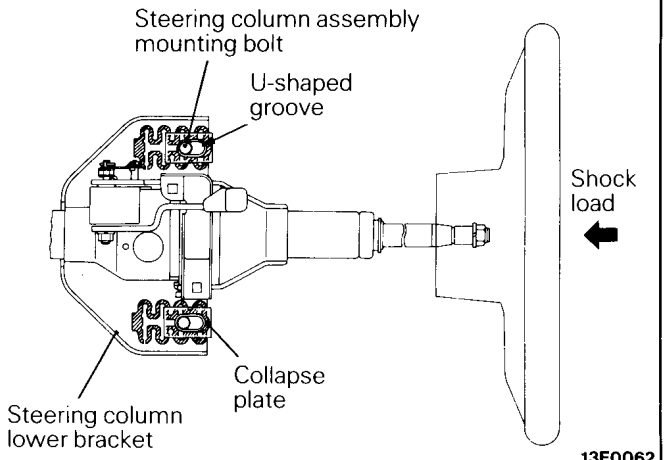


STEERING COLUMN

SHOCK ABSORBING STRUCTURE

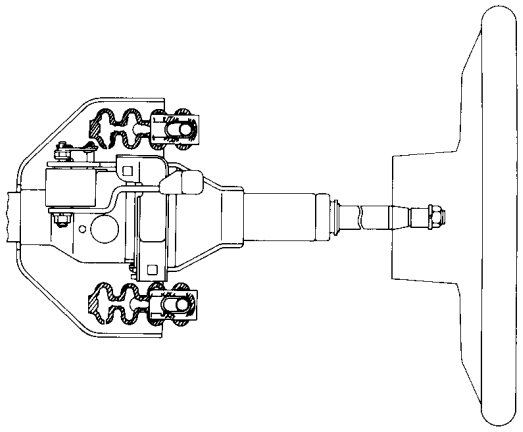
(1) When the vehicle collides with something and there is a load added to the steering shaft from the gear box (primary shock), the steering shaft (lower) of the steering shaft assembly crushes the polyacetal resin, absorbing the shock load using the friction of the steering column (lower pipe) and steering column bushing as it slides into the steering shaft (lower pipe).

BEFORE SHOCK



13E0062

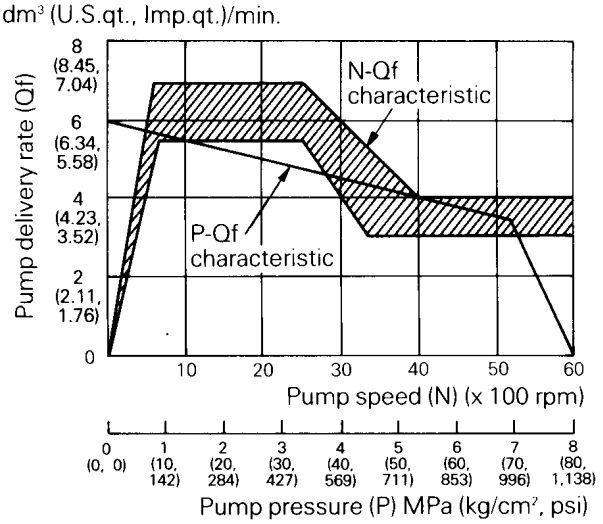
AFTER SHOCK



13E0061

(2) If the driver's body is thrown against the steering wheel (secondary impact), the steering column assembly will be released forward and the collapse plate extended to absorb the impact load, as the mounting bolt hole of the steering column lower bracket is grooved in the form of character U.

OIL PUMP PERFORMANCE



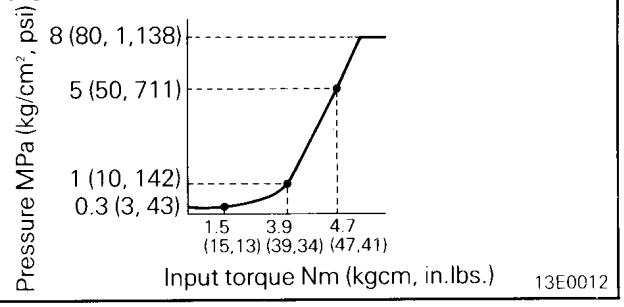
NOTE
(1) P-Qf characteristic: Pump pressure and pump delivery rate
(2) N-Qf characteristic: Pump speed and pump delivery rate

13E0011

OIL PUMP

The oil pump is a vane type with a fluid flow control system which reduces steering effort when the engine speed is low and properly increases it when the engine speed is high.

POWER STEERING GEAR BOX INPUT AND OUTPUT CHARACTERISTIC DIAGRAM

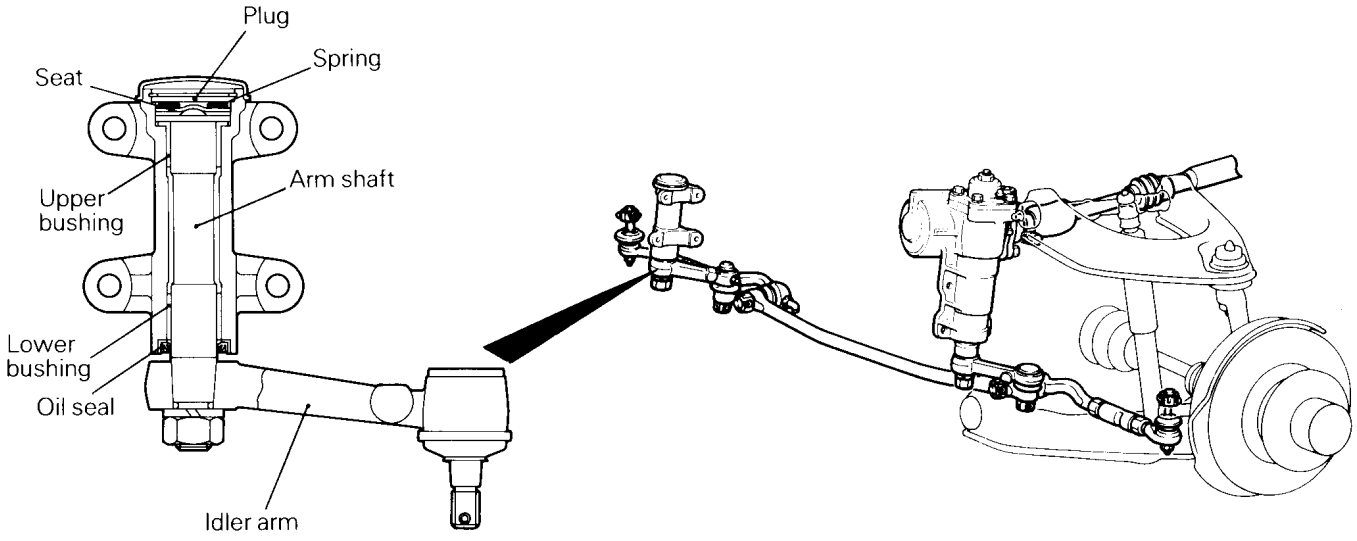


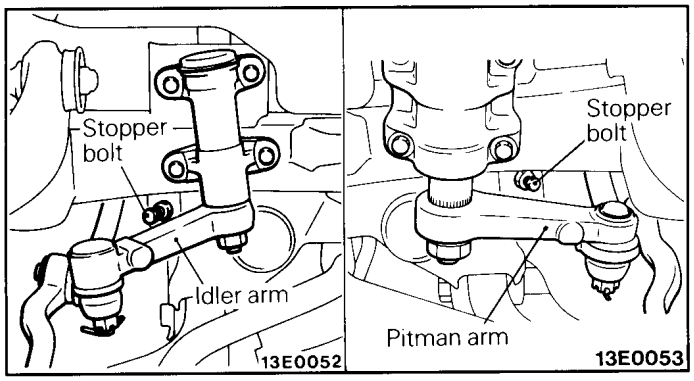
POWER STEERING GEAR BOX

The power steering gear box uses a large diameter rack piston [ϕ74 mm (2.9 in.)] and variable gear ratio (16.4 to 18.0) to reduce steering effort and improve steering feeling.

STEERING LINKAGE

The idler arm support construction has been changed to improve steering feeling.





STEERING ANGLE

The side faces of the pitman arm and idler arm are blocked by a stopper bolt mounted on the frame to restrict the steering angle and prevent noise that may otherwise be generated when maximum steering is done.

BRAKES

E9DHAAG

The brake system offers outstanding reliability, dependability and braking performance, and gives the driver better braking feeling.

FEATURES

Improved braking performance

1. A multi mode type anti-lock brake system (ABS) has been adopted to prevent locked wheel slipping and assure proper braking.
2. Disc brakes have been adopted for the four wheels.
3. Two-piston type front ventilated disc brakes have been adopted to stabilize braking and improve braking feeling.
4. A tandem brake booster has been adopted which provides powerful braking by applying light foot pressure.
5. Parking brake accommodated drum in rear type disc brakes or 10" leading-trailing type drum brakes have been adopted which offer outstanding braking stability.

Improved serviceability

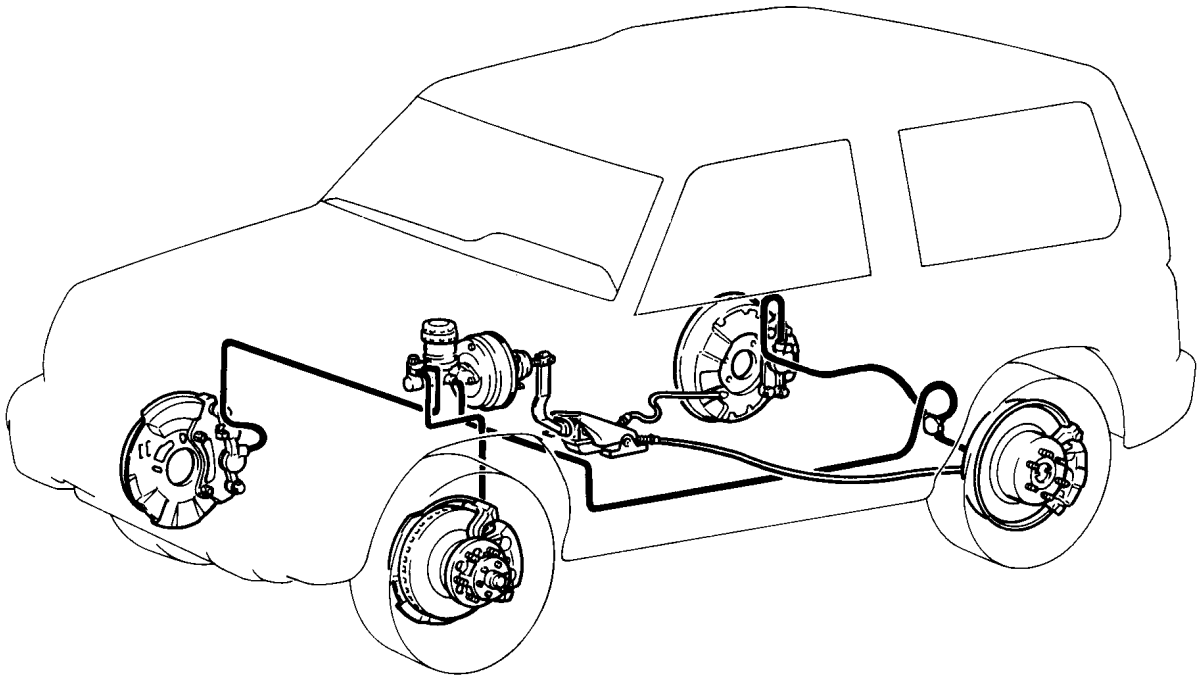
1. For ease of inspection, diagnosis functions have been adopted for the 4ABS.
2. For ease of removal and re-installation, the outer disc system has been adopted for the rear.
3. For ease of identification, the colour of the reserve tank cap of the master cylinder has been changed to white.

Higher safety

1. An audible type wear indicator has been adopted to alert the driver when the pad service limit is reached.
2. A blend proportioning valve has been adopted to prevent premature locking of the rear wheels.

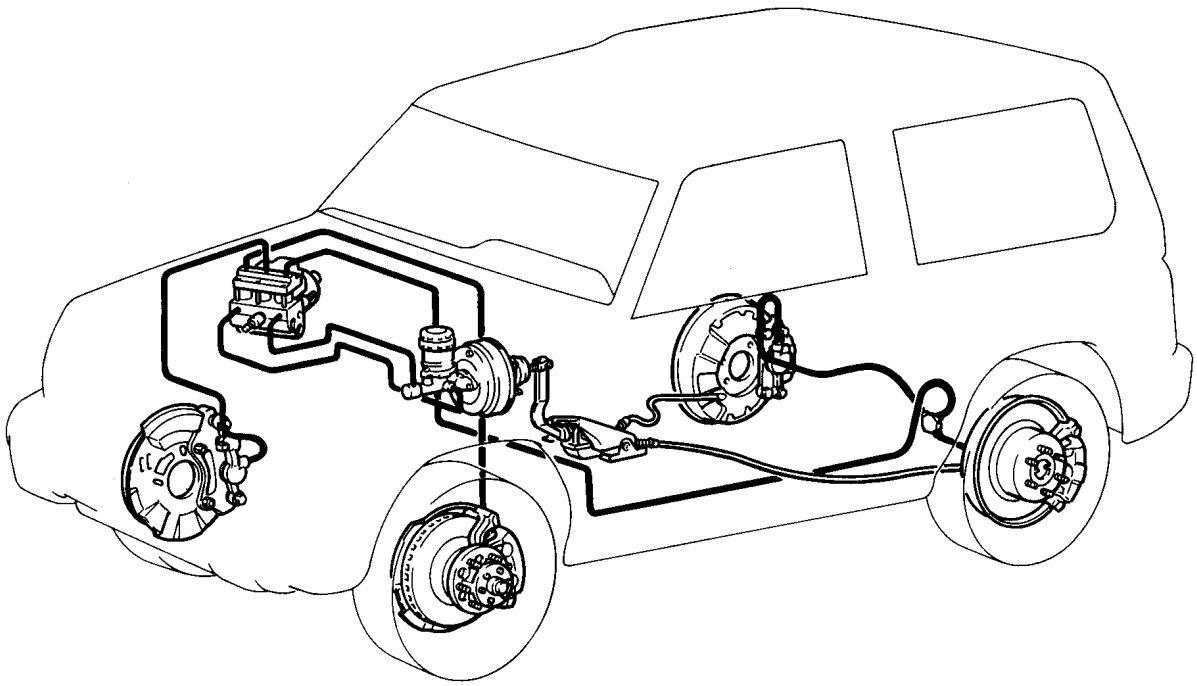
CONSTRUCTION DIAGRAM

<Vehicle without ABS>



14E0158

<Vehicle with ABS>



14E0067

SERVICE BRAKES

SPECIFICATIONS

Vehicles for Europe

Items	2400, 3000	2500D
Master cylinder		
Type	Tandem type (with level sensor)	Tandem type (with level sensor)
I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)
Brake booster		
Type	Vacuum type, tandem	Vacuum type, tandem
Effective dia. of power cylinder mm (in.)	205 + 230 (8 + 9)	180 + 205 (7 + 8)
Boosting ratio	6.0	6.0
Proportioning valve		
Type	Load sensing proportioning valve	Load sensing proportioning valve
Front brakes		
Type	Floating caliper, dual pistons, ventilated disc (M-R57W)	Floating caliper, dual pistons, ventilated disc (M-R57W)
Disc effective dia. x thickness mm (in.)	228 x 24 (8.98 x 0.94)	228 x 24 (8.98 x 0.94)
Wheel cylinder I.D. mm (in.)	42.8 (1 11/16) x 2	42.8 (1 11/16) x 2
Lining thickness mm (in.)	10.0 (0.39)	10.0 (0.39)
Clearance adjustment	Automatic	Automatic
Rear brakes		
Type	Floating caliper, single piston, solid disc (M-R59S)	Floating caliper, single piston, solid disc (M-R59S)
Disc effective dia. x thickness mm (in.)	272 x 18 (10.71 x 0.71)	272 x 18 (10.71 x 0.71)
Wheel cylinder I.D. mm (in.)	42.8 (1 11/16)	42.8 (1 11/16)
Lining thickness mm (in.)	9 (0.354)	9 (0.354)
Clearance adjustment	Automatic	Automatic
ABS		
Rotor teeth		
Front	110	110
Rear	110	110
Speed sensor type	Magnet coil type	Magnet coil type

Vehicles for General Export

Items	2600		2500D (except vehicles without wide fender)		Vehicles with wide fender
	2-door models	4-door models	2-door models	4-door models	
Master cylinder					
Type	Tandem type (without level sensor)	Tandem type (without level sensor)	Tandem type (without level sensor)	Tandem type (without level sensor)	Tandem type (without level sensor)
I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)
Brake booster					
Type	Vacuum type, single	Vacuum type, tandem	Vacuum type, single	Vacuum type, single	Vacuum type, tandem
Effective dia. of power cylinder mm (in.)	230 (9)	205 + 230 (8 + 9)	205 (8)	230 (9)	180 + 205 (7 + 8)*1 or 205 + 230 (8 + 9)*2
Boosting ratio	5.5	6.0	5.5	5.5	6.0
Proportioning valve					
Type	Blend proportioning valve	Blend proportioning valve	Blend proportioning valve	Blend proportioning valve	Blend proportioning valve
Front brakes					
Type	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)*1 or Floating caliper, dual pistons, ventilated disc (M-R57W)*2
Disc effective dia. x thickness mm (in.)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)*1 or 228 x 24 (8.98 x 0.94)*2
Wheel cylinder I.D. mm (in.)	60.3 (2 3/8)	60.3 (2 3/8)	60.3 (2 3/8)	60.3 (2 3/8)	60.3 (2 3/8)*1 or 42.8 (1 11/16) x 2*2
Lining thickness mm (in.)	10.5 (0.41)	10.5 (0.41)	10.5 (0.41)	10.5 (0.41)	10.5 (0.41)*1 or 10.0 (0.39)*2
Clearance adjustment	Automatic	Automatic	Automatic	Automatic	Automatic
Rear brakes					
Type	Leading trailing	Leading trailing	Leading trailing	Leading trailing	Floating caliper, single piston, solid disc (M-R59S)
Drum I.D. mm (in.)	254 (10)	254 (10)	254 (10)	254 (10)	–
Disc effective dia. x thickness mm (in.)	–	–	–	–	272 x 18 (10.71 x 0.71)
Wheel cylinder I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	42.8 (1 11/16)
Lining thickness mm (in.)	4.6 (0.181)	4.6 (0.181)	4.6 (0.181)	4.6 (0.181)	9 (0.354)
Clearance adjustment	Automatic	Automatic	Automatic	Automatic	Automatic
ABS*2					
Rotor teeth					
Front	–	–	–	–	110
Rear	–	–	–	–	110
Speed sensor type	–	–	–	–	Magnet coil type

NOTE
*1: Diesel powered vehicles
*2: Petrol powered vehicles

Vehicles for GCC

Items	2600		3000	2500D
	2-door models	4-door models		
Master cylinder				
Type	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)
I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)
Brake booster				
Type	Vacuum type, single	Vacuum type, tandem	Vacuum type, tandem	Vacuum type, tandem
Effective dia. of power cylinder mm (in.)	230 (9)	205 + 230 (8 + 9)	205 + 230 (8 + 9)	180 + 205 (7 + 8)
Boosting ratio	5.5	6.0	6.0	6.0
Proportioning valve				
Type	Blend proportioning valve	Blend proportioning valve	Blend proportioning valve	Blend proportioning valve
Front brakes				
Type	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, dual pistons, ventilated disc (M-R57W)	Floating caliper, single piston, ventilated disc (M-R56V)
Disc effective dia. x thickness mm (in.)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)	228 x 24 (8.98 x 0.94)	227 x 22 (8.94 x 0.87)
Wheel cylinder I.D. mm (in.)	60.3 (2 3/8)	60.3 (2 3/8)	42.8 (1 11/16) x 2	60.3 (2 3/8)
Lining thickness mm (in.)	10.5 (0.41)	10.5 (0.41)	10.0 (0.39)	10.5 (0.41)
Clearance adjustment	Automatic	Automatic	Automatic	Automatic
Rear brakes				
Type	Leading trailing	Leading trailing	Floating caliper, single piston, solid disc (M-R59S)	Floating caliper, single piston, solid disc (M-R59S)
Drum I.D. mm (in.)	254 (10)	254 (10)	–	–
Disc effective dia. x thickness mm (in.)	–	–	272 x 18 (10.71 x 0.71)	272 x 18 (10.71 x 0.71)
Wheel cylinder I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	42.8 (1 11/16)	42.8 (1 11/16)
Lining thickness mm (in.)	4.6 (0.181)	4.6 (0.181)	9 (0.354)	9 (0.354)
Clearance adjustment	Automatic	Automatic	Automatic	Automatic
ABS				
Rotor teeth				
Front	–	–	110	–
Rear	–	–	110	–
Speed sensor type	–	–	Magnet coil type	–

Vehicles for Australia

Items	2600, 2500D (vehicles with leaf spring)		3000	2500D (except vehicles with leaf spring)
	2-door models	4-door models		
Master cylinder				
Type	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)
I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)	23.8 (15/16)
Brake booster				
Type	Vacuum type, single	Vacuum type, tandem	Vacuum type, tandem	Vacuum type, tandem
Effective dia. of power cylinder mm (in.)	230 (9)	180 + 205 (7 + 8)*1 or 205 + 230 (8 + 9)*2	205 + 230 (8 + 9)	180 + 205 (7 + 8)
Boosting ratio	5.5	6.0	6.0	6.0
Proportioning valve				
Type	Load sensing proportioning valve	Load sensing proportioning valve	Load sensing proportioning valve	Load sensing proportioning valve
Front brakes				
Type	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, single piston, ventilated disc (M-R56V)	Floating caliper, dual pistons, ventilated disc (M-R57W)	Floating caliper, dual pistons, ventilated disc (M-R57W)
Disc effective dia. x thickness mm (in.)	227 x 22 (8.94 x 0.87)	227 x 22 (8.94 x 0.87)	228 x 24 (8.98 x 0.94)	228 x 24 (8.98 x 0.94)
Wheel cylinder I.D. mm (in.)	60.3 (2 3/8)	60.3 (2 3/8)	42.8 (1 11/16) x 2	42.8 (1 11/16) x 2
Lining thickness mm (in.)	10.5 (0.41)	10.5 (0.41)	10.0 (0.39)	10.0 (0.39)
Clearance adjustment	Automatic	Automatic	Automatic	Automatic
Rear brakes				
Type	Leading trailing	Leading trailing	Floating caliper, single piston, solid disc (M-R59S)	Floating caliper, single piston, solid disc (M-R59S)
Drum I.D. mm (in.)	254 (10)	254 (10)	–	–
Disc effective dia. x thickness mm (in.)	–	–	272 x 18 (10.71 x 0.71)	272 x 18 (10.71 x 0.71)
Wheel cylinder I.D. mm (in.)	23.8 (15/16)	23.8 (15/16)	42.8 (1 11/16)	42.8 (1 11/16)
Lining thickness mm (in.)	4.6 (0.181)	4.6 (0.181)	9 (0.354)	9 (0.354)
Clearance adjustment	Automatic	Automatic	Automatic	Automatic
ABS				
Rotor teeth				
Front	–	–	110	–
Rear	–	–	110	–
Speed sensor type	–	–	Magnet coil type	–

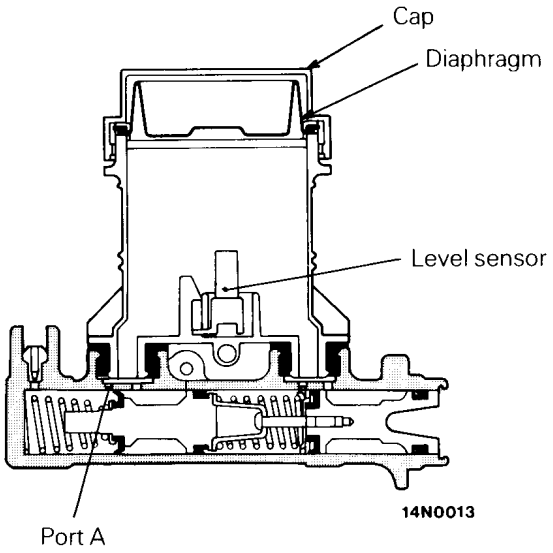
NOTE
*1: Diesel powered vehicles
*2: Petrol powered vehicles

MASTER CYLINDER

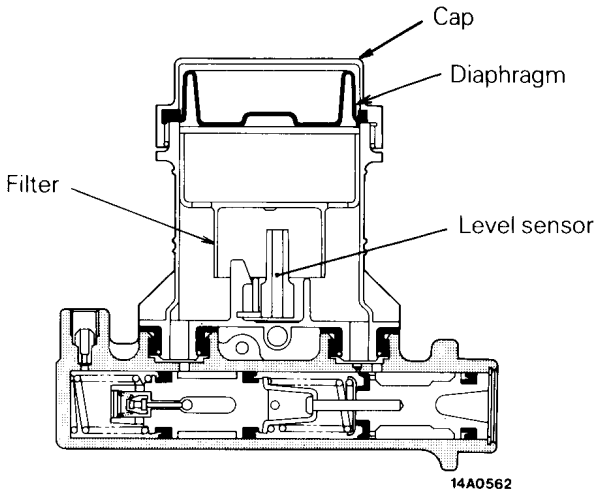
The master cylinder is constructed for a maximum measure of safety and offers the following features.

- A tandem type master cylinder has been adopted.
- On vehicles with ABS, a built-in filter has been provided in the reserve tank to prevent entry of foreign substances into the brake lines when brake fluid is added or replaced.
- On vehicles with ABS, compared with vehicles without ABS, port A has been abolished and the shape of the secondary piston changed.
- The colour of the reserve tank cap has been changed to white for improvement of serviceability.

<Vehicles without ABS>



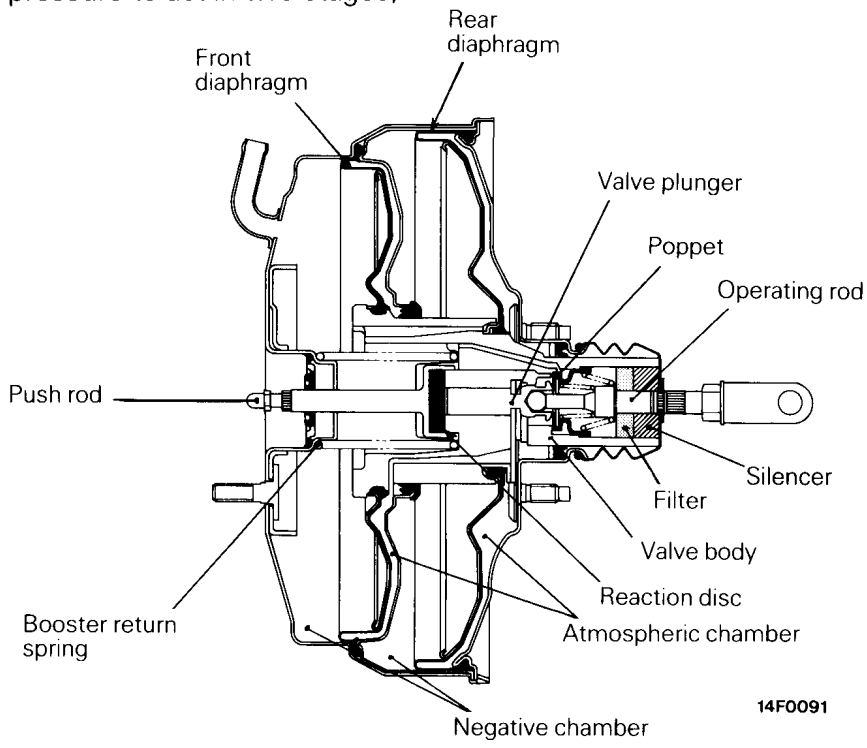
<Vehicles with ABS>



BRAKE BOOSTER

The brake booster is a tandem or single type. Either of the types is selected for the right type of vehicle.

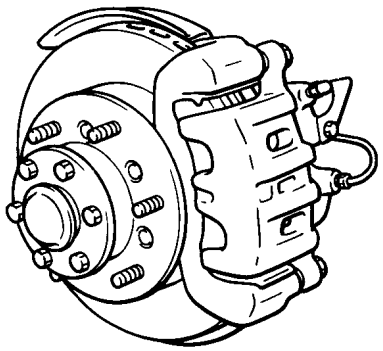
- The tandem type has two diaphragms to cause the difference between the atmospheric pressure and negative pressure to act in two stages, providing large boosting effects without increasing its outside diameter.
- A non-disassembly design has been adopted for size and weight reduction.



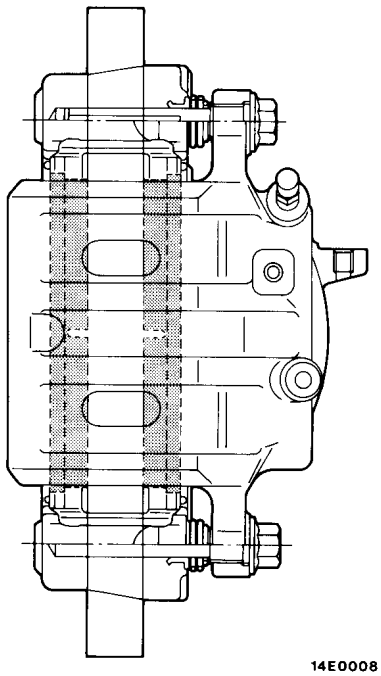
FRONT BRAKES

- The front brakes are 15" single piston (M-R56V type) or 15" dual pistons (M-R57W type) ventilated disc brakes.
- For the sake of safety, an audible type wear indicator has been provided on the pad inside the body.

M-R57W



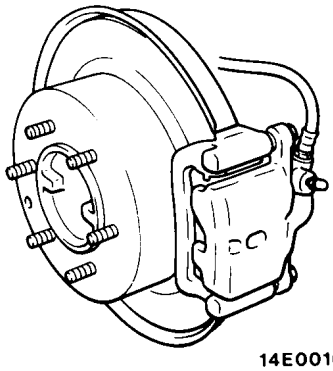
14E0009



14E0008

REAR DISC BRAKES

- The rear disc brakes are 15" single piston (M-R59S type) drum in type disc brakes.
- For ease of servicing, the outer disc type has been adopted which tightens the wheel and disc jointly.
- For the sake of safety, an audible wear indicator has been provided on the pad inside the body.



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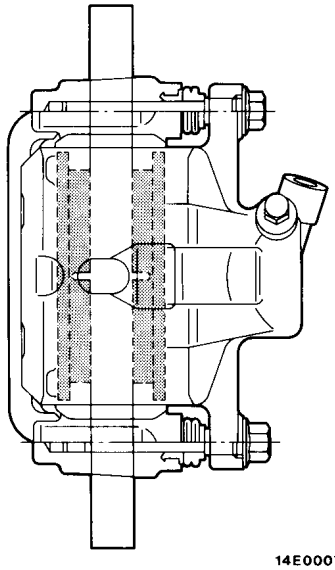
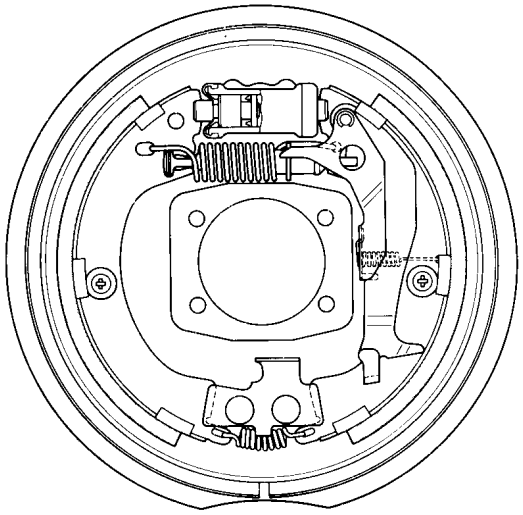


14E0007

REAR DRUM BRAKES

The rear drum brakes are 10" leading-trailing brakes with an auto adjuster mechanism which always provides stable braking when traveling forward or backward.



14G0011

ANTI-LOCK BRAKE SYSTEM (ABS)

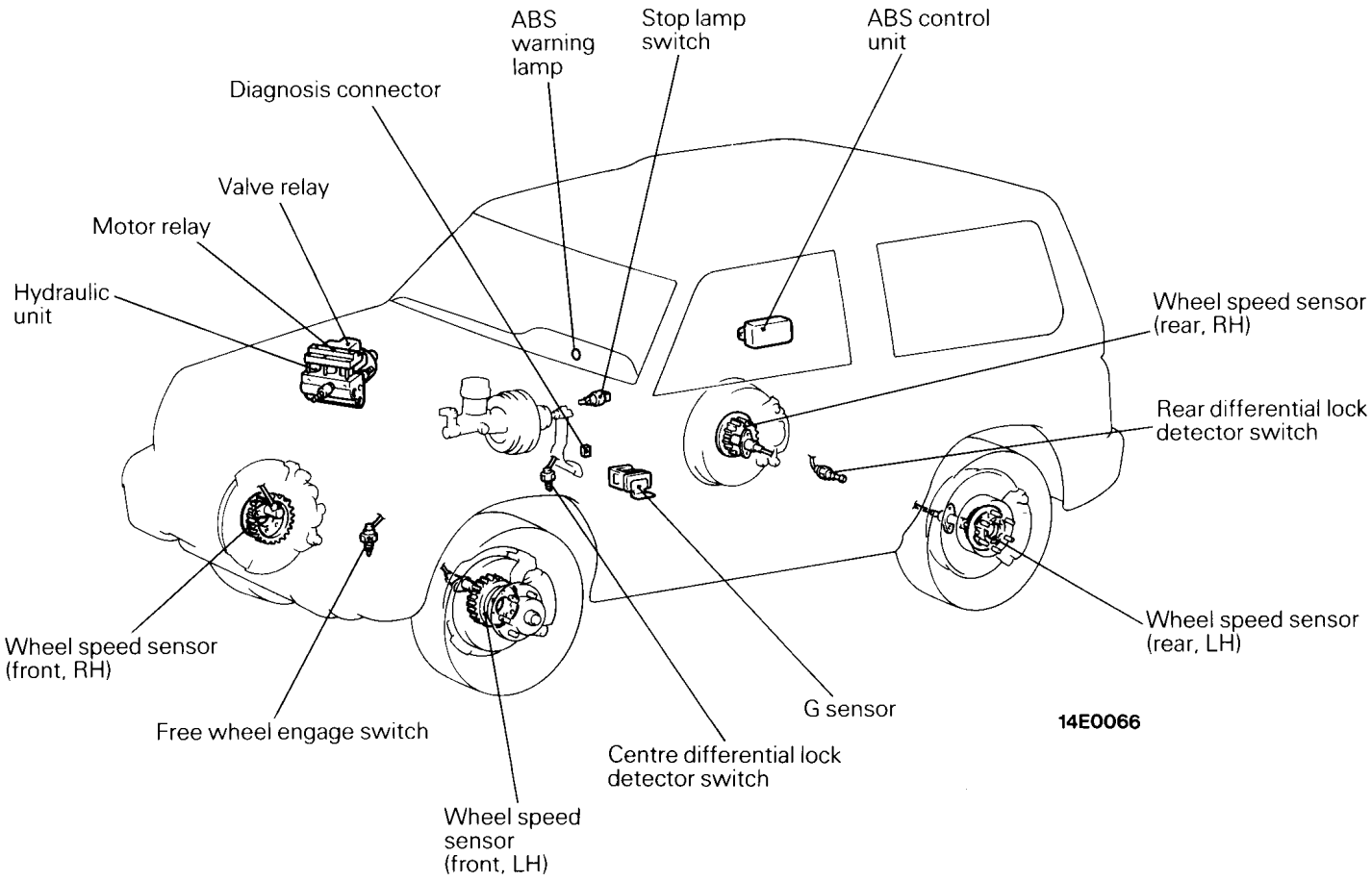
E9DIAAF

The anti-lock brake system (ABS), an improved version of the ABS now in use in the 2WD vehicles and the 4WD vehicles (VCU 4WD) such as the Galant, is compatible with the full drive mode of the Superselect 4WD. It is the world's first ABS applicable not only in the 2WD and VCU 4WD (centre differential free) modes but also in the directly coupled 4WD (centre differential locked) or rear differential locked mode.

The ABS dramatically improves the "traveling" as well as "braking" performance of the Superselect 4WD. Under any traveling conditions such as a slippery road surface, the ABS assures well-balanced implementation of all phases of traveling performance at an incredibly upgraded level.

NOTE
VCU: Viscous Coupling Unit

CONSTRUCTION DIAGRAM



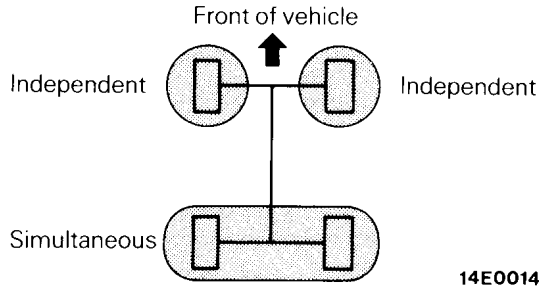
LIST OF MAJOR COMPONENTS

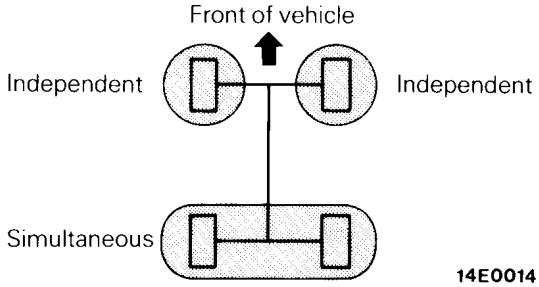
Part name		Function
Sensors	Wheel speed sensor	Sends wheel speed signal of each wheel to the ECU.
	G sensor	Sends an output voltage corresponding to the body acceleration to the ECU.
	Stop lamp switch	Sends the signal indicating whether the brake pedal is depressed or not to the ECU.
	Free wheel engage switch	Sends ON or OFF signal corresponding to the status of the drive system to the ECU.
	Centre differential lock detector switch	
	Rear differential lock detector switch	
Actuators	Hydraulic unit (HU)	Controls the brake fluid pressure of each wheel in response to the signal from the ECU.
	Motor relay	Enters the ON state in response to the signal from the ECU and drives the pump motor in the HU.
	Valve relay	Enters the ON state in response to the signal from the ECU and supplies power to the solenoid valve in the HU.
	ABS warning lamp	Located in the combination meter, the lamp lights when the ABS fails.
	Diagnosis connector	Outputs a diagnosis code.
Electronic control unit (ECU)		Drives the hydraulic unit, etc. in response to the signals from the individual sensors.

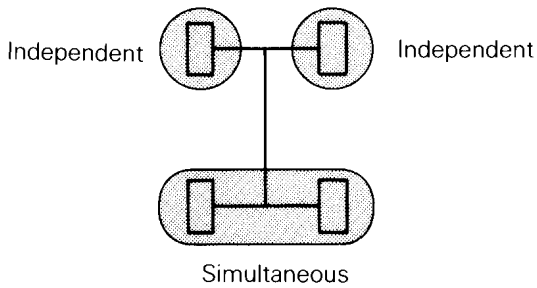
FEATURES

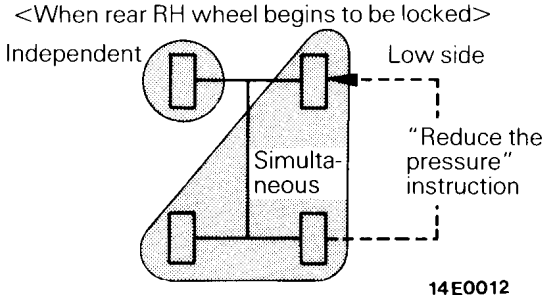
1. Operates in all of the 2WD, VCU 4WD and directly coupled 4WD drive modes. (The world's first of its kind)	The basic concept is a 4-sensor, 3-channel control system for independent control of the front RH and LH wheels and integrated control of the rear wheels. It provides proper controls suitable for different drive modes.
2. Prevents vibration of the directly coupled 4WD.	Provides controls to prevent vibration (judder) which often occurs in the directly coupled 4WD mode where the front and rear wheels interfere with each other.

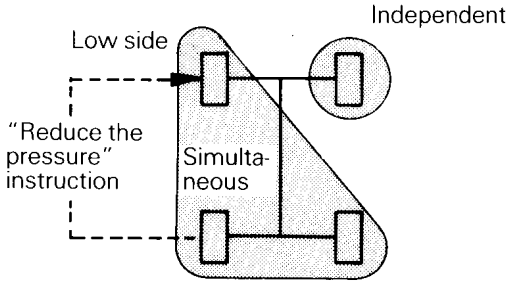
[Controls for different drive modes]

<table>
<tr><th rowspan="2">Drive Mode</th><th colspan="2">ABS controls</th></tr>
<tr><th>Normal condition (Condition other than described at right)</th><th>Rear wheels showing signs of locking a little earlier than front wheels</th></tr>
<tr><td>2WD or VCU 4WD mode</td><td>3-channel control for independent control of front RH and LH wheels and Select Low control of rear wheels
 

14E0014</td><td>3-channel control for independent control of front RH and LH wheels and Select Low control of rear wheels
 

14E0014</td></tr>
<tr><td>Directly coupled 4WD mode</td><td>3-channel control for independent control of front RH and LH wheels and Select Low control of rear wheels
 

14E0014</td><td>"Reduce the pressure" instruction generated at rear wheels is simultaneously sent to the low side front wheel to reduce the torsional torque and prevent vibration.
<When rear RH wheel begins to be locked>
 

14E0012
<When rear LH wheel begins to be locked>
 

14E0013</td></tr>
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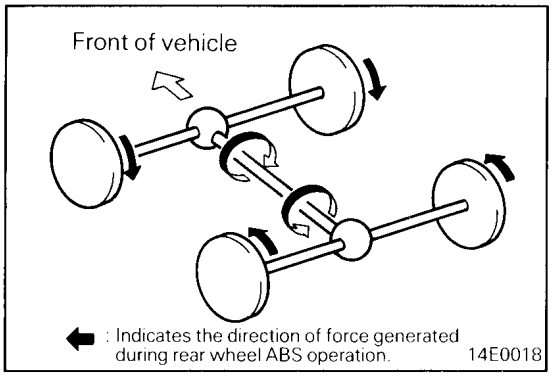


[Reference: about vibration that occurs during ABS operation of directly-coupled 4WD]

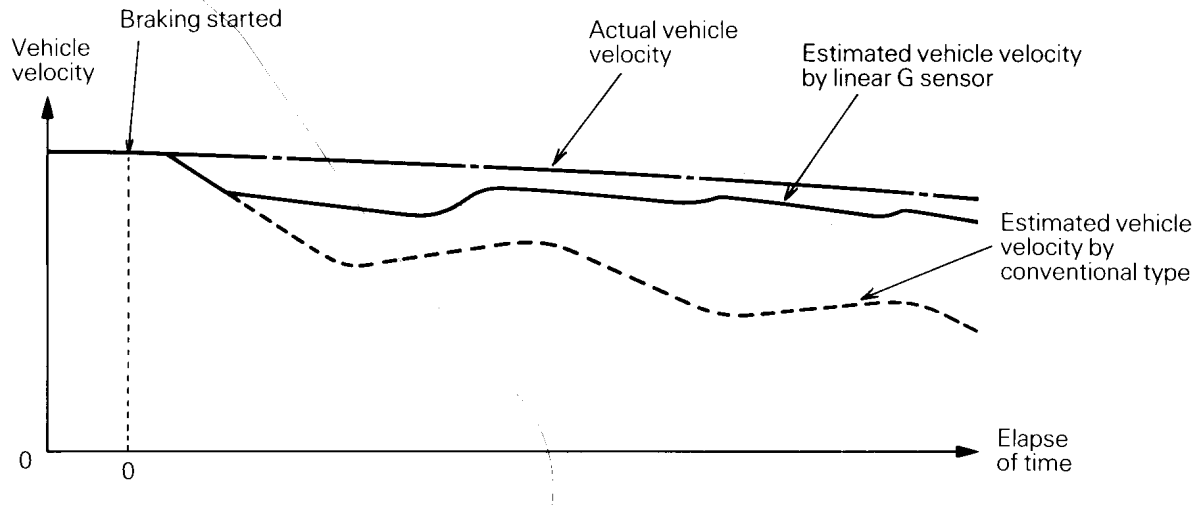
On 4WD vehicles, the front and rear wheels are coupled by the drive shaft. Therefore, when the rear wheels under control by brakes begin to be locked, operation of the ABS reduces braking on both of the rear wheels so that the wheels regain a rotating speed, but retains sufficient braking on both of the front wheels. As a result, torsional torque acts on the drive shaft that couples the front and rear wheels as shown.
If operation of the ABS is terminated in this condition and all of the wheels return to the same state, the torsional torque goes out so that the drive shaft starts going back to the original state, inducing wheel vibration. This phenomenon causes practically no problem in the VCU equipped full time 4WD vehicles like the Galant. On the directly coupled 4WD vehicles, however, the front and rear wheels are held together with a stronger force so that the phenomenon becomes more obvious. To prevent it, control is necessary.

3. VCU 4WD or directly coupled 4WD vehicle velocity estimated	Precise vehicle velocity obtained from linear G sensor to provide highly efficient control

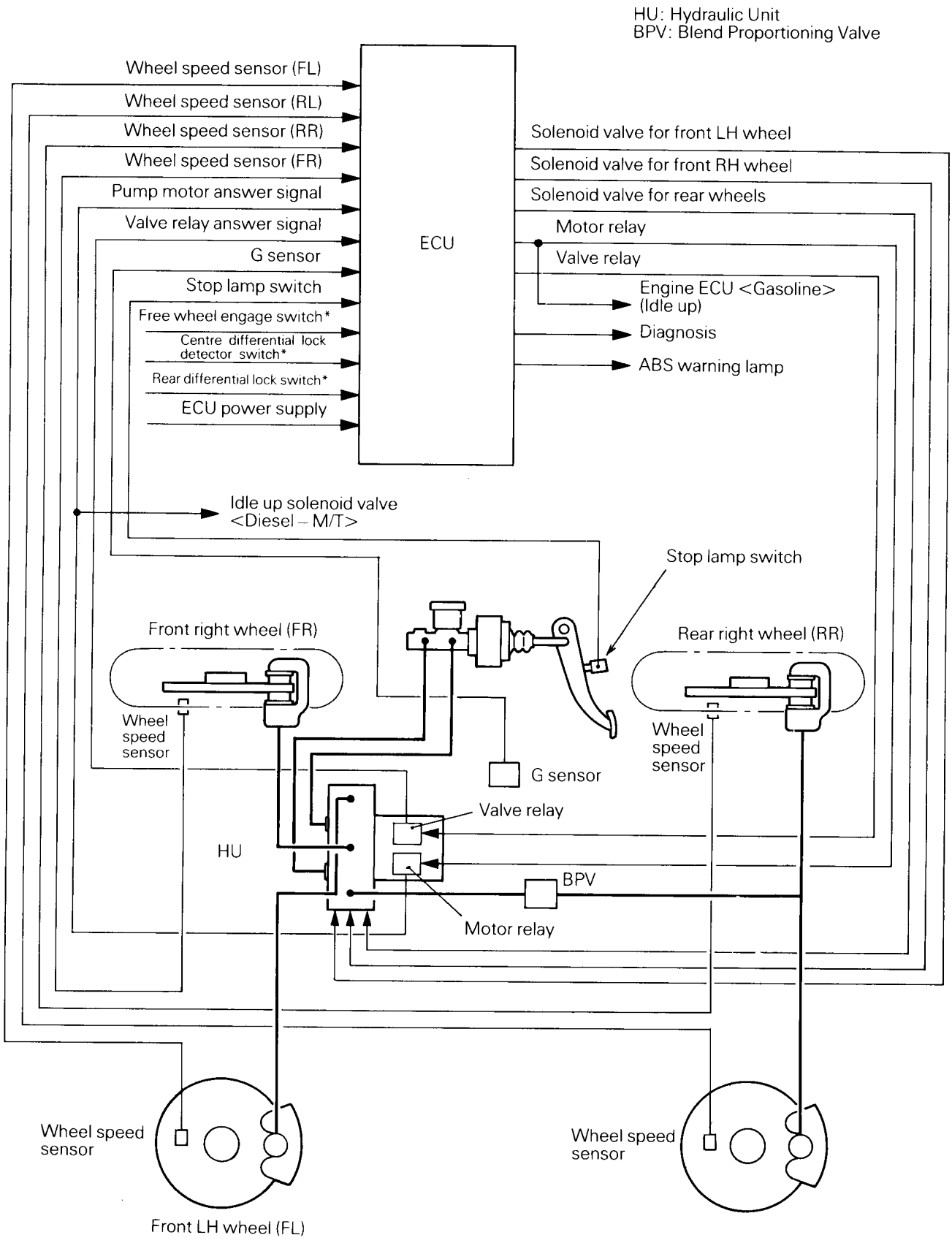
[Reference: estimated vehicle velocity of 4WD vehicle]

In the case of a 4WD vehicle, the front and rear wheels are coupled by the drive shaft. Therefore, application of braking to one of the wheels affects the other three wheels and causes all the wheels to reduce their rotating speed, making it impossible to precisely estimate the vehicle velocity.
For this reason, the ABS for the full time 4WD vehicles like the Galant has a G sensor added for the purpose. Such 4WD vehicles are equipped with a VCU, and the front and rear wheels are not held together so tight as those of the directly coupled 4WD vehicles. The G sensor used for such vehicles, therefore, is one that is caused to be ON when the vehicle velocity is smaller than a given value, and OFF when it is larger.
In the case of the Pajero, additional capability is required for compatibility with the directly coupled 4WD (centre differential locked) mode. For this reason, the Pajero uses a displacement-sensitive type G sensor which generates an output voltage corresponding to the reduced degree of vehicle velocity.

[Comparison of estimated vehicle velocities by use of linear G sensor and ON/OFF type sensor for directly coupled 4WD vehicle]



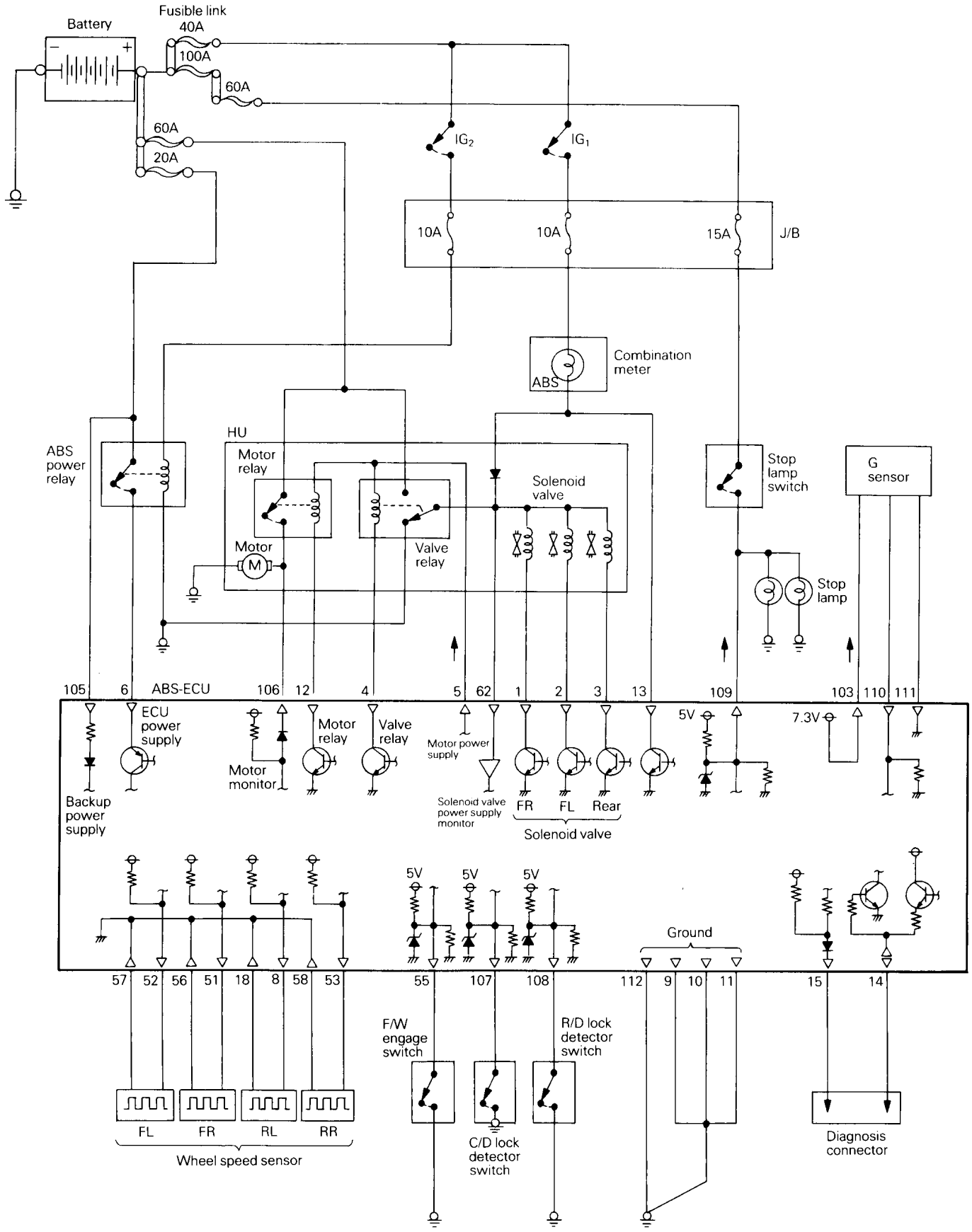
ROUGH SKETCH OF THE SYSTEM



Remarks
The switches marked * are shared by the drive system.

14E0001

ABS ELECTRICAL CIRCUIT DIAGRAM



ABS-ECU connector pin configuration

1	2	3	4	A	5	6	7	8	51	52	53	A	54	55	101	102	A	103	104	105
9	10	11	12	13	14	15	16	17	18	56	57	58	59	60	61	62	106	107	108	109	110	111	112	

C/D: Centre Differential
R/D: Rear Differential
F/W: Free Wheel

14E0022

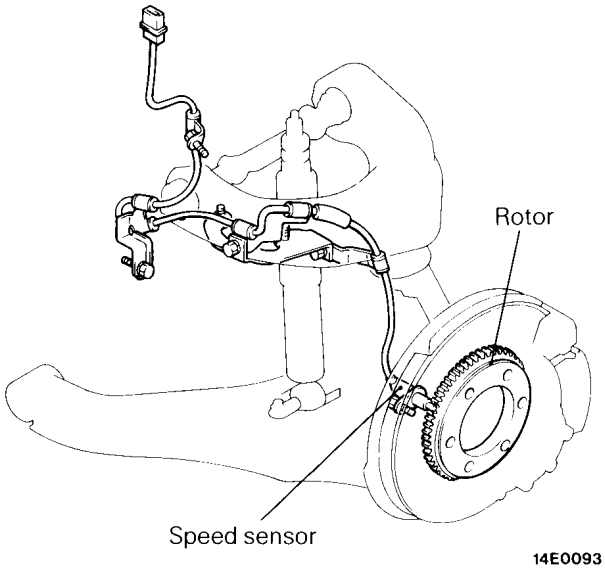
DESCRIPTION OF CONSTRUCTION

SENSOR

WHEEL SPEED SENSOR

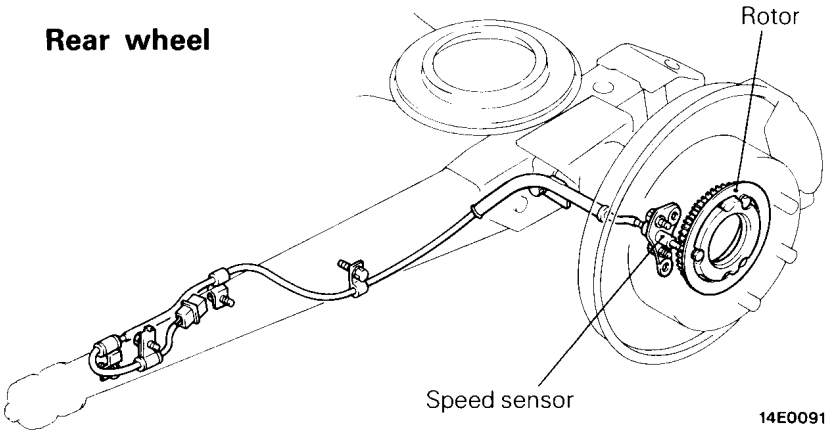
The wheel speed sensor for a front wheel consists of a rotor (110 teeth) mounted to the front hub and a speed sensor mounted to the knuckle arm.
The wheel speed sensor for a rear wheel consists of a rotor (110 teeth) mounted to the rear axle shaft and a speed sensor mounted to the rear wheel bearing case.
The sensor gap for a front wheel is not adjustable, whereas the one for a rear wheel is adjustable.

Front wheel



14E0093

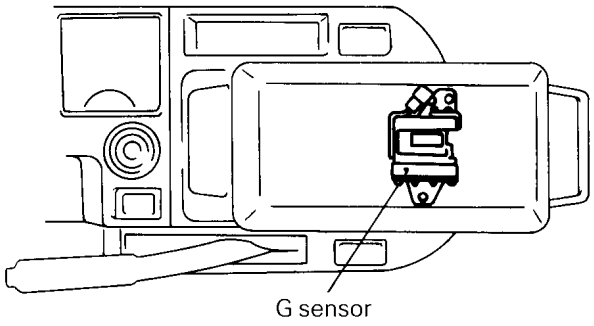
Rear wheel



14E0091

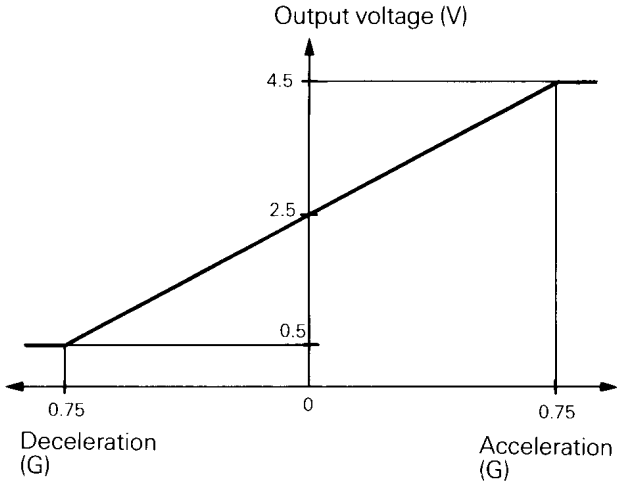
G SENSOR

The G sensor is located on the back bone behind the parking brake lever and outputs a voltage corresponding to the forward and backward vehicle acceleration and deceleration (body G).



14E0099

G sensor output characteristics



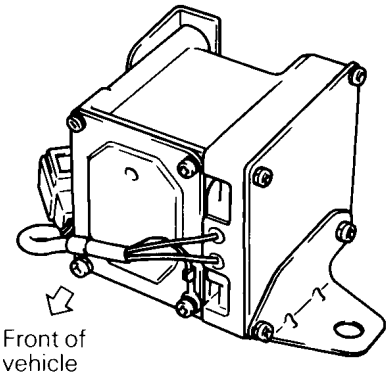
14E0019

Construction and Operation of G Sensor

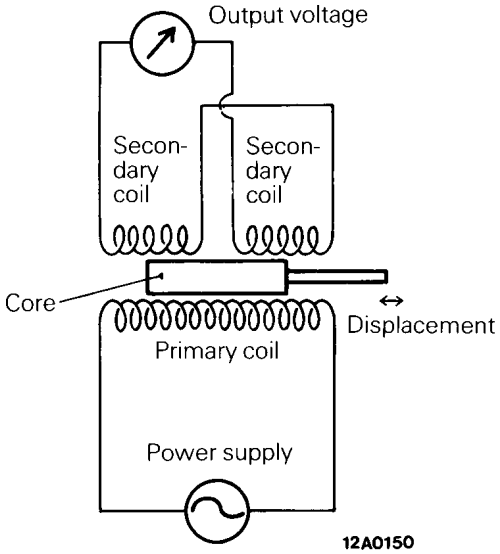
The G sensor is a differential transformer type displacement-sensitive sensor and has built-in control circuits such as an oscillator circuit for supplying AC power to the exciting coil, a rectifier circuit at the detecting coil side, etc.
To suppress vibration of the moving part (core) of the differential transformer, the G sensor is filled with silicone oil.

[Theory of operation for measurement of displacement (acceleration) of differential transformer]

(1) When transformers that output the same voltages opposite to each other in polarity are connected in series, and the core positioned at the centre, the AC voltages induced in the secondary coils become equal to each other. Since the voltage waveforms from both of the coils are opposite in phase, no output voltage is produced.
(2) If the core leaves the centre position, a difference is created between the induced voltages of both coils. As a result, an AC voltage proportional to the difference is produced at the output of the amplifier.
The polarity of the AC voltage is reversed, depending on whether the core is positioned at the right or left.
(3) The displacement of the core (acceleration) can be determined by converting the magnitude of the displacement of the core into the magnitude of a positive or negative voltage by use of this phenomenon.

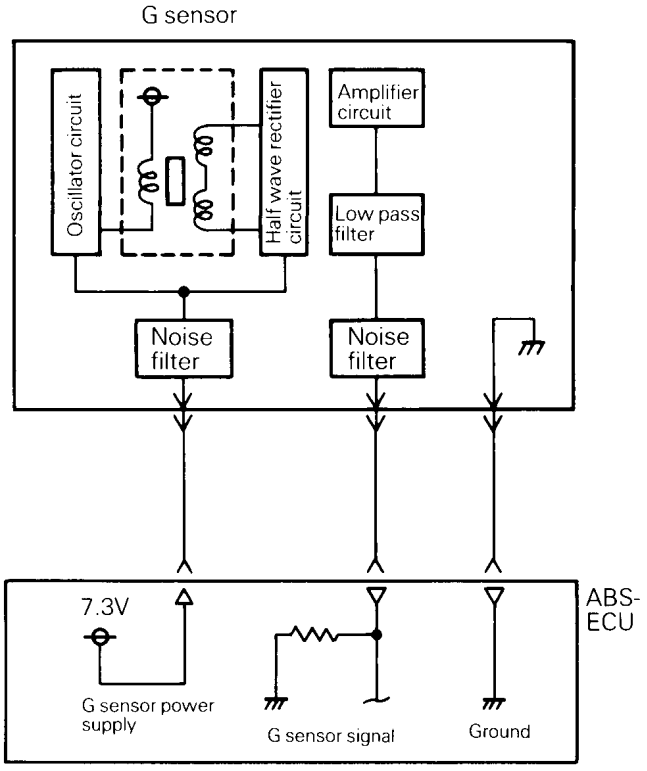


14E0037



12A0150

Circuit diagram



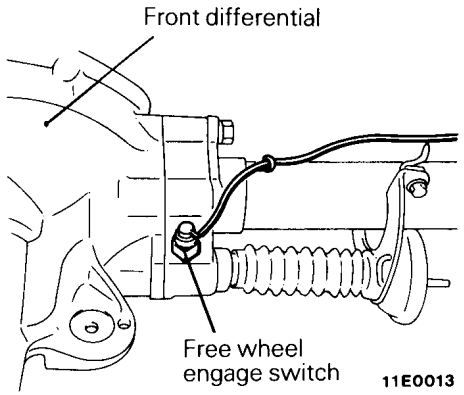
14E0023

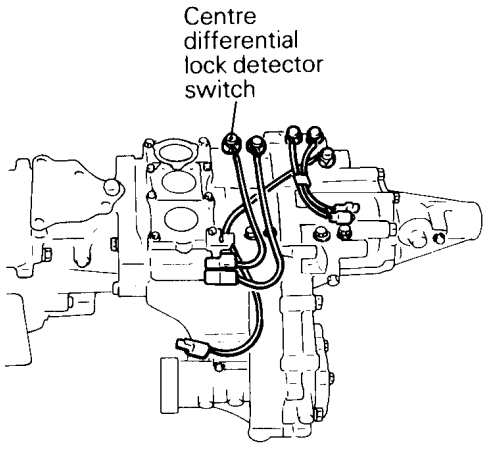
FREE WHEEL ENGAGE SWITCH AND CENTRE DIFFERENTIAL LOCK DETECTOR SWITCH

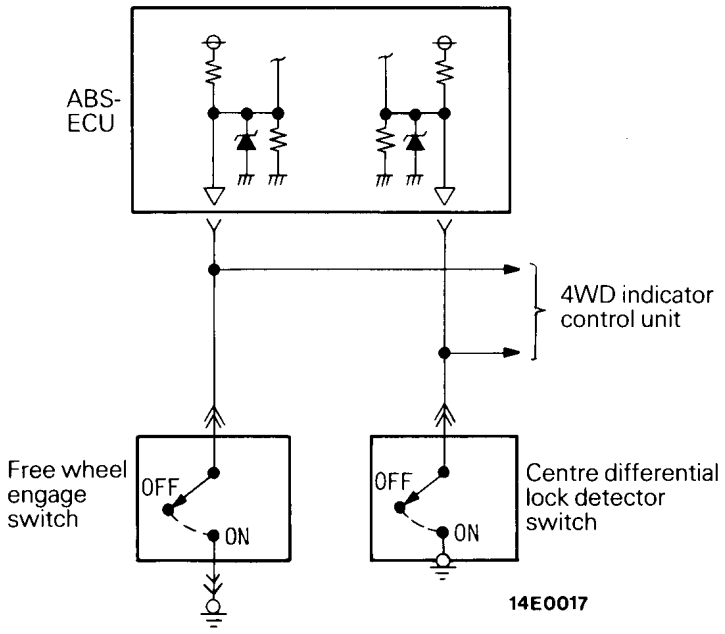
The two switches are shared by the Superselect 4WD system and send a signal on the status of the drive system to the ABS-ECU. In response to this signal, the ABS-ECU selects a proper control mode suitable for the status of the drive system. (Refer to P. 3-48.)

Status of Each Switch and Drive System

	2WD	4WD	
		Centre differential free	Centre differential lock
Free wheel engage switch	OFF	ON	ON
Centre differential lock detector switch	OFF	OFF	ON

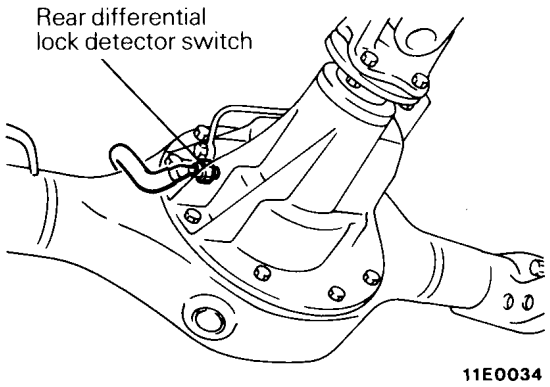




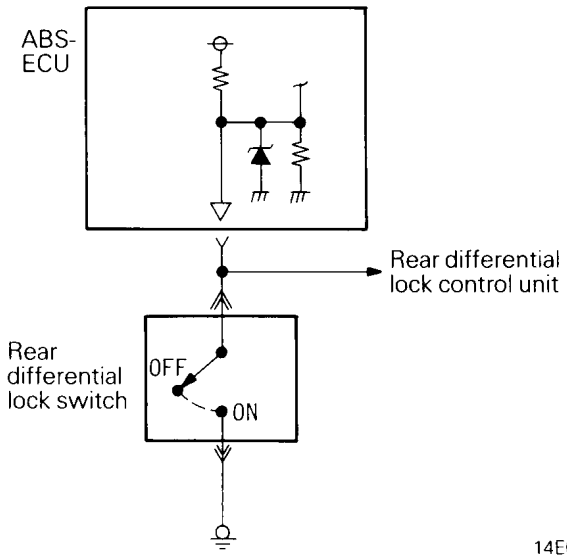


REAR DIFFERENTIAL LOCK DETECTOR SWITCH

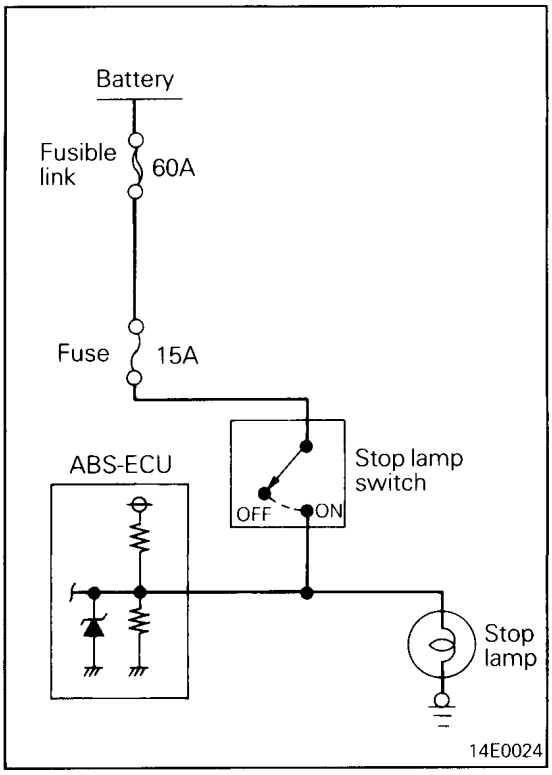
The rear differential lock detector switch is shared by the rear differential lock system and outputs an ON signal to the ABS-ECU when the rear differential is in the locked state. When it is in the free state, the switch outputs an OFF signal.
In response to this signal, the ABS-ECU corrects the ABS control to prevent premature locking of the rear wheels.



11E0034



14E0016



14E0024

STOP LAMP SWITCH

When the brake pedal is depressed, the stop lamp switch enters the ON state. When the brake pedal is released, the switch is forced to the OFF state. The output rises to the battery voltage (HIGH) when the switch enters the ON state, and falls to about 0V (LOW) when the switch is caused to be OFF.
This voltage is monitored by the ECU to determine whether the brake pedal is depressed or not. The ECU uses the information to aid in ABS control.

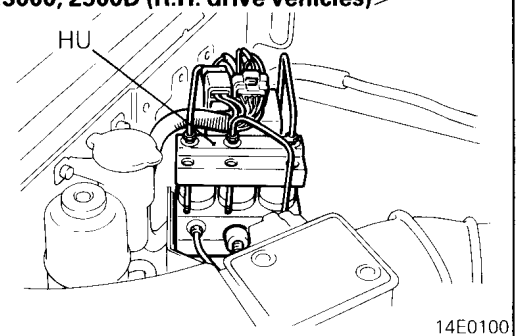
ACTUATOR

HYDRAULIC UNIT (HU)

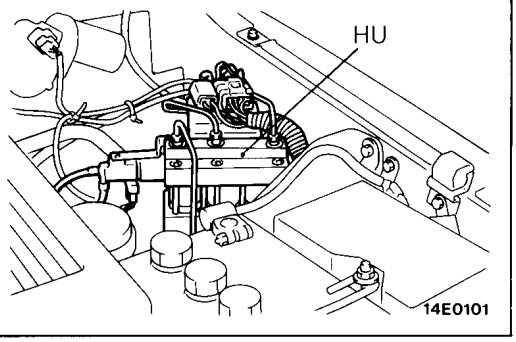
The HU is elastically supported by the fender shield with a bracket in between.
The HU consists of a pump motor, plunger pump, solenoid valve, etc. A relay box comprising a motor relay and valve relay is externally mounted.

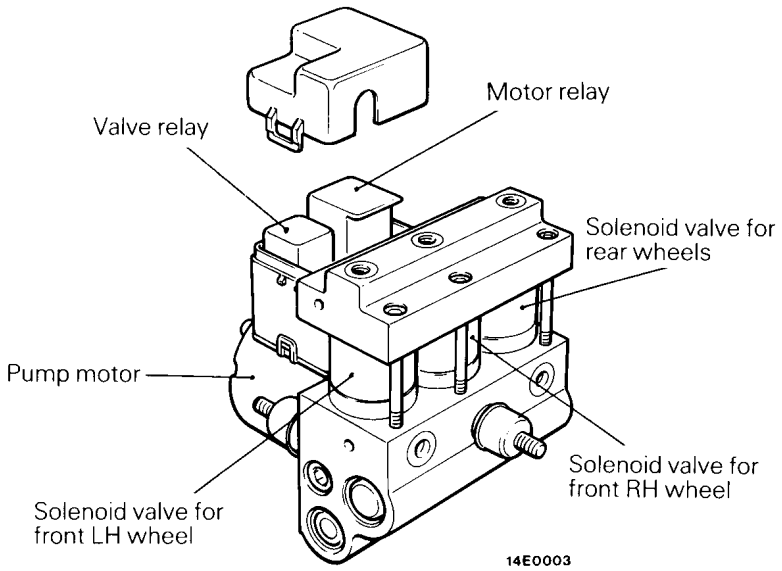
The fluid passages in the HU are in two separate systems; one for the front wheels and one for the rear wheels. Three solenoid valves are provided; one for the front LH wheel, one for the front RH wheel, and one for the rear wheels.

<3000, 2500D (R.H. drive vehicles)>

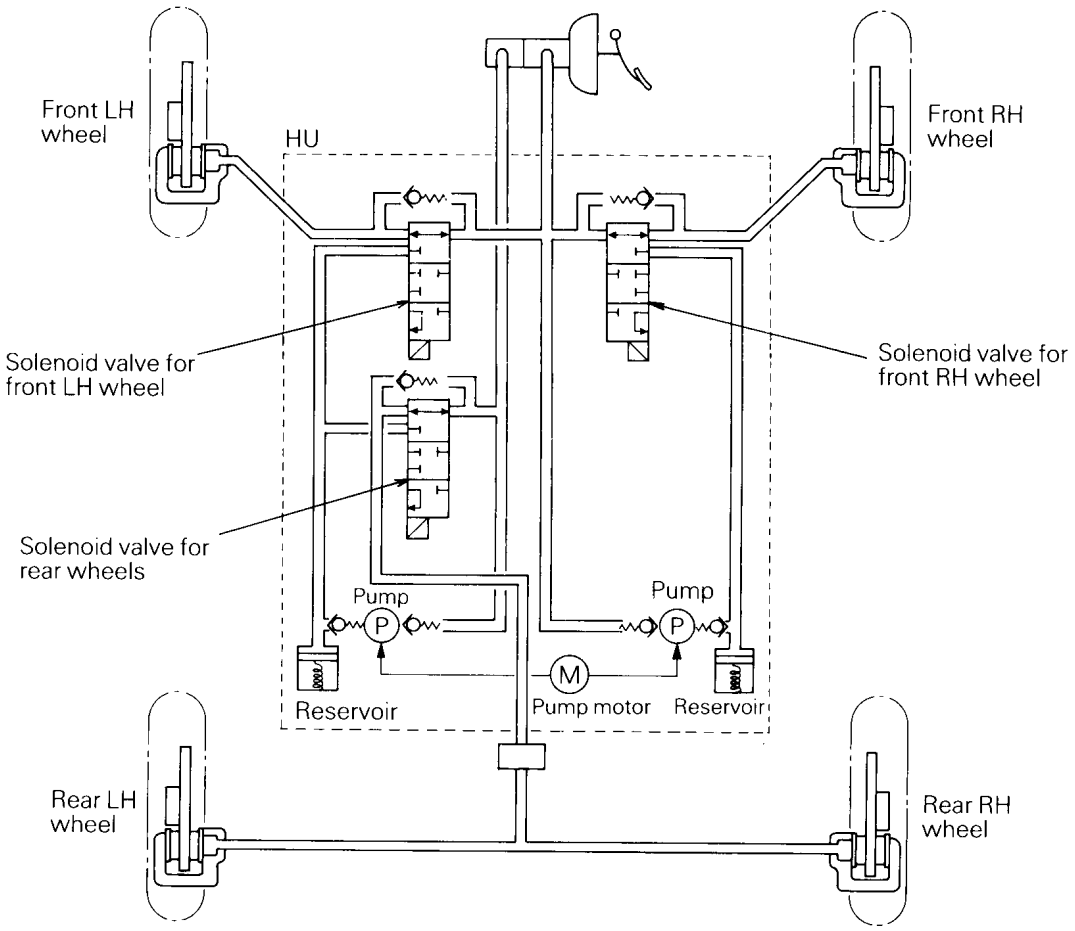


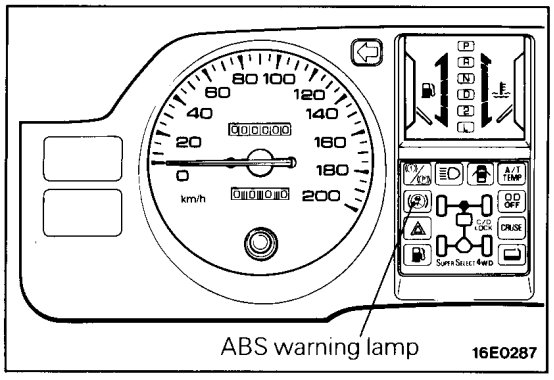
<2500D (L.H. drive vehicles)>





Function Diagram





ABS WARNING LAMP

The ABS warning lamp continues to light:

(1) During an initial check performed when the ignition key is placed in the ON position or when the engine is started (The lamp is defective if it does not light during the initial check.)

(2) When the ABS fails (the lamp stays ON until the IG is OFF) The ABS warning lamp also lights when the ECU power voltage is abnormally low or high. In this case, it goes out when the power voltage re-enters the specified voltage range.

ELECTRONIC CONTROL UNIT (ECU)

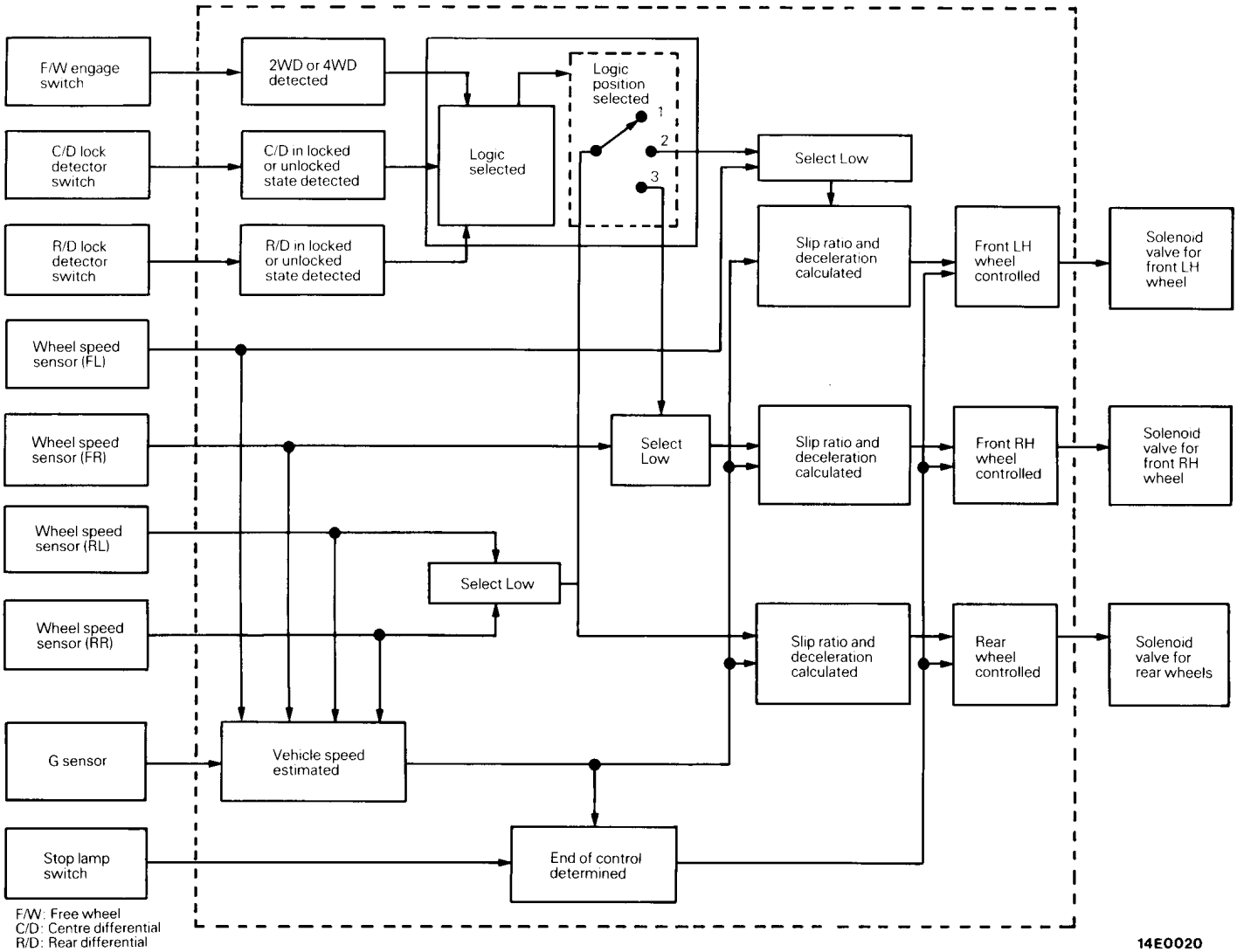
The ECU calculates the wheel slipping conditions (slip ratio, deceleration) according to a predetermined theory on the basis of the wheel speeds detected by the wheel sensors and the signals from the wheel speed sensors and G sensor, and controls the solenoid valves in the HU to make sure that the wheels are not locked.

As a piece of data for determination of the end of control, signals on the stop lamp switch are input to the ECU.

[Major control actions]

(1) The Pajero ABS must be compatible with all of the 2WD, VCU 4WD (centre differential free) and directly coupled 4WD (centre differential lock) modes. Therefore, the signals from all of the 2WD/4WD, centre differential lock and rear differential lock detector switches are input to the ECU. In response to these switch signals, the ECU determines the status of the drive system, select a proper logic suitable for the status, and switches to the selected logic. (Refer to P. 3-48.)
Position 1, the logic selecting position shown below, is associated with the 2WD and VCU 4WD modes, whereas positions 2 and 3 are associated with the directly coupled 4WD mode. When the ECU is in the directly coupled 4WD mode, if it finds that the rear wheel rotating at a lower speed is the LH one, it selects position 2. If it is finds that the rear wheel rotating at a lower speed is the RH one, it selects position 3.
(2) In the rear differential lock mode, the ECU corrects the slipping amount of the rear wheels to a somewhat smaller value to prevent premature locking of the rear wheels when the vehicle gets out of a slippery road surface to a dry paved surface, thereby ensuring the stability of the vehicle.
(3) In addition to the functions mentioned above, the ECU has a self diagnosis function. If a fault is detected by the diagnosis function, the ECU activates the fail safe function and also lights the ABS warning lamp.

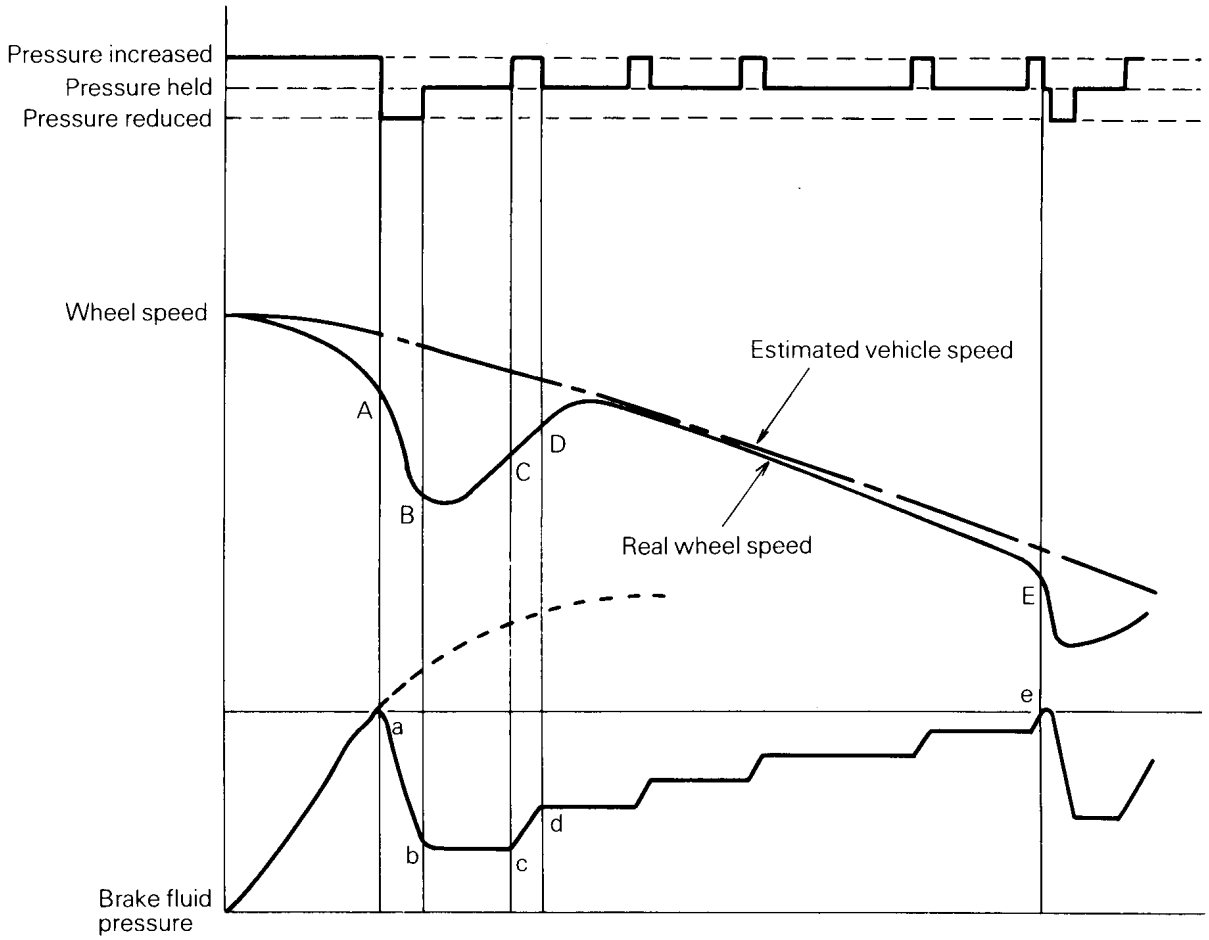
Block Diagram



BRAKE FLUID PRESSURE CONTROL

ABS Control Cycle

(1) In response to the signals from the wheel speed sensors of the four wheels, the ECU calculates the respective wheel speeds and wheel decelerations and estimates the vehicle speed at the moment.
(2) Application of brakes increases the fluid pressure that acts on the wheel cylinder, thereby reducing the wheel speed. If the difference between the wheel speed and vehicle speed increases to the extent that the wheel decelerating condition reaches a predetermined value (point A), the ECU determines that the wheel is getting locked and sends a "reduce the pressure" signal to the solenoid valve to reduce the brake fluid pressure. (Between a-b)
(3) Accordingly, the wheel deceleration starts recovery. When the wheel speed reaches point B, the ECU sends a "hold the pressure" signal to cause the wheel cylinder to retain the brake fluid pressure, and waits and sees for a while. (Between b-c)
(4) If the wheel deceleration continues further recovery and goes past point C, the ECU determines that the danger of locking has been averted and issues an "increase the pressure" signal to increase the brake fluid pressure again. (Between c-d)
(5) The brake fluid pressure is controlled by repeated fluid pressure increasing and holding operations. (Between d-e)
(6) If the wheel decelerating condition exceeds the preset value, the cycle of operations described above in (2) through (5) is repeated to control the brake fluid pressure.



Remarks
When the brake fluid pressure changes, the wheel speed changes a little later. This is because the inertial force acts on the wheel.

14N0069

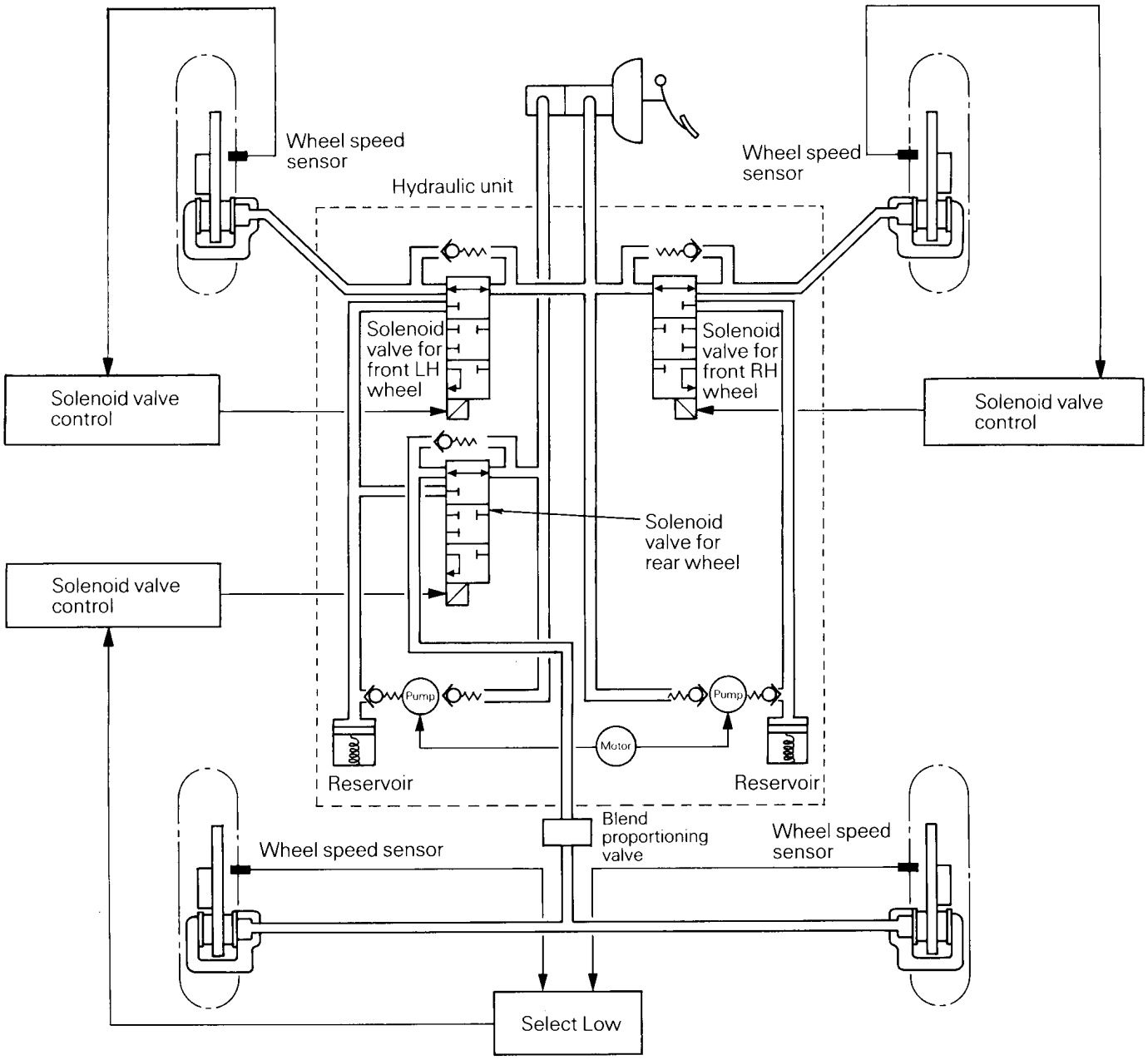
Vehicle Speed for Control

When the vehicle speed exceeds 9 km/h (6 mph), the ABS is ready for operation. When the vehicle speed decreases to about 2 km/h (1 mph) or less, the ABS stops control operations.

Control of 4 Wheels

The ABS control mode is essentially the 3-channel control mode. Based on this control mode, the ABS provides controls that differ between the 2WD and VCU 4WD modes and directly coupled 4WD mode.

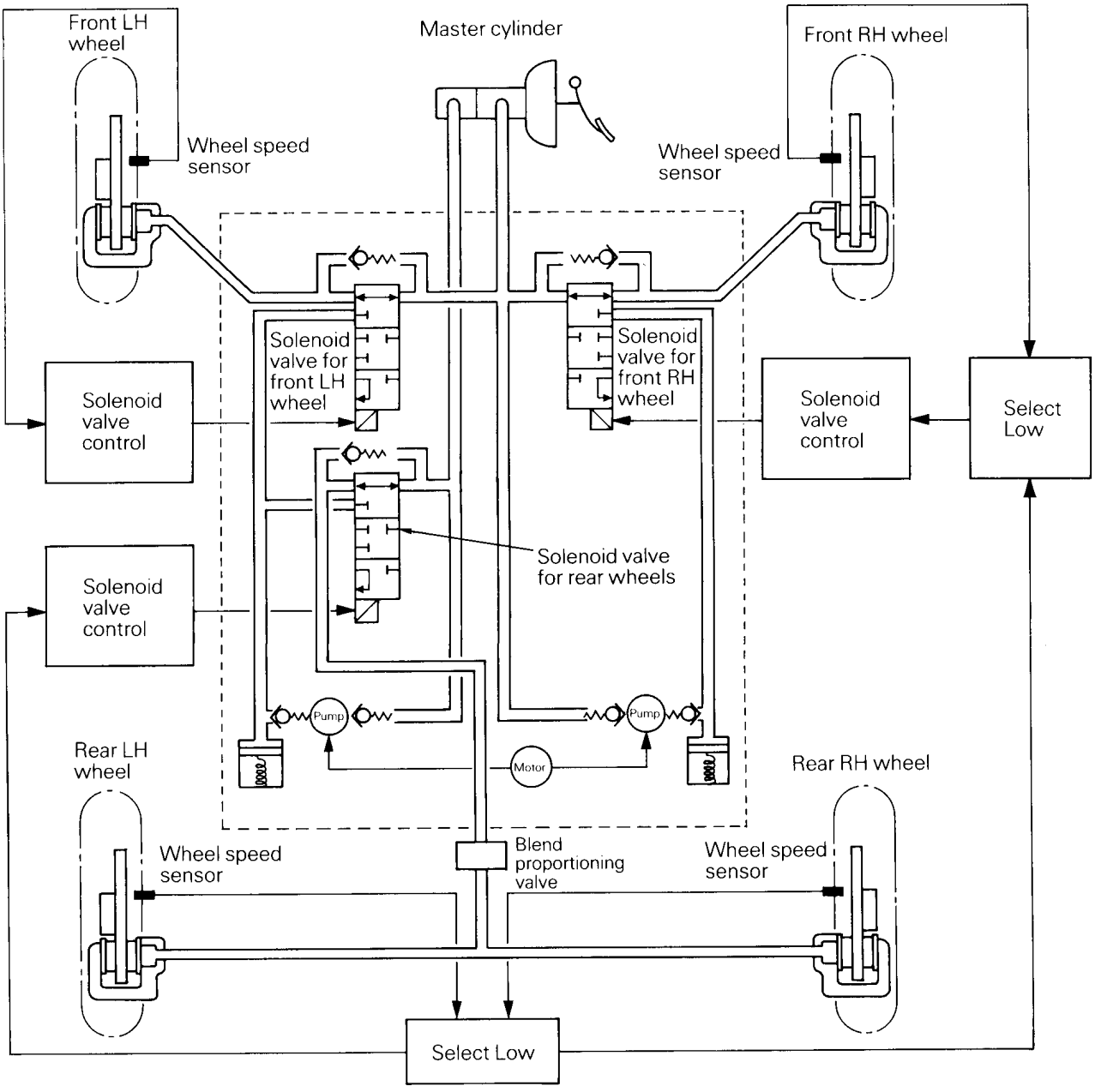
1. VCU 4WD or 2WD Mode
   In the VCU 4WD or 2WD mode, the ABS controls the front RH and LH wheels independently, while achieving Select Low integrated control of both rear wheels.



14E0005

2. Directly Coupled 4WD
In the directly coupled 4WD mode, the ABS provides controls based on the controls in the VCU 4WD (centre differential free) and 2WD modes. If one of the rear wheels is about to be locked during ABS operation with the vehicle speed at approximately 15 km/h (9 mph) or more, the ABS achieves Select Low control of the front wheel located on the same side as the rear wheel rotating at a lower speed.
In other words, the wheel speed of the rear wheel rotating at the lower speed is compared with the wheel speed of the front wheel located on the same side, and the solenoid valve for the front wheel is controlled to match the lower speed. The fluid pressures that act on both rear wheels and the front wheel located on the same side as the rear wheel rotating at the lower speed, three wheels in total, are simultaneously controlled. (The illustration shown below applies when the rear RH wheel is getting locked.) Namely, when a rear wheel is about to be locked, the ABS provides controls that reproduce a simulated diagonal 2-channel control mode*.

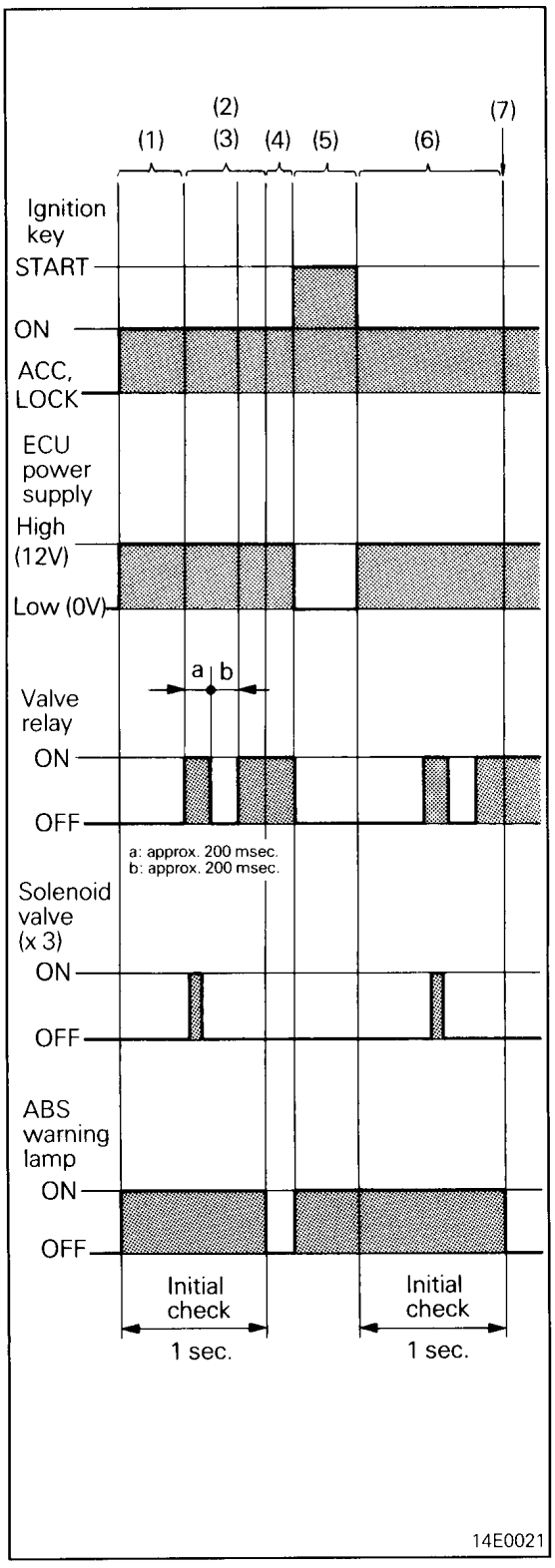
*: Diagonal 2-channel control mode: Control mode adopted for Galant and other 4WD vehicles



14E0002

FAIL SAFE FUNCTION

Should the ABS system fail, the ECU isolates the system and allows the brakes to operate normally, assuring a high level of safety.
If the ECU determines on the basis of the result of self diagnosis that the ABS is out of order, the ECU lights the ABS warning lamp. At the same time, it causes the valve relay to deactivate the solenoid valve controls in the HU and restore normal brake operations.



INITIAL CHECK FUNCTION

The ECU activates the self diagnosis function to perform an initial check when starting the ABS system in operation.
When a fault is detected, the ECU lights the warning lamp and stops the ABS system from functioning.

Initial Check Operations

(1) When the ignition key is placed in the "ON" position, the power is supplied to the ECU, and self diagnosis of the internal circuits of the ECU executed first. During the period the ABS valve relay stays in the "OFF" state.
(2) Then the ECU drives the ABS valve relay to the "ON" to "OFF" to "ON" state for self diagnosis of the ABS valve relay. When the ABS valve relay is in the first "ON" state, current is supplied to all the solenoids for a very short interval to execute self diagnosis of the solenoids and solenoid drive circuits.
(3) During the diagnosis period in (2), the two microcomputers in the ECU check all of the input signals, including switch signals, against one another.
(4) When the initial check operations described above are completed, the warning lamp goes out.
(5) When the ignition key is placed in the "START" position, the power supply to the ECU is cut off. However, since the ABS valve is caused to be "OFF", the warning lamp is lit by the ground side contact circuit of the ABS valve.
(6) If the engine is successfully started and the ignition key brought back to the "ON" position, the power supply to the ECU is restored. As a result, the initial check operations described in (1) through (3) are re-executed.
(7) When the initial check operations are completed without any error, the warning lamp goes out and the ABS is ready for operation.

INITIAL MOTION CHECK FUNCTION

When the vehicle started in motion reaches a vehicle speed of approximately 8 km/h (5 mph), the ECU performs the following checks.

(1) Motor check (only the first time the vehicle is started in motion*)
The ECU rotates the motor for an interval of approximately 0.5 second to check that the motor relay and motor are driven.

(2) Solenoid valve check
The ECU supplies current to all the valves simultaneously for a very short interval and sends "reduce the pressure" and "hold the pressure" signals to check that the valves are driven.

(3) Wheel speed sensor check
The ECU checks whether wheel speed signals are input from all of the wheel speed sensors, beginning at the time when the vehicle is started in motion.

NOTE
* The first time the vehicle is started in motion refers to the first time it is started in motion after the system has started.

CONSTANT CHECKS

In addition to the initial check and initial motion check functions, the ECU has a function that constantly checks the following items.

1. **Mutual Calculation Result Check**
The ECU contains two microcomputers which mutually check the respective results of calculations.
2. **Power Supply System Check**
The ECU checks whether the IG power voltage and valve relay voltage are within the operating voltage limits.
3. **Valve Relay Check**
The ECU checks whether the valve relay is always in the ON state.
4. **Solenoid Valve Check**
The ECU constantly outputs a signal to each of the solenoid valves to check whether the signal is in agreement with the status of the solenoid valve.
5. **Input Switch System Check**
The ECU checks the free wheel engage switch and centre differential lock detector switch separately for open circuit, and also checks for illegal input combinations other than the specified ones to be input from the two switches. (The ECU determines the status of the drive system on the basis of the combinations of inputs from the two switches. If it detects any illegal combination, it determines that the switches are defective.)
   - Rear differential lock detector switch
   Checks the switch for open circuit.
   - Stop lamp switch
   Checks the switch for open circuit and ON failure.
6. **G Sensor Check**
   - Checks to ensure that the G sensor power voltage is not out of the specified limits (7.0 to 7.6V).
   - Checks for an abnormal output voltage (open circuit or short circuit) from the G sensor.
   - Checks for an abnormal output voltage that may be output from the G sensor for a long time.
7. **Motor System Check**
Checks that the output voltage from the ECU itself is in agreement with the drive status of the motor.
8. **Wheel Speed Sensor System Check**
   - When the wheel speed input from any of the wheels is approximately 8 km/h (5 mph) or more, the ECU checks whether the wheel speeds input from the other wheels are correct.
   - When the vehicle speed is approximately 20 km/h (12 mph) or more, the ECU compares the wheel speeds to check for an abnormally high or low wheel speed that might have been input.
   - Monitors the voltages on the (+) wires of the wheel speed sensors to check for a sensor that might have been open-circuited or short-circuited to the body.

DIAGNOSIS FUNCTION

To facilitate ABS system checks, the ECU has the following functions.

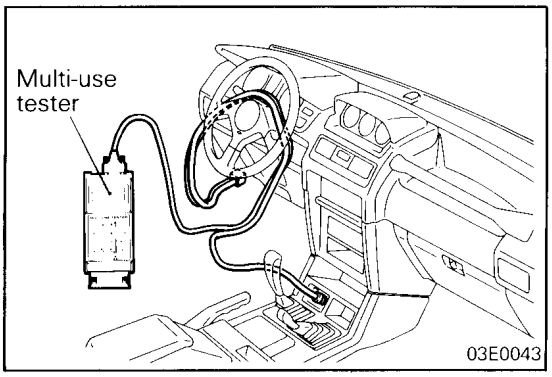
- Diagnosis code output
- Service data output
- Actuator test

All of the functions can be checked by use of a multi-use tester (MUT).
A diagnosis code can be checked in terms of the deflection of the pointer of a voltmeter.

Procedure for Entry into Diagnosis Function by Use of MUT and Subsequent Controls

With the vehicle stationary, connect an MUT to the diagnosis check connector. The MUT functions can then be used. After communicating with the MUT to determine that the MUT has been fixed to the ABS system, the ECU enters the MUT mode.

NOTE
1. Make sure that the ignition switch is in the OFF position when the MUT is connected. If the MUT is connected with the ignition switch at ON, the ECU does not enter the MUT mode.
2. In the MUT mode, the ABS warning lamp is lit and the anti-lock controls inhibited during an actuator test only in order to prevent a mode where the brakes temporarily fail to function.



Conditions for entry into MUT mode	① When wheel speeds of all four wheels are 0 km/h (0 mph) (vehicle stationary), the ignition switch is OFF. ② The MUT's check harness is connected to the diagnosis check connector of the vehicle (the SELF DIAGNOSIS/DATA TRANSFER changeover terminal is connected to the ground), and the ignition switch is then placed in the ON position. ③ The ABS system is selected by the MUT control switch. (The specified serial data is received.)
MUT mode	When the ABS warning lamp is OFF, the ECU communicates with the MUT and provides normal anti-lock controls. During an actuator test, however, the ECU lights the ABS warning lamp and inhibits the anti-lock controls.

Self Diagnosis Codes

A total of 24 items are diagnosed, and the results of diagnosis stored until the battery terminals are disconnected.

If a MUT is connected, the ECU communicates with the MUT. When no MUT is used, a voltmeter may be used as in the past to get visible indications.

1. SELF DIAGNOSIS ITEMS

Code No.	Description	
11	Wheel speed sensor (FR) open circuit	
12	Wheel speed sensor (FL) open circuit	
13	Wheel speed sensor (RR) open circuit	
14	Wheel speed sensor (RL) open circuit	
15	Abnormal wheel speed sensor signal associated with any of four wheels	
16	Abnormally high or low battery voltage	
21	Wheel speed sensor (FR) short circuit or excessive gap	
22	Wheel speed sensor (FL) short circuit or excessive gap	
23	Wheel speed sensor (RR) short circuit or excessive gap	
24	Wheel speed sensor (RL) short circuit or excessive gap	
25	Free wheel engage switch open circuit	
26	Centre differential lock detector switch open circuit	
27	Rear differential lock detector switch open circuit	
31	Abnormal G sensor power voltage (including power cable short circuit)	
32	G sensor signal wire open circuit, short circuit or abnormal signal	
33	Stop lamp switch open circuit or ON failure	
41	Solenoid valve for front RH wheel	No answers to drive signals for solenoid valves associated with individual items
43	Solenoid valve for front LH wheel	
45	Solenoid valve for rear wheels	
51	Valve relay out of order	
52	Motor relay or pump motor out of order	
63	ECU out of order	
64		

2. DIAGNOSIS CODE INDICATION METHOD

All of the failure codes in store are indicated when either an MUT or voltmeter is used.

NOTE

1. In the case of a fault concerning diagnosis code No. 16 "Abnormally high or low power voltage", it is indicated only when the fault still exists. (None of the faults of its kind that occurred in the past is indicated.)
2. Even if faults associated with a code No. successively occur, the code that is indicated is only the first code stored in memory.

3. FAULT CODE MEMORY CLEARING PROCEDURE

The fault codes in store can be cleared by disconnecting the negative battery cable for more than 10 seconds or by using an MUT.

NOTE

1. When the ABS-ECU was made to stop functioning by the fail safe function, the diagnosis codes in store cannot be cleared.
2. To check whether the diagnosis codes have been cleared, repeat the procedure to check diagnosis codes.
3. After the memory has been erased, no instruction from an MUT will be accepted. To check diagnosis codes, temporarily stop the engine, re-start it, and repeat the MUT procedure.

Service Data Outputs

Of the data items input to the ECU, the following items can be read out by an MUT.

SERVICE DATA OUTPUT ITEMS

Service data item		Displayed unit
Code No.	Items	
11	Front RH wheel speed	km/H
12	Front LH wheel speed	km/H
13	Rear RH wheel speed	km/H
14	Rear LH wheel speed	km/H
16	ECU power voltage	V
25	Free wheel engage switch in ON or OFF state	ON/OFF
26	Centre differential lock detector switch in ON or OFF state	ON/OFF
27	Rear differential lock detector switch in ON or OFF state	ON/OFF
32	G sensor output voltage	V
33	Stop lamp switch at ON or OFF position	ON/OFF

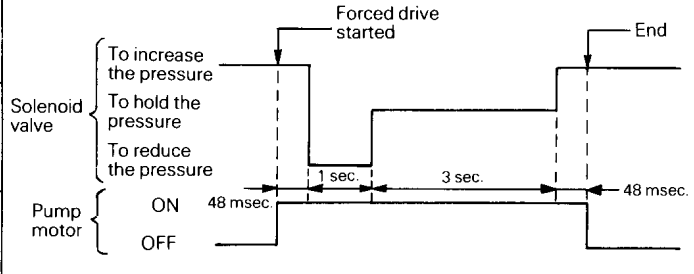
Actuator Test Function

Using an MUT, you can easily check operation of the following actuators by forced actuator drive.

NOTE

1. When the ECU is in the stopped state, no actuator test can be executed.
2. To perform an actuator test, the vehicle must be stationary.
3. When the maximum wheel speed reaches 10 km/h (6 mph) during a forced actuator drive, the forced actuator drive is interrupted.
4. While an actuator test is in progress, the ECU lights the ABS warning lamp and inhibits the anti-lock controls.

ACTUATOR SPECIFICATIONS

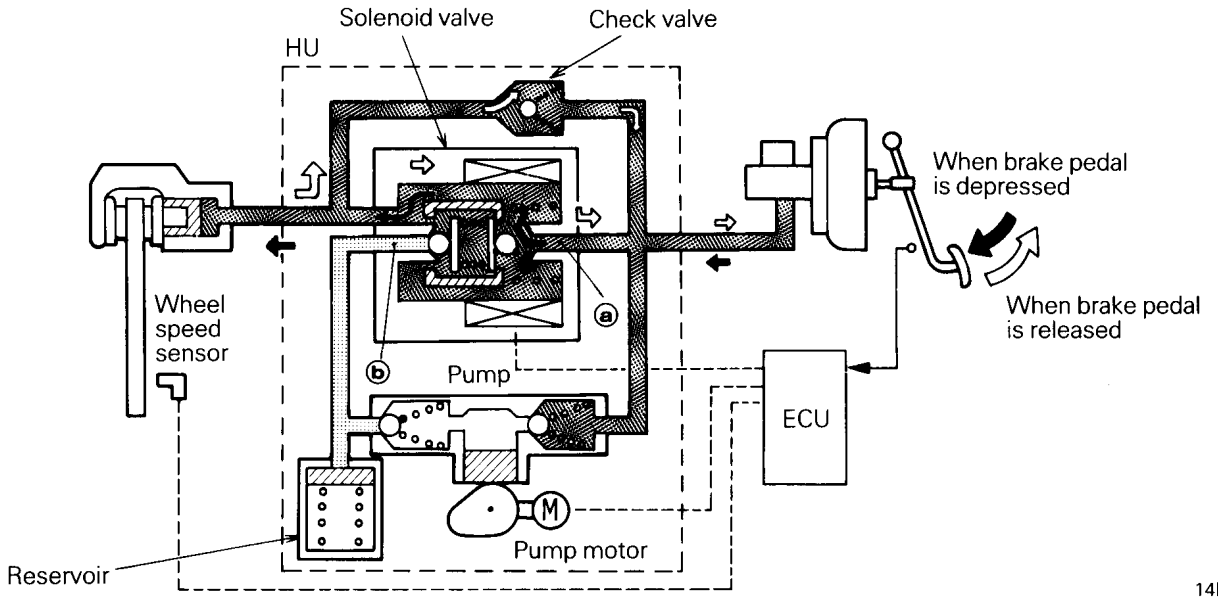
No.	Components to be driven		Drive pattern
01	Solenoid valve and pump motor of associated channel of HU (Simplified inspection mode)	Solenoid valve for front LH wheel	
02		Solenoid valve for front RH wheel	
03		Solenoid valve for rear wheels	

OPERATION OF THE SYSTEM

WHEN ABS IS NOT IN OPERATION

When the brake pedal is depressed, the brake fluid is routed to the solenoid valve. At this point, the ECU does not supply current to the solenoid valve, the inlet port ⓐ of the solenoid valve is in the opened position, and the outlet port ⓑ is in the closed position. Therefore, the brake fluid from the master cylinder is forced through the solenoid valve to the wheel cylinder and causes the brakes to apply.

When the brake pedal is released, the brake fluid pressure in the master cylinder falls, and the brake fluid returns through both the check valve and solenoid valve to the master cylinder.

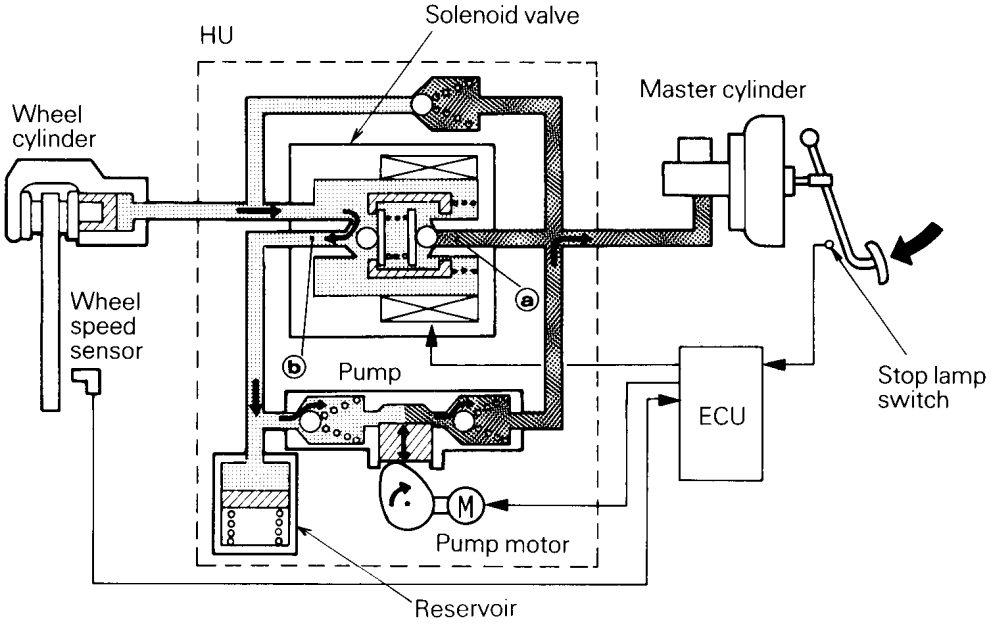


WHEN ABS IS IN OPERATION

Operation to Reduce Fluid Pressure

When a wheel is about to be locked by brake application, the ECU supplies "reduce the pressure" current to the solenoid valve to close the inlet port ⓐ of the solenoid valve and open the outlet port ⓑ. As a result, the brake fluid from the master cylinder is routed through the outlet port ⓑ to the reservoir to reduce the fluid pressure in the wheel cylinder.

As soon as the ECU supplies the current to the solenoid valve, it drives the pump motor to return the brake fluid collected in the reservoir to the master cylinder. In this case, pedal kickback is generated which forces the brake pedal back to some extent.



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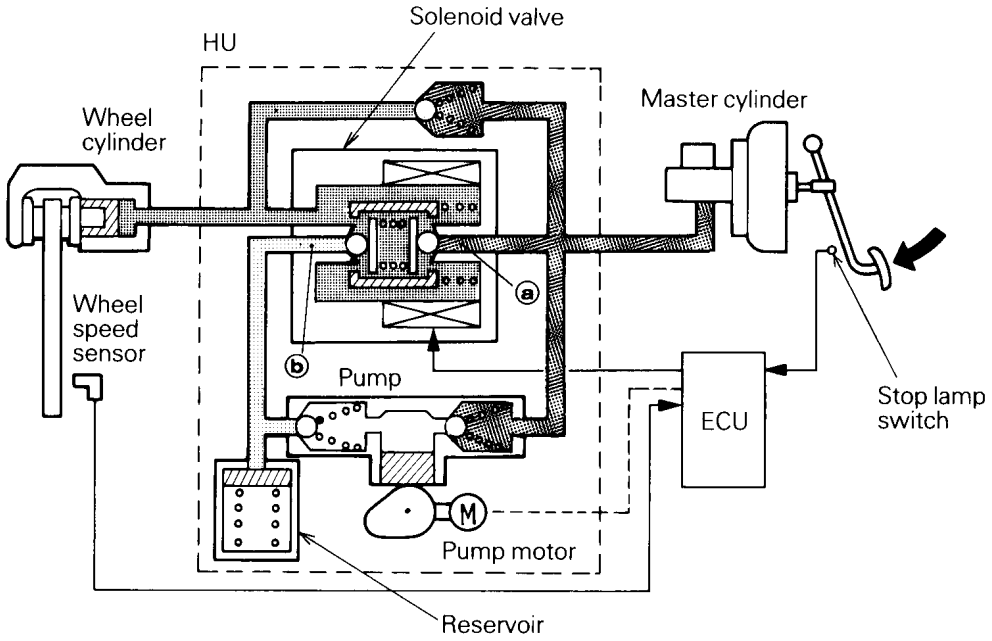
Operation to Hold Fluid Pressure

If the fluid pressure in the wheel cylinder is reduced (or increased) to an optimum value, the ECU supplies "hold the fluid pressure" current to the solenoid valve to close both inlet port ⓐ and outlet port ⓑ. As a result, the fluid pressure in the wheel cylinder is maintained at the value.



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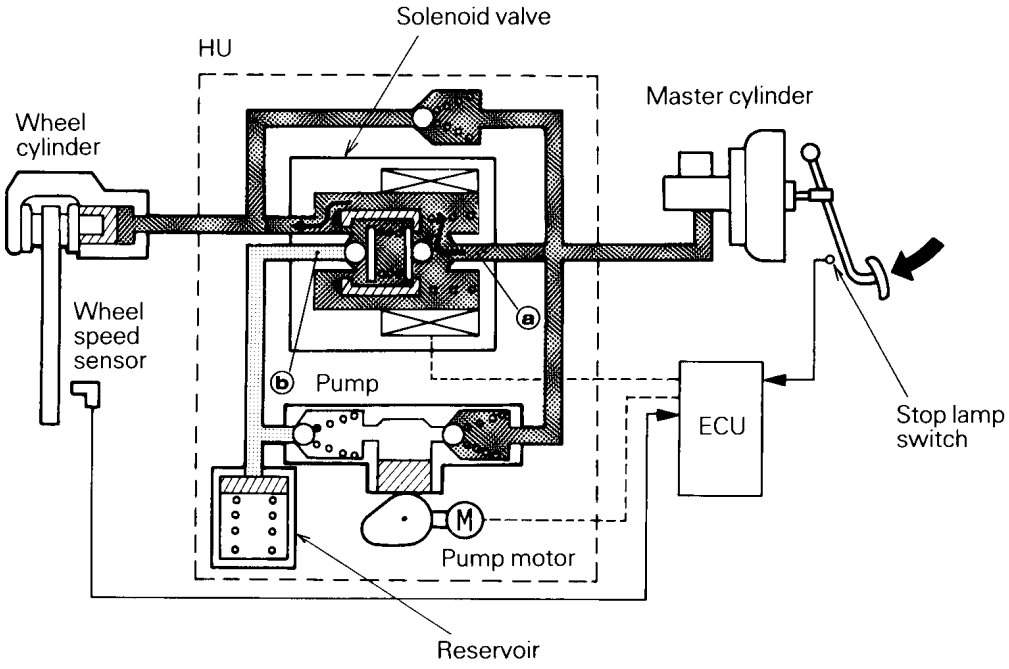
Operation to Increase Fluid Pressure

When the fluid pressure in the wheel cylinder has to be increased, the ECU stops supplying current to the solenoid valve. Accordingly, the inlet port ⓐ is opened and the outlet port ⓑ closed just like when the ABS is not in operation, and the fluid pressure in the wheel cylinder is increased. In this case, since the brake pedal is slightly pulled, pedal kickback is generated.

The fluid pressure increasing speed is controlled by repeating the fluid pressure increasing operation.



14F0056

PARKING BRAKES

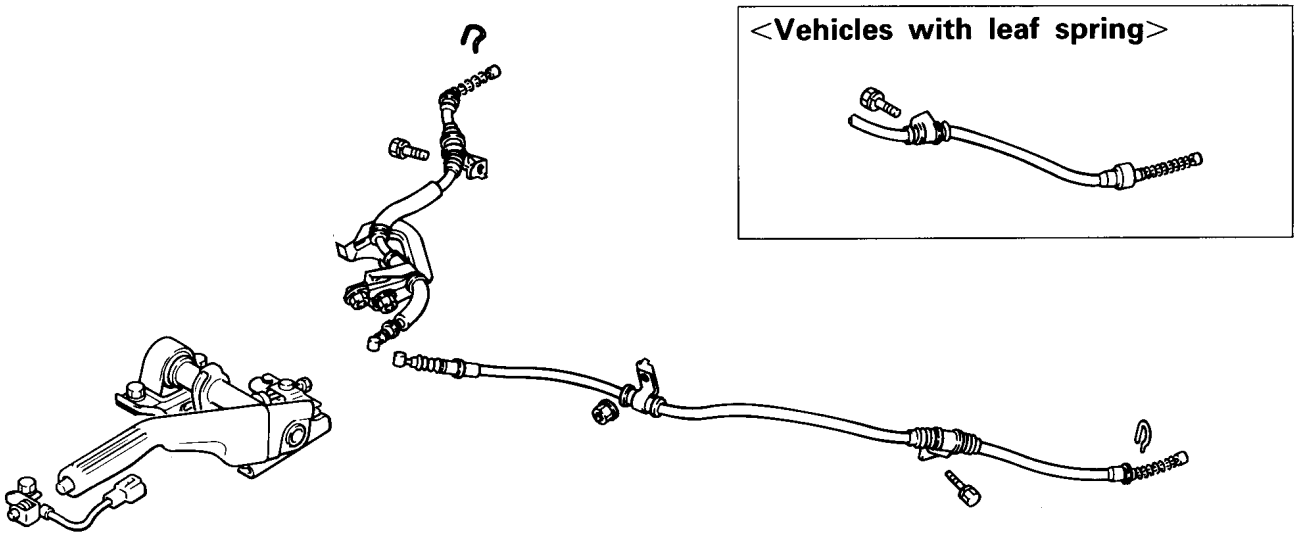
E9DJAAD

The parking brakes come in two types; the drum in disc type equipped with dedicated parking brake lining shoe, and the drum brake type which serves as combined parking and service brakes. Either of the two types is properly selected for the right type of vehicle.
For ease of operation, the lever is offset toward the driver's seat from the floor backbone centre.

SPECIFICATIONS

Items	Vehicles with rear drum brake	Vehicles with rear disc brake
Brake operation type	Lever type	Lever type
Cabling	V-shaped cabling	V-shaped cabling
Brake system	Serving also as service brakes (Drum brake type)	Dedicated parking brakes (Drum in disc type)

2-door models <vehicles with coil spring>



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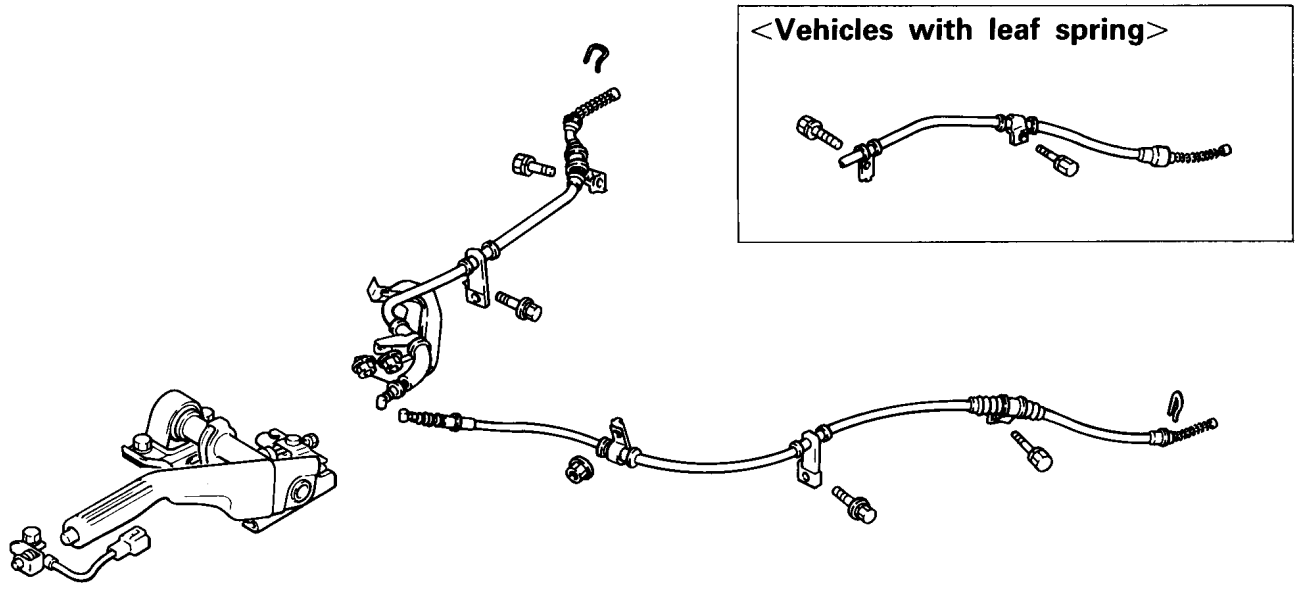
4-door models <vehicles with coil spring>



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