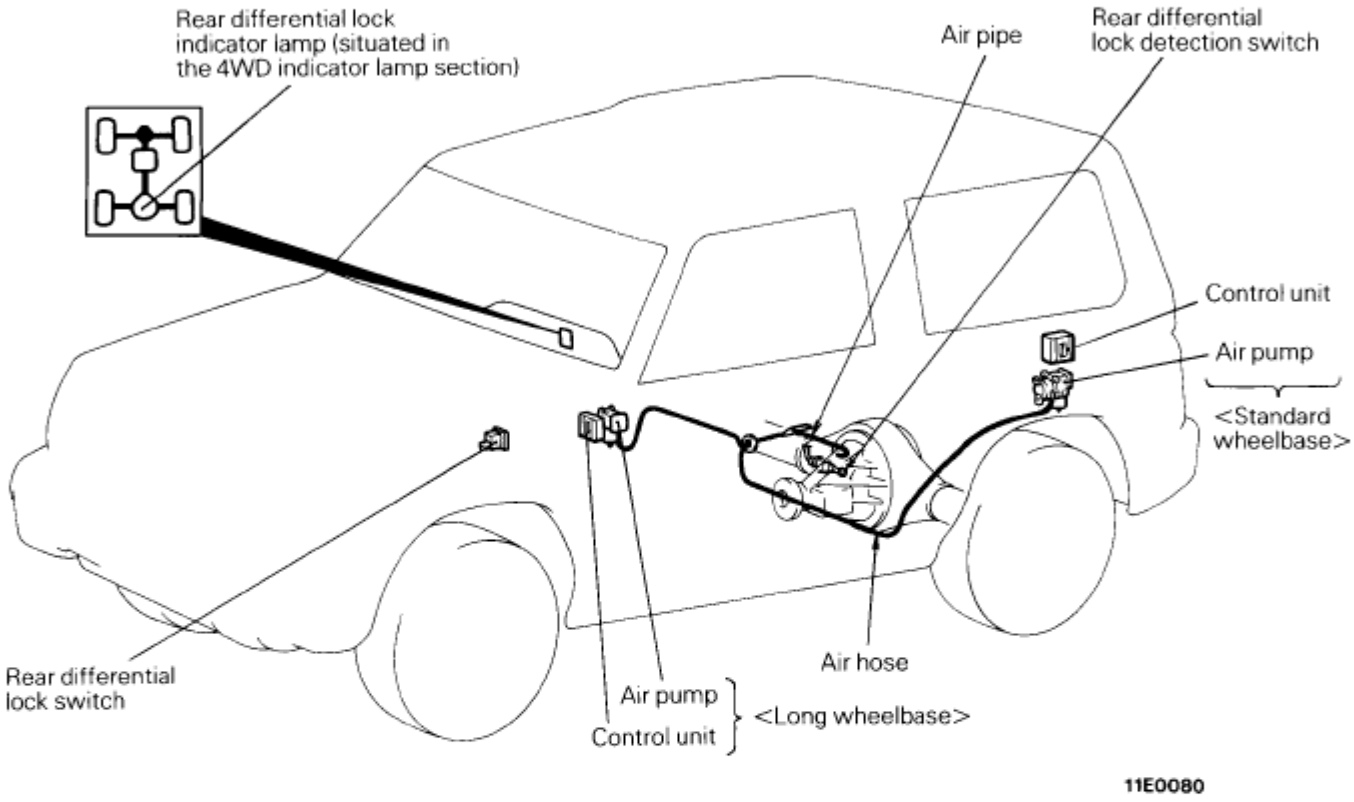
REAR DIFFERENTIAL LOCK SYSTEM

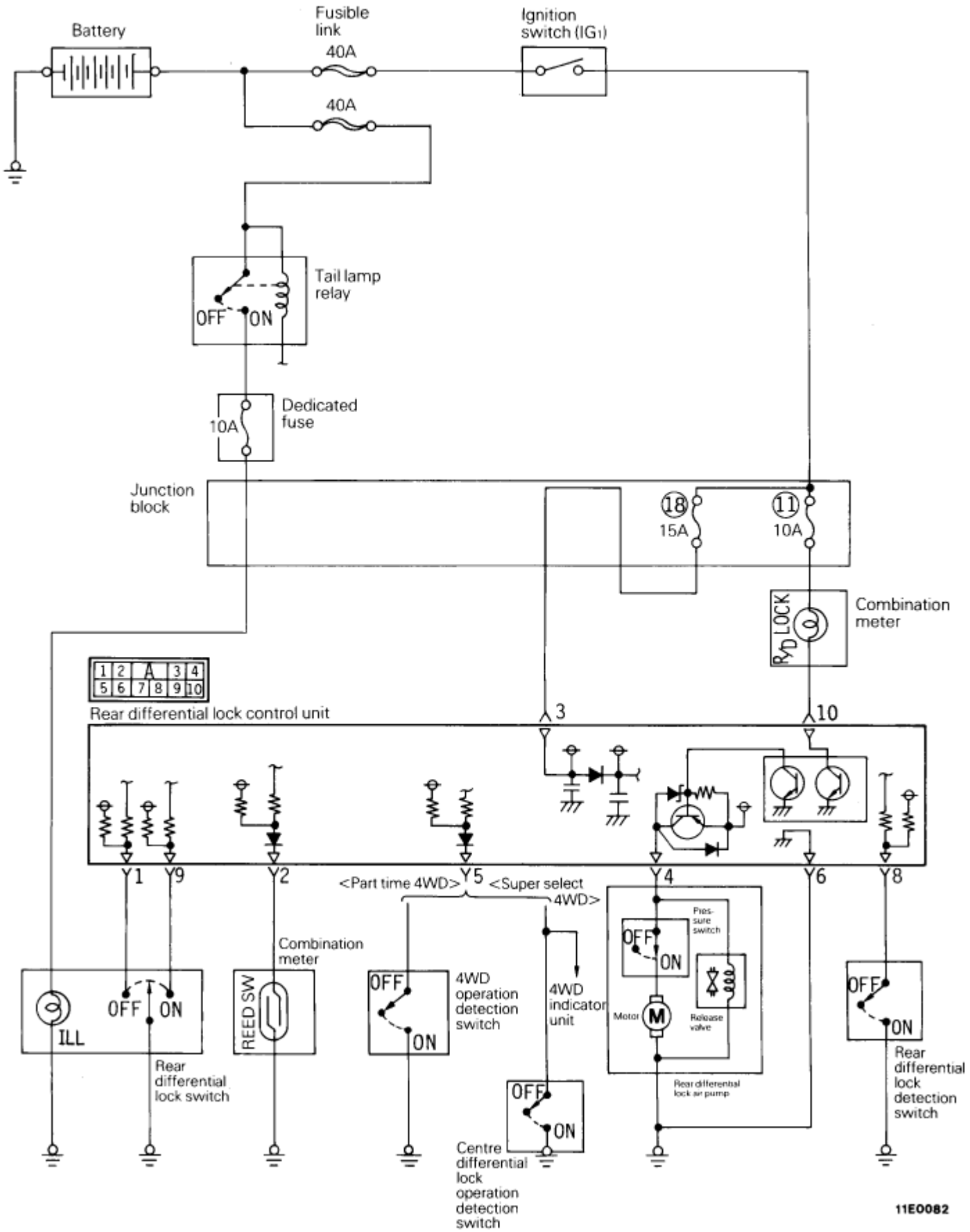
- Locks the right and left wheels completely, making it easier for the vehicle to get out of a trapped position or on a rocky or snowy road.
- Accommodated in a compact structure with a built-in diaphragm, giving high dependability against damage cold weather, etc.
- Easier to operate with a changeover switch
- Electronically controlled to allow locked condition changeover at a vehicle speed of 12 km/h (7 mph) or less for safety and to protect the lock mechanism.
- Consists of three sections; Electronic control section, Air piping section and Differential lock section.



Part Name		Summary of Function
Electronics control section	Rear differential lock switch	An automatic reset type switch which sends ON/OFF signal to the control unit.
	Rear differential lock indicator lamp	Situated in the 4WD indicator lamp section of the combination meter, the lamp lights when the system starts operation, and flashes* during changeover operation.
	Rear differential lock detection switch	A switch for detecting whether the rear differential is in the locked or free state. Switches between ON and OFF in combined operation with the movement of the drive cam in the differential case.
	Rear differential air pump	Interlocked with the rear differential lock switch, the pump can be operated only when the vehicle speed is less than 12 km/h (7 mph).
	Control unit	Controls the air pump, etc. on the basis of signals from the various switches.
Air piping section	Air hose, pipe	Establishes connection between the air pump and rear differential and forces the air from the air pump.
Differential lock section	Rear differential	Consists of an actuator, pressure plate, etc. accommodated in the rear differential. The rear differential lock detection switch is mounted.

NOTE
*: The rear differential lock system employs a wait mechanism for protection of the lock mechanism. Even if the switch is operated, the system may not start changeover immediately. The wait state is indicated by a flashing lamp.
The lamp also flashes when the interlocked state (where changeover is inhibited by the control unit) is created by operating the switch with the vehicle at a speed of 12 km/h (7 mph) or more.

REAR DIFFERENTIAL ELECTRICAL CIRCUIT DIAGRAM



REAR DIFFERENTIAL LOCK SYSTEM

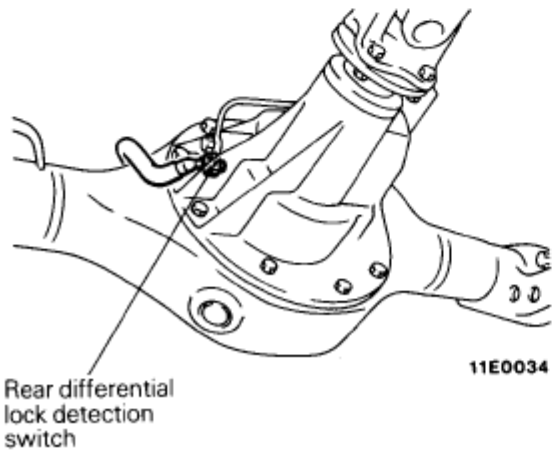
- The indicator lamp flashes during changeover from the free to locked state and is illuminated when the changeover is completed. When changeover is made from the locked to free state, the indicator lamp similarly flashes during the changeover, and goes out when the changeover is completed.
- For safety and protection of the lock mechanism, the rear differential lock system does not change over the differential to the locked state when the vehicle speed is in excess of 12 km/h (7 mph), but the indicator lamp in the combination meter flashes to alert the driver. When the vehicle speed decreases to 6 km/h (4 mph) or less, changeover can be made to the locked state. Changeover from the locked to free state can be made even when the vehicle speed is more than 12 km/h (7 mph).

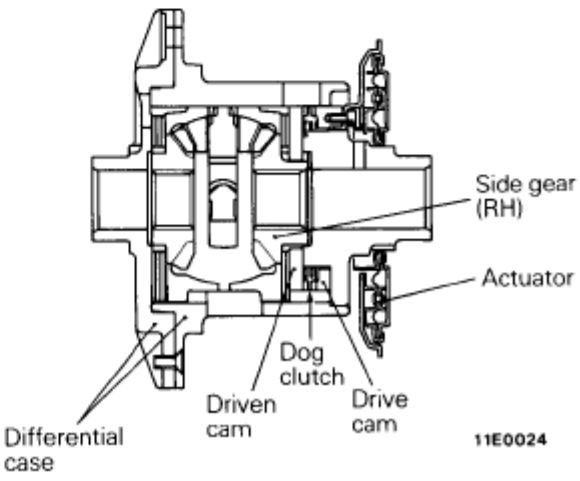
Rear differential lock switch	Vehicle speed	Rear differential lock air pump	Rear differential lock changeover	Rear differential lock indicator lamp
Neutral	Ignored	Not operated	Free	OFF
Neutral → ON signal	Lower than 12 km/h (7 mph)	Operated	Free → Locked	Flashing → ON
	12 km/h (7 mph) or higher	Not operated	Free	Flashing
Neutral → OFF signal	Ignored	Not operated	Locked → Free	Flashing → OFF

NOTE
The rear differential can be locked only when the centre differential is in the locked state. When the centre differential is reset, the rear differential is also automatically reset.

REAR DIFFERENTIAL

The rear differential lock system is a compact structure with a built-in diaphragm type actuator accommodated in the rear differential casing, assuring high dependability against damage, etc. The switch which detects the locked state is mounted on the differential carrier.
The air pressure generated by the air pump actuates the actuator to put the dog clutches of the drive and driven cams in mesh, thereby locking the motion of the differential case and side gear (RH).

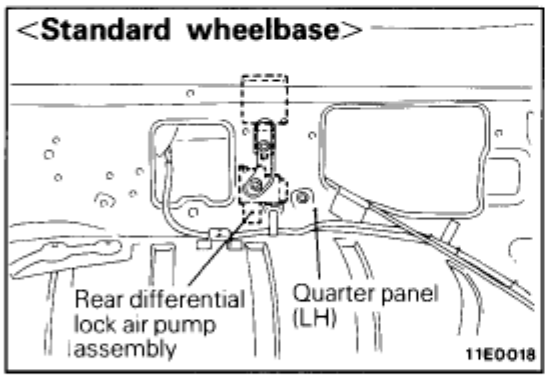


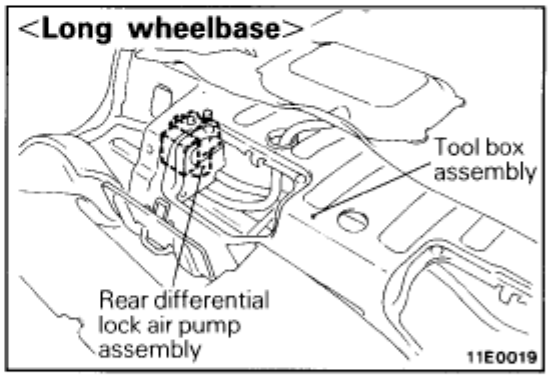


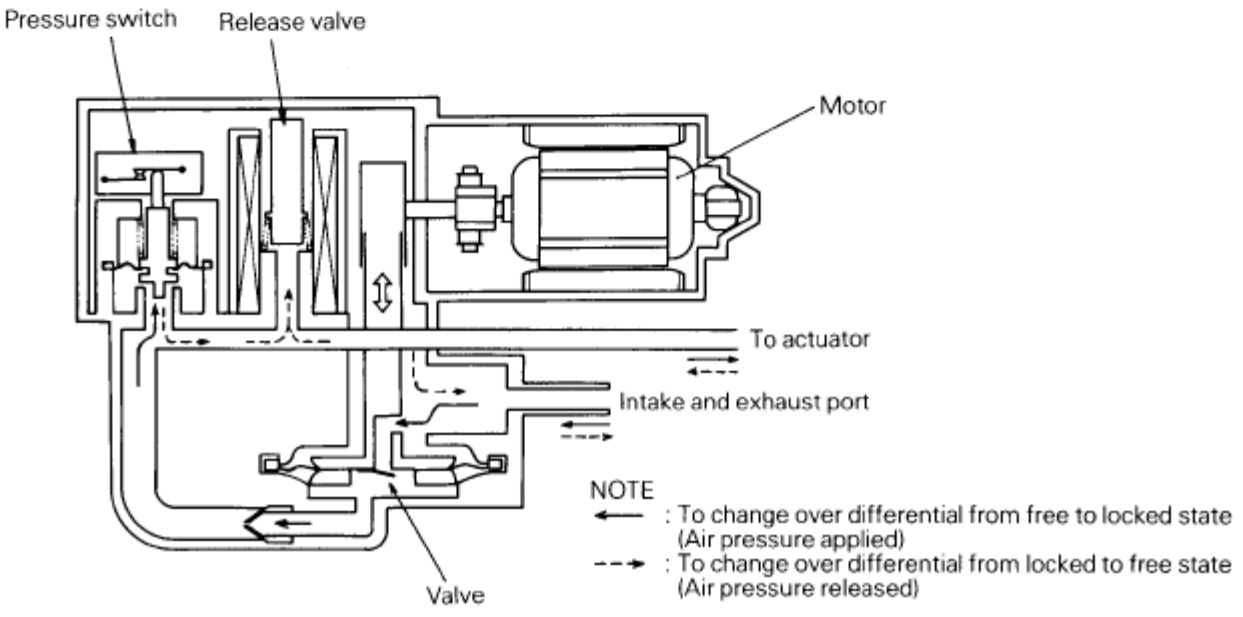
REAR DIFFERENTIAL LOCK AIR PUMP ASSEMBLY

On the J top and metal top vehicles, the air pump assembly is mounted on the quarter panel (LH). On the long wheelbase vehicles, the air pump assembly is mounted in the tool box assembly under the rear seat with a bracket in between.
The air pump assembly consists of a motor, pressure switch and release valve. When the differential lock switch is turned ON, the motor operates the air pump to generate an air pressure which actuates the differential into the locked state. To retain the differential in the locked state, the air pressure is maintained constant by the function of the pressure switch.
When a predetermined pressure is exceeded, the pressure switch switches OFF to stop the motor. When the pressure falls below a predetermined value, the pressure switch is turned ON to start the motor. Basically, the motor operates intermittently, depending on the air pressure.
When OFF signal from the differential lock switch is detected, the control unit stops the motor. At the same time, the release valve opens to let the internal pressure escape and reset the locked state of the differential.

Rear differential changeover	Air pump	Pressure kPa (kg/cm², psi)	Pressure switch	Release valve
Free → Locked (air pressure applied)	Operated	0 → 25 to 40 (0.25 to 0.40, 4 to 6)	ON → OFF	Closed (current supplied)
Locked (air pressure retained)	Not operated	25 to 40 (0.25 to 0.40, 4 to 6)	OFF	Closed (Current supplied)
Locked → Free (air pressure released)	Not operated	25 to 40 (0.25 to 0.40, 4 to 6) → 0	OFF → ON	Opened (No current supplied)





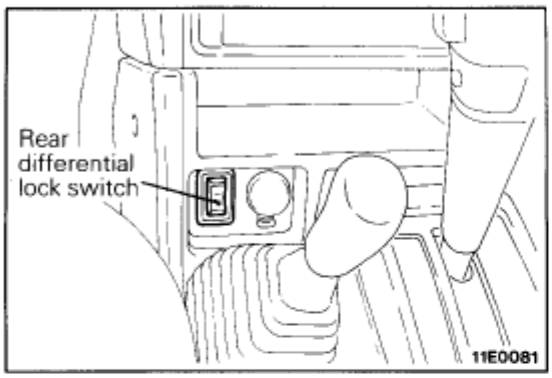


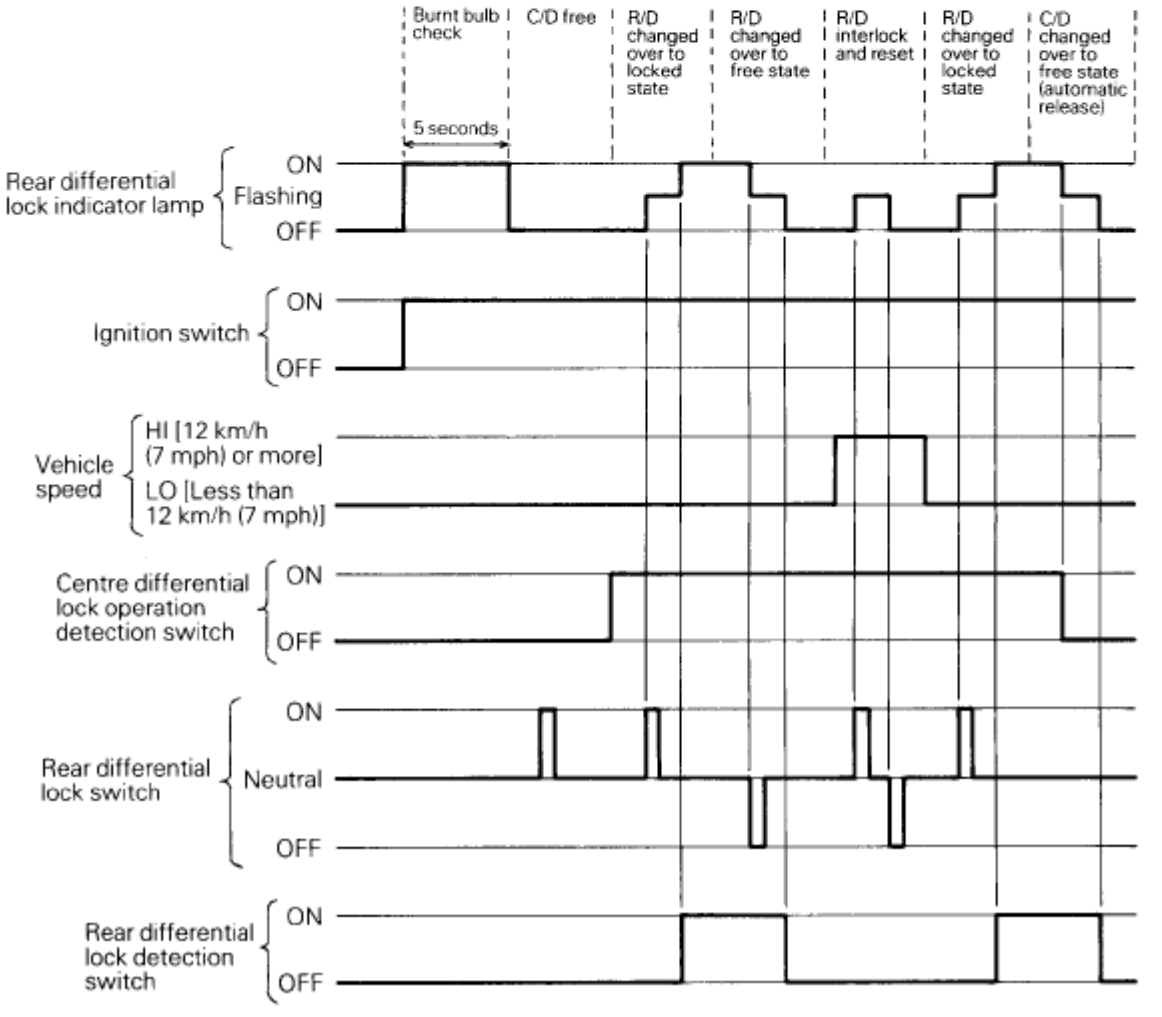
REAR DIFFERENTIAL LOCK INDICATOR LAMP

The rear differential portion of the 4WD indicator lamp in the combination meter either flashes or is illuminated, amber colour.

Functions

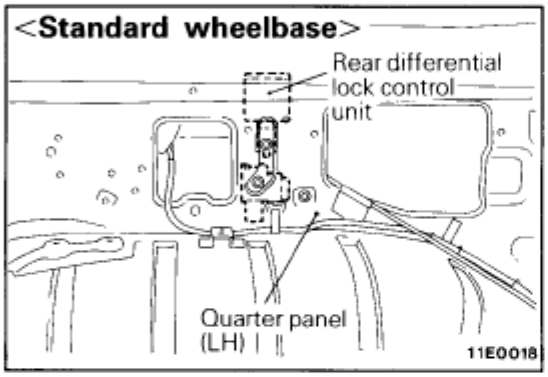
(1) When the rear differential is locked (the dog clutches in mesh), the indicator lamp is illuminated.
(2) When the rear differential is in the state where the changeover is in progress [where any attempt to change over the differential from the free to locked state with the vehicle at a speed of 12 km/h (7 mph) or more is inhibited by the control unit], the indicator lamp flashes.
(3) To check for a burnt bulb, the indicator lamp is unconditionally lit for five seconds immediately after the ignition switch has been turned ON (the engine started).

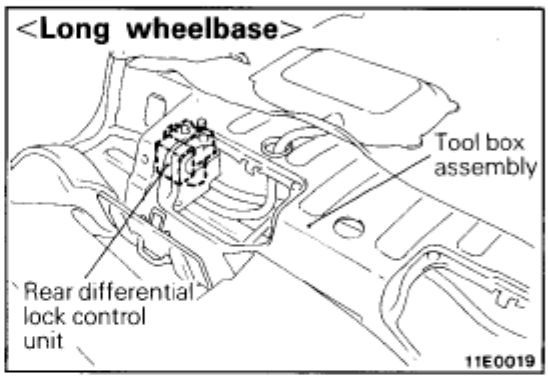




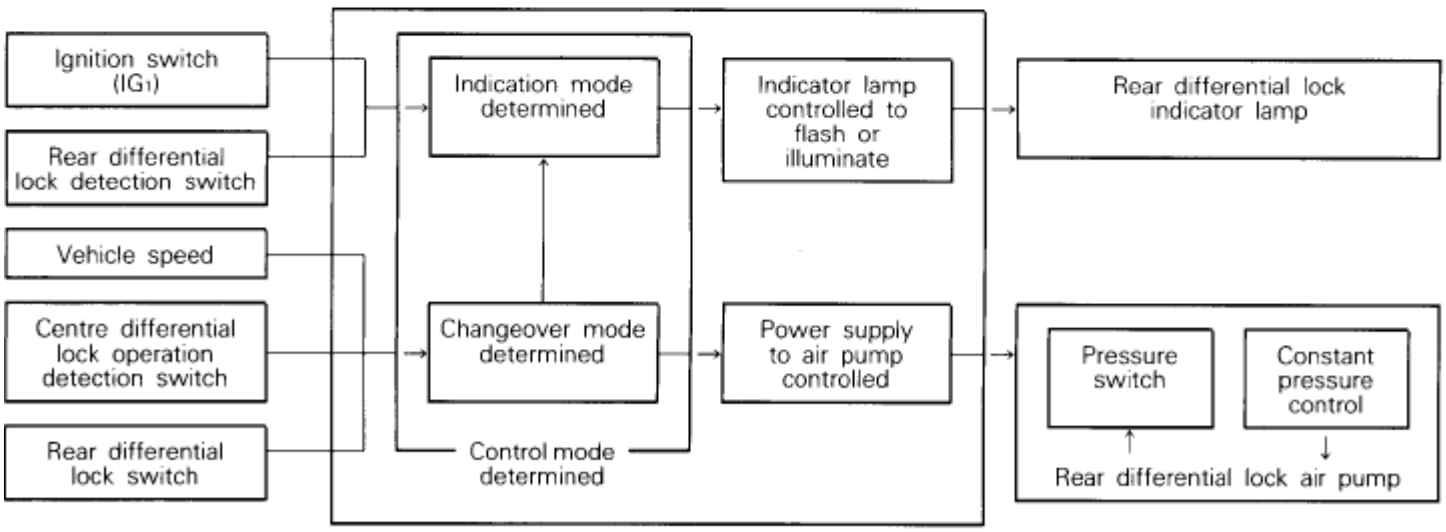
REAR DIFFERENTIAL CONTROL UNIT

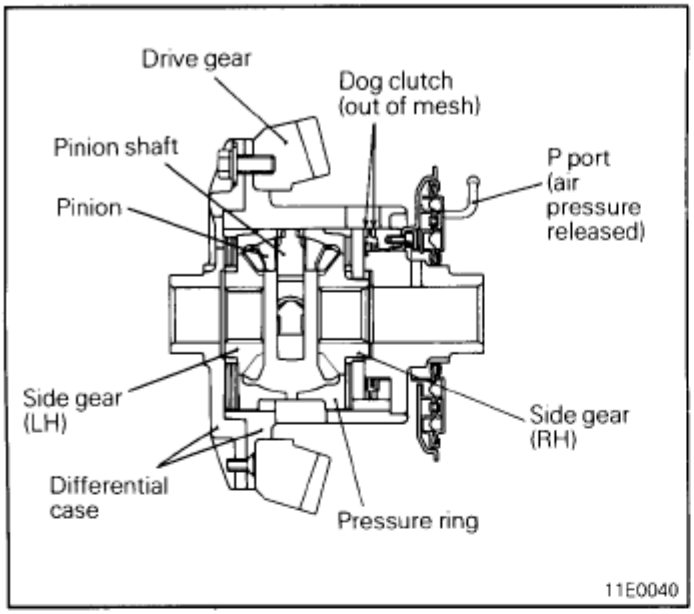
- On the J top and metal top vehicles, the control unit is mounted on the quarter panel (LH). On long wheelbase vehicles, the control unit is mounted in the tool box assembly under the rear seat with a bracket in between.
- Achieves ON/OFF control of power supply to the rear differential lock air pump in response to the ON/OFF signals from the rear differential lock switch and centre differential lock operation detection switch.
- When the vehicle speed is 12 km/h (7 mph) or more, the control unit inhibits changeover of the air pump from OFF to ON.
- Causes the rear differential lock indicator lamp to come on or go out in response to the ON/OFF signals from the rear differential lock detection switch. When changeover is in progress or when the interlocked state exists, the control unit causes the indicator lamp to flash.
- When the ignition switch is turned ON, the control unit causes the indicator lamp to light for approximately 5 seconds regardless of the ON/OFF states of all the switches.





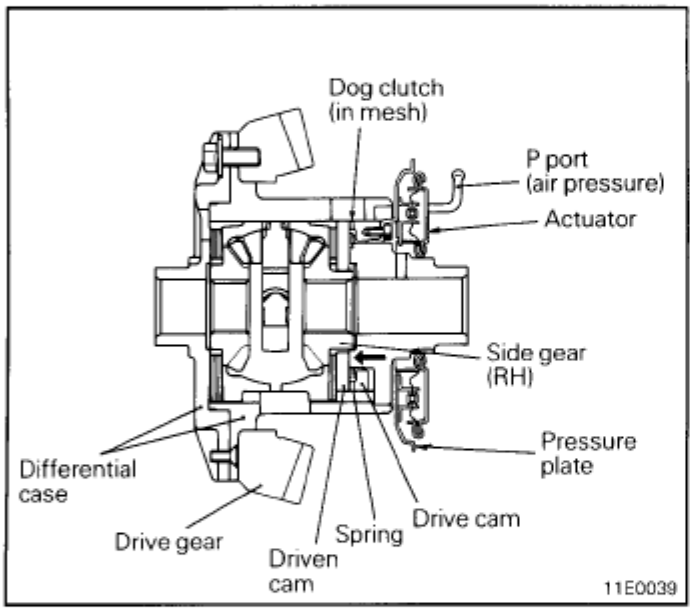
Block Diagram





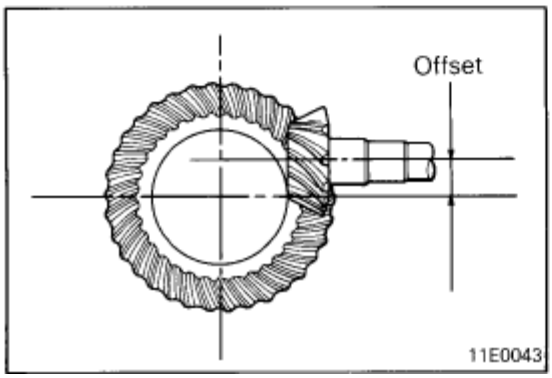
OPERATION OF SYSTEM

(1) Free state
The torque input from the drive gear is transmitted through the differential case, pressure ring, pinion shaft, pinion gear and side gear to the right and left rear axle shafts. Even if the right and left shafts differ in rotating speed, the normal differential functions are accomplished, as there is no hindrance.



(2) Locked state
Application of an air pressure from the P port allows the actuator to operate, moving the pressure plate and drive cam in the direction of the arrow. As a result, the dog clutches of the drive and driven cams are brought into mesh to block the differential action of the differential case and side gear (RH) to create a locked state. In addition, the differential case and drive cam are meshed, as long as the torque is applied from the drive gear to the differential case, the drive cam is pressed against the driven cam and cannot be released.

(3) When locked state is released
When the air pressure applied to the P port is released, the actuator releases the pressure plate. When the torque applied to the differential case is removed, the drive cam is moved in the direction of the arrow by the spring, and is separated from the driven cam to restore the normal differential functions.



FRONT DIFFERENTIAL

The front differential is of a reverse offset configuration. In this configuration, the helix direction of both the drive gear and pinion gear is opposite to that of an ordinary differential. Consequently, the drive surfaces of the gear teeth are the leading surfaces contrary to the trailing surfaces in an ordinary 4WD vehicles' differential. This design is effective at reducing gearing noise.