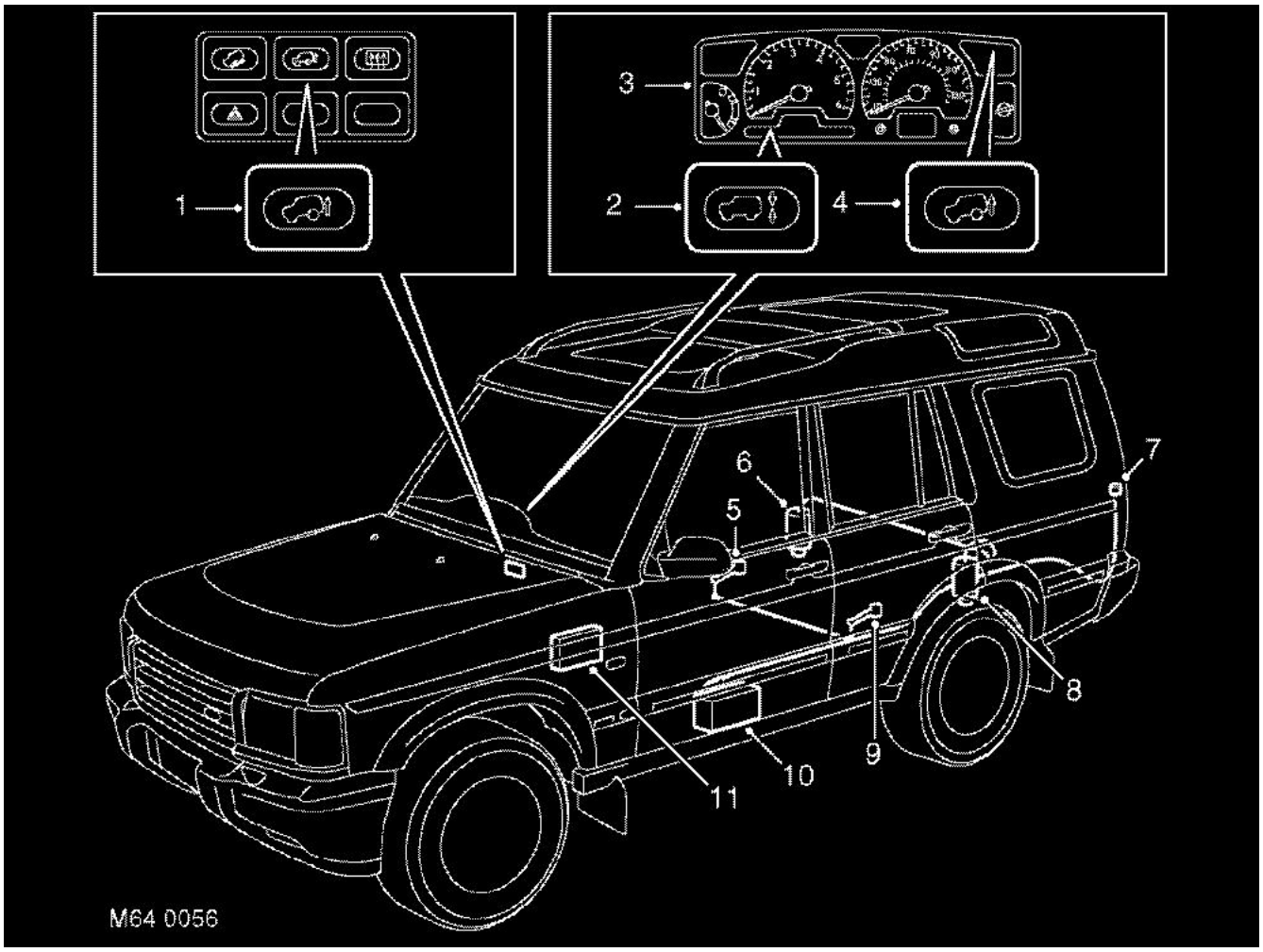
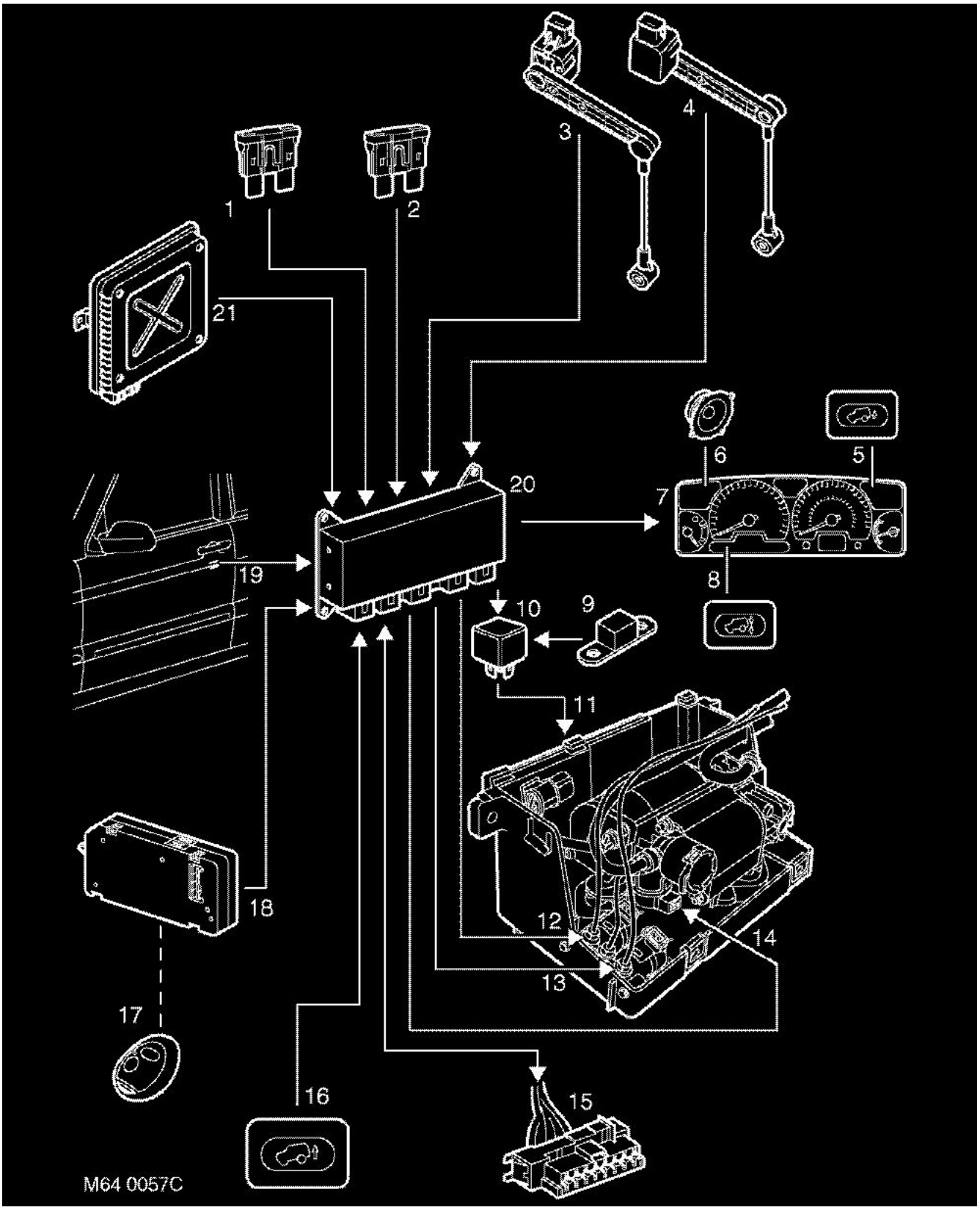
SLS component layout

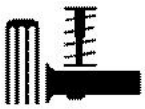


RH drive shown, LH drive similar

1 Off-road mode switch
2 SLS warning lamp
3 Instrument pack
4 Off-road mode warning lamp
5 RH Height sensor
6 RH Air spring
7 Air inlet filter
8 LH Air spring
9 LH Height sensor
10 Air supply unit
11 SLABS ECU

SLS system control diagram





1 Battery supply (via SLABS relay)
2 Ignition supply
3 RH height sensor
4 LH height sensor
5 Off-road mode warning lamp
6 Audible warning speaker
7 Instrument pack
8 SLS warning lamp
9 Fusible link 9
10 SLS relay
11 Air supply unit
12 RH air valve
13 LH air valve
14 Exhaust valve
15 Diagnostic socket
16 Off-road mode switch
17 SLS remote handset
18 Body Control Unit (BCU)
19 Door switches
20 SLABS ECU
21 Engine Control Module (ECM)

Description - SLS

General

The Self Levelling Suspension (SLS) system is an optional fitment and comprises an Electronic Control Unit (ECU), air supply unit, two air springs and two height sensors. The SLS system only operates on the rear suspension and is designed to keep the vehicle level to compensate for uneven loads or when towing. The system controls the gap between the chassis and the rear axle to a tolerance of ± 0.5 mm (0.02 in). The ride height of the rear of the vehicle can be controlled in three modes of operation; normal ride height, Off-Road Mode (ORM) and extended mode. A transportation mode, initiated using TestBook, is also available for moving the vehicle on a trailer.

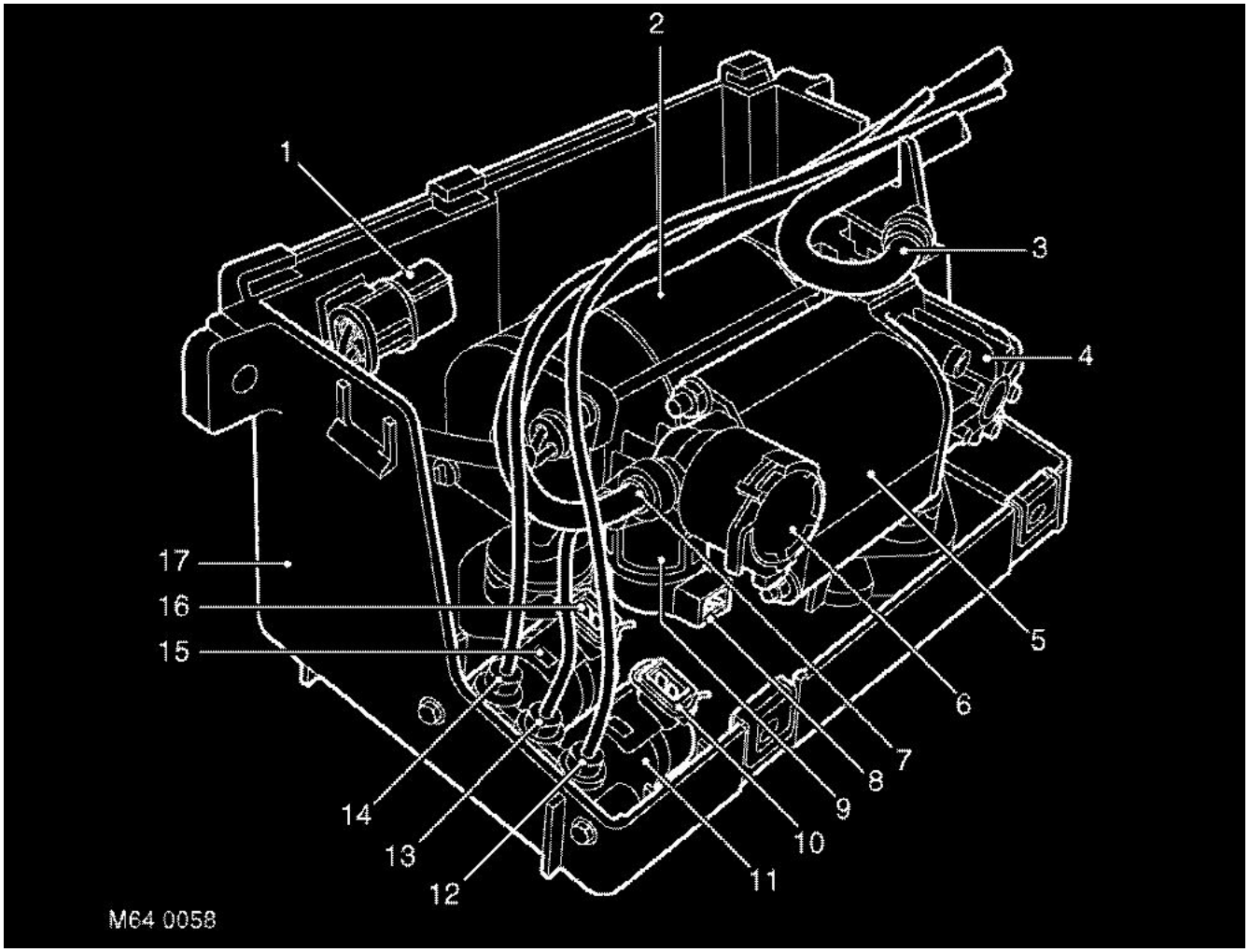
The system is controlled electronically by an ECU which is shared with the ABS system and known as the Self Levelling and Anti-Lock Braking System (SLABS) ECU. The system operates by using an air supply unit to inflate or deflate the air springs to maintain a constant ride height.

An accessory remote handset is available to remotely operate the SLS system to allow easier connection and disconnection of trailers.

Two SLS system warning lamps are located in the instrument pack. The warning lamp in the bottom left corner of the instrument pack is the SLS warning lamp. If a fault is detected in the system, the warning lamp will illuminate continuously in an amber colour. The warning lamp also flashes in an amber colour when the remote handset is being used. The second warning lamp, located in the top right of the instrument pack is the ORM warning lamp. When ORM is selected the warning lamp is continuously illuminated in an amber colour. When the SLS is between standard ride height and ORM or in extended mode, the warning lamp will flash. Standard ride height, measured between the tip of the axle bump stop rubber and the axle, is 61.5 mm (2.42 in). ORM ride height, measured between the tip of axle bump stop and the axle, is 100 mm (3.93 in).

A switch is located in the group of six switches on the fascia and is used to select the ORM. The switch is non-latching and must be depressed for a minimum of 0.5 seconds to signal the ECU that ORM has been requested.

Air supply unit



1 Compressor electrical connector
2 Electric motor
3 Air intake hose
4 Compressor
5 Air dryer
6 Pressure limiting valve
7 Exhaust hose
8 Exhaust valve electrical connector (black harness connector)
9 Exhaust valve
10 LH air valve electrical connector (blue harness connector)
11 LH air valve
12 LH air spring supply pipe
13 Air supply/exhaust pipe
14 RH air spring supply pipe
15 RH air valve
16 RH air valve electrical connector (natural harness connector)
17 Housing

The air supply unit is located in a central position on the outside of the left hand chassis longitudinal. The unit is contained in a plastic housing attached to the chassis. The housing has a removable lid which is secured with Dzus fasteners for access to the unit.

The air supply unit comprises a 12 V electric motor, a compressor and air dryer unit, a pressure limiting valve, an exhaust valve and two air supply control valves. The exhaust and control valves are solenoid operated responding to signals from the SLABS ECU. The electric motor, compressor, air dryer and pressure limiting and exhaust valve are mounted on flexible rubber mountings to reduce operating noise.

The electric motor drives a crank with an eccentric pin to which a connecting rod is attached. The connecting rod has a piston which fits in the bore of the compressor. Operation of the motor rotates the crank, moving the piston in the bore of the compressor.

The compressor is attached with Allen bolts to the motor housing and sealed with an O-ring. Attached to the compressor is the air dryer which contains a silicate box for removing moisture from the compressed air. Air supplied to inflate the air springs passes through the air dryer. When the air springs are deflated, the exhaust air also passes through the air dryer, removing the moisture from the unit and expelling it to atmosphere.

Attached to end of the air dryer unit is the pressure limiting valve. The valve protects the air springs from over inflation. The pressure limiting valve also operates when the exhaust valve is opened. The valve is pneumatically operated, responding to air pressure applied to it.

The exhaust valve is also located with the pressure limiting valve. The exhaust valve is solenoid operated by the ECU and directs air from the air springs and control valves to atmosphere when required.

The two air control valves for the LH and RH air springs are located at the forward end of the housing. Each valve is connected to the compressor/air dryer unit through a shared single pipe which directs air to and from the air springs. Each control valve is individually operated by the ECU.

All air connections to and from the air supply unit are made through the SLS air harness which is located along the left hand chassis longitudinal.

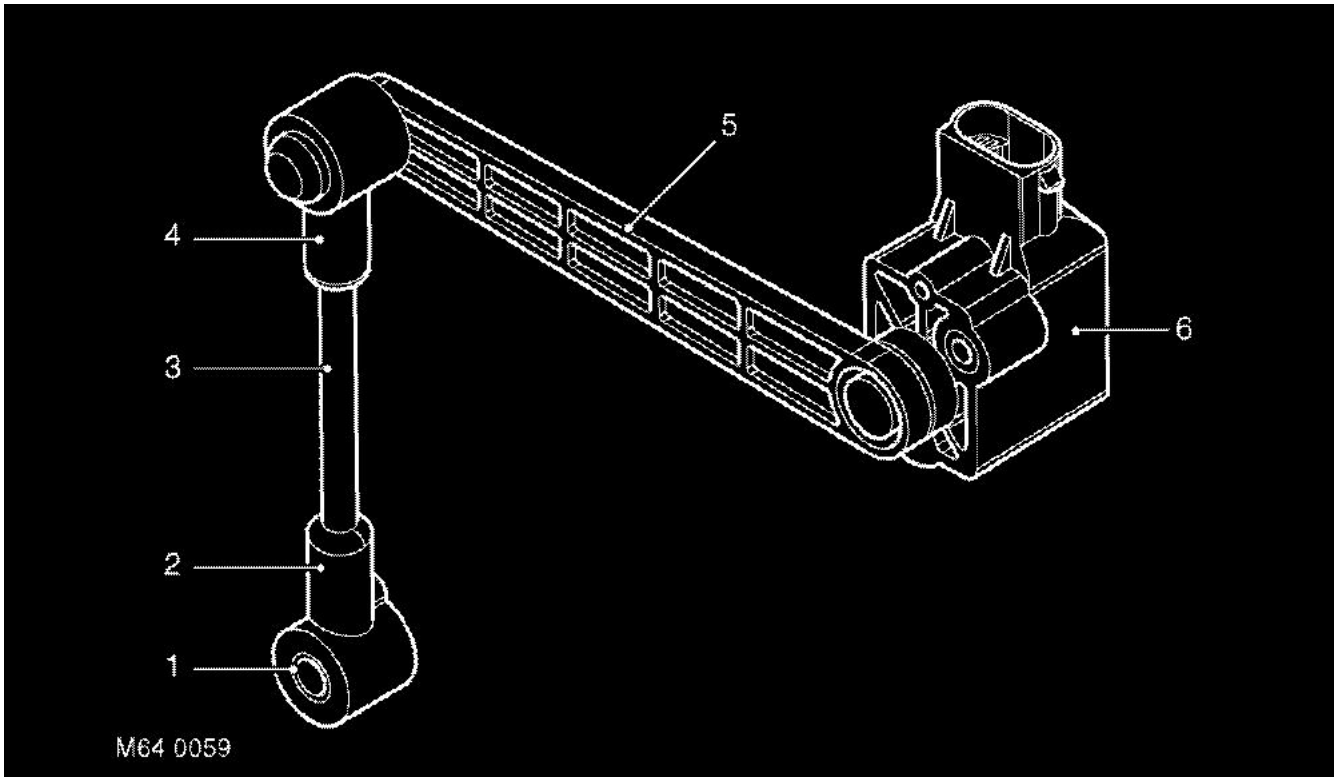
If faults occur with the air supply unit, fault codes are stored in the SLABS ECU. These fault codes cover the compressor power supply and the LH and RH air control valves and the exhaust valve. The current and past fault codes can be retrieved with TestBook. TestBook can also be used to operate the compressor and the valves for diagnostic purposes.

Air intake filter
The air intake filter is located in the left hand 'E' post, behind the tail lamp assembly. The filter comprises a plastic moulded housing which contains two filters of differing density to remove particulate matter from the air drawn in by the compressor. The air intake filter has a pipe which is connected to the SLS air harness by a quick release connector. The air intake filter must be replaced as an assembly.

Air intake/Exhaust silencer
The air intake/exhaust silencer is located on the outside of the left hand chassis longitudinal, behind the air supply unit. The silencer is an integral part of the SLS air harness and cannot be serviced individually.

The intake and exhaust air to and from the compressor passes through the silencer. The plastic moulded silencer has two chambers. One chamber reduces system exhaust noise and the other dampens intake air pulses produced by the compressor.

Height sensors



1 Spacer
2 Link end
3 Link
4 Link end
5 Arm
6 Sensor body

Two height sensors are located on the outside of each chassis longitudinal forward of the rear axle. Each sensor body is attached to a fabricated bracket and secured with two screws. The sensor is attached to the top of each radius arm by an arm, a link and two link ends. The link ends allow articulation of the arm to allow for suspension travel. The lower link arm is attached to a lug of the top of the radius arm and is secured with a bolt and locknut.

The sensor body and arm are manufactured from moulded nylon. The two link ends are made from natural rubber and the link is made from mild steel. The rubber link ends allow flexibility of the arm and resistance to damage.

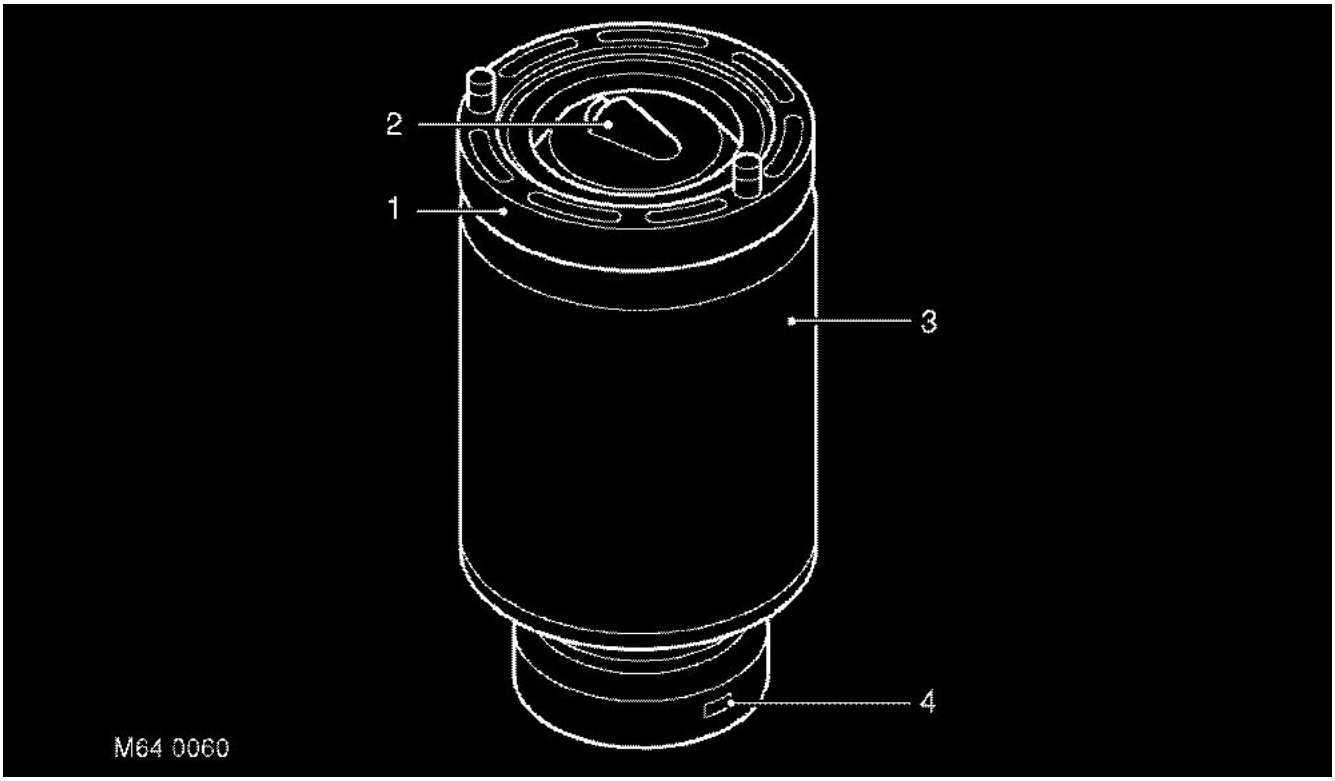
Each sensor is connected to the main chassis harness by a multiplug. The three pin multiplug provides an earth, a 5 V supply voltage and an output signal voltage to the SLABS ECU.

Each sensor operates on the Hall effect principle. A magnet is attached to the shaft and rotates with movement of the arm. The magnetic flux generated acts on a Hall effect sensor and depending on its position varies the current across the sensor. This current is measured and amplified and passed to the SLABS ECU as a linear output voltage signal, which varies depending on the angular position of the sensor. The signal information is processed and the ECU can determine the vehicle height.

When the sensors are replaced or removed for any reason, a calibration procedure is required to recalibrate the sensors and the SLABS ECU. The calibration procedure requires the use of TestBook and calibration blocks to set the axle to chassis height to a known value.

If faults occur with the height sensors, fault codes are stored in the SLABS ECU. The current and past fault codes can be retrieved with TestBook.

Air springs



1 Top plate
2 Voss connector
3 Air bag
4 Piston

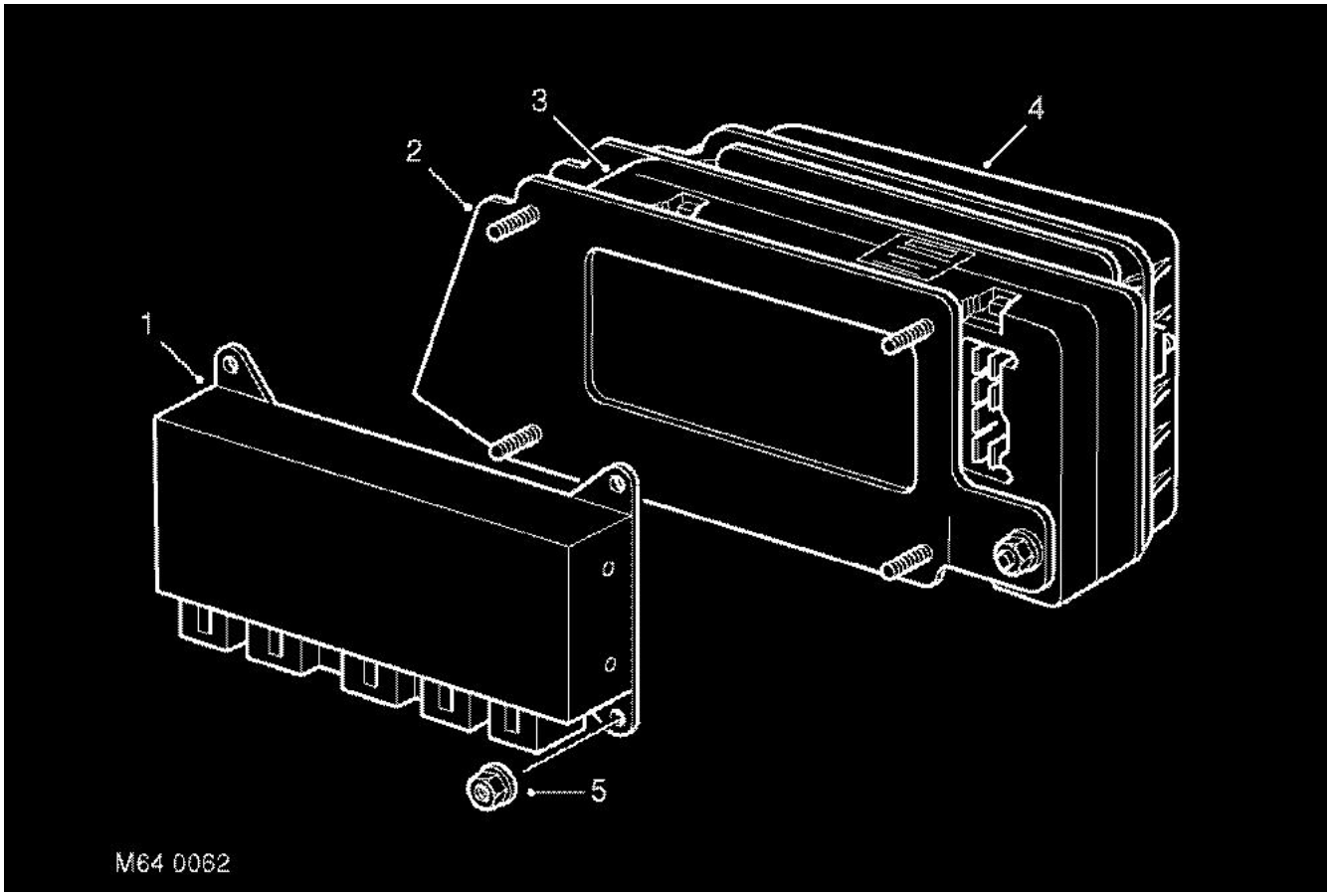
On vehicles without SLS, coil springs are used. On vehicles with SLS two air springs are fitted between the chassis and the rear axle to replace the coil springs. Each air spring is located at its base on a fabricated platform on the rear axle. The top of the spring locates in a fabricated bracket attached to the outside of each chassis longitudinal.

The plastic base piston is recessed with a boss with two lugs moulded in the centre for attachment to the axle. The piston is secured by locating the lugs in a slotted hole in the axle platform and rotating the spring through 90°, locating the lugs in the slot. The plastic top plate has two grooved pins which locate through holes in the chassis bracket. Two spring clips locate on the grooved pins and retain the top of the spring in position.

Each air spring comprises a top plate, an air bag and a base piston. The air bag is attached to the top plate and the piston with crimped rings.

The air bag is made from a fibre reinforced flexible rubber material which allows the spring to expand with air pressure and deform under load. The top plate comprises the two bonded grooved pins and a female Voss connector in the centre. The Voss connector allows for the attachment of the air supply pipe from the air supply unit. The piston is also made from plastic and is shaped to optimise the springs characteristics.

SLABS ECU



1 SLABS ECU
2 Bracket
3 BCU (Ref. only)
4 ACE ECU (Ref. only)
5 Attachment nuts

The SLABS ECU is mounted on a bracket behind the passenger glove box and is identified from the other ECU's by its five connectors. The five connectors are located on the lower face of the ECU and mate with five connectors from the main harness. The twelve, six and eighteen pin connectors are used to supply inputs and outputs to and from the ECU. The remaining connectors are used for the ABS operation.

BRAKES, DESCRIPTION AND OPERATION, Description.

The SLABS ECU receives a continuous battery supply from fuse 11 in the engine compartment fusebox. An ignition 'ON' signal is supplied from the ignition switch via fuse 28 in the passenger compartment fusebox. The ECU has the ability to control when it requires power and is not reliant on the ignition signal for it to power up.

The ECU incorporates a counter which times the operation of the SLS system and prevents the compressor exceeding its duty cycle. The ECU can remain powered for up to 1.5 hours after ignition off is sensed to allow the counter to continue running to avoid an ignition cycle resetting the counter.

Opening any of the doors will power up the ECU, irrespective of ignition switch position. The door open signal is sensed by the door switch completing an earth path which is sensed by the ECU. The ECU cannot differentiate between any of the doors. The door open signal powers the ECU for up to 30 minutes to allow the vehicle to re-level when a load is removed or passengers leave the vehicle.

The ECU supplies a 5 V current to each of the height sensors. Each height sensor uses the current to supply an analogue input to the ECU. The ECU can calculate from the input received from each height sensor the height of the vehicle and can then power the air supply unit as necessary to raise or lower one or both air springs to level the vehicle.

When SLS compressor operation is required, the ECU provides a battery supply to energise the SLS relay located in the engine compartment fusebox. When the relay contacts close, a 12 V supply passes through fusible link 9 in the engine compartment fusebox, through the relay contacts and operates the air supply unit compressor. The ECU will then supply power to operate one or both air control valve solenoids and/or the exhaust valve solenoid to inflate or deflate the air springs as required. The compressor does not need to be powered to deflate the air springs.

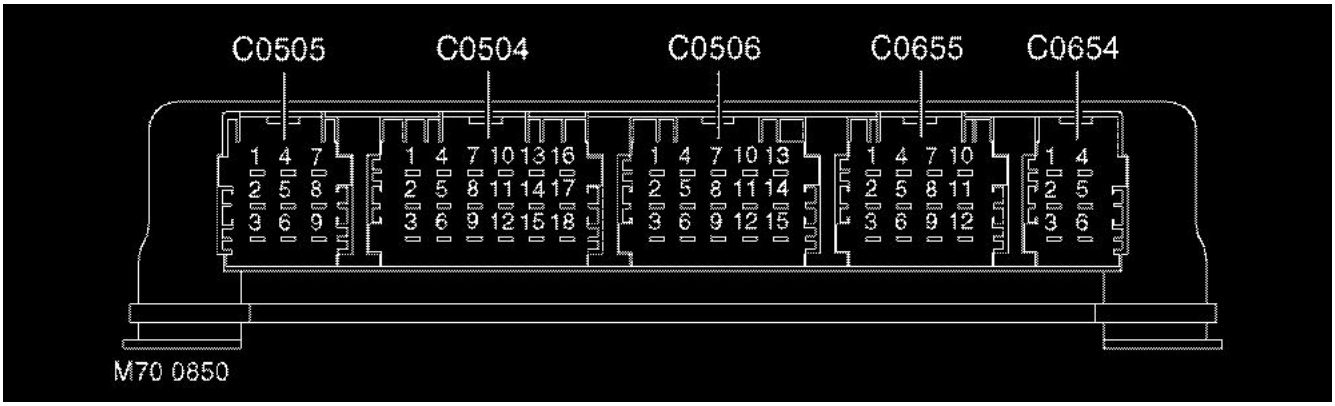
The ECU also controls the operation of the SLS audible warning, the SLS warning lamp and the ORM warning lamp. When the ignition is switched to position II, the ECU performs a three second bulb check and illuminates the SLS and ORM warning lamps in the instrument pack to check for operation. When the system is operating or a fault is sensed by the ECU, the ECU will operate the appropriate warning lamp and audible warning as required. The audible warning is operated by the Body Control Unit (BCU) when it receives a signal from the SLABS ECU. The audible warning is emitted from a speaker at the rear of the instrument pack.

Depressing the ORM switch for a minimum of 0.5 seconds, completes an earth which the ECU uses as a signal to initiate the ORM if conditions allow. When the ECU starts ORM, the same earth that was completed by the ORM switch is pulled to earth by the ECU to activate the ORM warning lamp. The ECU checks for a further operation of the ORM switch by continuously and very quickly removing the earth for the ORM warning lamp. If the ORM switch is operated for more than 0.5 seconds, the ECU will detect this and de-activate the ORM.

The SLS part of the SLABS ECU also uses the road speed data generated within the SLABS ECU by the ABS system. Operation of ORM and extended mode are road speed sensitive and use the ABS signal to monitor the vehicle speed.

When the accessory remote handset is used for the SLS lower and raise functions, the handset transmits RF signals which are received by the same RF receiver used for the alarm/remote door locking system. The RF receiver passes this data as a 25 Hz PWM signal to the BCU. The BCU then transmits this data to the SLABS ECU as raise or lower data. TestBook is required to program the BCU for remote handset operation.

SLABS ECU connector pin details



Connector/Pin No.	Description	Input/Output
C0504		
1	Battery supply	Input
2	Ignition supply	Input
5	K line (diagnostics)	Input/Output
12	Earth	Input
C0654		
1	Left height sensor supply	Output
2	Left height sensor earth	Input
3	Left height sensor signal	Input
4	Right height sensor supply	Output
5	Right height sensor earth	Input
6	Right height sensor signal	Input
C0655		
1	Driver's door switch	Input
2	Passenger and tail door switches	Input
3	Left air valve	Output
4	Right air valve	Output
5	Exhaust valve	Output
6	Air compressor (SLS relay)	Output
7	Audible warning	Output
8	SLS warning lamp	Output
11	ORM switch/ORM warning lamp	Input/Output
12	Remote handset raise/lower signal	Input
Connectors and pins not listed are either not used or used by the brakes system. **BRAKES, DESCRIPTION AND OPERATION, Description.**		

Failure modes

Failures are indicated by the SLS warning lamp in the bottom left corner of the instrument pack illuminating continuously in an amber colour. The following tables show the type of system failures and their effects on the system operation.

Height sensors

Failure	Effect
Sensor output stuck at 5 V	Vehicle will not level
Sensor output stuck at 0 V	Vehicle will not level
Mechanical link between radius arm and sensor broken	Vehicle will not level

Door Switch Inputs

Failure	Effect
Harness leads for open doors are are broken or shorted to V Batt.	Air suspension levels when one or more doors are open
Harness leads to door(s) shorted to earth	Air suspension will not level

SLS off-road mode switch

Failure	Effect
Fault in wiring harness	Off-road mode cannot be selected
Failure of off-road mode switch	Off-road mode is activated when switch has not been selected

Air supply unit air control valves

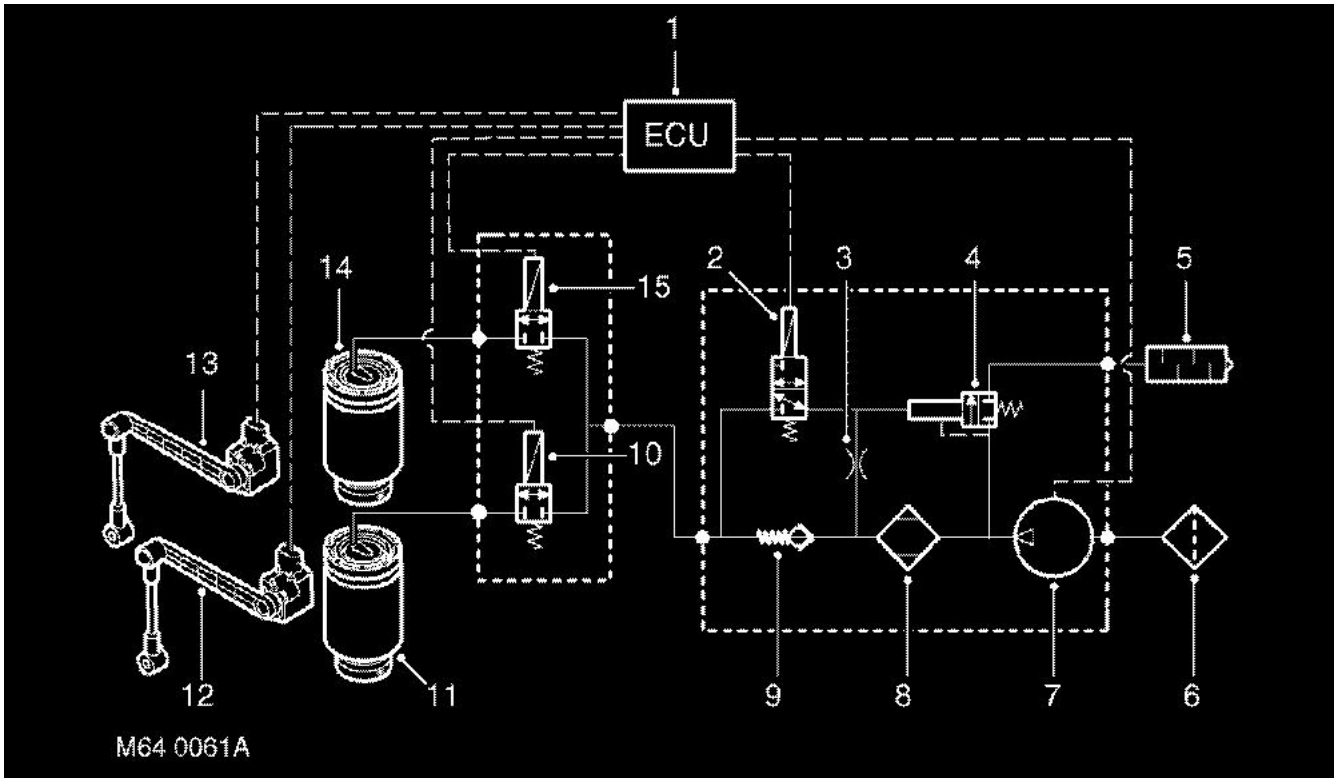
Failure	Effect
Valves open or short circuit	Vehicle does not level or levels unevenly

Air supply unit compressor

Failure	Effect
Faulty relay, harness fault or compressor fault	Vehicle does not level upwards

Operation

Circuit diagram



1 SLABS ECU
2 Exhaust valve
3 Restrictor
4 Pressure limiting valve
5 Silencer
6 Inlet air filter
7 Compressor
8 Air dryer
9 Non-return valve
10 RH air control valve
11 RH air spring
12 RH height sensor
13 LH height sensor
14 LH air spring
15 LH air control valve

The SLS system is active when the ignition switch is in position II, when one or more doors are open and for up to thirty minutes after all doors have been closed. If the rear axle is articulated by more than 100 mm (3.93 in), the ECU will not activate the SLS system.

The air supply unit compressor will only operate to raise the rear of the vehicle when the engine is running, with the exception of the remote handset operation which does not require the engine running. Three modes of SLS operation are available; Normal Ride Height, Off-Road Mode (ORM) and Extended Mode. A fourth mode, transportation mode, is programmed by TestBook for transport or recovery of the vehicle on a trailer.

Normal ride height
When the vehicle is stationary, a door is open and the ignition is off, the SLS system will allow the rear of the vehicle to lower to within 20 mm of the normal ride height as load is removed from the vehicle. The SLS system will only operate the compressor to raise the rear of the vehicle when the engine is running, unless requested using the remote handset.

Off-road mode (ORM)

ORM is used to raise the rear of the vehicle from normal ride height to the ORM ride height of 100 mm between the tip of the bump stop and the axle.

ORM is activated by depressing the ORM switch located on the fascia for not less than 0.5 seconds. With the engine running, all doors closed and the vehicle speed below 18 mph (30 km/h), the audible warning will sound once and the ORM warning lamp in the instrument pack will start to flash when the switch is released. The compressor will be started and the air control valves will be energised by the ECU to inflate the air springs and raise the rear of the vehicle.

When the full ORM height is reached, the ECU will terminate compressor operation and close the air valves. The ORM warning lamp will stop flashing and remain continuously illuminated to inform the driver that the SLS system is in ORM.

When ORM is no longer required, depressing the ORM switch for not less than 0.5 seconds with all doors closed will lower the SLS to normal ride height. The audible warning will sound once and the ORM warning lamp will flash as the suspension lowers. The ECU energises the air control valves and the exhaust valve to release air pressure from the air springs. When standard ride height is reached the ORM warning lamp will extinguish and the ECU will de-energise the air control valves and the exhaust valve solenoids.

If the SLS is in ORM and the vehicle speed exceeds 18 mph (30 km/h), the ECU will lower the SLS to standard ride height. The driver will be informed of this by an audible warning and the ORM warning lamp flashing as the suspension lowers. When normal ride height is achieved, the ORM warning lamp will extinguish.

At sea level, the time to change the SLS from normal ride height to ORM or visa versa will take between 15 and 20 seconds.

If the ECU determines that conditions are not correct for SLS operation, i.e.; axle articulation or system fault, the audible warning will sound three times to inform the driver that the ORM request has not been granted.

Extended mode

The extended mode is automatically operated by the ECU and requires no input from the driver. Extended mode operates when the chassis is grounded causing the rear wheels to spin. This information is generated by the ABS function of the SLABS ECU.

When the ECU senses that the chassis is grounded and the vehicle speed is less than 6 mph (10 km/h), the ECU will operate the compressor and energise the air control valves for 25 seconds to raise the rear of the vehicle. This operates irrespective of the mode that the SLS system is in at that time. To inform the driver, the ORM warning lamp will flash continuously at all times that the system is in extended mode.

The driver can exit the extended mode by depressing the ORM switch for not less than 0.5 seconds or by exceeding 8 mph (13 km/h).

Remote handset SLS control

The remote handset is an accessory item which allows the SLS to be operated between normal ride height and bump stop height to allow easier connection and disconnection of trailers. The remote handset is similar in appearance to that of the remote door locking handset but does not have an integral key. A circular button with an arrow is used to raise the SLS and an oval button with the 'Land Rover' logo is used to lower the SLS.

The remote handset control requires all doors to be closed and the ignition to be in position II, but the engine does not need to be running.

Pressing the lower button will signal the SLABS ECU, via the RF receiver and the BCU, to energise the exhaust valve and air control valves. The SLS will lower up to 60 mm (2.36 in) below normal ride height if the button is held. If the button is released the SLS will stop at that point.

Pressing the raise button will signal the SLABS ECU, via the RF receiver and the BCU, to start the compressor and energise the exhaust valve and air control valves. The SLS will raise to normal ride height if the button is held. If the button is released the SLS will stop at that point.

When raising or lowering the SLS using the remote handset, the SLS warning lamp will flash and the audible warning will sound when the system is operating. When the SLS is fully lowered the warning lamp will stay illuminated. The SLS will reset to normal ride height if the vehicle speed exceeds 3 mph (5 km/h) for 10 seconds when the SLS is lowered.

Transportation mode

Transportation mode must be used when the vehicle is transported on a trailer and secured by the chassis. The transportation mode can only be enabled and disabled with TestBook.

The transportation mode lowers the rear suspension onto the bump stops with the engine not running. When the suspension is in transportation mode, the SLS warning lamp is continuously illuminated when the ignition is in position II.

When the engine is started in transportation mode, the SLS system will raise the rear suspension until a gap of 25 mm (1 in.) exists between the bump stop and the axle. The SLS warning lamp will flash continuously while the SLS system is raising the suspension. When the gap between the bump stop and the axle is achieved, the warning lamp will illuminate continuously.

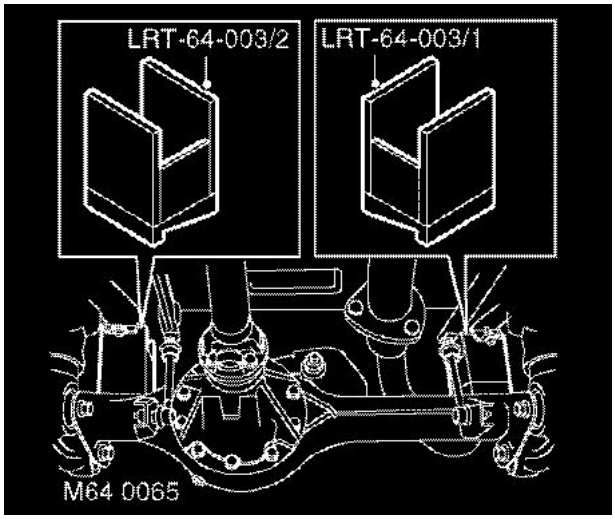
When TestBook is used to disable the transportation mode, the rear suspension will raise to normal ride height when the engine is running.

SLS calibration blocks

64.50.38

Fit

1. Connect TestBook to vehicle.
2. Ensure contact faces of calibration blocks **LRT-64-003/1** and **LRT-64-003/2** are clean.



3. Using Testbook, operate the SLS system to raise the body, position the calibration blocks **LRT-64-003/1** and **LRT-64-003/2** between the rear axle and the body, then lower the body onto the calibration blocks. **The calibration blocks are handed and only fit one way.**

Remove

1. Using Testbook, operate the SLS system to raise the body, remove the calibration blocks **LRT-64-003/1** and **LRT-64-003/2** from between the rear axle and the body.
2. Disconnect TestBook from the vehicle.