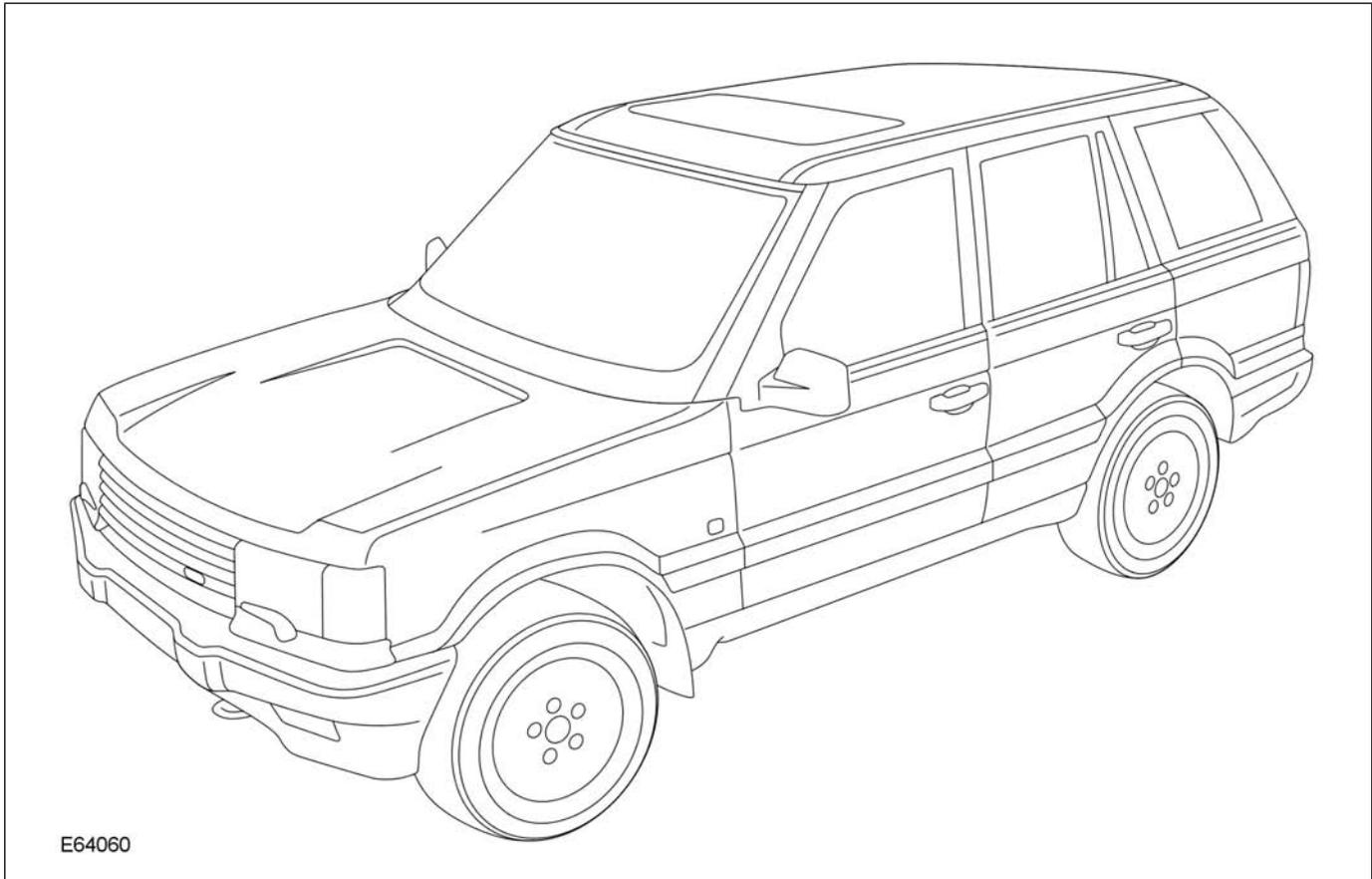
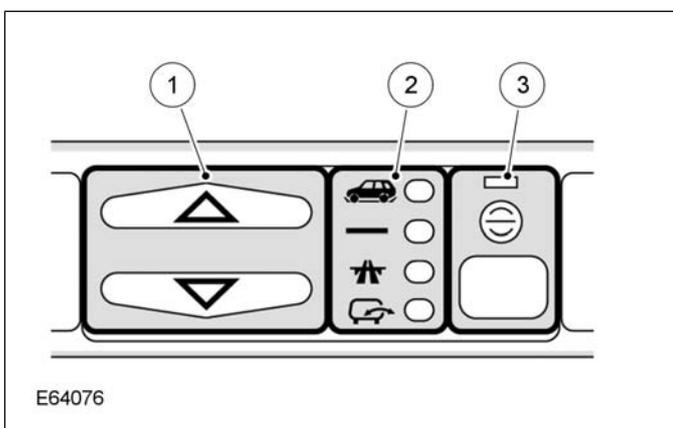


On completing this lesson, you will be able to:

- Describe the principles of air suspension operation
- Operate the system control switches to obtain the desired vehicle condition fit for the purpose.

RANGE ROVER (LP)**System Control**

All driver related controls are situated in the center of the fascia.

Control Switch Panel**Switch Panel**

The switch panel consists of the following:

- Height control switch
- Inhibit switch

The height control is a rocker type switch used by the driver to select the required vehicle ride height.

Height Changes

NOTE: The vehicle will not respond to switch inputs until the switch is released.

All changes to vehicle ride heights are indicated to the driver by the ride height indicator lamps located next to the switch.

The inhibit switch is a mechanical latching switch and is used to modify the automatic ride height system changes.

Selection of the inhibit switch function is indicated to the driver by the illumination of a tell-tale LED located in the switch.

The LED is bulb tested with the ride height indicator lamp.

Indicator Lamps

Between the height control rocker switch and the latching inhibit switch is the indicator warning lamp panel.

This panel has the following indicator lamps:

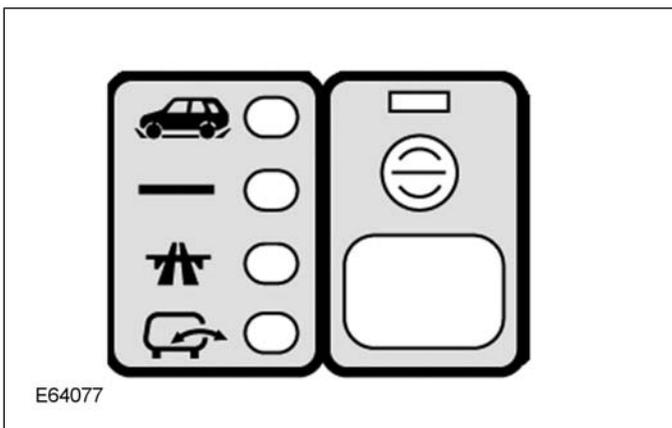
- High profile
- Standard height
- Low profile
- Access mode

Two other driver indicator lamps are:

- Instrument warning lamp
- Inhibit mode tell-tale light

Indicator and Tell-Tale

Indicator & Tell-Tale Lamps



With the ignition key turned to position 2, all four indicator lamps, the air suspension warning light and the inhibit switch lamp will be illuminated continuously.

When the engine is started, the lights will remain illuminated for 2 seconds, after which the current ride height setting will be displayed.

Two indicator lights will illuminate when the vehicle is between ride heights, with the selected ride height lamp flashing.

When the selected height is achieved the indicator lamp will be illuminated constantly and the previously selected ride height indicator lamp will be extinguished.

The inhibit lamp is illuminated while it is activated, i.e. inhibit switch latched results in the LED being switched-on.

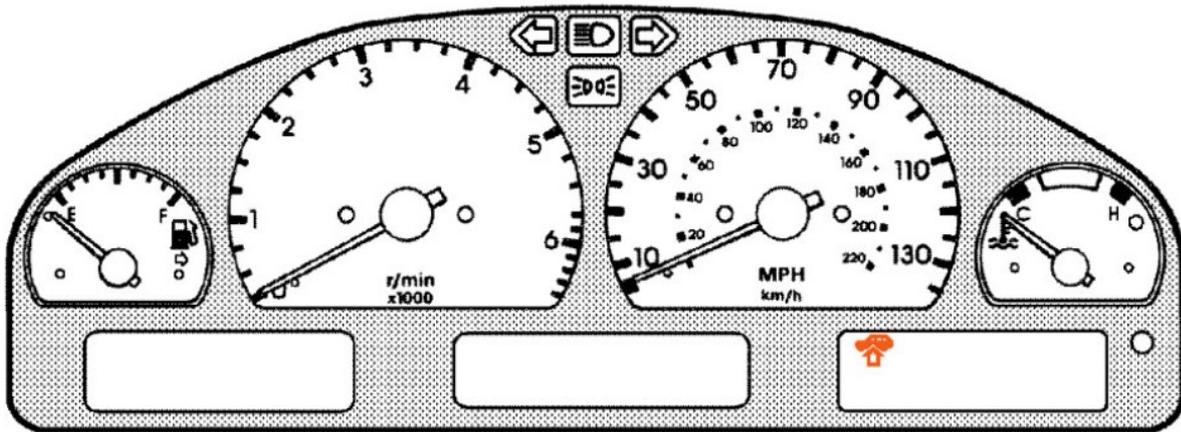
Both switches are illuminated with the side light switched on.

Additional driver information is provided by the message center in the instrument cluster.

Instrument Cluster Warning

An amber air suspension warning lamp is located in the instrument cluster.

Instrument Cluster



E64078

The warning lamp will be constantly illuminated when driving at high ride height profile and will flash when the vehicle is at extended ride height.

The lamp will also illuminate when a fault within the air suspension system has been detected.

A bulb check function is provided when the ignition is turned to position 2, and for 2 seconds after the engine is started.

Height Profile Description

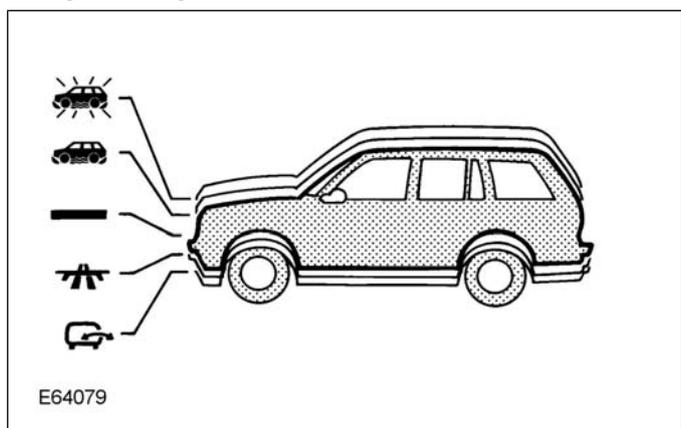
Electronic Air Suspension (EAS) provides five different height settings, including an 'Access' mode.

Ride Heights Available

- Extended ride height
- High ride height
- Standard ride height

- Low ride height
- Access height with Crawl mode

Height Settings



E64079

These settings when chosen will either increase or decrease the vehicle ride height to ground clearance to cope with the differing driving conditions.

EAS Inhibits

Requested ride height changes will **NOT** take place if any of the following are active:

- Tailgate open
- Any door open
- Foot brake continuously applied for less than 3 minutes
- Engine not running

The engine not running inhibit has an exception for Access height selection within 40 seconds of switching the ignition off.

 **WARNING: Frequent changes between ride height could cause the air supply compressor to overheat.**

NOTE: If the compressor overheats, the system will cease activity and will resume full operational status again within a few minutes once the compressor has cooled.

If Access mode is required, ensure the handbrake is applied and select 'P' for automatic transmissions variants.

Standard Ride Height

With the inhibit switch in the off position (un-latched) and at speeds below 50 mph (80 km/h) the standard ride height indicator will be illuminated.

Standard Height Symbol



The standard vehicle ride height will be maintained under all load conditions.

Maintaining the vehicle ride height under all load conditions assists in maintaining correct headlamp leveling.

Low Ride Height Description

Low ride height is automatically selected when the vehicle speed exceeds 50 mph (80 km/h) for at least 30 seconds with the inhibit switch in the off position (un-latched).

Low Height Symbol



The low ride height indicator will flash during the height change and the standard ride height indicator will extinguish when the low ride height profile has been attained.

Standard ride height is automatically selected when the vehicle speed drops below 35 mph (56 km/h) for at least 30 seconds with the inhibit switch in the off position (un-latched).

The driver can select low ride height at any speed.

With the vehicle at the low ride height setting, depressing the inhibit switch (latched) will result in the vehicle maintaining ride height regardless of speed.

Access Ride Height

This feature is used to make access to and from the vehicle much easier.

Access Ride Height Symbol



A number of conditions need to be completed in order to permit the vehicle to descend in to access mode.

The following are conditions that need to be met:

- Vehicle stationary
- Doors closed
- Tailgate closed
- Park brake applied
- Foot brake released
- Park selected (automatics)
- Switch pressed down and released

While the vehicle is descending, the access indicator lamp will flash.

When access mode is attained, the indicator lamp will remain constantly illuminated.

The standard ride height lamp will be extinguished.

Access mode can be selected up to 40 seconds before stopping the vehicle, i.e. approaching residential driveway in readiness to stop and park the vehicle.

NOTE: It is possible to select access mode up to 40 seconds after switching the engine off.

NOTE: Opening a door or tailgate will immediately stop the vehicle height changes.

When the door is closed, the height change will then be completed.

If the door is opened for more than 30 seconds, the system will need reminding of the required height when the door or tailgate is closed.

On stopping the vehicle, applying the park brake, releasing the foot brake and selecting park (automatics), the vehicle will lower to the requested access mode ride height.

Driving the vehicle will result in an automatic return to standard ride height.

Alternatively standard ride height can be achieved by closing all doors, starting engine and pressing the up switch.

The standard indicator lamp will flash during the height change.

When standard ride height is attained the indicator will remain constantly illuminated and the access indicator lamp will be extinguished.

Crawl Mode

In areas where height is restricted, the vehicle may be driven in access mode, however this mode is then renamed crawl mode.

Crawl (Access) Mode Symbol



To achieve crawl mode ensure the inhibit switch is un-latched and select access mode.

When access ride height is achieved, press the inhibit switch.

The inhibit switch indicator will be illuminated to show it has been selected.

The message center in the instrument pack will beep three times and display 'EAS MANUAL'.

The vehicle may now be driven at speeds up to 20 mph (32 km/h).

If the vehicle is accelerated to 10 mph (16 km/h), the message center will beep three times and display 'SLOW 20 MPH MAX'.

If the vehicle speed exceeds 25 mph (40 km/h), the vehicle will rise to low profile, with low warning flashing.

On slowing down to 20 mph (32 km/h), the vehicle will lower to access mode height with the access warning indicator illuminated.

When the vehicle speed falls below 5 mph (8 km/h), the message center will beep three times and display 'EAS MANUAL'.

To cancel Crawl Mode, release the inhibit switch or depress the up switch.

High Ride Height

This mode is used to improve approach and departure angles and also to improve the characteristics of the vehicle when wading.

High Mode Symbol



When at standard ride height, pressing the up switch will select the High Ride Height profile providing the vehicle road speed is below 35 mph (56 km/h).

The high ride height indicator lamp will flash during the height change.

When the change is complete the indicator lamp will remain constantly illuminated, and the standard ride height indicator lamp will be extinguished.

The amber air suspension indicator lamp in the instrument pack will also be illuminated.

If the road speed exceeds 35 mph (56 km/h), the vehicle will return to the standard ride height profile.

High Lock Mode

The vehicle can be placed in to a safety condition, known as 'High Lock' mode.

High Lock mode permits the vehicle to be worked on without the system operating.

Thus making the vehicle safe to work on, i.e. the system locks out the controls etc.

High Lock mode is indicated by the warning LED's flashing in sequence from the bottom upwards.

The T4 diagnostic equipment is required to activate and deactivate 'High Lock' mode.

Extended Ride Height

This mode is activated if the chassis is grounded leaving a wheel or wheels unsupported.

Extended Height Symbol



The first initial ECU reaction is to lower (deflate) the affected air springs.

After a timed duration, if the ECU has not detected a height change, it will re-inflate the air springs to an extended height in an attempt to regain traction.

This position will be held for 10 minutes, after which the vehicle will automatically return to standard ride height.

⚠ WARNING: If the vehicle speed exceeds 35 mph (56 km/h), the vehicle will immediately lower to the standard ride height position.

This speed could be achieved for example by a wheel spin type conditions.

Alternatively, pressing the ride level control switch down will lower the vehicle 20 mm to the high profile height.

Transportation Review

Vehicles leaving the factory are transported with the EAS system electronically frozen in the access mode condition.

When the road speed exceeds 25 mph (40 km/h), the vehicle will rise to Low Ride Height.

It will return to access mode height if the speed falls below 24 mph (38 km/h).

This condition is cancelled at the PDI (Pre Delivery Inspection) stage by entering the appropriate commands using the T4 diagnostic equipment.

WARNING:

When an air suspension vehicle is secured to a transporter using the chassis lashing eyes, there is a possibility that the securing strap tension could be lost.

This is due to the following conditions occurring:

- Air leakage
- Self-leveling operation
- Operation of the ride height controls

PRECAUTION:

To prevent this occurrence from happening the ride height should be set to access mode before securing to the transporter.

NOTE: If the engine cannot be run and the vehicle is not in access mode, the vehicle can still be transported.

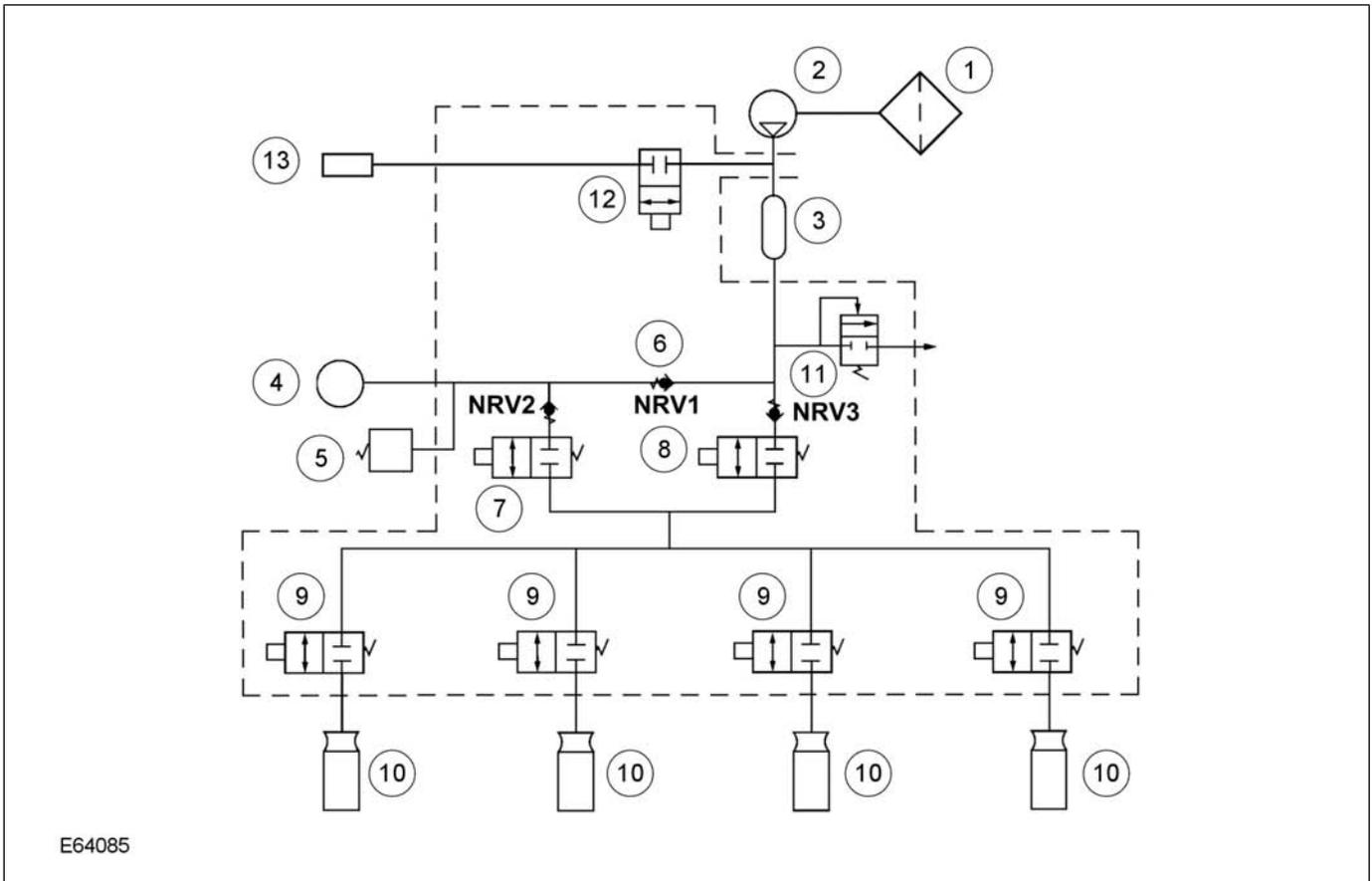
However, the vehicle must be secured to the transporter by the road wheels and not the chassis lashing eyes.

As an indication that the vehicle is in Transportation mode, the LED's flash in sequence from the top downwards.

Transportation mode can be activated and deactivated only by the T4 diagnostic equipment.

EAS System Review

Air Suspension Schematic



E64085

EAS Operating Review

Air is drawn in through the compressor inlet filter (1) to the compressor (2), where it is compressed to 10 bar (145 psi).

Compressed air passes to the air drier unit (3) where moisture is removed as it flows through the desiccant.

Dried air passes through non-return valve NRV1 to the air supply reservoir (4).

The 3 non-return valves: NRV1, NRV2 and NRV3 (6) are used to ensure correct air flow. These non-return valves also prevent loss of spring air pressure if a total loss of reservoir pressure occurs.

The green pressure switch (5) maintains system pressure between set limits by switching the compressor on and off via an ECU controlled relay.

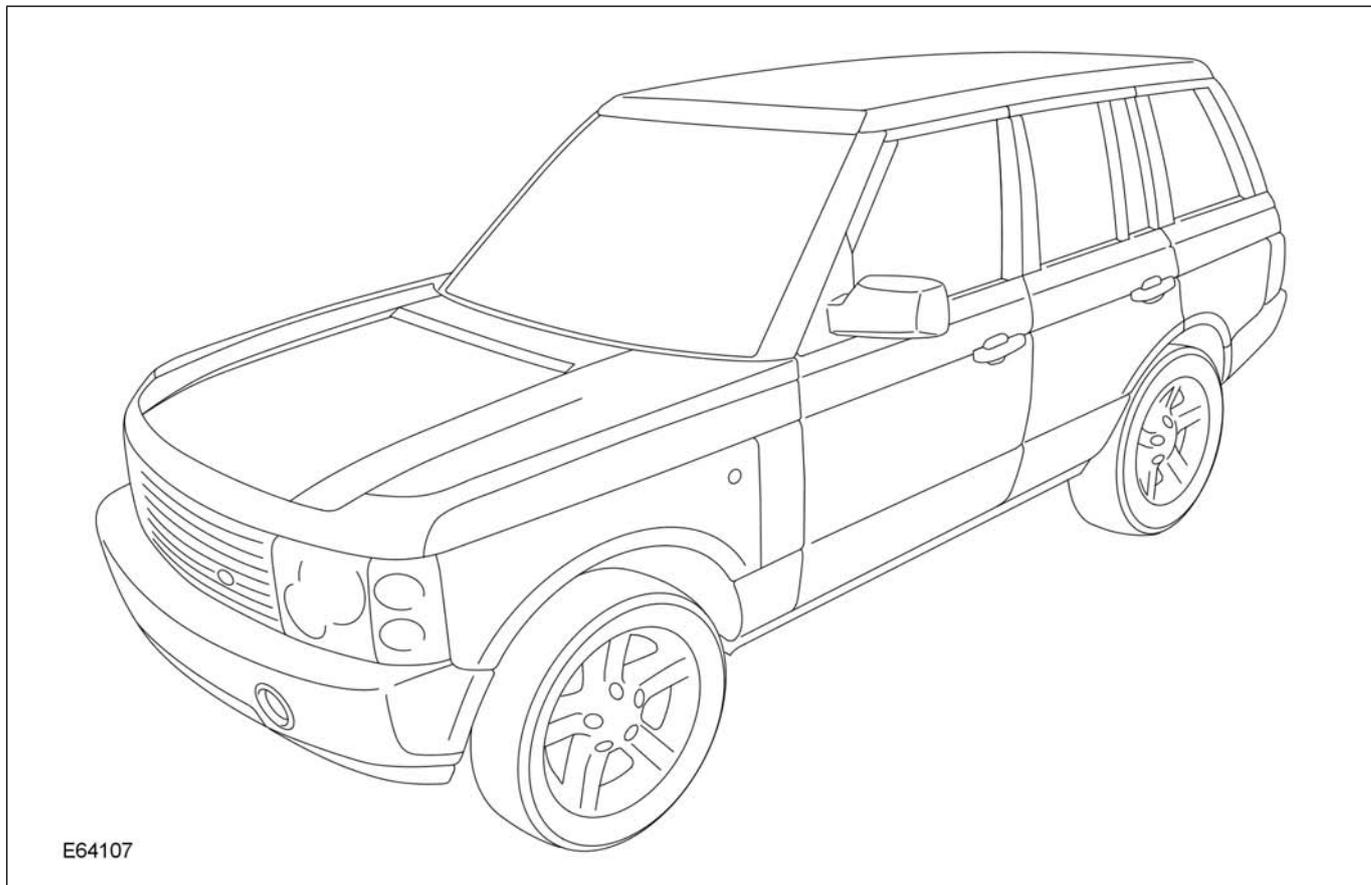
For air to enter an air spring (10), the inlet valve (7) must be energized together with the relevant air spring solenoid (9).

For air to be exhausted from an air spring (10), exhaust valve (8) must be energized together with the relevant air spring solenoid (9). All exhausted air passes through the air drier unit which purges moisture from the desiccant and regenerates the drier.

Air is finally exhausted through an air operated diaphragm valve (12) to atmosphere via a silencer (13) mounted below the valve block assembly.

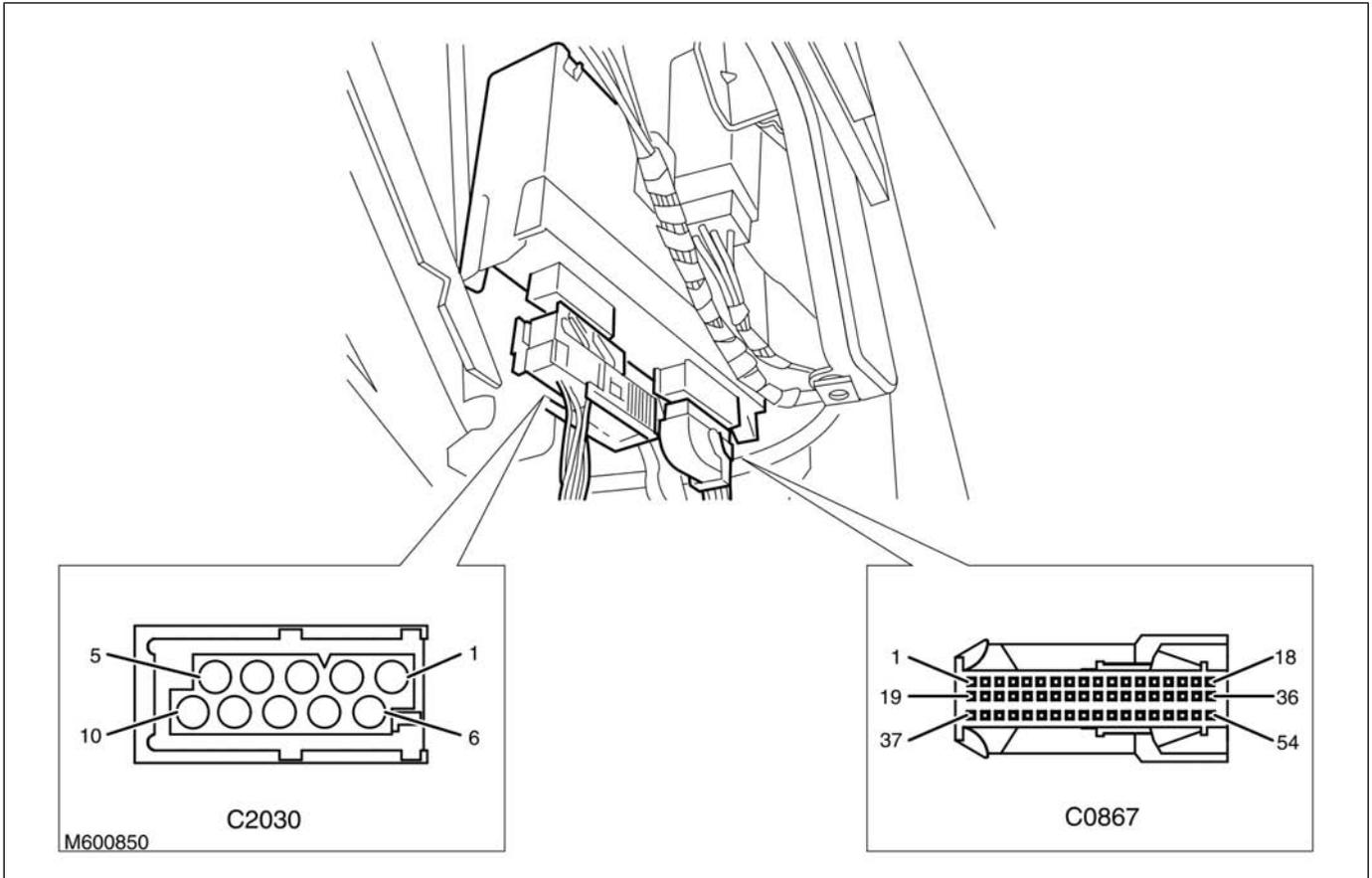
A pressure relief valve (11) is fitted and can be identified by its brass color and its location next to the green pressure switch (5) on the valve block.

RANGE ROVER (LM)



System Control

Air Suspension ECU



The air suspension ECU monitors the vehicle ride height through the use of four non contact type Hall effect height sensors up to VIN 174107 and from VIN 174108, four single track potentiometer type sensors.

The ECU has three modes of operation:

- Normal
- Periodic wake-up
- Transportation

When a service replacement air suspension ECU is fitted, the air suspension system will not function until configured with T4 diagnostic equipment.

Normal Mode

The air suspension ECU will enter normal mode when it receives a 'wake-up' signal from the Body Control Unit (BCU).

The BCU, located under the passenger front seat will provide the 'wake-up' signal when the following occurs:

- A door is opened
- Vehicle is remote unlocked
- The ignition is switched on

The BCU will continue to supply the 'wake-up' signal for 15 minutes after the ignition is switched off.

The air suspension ECU will then remain active for a further 10–15 seconds to enable any new data to be written to its Electronic Erasable Programmable Read Only Memory (EEPROM).

System Wake-Up

If the BCU has supplied a 'wake-up' signal, but the ignition is in the off position, the air suspension ECU will enter an Inactive Mode.

Under these circumstances, air suspension functionality is reduced.

However, the air suspension ECU will continue to monitor vehicle ride height and make any necessary adjustments.

All ride height selections made by the rotary switch will be ignored and therefore the ECU will not illuminate the LED's or allow the compressor to fill the reservoir.

However, if the pressure in the air reservoir falls below 9 bar (130 psi) the ECU will power the compressor to raise the vehicle to the current height.

Ignition On

If the ignition is switched on but the engine is not running, the air suspension ECU will continue to monitor vehicle ride height and make any necessary adjustments.

Downward ride height selections made via the rotary switch will be accepted, and the LED's will illuminate as normal.

Upward ride height selections made via the rotary control switch will be rejected, but the ECU will allow the vehicle height to increase to return the vehicle to the current ride height, e.g. if a load has been added to the vehicle.

These height changes are made using the air suspension reservoir providing the available air pressure is more than 9 bar (130 psi).

If the air pressure is less than 9 bar (130 psi) the compressor is used for height changes.

Filling of the reservoir remains inhibited as per ignition off status.

Periodic 'wake-up' Mode

When the 'wake-up' signal is removed by the BCU, the air suspension ECU powers down.

The air suspension ECU will wake-up approximately every six hours and level the vehicle height if required.

The air suspension ECU will determine which corner is lowest and adjust the remaining corners to the same level.

This action takes approximately 6–10 seconds to perform.

The air suspension ECU will then remain active for further 10–15 seconds to enable any new data to be written to its EEPROM.

NOTE: The air suspension ECU will not raise the vehicle during the wake-up mode.

If the air suspension ECU fails to level the vehicle, i.e. an obstruction beneath the vehicle for example, the periodic 'wake-up' mode will be suspended until the air suspension ECU receives a 'wake-up' signal from the BCU.

Transportation Mode

To enable the vehicle to be delivered safely from the factory to the dealership, the air suspension system is set in transportation mode.

When the engine is running, the ride height will be set at 'Transportation High', (this is the same as standard ride height).

All four LED's will illuminate in a sequence being at the top and travel downwards to indicate that Transport mode is active.

When the engine is not running, the air suspension ECU will drop the ride height by 60 mm to 'Transportation Low'.

When the ride height is at 'Transportation Low' the vehicle can be lashed to a transporter, without the risk of straps loosening due to ride height lowering.

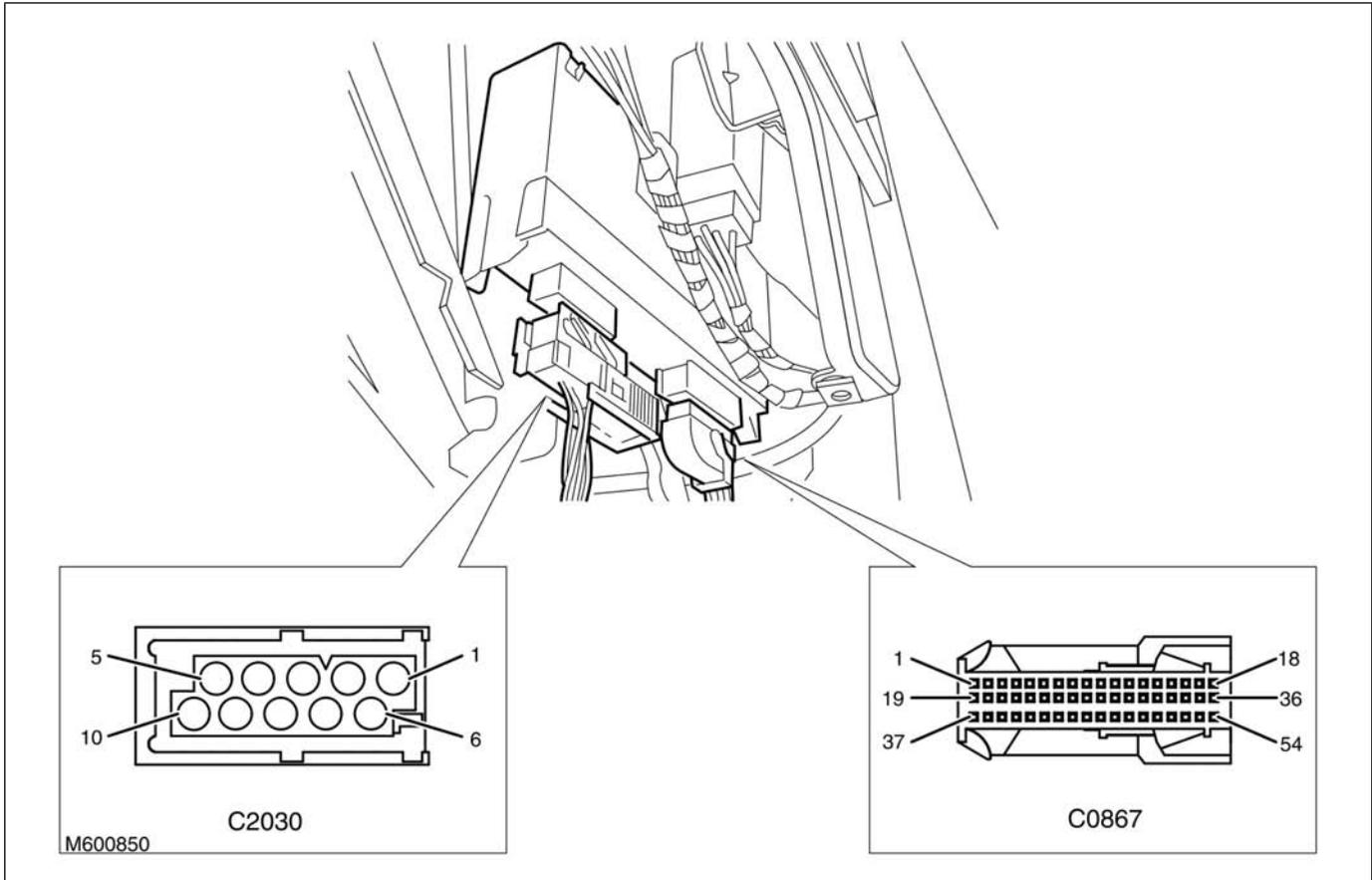
Transportation Low is 20 mm below access mode at 680 mm

Vehicle Height Table

Speed	Height Mode	Vehicle Height	Comments
<31 mph (49 km/h)	Off-Road Height	Front 800 mm Rear 790 mm	Fronts up 60 mm Rears up 50 mm
	Standard Height	740 mm	Also used for Transport High Mode
>62 mph (>99 km/h)	Motor way Height	720 mm	Reduction of 20 mm from Standard Ride Height (this is also the Default Ride Height)
	Access Height	700 mm	Reduction of 40 mm from Standard Ride Height
	Transport High	740 mm	Same as Standard Ride Height
	Transport Low	680 mm	Reduction of 60 mm from Standard Ride Height

ECU Harness Connectors

ECU Connectors



NOTES:

Pin Out Information Chart

DO NOT BACK PROBE SEALED CONNECTORS OR PIERCE WIRING INSULATION TO TAKE ANY VOLTAGE MEASUREMENT READINGS

Pin Out Data - C0867

Pin No	Description	Input or Output	Voltage Reading
1	Not used	-	-
2	CAN bus 'high'	Input/Output	2.5v
3	Control switch up selection	Input	12v /0v
4	Control switch hold selection	Input	12v /0v

Pin No	Description	Input or Output	Voltage Reading
5	Control switch Motor way ride height LED	Output	4.0v /1.4v
6	RHF corner valve control	Input	Gnd
7	RHF and LHF corner valves power supply	Output	12v
8	LHF corner valve control	Input	Gnd
9	RHR corner valve control	Input	Gnd
10	RHR and LHR corner valve power supply	Output	12v
11	LHR corner valve control	Input	Gnd
12	Reservoir control valve	Input	Gnd
13	Reservoir valve power supply	Output	12v
14	Exhaust pilot valve power supply	Output	12v
15	Exhaust pilot valve control	Ground	Gnd
16	Air suspension relay control	Output	12v
17	High pressure exhaust valve power supply	Output	12v
18	Not used	Not used	Not used
19	Not used	Not used	Not used
20	CAN bus 'low'	Input/Output	2.5v
21	Control switch down selection	Input	12v /0v
22	Control switch off-road ride height LED	Output	4.0v /1.4v
23	Control switch access ride height LED	Output	4.0v /1.4v
24	RHF height sensor signal	Input	0.5v /4.5v
25	LHF height sensor signal	Input	0.5v /4.5v
26	RHR height sensor signal	Input	0.5v /4.5v
27	LHR height sensor signal	Input	0.5v /4.5v

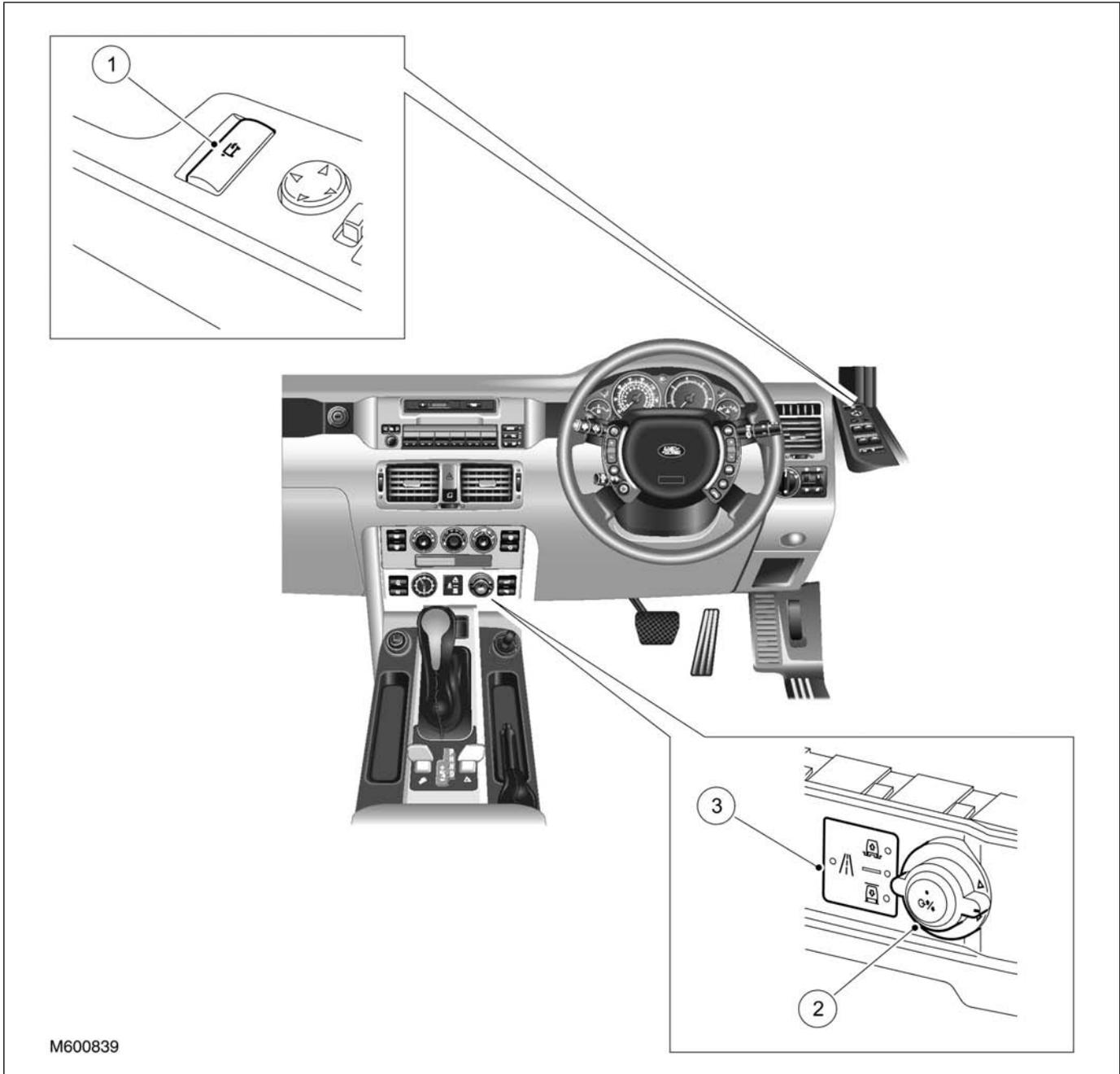
Pin No	Description	Input or Output	Voltage Reading
28	Air pressure sensor signal	Input	0.5v /4.5v
29	Not used	Not used	Not used
30	Not used	Not used	Not used
31	Temperature sensor	Output	12v O/C (3.6v @ 22°C)
32	LHF height sensor power supply	Output	5v
33	RHF height sensor power supply	Output	5v
34	Air pressure sensor power supply	Output	5v
35	High pressure exhaust valve control	Ground	Gnd
36	Not used	Not used	Not used
37	'K' bus	Input/Output	12v
38	Wake-Up signal	Input	12v /0v (time period)
39	Ride height switch (driver's door module)	Input	12v /0v
40	Control switch standard ride height LED	Output	4.0v /1.4v
41	Control switch inhibit LED illumination	Output	4.0v /1.4v
42	RHF height sensor ground	Ground	Gnd
43	LHF height sensor ground	Ground	Gnd
44	RHR height sensor ground	Ground	Gnd
45	LHR height sensor ground	Ground	Gnd
46	Air pressure sensor ground	Ground	Gnd
47	Not used	Not used	Not used
48	Not used	Not used	Not used
49	Temperature sensor ground	Ground	Gnd
50	RHR height sensor power supply	Output	5v
51	LHR height sensor power supply	Output	5v
52	Gnd	Gnd	Gnd

Pin Out Information Chart**Pin Out Data - C2030**

Pin No	Description	Input or Output	Voltage Reading
1	Not used	Not used	Not used
2	Front cross link valve ground	Ground	Gnd
3	Rear cross link valve ground	Ground	Gnd
4	Not used	Not used	Not used
5	Ground	Ground	Gnd
6	Not used	Not used	Not used
7	Rear cross link power supply	Output	12v
8	Front cross link power supply	Output	2v
9	Not used	Not used	Not used
10	Battery power supply	Input	12v

Operating Modes

Control Switch



M600839

Item	Description
1.	Ride height selector
2.	Ride height selector indicator panel
3.	Suspension inhibit switch
4.	Drivers door Access Switch

Modes of Operation

The air suspension ECU is able to provide four different ride height settings:

- Off-Road
- Standard
- Motorway
- Access

The ride heights are selected via the rotary control switch mounted on the center console.

Rotating the switch upwards or downwards selects a different ride height, providing all the outlined required criteria have been met.

The center of the rotary switch contains the 'Inhibit/Hold' switch.

The 'Inhibit/Hold' switch prevents the air suspension ECU from automatically changing from the currently selected ride height.

LED Illumination

Next to the rotary control switch are mounted a series of four LED's.

An illuminated LED indicates which ride height is active.

If a new ride height is selected using the rotary control switch, the 'current' height LED remains illuminated and the 'requested' height LED flashes until the vehicle achieves the new ride height.

If a new ride height is selected using the rotary control switch and the 'current' height LED flashes briefly, this indicates that the ride height selection is invalid and will not be performed.

When the operating parameters are correct for the new ride height, the height change request must be repeated.

Standard Height

Standard ride height '740 mm' is used during the majority of driving conditions.

This setting is used as a datum point for all the remaining ride heights, and is defined as '0 mm'.

All other ride height settings are described as above or below this setting.

The standard ride height setting can be active at any vehicle speed.

Access or off-road ride height can be selected from the standard ride height using the rotary control or the driver's door module access switch.

When the vehicle is in standard ride height, the 'Inhibit/Hold' switch can be selected.

The use of this switch prevents automatic height changes from taking place and disables manual height changes until the 'Inhibit/Hold' switch is de-selected.

If a height change is selected with the 'Inhibit/Hold' function active, the standard ride height LED will flash.

When towing, the electrical connection of the trailer socket will cause the vehicle to set the air suspension to standard ride height.

No other ride height setting is available whilst towing.

Off-Road Height

Off-Road ride height is the highest of the selectable settings, and raises the front of the vehicle by 60 mm and the rear of the vehicle by 50 mm from the standard ride height.

Off-Road ride height is selected by turning the rotary control switch upwards when the vehicle is traveling at less than 31 mph (49 km/h).

The suspension will return to the standard ride height setting if the rotary switch is turned downwards, or the vehicle speed rises above 31 mph (49 km/h).

If the vehicle is traveling too fast when Off-Road ride height is selected, the Standard ride height LED will flash, and the request will not be carried out.

The driver must repeat the Off-Road ride height request once the vehicle speed has been reduced.

When the vehicle is in the Off-Road height setting, the 'Inhibit/Hold' switch will not be operational.

Similarly, if the vehicle is in the Standard ride height setting with 'Inhibit/Hold' selected, the vehicle will not move in to the Off-Road height setting until 'Inhibit/Hold' is de-selected.

Motorway Ride Height

Motor way ride height lowers the vehicle by 20 mm from the standard ride height setting (740 mm) and improves the high speed handling of the vehicle.

Motor way ride height is only active when the vehicle is traveling at more than 62 mph (99 km/h) for more than 30 seconds.

The function is automatic and not selectable by the driver.

If the vehicle speed falls below 43 mph (69 km/h) for more than 60 seconds, the ECU automatically returns the vehicle back to the standard ride height setting (740 mm).

If the vehicle stops while the Motor way ride height is active, the timer is paused, stopping the vehicle rising un-necessarily.

Although Motor way ride height is not selectable by the driver, the Inhibit/Hold switch can be used to keep the Motor way ride height active, thus preventing automatic return to the standard ride height setting.

The vehicle will return to the standard ride height setting once the Inhibit/Hold switch is de-selected, and the vehicle speed is below 43 mph (69 km/h).

Motor way ride height may be de-selected by the driver at any speed by turning the rotary control switch upwards.

The vehicle may return to Motor way ride height if the vehicle speed remains greater than 62 mph (99 km/h) and the driver does not select Inhibit/Hold when the vehicle returns to standard ride height.

If the vehicle speed is within the required parameters, the driver can select access ride height by turning the rotary switch downwards or pressing the access switch on the driver's door.

Access Ride Height

Access ride height lowers the vehicle by 40 mm from the standard ride height setting when the vehicle is stationary or moving at very low speeds in order to improve access to the vehicle.

Access ride height can be selected by operating the access switch either on the driver's door module or the rotary control switch downwards when the vehicle is in standard, off-road or Motor way ride heights.

Access Modes

Access ride height has three different modes of operation:

- Access height
- Access pre-select
- Crawl mode

Access Height

If the vehicle is stationary or traveling at less than 15 mph (24 km/h) Access Height mode can be selected.

Should the vehicle speed increase to more than 18 mph (29 km/h) the vehicle automatically returns to the standard ride height setting.

Access Pre-Select

If the vehicle is traveling below 49 mph (78 km/h) and access height is selected, the vehicle enters the 'Access Pre-Select' mode.

The ECU acknowledges this request by flashing the 'Access' LED, but the height of the vehicle does not change immediately.

If the vehicle is traveling above 49 mph (78 km/h) and access height is selected, the 'Standard' LED will flash and the request will be denied.

When access pre-select mode is active, the vehicle will automatically lower to Access ride height if the speed drops below 15 mph (24 km/h) within 65 seconds of the request being made.

If the vehicle speed rises to above 49 mph (78 km/h) after 'Access Pre-Select' mode has been selected, or if it takes longer than 65 seconds to come to a rest, access ride height will not be activated and the vehicle will remain at its current height.

Crawl Mode

Crawl mode does not change the vehicle height, but inhibits all automatic and manual height changes and allows the vehicle to be driven at a higher speed than normal in access mode.

If the vehicle is in the Access ride height mode, and the Inhibit/Hold function is selected, 'Crawl' mode is activated.

If the vehicle is waiting to initiate the change to Access ride height mode (due to road speed being above the allowed parameter) when the request is made, the pre-selected access request is cancelled and the vehicle returns to standard ride height.

The Inhibit/Hold button remains active so that all automatic and manual height changes are disabled.

Crawl mode allows the vehicle to be driven at speeds up to 25 mph (40 km/h) without returning to the standard ride height setting.

If the vehicle speed reaches 22 mph (35 km/h), a chime will sound from the instrument pack sounder and the message center will display a 'SLOW DOWN' warning message.

If the vehicle exceeds 25 mph (40 km/h), crawl mode is cancelled and standard ride height will become active automatically.

Inhibit Features

A number of conditions exist where a change in ride height would be undesirable.

To counter this, the air suspension ECU is programmed with a number of system inhibits.

If any of the following conditions exist, the air suspension ECU will suspend height changes and height corrections.

Compressor Inhibit

A temperature sensor located within the compressor protects the compressor from overheating.

If the compressor temperature rises above set limits, the ECU will inhibit compressor operation.

The limits are shown in the following table:

	Filling Reservoir	Height Regulation
Stop	100°C (212°F)	110°C (230°F)
Start	80°C (176°F)	105°C (221°F)

Compressor Time-Out

Compressor operation will be halted after 180 seconds of continuous operation.

If the compressor was attempting to regulate system pressure, it remains inhibited for 20 seconds.

However, if the compressor was attempting to fill the reservoir, it remains inhibited for 180 seconds.

The time-out functions act as a further safe guard against over heating.

Cornering

If the air suspension ECU registers a cornering force greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the cornering force falls to less than 0.15g for 0.5 seconds.

The air suspension ECU receives a message from the ABS ECU on the CAN bus relating to cornering force.

Rapid Acceleration

If the air suspension ECU registers rapid acceleration greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid acceleration falls to less than 0.2g for 1 second.

Acceleration is calculated by the air suspension ECU from a vehicle speed signal received via the CAN bus.

Rapid Deceleration

If the air suspension ECU registers a rapid deceleration greater than -0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid deceleration rises above -0.2g for 1 second.

Deceleration is calculated by the air suspension ECU from a vehicle speed signal received via the CAN bus.

Axle Articulation

To avoid excess pressure differentials between different air springs, the air suspension ECU will inhibit all height changes and corrections if the axle articulation is greater than 350 mm.

The system will remain inhibited until axle articulation falls below 350 mm.

Vehicle Lift

The air suspension ECU will inhibit all height changes and corrections if it detects all four corner heights are greater than 90 mm.

This is interpreted as the vehicle being on a wheel free lift with all wheels hanging freely.

In this situation, the corner heights will not change when air is released from the air springs.

The system will remain inhibited until any of the following conditions exist:

- All four corners fall below 90 mm
- The rotary switch is moved to the 'Up' or 'Down' position
- Vehicle speed rises to greater than 25 mph (40 km/h) for longer than 3 seconds

Vehicle Jacking

The air suspension ECU will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 3 seconds.

This is interpreted as the corner identified is moving too slowly due to being supported on a car jack.

In this situation, the corner height will not change when air is released from the air spring because the car jack acts as a mechanical prop.

The system will remain inhibited until any of the following conditions exist:

- The height of the wheel identified as lowering too slowly, returns to the height where jacking was detected
- The rotary switch is moved to the 'Up' or 'Down' position
- Vehicle speed rises to greater than 25 mph (40 km/h) for longer than 3 seconds

Maximum Run Time

The maximum amount of time the valves within the 5-way valve block can be open is 33% in 300 seconds.

Door Open

The air suspension ECU will stop all height change requests while any of the doors are open.

Vehicle leveling is also inhibited with any door open.

Trailer Mode

Using the Land Rover electrical trailer kit will cause the air suspension to be set to the standard height setting.

If the vehicle is at any other height when the trailer is connected, the air suspension will adjust to the standard height setting and stay in that mode until the trailer is disconnected.

System Operation Review

Under normal operating conditions, the air suspension ECU will keep the vehicle level at the 'current ride height'.

Filters

The incoming height sensor signal from each of the corner height sensors are passed through filters to remove irregular signals produced by road noise or other irregularities.

Fast Filter

When the vehicle is stationary or a height change is in progress, the signals are passed through a 'fast' filter.

The 'fast' filtered signals track the true rate of height change when the vehicle height changes and can also remove road noise when the vehicle is driving.

Slow Filter

When the vehicle is moving, the signals are passed through a 'slow' filter.

The 'slow' filtered signals remove almost all road noise from the signals and outputs a true long term average for each corner height.

The 'slow' filtered signals cannot be used to respond to quickly changing ride height changes.

ECU Monitoring

The air suspension ECU monitors each corner height signal using the fast filtered signals if the vehicle is stationary or the slow filtered signals if the vehicle is moving.

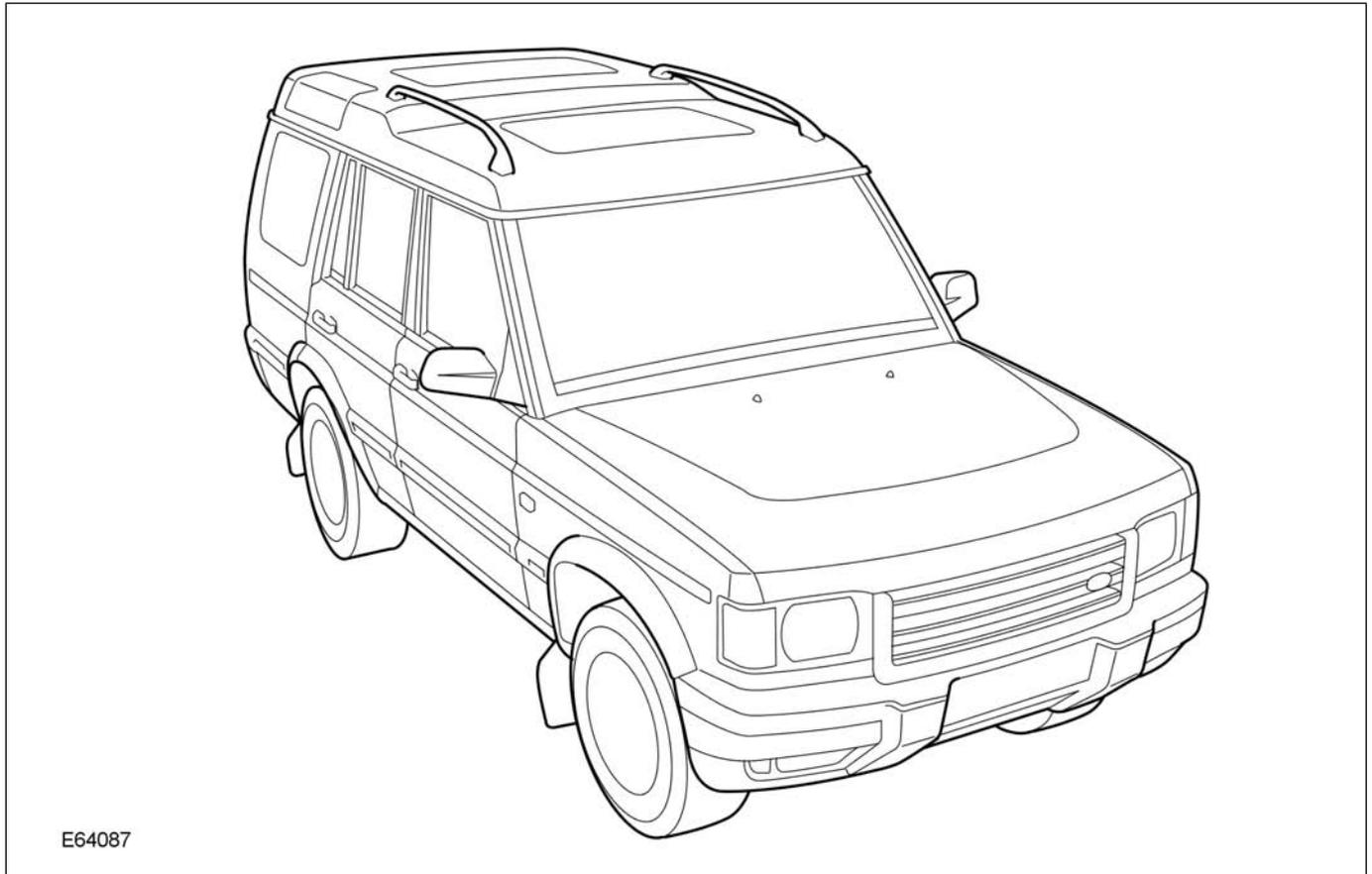
If the height remains in a 'dead band' which is ± 10 mm from the target height, the ECU does not implement any height adjustment changes.

When the ECU detects that a corner has moved outside of the 'dead band' the ECU operates the compressor and/or the valves to raise or lower the corresponding corner(s) back into the target height.

When the engine is not running, the 'dead band' target height tolerance is increased to ± 20 mm.

In all cases, the ECU will bring the corner height as close as possible to the target height.

The ECU monitors the rate of height change from the corner signals to predict when to close the valve so that the target height does not over shoot.

DISCOVERY SERIES II**System Control**

The leveling system is capable of lowering the rear suspension to within 20 mm of the target height for up to 30 minutes after a door has been opened.

This allows the suspension to be leveled as the vehicle is unloaded.

With the exception of this unloading function, all other leveling functions are disabled if the doors are open while the vehicle is stationary.

The SLABS ECU will disable all leveling activities if the height sensors indicate that the rear suspension is articulated more on one side than the other by more than 100 mm above its target ride height.

The SLABS ECU monitors the signals from the height while it is changing the rear ride height.

If the rear ride height is not changing as the SLABS ECU expects it to, then all valve and compressor activity will be halted.

If the vehicle is moving at a speed greater than 3 mph (5 km/h) when this happens, a fault will be logged in the ECU.

Full functionality will be re-enabled when the expected movement is seen, or when the target ride height is changed, e.g. by selection of the off-road mode or by use of the plip function.

The SLABS ECU monitors the use of the compressor and the control valves.

If these components are being over used then they are disabled to allow them to cool down, and an event code is stored in the ECU for interrogation by T4 diagnostic equipment.

If the SLABS ECU decides that the compressor or the valves are being over-used, the leveling behavior of the system may become erratic.

Malfunction Lamp

The SLS system has two information lamps in the instrument pack.

Situated in the bottom left of the instrument pack is the first amber warning lamp.

Malfunction Lamp



If this lamp is continuously illuminated, it indicates that either a malfunction has been detected or that the transit function is set.

If the lamp flashes then either the plip function is being used or the transit function is raising the rear suspension.

Off-Road Lamp

The second amber warning lamp is situated in the top right of the instrument pack.

This is the off-road warning lamp.

Off-Road Lamp



If the off-road lamp is continuously illuminated, it indicates that the self leveling suspension is in off-road mode.

If the off-road lamp flashes, this indicates that the SLS is between the standard ride height and the off-road mode, or that the vehicle is in extended mode.

Warning Control

The SLABS ECU controls the operation of the SLS audible warning, the SLS warning lamp and the off-road mode warning lamp.

When the ignition is switched to position two, the ECU performs a three second bulb check and illuminates the SLS and off-road mode warning lamps in the instrument pack as a bulb operation check.

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 in the rear of the instrument pack.

Operational Modes

The self leveling suspension has several different modes of operation.

These modes of operation are as follows:

- Extended mode height
- Off-Road mode
- Standard ride height
- Transportation mode

Select - Off-Road Mode

To provide the vehicle in off-road conditions with additional height, an off-road mode is employed.

Activating the off-road mode requires a press of the self leveling switch on the fascia for a minimum of 0.5 second.

A single audible warning from behind the instrument pack will be given.

On release of the switch the off-road warning lamp on the instrument pack will flash, indicating a change of ride height.

When the vehicle is at the off-road target height, the lamp will stop flashing and remain illuminated.

Exit - Off-Road Mode

To exit the off-road mode, press the self leveling switch for a minimum of 0.5 second.

An audible warning from behind the instrument pack will sound once.

On release of the fascia switch, the warning lamp will flash and the system returns the rear suspension back to the standard ride height setting.

Off-Road Mode Speed

Off-Road mode can only be selected if: the vehicle speed is below 19 mph (30 km/h), all doors are closed (if the vehicle is stationary), the engine is running and the rear axle has less than 100 mm of articulation.

If any of these conditions are not satisfied, the audible warning will sound three times and the off-road warning lamp will extinguish when the switch is released.

Off-Road Heights

The off-road height setting is 100 mm from the bump stops on the chassis to the axle.

The vehicle will return automatically to the standard setting of 60 mm from the axle bump stops if the vehicle speed exceeds 19 mph (30 km/h).

Whilst returning to the standard height setting the warning lamp will be flashing and an audible warning sound will be emitted.

Off-Road mode can only be de-selected if all the doors are closed (if the vehicle is stationary) and the rear axle has less than 100 mm of articulation.

If any of these conditions are not satisfied, the audible warning will sound three times and the off-road warning lamp will remain illuminated when the switch is released.

Extended Mode

This mode is not selectable by the driver.

Extended mode operates only under the direct control of the SLABS ECU.

Extended mode operation will only occur when the SLABS ECU detects the chassis is grounded and the rear wheels are turning with a vehicle speed less than 6 mph (9 km/h).

This function is employed to increase the rear suspension height to clear an obstacle.

Under extended mode conditions the compressor will operate for 25 seconds.

The SLS warning lamp (top right of instrument pack) will flash at a different rate: 75% ON, 25% OFF.

This function will be cancelled if the vehicle exceeds speeds of more than 8 mph (13 km/h) or if the fascia switch is pressed for a minimum of 0.5 seconds.

Transportation Mode

The self leveling suspension has a transportation mode function.

This function should be used whenever the vehicle is to be transported on a trailer and is lashed down using the chassis frame.

Transportation mode can only be enabled and disabled using T4 diagnostic equipment.

The transportation mode function is to lower the rear suspension onto the bump stops, when the engine is not running.

In this condition, the malfunction warning lamp (left lower corner of instrument pack) will be illuminated continuously if the ignition is in position two.

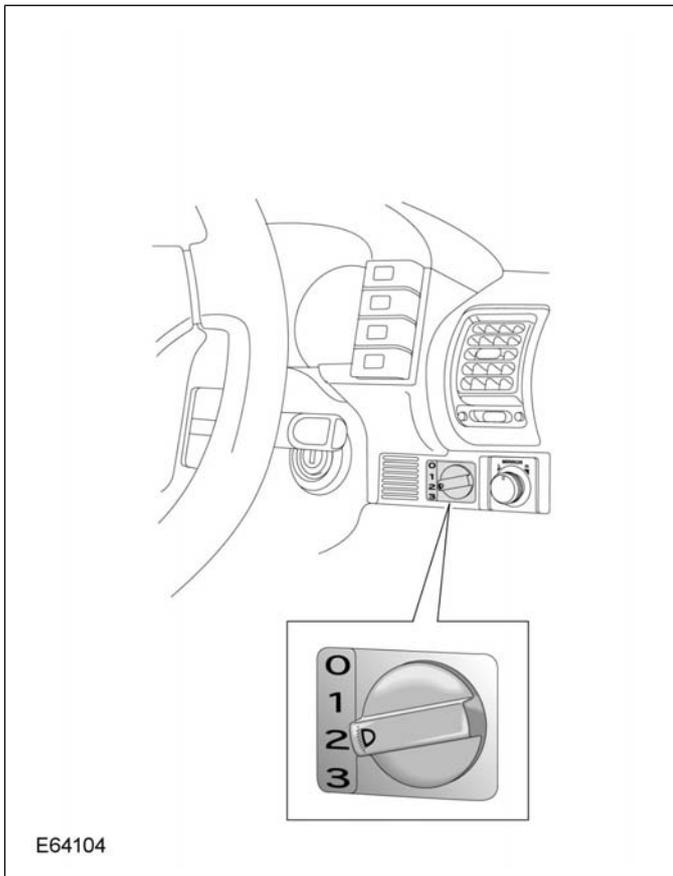
When the engine is running, the transportation function raises the rear suspension until a gap between the chassis mounted bump stops and axle is 25 mm.

In this condition, the malfunction warning lamp (left lower corner of instrument pack) will flash while the suspension is rising, then it will be illuminated continuously when the 25 mm bump stop gap has been achieved.

Headlamp Adjuster

Discovery Series II features a headlamp leveling switch located on the vehicle fascia panel.

Headlamp Level Switch



The switch adjusts the headlamp setting to the driver's preference, i.e. if the driver has chosen manually to raise the vehicle into off-road mode, the headlamp aim can be re-adjusted to provide maximum illumination.

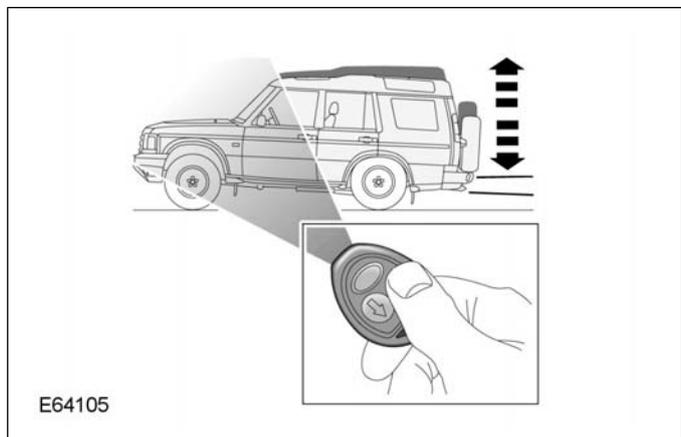
When the SLABS ECU has leveled the rear suspension, the driver can then set the headlamps to suit the driving requirement.

This is especially useful when towing, as the vehicle's pivot point will cause the headlamps to rise at the front due to the weight pulling down on the rear of the vehicle.

The remote plip feature is available as an optional accessory.

A dedicated air suspension remote transmitter allows the driver to stand outside the vehicle and adjust the height to match that of a trailer hitch for hitching and un-hitching the trailer.

Remote Operation



This enables the rear vehicle height to be controlled between standard ride height and bump stop height.

This option is purchased from the dealer and has to be configured using T4 diagnostic equipment.

RF Receiver

The remote transmitter transmits RF signals which are received by the same RF receiver used for the alarm and remote door locking system (located in the headlining rear of sunroof).

The RF receiver passes this data as a 25 Hz PWM signal to the BCU (located behind passenger glove box).

The BCU then transmits this data to the SLABS ECU to raise or lower the vehicle as required.

If point required is overshoot then the engine will require running to raise the vehicle up.

Remote Preliminary

To operate the remote transmitter the ignition must be in position two and all door must be closed.

The vehicle must be stationary and the self leveling suspension should be at the standard ride height.

Remote Lowering

Pressing the lower button on the plip will allow the suspension to be lowered up to 60 mm below the standard ride height setting.

Remote Raising

Pressing the raise button on the remote transmitter will allow the vehicle to raise up to the standard ride height setting.

Remote Operation

If either button on the remote transmitter is released during the remote operation then the suspension height will freeze at whatever height it is currently positioned.

Warnings

A warning will be issued whilst undertaking the operation of modifying the suspension height in response to the remote transmitter signal.

The SLS warning lamp (located top right of instrument pack) will flash and an audible warning sound is emitted.

Remote Feature - Exit

The rear suspension height will automatically return to the standard ride height setting.

This is provided the vehicle speed exceeds 3 mph (5 km/h) for longer than 5 seconds, or instantly if the speed exceeds 7 mph (11 km/h).

Door Switches

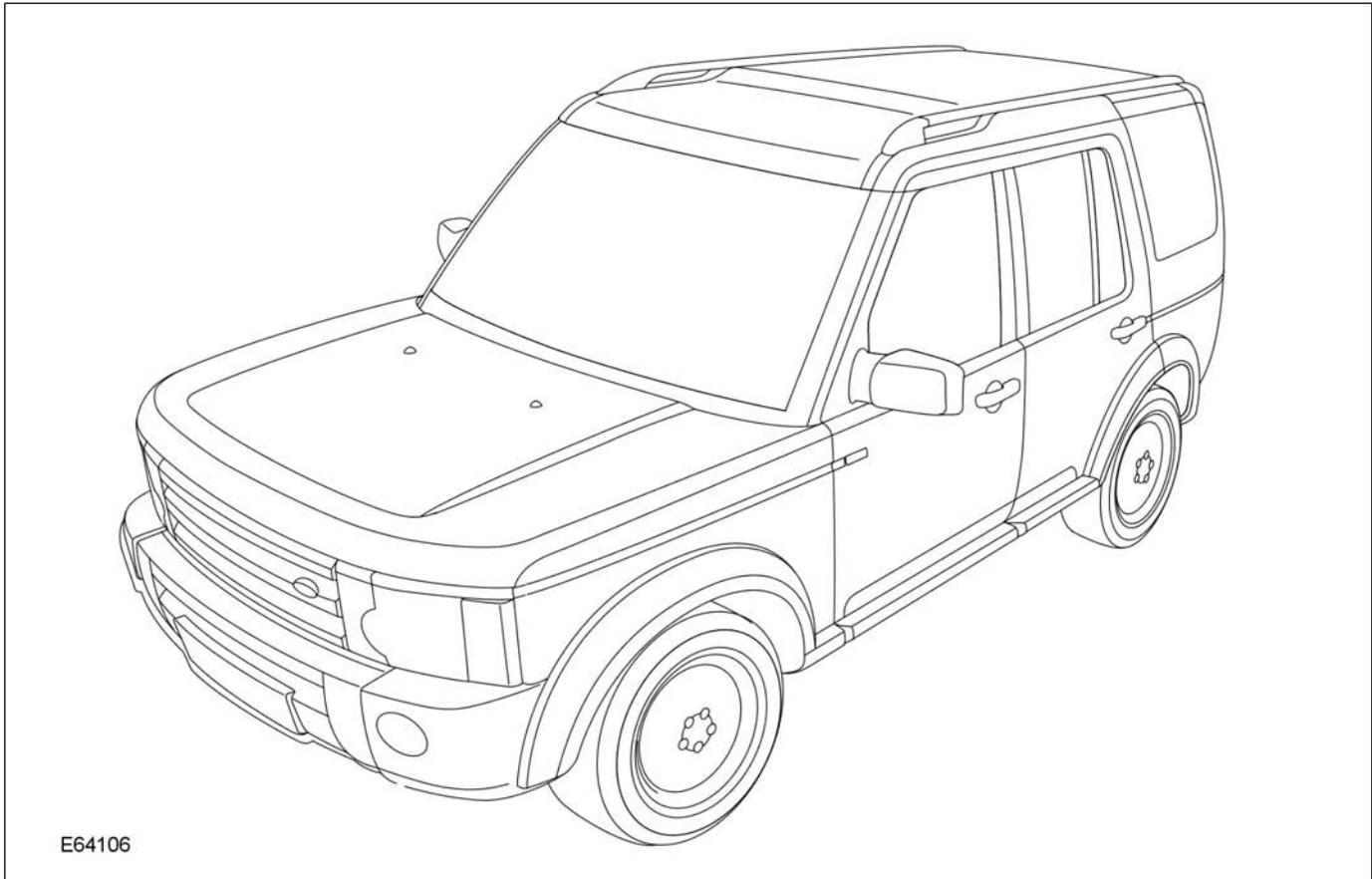
The driver, passenger and rear entry door switches are important in the operation of the self leveling suspension system.

The leveling system will not operate if the SLABS ECU detects that the vehicle is stationary and a door is open.

Within the SLABS ECU the driver's door switch and the passenger door switches are connected together.

Therefore, the SLABS ECU cannot determine which is open, or if more than one door is open.

DISCOVERY 3 / LR3

**System Control**

The driver can manually select, using the air suspension switch, one of four ride states:

- **ON-ROAD** - this height is the normal operating height of the vehicle
- **OFF-ROAD** - this height is higher than the on-road height and provides improved ground clearance, approach, departure and break over angles
- **ACCESS** - this height is lower than the on-road height and makes vehicle entering and exiting easier for the occupants
- **CRAWL (locked at access)** - this mode allows the vehicle to be driven at the access height at low speeds to provide increased roof clearance in low car parks, etc
- **TRANSPORTATION** - this mode is made available, but it is only selectable or removable using the T4 diagnostic equipment
- **REMOTE** - this additional function allows the vehicle to be raised or lowered from outside of the vehicle whilst the vehicle is stationary. This assists with the attachment of a trailer and is achieved using the buttons on the remote handset and the ignition switch in the off position. The remote handset can also be programmed to perform a number of additional functions, however the previous feature will be overwritten
- **EXTENDED** - if the air suspension control module senses that the vehicle has grounded and lost traction, the control module can temporarily increase and/or redistribute the volume of air supplied to the affected air spring(s) to maximize the available traction. This

is known as extended mode and will be indicated to the driver by the lamps on the air suspension switch flashing.

Height Change Restrictions

If the air suspension control module senses that the vehicle is prevented from moving upwards or downwards during a height change or leveling correction, the control module will adopt a safe state and further height changes will be suspended.

NOTE: Vehicle height changes are prevented if the air suspension control module receives a 'Door Open' signal from the Central Junction Box (CJB).

If a fault is detected by the air suspension control module, the control module will reduce the system functionality dependent on the type and severity of the fault.

Fault Warnings

The control module will also store a fault code which can be retrieved using the T4 diagnostic equipment.

If a severe fault occurs, the control module will attempt to put the vehicle in a safe condition.

A fault condition is relayed to the driver by the illumination of the air suspension warning indicator, the instrument cluster message center and an audible warning emitted from the instrument cluster.

If the detected fault is minor and does not affect vehicle safety, the air suspension warning indicator in the instrument cluster will illuminate in an amber color and the fault should be rectified at the earliest opportunity.

If a more severe fault is detected above 31 mph (50 km/h) vehicle speed, the warning indicator will illuminate in a red color and the vehicle should be driven with care until the fault is rectified.

An audible warning is emitted by the instrument cluster sounder when the warning indicator is illuminated.

The indicator will change to an amber color and the audible warning will stop when the vehicle speed is reduced.

On-Road Mode

This is the normal ride height for the vehicle.

Off-Road Mode

Off-road mode will only be activated if the vehicle speed is less than 25 mph (40 km/h).

The vehicle will be raised 55 mm (2.2 in) higher than the on-road height to provide additional body clearance and improved approach, departure and break over angles.

If the vehicle speed exceeds 31 mph (50 km/h), the air suspension control module will automatically lower the vehicle to the on-road mode height.

NOTE: The suspension can be automatically set to off-road mode via Terrain Response and low range programs are selected.

At 25 to 28 mph (40 to 45 km/h) a message is displayed to warn the driver to slow down or the vehicle will lower.

Access Mode

Access mode lowers the vehicle body height by 50 mm (2 in) and provides easier entry, exit and loading of the vehicle.

Access mode can be pre-selected when the vehicle is moving.

The vehicle will partly lower as the vehicle speed decreases, lowering to the full access mode height when the vehicle reaches 5 mph (8 km/h).

If the required road speed is not reached within a predetermined time, the air suspension will return the vehicle to the previously selected height.

Access mode can be selected at any vehicle speed.

Access Mode Speeds

When access mode is selected, the response from the air suspension system will depend on the vehicle speed.

The following speed ranges indicate the criteria and effects of using the control switch to make a height adjustment.

>12.5 MPH (20 KM/H)

- If the vehicle speed is greater than 12.5 mph (20 km/h) when the access mode switch position is selected, the air suspension control module will wait for up to one minute for the vehicle speed to be reduced
- The access mode lamp and the lowering lamp will flash while the air suspension control module waits for the vehicle speed to be reduced, the on-road mode lamp will remain illuminated
- If the vehicle speed is not reduced sufficiently, the access mode request will be cancelled after the one minute time threshold

<12.5 MPH (20 KM/H)

- If the vehicle speed is less than 12.5 mph (20 km/h) when the access mode switch position is selected, the air suspension control module will lower the suspension to a part lowered height and will remain at this height for up to one minute
- The on-road mode lamp will extinguish as the air suspension control module lowers the suspension to the part lowered height
- The access mode lamp and the lowering lamp will illuminate

- When vehicle part lowered is reached, the 'lower' lower lamp will flash
- If the vehicle speed is not reduced to less than 5 mph (8 km/h) in the one minute period, the access mode request will be cancelled

<5 MPH (8 KM/H)

- If the vehicle speed is less than 5 mph (8 km/h), the suspension will be lowered to access mode immediately
- The access mode lamp and the lowering lamp will illuminate
- When the access mode height is reached, the lowering lamp will be extinguished

Access height may be selected up to 40 seconds after the ignition is turned off, provided that the driver's door has not been opened within this time.

The suspension will automatically rise from access mode when the vehicle speed exceeds 6.2 mph (10 km/h).

If access mode was selected directly from off-road mode then the system will return to off-road mode when the vehicle speed exceeds 6.2 mph (10 km/h).

Otherwise the system will lift the suspension to On-road height.

Off Road - Access Mode Selection

When the suspension is in off-road mode height, pressing the air suspension switch once and then a second time before the lowering lamp is extinguished, the control module will lower the suspension to access mode height.

The control module will remember to return the suspension to off-road height automatically if the vehicle speed increases above 6.2 mph (10 km/h).

Crawl Mode

Crawl mode allows the vehicle to be driven at a locked access height.

This mode can be selected at a speed of less than 21.7 mph (35 km/h) and permits the vehicle to be driven at low speeds to improve clearance in areas with restricted headroom, i.e. car parks.

If the vehicle exceeds 24.8 mph (40 km/h), crawl mode will be cancelled and the vehicle will return to on-road height.

Selection of crawl mode is via the height selector switch and holding the switch in the down position for longer than 2 seconds.

The access mode lamp and the crawl mode lamp will be illuminated.

When the control module is in crawl mode, on-road mode height will be selected automatically if the vehicle speed exceeds 25 mph (40 km/h).

At 18.6 to 21.7 mph (30 to 35 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will raise.

Crawl mode can also be manually cancelled by moving the switch in the up direction for 1 second.

The access mode lamp and the crawl mode lamp will be extinguished.

Automatic Height Changes

When the suspension is in off-road mode, access mode or crawl mode height, the air suspension control module will change the suspension height automatically when the vehicle speed exceeds a predetermined threshold.

When the suspension is at off-road mode or crawl mode height, the control module issues a warning to advise the driver that the vehicle is approaching the speed threshold.

The instrument cluster sounder will emit a chime, a message will be displayed in the message center (if fitted) and the on-road mode lamp and either the raising or lowering lamp will flash.

The off-road or crawl mode height speed warning is removed when the vehicle speed is reduced.

Door Open Functionality

If one or more of the vehicle doors are opened during a height change when the vehicle is stationary, the air suspension control module will restrict any further height changes.

The door open signal is transmitted by the CJB on the HS CAN bus and received by the air suspension control module.

This keeps the vehicle level to the set height when a door opens to allow for changes in loading conditions.

A secondary hardwired door status signal is also transmitted from the CJB to the air suspension control module.

This signal provides door status information when the high speed CAN bus is off, i.e. during periodic re-leveling.

A hardwired door status signal is also transmitted from the CJB to the air suspension control module.

The lamp on the air suspension switch for the target mode height will remain illuminated and the raising or lowering lamp will flash.

If all of the doors are closed within 90 seconds, the height change will resume.

If the 90 second period is exceeded and all of the doors are not closed, the height change will be cancelled.

The mode lamps showing the previously selected height and the target height will be illuminated.

The mode height change can be re-selected by operating the switch, however, if the vehicle is driven at speed of more than 5 mph (8 km/h) the control module will continue to raise or lower the vehicle to the target mode height.

Extended Mode

If the vehicle becomes grounded and the traction control becomes operational, the air suspension control module automatically increases the mass of air in the air springs to raise the vehicle clear of the obstruction.

Extended mode is activated automatically and cannot be selected manually.

When the air suspension control module has activated the extended mode, the off-road mode lamp will flash if the suspension is above off-road mode height.

No specific height change figure is provided, this is because the system uses a time basis for extended height changes.

When the vehicle becomes grounded the height sensor information is not taken into account, i.e. mistrusted.

As the vehicle enters into traction control operation the air suspension system will keep applying more air to the offending corner air spring until traction is regained.

To exit the extended mode, press the air suspension switch briefly in the up or down position or drive the vehicle at a speed of more than 12.5 mph (20 km/h).

Warning Lamps

The off-road mode and on-road mode lamps will flash if the suspension is between off-road mode and on-road mode heights.

The on-road mode and access mode lamps will flash if the suspension is between on-road mode and access mode.

A message will also be displayed in the message center if fitted.

Suspension Prevented From Moving

If the air suspension control module is attempting to change the suspension height and it detects that the suspension is prevented from moving, the control module will stop all suspension movement.

This can be caused by:

- Jacking the vehicle
- Attempting to lower the vehicle onto an object
- Raising the vehicle against an obstruction

The air suspension switch lamps operate as described for extended mode and the same message is displayed in the message center if fitted.

To start the air suspension system operating, press the air suspension switch briefly in the up or down position or drive the vehicle at a speed of more than 12.5 mph (20 km/h).

Periodic Re-Leveling

When the vehicle is parked, the air suspension control module 'wakes up' two hours after the ignition was last switched off and then once every six hours.

The vehicle height is checked and if the vehicle is not level within a pre-set tolerance, small downwards height adjustments may be made automatically.

Transportation Mode

Transportation mode is a factory set mode which locks the suspension to enable the vehicle to be safely lashed to a transporter.

This mode can only be selected or deselected using the T4 diagnostic equipment.

When the ignition switch is switched off, the vehicle will be lowered onto the bump stops.

This ensures that the securing straps do not become loose should there be an air pressure reduction in the air springs.

When the engine is running, the air supply unit will operate to raise the vehicle height, allowing the vehicle to be loaded.

When the ignition switch is subsequently switched off, the vehicle will again lower onto the bump stops.

An audible warning will be emitted from the instrument cluster sounder until the vehicle has reached the higher transportation height.

CAN Inputs

The air suspension control module uses inputs received on the CAN bus from other systems on the vehicle.

The system uses data from the following listed components or systems to control the suspension operation in differing driving conditions.

- Longitudinal acceleration
- Lateral acceleration
- Steering angle
- Wheel speed data

The system will react differently if one or more of these data inputs is missing or incorrect.

As an example, if the steering angle sensor is missing or incorrect, the air suspension control module assumes a default value.

The default value is defined as zero and may result in some unnecessary leveling activity.

Air Supply Unit Relay

The air supply unit relay is located in the battery junction box in the engine compartment.

The relay is connected directly to the battery via fusible link 10E (60A).

The relay coil is connected to and controlled by the air suspension control module.

The relay is used by the air suspension control module to control the operation of the compressor.

When air supply unit operation is required, the air suspension control module supplies power and ground for the relay coil which energizes, closing the relay contacts.

This allows battery voltage via the fusible link to pass through the relay and operate the air supply unit electric motor and the compressor.

The battery voltage is also passed from the relay, via a splice joint in the harness, to the air suspension control module and is used as a signal that the air supply unit is receiving power.

System Inhibits

A number of conditions exist where a change of ride height would be undesirable.

To counter this, the air suspension control module is programmed with a number of system inhibits.

If any of the conditions detailed below exist, the air suspension control module will suspend height changes and height corrections.

Compressor Inhibit

The temperature sensors located within the compressor protect the compressor from overheating.

If the compressor temperature rises above set limits, the air suspension control module will inhibit the compressor operation.

These limits are shown in the following table:

Compressor Head Temperature Inhibit

	LIFTING	RESERVOIR FILLING
STOP	150°C (302°F)	140°C (284°F)
START	130°C (266°F)	120°C (248°F)

Compressor Brush Temperature Inhibit

	LIFTING	RESERVOIR FILLING
STOP	140°C (284°F)	130°C (266°F)
START	120°C (248°F)	110°C (230°F)

Cornering Inhibit

If the air suspension control module registers a cornering force greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the cornering force falls to less than 0.15g.

The air suspension control module receives a message from the lateral acceleration sensor (which is an integral part of the ABS yaw rate sensor) on the high speed CAN bus for the cornering force.

Rapid Acceleration Inhibit

If the air suspension control module registers a rapid acceleration greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid acceleration falls to less than 0.15g.

Acceleration is calculated by the air suspension control module from a vehicle speed signal received via the high speed CAN bus.

Rapid Deceleration Inhibit

If the air suspension control module registers a rapid deceleration smaller than -0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid deceleration rises above -0.15g.

Deceleration is calculated by the air suspension control module from a vehicle speed signal received via the high speed CAN bus.

Vehicle Jacking Inhibit

The air suspension control module will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 1.2 seconds.

This is interpreted as the corner identified as moving too slowly being supported on a jack.

In this situation, the corner height will not change when air is released from the air spring because the jack acts as a mechanical prop. The system will remain inhibited until any of the following conditions exist:

- The air suspension switch is moved to the up or down position
- Vehicle speed rises to more than 9.3 mph (15 km/h) for more than 15 seconds

Door Open Inhibit

The air suspension control module will stop all height change requests while any of the doors are open.

Vehicle leveling will still however continue with a door open.

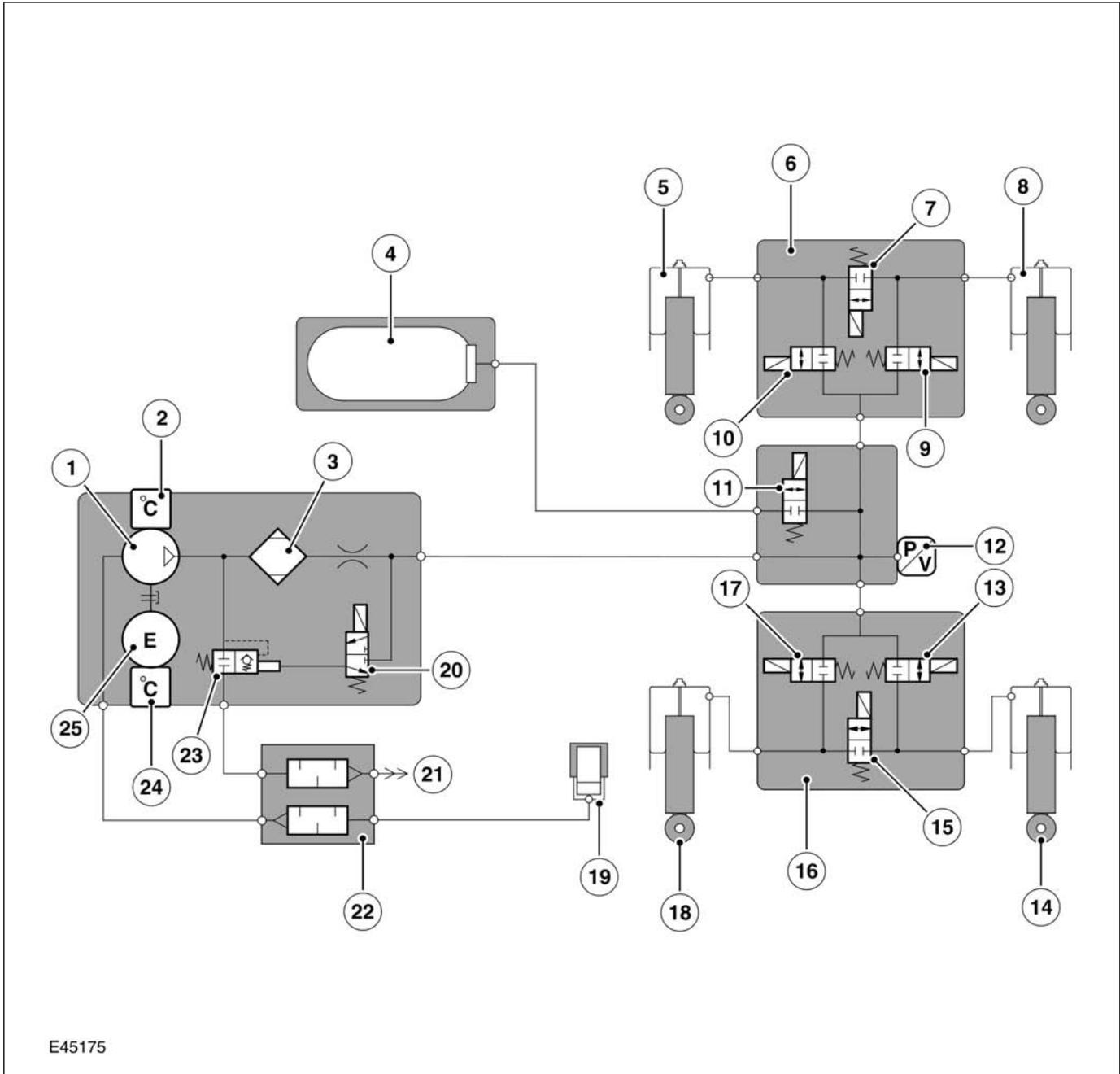
This leveling is restricted to keep the vehicle at the height when the door was opened, if the vehicle load changes.

Motorway Lowering

This function was not available at launch and has been introduced to the Discovery 3 / LR3 range of vehicles at what is known as Job1 plus 90 days, i.e. available on vehicles 90 days after the launch vehicles were released.

Pneumatic Schematic

Pneumatic Circuit



Pneumatic Circuit

Item	Description	Item	Description
1.	Compressor	14.	RH air spring damper module
2.	Compressor temperature sensor	15.	Cross link valve
3.	Air drier unit	16.	Rear valve block
4.	Reservoir	17.	Rear LH corner valve
5.	Front LH air spring damper module	18.	Rear LH air spring damper module
6.	Front valve block	19.	Inlet air filter
7.	Cross link valve	20.	Pilot exhaust valve
8.	Front RH air spring damper module	21.	Exhaust
9.	Front RH corner valve	22.	Air silencer
10.	Front LH corner valve	23.	Pressure relief and exhaust valve
11.	Reservoir control valve	24.	Motor temperature sensor
12.	Pressure sensor	25.	Electric motor
13.	Rear RH corner valve		

Spring Pressures

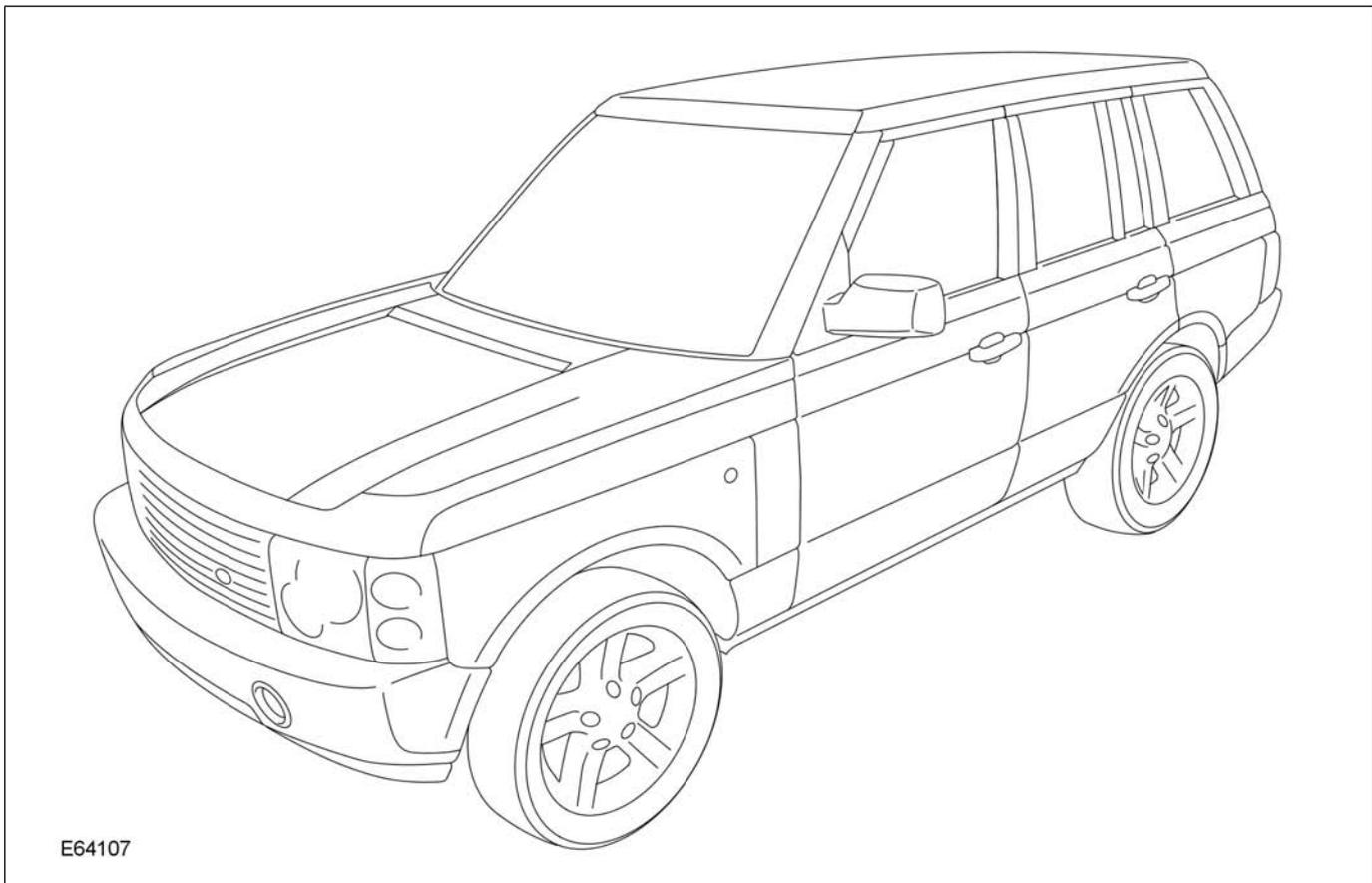
Air spring pressure depends on vehicle loading.

Nominal Pressure:

- Fronts 8.5 bar
- Rears 5.5 bar

GVW Pressure:

- Fronts 9.9 bar
- Rears 7.8 bar

2006MY Range Rover (LM)**System Control**

The driver can manually select, using the air suspension switch, one of four ride states:

- **ON-ROAD** - this height is the normal operating height of the vehicle
- **OFF-ROAD** - this height is higher than the on-road height and provides improved ground clearance, approach, departure and break over angles
- **ACCESS** - this height is lower than the on-road height and makes entering and exiting the vehicle easier for the occupants
- **CRAWL (Locked at access)** - this height allows the vehicle to be driven at the access height at low speeds to provide increased roof clearance in low car parks etc.

HIGH SPEED - A non-selectable, automatic high speed mode is provided which lowers the vehicle height to improve vehicle handling.

NOTE: Vehicle height changes are restricted if the air suspension control module receives a 'Door Open' signal from the Generic Electronic Module (GEM) and the speed is less than 5 mph (8 km/h).

An additional 'TRANSPORTATION' mode is also available but is only selectable using T4. When this mode is active most vehicle systems, in addition to the air suspension, are inhibited or restricted to a minimal functionality.

If the air suspension control module senses that the vehicle has grounded and lost traction, the control module can temporarily increase and/or redistribute the volume of air supplied to the affected air spring(s) to

maximize the available traction. This is known as extended mode and will be indicated to the driver by the lamps on the air suspension switch flashing.

If the air suspension control module senses that the vehicle is prevented from moving upwards or downwards during a height change or leveling correction, the control module will adopt a safe state and further height changes will be suspended.

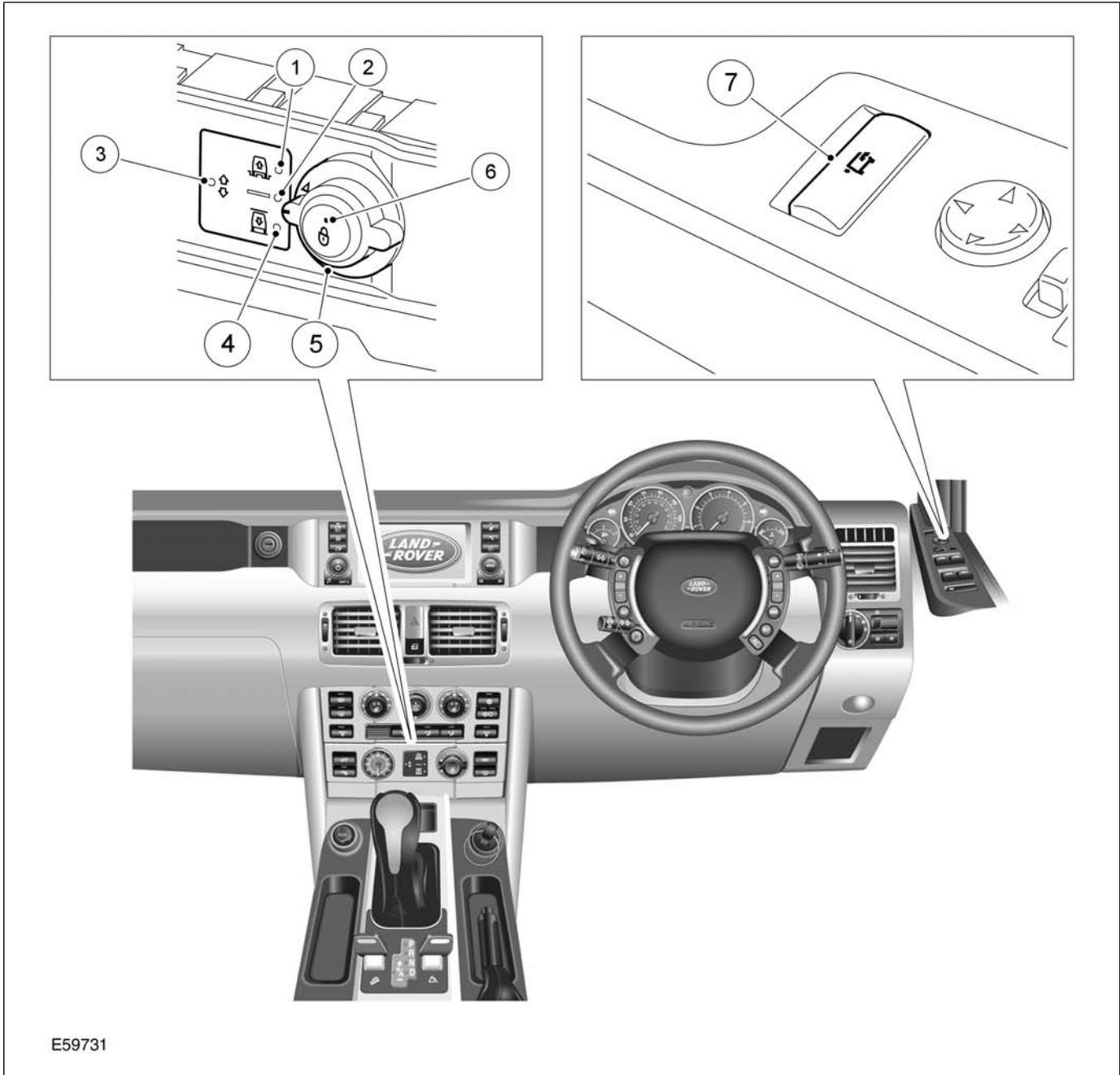
If a fault is detected by the air suspension control module, the control module will reduce the system functionality dependent on the type and severity of the fault. The control module will also store a fault code which can be retrieved using T4. If a severe fault occurs, the control module will attempt to put the vehicle in a safe condition. A fault is relayed to the driver by the instrument cluster message center and an audible warning emitted from the instrument cluster.

If the detected fault is minor and does not affect vehicle safety, the instrument cluster message center will display the message 'SUSPENSION FAULT' and a chime will be emitted. The fault should be investigated and rectified as soon as possible.

If the detected fault is more serious, the message center will display the message 'SUSPENSION FAULT NORMAL HEIGHT ONLY' and a chime will be emitted. The fault should be investigated and rectified as soon as possible.

If the detected fault is more severe the message center will display the message 'SUSPENSION FAULT MAX SPEED 50KPH' and two chimes will be emitted every thirty seconds if this speed is exceeded. The message will change to 'SUSPENSION FAULT' when the vehicle speed is reduced to less than 31 mph (50 km/h). The vehicle should be driven slowly until the fault is rectified.

Air Suspension Control Switch



E59731

Item	Description
1.	Off-Road height LED
2.	On-Road (normal) height LED
3.	Height change LED
4.	Access height LED

Item	Description
5.	Air suspension rotary control switch
6.	Hold button and LED
7.,	Drivers door module access switch

System Operation

Under normal operating conditions, the air suspension control module keeps the vehicle level at the 'current' ride height.

The incoming height signals from the sensors are passed through filters to remove irregular signals produced by road noise or other irregularities.

When the vehicle is stationary or a height change is in progress, the signals are passed through a 'fast' filter, which tracks the true rate of change of height.

When the vehicle is moving, the signals are passed through a 'slow' filter.

The 'slow' filtered signals remove almost all road noise from the signals and output a true long term average for each corner height. The 'slow' filtered signals cannot be used to respond quickly during height changes.

Software Filters

The air suspension control module monitors each corner height signal using the fast filtered signals if the vehicle is stationary or the slow filtered signals if the vehicle is moving.

If the height remains in a 'dead band' which is ± 10 mm from the target height, the control module does not implement any height adjustment changes.

When the control module detects that a corner has moved outside of the 'dead band', the control module operates the compressor and/or the valves to raise or lower the corresponding corner(s) back into the target height.

Modes of Operation

On-Road Mode

This is the normal ride height for the vehicle.

Off-Road Mode

Off-road mode will only be selectable if the vehicle speed is less than 25 mph (40 km/h).

The vehicle will be raised 55 mm (2.2 in) higher than the on-road mode to provide additional body clearance and improved approach, departure and break over angles.

If the vehicle speed exceeds 31 mph (50 km/h), the air suspension control module will automatically lower the vehicle to the on-road mode height.

At 25 to 28 mph (40 to 45 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will lower.

Access Mode

Access mode lowers the vehicle body height by 40 mm (1.6 in) and provides easier entry, exit and loading of the vehicle.

Access mode can be pre-selected when the vehicle is moving.

The vehicle will partly lower as the vehicle speed decreases, lowering to the full access mode height when the vehicle reaches 5 mph (8 km/h).

If the required road speed is not reached within a predetermined time, the air suspension will return the vehicle to the previously selected height.

Access mode can be selected at any vehicle speed. When access mode is selected, the response of the air suspension system will depend on the vehicle speed:

>12.5 mph (20 km/h)

- If the vehicle speed is more than 12.5 mph (20 km/h), the air suspension control module will wait for up to one minute for the vehicle speed to be reduced.
- The access mode LED and the height change LED will flash while the air suspension control module waits for the vehicle speed to be reduced, the on-road mode lamp will remain illuminated.
- If the vehicle speed is not reduced sufficiently, the access mode request will be cancelled after 1 minute.

<12.5 mph (20 km/h)

- If the vehicle speed is less than 12.5 mph (20 km/h), the air suspension control module will lower the suspension to a part lowered height and will remain at this height for up to one minute.
- The on-road mode lamp will extinguish as the air suspension control module lowers the suspension to the part lowered height.
- The access mode lamp and the height change LED will illuminate. When part lowered is reached, the height change LED will flash.
- If the vehicle speed is not reduced to less than 5 mph (8 km/h) in the one minute period, the access mode request will be cancelled.

<5 mph (8 km/h)

- If the vehicle speed is less than 5 mph (8 km/h), the suspension will be lowered to access mode immediately.
- The access mode LED and the height change LED will illuminate.
- When the access mode height is reached, the height change LED will be extinguished.

Access height may be selected up to 40 seconds after the ignition is turned off, provided that the driver's door has not been opened within this time.

The vehicle will automatically rise from access mode when the vehicle speed exceeds 6.2 mph (10 km/h).

If access mode was selected directly from off-road mode then the system will return to off-road mode when the vehicle speed exceeds 6.2 mph (10 km/h).

Otherwise the system will lift the suspension to on-road height.

Selecting Access Mode Directly from Off-Road Mode

When the suspension is in off-road mode height, pressing the air suspension rotary switch once and then a second time in a downward direction before the height change LED is extinguished, the control module will lower the suspension to access mode height.

The control module will remember to return the suspension to off-road height automatically if the vehicle speed increases above 6.2 mph (10 km/h).

Alternatively, pressing the driver's door module access switch once will perform the same function.

Crawl (Locked at Access) Mode

Crawl mode allows the vehicle to be driven at access height.

The vehicle is locked in access height and can be selected at a speed of less than 21.7 mph (35 km/h) and can be driven at low speeds to improve clearance in areas with restricted headroom, i.e. car parks.

If the vehicle exceeds 25 mph (40 km/h), crawl mode will be cancelled and the vehicle will return to on-road height.

To select crawl mode the vehicle must first be in access mode.

Crawl mode is selected by pressing the 'hold' button once. When selected, the hold button LED will be illuminated.

When the control module is in crawl mode, on-road mode height will be selected automatically if the vehicle speed exceeds 25 mph (40 km/h).

At 18.6 to 21.7 mph (30 to 35 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will raise.

Crawl mode can also be manually cancelled by pressing the hold button once.

The access mode LED and the hold LED will be extinguished.

High Speed Mode

High speed mode is a non-selectable, automatic mode which lowers the vehicle height by 20mm to improve vehicle handling.

This feature is fully automated and is 'invisible' to the driver.

If the vehicle speed exceeds 100 mph (160 km/h) for more than five seconds, the air suspension control module initiates the high speed mode.

When the vehicle speed reduces to less than 80 mph (130 km/h) for more than 30 seconds, the vehicle returns to the on-road height.

This function is cancelled if a trailer is connected to the trailer socket.

Automatic Height Change Warnings

When the suspension is in off-road mode, access mode or crawl mode height, the air suspension control module will change the suspension height automatically when the vehicle speed exceeds a predetermined threshold.

When the suspension is at off-road mode or crawl mode height, the control module issues a warning to advise the driver that the vehicle is approaching the speed threshold.

The instrument cluster sounder will emit a chime, a message will be displayed in the message center and the on-road mode LED and the height change LED will flash.

The off-road mode or crawl mode height speed warning is removed when the vehicle speed is reduced.

Special Modes

Door Open Functionality

If one or more of the vehicle doors are opened during a height change when the vehicle is stationary, the air suspension control module will restrict further height change.

The door open signal is transmitted by the generic electronic module (GEM) on the 'K' bus to the instrument cluster gateway and from the cluster it is transmitted on the high speed CAN bus and received by the air suspension control module.

This keeps the vehicle level to the set height when a door opens to allow for changes in loading conditions.

The LED on the air suspension LED display for the target mode height will remain illuminated and the height change LED will flash.

If all of the doors are closed within 90 seconds, the height change will resume.

If the 90 second period is exceeded and all of the doors are not closed, the height change will be cancelled.

The mode LEDs showing the previously selected height and the target height will be illuminated.

The mode height change can be re-selected by operating the rotary switch, however, if the vehicle is driven at speed of more than 5 mph (8 km/h) the control module will continue to raise or lower the vehicle to the target mode height.

Extended Mode

If the air suspension control module senses, via the height sensors, that the vehicle has become grounded, the air suspension control module automatically increases the mass of air in the air springs to raise the vehicle clear of the obstruction.

Extended mode is activated automatically and cannot be selected manually.

When the air suspension control module has activated the extended mode, the off-road mode lamp will flash if the suspension is above off-road mode height.

The off-road mode and on-road mode lamps will flash if the suspension is between off-road mode and on-road mode heights.

The on-road mode and access mode lamps will flash if the suspension is between on-road mode and access mode.

A message will also be displayed in the message center.

To exit the extended mode, press the air suspension switch briefly in the up or down position or alternatively drive the vehicle at a speed of more than 12.5 mph (20 km/h).

Additional Lift in Extended Mode

When extended mode has been invoked and the automatic lifting of the vehicle is complete, the driver can request an additional lift of the vehicle.

This can be particularly useful when extended mode has been activated on soft surfaces.

The additional lift can be requested once the height change LED has extinguished.

Press and hold the air suspension switch in the up position for 3 seconds whilst simultaneously depressing the brake pedal.

A chime from the instrument cluster will sound to confirm that the request has been accepted.

The height change LED will be illuminated while the vehicle is being lifted.

Suspension Prevented From Moving

If the air suspension control module is attempting to change the suspension height and it detects that the suspension is prevented from moving, the control module will stop all suspension movement.

This can be caused by jacking the vehicle, attempting to lower the vehicle onto an object or raising the vehicle against an obstruction.

The air suspension switch lamps operate as described for extended mode and the same message is displayed in the message center.

To re-start the air suspension system operating, press the air suspension switch briefly in the up or down position or drive the vehicle at a speed of more than 12.5 mph (20 km/h).

Periodic Re-leveling

When the vehicle is parked, the air suspension control module 'wakes up' two hours after the ignition was last switched off and then once every six hours.

The vehicle height is checked and if the vehicle is not level within a pre-set tolerance, small downwards height adjustments may be made automatically.

Transportation Mode

Transportation mode is a factory set mode which locks the suspension to enable the vehicle to be safely lashed to a transporter.

The suspension transportation mode is automatically set when the vehicle is configured for transportation mode using T4.

Transportation mode also affects other vehicle systems which are inhibited or restricted to minimal functionality.

When the ignition switch is switched off, the vehicle will be lowered onto the bump stops.

This ensures that the securing straps do not become loose should air leak from the air springs.

When transportation mode is active, the off-road, access and hold switches are disabled.

Periodic re-leveling is also disabled.

When the engine is started, the air suspension control module will cause the vehicle to rise to a height of –20mm to allow sufficient ground clearance for the vehicle to be loaded.

While the height is changing, all the LEDs in the air suspension control switch will flash and a chime will be emitted by the instrument cluster.

When the height of –20mm is reached, all the LEDs will illuminate continuously and the chime will stop.

When the engine is switched off, the air suspension control module will cause the vehicle to lower to a height of –60mm to allow the vehicle to be strapped down.

While the height is changing, all the LEDs in the air suspension control switch will flash and a chime will be emitted by the instrument cluster.

When the height of –60mm is reached, all the LEDs will illuminate continuously and the chime will stop.

Calibration Mode

This mode is used when the air suspension control module has been replaced or a height sensor or suspension component has been dismantled or replaced.

The following conditions apply when the vehicle is in calibration mode:

Calibration Conditions

- The ride height is set to tight tolerance
- Fault reaction to Vehicle Identification Number (VIN) mis-match with the Car Configuration File (CCF) is disabled
- The raise, lower, access and hold switches are disabled
- System is controlled to on-road height only.

System Inhibits

A number of conditions exist where a change in ride height is undesirable.

To counter this, the air suspension control module is programmed with a number of system inhibits.

If any of the conditions detailed below exist, the air suspension control module will suspend height changes and height corrections.

Compressor Time-Out

Two temperature sensors are located within the compressor to prevent overheating.

If the temperature of the motor brush assembly or the compressor cylinder head rise above pre-set limits, the air suspension control module will inhibit the compressor operation.

The limits are detailed in tables in the Air Supply Unit section of this workbook.

Cornering

If the air suspension control module registers a cornering force greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the cornering force falls to less than 0.15g.

The air suspension control module receives a message from the lateral acceleration sensor (which is an integral part of the ABS yaw rate sensor) on the high speed CAN Bus for the cornering force.

Rapid Acceleration

If the air suspension control module registers a rapid acceleration greater than 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid acceleration falls to less than 0.15g.

Acceleration is calculated by the control module from a vehicle speed signal received via the high speed CAN bus.

Rapid Deceleration

If the air suspension control module registers a rapid deceleration smaller than - 0.2g it will inhibit all height changes and corrections.

The system will remain inhibited until the rapid deceleration rises above - 0.15g.

Deceleration is calculated by the control module from a vehicle speed signal received via the high speed CAN bus.

Vehicle Jacking

The air suspension control module will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 1.2 seconds.

This is interpreted as the corner identified as moving too slowly being supported on a jack.

In this situation, the corner height will not change when air is released from the air spring because the jack acts as a mechanical prop.

The system will remain inhibited until any of the following conditions exist:

- The air suspension rotary switch is moved to the up or down position
- The vehicle speed rises to more than 9.3 mph (15 km/h) for more than 15 seconds.

Door Open

The air suspension control module will stop all height change requests while any of the doors are open.

Vehicle leveling continues with a door open by keeping the vehicle at the height when the door was opened if the vehicle load changes.

RIDE HEIGHT CONTROL

Height Control

The air suspension control module is able to provide three different ride heights:

- On-road (normal)
- Off-road
- Access.

The ride heights are selected via the rotary control switch mounted on the center console. Rotating the switch upwards or downwards selects a different ride height (providing all the criteria outlined below are met). The center of the rotary switch contains the 'Hold' switch. The 'Hold' switch allows the air suspension control module to lock the access mode in crawl mode.

The rotary control switch contains one LED for the 'Hold' function. Four further LEDs are located in a display panel adjacent to the switch and display height change, off-road mode, on-road (normal) mode and off-road mode. The symbols illuminate to show the current selected ride height and if a height change is in progress.

If a requested height change is not allowed, i.e. vehicle speed too fast, the height change LED will flash and a chime will be emitted.

A flashing off-road or access LED indicates that the air suspension system is in a waiting state or the system will override the driver's selection because the speed threshold is too high.

The driver can also ignore the system's warning signals and allow the height to change automatically. For example, increasing the vehicle speed to more than 25 mph (40 km/h) will cause the control module to automatically change the ride height from off-road to on-road mode.

On-Road

On-road ride (normal) height is used during most driving conditions.

This setting is used as a datum for the remaining ride heights and is defined as 0 mm. All other ride height settings are described as above or below this setting.

The on-road height can be active at any vehicle speed.

Access or off-road ride height can be selected from on-road ride height using the rotary control or the drivers door access switch.

Off-Road

Off-road mode will only be selectable if the vehicle speed is less than 25 mph (40 km/h).

The vehicle will be raised 55 mm (2.2 in) higher than the on-road (normal) mode to provide additional body clearance and improved approach, departure and break over angles.

If the vehicle speed exceeds 31 mph (50 km/h), the air suspension control module will automatically lower the vehicle to the on-road mode height.

At 25 - 28 mph (40 - 45 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will lower.

High Speed

High speed height lowers the vehicle by 20 mm, and improves the high speed handling of the vehicle.

High speed height is only active when the vehicle is traveling at more than 100 mph (160 km/h) for more than 5 seconds, and is not selectable by the driver.

If the vehicle speed falls to below 80 mph (130 km/h) for more than 30 seconds, the control module automatically returns the vehicle to the on-road height setting.

If the vehicle stops while the high speed height is active, the timer is paused, stopping the vehicle rising unnecessarily.

When towing, the electrical connection of the Land Rover trailer socket will be detected and stop automatic lowering to the -20mm position.

Access Height

Access ride Height lowers the vehicle by 40 mm (1.6 in) when the vehicle is stationary or moving at very low speeds in order to improve ease of access to the vehicle.

Access ride Height can be selected by operating the access switch on the drivers door module when the vehicle is in on-road Height or by turning the rotary

control switch downwards once when the vehicle is in on-road Height or twice when the vehicle is in off-road Height.

Access Height can be selected at any vehicle speed. When access Height is selected, the response of the air suspension system will depend on the vehicle speed.

Access ride Height has three different modes of operation:

- Access Height
- Access Select from Off-Road Height
- Crawl Mode.

Access Height

If the vehicle speed is 5 mph (8 km/h) or less, the vehicle will lower to full access Height immediately.

The access Height LED and the Height change LED will illuminate.

When the access Height is reached, the Height change LED will extinguish.

If the vehicle is traveling at less than 12.5 mph (20 km/h) 'Access Height' mode can be selected.

The control module will lower the suspension to a part lowered Height and will remain at this Height for up to one minute for the vehicle speed to be further reduced.

The on-road LED will be extinguished as the control module lowers the suspension to the part lowered Height.

The access Height LED and the Height change LED will both be illuminated. When the part lowered Height is reached, the Height change LED will flash.

If the vehicle speed is not reduced to less than 5 mph (8 km/h) within the one minute period, the access Height request will be cancelled and the vehicle will return to on-road Height.

If the vehicle speed is more than 12 mph (20 km/h), the control module will wait for up to one minute for the vehicle speed to be reduced.

The access Height LED and the Height change LED will flash while the control module waits for the vehicle speed to be reduced, the on-road Height LED will remain illuminated.

If the vehicle speed is not reduced sufficiently, the access Height request will be cancelled after one minute.

Access Height may be selected up to 40 seconds after the ignition is switched off, provided that the driver's door has not been opened within this time.

The suspension will automatically rise from access Height when the vehicle speed exceeds 6.2 mph (10 km/h).

If access Height was selected directly from off-road mode, then the system will return to off-road Height when the vehicle speed exceeds 6.2 mph (10 km/h).

Otherwise the system will return the suspension to on-road Height.

Access Selected from Off-Road Height

When the suspension is in off-road ride Height, rotating the air suspension rotary switch downwards once and then a second time before the Height change LED has extinguished, or pressing the access switch on the driver's door module once, will cause the control module to lower the suspension to access Height (providing the speed thresholds are met).

The control module will remember to return the suspension to off-road Height automatically if the vehicle speed increases to more than 6.2 mph (10 km/h).

Crawl Mode (Locked at Access Height)

Crawl mode does not change the vehicle Height, but modifies automatic Height changes and allows the vehicle to be driven at access Height but at a higher speed than in access mode.

Crawl mode is selected when the vehicle is at the access ride Height and 'Hold' is selected.

If 'Access Height' has been selected, but the air suspension control module has not lowered the vehicle because the road speed is too high, when 'hold' is selected the 'Access Height' request is cancelled and the vehicle remains at on-road ride Height.

The 'Hold' button remains active so that all automatic and manual Height changes are disabled.

Crawl mode allows the vehicle to be driven at speeds up to 25 mph (40 km/h) without returning to the on-road Height.

If the vehicle speed reaches 22 mph (35 km/h), a chime will sound from the instrument cluster sounder and the message center will display a 'SLOW DOWN' warning message.

If the vehicle speed exceeds 25 mph (40 km/h), crawl mode is cancelled and on-road Height will become active automatically.

