



ROVER 75

Technical Brochure

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Introduction to Rover 75

Style and substance



Figure 1 New Rover 75

The Rover 75 (see Figure 1) is the first Rover vehicle in over two decades to have been designed as an all-new concept; a 'blue sky' project. The launch of Rover 75 is a big moment in Rover's long and distinguished 95 year history. The first Rover vehicle was manufactured in Coventry in 1904, a single cylinder vehicle producing 8hp. Rover went from strength to strength and the first half of the 20th century culminated in 1949, with the launch of the P4 Rover 75 (see Figure 2), affectionately known as "Auntie" Rover. An ancestor of the new Rover 75, the P4 model was a fine example of a stylish and luxurious British saloon car synonymous with the name Rover.



Figure 2 P4

The Rover 75 heralds the renaissance of the Rover brand, introducing new technology and a new focus. The style and comfort expected by Rover customers is supported by an engineering excellence which begins in the design stages and carries forward through the whole of the manufacturing process. Rover 75 combines modern aesthetics, and technology, with classic proportions. The body shape is reminiscent of vehicles from Rover's ancestry, but everything has evolved, bringing the Rover saloon up to date through refinement and reinterpretation.

Rover, as a brand, is renowned for making classic, elegant and stylish British cars. This trait is now supported by state-of-the-art design and test facilities at the Gaydon Test Centre and the all-new manufacturing facility at Rover Oxford. This engineering quality combines with Rover's inherent style to deliver the complete package; a vehicle with style and substance. The Rover 75 is stunning to look at but the lines of beauty are also efficient stream-lines. Style is not compromised by functional efficiency, for example, the stylish chrome rear number plate surround also doubles as an aerodynamic spoiler (see Figure 3).



Figure 3: Rear view of the Rover 75 showing the chrome number plate surround and rear light assembly.

The stylish appearance of Rover 75 needs little description as it is there for all to see. But behind the beautiful exterior lies all the hard work undertaken in the design of the vehicle and the design of the manufacturing process which give the vehicle its inherent build quality. Designers at the Gaydon Test Centre had access to state-of-the-art design, test and development facilities. Computer simulation and other technologies make it possible to perfect systems before they are manufactured. This way, systems are developed and tested without wasting time and money on ultimately unfeasible designs.

Rover 75



Figure 4 Rover 75

Rover 75 (see Figure 4) is a compact, four door and 5-seater luxurious executive British saloon car. The body shell is built to a dimensional tolerance of less than 1.5mm. It makes extensive use of high strength, double thickness, zinc-coated steels producing a body stiffness twice that of current Rover models, and equal to that of the acclaimed BMW 5-series. Excellent suppression of noise, vibration and harshness (NVH) produces class leading levels of refinement and comfort.

Rover 75 has MacPherson struts to the front and a multi linked 'Z' axle to the rear providing superb handling and ride comfort. The award winning 'K' Series long bolt petrol engine is available in three sizes; the KV6 2.5 litre and 2.0 litre, and the four cylinder K1.8. Also available is an all new "common rail" direct injection diesel turbo 2.0 litre engine. Rover 75 features new 5-speed manual and automatic transmissions; the automatic offering electrically controlled adaptive modes.

Focal points of the interior (see Figure 5) are the dashboard and the centre console. A bold new design statement, the two-tone fascia provides a high level of customer appeal. The real wood finisher panels on the fascia have their own intrinsic beauty as well as functionality. The fascia houses a full size North American specification (NAS) airbag, which is very demanding in terms of space and location.



Figure 5 Interior

The instrumentation delivers precise information through careful use of graphics and background colour. The traditional three spoke steering wheel houses a NAS size airbag as well as horn, remote audio and cruise control switches. The steering wheel is adjustable for both height and reach. The two-tone interior panels have been designed to provide maximum stowage along with side intrusion protection. For optimal ergonomics, the electric window lift switches and mirror controls are all door mounted.

The seats, (see Figure 6) which carry side airbags (Thorax airbags), are designed to reflect the comfort and style of the original P6 seat, which itself has become a design icon of the nineties. The header console has assumed more prominence in this car than normal. It houses the microphone for the integrated telephone, the sunroof switch and courtesy and map lamps.



Fi f ats

Vehicle overview

The key attributes concentrated on from the design stage through to production are:

- Quality and reliability
- Comfort and refinement
- Active and passive safety

The following information provides a brief insight into the “invisible” strengths of Rover 75.

Body s ess

Making full use of new high strength steels and latest computer technology simulating shapes, thickness, materials and designs, Rover engineers were able to achieve torsional stiffness 2.5 times better than the current Rover 600 within the bodyshell weight target. This body stiffness provides the car with the right framework to fight road and powertrain-induced vibrations. It allows precise and consistent suspension geometry and tuning. It provides lasting freedom from squeaks and rattles and improves NVH through reduced panel flexing and booming. The stiff body provides an extremely resistant passenger compartment around which the energy absorbing zones can be optimised for crash protection.

Noise vibration and harshness

Attention has been focused on the science of insulation: the suppression of wind, road and powertrain noise vibration and harshness (NVH). Rover 75's most notable NVH features include:

- A full double bulkhead between the engine and the passenger compartment
- A triple door sealing system
- Exceptionally stiff engine mounts
- The optimisation of local body stiffness to suspension bush rates
- The application of noise absorbing materials and thicker glass
- Insulation of subframes and powertrain
- The design of the exterior trim shapes

Dynamic assessment was carried out at all relevant speeds, over mixed surfaces and in a variety of climates. The research and design programme was supported by the combined expertise and facilities, both aerodynamic and acoustic, of Rover Group and BMW. The result is a car that will be class leading in interior noise quality and dB levels.

sis

The suspension system uses MacPherson struts mounted on a perimeter subframe at the front, and a subframe mounted multi-link 'Z' axle at the rear. To save weight and reduce unsprung masses, all suspension elements are made from high strength steel or aluminium. The front subframe contributes significantly to frontal energy absorption on impact.

Extensive computer modelling was used to develop the suspension geometry and optimise the kinematic and elastokinematic performance i.e. the analysis of suspension movement and the forces acting on it. Developed to offer ride refinement without sacrificing handling, or masking feedback, it will allow drivers of varying ability to maintain safe control up to very high limits. Rover 75 has precise and predictable behaviour and the front suspension geometry has an exceptional tolerance to wheel imbalances.

The steering is a servo assisted rack and pinion system. The steering column features two crash collapse mechanisms, height and reach adjustment, and an integrated steering lock. To reduce weight, the upper column is made of die-cast magnesium.

The all-disc braking system features a latest generation four wheel sensed anti-lock braking system (ABS) with electronic brake distribution. A drum is incorporated into the rear discs for the parking brake. Traction control is available on certain derivatives of Rover 75.

nes

Four engine options are available with Rover 75. Two are evolutions of current Rover engines, two are new.

The 1.8 'K' Series four cylinder is an evolution of the engine first used in the *I F*. The KV6 quad cam engine, introduced in 2.5 litre configuration for the 96 model year Rover 800 has been modified, and is now offered in 2.5 litre displacement and a new 2.0 litre displacement.

The introduction of the KV6 engines in Rover 75 coincides with the transfer of production to a new higher capacity production line.

The 2.0 litre diesel engine is a development of the M47 diesel engine introduced with the new BMW 3-series. It is a high pressure, direct injection diesel, using the Bosch common rail fuel delivery system. All engines are European commission directives stage 3 (ECD3) compliant.

ty

Driver and passenger airbags, front buckle pretensioners and rear reel pretensioners are fitted as standard to Rover 75. Thorax bags, fitted inside the front seats, (see Figure 7) are standard fit, with side head impact protection available as an option.

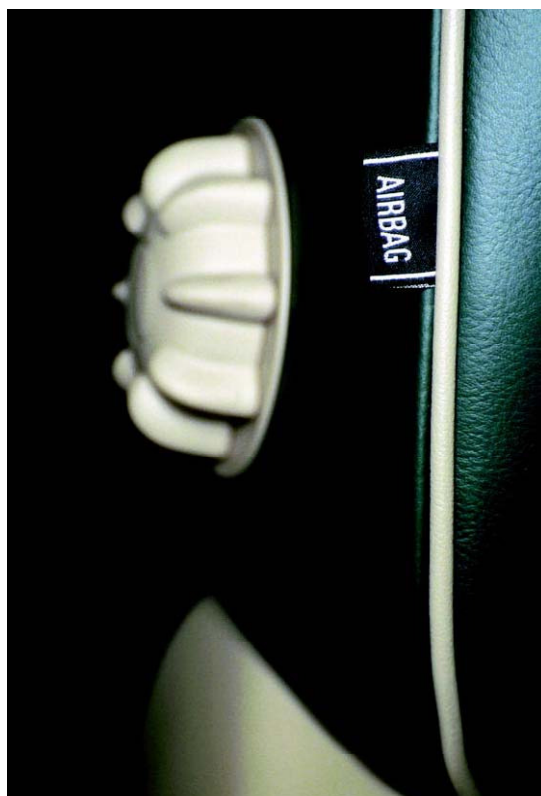


Figure 1

Body electronics

Rover 75 uses highly multiplexed electrical circuitry utilising CAN-Bus (controller area network) architecture for powertrain systems and BMW's K-Bus architecture for body electronic systems. The CAN-Bus and K-Bus systems communicate with each other via the instrument pack, which is a complex interface unit. Diagnostics are carried out via the diagnostic line using TestBook, with a specific Rover 75 disc and a new 16 pin red diagnostic connector lead. A whole range of electrical and electronic optional features are available with Rover 75.

Trim levels and options

Rover 75 is available in three major trim levels:

Tr 1

Trim level 1 consists of the following features:

- Anti-lock braking system
- Driver, passenger and thorax airbags
- Front and rear seatbelt pretensioners
- Radio cassette
- Electric front windows
- Power and heated wing mirrors
- Real wood dashboard
- Velour trim
- Analogue clock
- Height adjustable driver seat with lumbar support
- Height and reach adjustable steering column
- Immobilisation
- Perimetric alarm
- Central door locking

Tr 2

Trim level 2 consists of the features included in trim level 1 with the following additional and upgraded features:

- Automatic temperature control
- Alloy road wheels
- Electric rear windows
- Rear armrest and rear cup holder
- Leather steering wheel and leather gear knob
- Rear chrome treadplates
- Speckled velour trim — with access to personal colour palette and trim scheme
- Illuminated sun visors



Figure 8 Features

1 3

Trim level 3 consists of the features included in trim level 1+2 with the following additional and upgraded features:

- Leather seating
- Leather handbrake grip
- Heated and powered front seats
- Passenger lumbar support
- Fog lamps
- Rear map lights, rear map pockets, box in rear armrest
- Unique styled alloy road wheels (see Figure 8)
- Chrome door mirrors (see Figure 8)

interior colours

There is a choice of 9 exterior colour palettes, three solid, three metallic and three pearlescent. Each of these can be combined with a matching interior colour (either sandstone beige or ash grey).

The personal line option is available on trim levels 2 and 3 and offers a further three colours of interior, these being blue, burgundy and green. Also, a supplementary line of eight unique exterior palettes is offered with a choice of two of the five matching interior colours. This means the interior can be made up of any two of the interior colours giving a two-tone interior.

Options

A wide range of individual options allow customers to tailor their vehicle to their personal requirements and budget. Available options are:

- Alpine radio cassette head unit
- Compact disc (CD) autochanger
- Harmon Kardon sound system
- Navigator (low-line navigation system)
- High line navigation system
- Integrated telephone
- Electric sunroof
- Folding rear seat
- Rear electric windows (TL 2)
- Rear electric sunblind
- Front fog lamps
- Heated washer jets and headlamp cleaning
- 15 inch alloy road wheels (TL 1)
- 16 inch alloy road wheels (TL 2 and TL 3)
- Leather seats (TL 1 and 2)
- Heated front seating (TL 1 and 2)
- Cruise control
- Traction control
- Side head impact protection
- Volumetric alarm protection

As well as these factory fit options a wide range of accessories are available

The Rover mission

“By the year 2005, Rover will be established as a specialist manufacturer of premium-positioned front-wheel drive vehicles, marketing a range of motor cars competing in the medium and executive sectors of the market.”

Rover 75 is a further step towards this vision. The vehicle will attract those who aspire to the refined drive and on street presence of the Rover 75. The kudos of being seen in a Rover 75 is backed up with complete motoring pleasure, provided by the quality of the design and the engineering of the vehicle.

Body electrics

Main harness

The main vehicle harness fitted to Rover 75 is a single harness that stretches from the headlamps at the front of the vehicle to the lighting at the tail end. The harness separates at each of the side doors into separate door harnesses. The sunroof harness is also separate from the main harness and is an integral part of the roof lining. Many new style connectors are incorporated into the harness and special tools will be needed to disassemble and reassemble them.

The harness repair procedure is carried out by splicing into the harness and replacing the relevant part. The harness can be purchased in individual lengths via the parts supplier and the length which contains the piece of the harness needing repair should be ordered. The replacement piece can then be spliced into the main harness.

Integral to the main harness are the supplementary restraint system harness, the CAN-Bus twisted wire pairs, the single wire K-Bus data link and the single wire diagnostic line.

Networks

Technological advancement in vehicle electronics has led to many changes and improvements in vehicle electrical systems. Vehicles are now fitted with systems which, although complex in functionality, are user friendly and very reliable. Electronic control units are used to control and monitor the operation of the systems and Rover 75 has more electronic control units (ECU) controlling systems than any Rover product to date. An ECU is populated with solid state components, the capacity of which is matched to the complexity of the system it has to control. ECU's receive input signals corresponding to the current state of the system under its control. The signals to the ECU come from various sensors and switches and these inputs dictate the outputs the ECU's send to the actuators of the system.

The vehicle electrical architecture of Rover 75 has been designed to exploit the full potential of its technological advances. Rather than having an ECU dedicated to its system and unaware of the operation of other systems, the systems around the Rover 75 are all linked together. The ECU's are linked to each other via Bus-systems, allowing communication and exchange of information. Harness bulk and complexity is kept to a minimum using this new method to relay information to and from the different systems. This method used by Rover 75 is called **multiplexing**.

Multiplexing is a technique which uses the same wiring repeatedly for communication between all systems. The systems are all inter-connected, forming a network of communication lines. The information from sensors, switches etc. are converted to digital signals by the system ECU and relayed serially throughout the system network, which is also referred to as a data bus system. A network can be defined as an interconnection of various systems which allows exchange of information. The public telephone system can be said to be a network within which information can be exchanged. The signal from the sender needs converting on transmission and reconvertng at the reception end. The signal ends up in the correct format to be understood by the recipient. There may be a protocol to follow, for example having to wait to re-dial if a line is in use. On Rover 75, system information is prioritised and will find the correct destination through correct coding.

The Rover 75 network system uses a number of interconnected Bus-systems and the gateway for these Bus-systems is the instrument pack. Most ECU's are connected to this system and can transmit and receive messages on the system. All messages that are transmitted on the Bus-systems are made up of binary digits, referred to as bits. The bit can be one of two states: 0 and 1. The combination of bits that make up a signal is transmitted in this digital format on the Bus-system. Internal to each ECU is the special equipment required to convert the digital signal back to the value that it represents. Each message will contain information in its code as to where the message starts and ends, and an identifier to ensure the message finds the correct destination. The signal also contains a check function which a receiving ECU uses to check the plausibility of the signal. The ECU that transmits a signal also monitors the return of that signal. This way it can check if the signal is the same as the one transmitted and any faults can be dealt with.

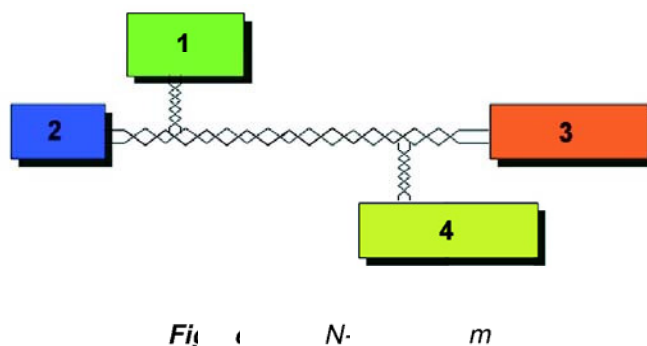
Information from a single sensor can be used to feed many units, saving on harnessing and the number of sensors needed. For example, one of the Anti-lock braking system wheel speed sensors is hard wired to the instrument pack (IPK) for the speedometer. The IPK converts this signal into a K-Bus format and transmits a message on the K-Bus feeding the speed dependent wiper control and the speed dependent radio volume.

Advantages of multiplexing:

- Harnesses are smaller and less complex
- Harnesses are cheaper and lighter
- Improved reliability-reduced wires and connections
- New systems can be added easily 'Plug and Play' (If the appropriate wiring is fitted to the existing harness)

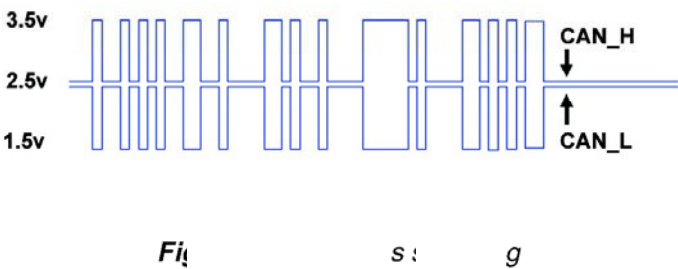
The Bus-systems in use on Rover 75 are the CAN-Bus, the K-Bus and the Diagnostic line. These systems make up part of the main harness. The instrument pack acts as the communication gateway, enabling transfer of data from one Bus-system to another. The instrument pack contains a microprocessor which converts and processes all signals into the format required for transmission onto another Bus-system. There are other dedicated Bus-systems in use on Rover 75 such as a window lift Bus and a satellite navigation display Bus. These Bus-systems work in isolation and will not be discussed here.

CAN-Bus (controller area network)



1. Automatic transmission control unit
2. Engine control module
3. ABS/ traction control ECU
4. Instrument pack

The CAN-Bus system (see Figure 9) has been developed by Bosch and is becoming the industry standard for Europe. The CAN system is a high speed serial data bus system linked by a twisted pair of wires: yellow/black and yellow/brown. The wires are twisted to minimise electromagnetic interference from the signal passing down the lines to other systems in the vehicle, such as the radio system. Both wires carry information and for CAN to operate, both signals must be present. The CAN system is the fastest of the Bus-systems used on Rover 75, capable of carrying 500,000 bits of information every second. It is used for systems where the speed of exchange of information is vital for their performance; engine management systems, automatic transmission and traction control.



As stated, CAN consists of a twisted pair of wires. One line is called CAN high (CAN_H) and the other line is called CAN low (CAN_L). CAN_L switches between 2.5 and 1.5 volts. CAN_H switches between 2.5 and 3.5 volts (see Figure 10).

With both CAN_H and CAN_L both at 2.5 volts there is no potential difference (voltage) between them and this is known as the recessive state and is equivalent to logic 1.

With CAN_H switched to 3.5 volts and CAN_L switched to 1.5 volts there is a potential difference of 2 volts between them and this is known as the dominant state and is equivalent to logic 0.

CAN_H and CAN_L always switch together and these two states are the only two possible. When an ECU transmits a signal, it is made up of a series of dominant and recessive states generated by the simultaneous switching of the CAN wires. The signal is a combination of the two possible states, in effect 0 and 1, hence a digital signal.

The structure of a CAN-Bus signal is made up of several parts as shown below:

CAN message structure

Start	Identifier/Name	Control Field	Data 0-64 Bits	CRC Test	Confirm	End of Frame
-------	-----------------	---------------	----------------	----------	---------	--------------

The message can vary from a minimum of 44 bits in length to a maximum of 108 bits.

The 'identifier' part of the signal will determine the content of the signal and the priority of the signal. Arbitration is necessary when a message is transmitted at the same time as another message. The priority of the message is also contained in the identifier.

As an ECU transmits a signal onto CAN it also reads back the identifier on CAN and if it does not recognise the identifier as its own this means it has lost arbitration to another signal transmission and it stops the transmission of its own message. The ECU will wait until the Bus is quiet before transmitting its message again.

Error checking of the signal is performed by the cyclic redundancy check (CRC). All the bits that make up the signal are assembled into an algorithm and this is sent as the CRC part of the signal. The receiver ECU will assemble the signal into the same algorithm and the result should match the CRC part of the signal. If they do not match, an error is recognised and the message is ignored. No acknowledgement is given to the erroneous message. Because the ECU which transmits the message is also waiting to receive an acknowledgement, it recognises that the message is faulty and re-transmits the message. Calculations for the amount of error messages which escape these checks have shown an average of 1 error per 10,000,000,000,000 messages manages to get through.

The CAN system is terminated at the instrument pack and at the engine control module (ECM) using 120 ohm resistors. This helps to suppress electrical reflections, which might otherwise cause bit errors.

F a g

In trying to diagnose and locate a fault on the CAN-Bus or any of its associated components a logical approach should be used. Examples:

- Are the tachometer and coolant gauges working? If either is working, this indicates the CAN link from the ECM to the IPK is operating
- Does the 'park, reverse, neutral, drive and low' (PRNDL) display show the current gear on the IPK? If it does, this indicates that the CAN link from the automatic transmission control unit to the IPK is operating
- During the start up bulb check, the traction control lamp in the IPK illuminates for four seconds and then goes out. The lamp is held off via the CAN-Bus system. If it does this it is an indication that the CAN link from the ABS/traction control ECU to the IPK is operating

Note: TestBook must be used to diagnose the CAN system. It is a complex interconnected system and TestBook will assist the operator through the diagnostic route.

ECU's are very reliable and ECU failures are rare. Wiring faults and poor connections are more common and the symptoms of the fault will vary with the location and severity of the fault. Faults on the system can be diagnosed logically by observing the symptoms and using a process of elimination. TestBook will guide the operator through the process.

If either CAN_H or CAN_L short to ground or short against each other, the CAN-Bus will not function and, therefore, communication will not take place. If a break appears in one of the lines, diagnostic equipment may be used to interrogate each ECU and find out what it is receiving and what it is not. When the CAN system is inoperative, each system ECU will operate independently-some in a default 'limp home' mode.

When repairing a section of harness, care must be taken with the CAN twisted pair of wires. It is important that the twisted pair should not be unwound more than 3 - 4 cm. The wires should also be repaired with a crimped joint rather than a soldered joint.

K-Bus (karosserie = body)

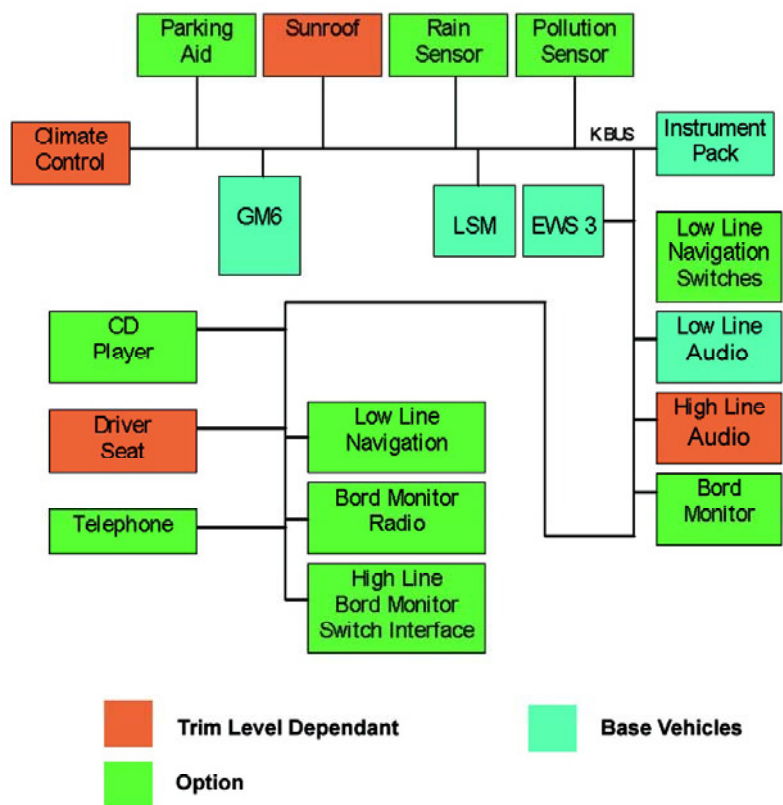


Figure 11

The K-Bus system (see Figure 11) utilised in Rover 75 is the same proven K-Bus serial communication network used by BMW. It uses a single wire coloured white/red/yellow. It is slower than the CAN-Bus system, being capable of carrying 9600 bits of information a second. This is why systems which need fast updates to information tend to use the CAN-Bus system (i.e engine and transmission systems). Less critical systems use the K-Bus system. K-Bus is the system which connects all the body electronic systems together and to the IPK.

K-Bus switches between 0–12 volts and has a low impedance, making it resistant to electromagnetic interference. Most users are active on the K-Bus when the ignition is switched to auxiliary position. Some are active with the ignition off, such as seat memory, which can operate independently of the ignition.

K-Bus message structure

Sender	Length	Receiver	Code	DB1	DB2	DBn	CHKSUM
--------	--------	----------	------	-----	-----	-----	--------

The K-Bus message is called a telegram by BMW and, as the illustration above shows, is made up of several parts. The data part is made up of a number of data bytes. Each ECU has an address which forms part of the signal. Each of the ECU's also contain a Bus interface to transmit and receive data to and from the Bus-system. This converts all the sensor information into a digital format and back again.

The K-Bus system is primarily an event-driven system in that messages are sent after a request has been made on one of the systems. (e.g. lights on, sunroof open, etc). As with CAN-Bus there is a priority system. Arbitration on the K-Bus is controlled by the sender of the message. Each sender has a ranking which governs where it stands in the pecking order. The ground module (GM6) has the highest priority on the K-Bus system and messages from the GM6 override any other K-Bus message which has been transmitted simultaneously.

Each of the K-Bus users are continually monitoring the activity on the system. When a user needs to transmit, it waits until there is no activity and then transmits its message. The sender then listens to the system for its own message. If it doesn't receive back its own message this means a user with higher priority has also transmitted. The lower priority user then has to wait until the Bus becomes inactive and then re-transmit. When it receives its own message back this is confirmation of a successful transmission.

As with the CAN-system, logical approaches should be used to determine faults, e.g. with a door open on the vehicle, is the warning displayed in the instrument pack? If the door open warning is displayed this indicates the K-Bus from the GM6 body controller to the instrument pack is functioning correctly.

If the Bus is found to be at zero volts during diagnosis this could mean that the line is shorting to ground. The Bus system will not function if it is shorting to ground. Two pull up resistors, one located in the GM6 and one in the light switch module, pull the Bus voltage high. If the Bus is found to be at zero volts it could be caused by the light switch module (LSM) and the GM6 not being connected or not functioning correctly.

Note: It is essential that TestBook is used to diagnose the K-Bus system.

Diagnostic line

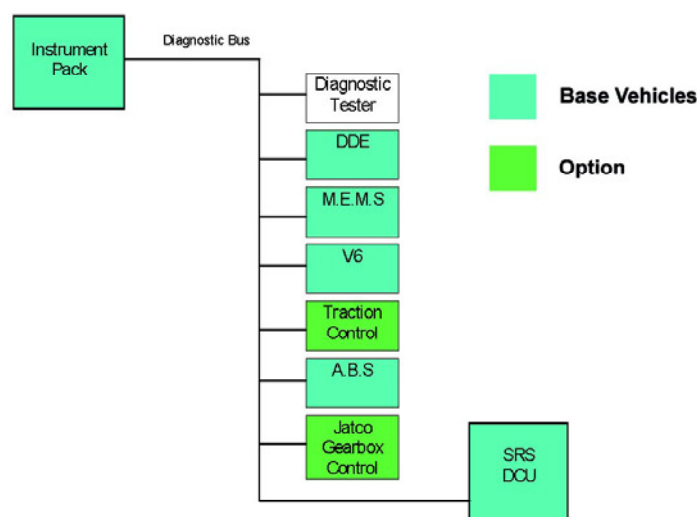


Fig. 2 ne

The diagnostic line (see Figure 12) uses a single wire and is capable of carrying 10,400 bits of information a second. The diagnostic line is used by TestBook to interrogate what each ECU is monitoring on the networks and helps in the fault finding process. It uses a protocol very similar to that of the K-Bus system and is accessed by TestBook via the 16 pin diagnostic connector located in the driver's footwell.

The diagnostic line is connected directly to the instrument pack, the ECM, the ABS/TC ECU, the Jatco gearbox (where fitted) and to the supplementary restraint system DCU. This diagnostic line enables TestBook to interrogate individual ECU's memories for fault finding purposes. The IPK link enables TestBook to reach the ECU's on the K-Bus via the diagnostic link. The IPK microprocessor converts the messages to and from the K-Bus into the appropriate format, enabling the transfer of data. Therefore, interrogation of ECU memories of systems on the K-Bus is also possible.

The CAN-system cannot be accessed using TestBook but TestBook will assist the operator through a fault finding process which is a logical and manual procedure, as outlined above. During the design and manufacture of CAN-systems, they can be interrogated and monitored using specialist equipment. Rover Group engineers use a 'Canalyser' to explore and record the functionality of the system. In servicing, this expensive specialist equipment will not be necessary as the CAN-Bus may be diagnosed via the diagnostic line-interrogating each CAN ECU. Problems are likely to occur with faulty wires or poorly made connections and, in these cases, it will mean the loss of a signal completely. Checks for continuity of a network's wires can be carried out using a multi-meter. Faulty ECU's can be replaced by a new ECU which, if correctly configured, can be plugged directly into the CAN-system.

GM6 body controller



Figure 13

The GM6 (ground module) body controller (see Figure 13) is the central control unit which controls several of the systems on Rover 75 and is integrated with other systems. It communicates with other systems fitted to Rover 75 via the K-Bus system. There are two versions of the GM6: a highline and a lowline version. The highline version is black in colour and the lowline is cream coloured. They function in the same way and the only difference is that the highline controls the electric rear window lift system in addition to the other systems that both highline and lowline versions control.

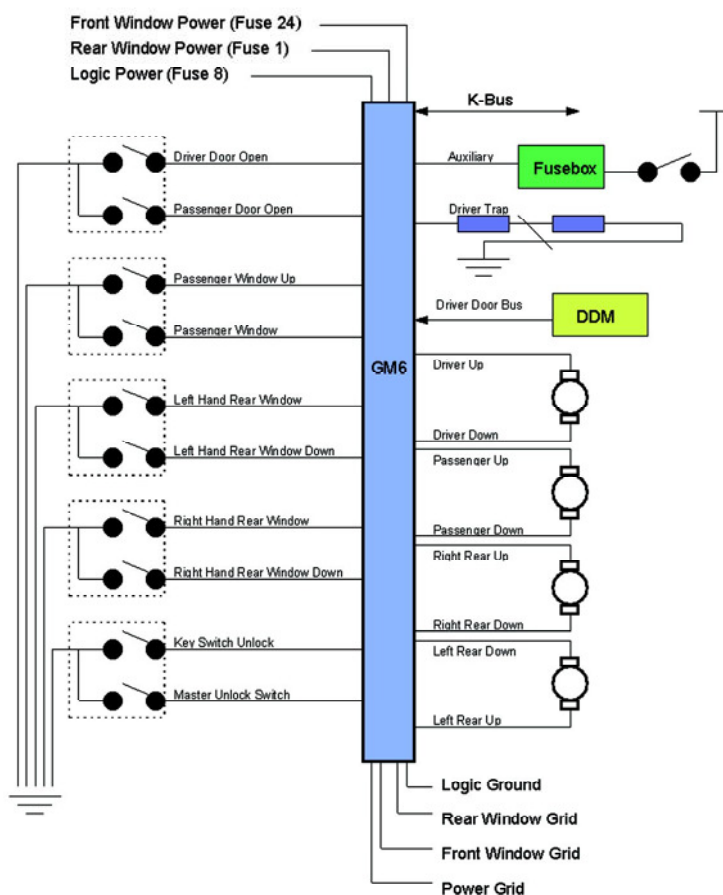
The GM6 is located on the passenger side, behind the glovebox on the cross car protection beam. Access is via the removal of the glovebox. It is secured to two weldnuts on the cross car protection beam using two M6 bolts. The GM6 also has two push-fit mounting ears. The systems controlled by the GM6 are as follows:

- Front window lift system
- Rear window lift system (highline version only)
- Alarm and R/F system (not receiver)
- Lowline HEVAC
- Interior lighting system
- Wiper system (including powerwash for the headlamps)
- Heated rear windscreen
- Central door locking
- Fresh air/recirculated air flap (all levels of HEVAC)

(ai mode

The vehicle leaves the factory in transit mode and needs to be taken out of transit mode using TestBook. Transit mode is a power saving mode which alters how the vehicle systems operate whilst in transit to prevent battery discharge.

Window lift system



o i t

The GM6 controls all window lift operations (see Figure 14). The driver's door switchpack (see Figure 15) can operate all the windows in the vehicle and communicates with the GM6 using a discrete serial communication Bus (WIN-Bus). This is a single wire through which all driver demands are sent to the GM6 as digital signals. The GM6 receives these signals, converts them and transmits them as outputs to the relevant motors. The switches controlling the passenger and rear windows are all hard wired to the GM6 and switch to ground. The switches are monitored by the GM6.



Figure 15: Driver's door switchpack

Operation of the window lift system is available with the ignition switched to auxiliary position 1 or ignition position 2. There is a TestBook programmable time out feature that enables the window lift system to be operated for a predetermined amount of time after the ignition has been switched off. The programmable time is between 0 and 40 seconds with the default setting being 40 seconds. The timing function is disabled if either of the front doors are opened or if either of the front doors were open when the ignition was switched off. The timing function disable feature is TestBook programmable. The disable feature can be configured to function with the opening of the front doors or with the opening of all of the doors.



Figure 16

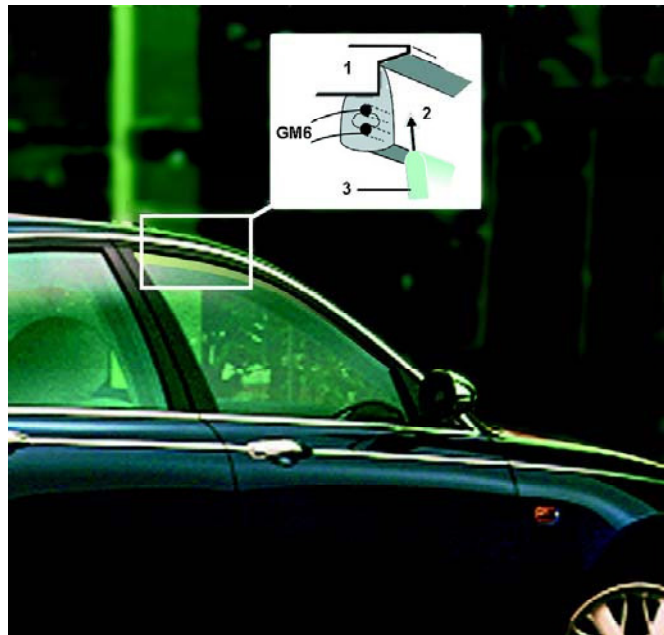
The individual door switches (see Figure 16) which control the movement of the electric windows are located on the door trim casings on the grab handle. The front passenger and rear passenger window switches are rocker type switches. The rocker switches are momentary action and have three positions:

1. Central position - off
2. Up position - drives window up
3. Down position - drives window down

The driver's door switchpack contains switches for the operation of all the windows. Where rear electric windows are fitted there is a rear window disable switch on the driver's door switchpack. When this switch is operated it will inhibit operation of the rear window switches, leaving control of the rear windows to the driver.

One-shot

A one-shot down feature is available on all windows. Pressing any of the window switches down for less than 0.4 seconds will drive the window to fully open. Operation of any of the switches for longer than 0.4 seconds activates manual control of the window. In this instance, the window will move in the direction selected for as long as the switch is pressed/operated.

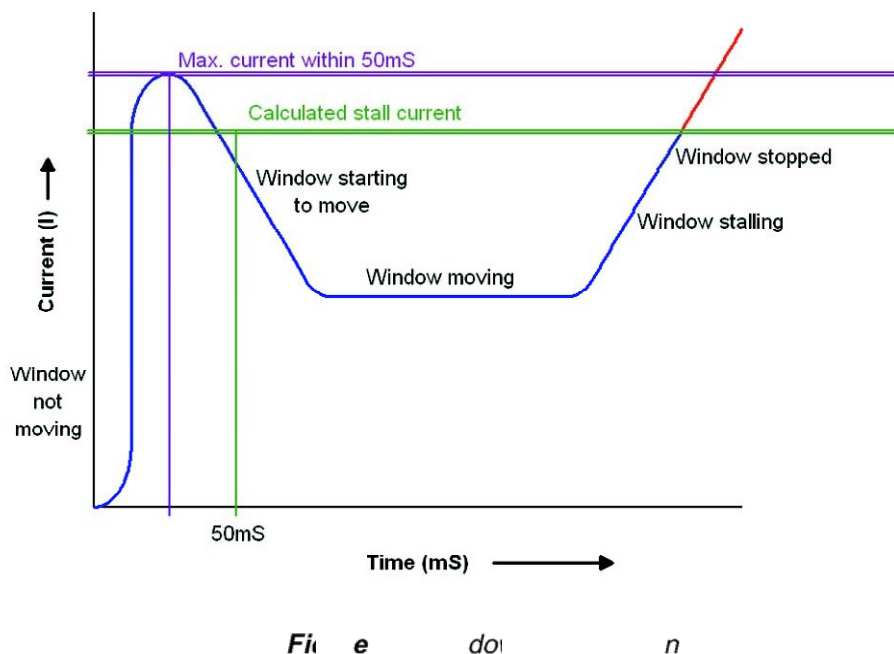
Anti-trap**Figure 17**

- 1. Door frame finisher
- 2. Object
- 3. Glass

This feature is available on the driver's window on higher trim levels of Rover 75. Where fitted, the added feature of one-shot close is available. The anti-trap function is designed to detect when an object is placed between the top edge of the glass and the top of the window frame. The anti-trap system uses a hollow rubber seal with two conductors running through it (see Figure 17). One of the conductors is wired to the GM6 and the other is wired to ground. The rubber seal is fixed to the door inner frame finisher using double sided tape. When an object is placed between the top edge of the glass and the top of the window frame, the window will transmit pressure through the object. The pressure from the object will be exerted onto the conductive rubber seal. This pressure will force the conductors to make contact with each other and the GM6 will register a change of resistance between the conductors. The GM6 registers this as an obstruction and drives the window downwards to the fully open position.

The trap sensor has highest priority on the window up movement. If the sensor fails, the GM6 will adopt 'inch mode'. This is a fail-safe procedure which, when an up request is made on a system with a faulty trap seal, will drive the window up for 0.5 seconds. To fully close the window the switch will need to be repeatedly pressed and released until the window is fully home.

Window operation



The GM6 also monitors the current flowing during a window movement to detect when the window has reached its fully open or fully closed position (see Figure 18). The peak current drawn during a window movement will be at the start of the operation. This is because the window motor must initially overcome the friction between the window contact and the door frame. When the window begins to move there is a current drop. The GM6 will record the current level at the start of the window operation and base its figure for stopping the window motor on this. When the window reaches its full travel, the current builds again as the motor continues attempting to drive the window. When the current reaches the level determined by the GM6 from the start current it switches off the motor.

The GM6 automatically calibrates itself with each window use i.e. it measures the starting current at the beginning of every window operation. It does this because the start current can vary with conditions, particularly changes in temperature. A predetermined current level is not suitable for these reasons. There is an overall current threshold stored in the GM6 to protect the system from high currents caused by stiff or stuck windows. When the current reaches this level, the GM6 automatically switches the motor off. If the motor stalls, for whatever reason, the current will rise until it passes the start current, or overall current threshold, after which the motors will be turned off by the GM6.

Window conflicts

Switch conflicts occur when a local window switch is pressed simultaneously with the corresponding switch in the driver's door module in the opposite direction. When this occurs the window will stop moving. Further operation of the window causing conflict will cause the inch mode to be adopted.

Lazy venting

Lazy venting of the windows and sunroof is available through use of the key or the master lock switch. The key must be inserted into the driver's door lock and turned and held in the unlock position for longer than one second. This function will only operate if there is no other key in the ignition. The windows will continue to move until they are fully open or until the key is released in the driver's door switch. Provided the window lift system is operative, lazy venting can be carried out by holding the master lock switch on the centre console in the unlock position for longer than 1 second.

The GM6 limits the time for which any window motor may operate to seven seconds. If this time limit is reached, the output is switched off, regardless of any other condition.

Interior lighting

All interior lighting is controlled by the GM6 (see Figure 19). The components that make up the interior lighting system are as follows:

- GM6 body controller
- Front interior lamp unit
- Rear interior lamp unit
- Boot lamp
- Vanity mirror units
- Door latches
- Boot latch
- Radio frequency (RF) transmitter/receiver
- Inertia switch
- Ignition switch
- Body and door harnesses
- Instrument pack
- Glovebox lamp and switch

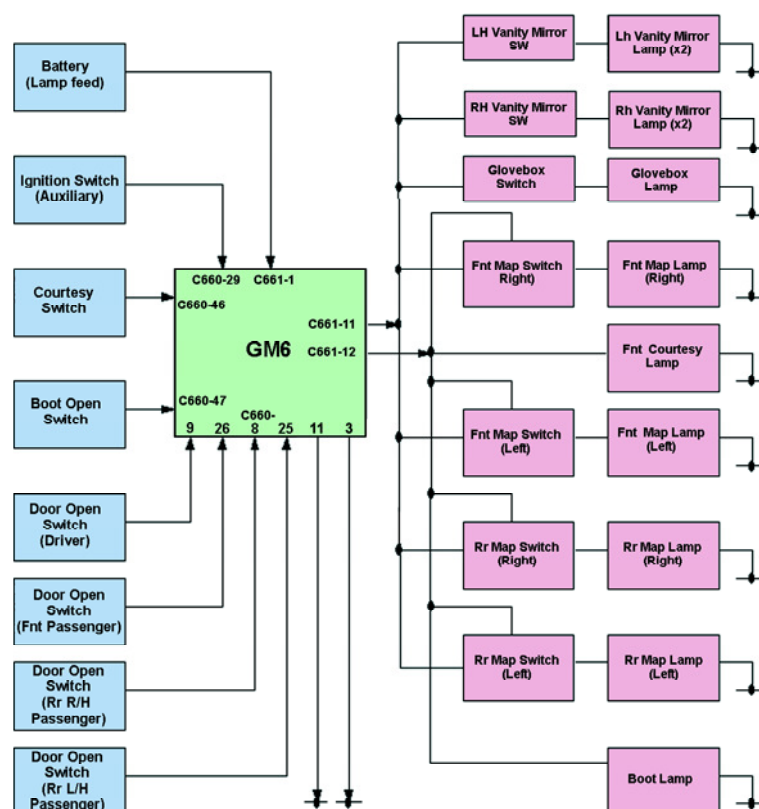


Fig. 11. Interior lighting system wiring diagram.

The manual interior light switch is located in front of the interior light unit. It is a single momentary push switch and toggles the mode of operation between three selectable modes:

1. Automatic control
2. Permanent "on"
3. Permanent "off"

Note: On power up of the vehicle, the interior light switch defaults to automatic mode.

There are front and rear central courtesy lamp units available, both with directional reading lamps.

Automatic mode

When in automatic mode, the interior light output ramps up gradually when one or more of the doors are opened, and fades out after a 20 second delay after all the doors are shut, providing the auxiliary ignition position is off. If auxiliary ignition is on, the lights will fade out as soon as the doors are shut.

If any door is left open for longer than 16 minutes in automatic mode, the interior light output is switched off. The system resets once the open doors are closed or if a valid on/off signal is received from the interior light switch.

The boot open input has the same affect on the system as a door open input.

In automatic control mode the following inputs will switch the interior light on:

- Any open door
- External unlock (Via key or remote handset)
- Inertia switch triggered with alarm disarmed
- Interior light switch operated with interior lights off and alarm disarmed
- Boot open
- Auxiliary ignition position turned from on to off when the sidelights have been on in the previous 32 seconds. In this instance, the light will remain on for 20 seconds. This is a TestBook programmable feature

The interior lights will be switched off in the following conditions:

- All doors and boot shut with auxiliary position on or ignition position 2 on. Lights can still be switched on manually in this instance via the interior light switch
- All doors shut with auxiliary position off-delay of 20 seconds. This is dependent on the interior light switch not being switched on
- When auxiliary position is switched from on to off if the sidelights were on during the previous 32 seconds. In this case, there is a 20 delay before lights off
- External lock (via key or remote handset), provided all panels are closed
- When door(s) and/or boot are open for longer than 16 minutes
- Interior light switch is pressed with interior lights on
- Inertia switch reset
- Interior light output on for longer than 16 minutes
- Ignition turned on

on/off

Soft on/off, or ramp up and fade out, of the interior lamps is automatic on all interior lamps, except for the manual operation of the interior light switch operations. Metal oxide semi-conducting field effect transistors (MOSFET) are used to pulse width modulate (PWM) the two outputs from the GM6 which feed the lamp circuits. This modulation follows a linear ramp, increasing and decreasing (on and off) the current supplied to give a smooth and proportional change in light intensity (ramp up and fade out) .

Sunroof

The Sunroof system has essentially four serviceable components. The following identifies these components and their locations:

- Remote switch - located in the header console, at the front of the vehicle
- Motor and electronics - situated just in front of the sunroof aperture
- Harness - runs from the control unit to the switch and down the left hand 'A' post where it joins the body harness
- Mechanisms - located around the sunroof aperture

Removal of these components will necessitate the removal of the headlining to expose the fixings.

switch control modes

The sunroof control unit controls the operation of the sunroof, via the remote switch (see Figure 20), and the GM6. Operation of the sunroof is enabled upon turning the ignition key to the Auxiliary (AUX.) position and is disabled 45 seconds after the ignition is switched to the '0' position. Modes of operation available to the user are shown below:



1. Tilt
2. Inch close
3. One touch close
4. Inch open
5. One touch open

To achieve position 1, 2 and 4, gently push the switch in the direction indicated in the diagram. To achieve positions 3 and 5, push firmly (for at least 500ms) and release in the direction indicated.

Features and functionality

The following describes the sunroof system's features and their functionality:

t

With the sunroof in the closed position, operating the switch to position 1 (500ms), will tilt the sunroof in one continuous movement. Pressing the switch in the tilt direction again, prior to the sunroof reaching the tilt position, will stop the operation. Operating the switch when the sunroof is open, will cause the sunroof to, first close and then move to the tilt position in one continuous movement.

ose

Continuously operating switch position 2, with the sunroof in the tilt or open position, will close the sunroof. If the switch is released before the sunroof is closed, the sunroof will stop moving.

One touch close

Momentarily activating switch position 3 (less than 500ms) while the sunroof is open, will initiate a one touch operation and the sunroof will move to the closed position in one continuous movement. Push and hold switch position 3, while the sunroof is in the tilt position, will cause the sunroof to close, unless the switch is released, which will stop all movement.

open

With the sunroof closed or in the tilt position, continuously operating switch position 4 will move the sunroof to the fully open position. If the switch is released prior to the sunroof reaching the open position, all movement will cease.

One touch open

Momentarily operating switch position 5 (less than 500ms) while the sunroof is closed or partially open, initiates a one touch operation and moves the sunroof to the open position in one continuous movement. Continuously operating the switch when the sunroof is in the tilt position, will cause the sunroof to, first close and then move to the open position. Releasing the switch prior to the sunroof reaching the closed position will cease all movement. Releasing the switch when the sunroof has reached the open range will cause the sunroof to move to the open position in one continuous movement.

Lazy venting

Turning the key in the driver's door to the unlock position and holding it there for at least 1 second, will activate the 'lazy venting' feature, this will cause the sunroof and windows to open. If the key is released, prior to the open positions being achieved, all movement will cease.

Electric operation

In circumstances where it is not possible to close the sunroof electrically (e.g. if the battery is discharged), then the sunroof can be closed or opened manually by means of a hexagonal crank handle. Removing the headlining panel insert will reveal the crank drive. If the sunroof is operated by the mechanical crank, then the control unit will not measure any sunroof movement while the battery is fully discharged or disconnected. Initialisation will be required to re-synchronise the control unit.

Initialisation

Initialisation is achieved by holding the remote switch in the roof, in the one touch closed position 3 or the tilt position 1 for more than 15 seconds after the sunroof has stopped its movement. After at least 15 seconds, the sunroof will move to a mechanical end block and the control unit will calibrate its position.

Anti-trapping safeguard

The anti-trapping safeguard is only active during one touch closing (position 3) and must respond at a jamming force of 10 N/mm. There is no trapping safeguard feature during the tilt range (position 2), hence, there is no one touch close movement available from tilt to closed. If jamming is detected, the sunroof will either stop and reverse for 1 second or revert back to its start point, depending upon regional market legislation.

Lock shut off

During the engine cranking sequence, the sunroof is deactivated. Any current actions, such as opening or tilting, are immediately terminated and the sunroof stops. If, whilst cranking, the driver operates the switch again, the Sunroof Control Unit will drive the sunroof as directed.

Interlocks

The GM6 has the ability to completely disable the sunroof via the sunroof ECU. The reason for this, is that legislation dictates that after 45 seconds all closures must be disabled. The GM6 re-enables the sunroof upon the key being switched to the Auxiliary position.

The instrument pack interacts with the sunroof ECU so that it can monitor the status of the ignition key in order to stop movement of the sunroof while the vehicle is being cranked.

The light switch module transmits a pulse width modulated signal directly to the remote switch to illuminate it.

If the sunroof is left open when the superlock function is activated, the volumetric sensors will automatically be disabled by the GM6. This avoids the alarm being inadvertently triggered.

A self diagnostic facility, through TestBook, is provided within the control system. The exchange of data with the diagnostic unit is via the instrument pack gateway by means of the Diagnostic Bus

Although the sunroof system supports TestBook diagnostics, there are some faults that fall out of the range of the controllers diagnostic capability. These are included in the following table.

Symptom	Possible fault/solution
Sunroof does not move under any circumstances	Check connector to sunroof ECU Check fusing circuit for sunroof Check roof harness connector for signs of power to the sunroof
Sunroof does not respond to any switch inputs	Check sunroof switch connector for back out Check sunroof harness for continuity Change sunroof switch if necessary Change ECU if necessary
No illumination of the sunroof switch	Check sunroof switch connector for back out Check sunroof harness for continuity Change sunroof switch if necessary
Sunroof does not respond to a single switch position (>500)	Check sunroof switch connector for back out Check ECU connector for back out Check sunroof harness for continuity Change sunroof switch if necessary Change ECU if necessary
Sunroof does not have 'one touch' operation	Check sunroof switch connector for back out Check ECU connector for back out Re-initialise sunroof Check sunroof configuration via TestBook Change the sunroof switch if necessary Change the ECU if necessary
Sunroof will only move to an open position when trying to close ('one touch' only)	Re-initialise sunroof and re-test If problem persists, change ECU
Sunroof backs off from closed position	Re-initialise sunroof and re-test If problem persists, change ECU
Lazy function does not work	Check K-Bus is functioning correctly Check all connectors back to the door key switch Diagnose the GM6

Windscreen wiper system

The wiper and wash systems are controlled by the GM6 body controller. The front wiper system is controlled by the right hand column stalk connected to the steering column (see Figure 21). There are two wiper speeds and five wiper stalk positions available to the driver:

1. Off
2. Flick wipe
3. Intermittent wipe
4. Continuous slow wipe
5. Continuous fast wipe

The front wipers will only operate with the ignition in position 1 or 2. The wiper function is disabled during engine cranking.

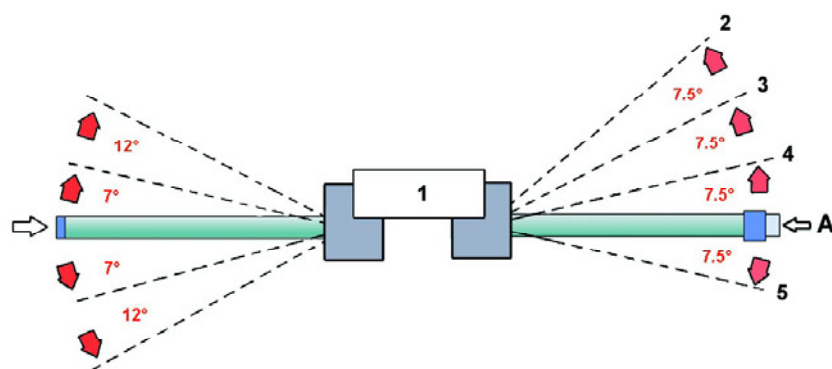


Fig. 11-13-RO-W: Wiper control

1. Rotary coupler
2. Fast wipe
3. Slow wipe
4. Intermittent wipe
5. Flick wipe

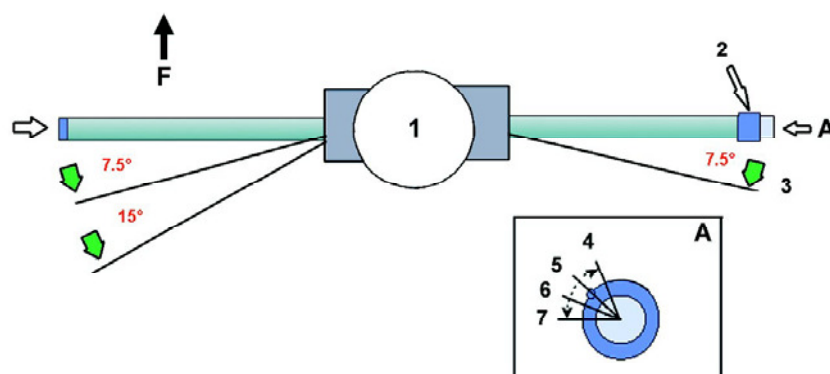


Fig. 11-13-RO-W: Wiper control

1. Rotary coupler
2. Intermittent wiper control delay
3. Programme wash/wipe
4. End stop
5. Second detent
6. First detent
7. End stop

ck wipe

Initiated by moving the wiper stalk down. When the stalk is moved down and released one slow speed wipe is performed by the wipers. Holding the stalk down operates the wipers continuously at fast speed. When the stalk is released in this mode, the wipers revert to slow speed until they reach their park position, where they stop.

Intermittent wipe

Moving the stalk switch up one position initiates intermittent wipe. In this position, the wipers will initially perform a wipe at slow speed and then return to their park position. The wipers will remain in the park position for a length of time governed by the vehicle speed and the position of the thumbwheel potentiometer on the stalk. The dependency upon vehicle speed is a TestBook configurable option. The thumbwheel potentiometer (see Figure 22) has four positions, each relating to a different delay time between wipes. When the speed of the vehicle increases, the delay time between each wipe decreases proportionally. The range of delay time can vary between 2 and 26 seconds.

Slow speed wipe

Moving the stalk switch up two positions from the off position initiates slow speed wipe. In this position, the wipers operate at their slow speed continuously. When switched off, the wipers continue to operate until they reach their park position. In this mode, if the vehicle slows down to less than 8 km/h the wipers operate at intermittent wipe. If the vehicle speed subsequently rises above 8 km/h, the wipers will return to slow speed wipe. This speed change function is a TestBook configurable option.

Fast speed wipe

Moving the stalk up three positions from the off position initiates fast speed wipe. In this position, the wipers operate continuously at their fast speed. When switched off, the wipers continue to operate at slow speed until they reach their park position. In this mode, if the vehicle slows to less than 8 km/h the wipers operate at slow speed wipe. If the vehicle speed subsequently rises above 8 km/h, the wipers will then return to fast speed wipe. This speed change function is a TestBook configurable option.

Programmed wipe

Moving the stalk rearwards initiates a programmed wipe. Whilst the stalk is held rearward the washer pump and the wipers will run continuously until the stalk is released. The wipers will start wiping only if the wash has been activated for at least 0.75 seconds. When the stalk is released, the wipers will automatically perform three slow wipes and then return to their park position. If during the programme wipe the stalk position is changed, the programme wipe will cease operation and the newly requested wiper function will be carried out.

There is a washer fluid level switch connected to the instrument pack, which is held open when the fluid level is above a predetermined level. When the washer fluid reaches a predetermined low level, the switch closes. Once the switch has been closed for longer than twenty seconds the warning lamp in the instrument panel will illuminate. A message will be displayed on those instrument packs fitted with a message centre.

Headlamp power wash

The headlamp power wash system is available as an option on Rover 75. When the windscreen washer pump is operated with the ignition on, and if the dipped headlamps or main beam are on, the headlamp power wash pump is also operated. It will operate on the first operation of the windscreen wash and will then continue to operate on every 5th operation of the windscreen wash.

The windscreen wash has priority and when the washer fluid is below a certain level the power headlamp wash will be inhibited. The GM6 controls the switching of the headlamp power wash via a relay located in the passenger compartment fusebox.

Heated washer jets

Another option available on Rover 75 is heated washer jets. There are two heating elements in the tip of the washer jets to prevent the build up of ice inhibiting the operation of the jets. These are not controlled by the GM6. They are switched directly from the ignition switch.

Wiper park

The windscreen wipers can be configured using TestBook to park in one of two ways when the auxiliary position is switched off:

1. Continue with its current cycle until the wipers reach their park position
2. Stop immediately as soon as ignition is turned off. When auxiliary ignition is restored, and the wipers are switched off, the wipers will return to their park position

Wiper stall protection

The front wiper park switch is used to detect stalling of the wipers. If the wiper run relay is on and the wiper park switch is open circuit, or short circuit, for longer than 18 seconds, then the wiper run relay will be de-activated and the wipers will be stopped and will not park.

The wiper motor cannot be restarted after a stall detection, until the ignition auxiliary position is turned off, and then back on again, or if the wiper stalk is moved to the off position and then back to any of the on positions.

Automatic wiper control



Figure 23: Rain sensor

The rain sensor (see Figure 23) is available as an option on Rover 75. The system controls the frequency of the windscreen wipe cycles, reducing the amount of driver intervention necessary to cope with varying environmental conditions. The rain sensor informs the GM6 when it is necessary to automatically initiate wipe cycles. The rain sensor is mounted directly onto the windscreen, behind the rear view mirror with the socket facing the roof. The sensor is attached directly onto the rain sensor optical body (prism). This unit is heat-mounted onto the windscreen. The system has its own infra-red light source and measures the amount of light escaping/reflecting through the windscreen, which varies according to the amount of water on the windscreen. The system also has its own heating element to defrost/demist the windscreen where the sensor is located.

Automatic wiping is initiated when the ignition is in position 1 or position 2 and the wash/wipe lever is raised to the first position - intermittent mode. On selection, the system will instigate a wipe cycle for initial calibration and from there on, re-calibration will occur on every wipe cycle to adjust to changing conditions. The frequency of the wipe cycle varies proportionately to the degree of wetness on the windscreen. The sensitivity of the system is adjusted manually by using the thumbwheel potentiometer on the wiper stalk. The system has software capable of compensating for long term variations caused by scratches or stone chips. The system can also compensate for temporary variations in the surface of the windscreen caused by dirt or salt and water smears caused by worn wiper blades.

When the vehicle is travelling below 8 km/h the sensitivity of the system is reduced automatically. In these circumstances, the wipers will operate continuously only if there is heavy rain. Vehicle speed is relayed via K-Bus to the rain sensor every two seconds. The sensitivity of the sensor is then adjusted continuously to match the current vehicle speed.

The system communicates via the K-Bus system and is self-calibrating. When the wiper switch is in the intermittent position, the rain sensor sends a message to the GM6 body controller every 10 seconds, signalling its correct operation. If the GM6 doesn't receive a message from the rain sensor for a period greater than 12 seconds, it instigates the standard operation of intermittent mode wiping. If the rain sensor message arrives at the GM6 subsequent to the 12 second period, rain sensor intermittent control will be restored. If the rain sensor loses power and does not transmit the message for over 12 seconds, the rain sensor will not regain control. In this instance, once power is restored, to restore rain sensor intermittent control, the wiper stalk must be moved to the off position and then back to the intermittent position. Alternatively the ignition can be turned off and back on again.

The rain sensor receives two pieces of information from the GM6, via K-bus. A single message from the GM6 informs the rain sensor of the wiper stalk position and the wiper thumbwheel position. These messages are event driven (i.e. sent only when the status of one or both of the switches has been changed, or if there is a request by the rain sensor).

The rain sensor receives a number of messages via K-bus from the instrument pack. These contain information about:

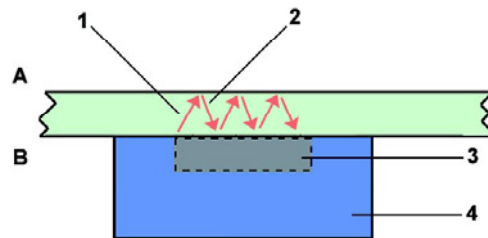
- **Ignition status:** Determines operation of the rain sensor
- **Vehicle speed:** Used to adjust vehicle sensitivity. Higher speeds require greater sensitivity
- **Ambient temperature:** Used by the rain sensor to adjust the temperature of its internal heater to prevent condensation and icing of the rain sensor windscreen portion

Rain sensor functionality

The rain sensor consists of four major components:

1. **Infra-red transmitter and receiver:** The transmitter sends infra-red light through the windscreen, via the optical unit (prism). When the infra-red light hits the connection point between the glass and air it is reflected back into the optical unit (prism). The receiver measures the intensity of the incoming infra-red rays. The sensor is calibrated to determine from the reflected infra-red rays the amount of water on the windscreen. From this information the sensor can calculate when to initiate a wipe
2. **Heating element:** This component ensures the optical element and the windscreen piece it is attached to remain free from condensation and/or ice
3. **Photoelectric cell:** In poor visibility and dark driving conditions the driver can experience intense dazzle from light shining through water droplets on the windscreen. In these dark and wet conditions the human eye is more sensitive to the headlights of oncoming vehicles. To compensate for this, the rain sensor sensitivity is increased and wipe cycles become more frequent. This helps to prevent dazzle by ensuring water droplets are removed rapidly from the windscreen in wet and dark conditions. A photoelectric cell is used to control the sensitivity of the rain sensor to match the visibility conditions
4. **Microprocessor:** Located within the sensor, this is where the calculation for the delay between wipes is determined against the given inputs

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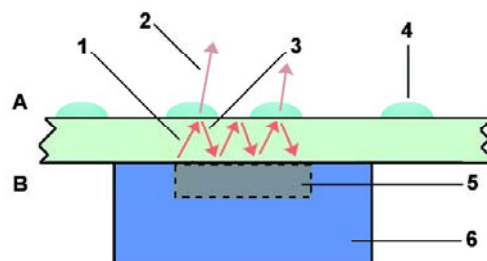
an w een

- 1. 100% light transmitted
- 2. 100% light received
- 3. Optical unit (Prism)
- 4. Rain sensor

A = Outside vehicle B = Inside vehicle

The rain sensor operation is based on the principles which govern light reflection at bordering layers between materials. Different materials have different refraction indices, which mean that they reflect light in different ways. In clean and dry circumstances, the bordering materials that the rain sensor measures are glass and air. In wet circumstances, the bordering materials are a combination of glass, air, and water.

The transmitter within the rain sensor sends out infra-red light via the optical prism, through the windscreen. The infra-red light is transmitted at a precise angle, which means that when the windscreen is dry and clean 100% of the light transmitted is reflected back into the rain sensor (see Figure 24) (although, in reality, some of the light is absorbed by the windscreen). This is called 'total reflection'. In this instance, the amount of light transmitted is equal to the light entering the receiver.



Fi_l e en

- 1. 100% light transmitted
- 2. Lost light
- 3. Less than 100% light received
- 4. Raindrop
- 5. Optical unit (prism)
- 6. Rain sensor

When the windscreen is wet over the area monitored by the rain sensor, total reflection does not occur (see Figure 25). Some of the light escapes by refraction into the rain droplets and only a reduced percentage of the light is reflected. The proportion of light escaping and light reflecting is determined by the wetness of the windscreen. The wetter the windscreen, the less infra-red light is reflected back into the rain sensor. The sensor can calculate, from the amount of infra-red light being reflected, how wet the windscreen is and when a wipe cycle is required.

i n s t r u m e n t s

If the rain sensor needs replacing, or a windscreen fitted with a rain sensor needs replacing, the sensor can be removed from the screen via two retaining clips. The replacement sensor can then be clipped in its place. If the windscreen is being replaced, the optical element is discarded with the windscreen. The sensor is then fitted to the replacement windscreen which has an optical element pre-fitted.

If the optical element becomes faulty a new screen with an optical element pre-fitted will need to be fitted.

Note: When cleaning the car in an automatic car wash, the wiper switch stalk must be in the OFF position or the ignition should be OFF.

Locking and alarm systems

Introduction

The components for the locking and alarm systems are common and interlinked. They can be segregated from each other via TestBook programming but this is rare and the systems will, therefore, be discussed together.

Keys



Figure 26: Keys

The Rover 75 vehicle locking and alarm systems are controlled by the GM6 body controller. The vehicle is provided with three types of key, all of which can be used to lock/unlock the vehicle and arm/disarm the alarm. The three types of key are:

- Key with a remote transmitter for locking/unlocking the vehicle, and a transponder for re-mobilising the vehicle (see Figure 26)
- Key with a transponder
- Plastic emergency key with a transponder (sometimes called a wallet key) (see Figure 26)

The key blade has an internal waveform and the mechanical code for the waveform of a vehicle key blade is kept on a BMW database. The codes are stored against the vehicle identification number on the database run by BMW, in Dingolfing, Germany. Hence a customer can have a new key cut only through a Rover dealer. All the keys contain a transponder used by the immobilisation system of the vehicle and all the transponder data is also stored on this database.

The remote transmitter is an integrated keyhead transmitter with a mechanical key. The transmitter contains two buttons. One for locking and superlocking of the vehicle, and one to unlock the vehicle. The battery inside the handset can be replaced. The correct battery type is CR 2032. The transmitter sends out a signal which is picked up by the receiver which is located next to the handbrake, under the centre console. The signal needs decoding and this is carried out by the GM6.

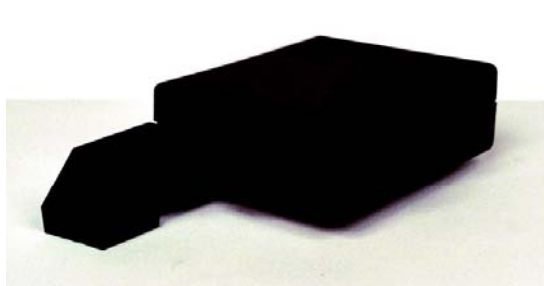


Figure 27: Remote transmitter

The transmitter and receiver (see Figure 27) use a rolling code as part of the lock and unlock signal. Every time the transmitter is pressed the rolling code changes to the next code. The GM6 is synchronised with the transmitter and is aware of the next code to expect. To cater for use of the remote transmitter away from the vehicle (usually inadvertent or idle pressing of the buttons), there is a window allowing 999 forward rolls of the code to be recognised by the system. If the rolling codes do become out of synchronisation, there is a simple process to resynchronise the remote handset with the GM6: To resynchronise the remote transmitter with the vehicle, press either button on the remote handset four times within its operating range.

The key will unlock the door and disarm the alarm in all circumstances. If the battery is discharged the key will still operate the door latch but a greater effort will be required. There is no emergency key access code (EKA).

Note: All keys contain a transponder, which is one of the primary components of the immobilisation system and will be covered later in this brochure.

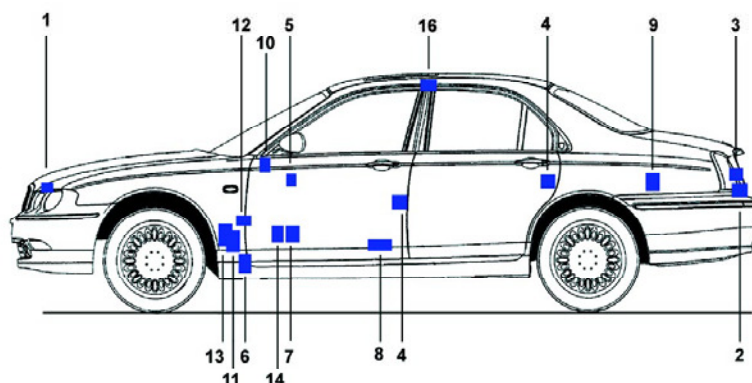
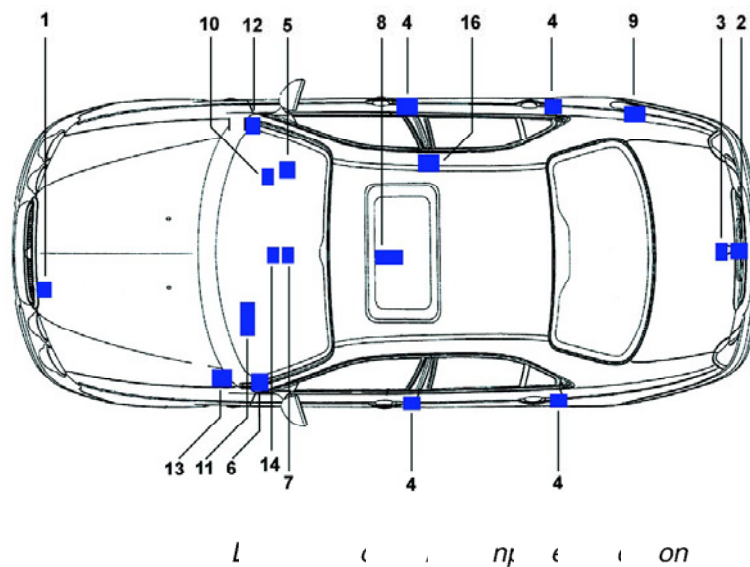


Figure 28: Location of components



The following table should be referred to in conjunction to Figure 28 and 29.

Locking/alarm components and their location

	Component	Location
1	Bonnet switch	Bonnet locking platform
2	Boot key barrel switch	Behind the boot key barrel
3	Boot open switch/release actuator	Inside the boot lid, adjacent to latch
4	Door latches	Located in individual doors
5	Ignition switch	Back end of steering column
6	Inertia switch	Inner surface of passenger side A-post, up behind the glovebox
7	Master lock switch	Centre console
8	RF receiver	Under the centre console, near the handbrake
9	Fuel flap release actuator	Rear of fuel filler flap
10	Security/alarm light emitting diode (LED)	Instrument pack
11	Battery back-up siren/alarm horn	Plenum chamber
12	Internal boot release switch	'A'-post
13	GM6 body controller	Behind glove box
14	Hazard lights/light switch module	Centre console/front fascia
15	RF remote	Keyhead
16	Volumetric sensor	Top of driver's side 'B'-post

Vehicle locking

Electro-mechanical door latches are fitted to Rover 75. All the actuators, switches and electrical systems are integrated into the latch assemblies, improving security. The door latches have three possible mechanical states:

- **Unlocked:** Sill button up. External release handle operational
- **Central door locking (CDL):** Sill button down (flush and inaccessible). External release handle disabled. Internal release handle operational (requires two pulls to open the door: One to lift the sill button, a second to open the door)
- **Superlocked:** Sill button down. External release handle disabled. Internal release handle disabled



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There is no driver side sill button switch in the latch assembly. Instead, the control input for the system is the master locking switch on the centre console (see Figure 30). The GM6, therefore, receives no feedback as to the position of the latches and every time a lock/unlock request is made from the master locking switch, the GM6 has to drive the latches regardless of their position.

The GM6 monitors the master locking switch and operates a latch motor protection feature. This will allow a limited number of operations over a predetermined period of time, after which operation of the latches will be disabled. This prevents overheating of the latch motors. After this period the latches will only operate after the appropriate amount of time has elapsed in order for the latches to cool. The last operation will always be an unlock operation, making it impossible to be locked in the vehicle as a result of latch motor protection.

The locking of individual doors can be achieved by pressing the door sill button relevant to the door. Central door locking can only be achieved using the master locking switch on the centre console, by using the driver's key, or by using the remote handset (superlock). The vehicle cannot be centrally locked by any of the individual sill buttons.

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The inertia switch is located behind the glovebox on the inner surface of the passenger side 'A'-post. When triggered (with alarm disarmed), the fuel supply is cut off, the vehicle centrally unlocks and the hazard lights operate. In this situation, the hazard lights can be switched off only by operating the hazard light switch on the centre console. To reset the inertia switch, the button should be pressed down. If the inertia switch is triggered with the alarm armed, the alarm will be triggered.

Speed Locking

This feature is available on Rover 75 as a dealer configurable option. When selected, the vehicle will lock automatically when the speed reaches 4 km/h. This will occur once every ignition cycle and can be overridden using the master lock switch.

Throttle Locking

This feature is available on Rover 75 as a dealer configurable option. This allows the vehicle to be externally locked, using a spare key, with the engine running.

Single Point Entry

The system supports single point entry. This is a security feature which unlocks only the driver's door on receiving an unlock signal from the remote transmitter or the key. To unlock the other doors, the keyholder can either press the remote handset unlock button a second time, turn the key in the lock a second time, or they can enter the car and open the other doors using the master lock switch on the centre console. If, on SPE, the car is unlocked from the superlocked state, the driver's door will unlock and the other doors will change from the superlocked state to CDL locked state. This makes it impossible to drive away with any of the doors in the superlocked state.

Door latches

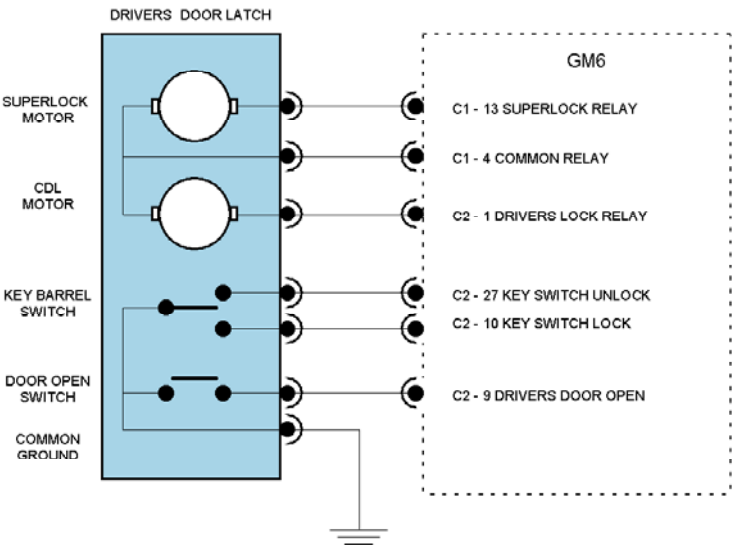
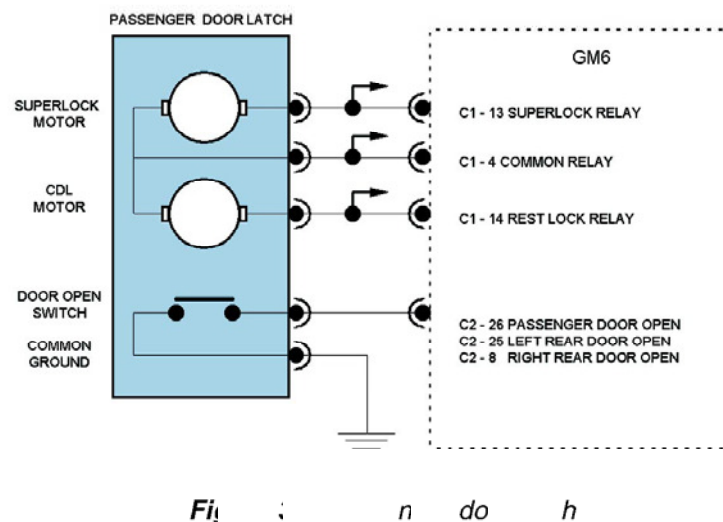


Fig. 1.10. Drivers door latch

The driver's door latch (see Figure 31) comprises of:

- **Door open switch:** A microswitch held open circuit with door closed. Shorted to ground when door opens
- **Key switch:** Lock. Microswitch held open circuit with the key centred. Shorted to ground when the key is turned to the lock position
- **Key switch:** Unlock. Microswitch short circuit to ground when the key is in the unlock position. Open circuit in other states
- **CDL Motor:** Actuator motor. Achieves locking and unlocking condition of latch. Controlled by the GM6
- **Superlock motor:** Actuator motor. Achieves superlocking/unlocking condition of latch. Controlled by GM6

The passenger door latches (see Figure 32) are the same as the driver's door latch but without the Key lock/unlock microswitches. The door open switches each have an individual input to the GM6. The GM6 has the facility to log the 15 most recent triggers of the alarm. The individual door switch feeds means it is possible to distinguish which latch has triggered the alarm. This can be beneficial in the fault finding process.



Mislock

An audible mislock sound provides information to the driver that an attempt to lock the vehicle has been made with a part of the vehicle open. The sound is generated by the GM6, which momentarily drives the alarm horn, or battery backed-up sounder (BBUS) if fitted.

If a lock, or superlock, is requested whilst the key is in the ignition lock, or when the driver's door is open, a mislock sound will be given. In these cases no locking will take place.

If a lock, or superlock, is requested with the boot or bonnet open then a mislock sound will be given. In this case, the vehicle will superlock.

If a superlock is requested whilst any of the passenger doors is open, a mislock sound will be given. In this case the doors will central lock only.

Lazy venting

Lazy venting is controlled by the key in the driver's door lock. The key must be turned in the unlock direction for more than a second and then held until the windows and sunroof are fully open, or until they are open to the distance required.

Anti-theft alarm

The anti-theft alarm is controlled by the GM6. When armed, the GM6 monitors the switches contained in the doors, boot and bonnet. It also monitors the vehicle interior if volumetric protection is provided. When triggered, the alarm initialises both visual and audible warning signals. The hazards will flash and the alarm horn, or BBUS if fitted, will sound. The alarm will trigger its responses a maximum of three times per arming cycle.

The components that make up the anti-theft alarm are located around the vehicle in positions which make access to them difficult in a short period of time. The alarm status (fully armed, partially armed or disarmed) is stored in the GM6 non volatile memory. This means that if power is lost for a period of time, the alarm will recover its correct operating mode when power is restored. If the power, or ground, is removed from the GM6 whilst the alarm is sounding, then, when the power is resumed, the alarm will continue to sound for a maximum of 30 seconds or until it is disarmed.

The precise way in which the alarm and locking system function is dependent upon the market programming of the GM6. Some markets do not require particular locking and alarm functions and in these markets they are disabled. It is possible, using TestBook, to programme dealer options to suit customer preferences. The market options are as follows:

1. United Kingdom (UK) & Europe
2. Rest of the World
3. Japan
4. Gulf

The following table describes the configuration for each market option and identifies features which are programmable using TestBook.

Name	Function	Market option	Dealer option
Alarm	Full alarm system including LED enabled	1, 2	No
	Alarm function disabled	3, 4	No
Hazards	Hazards will confirm successful locking/unlocking and flash when alarm is sounding	1, 2	No
	Hazards will confirm successful locking/unlocking of vehicle	3, 4	No
Remote locking	Superlocking enabled with single press	1, 2	No
	CDL locking with one press - superlock with second press	3, 4	No
SPE	SPE with remote transmitter or keylock action	1, 2	Yes
	SPE disabled	3, 4	Yes
Speed auto lock	Vehicle locks automatically when car travels above 4 Km/h	Dealer selectable	Yes
Bathrobe locking	This enables the car to be locked, using a spare key, with the engine running	Dealer selectable	Yes
Mislock	Sounder is pulsed when the vehicle is locked with an open panel	1, 2	No
	Mislock disabled	3, 4	No

The alarm can be armed by locking the vehicle using the key or the remote handset. The following table describes the effect on the security system of the various arming actions that can be carried out using the key and the remote handset. It should be noted that, though the vehicle can be locked and unlocked using the master lock switch on the centre console, the alarm cannot be armed or disarmed using this switch.

Lock request	Perimetric protection	Volumetric protection	CDL locked	Superlock
Master lock switch	No	No	Yes	No
Key lock	Yes	No	Yes	No
Remote lock	Yes	Yes	No	Yes (see market table above)

Perimetric protection

The Rover 75 anti-theft alarm provides perimetric protection. This means that if the doors, bonnet or boot are opened when the alarm is armed, the audible and visual warning outputs will be activated. The audible output will be provided by an underbonnet alarm horn or a battery backed-up siren, where fitted. If entry is gained into the car without opening of the boot, bonnet or any of the doors when the alarm is armed (by smashing a window), pressing the boot release switch or the master lock switch will trigger the alarm. As the alarm will still be armed in this type of forced entry the opening of any of the doors, bonnet or boot will trigger the alarm.

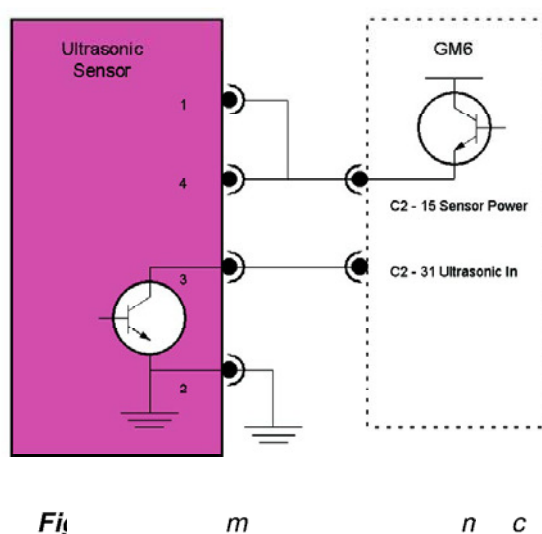
Volumetric protection



Figure 1: Footwell sensor

Volumetric protection: Volumetric protection of the vehicle through ultrasonic sensing is available with certain trim levels on Rover 75. The sensor is located at the top of the driver side 'B'-post (see Figure 33). The ultrasonic sensor is the same as the sensor used in other Rover vehicles. The sensor has a transmitter and receiver located internally. They monitor the vehicle interior and, if an intrusion is detected, they signal to the GM6 to activate the alarm signals. Volumetric protection sensors monitor in two modes:

- **Detection of breaking glass:** The sensor can detect the characteristic high frequency sounds produced by breaking glass
- **Movement of air:** The sensor can detect movement in the vehicle by the effect of the movement on the ultrasonic signals transmitted by the sensor. The sensor utilises the Doppler principle, monitoring the effect of air movement on the wavelength of the transmitted signal



The volumetric sensor has four connections: power (4), ground (2), trigger (3) and a further 12 volt feed for vehicle type configuration (1) (see Figure 34). The trigger line is pulled up to battery voltage by a resistor in the GM6 when the volumetric sensing is active. The alarm is triggered by the sensor switching the trigger line to ground. This signal is picked up by the GM6, which drives the alarm.

When volumetric sensing is activated there is a delay/settle down period of 20 seconds to allow the air movement, caused by the occupants exiting the vehicle, to stabilise. During this period, the volumetric input to GM6 is ignored.

The GM6 will not activate volumetric sensing if the vehicle is locked with any of the electric windows, or the sunroof open. It is not possible for the GM6 to recognise that a manual window left open and this, therefore, will not inhibit the activation of volumetric sensing.

Where volumetric sensing is provided, it is possible to inhibit the volumetric sensing, when necessary, by locking the vehicle with the key via the driver's door lock. In this case, perimeter protection is armed and BBUS is operational, where fitted.

Battery back up siren (BUS)



Fig. 34 BUS

Another security feature available is the BBUS (see Figure 35). It is located under the plenum on the opposite side to the wiper motor. BBUS can distinguish between a slow battery discharge and a fast battery discharge/disconnection. It is active only when the alarm is armed. If the battery is disconnected with the alarm armed, the siren will sound, being powered by its back-up Nickel metal hydride (NiMH) battery power supply. A BBUS disconnected with the alarm armed will not sound continuously but will cycle following the alarm programmed pattern. This is on for 25 seconds then off for 10 seconds. The BBUS will sound for up to 10 cycles under its own battery power – depending upon the charge condition of the batteries. When disconnecting a vehicle battery, or BBUS, always ensure the alarm is disarmed to prevent the BBUS from sounding. A vehicle not fitted with BBUS will have an alarm horn fitted in its place, or nothing.

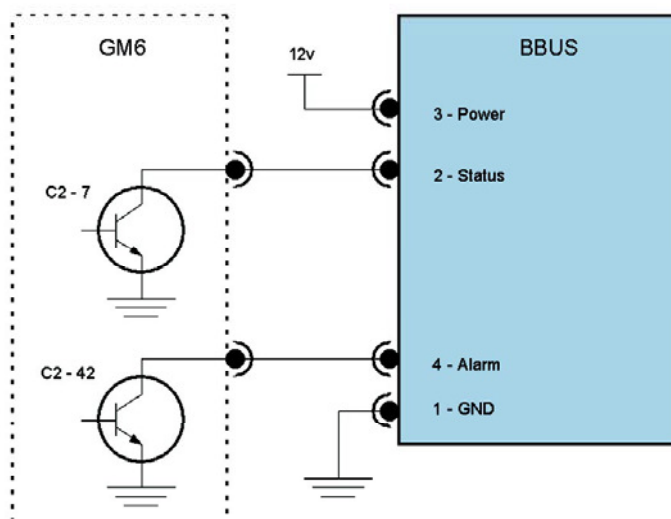


Fig. 35 BBUS

There are four connections to the BBUS (see Figure 36):

1. **Ground.** This provides the ground path for the battery charging. This line is also protected against tamper and, if disconnected, the sounder will be powered by the batteries
2. **Status line.** This line controls the arming and disarming of the BBUS. In the disarmed state the line is pulled high by a pull up resistor located inside the BBUS. In the armed state the line is pulled to ground by the GM6. This line is also protected against tamper
3. **Power.** This is the power feed to the BBUS from the vehicle's battery. When the vehicle is running, this feed is used to charge the NiMH batteries. When the alarm is triggered, this power line is used to power the sounder internal to the BBUS. If, with the alarm armed, power is lost from this line due to tampering, the internal batteries will power the sounder
4. **Alarm line.** This line causes the siren to sound. In normal circumstances it is held high, at battery voltage, by a pull up resistor inside the BBUS. It is pulled low to sound the alarm by the GM6

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Partial arming of the perimetric alarm is also available when one or more of the hinged panels are left open (doors, boot, bonnet). A mislock sound is given but some parts of the system will still be active. If the open panel is subsequently closed, the panel becomes part of the active alarm. Possible partial arming states are:

- Bonnet open: Locking and superlocking of the rest of the vehicle is possible. Also, perimetric arming of the alarm for the rest of the vehicle is possible
- Boot open: Locking and superlocking of the rest of the vehicle is possible. Perimetric alarm of the rest of the vehicle is possible. Volumetric sensing disabled
- Any of the passenger doors open: CDL locking of all panels is possible. Superlocking is disabled. Perimetric protection of other panels is possible. Volumetric sensing disabled
- Driver's door open: It is not possible to lock the vehicle. It is not possible to arm any part of the alarm

***h* rm LED**

The deterrent flashing LED is located in the instrument pack and is driven by the GM6. When the vehicle is armed successfully, the LED will flash rapidly for 10 seconds. After this period the LED will slow flash with a 5 % duty cycle until the alarm is disarmed.

If the alarm is armed with any of the panels open (partial arming) a mislock sound is given and the LED flashes slowly. After 10 seconds the LED will slow flash with a 5% duty cycle.

If the alarm is triggered, the LED will flash rapidly to indicate to the returning driver that the alarm has been triggered whilst they were away. The LED will go out when the ignition is turned to auxiliary, or after one minute from the unlocking of the vehicle.

Immobilisation

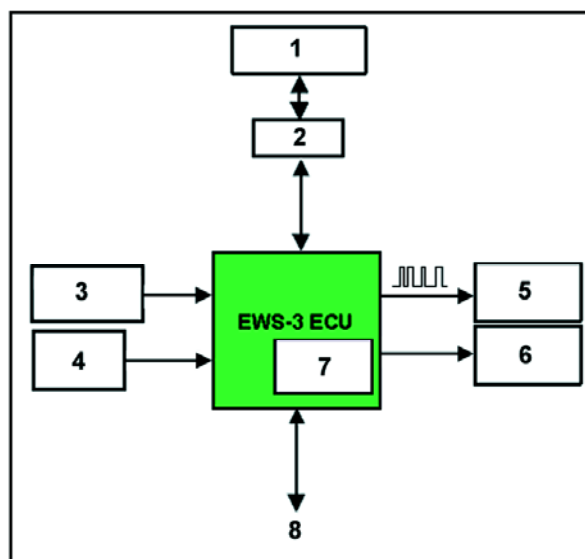
Engine immobilisation EWS-3

The immobilisation system used on Rover 75 has been developed by BMW and is referred to as EWS-3 (Elektronische Wegfahrsperre). EWS-3 is used on BMW 7-series, 5-series and the new 3-series which was introduced in 1998. The main function of the system is to prevent unauthorised starting of the vehicle by creating a secure interface which cannot be copied or bypassed in any way. It also checks systems to ensure that the vehicle is in a safe condition for starting. Immobilisation is carried out by disabling the starter motor and by preventing engine fuelling via the ECM. Although the EWS-3 system uses components in common with the locking and alarm system it is a stand alone system.

The components that make up the immobilisation system are:

1. Immobilisation ECU— EWS-3
2. Engine control module (ECM)
3. GM6 (Body controller)
4. Key transponder
5. Ring antenna (transponder coil)
6. Instrument pack (diagnostics gateway)
7. Park/neutral switch (Auto gearbox)
8. Ignition switch

Overview of the immobilisation system EWS-3



1. Transponder
2. Ring antenna
3. Park/neutral switch
4. Ignition switch
5. Engine control module
6. Starter motor
7. EWS-3 ECU
8. K-Bus link

When a key is inserted in the ignition, a three stage check is carried out. Each key has a unique identification number and this is sent by the key transponder to the EWS-3 ECU. A password unique to the key is used by the EWS-3 ECU to communicate with the transponder. The final stage of the key identification is the confirmation that the rolling code from the transponder matches with the EWS-3 ECU rolling code. Once the EWS-3 has confirmed that a valid key is requesting the starting of the vehicle, it will energise the starter motor relay and inform the ECM that starting has clearance by sending the correct code to the ECM.

The EWS-3 ECU controls the starting of the vehicle by communicating with the ECM via a unidirectional data line. It also uses data sent by the ECM via messages on the CAN-Bus. These messages are converted by the instrument pack into the format compatible with the K-Bus system and sent to the EWS-3 ECU. The EWS-3 also controls the operation of the starter motor via control of the starter motor relay. This relay is internal to the EWS-3 ECU.

EWS-3 electronic control unit



Fig. 38 : EWS-3

The EWS-3 ECU (see Figure 38) is located on the driver's side A-post and secured by two fixings. The ECU arrives from the supplier as a blank unit and is programmed with a starting code during vehicle manufacture. This code has to be learnt by the ECM and this programming is also carried out during the manufacture of the vehicle. This starting code is then used as a base point for the rolling code by both the EWS-3 and the ECM.

The EWS-3 electronic control unit governs the overall immobilisation and re-mobilisation of the vehicle. Without it receiving a valid signal from a key transponder it will inhibit starting of the vehicle. The starter motor will be disabled and the ECM will not initiate fuelling of the vehicle. Each key has its own identity and the EWS-3 is capable of supporting up to ten keys.

When all the key slots have been used and more keys are required, the EWS-3 must be removed and a new EWS-3 fitted. Therefore, a maximum of 10 keys per vehicle are available at any given time. When new keys are supplied, they arrive ready for use with the vehicle, having been pre-programmed with the relevant coding. This coding relates to a new slot in the EWS-3 ECU. The ECU is capable of recognizing the first use of the new key and initiates the rolling code transfer from then on.

The EWS-3 can communicate with the different types of engine management systems incorporated in the Rover 75 range using the same protocol. The EWS-3 also has a link to the K-Bus system, from which it receives data about the condition of the vehicle. From this it can establish if it is safe to start the vehicle (i.e. engine speed, locking status etc). On vehicles fitted with automatic transmission, there is an input from the Park/Neutral switch which must be present before the EWS-3 allows re-mobilisation of the vehicle.

When a replacement EWS-3 is fitted, TestBook will be able to recognise what type of transmission is fitted to the vehicle via the central coding key information stored in the EWS-3 ECU, the IPK and the ECM.

If a fault occurs with the EWS-3 ECU, a replacement is available only through a recognized dealership, which will follow a strict process for the replacement of immobilisation components. A database at BMW in Germany holds all the relevant information for every EWS-3 ECU against the vehicle identification number. Information cannot be read directly from the EWS-3 ECU using TestBook or any other diagnostic tool. If a replacement EWS-3 ECU is requested, the appropriate information is accessed and programmed into the replacement EWS-3 ECU at the relevant centre. The EWS-3 ECU will arrive at the dealership ready for fitment to the vehicle. Once the replacement part has been fitted to the vehicle, TestBook will be required to re-synchronise the EWS-3 ECU with the engine control module.

Note: It should be noted that no blank EWS-3 ECU's, or blank keys, will be stocked by the dealers.

EWS-3 also incorporates a starter motor protection function. When the engine speed exceeds a predetermined value, the starter motor relay inside the EWS-3 ECU is disabled. This prevents destruction of the starter motor in the event of a sticking ignition switch.

Engine control module (ECM)

The EWS-3 ECU is capable of working with the three different engine controls modules fitted Rover 75 derivatives. KV6 2.0 and 2.5 litre engines use a Siemens 2000 engine management system. The K1.8 uses Rover modular engine management system (MEMS 3). The diesel M47 uses the digital diesel electronic (DDE 4.0) engine management system.

Each ECM arrives from the supplier in a blank condition (i.e. without a starting code base point). During the manufacture of the vehicle, there is a process carried out whereby the ECM learns the starting code from the EWS-3 ECU. This process means that the swapping of the ECM or the EWS-3 ECU from one vehicle to another will not be possible because the correct code will not be present in both ECU's. The ECM will allow starting of the vehicle only on reception of a valid code from the EWS-3.

Each ECM can learn only one starting code. For it to learn another it must first be blanked by the supplier. A new ECM will be required in most circumstances and TestBook will be needed to transfer the codes from the EWS-3 ECU to the blank ECM.

There is a window which allows the EWS-3 rolling code to roll ahead of the ECM. If the ECM and the EWS-3 should become out of synchronisation they will need to be re-synchronised using TestBook.

GM6

The function of the GM6 in the immobilisation of the vehicle is to provide the EWS-3 with the locking status of the vehicle. The vehicle will not start in a superlocked state. If, upon receiving a valid key signal, the EWS-3 ECU receives a signal from the GM6 that the vehicle is in the superlocked state, the starting process will be suspended momentarily. The EWS-3 will output, via K-bus, the mobilised status of the vehicle to the GM6. The GM6 will then change the vehicle from the superlocked state to an unlocked state. Starting of the vehicle can then take place. Superlocking of the vehicle is carried out by pressing the remote lock button located on the keyhead. It is possible to inadvertently press this button prior to inserting the key in the ignition. The car would then be in the superlocked state and GM6 intervention is necessary to prevent starting and driving of the vehicle.

The GM6 also prevents external locking of the vehicle if the key is in the ignition, by checking the immobilisation status via K-bus. Only if the EWS-3 has put out via K-bus the message that a valid key is not in the ignition lock will the GM6 allow the vehicle to be locked externally.

Ring antenna and key transponder

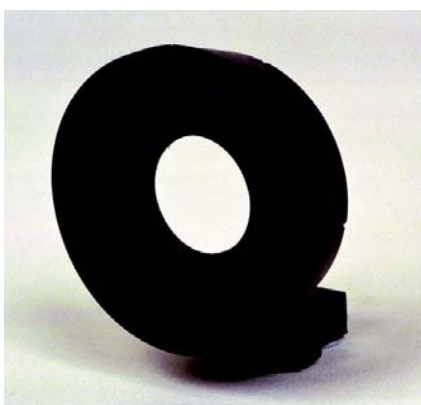


Figure 39: Ring antenna

The ring antenna (see Figure 39) is clipped onto the ignition key barrel. When the key is placed in the ignition and switched to auxiliary position, the ring antenna energises the transponder in the key. This is achieved by induction using a 125 kHz frequency power supply from the EWS-3 ECU. This enables transfer of data to take place to and from the transponder in the key.

The wires to the antenna are part of the main harness and should not be more than one metre long to prevent interference to the signal. The transponder has to impart its unique identification number and a valid rolling code. When a valid key signal is read, the vehicle can be started and a new rolling code is written to the transponder for the next operation by the EWS-3 ECU.

The key is made up of a mechanical blade and a transponder. The key blade has an internal mechanical waveform. The code for this waveform is stored on a database by BMW, Germany. The transponder chip consists, primarily of a wireless electrical erasable programmable read only memory (EEPROM) which can be written to and read from by the EWS-3 ECU. The range for communication between the ring antenna and the transponder is 2 centimetres. The identification data is programmed into the blank transponder during vehicle manufacture. Each of the transponders is matched with one of the 10 key slots contained in the EWS-3 ECU. Once it is programmed in it cannot be overwritten.

The codes for all 10 slots are programmed randomly into the EWS-ECU during manufacture of the vehicle. Three of these slots are taken up immediately by the three keys which are coded during vehicle manufacture for the vehicle's owner. The data and codes for each of the 10 slots are stored in a database at BMW, Dingolfing, Germany. The information on all EWS-3 ECU's, transponder keys and lock sets is not stored anywhere by Rover Group. When a new key or lock set is required it must be processed through a recognised dealership, which will order the new component. The relevant data will need to be accessed from Dingolfing, Germany.

It is vitally important that the vehicle identification number (VIN) is recorded accurately. Inaccuracies can mean a delay in the supply of parts to the customer with an invalid VIN. If the inaccuracy has led to the recording of a VIN which is incorrect in relation to the vehicle but is recognised by the database as a valid VIN (for another vehicle), this can lead to the manufacture of an incorrectly coded key. This not only causes a delay for the customer but also means slots from another vehicle EWS-3 ECU have been used wrongly. The replacement parts arrive ready for fitting to the vehicle.

If a key is lost, the slot it is addressed to should be disabled to prevent unauthorised starting of the vehicle. This is done using TestBook and requires all available valid keys to complete the process. This way, TestBook can read the identity of all the keys still available and can disarm the slot of the missing key. If the key is subsequently found, the process can be reversed and the slot made valid again.

The transponder chip also contains customer service data which is updated whilst the vehicle is being driven. The service data includes VIN, total mileage and service due date.

Instrument pack

The instrument pack is the gateway for all the Bus-systems and it is through this gateway that diagnostic and programming equipment communicates with the EWS-3 system. The EWS-3 communicates with the ECM using a unidirectional link and with the rest of the vehicle via the K-Bus-system.

On highline instrument packs, 'Engine Disabled' will be displayed on the message centre when the ignition is on and either no key or a wrong key is detected. If the transponder in a correct key is faulty, 'Engine Disabled' will be displayed and the vehicle will not start.

Emergency access

There is no Emergency Key Access (EKA) code facility with Rover 75. Any correct key will facilitate entry into the vehicle, even when the CDL system is non functional. Re-mobilisation of the vehicle will be possible only with the correct key in the ignition with a working transponder with valid codes. An emergency key is supplied with the vehicle. It contains a relevant coded transponder and is slim enough to fit into a wallet or purse.

Instrumentation

Instrument panel

The primary function of the instrument pack (IPK) is to provide the driver with continuously updated information about the vehicle and to indicate faults as they occur-usually by illuminating a warning lamp. The IPK fitted to the Rover 75 is an intelligent unit controlled by a microprocessor and acts as the gateway for the network Bus-systems. The IPK has an EEPROM which stores updated information in this non volatile memory.

The IPK is designed to display information quickly and unambiguously. For this reason, the IPK has a central and prominent position within the driver's field of vision, requiring only the slightest eye adjustment to access the data displayed. The IPK uses a combination of analogue and digital displays combining new technology with proven effective display gauges.

There is a highline and a lowline version of the Rover 75 IPK. Both perform the same function and display the same information, the only difference is in the methods used to display some of the information to the driver. All of the gauges displayed on the highline IPK are identical to the gauges displayed on the lowline IPK. The difference arises with the upper warning lamp array on the lowline IPK (see Figure 41) being replaced with a 2.5 inch Bi-colour display message centre on the highline IPK (see Figure 40).



Figure 40

The IPK has three main modes controlled by the position of the ignition, and different functions are available with each position:

- **Ignition Position 0 (KL.30 or Off):** In this position, the IPK is in stand by mode and the quiescent current drain is 1mA. In this position the IPK is monitoring the K-Bus because some systems are operative with the ignition off (e.g. seat memory will operate when driver's door is opened before the ignition is switched on). If the trip reset button is pressed in this state, the digital odometer will illuminate and display the total mileage, and the fuel gauge will be driven and display the fuel level
- **Ignition Position 1 (KL.R or Auxiliary):** In this position, the IPK calculates and displays the ambient temperature. On highline IPK's, the message centre is switched on and after receiving messages from the GM6, via K-Bus, the vehicle map is displayed, indicating the status of the doors. On lowline IPK's, the relevant warning lamp is illuminated to indicate if a door is open. The digital odometer comes on and remains on
- **Ignition Position 2 (KL.15 or Ignition On):** In the position, all the gauges become active and the CAN-Bus also becomes active. The IPK carries out a bulb check on the low fuel warning lamp and the high coolant temperature warning lamp. These lamps will illuminate for four seconds after switching to ignition position 2 and will extinguish if everything is correct. Other warning lamp bulbs are checked by their own controlling ECU and the bulbs are illuminated for a time controlled by that ECU. E.g. ABS, supplementary restraining system (SRS) etc
- **Ignition Position 3 (KL. 50 or Crank)**

Bus connections

The instrument pack is the gateway for all the Bus-systems on the vehicle. Many signals generated by sensors on the vehicle need to be transmitted on more than one of the Bus-systems. The Bus-systems use different protocols and work at varying speeds/frequencies. The signals are received from one of the Bus-systems by the IPK and are formatted by the microprocessor in the IPK. This makes the signal compatible for transmission on the other Bus-systems. The Bus-systems connected to the IPK are:

- **CAN-Bus:** Used primarily for communication between the engine management system, the automatic transmission control unit and ABS systems fitted with traction control
- **K-Bus:** Used primarily for communication between body electronic systems (e.g. GM6, light switch module, memory seats etc)
- **DS2-Bus (Diagnostic Line):** Used by TestBook to communicate with system ECU's
- **Nav-Bus:** A discrete navigation bus to the IPK for displaying navigation communications

Instrument pack gauges



Figure 4 Instrument pack

The major gauges and displays incorporated by the instrument pack are as follows:

Speedometer

Located on the right hand side of the instrument panel, the speedometer is one of the major analogue dials. The wheel speed signal is hardwired from the ABS ECU (front right wheel speed sensor) which transmits the signal as a digital square wave (39,000 pulses per mile). The IPK translates/calculates and displays the information on an analogue gauge in mph and km/h: Scale is 0 – 150 mph and 0 – 240 km/h. The IPK then transmits the vehicle road speed on the CAN and K-Bus.

Odometer

The odometer unit is located at the bottom of the centre column in the instrument pack. It is a digital display, driven by the IPK from data received from the road speed signal. The distance travelled is updated in 10 metre increments and stored in the random access memory (RAM) of the IPK. The data is transmitted on K-Bus and stored and updated to the EEPROM inside the IPK every 2 Kilometres. The odometer display is in kilometres or miles (depending on market requirements) and is a 6 digit figure in a 7 segment LCD display. The total mileage will be displayed continuously in ignition position 1 or 2 and displayed for a predetermined amount of time if the trip computer button is pressed with the ignition off.

The light switch module is used as a back-up facility to store the odometer reading. The IPK updates the LSM every 100 kilometers by transmitting the odometer total mileage reading on K-Bus. Every time the ignition is switched to position 2, the IPK and the LSM compare VINs and total mileage reading for plausibility.

The IPK displays the external temperature continuously in the odometer, based on signals received from the ambient temperature sensor located on the front grille.

Service interval announcement/display

The service interval display (Service interval announcement/display) is used to display the number of miles to the next due vehicle service. The distance is displayed for four seconds after the ignition has been switched to position 2. Three types of vehicle inspection and service are displayed by the SIA display:

1. Distance until oil service due
2. Distance until an inspection due
3. Time service due now

The SIA display must be reset after a service or inspection to allow the SIA to display the next vehicle inspection or service due date.

Engine temperature

Engine coolant temperature is displayed on an analogue gauge located in the left hand side of the IPK. The engine management system transmits this message to the IPK via the CAN-Bus system. When the engine coolant becomes excessively high, a high temperature warning lamp is illuminated in the red segment at the top of the scale.

Fuel gauge

Fuel quantity in the fuel tank is displayed by an analogue gauge on the right hand side of the IPK. It is fed by two fuel level senders, each made up of a float and variable resistor. The senders are connected in series and if any fault occurs in this circuit the gauge defaults to zero and the low fuel warning lamp is illuminated. The IPK performs complex algorithms on the signals from the senders to ensure the correct fluid level is calculated. As the fuel tank is a saddle tank fuel will 'slosh' over from one side to the other during vehicle cornering and other manoeuvring. To compensate for this, an anti-slosh algorithm lowers the speed and sensitivity of the gauge based on the speed the vehicle is travelling.

There is a low fuel level warning lamp located in the red segment of the fuel gauge.

Tachometer

The engine speed in rev/min is displayed on a major analogue gauge on the left hand side of the IPK. It receives its signal from the engine management system via the CAN-Bus system. Diesel derivatives scale is 0–6000 rev/min. Petrol derivatives scale is 0–8000 rev/min.

Transmission

Vehicles fitted with the Jatco automatic transmission use two 13 segment star display characters to indicate the current gear lever position and the driving mode which has been selected. The message is transmitted by the automatic transmission control unit (ATCU) to the IPK via the CAN-Bus system.

If a fault occurs with the gearbox, the ATCU will instigate an emergency program which allows the gearbox to continue to function but in a limited manner. If the fault has led to a default to fourth gear being selected, the IPK will display this fault in the two 13 segment star displays as EP (emergency programme).

Trip computer

The highline IPK has a trip computer which is active in ignition position 1(KL.R) and position 2(KL.15). It is selected by pressing the trip computer switch located at the end of the left hand column stalk. Selecting the trip computer displays a menu in the message centre which is scrolled through by pressing on and off the trip computer switch. (**Note:** continuous pressing of the trip computer switch will not scroll the menu). The current feature selected will be displayed for 30 seconds by the trip computer and if no further buttons are pressed the display will switch off. A feature is reset by selecting it and holding the trip computer switch for longer than 2 seconds.

If a warning message appears when the trip computer is being used, the warning message has the highest priority. The trip computer will be replaced in the display by the warning message. A further press of the trip computer switch will return the display to the part of the trip computer that was active before the warning message interruption. If the fault continues to exist, the trip computer will time out every 20 seconds and the warning message will be displayed.

The trip computer has priority over the Navigator display.

The trip computer has the following functions:

- **Trip distance–2:** This is the second independent trip distance recorder. The first trip distance recorder is part of the lower digital display unit containing the odometer and service interval data
- **Average fuel consumption:** The microprocessor in the IPK calculates the average fuel consumption by monitoring the fuel used against distance travelled as a straightforward arithmetical average. The fuel consumption data at a given time is based on fuel injector pulse timing and is supplied to the IPK by the engine control module. This function can be reset by pressing the trip switch for longer than 2 seconds with the function selected. The figure displayed by the average fuel consumption display relates to the distance travelled since the last reset function
- **Distance till empty:** The IPK computes the distance till empty based on fuel tank contents against fuel consumption. The information displayed is based on the assumption that the average fuel consumption will remain approximately the same until the fuel tank is empty. This figure is based on current driving styles and the figure will, therefore, reflect any changes produced by changes in driving styles. The IPK automatically recomputes the distance till empty figure when fuel is added to the tank
- **Overspeed warning:** This is a visual and audible warning to the vehicle driver that the vehicle is travelling at a speed in excess of the speed programmed into the trip computer. With the overspeed warning feature selected, the speed limit is set by pressing the trip switch for longer than 1 second and this sets the limit at the current vehicle speed. Press the button for a further 2 seconds and the set speed increases in increments of 5 mph (or km/h) every second. (The scale set in the odometer trip distance 1 governs whether the overspeed is in mph or km/h. The overspeed function can only be turned off when it is selected by pressing the trip reset button, which toggles the function on and off
- **Average speed:** The average speed is displayed in relation to the overall trip distance recorded

Fault finding and diagnostics

Because the IPK is the gateway for the Bus-systems, it is useful in fault diagnosis and can help to identify and eliminate suspected faults with the Bus-systems and other systems on the Bus networks. TestBook should always be used for fault diagnosis on the Bus-systems but the following logical approach, using the process of elimination, can assist in isolating the area in which the fault exists.

Can-Bus fault diagnosis

The IPK displays seven messages it receives from CAN. These are:

1. Tachometer
2. Engine temperature
3. Air conditioning
4. PRNDL display (automatics only)
5. Check engine lamp
6. Glowplugs (Diesel only)
7. Traction control

If any of these signals are present at the IPK, it is established that Can-Bus is functioning correctly as a communication link. If all of these signals are absent from the IPK then it is likely that a CAN-Bus fault exists (short to ground, open circuit). If signals 1–3 are not present, then the ECM is suspect as this transmits these signals onto the CAN-Bus. If an individual signal is missing, it is likely to be a fault with that particular circuit or system, or with this particular connection to the CAN-Bus.

K-Bus fault diagnosis

If the main beam indicator lamp and the direction indicator tell tale lamps operate, this is an indication that the K-Bus link to the IPK is functioning correctly. If the vehicle map operates on the message centre (highline IPK) (see Figure 42) or a door open indicator lamp (lowline IPK) functions, this indicates the K-Bus link to the GM6 is functioning correctly.



Figure 42

The air conditioning system communicates on both the CAN and K-Bus systems and if it is functioning correctly this indicates the IPK is functioning correctly as the gateway between the two Bus systems.

The air conditioning system can be checked for correct operation by turning the system on, opening the bonnet and monitoring the air compressor clutch. If the clutch cycles on and off the system is functioning correctly.

Other logical and systematic fault finding approaches can be used to isolate faults and to determine correctly functioning Bus-systems.

Diagnostics

TestBook is used to access the memory inside the IPK and it can be used to read and clear the stored faults. TestBook can also read inputs to the IPK and drive the warning lamps and gauges (It cannot drive SRS, ABS, seatbelt, low oil pressure, or the battery charge low warning lamps). TestBook is also used to reset the SIA (service interval display).

Parking aid

Introduction

The electronic parking aid system is a system designed to assist the driver when reversing by detecting obstacles behind the vehicle up to a range of 1.5 metres. Many drivers can experience difficulties when trying to park a vehicle, perhaps because of poor visibility or tight parking spaces. The parking aid helps to eradicate these difficulties and helps take the stress out of parking. The parking aid uses sound to inform the driver of the clearance between the rear bumper and obstructions and provides easier parallel parking.

The system is operational only with the ignition in position 2. On selecting reverse gear the driver will hear a short audible beep from a system dedicated-speaker. This is an indication that the system is active. When the rear of the vehicle comes within 1.5 metres of an obstacle the system will emit audible beeps at a low frequency. The frequency of the beeps will increase proportionally as the rear of the vehicle gets closer to the obstacle. It will become a continuous tone when the vehicle gets to within 0.35 metres of the obstacle. At all times, the driver is in complete control of the vehicle and the parking aid system merely supplies information upon which the driver can act.

The parking aid system comprises of the following components:

- Four ultrasonic sensors located on the rear bumper
- Parking aid ECU located in the boot space area
- Dedicated speaker located on the parcel shelf
- K-Bus interface

Functionality

When reverse gear is selected and the ignition is in position 2, a short audible beep is sounded to indicate that the parking aid system is operational.

The parking aid system is interfaced with the K-Bus system and, when reverse gear is selected, a message is sent via the K-Bus system to the parking aid ECU, stating that the vehicle is in reverse gear and operation of the parking aid system will be initiated. The K-Bus interface also supplies information on the speed that the vehicle is travelling at and whether or not a trailer has been fitted to the vehicle. The parking aid system is inhibited when a trailer is fitted.



Fig. 1. Parking aid sensors

Sensors: The sensors (see Figure 43) function as both transmitters and receivers, each sensor emitting, in sequence, ultrasonic pulses. These pulses establish a field of detection and the reflected signals from these pulses are received by the sensors and sent to the parking aid ECU. The ECU processes these signals and governs the output to the parking aid speaker. The sensors change from transmitting mode to reception mode under the control of the ECU and can be used in a combination mode when they transmit ultrasonic pulses and receive the echoes/reflections from their own ultrasonic pulses. When in reception mode, the sensor will receive the reflected signals from the other sensors in transmission mode.

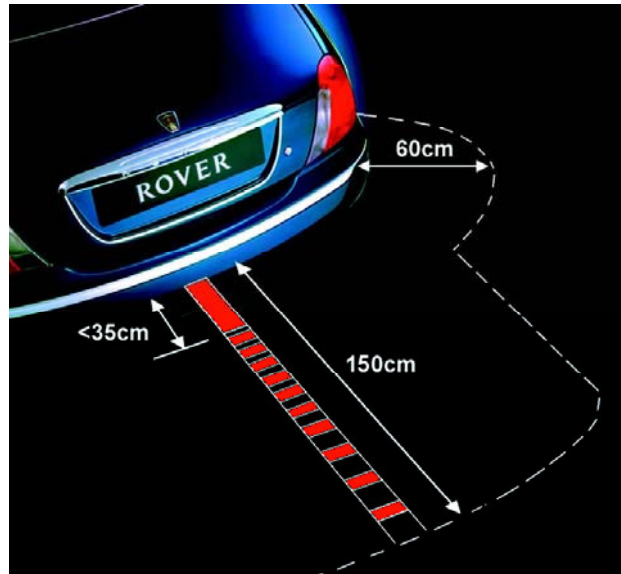


Figure 43

The diagram (see Figure 44) illustrates the field of detection. Detection covers a range of 1.5 metres directly behind the rear bumper of the vehicle and up to 0.6 metres from each side of the rear bumper.

The response to possible reversing situations is as follows:

- If there is no obstruction to the rear of the vehicle within its field of detection, then, after the initial audible beep when selecting reverse, no sound will be heard from the parking aid speaker
- If there is a detectable obstruction to the rear of the vehicle between 1.5 and 0.35 metres from the rear bumper, the parking aid speaker will output audible warning beeps, the frequency of which is dependent upon the actual distance between the obstruction and the vehicle bumper
- If there is a detectable obstruction within 0.35 metres of the rear bumper, the parking aid speaker will output a continuous audible warning tone
- If the vehicle is reversing and there is a wall/object running parallel to the side of the vehicle within the detection range of the corner sensor, the system will initially output an audible warning tone. If, after three seconds, the distance between the wall/object and the vehicle has not decreased, the system will recognise this and stop the audible warning to the driver

The system can pick up objects such as posts, wire mesh fences and other vehicles. However, if the obstruction is at a very low level it is possible that the sensors may not pick it up, so the driver needs to be aware of this.

Parking aid ECU

The ECU for the parking aid system is located in the boot area of the vehicle and it receives all the digital signals from the four sensors. The ECU calculates the distance of an obstruction from the time lag of the echoed signal. Time lag is the time the transmitted signal takes to travel from the sensor to the obstruction and back to the sensor. The sensors are connected to the main harness using water tight connectors and communication between the ECU and each of the sensors takes place over a single bi-directional line. The sensors amplify the signal and convert it into a digital format compatible with the ECU. The combined signals give the ECU the ability to form a picture of the relative position of the obstruction.

Because the sensors can receive the reflected signals from the other sensors, triangulation is possible. Triangulation is a triangle formed by the obstruction and two measuring sensors. This is a more accurate way of measuring the clearance of an obstruction-smaller obstructions and difficult geometric shapes are better recognized and errors reduced. Distances from individual sensors and distances from two adjacent sensors (triangulation) give the ECU enough information to determine the relative location of the obstruction and the minimum distance between the vehicle and the obstruction.

When reverse gear is selected there is a delay of one second before the parking aid is activated. This stops the parking aid from being activated unintentionally on a vehicle fitted with automatic transmission. To put an automatic transmission in Park mode requires the gear select lever to pass momentarily over the Reverse gear from a forward drive mode and the delay prevents the parking aid being activated by this movement. The delay also applies to vehicles fitted with the Getrag manual transmission.

When a trailer has been fitted to the vehicle, the light switch module will put a signal on the K-Bus to this effect. The parking aid ECU will receive this information via its K-Bus link. The parking aid ECU will then suspend operation of the parking aid system.

en ults

If the ECU recognises a fault with the system, the driver will hear a continuous audible beep for five seconds on selection of reverse gear. The system fault audible warning is at a perceivably higher pitch than the normal system warning beep for an obstruction. This indicates that the system is not in operation. If a fault occurs with the sounder, then nothing will be heard on selection of the reverse gear.

Diagnostics can be carried out using TestBook. The parking aid ECU is capable of storing individual sensor faults and the type of fault. The ECU is also capable of storing errors and faults which occur internally to the ECU.

The ECU can recognise and store both permanent and intermittent faults. The ECU can also indicate connection errors that occur with any of the connection pins in the system.

Note: The diagnostic functionality and K-Bus related features are available only for vehicles fitted with the parking aid as original equipment. It is not available for aftermarket accessory systems.

Exterior lighting



Figure 45: Light switch module

Lighting of a vehicle is very important both in terms of the driver being able to see the road ahead clearly and other road users being able to see the driver's vehicle clearly. The light emitted needs to be dispersed and directed efficiently so that oncoming drivers are not dazzled. Consequences of lighting failure have to be considered and emergency back up systems are required for safety reasons. An ECU fitted to Rover 75 carries out control and operation of all exterior lighting (with the exception of the reverse lights).

The light switch module (LSM) (see Figure 45) is the control unit which operates all exterior lighting, headlamp levelling and instrument panel illumination. The LSM consists of a switch pack and an ECU and is located on the dashboard. Though they are connected together, each can be replaced separately when necessary. The battery supply to the LSM is via two large fuse linked lines. The purpose of these is to provide a method of isolating the LSM, rather than providing overcurrent protection.

Smart field effect transistors (FETs) in the LSM protect the lamp circuits from high voltage surges. These Smart FET's replace standard circuit fuses and react to the heat generated by the excess current flow caused by shorting circuits. Unlike conventional fuses, which need replacing, Smart FETs will continue to operate as normal once the fault has been rectified.

Front fog lamps, available as an option, are protected by a conventional fuse and their controlling relay is located inside the engine bay fusebox.

The LSM also functions as the back up for storage of vehicle information used by the instrument pack. The LSM stores VIN, total mileage and service interval data. The process for changing a LSM and its relation to the instrument pack is clearly defined and must be adhered to for correct transfer of vehicle data. The non volatile memory also stores faults and controller errors and diagnosis is carried out using TestBook.

Bulb monitoring is carried out by the LSM which communicates with the IPK and the GM6 via the K-bus link. The LSM will check the condition of a bulb when the actual circuit for that bulb is switched on. When a faulty bulb, or lamp circuit, is detected, the instrument pack will inform the driver of this. The method used to relay this information to the driver is dependent on the type of instrument pack fitted to the vehicle.

The LSM also provides other features such as tail lamp back up, headlamp level adjustment, emergency back up and a headlamp time out facility.

Control of the main beam and indicator lamps is carried out via the left hand stalk located on the steering column.

Exterior lights controlled by the LSM are :

- Dipped beam *
- Brake lamps *
- Side lights (also called front position lamps) *
- Direction indicators *
- Side repeaters
- Main beam *
- Tail lamps (also called rear position lamps) *
- Rear fog lamps *
- Front fog lamps (if fitted)
- Centrally high mounted stop lamp (CHMSL)
- Licence plate lamps * (Bulb fault displayed only when both lamps are faulty)

* Bulb monitoring by the LSM with circuits switched on.

The reverse gear lamp is wired directly from a reverse gear switch on the Getrag manual gearbox and from a separate relay on the Jatco automatic gearbox.



Fig. 46 Light Switch Module (LSM) switch pack

The LSM switch pack (see Figure 46) is located on the end of the driver's side of the dashboard. It consists of :

- Side lamps (position lamps) and dipped beam master rotary switch
- Rear fog lamps
- Headlamp leveller-thumbwheel control
- IPK illumination-thumbwheel control
- Front fog lamps (if fitted)

The master rotary switch has three positions:

1. Off
2. Position lamps
3. Dipped headlights

If front fog lamps are fitted retrospectively, as an accessory, the standard switch pack will need to be changed to incorporate the switching of the front fog lamps. The changing of the switch pack is a detailed process and should be followed precisely (See Workshop Manual).

Bulb Failure Monitoring

Motor vehicle traffic regulations state that a driver should check the operation of the entire vehicle lighting systems before beginning a trip. Penalties can be imposed on drivers who drive with faulty lighting systems, even though they may be unaware of a problem. The LSM fitted to Rover 75 has the ability to monitor the lighting circuits for continuity and correct operation. This function is operational only with the lighting circuits being switched on. If a long journey is to be undertaken initially in daylight but will continue on into the night and darkness, the correct functioning of the lighting circuits should first be checked. This can be done manually or by switching the lighting circuits on and checking that the bulb failure warning lamp does not illuminate.



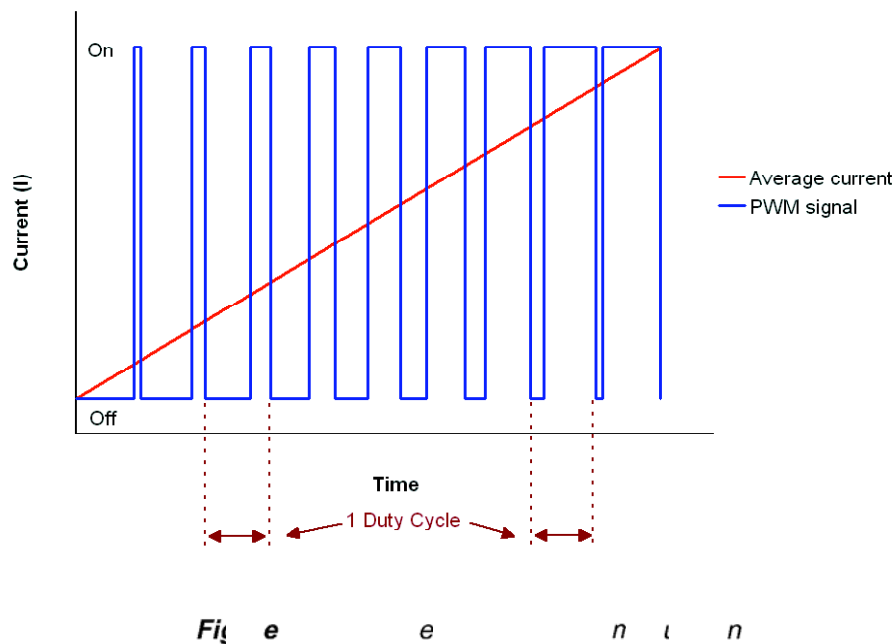
Figure 47: Bulb Failure Warning Lamp

Power-MOSFET transistors (metal-oxide semiconductor field effect transistors) are incorporated in the lighting circuits and control bulb monitoring. Power MOSFET transistors are used as switches in much the same way as bi-polar junction transistors. The big difference is that the Power-MOSFET transistor uses a voltage as the input signal as opposed to a current. This makes them much more efficient using about one tenth of the power required by a bi-polar junction transistor. Therefore, they generate less heat.

'Hot' monitoring is monitoring of the lamp circuits when they are switched on. The electronic microprocessor contained within the LSM continually monitors the status of the outputs to each activated lamp. The microprocessor in the LSM feeds the transistor which, in turn, feeds the lamp circuit. A line is also taken from the transistor, which is fed back into the microprocessor. This line will jump from 0 volts to 5 volts when the circuit becomes open circuit, which usually is caused by a bulb failure. On perceiving that the status line is at 5 volts, the LSM communicates to the instrument pack via K-bus. The IPK will indicate the fault to the driver using the vehicle map (if fitted), by displaying the bulb failure warning lamp or by displaying a text message in the IPK (see Figure 47).

Once a bulb failure is detected it is stored in the LSM memory. This means that, until the failure is rectified, the instrument pack will illuminate the bulb failure warning lamp when the ignition is switched to position 2. In this instance the bulb failure warning lamp will illuminate whether the lighting circuits are switched on or off. When the bulb failure has been rectified, the lighting circuit must first be switched on before the bulb failure warning lamp will extinguish.

Is width modu n



The LSM also controls the variable **pulse width modulated (PWM)** output to illuminate LEDs for instrumentation and switches. PWM varies the effective/average current flowing in a circuit by rapidly switching that circuit on and off (see Figure 48). The LSM uses a MOSFET transistor to control the PWM of its lighting circuits and is called a dimmer output. The rapid pulsing or alternation is also referred to as a duty control cycle. This refers to the ratio of time spent ON to time spent OFF of the switching element. Varying the PWM output therefore varies the effective current flowing through the illumination LEDs for instrumentation and switches and varies the intensity of their luminance. The illumination and dimming function is controlled by a thumbwheel on the LSM and drives the level of illumination of the following components:

- Driver window lift switch
- All passenger window lift switches
- Sunroof switch
- Head unit
- Gearbox and auto selector
- Cigar lighter
- Sunblind switch
- Traction switch
- Boot/fuel flap switch
- Master lock switch (CDL)
- Satellite navigation switches
- Driver and passenger seat heater switches
- IPK illumination
- Clock

Headlamp levelling system

Headlamp levelling systems are becoming a mandatory requirement in more and more countries and headlamp level adjustment is fitted as standard on Rover 75. The LSM controls the headlamp beam aim adjustment. This system makes it possible to adjust the headlamp aim for varying loads and, therefore, prevent the dazzling of oncoming traffic. It also gives the driver of the vehicle good road lighting at all times. Variation of the headlamp beam aim is carried out by the control of stepper motors contained within the headlamp assembly.

Operation of the headlamp beam aim adjustment is possible only when the LSM receives a message, via the K-Bus link, that the engine is running or when the position lamps (side lights) or the dipped beam lamps are switched on. The system is self synchronising and with every operation of the headlamps the stepper motors will need to find their reference point. The motors are driven up to their full travel, during which time the headlamps will be observed to move downwards and then back to the selected level.

Manual operation is driven by the operation of a knurled thumbwheel on the LSM which adjusts a potentiometer setting. This potentiometer setting has a direct affect on the position of the stepper motors which, in turn, control the headlamp level. There are three settings numbered 0, 1 and 2.

Automatic adjustment of the headlamp beam height is a legal requirement for cars fitted with gas discharge lamps. As with the manual systems, linear stepper motors are used to physically adjust the height of the headlamp. Automatic headlamp beam adjustment is not available currently on Rover 75.

Brake-up



Figure 49

If a fault is detected with a tail lamp bulb during a bulb monitor check and the bulb is inoperative, the LSM has a back up safety feature: the LSM will illuminate the corresponding brake lamp (see Figure 49). The intensity of the brake lamp in normal circumstances is brighter than the intensity of a tail lamp and the LSM compensates for this. The LSM varies the current to the bulb using a MOSFET to modulate the pulse width of the supply to a frequency equal to the luminosity of a tail lamp. The bulb failure warning lamp will still be illuminated in this instance.

Tail lamps and side lights are driven continually by a pulse width modulated output from the LSM to improve bulb service life. This keeps the bulb voltage at 13.5 volts should the supply voltage rise above the 13.5 volt threshold.

parking lamp

When the ignition is switched off the parking lamp function is available. In this state, when the direction indicators are operated the corresponding position lamp and tail lamp on that side will be illuminated. Hence, with the right hand direction indicator switch active the right hand position lamp (side light) and the right hand tail lamp are operative, and vice versa. To prevent this function from being initiated accidentally, it is necessary to first return the direction indicator stalk to the off position and then set it as required.

Automatic lamp time-out

Another feature controlled by the LSM is the walk home facility or automatic headlamp time-out provided to illuminate the area in front of the vehicle for a given amount of time after exiting the vehicle. This function operates when the ignition is switched off before the dipped headlights are switched off. When this occurs, the dipped headlights remain on for the amount of time programmed between 20 – 180 seconds (the default setting being 30 seconds).

Gas discharge lamps

Gas discharge lamps (Xenon) are currently not supported by Rover 75. In the future, they may be specified as a factory fit option in place of conventional dipped beam lamps. The LSM will be able to drive this type of lamp.

Emergency operation

In the event of an LSM failure, the lighting system still needs to be driven for safety purposes. Independent hardware is fitted to Rover 75 and is activated in the event of a LSM failure with the ignition in position 2. The emergency operation is held off by a functional LSM which supplies a pulsing signal from a monoflop to the emergency system. An electronic circuit provides the pulse and it must operate at a minimum of 15Hz to prevent activation of the emergency system. When the emergency system is activated, the dipped beam and the tail lamps are switched on regardless of the position of the master light switch. Also, the brake lamps will operate as normal when selected. All other functions controlled by the LSM will not operate.

Emergency operation will also be activated when the vehicle battery terminal voltage is very low (i.e. less than 6V at the LSM) and the ignition is in position 2.

Trailer mode

If a trailer or caravan is to be connected to a Rover 75, it is necessary to fit a Rover 75 towing electrics kit, which includes a trailer module and all associated connectors and wiring. It is necessary to separate the load current circuits of the trailer from the circuits of the towing vehicle. If this is not done, the bulb monitor feature of the exterior lamps will not function and permanent damage to the LSM may result. The LSM can be connected to a dedicated trailer module which separates load currents of the trailer from the towing vehicle. Communication between the LSM and the trailer module is via a dedicated serial bi-directional data line. When fitted, the rear fog lamps are inhibited and all trailer bulbs will be monitored in the same way the other vehicle bulbs are monitored.

Note: This is a dealer fit accessory.

Brake light switch

The brake light switch is a Hall effect proximity sensor monitoring movement of the metallic brake pedal. This means the brake switch works without contact, generates no noise from actuation and allows for simplified adjustment. The output from the Hall sensor holds the brake lamps off when the brakes are not applied. The brake lamp is active in ignition position 1 or 2. If the brake lamp switch is removed or disconnected, the brake lamps will remain on with the ignition in position 1 or 2.

Hazard warning lamps

The hazard warning switch is a momentary action switch located on the centre console. When activated, it switches the line from the LSM to earth. The switch latches electronically and the LSM activate all direction indicators and side repeater lamps. The tell tale lamps on the instrument pack and the hazard switch illumination will also flash synchronously with the hazard lamps. The hazards will function regardless of the ignition position. When being towed with the hazard lamps on, the direction indicators are still functional and can be selected by operating the LH/RH indicator stalk.

Daytime running lamps

Some markets have requirements for the headlamps and other lamps to illuminate if the car is moving or the ignition is switched on. This function is referred to as 'daytime running lamps'. This function is programmable using TestBook. Three options are available:

1. No operation of the daytime running lamp function
2. Ignition ON. Side light switch OFF. Dipped beam, position lamps, license plate lamps and tail lights ON
3. Ignition ON. Side light switch OFF. Reduced intensity main beam lamps, position lamps and tail lamps will be on

Note: Option 3 is intended for use in the Canada market only and must not be used for any other market.

Cruise control

Introduction

Cruise control is a system which attempts to maintain the speed of a vehicle at a defined setting by automatically controlling the throttle angle. It was designed to make driving long distances on motorways less stressful by taking over throttle control from the driver. Cruise control is available as an option on KV6 and M47 derivatives of Rover 75.



Fig. 49 Cruise Control ECU



Fig. 50 R40 Petrol Cruise Control ECU

An ECU (see Figure 50) is at the centre of the KV6 cruise control system, monitoring various inputs and changing various outputs to maintain the set speed. Cruise control is a good example of a closed loop control system, with a number of safety inputs which disengage the system for practical reasons. For example, on braking it would be hazardous to continue allowing the cruise control system to attempt to maintain the speed of the vehicle.

Differences exist between the components that make up the cruise control petrol system and the diesel system but the driver interface and system operation are basically the same.

KV6 cruise control

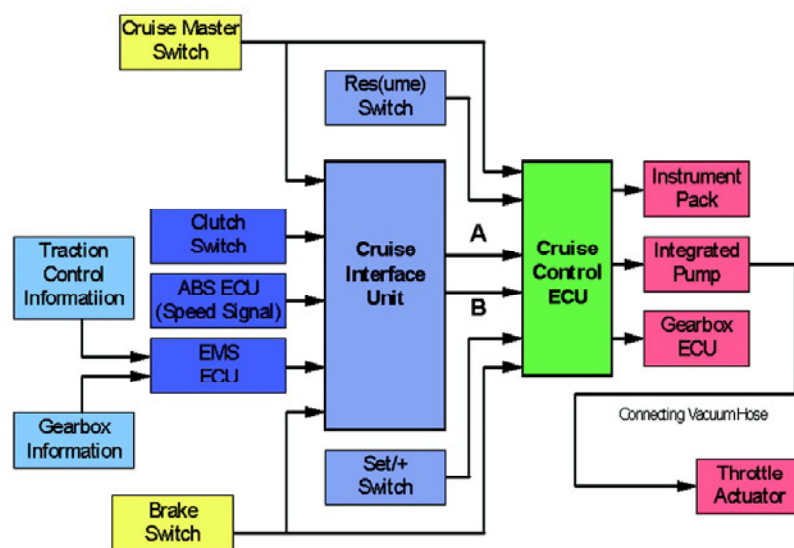


Figure 52

The KV6 cruise control system is a Hella pneumatic system which, through the controlling ECU, adjusts the throttle angle to suit the set speed. The system uses a vacuum pump to control a pneumatic actuator, which adjusts the throttle angle via a connecting rod (see Figure 52). The vacuum pump unit also contains the pressure control valve (regulation valve) and the pressure release valve (dump valve).

When the vehicle is in cruise control mode and is travelling at the set speed, the cruise ECU is in control of the speed of the vehicle. The cruise control warning lamp located in the instrument pack will be illuminated to inform the driver that cruise control is active. The ECU will have energised the vacuum pump, which, in turn, will have moved the throttle actuator diaphragm to a position which corresponds to the set speed required. The ECU monitors the effect on the speed of the vehicle via the wheel speed signal from the ABS ECU. To maintain the speed, the ECU will continually monitor the wheel speed signal. Varying driving conditions such as gradients and wind resistance can alter the speed of the vehicle. The ECU will control the actuation of the vacuum pump and of the regulator solenoid valve, to increase and decrease the throttle angle, as required.

Cruise control operation

To enter cruise control, the driver needs first to press the cruise master switch located on the dashboard. The cruise system is operative only within the range 28 - 125 mph (40 - 200 km/h) and the driver must be aware of this. When the required cruising speed is reached, using the accelerator pedal, the Set + button on the steering wheel (see Figure 53) should be pressed. The vehicle will attempt to maintain the current speed as long as the ECU receives no inputs signalling application of the brakes, clutch or throttle.

If the brake pedal or the clutch pedal (on manual vehicles) or the Res(ume) switch are activated, cruise control will be suspended. On cruise suspension, the set cruise speed will be stored in the cruise ECU. The driver will have complete control of the vehicle and will have to apply throttle to prevent the vehicle from coasting to a stop. Cruise control is restored by pressing the Res switch again and the system will return the vehicle to the speed stored in the cruise control ECU. If the cruise ECU recognises a fault with the system or any of its associated components it will suspend the operation of cruise control indefinitely i.e. Until the fault is rectified.

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There are three ways to accelerate the vehicle when cruise control is active:

1. Using the accelerator pedal: Application of the accelerator pedal will increase the vehicle speed proportional to the pedal depression. Once the pedal is released the vehicle will return to the stored speed. This feature is useful when overtaking is necessary
2. Pressing and holding the Set+ button: The vehicle will accelerate until the button is released and will then maintain the speed at which the button is released. This speed is then stored by the cruise control ECU
3. "Tapping" (pressing and releasing within 500 milliseconds) the Set+ button: This action increases the speed of the vehicle by increments of 1mph (1.6 kph) and maintains that speed. When the Set+ button has been tapped for the last time, that is the speed which is stored in the cruise control ECU memory



Fig e : € nq h€ c s

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Cruise control can be cancelled by pressing the cruise master switch on the dashboard or by turning off the ignition. In both of these cases the cruise speed stored in the cruise control ECU memory will be lost. On reactivation of the cruise control system a new cruise speed will have to be set by pressing the Set+ speed at the appropriate speed.

Components and their functions

The following list outlines the location and functionality of cruise control components:

- **Master control switch:** Located on the dashboard, this switch is placed in series between the ignition feed and the cruise control ECU. This switch controls the electrical supply to the system and acts as an isolator or On/Off switch. When switched on, the switch is illuminated, indicating that cruise control is active
- **Cruise control ECU:** Located in the passenger footwell, next to the ATCU (where fitted). This unit controls the system, based on a number of inputs from around the vehicle
- **Cruise control interface unit** (see Figure 51): Located in the passenger footwell, and attached to the same bracket as the cruise ECU. This unit receives the road speed signal direct from the ABS ECU and changes its frequency to a format compatible with the cruise control ECU. The ABS wheel speed sensors are Hall effect type sensors and deliver 39,000 pulses per mile. The interface unit converts this to 8,000 pulses per mile, which is compatible with the cruise control ECU
- **Wheel speed sensor:** Wheel speed is supplied to the cruise control system via the ABS ECU from the wheel sensors. If the wheel speed signal is not present then the supply to the vacuum pump will not be activated and cruise will not engage. The wheel speed sensor which feeds the cruise system, via the ABS ECU, is the front left wheel speed sensor. Therefore, if this sensor fails the cruise system will be inoperative
- **'Set +' switch:** Located on the steering wheel, this switch is used to set the cruise control speed by pressing once and to increase the set cruising speed by pressing and holding until the desired speed is reached. 1mph increments are achieved by pressing for less than 0.5 seconds
- **'Res -' switch:** Located on the steering wheel below the Set + switch, this switch is used to return to the stored cruise speed after cruise has been suspended. It is also used to suspend cruise control by pressing it once when cruise control is active
- **Brake switch:** The brake signal is supplied by the Hall effect brake switch fitted to the brake pedal. On application of the brakes, the cruise ECU will cancel cruise and remove the supply to the vacuum pump. The ECU will also switch the solenoid located on the vacuum pump to release the vacuum contained within the actuator
- **Clutch switch:** This switch is located on the clutch pedal and is a Hall effect proximity sensor. The switch feeds into the cruise interface unit and when the clutch is pressed, the interface unit signals to the cruise ECU, which will suspend cruise control of the vehicle
- **Integrated vacuum pump** (see Figure 54): This is located by the right valance on the vehicle longitudinal. Integrated with pump unit are the regulator solenoid valve and the release/dump solenoid valve. The cruise ECU controls the electrical inputs to the vacuum pump and motor, and to the solenoid valves. Switching on and off of the vacuum pump and the control of the vacuum release dump solenoid valve are governed by the cruise ECU. The cruise ECU controls the throttle actuator and maintains the throttle in the correct position to match the cruise speed selected. It does this by continuously switching the vacuum motor on and off, and opening and closing the release/dump solenoid valve. The vacuum release/dump control solenoid is opened fully when cruise is suspended and the power to the vacuum pump and motor is switched off. Therefore, the vacuum acting on the throttle actuator is released. The instrument pack taps off the supply from the cruise ECU to the pump and uses it to illuminate the cruise active indicators. This line is also fed to the automatic transmission control unit (ATCU) and enables selection of the cruise control shift map
- **Pneumatic actuator** (see Figure 55): This is attached to the throttle assembly and controls the throttle angle, via a rod linkage
- **Park/neutral/reverse switch:** Automatics only. When the gear selector lever is in park, neutral or reverse, cruise is inoperative. There is also a link to the automatic transmission control unit which informs the ATCU that cruise has been activated and the correct gear shift map can be selected
- **Cruise control instrument lamp:** When cruise is active, the yellow warning lamp is illuminated on the instrument panel to inform the driver that cruise control is active



Figure 54: Cruise control actuator



Figure 55: Cruise control interface unit

Diagnostics and fault finding

TestBook is used to interrogate the cruise ECU memory for faults stored via the diagnostic link located in the driver's footwell compartment.

M47 diesel cruise control

The cruise control system on KV6 is a stand alone system with its own ECU and interface unit and it controls the throttle angle directly. On the M47 engine, the cruise control system is integrated into the Bosch engine management system and fuel delivery is controlled via the drive by wire system. There is no vacuum pump or throttle actuator.

Software within the engine management system, working in conjunction with associated components around the vehicle, directly controls the fuel injector pulse width. This control ensures the right amount of fuel is delivered to maintain the vehicle at the set speed programmed by the driver.

Other components of the M47 cruise control system are the cruise interface unit, and inputs from around the vehicle i.e. brake switch, clutch switch, steering wheel switches, the master switch, road speed signal and a signal from the automatic gearbox, where fitted (see Figure 56).

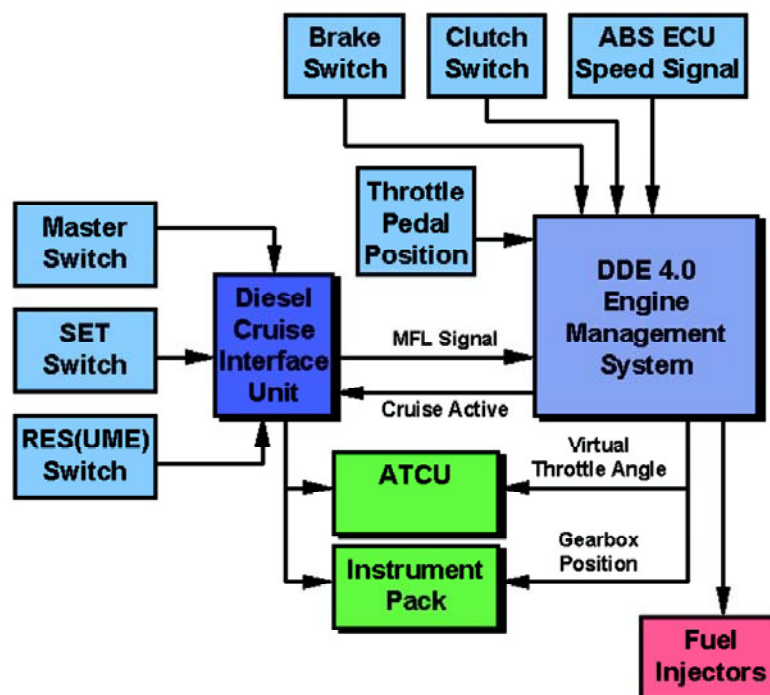


Figure 4 Diesel Cruise Control System

As stated, the customer interface with the M47 cruise control system is the same as the KV6 cruise control system.

Unit Detail



Figure 5 Unit Detail

This is an ECU which listens on the CAN-Bus system and converts driver inputs from the master switch and the steering wheel switches into the digital format that is compatible with the ECM. This serial message is termed multi-function logic (MFL) and is transmitted via a discrete link between the interface unit and the ECM. The interface unit (see Figure 57) also provides hard wired signals to the instrument pack and the ATCU when cruise is active.

Multi-function logic signals are similar to the signals used on the Rover 75 K-Bus system. A series of pulses between 0 and 12 volts are transmitted from the interface unit to the ECM. The ECM can convert these pulses into a message which determines the status of the cruise switches. This signal is sent continually to the ECM and if it is not present, cruise will be suspended by the ECM. The ECM will store an MFL fault in this type of failure.

Interface module

The signal from the interface unit to the ECM will contain information supplied by the steering switches. The ECM monitors various other inputs from around the vehicle and can calculate a fuelling strategy based on the inputs to maintain the required speed. The ECM also delivers a signal to the ATCU, via the CAN system, which is equivalent to the throttle angle (virtual throttle angle). This signal is used to control gear shifting to suit requirements.

The brake and clutch signals, along with the wheel speed signal, are fed into the ECM. When circumstances arise requiring suspension of cruise, the ECM sends a signal to the interface unit, via CAN, that it is suspending cruise and the interface unit stops the cruise active signal to the ATCU and the instrument pack.

This system suspends and cancels cruise in the same circumstances as the KV6 system. The M47 diesel cruise control system will also cancel cruise if the vehicle speed overshoots the stored speed by over 16 km/h for more than 30 seconds. This can be as a result of the vehicle going down hill for long periods or by the driver overriding cruise using the accelerator pedal.

Diagnostics and fault finding

Diagnostic is carried out using TestBook which interrogates the engine control module for faults stored on the cruise control system. Although the interface unit is an ECU, it cannot communicate with TestBook via the diagnostic line.

A fault with the interface unit can be detected by measuring the multi-function logic output to the engine management system using a voltmeter. When functioning correctly, the reading will fluctuate midway between 0 and 12 volts e.g. 6 - 8 volts. If the reading is either a constant 0 volts or a constant 12 volts this indicates a failure inside the interface unit. An MFL fault will be stored by the ECM. A faulty CAN harness link from the interface unit to the ECM could trigger the ECM to store an MFL fault because the MFL signal would not be present. If the MFL signal is present at the output from the interface unit but an MFL fault is stored by the ECM, it is logical to assume a fault with the CAN link.

Heating, ventilation and air conditioning

Base unit

The base heating and ventilation system is controlled by rotary knobs connected to control cables. The cables control the temperature of the air and the distribution to the outlet vents. Temperature control is by air blend through the heater box. The distribution cable is connected to the heater box and drives various cams and linkages to open and close vents located around the vehicle. A servo motor controls a flap which directs air into the heater box from either the outside (fresh air) or from within the cabin (recirculated air).

The blower unit is hard wired, has four speeds and air is ducted around the vehicle according to control settings. Driver controls:

- Adjust the temperature of the air flowing through the system
- Recirculate the air flowing in the system
- Control the distribution of the air in the system
- Control the speed of the blower (four different speeds)
- Control the operation of the heated rear window

Heated rear window (HRW)

The heated rear window is controlled by the GM6 body controller. The time it remains on is governed by the prevailing conditions: on operation of the HRW switch, if the outside temperature is less than 10° C the HRW will remain on for 20 minutes. If the outside temperature is 10° C or above the HRW will remain on for 12 minutes.

If the battery voltage is less than 12.5 volts the HRW will turn off for 21 seconds of every minute until the battery voltage has returned to 12.9 volts. During this low volts on/off cycling the HRW illumination LED will remain on throughout.

If the outside temperature is below 10° C and the coolant temperature is 40°C when the vehicle is started, the GM6 will automatically switch the HRW on for 20 minutes. The outside ambient temperature is supplied from a sensor located in the front bumper. This sensor is hard wired to the instrument pack and is broadcast on the K-Bus system by the instrument pack. The GM6 receives this information and controls the timing of the HRW accordingly.

Recirculation

This function is selected by operation of a switch on the fascia switchpack. Pressing the switch once, for less than a second, closes the airflow flaps to outside air. Air is then taken from the inside of the vehicle for four minutes, the duration being controlled by the GM6. Pressing and holding the recirculation switch for longer than 1 second will cause the switch to latch electronically and recirculation will remain on until the switch is operated again. The recirculation LED will flash to acknowledge to the driver that continuous recirculation mode has been selected.

Blower control

The blower control on the dashboard has four selectable speeds and the blower motor is located on the top, rear, right hand side of the heater unit. Access is by lowering of the pedal box.

Higher specification vehicles utilise ventilation with an air conditioning system to control the temperature and humidity of the vehicle interior. This gives the driver a wider range of control of the vehicle interior environment and provides greater comfort for vehicle occupants.

Automatic temperature control (ATC) is also available on Rover 75. This reduces the need for frequent driver adjustments to maintain the interior vehicle temperature at a comfortable level. The affect of the outside environment on the vehicle interior environment is automatically compensated for by the ECU and the driver is unaware of the adjustments being made.

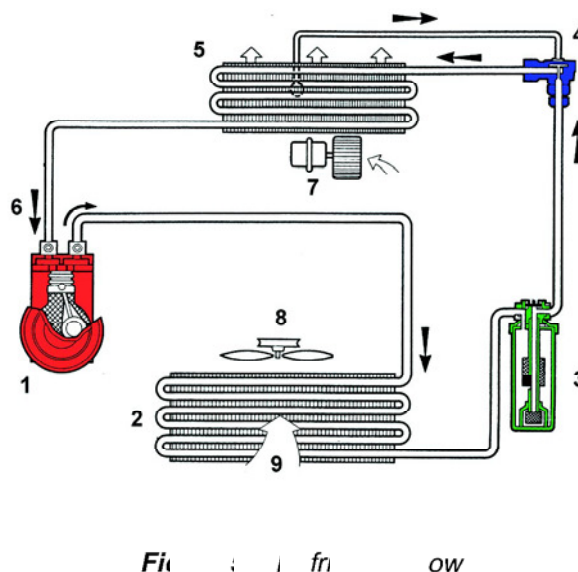
Note: If air conditioning is available and selected then recirculation mode will automatically be selected.

Lowline air conditioning (manual)

The lowline air conditioning system is made up of the basic heating, distribution, recirculation, HRW and blower system, described above, integrated with an air conditioning system. This air conditioning system is controlled by the GM6 body controller. The GM6 also controls the HRW timing and the recirculation timing for demisting the vehicle. In effect, the air conditioning system is the fitting of another heat exchanger but one which contains a very cold substance called refrigerant. The air passing through it is cooled by the transfer of heat from the air to the refrigerant.

Air conditioning provides cool and dry (dehumidified) air into the vehicle interior, using fresh or recirculated air. The cooling effect is achieved by the continuous condensing and evaporating of a refrigerant. To achieve cool, dry air, the system requires the following main components:

- Compressor
- Condenser
- Evaporator
- Receiver/drier (integrated into the condenser)
- Thermostatic expansion valve
- Cooling fans
- Air conditioning pipes



1. Compressor
2. Condenser
3. Receiver drier -
Integral to the condenser on Rover 75
4. Thermostatic expansion valve
5. Evaporator
6. Flow into compressor
7. Blower motor
8. Cooling fan
9. Cooling air flow

The compressor (1) compresses the refrigerant, which is in gas/vapour form at this stage and, in doing so, increases the refrigerant temperature and pressure. The refrigerant flows into the condenser (2) located at the front of the vehicle, in front of the coolant radiator. The cooling effect of the air flow condenses the refrigerant into a liquid form which then flows to the receiver/drier (3), still at high pressure. The receiver/drier acts as a refrigerant storage tank, absorbs moisture/water and filters out any particles in the refrigerant. From here, the liquid refrigerant flows back through the lower portion of the condenser to further cool the liquid refrigerant (sub-cooling). The refrigerant then flows into the thermostatic expansion valve (4) which controls the amount of refrigerant entering the evaporator (5) and lowers its pressure allowing it to expand. The pressure drop rapidly reduces the temperature of the refrigerant. The heat from the air flowing into the vehicle interior is much warmer and heat transfers from the air to the refrigerant cooling the air and warming the refrigerant. The refrigerant changes back into gas/vapour and is sucked back into the compressor for the cycle to begin again (see Figure 58).

Only gas must be drawn into the compressor or it can cause hydrostatic lock and stall.

When operating, the top of the condenser will normally be full of warm/hot gas and the bottom full of warm liquid refrigerant.

The refrigerant boiling point is very low (approx minus 30°C at atmospheric pressure) but can be compressed back to liquid form by increasing the pressure at which it is contained. Compression of the refrigerant produces heat, and this heat is removed by the condenser, located at the front of the vehicle.

Automatic temperature control (ATC)



Trim levels 2 and 3 of Rover 75 are fitted with an automatic temperature control unit which is ECU controlled and works in conjunction with the GM6 body controller (see Figure 59). The GM6 controls the operation of the HRW, recirculation and the controlling timers. Other features of the system are controlled by the electronic control unit incorporated into the ATC. Features of ATC include:

- Side to side temperature control
- Air distribution control
- Blower control
- Centigrade/Fahrenheit control
- Air conditioning control 'economy' (ECON)
- Defrost control
- Automatic temperature control
- Recirculated/fresh air control
- Heated rear window control - via K-Bus

ATC inputs and outputs

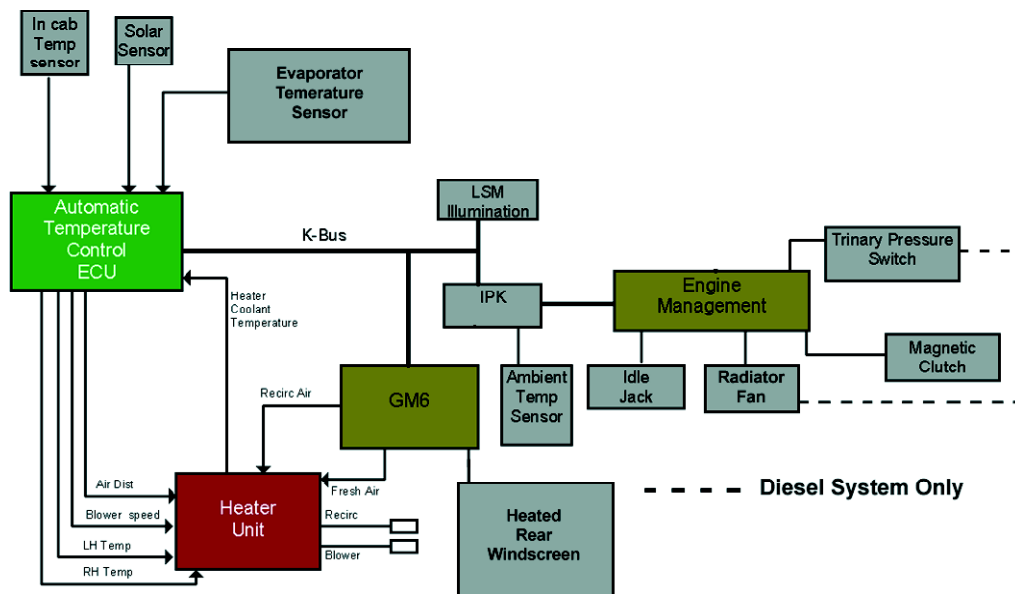


Figure A1 Inputs

Automatic control of the HEVAC system is achieved by a single press of the AUTO button. The system ECU will continually monitor sensory inputs and adjust outputs to keep constant the temperature selected by the customer (see Figure 60). The ATC has six different settings of blower speed, adjusted using the plus (+) and minus (−) switches. Sensors and actuators incorporated in the system are described below.

Temperature sensor



Figure 60 Temperature sensor

The solar sensor (see Figure 61) is located on the top of the fascia and measures sunlight, or solar loading, on both the left and right hand side of the vehicle interior, giving separate outputs for each. When sunlight warms the interior of the vehicle, with the system in automatic mode, the solar sensor signals this to the ATC ECU. The heating and ventilation settings will be adjusted to compensate for the solar warming effect to the top of the vehicle interior. Having the ability to detect the affect of sunlight on both sides of the vehicle, means the air temperature can be adjusted on each side of the vehicle to compensate for the angle of the sun. A rapid rise in heat generated in car by the sun would cause the ATC ECU to apply a rapid cooling response by directing cool air to the face vents.

The sensor is 'D' shaped and consists of two photo diodes which are sensitive to the infra red light contained in sunlight. Photo diodes are used for their fast response times and their relative insensitivity to changes in ambient temperature. When the system is being checked for faults using the system's internal diagnostics in a dimly lit area, fault codes 21 and 22 may indicate a solar sensor malfunction. The fault is eliminated if a torch is shone directly onto the sensor.

Ambie mperatu sensor

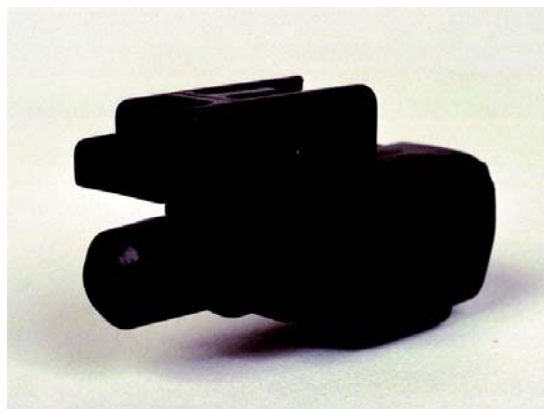


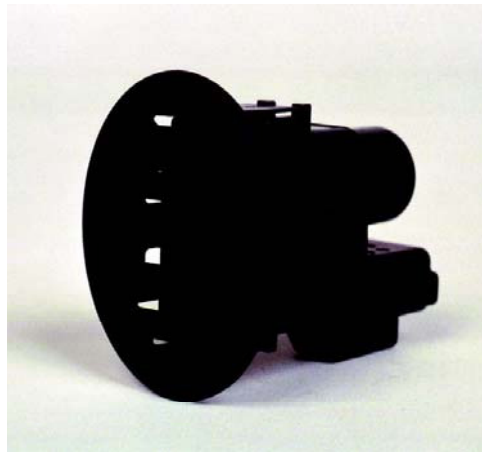
Fig 62 Ambient temperature sensor

The ambient temperature sensor (see Figure 62) is located on the front bumper and hard wired directly to the instrument pack. The signal is processed by the instrument pack and put out onto the K-Bus system. The sensor is an NTC thermistor bead which means its resistance change is inversely proportional to changes in temperature. The controlling ECU will detect changes in resistance by the effect it has on the current flowing through the sensor circuit. The ECU is calibrated to convert these resistance changes into temperature changes. This sensor provides information to the ATC ECU so it can modify the blend of air entering the vehicle interior to compensate for ambient temperature changes. The instrument pack runs the data from this sensor through a compensation algorithm, which regulates the air blend according to vehicle speed.

Evaporator temperature sensor

The evaporator temperature sensor is located in the front of the evaporator matrix near to the fins and is an NTC thermistor bead sensor. This sensor information is used to prevent the refrigerant, which passes through the evaporator, from reaching such a low temperature that the evaporator freezes. If the temperature reaches -4°C the compressor will be switched off to prevent water freezing on the evaporator, as this would restrict air flow.

Illustration



or

The in-car sensor (see Figure 63) monitors the temperature of the vehicle interior and is located on the fascia, towards the driver's side at key height. It is an aspirated thermistor bead sensor, drawing air over the sensor element via a venturi tube from the heater unit. By continually measuring the air drawn from the cabin, the average in-car temperature is measured and not affected by the outlet vent setting or the dashboard temperature. The sensor provides continually updated information to the ATC ECU about the vehicle's interior temperature. From this, the ECU can alter the system settings and monitor the affect on the in-car temperature. Though it is biased towards the driver's side of the vehicle, the sensor readings can be used to vary the passenger temperature in relation to the driver's side.

Heater coolant temperature sensor

The coolant sensor is located in the base of the heater unit and monitors the temperature of the coolant flowing through the heater matrix. This is an indication of the amount of heated air which can be generated. From this, the amount of air flow to be directed over the matrix can be calculated by the ECU.

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The trinary switch is located on the left hand side of the engine (when viewing the vehicle from the front), half way down at the rear and it is mounted on the air conditioning pipe. The switch is wired to the engine control module and to the cooling fan relay pack for K1.8 and KV6 derivatives of Rover 75. On M47 derivatives, the trinary switch is wired from the engine control module directly to the air conditioning clutch relay. This is, in fact, three sealed switches contained inside a single housing. Two of the switches monitor the refrigerant pressure in the system and, if the pressure of the system becomes dangerously high or low, the relevant switch provides an open circuit and the compressor is disengaged. The third switch (medium) is designed to operate the cooling fan at a higher speed, if the pressure rises above a predetermined level. The fan is automatically switched to high speed when the pressure in the system reaches this level. The pressure is thus reduced by reducing the refrigerant temperature.

On M47 derivatives, the trinary high and low pressure switches are wired directly in line with the compressor clutch relay. On petrol engine derivatives, the high and low pressure switches are wired to the engine control module, which controls the switching of the compressor. On petrol derivatives, the trinary medium pressure switch is wired to the engine control module, whilst on diesel derivatives it is wired directly to the fan pack.

K-Bus

The K-Bus system enables transfer and reception of signals to and from the rest of the vehicle system ECUs that the ATC ECU needs to communicate with. Without the K-Bus link, the air conditioning, recirculation and the HRW will be inoperative. The K-Bus is linked to the CAN system via the instrument pack, and air conditioning requests travel along this route to the ECM.

Fresh air re u vo motor

This motor is used to open and close the flaps which control whether outside air enters the vehicle or recirculated air is used. For security reasons, with the ignition off, the flap will close. The operation of the recirculation state is timed by the GM6 to minimise misting up of the windscreen. If this motor fails in recirculation mode, with air conditioning switched off, there will be a tendency for the windscreen to mist up.

/ distribution motor

This motor controls the route the air takes from the heater matrix into the cabin of the vehicle by movement of several flaps. Options are Face, Face /Feet, Feet, Feet/Screen or Screen.

ON

With the ECON switched on, the ATC unit will switch off the compressor and, therefore, take the loading from the engine. The system will still attempt to meet the set temperature using the other parts of the system under its control.

Manual control

When in automatic mode, the whole system is being controlled by the ECU in order to meet the set requirements. It is possible to take manual control of individual features by pressing that feature's switch (e.g. recirculation). In this mode, the AUTO LED will extinguish, although all the other features are still under ECU automatic control. The display on the ATC unit will indicate which features are being manually operated and which are under the control of the automatic temperature control unit.

Note: For the air conditioning to switch on, the engine speed must be a minimum of 500 rev/min. The default setting will be 22 degrees Centigrade but once this has been altered the system stores the last requested temperature.

Variable stroke compressor

A new variable stroke compressor, as fitted to smaller Rover vehicles e.g. 200 and 400, is used by both air conditioning systems. This replaces the fixed stroke compressor used on previous Rover 600 and 800 vehicles. The fixed stroke compressor led to temperature cycling.

This temperature cycle was caused by the limitations of the compressor which was switched on and off when the evaporator temperature reached pre defined limits. When switched on, the fixed stroke compressor gave a maximum and 'fixed' output. This was kept constant until the set evaporator temperature was reached and then the compressor was switched off by the system. With the compressor off, the air temperature rose until the system switched the compressor back on at another set temperature. This caused air temperature fluctuation which could be felt by the customer.

The variable stroke compressor minimises temperature cycling because it has the ability to vary its output. The compressor continuously varies its stroke to maintain a constant evaporator temperature. This means that rather than the compressor being switched on and off, it is on constantly but at a reduced load to suit system requirements.

Integrated sub-cooled air conditioning

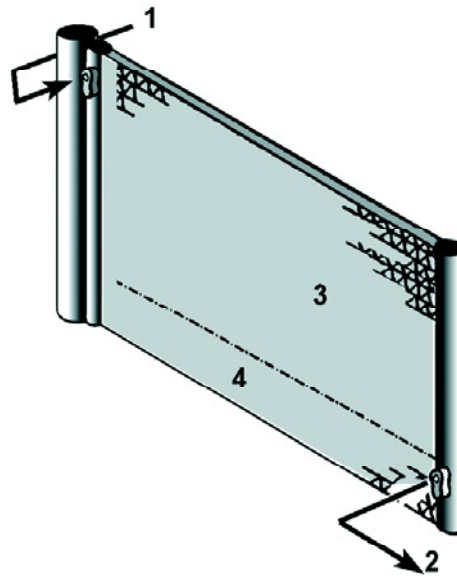


Fig 6

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- 1. Inlet (from receiver drier)
- 2. Outlet
- 3. Condenser
- 4. Sub-cooler

Rover 75 is fitted with a new sub-cooled air conditioning system. The condenser unit houses the sub cooler at its base (see Figure 64). The receiver drier is also integrated into the condenser. The sub-cooler re-routes the refrigerant and provides a larger cross-section for the cooling effect on the refrigerant. Advantages of this type of set up are:

- Improved system performance
- Cost reduction
- Weight reduction
- Reduction in power consumption
- Reduction in refrigerant charge quantity (cost saving)
- Less joints in the system (better reliability - less chance of leakage)

ATC on-board diagnostics (OBD)

To activate the self check mode on ATC, AUTO and MODE buttons must be pressed simultaneously and the ignition turned from off to position 2. Self check mode will illuminate all of the display segments for a visual check. The motors and sensors around the system will then be checked and faults will be indicated using a numeric fault code system.

Fault code number	System fault
11	In car temperature sensor
12	Ambient temperature sensor
13	Evaporator temperature sensor
14	Water temperature sensor
21	Left solar sensor
22	Right solar sensor
31	Left air mix motor
32	Right air mix motor
33	Air distribution motor

Fuel burning heater

Thermo Top C: Supplementary heater



Figure 65: Fuel burning heater

The supplementary fuel burning heater (FBH) is a standard fit on Rover 75 diesel derivatives. Supplied by Webasto, the Thermo Top C heater is located in front of the battery box (see Figure 65) and delivers 5kW of heat to the vehicle interior. Diesel engines are thermally very efficient and provide only a limited amount of heat for the HEVAC system. In cold climate conditions, for the occupants of a diesel engine vehicle to feel comfortably warm, it is necessary to fit a supplementary heater. With a fuel burning heater, occupants will feel comfortably warm in a shorter period than in a vehicle without a fuel burning heater fitted.

Advantages of a fuel burning heater over heaters using other fuel sources are:

- Requires a very small electrical supply as heat is generated by burning fuel and therefore it doesn't drain the battery
- Produces a high power heating output of 5 kW
- Good thermal efficiency
- Environmentally friendly because of optimum and continuous combustion

Operation

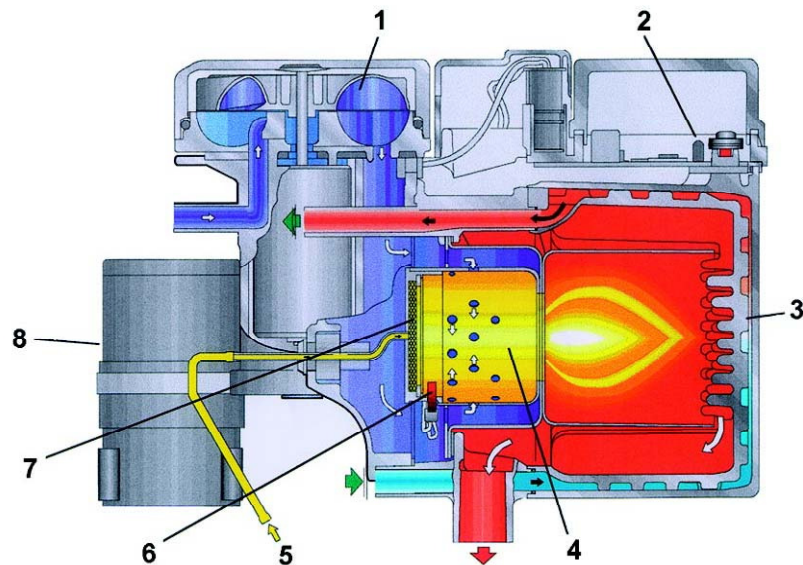


Fig. 1. Fuel burning heater

1. Combustion air fan
2. Electronic board
3. Heat exchanger
4. Stainless steel burner
5. Fuel supply
6. Glowpin/Flame detector
7. Evaporator
8. Water pump

The Webasto fuel burning heater is a self contained unit, with the vehicle's coolant pipes connected to the unit. Water flows in series from the cylinder head through the fuel burning heater and into the heater matrix. The coolant always flows through the heater unit even if the fuel burning heater is not currently adding heat energy to the coolant.

Air enters the fuel burning heater through a silencer and is directed through a combustion air fan. From here it passes into the burning chamber. The fuel required is delivered via a dosing pump with solenoid valve control. The fuel then passes through an evaporator into the burning chamber where it mixes with the air. A glow pin is used to ignite the mixture (see Figure 66). The glow pin also acts as a flame detector and if there is no heat produced by the flame the heater system closes down. Operation of the fuel burning heater is based on ambient temperature supplied by the ambient temperature sensor located on the front bumper.

The components that make up the fuel burning heater are as follows:

- Internal ECU
- Heat exchanger
- Evaporiser
- Stainless steel burner/chamber
- Glow pin/flame detector
- Water pump
- Combustion air fan
- Temperature sensor

External components of the fuel burning heater system are:

- Induction pipe (with in-built silencer)
- Ambient temperature sensor
- Dosing pump
- Dedicated fuel line

If the ambient temperature sensor measures the outside temperature to be below 5°C (41°F) and the engine is running, the ambient temperature sensor allows the voltage through to the fuel burning heater ECU. This feed enables the heater and auxiliary water pump to start operating. However, should the internal temperature sensor detect an existing coolant temperature of above 76°C (169°F) then the burner will not operate. This condition will remain unchanged until the coolant temperature drops to below 76°C (169°F). When this signal is received, the fuel burning heater ECU enters 'start-up' mode. When this mode is first initiated, the ECU powers the combustion air intake at a slow speed, drawing air in through the silenced inlet pipe. The ECU then provides power to the glowpin. This action pre-heats the combustion chamber for 20 seconds. After 20 seconds, the ECU starts to operate the 'dosing' pump at 0.7 Hz. The fuel entering the combustion chamber is ignited by the glowpin. The exhaust gases leave the fuel burning heater by the exhaust tube mounted on the inner wing. The ECU will then start to increase the fuel pumps rate and increase the amount of air entering the combustion chamber.

After 90 seconds of fuel has been supplied at full load, the glowpin will switch off and act as a flame detector. After the ignition sequence, if no flame is detected the fuel burning ECU will switch the fuel dosing pump off. It will continue to operate the combustion fan to purge the unit. The fuel burning ECU will then initiate the start-up sequence again. It will try to ignite the system only three times in one ignition cycle. The water jacket temperature is monitored constantly via a temperature sensor incorporated into the fuel burning heater. This sensor measures the temperature of the water jacket and not the actual coolant temperature. At 72°C (162°F) the temperature sensor signals the fuel burning heater ECU to switch to half heat (2.5kW). When this happens, the ECU will slow down the combustion air fan and reduce the frequency at which the dosing pump operates.

Once the engine has been turned off, the dosing pump will stop supplying fuel to the heater. The flame inside the fuel burning heater will continue to burn the existing fuel. To ensure that all the fuel is burnt safely, the fuel burning heater ECU continues to operate the combustion fan for 2 minutes.

The fuel burning heater is designed to shut down for approximately 2 minutes, should it be run continually for periods in excess of 72 minutes (+/- 10%). This is to allow the glowpin to re-ignite and burn off any unburnt particles.

Diagnostics

The fuel burning heater is capable of storing fault codes which are retrievable through TestBook. TestBook also has the ability to read real time inputs and outputs.

The fuel burning heater ECU will try to ignite the fuel burning heater three times within one operating cycle, (engine running and ambient temperature below 5°C (41°F)). If the heater fails to ignite, a fault is stored and the fuel burning heater will remain dormant until the conditions needed to operate are met again. If the fuel burning heater fails to ignite the fuel on three consecutive trips, (engine running, temperature below 5°C (41°F)) it will not attempt to operate again until the fault codes have been cleared.

The fuel burning heater ECU has a volatile memory. If all power is lost to the fuel burning heater, any fault code stored inside its memory will be lost. On reconnection of power the fuel burning heater will operate as if no previous faults have occurred.

No configuration is needed by TestBook. If a new fuel burning heater is ever fitted, it is a straight replacement.

Satellite navigation

What is satellite navigation?

The first in-car satellite navigation systems were developed in the 1970's but were limited to either an arrow pointing in the direction the vehicle was to follow, or an image of the vehicle's current position displayed on a map. Modern satellite navigation systems have progressed a long way since then, becoming more accurate, more efficient and providing more detailed information about the calculated route.

A modern satellite navigation system is an in-car guidance system which uses information transmitted from satellites orbiting the earth. From this information, the in-car computer can pinpoint the present position of the vehicle. The system computes this information against other data, which is generated in the car, and is able to calculate a route for the driver to take to reach his/her requested destination. The information is displayed on a monitor somewhere in the vehicle and is accompanied by computer generated audio instructions informing the driver when and where to manoeuvre.

The driver can choose between a route containing motorways, a route avoiding main roads, the shortest route (distance covered) or the quickest route (which takes into account speed limits along the route). Lists of hospitals, hotels, monuments and museums are also available.

Modern satellite navigation systems need three pieces of information to function correctly:

- The current position of the vehicle
- The direction in which the vehicle is travelling
- The speed at which the vehicle is travelling

This information is fed to the on-board computer, which also receives the required destination via the customer interface unit. The computer will contain in its memory complete mapping of the country in which the car is being driven. This mapping will have been programmed into the computer via its CD-ROM drive. Using all the information available the computer will detail a route for the driver to follow based on driver preference (e.g. no motorways).

Global positioning system

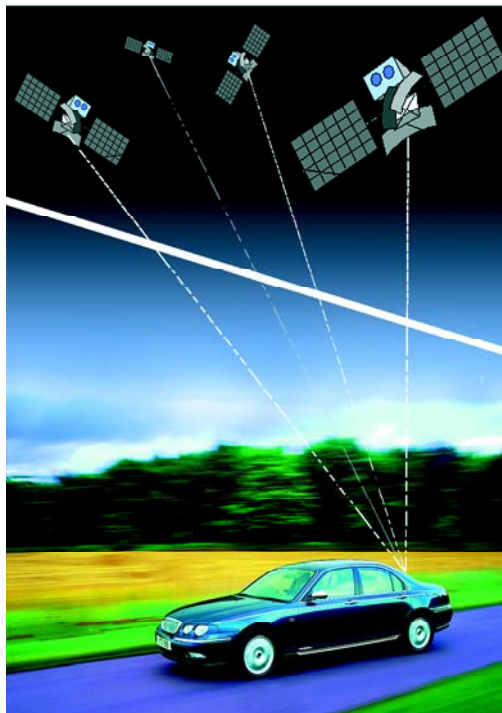


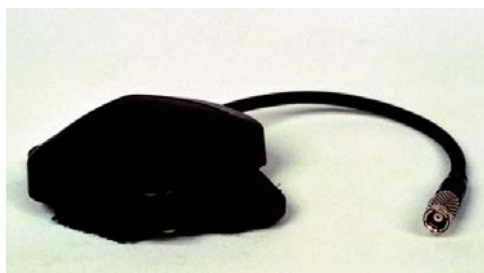
Figure 67: Global positioning system

The system used to calculate the current position of the vehicle is called the global positioning system (GPS). The system uses satellites which are owned by the American military forces. In all, 24 satellites orbit the earth at 20,000 km, and between 5 and 11 of these satellites can be seen from a single point at any given time. Each satellite transmits radio waves carrying information about its own position: latitude, longitude, altitude, almanac data and an accurate time signal generated by an on-board atomic clock. The vehicle needs to receive data from at least four different satellites to give a three dimensional fix on its current position (see Figure 67). As the vehicle moves, this information is continually being updated. The GPS is made up of two systems, which vary in their ability to pinpoint accurately:

1. Precision positioning system (PPS)
2. Selective positioning system (SPS)

The PPS is accurate to 20 metres but is coded for security reasons and only available to the United States of America (USA) military. The SPS is accurate to 100 metres, with the lower accuracy 'error' induced deliberately by the USA military. This system is made freely available to all. The computer is intelligent enough to be able to take this error into its calculations and predict that you are actually on a road rather than in the middle of a field!

The GPS antenna (see Figure 68) fitted to Rover 75 is mounted on the rear parcel shelf and relays the signals from the satellites to the GPS receiver, which is located in the boot of the vehicle and feeds the computer.

*enna*

All navigation systems use the GPS system. How a system derives the rest of the information it receives is system specific. The following descriptions of the Gyro compass, the vehicle speed sensor and the system computer refer to Rover 75 systems. These components are common to both the lowline navigator system and the highline Bordmonitor systems.

Gyro compass

The direction in which the vehicle is travelling is determined by the computer from information provided by the gyro compass, which is located inside the computer. This is a solid state device which determines angular acceleration of the vehicle (i.e. when the vehicle is turning). It does not determine the absolute heading of the vehicle and requires the computer to determine this. It is not susceptible to electrical magnetic interference from items such as the heated rear screen.

Vehicle speed sensor

The speed of the vehicle is calculated using the information from the ABS ECU provided by the wheel speed sensors. The signals from the left and right rear wheels are hardwired via the ABS ECU to the navigation computer. For an explanation of how the wheel speed sensors operate, see section on Anti-lock braking system.

Satellite navigation computer



Figure 69: Satellite navigation computer

The satellite navigation computer is the unit which receives all the system inputs and controls all the system outputs. Maps of various countries are programmed into the computer via a CD-ROM drive. Maps are continually being updated and new editions are released every six months. Only one country at a time can be programmed into the computer, and therefore, when travelling from country to country the relevant CDs will be required. On crossing a country border, the relevant CD-ROM will have to be fed into the computer to enable the computer to generate a route for the driver to follow. (From England to France: England Map CD-ROM with destination = Dover port. Cross channel then program the computer with the France Map CD-ROM and input French destination.)

The computer used by Rover 75 is located on the right hand side of the boot (see Figure 69).

Rover 75 satellite navigation

The Rover 75 will be the first Rover Group product to feature satellite navigation as original equipment. Land Rover products, such as Range Rover Autobiography, have offered a form of satellite navigation, but this has been as a special fit.

The two systems used by Rover 75 are Rover modified versions of existing BMW E46 satellite navigation systems. The main modification involves the customer interface units which have been made easier to programme. There are highline and lowline specifications of the system. The main difference between the highline and lowline specifications is that the highline has a 5 inch colour monitor and the lowline uses the 2.5 inch Bi-colour message centre located in the instrument pack. The highline system with colour monitor uses 'red, green, blue' (RGB) technology and needs to use screened co-axial cable to communicate between the computer and the display (Bordmonitor). All other inputs to the computer use the K-Bus system. The lowline satellite navigation system can communicate on the K-Bus system and uses a discrete Navigation Bus to send graphics information to the display in the instrument pack.



Figure 70

The components that make up the Rover 75 satellite navigation system are:

- Icon monochrome display (lowline) or Bordmonitor colour liquid crystal display (LCD) (highline) (see Figure 70)
- Navigation computer
- Gyro compass (built into Navigation computer)
- GPS antenna and receiver
- CD ROM map reader (built into navigation computer)
- Interface: switch unit (lowline) or Bordmonitor (highline)
- K-Bus serial link
- Wheel speed sensor
- Reverse signal input
- Audio speaker (highline) or dedicated speaker (lowline)

The driver first follows the correct process for inputting a destination into the system via the interface unit. The system will calculate the vehicle's current position and then calculate a route for the driver to reach the destination. The time this takes varies with the length and complexity of the route. It can take only seconds for some routes but up to two minutes for more complex routes. The reason for this is that the maps have to be accessed from the CD-ROM which contains up to 600 megabytes of data. Alternative techniques may be faster but all have drawbacks. The advantages of the CD-ROM is that it is relatively low in cost and can store a large amount of information. Also, the map databases covering different countries can be loaded simply by changing the CD-ROM. The inconvenience of the slower response time is compensated for by the elimination of a complex and costly map database changing process.



Figure 71

The GPS receiver (see Figure 71) determines the vehicle's current position and compares it with the 'dead reckoning' position. The dead reckoning position is determined from the gyro compass and the wheel speed signal overlaid on the CD-ROM database. At any given point in time the computer can determine the vehicle's current position by reconciling the dead reckoning positioning with the GPS positioning. This is displayed by the monitor and used by the computer to calculate the next manoeuvre for the driver to undertake in order to reach the destination.

If the driver strays from the route accidentally or is forced to alter the route, because of road works etc. the system automatically re-routes. The system is an aid to the driver who is in unfamiliar territory.

Rover 75 highline satellite navigation system



Figure 72

The Bordmonitor (see Figure 72) is at the heart of the highline navigation system fitted to Rover 75. It is located in place of the radio cassette unit under the fascia and is the interface unit for the customer to operate the satellite navigation system, the audio system and the television. With the Bordmonitor, the driver can select either an icon based display or a map displayed on his/her monitor. The highline system uses the front audio speakers, momentarily muting the sound of the audio system while the satellite navigation system uses the speakers.

Navigation system

The system will operate only in ignition position 1 or 2, although it is possible to remove a CD-ROM from the computer by pressing the eject button twice. With the ignition on, the navigation system is operated by pressing the menu key on the Bordmonitor. The main menu will illuminate and Navigation is selected by turning the left hand rotary knob until it highlights Navigation and then pressing the knob.



Figure 73

All navigation programming is carried out by using the LH rotary knob. When entering a new destination, the alphabet is displayed and the destination is inputted by selecting and accepting each letter of the destination in order by turning and pressing the LH rotary button (see Figure 73).

Familiar addresses are stored in the address book and various options are available by switching from screen to screen, such as hotels, hospitals, museums and monuments. A choice of two languages is available and a choice on the type of route can also be chosen.

Audio module



Figure 74

The highline satellite system fitted to the Rover 75 is integrated with the audio system and also has a colour television tuner available as an option. This is a video module located in the rear edge of the spare wheel well and is secured via a bracket on the vehicle body using a single M6 flanged screw (see Figure 74). In essence, this is a television receiver and has a teletext function. The video module drives the display in the Bordmonitor with separate RGB video signals. The module receives television signals, via two co-axial cables, from the TV antenna on the rear screen and from the amplifier located on the right hand side D-post.

Note: The television function will be inhibited when the computer receives a signal that the vehicle is moving!

The radio tuner is located in the boot of a vehicle fitted with the Bordmonitor navigation system.

Rover 75 lowline satellite navigation system

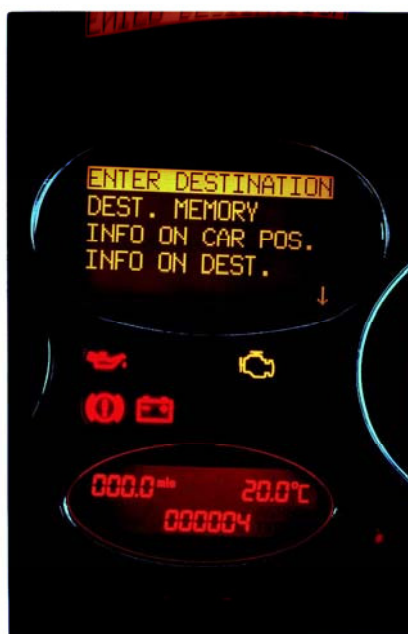


Figure 75

The lowline system is integrated with the highline system and uses a switch pack located on the centre console as its customer interface and uses the instrument pack message centre to display messages (see Figure 75). The display is a 2.5 inch Bi-colour display and icon-only based. The lowline system uses a dedicated speaker, unlike the highline system which uses the front audio speakers. The lowline system is equally as accurate as the highline system and it is only the customer interface units, speakers and the display that make up the differences between the two systems.

The lowline navigation switch pack is mounted in the radio cassette unit in the fascia (see Figure 76). It uses the K-Bus system to communicate with the navigation computer. The switch pack has five operational user controls/switches:

- Rotary menu controller
- On/off switch: Toggles the Navigation system between Standby and ON
- Mute: Toggles the audio output ON and OFF
- Re-route: This switch is functional only in guidance mode and operation of this switch presents the user with the Re-route screen from which the user can select a length of Re-route
- Repeat: This switch is functional only in guidance mode and operation of this switch repeats the last audio message (if it is still valid)

Two green LEDs are also located on the switch pack. One indicates that the navigation system is on and the other illuminates when the navigation speaker has been muted.

Figure 76: Lowline navigation switch pack



Figure 76: Lowline navigation switch pack

The lowline navigator is operated as follows:

1. Switch on the system using the on/off switch (In ignition position 1 or 2)
2. LED will illuminate to indicate the system is on
3. The system will transmit a message to the instrument pack, via Nav-Bus, requesting a navigation display in the message centre
4. Navigation menu will appear on the message centre display

From here it is necessary to use the buttons listed above to program the required destination and options. The rotary menu controller is turned clockwise and anti-clockwise to move the screen cursor down and up respectively. When the required function is highlighted, it is selected by pressing the rotary controller button.

TestBook diagnostics

Information can be accessed through the diagnostic line using TestBook on both highline and lowline systems. Information which can be accessed includes the following:

- Rover part number
- Hardware and software version
- Week and year of manufacture
- Button status (lowline switchpack)
- LCD brightness (Highline Bordmonitor)
- Read error memory/fault codes

The button status function can be used to determine the correct functioning of the switchpack. Sticking button can be observed on the TestBook screen as well as the correct functioning of all the keys as they are pressed.

Fault codes

Fault codes are stored in the memory of the system ECUs and are accessed using TestBook. The following table lists the faults that can be stored by the navigation computer memory for both lowline navigator and highline Bordmonitor systems:

ECU fault codes

Fault code	Description
01	Navigation computer error
04	GPS sensor error
05	Temperature error
06	Application software error
07	Display error
08	Audio error
09	CD error

On-board diagnostics

Both the highline navigation system and the low line navigator feature on-board diagnostics:

On-board diagnostics lowline navigator

The lowline navigator can be put into on-board diagnostics mode by highlighting the 'SETTINGS' mode from the main menu and pressing the Re-route button for over 8 seconds. A service mode menu then appears and this allows various tests to be carried out on the system.

The service mode has three main functions:

1. To check that components are fitted and to determine their hardware/software levels
2. To perform a health check on the system inputs
3. To check the status of the GPS reception

Selecting the NAVIGATION, GPS AND SWITCHPACK functions displays the versions fitted to the system. Selecting the SENSOR TEST mode will present a screen displaying the current sensor inputs. To check all the sensors are operating correctly it will be necessary to drive the vehicle a short distance and this must be taken into consideration when entering this test mode. The screen displays the operation of the wheel speed sensors, the gyro compass, the direction sensor and the status of the GPS system.

On-board diagnostics: highline Bordmonitor

The highline Bordmonitor navigation system can be put into on-board diagnostic mode by highlighting the 'SETTINGS' mode from the main menu and pressing the Menu key for over 8 seconds. The Bordmonitor service mode screen is very similar to the lowline navigator service mode screen and checks the components they have in common in the same way. It differs in that it has a on-board monitor mode, a navigation/graphic mode and a video module mode. Various tests on the system can be carried out using these modes.

Languages and software loading

Software is loaded onto both systems via the CD-ROM drive on the computer. This allows different languages to be loaded and allows the systems to be updated with new or different maps. Software loading is achieved by inserting the CD into the CD drive. The ignition must be in position 1 or 2. The navigation computer will then compare the software contained by the new CD with the software currently loaded on to the system. If it finds the CD contains a later version of the software it will automatically load the new software - overwriting the older software. The display will indicate software is being loaded using the display with a prompt and progress bar. When loading is complete, the CD will be ejected automatically and the user will be prompted to remove the CD and confirm.

When software loading is taking place the ignition must remain on for the duration of the loading.

At PDI, the system will prompt for a software loading disc to be inserted so the correct languages and the latest software can be loaded. Market destination will determine which languages are loaded at PDI. Two languages are programmed into each system.

Markets and languages are outlined in the table below:

Market	Language 1	Language 2
UK	UK English	German
USA	US English	French
Germany	German	UK English
Spain	Spanish	UK English
Italy	Italian	UK English
France	French	UK English

In-car telephone

Introduction

Car telephones have become a widespread and popular accessory over recent years and development has taken place to make their use as simple and as safe as possible for the driver. This makes it possible for the driver to concentrate more on the actual driving of the vehicle. Two types of telephone are available with Rover 75; the Nokia 3110 and the Siemens S10 (see Figure 77).



F i N 1 n c n S10

System components

The telephone system available on Rover 75 consists of the following components:

- Handportable telephone and a telephone card holder
- Eject box, which locates on the centre console. This houses the telephone and also contains the battery charger and aerial connection
- Interface unit or cellular communications interface (CCI), which is located in the boot. This unit converts the signals to and from the telephone and makes them compatible with the vehicle K-Bus system
- Compensator, which is located in the boot of the vehicle. This unit acts as an amplifier to compensate for potential loss of signal power through the antenna cables and curly cord
- Microphone, which is located in the reading light unit
- Antenna, which is located on the rear windscreen
- Audio speakers or the single speaker, which are utilised for the telephone system, are located in the front doors, for the highline audio system, or the driver's footwell, for the Bordmonitor system



g f tor

There are two versions of the CCI, one for use with the Bordmonitor Navigation System and the other for use with the highline audio system. Both units work with either the Nokia 3110 or Siemens S10 telephone options. The CCI system can be used with either of the two handportable telephones. However, if the telephones are changed, TestBook will be required to re-configure the CCI and, for stowage and connection, the correct eject box needs to be fitted (see Figure 79).



Fig e Λ a ef ne and box

Telephone system inputs and outputs

The following list describes the telephone system inputs:

- Microphone (see Figure 80)
- Battery '+'
- Ignition switch position 1 (aux.)
- Illumination (via the GM6)
- Head unit switches: volume, presets 1-6, seek up/down, 'bass/treble/balance/fader', 'telephone', 'CD/tape', 'FM', 'AM'
- Remote wheel switches: volume up/down, seek up/down, 'mode', 'send', 'end'
- Antenna and compensator (receives RF signal)
- Turn and push switch (radio or Bordmonitor)
- K-Bus

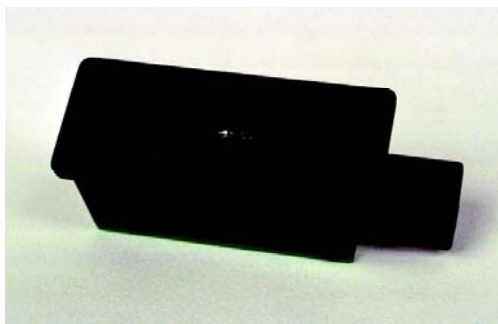


Figure 80

The following list describes the telephone system outputs:

- Antenna and compensator (amplifies RF signal) (see Figure 78)
- Audio to radio or loudspeaker
- Radio display (phone numbers, etc.)
- Mute to radio
- Instrument pack (diagnostic gateway)
- K-Bus

Features and functionality

There are 3 means of controlling the various functions of the telephone. They are:

1. Through the navigation display and control
2. Through the radio
3. Through the steering wheel remote controls

The navigation computer can display the 8 numbers dialled most frequently (see Figure 81) and can simultaneously display up to 8 alphabetically listed names (see Figure 82), by using the turn and push switch to select the relevant menus. By selecting the relevant menu option, the navigation computer can also display the last 10 numbers dialled and the entry of the telephone number for fast dialling.



Fig 1 e l i u een



Fig 2 e y en

Using one of the preset buttons on the radio allows the recall of the first 6 locations on the subscriber identity module (SIM) card. Pressing and holding down one of the preset buttons allows speed dialling of the first six locations. The seek up/down button permits scrolling through the contents of the SIM card in alphabetical order and the 'TEL.' button recalls the last numbers dialled.

The seek up/down remote control buttons on the steering wheel allow the search and selection of names and telephone numbers stored on the SIM card. The mode button allows the user to switch between audio and telephone functions, while the volume control keys adjust the telephone and audio volume output, depending on the function selected.

Pressing the 'bass/treble/balance/fader' button on the head unit allows individual digits to be entered on the top line of the display. The display shows digits from '0 - 9', '+' (addition) and 'C' (cancel), and, by rotating the control button, highlights the desired number. Pressing the control button selects the highlighted number and adds it to the telephone number displayed on the lower line. Pressing 'C' deletes a digit, pressing and holding 'C' returns to the main telephone menu.

Selecting 'dial number' from the Bordmonitor menu will display a ring of numbers (similar to old fashioned telephones) (see Figure 83). Rotating the control button moves the cursor around the ring and pressing the button selects that digit, adding it to the number to be dialled. When the number is complete, select the '>' arrow to exit from the dialler and press the handset button to call the number displayed.



L u een

Because the display is shared with various systems (audio, navigation, phone), each system will need to know which function is controlling the display at any one time. Control can pass to and from the telephone system when:

- The user selects phone mode
- The user leaves phone mode
- The telephone rings
- A new text message arrives
- The telephone is switched off
- The telephone is connected or disconnected

If 'telephone', from the Bordmonitor menu, or the 'TEL.' button, on the head unit, is selected, a K-Bus message is sent to all local Bus members informing them that the telephone has control of the display. This is known as phone mode.

If 'return', from the telephone main menu, or 'AM/FM/CD' or 'tape', from the head unit, is selected, the system will leave phone mode. A message will be sent to all Bus members to inform them which system now has control of the display.

If the telephone detects an incoming call, a Bus message will be sent to the radio or Bordmonitor to inform them of the situation. Control of the display will then be released to the telephone and the relevant information is displayed to the driver.

When a text message arrives, the telephone will request use of the display by sending a Bus message to the radio. The display will then be released to the telephone and the system will be in phone mode. In the case of the Bordmonitor, an envelope is displayed, whenever there are any unread messages.



T a n

If the telephone is switched off whilst in phone mode, a message is sent to the display. The display then takes control from the telephone and sends a message to all the other Bus members.

If the telephone is disconnected, a 'phone off' message is sent. If the phone mode is then selected, a display of 'please plug in phone' appears, waits 10 seconds, and, if the telephone is not plugged in, sends the 'phone off' message again.

There are two connections to the audio output, the first being the sound generated by the telephone, and the second signal that causes the radio's own output to be muted. Whenever the telephone is in use, the system will request that the output from the radio is muted.

The audio signal from the telephone to the radio, when connected to the highline radio, is routed through the radio's audio amplifiers to the front speakers. When connected to the Bordmonitor, the audio signal from the telephone is routed through an amplifier in the CCI to a small loudspeaker mounted on the diagnostics socket bracket above the driver's footwell.

Cellular communication interface (CCI) requirements



Figure 1: CCI unit

The CCI (see Figure 85) will wake up and start the running code when power is supplied. However, unless one of the three following conditions is detected, the system will begin the low power sleep mode.

1. A telephone is plugged in and switched to the on position. The telephone is already on when it is plugged in. The system will switch off the telephone for a few moments after a battery has been reconnected. A call is in progress, then it will switch off once the call has ended
2. The ignition switch is in position 1 or 2
3. The radio has been switched on with the ignition in position '0'

The CCI also has a power down routine, which will switch off the telephone and cause the CCI to go into sleep mode. The power down routine includes a delay of approximately 30 seconds at various points. This allows, for example, the driver to crank the engine without the telephone switching off and then back on again, or to unplug and remove the handset and for it to remain switched on. If the telephone is in use, the power down routine will not begin until the call has finished. The following conditions can start the power down routine:

1. The ignition switch is turned to the '0' or 'cranking' position
2. If the radio switches on with the ignition in position '0', and the 20 minute timer has expired, so the radio has switched off
3. The system is powered up because the telephone is plugged in or has been switched on by the driver, whilst the ignition is in the '0' position
4. The driver switches the telephone off or unplugs it
5. The system detects that no calls have been made or received within the last 60 minutes

Audio system

Introduction

The Rover 75 model range features various audio system options. The exact specification of the equipment fitted to any particular vehicle is dependent upon the regional requirements of its market destination. In all cases, the audio system will basically comprise a head unit (dashboard mounted control unit), speakers, steering wheel switches and antenna. There are three audio system configurations available and further CD Autochanger, and Premium audio system options.

Configurations

The configurations for the various audio systems used on Rover 75 are as follows:

Lowline audio system configuration

The Lowline audio configuration is as follows:

- Philips 4 x 14W radio data system (RDS) radio/cassette head unit, which is CD autochanger compatible
- Goodmans 4 x 165mm 25W Bass Driver speakers (1 in each door)
- Goodmans 2 x 25mm 35W tweeters (1 in each front door)
- Remote steering wheel control switches
- One FM and AM rear windscreen antenna
- Antenna isolator (located in the left hand D-post)
- Antenna filter unit (located in the right hand D-post)

Highline audio system configuration

The highline audio configuration is as follows:

- Alpine 4 x 20W RDS Radio/Cassette head unit, which is CD autochanger and telephone compatible
- Goodmans 4 x 165mm 25W Bass Driver speakers (1 in each door)
- Goodmans 4 x 25mm 35W tweeters (1 in each door)
- Remote steering wheel control switches
- Three FM and one AM rear windscreen antenna's, with full diversity on FM
- Antenna isolator (located in the left hand D-post)
- Antenna filter unit (located in the right hand D-post)

Bordmonitor audio configuration

The Bordmonitor audio configuration is as follows:

- Alpine 4 x 20W RDS Bordmonitor head unit with integral cassette, which is CD autochanger and telephone compatible
- Remote radio unit (located in spare wheel recess, in the boot)
- Television/Video module (located in spare wheel recess, in the boot)
- Goodmans 4 x 165mm 25W Bass Driver speakers (1 in each door)
- Goodmans 4 x 25mm 35W tweeters (1 in each door)
- Remote steering wheel control switches
- Three FM and one AM rear windscreen antenna's, with full diversity on FM
- Two TV rear windscreen aerials, with full diversity
- Antenna isolator (located in the left hand D-post)
- Antenna filter unit (located in the right hand D-post)

CD Autochanger audio configuration

The CD autochanger audio configuration is as follows:

- Alpine 6 disc CD Autochanger, located in the glovebox

The premium audio system option is only available with the Highline audio or Bordmonitor configurations. The following will highlight the main differences over and above their standard specifications.

- Harman Kardon 280W audio amplifier (located on the right hand side of the boot)
- Harman Kardon 4 x 165mm Bass Driver speakers (1 in each door)
- Harman Kardon 4 x 25mm tweeters (1 in each door)
- Harman Kardon Sub Woofer, incorporating 2 x 150mm speakers (located under the rear parcel shelf, in the boot)

Lowline audio system



Lowline audio system

The following describes the features and functionality of the Lowline audio system (see Figure 86).

The Lowline radio can only become active when the ignition switch is in position 1 or 2. Once the unit has been activated, the transfer of data begins with K-Bus participants (illumination control unit, CD autochanger, etc.) which is necessary for full functionality of the unit. Each time the unit is activated, it will begin its operation in the same mode in which it was last used. This is known as 'last function mode' (LFM).

Autostore

The autostore facility is available on the FM-2 and MW-2 wavebands. This feature will automatically store the 6 strongest stations on the 6 pre-set memories. The 2 frequency wavebands can be used for manual memorising but will be overwritten by any autostore operation. Autostore is initiated by pressing either the FM or MW buttons for longer than 2 seconds.

Loudness/tone

The 'Loudness' function is automatically active and cannot be deactivated. This function does not limit the amount of Bass adjustment available to the operator. Pressing the 'Tone' button, recognised by a musical note symbol, for more than 2 seconds will cause the bass, treble, fader and balance controls to go to the middle position. The message 'flat' will be displayed in the head unit for 3 seconds.

CD changer

If the CD button is selected but a CD autochanger is not installed, the request will be ignored without a message displayed. If a CD has been installed but there are no discs in the magazine, the message 'no discs' will be displayed. If the magazine has been removed, the message 'no magazine' will be displayed.

Traffic and news

The traffic announcement function is selected by pressing the information button on the head unit, indicated by the 'i' symbol, this will display the message 'traffic'. Pressing and holding the information button will activate the news mode, displayed 'news'. If the traffic mode and news mode are active at the same time, the traffic mode has a higher priority.

Tape

A tape is inserted and ejected mechanically on the Low Line Audio system. A tape will remain in the tape loader, after insertion, when a source selection (tape to tuner or tape to CD) is performed. The tape can be ejected by pressing the fast forward and rewind buttons simultaneously. If a problem arises with the tape whilst it is running or the tape stops, due to a fault, the message 'tape error' will be displayed.

Note: There are no regional configurations for the Lowline Audio system.

Highline audio system

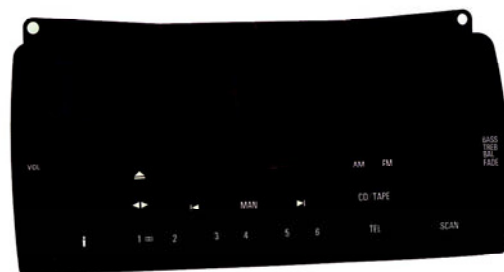


Figure 11-13-RO-W: Ver 1.0

The following describes the features and functionality of the Highline audio system (see Figure 87), over and above the Lowline audio system.

The Highline audio system can be operated with the ignition in the off position, by activating the unit's power button. This feature primarily facilitates the radio operation, but has a secondary benefit of supporting the telephone facility. This secondary benefit permits the head unit to become active, with the ignition off, allowing incoming calls to be received and out going calls to be made. When the head unit is activated with the ignition off, a timer begins which will automatically switch the head unit off after 20 minutes to prevent unnecessary battery discharge, if, for example, the head unit has been inadvertently left on after the driver has left the vehicle.

seek

The seek facility of this unit, located either side of the 'man' button, will either seek automatically for stations, or can be manually controlled by pressing the 'man' button followed by either of the seek buttons. The 'scan' button, when activated, scans through the waveband and plays 5 seconds of each radio station detected until the driver stops this procedure by pressing the 'scan' button again or one of the 6 preset buttons. The system also supports full diversity of the 3 FM aerials integrated in the rear windscreen. This allows switching between aerials to achieve the optimum radio signal.

Tape

The Highline audio system facilitates an electronic tape system, as opposed to mechanical, and requires the unit to be switched on to enable the tape to be ejected. Pressing the button marked with one solid triangle will eject the tape and the button located directly underneath the eject button will reverse the direction of play. Whilst in tape mode, with the 'man' button in the on position, the fast forward and fast rewind functions are activated through the 'seek' buttons. The music search facility is also activated through the seek buttons. With the 'man' button in the off position, the music search facility is active and will display either 'seek >>' or 'seek <<' depending on the direction selected. The 'scan' feature is also available during tape mode. Pressing the 'scan' button activates a search for the next track followed by a 5 second playback of the track and subsequent tracks. Pressing the 'scan' button again or either the fast forward or fast rewind buttons will stop this procedure. The 'Dolby Noise Reduction' facility is activated through the radio pre-set button 1 and will display the Dolby symbol in the top right hand corner of the display.

Speed dependent volume

The speed dependant volume control automatically adjusts the audio signal balance, boosting the lower frequency notes to overcome tyre to road noise, using inputs from the wheel speed sensors, via the instrument pack. This capability ensures the perceived volume of sound remains at a constant level, regardless of the predictable changes in background noise caused by increases and decreases in vehicle speed. There are 4 preset volume curves available, selectable by initiating the service mode.

Note: Depending upon the vehicle's market destination, the 'CD/tape' button, and 'tel.' button, on vehicles for Europe and the rest of the world, will be replaced with a separate 'tape' button, and a separate 'CD' button for Japan.

Bordmonitor



Figure 88

The following describes the features and functionality of the Bordmonitor (see Figure 88), over and above the Highline audio system.

The fundamental differences of the Bordmonitor, over and above the Highline audio system, is that the Bordmonitor incorporates a colour monitor with the capability of supporting the Navigation and television features (see relevant sections). Also, the black box radio tuner (i.e. no faceplate) and speaker amplifiers are located in the spare wheel well of the boot, as opposed to being an integral part of the head unit.

In addition to the 3 FM and one AM aerials integrated in the rear windscreen, as per Bordmonitor and Highline audio systems, there are also 2 TV aerials, with full diversity, to facilitate the Television feature of the Bordmonitor.

The tape system incorporates all the features of the High Line Audio system except for the 'Dolby Noise Reduction' feature, which, on the Bordmonitor, has the ability of selecting either Dolby B or C.

CD autochanger and premium audio system options

If the Premium audio system option is fitted, the Goodmans speakers and tweeters are all replaced with Harman Kardon speakers and tweeters with the introduction of a Harman Kardon Sub Woofer that contains 2 speakers within the tuned and ported box. This unit is located in the boot and ported through a grill in the rear parcel shelf.

The 6 disc CD autochanger (see Figure 89), located in the glovebox, is available as an independent option for all units. Its operation is controlled using the buttons on the head unit. If the Bordmonitor is fitted, the CD operation is accessed through the menu display, using the 'turn and push' button to highlight and select the feature required.



Figure 89 CD autochanger

Security

Each unit has a permanent 4 digit code that is noted on a card supplied with the unit. The head units are unique to Rover 75 and require 2 special security keys in order to withdraw the head unit from the dashboard. Each of the 3 head units accommodates its own unique key.

Serviceability

The following describes the features and functionality of the service mode.

To activate the service mode, the 'M' button on the Lowline audio system, and the 'man' button on the Highline audio system, must be pressed and held for at least 8 seconds, within 8 seconds of the unit becoming active. Once in service mode, the serial number of the head unit will be displayed automatically. Pressing either the + or – buttons on the Lowline, or either of the seek buttons on the Highline audio systems, will permit scanning clockwise and anti-clockwise through the various modes. The unit must be switched off to exit the service mode. The following are examples of what can be accessed through the service mode:

- Serial number - Displays the last 8 digits of the serial number
- Version - Displays information regarding the software
- Traffic volume - Displays adjustment increments -9 to +9
- RDS On/Off - The program service name display is enabled/disabled
- Speed dependant volume curves (choice of 4) - Highline and Bordmonitor audio systems only

Memory seats

Introduction

Memory seats are available as an option on certain Rover 75 models, with all seat movement being controlled by the memory ECU. The memory seat system controls the four axes of seat movement, which are:

- Cushion slide
- Cushion height
- Cushion tilt
- Backrest angle

The system can record three different memory settings, as well as having direct control over the seat motors for manual operation. The unit has a tool-free diagnostic procedure (self test function), as well as full serial communication diagnostics, using TestBook.

Components and locations

The following table lists the components, and their locations, that form the memory seat system.

Component	Location
Memory seat ECU	Under the driver's seat mounted to the seat frame
Seat adjustment switch pack	Outer valance of the driver's seat
Memory seat switch pack	Outer valance of the driver's seat
Seat cushion slide motor	Under front drivers seat, midway between slides
Seat cushion front (tilt) motor	Under drivers seat
Seat cushion rear (height) motor	Under drivers seat
Seat backrest motor	Inside the backrest of the drivers seat
Seat harness	Inside the drivers seat
GM6	Behind the glovebox on the passenger side
Instrument pack	On the dashboard



Fig. 11-13-RO-W: Ver 1.0

The switch pack for the seat adjustment consists of two separate switch assemblies (see Figure 90). A 6 way adjustment switch for the cushion (slide forward and backward, height up and down, and tilt up and down) and a 2 way adjustment switch for the backrest (raise and lower). The seat memory switch pack consists of four separate switches, one marked M, and 3 marked with either 1, 2 or 3 dots, all housed in one pack.

Seat motors

The cushion slide motor, cushion height motor, cushion tilt motor and backrest motors are supplied as part of the seat assembly or as part of a kit of components for service replacement. A Hall effect sensor, in each of the four seat motors, produces a pulse signal as the motor is rotating. The sensor emits a regular train of pulses, between 0 and 12V, which the memory ECU counts. This allows the ECU to determine the position of each axis of the seat.

Only two seat motors can be driven at any one time. However, due to the sharing of relays, there are certain combinations of motors that cannot be driven together. The following table indicates which axes can and cannot be operated at the same time.

	Bk.rest up	Bk.rest dn	Tilt up	Tilt dn	H.ght up	H.ght dn	Fward	Bkward
Bk.rest up	N/A	No*	No**	No**	Yes	Yes	Yes	Yes
Bk.rest down	No*	N/A	No**	No**	Yes	Yes	Yes	Yes
Tilt up	No**	No**	N/A	No*	Yes	Yes	Yes	Yes
Tilt down	No**	No**	No*	N/A	Yes	Yes	Yes	Yes
Height up	Yes	Yes	Yes	Yes	N/A	No*	No**	No**
Height down	Yes	Yes	Yes	Yes	No*	N/A	No**	No**
Fward	Yes	Yes	Yes	Yes	No**	No**	N/A	No*
Bkward	Yes	Yes	Yes	Yes	No**	No**	No*	N/A

Key:

N/A = Not Applicable

Yes = Can be activated together

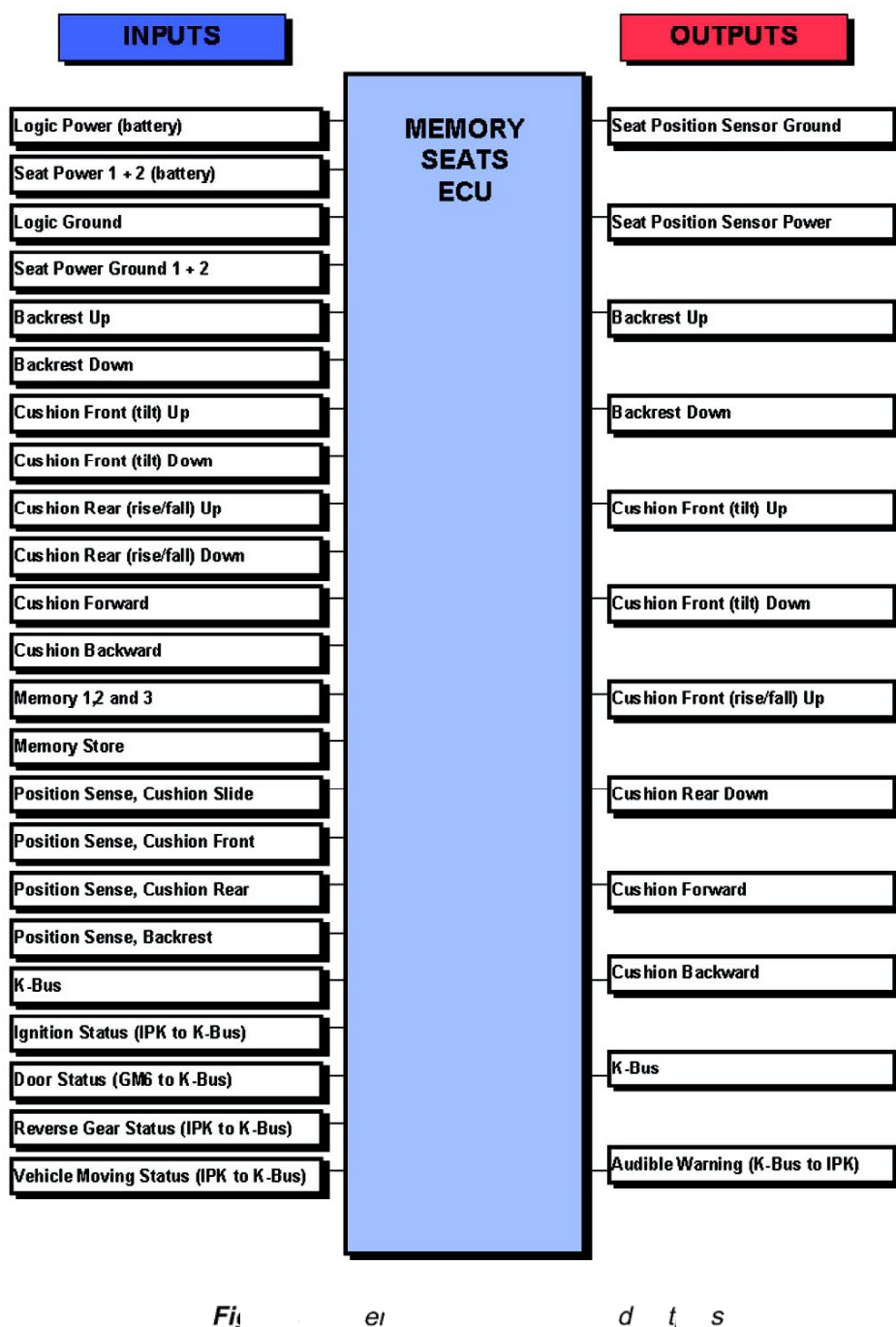
No* = Cannot be activated together (Physically impossible)

No** = Cannot be activated together (Relay sharing restriction)

If two motors are being driven and a third is requested, the last switch request will be ignored until either of the two motors stop. The third motor will only begin its operation providing the switch has been released and re-selected.

Block diagram of memory seats inputs and outputs

The following diagram illustrates the inputs and outputs of the memory seat system (see Figure 91).



System functionality

Providing the key is in the auxiliary or ignition position, or either of the front doors are open, manual mode or memory ('one touch' mode) adjustment of the front seats will be enabled.

Pressing the appropriate numbered memory switch on the driver's seat valance allows the seat to start moving to the position appropriate to that memory. The cushion slide and backrest will move first, followed by the cushion height and tilt. If the vehicle is stationary, the memory recall will operate in a 'one-touch' mode, whereby the switch can be released and the seat will continue to move to the memory position. If, however, the vehicle is in motion when the switch is released, then the system will operate in manual mode. This means that when the switch is released, the seat will stop moving. In order to reach the intended memory position, the switch must not be released until all movement has stopped. The instrument pack will emit 2 'gong' tones to indicate that the recall operation has been successfully completed.

If any of the seat adjustment or memory switches are activated during a 'one touch' memory recall, the recall will be overridden and the seat will begin to move in the direction corresponding to the switch that has been pressed.

The following procedure will store a memory position:

1. Ensure the key is in the auxiliary or ignition positions
2. Manually adjust the seat to the desired position, using the seat switches
3. Press and hold the 'memory store' switch
4. Press and release the desired numbered memory switch
5. Release the 'memory store' switch

A single 'gong' will be emitted from the instrument pack to indicate that the store operation has been successful.

Pressing and holding the unlock button on the remote transmitter for at least one second, will initiate a memory recall (the doors are not to be open for this operation). This feature is known as 'lazy entry'. If the key is turned to either auxiliary or ignition, or any of the doors are opened, or the lock or unlock button on the remote transmitter is pressed, then the 'lazy entry' feature will stop immediately.

Interaction with other systems

The GM6 sends information to the memory ECU regarding the door open status, 'lazy entry' request, and 'lazy entry' cancel. This information is passed to the memory ECU using telegrams on the K-Bus. The door status information is used to enable seat movement and to cancel the 'lazy entry' procedure. The GM6 ECU generates the 'lazy entry' request upon receiving the appropriate signal from the remote transmitter. Upon receipt of a 'lazy entry' request telegram, the memory ECU will move the seat to the appropriate memory position.

The instrument pack sends information to the memory ECU regarding the ignition status and vehicle moving status. The information is passed to the memory ECU using telegrams on the K-Bus. The ignition status information is used to enable seat movement and in the control of 'lazy entry'. The vehicle moving status signal, from the ABS vehicle speed sensor, is used to inhibit the 'one-touch' memory recall when the vehicle is moving. Telegrams can be sent on the K-Bus to the instrument pack from the memory ECU requesting either a single or double 'gong', ignition status, or vehicle moving status.

The memory ECU can be forced into a self test diagnostic mode without the need for specialist tools by following a special operational sequence. This feature will allow confirmation that all switch inputs are being received by the ECU. It will also test the motor outputs.

On-board diagnostics

Introduction

The European Commission anti-pollution committee has set its next directive, which will continue to make further progress for the reduction of harmful pollutants produced by motor vehicles.

Introduction of ECD3 will not only be a further step in reducing harmful emissions, but will also introduce a fault monitoring system, known as On Board Diagnostics (OBD).

This type of fault control monitoring (OBD) will be a mandatory requirement for all petrol driven vehicles that are sold within the European Community from the 1 January 2000.

Historical

OBD monitoring systems for emissions related faults, were first introduced in North America. The introduction of OBD meant that the number of emissions related problems could be identified. Over the following years, technology has improved, so has OBD and its ability to identify and report to the driver, sophisticated emission related malfunctions.

How will the problem be reported to the driver?

The problem is reported in the form of a Malfunction Indication Lamp (MIL) in the instrument pack. This can be displayed in a number of optional ways and for Europe, Rover 75 will use a pictorial display of an engine outline on an amber background.

The benefits of OBD

Apart from reporting a fault or faults to the driver via the Malfunction Indication Lamp (MIL), it also records the fault to assist the person who will take responsibility for the repair.

How to investigate the fault or faults stored?

To carry out an investigation, diagnostic test equipment, such as TestBook, will allow access to the Engine Control Module (ECM) via serial communication link.

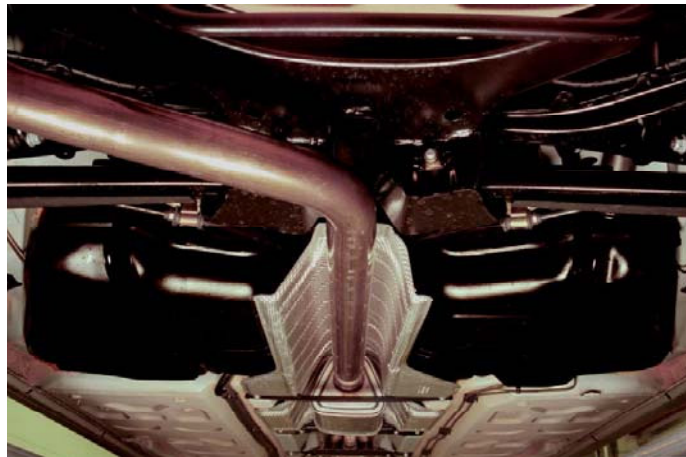
The information stored will help the repairer to establish the true cause of the failure or fault. This can be displayed in a number of ways, a fault code number or a text statement. In addition, a captured window of information about the vehicles running condition at that moment in time is stored. This is known as freeze frame data.

This should help the repairer to identify the cause of the fault and greatly reduce repair times in the workshop.

Fuel systems

Petrol fuel system

Rover 75 petrol derivatives are fitted with a returnless fuel system incorporating a blow moulded plastic saddle tank with plastic underfloor fuel and vent lines. The fuel lines are covered with a flame retardant material. The tank houses the fuel pump, fuel filter, twin sender units, twin venturis and a pressure regulator. Fuel pressure is regulated at 3.5 bar and excess fuel is relieved back to the swirl pot within the tank.



Fi nk

The fuel tank is located on the underside of the vehicle, forward of the rear suspension subframe and directly under the rear seats (see Figure 92). The tank has a capacity of 66 litres gross (64.8 litres useable) and is made from moulded plastic. It is secured to the vehicle floorpan via an H frame strap assembly. The filler has a restricted neck (except Japan and Gulf markets) and is located on the right hand side (RHS) of the rear wing panel. The fuel filler flap has a locking pin and this opens and closes with the central locking system. Care must be taken when fuelling the car to avoid damage to the filler flap. If an attempt is made to close the fuel flap with the vehicle locked, the pin will foul on the vehicle side panel.

The tank is protected from the heat of the exhaust system by a reflective metallic heatshield.

The fuel pump is fitted inside a plastic housing and mounted on three damper rubbers to minimise noise. Access is via a panel under the rear seats and a special tool is needed to remove the notched locking ring.

fuel system main components

The following list outlines the main components of the petrol fuel system:

- Plastic saddle tank
- Twin sender units
- Fuel filter
- Pressure regulator
- Fuel pump
- Expansion tank
- Charcoal canister
- Vents/breathers
- Filler pipe assembly

Fuel is pumped from the right hand side of the saddle tank to the left hand side of the tank. The fuel passes through the filter to the engine fuel injectors and the fuel pressure is regulated at 3.5 bar. Excess fuel, which is bled by the pressure regulator, is directed to the two venturis. These lift fuel from the base of the tank and maintain the fuel level in the RHS swirl pot.

The venturi contains a constricted passage which increases the velocity of the fuel and lowers its pressure. This depression draws the fuel from the left hand side (LHS) of the tank into the swirl pot located in the RHS of the tank. Saddle tanks fitted to other Rover Group vehicles (Freelander and Land Rover) rely on 'splash return' to transfer the fuel from one side to the other. These tanks are sloped on one side to assist the transfer of fuel to the pump side when the vehicle is cornering, and they have a shallow saddle compared with the Rover 75 saddle tank. The extra venturi, fitted in the LH chamber of the Rover 75 tank, ensures that the swirl pot is full, regardless of vehicle movement. The pressure regulator has a T joint which feeds fuel into the RHS venturi which, in turn, feeds directly into the swirl pot.

The twin sender units are connected in series within the harness and send signals to the instrument pack, which uses a complex algorithm to accurately measure the quantity of fuel in the tank. Fuel tank venting is carried out via a centre vent elbow and two float valves connected to the expansion tank.



r

The charcoal canister is located behind the right hand rear wheel and is mounted on the vehicle longitudinal (see Figure 93). It contains activated carbon which absorbs fuel vapour prior to venting to atmosphere. Fuel vapour is then drawn into the engine when the purge valve has been activated by the ECM.

Diesel fuel systems

The diesel system is similar to the petrol system but with some added components required because of diesel's characteristics. The main differences are that an extra underbonnet fuel pump is required and that it has a fuel return line. Also, a diesel cooler is fitted to the fuel tank return line. The right hand venturi on the diesel system is fed directly from the pump in the tank and a T-joint feeds the venturi in the opposite side. Unlike the in-tank filter fitted to petrol derivatives, the diesel filter is fitted externally to the tank in an underbonnet location.

The extra pump is fitted before the fuel filter and increases the pressure to assist the fuel through any potential blockage of the filter during cold starts. The extra pump helps to ensure all engine fuelling requirements are satisfied in all conditions.

A pressure regulator is located after the filter and relieves fuel into the secondary pump feed.

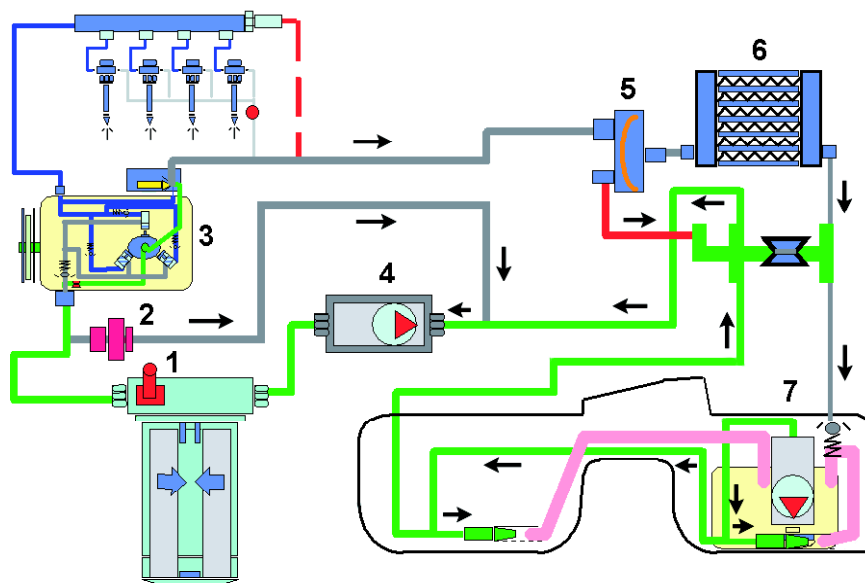


Figure 10: Diesel fuel system

1. Pressure sensor and fuel filter
2. Pressure relief valve
3. High pressure injection pump
4. In line electric fuel pump (medium pressure)
5. Bi-metallic by-pass valve
6. Fuel cooler
7. Fuel pump

A fuel cooler is fitted next to the rear right hand wheel (see Figure 95), the same location as for the charcoal canister on petrol derivatives. The fuel returning from the engine is at a very high temperature and must be cooled before it is returned to the swirl pot. If the fuel is not over a predetermined temperature a bi-metallic by-pass valve directs the fuel into the line feeding the medium pressure pump and some of the fuel returns to swirl pot. When the fuel is above a predetermined temperature the by-pass valve directs the fuel through the air blast cooler. From the cooler the fuel is returned to the swirl pot, via an in-tank duck bill valve, where it is again picked up by the fuel pump (see Figure 94).

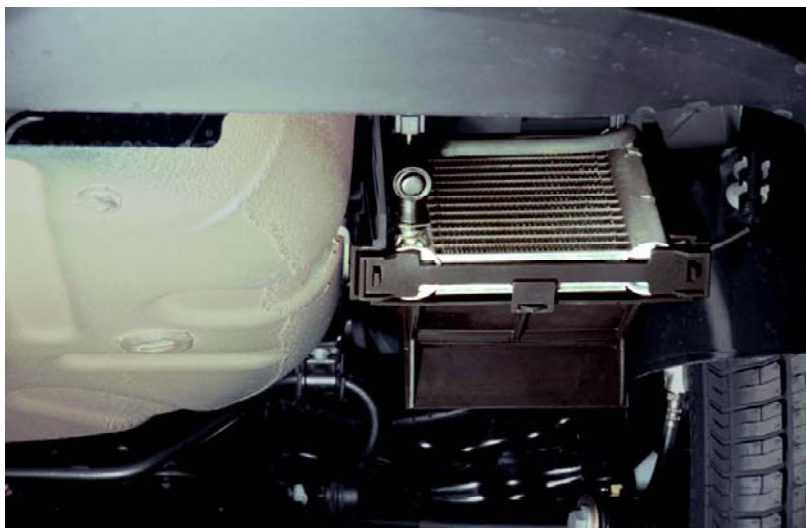


Fig 95

Diesel produces less vapour than petrol and venting is carried out by a single centre vent.

K series 1.8 engine

Engine mounts

All Rover 75 engines are mounted via a twin tie bar torque axis system i.e. 2 mass carriers and 2 torque reacting tie bars including :

- Right hand hydromount
- Left hand hydrobush
- Upper tie bar
- Lower tie bar. This is new and links the sump to the subframe cross member

Brackets, fixings and mount rates vary with the engine type but the type of mount is common to all power units.

The hydromount and hydrobush carry the mass of the engine and the tie bars control the torque inputs. The mass carrying mounts control the vertical and lateral movements of the engine, which are generated by the engine itself, and those induced by road inputs through the suspension. The tie bars' main purpose is to control the natural fore-aft roll of the engine during acceleration and deceleration.

K1.8 engine

The award winning 'K' series engine was launched in 1989 and has since been developed successfully for use in many Rover Group vehicles, including: Rover 200, 400, 600, *Intercept* and Freelander. The engine is built up from aluminium castings bolted together. These consist of three major castings: the cylinder head, the cylinder block, and the bearing ladder, which is line bored to provide the main bearing bores. Attached to these major castings are three minor castings: above the cylinder head are the camshaft carrier and the camshaft cover; underneath the bearing ladder is an oil rail.

Ten cylinder head bolts pass through the cylinder head, the cylinder block and the bearing ladder and screw into the oil rail. This puts the cylinder head, the cylinder block and the bearing ladder into compression, with all the tensile loads being carried by the cylinder head bolts. When the cylinder head bolts are removed, additional fixings are used to retain the bearing ladder to the cylinder block and the oil rail to the bearing ladder.

The cross flow cylinder head has four valves per cylinder and a central spark plug combustion arrangement. The inlet ports are designed to induce swirl and to control the speed of the induction charge. This serves to improve combustion and, hence, fuel economy. Performance is also increased with a reduction in exhaust emissions. Self adjusting hydraulic tappets are fitted to the top of each valve and are operated directly by the camshafts.

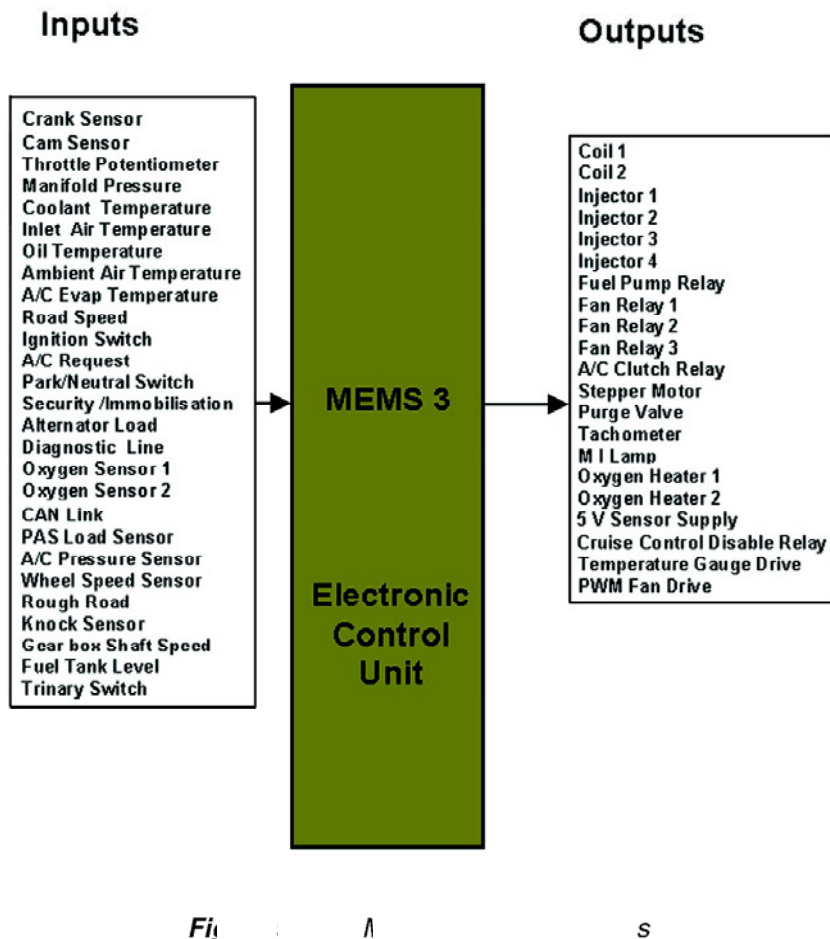
The launch of Rover 75 has seen the further development and improvement of the K1.8 engine. Changes have been made to the design of the engine to improve performance, to allow installation to the new model and in order to meet the forthcoming ECD 3 emissions regulations. These regulations come into force on 1 January 2000. An upgraded engine management system is fitted (MEMS 3) and the engine is compatible with the new 5-speed Jatco automatic gearbox and the new Getrag manual gearbox.

Rover 75 modifications to K1.8 include:

- **Right hand engine mount:** New five point fixing gives a stiffer mount
- **Exhaust manifold:** Houses starter catalyst and heatshield
- **Cylinder block:** Modified to suit new right hand engine mount and additional fixings for starter catalyst support
- **Camshaft:** Houses target/reluctor for the camshaft sensor
- **Camshaft sensor:** Mounted in the camshaft cover for sequential fuel injection
- **New variable valve control (VVC) lightweight tappets**
- **Automatic tension camshaft belt:** Replaces manual tension process
- **Cylinder head:** Machined to suit new camshaft seals and the camshaft belt auto tensioner
- **Plug top coils:** Replace remote coils . Two twin output coils (plug top mounted) each supply a pair of cylinders - 1&4 and 2&3
- **Cam cover:** Modified to fit cam sensor and plug top coils
- **Dual mass flywheel:** Reduces gearbox noise
- **Automatic tension air conditioning drive belt:** Replaces current manual tensioner
- **Temperature manifold absolute pressure (TMAP) sensor:** Relocated from the ECM to the opposite end of the throttle plate on the inlet manifold
- **Throttle body assembly:** Uses a bi-polar stepper motor to control air by-pass around the throttle body for idle speed control
- **Injectors:** Targeted fuel injectors
- **New con-rods**
- **New alternator and starter motor:** Supplied by Denso-improved reliability
- **Revised engine management system (EMS) sensors:** To suit new MEMS 3 unit
- **New plastic spark plug cover**

Modular engine management system 3

MEMS 3



MEMS 3 is the engine management system fitted to the K1.8 engine used for Rover 75. It has been designed to meet the new emissions regulations which will come into force in year 2000: The European Commission Directive Stage 3 (ECD 3). This mandate controls the level of exhaust emissions, evaporative emissions and on-board diagnostics (OBD) required by all vehicles manufactured from 1 January 2000. OBD gives the vehicle the ability to monitor system components, the failure of which would cause emissions to exceed legislated thresholds. The fault codes ('P' codes) are stored in the ECU memory. (From 1 January 2000, under certain fault conditions the driver will be made aware of the fault by the illumination of the Malfunction Indicator Lamp (MIL) on the instrument panel). Before 1 January 2000, MEMS 3 will log all the fault codes but will not illuminate the Malfunction Indicator Lamp. Vehicles that are manufactured to be registered on, or after, 1 January 2000 will have the MIL function active.

This section provides a brief overview of the functionality of the system and its interactions with other systems. It also outlines the inputs to the system and actuator outputs controlled by the system (see Figure 96).

New features on MEMS 3 are:

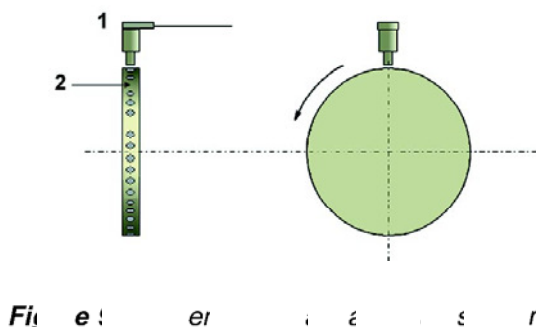
- Targeted injectors with sequential fuelling
- Plug top coils
- Alternator load sensing
- Power assisted steering (PAS) load sensing
- Bi-polar stepper motor
- Twin Oxygen sensors (pre & post catalyst) with direct drive heaters. (Single pre-catalyst sensor until 1 January 2000)
- Direct battery feed and low power mode
- CAN link
- OBD
- Malfunction indicator lamp

MEMS 3 components and their functions

The information that is required by the engine control module is provided by the following sensors:

1. Crankshaft sensor

2. Flywheel



1. Crankshaft sensor
2. Flywheel

The crankshaft sensor is used to determine the speed and position of the engine crankshaft. A Hall effect sensor is used and is mounted radially in relation to a profiled target located on the flywheel (see Figure 97). The Hall effect sensor transmits a digital signal to the ECM relative to the speed and position of the crankshaft. The information is picked up from targets (or teeth) on the flywheel equi-spaced 10 degrees apart. The sensor is able to determine the angular position of the flywheel by the fact that four targets are missing. The missing targets are strategically placed on the flywheel and their positions are stored in the ECM memory. The signal from the Hall sensor will inform the ECM of the relative position of the flywheel and its rotational speed (see Figure 98). From this information the ECM can synchronise itself with the engine for fuelling and ignition timing.

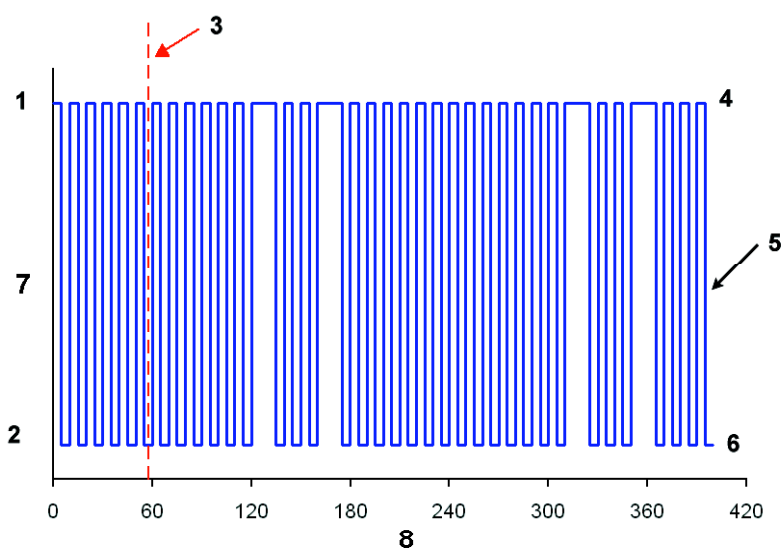
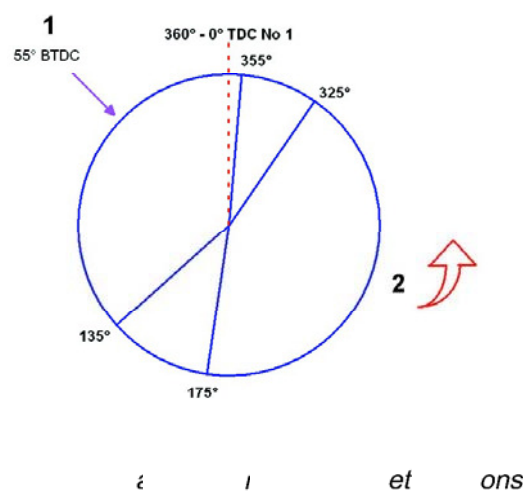


Figure 1

- 1.Voltage high
- 2.Voltage low
- 3.Crankshaft position sensor
- 4.Tooth base
- 5.Signal from crankshaft sensor
- 6.Tooth crown
- 7.Voltage
- 8.Crankshaft position -
Degrees from TDC No.1 cylinder

Missing target positions are at 80°, 120°, 270° and 300°, relative to the crank sensor position. The crank sensor position is 55° shifted from cylinder number 1 top dead centre (TDC) (see Figure 99).



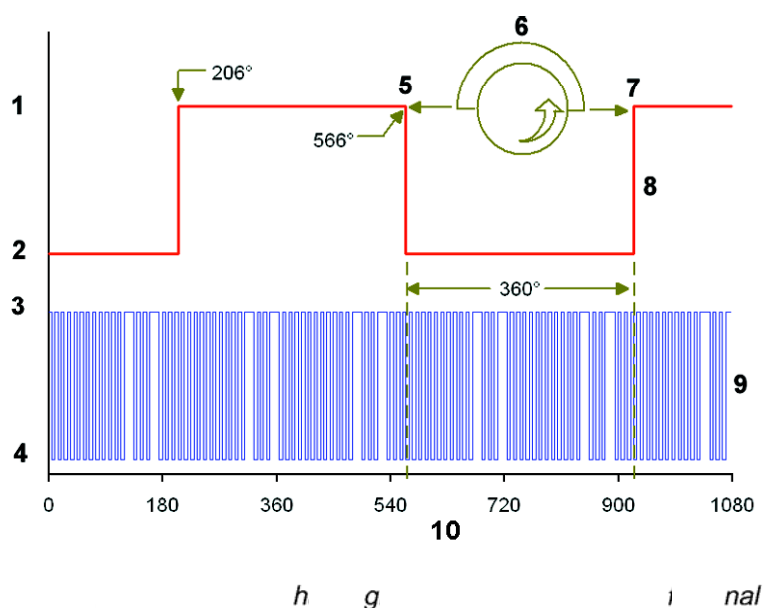
- 1.Crankshaft sensor
- 2.Direction of engine rotation

If the crank sensor fails, or the signal is not received by the ECM, there will be no fuelling and no ignition, hence the engine will not run.

C Camshaft sensor

The camshaft sensor is a Hall effect sensor used in conjunction with the cam wheel to identify the position of the camshaft. A half moon cam wheel reluctor is used. This type uses one long target which extends over 180 degrees of the wheel (i.e. over half of the wheel) (see Figure 100). The cam wheel and sensor are located on the end of the exhaust camshaft on the non timing belt end. The information transmitted by this sensor to the ECM is used to synchronise the timing of the fuel injectors.

The half moon cam wheel provides less information to the ECM than the previous nine tooth cam wheel and cannot be used as a back up crank signal when the crank sensor fails. The benefits are that the ECM can now achieve camshaft synchronisation at the same time as crank synchronisation, giving sequential fuelling during cranking.



- 1.Voltage high (camshaft)
- 2.Voltage low (camshaft)
- 3.Voltage high (crankshaft)
- 4.Voltage low (crankshaft)
- 5.Camshaft profile
- 6.Start point
- 7.End point
- 8.Camshaft sensor signal
- 9.Crankshaft sensor signal
- 10.Crankshaft position -
Degrees from TDC No1 cylinder

e Ignition

Misfire detection is part of the OBD system and recognises a cylinder misfire from its effect on the speed of the crankshaft. The ECM can alter its fuelling strategy to cope with a misfire (stores faults).

The crankshaft is continually accelerating and decelerating. The speed and variation of this cycle corresponds to the firing cycle of the cylinders. The ECM is programmed with the pattern to expect when all cylinders are firing correctly. If, for whatever reason (valve sticking etc), a cylinder misfires, the speed of the crankshaft will alter. The ECM will recognise this from the signal received from the crankshaft sensor and can determine which cylinder has misfired. Based on the information received from a number of other sensors, the ECM alters its fuelling strategy accordingly.

Misfire detection must be disabled when the vehicle is travelling over 'rough road'. This is necessary because the driving conditions can affect the speed of the crankshaft, which the ECM may read as engine misfire. Consequently, the fuel strategy may be altered unnecessarily. The MEMS 3 detects 'rough road' via a hard wired output from the anti-lock braking system ECU. The affect on the wheel speed of a 'rough road' is transmitted by the wheel sensors to the ABS ECU and from there to the ECM.

Misfire detection must also be suspended when fuel levels fall below 15% of the fuel tank capacity. This is because fuel starvation can occur, causing misfire. This prevents the possibility of a large number of faults being stored by the ECM as the fuel tank gets close to being empty. The ECM receives its fluid level from the instrument pack via the CAN-Bus link.

J *nsor*

The Oxygen sensor fitted to K1.8 derivatives of Rover 75 is located in the exhaust manifold. It is used to measure the content of the Oxygen in the exhaust gases before the catalytic converter. The sensor starts working at approximately 300°C. To shorten the amount of time it takes to reach operating temperature, the sensor contains an internal heating element. This element is driven directly by MEMS 3. To prevent electromagnetic interference the sensor wiring in the engine harness is screened.

The pre-catalytic converter sensor is important in maintaining the air/fuel ratio at 14.7 : 1. The amount of Oxygen not required to burn the fuel will read as excessive Oxygen in the exhaust gases. The ECM receives signals from the Oxygen sensor and can alter the air intake, or the amount of fuel injected, accordingly.

Throttle potentiometer

The throttle potentiometer is located at the end of the throttle spindle in the throttle body. It provides the ECM with the throttle position, indicating driver demand. The throttle potentiometer can be reset if it is suspected of being out of calibration. This can result in poor or excessive idle speed, or a general lack of performance caused by the inaccuracy of the signal from the throttle potentiometer. To reset the potentiometer, the ignition must be in position 2. The throttle pedal should then be pressed to its full extension and then allowed to return to the top of its travel. This action is then repeated four times, making five in total. Turn the ignition off and wait five seconds. TestBook can be used to measure throttle angle.

Temperature measurement (absolute manifold pressure sensor MAP)

The TMAP sensor is located in the inlet manifold and provides a signal to the ECM, corresponding to absolute manifold pressure and determining engine load. If this sensor fails, the ECM has a back up strategy. It has a number of default pressure settings it can use, determined by engine speed and throttle angle. The driver may not notice a fault exists but a fault will be stored in the ECM memory for diagnostic interrogation.

Coolant temperature sensor

This is an NTC thermistor bead, housed in a metal casing inside the cooling system hot water outlet. If this sensor fails, the ECM defaults to a value based on information from the oil temperature sensor. The driver may not notice the fault but the fault will be stored in the ECM memory for diagnostic interrogation.

Mass air flow sensor

An NTC thermistor bead, located in the air intake system. Failure of this sensor reduces engine performance and driveability.

Intake air temperature sensor

An NTC thermistor bead, encapsulated in a metal casing. Failure may result in reduced engine performance.

Pressure reading sensor

Pressure reading sensor used to alter engine idle speed based on load on engine from the PAS system.

Engine control module outputs

Outputs controlled by the ECM are as follows:

- **Stepper motor:** Used to control air bypass around the throttle butterfly for idle speed control. Failure results in poor idle speed control, poor driveability and starting difficulties
- **Purge valve:** Used to control evaporative emissions from the fuel tank, preventing fuel vapour escaping to the atmosphere. This vapour is fed back into the intake system to be burnt in the engine. It is controlled by a PWM drive from the ECM
- **Main relay:** A normally open contact relay used to control battery feed to the injectors, the crank and cam sensors and other system components. The components are protected from reverse battery conditions because the relay will not energise in this condition. The MEMS 3 system has a direct battery feed, unlike previous MEMS systems
- **Fuel pump relay:** A normally open relay used to control the fuel pump. An inertia switch is fitted in the control line to the relay between the ignition switch and the fuel pump relay
- **Cooling fan:** MEMS 3 controls a 2-speed cooling fan system
- **Ignition coils:** Plug top mounted ignition coils are fitted to the K 1.8 engine. They are twin output coils, one supplying cylinder 1&4 and the other supplying 2&3. Safety precautions will need to be observed when working on or removing ignition coil units and leads
- **Injectors:** Bosch targeted injectors

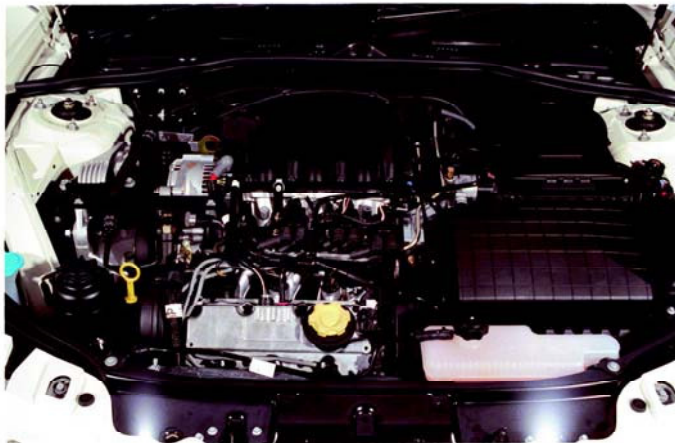
MEMS 3 interfaces:

MEMS 3 interfaces with several of the systems fitted to Rover 75. The operation of these systems has an affect on the functionality of the engine management system. The exact interaction will not be described here. The systems are:

- Air conditioning
- Power assisted steering
- Cruise control
- Immobilisation
- Jatco SFPO
- Instrument pack
- GM6 body controller
- Anti-lock braking system

KV6 Engine

Introduction



ne

The launch of the Rover 75 introduces the latest KV6 engine (see Figure 101), modified to improve performance, to fit the Rover 75 set up and to meet the forthcoming ECD 3 emissions regulations. Transversely mounted, the new KV6 2.5 litre engine reaches higher revolutions per minute and develops more power than the KV6 fitted to the Rover 800. Modifications were also necessary to make the engine compatible with the new Getrag manual gearbox and the new 5-speed Jatco automatic transmission. A KV6 2.0 litre engine derivative will also be available on Rover 75. MEMS 2J is replaced by the Siemens 2000 engine management system and all of the sensors which carry information to the system are new.

The increase in production volumes has meant a change in manufacturing and assembly methods. The low volume trolley system of assembly has been replaced with a high volume moving track assembly, with strict build processes.

The 90° cylinder block configuration remains, with four valves per cylinder. Left hand and right hand cylinder heads are identical castings and have identical inlet camshafts. The left hand inlet camshaft houses a reluctor, which is used to measure engine position and cycle. Lightweight hydraulic tappets are used and knock sensors are fitted to each middle cylinder to measure detonation timing.

The cylinder block is made of aluminium alloy and is cast in three sections: the cylinder block; the bearing ladder; and the lower crankcase. The KV6 block configuration employs damp liners which slide into the lower part of the cylinder block. The liners are smaller than the big end forging of the con-rod and need to be removed complete with piston and con-rod.

The KV6 drives the Rover 75 front wheels, with equal length drive shafts. This eliminates torque steer, which is caused by the shorter length drive shaft which pulls the car to that side. A new lower tie fixing support bar is fitted to the engine to improve mounting characteristics.

KV6 modifications

The modifications made to the KV6 for Rover 75 are as follows:

- **New engine acoustic cover:** A new plastic cover, foam bonded on the inside and with a rubber seal around the oil filler cap. Improved noise absorption and cosmetic improvement
 - **New exhaust valves:** As K-Series, now incorporating carbon breaks to prevent sticking valves. All valves seats are machined in three planes, improving valve to seat sealing
 - **New oil cooler:** Fitted as standard next to the sump to keep the oil cool under heavy loads and in high ambient temperatures
 - **New shape cylinder head assembly:** To suit the new engine layout for Rover 75
 - **New cylinder head gasket:** Five layer steel gasket, as L Series and T Series
 - **New cylinder block:** New casting process
 - **New water pump:** Revised face and new internal seals - driven by the primary drive belt
 - **New sump:** Incorporating baffle plate and oil cooler
 - **New oil pump and filter:** The oil filter is slimmer and the oil pump is fitted to the engine via M8 flanged bolts
 - **New starter motor:** Supplied by Denso, gives improved reliability
 - **New alternator:** Supplied by Denso. Secured to a new one piece mounting bracket with two split bushes to improve belt alignment
 - **New PAS pump:** Next generation
 - **New auxiliary drive belt:** A shorter belt is fitted to derivatives without air conditioning - driving the alternator and the PAS pump. If air conditioning is fitted - a longer auxiliary drive belt is fitted driving the alternator, the PAS pump and the air conditioning. The belt tensions automatically
 - **Breather pipes:** Nylon with new quick fit connectors
 - **New spark plugs:** Platinum coated
 - **Ignition coils:** Supplied by Denso, the coils deliver an improved spark with less signal interference. They are no longer fitted as a bank of three but individually fitted for easier servicing
 - **Crankshaft position sensor:** Now gearbox mounted
 - **New inlet camshaft mounted dampers:** Fitted inside the cam belt covers, these dampers minimise torsional vibration
 - **Returnless fuel system**
 - **New cam covers:** With extra volume to assist crankcase breathing
 - **New inlet manifold:** With new improved variable track length for better volumetric efficiency. The variable induction system uses valves and actuators to vary the overall track length of the intake manifold. This gives the ECM the ability to alter, when necessary, the charge resonance frequency by actuating the valves in a particular sequence to suit engine load. Peak torque is therefore available at several different speeds. Engines with fixed intake manifold track length have peak engine torque limited to a fixed speed when the valve opening frequency is in 'tune' with the charge resonance frequency. At this speed maximum volumetric efficiency occurs and peak engine torque is produced. Being able to alter the tract length of the intake manifold means the tuning of the valve opening frequency can be matched with the charge resonance frequency over different engine loads/speeds. Peak engine torque is now available over a wider range of engine speeds and loads.
The variable induction system (VIS) on Rover 800 KV6 was a twin throttle body set up with a two stage variable manifold. The new KV6 fitted to Rover 75 is a single throttle body set up with a three stage variable manifold
- Note:** The inlet manifold is a sealed plastic unit and is not serviceable
- **New one piece plastic fuel rail with damper:** Feeds injectors. A Schrader valve is fitted to the fuel rail, aiding diagnostics by making it possible to measure the fuel pressure and fuel flow rates at varying engine loads

- **New air assisted injectors:** Improving air/fuel mix and emissions, these injectors are located on the inside of the 'V', directly below the ignition coils. An air assist injector consists of a small solenoid which is used to inject air and fuel simultaneously so that the fuel is atomised. The injector is activated by the ECM to lift off its base, allowing the fuel to pass into the intake manifold

Note: The air assisted injectors are colour coded to distinguish between the 2.0 litre and the 2.5 litre engines

C haft our code

New inlet and exhaust camshafts are fitted to KV6 and paint colour coding differentiates the 2.0 litre from the 2.5 litre as shown in the following table:

2.0 Litre	Inlet camshaft	White paint mark (on full diameter of the shaft)
2.0 Litre	Exhaust camshaft	Green paint mark (on full diameter of the shaft)
2.5 Litre	Inlet camshaft	Red paint mark (on full diameter of the shaft)
2.5 Litre	Exhaust camshaft	Blue paint mark (on full diameter of the shaft)

Throttle bodies

A new range of throttle bodies are available with the new KV6, and the correct one must be stipulated:

1. With traction control
2. With cruise control
3. With traction control and cruise control
4. Without traction control or cruise control

Inlet manifold

The Rover 75 inlet manifold has been designed to suit both 2.0 litre and 2.5 litre KV6 engines. The intake manifold combines plenum resonance for good low speed torque, with variable length primary tracts for good mid and high speed torque.

Int: manifold construction

The intake manifold features a single throttle body feeding into a 'Y' piece which separates to two secondary pipes (see Figure 102). The secondary pipes feed into two main plenums, one for each bank of three cylinders. At the closed end of the plenums is a balance valve, which is actuated by an electronic actuator. This enables the two plenums to be connected together.

From the twin plenums, the primary tract length to the head face is approximately 500 mm. Each of these tracts has a side junction with a power valve into a third plenum, approximately 350 mm from the head face. These six power valves are each connected to a link rod which is operated by an electric actuator. Operation of this link rod allows the primary tract lengths to be varied between 350 mm and 500 mm. The third plenum is not fed with air other than from the main twin plenums via the six primary tracts.

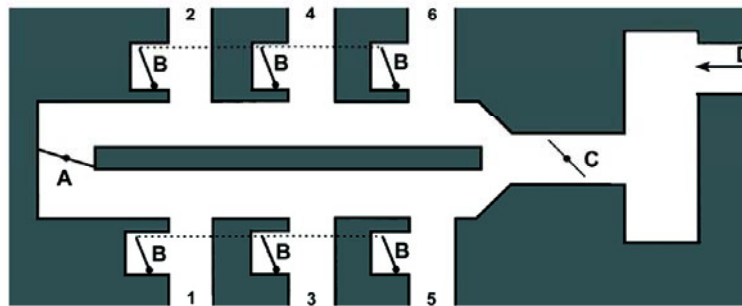


Fig. 1 h m d

- a. Balance valve
- b. Motor actuated power valve
- c. Throttle
- d. Air intake

The variable geometry manifold operates in three conditions for the 2.0 litre and 2.5 litre engines:

1. At low speed, the balance valve and the power valves are closed. Effectively, this allows the engine to breathe as two three cylinder engines, each having a separate plenum and long primary tract. The primary and secondary tracts, and the plenum volume are tuned to resonate at 2,700 rev/min, giving a torque peak at this speed
2. For increased mid-range torque performance, the plenums are connected together using the balance valve, but the power valves remain closed. This allows the engine to use the long primary tract length which is carefully tuned with the balance valve, to produce maximum torque at 3,750 rev/min (2.5 litre) and 4,000 rev/min (2.0 litre)
3. At high engine speeds, the balance valve remains open and the six power valves are opened. This allows the engine to breathe from the third plenum via the short primary tract length. These lengths and diameters are tuned to produce a spread of torque from 4,000 rev/min upwards, with maximum power at 6250 rev/min for the 2.5 litre and at 6,500 rev/min for the 2.0 litre engine

In addition to the operation described above, the manifold is also used to give an improvement in part-load fuel consumption. At part-load throughout the emissions cycle the manifold is switched to condition 3.

The pressure dynamics significantly reduce the pumping losses below 4000 rev/min resulting in improved fuel consumption.

KV6 engine management system

Introduction



Fig. 1 e 4 M

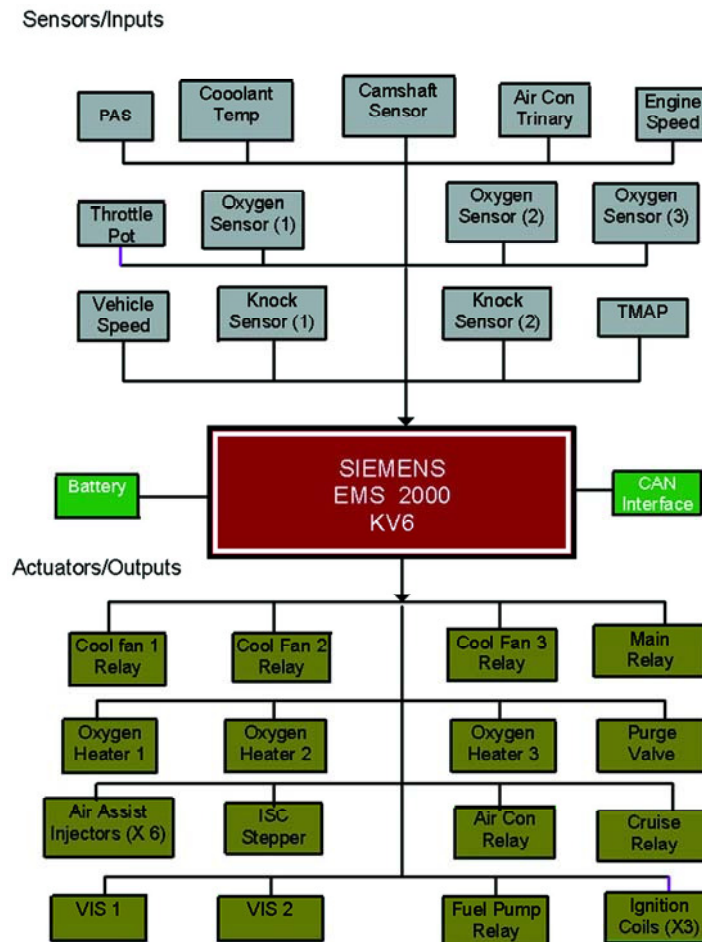
Engine management systems are designed to maintain an engine's optimum level of performance throughout its entire range of operation. Based on data received from various sensory inputs, the engine control module (ECM) (see Figure 103) precisely controls the air/fuel ratio and spark timing, providing optimum combustion for varying loads. Idle speed and fuel evaporative emissions are all monitored and controlled.

Note: This type of monitoring and control not only gives a very good fuel economy and engine performance but also helps to minimise the emission of harmful pollutants.

For Rover 75 derivatives with the KV6 engine, the MEMS 2J (used previously on KV6 engines) has been replaced by the Siemens 2000 engine management system. This has meant changes to many of the sensors and actuators associated with the system. The Siemens system is fully compliant with ECD 3 emissions regulations and has a facility for on-board diagnostics (OBD). The OBD lamp, or MIL, will not be active at launch but will be active on all vehicles registered on and after 1 January 2000.

Functionality

All engine management systems base their control and outputs on information received from various sensors around the vehicle. How the ECM reacts is based on the tuning of the system. Engine management systems also interface with many of the other systems on the vehicle and their operation effects the functionality of the engine management system. The input sensors and output actuators for Siemens 2000 are shown in the block diagram below (see Figure 104):



F i g u r e 1 1 S e n s o r s a n d A c t u a t o r s

VIS 1 is a motor-actuated manifold balance valve. VIS 2 is a motor actuator for 6 variable tract butterfly valves.

Sensors and their functionality

The sensors which form part of the Siemens 2000 engine management system are as follows:

S e n s o r

The crankshaft position sensor is a very important sensor as it is this signal which informs the ECM how fast the engine is rotating and at what rotational position the crank is in at any given point. It is the basis for fuel injection and coil firing times and, in conjunction with the camshaft sensor, informs the ECM as to where the engine is in its cycle. If this sensor fails, the engine will crank but it will not start because this sensor provides information controlling fuelling and ignition.

On vehicles fitted with manual transmission, the crankshaft sensor is located above the flywheel radially mounted 45° towards bank 1. On vehicles fitted with automatic transmissions, the sensor is mounted in the torque converter radially at approximately 90° towards bank 1. The sensor is a Hall effect type picking up its signals from the flywheel.

C haft sensor

The camshaft position sensor is located on bank 1 at the top of the engine (cylinder 5) and, like the crankshaft sensor, is a Hall effect type sensor. This sensor produces one pulse every revolution of the camshaft and is used to synchronise the injectors so that fuel is injected into the correct cylinder at the right time (sequential fuelling). If the camshaft sensor fails, the engine will not start. If failure occurs with the engine running it will continue to run with sequential fuelling.

Coolant temperature sensor

The coolant temperature sensor is engine-mounted between cylinder 5 and cylinder 6, inside the V. The sensor signal is used by the ECM to vary the air/fuel mix with variance of engine temperature. It does this by varying the injector ON time. The engine is required to run at approximately 18°C to run at the correct stoichiometric ratio (Lambda 1). This sensor also provides information for control of the radiator fan speed and drives the temperature gauge.

TMAP sensor

The TMAP sensor (temperature and manifold absolute pressure) is new and is located above and to the rear of the throttle body, on the inlet manifold. As the name suggests, it is a combined sensor, measuring the inlet air temperature and the manifold absolute pressure.

The inlet air temperature sensor is used in conjunction with the manifold absolute pressure sensor to determine the amount of air entering the engine. From this, the ECM can determine the amount of fuel required for the correct air/fuel ratio. Correct emission levels are produced when there is just enough air to burn all of the fuel. The inlet air temperature is also used to retard the ignition timing if the air temperature rises above 55°C.

The MAP sensor is a Piezo resistive pressure gauge used to measure the pressure of the air in the manifold after the throttle flap. This is used by the ECM to calculate engine load and is put out on the CAN-Bus. The traction control unit uses this signal and vehicles fitted with automatic transmissions use the signal for torque reduction calculations during gear changes.

Knock sensor

The knock sensors are located inside the V of each middle cylinder – 1 per bank. The term 'knock' describes the noise that is heard from the engine cylinders and is caused by over-advanced ignition timing. Advanced ignition timing is desirable and the engine will be at its most efficient with the ignition advanced as far as possible. The ECU will respond to signals from the knock sensor and will retard the ignition if knock detonation is detected.

Note: The knock sensor uses piezo electric technology and they require controlled torque tightening and very careful handling.

Oxygen sensor

Three Oxygen sensors are fitted to KV6 derivatives of Rover 75. One is fitted after the main catalyst and monitors the Oxygen content of the exhaust and the catalyst performance. The other two Oxygen sensors are fitted to each downpipe before the starter catalyst and monitor the Oxygen content of the engine exhaust. The post catalyst oxygen sensor will only be fitted to vehicles required to comply with ECD 3 from 1 January 2000 (see Figure 105).

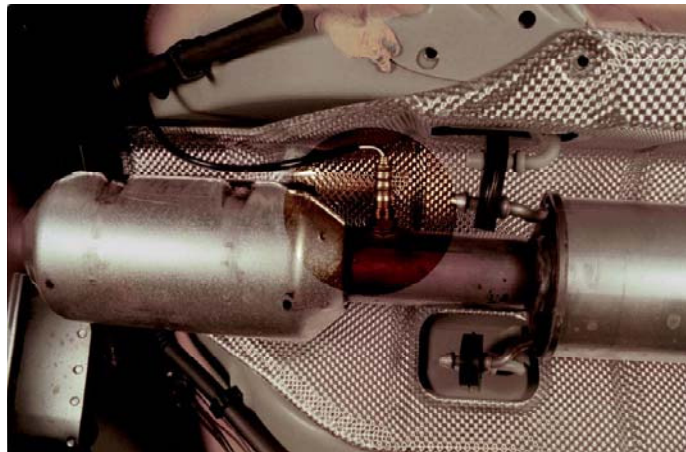


Figure 1

or

The Oxygen heater and the Oxygen sensor are a single package. The heater is an integral part of the Oxygen sensor and its sole function is to heat the sensor, bringing it to its operating temperature as quickly as possible.

Note: Controlled torque and careful handling are required with Oxygen sensors due to the ceramic tile inside the sensor.

with assisted steering pressure sensor

The PAS pressure sensor is located in the PAS pump outlet pipe and it enables the ECM to monitor the affect the loading of the power assisted steering is having on the engine. When necessary, the ECM increases the idle speed of the engine to compensate for the load from the PAS system.

Alternator loads are compensated for by the ECM, which receives a PWM input from the alternator. The ECM uses this input to help calculate the load on the engine. The more electrical systems that are in operation, the more electricity is required from the alternator, which, in turn, puts a greater load on the engine. When necessary, the ECM can alter the idle speed via the stepper motor.

System interactions

The Siemens 2000 engine management system interacts with many of the other systems on the vehicle. These are:

- Air conditioning system (where fitted): ECM has control over the engagement and disengagement of the magnetic clutch
- Immobilisation system: ECM works in conjunction with the EWS3 ECU to immobilise the vehicle
- Traction control system (where fitted): ECM will reduce engine torque when wheel slip is detected during certain driving conditions
- Automatic transmission (where fitted): ECM communicates over the CAN-Bus system with the ATCU to ensure smooth gear changing
- Instrument pack: The IPK displays various information it receives from the ECM via CAN-Bus, such as engine speed, coolant temperature etc.
- Cruise control: The ECM controls the engagement of cruise control. It will not enable cruise unless certain parameters are met: e.g. speed in excess of 25mph
- ABS: Used for rough road detection to eliminate false misfire detection. The ECM calculates the rotational speed of the crankshaft, via the crankshaft sensor, and compares this to the previous segment speed. The ECM can determine expected values of the crankshaft based on various inputs. If the speed is lower than expected then it is possible a misfire has taken place. From the crankshaft and camshaft sensor signals, the cylinder in which the misfire has taken place, can be determined

Misfire detection must be suspended when driving over rough terrain as the vibrations can lead to false misfire detection. The signal from the ABS ECU is used to determine when the vehicle is travelling over rough terrain.

The ABS ECU also transmits its road speed signal to the ECM

Diesel engine

Introduction



Figure 106: The M47R diesel engine

The diesel engine fitted to Rover 75 is known as the M47R (see Figure 106). This engine is a new member of the latest generation of diesel engines being developed by BMW and Rover engineers and is made by BMW in Steyr, Austria.

Fitted with this engine, Rover 75 represents two firsts:

- It is the first British car with common rail diesel technology
- It is the first time a Rover car has been available with a diesel engine and automatic transmission

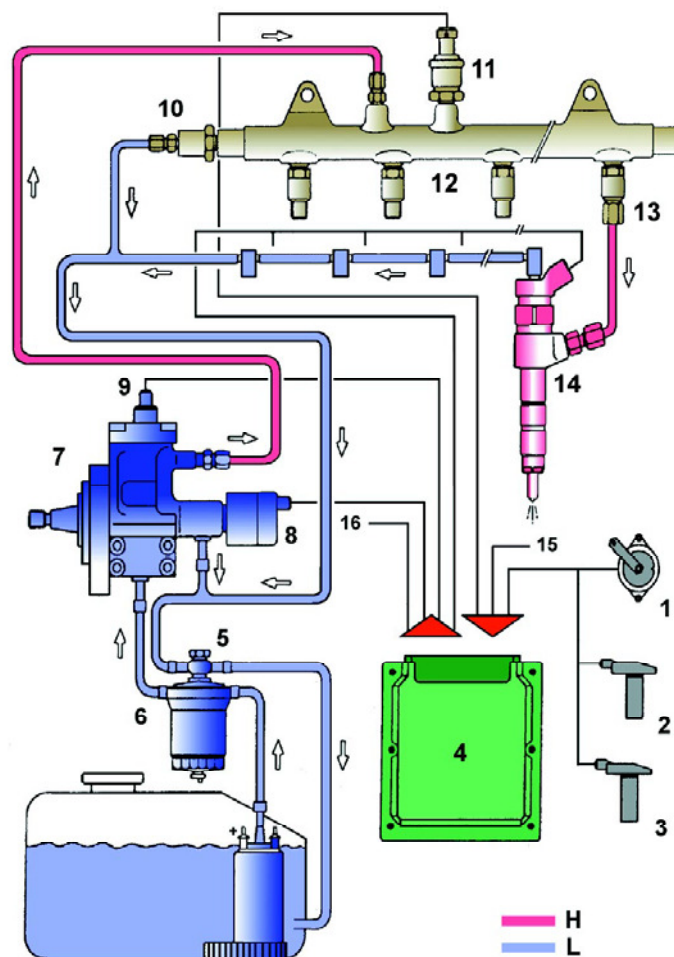
Equipped with a double chain-driven overhead camshaft and four valves per cylinder, Rover 75 also becomes Rover's first 'multivalve' diesel.

Common rail technology only appeared for the first time at the end of 1997 when Alfa Romeo launched the 2.4-litre 156. Mercedes then launched a 2.2 common rail engine in the C-class, and the technology has also appeared in Isuzu vehicles. M47R follows the launch of M47D (not common rail) in E46 and the six-cylinder M57R (common rail) in 5 and 7 Series.

Rover 75, with 85kW, is the most powerful two-litre common rail diesel available. It produces 43.6 kW/litre, compared with 40.3 kW/litre for the Alfa Romeo 156 1.9JTD, 41.9 kW/litre for the 156 2.4 JTD and 42.8 kW/litre for the Mercedes 220CDI. This is the key.

Rover 75 also shares the latest diesel technology with the new six-cylinder executive and luxury class BMW 5 and 7 Series.

How is the common rail principle the most advanced fuel injection system for diesel engines? (see Figure 107).



Fil m ion

1. Accelerator
2. Engine speed (crank)
3. Engine speed (cam)
4. Engine control module
5. Overflow valve
6. Fuel filter
7. High pressure pump
8. Pressure regulating valve
9. Plunger shut-off
10. Pressure limiting valve
11. Rail pressure sensor
12. Common rail
13. Flow limiter
14. Injector
15. Sensor inputs
16. Actuator outputs

Fuel is accumulated at very high pressure in a supply line, or rail, that feeds the four individual electronically controlled injectors. This means the high pressure fuel is always 'on tap' at any engine speed. The alternative conventional distributor pump supplies fuel individually to each injection valve via a separate line. The common rail's consistently correct high pressure ensures very fine spray atomisation which optimises combustion. Common rail technology delivers these benefits:

- Reduced fuel consumption
- Fewer emissions
- More refinement

As common rail engines also use direct injection, this enhanced economy is on top of the advantage direct injection gives over indirect injection with its less efficient pre-combustion chambers.

M47R also features 'pilot fuel injection' to reduce the characteristic diesel engine clatter, which is caused by the typical ignition delay of diesels. The engine management system briefly opens the centrally located injection valve before injecting the main charge of fuel. This makes the main dose burn more softly, ensuring a quieter diesel operation.

Noise and vibration control has been optimised in other areas:

- The outer walls of the crankcase are particularly stiff in key locations and thus resistant to vibrations without adding unnecessary weight
- The oil filter and crankcase are also stiffly and rigidly connected to each another
- The two-piece oil sump reduces noise to a minimum
- The cylinder head cover with its integrated air filter housing is decoupled from the cylinder head and so absorbs and minimises upward transmission of noise

As well as having common rail direct injection with full electronic control, M47R features a turbocharger and an intercooler. These units, together with the twin inlet valves, complement the highly efficient injection process by supplying a dense high-charge air dosage into the chamber to give prime combustion performance.

All diesel Rover 75s have an engine-coolant heater. If the ambient air temperature is below a certain level, the unit draws fuel from the tank at switch-on and burns it, heating the coolant between the engine and the heating system. This accelerates warm-up of both the engine and the passenger compartment. Because it helps get the engine to optimum operating temperature quickly, the overall effect on fuel consumption is negligible. The auxiliary heater offsets the inadequate heating of the passenger compartment that can result from the efficiency of diesel direct injection.

Enhancing fuel efficiency, roller-type rocker arms reduce friction in the valve timing mechanism.

The result of all this is that M47R is a formidable weapon in the Rover 75's power unit armoury.

It is even more powerful than the Rover 'L-Series' (which still gives the Rover 200 and Rover 400 competitive advantage in the lower and upper medium sectors), while its extraordinary torque output almost matches that of the outgoing 825 - half a litre bigger.

The engine provides all the economy expected of a modern di engine, while delivering power closer to the smoothness of a good petrol engine than any previous 4-cylinder diesel. Its refinement at idle is exemplary.

The M47R-powered Rover 75 delivers a potent combination of mighty performance and pound-stretching frugality:

2.0 CDT Manual	Rover 75
Max power (kW @ rpm)	85@ 4000
Max torque (Nm @ rpm)	260@ 2000
Acceleration (secs) 0-60mph/0-100 km/h	11.0/11.7 T
30-50 mph in 4th/ 80-120 km/h in 5th gear	7.6/13.7 T
Top speed (mph/km/h)	120/193 T
Fuel economy (combined) (mpg/l/100km)	51.4/5.5 T

T = Target

CDT = Common Rail Diesel Turbo

Diesel engine management system

DDE 4.0

The diesel engine management system fitted to Rover 75 is known as DDE 4.0 and is different to previous engine management systems fitted to Rover vehicles:

- It is the first ECU controlled common rail direct injection engine used by Rover Group, replacing control by rotary pump and ECU
- All sensors and actuators are new
- It complies with new ECD 3 emission standards
- It interfaces with other systems on the vehicle using CAN-Bus based architecture

DDE 4.0 inputs

Inputs to the DDE 4.0 engine management system are described in the following table:

	Input component	Location
1	Crank sensor	Engine block
2	Camshaft sensor	Rocker cover
3	Coolant temperature sensor	Engine block
4	Air flow meter	Induction system
5	Boost pressure sensor	Intake manifold
6	Rail pressure sensor	Fuel rail
7	Pedal demand sensor	Pedal box
8	Brake switch	Pedal box
9	Clutch switch	Pedal box
10	Cruise control	A-post
11	EWS-3 ECU	A-post
12	Diagnostic line	Driver footwell
13	Vehicle speed	ABS ECU
14	CAN	Main harness and engine harness
15	Fuel pressure sensor	Fuel filter

The outputs controlled by the DDE 4.0 engine management system are described in the following table:

	Output component	Location
1	Main relay	Fuse box
2	EGR modulator	Intake manifold
3	Glowplug relay	Plenum
4	Fuel regulator valve	High pressure pump
5	Injectors	Cylinder head
6	Fan control	Cooling pack
7	Air conditioning fan control	Cooling pack
8	Diagnostics	Driver footwell
9	CAN-Bus	Main harness and engine harness

System interfaces

As with all engine management systems, the DDE 4.0 system interfaces and interacts with many of the other systems fitted to the vehicle. Communication is via the CAN-Bus and the K-Bus system using the instrument pack as the Bus interface. Systems on Rover 75 which interface with DDE 4.0 are as follows:

Immobilisation

The engine control module plays a big role in the immobilisation of the vehicle. Engine fuelling will be inhibited until the ECM synchronises with a coded signal received from the EWS-3 ECU. This signal is hard wired directly from the EWS-3 ECU to the ECM. For a full explanation of this function please refer to the section on immobilisation.

Instrument pack

The instrument pack is the gateway for the Bus-systems and for the engine management system to communicate with the other vehicle systems. The engine management system provides the following data to the instrument pack for driver information:

- Engine speed (rev/min)
- Coolant/engine temperature
- Glowplugs (operation)
- Fuel consumption (trip computer)
- Cruise active lamp - via cruise control interface ECU
- Diagnostic lamp. This lamp indicates to the driver that there is a problem with the car which may result in reduced power or that a vital feature of the engine has developed a serious fault. Engine switch off and loss of power are the symptoms
- Malfunction indicator lamp (MIL). Not supported until 1 January 2003 for diesel derivatives. This lamp will be an indication to the driver that a fault has occurred with the vehicle which is likely to increase tail pipe emissions

Automatic transmission

The automatic transmission control unit (ATCU) is constantly exchanging information with the engine management system ECU to control smooth operation of gear changes. Throttle angle and engine speed are continually sent to the ATCU from the ECM, via CAN. The ATCU controls gear shifts from this information.

When cruise control is engaged, the ATCU needs to receive a signal relating directly to the throttle position so that it can control gear selection. As this is a drive-by-wire system with no pedal movement, during cruise the ECM signals the 'virtual' throttle angle to the ATCU.

When a gear change is about to occur, the ATCU signals to the ECM for a momentary reduction in engine torque for a smoother operation.

The data sent on the CAN-Bus system, which is used by the ATCU, is as follows:

- Actual throttle angle
- Virtual throttle angle
- Engine speed
- Coolant temperature
- Ignition switch position

The data sent by the ATCU on the CAN-Bus system that is relevant to the engine management system is as follows:

- Torque reduction request
- Gear lever position
- Current selected gear and target gear, if shifting is occurring

Traction control

The traction control ECU can request a reduction in engine torque via the CAN-Bus system, and the engine management system will then reduce engine torque by a precise reduction in fuel quantity delivery. This is only one of the options the traction control system can use to improve wheel traction. Data transmitted on CAN for traction control functions are as follows:

- Throttle angle
- Torque increase/decrease commands
- Current engine torque

Heating, ventilation and air conditioning

Air conditioning requests are sent via the CAN-Bus system, from the instrument pack to the ECM. Air conditioning requests to the instrument pack are sent via the K-Bus system. The GM6 controls the request for manual air conditioning, and automatic temperature controls requests for air conditioning are sent by the system ECU. Upon receiving an air conditioning request, the ECM will engage the compressor clutch and alter the engine speed to compensate for the extra load.

The cooling strategy employed by the engine management system is affected by the HEVAC system. A single fan is used with 3 speeds to cope with varying loads on the engine. Priority is given to the highest requested fan speed. When air conditioning is selected, the fan speed immediately switches to speed 1 (low) unless the coolant temperature sensor reading requires a higher speed to be selected. If the medium pressure switch in the trinary switch is triggered, the fan speed is set to speed 2 (medium). The engine management system remains powered up for 10 minutes following ignition switch off to continue cooling in high temperatures, if necessary.

Getrag 283

Manual transmission

All Rover 75 derivatives with manual transmission feature a newly developed Getrag gearbox (see Figure 108). This is the first time Getrag have supplied Rover Group. The gearbox, named 283, is made in Italy in a brand new factory that meets the most demanding manufacturing and quality standards in the world.

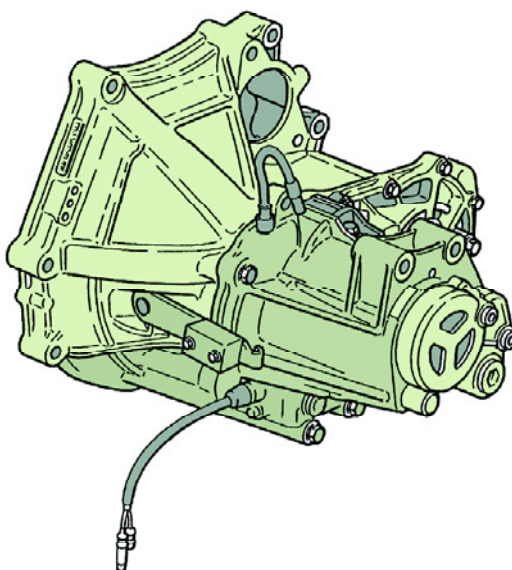


Fig. 1 (a) x

The new gearbox has been designed to handle the high torque outputs of the KV6 and M47R engines and has a capacity of 273Nm. It is 'fill for life', requiring no oil change.

Gearboxes destined for petrol Rover 75 derivatives have a common set of ratios, but different final drives to suit each particular engine. The diesel has its own set of ratios and final drive.

The following table gives the gear ratios of all the Rover 75 derivatives with 5 speed manual transmission (Getrag 283).

Manual transmission gear ratios

Gear ratios	1.8	2.0 V6	2.5 V6	2.0 CDT
1st	3.577	3.577	3.577	3.577
2nd	2.022	2.022	2.022	2.022
3rd	1.348	1.348	1.348	1.292
4th	1.029	1.029	1.029	0.919
5th	0.809	0.809	0.809	0.686
Reverse	3.308	3.308	3.308	3.308
Final drive	4.410	4.410	3.944	3.737

- Synchromesh is provided on reverse as well as all forward gears. This is the first application of reverse gear synchromesh on a Rover car. It provides a significant benefit over 600 and 800. The lack of reverse gear synchromesh can result in reverse gear crash and customer dissatisfaction
- First and second gears have two-cone synchromesh. This reduces gearchange loads where the highest speed differences have to be overcome and the greatest forces endured
- The gear machining process reduces gear noise compared with PG1
- The hydraulically activated clutch and concentric slave cylinder together give a light pedal load and smooth travel
- A dual-mass flywheel provides additional inertia and smooths out pulses from the engine, resulting in fewer vibrations and an altogether smoother and more refined drive
- Equal length driveshafts, obtained by incorporating a link shaft, assist handling. This is the first time a Rover engineered front wheel drive car has had equal length driveshafts. The great advantage is absence of torque steer

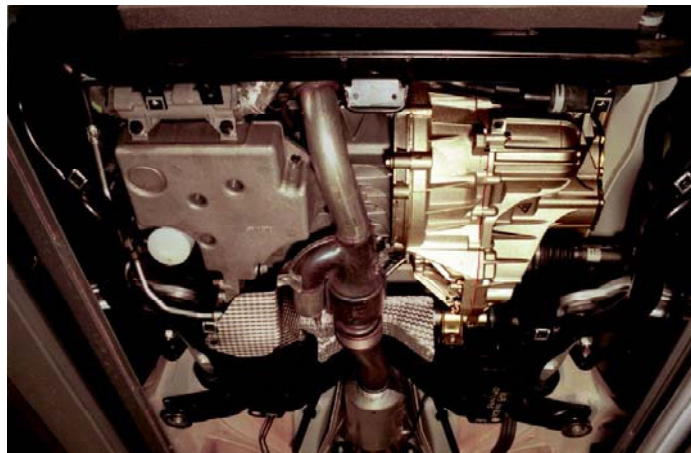


Fig 1 (a) 3

Automatic transmission

Introduction to Jatco SFPO

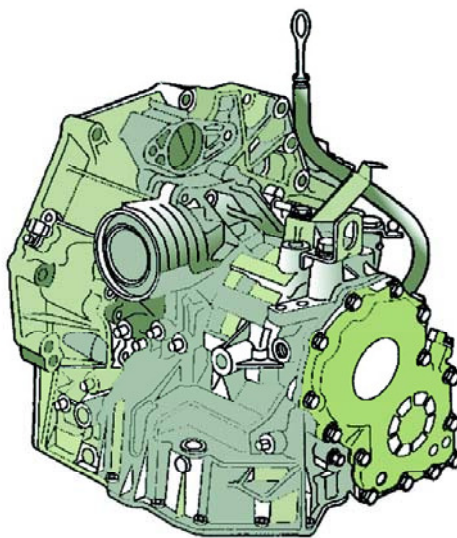


Fig. 1

The Jatco SFPO Specifications and gear ratios are described in the following tables:

Specifications

Item	Specification
A/T type	JF 5-forward speeds and 1 reverse speed with planetary gears
Torque converter	Symmetrical 3-element, 1-step 2 phase with lock-up mechanism
Oil pump	Trochoid gear drive
Control system	Electronic control
Lubricating system	Forced oil delivery system
Cooling system	Outer cooling system
A/T fluid	Nisseki 402 or equivalent

Gear ratios

Gear	Close ratio: KV6 2.5	Wide ratio: KV6 2.0, M47 and K1.8
1st	3.474	3.801
2nd	1.948	2.131
3rd	1.247	1.346
4th	0.854	0.935
5th	0.685	0.685
Reverse	2.714	2.970

The Jatco SFPO (see Figure 110) is the first fully electronic controlled automatic transmission fitted to a Rover Group vehicle. The Rover 800 has a Jatco FAD gearbox fitted which was developed from hydraulic controlled transmissions and electronic control, but all its service diagnostics are carried out via the engine management system. The new Jatco SFPO is part of a new family of transmissions with a stand alone diagnostics system accessed via TestBook. It has 5-speed adaptive control and is fully European on-board diagnostics (EOBD) compliant.

Gear shift and torque converter lock-up are driven by the throttle angle and the vehicle speed: torque converter lock-up being available in 3rd, 4th, and 5th gears. At high speeds, with a small throttle angle, it is possible for the automatic transmission control unit (ATCU) to lock-up the torque converter, thus transmitting maximum power from the engine to the wheels of the vehicle without slip occurring. The ATCU is located in the passenger footwell, next to the cruise control ECU, if fitted.

The vehicle will start only with the Park or Neutral gear selected. The EWS-3 immobiliser monitors the gear selector position on CAN-Bus, transmitted by the ATCU. Also, the start inhibitor switch is hard wired from the transmission to the EWS-3. The switch is open circuit for all gear selector positions except for Park and Neutral positions, when it is closed. The EWS-3 will allow vehicle starting when it receives a closed inhibitor switch signal or a CAN message transmitted from the ATCU stating that the selector position is in 'P' or 'N'. The EWS will allow starting of the vehicle if any of the two signals are present and when all other starting parameters are met.

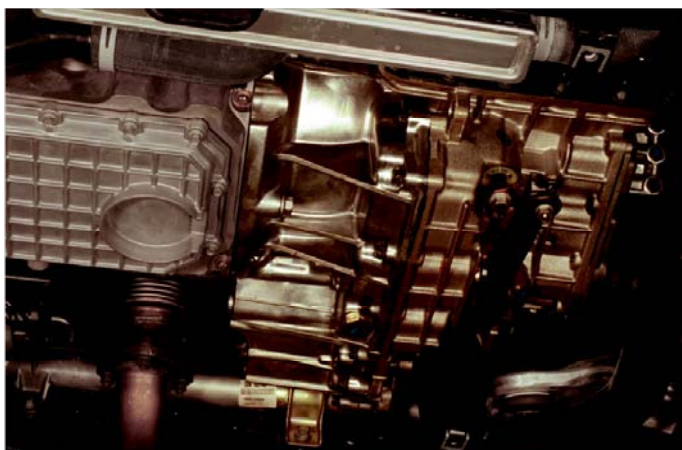
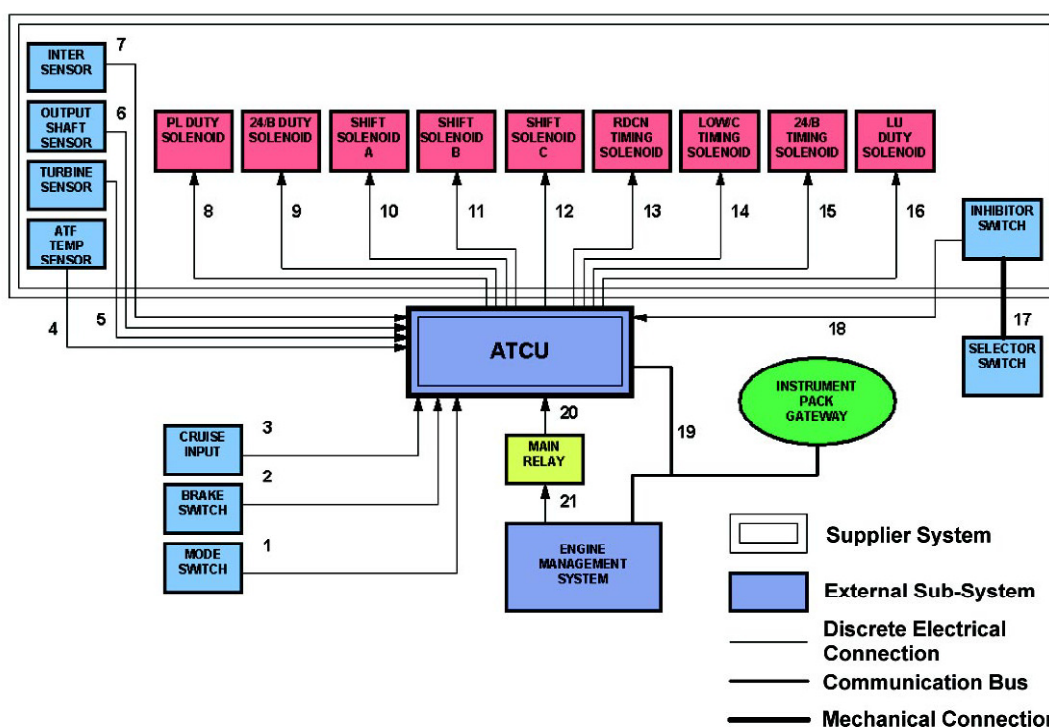


Figure 110 PO

A safety feature of the transmission system is 'reverse inhibition'. When the vehicle speed exceeds 10 km/h in the forward direction, the ATCU switches a solenoid which drains the oil from the reverse clutch. This prevents the reverse gear from being selected when the vehicle is moving forward and prevents transmission damage from such an occurrence.

There are seven sets of contacts contained within the inhibitor switch assembly, and the ATCU monitors these switches to determine the position of the gear range selector. From this, the ATCU can select the appropriate shift pattern. It also transmits a signal on to the CAN-Bus as to the gear selected. This CAN signal is used by the IPK, which illuminates the corresponding part of the PRND432 display. The IPK also has a star segment display informing the driver which mode has been selected: 'D' means the transmission is in normal drive mode; 'S' means sport mode has been selected; and a snowflake symbol indicates winter /snow mode has been selected.

There are many fail-safe default modes that the ATCU will enter when a fault is detected. The actual default mode selected depends on what fault has occurred. The criteria for each default mode is that the driver is safe to drive the vehicle and the least amount of damage will be done to the transmission by continuing to drive with the fault. Failure modes can mean a mechanical default to 4th gear, high pressure gear shifts and torque reduction control inhibited. If the 4th gear default is active, the driver is made aware by a message sent from the ATCU, via CAN, to the IPK. The IPK displays EP (emergency program) using the mode segment display and the gear selected segment display. The fault(s) will be stored in the ATCU non-volatile memory, which is accessed using TestBook.



Fi t c am

nc cc gē cha s

Automatic transmission gear changes are made by actuators (solenoids) that are controlled by the ATCU. Complete transmission control is achieved using 9 solenoids, which regulate the control valve operation. Three solenoids are used to control the direction of oil flow through the transmission and, hence, the selected gear. One solenoid is used to engage and disengage the lock-up of the torque converter.

The other five solenoids are used to control the line pressure within the transmission and the actuation of brake bands internal to the transmission. These solenoids directly affect shift quality and refinement.

As stated, gear selection is controlled by the ATCU and achieved by the operation of nine control valve solenoids, which govern the pressure and direction of oil flowing through the transmission. The solenoid valve block is located inside the transmission system. The three shift solenoids which engage the various gear ratios within the transmission are called A, B and C on the block diagram above (see Figure 112) and there is a given combination of these solenoid states for the selection of each gear.

The following table indicates the status of each of the three shift solenoids against each engaged gear.

Solenoid	1st gear	2nd gear	3rd gear	4th gear	5th gear
Shift solenoid A	X	O	X	X	O
Shift solenoid B	O	O	O	X	X
Shift solenoid C	O	X	X	O	O

X = OFF O = ON

The lock-up (LU) duty solenoid is used to control the lock-up of the torque converter and is activated by the ATCU and dependent upon throttle position and vehicle speed.

The pressure of the transmission fluid must be regulated correctly. If pressure becomes too high, gear shifting will occur at high speeds which are uncomfortable for the passengers and can damage the transmission. If the line pressure becomes too low, gear shifting will take longer to complete and can shorten the life of the various clutches within the transmission. Line pressure is regulated mainly by a single solenoid control valve called the line pressure duty solenoid (PL), though, in certain circumstances, four further solenoid control valves are used to aid line pressure regulation: these being the three timing control solenoids and the 24/Brake duty solenoid. The required line pressure is calculated by the ATCU from current engine speed, vehicle speed, current engine torque and throttle angle signals, and operates the solenoids to achieve the required line pressure.

As well as assisting in the control of the line pressure, the three timing solenoids have two main functions:

1. **Line pressure cut back:** Upon take up, the transmission needs a high line pressure. The ATCU controls the low clutch timing solenoid (dependent upon vehicle speed) in order to switch the oil circuit of the line pressure to and from cut back
2. **Reverse inhibition:** If reverse is selected when the vehicle speed exceeds 10 km/h the ATCU switches the low clutch timing solenoid. This drains the oil from the reverse clutch

Adaptive control

Being electronically controlled means it is possible to vary the characteristics of the shift maps. The shift maps can be selected manually by the driver mode options (snow mode, sport mode, normal drive mode, 4, 3, 2) or by automatic intervention by the ATCU because of prevailing driving conditions. The automatic shift map adaptations are called strategies, and all are active upon power up of the vehicle, when the ATCU will default to normal drive mode. The Jatco SFPO supports the following strategies:

1. **Hill/trailer mode engagement:** This is an adaptive mode with which the ATCU detects steep gradients and automatically enters into this mode. ATCU detection is by monitoring of engine torque values, throttle angle and engine speed. Pulling a trailer has a similar effect on a vehicle in terms of torque requirements as a vehicle climbing an incline and, hence, they are paired together. This mode will also assist when the vehicle is being driven at high altitude because of reduced engine torque caused by the lower oxygen content of the atmosphere. This mode helps to prevent the gears shifting up and down in response to frequent throttle pedal adjustments that the driving conditions require
2. **Downhill recognition:** This strategy decreases the need for the application of the brakes when driving downhill. Auto transmissions tend to up shift with an increase in speed and a decrease in throttle angle requiring driver intervention with the application of the brakes. The Jatco SFPO recognises the decrease in throttle angle and the increase in speed as a slope, and, when the brakes are applied, the shift pattern changes. The transmission shifts down a gear and stays in this mode until the application of the throttle
3. **Cooling strategy engagement:** Torque converter lock-up will not usually occur in 2nd gear and under high loading conditions the transmission can generate excessive heat. Locking the torque converter or changing gear can reduce the amount of heat generated. The ATCU will recognise that a low gear has been selected and that engine speed, engine torque and throttle angle are all high and it will engage the cooling strategy. This strategy has its own defined shift map and a torque converter map which allows torque converter lock-up in the lower gears
4. **Cold start/climate strategy:** This strategy will hold onto the gears for longer than usual and will prevent torque converter lock-up until the oil has reached a predetermined temperature. This has the effect of warming up the powertrain of the vehicle and it reaches its optimum performing temperature earlier, improving vehicle emissions, fuel economy and vehicle driveability. This is the opposite of the cooling strategy

Driver selectable modes



Figure 113: Driver mode selector switch

The strategies above are all controlled automatically by the ATCU without driver intervention. The driver can select various shift maps by selecting the sport mode or the snow/winter mode from the driver mode switch on the centre console (see Figure 113). The vehicle will remain in this mode until another mode is selected or the ignition is turned off. The transmission will default to normal/drive mode on vehicle start up.

Sport mode

In this mode, the ATCU will hold on to the gears for longer than usual, improving acceleration performance, and will downshift more readily giving faster overall vehicle responsiveness.

Snow/winter mode

This mode is designed for use in icy and wet conditions, and it limits the amount of wheel slip when the transmission is shifting between the gears by shifting gear at reduced engine torque loads.

Cruise control mode engagement

Cruise control is available as an option and the ATCU has a shift map designed to operate when cruise is in operation. With cruise control selected, the ATCU and the Cruise ECU can conflict in certain driving conditions. The cruise ECU can request rapid and large throttle variations to maintain the set speed and the transmission will automatically shift up and down the gears to compensate. To prevent continual shifting up and down of the gears, a hard wired link is taken from the cruise system to the ATCU and, when cruise is selected, a control shift map suitable to the circumstance is selected. This strategy is less sensitive to throttle openings and gear shifts are less frequent, giving a smoother ride

Inputs and outputs

The outputs from the ATCU control the overall operation of the transmission. The outputs are based on various sensory inputs from around the vehicle, providing current vehicle status. The inputs to, and outputs from, the ATCU are outlined in the tables below:

ATCU inputs

Input signal	Location	Function
Vehicle speed sensor	Internal to the transmission O/P shaft	Senses the output shaft rotational speed to determine the vehicle speed
Turbine sensor	Internal to the transmission I/P shaft	Senses the turbine runner rotational speed to determine the input rotation power being delivered to the A/T
Intermediate sensor	Internal to the transmission	Senses the rotational output speed of the A/T output gear of 4-speed gear train
Cruise active O/P	Signal from the cruise ECU	Senses cruise control mode
Inhibitor switches	Bottom of the transmission	Senses the position of the gear select lever
Pattern selection switch	Gear selector console	Sense the driving mode selected, Drive (normal), Sport or Snow
Oil temperature sensor	Internal to the transmission	Senses temperature of the automatic transmission fluid
Brake switch	Pedal box	Senses application of the footbrake

ATCU outputs

Output signal	Function
Shift solenoid A	Operates shift valve A in the control valve as part of the gear change control
Shift solenoid B	Operates shift valve B in the control valve as part of the gear change control
Shift solenoid C	Operates shift valve C in the control valve as part of the gear change control
Line pressure solenoid	Adjusts the throttle pressure as part of line pressure control
Low clutch timing solenoid	Adjusts roller clutch pressure as part of gear change and line pressure control
Lock-up solenoid	Operates the lock-up control valve
Reduction timing solenoid	Adjusts reduction brake pressure as part of gear change control
Torque down request signal	This signal is supplied to the ECM from the ATCU and request a reduction in engine torque.
2, 4 brake timing solenoid 2, 4 brake duty solenoid	Adjusts brake pressure during the gear change to and from 2nd, 4th and 5th gear

Diagnostics

Full diagnostics are available via TestBook, using the Rover 75 disc and the correct lead. Full 'P' code support is provided to meet with EOBD requirements.

Steering and suspension

Steering

The Rover 75 steering system is a servo-assisted rack and pinion linear ratio system, tuned to feel very responsive to driver inputs, while resisting reaction to road imperfections and providing isolation from vibrations (see Figure 114).

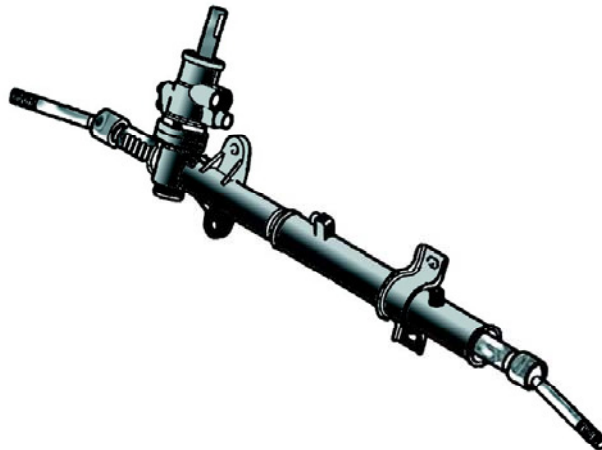


Figure 1 n ϵ k

Power is supplied by a conventional engine-driven pump. Not conventional are the fluid pressure and flow rate. The fluid pressure of 100 bar and the flow rate of 7.8 litres/minute mean the system is operating at significantly higher outputs than other Rover vehicles (e.g. Rover 400 55-60 bar, Rover 800 75 bar). This high pressure coupled with the compact rack tube enables the system to produce high levels of assistance whilst retaining packaging and weight benefits. The steering gear valve boasts a six-land design which gives increased flexibility in tuning the steering feel. It also helps reduce valve hiss which is a characteristic of steering systems with high flow rates. Aluminium tubing is used for the fluid.

Extensive development was carried out on steering system feel and ratio. The overall ratio (the relationship between steering wheel turns and road wheel turns) is a quick 18:1. This has been chosen to ensure confidence inspiring driving, and it gives a more direct response than most competitors. The car has been designed to perform well at high autobahn speeds, yet no jitteriness is fed back, and the car is sheer joy on winding roads.

One special feature, seen for the first time in a Rover, is a pressure sensor. This is a system that monitors fluid pressure and during high load situations (e.g. full lock) sends a signal to the engine management system to maintain engine speed at normal level and so prevent stall. This will be beneficial when making tight manoeuvres at low engine speeds.

Both axial and tilt adjustment of the steering column are provided, for the first time on a Rover car since the SD1. The total travel is 50mm either way, a greater range than on 75's predecessors.

There are two more nice touches in the adjustment mechanism. To enhance and refine the column during adjustment, the extremities of travel have 'oft stops' which eliminate mechanical thump, a criticism directed at many current vehicles. Furthermore, in the tilt plane a special rate spring has been engineered. This prevents the column falling to its lowest position on releasing the clamp, and it assists in raising the column to a new position.

With Rover 75 being designed to provide class-leading occupant protection, the steering column has two independent safety mechanisms. Firstly, the splined intermediate shaft exhibits displacement absorption during frontal collapse of the body structure and rearward movement of the engine towards the bulkhead. Secondly, the upper column features energy absorption by way of dynamic friction over 100mm of stroke. This greatly reduces head, neck and chest injury during impact by controlling deceleration of the driver's torso as the airbag deflates.

The upper column is a new one-piece housing, instead of a conventional separate lock tube attached to the shaft. The use of magnesium alloy in the manufacture of the lock housing stems from the latest automotive technology and brings benefits of both weight saving and increased tooling life over aluminium or zinc alloys.

The lock itself complies with both current and future legislation. Current legislation dictates that the column or steering lock should withstand one single load application. However, if such a system is overloaded the lock bolt will shear, thus enabling the vehicle to be steered. The latest legislation demands that the system should be capable of resisting a series of loads lower than the original specification. The Rover 75's steering lock mechanism is extremely secure, able to bear several forces and make the car almost impossible to steer.

An additional feature of the steering lock is 'overcrank prevention'. In current vehicles it is possible to engage the starter motor when the engine is already running, resulting in embarrassing graunching noises and potential damage to flywheel and starter motor. Overcrank prevention means this cannot be done, especially useful when a car is as quiet as the Rover 75.

A design target for Rover 75's steering column was to minimise column shake, so complementing the low overall NVH levels achieved with the rest of the car. The heavy steel fabricated mounting attaching the column to the screen rail and dashboard tube was replaced in favour of a much stiffer and lighter aluminium casting. Design techniques such as finite element analysis and rapid prototyping enabled the component to be designed, tuned and tested in a very short time. The engineered solution isolates the driver from the forcing frequencies generated by the engine at idle, for all engine variants.

The steering column bulkhead grommet is twin-walled, stiffened, thickened and has a sealed bearing to the steering column to minimise noise intrusion into the passenger compartment.

The steering shaft-rack fitting is a new swing-yoke type, replacing the conventional spline fitting. This fitting makes for a consistently correct and therefore secure fitting of the shaft to the steering gear. It requires a one-handed operation at the factory, rather than the usual two. This ergonomic benefit arose through the use of E-build.

The steering wheel itself has been designed to accommodate a 60-litre airbag to meet North American regulations. It currently houses an example of the latest technology in European-sized airbags. It has been developed with the steering column to give extremely low levels of occupant injury during frontal impact. The standard mid-tilt angle was optimised for occupant safety in a crash.

The wheel also acts as a mounting for the audio controls, cruise control and the twin horn buttons, positioned ergonomically for ease of use. A rotary coupler provides a constant and reliable electrical path from the column assembly to the airbag and the other steering wheel functions. The column cowl has been designed so that there are no visible fixings.

The steering wheel is available in two standard soft feel and five leather colours that are integral with the whole interior design. A wood rimmed wheel is available as an accessory. This had an integral place in the overall test programme. The three sections are made from laminated tulip wood.

Suspension systems

Introduction

The front suspension system is MacPherson strut with a rear facing 'L' shaped lower arm mounted on a peripheral front subframe which is, in turn, mounted to the body via six rubber mounts.

The wide spacing and quantity of the mounts, coupled with the positioning both in front of and behind the road wheels gives an excellent side force steer performance whilst allowing relatively soft mounts to be used. This, in turn, improves front axle refinement. The lower arm front mounting point is a ball joint, replacing the more common bush type mounting, and positioned well forward. This, again, improves the side force steer characteristics of the suspension, preventing corruption of the steering intentions of the driver by the response of the axle when cornering.

The lower rear arm mounting voided bush does not need to react to any axial load, due to the front mount being a ball joint, and can, therefore, be easily tuned to obtain the optimum compliance steer and bump steer characteristics.

The anti-roll bar is mounted off the subframe and attached via a double ball jointed link to the strut spring pan. This arrangement makes the anti-roll bar act on a virtually 1:1 ratio and without efficiency losses. The anti-roll bar bushes allow relative movement between bar and bush due to their Polytetrafluorethylene (PTFE) lining. This allows the bush to be very stiff, improving the response of the anti-roll bar system.

The whole front and rear axle assemblies have been modelled extensively and optimised in terms of their handling characteristics using the automated dynamic analysis of mechanical systems (ADAMS) software package, in conjunction with practical development work. ADAMS is a package designed to aid the studying of kinematics and elastokinematics i.e. the analysis of suspension movement and the forces acting on it. The suspension geometry has also been tuned to be insensitive to steering shimmy and brake judder.

The rear suspension fitted to Rover 75 is based on the BMW 'Z' axle concept, but re-engineered and optimised to suit the front wheel drive set up of Rover 75. The system allows excellent camber compensation into bump, keeping the tyre tread flat on the road when the vehicle rolls. Its tuning also allows anti-lift under braking and anti-squat under acceleration.

Side force steer, bump steer and compliance steer characteristics are controlled by means of careful tuning of the suspension geometry, the trailing arm compliance bush and the subframe mounting bushes.

Rubber mounting of the rear subframe also gives enhanced rear axle refinement. The anti-roll bar system has been designed to give the best achievable bar efficiency, using a link (bushed at one end and ball jointed at the other) mounted off the upper arm, and PTFE lined clamp bushes to the subframe, similar to those on the front axle.

Front suspension

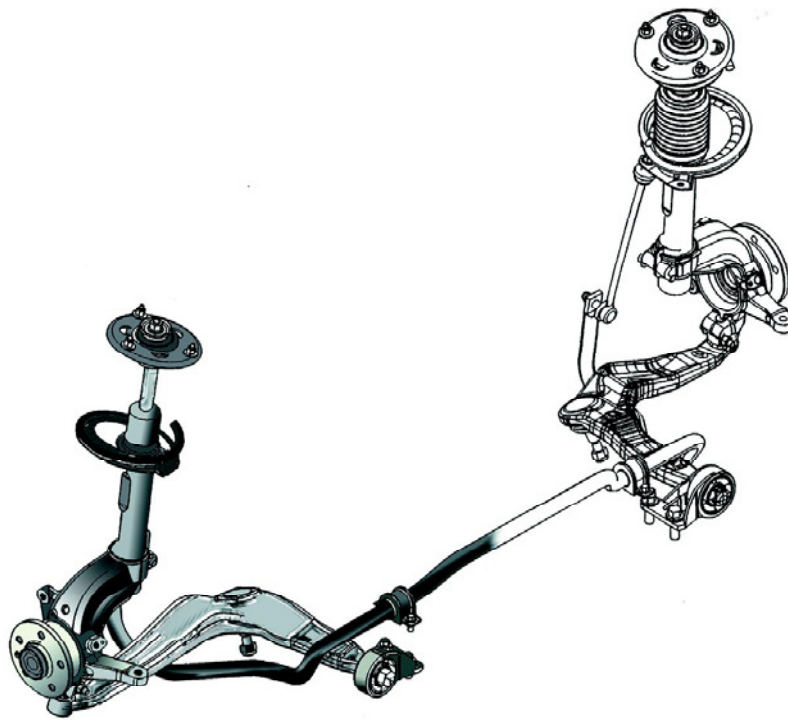


Fig. 1 Suspension

Rover 75 features independent front suspension (see Figure 115) consisting of four main components:

- MacPherson struts
- 'L' shaped lower arm assembly
- Anti-roll bar
- Rubber mounted peripheral subframe

Front strut

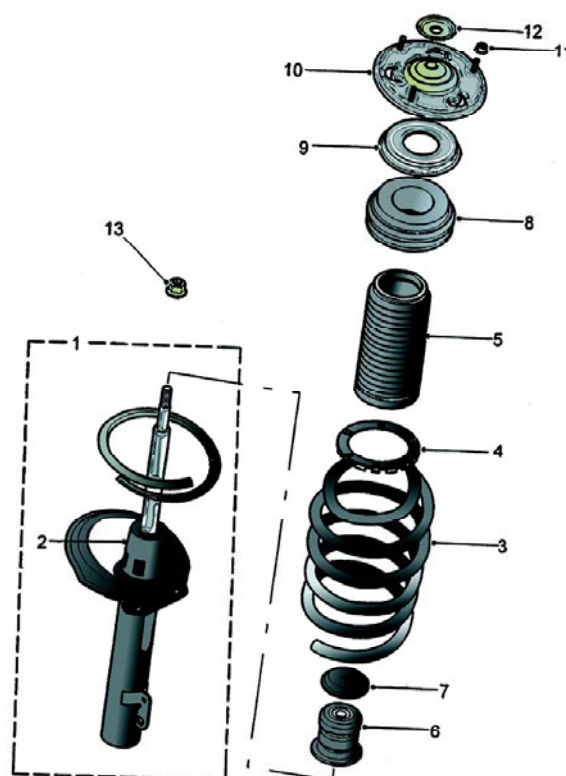


Fig 1

1. Damper assembly
2. Bump cap
3. Road spring
4. Slip ring
5. Dust cover
6. Spring aid
7. Bump stop washer
8. Spring isolator
9. Strut bearing
10. Top mounting assembly
11. Nut/washer - strut to body
12. Rebound washer
13. Flanged nut

This is a gas charged, twin tube MacPherson strut (giving 90mm bump and 90mm rebound) with a double ball jointed anti roll bar (ARB) link to the spring seat. The strut is mounted to the body of the vehicle using three M8 nut/washer assemblies and provides degressive damping to the vehicle. The strut is fully serviceable - including the top mount, road spring, upper spring isolator, bellows, slip ring, bearing and bump cap (see Figure 116).

Front lower arm assembly



Figure 117: Front lower arm assembly

The front lower arm (see Figure 117) is an aluminium forging with double integral ball joints and a hex pin-to-bush fitting. The outer ball joint is secured to the front hub by a single M10 flanged Nyloc deformed thread nut and bolt. An M14 flanged Nyloc nut secures the tapered inner ball joint to the peripheral front subframe. The 'voided' push-fit bush, with a nylon outer and steel interleaf, is housed in a cast iron bracket, which is secured to the subframe using two M14 bolts. The void angle is optimised to give good steer characteristics. Therefore, the orientation of the bush is critical. Under extreme loading caused by a frontal collision the housing is designed to shear off, improving the crashworthiness of the vehicle.

The lower arm should not be used as a levering point or hammered down to release the ball joints, as it bruises easily. A service tool should be used to lever down the ball pin and a lug is provided on the hub to provide a levering point. The arm must not be used as a jacking point.

Front tie bar

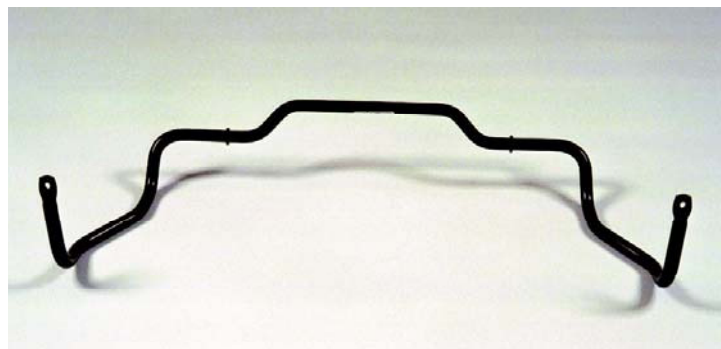


Figure 118

Made from solid spring steel, the front ARB (see Figure 118) is mounted to the front struts by double ball jointed links. The top of the link operates on the spring seat for maximum efficiency. ARB bushes to the subframe are lined with PTFE and allow the bar to rotate freely in the bush, eliminating 'squeak'. The bushes must not be greased. Steel washers, crimped to the bar, prevent lateral movement of the bar relative to the subframe.

Front subframe

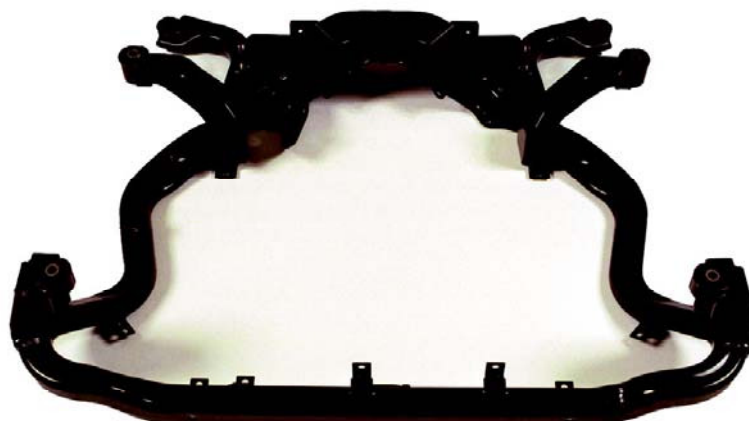


Figure 119

The front subframe (see Figure 119) is a peripheral subframe made from tubular steel, with six rubber mounts to the vehicle body. This arrangement improves the side force steer characteristic of the vehicle and the subframe improves the crashworthiness of the vehicle in frontal collisions. The rubber mounts improve the noise, vibration and harness characteristics of the vehicle. The subframe is machined after fabrication to ensure highly accurate location of all suspension components and hence good suspension geometry control.

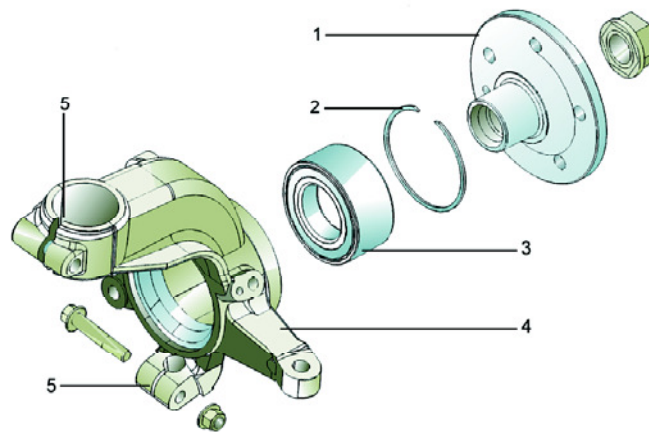
Front swivel hub

The front swivel hub (see Figure 120) is cast iron with a hollow neck and bolts to the outer ball joint on the lower arm and to the front strut. The hub houses the front ABS wheel sensor and has an integral steering lever. Servicing the strut requires the removal of the lower arm outer ball joint as the first operation.



Fig

b



Fig

a

c

h

r

y

1. Flange drive assembly
2. Circlip
3. Wheel bearing
4. Front hub
5. Pinch joints -
hub to strut (top) and hub to lower
arm ball joint (bottom)

Front wheel bearing

The front wheel bearing (see Figure 122) includes a magnetic multi-pole seal used by the anti-lock braking system. The bearing is colour coded to ensure correct fitting. The black face containing the magnetic pole wheel must be inserted facing inboard, with the silver face outboard. The bearing is supplied with the black magnetic encoder protected by a plastic cap. This must be removed before fitting the new bearing. During the fitting of the bearing it should be kept clear of dirty surfaces, kept away from magnetic sources and impacts to the bearing should be avoided.



Figure 122 Front wheel bearing

Front drive flange

The front drive flange is made from forged steel and the wheels are bolted to it using five M14 bolts. The brake disc is retained to the flange via a large countersunk screw which must be torqued to 30 Nm.

Rear suspension

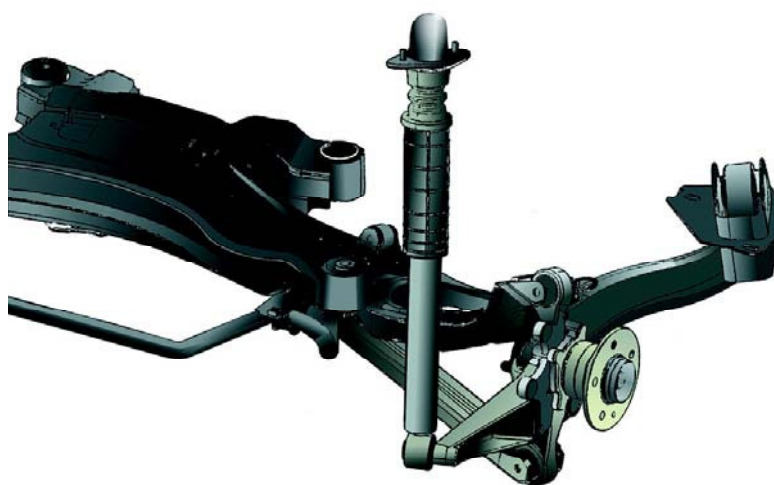


Figure 123 Rear suspension

The rear suspension fitted to Rover 75 is based on the BMW Z axle concept, adapted and optimised to suit the front wheel drive set up of Rover 75 (see Figure 123). Renowned for its excellent camber compensation into bumps, the rear suspension comprises the following components:

- Rubber mounted rear subframe
- Rear trailing link
- Rear lower arm
- Rear upper arm
- Anti-roll bar
- Damper
- Road spring and isolators

Figure 124



Figure 124 Rear subframe

Mounted to the body of the vehicle via four rubber mounts, the rear subframe (see Figure 124) supports the suspension members at the rear of the vehicle. The rubber mounts provide isolation from noise. The front mounts are voided to give the best compromise between isolation and handling. The voids must be positioned in the correct orientation when servicing the bushes.

Rear trailing link



Figure 1 Rear trailing link

The rear trailing link (see Figure 125) is made from hollow cast iron with a 5mm wall thickness. A press fit hollow ball joint connects the upper arm and a ball bush locates the lower arm. The link to body is via a compliance bush, with axial snubbers and rates tuned for side force steer, ride handling and noise compromise. The toe can be adjusted, via the trailing link fabricated bracket to body, using correct tooling. Service tools are available for the compliance bush, the ball bush and ball joint. The compliance bush, if removed, must be refitted in the correct orientation. The toe adjustment bracket, if removed from the bush, must be refitted by aligning the bottom plate of the bracket with a cast line on the trailing link.

Upper arm



Fig 126 Upper arm

The upper arm (see Figure 126) is made from fabricated steel and carries the anti roll-bar link bracket. It is handed and marked to indicate to which side of the vehicle it fits. It connects to the road spring via a spring isolator and has a retention keyway to locate and retain the isolator. The isolator must be located in the keyway and rotated through 90° for correct fitment. It is important to ensure that the cut-outs on the isolator match to the holes in the upper arm provided for drainage. The 4 lateral link bolts are a common length and must be tightened at kerb trim height.

L m



Fig 127 Lower arm

The lower arm (see Figure 127) is a steel fabrication and the left and right hand sides are identical. The inboard bush cannot be replaced separately and replacement requires a new lower arm. The lower arm must be fitted the correct way up and marks 'UP↑' are provided on the arm for service fitment. A plastic protector is fitted to prevent stonechip damage and this is handed and must be the right way up. The protector is marked for identification and also to warn against jacking on the arm.

Lower arms and isolators

There are four different springs to cover the vehicle weight range, and spring identification is by colour codes and component identification code labels. A label located underneath the rear seats gives the component identification code for the front and rear springs fitted to the vehicle. There are three different thicknesses of lower isolators for trim height control.

Figure 127

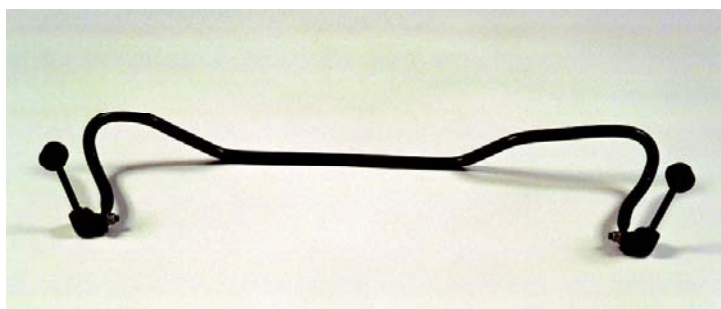
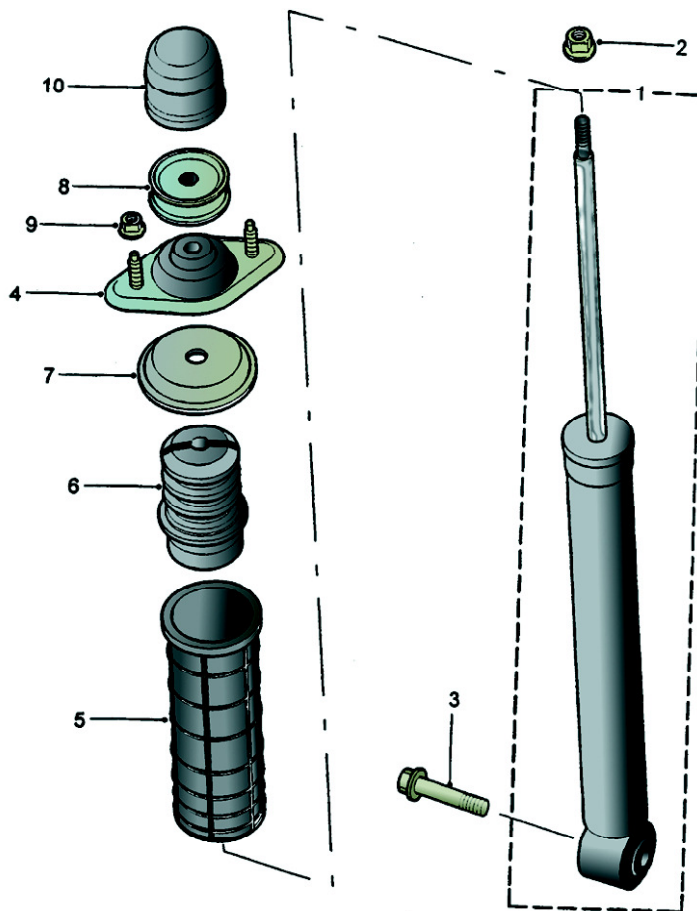


Figure 127

The rear anti roll bar (see Figure 128) is hot formed from solid steel, and is fitted with handed links to the upper arm. The links have a ball joint at the ARB end and a bush at the other. The clamp bushes are PTFE lined and should not be greased. The link bush to the upper arm connection must be tightened at kerb position.

Figure 128

The rear bearing assembly houses the magnetic pole wheel used by the ABS sensor to measure road speed. The outer flange supports the wheel via five bolts. A tag washer, stake nut and grease cap secure the hub assembly to a slotted spindle. A service kit is available.

a. mper**Fig e R d per**

- 1. Damper assembly
- 2. Flanged nut
- 3. Flanged bolt with fail-safe washer
(not shown) - damper to trailing arm
- 4. Mounting assembly
- 5. Bellows
- 6. Spring aid
- 7. Bump stop plate -
damper/spring assembly
- 8. Rebound plate
- 9. Nyloc flanged nut - mount to body
- 10. Noise isolator cap

The damper is retained to the body via a swish cap noise isolator and 2 studs/nuts. The lower bush is not serviceable and must be tightened to the trailing arm at kerb. The top mount, spring aid, shroud, washers and the bump cap can all be serviced separately (see Figure 129).

Supplementary restraint systems

Introduction

In recent years, technical advances in vehicle safety systems have significantly reduced the risk of injury to occupants involved in road accidents. Crumple zones, anti-submarine seats and collapsible steering columns all enhance vehicle safety. These designs, combined with the seat belt system, make up the primary restraint systems.

The amount of protection provided by the primary restraint system can always be improved. In the event of a frontal impact, the upper torso and head of the front occupants can come in to contact with the windscreen and vehicle interior. Therefore, additional measures have been introduced to supplement the primary restraint system. These have subsequently become known as supplementary restraint systems (SRS).

Supplementary restraint systems are designed to work in conjunction with the primary restraint systems, providing additional protection to occupants. In the event of a crash, forces are exerted on the occupants of the vehicle, which results in them moving, in directions determined by the exact point of the impact. SRS systems inflate airbags to absorb the energy from the moving occupant and/or move them away from intrusions into the vehicle.

Driver and passenger airbags are fitted as standard on Rover 75. Inflatable tubular structure (ITS) and Thorax airbags, designed to enhance the level of protection provided in side impacts, are available with Rover 75. ITS is available as an option, Thorax is fitted as standard. Front pretensioners are fitted to all Rover 75 derivatives. Rear pretensioners, new to Rover, are also fitted as standard. A single Diagnostic and Control Unit (DCU), monitors and controls all SRS circuits in conjunction with side impact sensors. The service life of the components incorporated into the Rover 75 SRS system is fifteen years. After this time, the components must be replaced.

The components incorporated into the SRS system on Rover 75 are as follows:

1. Driver and passenger airbags
2. Thorax airbags
3. Side head impact protection via Inflatable Tubular Structures (ITS)
4. Front and rear pretensioners
5. SRS harness (incorporated into the main body harness)
6. Side impact sensors
7. Diagnostic and Control Unit (Incorporating front impact sensors)
8. Rotary coupler

Diagnostic and control unit

The DCU is located behind the lower centre console, under the handbrake. It is secured to the body of the vehicle on the transmission tunnel with three 6mm external Torx head Powerlock bolts. A reserve power supply is also incorporated into the DCU. This will provide power to deploy the airbags in cases where the battery connection is lost.

The Diagnostic and Control Unit (DCU) functions as the 'brain' of the system. It continuously monitors the SRS system and its components for faults. If a fault is detected within the SRS system, then the DCU will illuminate the warning lamp in the instrument pack. On vehicles fitted with a highline instrument pack, a message is also displayed in the message centre. The SRS system may not function whilst the warning lamp is illuminated. The DCU memory will need to be interrogated and the cause of the faults diagnosed using TestBook. When the ignition switch is turned to position 2, the DCU will initiate a bulb check. At this time the SRS warning lamp will illuminate for approximately 4 seconds. The message centre does not display its SRS message during this period.

The DCU controls deployment of all of the airbags and seat belt pretensioners. It works in conjunction with the side impact sensors and is capable of monitoring crash events impacting upon the vehicle through 360 degrees in the horizontal plane (i.e. in any direction horizontally). Sensors located in the DCU are used to monitor the force of any crash event impacting upon the vehicle. Two types of sensor are used: accelerometer type crash sensors and mechanical safing sensors. The sensors are, effectively, in series and both must be activated before the DCU will deploy the appropriate airbag(s) and/or pretensioners.

In cases where the vehicle is involved in a frontal collision where force exceeds the DCU programmed threshold, then both driver and passenger airbags will be deployed, together with all pretensioners. The DCU manages this event by activating electronic switches incorporated into the circuits which feed the squibs for each of the relevant airbags/pretensioners. Squibs are contained within each of the airbag modules and, when they are given the appropriate amount of energy, they act as the initiator for the chemical reaction that inflates the bag.

As stated, ITS and Thorax airbags provide protection to front seat occupants from lateral impacts to the vehicle. When deployed, the Thorax airbag protects the occupant from the side intrusion of the vehicle. The ITS is designed to cushion the head of the occupants sat in the front seats. They provide protection in side barrier and pole crashes, and also reduce neck injuries. Internal to the DCU are accelerometers which measure the lateral acceleration/deceleration of the vehicle. The accelerometers work in series with the side impact sensors. The side impact sensors also react to lateral forces. In the case of Rover 75, the accelerometers internal to the DCU act as safing sensors. They must be 'triggered' together with the side impact sensors, before the DCU will deploy the ITS and Thorax airbags.

The DCU fitted to Rover 75 is capable of sensing rear impacts. If the force of the impact is above the pre-programmed threshold, then the DCU will activate all seat belt pretensioners via electronic switching to their respective squibs.

Warning lamp



amp

The SRS warning lamp (see Figure 130) is located in the instrument panel. It is controlled by the DCU and is used to indicate the status of the SRS system.

The illumination strategy supported by the DCU is as follows:

- **Healthy system:** When the ignition is switched to position 2 the SRS warning lamp will illuminate for approximately 4 seconds. The lamp should then extinguish and remain off for the duration of the ignition cycle
- **Permanent fault:** When the ignition is switched to position 2 the SRS warning lamp will illuminate for approximately four seconds. After this, it will extinguish momentarily and then re-illuminate. The lamp will then remain on for the duration of the ignition cycle. In these circumstances, details of the fault will be stored in the DCU's memory
- **Intermittent fault:** When the ignition is switched to position 2 the SRS warning lamp will operate as in the healthy system sequence. If a fault occurs during the ignition cycle, then the SRS lamp will illuminate. It will remain illuminated for the duration of the ignition cycle. If the fault is not present when the ignition is next switched to position 2 then the warning lamp will again follow the operating sequence of a healthy system. In these circumstances, details of the intermittent fault will be stored in the DCU's memory
- **Low battery voltage:** The SRS warning lamp will illuminate whilst the battery voltage is low. It will extinguish as soon as 'correct' system voltage is restored. Details of the fault will be recorded in the DCU's memory
- **If the SRS warning lamp does not illuminate:** This indicates either a fault with the SRS warning lamp LED or that the instrument pack has no power supply

Note: The SRS malfunction warning icon displayed in a vehicle fitted with a message centre will be displayed only when there is a system malfunction. The standard SRS warning lamp is fitted in conjunction with the message centre.

Side impact sensors

The side impact sensor units are located on the seat cross members on each side of the vehicle, underneath the carpet. They are secured by two 5mm internal Torx head T30 Powerlock bolts. The side impact sensors consist of an electronic accelerometer, a microprocessor and a serial link which connects the sensors to the DCU. The sensors perform a self-check operation when the ignition is switched to position 2. Throughout the ignition cycle the sensors communicate with the DCU via the serial link. The microprocessors inside each sensor determine, via the accelerometer, the force of any lateral impact. The sensor will transmit a signal to the DCU where the force exceeds the predetermined level. The message is sent to the DCU via the serial link. If the DCU's internal 'safing' accelerometer has also detected excessive force, then the DCU will initiate deployment of the ITS (where fitted) and Thorax airbags.

The decision to deploy the ITS and Thorax airbags has to be made three times as fast as a front impact to ensure airbags are effective. A crash pulse can take several milliseconds to cross the vehicle, depending on the vehicle structure. For this reason, side impact sensors are used to identify and transmit information about side impacts as early as possible. Therefore, the safing function of the DCU can be simplified and the deployment speed increased.

Thorax airbags



Figure 131

Thorax airbags (see Figure 131) are located within the front seats. They are secured by two 6mm flanged head nuts. The airbag is folded and carefully packaged in a plastic container. The airbag container also houses the hybrid inflator, which contains a nitro-cellulose charge and gas stored at 200 bar. When deployed, rapid inflation of the bag with Nitrogen/Argon forces the container to open and the airbag is released and deployed through the seat cover. With Thorax airbags, it is the heat generated by the charge which causes the gases to expand and fill the airbag, as opposed to the chemical reaction which initiates the deployment of the driver's airbag. The seat cover seam, through which the airbag deploys, is constructed and controlled during manufacturing. The thread is designed to fail when the Thorax airbag is deployed. This ensures the correct deployment of the airbag.

The thread used on the part of the seat cover where the airbag is designed to deploy, is approximately half the strength and thickness of the normal seat cover seam thread. The pitch of the thread is very important if it is to 'unzip' on deployment of the Thorax bag. The pitch should be between 5–6 mm for correct thread failure and uniform deployment of the thorax bags. Too small a pitch and the extra number of securing points makes it more difficult for correct deployment of the Thorax bag. Too big a pitch and the seam will not be secure and may work loose.

If the vehicle is involved in a crash event where a lateral force is exerted on the vehicle above the predetermined threshold, then the Thorax airbag will be deployed by the DCU.

The Thorax airbag is designed to push the occupant away from any possible intrusions into the vehicle. The airbag deployment seam should be kept clear of any obstructions (including passengers). The approximate capacity of the Thorax airbag is 12 litres when fully inflated and is made of silica-coated nylon. When deployed, the Thorax airbag takes approximately 12 milliseconds to inflate fully. Inflation of a Thorax airbag propels the occupant away from the point of impact at an earlier stage and at a lower speed than would occur in a collision involving a vehicle without Thorax airbags fitted, so reducing injury to the occupant.

Installation of the Thorax airbag inside the seat ensures that, no matter what position the seat is in, the airbag is always in the correct position, in relation to the occupants (sitting correctly), to provide full protection. In service, a faulty Thorax airbag is replaceable following the safety guidelines. Replacement is via untrimming the seat and removal of the air bag via its two securing nuts. This process does not affect the special thread used in the Thorax deployment seam.

Side head impact protection



Figure 132 Inflatable tubular structure

Side head impact protection is provided on Rover 75 via inflatable tubular structures (see Figure 132). The inflatable tubular structures (ITS) are located above the front side window apertures. They are secured to the body of the vehicle by three 6mm external Torx head Powerlock bolts. The 'A'-post houses the ITS pyrotechnic inflator, feeding through a Kevlar tube. Once inflated, an ITS covers the area from the 'A'-post mid door to the top of the 'B'-post. An ITS is designed to cushion the head of the driver or front seat occupant in a crash event involving a side impact. When inflated, an ITS is approximately 130mm in diameter. Unlike conventional airbags, an ITS deflates slowly. Typically, an ITS will take 5–6 seconds to deflate. This extended period offers prolonged protection to the head of the occupant.

In its non-deployed state, the ITS follows the curves above the window aperture inside the headlining. The ITS consists of an internal nylon silicon-coated bag, into which the generated gas flows, and an outer woven fabric tube which determines the shape of the airbag. When deployed, the ITS inflates rapidly. The effect of inflation causes the ITS to decrease in length and sets up axial tension. This axial tension forces the ITS through the headlining into position. The capacity of an ITS is approximately 12 litres when fully inflated. In the case of Rover 75 an ITS will take approximately 35 milliseconds after the detection of an impact to inflate fully.

Driver airbag



Fig 1 ag

The driver's airbag module (see Figure 133) is located within the steering wheel and is secured using two Torx fixings. It is deployed by the DCU in circumstances where the vehicle is involved in a frontal collision of sufficient force. It will reach its fully inflated state approximately 30 milliseconds after detection of the impact. Once inflated it will absorb the energy of the accelerating occupant, cushioning the head and the upper torso. The plastic cover features an engineered tear seam, or airbag door. This is a deliberately weakened part of the cover, and designed to tear and rotate around a pivot when the airbag is deployed. This allows uniform deployment of the airbag and ensures it inflates in the correct position. The approximate capacity of the driver's airbag in this application is 45 litres.

Rotary coupler and supplementary restraint system harness

The rotary coupler is located under the driver's airbag module at the top of the steering column. Its function is to maintain electrical connection between the driver's airbag and the SRS harness, whilst allowing the necessary rotary movement. The rotary coupler also maintains electrical connection between the steering wheel mounted cruise control, horn and audio system switches, and the vehicle wiring harness. The rotary coupler allows for a maximum amount of rotary movement (5 turns). When fitting a rotary coupler it must be fitted in its centralised position. This is indicated by a white segment on the indicator wheel. To centralise the coupler it should be rotated clockwise or counter-clockwise until the white segment appears on the indicator wheel.

The rotary coupler forms part of the column switch assembly but is available as a separate part for service.

The function of the SRS harness is to provide electrical connection to all parts of the SRS system. It is incorporated into the main body harness but is distinctive with its yellow outer covering.

Passenger airbag



Fig 1 Passenger airbag

The passenger airbag is made of silicon-coated nylon and is incorporated into the fascia, above the glovebox (see Figure 134). It is mounted to the cross car tube by way of four 6mm external Torx head Powerlock bolts. Deployment of the passenger airbag (see Figure 135) is controlled by the DCU. The capacity of the passenger airbag is 120 litres and it takes 40 milliseconds to inflate fully. In its inflated condition, the passenger airbag is partially supported by the fascia and the windscreen. It is important, therefore, that the windscreen installation is capable of withstanding severe impacts. Particular care must be taken when replacing the windscreen to ensure that protection is optimised.



Fig 2 Passenger airbag

Vents are located at the back of the driver and passenger airbags through which the gas escapes under occupant loading. Under occupant loading, the airbags deflate at a controlled rate dependent upon the load applied. This ensures the protection provided is optimised and that the driver's view is not restricted.

Front seat belts and pyrotechnic buckle pretensioners

Inertia reel three point seat belts featuring pyrotechnic pretensioners are fitted for both front seat occupants. Both front seat belts feature height adjusters located on the upper B/C post. The height adjusters are Bowden cable-operated and are linked to seat movement.

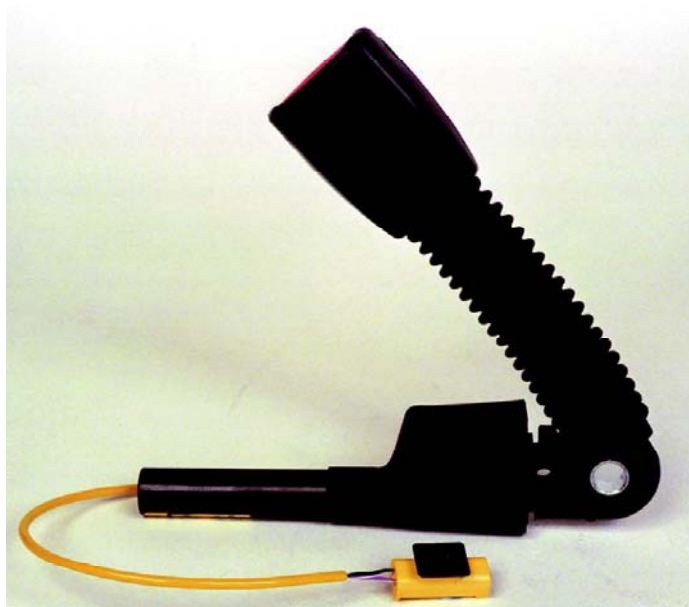


Figure 136

Pyrotechnic buckle pretensioners (PBP) are attached to the front three point seat belt system in place of the fixed buckle (see Figure 136). When deployed, PBPs reduce slack in the seat belt webbing, which, for example, can be caused by excessive layers of clothing. The amount of slack can be reduced by up to 70mm. This action enables the seat belt to restrain forward movement of the occupant at an earlier stage than would be the case with conventional seat belts. This reduces the amount of movement permitted. Limiting the amount of movement helps prevent the occupant from coming into contact with hard parts of the vehicle interior and helps to prevent occupant submarining. In addition, PBPs keep occupants in the correct position for effective airbag operation.

Load limiters are fitted to the front seat belt webbing reels. These will limit the amount of load from the belt acting on the occupant in the event of a collision. Load limiters are fitted only to seat belt reels where an airbag is fitted for the seat occupant. The load is reduced via a torsion bar inside the webbing unit. When a collision event occurs, the inertia reel prevents the release of any more of the belt and the pretensioners take up any excess slack in the seat belt. The inertia from the accident forces the occupant forward into the belt, which is designed to elongate under loading. The amount of load transferred to the occupant by the seat belt can still be excessive as a result of severe deceleration of the vehicle. In this type of event, if the load reaches approximately 3.8 kN, the load limiter torsion bar in the reel housing twists. This twisting allows the release of a further small portion of the seat belt reel in a controlled manner and eases the load acting upon the occupant of the vehicle.

The front PBPs are located adjacent to the front seats and are secured to the seat frames. The PBPs are controlled by the DCU, which deploys them in conjunction with the airbags.

Front pyrotechnics seatbelt pretensioner system consists of:

- A buckle head to attach the seat belt to the system
- A piston located inside a cylinder
- A gas generator/propellant and squib
- A cable to connect the buckle head to the gas generator
- Electrical connection to the DCU, via SRS harness

The PBPs are deployed simultaneously with the airbags during a frontal crash event. The PBPs will deploy independently if the vehicle receives a rear impact exceeding a predetermined force. When deployment is necessary, the DCU will electronically fire the PBP squibs. This, in turn, initiates a chemical reaction inside the gas generator which produces a large quantity of Nitrogen gas. The Nitrogen gas increases the pressure within the cylinder, forcing the piston up the cylinder. The piston is attached to the seat belt buckle head by a cable. Consequently, movement of the piston causes the buckle head to retract. Therefore, a quantity of slack is taken out of the seat belt and the movement of an occupant during a collision is restrained.

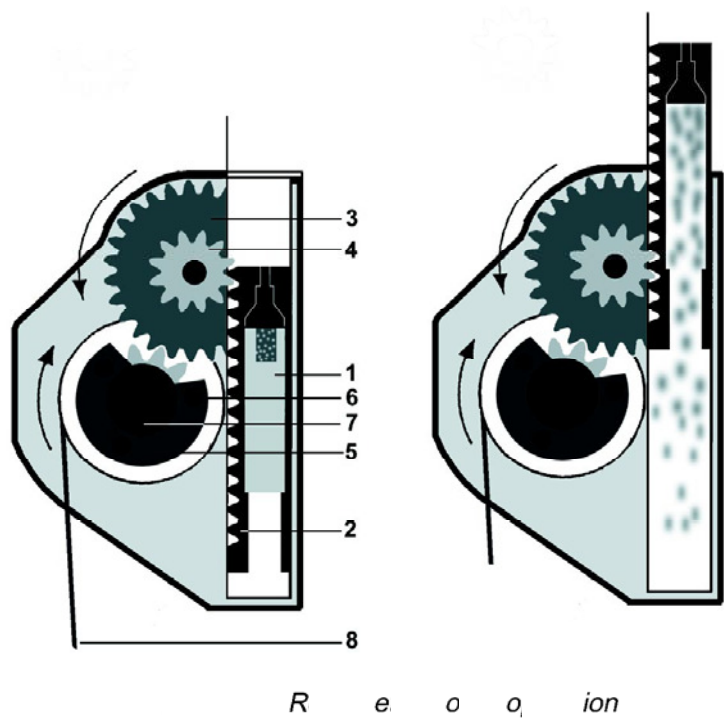
All passenger seat belt are fitted with automatic locking retractors (ALR). This is a feature designed to assist in the fitting of child seats. When the seat belt is pulled to its full extension a click will be heard to indicate that ALR is active. The seat belt will now return on a ratchet mechanism to prevent any further extension of the seat belt. Using this mechanism, the child seat can be fitted securely and tightly. To release ALR, the seat belt must travel to its fully home position.

Rear pretensioners



Figure 137: Rear pretensioner

The safety of rear occupants of a Rover 75 is enhanced by three inertia reel three point seat belts, each with electronically operated pyrotechnic reel retractors (see Figure 137). Located in the parcel shelf, the reel contains a nitro-cellulose charge which produces Nitrogen and CO². Activated by the DCU, the gases produced by the charge act upon a piston which operates a rack and pinion mechanism fitted with a roller clutch. They are capable of pretensioning the reel to a distance of up to 180mm (see Figure 138).



Supplementary restraining system deployment conditions

The following table outlines the type of response from the Rover 75 SRS system for a given type of impact:

SRS deployment conditions	
Type of impact	SRS response
Frontal Impact	Deployment of driver's airbag Deployment of passenger airbag Deployment of front and rear pretensioners
Side Impact	Deployment of Thorax airbag and ITS
Rear Impact	Deployment of front and rear pretensioners
Angled impact	If forces from the angled impact generate front and side impact forces over their thresholds, the DCU will deploy the relevant units. It is possible that an angled impact will cause the simultaneous deployment of the driver's airbag, passenger airbag, Thorax airbag, ITS and all pretensioners
Roll over	No part of the SRS system is designed to detect a roll over event. However, it is possible that the forces that the vehicle is subjected to during a roll over event will exceed frontal, side and rear impact thresholds and the system will react by deploying the relevant SRS units

Safety precautions

When working on any part of the SRS system and any of its associated components the following safety precautions must be adhered to:

- Remove the ignition key from the ignition switch and observe the system safe time of 10 minutes before commencing work on the vehicle. This allows the energy reserve capacitors in the DCU to discharge fully and prevents accidental deployment of airbags due to mishandling
- Always disconnect the negative terminal at the battery first, followed by the positive terminal
- Never substitute components from other vehicles
- Never cut/splice or try to repair the airbag harness
- Never try to dismantle or incinerate individual SRS components
- When an airbag module is removed from a vehicle it must be stored temporarily in the boot of the vehicle with its trim cover facing upwards, or within an approved storage container. Ensure the boot/container is secured
- When carrying airbag modules, always point the trim cover towards the body with the metal base away from the body. Never wrap your arms around the module
- Always ensure that airbag modules are kept dry and cool
- Never use multimeters or other general test equipment on SRS components or connectors
- Always disconnect the battery before carrying out any electric welding on the vehicle
- An airbag fault should only be diagnosed using TestBook
- Always use new fixings on replacement of an SRS component
- Ensure the electrical safety components are installed correctly. There must be no gap between the electrical safety component and the bracket to which it is mounted. Ensure that the fixings are torque controlled
- If you suspect any component has been damaged or dropped, do not use it. Install a new component
- If an airbag module has deployed, be aware that it will be hot for up to 30 minutes
- Always follow the correct procedure for fitting and working with a rotary coupler
- In the event of an impact severe enough to deploy the restraints components, the whole of the electrical safety system must be replaced (including the harness)

Anti-lock braking system and traction control

Braking and slip

Before we discuss the braking and traction control systems fitted to the Rover 75 a brief reminder of some braking principles:

In principle, braking is the conversion of kinetic energy into heat energy. This is usually carried out by the rubbing of a pad or a shoe against a disc or a drum fixed to the wheels of the vehicle. Optimum braking efficiency and, therefore, the shortest possible stopping distances for a vehicle are achieved if the pressure applied to the brakes keep the wheels of the vehicle on the verge of skidding, but without actually allowing the wheels to skid.

In normal circumstances, slip occurs when the application of the brakes causes the rotational speed of the wheels to be less than that to the actual speed of the vehicle. Slip is expressed as a coefficient of the wheel speed to the vehicle speed, and is expressed as a percentage. 100% slip equates to a non rotating wheel on a vehicle which is moving, (i.e. a locked wheel). 0% slip is equal to a wheel rotating at a speed equivalent to the actual speed of the vehicle. As the graph illustrates, to obtain optimum braking efficiency (i.e. maximum vehicle retardation) the coefficient of slip should be maintained between 10–30%. Anti-lock braking systems help to keep the slip coefficient within this range, and therefore, assists in keeping the vehicle braking at optimum performance levels (see Figure 139).

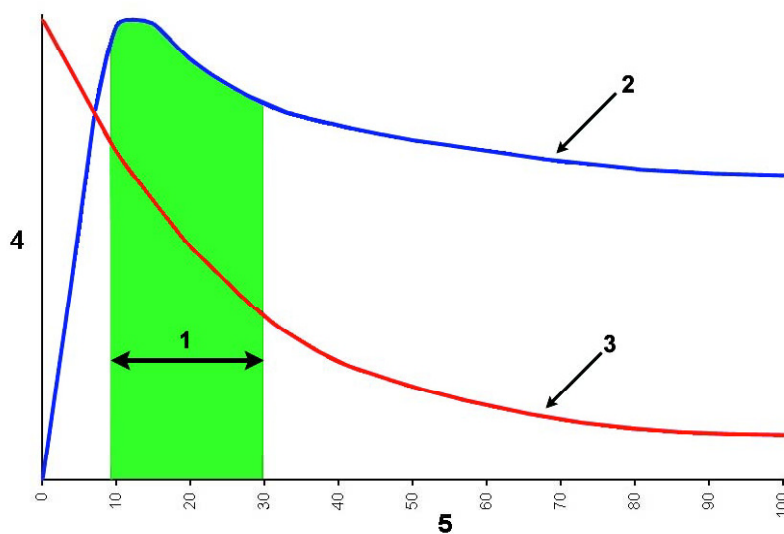


Fig 1 g y

1. Optimum braking performance
2. Longitudinal adhesion
3. Lateral adhesion
4. Adhesion
5. % of wheel slip

Anti-lock braking systems

Anti-lock braking systems (ABS) are designed to improve the performance of braking systems in emergency braking situations and on slippery surfaces by preventing of wheel locking. Most motor vehicle anti-lock braking systems prevent wheels from locking by monitoring the relative speeds of each wheel and adjusting the hydraulic pressure applied when braking. If the wheels are allowed to lock, the coefficient of friction between the vehicle and the road surface, through the tyres, is reduced. In addition, when wheel lock occurs, control of the vehicle direction via the steering system is virtually impossible. Directional control can be restored only by unlocking the wheels. Cadence braking techniques can be used in such circumstances. Anti-lock braking systems automatically modulate the hydraulic pressure applied to each wheel, preventing wheel lock and generating optimum braking performance. In such circumstances, the driver maintains full control of the vehicle both in terms of the vehicle retardation and directional control.

Rover 75 braking system

All Rover 75 derivatives are fitted with a diagonally-split, servo-assisted braking system and Rover 75 use single piston sliding calipers on the front and rear. Front brake discs are reverse vented and are 284mm in diameter and 22mm thick (see Figure 140). The rear brake discs are solid and are 280mm in diameter and 10mm thick. The rear discs also incorporate drum units for the parking brake mechanism.



Fig 1 nt c € c

Bosch 5.7 anti-lock braking system

ABS is fitted as standard on all Rover 75 derivatives. The system used is the Bosch 5.7 ABS. The main components incorporated within this system over and above the conventional braking system components are:

- Electronic control unit
- Wheel speed sensors (4 off)
- Hydraulic modulator
- Harness
- Four wheel bearings (4 off: housing magnetic poles)
- ABS warning lamp

Electronic control unit

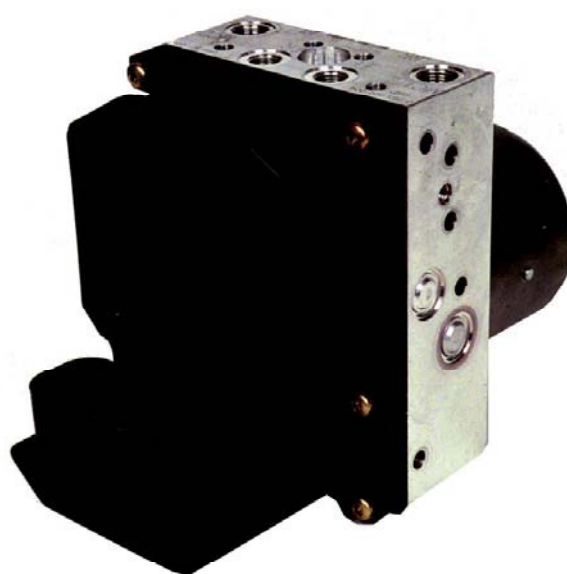


Fig. 141. Electronic Control Unit (ECU)

The ABS system is controlled electronically by the ABS ECU (see Figure 141). This unit is attached directly to the hydraulic modulator, which is located beneath the battery. The rotational speed of each wheel is monitored continuously by a Hall effect sensor. The sensors transmit frequency-dependent signals to the ECU. The ECU converts these signals into wheel speeds. In normal braking circumstances, all four wheels will decelerate at a similar rate. In circumstances where a wheel is about to lock, or is locked, it will decelerate more quickly than the other wheels. If the ABS ECU receives a wheel speed signal below the ECU expected reference speed, the ECU will take over control of the braking pressure applied to that particular wheel. The ECU does this to prevent wheel lock.

The ECU can maintain the current level of pressure supplied to the brakes, reduce the amount of pressure supplied to the brakes and restore the amount of pressure to pedal pressure. It does this through controlling the solenoid switched valves located within the hydraulic modulator. If the ECU has, via the modulator, lowered the pressure applied to a locking wheel, then the wheel will be able to rotate more freely (i.e. will not lock). Once the wheel speed returns to allowable limits, the ABS ECU informs the modulator to re-apply braking pressure to that wheel. All this occurs at very high speed and the rapid readjustment of braking pressure controls the coefficient of slip and provides optimum braking performance.

Hydraulic modulator

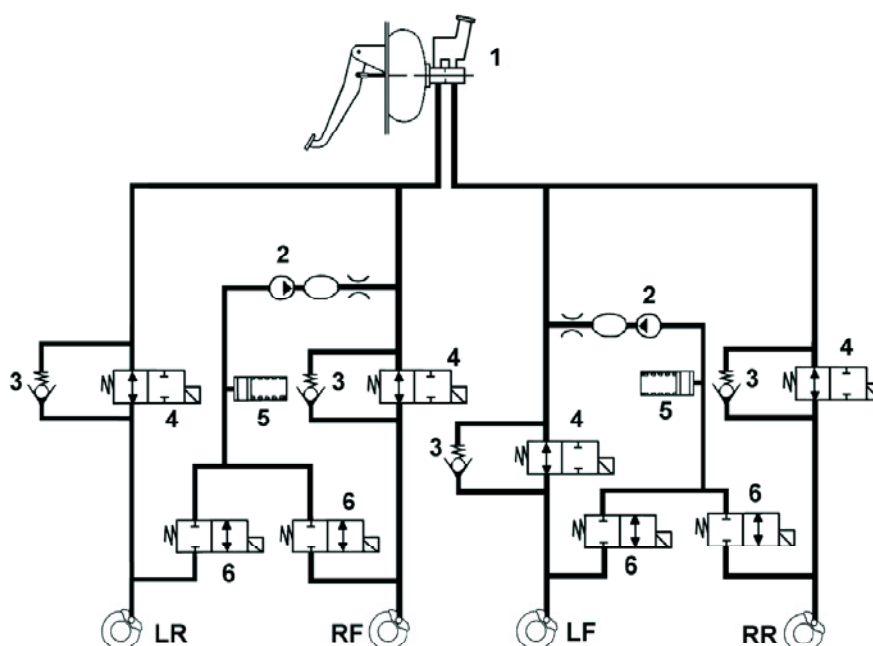


Figure 142

- 1.Master cylinder
- 2.Recirculation pump
- 3.Poppet valve
- 4.Inlet solenoid valve
- 5.Expansion/damper chamber
- 6.Outlet solenoid valve

The hydraulic modulator consists of a pump, damper chambers and 8 solenoid switched valves. There are four inlet valves and four outlet valves. Two solenoid valves are used to control the amount of braking pressure at each wheel. Under normal braking conditions, the inlet valve remains open and the outlet valve remains closed. The pressure applied at each brake is controlled by the amount of force applied to the brake pedal, via the master brake cylinder and the servo. In circumstances where ABS control has been initiated, the ABS ECU ultimately controls the amount of braking pressure applied to each wheel (see Figure 142).

In circumstances where the amount of brake pressure applied to a wheel needs to be maintained, the ECU closes the inlet valve. This prevents any further pressure being applied. The outlet valve remains closed. This effectively keeps the applied pressure constant. This phase is known as 'maintaining pressure' or pressure hold. If the amount of pressure applied to a wheel is deemed to be too high (i.e. the wheel is about to lock), the ECU will close the inlet valve and open the outlet valve. This will allow brake fluid to flow from the caliper into the dampers. Braking pressure is, therefore, lowered to a level governed by the ABS ECU. Dampers are incorporated to speed up the reaction of the system, allowing pressure to be released more rapidly. This is because the pump cannot start up quickly enough to reduce pressure. This phase is called 'pressure drop'. It is during this phase that the driver will experience feedback with brake pedal kickback. The kickback is an effect of the brake fluid being redirected rapidly through the modulator and pumped back to the master cylinder through the dampers. Although initially it may be a little disconcerting, feedback through brake pedal kickback is necessary to make the driver aware that conditions have led to ABS intervention.

The ABS ECU also controls **electronic brake-force distribution (EBD)** via the modulator. EBD modulates the brake pressure applied to the rear of the vehicle relative to that applied to the front, and takes the place of a conventional pressure conscious reducing valve. The amount of pressure applied to the rear brakes relative to the amount applied to the front brakes is critical to ensure vehicle stability is maintained when braking. The state of the vehicle, with regard to load and distribution of load, will affect the distribution of brake pressure. A vehicle fully loaded without EBD (and without ABS) will remain stable, with equal pressure applied to the front and rear axles. However, if equal pressure is applied to the front and rear axles of a lightly loaded vehicle the rear axle would be excessively braked and the vehicle could become unstable with possible rear wheel lock (on a vehicle without a pressure conscious reducing valve (PCR)). Using the modulator allows the braking force to be appropriately distributed to the front and rear axles under varying vehicle loading conditions. The ABS ECU adjusts the brake pressure using the solenoid valves within the modulator and compensates automatically for different vehicle load. The amount of brake pressure adjustment required to meet a given load is calculated by the ECU. The calculation is based on slip measurement it receives from the wheel speed sensors. EBD brake apportioning starts with a 1:1 ratio and is then adjusted by the ABS ECU based on the signals received from the wheel speed sensors. Unlike the anti-lock braking system, EBD is active under normal braking conditions. The ABS ECU will only adjust the rear brake pressure within a percentage of the pressure applied to the front. Whilst EBD is active, the driver may feel a slight brake pedal drop and the slight lowering of brake pressure. This is caused by the rapid switching of the solenoid valves in the modulator.

Wheel speed sensors



Figure 143

The wheel speed sensors fitted to the Rover 75 are active Hall effect type sensors (see Figure 143). These require a 12 volt supply to operate. The front sensors are mounted on the front hubs and the rear sensors are mounted on the inside face of the trailing arm. Both front and rear sensors are secured by single fixings. The sensors pick up varying magnetic pulses generated by the moving magnetic pole wheel located inside the wheel bearings. The pole wheel is made up of magnetic encoded elements impregnated in rubber. Each wheel contains 46 pole pairs. The Hall effect is named after the physicist Edward Herbert Hall who first discovered the effect. The Hall effect is the potential difference which appears across a current carrying conductor when a magnetic field acts at right angles to the current flow. Benefits of the new sensors include greater accuracy, and the use of a sealed bearing to house the pole wheels means greater stability of the signal over the life of the vehicle, less dirt ingress and greater protection from damage.

Each sensor contains a microchip. The chip is supplied with a voltage from the battery. The circuit inside the chip contains a semi-conductor through which a small current flows. Consequently, the sensors are termed 'active' sensors, as opposed to 'passive' sensors (inductive type sensors). The Hall effect sensor converts the physical value of rotational speed into an electrical signal of constant amplitude. It is the frequency which varies with the speed of the wheel. When the magnetic poles pass the sensor the chip switches 'ON' and 'OFF', generating a varying voltage at the ends of the semi-conductor. This voltage switches 'High' and 'Low' at a rate proportional to the speed of the wheel. This signal is relayed in the form of a 'square wave' to the ABS ECU. Low = off = 0.5 volts; High = on = 3 volts.

Traction control

Traction control serves to prevent the wheels of a vehicle from spinning and helps the driver to maintain vehicle control, grip and stability in cases where slip occurs due to acceleration forces (as opposed to deceleration forces that cause slip when braking). Rover 75 vehicles fitted with the KV6 and M47 engine will have traction control available as an option. The system configuration differs according to the precise application. The components that make up the respective systems are enhancements of the anti-lock braking system.

KV6 traction control

The additional components required for traction control on an Rover 75 equipped with a KV6 engine are:

- Four extra hydraulic valves
- TC warning lamp
- Can-Bus Link
- Additional throttle body
- Additional throttle cable
- Throttle cable actuator
- Electronic control unit
- Traction control off switch

The ABS ECU monitors and controls activation of traction control on KV6 Rover 75. Wheel spin is identified by the ABS ECU using the signals it receives from the wheel speed sensors. Wheel spin will correspond to a signal which shows the wheel speed to be higher than that of the overall vehicle speed (i.e. the opposite of the signal received when wheel lock occurs). When a wheel is beginning to spin and is outside of 'expected' values, based on the signals received from all four sensors, the ABS ECU will initiate one or all of the following actions to eliminate the wheel spin:

1. Application of the brakes
2. Reduction in the amount of air entering the engine via the secondary throttle unit
3. Request for a reduction in engine torque via the CAN-Bus system

The action initiated by the ABS ECU will depend upon the precise conditions and vehicle status. This information is relayed to the ABS ECU as a series of inputs and through communication with other ECUs on the CAN-Bus system.

If both drive wheels are about to spin and are outside the expected values, then the ABS ECU will first request a reduction in engine torque via the CAN link with the engine management system. If the wheel sensor signals remain outside the expected values, then the ABS ECU will signal the traction control ECU to reduce the air flow entering the engine via the secondary throttle body. This will result in a further reduction of engine torque. The ABS ECU will monitor the effects of these actions and make further adjustments until the wheel speeds return to expected values.

If one of the drive wheels begins to spin and is outside the expected value, the ABS ECU will apply the brake to this wheel. This wheel will then start to slow down, consequently reducing slip. Simultaneously, the extra engine torque will be transmitted to the opposing drive wheel via the action of the differential.

M47 traction control

The additional components for traction control on an Rover 75's equipped with an M47 engine are:

- Four extra hydraulic valves
- Traction control warning lamp
- CAN-Bus link
- Traction control off switch

The traction control system fitted to Rover 75 derivatives equipped with the M47 engine will also reduce engine torque in certain conditions. However, it is unable to achieve this using a secondary throttle body as with petrol derivatives and an extra ECU (a traction control ECU to operate the secondary throttle) is not fitted. The ABS ECU is at the centre of traction control and when a wheel is beginning to spin it will initiate one of the following actions:

- Application of the brakes
- Request for a reduction in engine torque via the CAN-Bus system

Therefore, whenever a reduction in engine torque is required, it is initiated via the CAN-Bus link with the ECM. The reduction in engine torque is achieved by reducing the quantity of fuel supplied to the engine. Traction control can also apply the brakes to the spinning wheel, as described above. How the ABS ECU decides to counter wheel spin varies and is dependent upon prevailing conditions.

Traction control on both the KV6 and the M47 can be disabled by operating the disable switch located on the centre of the dashboard next to the cruise control switch (see Figure 144). If selected, the disablement will last for the duration of the current ignition cycle. On restarting the vehicle, the traction control will be restored.



Fi 4 c ch

ne drag control

If a vehicle is on a very low μ (μ) surface, or aquaplaning, and the throttle is released, the engine torque alone can drag down the wheels into lock. This is without the application of the brakes. In these cases, the speed of the vehicle wheels can be increased back to the vehicle speed by increasing the engine speed with use of the engine idle speed controller. (The clutch must be engaged). This engine drag control function is available on all Rover 75 vehicles fitted with traction control.

Warning/operating lamps

The warning lamps for the braking and traction control systems are described below:

Traction control

When traction control is switched off via the traction control disable switch, a warning lamp is illuminated in the instrument pack :



Figure 145 Traction control warning lamp

Traction Control: The traction control lamp is situated in the instrument pack (see Figure 145). The lamp is yellow and will illuminate for approximately four seconds to check that the bulb is functioning whenever the ignition switch is turned to position 2. If the traction control system develops a fault, the lamp will remain illuminated whilst the ignition is on. The system will need to be interrogated using TestBook and the fault diagnosed and rectified. During operation of traction control, the lamp will illuminate for a minimum of two seconds, even in cases where the system operates for a shorter period.

Braking system



Figure 146 ABS warning lamp

The ABS warning lamp is situated in the instrument pack (see Figure 146). The lamp is amber and will illuminate for approximately four seconds to check that the bulb is functioning whenever the ignition switch is turned to position 2. If the warning lamp remains on continuously, or illuminates during the ignition cycle, a fault has been detected within the system. The system will need to be interrogated using TestBook and the cause of the fault diagnosed and rectified.

An intermittent fault will illuminate the ABS warning lamp when it occurs and it will remain illuminated for the duration of that ignition cycle. If the fault is absent when the ignition is next switched on, the warning lamp will extinguish after the start up bulb check. However, if the fault which has been remedied was a fault with either the sensor or the pump, the ABS warning lamp will remain illuminated until the vehicle reaches 12 km/h. The cause of the fault will be stored in the ABS ECU memory. If this fault does not re-occur over the next twenty ignition cycles, the fault will be erased from the memory.

Electronic brake distribution



Figure 1 EBD lamp

EBD shares its warning lamp with the parking brake/low brake fluid warning lamp. The lamp is red in colour and located within the instrument pack (see Figure 147). It will illuminate if there is a fault within the EBD system. It will also illuminate whilst the handbrake is on or if the brake fluid level is low. Legislation states that it is not permissible to drive with this red warning lamp illuminated.

The brake fluid reservoir incorporates a reed switch located near the bottom - held closed circuit by a magnetic float. When the brake fluid level drops below a set level, the magnetic float no longer holds the reed switch closed and the circuit continuity is broken. The reed switch is hard wired to the instrument pack in series with the EBD output from the ABS ECU. The warning lamp is 'active' - held high at IPK and held off by ABS ECU outputs - and will, therefore, illuminate if the circuit is broken. The parking brake switch is also connected to the warning lamp in the instrument pack via a parallel arrangement.

Brake pad wear warning lamp



Figure 2 Brake pad wear lamp

When the brake pads have worn down to a level where they require changing, a warning lamp will illuminate in the IPK. It is amber in colour (see Figure 148).

Glossary

The following, explains the abbreviations used within this brochure:

ABS	Anti-lock braking
ADAMS	Automated dynamic analysis of mechanical systems
ALR	Automatic locking retractors
AM	Amplitude modulation
ARB	Anti roll bar
ATC	Automatic temperature control
ATCU	Automatic transmission control unit
AUTO	Automatic
AUX.	Auxiliary
BBUS	Battery backed-up sounder
CAN	Controller area network
CCI	Cellular communications interface
CD	Compact disc
CDL	Central door locking
CDT	Common rail diesel turbo
CHMSL	Centrally high mounted stop lamp
CRC	Cyclic redundancy check
DB	Data byte
DCU	Diagnostic and control unit
DDE	Digital diesel electronic
DS2-Bus	Diagnostic bus
EBD	Electronic brake-force distribution
ECD3	European commission directive stage 3
ECM	Engine control module
ECON	Economy
ECU	Electronic control unit
EEPROM	Electrical erasable programmable read only memory
EGR	Exhaust gas recirculation
EKA	Emergency key access code
EMS	Engine management system
EOBD	European on-board diagnostics
EP	Emergency programme
EWS-3	Elektronische Wegfahrsperre
FBH	Fuel burning heater
FET	Field effect transistors
FM	Frequency modulation
GM6	Ground module
GPS	Global positioning system
HEVAC	Heating, ventilation and air-conditioning
HRW	Heated rear window
IPK	Instrument pack
ITS	Inflatable tubular structure
K-Bus	Karosserie-Bus (body)
KL	Klemme
KV6	K series engine 'V' configuration 6 cylinder
LCD	Liquid crystal display
LED	Light emitting diode

LFM	Last function mode
LH	Left hand
LHD	Left hand drive
LHS	Left hand side
LSM	Light switch module
LU	Lock-up
MEMS	Modular engine management system
MFL	Multi-function logic
MIL	Malfunction indication lamp
MOSFET	Metal-oxide semiconductor field effect transistor
MW	Medium wave
NAS	North American Specification
NiMH	Nickel metal hydride
NTC	Negative temperature coefficient
NVH	Noise, vibration and harshness
OBD	On-board diagnostics
PAS	Power assisted steering
PCRV	Pressure conscious reducing valve
PDI	Pre delivery inspection
LP	Line pressure
PPS	Precision positioning system
PRNDL	Park reverse neutral drive low
PSP	Pyrotechnic seatbelt pretensioner
PTFE	Polytetrafluorethylene
PWM	Pulse width modulation
RAM	Random access memory
RDS	Radio data system
RF	Radio frequency
RGB	Red green blue
RH	Right hand
RHD	Right hand drive
RHS	Right hand side
ROM	Read only memory
SD	Solihull development
SIA	Service interval announcement
SIM	Subscriber identity module
SPS	Single point entry
SPS	Selective positioning system
SRS	Supplementary restraint system
TC	Traction control
TDC	Top dead centre
TEL.	Telephone
TL	Trim level
TMAPS	Temperature manifold absolute pressure sensor
TV	Television
UK	United Kingdom
USA	United States of America
VIN	Vehicle identification number
VIS	Variable induction system
VVC	Variable valve control
WIN-Bus	Window bus