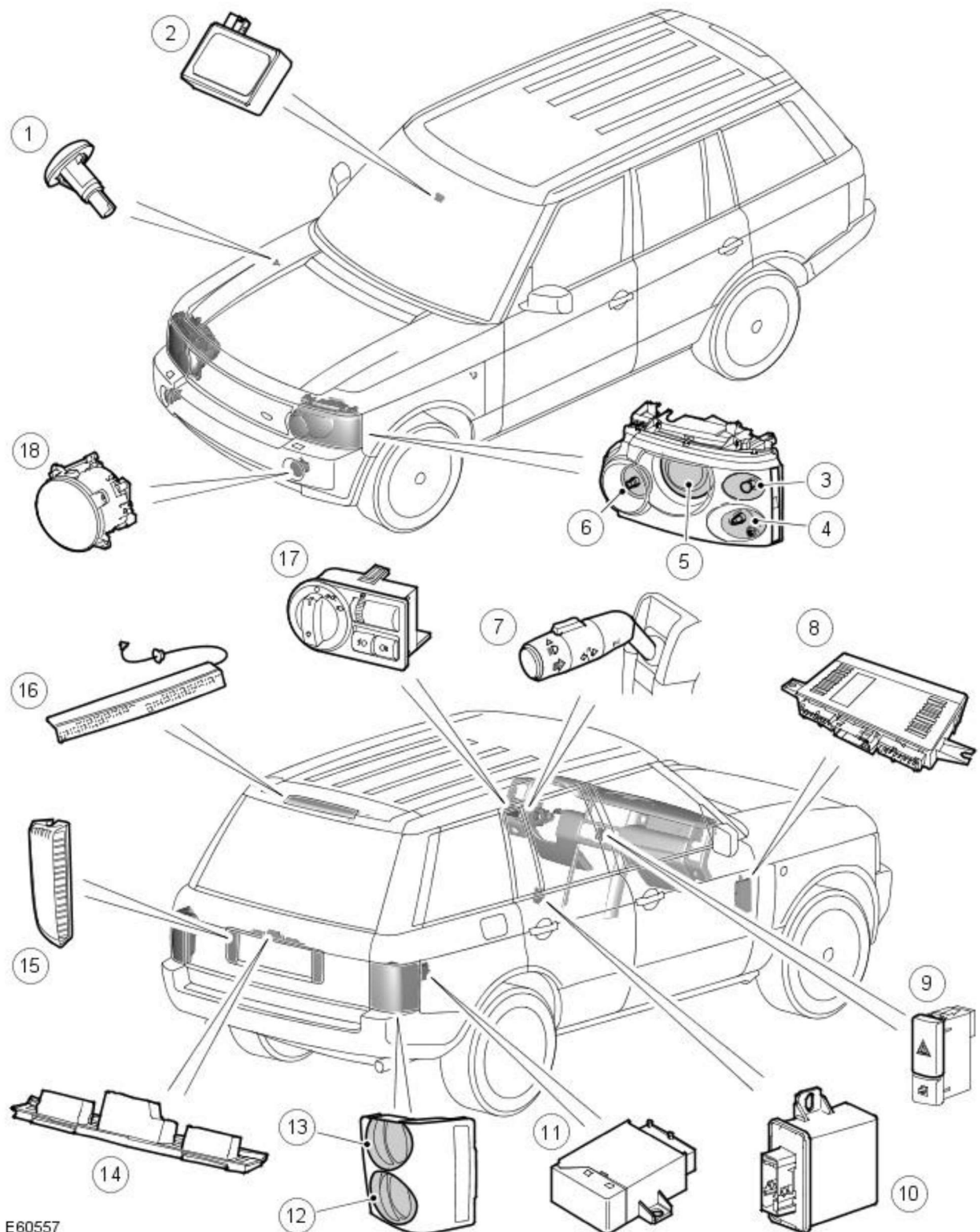


Exterior Lighting - Exterior Lighting

Description and Operation

Exterior Lighting Component Location



Item	Part Number	Description
1	-	Turn signal indicator side repeater
2	-	Rain/light sensor
3	-	Front turn signal indicator lamp
4	-	Side lamp and static bending lamp (if fitted)
5	-	High/low beam headlamp
6	-	High beam (fill in) lamp
7	-	Left hand steering column multifunction switch
8	-	Light Check Module (LCM)
9	-	Hazard warning lamp switch
10	-	Adaptive Front lighting System (AFS) control module
11	-	Trailer module (if fitted)
12	-	Tail lamp and tail and rear fog lamp
13	-	Stop lamp and turn signal indicator lamp
14	-	License plate lamps
15	-	Reversing lamps
16	-	High mounted stop lamp
17	-	Lighting control switch
18	-	Front fog lamp

OVERVIEW

The exterior lighting is controlled by the Light Check Module (LCM). The LCM controls the following vehicle functions:

- Control and monitoring of exterior lamps including turn signal indicators and hazard warning functionality

- Illumination dimmer control of instrument cluster and all interior switch illumination

- Communication and control and monitoring of trailer lighting via the trailer module

- Monitoring and evaluation of check control inputs from other system control modules and output of applicable messages in the instrument cluster message center.

The LCM is connected to the I Bus and communicates with other vehicle systems via the instrument cluster. The LCM contains a microprocessor which performs the control, monitoring and evaluation functions.

A combined rain/light sensor is fitted which controls the automatic wiper operation and the automatic lighting function.

The exterior lighting system comprises the following exterior lamps:

- Front and rear side lamps

- License plate lamps

- Side marker lamps (if fitted)

- Front and rear turn signal indicator lamps

- Turn signal indicators side repeater lamps

- Stop lamps and high mounted stop lamp

- Reversing lamps

- Rear fog lamps

- Front fog lamps

Static bending lamps (if fitted - All except NAS)

Low and high beam headlamps

Adaptive Front lighting System (AFS) (if fitted).

Exterior Lamp Bulbs

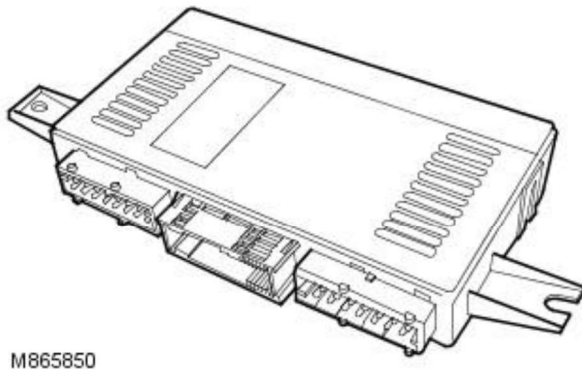
The following table shows the bulbs used for the exterior lighting system and their type and specification.

Exterior Lamps Bulb Type/Rating Table

Bulb	Type	Rating
Halogen headlamps - Low beam only	Halogen H7 Long Life (LL)	55W
Bi-Xenon headlamps - Low/High beam	Xenon D1S	35W
Headlamps - High beam 'fill-in'	Halogen H7 LL	55W
Static bending lamp (if fitted - all except NAS)	Halogen H8	35W
Front fog lamps	Halogen H11	55W
Rear fog lamps (all except NAS)	Bayonet P21	21W
Rear fog lamps (NAS only)	Bayonet PR21	21W
Turn signal indicators - Front (all except NAS)	Bayonet PY21	21W
Turn signal indicators - Front (NAS only)	Wedge S8W 3457K	27W
Turn signal indicators - Side repeaters	Wedge WY5W	5W
Turn signal indicators - Rear (3.0 Td6 and 4.4L V8 models only)	Bayonet PY21	21W
Turn signal indicators - Rear (4.2L V8 supercharged models only)	Bayonet PW21 Osram Diadem	21W
Stop lamps	19 LED's	-
Tail lamps	Bayonet Twin filament P21/5W	21/5W
High mounted stop lamp	20 LED's	-
License plate lamps	Capless C11	5W
Reversing lamps	Bayonet H6W	6W
NAS - Side marker lamp (front/rear)	Capless W5W LL	5W

The bulbs, with the exception of the LED's, are driven by Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) within the LCM. The LCM provides a Pulse Width Modulation (PWM) output to the front parking lamp and the tail lamp bulbs to extend the bulb life. The PWM output is rapidly switched on and off to provide bulb emulation when a bulb fails.

LIGHT CHECK MODULE (LCM)



The LCM is located on the RH 'A' pillar, behind the trim panel. The LCM is connected to the vehicle wiring harness with three multiplugs.

The LCM receives two permanent battery power supplies via the Central Junction Box (CJB) and power feeds from the ignition switch positions I (AUX) and II (IGN).

The lighting circuits are not protected by conventional fuses. The control circuitry within the LCM for each individual circuit can detect and isolate a problem circuit.

A monitoring system within the LCM can determine a bulb failure and indicate this to the driver via the instrument cluster message center.

Input Signals for Lamp Control

The LCM receives inputs from the following switches:

Lighting control switch for side lamps and headlamps

Momentary push switches for front and rear fog lamps

Left hand steering column multifunction switch for turn signal indicators and high beam/headlamp flash

Stop switch

Momentary push switch for hazard warning.

The switches are supplied with a 10mA supply from the LCM and switch to ground when operated. The LCM detects that a switch has been operated (ON) when its closing resistance is less than 100 Ohm and is detected as OFF when its resistance is more than 10K Ohm.

The LCM also receives ignition switch status via hardwired connections and also on the I and K Bus via the instrument cluster.

A reverse gear engaged signal is also received on the I and K bus systems to enable the LCM to activate the reverse lamps. The trailer module also outputs a signal to inform the LCM that a trailer is or is not connected. If a trailer is connected, the LCM transfers control of the trailer reverse lamps and the rear fog lamp to the trailer module.

Via the bus systems the LCM receives a hazard warning lamp activation message from the restraints control module, via the generic electronic module (GEM), in the event of a crash or from the GEM if the alarm system is triggered.

Circuit Protection

Operation of the lamps is performed using overload proof Metal Oxide Semiconductor Field Effect Transistors (MOSFETs). The MOSFETs have a diagnostic output for bulb monitoring and can detect overload, load interruption with the lamps switched on and short circuit to positive with the lamps switched off.

The MOSFETs are protected against short circuits, removing the requirement for the lamps circuits to be protected by fuses. The MOSFETs respond to heat generated by increased current flow caused by a short circuit. Normally this would cause the fuse to blow. The MOSFETs react to the heat increase and cut the supply to the affected circuit. Once the fault has been rectified or the MOSFET has cooled, the MOSFET will automatically reset and operate the circuit normally.

If an overload occurs, the current flow is dependant on the temperature of the related MOSFET and can be up to 20 times the rated current of the lamp. The MOSFET heats up and deactivates the load applied to the circuit. When the MOSFET cools the circuit is once again reactivated. This thermal cycling occurs continuously in the event of an overload occurring.

The brake switch is also monitored by the LCM. If the LCM detects a short circuit to ground in the switch circuit it activates messages to the driver in the message center. These messages will display brake switch defective and LH and RH stop lamp defective. The brake switch is also monitored when the ignition is in position II. The LCM checks the acceleration speed of the vehicle (via bus messages). If the vehicle is accelerating and the brake switch is still active after 10 seconds, the LCM starts a timer. If, after 2 minutes, the brake switch is still active and the vehicle is moving, the LCM activates defective switch messages in the instrument cluster message center.

Bulb Monitoring

Bulb failure monitoring is performed by the LCM processor. The lamps are cold and warm monitored by the MOSFETs in order to detect bulb failure.

The LCM processor provides outputs to each MOSFET. The output switches the MOSFET to supply the required output to power the lamp circuit. The microprocessor evaluates the lamp circuits by detecting the returned signals from the controlling MOSFET.

When the bulb is functioning normally, the output signal voltage from the controlling MOSFET is 0V. If a bulb in the circuit fails, an open circuit occurs and the MOSFET outputs a signal of 5V to the processor. The signal is interpreted as a bulb failure and generates a message which is output on the I Bus to the instrument cluster. The instrument cluster displays the applicable bulb failure message in the message center to provide visual warning to the driver.

Warm monitoring is performed continuously when the lamps are switched on by evaluating the diagnostic output of the MOSFET switches. Cold monitoring is performed at 32 second intervals when the lamps are switched off. The MOSFETs briefly switch on the lamps for approximately 1 millisecond (this is insufficient to illuminate the bulb) and checks the bulb as per warm monitoring.

Cold monitoring is not possible for the low/high beam headlamps of vehicles using xenon bulbs. On these vehicles the cold monitoring of the low/high beam headlamps is switched off in the LCM. The LCM detects a failed xenon bulb via a reduction in current flow to the affected headlamp's xenon control module.

When a xenon bulb fails, the control module's current consumption falls to 60mA, which the LCM detects as unsuccessful bulb illumination.

Alarm Indications

The LCM communicates on the I and K Buses with the GEM to display alarm visual indications for alarm arm, disarm and triggered conditions.
For additional information, refer to: Anti-Theft - Active (419-01A Anti-Theft - Active, Description and Operation).

If the hazard warning lamps are active when a lock or unlock request is made, the hazard warning cycle is interrupted to allow the visual indication of the requested lock cycle. When visual indication is completed, the hazard warning operation will continue.

If the vehicle is involved in crash of a severity for the restraints control module to initiate deployment of the airbags, the control module outputs a hazard warning lamps on request on the K bus to the instrument cluster and on the I bus from the instrument cluster to the LCM. The hazard warning lamps will be activated and will continue until the restraints control module outputs a message to deactivate the hazard warning lamps or until the hazard warning lamp switch is pressed.

Redundant Data Storage

The LCM stores data relating to the Vehicle Identification Number (VIN), total mileage and service interval indicator. This data is received by the LCM from the instrument cluster and used as a back-up in the event of instrument cluster replacement.

If the LCM is to be replaced, the Land Rover recommended diagnostic tool must be connected to the vehicle and the LCM replacement procedure followed to ensure that the stored data is transferred to the new unit.

Low Voltage Operation

If the battery voltage falls below 11.2V, the LCM operates the minimum lighting to preserve the remaining battery charge.

Crash Signal Activation

In the event of an accident of a severity to activate and deploy the airbags, the restraints control module requests various electrical operations to assist with the crash situation. The restraints control module requests via the bus systems to the LCM to activate the hazard warning lamps and flash the headlamp high beam at the same frequency.

Security System Activation

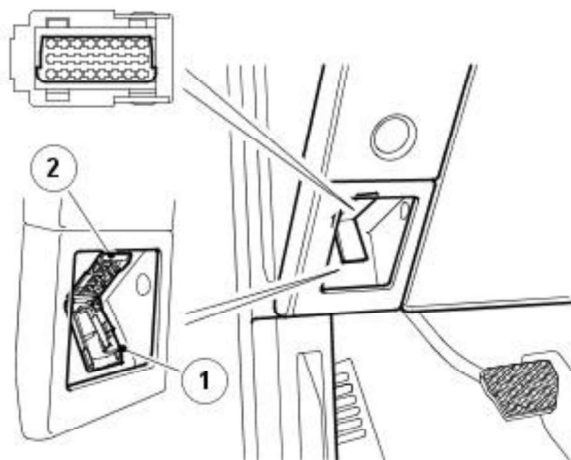
In the event of the security system being triggered, the GEM requests activation of the hazard warning lamps. In some markets the low beam and/or high beam headlamps can also be activated.

Instrument Panel and Switch Illumination Dimming

The LCM controls the instrument cluster backlighting illumination and also illumination of all instrument panel switches.

The LCM supplies a power output to all switch illumination bulbs at a voltage determined by the position of the manual dimmer rheostat. The switch illumination is activated when the lighting control switch is in the side lamp or headlamp position.

DIAGNOSTICS



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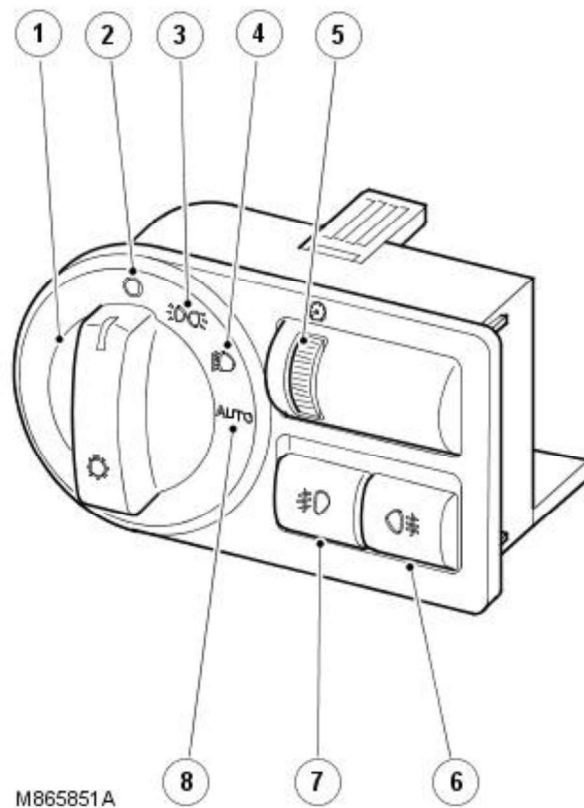
Item	Part Number	Description
1	-	Cover
2	-	Diagnostic socket

The diagnostic socket allows for the transfer of information between the LCM and the Land Rover recommended diagnostic tool. The diagnostic socket is located in the instrument panel, in the driver's stowage tray. The socket is secured in the instrument panel and protected by a hinged cover.

The LCM has diagnostic capabilities and stores fault codes relating to the lighting systems. The xenon control modules cannot be interrogated via the LCM, but the LCM incorporates xenon specific diagnosis up to the control modules.

The xenon control modules on 2006MY vehicles have no diagnostic functionality.

LIGHTING CONTROL SWITCH



Item	Part Number	Description
1	-	Lighting control rotary switch
2	-	Off position
3	-	Side lamps position
4	-	Headlamps position
5	-	Instrument illumination dimmer rheostat
6	-	Rear fog lamp switch
7	-	Front fog lamp switch
8	-	Auto position

The lighting control switch is located in the instrument panel between the steering column and the driver's door. The switch comprises a four position rotary switch for controlling side lamps and headlamps, a thumbwheel rheostat which manually controls the instrument panel and interior switch night illumination, and momentary push switches for front and rear fog lamps.

The rotary side and headlamp control switch has three connections to the LCM. One connection supplies a reference voltage to the switch contacts. The two remaining connections supply a combination of earth paths to the LCM for the side lamp, headlamp and 'AUTO' selection contacts.

The front and rear fog lamp switches operate in a similar way, completing earth paths to the LCM when the switch is pressed. The fog lamp switches are momentary, non-latching switches which briefly complete an earth path which is sensed by the LCM.

Lighting Control Switch Illumination

When the ignition is in position I or II, the switch legends on the lighting control switch are illuminated at maximum brightness when the lighting control switch is in the 'O' (off) position. When the lighting control switch is rotated to the side, headlamp or AUTO position the legend illumination is dimmed.

Lighting Control Switch/High Beam Functionality

The functionality of the high beam differs between halogen and bi-xenon headlamps. This is shown in the following table:

Lighting Control Switch and Multifunction Switch Position	Halogen High Beam (fill in) Lamp Only	Bi-xenon High Beam Headlamp
0 (Off)	OFF	OFF
0 (Off) + flash position	ON	OFF
Side lamps position	OFF	OFF
Side lamps position + flash position	ON	OFF
Headlamps or AUTO position	OFF	OFF
Headlamps or AUTO position + flash position	ON	OFF
Headlamps or AUTO position + high beam position	ON	ON
Daytime Running Lamps (DRL) Active	ON - Canada high beam at 5.5 to 6.0 Volts OFF Scandinavia low beam headlamps active	OFF

HEADLAMP ASSEMBLY

General

Three types of headlamp are available; Halogen, Bi-xenon or Adaptive Front lighting System (AFS). All headlamps share a common, clear lens.

The headlamps are located on the bonnet locking platform. Each headlamp is secured at the top to the bonnet locking platform with two screws and at the bottom to the front bumper support bracket with one screw. Headlamp removal is facilitated by removal of the radiator grille and removal of the three headlamp attachment screws.

Headlamp removal is required for replacement of any of the bulbs. The rear of the headlamp unit has removable access covers which allow access to the bulbs.

A large cover, which is rotated counter-clockwise to remove, allows access to the low/high beam bulb on both halogen and xenon headlamps.

A second cover, on the inboard side of the headlamp, can be removed to allow access to the high beam 'fill-in' lamp halogen bulb. The bulb is mounted in a holder with an extended end to aid removal.

A third cover, located on the outboard side of the headlamp, can be removed to give access to the side marker lamp bulb (NAS only), the side lamp bulb and the cornering/static bending lamp bulb (if fitted).

The turn signal indicator bulb is located on the outboard side of the headlamp. The bulb is a push fit into a holder which is secured in the headlamp body by rotating clockwise.

In all markets except NAS, the headlamps have two adjustment screws which allow for the manual setting of the vertical and horizontal beam alignment. A 6mm Allen key is used to rotate the adjusters to achieve the required setting. The inboard adjuster controls the vertical aiming and the outboard adjuster controls the horizontal aiming.

On NAS vehicles the headlamp is regarded as 'Visual Optically Left' (VOL) aiming. The adjustment screws have to be turned equal amounts to maintain the correlation in the vertical axis only. There is no horizontal adjustment. Refer to the Service Repair Procedures manual for headlamp alignment data and procedures.

Each headlamp has an integral sixteen pin connector which provides inputs and outputs for the various functions of the headlamp assembly. The usage of the pins differs between model variants. Refer to the Electrical Library and circuit diagrams for pin details.

Three breathers are located on the rear of the headlamp housing. The two lower breathers are fitted with 'C' shaped tubes and the upper breather has a 'T' shaped tube. The breather tubes which allow air flow in and out of the headlamp but prevent the ingress of moisture from rain, road spray or washing. If condensation occurs

within the headlamp, check that the breather tubes are not blocked with mud etc before further action is taken.

Headlamp Operation

The lamps contained within the headlamp assembly have differing functionality depending on the function selected.

The low beam headlamps are switched on when the ignition switch is in the ignition position (II) and:

the lighting control switch is the headlamp position

the lighting control switch is in the 'AUTO' position and a 'lights on' signal is received by the LCM from the rain/light sensor.

The low beam headlamps can also be operated by the headlamp delay feature.

The high beam headlamps are switched on when the ignition switch is in the ignition position (II) and:

the low beam headlamps are selected on in the headlamp position or the headlamps are activated by the AUTO feature and the left hand steering column multifunction switch is pushed forward, away from the driver

the headlamp flash function is operated by pulling the left hand steering column multifunction switch towards the driver.

Common Headlamp Features

Turn Signal Indicators

The turn signal indicator bulb is located in a holder at the rear of the headlamp assembly, above the outer removable cover. The holder secures the bulb and has contacts which connect with mating contacts integral with the headlamp housing. Rotating the holder in a counter-clockwise direction allows the holder and the bulb to be removed.

Two types of bulb are used for the turn signal indicator. In all markets except NAS, the bulb is a 21W with orange colored glass and a bayonet fitting. On NAS vehicles the bulb is a 27W with orange colored glass and a wedge fitting.

Side Lamps

The side lamp bulb is accessible by removing the outer cover from the rear of the headlamp. The 5W wedge side lamp bulb is located in a holder which is a push fit into the rear of the reflector of the side lamp and static bending lamp (if fitted).

Side Marker Lamps (NAS only)

The side marker lamp bulb is accessible by removing the outer cover from the rear of the headlamp. The 5W wedge side marker lamp bulb is located in a holder which is a push fit into a molded receptacle in the outer edge of the headlamp. The side marker lamp illuminates a small rectangular section between the orange side reflectors on the outside of the headlamp.

Tourist Lever

On all headlamp variants a tourist lever mechanism is located on the side of the projector module. This mechanism moves a flap to blank off a portion of the beam spread to enable the vehicle to be driven in opposite drive hand markets without applying blanking decals to the headlamp lens.

The position of the tourist lever varies between headlamp variants and drive hand markets. The following lists detail the lever location and positions for home and opposite drive hand markets.

Halogen Headlamps

UK LH side headlamp: tourist lever on the grille side

UK RH side headlamp: tourist lever on the grille side

ROW LH side headlamp: tourist lever on the grille side

ROW RH side headlamp: tourist lever on the grille side

For RH side lamps, the tourist function is operated by pushing up the lever. The delivery condition is with the tourist lever pushed down. For LH side lamps, the tourist function is operated by pushing the lever down. The delivery condition is with the tourist lever pushed up

Bi-Xenon / AFS Headlamps

UK LH side headlamp: tourist lever on the fender side

UK RH side headlamp: tourist lever on the grille side

ROW LH side headlamp: tourist lever on the grille side

ROW RH side headlamp: tourist lever on the fender side

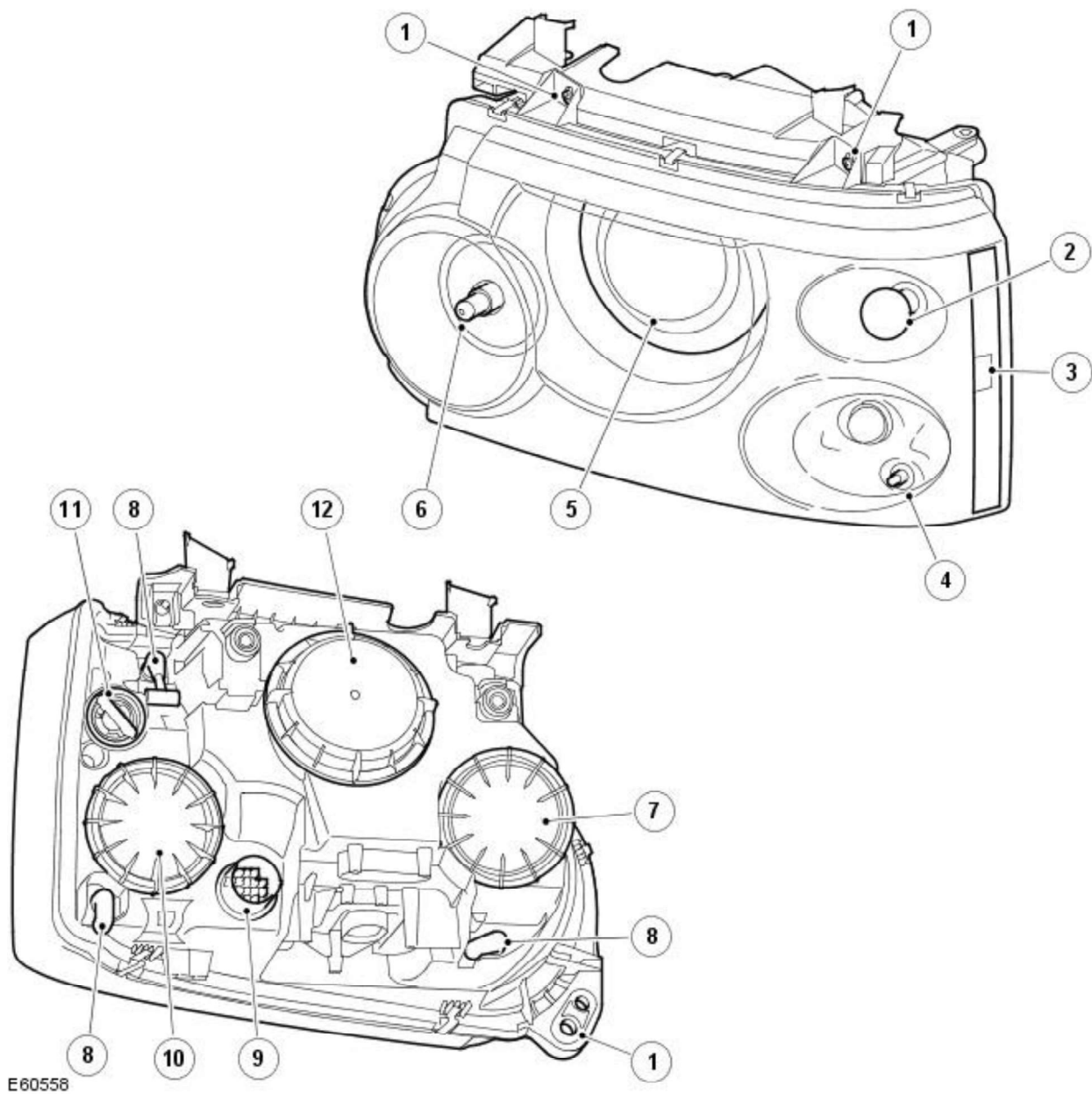
For all xenon and AFS headlamp variants the tourist function is operated by pushing the lever down. The delivery condition is with the tourist lever pushed up.

Static Headlamp Leveling - Halogen and Xenon Headlamps (not AFS)

Static vehicle headlamp leveling is performed by the air suspension system and the air suspension control module. The suspension system constantly monitors the vehicle attitude and adjusts the height of the front and/or rear of the vehicle accordingly. This maintains the correct vehicle attitude and consequently maintains the correct headlamp beam alignment.

The vehicle leveling system is fully automatic, therefore the lighting control switch does not have a manual leveling rotary control.

Halogen Headlamps

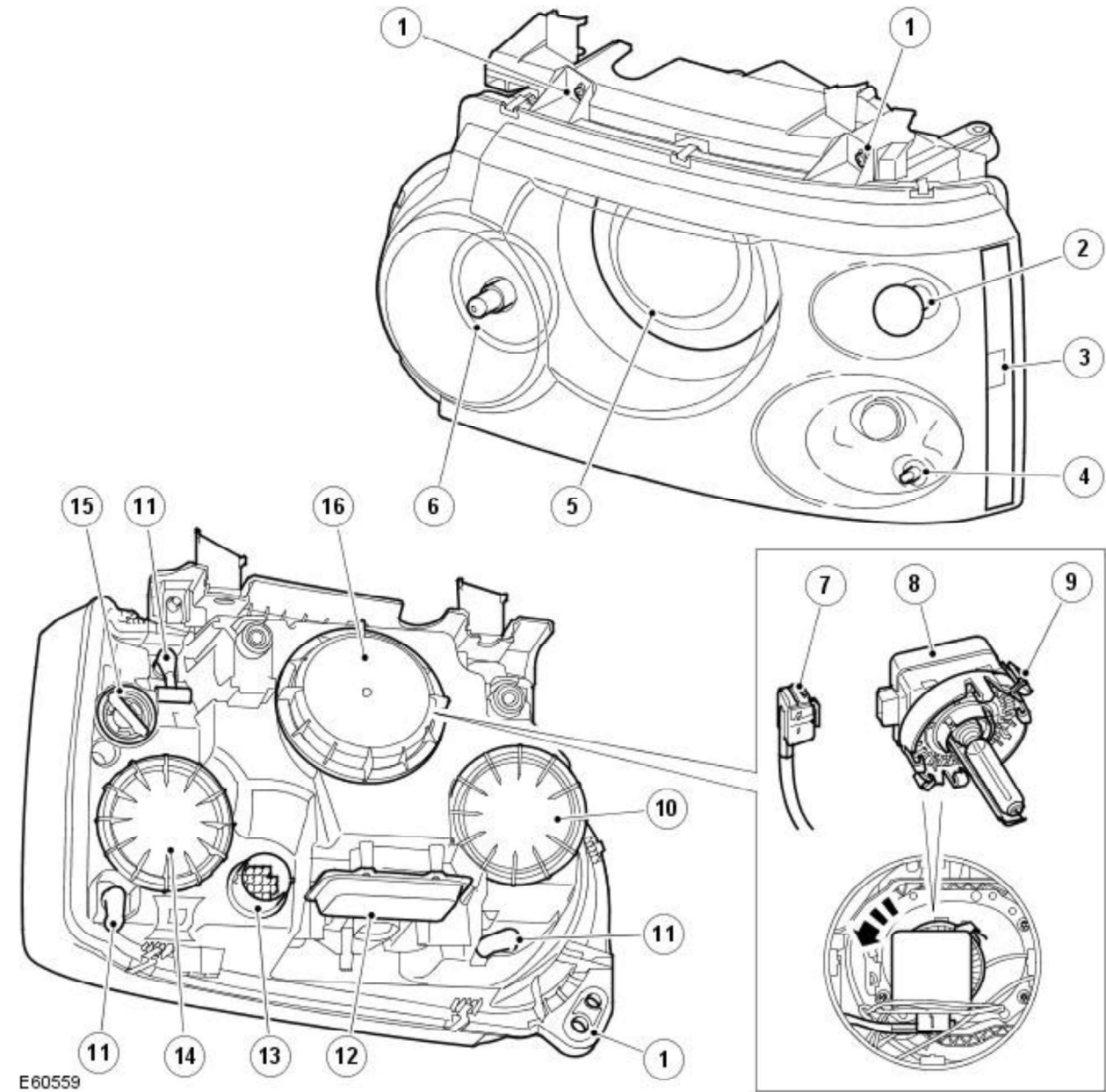


Item	Part Number	Description
1	-	Attachment screws (3 off)
2	-	Turn signal indicator lamp
3	-	Side marker lamp (NAS only)
4	-	Side lamp
5	-	Halogen projector module
6	-	High beam 'fill-in' lamp
7	-	Cover - high beam 'fill-in' lamp
8	-	Vent (3 off)
9	-	Electrical connector
10	-	Cover - Side lamp and side marker lamp (if fitted)
11	-	Bulb holder - turn signal indicator
12	-	Cover - Halogen bulb

The mono-halogen low beam only headlamp uses an H7 Long Life (LL) 55W halogen bulb. The lamp uses a projector lens, similar to the xenon headlamp. The projector module comprises an ellipsoidal lens and a reflector. The projector reflector collects the light produced by the halogen bulb and projects the light into a focal plane containing a shield. The contour of the shield is projected onto the road by the lens. The bulb is retained with conventional wire retaining clips.

A complex surface reflector is used for the halogen high beam 'fill-in' lamp. This type of reflector is divided into separate parabolic segments, with each segment having a different focal length. The high beam 'fill-in' lamp uses a H7LL 55W halogen bulb. The bulb is retained in an extended holder which allows easy access to the bulb. Once removed, the bulb can be removed from the holder by pulling it from its locating pegs.

Xenon Headlamps



Item	Part Number	Description
1	-	Attachment screws (3 off)
2	-	Turn signal indicator lamp

3	-	Side marker lamp (NAS only)
4	-	Side lamp
5	-	Bi-xenon projector module
6	-	High beam 'fill-in' lamp
7	-	Ignitor electrical connector
8	-	Ignitor unit and bulb
9	-	Mounting collar
10	-	Cover - high beam 'fill-in' lamp
11	-	Vent (3 off)
12	-	Xenon control module
13	-	Electrical connector
14	-	Cover - Side lamp and side marker lamp (if fitted)
15	-	Bulb holder - turn signal indicator
16	-	Cover - Halogen bulb

Safety Precautions



WARNING: The Xenon system generates up to 28000 volts and contact with this voltage could lead to fatality. Make sure that the headlamps are switched off before working on the system.

The following safety precautions must be followed when working on the xenon headlamp system:

DO NOT attempt any procedures on the xenon headlamps when the lights are switched on

Handling of the D1S xenon bulb must be performed using suitable protective equipment, e.g. gloves and goggles. The glass part of the bulb must not be touched

Xenon bulbs must be disposed of as hazardous waste

Only operate the lamp in a mounted condition in the reflector.

The xenon headlamps use a complex surface reflector for the halogen high beam 'fill-in' lamp. This type of lamp has the reflector divided into separate parabolic segments, with each segment having a different focal length. A halogen H7LL 55W bulb is retained in an extended holder. The holder is secured in the rear of the high beam 'fill-in' lamp lens by rotating clockwise.

The xenon headlamp is known as 'bi-xenon' because it operates as both a low and high beam unit. The xenon bulb is located in a projector module which comprises an ellipsoidal lens with a solenoid controlled shutter to change the beam output from low to high.

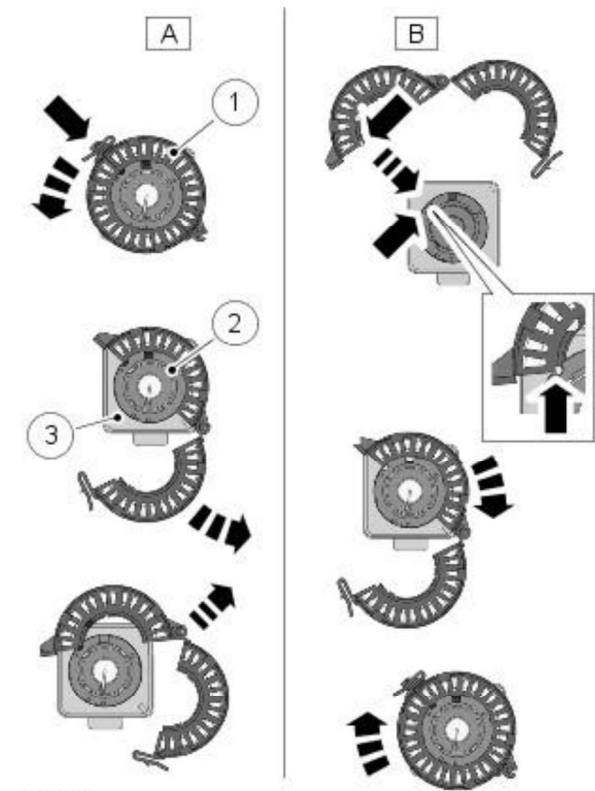
• **NOTE:** If the lighting control switch is in the 0 (off) position, the xenon lamps do not operate when the high beam 'flash' function is operated. If the lighting switch is in the headlamp position or the 'AUTO' position with the low beam headlamp active, the xenon low beam will remain on when the high beam 'flash' function is operated.

The xenon headlamp system is controlled by the LCM using a xenon control module and an igniter for each headlamp. The xenon control modules and the igniters provide the regulated power supply required to illuminate the xenon bulbs through their start-up phases of operation.

The xenon bulb is located in the rear of the projector module. The D1S xenon bulb incorporates an integral igniter unit and both components must be replaced if the bulb fails. A plastic mounting ring is fitted to the bulb and secures the bulb in the rear of the projector module. The mounting ring must be removed from the bulb and fitted to the replacement bulb.

The mounting ring locates in mating cut-outs in the xenon bulb. Refer to the illustration that follows for correct removal and replacement of the mounting ring.

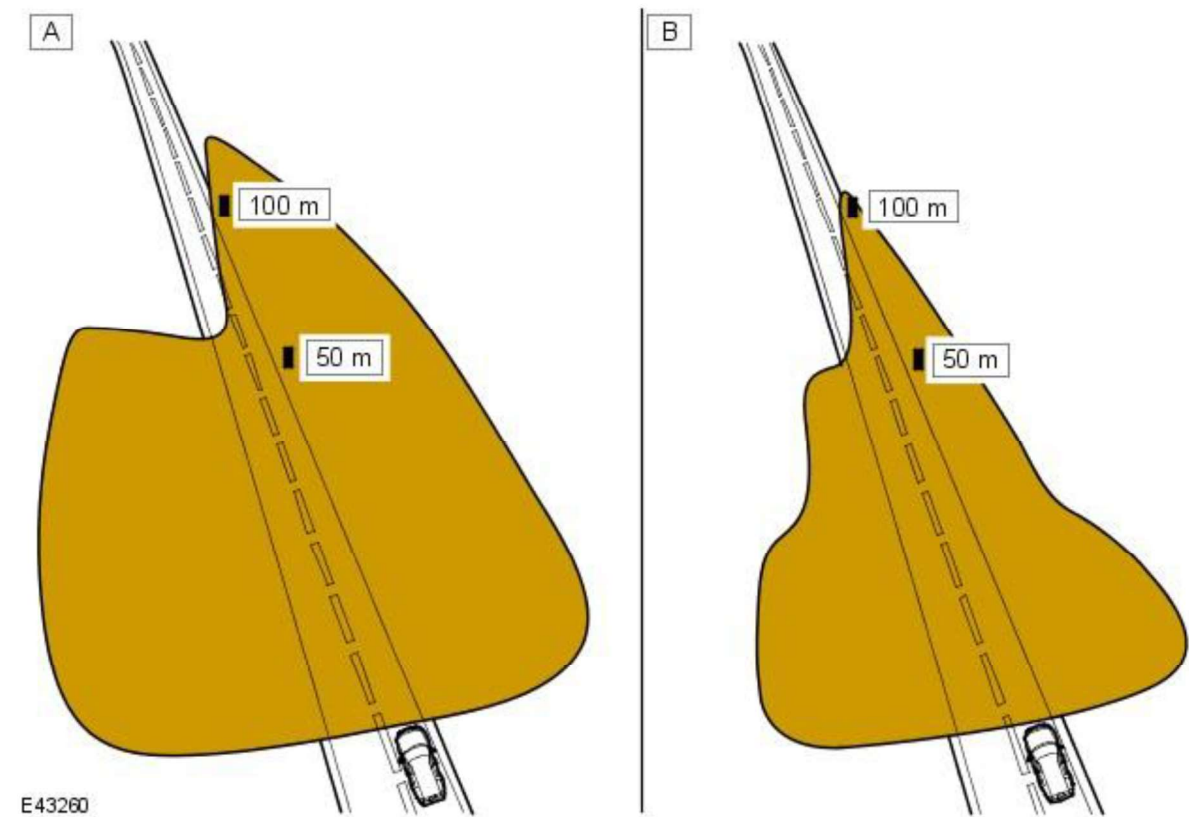
Xenon Bulb Mounting Ring Replacement



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Item	Part Number	Description
A	-	Locking ring removal
B	-	Locking replacement
1	-	Mounting ring
2	-	Xenon bulb
3	-	Igniter

Xenon/Halogen Headlamp Beam Comparison



Item	Part Number	Description
A	-	Bi-Xenon
B	-	Halogen

The xenon low/high beam headlamps use ellipsoidal technology for the lens and reflector providing improved night time visibility compared to conventional halogen headlamps. The xenon headlamps provide the following benefits when compared to halogen headlamps:

- Longer bulb life - Approximately 3 to 5 times longer than a halogen bulb
- Increased light output - xenon headlamps output 3 to 4 times more light on the road surface than halogen headlamps
- Blue/White light which is closer to natural daylight - compared to a yellow light produced by a halogen bulb
- Improved night time driving visibility - xenon lamps produce a wider and brighter beam in front of the vehicle than conventional halogen bulbs
- Lower running temperatures
- Lower power consumption.

The xenon headlamp is a self contained unit located within the headlamp assembly. The unit comprises a reflector, an adaptor ring, the lens, a shutter controller and the xenon bulb, which as an assembly is known as the projector module.

The reflector is curved and provides the mounting for the xenon bulb. The bulb locates in a keyway to ensure correct alignment in the reflector and is secured by a plastic mounting ring. The bulb is an integral part of the igniter and is electrically connected by a connector located in the igniter unit.

The shutter controller is a solenoid which operates the shutter mechanism via a lever. The shutter is used to change the beam projection from low beam to high beam and visa versa.

The xenon bulbs illuminate when an arc of electrical current is established between two electrodes within the bulb. The xenon gas sealed in the bulb reacts to the electrical excitation and the heat generated by the current flow to produce the characteristic blue/white light.

To operate at full efficiency, the xenon bulb goes through three stages of operation before full output for continuous operation is achieved. The three phases are; start-up phase, warm-up phase and continuous phase.

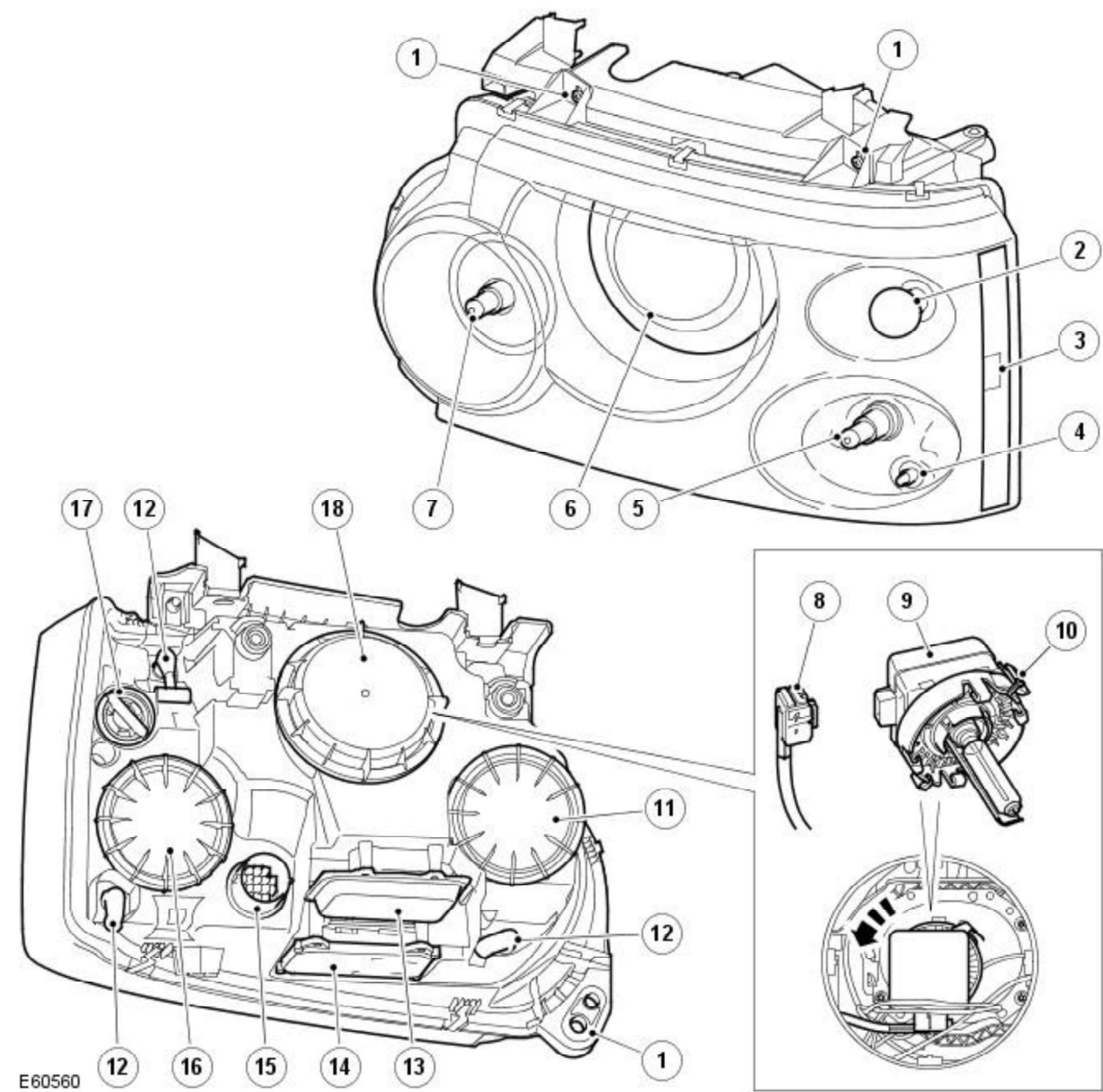
In the start-up phase, the bulb requires an initial high voltage starting pulse of up to 30000 volts to establish the arc. This is produced by the igniter. The warm-up phase begins once the arc is established. The xenon control module regulates the supply to the bulb to 2.6A which gives a lamp output of 75W. During this phase, the xenon gas begins to illuminate brightly and the environment within the bulb stabilizes ensuring a continual current flow between the electrodes. When the warm-up phase is complete, the xenon control module changes to continuous phase. The supply voltage to the bulb is reduced and the operating power required for continual operation is reduced to 35W. The process from start-up to continuous phase is completed in a very short time.

The xenon system is controlled by the LCM, the two xenon control modules and the two igniters. The xenon control modules (one per headlamp) receive an operating voltage from the LCM when the headlamps are switched on. The modules regulate the power supply required through the phases of start-up.

The igniters (one per headlamp) generate the initial high voltage required to establish the arc. The igniters have integral coils which generate high voltage pulses required for start-up. Once the xenon bulbs are operating, the igniters provide a closed circuit for regulated power supply from the control modules.

Adaptive Front Lighting System (AFS) Headlamps

The AFS headlamp is similar in its construction to the xenon headlamp described previously. The projector module is constructed and operates as described for the xenon headlamp with the addition of the AFS system which allows the projector module to be moved vertically and horizontally. The following description covers the additional differences to the xenon headlamp with AFS.



Item	Part Number	Description
1	-	Attachment screws (3 off)
2	-	Turn signal indicator lamp
3	-	Side marker lamp (NAS only)
4	-	Side lamp
5	-	Static bending lamp
6	-	Bi-xenon AFS projector module
7	-	High beam 'fill-in' lamp

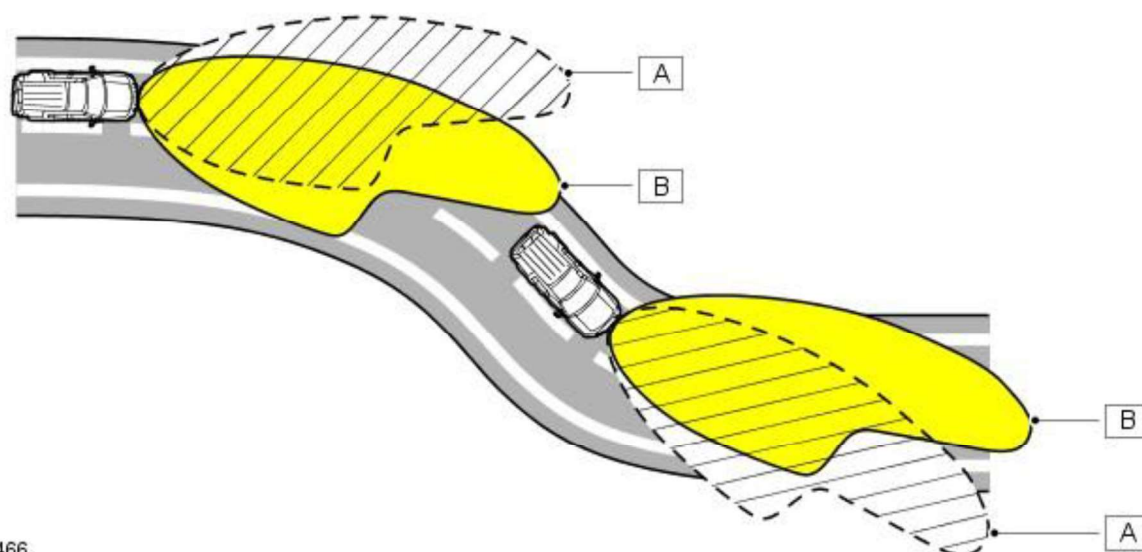
8	-	Ignitor electrical connector
9	-	Ignitor unit and bulb
10	-	Mounting collar
11	-	Cover - high beam 'fill-in' lamp
12	-	Vent (3 off)
13	-	Xenon control module
14	-	AFS power module
15	-	Electrical connector
16	-	Cover - Side lamp and side marker lamp (if fitted)
17	-	Bulb holder - turn signal indicator
18	-	Cover - Halogen bulb

The AFS is a system to improve driver visibility under differing driving conditions. AFS provides a larger visible area which is illuminated when cornering by adjusting the position of the beam distribution on the road. Horizontal adjustment is made automatically to the most suitable orientation for the driving conditions using steering angle and information from other vehicle sensors.

AFS is only available with xenon headlamps and also includes the dynamic headlamp leveling system described in the 'Headlamp Leveling' section of this document. The bi-xenon module within the headlamp is controlled by actuator motors which rotate the projector module on its vertical and horizontal axes to adjust the beam output to suit the cornering conditions and vehicle inclination. Only the bi-xenon lamp projector module swivels, the halogen high beam lamp unit remains static.

The AFS is controlled by an AFS control module which is located at the bottom of the left hand 'A' pillar. The module is connected to and controls an AFS power module located on the base of each headlamp. Signals from the AFS control module are processed by the AFS power module which powers stepper motors to adjust the vertical and horizontal alignment of the projector module. The AFS power module also controls and regulates the operation of the static bending lamp (if fitted) which is requested by the AFS control module but controlled by the LCM.

AFS Concept



E43466

Item	Part Number	Description
A	-	Conventional headlamp beam distribution
B	-	AFS headlamp beam distribution

The AFS xenon headlamp construction is similar to the non-AFS xenon headlamp assembly. The AFS headlamp has a xenon control module located on the underside of the lamp assembly. An additional AFS power module is located in front of the xenon control module. The AFS power modules supply the correct voltage to stepper motors which control the positioning and movement of the AFS projector module.

The AFS assembly contains an additional carrier frame which provides the location for the AFS actuators. The remaining lamps are as described previously. The AFS headlamp also incorporates a static bending lamp.

The carrier frame is attached to the AFS vertical actuator. The projector module has a central pivot point which allows the module to move horizontally in response to operation of the AFS horizontal actuator.

The AFS actuators are bi-polar (2 phase) dc stepper motors which are driven by a power output from the AFS power module. Each stepper motor receives its position information from the AFS control module via the applicable AFS power module. When the actuators are powered to their requested positions, a holding current is applied to maintain the actuator position.

The actuators do not supply a positional feedback signal to the AFS control module. Each stepper motor requires referencing each time the AFS system becomes active. When the AFS system is active, each vertical actuator is driven in the low beam position and each horizontal actuator is driven to an inboard position until a mechanical stop in the actuator is reached. Once the stop is reached a step counter in the AFS control module is set to zero and the actuator is then powered to the operating position as determined by the AFS control module software.

The AFS control module receives front and rear suspension height data to provide dynamic headlamp leveling adjustment via the vertical actuator motor. The AFS control module also receives vehicle speed signals from the ABS module to adjust the projector module vertically to increase the beam range as the vehicle speed increases.

AFS Control Module

The AFS control module is located at the bottom of the left hand 'A' pillar, behind the trim panel.

The AFS control module is a dual functionality unit which also incorporates software to control the dynamic headlamp leveling. The AFS control module is connected to the high speed CAN bus and receives inputs from other vehicle systems on the status of the following parameters:

Steering angle

Vehicle speed

Headlamp status

Engine running

Reverse gear selected

Automatic lighting on.

The AFS will only operate when the AFS control module receives an engine running signal on the CAN bus. When the engine running signal is received the AFS control module performs an initialization routine.

The AFS will also function when the lighting control switch is in the AUTO position and the AFS control module receives a lights on signal from the rain/light sensor and an engine running signal.

The AFS control module then monitors the inputs from the other vehicle systems to control the AFS functionality according to cornering angles and vehicle speed.

The AFS control module is connected to each AFS power module on a private LIN bus. The power modules read operating values supplied from the AFS control module and control the output drivers for the stepper motor actuators inside the headlamp assembly.

AFS Operation

The AFS controls the swiveling angle of each projector module using speed and steering angle signals. The angles of each projector module differ to give the correct spread of light, e.g. when turning left, the left hand projector module will have a greater swiveling angle than the right hand projector module.

Initialization Procedure

When the AFS control module receives an ignition on signal, the control module performs the initialization procedure which ensures that the headlamps are correctly aligned on both their vertical and horizontal axes.

The headlamp leveling initialization takes less than 3 seconds to complete. The headlamp leveling motors are powered from their current position, which can be either the upper or lower limit or somewhere in between, to their lower position and then back to the 0 degrees position.

The AFS swivel initialization starts less than 1 second after the headlamp leveling initialization is activated to ensure that the headlamps are at or below the 0 degree position in the vertical axis, thus preventing glare to oncoming vehicles. The AFS swivel initialization is completed in less than 2.5 seconds. The LH and RH AFS actuator motors are powered from the 0 degree position to their fully inboard position, then to their fully outboard position and then back to the 0 degree position.

Failure Mode

In the event of a failure of the AFS system, a warning indicator in the instrument cluster is illuminated to warn the driver. The AFS warning indicator illuminates when the ignition switch is in position (II) and will flash continuously until the fault is rectified. The AFS warning indicator will also be illuminated if a failure of the steering angle sensor or the vehicle speed signal is detected.

Illumination of the AFS warning indicator does not necessarily mean that there is a fault with the AFS system. The fault may be caused by a failure of another system preventing the AFS system operating correctly.

The AFS control module performs a diagnostic routine every time AFS is requested. If any fault is found, the AFS control module will suspend the operation of the AFS function.

If the AFS leveling system has failed with the xenon projector module in a position other than the correct straight ahead position, the AFS control module will attempt to drive the projector module to a position a small amount lower than the standard position. If the swivel function has failed, the AFS control module will lower the projector module using the leveling actuator motors to a position much lower than standard to prevent excess glare to oncoming vehicles.

The AFS control module software can detect an internal failure of the control module control circuits. The control module will power the projector modules to the zero position and prevent further operation.

Faults can be investigated by interrogating the AFS control module using the Land Rover recommended diagnostic tool to check for fault codes.

Static Bending Lamps

- **NOTE:** The static bending lamps are not fitted to NAS vehicles

The static bending lamps, which are a standard feature on AFS headlamps, are designed to illuminate the direction of travel when cornering at low speeds. The static bending lamp functionality, which controlled by the LCM, is unique to vehicles with AFS headlamps and operates using inputs from the steering angle sensor.

The static bending lamp is incorporated into the outer part of the headlamp assembly and shares the same housing and reflector as the side lamp. The design of the lens projects a spread of light from the vehicle at approximately 45 degrees to the vehicle axis.

The static bending lamp uses a 35W Halogen H8 bulb which locates in a holder which is connected via wires to the main connector on the headlamp housing. The holder is located in an aperture in the headlamp housing and rotated to lock. The bulb is accessible via a removable cover at the rear of the headlamp housing.

AFS Control

The static bending lamps operate with a steering angle sensor CAN signal which is received by the AFS control module and the LCM. The AFS control module sends a static bending lamp on request to the LCM which activates the static bending lamp bulb.

When the operation parameters of the lamp are reached, the LCM illuminates the static bending lamp bulb on using a full power PWM voltage. When the lamp is switched off, the LCM fades the bulb off by decreasing the PWM voltage in a linear manner depending on steering angle and vehicle speed.

Dynamic Headlamp Leveling - AFS Headlamps Only

Dynamic headlamp leveling is only available on vehicles with AFS headlamps.

The dynamic headlamp leveling adjusts the vertical alignment of the headlamps as a rapid response to changes in vehicle attitude due to acceleration or braking.

The dynamic system is fully automatic, therefore the lighting control switch does not have a manual leveling rotary control.

- **NOTE:** The AFS system also operates in conjunction with the static vehicle leveling system as described previously.

The dynamic system comprises the following components:

- Two headlamp leveling motors

- AFS control module

- Engine running signal from engine control module

- Vehicle speed information from ABS module

- Vehicle height information from air suspension control module.

When the ignition switch is in position (II), power is supplied to the lighting control switch via the ignition relay in the Battery Junction Box (BJB) and to the AFS control module. When the lighting control switch is moved to the side lamp or headlamp position, the supply from the ignition relay is passed to the AFS control module.

- **NOTE:** When the AFS control module receives an ignition on signal, the control module performs an initialization procedure for both the AFS and headlamp leveling motors.

The system operates by the AFS control module receiving inputs on the CAN from the air suspension control module for front and rear vehicle height, from the engine control module for engine running signal and from the ABS module for stop lamp switch active (brakes applied) and vehicle speed. The AFS control module processes these signals and provides an output to the headlamp leveling motors to adjust the headlamp vertical aim according to vehicle speed and attitude.

- **NOTE:** In markets with Daytime Running Lamps (DRL), the dynamic headlamp leveling system will not operate when the DRL are active.

AUTOMATIC HEADLAMPS

The automatic headlamp function is a driver assistance system. The driver can override the system operation by selection of side lamps or headlamps on if the ambient light conditions require front and rear lighting to be active.

The automatic headlamp system uses a rain/light sensor and the LCM, which are connected via the K bus and I bus to control the headlamp functionality. The light sensor is incorporated in the rain/light sensor located on the inside of the windshield, below the rear view mirror. The wiper system also uses the rain/light sensor for automatic wiper operation. Refer to the Wipers and Washers section for details of the rain/light sensor and automatic wiper operation.

For additional information, refer to: [Wipers and Washers](#) (501-16 Wipers and Washers, Description and Operation).

The light sensor measures the ambient light around the vehicle in a vertical direction and also the angular light level from the front of the vehicle. The rain/light sensor uses vehicle speed signals, wiper switch position and the park position of the front wipers to control the system.

The rain/light sensor can detect if the vehicle has entered a tunnel or similar environment and will activate the headlamps on entry to the tunnel when the ambient and forward light levels have fallen quickly. When the tunnel is exited, the rain/light sensor detects the sudden increase in light levels and requests the lights to be switched off.

Certain light and weather conditions are not detected accurately by the rain/light sensor. The driver should override the automatic headlamps function if in any doubt about weather conditions and the requirement for exterior lights to be active.

The automatic headlamp operation uses ambient light levels which are monitored by a photodiode incorporated in the rain/light sensor. The rain/light sensor sends a lights on/off request to the LCM on the K bus, which responds by switching on the low beam headlamps, front side lamps and rear tail lamps. The automatic headlamps are activated under the following conditions:

Twilight

Darkness

Rain

Snow

Tunnels

Underground or multi-level car parks.

Operation of the automatic headlamps requires the ignition switch to be in position II, the lighting control switch to be in the 'AUTO' position and a lights on request signal from the light sensor.

- **NOTE:** The front fog lamps will not operate if the automatic control lamps are switched on.

If the automatic headlamp function has been selected and the ambient light falls below a pre-defined level then the front and rear fog lamps can be manually activated. If the ambient light rises above that level then the fog lamps will be deactivated along with the rest of the lamps. If the ambient light then falls below this level again the lamps will be activated, but the fog lamps which were previously selected will not.

HEADLAMP DELAY

The LCM controls a headlamp delay function which illuminates the driveway after leaving the vehicle. The headlamp delay will operate on low beam headlamps only regardless of the position of the left hand steering column multifunction switch.

The delay is operated when the ignition is switched off and the key removed with the headlamps switched on (not in the AUTO position). The message center displays a 'HEADLIGHTS ON' message accompanied by a chime from the sounder. When the lighting control switch is moved to the 'off' position, the message center displays a 'HEADLIGHT DELAY' message and the low beam headlamps are activated for a period of approximately 45 seconds. After the delay period, the LCM automatically switches off the delay function, extinguishing the headlamps.

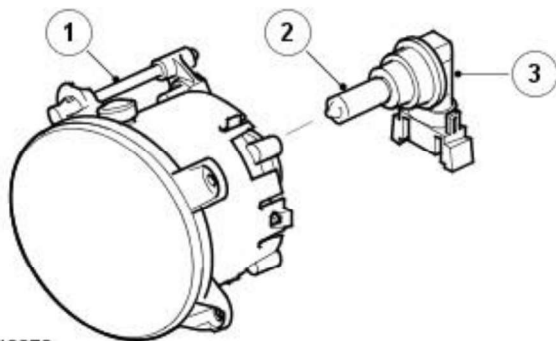
If the lighting control switch is in the 'AUTO' position and the ignition is switched off and the key is removed, the headlamp delay will not operate. The left hand steering column multifunction switch must be operated in the headlamp 'flash' position to activate the headlamp delay. The headlamps will extinguish after the delay period has expired.

INSTRUMENT CLUSTER WARNING LAMP ILLUMINATION

The warning lamps in the instrument cluster for left and right turn signal indicator, front and rear fog lamps and headlamp low and high beam and side lamps are activated by the LCM via messages to the instrument cluster on the I Bus. The synchronisation of the turn signal indicator warning indicator lamps with the external turn signal indicator lamp frequency is controlled by a cyclic transmission of the light status on the I Bus.

The AFS warning lamp is controlled by a signal from the AFS control module.

FRONT FOG LAMPS



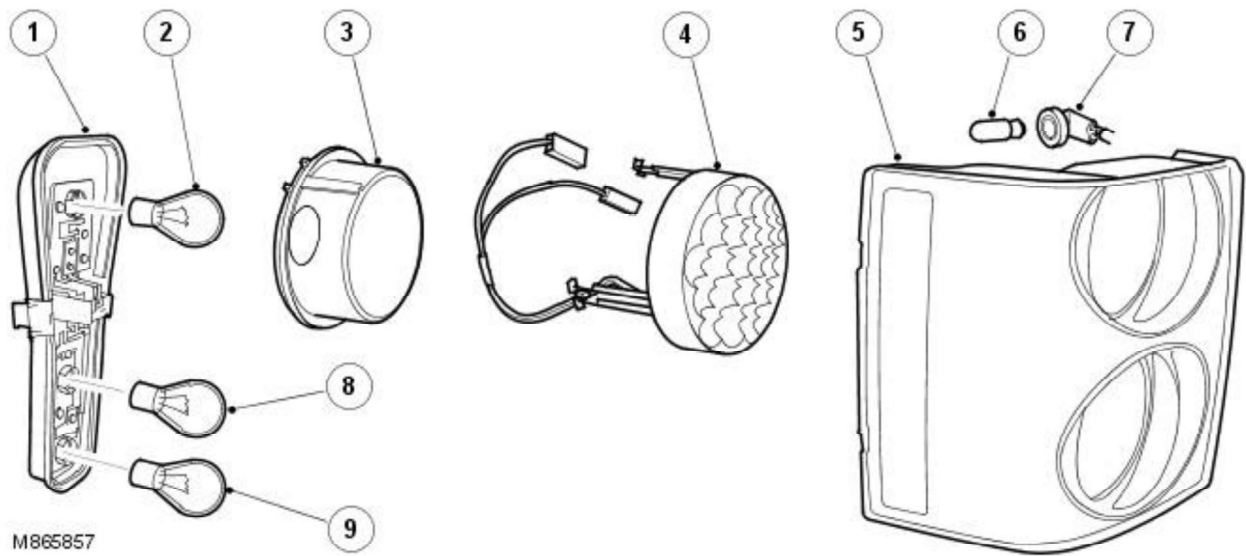
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Item	Part Number	Description
1	-	Lamp assembly
2	-	Halogen bulb
3	-	Bulb holder

The front fog lamps are located in the front bumper. Each lamp is secured to three lugs in the bumper and retained with self tapping screws and fasteners. Each lamp has two adjusting screws which provide for the vertical and horizontal alignment of the beam.

The 55W halogen bulb is located in a holder. The holders are secured in the lamp housing by rotating through approximately 10°. The holder has a connector to allow for connection to the electrical harness.

TAIL LAMP ASSEMBLY



M865857

Item	Part Number	Description
1	-	Tail lamp holder
2	-	Turn signal indicator bulb
3	-	Turn signal indicator reflector
4	-	Stop lamp LED assembly
5	-	Tail lamp lens
6	-	Side marker lamp bulb (NAS only)
7	-	Side marker lamp bulb holder (NAS only)
8	-	Bulb - tail lamp twin filament

9	-	Bulb - tail/rear fog lamp
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The rear tail and turn signal indicator lamp assemblies are located on the outer corner of each rear wing panel.

The lamp assembly is retained by two integral plastic clips which locate in corresponding clips secured to the body panel. The assembly is further retained by two self tapping screws which are accessed from inside the taildoor aperture. To remove the assembly, after removing the screws, the assembly must be prized at two indentations to release the clips. A non-metallic tool must be used with care to avoid damage to the paint finish.

The direction indicator, fog lamp and side lamp bulbs are located in a holder. The holder is secured in the lamp housing by two plastic clips. The holder has a connector to allow for connection to the electrical harness.

The upper lamp aperture is for the stop lamp and the turn signal indicator. The stop lamp comprises a plastic holder with contains 19 LED's. This illuminates through a circular prism lens in the center of the lamp to display the stop lamp in a red color. The turn signal indicator lamp is located behind the stop lamp LED unit. The bulb is located in a reflector unit which emits the turn signal indicator light around the outer diameter of the stop lamp LED assembly.

On 3.0 Td6 and 4.4L V8 models, the turn signal indicator uses a PY21W orange bulb. On 4.2L V8 supercharged models a PW21W Osram Diadem bulb is used. The Diadem bulb emits an orange light when illuminated but is not orange colored when inactive.

The lower lamp aperture is divided into two parts and provides for the tail lamp and the rear fog lamp.

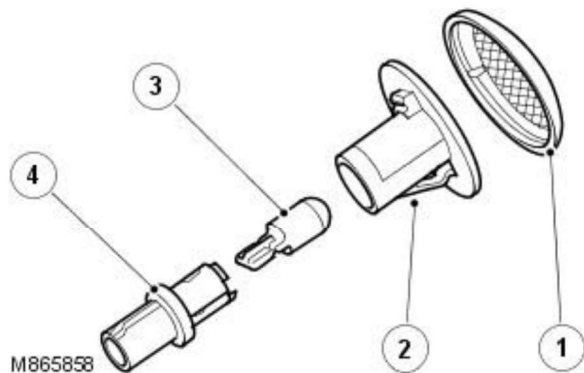
The rear fog lamp uses different bulbs depending on model. On 4.4L V8 models the rear fog lamp uses a P21W bayonet fitting bulb. On 4.2L V8 supercharged models the rear fog lamp uses a PR21W. This is also used for the tail lamp, operated by a PWM output from the LCM to produce a lower wattage output than the fog lamp.

The upper half of the tail lamp aperture is used solely for the tail lamp and uses a P21W/5W bulb on 4.4L V8 models and a PR21/5W bulb on 4.2L V8 supercharged models. Only the 5W filament is used for the tail lamp, with the 21W filament not used by any function.

On NAS vehicles, an additional lamp holder is used to accommodate the side marker lamp. The lamp assembly lens has a vertical section which is used as the side marker illumination required for the NAS market. The side marker lamp bulb is a 5W bayonet fitting.

All bulbs in the tail lamp assembly are monitored by the LCM and, if a failure is detected, alerts the driver via the instrument cluster message center.

SIDE REPEATER LAMPS



Item	Part Number	Description
1	-	Lens
2	-	Lamp body
3	-	Bulb
4	-	Bulb holder

The side repeater lamps are located in the front fenders, forward of the louvered air vents. The side repeater lamps are clipped into the fender aperture and can be removed by pushing forwards and pulling outwards from the fender.

The side repeater lamps use a capless 5W bulb which is pressed into contacts in a holder. The holder is located in the lamp assembly. These lamps are not monitored by the LCM and if a failure occurs the driver will not receive a message.

REVERSING LAMPS

The reversing lamps are located in the lower tail door and positioned at either side of the license plate. The lamps are secured in the tail door with a clip at the bottom and positively secured with a screw at the top.

Each reversing lamp uses a 6W bayonet type bulb. The LCM monitors the bulbs and, if a failure is detected, alerts the driver via the instrument cluster message center.

LICENSE PLATE LAMPS

Two license plate lamps are located in the trim above the license plate in the lower tail door. The lamps are press fitted in their apertures and secured by an integral plastic clip.

Each lamp uses a 5W festoon type bulb. The LCM monitors the bulbs and, if a failure is detected, alerts the driver via the instrument cluster message center.

HAZARD WARNING LAMPS

The hazard warning lamps use the front and rear turn signal indicator lamps as previously described. These are controlled by the LCM in response to a hazard warning lamp request from the instrument panel switch.

Crash Signal Activation

In the event of an accident of a severity to activate and deploy the airbags, the restraint control module requests various electrical operations to assist with the crash situation. The restraints control module requests via the bus systems to the LCM to activate the hazard warning lamps. These will continue to operate until deselected using the hazard warning lamp switch in the instrument panel. The lamps flash at a frequency which is the same as the frequency used to flash the headlamp high beam in the same situation.

DAYTIME RUNNING LAMPS (DRL)

DRL operation is detailed in a separate section.

For additional information, refer to: Daytime Running Lamps (DRL) (417-04 Daytime Running Lamps (DRL), Description and Operation).