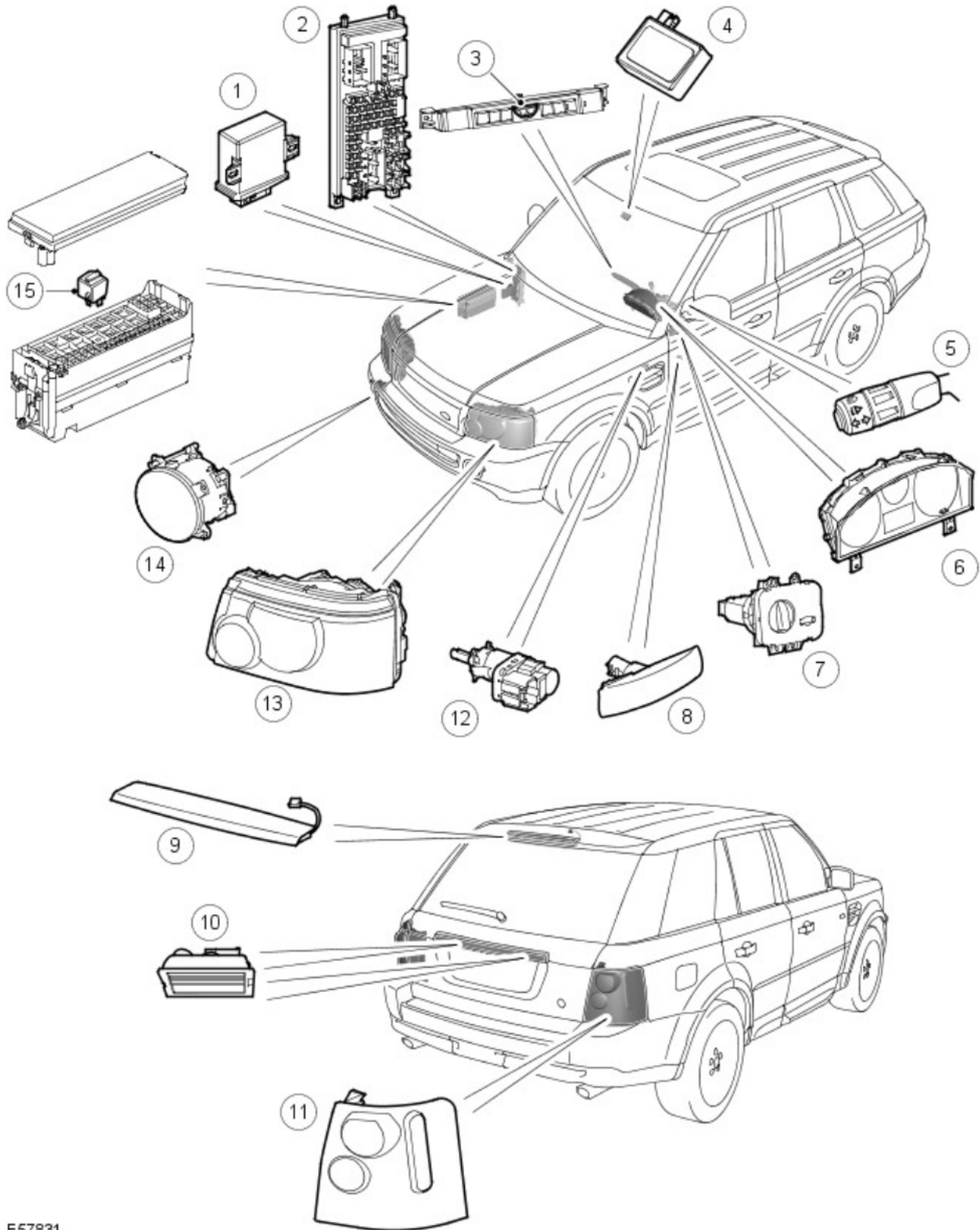


Exterior Lighting - Exterior Lighting

Description and Operation

Exterior Lighting Component Location



E57831

Item	Part Number	Description
1	-	Adaptive Front lighting System (AFS) control module
2	-	Central Junction Box (CJB)
3	-	Hazard flasher switch
4	-	Rain/light sensor
5	-	LH steering column multifunction switch

6	-	Instrument cluster
7	-	Lighting control switch
8	-	Turn signal indicator repeater lamp
9	-	High mounted stop lamp
10	-	License plate lamps
11	-	Rear lamp assembly
12	-	Stop lamp switch
13	-	Headlamp assembly
14	-	Front fog lamp
15	-	Front fog lamp relay (if fitted)

GENERAL

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 indicator repeater lamps
- Stop lamps and high mounted stop lamp
- Reversing lamps
- Rear fog lamps
- Front fog lamps (if fitted)
- Cornering/Static bending lamps (if fitted) - All except NAS
- Low and high beam headlamps
- Adaptive Front lighting System (AFS) (if fitted).

Exterior Bulb Type/Rating

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

Bulb	Type	Rating
Halogen Headlamps - Low/High beam	Halogen H7	55W
Xenon headlamps - Low/High Beam	Xenon D2S	35W
Headlamps - High Beam	Halogen H7	55W
Front fog lamps	Halogen H11	55W
Rear fog lamps	Bayonet P21	21W
Turn signal indicator lamps - Front - ROW	Bayonet PY21W	21W
Turn signal indicator lamps - Front - NAS	Wedge S8W 3457K	27/7W
Turn signal indicator repeater lamps	Capless W5W	5W
Turn signal indicator lamps - Rear	Bayonet P21	21W
Side lamps - Front	Capless W5W	5W
Stop/Tail lamps	Bayonet - Twin filament P21/5	21W/5W Note: 21W filament not functional on lower tail lamp
High mounted stop lamp	LED's	-
License plate lamps	Capless W5W	5W
Reverse lamps	Bayonet P21	21W
Cornering lamp/Static bending lamp	Halogen H8	35W
NAS - Side marker lamp (front/rear)	Capless W3W	3W

CENTRAL JUNCTION BOX

The Central Junction Box (CJB) is an integrated unit located behind the instrument panel on the passenger side of the bulkhead. The CJB contains fuses, relays and a number of microprocessors which control the power supply and functionality of the lighting system and other vehicle systems.

Input Signals

The CJB receives inputs from the following switches:

- Lighting control switch
 - Side lamp position
 - Headlamp position
 - Automatic (AUTO) position (if fitted)
- Brake switch
- Left hand steering column multifunction switch for turn signal indicators and high beam/headlamp flash
- Hazard flasher switch
- Rain/light sensor (LIN signal)

Circuit Protection

The CJB provides circuit protection for all exterior lighting circuits. Most exterior lighting circuits are protected by conventional fuses, however, the following circuits are protected by Field Effect Transistors (FETs).

- Low beam
- High beam
- Cornering/static bending lamps
- Turn signal indicator lamps
- Trailer turn signal indicator lamps.

Operation of the above listed circuits is protected by FETs which can detect overloads and short circuits. The FETs respond to heat generated by increased current flow caused by a short circuit. On a normal circuit this would cause the fuse to blow. The FETs respond to the heat increase and disconnect the supply to the affected circuit. When the fault is rectified or the FET has cooled, the FET will reset and operate the circuit normally. If the fault persists the FET will cycle, disconnecting and reconnecting the power supply.

The CJB stores fault codes which can be retrieved using T4. The fault code will identify that there is fault on a particular output which will assist with fault detection.

Alarm Indications

The exterior lighting system is used for alarm arm and disarm requests.

When the driver locks the vehicle, a visual indication of a successful lock request is displayed to the driver by the hazard flashers operating three times with a pattern of 500ms on and 500ms off.

When the driver unlocks the vehicle, a visual indication of a successful unlock request is displayed to the driver by the hazard flashers operating once for 3 seconds.

If the alarm is triggered, the hazard flashers are operated for ten 30 second cycles of on for 380ms and off 380ms with a 5 second off delay between each cycle.

For additional information, refer to: Anti-Theft - Active (419-01A Anti-Theft - Active, Description and Operation).

Lights on Warning Chime

When the ignition switch is in the off (O) or auxiliary (I) position and the lighting control switch is in the side lamp or headlamp position, a warning chime will sound if the driver's door is opened. This indicates to the driver that the exterior lights have been left on.

The chime is generated from the instrument cluster sounder on receipt of a lights on signal, a door open signal and an ignition switch off signal from the CJB on the CAN bus.

Crash Signal Activation

When a crash signal is transmitted from the restraints control module, the CJB activates the hazard flashers and the turn signal indicators in the instrument cluster.

The hazard flashers will continue to operate until the ignition switch is moved to the auxiliary position I or the off position O or the restraints control module no longer transmits the crash signal.

For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

Headlamp Timer

The CJB controls a headlamp timer function which allows the headlamps to remain on for a period of time after leaving the vehicle. This is a driver convenience feature which illuminates the driveway after leaving the vehicle.

To select this feature, the lighting control switch must be in the headlamp or side lamp position when the ignition switch is moved from the ignition position II to the off position. The lighting control switch must be moved to the off position or AUTO position (if fitted) to activate the timer. The timer function will then be initiated and low beam headlamps will be illuminated for the selected timer period.

The timer period is selectable by the driver and can range from 10 to 60 seconds in 10 second increments. The default timer period is set at 20 seconds.

The default setting can be changed by a Land Rover or authorised dealer or by the driver using the vehicle's customer personalisation options.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

With the vehicle stationary and the ignition switch in any position, pressing the trip computer button on the end of the left hand steering column multifunction switch gives access to the options. The options can be scrolled through using the audio search buttons on the steering wheel. The options are displayed in the message center. When the headlamp timer option is reached, the settings can be changed using the audio search buttons on the steering wheel. When the selection has been made confirmation is performed by pressing the trip computer button.

For additional information, refer to: Information and Message Center (413-08 Information and Message Center, Description and Operation).

• NOTE: The headlamp timer feature will be cancelled under the following conditions:

- The ignition switch is moved from auxiliary (I) to ignition (II)
- The lighting control switch is moved from off to side lamps.

The headlamp timer can also be operated using the ignition key personal button, if this feature has been set by the driver. For additional information, refer to: Handles, Locks, Latches and Entry Systems (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

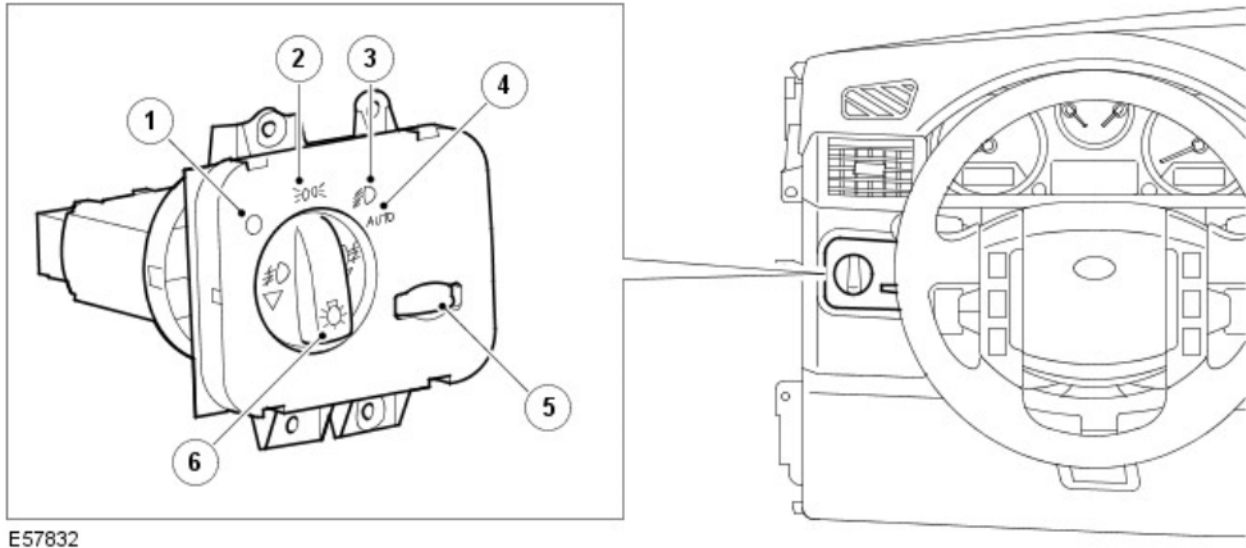
• NOTE: In certain markets the headlamp timer function using the ignition key personal button also activates the reversing lamps to provide additional illumination at the rear of the vehicle.

LIGHTING CONTROL SWITCH

The lighting control switch is located in the driver's side of the instrument panel, below the outer fresh air vent. The switch contains a rotary switch for selecting the vehicle exterior lighting functions and an instrument illumination dimmer rheostat.

Two variants of the switch are available to cover the different vehicle specifications and market variations.

- NOTE: Lighting control switch with AUTO function shown



E57832

Item	Part Number	Description
1	-	OFF position
2	-	Side lamps position
3	-	Headlamps position
4	-	Automatic headlamps position (if fitted)
5	-	Instrument illumination dimmer control
6	-	Rotary control switch

All outputs from the lighting control switch, with the exception of the dimmer control output, are subject to a voltage drop through the switch of approximately 200mV. Therefore, assuming that the input voltage to the switch is 12V, then the voltage measured at the switch output pins will be 11.8V.

Rotary Control

The rotary control can be turned to select one of four positions; off, side lamps, headlamps and automatic (AUTO). On vehicles without the automatic feature the switch only has three positions.

Three additional positions for fog lamps are available by pulling the rotary control; all fog lamps off, front fog lamps on only and front and rear fog lamps on. On vehicles without front fog lamps the switch can only be pulled once to activate the rear fog lamps.

On vehicles fitted with front fog lamps, the rotary control can be pulled to select fog lamps when it is in the side lamps or headlamps positions.

The rotary control can only be pulled to select rear fog lamps when it is in the headlamps position.

The fog lamps will be switched off automatically when the rotary control is turned to the off position or pushed in to the fog lamps off position.

Dimmer Control

The dimmer control provides a Pulse Width Modulated (PWM) output to control the illumination brightness of the instrument panel and other illumination. The dimmer switch operates using a rotary thumbwheel which is connected to a rheostat and a high side switch.

The rheostat is a variable resistor which provides a high or low resistance according to its set position. This output is passed to a switchable capacitor or a high side switch. The high side switch uses the output from the rheostat to determine the switching frequency of the capacitor which provides the PWM output of between 8 and 12V to determine the brightness of the illumination.

Automatic Headlamps

Refer to Automatic Headlamps in this section.

HEADLAMP ASSEMBLY

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

The headlamps are located on the front carrier assembly. Each headlamp is secured to the front carrier assembly with two locking plates. The locking plate slides in grooves in the rear of the headlamp and two holes in each plate locate on pins on the carrier. Each locking plate is pressed down to lock the pins in the locking plate holes. The locking plates allow removal of the headlamp from the carrier for bulb changing without the requirement for special tools. Removal of a headlamp requires the removal of the radiator grille.

The rear of the headlamp unit has removable access panels which allow access to the bulbs for replacement. A large cover, which is rotated anti-clockwise to remove, allows access to the low/high beam bulb on both halogen and xenon headlamps. Another removable cover provides access to the high beam only halogen bulb which is retained with a spring clip. A smaller cover, which is located behind the outer locking plate, can also be rotated anti-clockwise to provide access to the turn signal lamp bulb. Another cover located on the underside of the headlamp assembly provides access to the side lamp bulb, the cornering lamp/static bending lamp bulb and the side marker lamp bulb on NAS models.

The headlamps have two adjustment screws on the rear which allow for the manual setting of the vertical and horizontal alignment.

On NAS vehicles the headlamp is regarded as 'Visual Optically Left' (VOL) aiming. These have to be moved in the same direction and by the same amount to create vertical movement of the beam pattern. 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 Reference Library (ERL) for pin details.

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

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

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

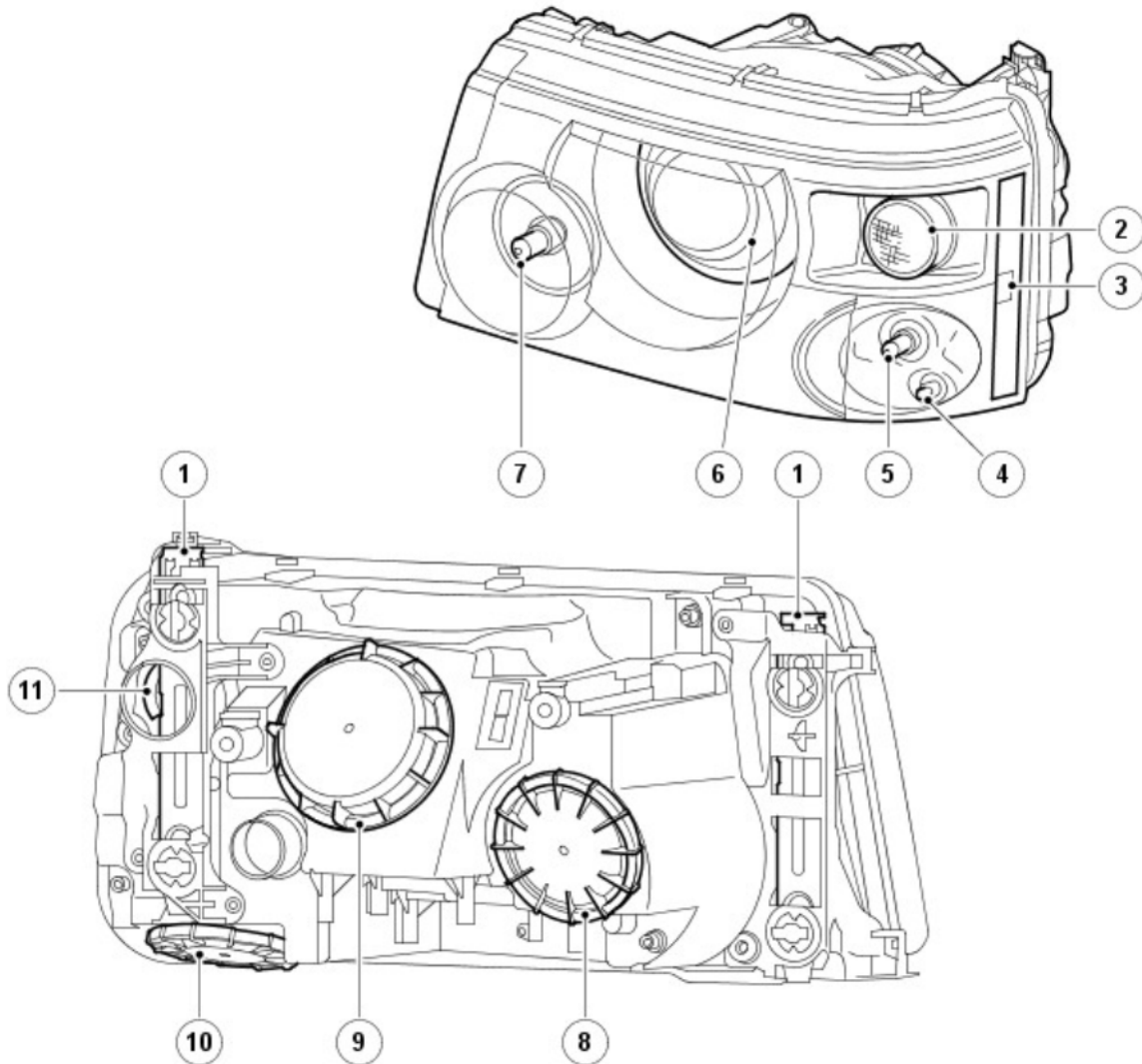
The high beam headlamps are switched on when the ignition switch is in position (II) and:

- The low beam headlamps are selected on in the headlamp position or activated via the AUTO feature
- The left hand steering column multifunction switch is pushed forward away from the driver.

The high beam headlamps will be switched off when:

- The left hand steering column multifunction switch is moved rearward towards the driver
- The low beam headlamps are switched off
- The ignition switch is moved to the auxiliary position (I) or off position (0).

Halogen Headlamps



E57833

Item	Part Number	Description
1	-	Locking plate
2	-	Turn signal indicator lamp
3	-	Side marker lamp (NAS only)
4	-	Side lamp
5	-	Cornering lamp (if fitted)
6	-	Bi-halogen low/high beam headlamp
7	-	High beam headlamp
8	-	High beam lamp access cover
9	-	Low/high beam lamp access cover
10	-	Side lamp/cornering lamp/side marker lamp access cover
11	-	Turn signal indicator lamp bulb holder (hidden)

The mono-halogen low beam only headlamp 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.

A complex surface reflector is used for the halogen fill in high beam lamp. This type of reflector is divided into separate parabolic segments, with each segment having a different focal length.

The low and high beam bulbs are quartz halogen H7, with a rating of 55W. The bulbs are retained in the headlamp unit with conventional wire retaining clips.

A tourist lever mechanism is located on the inboard 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 beam is changed by removing the access cover at the rear of the lamp assembly and moving a small lever located near the bulb holder, at the side of the projector. The tourist function is operated by pushing the lever upwards on LH headlamps and downwards on RH headlamps.

Cornering Lamp

- NOTE: The cornering lamps are not fitted to NAS vehicles

The cornering lamps are an optional feature designed to illuminate the direction of travel when cornering at low speeds. The design of the lens projects a spread of light from the vehicle at approximately 45 degrees to the vehicle axis.

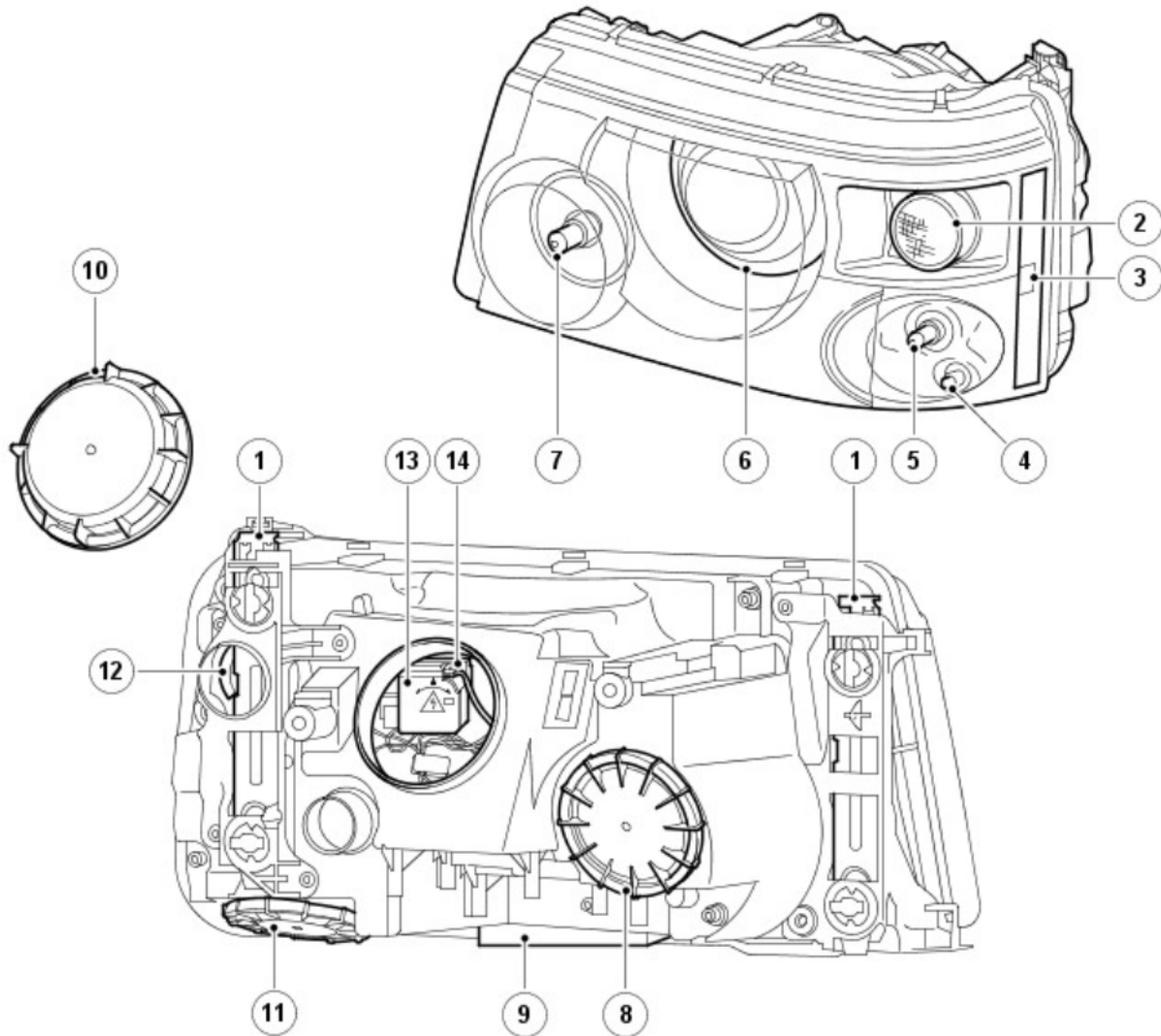
The cornering lamp is incorporated into the outer part of the headlamp assembly and shares the same housing and reflector as the side lamp.

The cornering lamp uses a 35W Halogen H8 bulb which is permanently located in an integral holder which is connected 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 on the base of the headlamp housing.

The cornering lamps are controlled by the left hand steering column multifunction switch with the lighting control switch in the headlamp position and the ignition switch in position II. The cornering lamps are supplied power via the ignition switch to ensure that they do not function with the headlamp delay feature. The cornering lamps are deactivated if the vehicle speed exceeds 25 mph (40 km/h).

Only one cornering lamp will illuminate at any one time. If the left hand turn signal indicators are selected on, the left hand cornering lamp will be illuminated and visa versa, providing the vehicle speed and lighting control switch positions are correct.

Xenon Headlamps



E57834

Item	Part Number	Description
1	-	Locking plate
2	-	Turn signal indicator lamp

3	-	Side marker lamp (NAS only)
4	-	Side lamps
5	-	Cornering lamp (if fitted)
6	-	Bi-Xenon low/high beam lamp
7	-	Halogen high beam lamp
8	-	High beam lamp access cover
9	-	Xenon control module
10	-	Low/high beam lamp access cover
11	-	Side lamp/cornering lamp/side marker lamp access cover
12	-	Turn signal indicator lamp bulb holder (hidden)
13	-	Igniter
14	-	Igniter connector

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 D2S 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 fill in high beam lamp only lighting unit, which is of the same design as the high beam unit used on the Halogen headlamps. This type of reflector has the reflector divided into separate parabolic segments, with each segment having a different focal length.

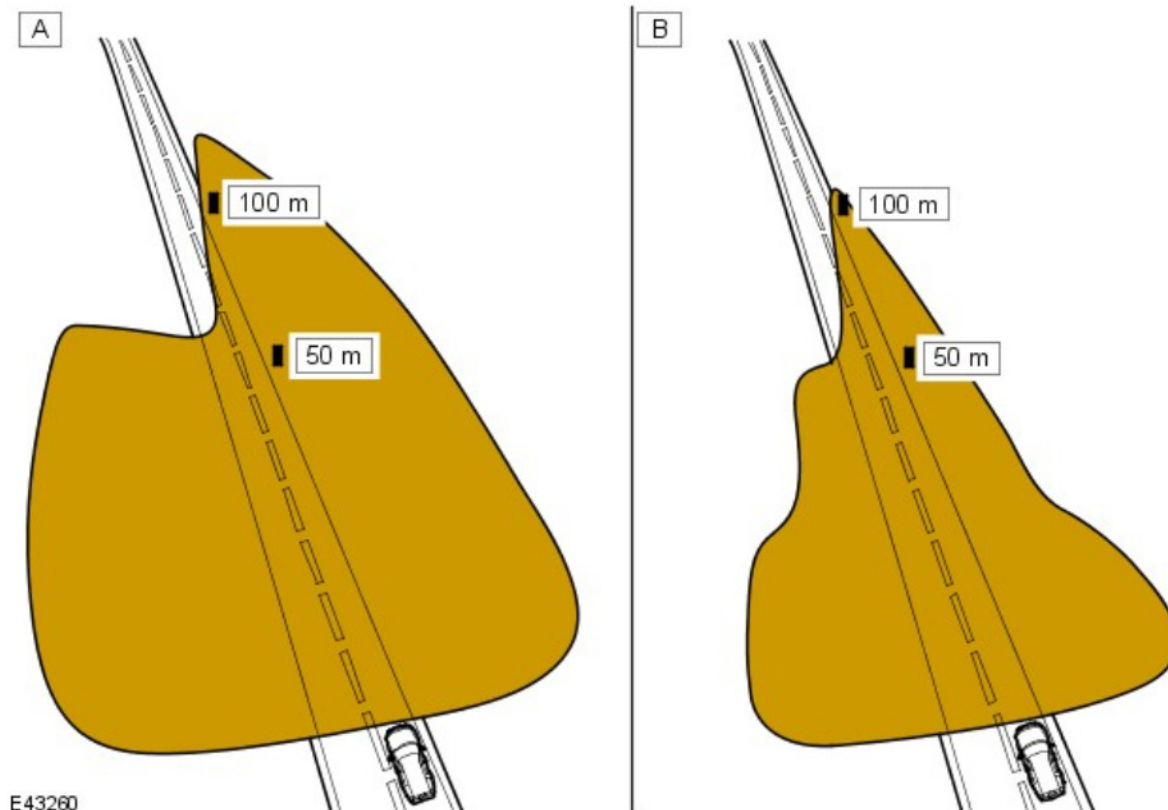
The high beam bulbs are quartz halogen H7, with a rating of 55W. The bulbs are retained in the headlamp unit with conventional wire retaining clips.

The xenon headlamp is known as bi-xenon and operates as both low beam and high beam headlamp unit. The xenon lamp or High Intensity Discharge (HID) lamp as they are sometimes called, comprises an ellipsoidal lens with a solenoid controlled shutter to change the beam output from low to high beam.

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

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

Xenon/Halogen Headlamp Beam Comparison



E43260

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 two wire locking tabs. The bulb has a centrally mounted single pin and an outer ring which each connect with the contacts in the igniter.

The igniter is located on the rear of the bulb and is secured by pushing onto the bulb and rotating clockwise. The igniter has an electrical connector which can only be installed in the igniter socket once the igniter unit is attached to the bulb and is automatically ejected when the igniter is removed.

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.

A tourist lever mechanism is located different sides of the projector module depending on market. 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 tourist function is operated by removing the access cover at the rear of the lamp assembly and pushing the tourist lever downwards.



WARNING: Make sure that the headlamps are off before removing the access cover.

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 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 igniters. The warm-up phase begins once the arc is established. The xenon control modules regulate the supply to the bulbs 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 stabilises ensuring a continual current flow between the electrodes. When the warm-up phase is complete, the xenon control modules change 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 CJB, the two xenon control modules and the two igniters. The xenon control modules (one per headlamp) receive an operating voltage from the CJB 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.

Turn Signal Indicator Lamp

The turn signal indicator lamp is incorporated into the outer part of the headlamp assembly. The lamp is located above the side lamp/comering lamp. The turn signal indicator lamp uses a PY21W bayonet orange colored bulb in ROW markets, a S8W 27/7W wedge bulb is used in NAS markets.

The bulb is fitted into a holder which connects with contacts in the headlamp housing. The holder is fitted into an aperture in the headlamp housing and rotated to lock into position. The cover is secured in the housing by rotating in a clockwise direction until locked. Access to the cover requires removal of the headlamp from the front carrier assembly and removal of the outer locking plate from the headlamp.

The turn signal lamps are operated by the left hand steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition switch in the ignition position (II), the hazard flasher switch is active at all times. When active, the turn signal lamps will flash at a frequency cycle of 380ms on and 380ms off.

If a bulb fails, the remaining turn signal lamps bulbs continue to flash at normal speed. The turn signal indicators in the instrument cluster will flash at double speed to indicate the bulb failure to the driver.

Side Lamp

The side lamp is incorporated into the outer part of the headlamp assembly and is located below the turn signal indicator lamp. The side lamp shares the same housing and reflector as the comering lamp and static bending lamp (when fitted).

The side lamp uses a W5W wedge fitting bulb which locates into a holder which is connected via wires to the main

connector on the headlamp housing. The holder is a push fit into a receptacle in the headlamp housing. The bulb is accessible via a removable cover on the base of the headlamp housing. Access to the cover requires removal of the headlamp from the front carrier assembly.

The side lamps are operated by selecting side lamps or headlamps on the lighting control switch. The side lamps are operational at all times and are not dependant on the ignition switch position. The side lamps will also be illuminated when the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

Cornering Lamp

- NOTE: The cornering lamps are not fitted to NAS vehicles

The cornering lamps are an optional feature designed to illuminate the direction of travel when cornering at low speeds. The design of the lens projects a spread of light from the vehicle at approximately 45 degrees to the vehicle axis.

The cornering lamp is incorporated into the outer part of the headlamp assembly and shares the same housing and reflector as the side lamp.

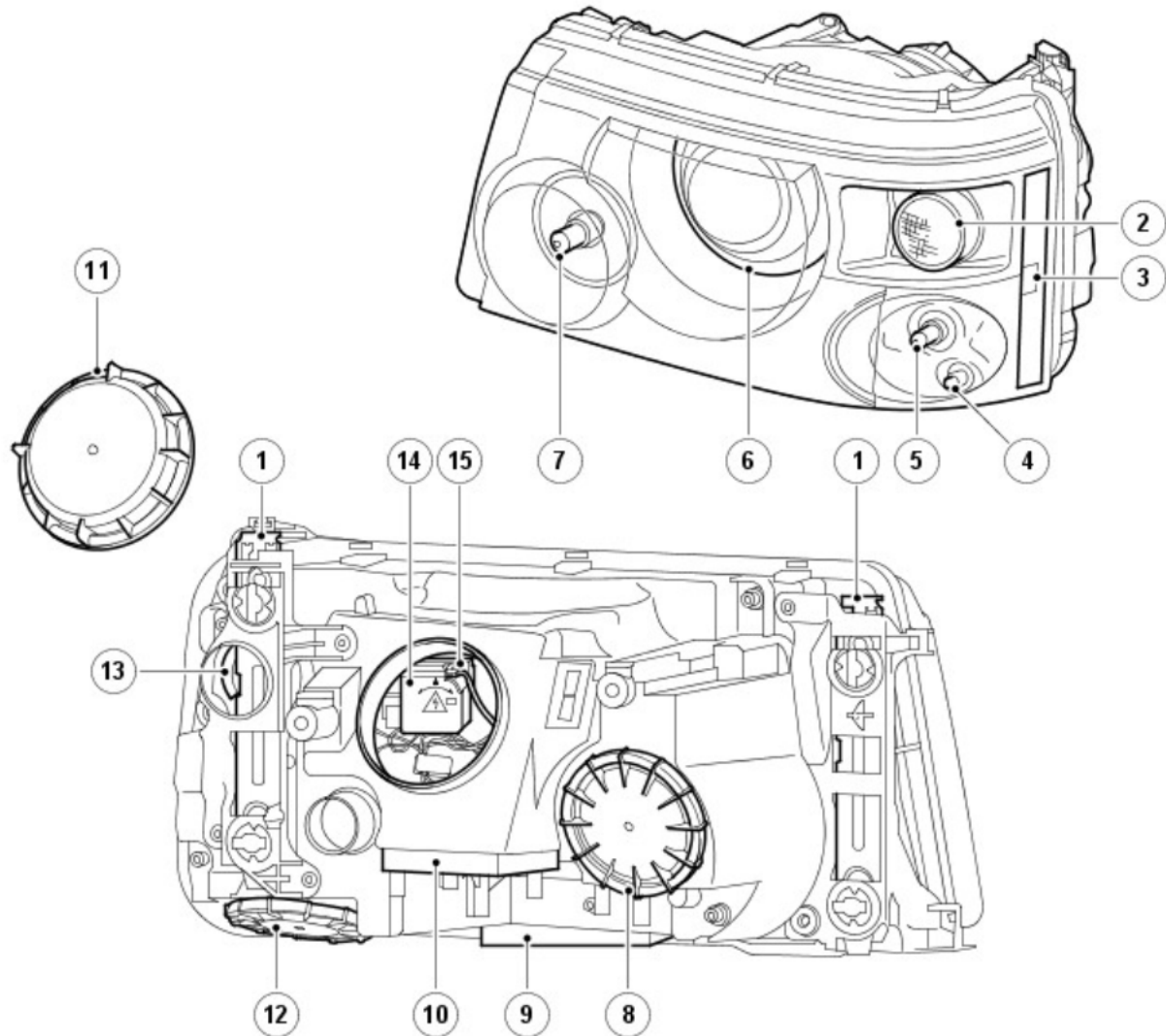
The cornering lamp uses a 35W Halogen H8 bulb which is permanently located in an integral holder which is connected on the headlamp housing. The holder is located in an aperture in the headlamp housing and rotated to lock. The bulb is accessible via a removable cover on the base of the headlamp housing.

The cornering lamps are controlled by the left hand steering column multifunction switch with the lighting control switch in the headlamp position and the ignition switch in position II. The cornering lamps are supplied power via the ignition switch to ensure that they do not function with the headlamp delay feature. The cornering lamps are deactivated if the vehicle speed exceeds 25 mph (40 km/h).

Only one cornering lamp will illuminate at any one time. If the left hand turn signal indicators are selected on, the left hand cornering lamp will be illuminated and visa versa, providing the vehicle speed and lighting control switch positions are correct.

ADAPTIVE FRONT LIGHTING SYSTEM (AFS)

Xenon Headlamp Assembly with AFS



E57835

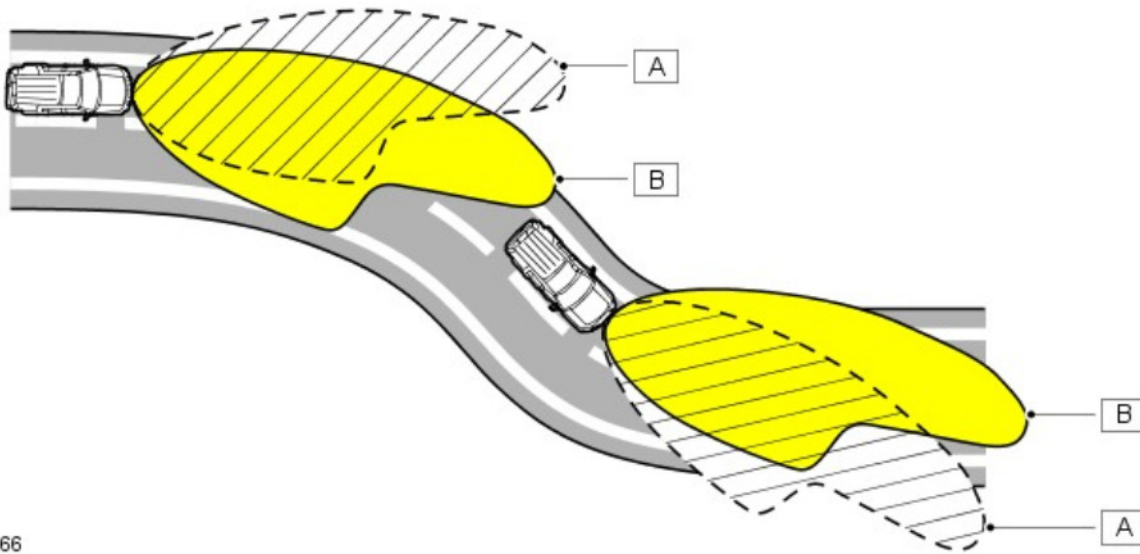
Item	Part Number	Description
1	-	Locking plate
2	-	Turn signal indicator lamp
3	-	Side marker lamp (NAS only)
4	-	Side lamp
5	-	Static bending lamp (All except NAS)
6	-	Xenon low/high beam AFS lamp
7	-	Halogen high beam lamp
8	-	High beam lamp access cover
9	-	Xenon control module
10	-	AFS power control module
11	-	Low/high beam lamp access cover
12	-	Side lamp and static bending lamp access cover (hidden)
13	-	Turn signal indicator lamp access cover (hidden)
14	-	Igniter
15	-	Igniter connector

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 'A' pillar, behind the CJB. The AFS control 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 xenon 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 CJB.

AFS Concept



E43466

A	Conventional headlamp beam distribution
B	AFS swivel headlamp beam distribution

AFS Control Module

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 initialisation 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 Control Module Connector C2193 Pin Details

Pin No.	Description	Input/Output
1	Not used	-
2	CAN high	Input/Output
3	CAN low	Input/Output
4	Shield ground	Input
5	Private LIN bus serial interface to AFS power modules	Input/Output
6 to 22	Not used	-
23	Ignition power supply	Input
24	Ground	Input
25	Not used	-

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.

Xenon Headlamp Assembly with AFS Construction

The AFS xenon headlamp construction is similar to the non-AFS xenon headlamp assembly. The AFS assembly contains an additional carrier frame which provides the location for the AFS actuators. The remaining lamps are as described previously

for the xenon headlamp assembly. The functionality of the static bending lamp on the AFS headlamp is different from the functionality of the cornering lamp on the xenon headlamp.

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.

Initialisation Procedure

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

The headlamp leveling initialisation 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 initialisation starts less than 1 second after the headlamp leveling initialisation 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 initialisation 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 T4 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 CJB, 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 CJB. The AFS control module sends a static bending lamp on request to the CJB which activates the static bending lamp bulb.

When the operation parameters of the lamp are reached, the CJB fades the static bending lamp bulb on using a PWM voltage over a period of approximately 2 seconds. When the lamp is switched off, the CJB fades the bulb off by decreasing the PWM voltage in a linear manner depending on steering angle and vehicle speed.

AUTOMATIC HEADLAMP OPERATION

The automatic headlamp function is a driver assistance system. The driver can override the system operation by selection of side lamp or headlamp on if the ambient light conditions require front and rear lighting to be active. The automatic headlamp system uses a light sensor and the CJB, which are connected via the LIN bus to control the headlamp functionality.

A 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.

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 automatic headlamp operation uses ambient light levels which are monitored by photodiode incorporated in the rain/light sensor. The rain/light sensor sends a lights on/off request to the CJB on the LIN 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 multistoried 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. If the rain sensor signal activates the wipers fast speed wipers, the low beam headlamps are activated, providing the lighting control switch is in the 'AUTO' position.

HEADLAMP LEVELING

Headlamp leveling provides for the adjustment of the vertical aim of the headlamps. The leveling system is primarily required to minimise glare to other road users when a heavy load is in the rear of the vehicle.

Two systems of headlamp leveling are available; static and dynamic.

Static Vehicle Headlamp Leveling

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.

Dynamic Headlamp Leveling (Air Suspension)

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

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 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 rotary 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 initialisation procedure for both the AFS and headlamp leveling motors. Refer to the previous AFS section for details of the initialisation procedure.

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.

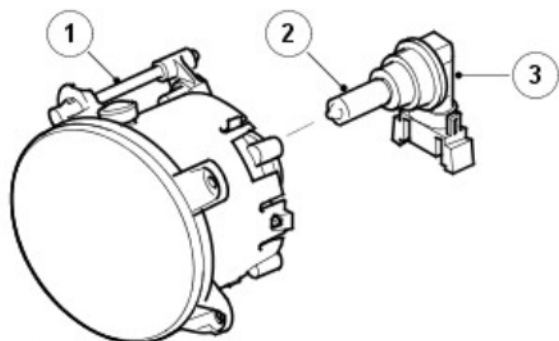
- **NOTE:** In markets with Daytime Running Lamps (DRL), the dynamic headlamp leveling system will not operate when the DRL are active.

DAYTIME RUNNING LAMPS (DRL)

Refer to the Daytime Running Lamps section for details.

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

FRONT FOG LAMP (If Fitted)



E43270

Item	Part Number	Description
1	-	Adjuster screw
2	-	Halogen bulb
3	-	Bulb holder

Front fog lamps are an optional fitment on low specification vehicles and a standard fitment on high specification vehicles.

Two front fog lamps are located in apertures in the front bumper. Each lamp is secured in the bumper with three screws which are covered with a finisher. The fog lamp has an adjuster screw which is accessible by removal of the lamp surround and is used to set the fog lamp to the correct alignment.

The fog lamp uses a 55W halogen H11 bulb which is located in a holder. The holder is located in a hole in the rear of the fog lamp housing and is turned to lock in position.

The front fog lamps are controlled by the lighting control switch. When the ignition switch is in the ignition position (II) and the lighting control switch is in the side lamp or headlamp position, the lighting control switch can be pulled to the first position to activate the front fog lamps.

If the switch is pulled to the second position, the front and rear fog lamps are activated. A front fog lamp warning indicator is illuminated in the instrument cluster when the front fog lamps are active.

Front Fog Lamps Functionality (NAS and Canadian Markets Only)

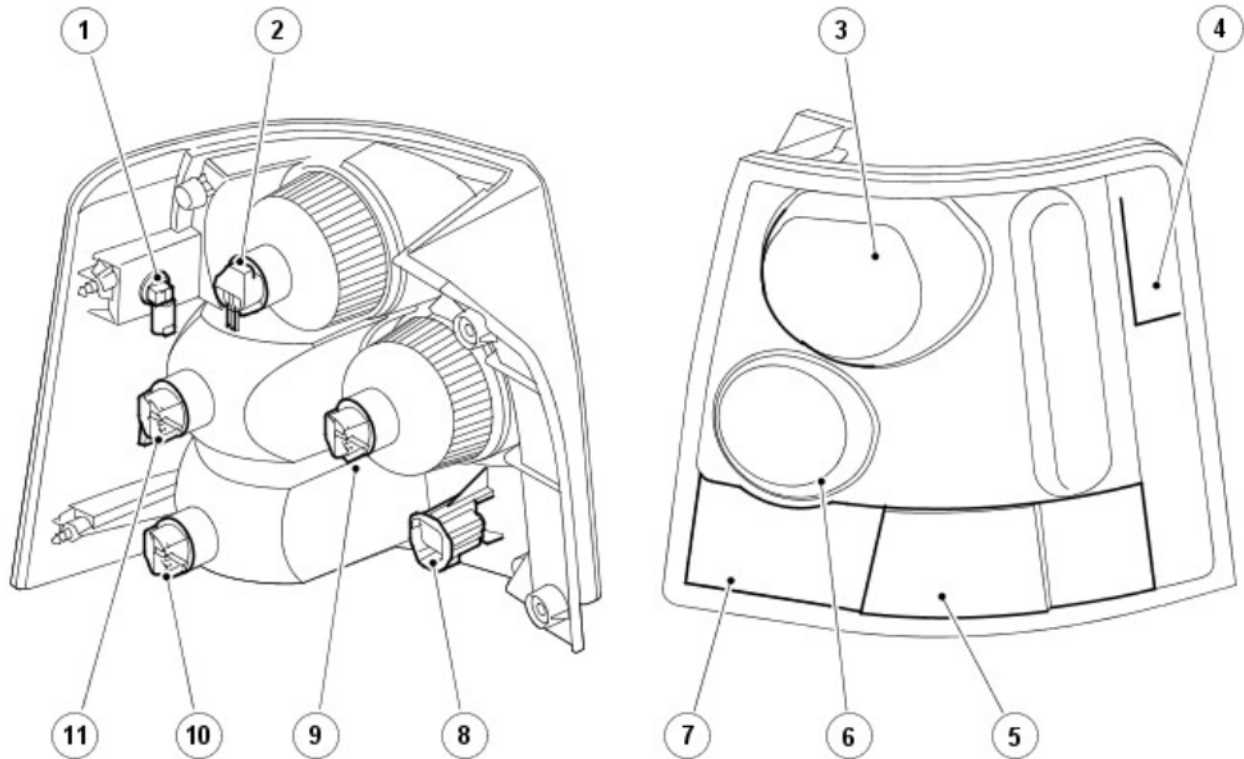
The front fog lamps are powered by an additional relay (relay 5) which is located in the BJB in the engine compartment.

The front fog lamps operate as described previously but with the following differences which cover local laws governing lamp usage.

If the low beam headlamps and the front fog lamps are on at the same time, when the high beam headlamps are switched on, the front fog lamps will be automatically switched off. When the high beam headlamps are switched off, the front fog lamps will be switched back on automatically.

- NOTE: The front fog lamps will also be switched off if the headlamp high beam flash function is operated.

REAR LAMP ASSEMBLY



E57837

Item	Part Number	Description
1	-	Side marker lamp bulb (NAS only)
2	-	Stop/side lamp bulb
3	-	Stop/side lamp
4	-	Side marker lamp (NAS only)
5	-	Fog lamp
6	-	Reverse lamp
7	-	Reflector
8	-	Electrical connector
9	-	Reverse lamp bulb
10	-	Fog lamp bulb
11	-	Turn signal indicator lamp bulb

The rear lamp assembly is a one piece unit which contains a stop/tail lamp, a turn signal lamp, a reversing lamp and a fog lamp. Five bayonet fitting bulbs are used (six on NAS vehicles with the addition of a side marker lamp). These are located in holders which fit into the applicable hole in the lamp housing and are locked by rotating. Each bulb holder is connected by wires to a connector on the rear of the lamp housing.

The rear lamp assembly is located in a recess in the vehicle body. Two studs on the outer edge of the lamp housing locate in the vehicle body. The lamp is secured with two screws which are located on the inner edge of the lamp housing, near the tailgate aperture.

Rear Stop and Side Lamp

The upper lamp is a combined stop and tail lamp and uses a 21W/5W bayonet fitting bulb. The stop lamp uses the 21W bulb filament and the side lamp uses the 5W bulb filament.

The stop lamp is activated when the ignition switch is in the ignition position (II) and the brake pedal switch is active (by depressing the brake pedal). The high mounted stop lamp will also be activated when the brake pedal is pressed.

The stop lamps can also be activated by the ABS when Hill Descent Control (HDC) is active. A signal from the ABS module energises a relay which supplies power to the stop lamps and high mounted stop lamp. For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

The side lamps are operated by selecting side lamps or headlamps on the lighting control switch. The side lamps are operational at all times and are not dependant on the ignition switch position. The side lamps will also be illuminated when the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

Turn Signal Indicator Lamp

The turn signal indicator lamp is located below the stop/tail lamp and uses a 21W bayonet fitting bulb.

The turn signal indicator lamps are operated by the left hand steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition switch in the ignition position (II), the hazard flasher switch is active at all times. When active, the turn signal indicator lamps will flash at a frequency cycle of

380ms on and 380ms off.

If a bulb fails, the remaining turn signal indicator lamp bulbs on that side of the vehicle flash at normal speed. The applicable turn signal indicator in the instrument cluster will flash at double speed to alert the driver to the bulb failure.

Reversing Lamp

The reversing lamp is located adjacent to the turn signal lamp and uses a 21W bayonet fitting bulb.

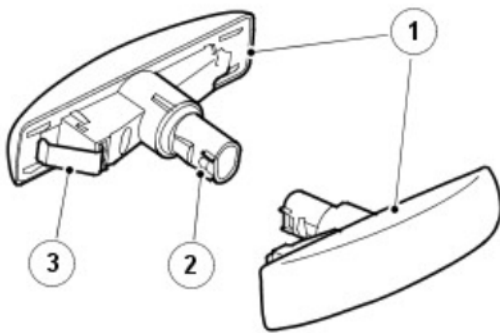
The reversing lamp is active when the ignition switch is in the ignition position (II) and the CJB receives a reverse selected signal on the CAN bus. The automatic transmission has a reverse switch which senses when reverse is selected.

Rear Fog Lamp

The rear fog lamp is located at the bottom of the rear lamp and uses a 21W bayonet fitting bulb.

The rear fog lamp is controlled by the lighting control switch. When the ignition switch is in the ignition position (II) and the lighting control switch is in the side lamp or headlamp position, the lighting control switch can be pulled to the second position (if front fog lamps fitted) to activate the front fog lamps. If front fog lamps are not fitted, the switch need only be pulled to the first position. A rear fog lamp warning indicator is illuminated in the instrument cluster when the rear fog lamps are active.

TURN SIGNAL INDICATOR REPEATER LAMP



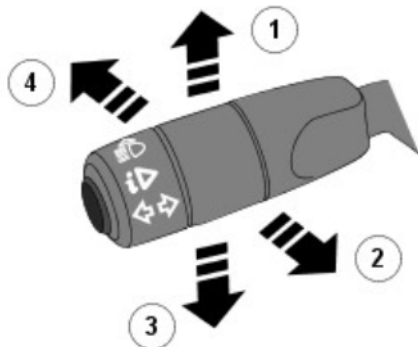
E43272

Item	Part Number	Description
1	-	Turn signal indicator repeater lamp
2	-	Bulb holder
3	-	Clip

The repeater lamps are located in the driver and passenger doors, below each door mirror. The lamps are dipped into an aperture in the door panel and can be removed by sliding rearwards and releasing the front edge of the lamp from the door. The repeater lamps use a 5W capless bulb which is located in a holder.

The repeater lamps have the same functionality as the front and rear turn signal indicator lamps and are operated by the left hand steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition switch in the ignition position (II), the hazard flasher switch is active at all times. When active, the repeater lamps will flash at a frequency cycle of 380ms on and 380ms off. If a lamp bulb fails, the remaining turn signal indicator lamp bulbs continue to flash at the normal rate.

LEFT HAND STEERING COLUMN MULTIFUNCTION SWITCH



E43273

Item	Part Number	Description
1	-	RH tum signal indicator lamp
2	-	Headlamp flash
3	-	LH tum signal indicator lamp
4	-	Headlamp high beam

The steering column multifunction switch is located on the left hand side of the steering column and controls the following

functions:

- Headlamp low/high beam
- Headlamp high beam flash
- Left/right turn signal indicator lamps
- Trip computer functions.

For additional information, refer to: Information and Message Center (413-08 Information and Message Center, Description and Operation).

The high beam on and flash functions are connected on separate wires to the CJB. When the switch is operated in either position a ground path is completed which is sensed by the CJB which activates the selected function.

The turn signal indicator lamps are connected and operate in a similar way with the ground path completed through a separate wire which is sensed by the CJB which activates the applicable turn signal indicator lamps.

HAZARD FLASHERS

The hazard flashers are controlled by a non-latching switch in the centre of the instrument panel. The hazard flashers operate at all times when selected and are not dependant on ignition switch position.

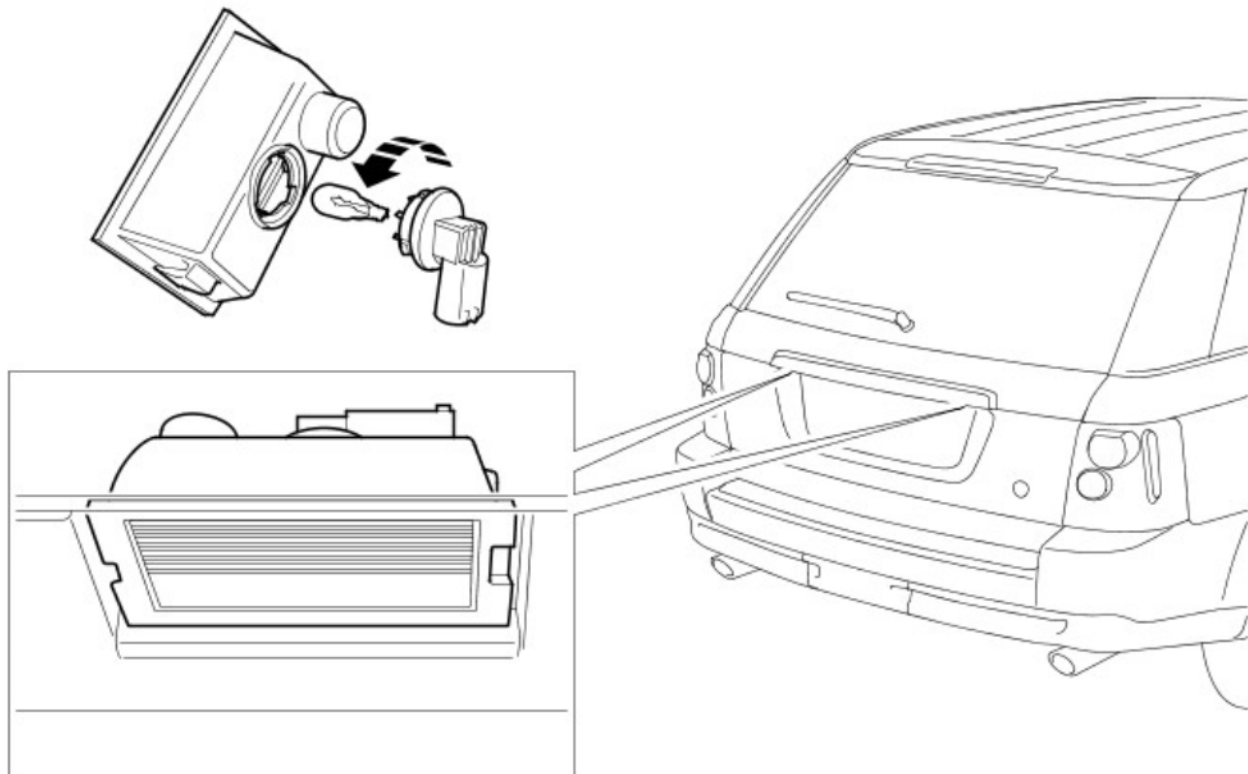
When the hazard flashers are selected on, all of the front, rear and side turn signal indicator lamps operate as previously described and both left and right turn signal indicators in the instrument cluster also flash. The hazard warning flashers flash at a rate of 380ms on and 380ms off. When the hazard flashers are active, they override any request for turn signal lamp operation.

If a trailer is fitted, the trailer turn signal lamps will flash at the same frequency as the vehicle indicators. The trailer warning indicator in the instrument cluster will also flash. If a trailer bulb is defective, the trailer warning indicator will not flash.

The hazard flashers can also be activated by a crash signal from the restraints control module. This is received by the CJB which activates the hazard flashers. The hazard flashers can be cancelled by moving the ignition switch to the auxiliary position I or the off position O or the crash mode is cancelled by the restraints control module.

For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

LICENSE PLATE LAMPS

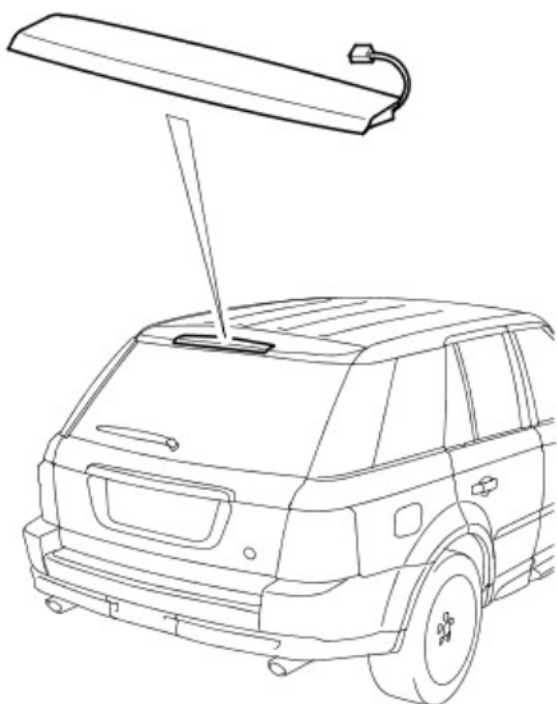


E57838

Two license plate lamps are fitted in the tailgate handle, above the license plate in the upper tailgate. Each lamp uses a 5W capless type bulb. The lamps are secured in the upper tail gate handle with integral clips. The lamps can be released from the handle using a small, flat blade screwdriver.

The license plate lamps are active at all times when the side lamps or headlamps are switched on.

HIGH MOUNTED STOP LAMP



E57839

The high mounted stop lamp is located in the tailgate spoiler.

The lamp comprises a plastic housing with a red coloured lens. The lamp is illuminated by 24 Light Emitting Diodes (LED's).

The high mounted stop lamp is activated, along with the tail lamp stop lamps, when the ignition switch is in the ignition position (II) and the brake pedal switch is active (by depressing the brake pedal).

The high mounted stop lamp and the stop lamps can also be activated by the ABS when Hill Descent Control (HDC) is active. A signal from the ABS module energises a relay which supplies power to the stop lamps. For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

TRAILER LIGHTING

Several different types of trailer socket can be fitted to the vehicle depending on market specifications. Refer to the Electrical Reference Library for specific socket details.

The CJB monitors the turn signal lamps and can detect if more than two lamps are fitted (the side turn signal lamps are not monitored). When a trailer is detected, the trailer warning indicator in the instrument cluster will flash in synchronisation with the turn signal indicators.

If one or more of the turn signal lamps on the vehicle or the trailer are defective, the trailer warning indicator will not flash to alert the driver to the bulb failure.

DIAGNOSTICS

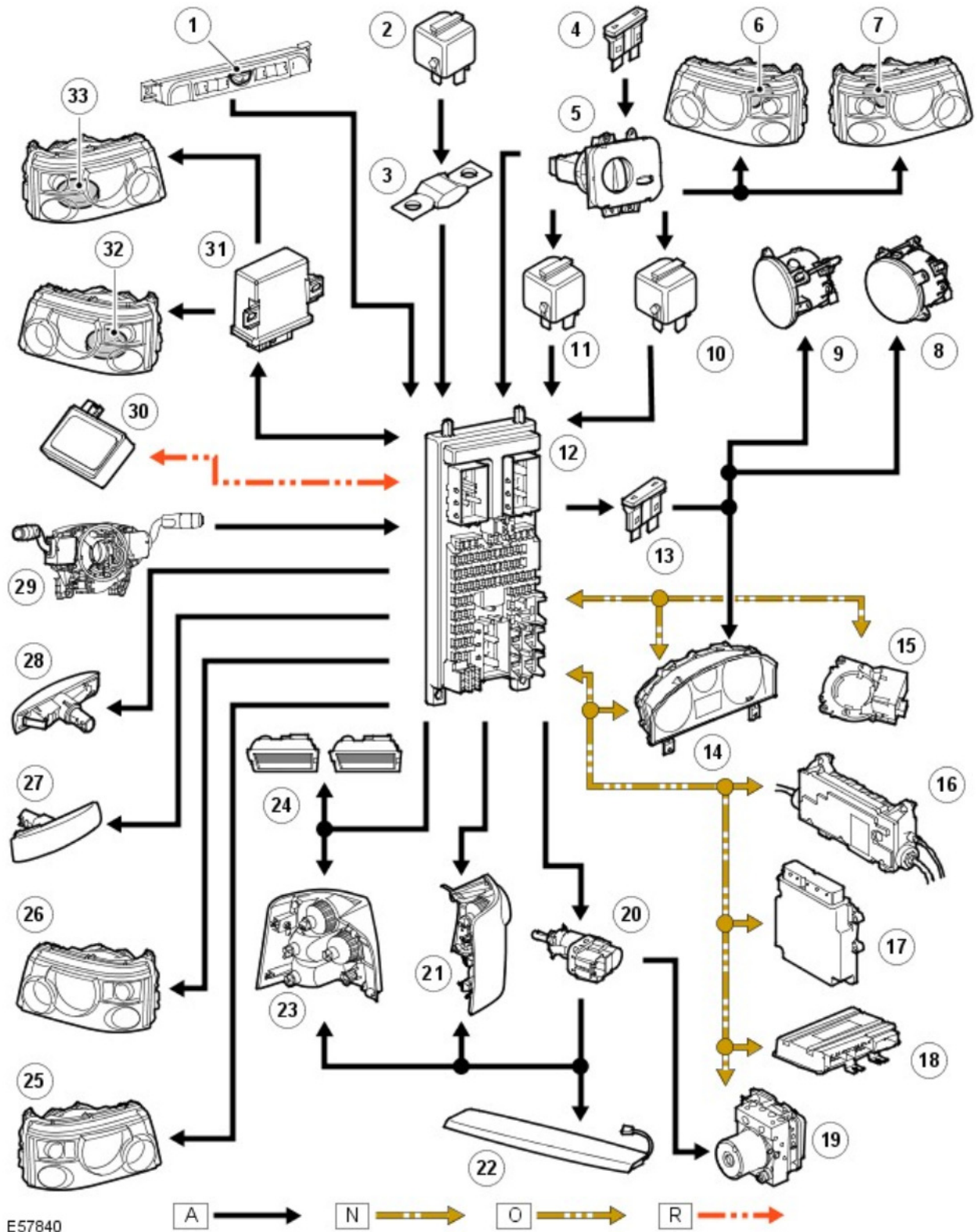
The diagnostic socket is located in the lower instrument panel closing panel, on the driver's side, below the steering column. Various lighting system functions are monitored by different systems which can store fault information. This can be retrieved using T4 or other suitable scan tool.

Central Junction Box (CJB)

The CJB monitors the status of the lighting circuits, relays and switches. If a fault occurs, the CJB stores a fault code applicable to the specific fault which can be retrieved using T4 or other suitable scan tool.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **N** = CAN Bus; **O** = LIN Bus; **R** = SPDIF



E57840

Item	Part Number	Description
1	-	Hazard warning lamps switch
2	-	Ignition relay
3	-	Fusible link 2E (permanent 12V supply)
4	-	Fuse 25E (permanent 12V supply)
5	-	Lighting control switch
6	-	LH headlamp leveling motor (if fitted)
7	-	RH headlamp leveling motor (if fitted)
8	-	LH front fog lamp
9	-	RH front fog lamp
10	-	Front fog lamp relay (NAS only)
11	-	Daytime Running Lamps (DRL) relay (if fitted)

12	-	Central Junction Box (CJB)
13	-	Fuse 38P (NAS only)
14	-	Instrument cluster
15	-	Steering angle sensor
16	-	Parking brake module
17	-	Engine Control Module (ECM)
18	-	Air suspension control module
19	-	ABS module
20	-	Stop lamp switch
21	-	LH rear lamp assembly
22	-	High mounted stop lamp
23	-	RH rear lamp assembly
24	-	License plate lamps
25	-	RH front headlamp assembly
26	-	LH front headlamp assembly
27	-	LH side repeater lamp
28	-	RH side repeater lamp
29	-	LH steering column multifunction switch
30	-	Rain/light sensor (if fitted)
31	-	Adaptive Front lighting System (AFS) control module (if fitted)
32	-	LH AFS Actuator (if fitted)
33	-	RH AFS actuator (if fitted)