Published: 29-Sep-2016

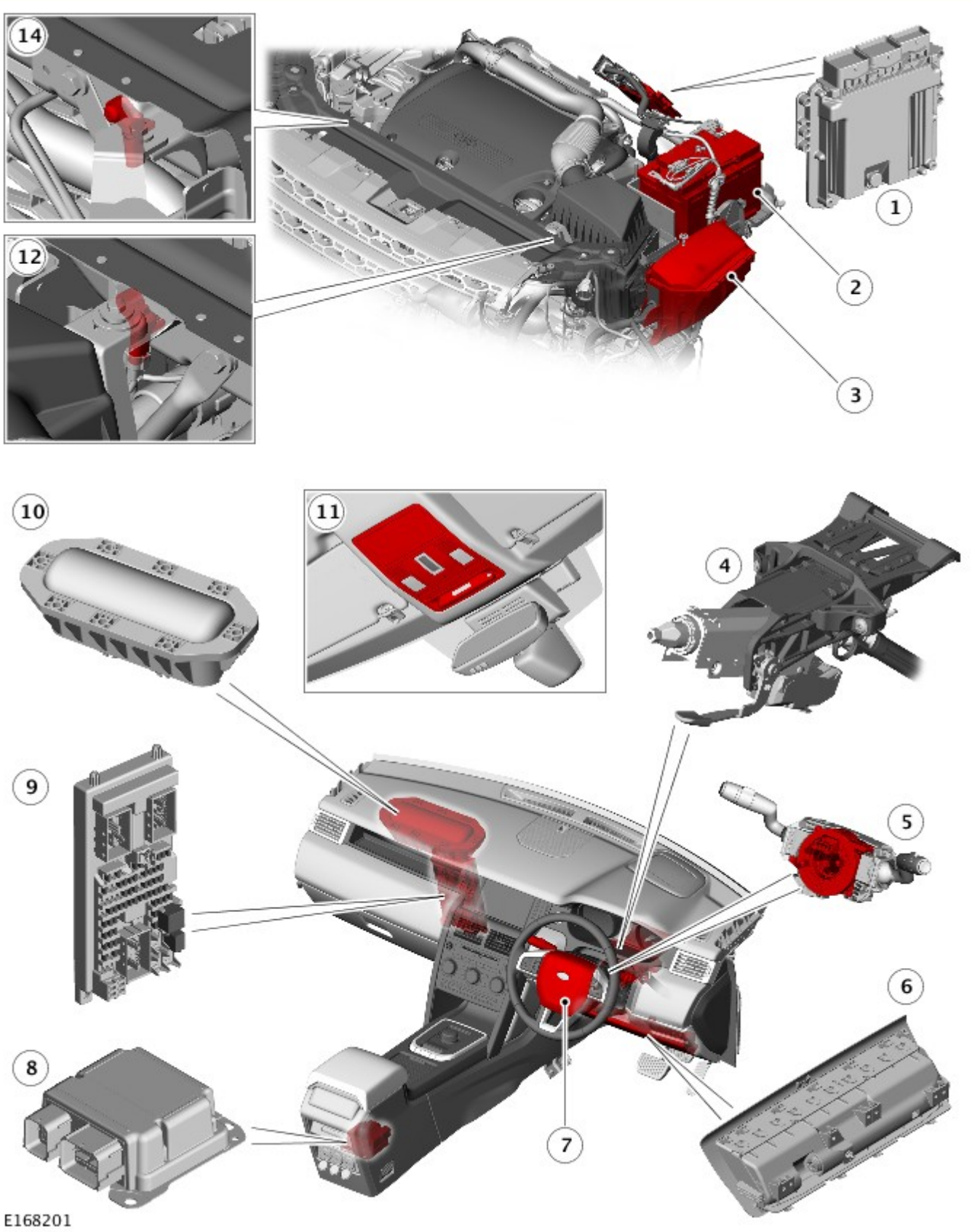
Supplemental Restraint System - Air Bag Supplemental Restraint System (SRS)

Description and Operation

COMPONENT LOCATION

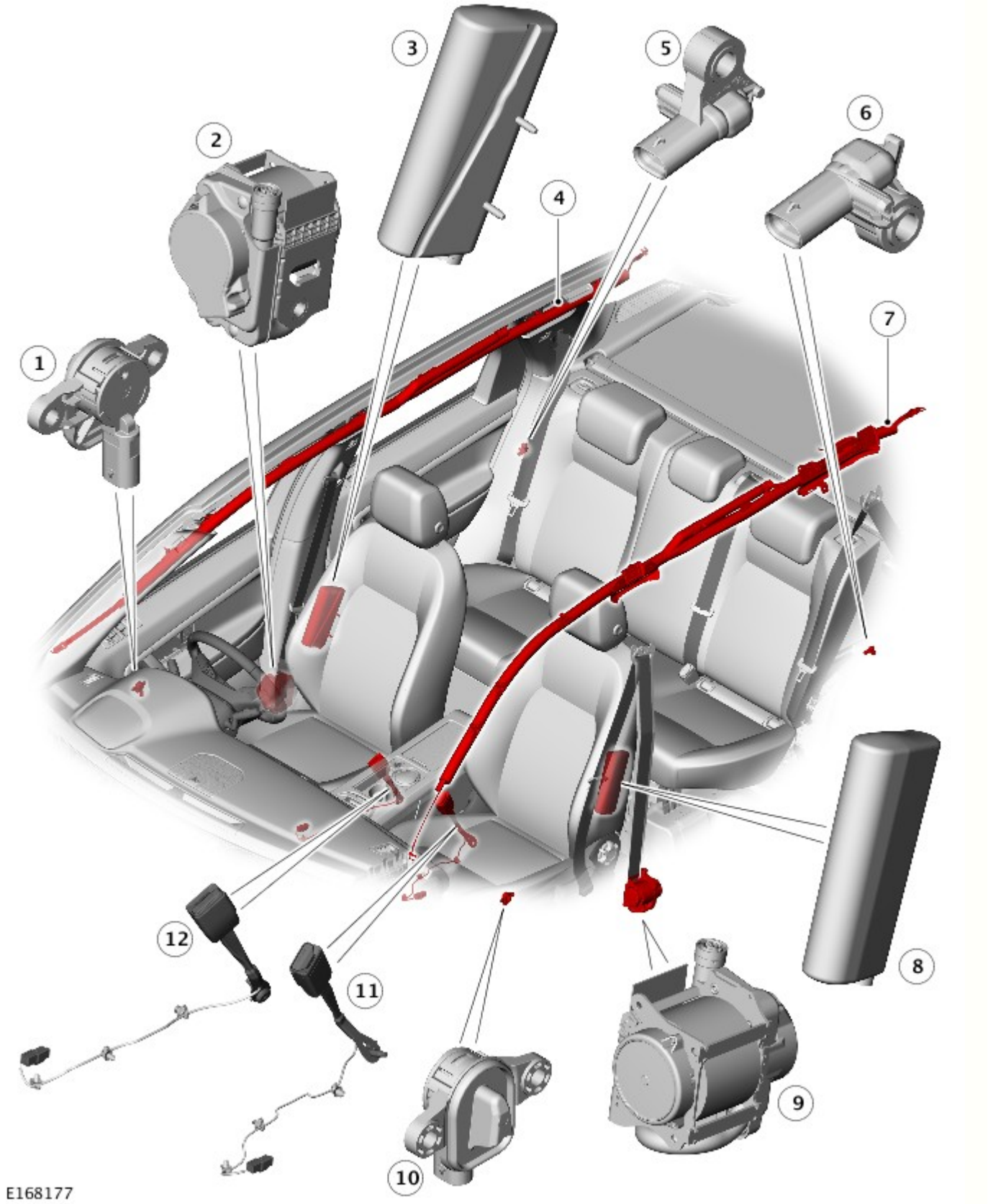
NOTE: Right Hand Drive (RHD) installation shown, Left Hand Drive (LHD) installation similar

Location 1 of 2



Item	Description
1	Engine Control Module (ECM)
2	Battery
3	Battery Junction Box (BJB)
4	Steering column collapse actuator
5	Clockspring (CLKSPG)
6	Driver lower airbag
7	Driver airbag
8	Restraints Control Module (RCM)
9	Central Junction Box (CJB)
10	Passenger airbag
11	Passenger airbag deactivation indicator
12	Right front impact sensor
13	Left front impact sensor

Location 2 of 2



Item	Description
1	Right impact pressure sensor
2	Driver seatbelt retractor and pretensioner
3	Driver side airbag
4	Right side air curtain
5	Right rear side impact sensor
6	Left rear side impact sensor
7	Left side air curtain

8	Passenger side airbag
9	Passenger seatbelt retractor and pretensioner
10	Left impact pressure sensor
11	Left front seatbelt buckle
12	Right front seatbelt buckle

OVERVIEW

The Supplemental Restraint System (SRS) provides additional protection for vehicle occupants in certain impact conditions by selective activation of driver and passenger airbags, side airbags, side air curtains and seatbelt pretensioners. Operation of the system is controlled by a Restraints Control Module (RCM).

The RCM receives inputs from various sensors around the vehicle to determine which devices, if any, should be activated during an accident. The inputs include those from an occupant classification system for the front passenger seat (North American Specification (NAS) vehicles only), front and side impact sensors and side impact pressure sensors.

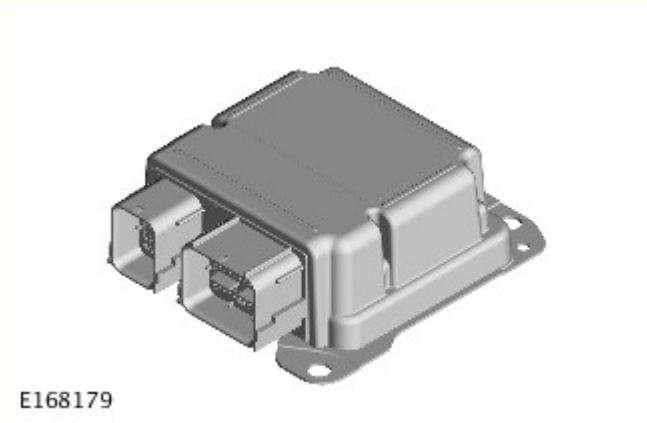
On all except NAS, Australia and Japan market vehicles, the passenger airbag can be enabled and disabled using the vehicle set-up menu in the Instrument Cluster (IC).
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

The activation status of the passenger airbag is given by an indicator in the front overhead console. The status of the SRS is given by an airbag warning indicator in the IC.

The airbags and air curtains feature hybrid inflators, which use a self-contained pyrotechnic device to heat a cylinder of compressed inert gas within the inflator. Above a calibrated pressure, the cylinder bursts and releases the gas into the airbag. The benefits of hybrid inflators are a cooler inflation gas, resulting in lower airbag surface temperatures, and elimination of the post-deployment effluent associated with solid pyrotechnic inflators.

DESCRIPTION

Restraints Control Module (RCM)



The Restraints Control Module (RCM) is installed on top of the floor tunnel, under the floor console, and controls operation of the Supplemental Restraint System (SRS). The main functions of the RCM include:

- Crash detection and recording.
- Airbags, pedestrian protection system and seatbelt pretensioners firing.
- Self-test and system monitoring, with status indication via the airbag warning indicator, and non-volatile storage of fault information.
- Supply of yaw rate and lateral acceleration data for the Anti-lock Brake System (ABS) control module.

The RCM determines which elements of the SRS are to be deployed by using two internal areas:

- Crash severity evaluation.
- Deployment handler.

Crash severity evaluation uses data from the RCM internal accelerometer, the front impact sensors and the seatbelt buckle switches. Based on this data, the RCM decides which level of airbag module deployment is required and forwards the information to the second area, the deployment handler.

The deployment handler evaluates the status of the seat position sensors, seatbelt buckle switches and, on North American Specification (NAS) vehicles, the occupant classification system, before a final decision is made about which restraints should be deployed.

Data from the side impact and pressure sensors is used by the RCM in conjunction with acceleration data from the RCM internal accelerometer to make a deployment decision. The RCM processes the acceleration data and, subject to an impact being of high enough severity, decides whether the side airbag and air curtain should be deployed.

Yaw rate and lateral acceleration data for the ABS control module is derived from the internal accelerometer and transmitted on the High Speed (HS) Controller Area Network (CAN) chassis and powertrain buses.

On board testing of the airbags, pedestrian protection system and pretensioner firing circuits, the warning indicator circuits and the RCM status is performed by the RCM, together with the storing of fault codes. The impact and pressure sensors perform basic self-tests.

The RCM drives the airbag warning indicator via a High Speed (HS) Controller Area Network (CAN) signal. If the warning indicator fails, a fault code is recorded and a warning tone is sounded in place of the indicator if a further fault occurs. In the event of a crash, the RCM records certain data which can be accessed via the diagnostic connector.

A sensor in the RCM provides confirmation of an impact to verify if airbags, pedestrian protection system and pretensioner activation is necessary. A roll-over sensor monitors the lateral attitude of the vehicle. Various firing strategies are employed by the RCM to ensure that during an accident only the appropriate airbags, pedestrian protection system and pretensioners are fired. The firing strategy used also depends on the inputs from the seatbelt buckle switches and, on NAS vehicles, the occupant classification system.

An energy reserve in the RCM ensures there is always a minimum of 150 milliseconds of stored energy available if the power supply from the ignition circuit is disrupted during a crash. The stored energy is sufficient to produce firing signals for the driver airbag, the passenger airbag and the seatbelt pretensioners.

When the ignition is switched on the RCM performs a self-test and then performs cyclical monitoring of the system. If a fault is detected the RCM stores a related fault code and illuminates the airbag warning indicator. The faults can be retrieved by Land Rover approved diagnostic equipment. If a fault that could cause a false fire signal is detected, the RCM disables the respective firing circuit, and keeps it disabled during a crash event.

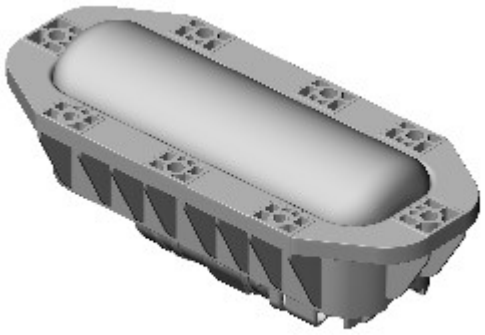
Driver Airbag

E171770

The driver airbag forms the center pad of the steering wheel. It provides head and chest protection for the driver when deployed during a frontal impact.

Lines, molded into the inner surface of the airbag cover, provide weak points that split open in a controlled manner when the airbag deploys. The driver airbag has a single stage inflator for Rest of World (ROW) and dual stage for North American Specification (NAS) markets.

Passenger Airbag



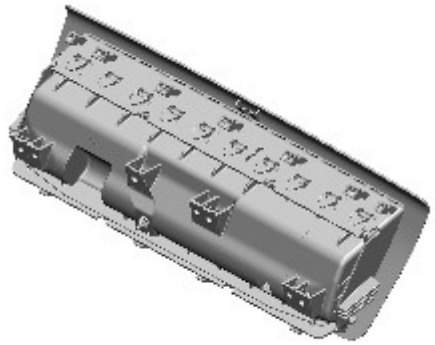
E171771

The passenger airbag is located in the instrument panel, behind the upper glovebox. It provides head and chest protection when deployed during a frontal impact.

The top of the passenger airbag is attached to a channel chute underneath the top pad of the instrument panel. Doors in the top of the channel chute are forced open, and split the top pad, when the airbag deploys.

The passenger airbag has a single stage inflator for ROW and dual stage for NAS markets.

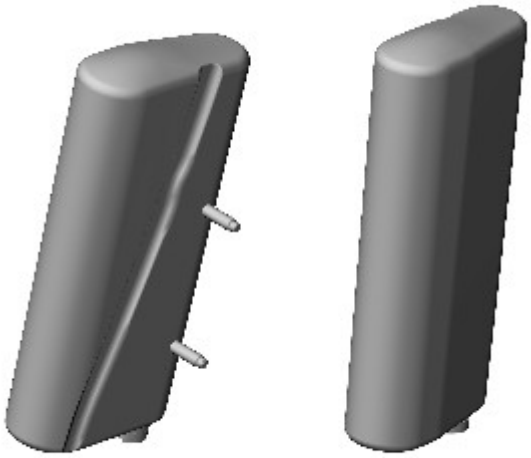
Driver Lower Airbag



E171773

The driver lower airbag has a single stage inflator. The module has an integral door and is attached to the lower trim panel beneath the steering column. Weak points in the door break in a control manner to allow the door to hinge downward when the airbag deploys.

Side Airbag



E171772

The side airbags are attached to the outside of each front seat backrest frame, under the backrest cover. They provide protection for the thorax, rib and pelvis when deployed during a side impact.

The side airbags are handed and each consists of a folded airbag and an inflator in a soft cover/wrapper. When the airbag deploys it fills within a deployment chute integrated into the seat trim, and splits open the airbag deployment seam in the backrest cover.

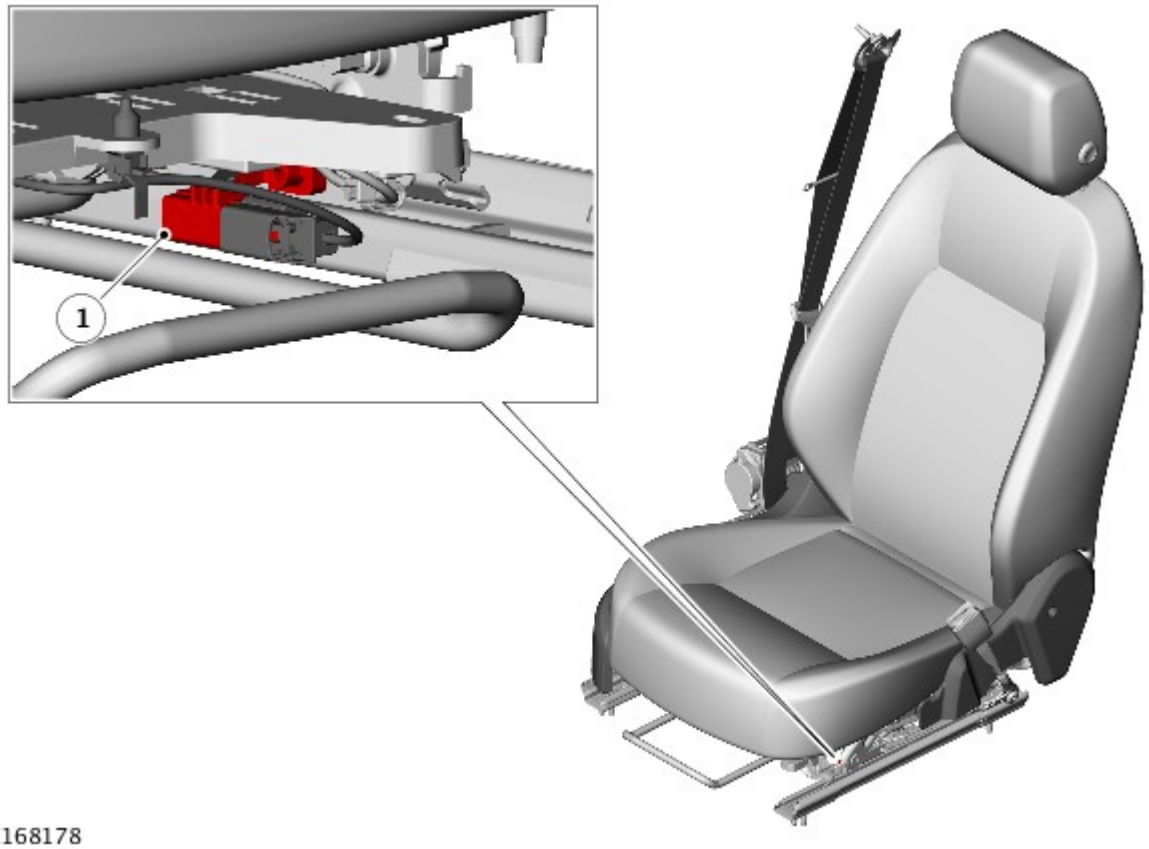
Side Air Curtains

E171774

The side air curtains are installed along both sides of the car, under the edges of the headliner. They provide head protection and roll-over ejection protection for outer seat occupants, in both the front and rear of the vehicle, when deployed during a side impact.

The front and rear ends of the side air curtains are anchored to the body, to maintain tension across their lower edges of the air curtains when they deploy. Their deployment area extends between the A and C pillar trims, passing over the upper B pillar trim.

Driver Seat Position Sensor



E168178

Item	Description
1	Driver seat position sensor

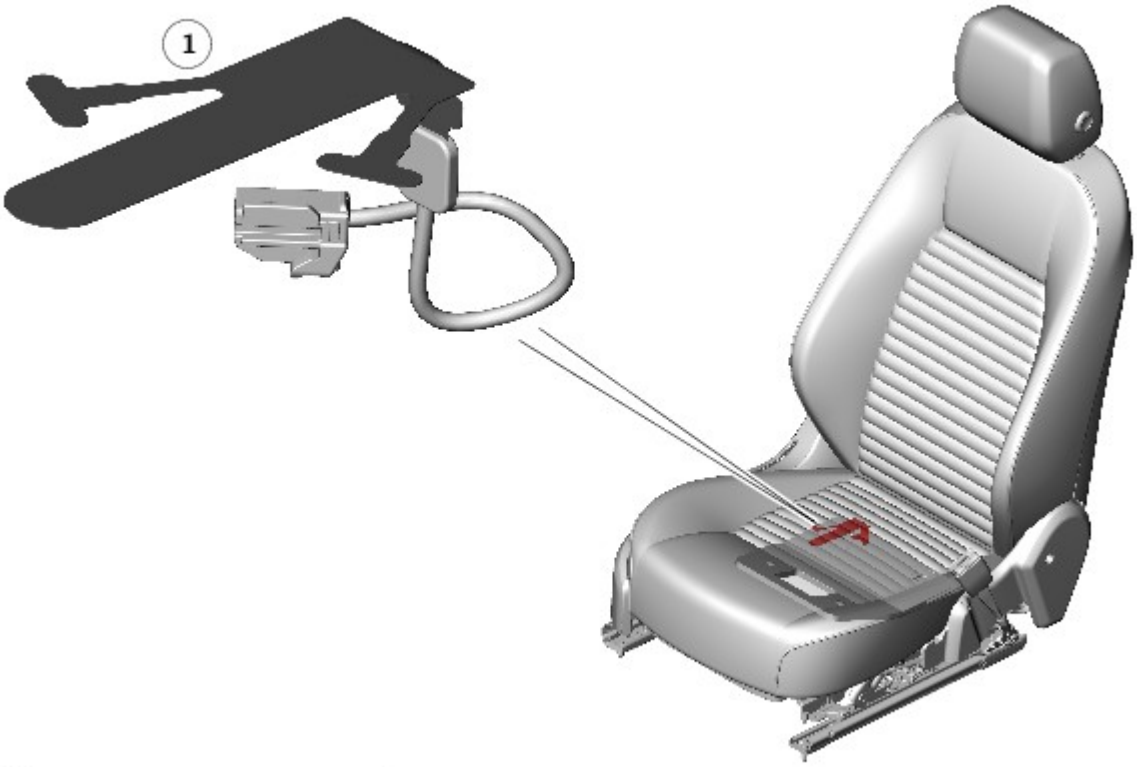
The driver seat position sensor, a 'Hall effect' type, is fitted to the underside of the driver's seat. The sensor is actuated by the target bracket attached to the seat slide. The disturbance caused when the target bracket passes the sensor creates an output signal for the Restraint Control Module (RCM). On receipt of this signal, which indicates when the seat is forward of a defined point in its travel, the RCM disables the second stage output of the driver airbag.

Occupant Monitoring

There are two types of occupant monitoring:

- In all markets except North American Specification (NAS), vehicles have an occupant detection sensor.
- In NAS markets, vehicles have an occupant classification sensing.

Occupant Detection Sensor

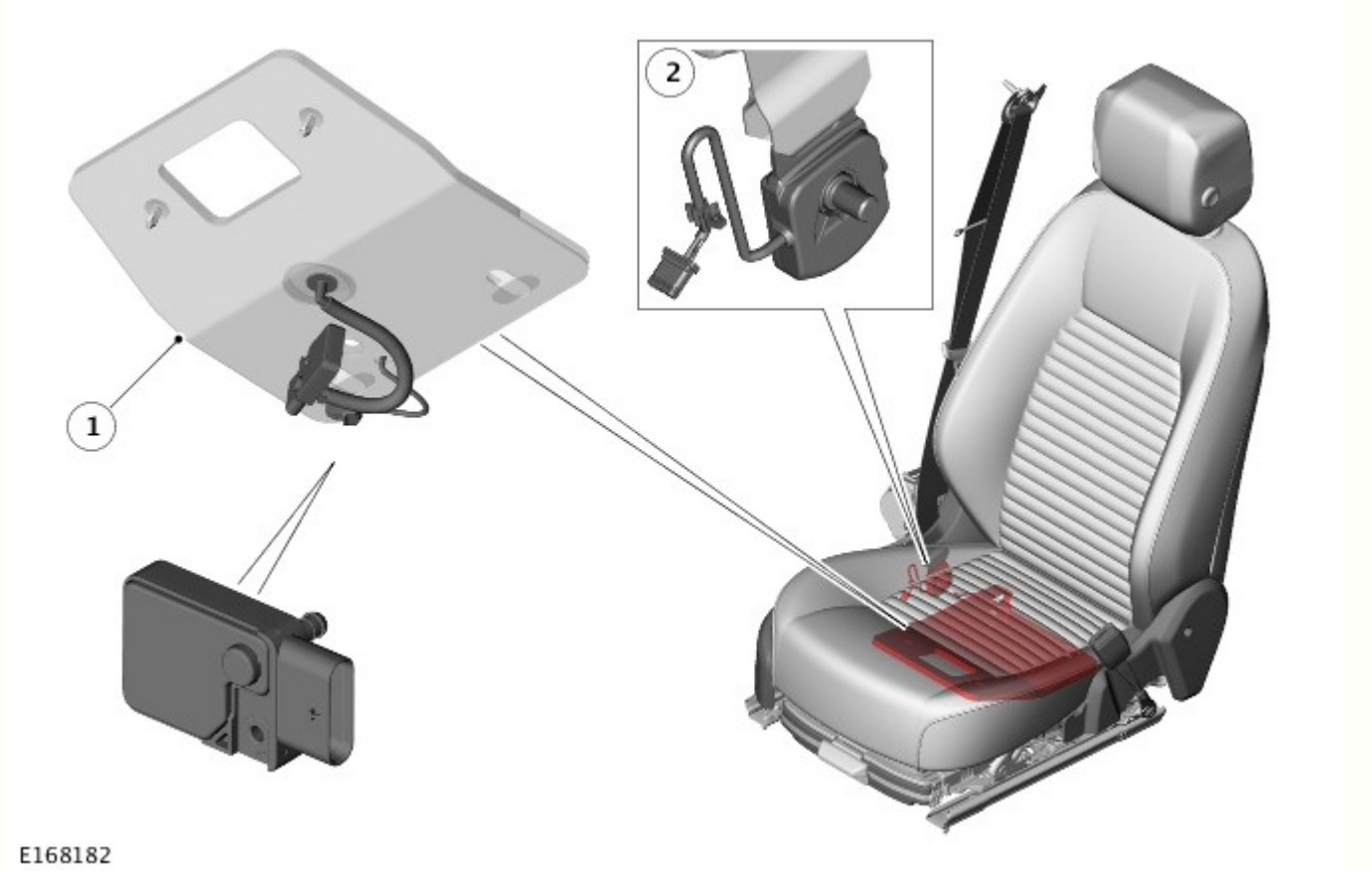


Item	Description
1	Occupant detection sensor

The occupant detection sensor is installed in the cushion of the front passenger seat, between the foam padding and the cover. The sensor consists of a foil contact circuit, embedded in a plastic sheet. Weight on the sensor reduces the resistance of the circuit, which is detected by the Central Junction Box (CJB).

The occupant detection sensor has no interface with the SRS. It only provides an input to the CJB for the seatbelt reminder function.
For additional information, refer to: Safety Belt System (501-20A Safety Belt System, Description and Operation).

Occupant Classification Sensing



Item	Description
1	Occupant Classification Sensor Control Module (OCSCM)
2	Seatbelt tension sensor

In North American Specification (NAS) markets where safety belt use is infrequent, additional technology is used to classify the occupant of the front passenger seat. The occupant classification sensing system provides seat load data to the Restraints Control Module (RCM).

The occupant classification system consists of:

- The OCSCM (Occupant Classification Sensor Control Module), installed under the front passenger seat.
- A pressure pad, installed under the cushion of the front passenger seat, which is connected to the OCSCM.
- A seatbelt tension sensor, integrated into the anchor point of the front passenger seatbelt.

The pressure pad is a silicone filled bladder. Any load on the pressure pad is detected by the OCSCM. The seatbelt tension sensor is a strain gauge which measures the load applied by the seatbelt anchor to the anchor bolt. The sensor is located in the lower seatbelt anchor point.

CAUTION: The occupant classification sensor control module, hose and pressure pad form a sealed assembly and must not be disassembled. The assembly can only be replaced as part of the occupant classification sensing service kit. The service kit includes the seat cushion pad, because the assembly is specifically calibrated to the pad, and each pad has a unique calibration.

The OCSCM supplies a reference voltage to the seatbelt tension sensor and, from the return signal, measures the load acting on the seatbelt anchor. The measurement is used to produce a correction factor for the load acting on the pressure pad. The tightness of the seatbelt affects the load acting on the pressure pad, so without the correction factor the OCSCM cannot derive an accurate occupancy status.

The OCSCM translates the load readings into a seat occupancy status and transmits the result to the RCM, on the High Speed (HS) Controller Area Network (CAN) powertrain bus.

The RCM monitors and processes the data from the OCSCM before making an airbag deployment decision. The system is designed to take account of several variables in addition to weight, including: inclination of the vehicle and exact position and structure of the weight on the seat.

This protects against inadvertent airbag deployment, for example, if the seat were occupied by an infant in a booster seat, or an unrestrained but very lightweight adult, in both these cases the airbag would be disabled. The occupant classification sensing system forms part of a strategy to control passenger airbag deployment depending on the occupancy scenario.

The occupant classification sensing has four possible states:

- **Seat Empty:** the passenger airbag, passenger side airbag and passenger seatbelt pretensioner operation is disabled; the passenger airbag deactivation warning indicator is not illuminated.
- **Occupied Inhibit:** when the seat is occupied by a small person, the passenger airbag, passenger side airbag and passenger seatbelt pretensioner operation is disabled; the passenger airbag deactivation warning indicator is illuminated.
- **Occupied Allow:** when the seat is occupied by a large person; the passenger airbag and passenger side airbag operation is enabled, the passenger airbag deactivation warning indicator is not illuminated. Passenger seatbelt pretensioner operation status depends on the seatbelt buckle status:
  - Active for buckled.
  - Inactive for unbuckled.
- **Error:** if a system fault is detected; the passenger airbag is enabled to deploy at 'stage-1' only, refer to airbag Dual Stage Inflators below. Passenger-side airbag operation is also enabled; the passenger airbag deactivation indicator is not illuminated. Passenger seatbelt and pretensioner operation status depends on the seatbelt buckle status:
  - Active for buckled.
  - Inactive for unbuckled.

Passenger Airbag Deactivation Indicator

Item	Description
1	Passenger airbag deactivation warning indicator

The Passenger Airbag Deactivation (PAD) warning indicator is installed in the front overhead console. When appropriate, the indicator illuminates to advise front seat occupants that the passenger airbag is disabled. Operation of the indicator is controlled by the Restraints Control Module (RCM) connecting/disconnecting a ground signal from the indicator. The RCM illuminates the indicator when:

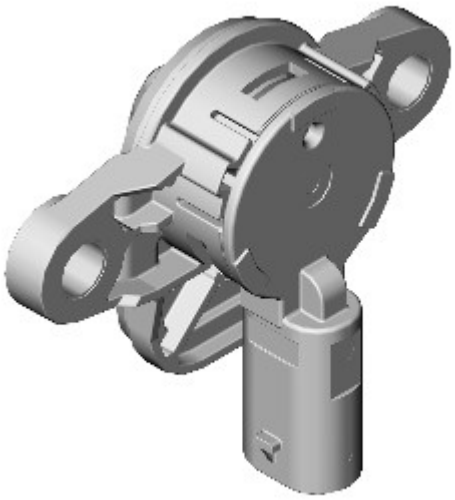
- There is a fault with the passenger airbag firing circuits.
- The passenger airbag is disabled in the Instrument Cluster (IC) set-up menu and the front passenger seat is occupied (all except NAS, Australia and Japan).
- • Required by the occupant classification system (NAS only).

Airbag Warning Indicator

E142265

Operation of the airbag warning indicator in the Instrument Cluster (IC) is controlled by a High Speed (HS) Controller Area Network (CAN) powertrain bus systems message from the Restraints Control Module (RCM). The RCM sends the signal to illuminate the airbag warning indicator if a fault is detected, and for approximately 6 seconds during the bulb check at the beginning of each ignition cycle.

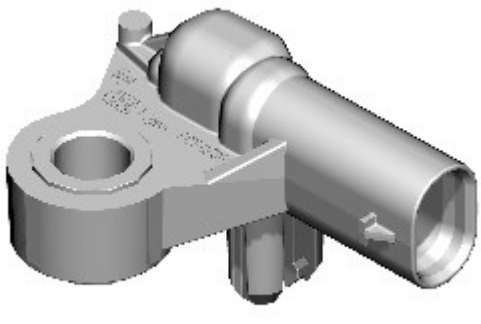
Impact Pressure Sensor



E168181

An impact pressure sensor is installed in each front door, attached to the door closing panels. The pressure sensors allow the Restrains Control Module (RCM) to detect any sudden pressure pulse that occurs in the front door during a side impact.

Impact Sensor

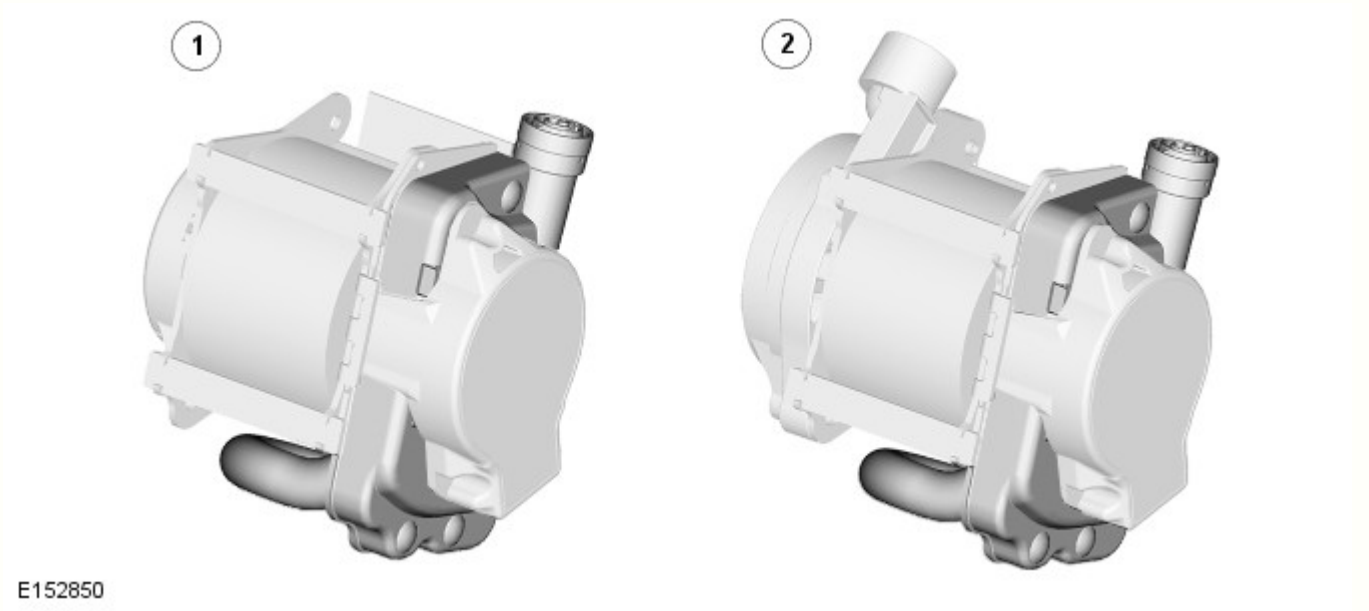


E173725

Impact sensors are installed in the front and both sides of the vehicle. The two front impact sensors are attached to the front end carrier, behind the inboard edge of each headlamp. The side impact sensors are attached to the base of each C/D pillar and to the inner panel of each rear quarter wheel housing, adjacent to the rear door latch strikers.

The impact sensors are accelerometers that allow the Restraints Control Module (RCM) to detect the sudden vehicle acceleration that occurs during an impact.

Pretensioners

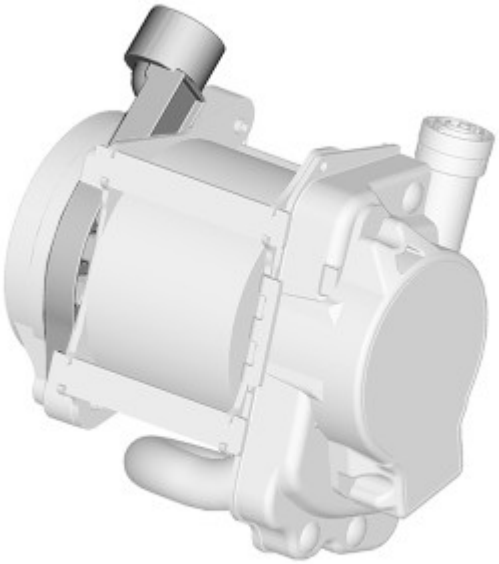


Item	Description
1	Seatbelt retractor and pretensioner (all except North American Specification (NAS) passenger seatbelt)
2	Seatbelt retractor, pretensioner and load limiter (NAS passenger seatbelt only)

A pyrotechnic pretensioner is integrated into each seatbelt retractor. The pretensioners are used to tighten the seatbelts during a collision to ensure the occupants are securely held in their seats.

When operated by the Restraints Control Module (RCM), the pretensioners rotate the spool holding the end of the webbing to tighten the seatbelt.

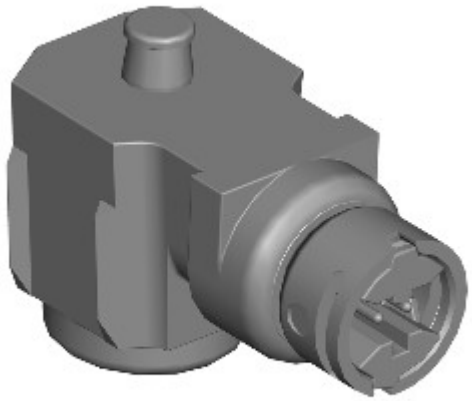
Load Limiter Actuator (NAS Passenger Seatbelt Only)



E152851

On North American Specification (NAS) vehicles, a pyrotechnic load limiter actuator is incorporated into the retractor of the passenger seatbelt to provide an adaptive load limiter. The adaptive load limiter has two different load limits, the standard load limit and a lower load limit. The lower load limit is designed to reduce the chest loading for smaller seat occupants during an impact, and is engaged when the Restraints Control Module (RCM) fires the load limiter actuator.

Steering Column Collapse Actuator (NAS Market)



E160495

A steering column collapse actuator is installed to provide increased energy absorption, if a crash situation occurs.

For additional information, refer to: Steering Column (211-04 Steering Column, Description and Operation)..

OPERATION

In a collision, the force of the impact is measured by the impact sensors, impact pressure sensors and the Restraints Control Module (RCM). The RCM evaluates the readings to determine the impact point on the vehicle and whether the readings exceed the limits for firing any of the airbags and pretensioners. During a collision, the RCM only fires the airbags, air curtains and pretensioners if the safing function confirms that the data from the impact sensor(s) indicates an impact limit has been exceeded.

The RCM incorporates the following impact thresholds to cater for different accident scenarios:

- Front impact, pretensioners.
- Front impact, driver and passenger airbags stage 1, belt unfastened.
- Front impact, driver and passenger airbags stage 1, belt unfastened.
- Front impact, driver and passenger airbags stage 2, belt unfastened.
- Front impact, driver and passenger airbags stage 2, belt fastened.
- Rear impact.
- Driver side impact.
- Passenger side impact.

Firing Strategies

The seatbelt pretensioners are fired when the pretensioner impact limit is exceeded. The RCM only fires the pretensioners if the related seatbelt is fastened.

The driver and passenger airbags are only fired in a frontal impact.

On North American Specification (NAS) vehicles, the passenger airbag is disabled unless the front passenger seat is occupied by a large person. In all markets except NAS, Australia and Japan, the passenger airbag can be selected off in the vehicle Set-up menu of the Instrument Cluster (IC).

If there is a fault with a seatbelt buckle switch, the RCM assumes the related seatbelt is fastened for the pretensioner firing strategy and unfastened for the driver and passenger airbag firing strategies. If there is a fault with the occupant classification sensor, the RCM disables the passenger airbag. If there is a fault with the passenger airbag deactivation switch, the RCM disables the passenger airbag.

If a side impact limit is exceeded, the RCM fires the side airbag and the side head airbag on that side of the vehicle. If the side impact limit on the front passenger side of the vehicle is exceeded, the RCM also evaluates the input from the occupant classification sensor, and fires the side airbag only if the front passenger seat is occupied by a large person (NAS only).

If multiple impacts occur during a crash event, after responding to the primary impact the RCM will output the appropriate fire signals in response to any further impacts if unfired units are available.

Front and Rear Impact Firing Strategy (All Except NAS)

Seatbelt Status		Strategy		
Driver	Front Passenger	Applicable Pretensioner	Driver Airbag	Passenger Airbag
Fastened	-	Fired at pretensioner threshold	Fired at belt fastened threshold	-
Unfastened	-	Not fired	Fired at belt unfastened threshold	-
-	Fastened	Fired at pretensioner threshold	-	Fired at belt fastened threshold
-	Unfastened	Not fired	-	Fired at belt unfastened threshold

Front and Rear Impact Firing Strategy (NAS)

Steatbelt Status			Strategy		
Driver	Passenger	Passenger Seat Classification	Applicable Pretensioner	Driver Airbag	Passenger Airbag
Fastened	-	-	Fired at pretensioner threshold	Fired at belt fastened threshold	-
Unfastened	-	-	Not fired	Fired at belt unfastened threshold	-
-	Fastened	Occupied allow	Fired at pretensioner threshold	-	Fired at belt fastened threshold
-	Fastened	Occupied inhibit or empty	Fired at pretensioner threshold	-	Not fired
-	Unfastened	Occupied allow	Not fired	-	Fired at belt unfastened threshold
-	Unfastened	Occupied inhibit or empty	Not fired	-	Not fired

Crash Signal

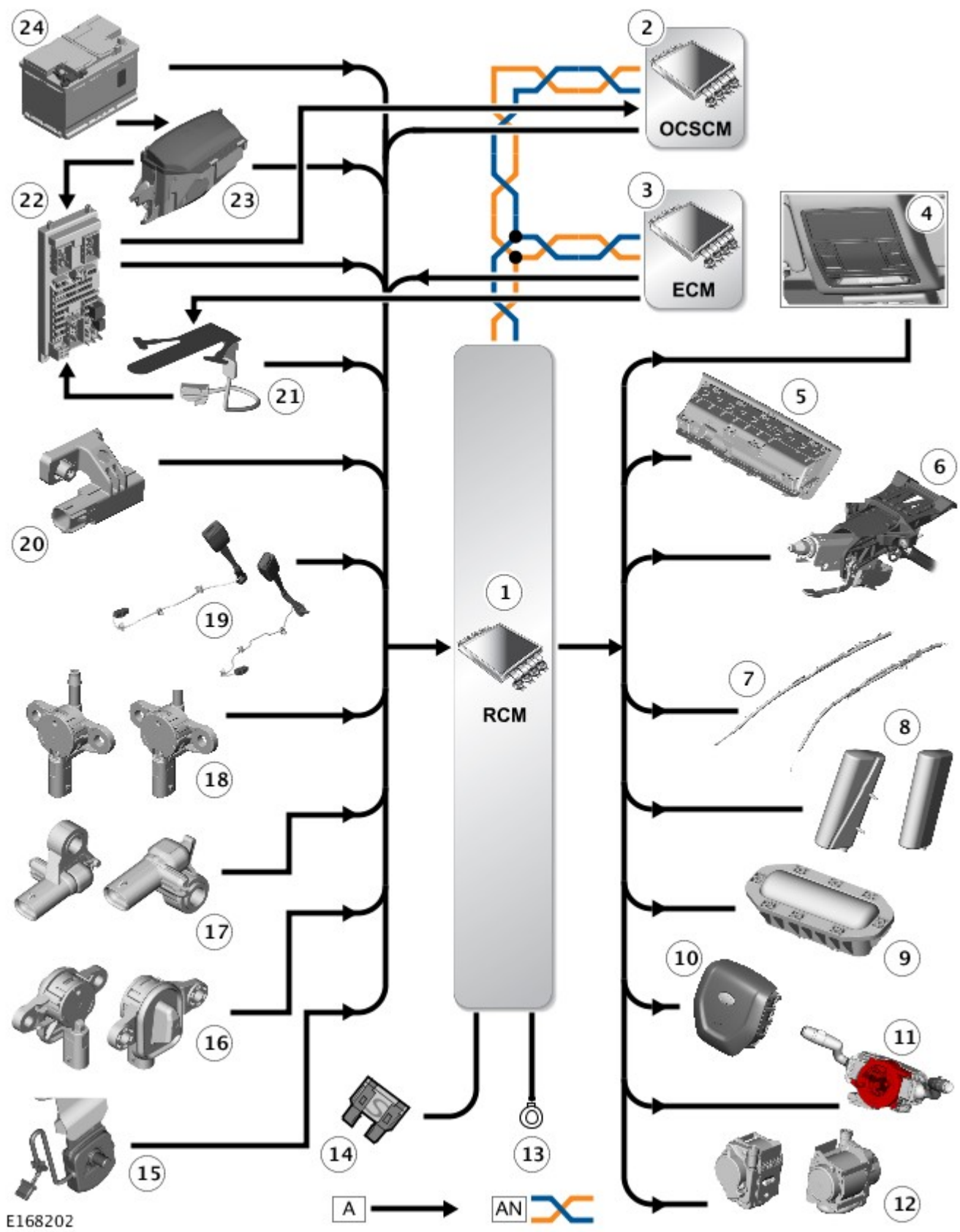
When the Restraints Control Module (RCM) outputs any of the fire signals it also outputs a crash signal to the Central Junction Box (CJB) and the Engine Control Module (ECM) on the High Speed (HS) Controller Area Network (CAN) powertrain bus systems. The crash signal is also hardwired to the ECM and the CJB. On receipt of the crash signal, the ECM cuts the power supply to the fuel pump relay and the CJB goes into crash mode. In the crash mode, the CJB:

- Activates all of the unlock signals of the vehicle locking system, even if the vehicle is already unlocked.

- Ignores all locking/superlocking inputs until it receives an unlock input, when it returns the locking system to normal operation.
- Activates the interior lamps. The interior lamps remain on permanently until they are manually switched off at the lamp unit, or the CJB crash mode is switched off and they return to normal operation.
- Disables the rear window child lock input until the crash mode is switched off.
- Activates the hazard flashers. The hazard flashers remain on until cancelled by the hazard warning switch or the crash mode is switched off.

The CJB crash mode is switched off by a valid locking and unlocking cycle of the locking system.

CONTROL DIAGRAM



Item	Description
1	Restraints Control Module (RCM)
2	Occupant Classification Sensor Control Module (OCSCM)
3	Engine Control Module (ECM)
4	Passenger airbag deactivation indicator
5	Driver lower airbag
6	Steering column collapse actuator
7	Side air curtains
8	Side airbags
9	Passenger airbag
10	Driver airbag
11	Clockspring (CLKSPG)
12	Pretensioners
13	Ground
14	Power supply
15	Seatbelt tension sensor
16	Impact pressure sensor
17	Side impact sensors
18	Pedestrian Protection System Control Module (PPSCM)
19	Seatbelt buckle
20	Driver seat position sensor
21	Occupant detection sensor
22	Central Junction Box (CJB)
23	Battery Junction Box (BJB)
24	Battery

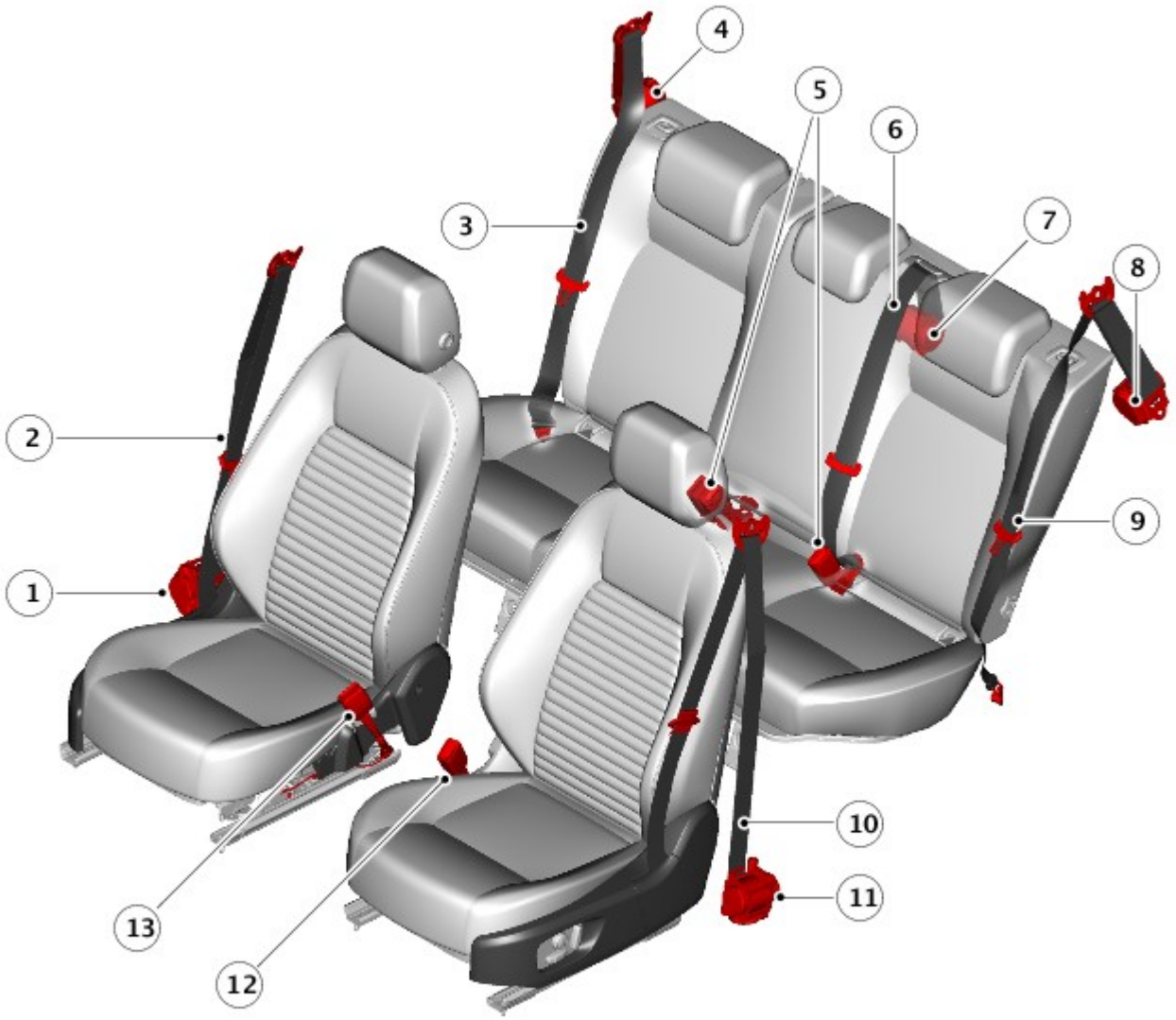
Published: 26-Jan-2015

Safety Belt System - Safety Belt System

Description and Operation

COMPONENT LOCATION

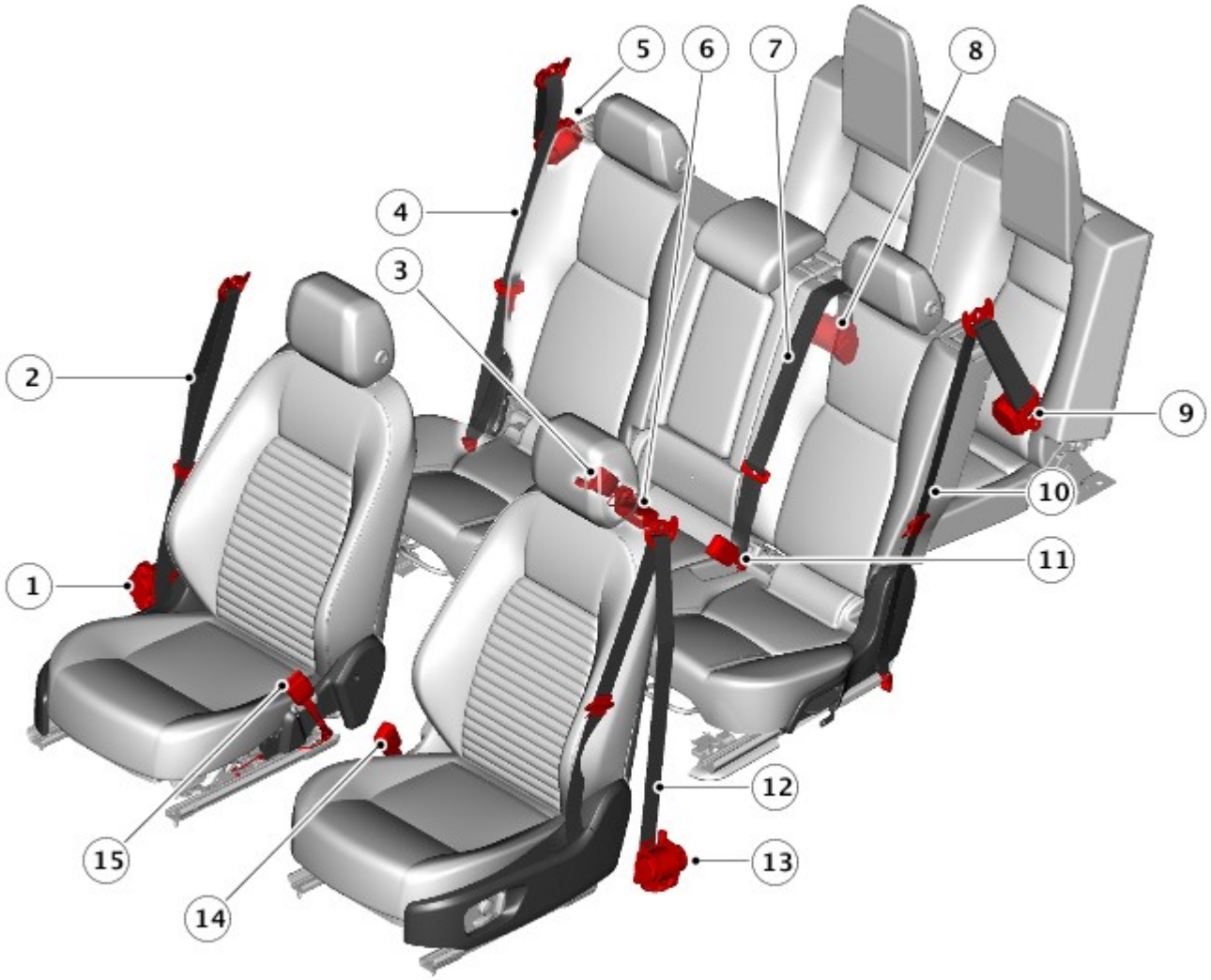
Component Location - Sheet 1 of 3 - 5 Seat Vehicles



E168135

Item	Description
1	Front right seatbelt retractor and pretensioner
2	Front right seatbelt
3	Rear right seatbelt
4	Rear right seatbelt retractor
5	Rear seatbelt buckles
6	Rear center seatbelt
7	Rear center seatbelt retractor
8	Rear left seatbelt retractor
9	Rear left seatbelt
10	Front left seatbelt
11	Front left seatbelt retractor and pretensioner
12	Front left seatbelt buckle
13	Front right seatbelt buckle

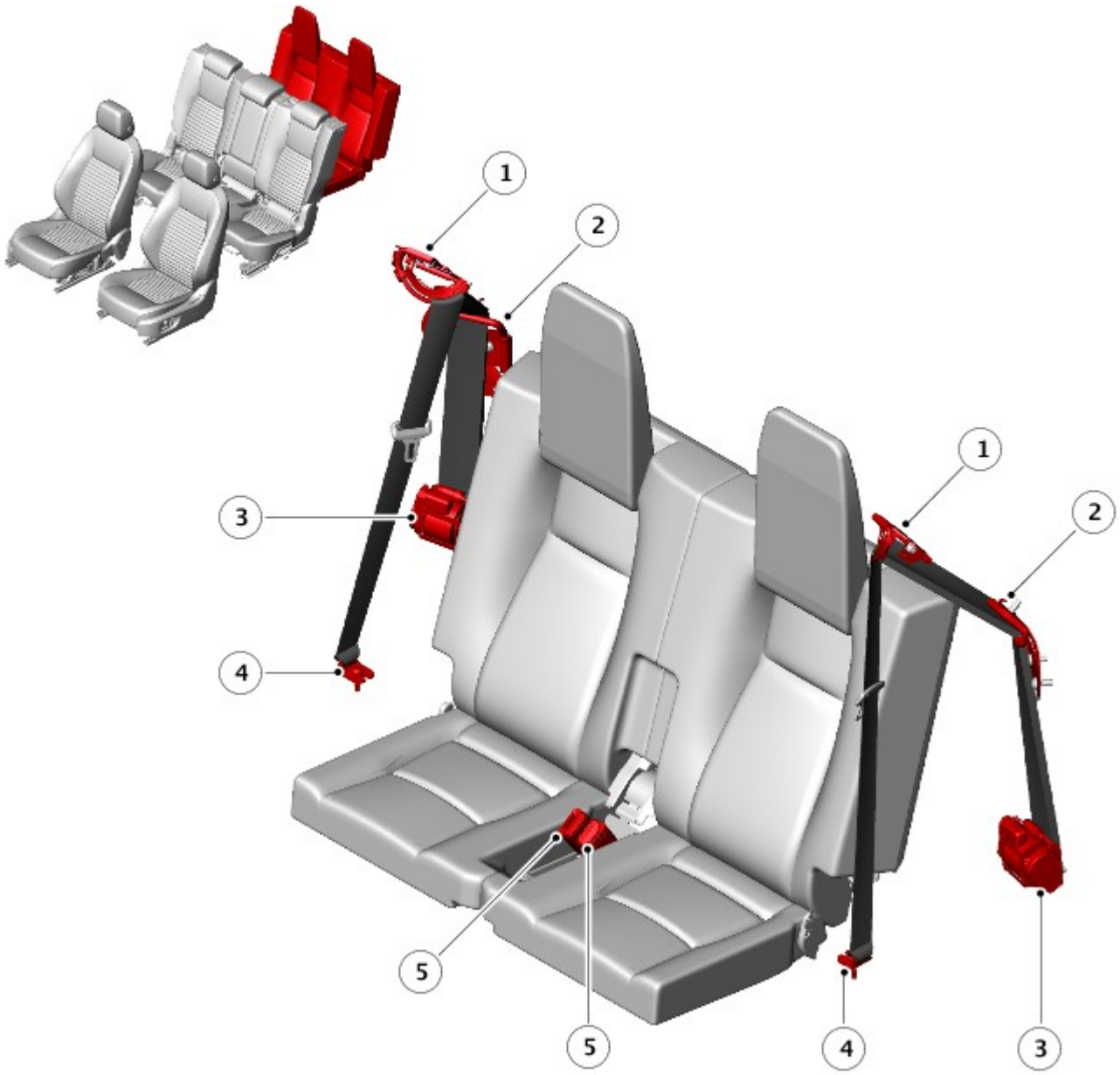
Component Location - Sheet 2 of 3 - 7 Seat Vehicles



E172754

Item	Description
1	Front right seatbelt retractor and pretensioner
2	Front right seatbelt
3	Rear right seatbelt buckle
4	Rear right seatbelt
5	Rear right seatbelt retractor
6	Rear center seatbelt buckle
7	Rear center seatbelt
8	Rear center seatbelt retractor
9	Rear left seatbelt retractor
10	Rear left seatbelt
11	Rear left seatbelt buckle
12	Front left seatbelt
13	Front left seatbelt retractor and pretensioner
14	Front left seatbelt buckle
14	Front right seatbelt buckle

Component Location - Sheet 3 of 3 - 7 Seat Vehicles



E172076

Item	Description
1	Upper Seatbelt mounting
2	Lower seatbelt mounting
3	Seatbelt retractor
4	Seatbelt anchor
5	Seatbelt buckle
6	Rear center seatbelt

OVERVIEW

A 3 point seatbelt is installed in all seating positions. Each seatbelt has emergency locking retractor functionality.

The emergency locking retractor function incorporates a lift shaft locking system with webbing sensor and car sensing activating mechanisms. The webbing sensor activates the locking mechanism if the webbing is subjected to a sharp pull. The car sensor activates the locking system if the vehicle is subjected to sudden deceleration or severe tilt angle.

A pretensioner is incorporated into the retractor of each front seatbelt and each third row seatbelt. The pretensioners, in the retractors are pyrotechnic devices that are controlled by the Restraints Control Module (RCM) in the Supplementary Restraint System (SRS).
For additional information, refer to: Air Bag Supplemental Restraint System (SRS) (501-20B, Description and Operation).

All row 2 passengers and front passenger emergency locking retractors are enhanced with automatic locking retractors North American Specification (NAS) only.

The automatic locking retractor allows webbing to be extracted to activate a ratchet device. This device allows webbing to be cinched tight to facilitate child seat fitment. With seatbelt webbing tensioned in automatic locking retractor mode the seatbelt is always locked.

A seatbelt warning indicator is installed in the Instrument Cluster (IC) to remind the all seat occupants to fasten their seatbelts. On NAS vehicles, when the ignition mode is accessory/convenience, the warning indicator illuminates if the seatbelt of an occupied front seat is not fastened. The warning indicator remains illuminated until the seatbelt of each occupied front seat is fastened, or the ignition mode is warning indicator is off. In all markets except NAS, a belt minder function provides a more intrusive reminder to fasten the front seatbelts.

DESCRIPTION

Second Row Seatbelts - 5 Seat Vehicles

The retractor of each outboard second row seatbelt is attached to the body immediately behind the C pillar. The webbing runs from the retractor, through an upper mounting on the C pillar, to an anchor point at the front of the related wheel arch.

The retractor for the center second row seatbelt is installed in the top of the seat back. The webbing runs from the retractor, over the top of the seat, to an anchor point at the base of the seat frame.

The buckles for the second row seatbelts are attached to the rear floor.

Second Row Seatbelts - 7 Seat Vehicles

The retractor of each outboard second row seatbelt is attached to the body immediately behind the C pillar. The webbing runs from the retractor, through an upper mounting on the C pillar, to an anchor point at the front of the related wheel arch.

The retractor for the center second row seatbelt is installed in the top of the seat back. The webbing runs from the retractor, over the top of the seat, to an anchor point at the base of the seat frame.

The buckles for the second row seatbelts are attached to the seat frame.

Third Row Seatbelts

The retractor of each third row seatbelt is attached to the body D the pillar. The webbing runs from the retractor, through two mountings on the D pillar, to an anchor point on the load space floor.

The buckles for the third row seatbelts are attached to the third row seat frame.

OPERATION

Front Belt Minder Function

The belt minder function provides warnings to the driver if the appropriate front seatbelts are not fastened when driving. The belt minder function is controlled by the IC using:

- High Speed (HS) Controller Area Network (CAN) Powertrain bus messages, from the RCM, to monitor the status of the front seatbelts.
- An input from the occupant detection sensor to monitor the status of the front passenger seat Rest Of the World (ROW).
- An input from the Occupant Classification Sensor Control Module (OCSCM) via HS CAN Powertrain bus to monitor the status of the front passenger seat (NAS).

When the ignition is switched to on, the IC illuminates the seatbelt warning indicator until one of the front seatbelts is fastened or the belt minder function is triggered. The belt minder function is triggered when the ignition switch is in accessory/convenience and the following conditions coexist:

- The belt minder function is enabled
- The vehicle is not in reverse
- Vehicle speed is initially set at 20 km/h (12mph) or more, then afterwards from 10 km/h (6mph) or more until ignition - cycled
- The driver seatbelt or, if the front passenger seat is occupied, the front passenger seatbelt, is unfastened.

When the belt minder is triggered, the IC generates the following warnings repeated for 10 seconds for a total of approximately 190 seconds

 NOTE: NOTE: There are slight timing differences between ROW and Federal USA (second is driver only, lights only) vehicles.

- Flashes the seatbelt warning indicator at 2 Hz.

After 10 seconds the seatbelt warning indicator changes from flashing to continuously illuminated for 20 seconds. While the trigger conditions still coexist, the warnings are repeated every 30 seconds until one of the following occurs:

- Approximately 3 minutes has elapsed from when the warnings were first triggered
- The seatbelt of each occupied front seat is fastened
- The ignition mode is position 0.

For non-Federal USA vehicles the belt minder function can be enabled and disabled using the driver seatbelt switch. The belt minder function can also be enabled and disabled using the recommended Land Rover diagnostic tool.

Successful completion of the change is indicated by a single chime and the seatbelt warning indicator flashing five times, at 2 Hz.

Seatbelt Warning Indicator

E135005

Visual Beltminder

A front and rear seat Beltminder system warns the driver when the seatbelt of an occupied seat is not fastened or is unfastened during a journey.

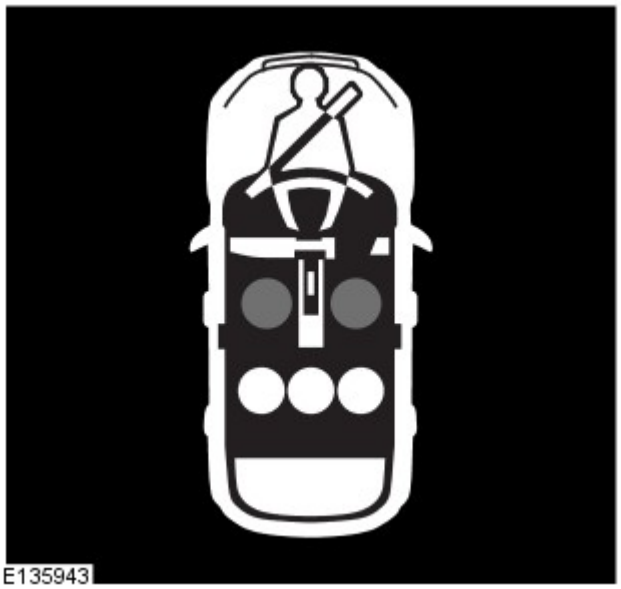


Diagram shows Beltminder located in the middle of the instrument cluster message center.

A graphic in "Visual Beltminder" indicates which seat belts are fastened at the start of a journey and also when a seat belt is fastened or unfastened during a journey. Each seating position is represented by a passenger icon, the color of which indicates the seatbelt status:

- Green - seatbelt in the indicated position is fastened
- Red - seatbelt in the indicated position has been unfastened while the vehicle ignition is on
- Grey - seatbelt not fastened, a red symbol will turn grey after 30 seconds.

NOTE: NOTE: The indicators will be displayed each time there is a status change, e.g., a seat belt is unfastened or a door is opened and then closed.

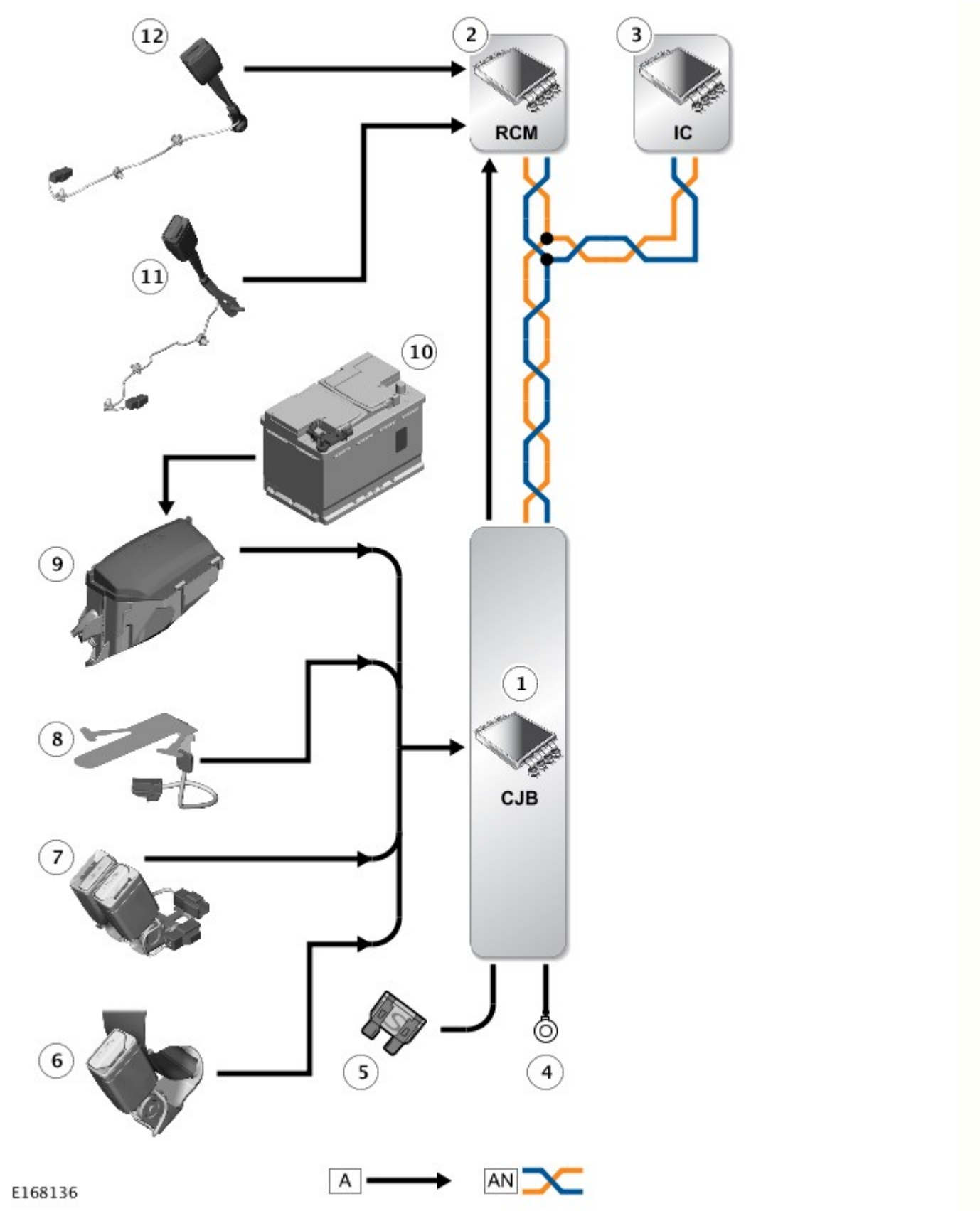
In addition, an audible warning will sound under the following conditions:

NOTE: NOTE: If a heavy object is placed on the front passenger seat, it may activate the Beltminder feature. It is recommended that any objects placed on the front passenger seat are secured using the seatbelt.

- The seatbelt of an occupied front seat is not fastened or is unfastened during a journey
- A rear seatbelt is unfastened.

Input/Output Diagram

INPUT/OUTPUT DIAGRAM - SHEET 1 OF 4 - ROW - 5 SEAT VEHICLES

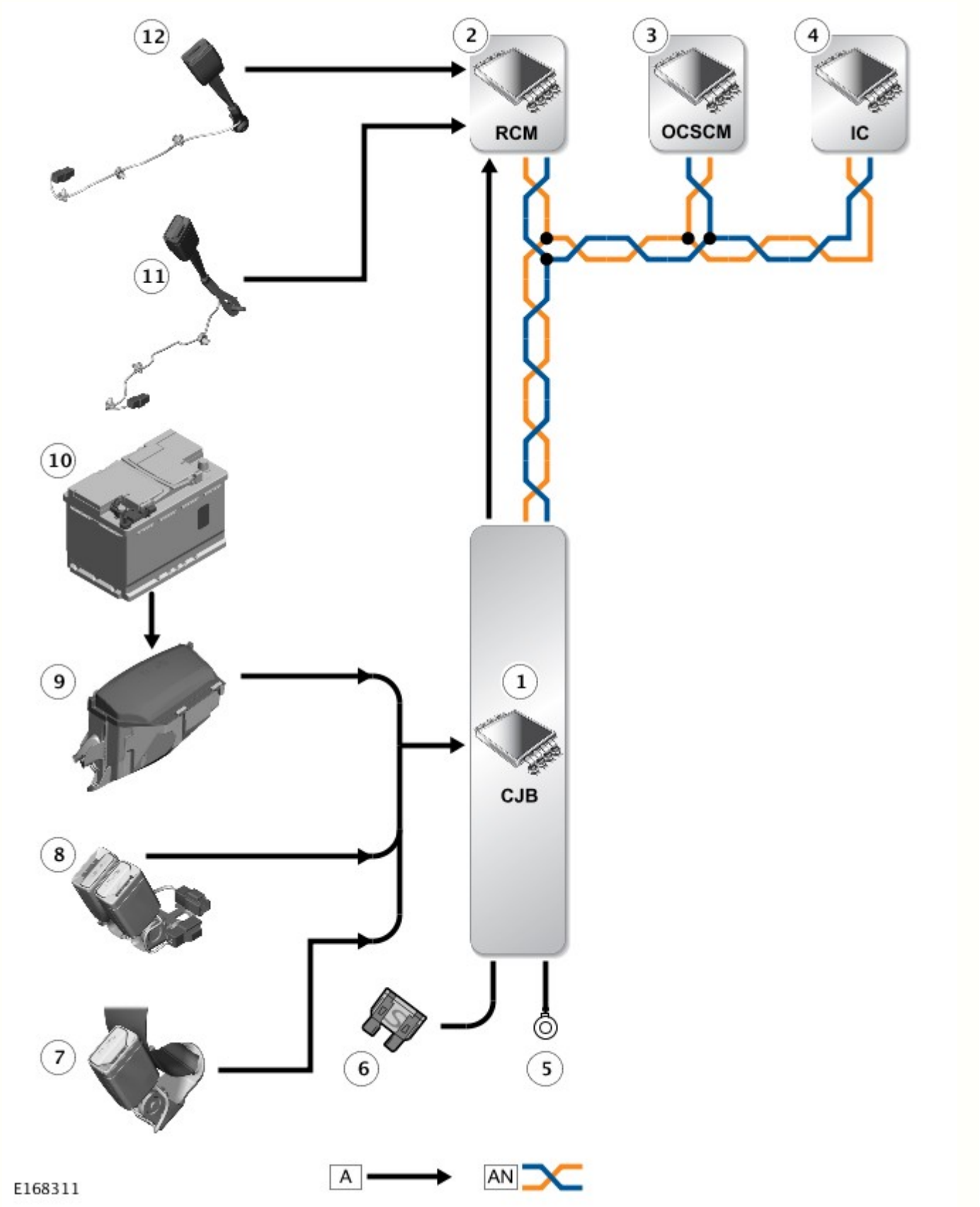


A = Hardwired; AN = High Speed (HS) Controller Area Network (CAN) Powertrain bus.

Item	Description
1	CJB
2	RCM
3	IC
4	Ground
5	Fuse
6	Rear seatbelt buckle

7	Rear seatbelt buckle
8	Occupant detection sensor
9	Battery Junction Box (BJB)
10	Battery
11	Driver seat seatbelt buckle
12	Passenger seat seatbelt buckle

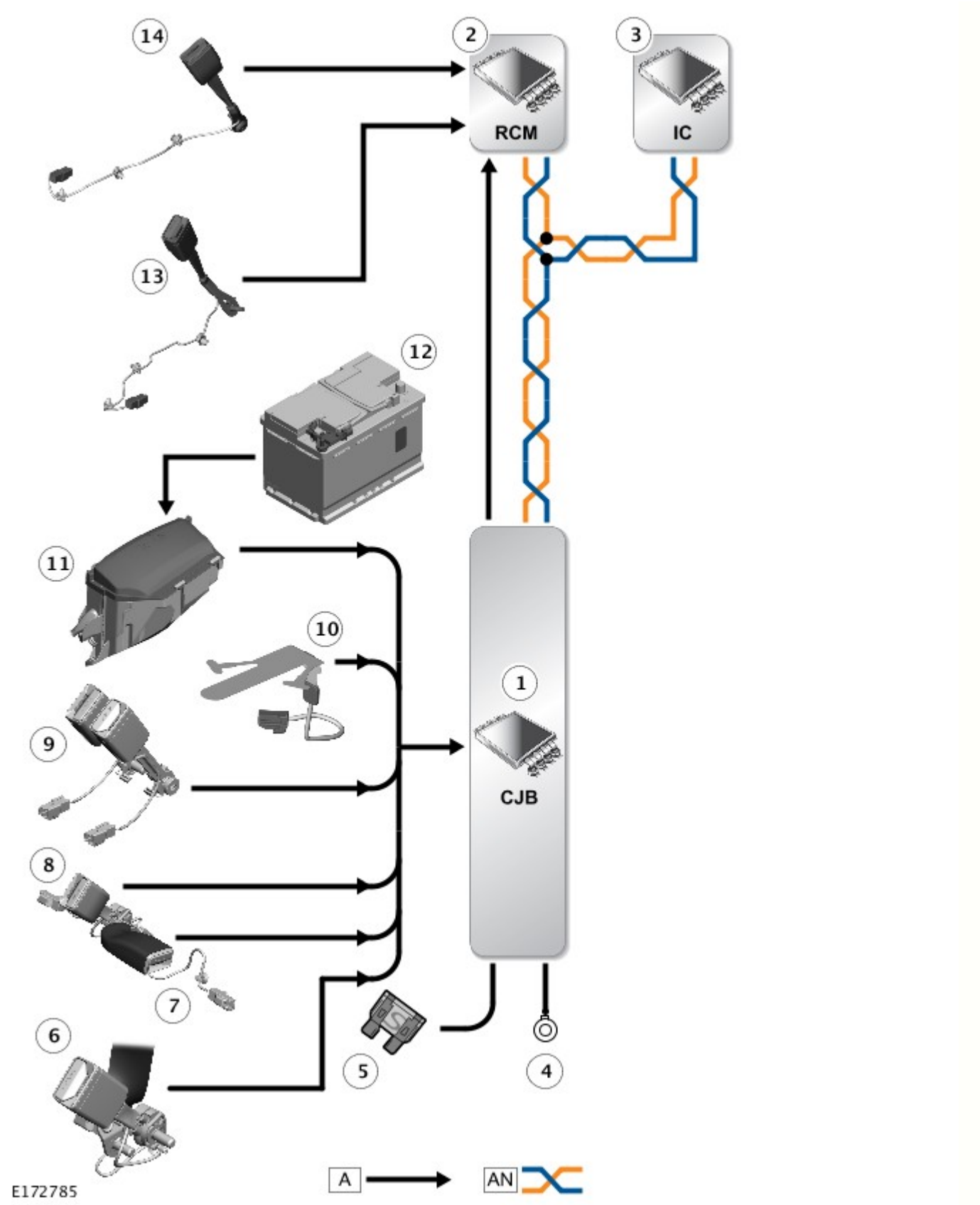
INPUT/OUTPUT DIAGRAM - SHEET 2 OF 4 - NAS - 5 SEAT VEHICLES



A = Hardwired; AN = High Speed (HS) Controller Area Network (CAN) Powertrain bus.

Item	Description
1	CJB
2	RCM
3	OCSCM
4	IC
5	Ground
6	Fuse
7	Rear seatbelt buckle
8	Rear seatbelt buckle
9	Junction Box (BJB)
10	Battery
11	Driver seat seatbelt buckle
12	Passenger seat seatbelt buckle

INPUT/OUTPUT DIAGRAM - SHEET 3 OF 4 - ROW - 7 SEAT VEHICLES

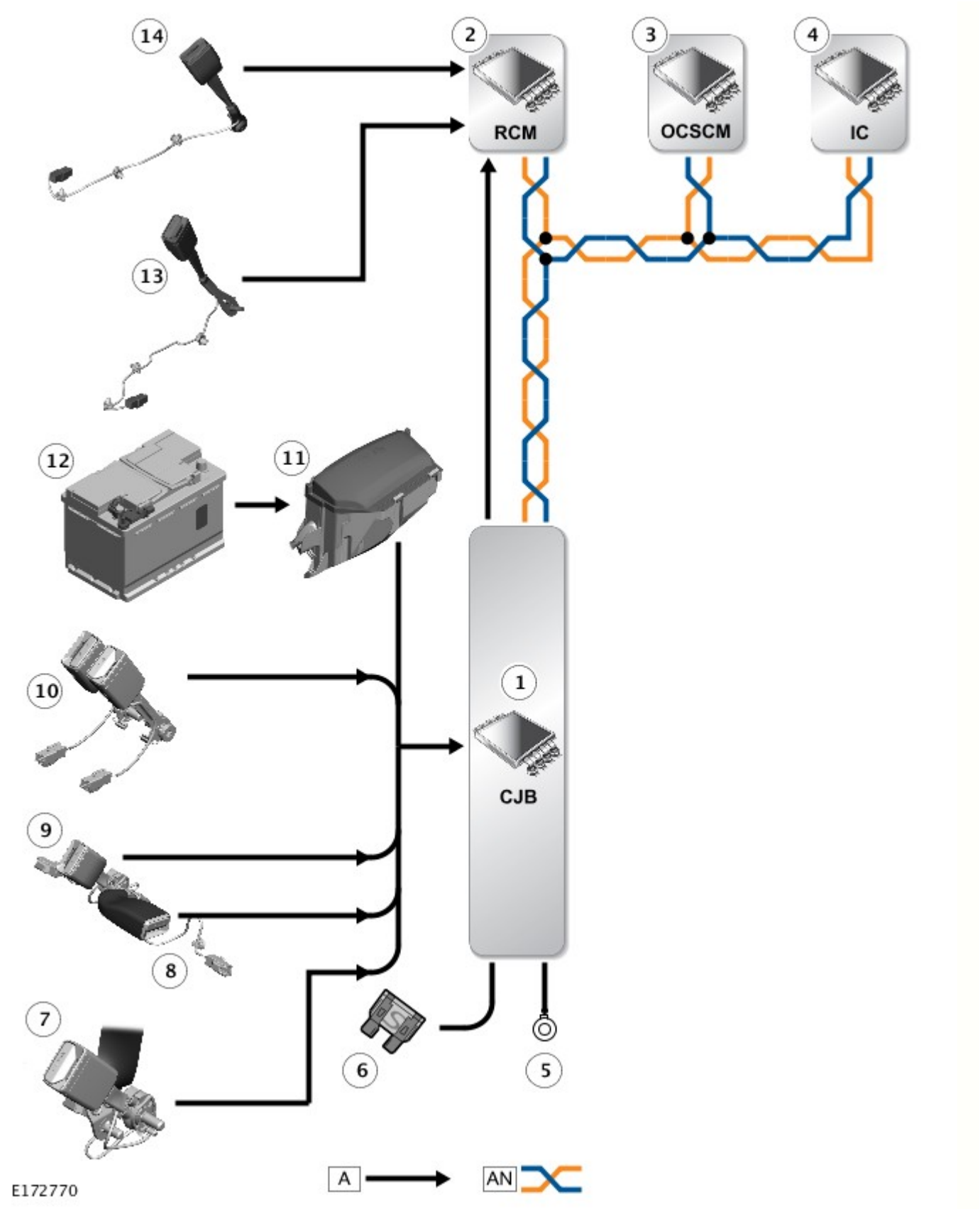


A = Hardwired; AN = High Speed (HS) Controller Area Network (CAN) Powertrain bus.

Item	Description
1	CJB
2	RCM
3	IC
4	Ground
5	Fuse
6	Rear left seatbelt buckle

7	Rear center seatbelt buckle
8	Rear right seatbelt buckle
9	Third row seatbelt buckles
10	Occupant detection sensor
11	Junction Box (BJB)
12	Battery
13	Driver seat seatbelt buckle
14	Passenger seat seatbelt buckle

INPUT/OUTPUT DIAGRAM - SHEET 4 OF 4 - NAS - 7 SEAT VEHICLES



A = Hardwired; AN = High Speed (HS) Controller Area Network (CAN) Powertrain bus.

Item	Description
1	CJB
2	RCM
3	OCSCM
4	IC
5	Ground
6	Fuse

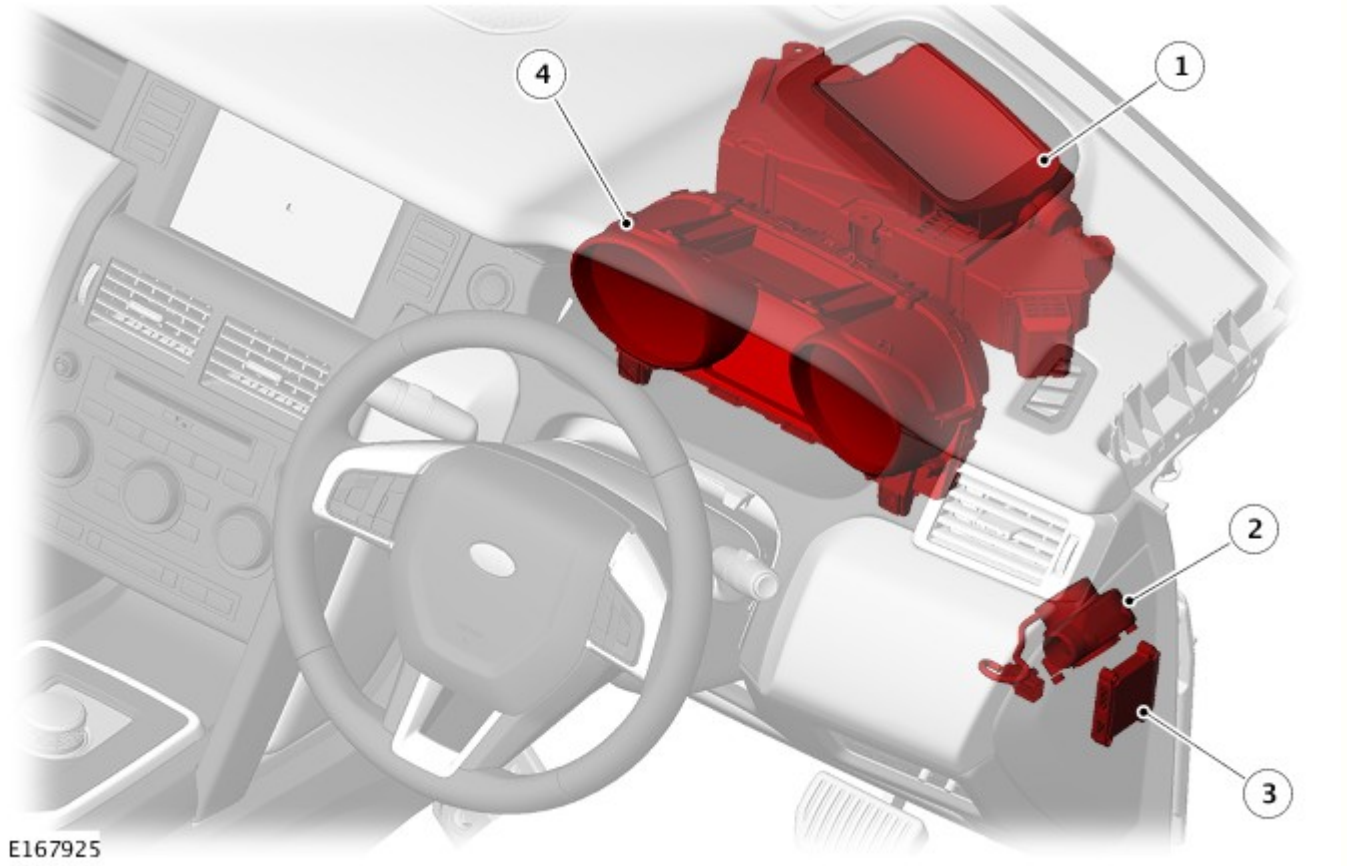
7	Rear left seatbelt buckle
8	Rear center seatbelt buckle
9	Rear right seatbelt buckle
10	Third row seatbelt buckles
11	Junction Box (BJB)
12	Battery
13	Driver seat seatbelt buckle
14	Passenger seat seatbelt buckle

Published: 03-Jun-2016

Instrument Cluster - Instrument Cluster

Description and Operation

COMPONENT LOCATION



Item	Description
1	Head Up Display Control Module (HUDCM)
2	Head Up Display (HUD) cooling fan motor
3	Head Up Display Cooling Fan Control Module (HUDCFCM)
4	Instrument Cluster (IC)

OVERVIEW

Instrument Cluster (IC)

The Instrument Cluster (IC) comprises of two analogue gauges for the speedometer, a tachometer and a 5 inch Thin Film Transistor (TFT) message center for driver information.

The analogue gauges are electronically driven using vehicle speed information from the Anti-Lock Brake System (ABS) control module for the speedometer and engine speed signals from the Powertrain Control Module (PCM) for the tachometer. The information is passed to the IC from the modules on the High Speed (HS) Controller Area Network (CAN) powertrain and comfort systems buses.

The speedometer is located on the left side of the IC and is available in four market variants:

- Major scale mph in Petrol
- Major scale km/h in Petrol
- Major scale mph in Diesel
- Major scale km/h in Diesel.

The secondary speedometer is a digital display in the message center. In most markets, the displayed units can be shown in the Trip Computer menu.

The tachometer is located on the right side of the IC and is available in two RPM displays one for petrol models and one for diesel models:

- Petrol models with a maximum engine speed of 8000 RPM
- Diesel models with a maximum engine speed of 6000 RPM.

The message center displays vehicle related information to the driver, for example:

- Engine temperature
- Fuel level
- Gear position
- Head Up Display (HUD) information
- Terrain Response Auto2®
- Speed Control
- Hill Descent Control (HDC).

Driver information is also displayed, for example:

- Navigation turn-by-turn information
- Voice control
- Trip computer information
- Basic audio details.

The gauges are illuminated in a pure white color, but change to a red color when dynamic mode is selected.

The IC features a number of warning indicators.

The warning indicators illuminate in one of four colors which indicate at the level of importance of the warning as follows:

- Red = Warning
- Amber = Caution
- Green = System operative
- Blue = Headlamp high beam operative.

A vehicle information and settings menu is available to allow the driver to select certain features and functions of the vehicle, IC, trip computer and service information, and to change them to their personal preference. A menu control joy pad is located on the right steering wheel switchpack and allows selection of the displayed functions and navigation of the menus. When selected, the menu is displayed in the message center.

Head Up Display (HUD)

The Head Up Display (HUD) is a transparent display that presents data without the driver requiring to look away from their viewpoint.

A virtual image is displayed on the windshield which appears at a distance of approximately 2 meters, giving the impression that the image appears around the end of the hood.

This function is designed to provide an increase in safety and convenience by maximizing eyes on the road time.

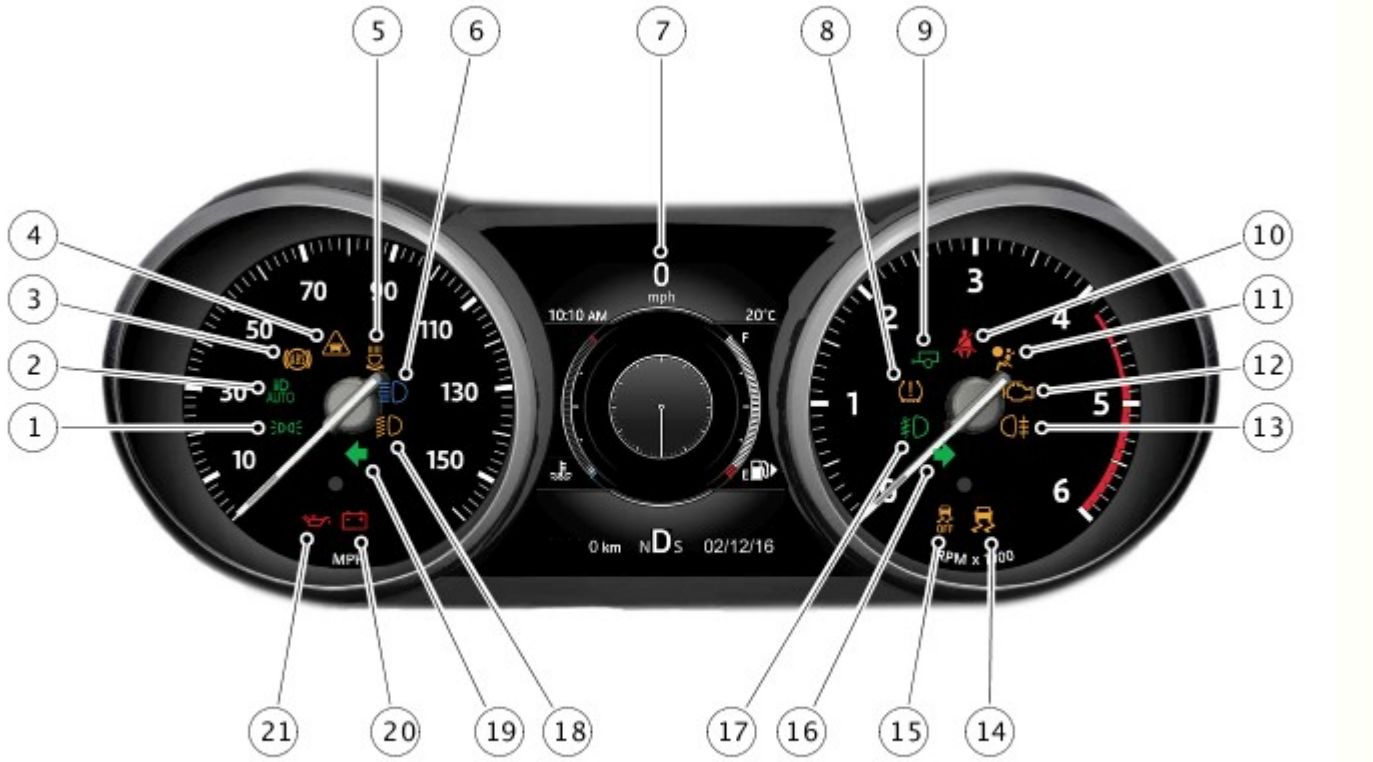
The HUD is designed to work with a specially designed windshield, which is formed to prevent double images and achieve the best display performance.

When selected the HUD feature projects the following driver information display onto the inside of the windshield:

- Vehicle speed
- Traffic Sign Recognition (TSR) and identified speed limits
- Gear selection
- Navigation instructions
- Speed Control/Automatic Speed Limiter (ASL) active symbol
- Speed Control/Automatic Speed Limiter (ASL) set speed symbol
- Follow mode active symbol.

DESCRIPTION

Warning Indicators



E188079

Item	Description
1	Side lamps on (green)
2	Auto High Beam (AHB) warning indicator (green)
3	Anti-lock Brake System (ABS) warning indicator
4	Warning / information (amber)
5	Adaptive Front Lighting System (AFS) warning indicator (amber)
6	High beam active warning indicator (blue)
7	Message center
8	Tire Pressure Monitoring System (TPMS) warning indicator (amber)
9	Trailer turn signal warning indicator (green)
10	Seatbelt warning indicator (red)
11	Airbag/Supplementary Restraint System (SRS) warning indicator (amber)
12	Malfunction Indicator Lamp (MIL) warning indicator (amber)
13	Rear fog lamps active warning indicator (amber)
14	Dynamic Stability Control (DSC) warning indicator (amber)
15	Dynamic Stability Control (DSC) off warning indicator (amber)
16	Right turn signal indicator (green)
17	Front fog lamps active warning indicator (green)
18	Low beam indicator (amber)
19	Left turn signal indicator (green)
20	Battery charge warning indicator (red)
21	Low oil pressure warning indicator (red)

The warning indicators are located in various positions in the Instrument Cluster (IC).

The warning indicators can be split into two groups:

- Self-controlled
- Externally controlled.

Self-controlled warning indicators are dependent on software logic within the IC for activation. The IC software controls the warning indicator check illumination at ignition on and all indicators whose operation is controlled by the IC the low fuel level warning indicator for example.

Externally controlled indicators are supplied with current from another system control module or illuminated by the IC on receipt of a CAN BUS message from another system control module. Some indicators are activated by an external system control module but the IC contains the control logic.

Analogue Instruments

The analogue speedometer and tachometer are located in the IC. The speedometer and tachometer are each driven by an electronic stepper motor. The characteristics of this type of motor produce damping of the pointer needle. Both of the gauges return to their respective zero positions when the ignition is switched off.

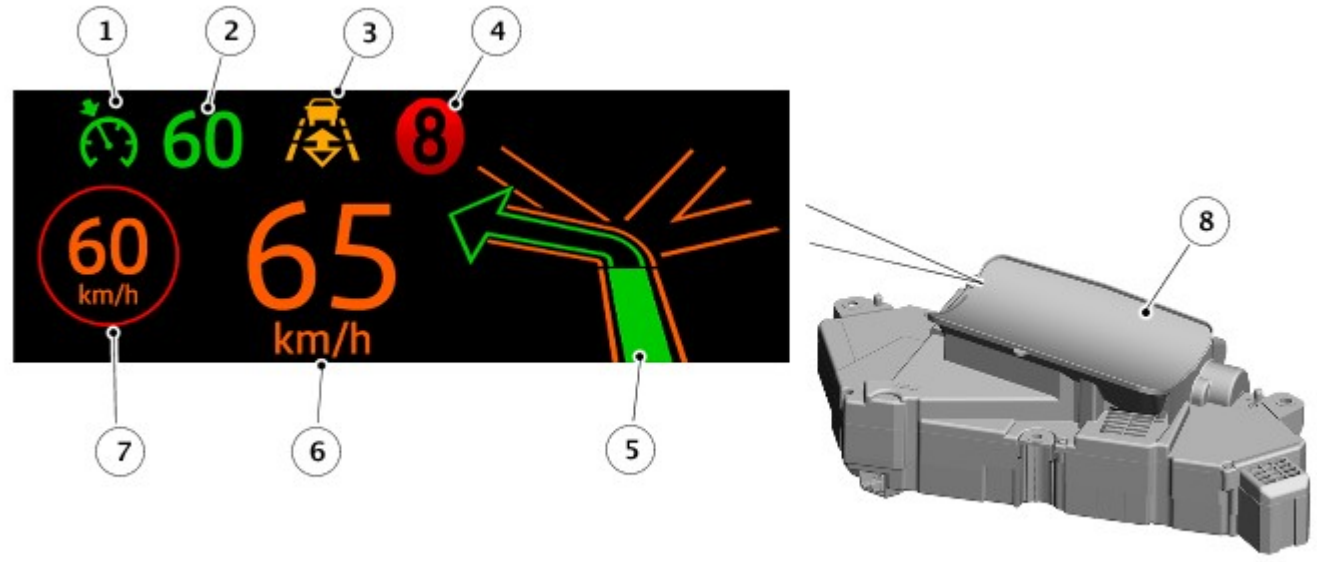
The wheel speed sensors are measured by sensors reading the rotational speed of the wheels from toothed targets on the hub. The wheel speeds are passed from sensors to the Anti- Lock Brake System (ABS) control module in the form of pulsed signals.

The tachometer is driven by an engine speed signal transmitted on the HS CAN powertrain systems bus from the PCM. The signal is derived from the Crankshaft Position (CKP) sensor.

Message Center

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

Head Up Display (HUD)



E167927

Item	Description
1	Speed control/adaptive speed control display
2	Speed control/adaptive speed control set speed
3	Follow mode warning indicator
4	Gear position display
5	Navigation turn-by-turn display
6	Current vehicle speed
7	Traffic Sign Recognition (TSR) display
8	Head Up Display control module (HUDCM)

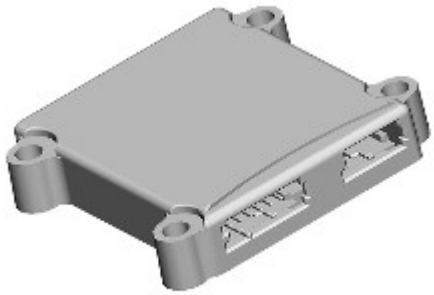
The HUD control module is located inside the instrument panel behind the IC. The operation of the HUD is controlled by the HUDCM.

The HUD control module receives a permanent battery voltage supply from the Rear Junction Box (RJB). The HS CAN comfort systems bus allows for the HUD control module to communicate with other modules such as Head Up Display Cooling Fan Control Module (HUDCFCM) and IC.

The HUD uses laser beams within the module to provide the light source, projecting images stored within the laser diode block, via a collimating lens, onto a Liquid Crystal On Silicone (LCOS) surface, with which the beams have a phase relationship.

The light is reflected off through a Fourier lens and a series of fold mirrors to create an image on a rotating diffuser. This reduces speckle effects of the laser light. The light is magnified and distorted, in cohesion with the windshield curvature, and passed across two further freeform curved mirrors, forming the virtual image seen by the driver.

Head Up Display Cooling Fan Control Module (HUDCFCM)



E167932

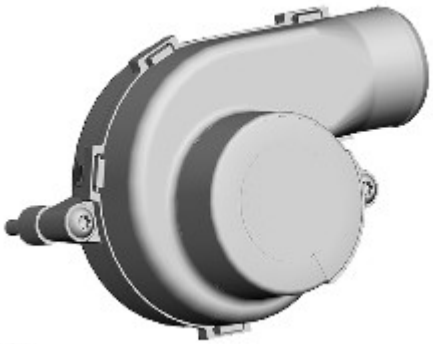
The HUDCFCM is located inside the instrument panel.

The HUDCFCM is powered by the RJB.

Information can be sent or received via the HS CAN comfort systems bus.

The HUDCFCM controls the HUD cooling fan.

Head Up Display (HUD) Cooling Fan Motor



E167931

The HUD cooling fan is located inside the instrument panel.

The HUD cooling fan is powered by the RJB.

The HUD cooling fan is controlled by the HUDCFCM.

The HUD cooling fan has a built in sensor to control temperature, so that the motor does not exceed it's operating temperature.

OPERATION

Instrument Cluster (IC)

The Instrument Cluster (IC) receives a permanent battery voltage supply from the Rear Junction Box (RJB). A High Speed (HS) Controller Area Network (CAN) powertrain systems bus and HS CAN comfort systems bus are also connected to the IC which communicates with other control modules.

The speedometer is driven by HS CAN signals transmitted to the Anti-Lock Brake System (ABS) control module. The wheel speed sensors are measured by sensors reading the rotational speed of the wheels from toothed targets on the hub. The wheel speeds are passed from sensors to the ABS control module in the form of pulsed signals. The ABS control module converts these signals into the HS CAN powertrain systems bus to the IC.

The tachometer is driven by an engine speed signal transmitted on the HS CAN powertrain systems bus from the Powertrain Control Module (PCM). The signal is derived from the Crankshaft Position (CKP) sensor. The signal received by the IC microprocessor and the output from the microprocessor drives the tachometer.

The steering wheel switchpack inputs are sent to the IC via the Local Interconnect Network (LIN) input. Other vehicle sensors are connected to the Gateway Module (GWM) assembly which processes the signals from the sensors and passes them to the IC on the HS CAN powertrain systems bus. The Ambient Air Temperature (AAT) signal is received by the PCM which processes the signal and passes the information to the Automatic Temperature Control Module (ATCM) unit which sends the signal to the IC.

Head Up Display (HUD)

The Head Up Display (HUD) is controlled from the Instrument Cluster (IC) message center menu.

When selected, the menu offers the following options:

- Selecting the position of the display on the windshield
- Display brightness
- Selecting which information is displayed on the HUD.

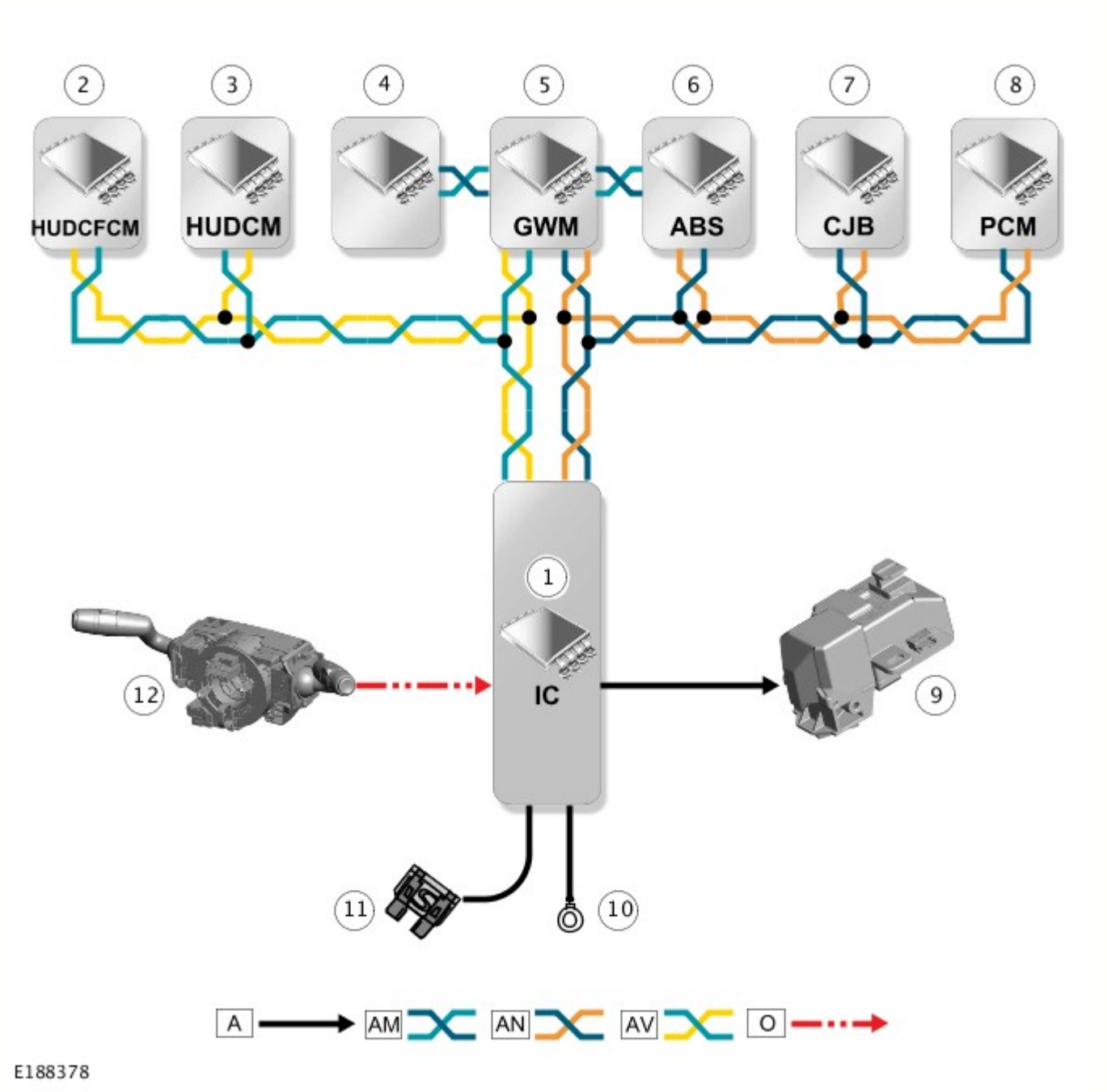
Control of the display brightness can be adjusted in three different ways:

- As listed above, manually, from within the message center menu
- If the vehicle lighting is switched on, the HUD display will adjust simultaneously with the manual adjustment of the IC panel light dimmer switch
- Automatic brightness, controlled using data from the forward ambient light sensor, housed in the rain sensor.

Prior to selecting the HUD windshield position the user should select their desired seating position. The steering wheel switchpack is used to set the horizontal position of the windshield display. Once set, the information can be saved in the seat memory control system, storing the selected preferences.

CONTROL DIAGRAM

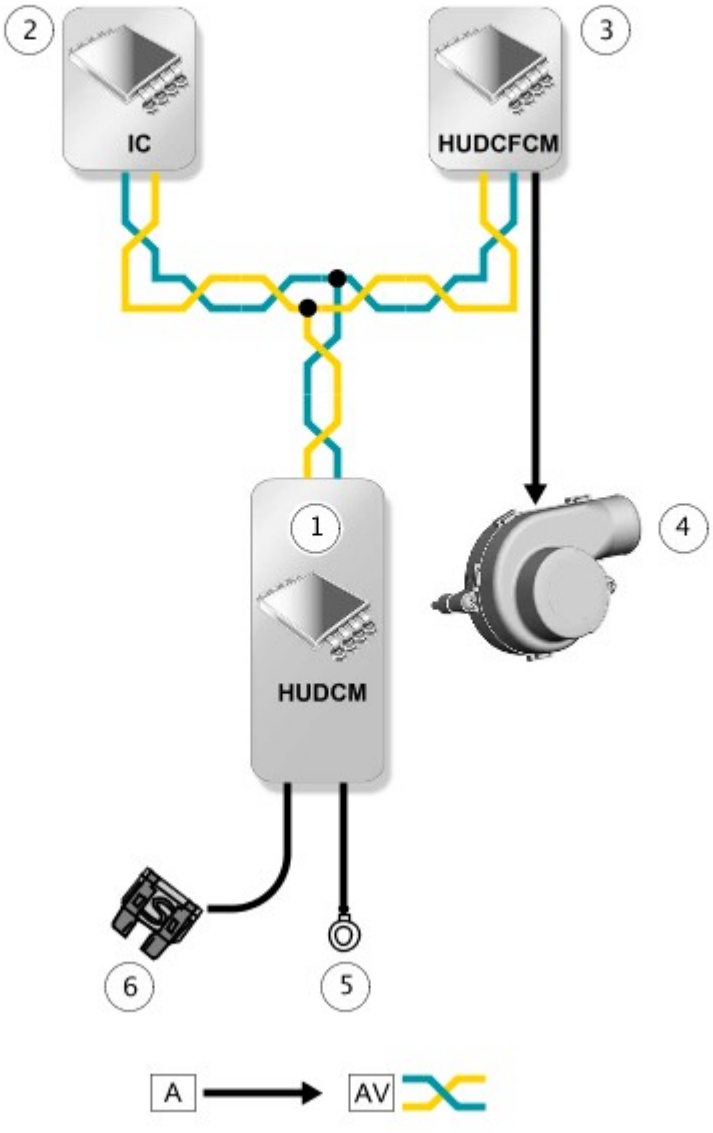
Control Diagram - Instrument Cluster (IC)



A = Hardwired; AM = High Speed (HS) Controller Area Network (CAN) Chassis systems bus; AN = HS CAN Powertrain systems bus; AV = HS CAN Comfort systems bus.

Item	Description
1	Instrument Cluster (IC)
2	Head Up Display Cooling Fan Control Module (HUDCFCM)
3	Head Up Display control module (HUDCM)
4	System Modules on High Speed (HS) Controller Area Network (CAN) Chasis systems bus
5	Gateway Module (GWM)
6	Anti-lock Brake System (ABS) Control Module
7	Central Junction Box (CJB)
8	Powertrain Control Module (PCM)
9	Electric Steering Column Lock (ESCL)
10	Ground
11	Power Supply
12	Steering Wheel Module (SWM)

Control Diagram - Head Up Display (HUD)



A = Hardwired; AV = High Speed (HS) Controller Area Network (CAN) Comfort systems bus.

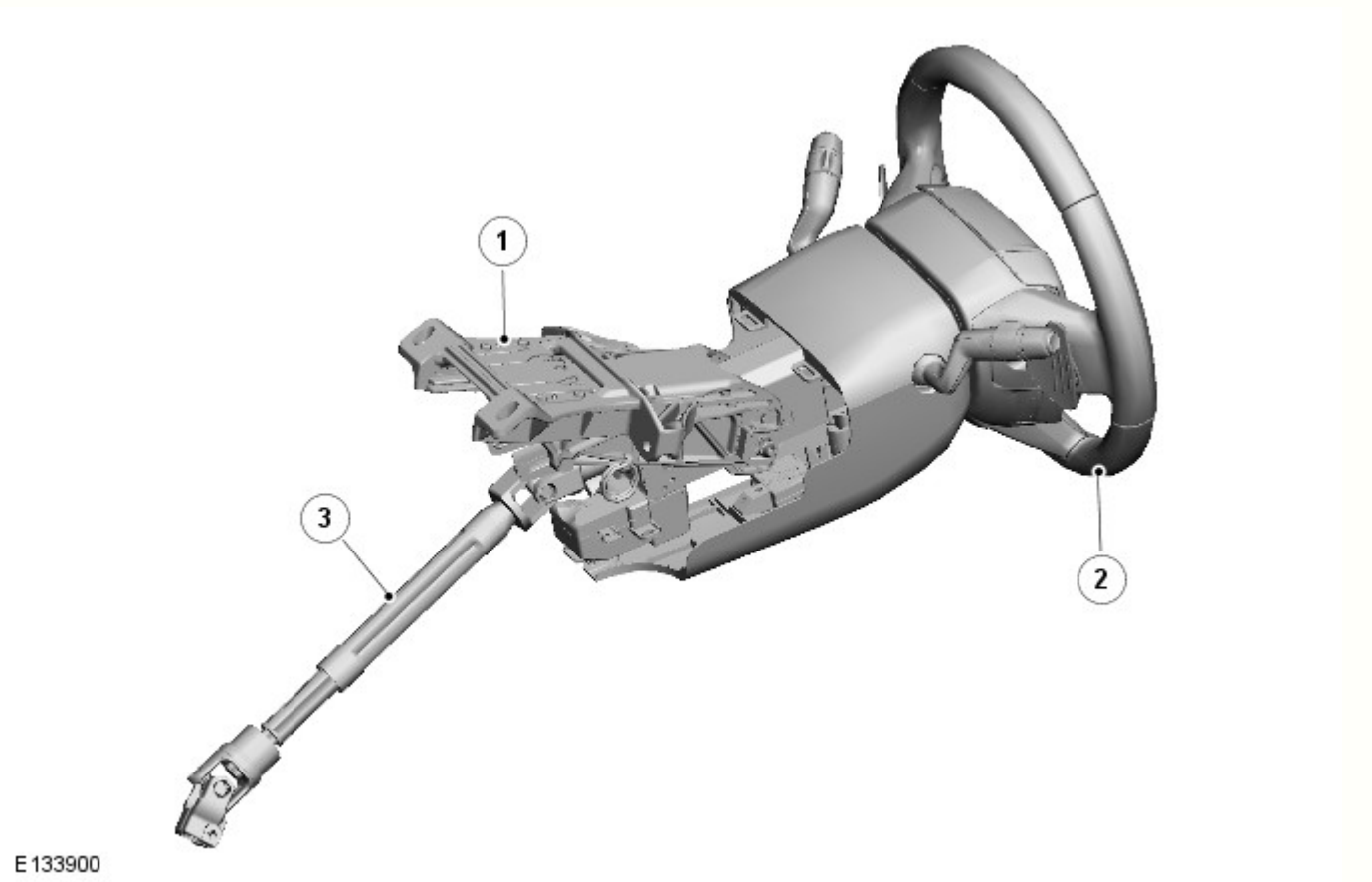
Item	Description
1	Head Up Display (HUD) Control Module
2	Instrument Cluster (IC)
3	Head Up Display Cooling Fan Control Module (HUDCFCM)
4	Head Up Display (HUD) cooling
5	Ground
6	Power Supply

Published: 30-Sep-2014

Steering Column - Steering Column

Description and Operation

COMPONENT LOCATION



Item	Description
1	Upper column
2	Steering wheel
3	Intermediate shaft

OVERVIEW

The steering column consists of an intermediate shaft, the upper column and the steering wheel, which are connected together to transfer driver steering inputs to the steering gear.

The steering column incorporates rake and reach adjustment, an Electric Steering Column Lock (ESCL) or dummy lock (dependent on market) and a steering column collapse actuator (North American Specification (NAS) only). Some vehicles also incorporate a steering wheel heater. Multifunction switches are attached to the steering wheel module on the upper column and to the steering wheel, for operation of the following vehicle systems:

- Exterior lighting.
  For additional information, refer to: Exterior Lighting (417-01, Description and Operation).
- Wipers and washers.
  For additional information, refer to: Wipers and Washers (501-16, Description and Operation).
- Speed control.
  For additional information, refer to: Speed Control (310-03, Description and Operation).

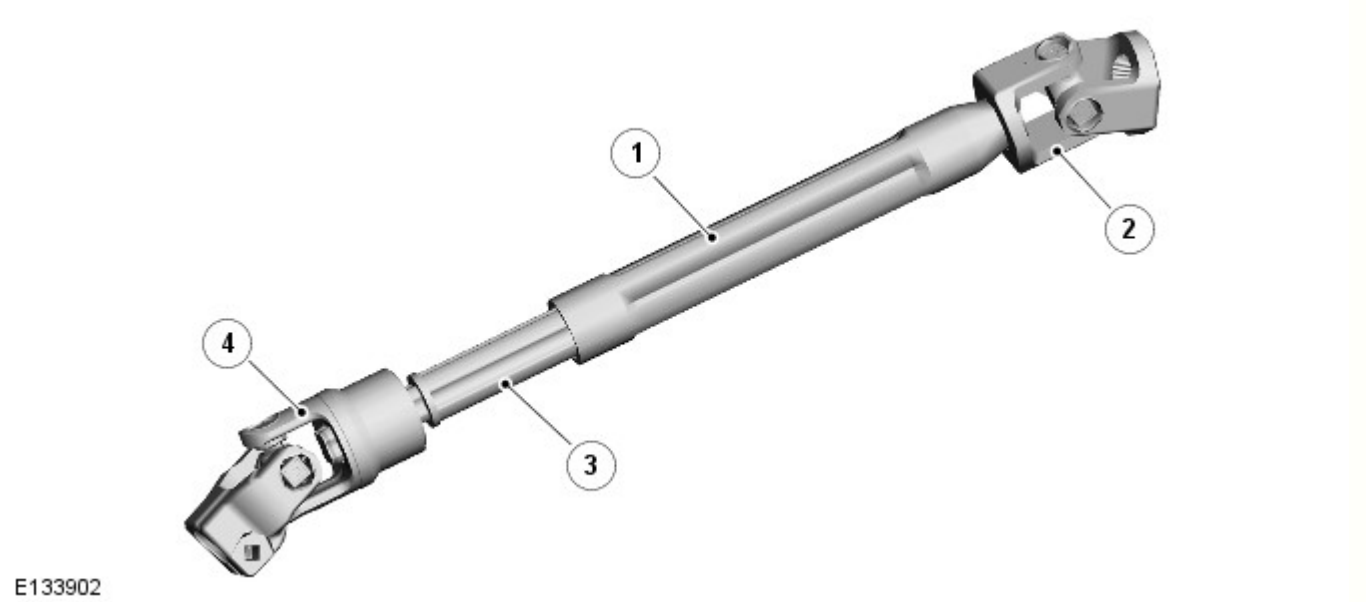
- Steering wheel heater. For additional information see this section.
- Audio/Video.
  For additional information, refer to: Audio System (415-01, Description and Operation).
- Vehicle information and settings menu.
  For additional information, refer to: Information and Message Center (413-08, Description and Operation).
- Telephone and voice control.
  For additional information, refer to: Cellular Phone (415-01, Description and Operation).

The steering wheel also incorporates the driver air bag, with integrated horn switch.
For additional information, refer to: Air Bag Supplemental Restraint System (SRS) (501-20B, Description and Operation).

On automatic transmission vehicles, two paddle switches are attached to the steering wheel.
For additional information, refer to: External Controls (307-05, Description and Operation).

DESCRIPTION

Intermediate Shaft



E133902

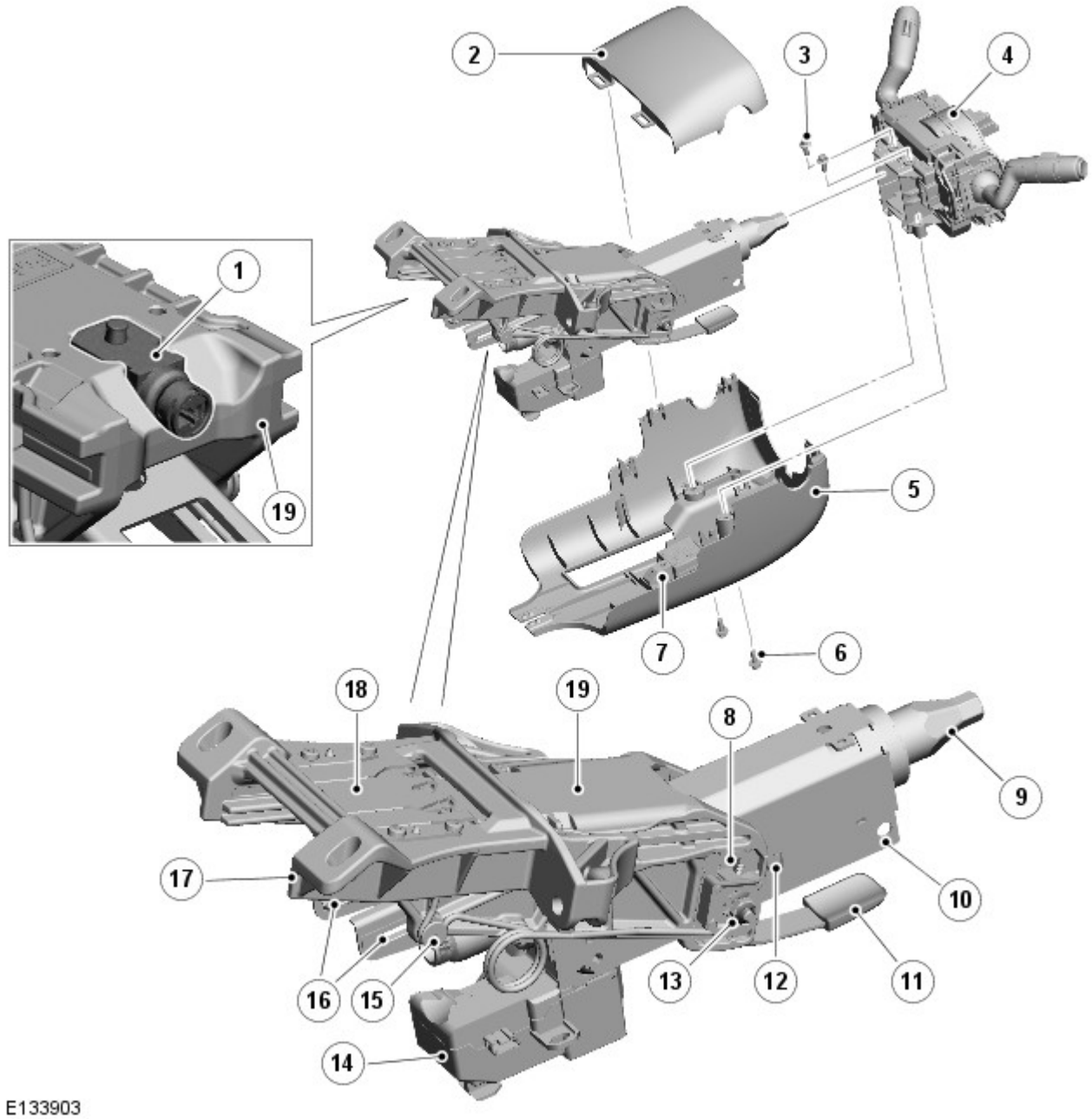
Item	Description
1	Outer tube
2	Upper universal joint
3	Inner tube
4	Lower universal joint

The intermediate shaft consists of inner and outer steel tubes that can move telescopically to:

- Permit system assembly.
- Allow steering wheel adjustment.
- Isolate the steering wheel from any movement of the steering gear in the event of a vehicle impact.

An isolator, on the inner tube, reduces Noise, Vibration and Harshness (NVH) in the steering column. Universal joints connect the ends of the intermediate shaft to the upper column and the input shaft of the steering gear.

Upper Column



Item	Description
1	Steering column collapse actuator (NAS only)
2	Upper shroud
3	Screw (2 off)
4	Switchgear assembly
5	Lower shroud
6	Screw (2 off)
7	Immobilizer Antenna Unit (IAU) transceiver (where fitted)
8	Rake adjustment slot
9	Upper column shaft
10	Bearing housing
11	Adjustment locking lever
12	Reach adjustment slot
13	Locking mechanism
14	Electric Steering Column Lock (ESCL)
15	Pivot pin
16	Reach adjustment slots

17	Outer bracket
18	Energy management plate
19	Inner bracket

The shaft of the upper column is installed in a bearing housing that is attached to an inner bracket with a pivot pin and an adjustment locking mechanism. Slots at the attachment points, in the bearing housing and the inner bracket, allow the bearing housing to move axially and to tilt in the inner bracket, to provide the rake and reach adjustment of the steering wheel. The locking mechanism is a friction lock, operated by a lever turning a cam disc.

The inner bracket is located on rails in an outer bracket, which is attached to the cross car beam. The inner and outer brackets are locked together by an energy management plate, which is attached to both brackets with screws. In a serious impact, to prevent excessive force causing injury as the driver strikes the air bag, the inner bracket progressively moves forwards on the rails in the outer bracket. The movement is controlled by the energy management plate. The plate has leaves attached to the inner bracket, which peel back in a controlled manner, absorbing energy and allowing the steering wheel to move with the driver.

The steering wheel module is attached to the top of the upper column by two bolts. The module incorporates the clockspring and the multifunction switches for the exterior lighting and the windows and washers.

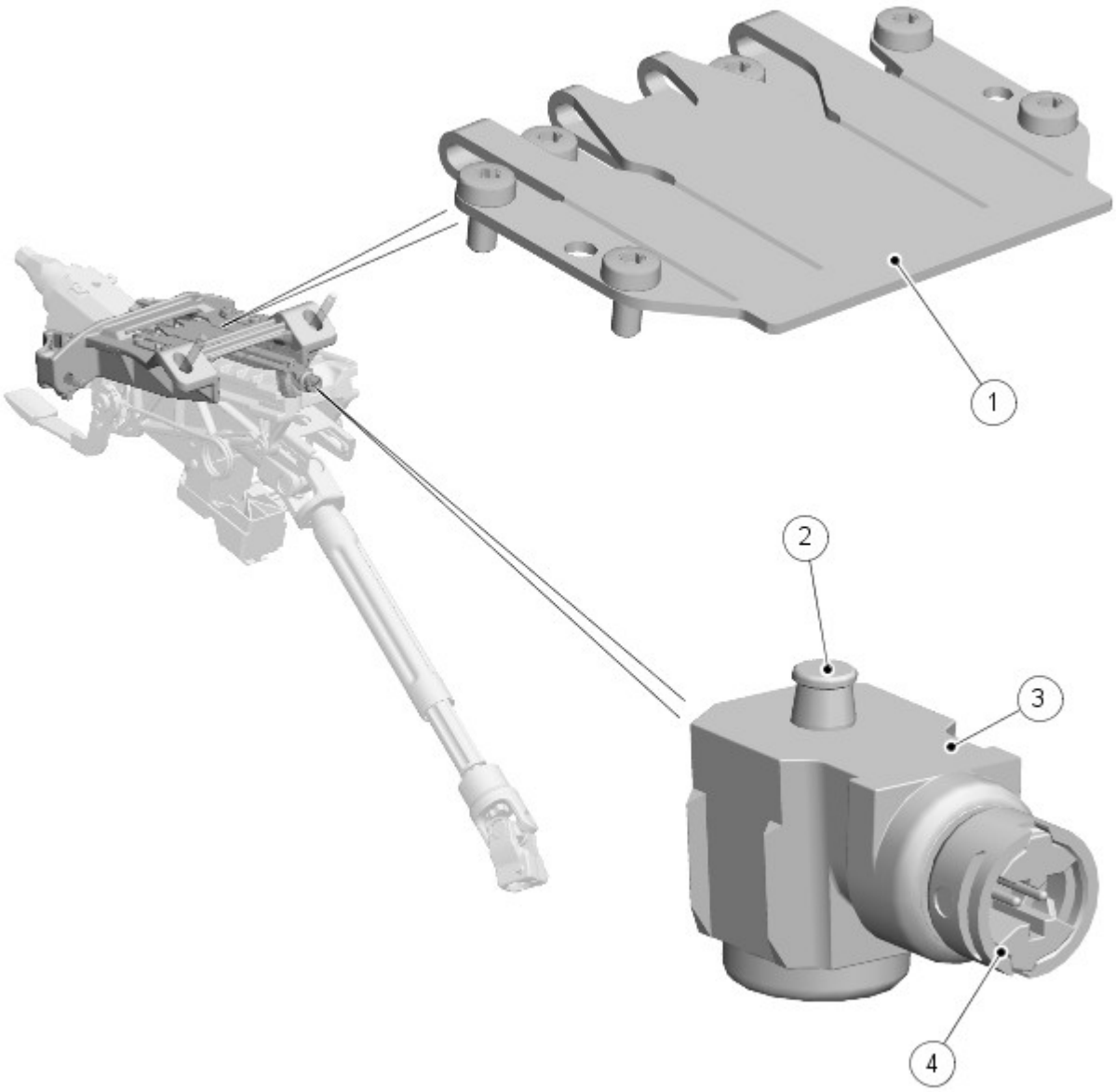
Upper and lower shrouds cover that part of the upper column not concealed by the instrument panel. On vehicles with passive entry passive start, an Immobilizer Antenna Unit (IAU) transceiver is installed in the lower shroud.
For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation).

Electric Steering Column Lock (where fitted)

An Electric Steering Column Lock (ESCL) is attached to the underside of the bearing housing.

In markets where an electric steering column lock is not fitted, a dummy lock is installed to provide a forward attachment point for the steering column lower cowl, and the electric steering column lock is disabled in the car configuration files.
For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation).

Steering Column Collapse Actuator (NAS Only)



E149557

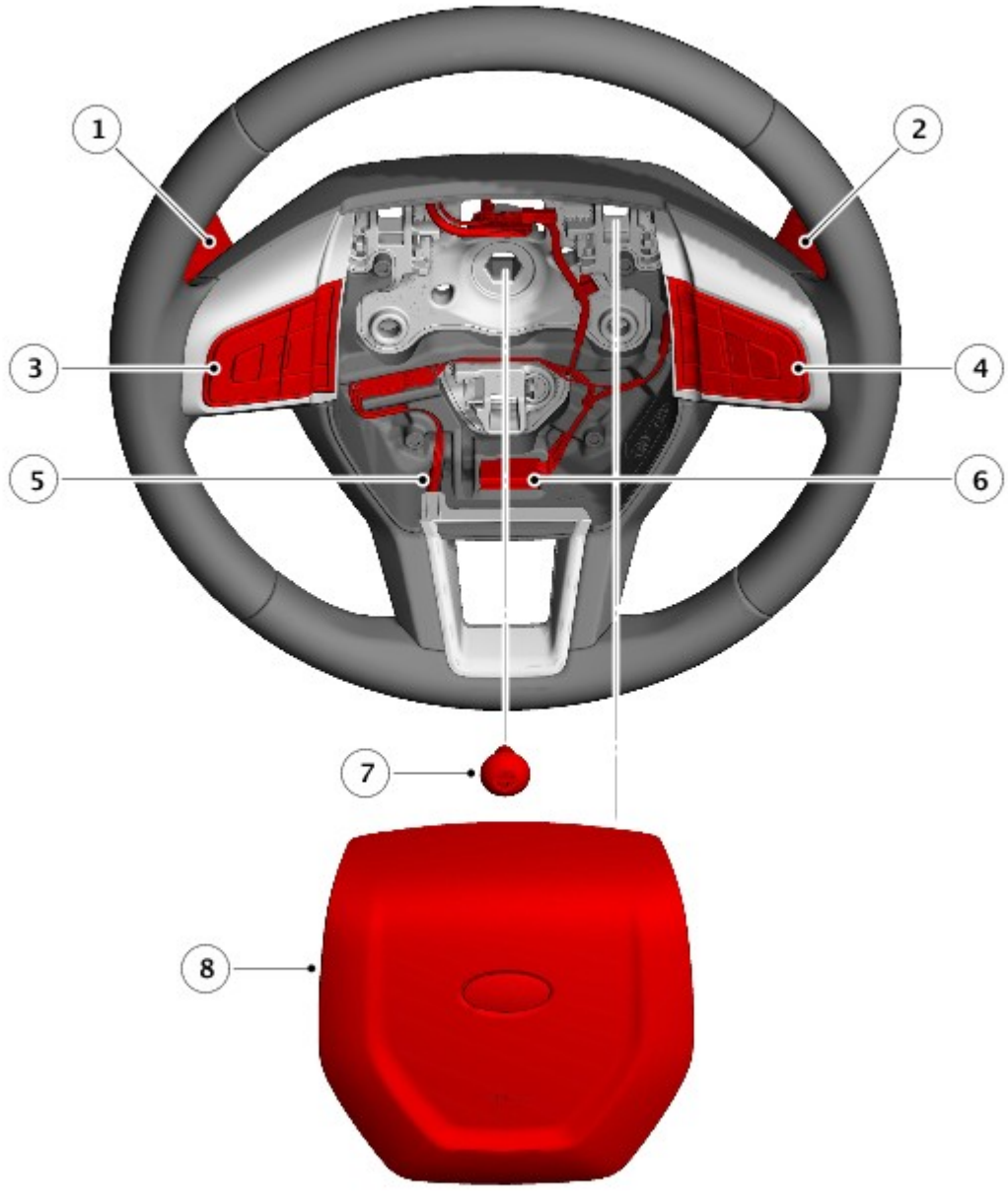
Item	Description
1	Energy management plate
2	Pin
3	Steering column collapse actuator
4	Electrical connector

A steering column collapse actuator is installed to provide increased energy absorption, if a crash situation occurs.

The steering column collapse actuator is located below the energy management plate. A pin on the actuator is engaged in a hole in the central leaf of the energy management plate.

When the system detects that the driver seat belt is buckled, and a crash situation occurs which activates the airbags, the device fires, which retracts the pin. This reduces the energy absorption to a level suitable for a restrained (belted) driver.

Steering Wheel



E163890

Item	Description
1	Downshift paddle switch (automatic transmission only)
2	Upshift paddle switch (automatic transmission only)
3	Left multifunction switchpack
4	Right multifunction switchpack
5	Heater mat connector
6	Heated steering wheel module
7	Steering wheel securing screw
8	Driver air bag

The steering wheel is located on the hexagonal drive end of the upper column shaft and secured with a screw.

The driver air bag and two multifunction switchpacks are installed in the center of the steering wheel. On automatic transmission vehicles, upshift and downshift paddle switches are attached to the front of the steering wheel. A link harness connects the steering wheel components to the clockspring.

Steering Wheel Heater (where fitted)

The steering wheel heater consists of a heater mat and a Negative Temperature Coefficient (NTC) temperature sensor installed around the rim of the steering wheel under the trim. A steering wheel heater control module, integrated into the link harness, regulates the temperature of the heater mat. A switch on the left multifunction switchpack switches the heater on and off.

A heater symbol in the switch is illuminated amber when the steering wheel heater is on. When the steering wheel heater is off, the symbol is either not illuminated or, if the exterior lighting is on, illuminated green.

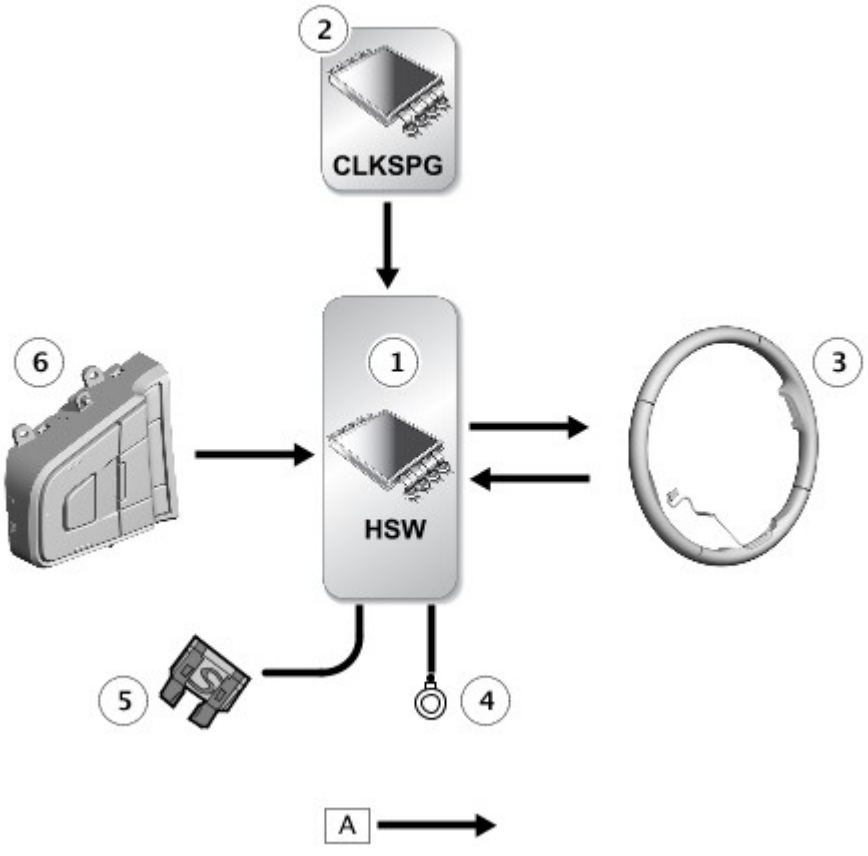
OPERATION

Steering Wheel Heater (where fitted)

The steering wheel heater control module receives a power supply from the extended ignition relay in the Battery Junction Box (BJB) via the clockspring. When the driver operates the steering wheel heater switch, a path is completed between the switch and the steering wheel heater control module, which then supplies power to the heater mat. The steering wheel heater control module monitors the heater mat temperature using the temperature sensor, and controls the power supply to keep the heater mat at the optimum temperature.

Control Diagram

A = Hardwired connection.



Item	Description
1	Heated steering wheel module
2	Clockspring
3	Heater mat and temperature sensor
4	Ground wire
5	Power supply
6	Heated steering wheel switch