

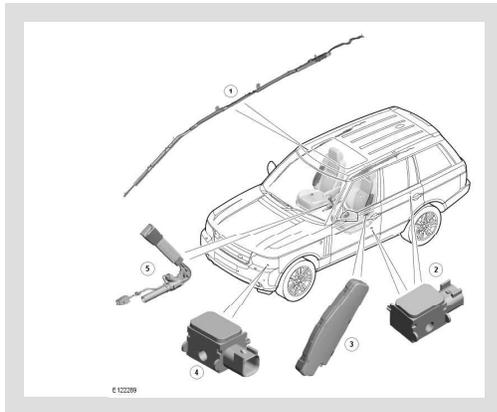
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SUPPLEMENTARY RESTRAINT SYSTEM

AIRBAG AND SAFETY BELT PRETENSIONER SUPPLEMENTAL RESTRAINT SYSTEM (G1246960)

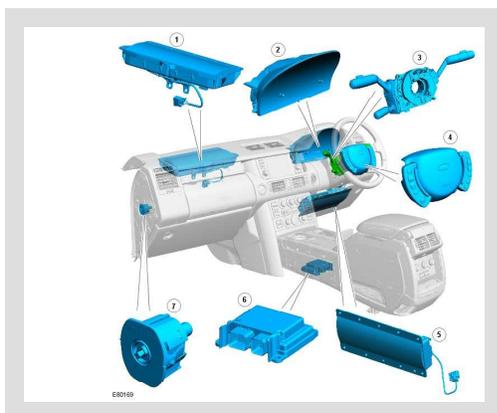
DESCRIPTION AND OPERATION

COMPONENT LOCATIONS - SHEET 1 OF 2



ITEM	DESCRIPTION
1	Side head air bag
2	Side impact sensors
3	Side air bag
4	Front impact sensors
5	Pretensioners

COMPONENT LOCATIONS - SHEET 2 OF 2



ITEM	DESCRIPTION
1	Passenger air bag

ITEM	DESCRIPTION
1	Instrument cluster
3	Clock spring
4	Driver air bag
5	Knee airbag
6	restraints control module (RCM)
7	Passenger airbag deactivation switch

OVERVIEW



WARNING:

All pyrotechnic devices are dangerous. Before performing any procedures on any pyrotechnic device, read all information contained within the Standard Workshop Practices section of this manual. For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

The supplemental restraint system (SRS) activates pretensioners and/or air bags if the vehicle suffers an impact above preset limits. When it activates the pretensioners/air bags the SRS also disconnects the starter lead from the battery. The SRS consists of:

- An RCM
- Four side impact sensors
- An occupancy sensor(NAS (north American specification) only)
- An occupancy sensor module (NAS (north American specification) only)
- Safety belt switches
- Safety belt pretensioners
- A driver air bag
- A passenger air bag
- Side air bags
- Head air bags
- A clockspring
- A warning lamp
- A driver knee bolster airbag
- A belt minder sensor
- A passenger airbag deactivation switch (Not NAS and Australia)

- A passenger airbag deactivation indicator (not Australia).

The SRS features selective activation of the air bags and pretensioners, and two stage driver and passenger air bags. The driver and passenger air bags each have two gas generators which are fired sequentially, with a variable time delay between firings to adjust the speed of air bag inflation to the severity of the crash impact.

RCM



The RCM is installed on the top of the transmission tunnel, beneath the transmission gear selector lever assembly, and controls the operation of the SRS. The main functions of the RCM include:

- Crash detection and recording.
- Air bag and pretensioner firing.
- Self test and system monitoring, with status indication via the warning lamp and non-volatile storage of fault information.



WARNING:

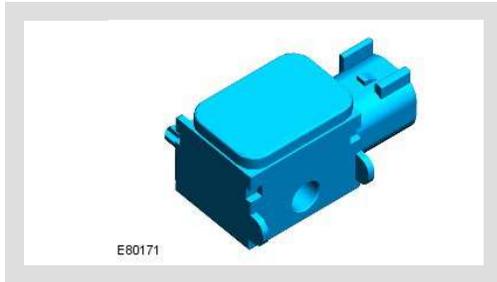
The electrical connectors must not be connected to the restraints control module unless it is properly secured to the vehicle. Movement of the restraints control module while connected to the vehicle wiring could cause air bag deployment.

A safing function is provided by accelerometers in the RCM to concur impacts. Various firing strategies are employed by the restraints control module to ensure the air bags/pretensioners that are fired are appropriate to the severity and direction of the impact. The firing strategy used also depends on the inputs from the safety belt buckle switches, seat position sensor, passenger air bag deactivation switch, and the occupant classification sensor, dependant on market.

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 switch is disrupted during a crash. The stored energy is sufficient to produce firing signals for the driver air bag, the passenger air bag and the safety belt 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 sends the signal to illuminate the air bag warning indicator. The faults can be retrieved by the Land Rover approved diagnostic system via the high speed controller area network (CAN) bus connection (J1962). 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.

IMPACT SENSORS



Impact sensors are installed in the front and both sides of the vehicle. The use of multiple impact sensors provides shorter air bag trigger times, through faster detection of lateral and longitudinal acceleration, and improves detection accuracy.

There are two front impact sensors, attached to the headlamp surround panel below the headlamps.

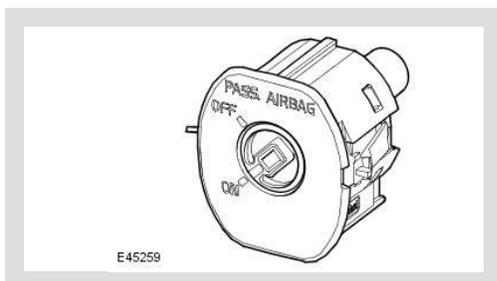
There are four side impact sensors located in the passenger compartment, as follows:

- One attached to the base of each B/C pillar
- One attached to the base of each D pillar.

Each impact sensor incorporates an accelerometer and a microchip powered by a feed from the RCM. The power feed also provides the interface connection through which the side impact sensor communicates with the RCM using serial data messages. Acceleration is evaluated by the microchip and transmitted to the restraints control module, which then makes the decision on whether or not to activate the air bags and pretensioners.

When the ignition is switched on the RCM supplies power to the impact sensors, which perform a self test. After satisfactory self tests the impact sensors continually output 'digital acceleration' messages to the restraints control module. If a fault is detected the relevant impact sensor sends a fault message, instead of the digital acceleration message, to the restraints control module. The RCM then stores a related fault code and illuminates the air bag warning indicator. Faults can be retrieved by the Land Rover approved diagnostic system from the RCM via the high speed CAN bus connection (J1962).

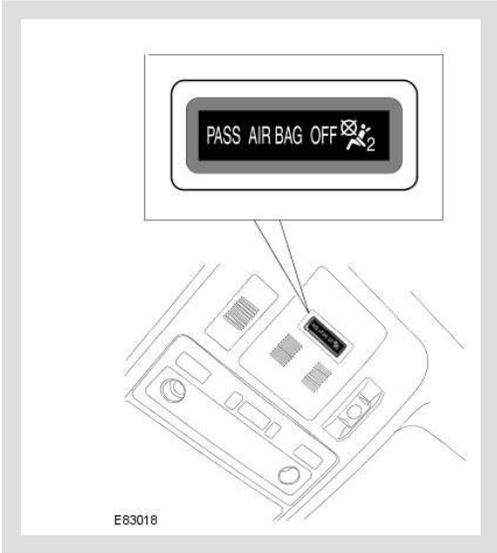
PASSENGER AIR BAG DEACTIVATION SWITCH (ALL EXCEPT NAS AND AUSTRALIA)



The passenger air bag deactivation switch provides a method of manually disabling the passenger air bag. The switch is installed in the front passenger end of the instrument panel and operated by the ignition key.

When the passenger air bag deactivation switch is operated, it changes a ground connection between two pins in the connectors of the RCM. When the passenger air bag deactivation switch is selected to OFF, the RCM disables the passenger air bag and, if the front passenger seat is occupied, illuminates the passenger air bag deactivation indicator.

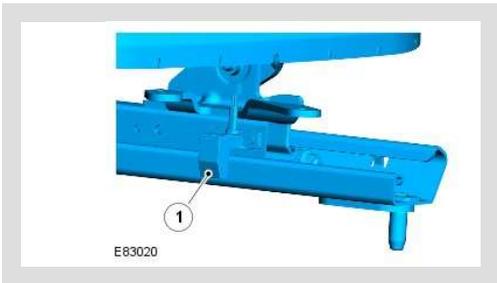
PASSENGER AIR BAG DEACTIVATION INDICATOR (ALL EXCEPT AUSTRALIA)



The passenger air bag deactivation indicator is installed in the overhead console (on the header rail). When appropriate, the indicator illuminates to advise front seat occupants that the passenger air bag is disabled. Operation of the indicator is controlled by the RCM. The RCM illuminates the indicator when:

- There is a fault with the passenger air bag firing circuit(s) that warrants disablement
- The passenger air bag is deactivated with the passenger air bag deactivation switch (where fitted)
- The occupant classification sensor sends a passenger air bag disable state.

SEAT POSITION SENSOR



ITEM	DESCRIPTION
1	Seat position sensor

The seat position sensor allows the RCM to detect when the driver seat is forward of a given point on the seat track. The seat position sensor consists of a Hall effect sensor attached to the driver seat frame. While the ignition is on, the RCM supplies the sensor with power, and monitors the return current. When the seat frame moves forwards, the sensor moves over the edge of the seat track, which changes the reluctance of the sensor. The change of current is detected by the RCM and used as a switching point. The switching point is when the center of the sensor is 3 ± 4 mm from the leading edge of the seat track.

When the driver seat is forward of the switching point, the RCM increases the time delay between firing the two stages of the inflator in the driver air bag. When the driver seat is rearward of the switching point, the RCM uses the normal time delay between firing the two stages.

OCCUPANT MONITORING

There are two types of occupant monitoring:

- In all markets except NAS & Australia, vehicles have an occupant detection sensor
- In NAS markets, vehicles have an occupant classification system

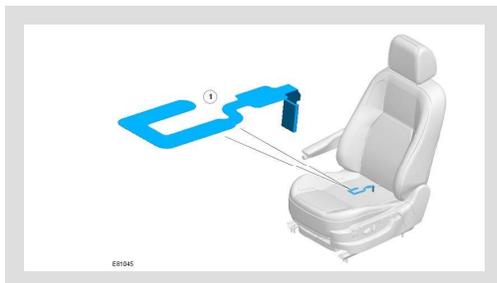
For markets which have an occupant detection sensor, this has no interface with the restraints system and only provides the belt reminder function.

For markets that have an occupant classification system, this provides the RCM with the occupancy status of the front passenger seat. The restraints control module uses this and the seat buckle status in the evaluation of the firing strategy for the passenger front air bag, side air bag, and pretensioner.

SAFETY BELT SWITCHES

A safety belt switch is installed in the buckle of each front safety belt to provide the RCM with a status signal of the related safety belt(s). When the safety belt is unfastened the switch outputs a low current to the RCM. When the safety belt is fastened the switch outputs a high current to the RCM.

OCCUPANCY SENSOR



ITEM	DESCRIPTION
1	Seat occupancy sensor

The occupancy 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. The occupancy sensor is directly connected to the instrument cluster and has no input into the SRS.

OCCUPANT CLASSIFICATION SYSTEM



ITEM	DESCRIPTION
1	Belt tension sensor
2	Pressure pad
3	Occupant classification system control module

The occupant classification system can determine if the front passenger seat is unoccupied, occupied by a small person, or occupied by a large person. The occupant classification system consists of:

- A pressure pad, installed under the cushion of the front passenger seat, which is connected to a pressure sensor
- A safety belt tension sensor, integrated into the anchor point of the front passenger safety belt
- An occupant classification module, installed under the front passenger seat.

The pressure pad is a silicone filled bladder. Any load on the pressure pad is detected by the pressure sensor.

The safety belt tension sensor is a strain gauge that measures the load applied by the safety belt anchor to the anchor bolt. The sensor is located in the lower safety belt anchor point.

Safety Belt Tension Sensor



The occupant classification module supplies a reference voltage to the pressure sensor and the safety belt tension sensor and, from the returned signals, measures the loads acting on the pressure pad and the safety belt tension sensor. The load measurement from the safety belt tension sensor is used to produce a correction factor for the load measurement from the pressure pad. The tightness of the safety belt affects the load acting on the pressure pad, so without the correction factor the occupant classification module cannot derive an accurate occupancy status.

The occupant classification module translates the load readings into a seat occupancy status and transmits the result to the RCM, on a dedicated high speed CAN bus link. The occupant classification module incorporates two load limits for the seat cushion: When the load exceeds the lower limit, but is less than the upper limit, the occupant is classified as small; when the upper limit is exceeded, the occupant is classified as large.

The occupant classification system has 4 possible states which are detailed in the following table.

CLASSIFICATION	SEAT STATUS	PASSENGER AIRBAG STATUS	AIRBAG INDICATOR STATUS
Empty	Empty	Disabled	Off
Occupied inhibit	The seat is occupied by a small person or child restraint is being used	Passenger air bag/Thorax airbag operation is disabled	On
Occupied allow	The seat is occupied by a large person	Passenger air bag/Thorax airbag operation is enabled	Off
Error	-	Passenger air bag/Thorax airbag operation is disabled	On

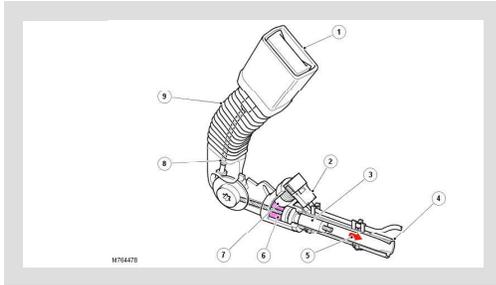
OCCUPANCY SENSOR MODULE



The occupancy sensor module is installed on the underside of the front passenger seat. The module supplies a power feed to the occupancy sensor and monitors the return voltage to determine if the seat is occupied or not. The result is transmitted to the RCM on the High speed CAN bus. The occupancy sensor module also monitors for short and open

circuits in the occupancy sensor. If it detects a fault, the occupancy sensor module transmits a fault message in place of the status message.

PRETENSIONER



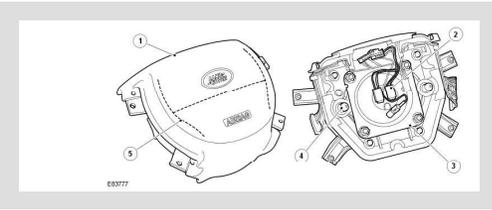
ITEM	DESCRIPTION
1	Safety belt buckle
2	Electrical connector
3	Piston
4	Piston housing
5	Direction of piston travel
6	Expanding gas
7	Squib/Gas generator
8	Steel cable
9	Gaiter

The pretensioners are used to tighten the front safety belts during a collision to ensure the occupants are securely held in their seats. A pretensioner is integrated into each front safety belt buckle and attached to a bracket on the inboard side of the seat.

Each pretensioner has a tube containing propellant and a piston. The piston is attached to a steel cable, the opposite end of which is attached to the safety belt buckle. A squib in the base of the tube provides an ignition source when triggered by a fire signal from the RCM.

On receipt of a fire signal from the RCM, the squib ignites the propellant. The propellant produces nitrogen gas that rapidly expands to drive the piston along the tube, pulling the cable and drawing the buckle downwards.

DRIVER AIR BAG



ITEM	DESCRIPTION
1	Cover
2	Electrical connector
3	Housing
4	Securing pins
5	Etched lines

The driver air bag forms the center pad of the steering wheel. Four pins and two latches locate and secure the driver air bag to the steering wheel. The latches consist of wire springs on each side of the driver air bag which engage with hooks in the steering wheel. The driver air bag is released from the steering wheel by pulling on the wire springs with a special tool inserted through a slot on each side of the steering wheel hub. Springs on the locating pins then push the driver air bag away from the steering wheel.

The driver air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator.

Lines molded into the inner surface of the driver air bag cover provide weak points that split open in a controlled manner when the driver air bag deploys. The inflated volume of the air bag is 57 liters (2.01 ft³).

PASSENGER AIR BAG



The passenger air bag is located in the instrument panel, behind the upper glove compartment. The bottom of the passenger air bag is attached to a mounting bracket on the in-vehicle crossbeam. The top of the passenger air bag is

attached to a re-enforcement lid in the top of the instrument panel. The reinforcement lid incorporates a single door that opens, splitting the instrument panel covering, when the air bag deploys.

The passenger air bag is grounded through an earth track and the module's connection to the in-vehicle crossbeam.

The air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator in each stage. The inflated volume of the air bag is 121 liters (4.27 ft³)."

SIDE AIR BAG



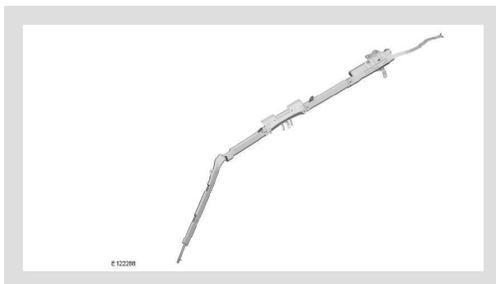
A side air bag is attached to the outside of each front seat backrest frame, under the backrest cover.

The side air bags are handed, and each consist of a molded plastic case which contains the folded air bag and the inflator. A cable connects the igniter of the inflator to a connector in the main seat harness connector block located under the front edge of the seat cushion.

When the air bag deploys it forces the front edge of the molded plastic case apart and splits open the backrest cover.

The side air bags use compressed argon as the inflation medium. The inflated volume of each side air bag is 12 liters (0.42 ft³).

SIDE HEAD AIR BAGS



The side head air bags are installed between the A and D pillar trims and above the outer edges of the headlining. The inflatable bags incorporate tether straps at each end which are attached to the body. When the air bag deploys, the inflating bag shortens in length and pulls on the tether straps, which forces it from behind the trim to cover the window in a straight line between the tether strap anchor points.

KNEE AIRBAG

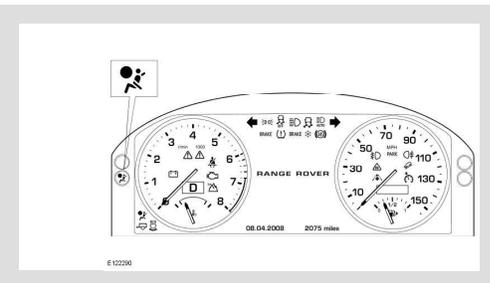


The inflatable knee bolster air bag is located behind the driver's knee bolster panel below the steering column. The flanges of the inflatable knee bolster air bag are attached to a re-enforcement lid in the driver knee bolster panel. The re-enforcement lid incorporates two deployment doors that are forced open, splitting the instrument panel covering, when the air bag deploys.

An EPC connector attaches a ground to the inflatable knee bolster air bag.

The inflatable knee bolster air bag has a single stage inflator with one connector on the outboard end. The inflator contains a non-azide propellant as the gas generator. The inflated volume of the air bag is 19 liters (0.67 ft³).

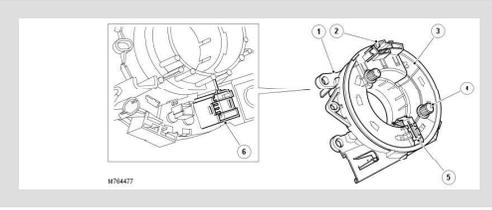
AIR BAG WARNING INDICATOR



The air bag warning indicator consists of a yellow light emitting diode (LED) behind a SRS graphic in the instrument cluster.

Operation of the air bag warning indicator is controlled by a high speed CAN bus message from the RCM to the instrument cluster. The RCM sends the signal to illuminate the air bag warning indicator if a fault is detected, and for approximately 6 seconds during the bulb check at the beginning of each ignition cycle.

CLOCKSPRING



ITEM	DESCRIPTION
1	Outer housing
2	Electrical connector
3	Inner housing
4	Drive spigot
5	Locking lever
6	Electrical connector

The clockspring is installed on the steering column to provide the electrical interface between the fixed wiring harness and the steering wheel. The clockspring provides connections for the driver air bag, horn and steering wheel switch packs.

A rotating link harness is encapsulated into a plastic cassette comprising outer and inner housings with integral connectors. Brackets on the outer housing accommodate the column stalk switches. A spring loaded locking lever attached to the outer housing automatically engages and disengages with the inner housing when the steering wheel is removed and installed. To prevent damage to the rotating link harness, both the steering and the clockspring must be centralized when removing and installing the steering wheel.

SRS OPERATION

In a collision, the sudden deceleration or acceleration is measured by the impact sensors and the accelerometers in the restraints control module. The restraints control module evaluates the readings to determine the impact point on the vehicle and whether the deceleration/acceleration readings exceed the limits for firing any of the air bags, pretensioners, and battery disconnect unit. During a collision, the restraints control module only fires the air bags and pretensioners if the safing function confirms that the data from the impact sensor(s) indicates an impact limit has been exceeded.

The restraints control module incorporates the following impact thresholds to cater for different accident scenarios:

- Front impact, pretensioners

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

The front impact thresholds increase in severity from pretensioners, through to driver and passenger air bag stage 2, belt fastened.

FIRING STRATEGIES

The safety belt pretensioners are fired when the pretensioner impact limit is exceeded. The restraints control module only fires the pretensioners if the related safety belt is fastened.

The driver and passenger air bags are only fired in a frontal impact. If an impact exceeds a stage 1 limit, but is less than the corresponding stage 2 limit, only one inflator in each air bag is fired (stage 2 is still fired for disposal after a delay of 100ms). If an impact exceeds the stage 2 limit, the two inflators in each air bag are fired simultaneously.

The passenger air bag is disabled unless the front passenger seat is occupied by a large person (NAS only), or the passenger air bag deactivation switch is on (all except NAS & AUS).

The stage 2 inflator of the driver air bag is disabled if the driver seat is forward of the switching point of the seat position sensor.

If there is a fault with a safety belt buckle sensor, the restraints control module assumes the related safety belt is fastened for the pretensioner firing strategy and unfastened for the driver and passenger air bag firing strategies. If there is a fault with the occupant classification sensor, the restraints control module disables the passenger air bag. If there is a fault with the passenger air bag deactivation switch, the restraints control module disables the passenger air bag.

If a side impact limit is exceeded, the restraints control module fires the side air bag and the side head air bag on that side of the vehicle. If the side impact limit on the front passenger side of the vehicle is exceeded, the restraints control module also evaluates the input from the occupant classification sensor, and fires the side air bag 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 restraints control module 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)

SAFETY BELT STATUS		STRATEGY		
DRIVER	PASSENGER	APPLICABLE PRETENSIONER	DRIVER AIR BAG	PASSENGER AIR BAG
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 Only)

SAFETY BELT STATUS		PASSENGER SEAT STATUS	STRATEGY		
DRIVER	PASSENGER		APPLICABLE PRETENSIONER	DRIVER AIR BAG	PASSENGER AIR BAG
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	Unoccupied inhibit /empty	Fired at pretensioner threshold	-	Not fired
-	Unfastened	Occupied allow	Not fired	-	Fired at belt unfastened threshold
-	Unfastened	Unoccupied inhibit /empty	Not fired	-	Not fired

The battery disconnect unit is fired:

- At driver and passenger air bag belt fastened threshold in a frontal impact
- At the driver and passenger side impact threshold in a side impact
- At the rear impact threshold in a rear impact.

CRASH SIGNAL

When the 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 CAN. The crash signal is also hardwired to the ECM and the CJB. The instrument cluster picks up the crash signal from the High speed CAN and gateways it to the lighting control module (LCM). On receipt of the crash signal, the CJB goes into a crash mode and the ECM cuts the power supply to the fuel pump relay. In the crash mode, the CJB:

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

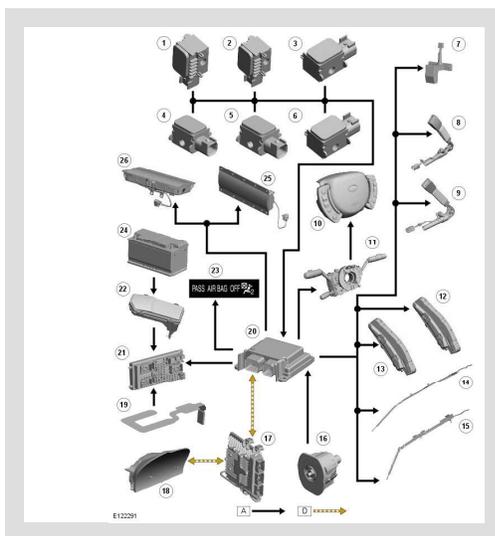
- Ignores all locking/superlocking inputs until it receives an unlock input, when it returns the locking system to normal operation.
- Activates the interior lamps. The interior lamps remain on permanently until they are manually switched off at the lamp unit, or the CJB crash mode is switched off and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

NOTE:

A = Hardwired; D = High Speed CAN



ITEM	DESCRIPTION
1	right-hand (RH) rear side impact sensor
2	left-hand (LH) rear side impact sensor
3	RH front side impact sensor
4	RH front impact sensor
5	LH front impact sensor
6	LH front side impact sensor
7	Seat position sensor
8	Safety belt pretensioner

ITEM	DESCRIPTION
9	Safety belt pretensioner
10	Drivers airbag
11	Clock spring
12	Side airbag
13	Side airbag
14	Head airbag
15	Head airbag
16	Passenger airbag deactivation switch
17	ECM
18	Instrument cluster
19	Occupant detection sensor
20	RCM
21	CJB
22	engine junction box (EJB)
23	Passenger airbag deactivated warning lamp
24	Battery
25	Knee airbag
26	Passenger airbag