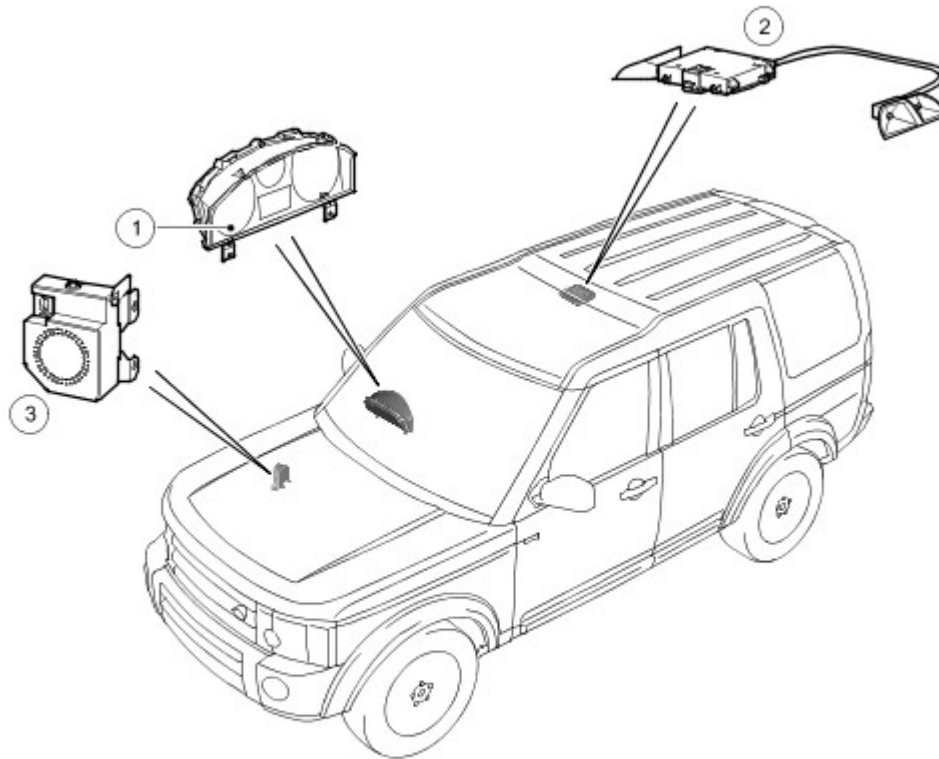


Published : Apr 21, 2004

## Anti-Theft - Active

### COMPONENT LOCATIONS



E44258

Item	Part Number	Description
1	-	Alarm indicator
2	-	Volumetric sensor
3	-	BBUS

### GENERAL

The anti-theft alarm system monitors the hinged panels for unauthorized opening. On some vehicles, the anti-theft alarm system also incorporates interior monitoring and vehicle tilt sensing functions.

Operation of the anti-theft alarm system is controlled by the Central Junction Box (CJB). When an alarm is triggered, the CJB sounds the vehicle horns or the Battery Backed-Up Sounder (BBUS) and illuminates the hazard flashers.

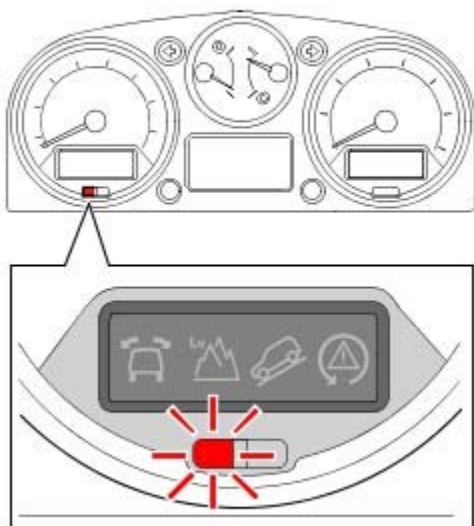
The anti-theft alarm system consists of:

- An alarm indicator.
- A BBUS (market dependant).
- A volumetric sensor (market dependant).

The anti-theft alarm system also uses:

- The CJB.
- The hood, door and tailgate ajar switches. For additional information, refer to [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems)
- The vehicle horns. For additional information, refer to [Horn](#) (413-06 Horn)

## ALARM INDICATOR



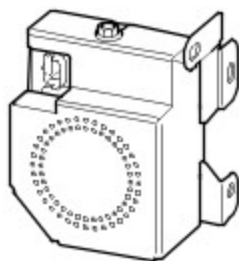
E44259

The alarm indicator is a red Light Emitting Diode (LED) installed in the instrument cluster to provide a visual indication of the anti-theft alarm system status. Operation of the alarm indicator is controlled by the CJB, which varies the flash rate to indicate the anti-theft alarm system status.

### Anti-theft Alarm System Status Indications

Status	Description	Alarm Indicator
0 - Disarmed	When system disarmed. Also first 10 seconds after being armed with a panel open.	Off.
1 - Armed	Entered 10 seconds after arming.	10 milliseconds flash every 2 seconds.
2 - Perimeter Arming	All panels closed. Indication delayed for 2.5 seconds to allow time to process double locking commands.	Two 10 milliseconds flashes every 2 seconds, for 10 seconds.
3 - Volumetric Arming	All panels closed and volumetric sensor armed. Indication delayed for 2.5 seconds to allow time to process double locking commands.	Three 10 milliseconds flashes every 2 seconds, for 10 seconds.

### BBUS (WHERE FITTED)



E44260

The BBUS is attached to the plenum in the engine compartment, next to the brake booster. The BBUS uses an integral sounder to produce the audio warning after an alarm has been triggered. In some markets, a tilt sensor is incorporated into the BBUS. Externally, the two types of BBUS look the same.

Operation of the BBUS is controlled by the CJB. The CJB and the BBUS exchange signals over a Local Interconnect Network (LIN) bus communications link. The BBUS is normally powered by a permanent battery power supply from the CJB. An integral rechargeable battery powers the sounder if the power feed is disrupted.

When it arms the anti-theft alarm system, in the perimeter mode or the volumetric mode, the CJB sends an arming signal to the sounder in the BBUS. When it arms the anti-theft alarm system in the volumetric mode, if a tilt sensor is fitted, the CJB also sends an arming signal to the tilt sensor. On receipt of the arming signals, the sounder and the tilt sensor respond with a status signal. If there is no response to the arming signals within 12 seconds, the CJB assumes there is a fault and sends a disarm signal to the sounder or the tilt sensor, as appropriate. The CJB also stores a related fault code.

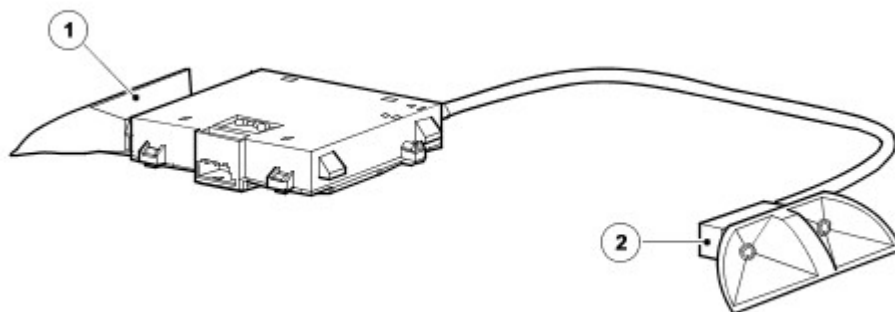
When the sounder is disarmed, while the anti-theft alarm system is armed, if the alarm is subsequently triggered the CJB uses the horns to sound the audio warning instead of the sounder.

While the sounder is armed, the CJB sends a periodic signal (heartbeat) to the BBUS, and the BBUS monitors the battery power supply and the communications link with the CJB. The BBUS operates the sounder if:

- It receives an alarm signal from the CJB or the tilt sensor.
- The power supply or the communications link from the CJB is disrupted.

The tilt sensor measures the longitudinal and lateral angle of the vehicle over a range of  $\pm 16^\circ$  from the horizontal. When the anti-theft alarm system is armed in the volumetric mode, the BBUS stores the current angles in memory and monitors the tilt sensor readings. If the vehicle attitude changes in either direction by more than the alarm limit, the BBUS activates the sounder.

## VOLUMETRIC SENSOR (WHERE FITTED)



E44261

Item	Part Number	Description
1	-	Front transmitter/receiver pair

2	-	Rear transmitter/receiver pair
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The volumetric sensor is installed in its own housing on the roof, just in front of the row 2 interior lamp housing, and monitors for intrusion into the passenger compartment when the anti-theft alarm system is armed.

The volumetric sensor consists of a microcontroller, two acoustic transmitters and two acoustic receivers. One transmitter and receiver pair faces forwards and one transmitter and receiver pair faces rearwards, to ensure complete coverage of the passenger compartment. The front transmitter and receiver pair are in a rubber mounting attached to the microcontroller housing. The rear transmitter and receiver pair are in a remote rubber mounting and connected to the microcontroller housing by a four wire lead.

The volumetric sensor is powered by a feed from the CJB. The CJB activates and de-activates the volumetric sensor when it arms and disarms the anti-theft alarm system in the volumetric mode. When the volumetric sensor is active it outputs ultrasonic pulses from the transmitters and checks the echoes picked up by the receivers for changes to the passenger compartment profile. If it detects a change of profile, indicating movement in the passenger compartment, the volumetric sensor reports the alarm to the CJB.

Each time the volumetric sensor is armed, it performs a self test. If there are no faults the volumetric sensor sends an acknowledgment signal to the CJB. If the CJB does not receive the acknowledgment signal it de-activates the volumetric sensor.

## SYSTEM OPERATION

### General

The CJB automatically arms and disarms the anti-theft alarm system when it operates the central locking system. For additional information, refer to [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems)

### Arming

On vehicles without the volumetric sensor and the tilt sensor, the anti-theft alarm system is armed in the perimeter mode when the vehicle is either locked or superlocked.

On vehicles with the volumetric sensor, the anti-theft alarm system is armed in one of two modes:

- Perimeter mode, where only the hinged panels are monitored, is employed when the vehicle is locked with the remote handset or the door key lock.
- Volumetric mode, where the hinged panels, the vehicle interior and, if the tilt sensor is incorporated, the vehicle attitude, are monitored. Volumetric mode is employed when the vehicle is superlocked with the remote handset or the door key lock.

The CJB arms the anti-theft alarm system when it locks or superlocks the vehicle, provided the following conditions coexist:

- The driver door is shut.
- A valid key is not in the ignition switch.
- The anti-theft alarm system is not in panic alarm mode.
- The anti-theft alarm system is enabled.
- The CJB is not in transit mode.

### Mislock

If the driver door is open when a lock or superlock request is received, the anti-theft alarm system remains disarmed and the CJB generates a mislock sound with a 100 milliseconds 'chirp' on the horns.

When the CJB arms the anti-theft alarm system, it enters the perimeter mode by beginning to monitor the status of the hinged panels and, where applicable, sending an arming signal to the BBUS. On a vehicle with a volumetric sensor installed, the CJB then transitions into the volumetric mode by sending arming signals to the volumetric sensor and the tilt sensor. The CJB ignores alarm signals from the volumetric sensor for 30 seconds after sending the arming signal, to

allow time for the vehicle interior to settle.

If any of the hinged panels, except the driver door, is open, the CJB arms in the perimeter mode, but ignores the open hinged panel as an alarm trigger and generates a mislock sound. On a superlocked vehicle with a volumetric sensor installed, if the open hinged panel is a door or the tailgate, the CJB remains in the perimeter mode instead of transitioning into the volumetric mode. If the open hinged panel is subsequently closed, and remains closed for 1 second, the CJB then includes it as a valid alarm trigger and, where appropriate, transitions into the volumetric mode.

## Disarming

The CJB disarms the anti-theft alarm system when it receives an unlock request from the remote handset.

When the vehicle is unlocked using the door key lock, the CJB disarms the anti-theft alarm system if, within 12 seconds, a valid key is installed in the ignition switch or an unlock request is received from the remote handset. The CJB detects the installation of a valid key from the transponder coil around the ignition switch. During the 12 seconds delay, only the hood ajar switch remains as a valid alarm trigger, and the instrument cluster speaker is pulsed at 0.5 second on, 0.5 second off. If, within the 12 seconds, a valid key is not installed in the ignition switch, there is no unlock request from the remote handset, or the hood is opened, the CJB enters the alarm mode.

The CJB can selectively disarm parts of the anti-theft alarm system, to prevent nuisance alarms being triggered, as follows:

- On vehicles with park heating and cooling, the CJB disarms the volumetric sensor, where applicable, when park heating or cooling is activated. This prevents air movement, produced by the blower, from triggering the alarm. The CJB re-arms the volumetric sensor when park heating or cooling is de-activated. The CJB disarms and re-arms the sensor in response to the Air Conditioning (A/C) alarm level request message which the Automatic Temperature Control Module (ATCM) outputs on the medium speed CAN bus.
- When the anti-theft alarm system is armed in the volumetric mode, if the vehicle battery voltage decreases to less than 9 volts the CJB will transition into perimeter mode by disarming the volumetric sensor and the tilt sensor. This prevents false alarms caused by the sensors not operating below 9 volts.
- Where a BBUS is installed, if the vehicle battery voltage decreases from 9.5 to 9 volts in more than 30 minutes, the CJB will disarm the BBUS and, if necessary, use the horns as the audible warning. This prevents false alarms caused by the CJB not supplying the heartbeat signal to the BBUS below 9 volts, which the BBUS would interpret as a tamper condition. If the voltage rises above 9.5 volts the CJB re-arms the BBUS.
- If the vehicle is unlocked using the remote handset and, within 1 minute, a hinged panel is not opened or a valid key is not put in the ignition switch, the CJB automatically relocks the vehicle and re-arms the anti-theft alarm system. This prevents the vehicle being left unlocked and disarmed by accidentally pressing the remote handset unlock button.

## Alarm

When the alarm is triggered, audible and visible warnings are produced by the CJB. Audible indications are produced using the horns or the BBUS. Visible indications are produced using the hazard flashers.

If the BBUS is used for the audible indications, the BBUS cycles the sounder on for 30 seconds and off for 5 seconds. If the alarm trigger is still present after the 5 seconds off period, the cycle of 30 seconds on, 5 seconds off, is repeated. The BBUS operates for a maximum of 10 cycles for each alarm trigger source, or until it receives a disarm signal.

If the horns are used for the audible warning, the CJB cycles the horns on for 30 seconds and off for 5 seconds. If the alarm trigger is still present after the 5 seconds off period, the cycle of 30 seconds on, 5 seconds off, is repeated. The CJB operates the horns for a maximum of 10 cycles for each arming cycle, or until it receives a disarm signal. The 10 cycle limit prevents damage to the horns from excessive use.

During the on period, the BBUS sounder or the horns are pulsed at 380 milliseconds on, 380 milliseconds off. The hazard flashers are also pulsed at 380 milliseconds on, 380 milliseconds off, in sequence with the audible warning.

The anti-theft alarm system transitions from an armed mode to the alarm mode if:

- The hood, a door or the tailgate is opened.
- The volumetric sensor signals an alarm condition.
- The tilt sensor signals an alarm condition.
- A non valid key is detected in the ignition switch. There is a 0.4 second delay between recognition of a key being installed in the ignition switch and identification of the transponder, to allow sufficient time to interrogate the key.
- The vehicle is unlocked using the door key lock and the CJB does not detect a valid key in the ignition switch or

receive an unlock request from the remote handset, within 12 seconds.

- If the personal button on the remote handset is configured to panic alarm, when the button is pressed the CJB triggers the alarm as detailed above. The panic alarm operates with the anti-theft alarm system either armed or disarmed. The CJB cancels the panic alarm when it receives a lock or unlock request from the remote handset, or detects a valid key in the ignition switch. On North American Specification (NAS) vehicles, after 160 seconds the panic alarm times out and the anti-theft alarm system returns to the previous operating state.

Door key lock signals are ignored after the alarm is triggered.

The alarm stops immediately and the anti-theft alarm system is disarmed on receipt of an unlock command from the remote handset.

The alarm stops immediately and the anti-theft alarm system returns to the armed mode on receipt of a lock command from the remote handset. The CJB ignores the current alarm trigger(s) and only considers the remainder of the alarm trigger sources as valid inputs for a further alarm. The ignored alarm trigger(s) are reinstated as valid alarm trigger sources after they remain in an untriggered state for a minimum of 1 second. For example, the anti-theft alarm system is armed in the volumetric mode when a door is opened and triggers the alarm. Pressing the lock button on the remote handset returns the anti-theft alarm system to the alarm mode and causes the CJB to ignore the inputs from the ajar switch of the open door and the volumetric sensor. One second after the door closes, the CJB considers the ajar switch input as valid again. After a further 30 seconds settling time, the CJB also considers the volumetric sensor input as valid again.

The CJB stores the last ten alarm triggers in a trigger log, which can be accessed over the medium speed CAN bus using T4. The trigger log can only be cleared when the system is disarmed. Each trigger entry contains a number that corresponds to the trigger source.

## Alarm Trigger Sources

Trigger No.	Description
0	No trigger stored
1	Driver door ajar switch
2	Front passenger door ajar switch
3	Rear LH door ajar switch
4	Rear RH door ajar switch
5	Tailgate ajar switch
6	Hood ajar switch
7	Ignition switch
8	External key lock turned to unlock
9	Tilt sensor
10	Volumetric sensor

If an alarm is triggered during an armed cycle, when the anti-theft alarm system is subsequently disarmed the CJB pulses the hazard flashers at 200 milliseconds on, 200 milliseconds off, for 3 seconds.

## Delivery Mode

When the vehicle is in the delivery mode, the anti-theft alarm system is disabled.

## Diagnostics

The CJB monitors the communication links with the BBUS, the tilt sensor and the volumetric sensor. If any of the communications links fail, the CJB stores a related fault code, which can be accessed with T4.

## Diagnostic Fault Codes

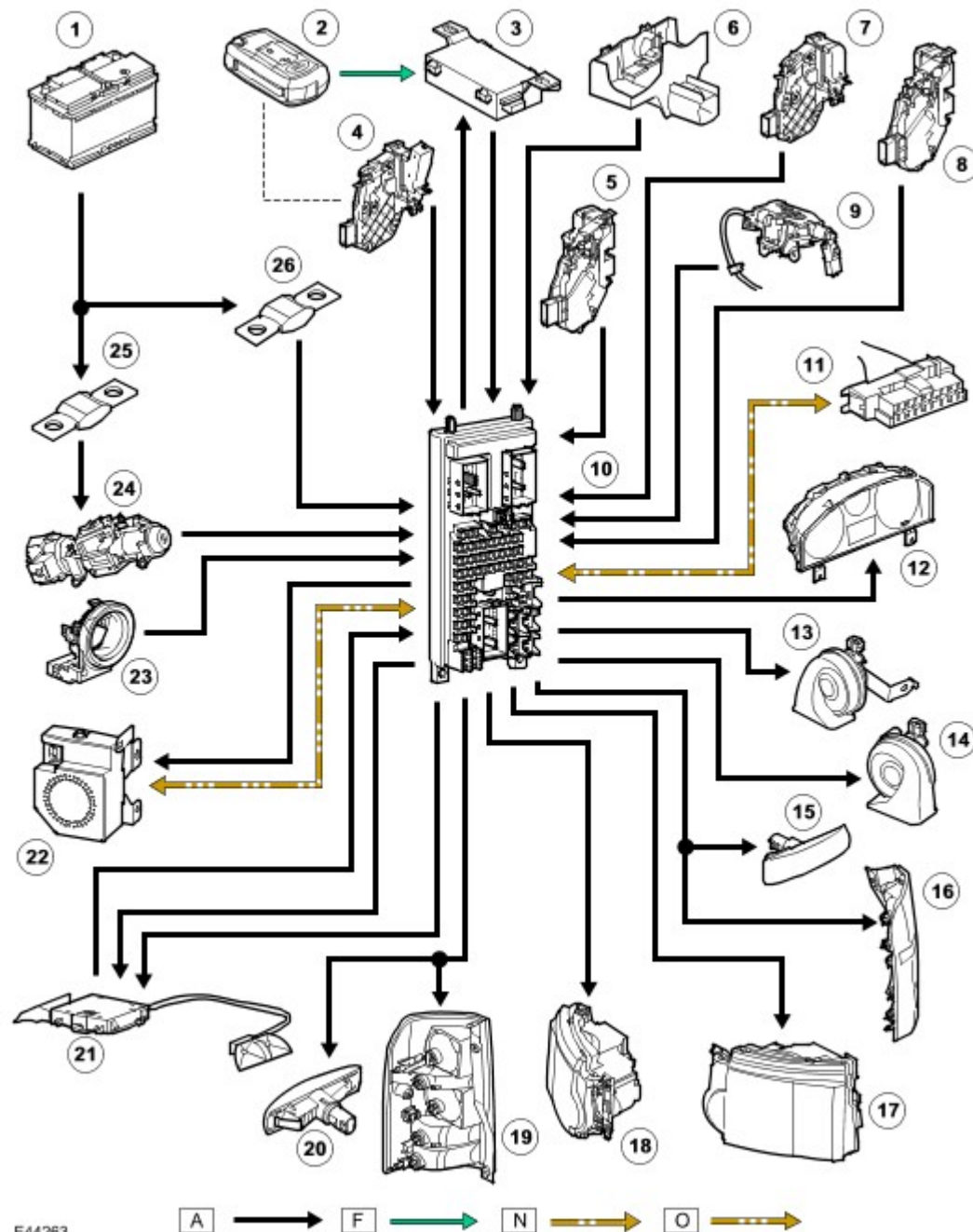
Fault	Description
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BBUS Communication Failure	If a response is not received on the BBUS LIN bus within 12 seconds of a status request from the CJB, the BBUS Communication Failure fault code is set. The CJB continues trying to communicate with the BBUS even if a communication failure has occurred.
BBUS Internal Fault	If the CJB sends a command (Arm / Disarm / Alarm / Sleep) to the BBUS, and the status from the BBUS does not show the BBUS has responded to the command within 12 seconds, the 'BBUS Internal Fault' fault code is set.
BBUS Trigger Source	The BBUS Trigger Source stores the reason for the last BBUS sound cycle. The values which can be stored are: 0 = Not triggered 1 = Due to power interruption 2 = Due to LIN communication interruption 3 = Due to an external command from the CJB
Tilt Sensor Internal Fault	If the CJB sends a command (Arm / Disarm / Sleep) to the tilt sensor in the BBUS, and the status from the BBUS does not show the BBUS has responded to the command within 12 seconds, the 'Tilt Sensor Internal Fault' fault code is set.
Volumetric Communication Failure	If a 100 milliseconds pulse response is not received on the Volumetric Trigger line, within 350 milliseconds of an arm command from the CJB, the Volumetric Communication Failure fault code is set.

## ANTI-THEFT ALARM SYSTEM CONTROL DIAGRAM

### NOTE :

A = Hardwired Connections; F = RF Transmission; N = Medium Speed CAN Bus; O = LIN Bus



E44263

Item	Part Number	Description
1	-	Battery
2	-	Ignition key
3	-	RF receiver
4	-	Left front door ajar switch, lock switch and unlock switch
5	-	Right front door ajar switch
6	-	Hood ajar switch
7	-	Left rear door ajar switch
8	-	Right rear door ajar switch
9	-	Tailgate ajar switch
10	-	CJB



11	-	Diagnostic socket
12	-	Alarm indicator
13	-	Left horn
14	-	Right horn
15	-	Right side repeater lamp
16	-	Right tail turn signal indicator lamp
17	-	Right front turn signal indicator lamp
18	-	Left front turn signal indicator lamp
19	-	Left tail turn signal indicator lamp
20	-	Left side repeater lamp
21	-	Volumetric sensor
22	-	BBUS
23	-	Transponder coil
24	-	Ignition switch
25	-	Fusible link 11E, battery junction box
26	-	Fusible link 17E, battery junction box