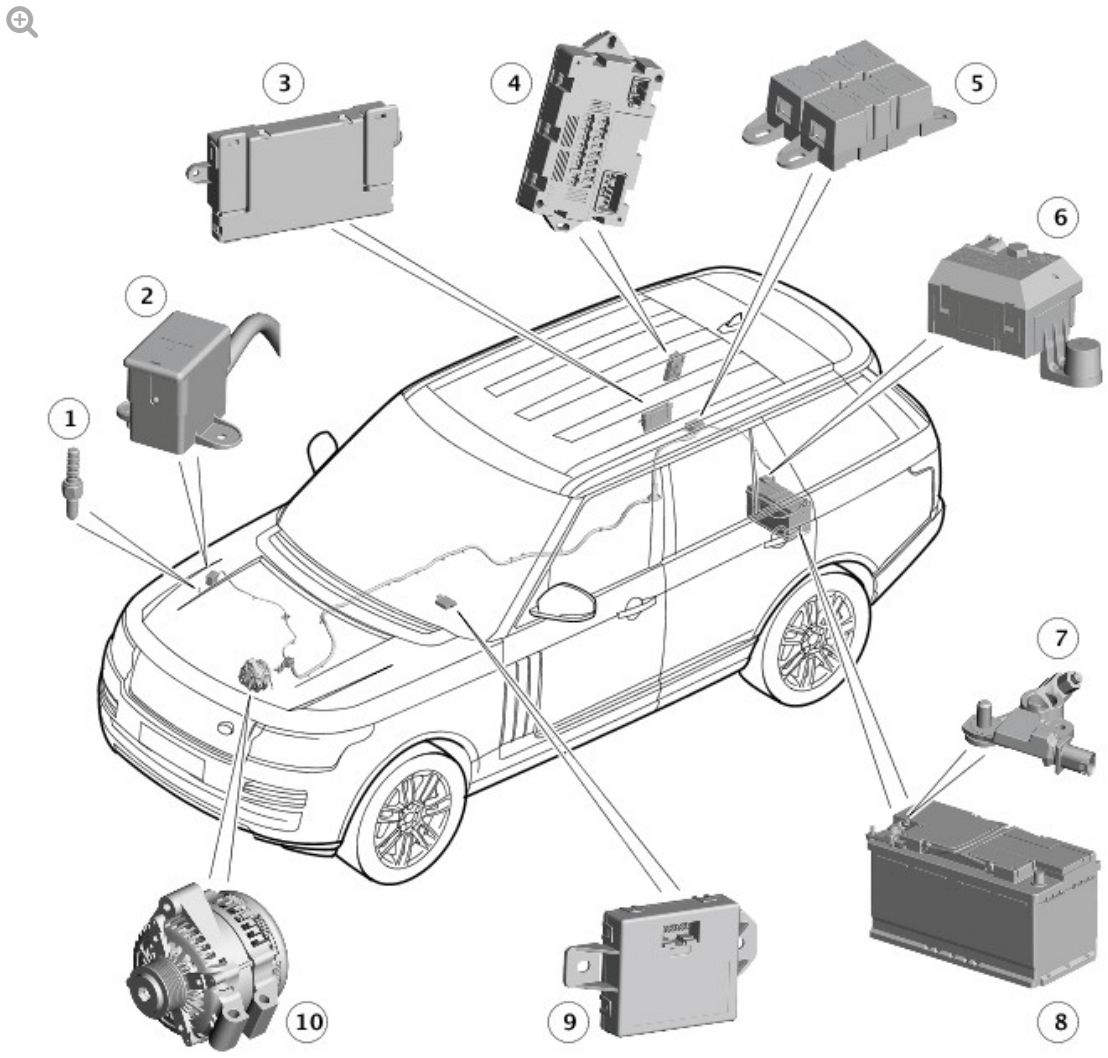
2016.0 RANGE ROVER (LG), 414-01

BATTERY, MOUNTING AND CABLES

DESCRIPTION AND OPERATION

COMPONENT LOCATION - SINGLE BATTERY VEHICLES



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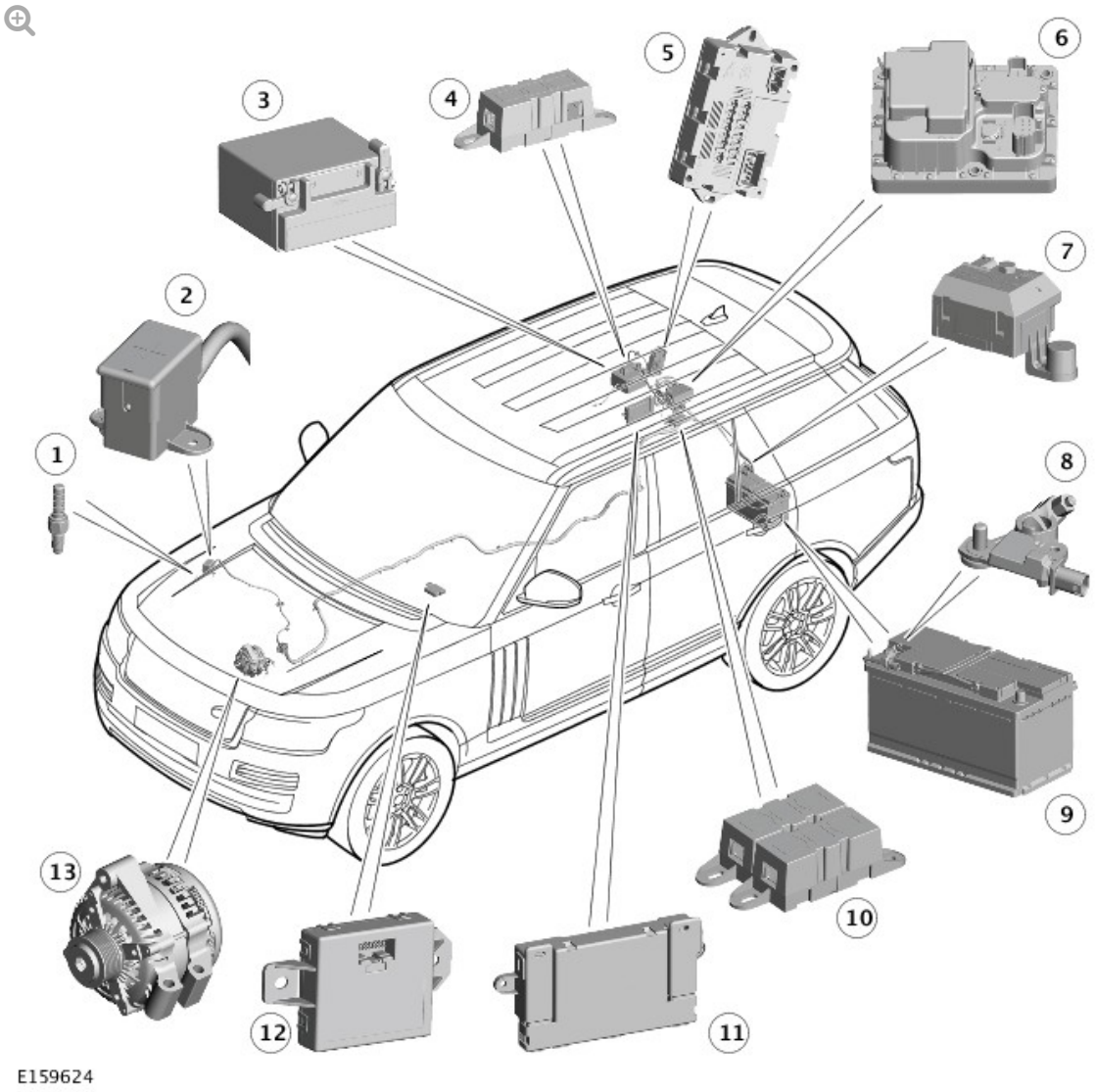
ITEM	DESCRIPTION
1	Jump start terminal negative (-)
2	Jump start terminal positive (+)
3	Battery Junction Box (BJB)
4	Quiescent Current Control Module (QCCM)
5	Battery Junction Box 2 (BJB2)
6	Transit relay
7	Battery Monitoring System (BMS) control module
8	Primary battery
9	Gateway Module (GWM)
10	Generator

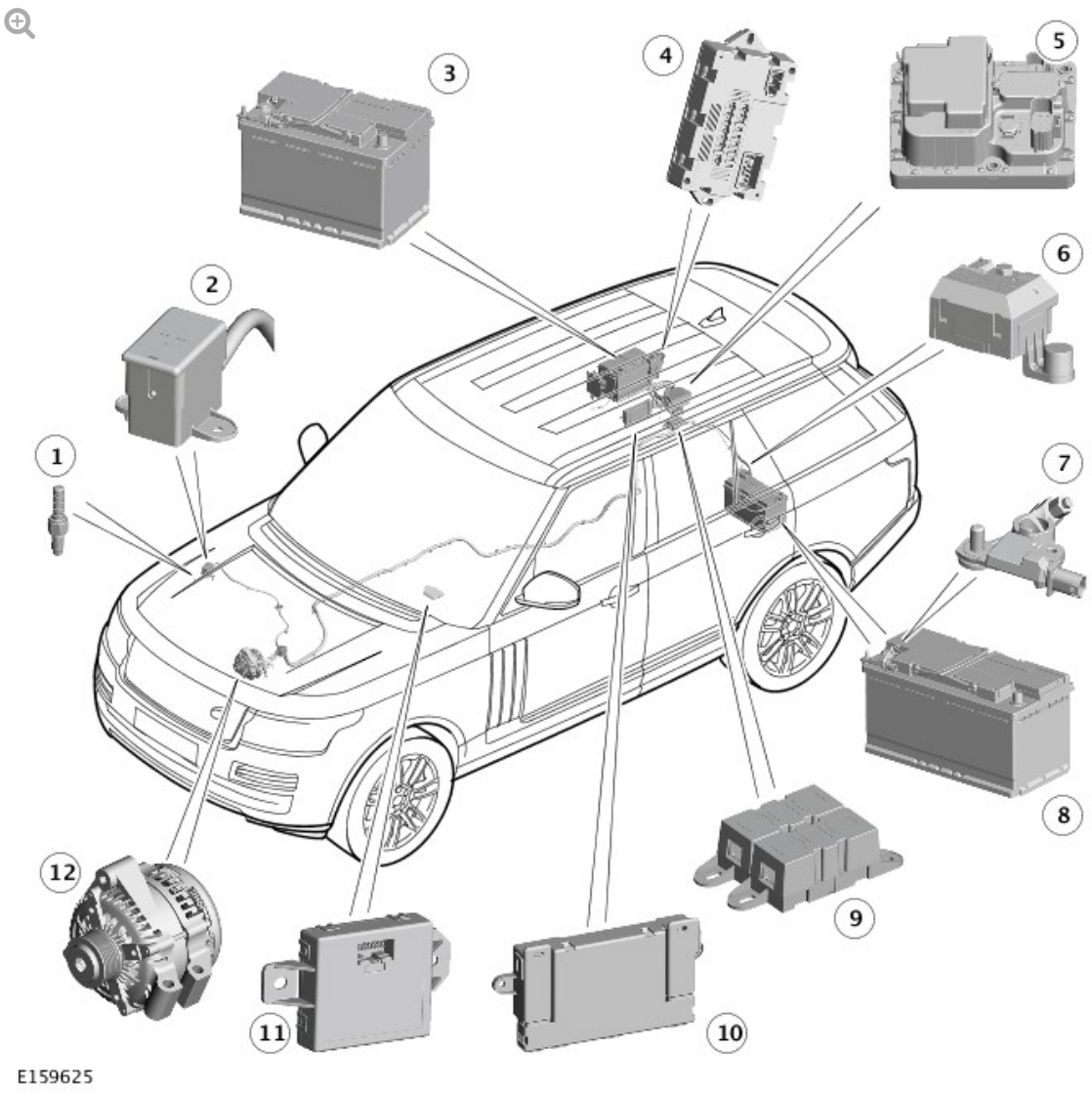
COMPONENT LOCATION - DUAL BATTERY SYSTEM WITH STOP/START SYSTEM



ITEM	DESCRIPTION
1	Jump start terminal negative (-)
2	Jump start terminal positive (+)
3	Secondary battery
4	Megafuse
5	Quiescent Current Control Module (QCCM)
6	Power Supply Distribution Box (PSDB)
7	Transit relay
8	Battery Monitoring System (BMS) control module
9	Primary battery
10	Battery Junction Box 2 (BJB2)

11	Battery Junction Box (BJB)
12	Gateway Module (GWM)
13	Generator

COMPONENT LOCATION - DUAL BATTERY SYSTEM WITHOUT STOP/START SYSTEM



ITEM	DESCRIPTION
1	Jump start terminal negative (-)
2	Jump start terminal positive (+)
3	Auxiliary battery
4	Quiescent Current Control Module (QCCM)

5	Power Supply Distribution Box (PSDB)
6	Transit relay
7	Battery Monitoring System (BMS) control module
8	Primary battery
9	Battery Junction Box 2 (BJB2)
10	Battery Junction Box (BJB)
11	Gateway Module (GWM)
12	Generator

OVERVIEW – SINGLE BATTERY VEHICLES

A single primary battery is located in the luggage compartment floor in a plastic moulded tray. The battery is secured in position by a foam pad and clamped in position by the air suspension air supply unit.

The primary battery on petrol and diesel vehicles is a 90Ahr, 850A CCA AGM (absorbed glass mat) VRLA (valve regulated lead-acid) battery.

A Battery Monitoring System (BMS) control module is mounted on the battery negative terminal. The BMS control module is integral with the battery negative cable and is controlled by the Gateway Module (GWM).

CAUTION:

To avoid damaging the BMS control module, always use the ground (negative (-)) terminal stud point and the positive (+) terminals on the right side top mount. Never connect directly to the primary battery negative or positive terminals when connecting a slave power supply to the vehicle, the BMS control module can be damaged.

If a new primary battery is fitted to the vehicle, the BMS control module will require re-calibrating using a Land Rover approved diagnostic system.

When the vehicle leaves the factory, a transit relay is fitted to the primary battery positive terminal. The transit relay is connected to the CJB (central junction box) which limits the electrical functions to essential items only, to reduce loads on the battery. The transit relay provides battery power to the BJB2 (battery junction box 2) which supplies the starter motor, generator and the positive jump start terminal. The transit relay must be removed from the vehicle during the PDI (pre-delivery inspection). For additional information, refer to the PDI Manual.

The battery provides power to the BJB (battery junction box) via BJB2. The BJB contains megafuses, delivering power to the CJB, the RJB (rear junction box), the AJB (auxiliary junction box), the EJB (engine junction box) and the starter motor and generator. In addition to all junction boxes containing fuses and relays, the RJB and CJB contain software to control a number of vehicle systems. These functions are covered in the appropriate sections of this manual.

Two jump start terminals are located adjacent to the right side top mount in the engine compartment. A cover protects the positive (+) terminal when not in use. If jump starting is required, the cover must be removed and the positive (+) jump lead attached securely. The cover must be fitted to the positive terminal when not in use. The negative (-) jump lead is attached to a stud located on the right side top mount.

The GWM (gateway module) hosts most of the software required to control the primary battery charging system and components. The GWM monitors the components and can store fault related DTC (diagnostic trouble code)'s. The GWM contains the intelligent power management system and the BMS software. Monitoring of the primary battery condition is controlled by the GWM and the BMS (battery monitoring system) control module.

OVERVIEW – DUAL BATTERY SYSTEM VEHICLES WITHOUT STOP/START SYSTEM

Two batteries are fitted to accommodate the dual battery system used for

starting systems without the stop/start system.

A primary battery is located in the luggage compartment floor in a plastic moulded tray and clamped in position by the air suspension air supply unit.

On TDV6 3.0L diesel and TDV8 4.4L diesel cold climate vehicles, the auxiliary battery is located on the right side of the luggage compartment on a battery support tray and secured with a strap, threaded rods and a clamp bolted to the tray.

- The primary battery is a 90Ahr, 850CCA AGM (absorbed glass mat) VRLA (valve regulated lead-acid) battery on all vehicles.
- The auxiliary battery fitted to TDV6 3.0L diesel and TDV8 4.4L diesel in cold climate markets is a 70Ahr, 760CCA AGM battery.

A BMS (battery monitoring system) control module is mounted on the primary and auxiliary battery negative terminals. The BMS control module is integral with the battery negative cable and is controlled by the GWM (gateway module).

CAUTION:

To avoid damaging the BMS control module, always use the ground (negative (-) terminal stud point and the positive (+) terminals on the right side top mount. Never connect directly to the primary battery negative or positive terminals when connecting a slave power supply to the vehicle, the BMS control module can be damaged.

If a new primary battery is fitted to the vehicle, the BMS control module will require re-calibrating using a Land Rover approved diagnostic system. This will also apply if a new auxiliary battery is fitted to TDV6 3.0L diesel and TDV8 4.4L diesel cold climate vehicles.

When the vehicle leaves the factory, a transit relay is fitted to the primary battery positive terminal. The transit relay is connected to the CJB which

limits the electrical functions to essential items only, to reduce loads on the primary battery. The transit relay provides battery power to the BJB2 (battery junction box 2) which supplies the starter motor, generator, PSDB (power supply distribution box) and the positive jump start terminal. The transit relay must be removed from the vehicle during the PDI. For additional information, refer to the PDI Manual.

The primary battery provides power to the BJB via the BJB2 (battery junction box 2). The BJB contains megafuses, delivering power to the RJB, the EJB and the starter motor and generator. In addition to containing fuses and relays, the RJB and CJB contain software to control a number of vehicle systems. These functions are covered in the appropriate sections of this manual.

Two jump start terminals are located adjacent to the right side top mount in the engine compartment. A cover protects the positive (+) terminal when not in use. If jump starting is required, the cover must be removed and the positive (+) jump lead attached securely. The cover must be fitted to the positive terminal when not in use. The negative (-) jump lead is attached to a stud located on the right side top mount.

DUAL BATTERY SYSTEM

The dual battery system used on TDV6 3.0L diesel and TDV8 4.4L diesel in cold climate markets differs from the dual battery system used on vehicles with the stop/start system. The dual battery system on non-stop/start system vehicles assists the primary battery with engine starting under certain ambient and electrical conditions.

The dual battery system uses the auxiliary battery which is switched in parallel with the primary battery if the ambient temperature falls below a certain threshold, or the state of charge of the primary battery falls below a certain level. The function of the auxiliary battery is to assist the primary battery in cranking the car at a suitable speed to provide a start

The dual battery system comprises the following components:

- PSDB (power supply distribution box)
- GWM (gateway module)
- Primary battery
- Auxiliary battery.

The GWM (gateway module) hosts most of the software required to control the dual battery system and components. The GWM monitors the components and can store fault related DTC's.

The GWM controls the charging system software in conjunction with the CJB, ECM (engine control module), ABS (anti-lock brake system) control module and TCM (transmission control module) via the HS (high speed) CAN (controller area network) powertrain and MS (medium speed) CAN body bus.

The GWM contains the intelligent power management system and the BMS (batter monitoring system) software. Monitoring of the primary and auxiliary battery condition is controlled by the ECM, GWM and the BMS control modules.

OVERVIEW – DUAL BATTERY SYSTEM VEHICLES WITH STOP/START SYSTEM

Two batteries are fitted to accommodate the dual battery system used for the stop/start system. For additional information, refer to:

Starting System (303-06A Starting System - TDV6 3.0L Diesel, Description and Operation),
Starting System (303-06B Starting System - V6 S/C 3.0L Petrol, Description and Operation).

A primary battery is located in the luggage compartment floor in a plastic moulded tray and clamped in position by the air suspension air supply unit.

On stop/start system vehicles, the secondary battery is located in the right

side of the luggage compartment on a battery support tray and secured with a strap bolted to the tray.

- The primary battery is a 90Ahr, 850CCA AGM (absorbed glass mat) VRLA (valve regulated lead-acid) battery on all vehicles.
- The secondary battery is a 14Ahr, 200CCA AGM battery on all vehicles with stop/start.

A BMS (battery monitoring system) control module is mounted on the primary battery negative terminal. The BMS control module is integral with the battery negative cable and is controlled by the GWM (gateway module).

The secondary battery is not fitted with a BMS control module.

CAUTION:

To avoid damaging the BMS control module, always use the ground (negative (-) terminal stud point on the right side top mount. Never connect directly to the primary battery negative terminal when connecting a slave power supply to the vehicle, the BMS control module can be damaged.

If a new primary battery is fitted to the vehicle, the BMS control module will require re-calibrating using a Land Rover approved diagnostic system.

When the vehicle leaves the factory, a transit relay is fitted to the primary battery positive terminal. The transit relay is connected to the CJB which limits the electrical functions to essential items only, to reduce loads on the primary battery. The transit relay provides battery power to the BJB2 (battery junction box 2) which supplies the starter motor, generator, PSDB (power supply distribution box) and the positive jump start terminal. The transit relay must be removed from the vehicle during the PDI. For additional information, refer to the PDI Manual.

The primary battery provides power to the BJB via the BJB2. The BJB

contains megafuses, delivering power to the RJB, the EJB and the starter motor and generator. In addition to containing fuses and relays, the RJB and CJB contain software to control a number of vehicle systems. These functions are covered in the appropriate sections of this manual.

Two jump start terminals are located adjacent to the right side top mount in the engine compartment. A cover protects the positive (+) terminal when not in use. If jump starting is required, the cover must be removed and the positive (+) jump lead attached securely. The cover must be fitted to the positive terminal when not in use. The negative (-) jump lead is attached to a stud located on the right side top mount.

DUAL BATTERY SYSTEM

The dual battery system is used on all vehicles with the stop/start system. The dual battery system prevents the vehicle electrical systems being subjected to undesirably low voltages during repeated engine restarts. If the electrical systems are subject to low voltages the customer may notice degraded performance of components and systems and incorrect fault DTC's may be stored.

The dual battery system isolates all electrical components and systems sensitive to low supply voltage from the primary battery while an engine start is in progress, and supplies them from the secondary battery. Without the dual battery system, the electrical power required by the starter motor to crank the engine for each start would cause a voltage drop across the entire vehicle electrical network, and cause control modules to function incorrectly and in some cases reset and/or record DTC's.

If the dual battery system is unable to prevent electrical supplies to the vehicle systems being subjected to low voltage levels during engine stop/start operations, due to the condition of the primary and/or secondary batteries or a system fault, the stop/start feature (where fitted) is disabled.

The dual battery system comprises the following components:

- PSDB (power supply distribution box)

- GWM (gateway module)
- Primary battery
- Secondary battery.

The GWM hosts most of the software required to control the dual battery system and components. The GWM monitors the components and can store fault related DTC's.

The GWM controls the charging system software in conjunction with the ECM, CJB, ABS control module and TCM via the HS (high speed) CAN powertrain and MS (medium speed) CAN body bus.

On vehicles with stop/start, the GWM software will monitor the status of the stop/start system and determine, along with the ECM, if battery condition is sufficient to support a stop/start event. It can also request to maintain vehicle systems by keeping the engine running or initiating a restart due to, for example, climate control system requirements or request for restart from the ECM. A brake pressure signal is received from the ABS control module which will indicate to the GWM that an engine restart is required from driver operation of the foot brake.

The GWM contains the intelligent power management system and the BMS (battery monitoring system) software. Monitoring of the primary battery condition for stop/start is controlled by the ECM, GWM and the BMS control module.

DESCRIPTION

PRIMARY BATTERY – ALL VEHICLES

The primary battery is located in a plastic tray under the luggage compartment floor in a central position in the luggage compartment, below the suspension air supply unit. A foam pad and the air suspension air supply unit bracket secures the primary battery in position. The battery is vented

via a tube which passes through a grommet in the floorpan.

On new vehicles the primary battery positive terminal is fitted with a transit relay. The transit relay must be removed using the correct process detailed in the PDI manual.

The battery negative terminal is fitted with a BMS (battery monitoring system) control module. The BMS control module is integral with the battery negative cable and communicates with the GWM via a LIN (local interconnect network) bus connection. The battery condition information is passed to the GWM which controls the generator output accordingly.

CAUTION:

To avoid damaging the BMS control module, always use the ground (negative (-) terminal stud point on the right side top mount. Never connect directly to the primary battery negative terminal when connecting a slave power supply to the vehicle, the BMS control module can be damaged.

Failure to use the recommended ground point will lead to the setting of a DTC. Incorrect information of battery condition will be retained by the BMS control module due to the unmonitored current flow into the battery. The system will however, recognize and compensate for the change in battery status after a period of time.

If a new battery is fitted, the BMS control module will require re-calibration using a Land Rover approved diagnostic system. Replacement of the BMS control module requires no action as the control module will re-calibrate automatically.

SECONDARY BATTERY – STOP/START SYSTEM VEHICLES

The smaller secondary battery is located in the right side of the luggage

compartment on a battery support tray and secured with a strap bolted to the tray. The battery negative (-) terminal is connected via a cable to the vehicle body. The positive (+) terminal is connected by a cable to the PSDB (power supply distribution box). The battery is vented via a tube which passes through a grommet in the floorpan.

The state of charge of the secondary battery is monitored by the GWM (gateway module).

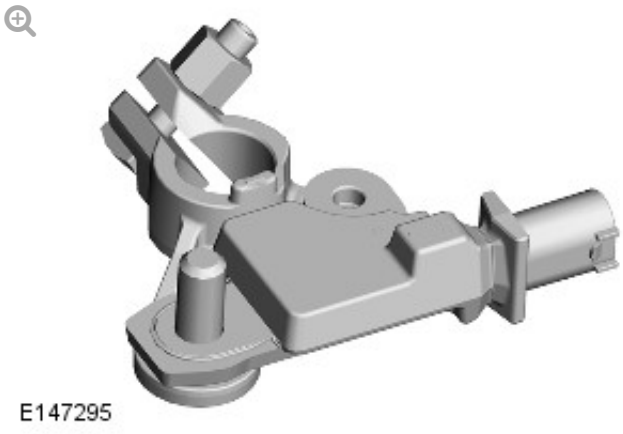
AUXILIARY BATTERY – TDV6 3.0L DIESEL AND TDV8 4.4L DIESEL COLD CLIMATE VEHICLES

The auxiliary battery is located on the right side of the luggage compartment on a battery support tray and secured with a strap, threaded rods and a clamp bolted to the tray. The battery negative (-) terminal is connected via a cable to the vehicle body. The positive (+) terminal is connected by a cable to the PSDB (power supply distribution box). The battery is vented via a tube which passes through a grommet in the floorpan.

The state of charge of the auxiliary battery is monitored by the Gateway Module (GWM) using the BMS control module.

BATTERY MONITORING SYSTEM (BMS)

Battery Monitoring System Control Module



SINGLE BATTERY AND DUAL BATTERY SYSTEM VEHICLES

NOTE:

The auxiliary and secondary batteries are not fitted with a BMS control module.

On all vehicles a BMS control module is located on the primary battery negative (-) terminal. The module is located on the battery post and is clamped to the post with a bolt and nut.

The primary battery negative ground cables are connected to the BMS control module and are attached to a ground stud on the vehicle body.

The BMS control module is connected into the vehicle wiring harness via a multiplug. The BMS control module receives a 12V power supply direct from the primary battery positive terminal. A LIN bus connection provides communication between the BMS control module, the GWM (gateway module) and the QCCM (quiescent current control module) for control and monitoring of the battery current drain and state of charge.

The BMS control module measures battery current and voltage, which it communicates to the GWM over a LIN bus connection. The GWM transmits the battery information over the MS (medium) CAN body and HS (high speed) CAN powertrain bus to other vehicle systems. Based on the information received from the BMS control module, the GWM and the ECM

will control the output from the generator and request the switching off of electrical loads if necessary.

CAUTION:

> Due to the self-calibration routine, it is recommended that all power supply diagnostic testing is carried out using the Land Rover approved diagnostic system rather than a digital multimeter.

The BMS control module is able to generate DTC's to help diagnose primary battery or generator power supply issues. These DTC's can be read using the Land Rover approved diagnostic system. The Land Rover approved diagnostic system can also be used to implement a primary and auxiliary battery and generator self test routine. For additional information, refer to the Diagnosis and Testing section of the workshop manual.

If a fault is detected, the GWM and the ECM will override the BMS control module.

The BMS control module DTC's can be used to help diagnose battery or generator power supply faults. The DTC's are stored in GWM. The Land Rover approved diagnostic system has a process for an automated power supply diagnostic procedure. The procedure provides a menu driven process to locate a fault in a logical sequence. The procedure uses the capability of the BMS control module and generator LIN bus controlled functions to provide current flow information and will detect if the BMS control module or generator are functioning correctly.

BMS LOW BATTERY WARNING AND ENERGY MANAGEMENT MESSAGES

The BMS continuously monitors the condition of the primary vehicle battery. If excessive battery discharge occurs, the system will begin to shut down non-essential electrical systems in order to protect the battery.

If the BMS calculates that battery condition is not within set parameters,

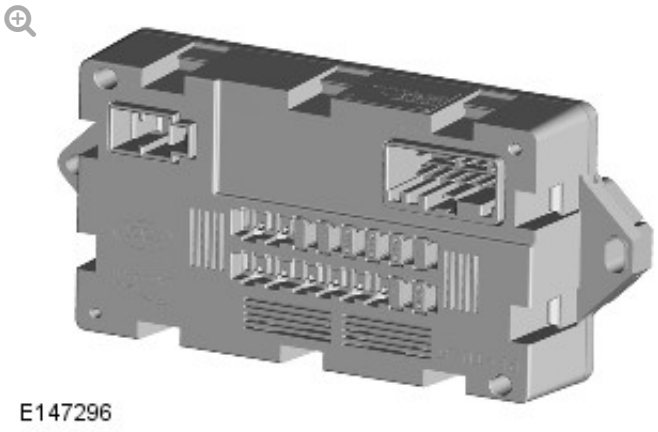
there are 3 messages that can be displayed, 2 on the touch screen and 1 on the message center. These inform the user that the battery is either at a low level of charge or the engine-off power consumption limit has been exceeded.

- **Low Battery - Please switch engine on or system will shutdown in 3 minutes**: is displayed as a **Warning** on the touch screen if the engine is not running. This indicates that the battery has fallen below a predefined threshold. As soon as the battery is charged back above this threshold then the message will be removed.
- **Low Battery - Please start your engine** is displayed on the message center if the engine is not running. This indicates that the battery has fallen below a predefined threshold. As soon as the battery is charged back above this threshold then the message will be removed or it can be manually removed by pressing 'OK'.
- **System will shut down in 3 minutes**: is displayed as an **Energy management** on the touch screen if the engine is not running, and system features are causing excessive battery discharge. After 3 minutes the BMS will begin shutting down vehicle systems. Normal system operation will resume when the engine is started.

This is based on a percentage of battery capacity available for the customer to use with the engine off. The percentage can change based upon several factors.

Once triggered, the resetting of this message will not occur until the vehicle is driven for 10 minutes with the engine running (to allow the battery to recoup any lost charge). However, if the engine is run for less than 10 minutes, the message will only be displayed after an additional 5 minutes with the ignition on but engine off.

QUIESCENT CURRENT CONTROL MODULE (QCCM) – ALL VEHICLES



The QCCM (quiescent current control module) is located right rear corner of the luggage compartment.

An addition to the BMS (battery monitoring system), and using signals already transmitted by the BMS control module(s), the QCCM cuts power supply to other non-essential control modules to avoid excessive discharge of the primary battery. The systems supplied via the QCCM are the audio/entertainment systems and the climate control systems.

Some control modules can cause unnecessary battery drain due to the module staying awake after the vehicle electrical system has been shut down. The QCCM in conjunction with the GWM, monitor and control the systems to prevent battery drain.

The system consists of three components:

- The BMS control module
- The GWM
- The QCCM

The BMS checks primary battery health by analyzing battery quiescent current, battery current drain or state of charge, and determines if any action is required to protect the primary battery. If action is required this is communicated to the GWM.

The GWM control logic uses this information to determine if action is

required to assist primary battery protection. The QCCM receives open and close commands from the GWM and reacts accordingly.

The software that controls the QCCM is contained within the GWM.

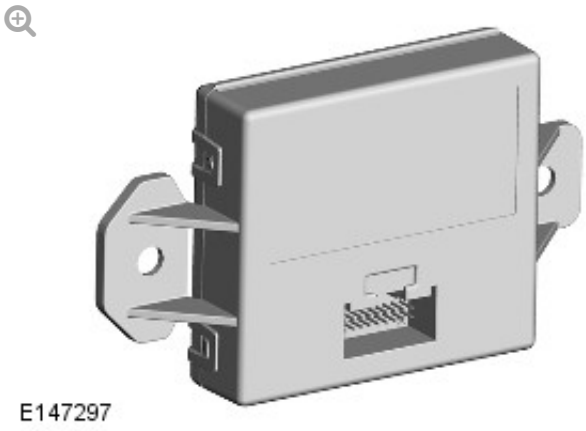
The system will be set in transit mode on delivery. Transit mode has no QCCM operation and the relays remain closed. Therefore battery drain could occur and the system will not react to it.

A PDI process requires the system to be put into Normal mode, which enables the QCCM, before handing over to the customer.

The QCCM has a routine to clean the relay contacts if required. This routine is performed using the Land Rover approved diagnostic system and, if unsuccessful, the unit will require replacement.

The module contains a number of fuses which supply and protect the audio/entertainment systems, the climate systems, the PSDB (power supply distribution box) and the GWM.

GATEWAY MODULE (GWM)



The GWM (gateway module) is attached to a bracket, which is bolted to the passenger side of the cross-car beam, behind the instrument panel.

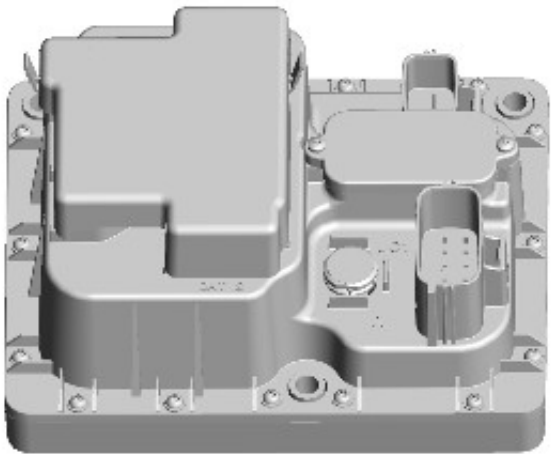
The GWM contains software to control the following functions:

- Determine condition of primary, auxiliary and secondary batteries.
- Control the output from the generator using load management software.
- Controls stop/start system using power management to inhibit unnecessary electrical loads.
- Control the PSDB (power distribution box) to enable the switching of the battery inputs.

The GWM communicates with other system modules on the HS (high speed) CAN powertrain and MS (medium speed) CAN body buses.

The GWM communicates with the BMS control module and the PSDB via a LIN bus.

POWER SUPPLY DISTRIBUTION BOX (PSDB)



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The PSDB (power supply distribution box) is located in the right side of the luggage compartment, rearward of the BJB. The PSDB incorporates two banks of MOSFET (metal-oxide-semiconductor field-effect transistor)'s, which are activated by the GWM (gateway module) to switch the vehicle loads between the batteries during stop/start on vehicles with stop/start

system, and also for charging the secondary or auxiliary battery.

The PSDB receives a battery supply direct from the primary battery to terminal 1 and a battery supply from the secondary or auxiliary battery to terminal 2 on the PSDB. The PSDB also incorporates a microcontroller, which receives commands from the GWM via a LIN bus connection. The PSDB connects or disconnects either the primary or secondary battery to the vehicle loads according to the GWM commands. In addition, there is a diagnostic connection between the GWM and PSDB, to detect faults with the PSDB.

The MOSFETs in the PSDB have a fail-safe body diode mode which will ensure there is always a connection from the primary battery to the vehicle loads in the event of a failure in the PSDB. At least 60A can be supplied to the loads in this mode. The GWM will detect such a failure and will shut down non-essential loads so as not to overload the power supply distribution box.

OPERATION

BATTERY MONITORING SYSTEM AND QUIESCENT CURRENT CONTROL – SINGLE AND DUAL BATTERY SYSTEM VEHICLES

When the ignition is off (power mode 0), the BMS (battery monitoring system) control module records the primary battery state of charge and begins to monitor the battery condition from this point.

If the battery state of charge falls by 7%, the BMS control module will monitor the primary battery for 5 minutes. The BMS control module sends a ‘warning’ message on the LIN bus to the GWM (gateway module). If after the 5 minute monitoring period, the battery charge has continued to fall or below 50% due to the quiescent drain current being too high, the BMS control module will determine that some control modules are still 'awake'.

The BMS control module sends a shutdown message on the LIN bus to the GWM. The GWM sends a CAN bus message on the MS (medium speed) CAN body and comfort bus, and HS (high speed) CAN powertrain and chassis bus networks to all control modules, requesting them to shutdown.

The BMS control module will monitor the primary battery state of charge for a further 15 minutes and determine if the battery state of charge is still dropping.

The BMS control module sends a 'Power Disconnect' signal to the GWM on the LIN bus. The GWM then sends a signal to the QCCM (quiescent current control module) on the LIN bus to open its internal relays. When the QCCM relays are open, the power supply from the primary battery to non-critical control modules is removed. The non-critical control modules are any modules associated with the infotainment system and also the climate control system.

The use of a LIN bus communication ensures that no other control modules are 'woken' during this process. If CAN bus communication was used, all modules on the CAN bus would be woken by the message.

BMS CONTROL MODULE SELF CALIBRATION

Periodically the BMS control module will initiate a self-calibration routine. To self calibrate, the battery monitoring system first charges the battery to its full condition.

NOTE:

If the vehicle is only driven for short periods the charging process could take a number of days to complete.

Once the battery is fully charged, the BMS control module will discharge the battery to approximately 75% of its full state of charge, but never lower than 12.2 V. The time taken to complete this part of the routine is dependent on the electrical load on the vehicle.

When the second part of the routine has been successfully completed, the BMS control module will return the battery to its optimum level of charge. The optimum level of charge will be between 12.6 V and 15 V, depending on battery condition, temperature and loading.

The BMS control module also monitors the primary battery condition with the engine switched off. If a low voltage condition is detected the BMS control module can request the infotainment system is switched off to protect battery voltage.

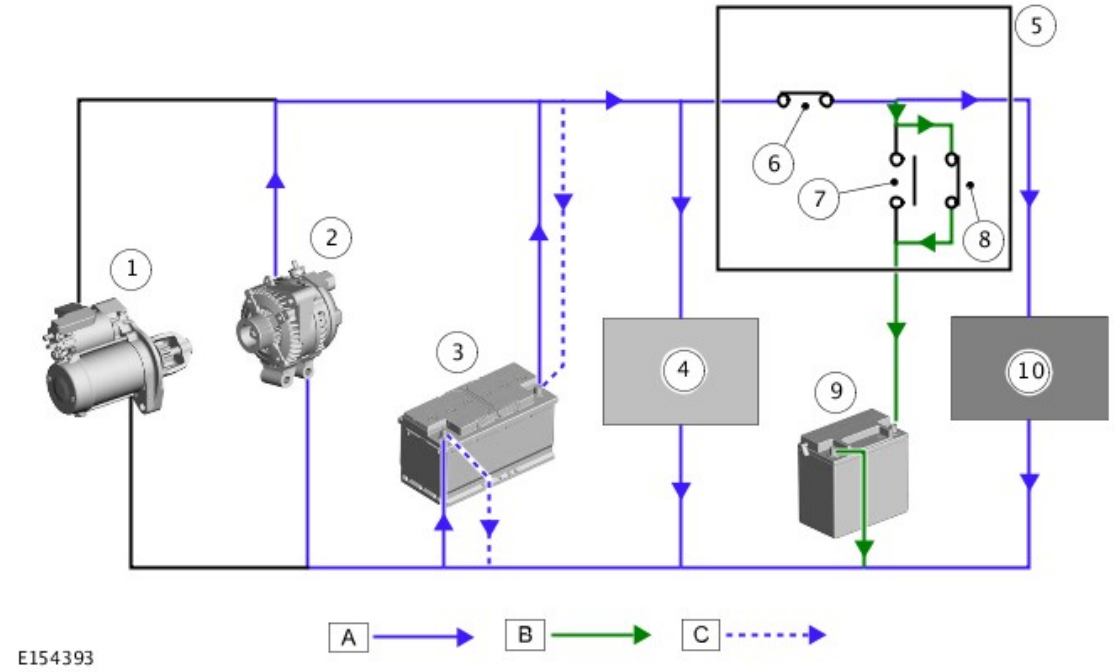
DUAL BATTERY SYSTEM – SECONDARY BATTERY STOP/START SYSTEM VEHICLES ONLY

The dual battery system prevents electrical loads on the vehicle being subjected to low voltage levels during an ECO (stop/start system) engine start. Low voltage can occur due to the power demand of the TSS (tandem solenoid starter) motor and could result in degraded performance of components and/or system control modules. The GWM (gateway module) contains the software to control the dual battery system and electrical load management system to ensure that ECO engine starts do not affect other vehicle systems.

The dual battery system isolates all power supply sensitive electrical components which may be affected by low voltage from the primary battery due TSS motor operation, and supplies them with power from the secondary battery when an engine start is in progress.

The PSDB (power supply distribution box) contains two banks of MOSFET (metal-oxide-semiconductor field-effect transistor)'s, which operate to change the power supply into two separate circuits when an ECO engine start is required. Sensitive electrical components are supplied from the secondary battery. The primary battery power is used exclusively to supply the TSS motor and maintain essential power loads to the engine management system required for engine starting. The PSDB operates according to commands from the GWM over the LIN bus.

Dual Battery system - Normal State (Engine Running)



NOTE: A = PRIMARY BATTERY/GENERATOR SUPPLY; B = SECONDARY BATTERY CHARGING; C = PRIMARY BATTERY CHARGING.

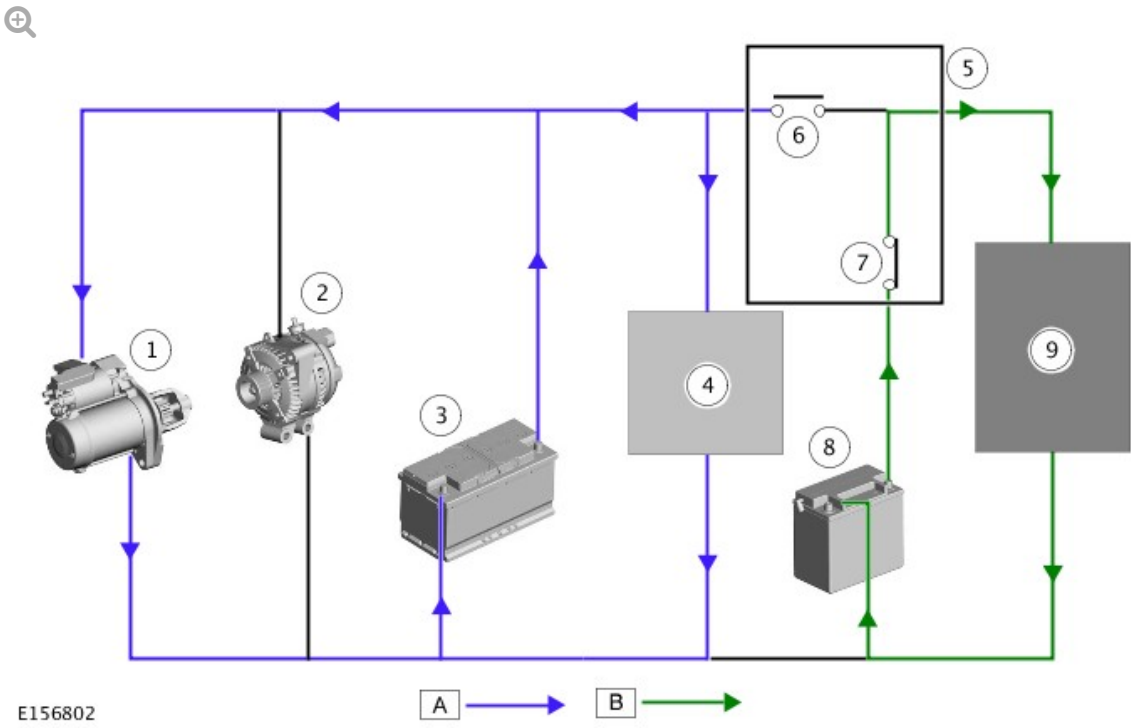
ITEM	DESCRIPTION
1	Tandem Solenoid Starter (TSS) motor
2	Generator
3	Primary battery
4	Power and engine management system loads
5	Power Supply Distribution Box (PSDB)
6	Battery 1 connection on Power Supply Distribution Box - connected
7	Battery 2 connection on Power Supply Distribution Box - disconnected
8	Battery 2 connection on Power Supply Distribution Box - connected
9	Secondary battery
10	Sensitive loads

When the engine is running, all electrical systems are powered from the

primary battery and the generator (the sensitive loads are supplied by the 'battery 1' connection of the power supply distribution box (6)). The GWM (gateway module) and the PSDB (power supply distribution box) communicate via the LIN bus, and the PSDB isolates the secondary battery from the system (7).

The GWM monitors the state of charge of both the primary and secondary batteries to ensure that sufficient voltage is available for the next ECO engine start. The GWM can apply charging to the secondary battery via the power supply distribution box, if it is required. If the charging of secondary battery is necessary, the PSDB connects the secondary battery, and the generator starts to charge it.

Dual Battery system - ECO Engine Stop/Start State



NOTE: A = PRIMARY BATTERY SUPPLY; B = SECONDARY BATTERY SUPPLY.

ITEM	DESCRIPTION
1	Tandem Solenoid Starter (TSS) motor
2	Generator

3	Primary battery
4	Power and engine management system loads
5	Power Supply Distribution Box (PSDB)
6	Battery 1 connection on Power Supply Distribution Box - disconnected
7	Battery 2 connection on Power Supply Distribution Box - connected
8	Secondary or auxiliary battery
9	Sensitive loads

When the ECO start is required, the GWM (gateway module) sends a signal to the PSDB (power supply distribution box) via the LIN bus. The PSDB isolates the primary battery from sensitive loads, and the primary battery supplies the starter motor and power loads only, to ensure the quick engine start. In same time the PSDB connects the secondary battery, to supply the sensitive loads while the ECO start in progress.

DUAL BATTERY SYSTEM – AUXILIARY BATTERY TDV6 3.0L DIESEL AND TDV8 4.4L DIESEL COLD CLIMATE VEHICLES

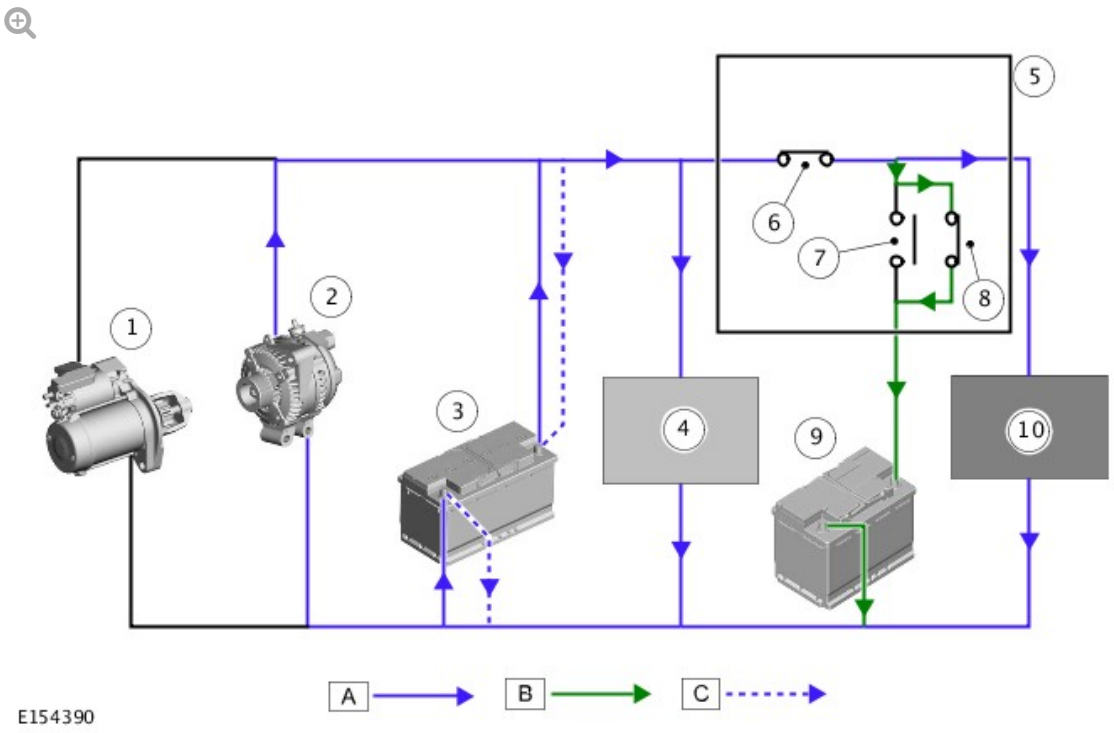
The dual battery system on vehicles with an auxiliary battery, allows both batteries to be connected in parallel, to provide increased amperage to the starter motor for efficient starting in cold climates. The auxiliary battery assists the primary battery in operating the starter motor to crank the engine at a sufficient speed for efficient starting.

The auxiliary battery is switched in parallel with the primary battery once the ambient temperature falls below a certain threshold, or the state of charge of the primary battery falls below a predetermined charge level.

In addition, in the cold climate vehicles with TDV6 3.0L diesel engine with stop/start system, the auxiliary battery supplies the sensitive loads when the ECO start is active. This is similar to the all markets vehicles with stop/start system, where a secondary battery is fitted.

The PSDB (power supply distribution box) contains two banks of MOSFET (metal-oxide-semiconductor field-effect transistor)'s, which operate to introduce the auxiliary battery in parallel with the primary battery, or to switch the auxiliary battery to supply the sensitive loads when an ECO start is required. The PSDB connects or isolates the batteries on receipt of LIN bus information from the GWM.

Dual Battery System - Primary and Auxiliary batteries - Normal state (Engine Running)



A = PRIMARY BATTERY/GENERATOR SUPPLY; B = AUXILIARY BATTERY CHARGING; C = PRIMARY BATTERY CHARGING.

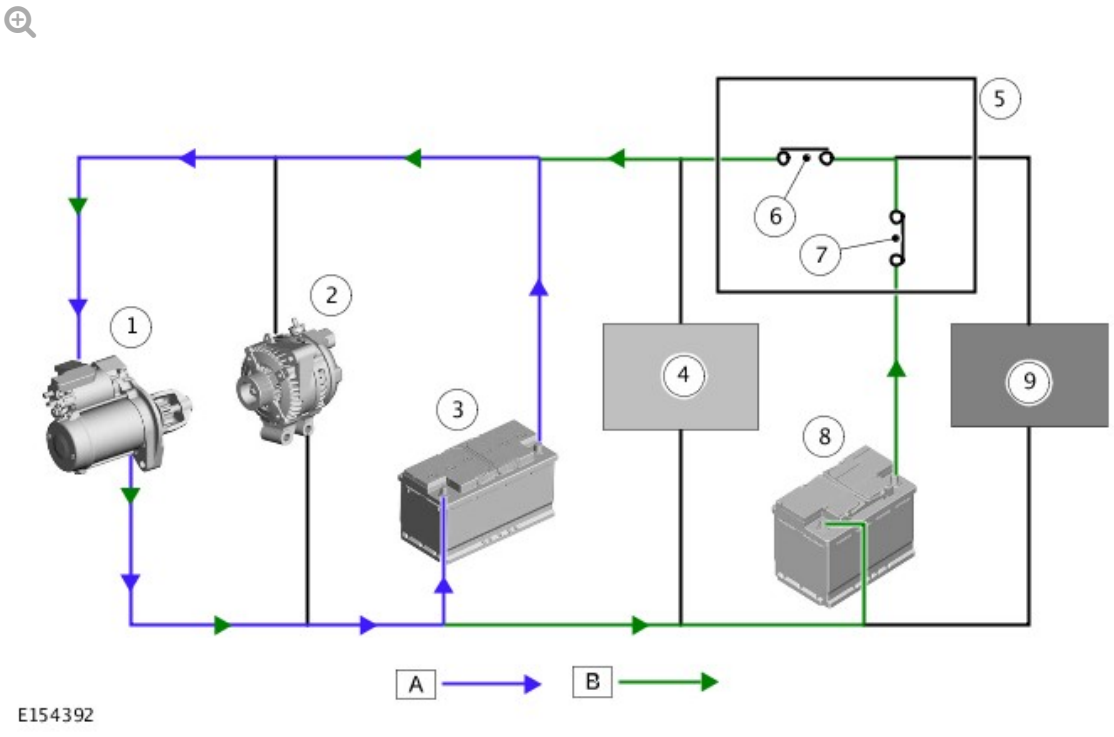
ITEM	DESCRIPTION
1	Starter motor / TSS motor
2	Generator
3	Primary battery
4	Power and engine management system loads
5	Power Supply Distribution Box (PSDB)
6	Battery 1 connection on Power Supply Distribution Box - connected

7	Battery 2 connection on Power Supply Distribution Box - disconnected
8	Battery 2 connection on Power Supply Distribution Box - connected
9	Auxiliary battery
10	Sensitive loads

When the engine is running, all electrical systems are powered from the primary battery and the generator. The GWM (gateway module) and the PSDB (power supply distribution box) communicate via the LIN bus, and the PSDB isolates the auxiliary battery from the system.

The GWM monitors the state of charge of both the primary and auxiliary batteries to ensure that sufficient voltage is available for the next ECO engine start. The GWM can apply charging to the auxiliary battery via the power supply distribution box, if it is required. If the charging of auxiliary battery is necessary, the PSDB connects the auxiliary battery, and the generator starts to charge it.

Dual Battery System - Primary and Auxiliary Batteries in Parallel for Starting

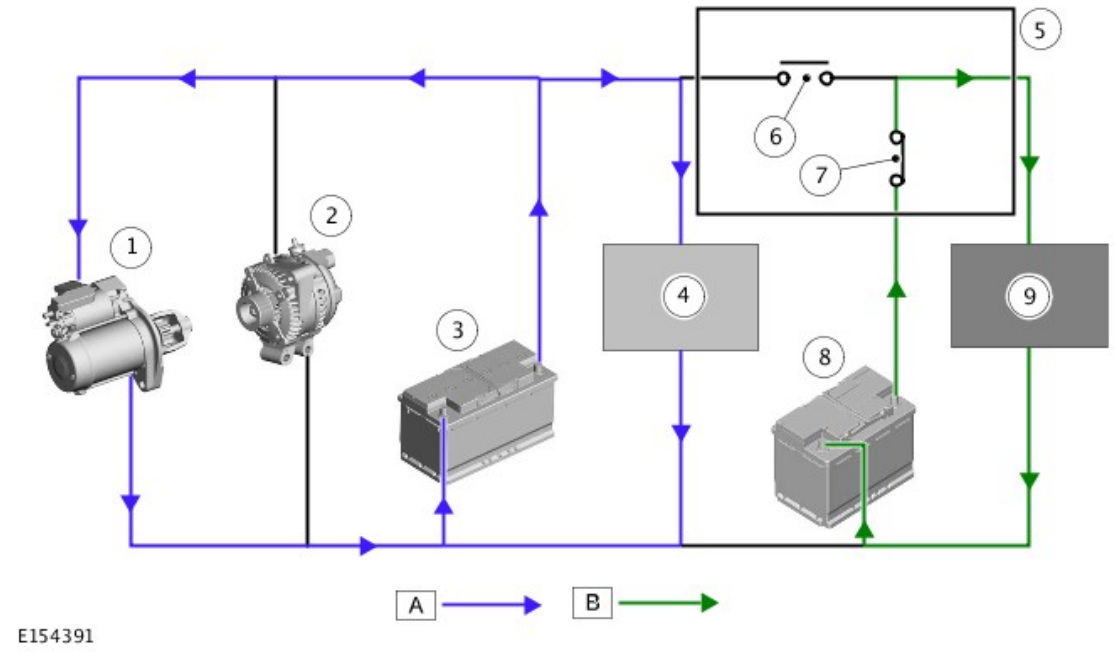


NOTE: A = PRIMARY BATTERY SUPPLY; B = AUXILIARY BATTERY SUPPLY.

ITEM	DESCRIPTION
1	Starter motor / TSS motor
2	Generator
3	Primary battery
4	Power and engine management system loads
5	Power Supply Distribution Box
6	Battery 1 connection on Power Supply Distribution Box - connected
7	Battery 2 connection on Power Supply Distribution Box - connected
8	Auxiliary battery
9	Sensitive loads

When the ambient temperature is below a predetermined level and the GWM (gateway module) receives a start signal via the HS (high speed) CAN powertrain bus from the CJB, the GWM communicates with the PSDB (power supply distribution box) via the LIN bus to keep the primary battery connected, and also connect the auxiliary battery. The power for the starter motor is supplied from both batteries. When the ECM receives the start signal, it energizes the starter relay in the EJB which operates the starter motor solenoid to operate the starter motor.

Dual Battery system - ECO Engine Stop/Start State with auxiliary battery



NOTE: A = PRIMARY BATTERY SUPPLY; B = AUXILIARY BATTERY SUPPLY.

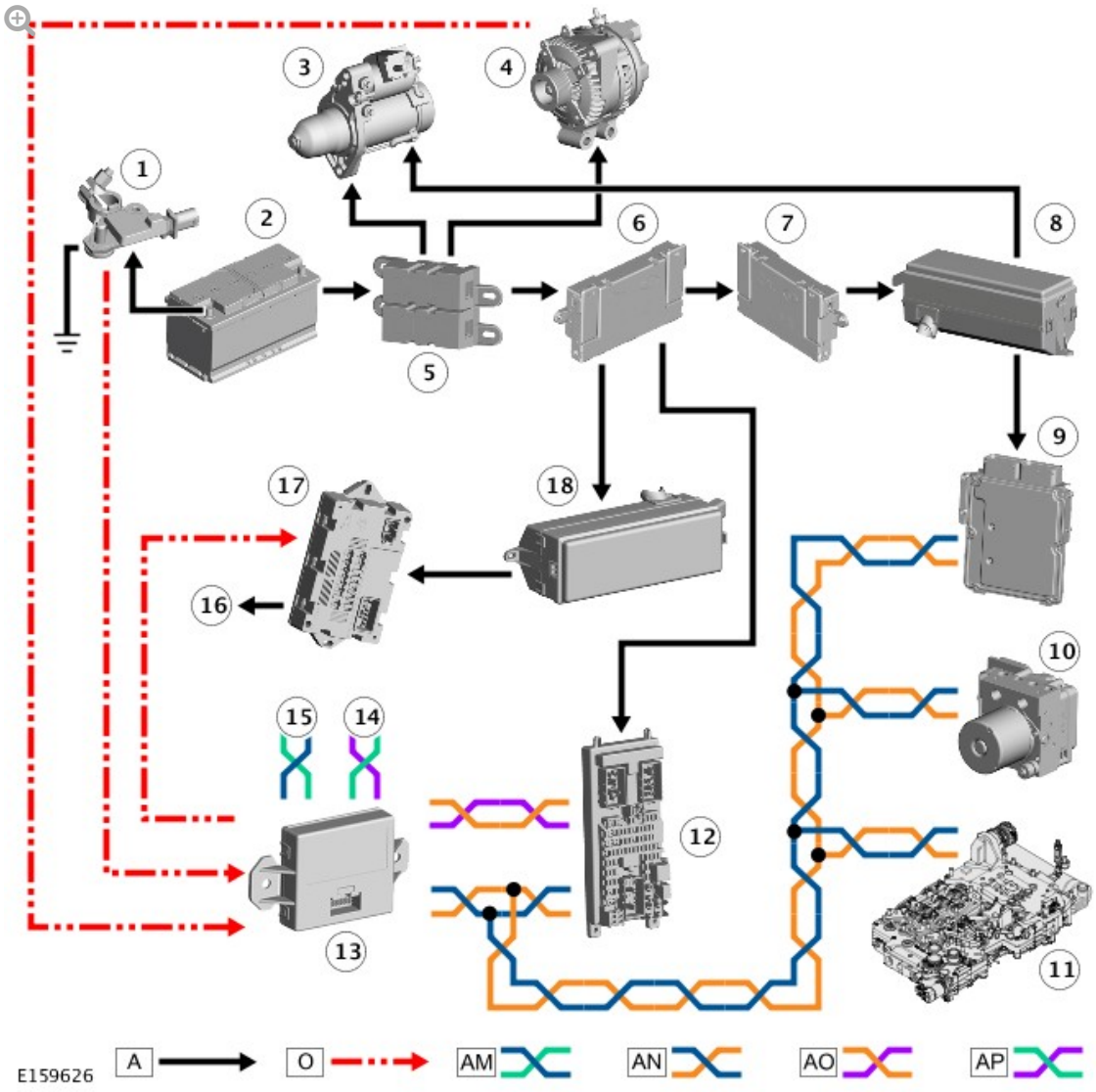
ITEM	DESCRIPTION
1	TSS motor
2	Generator
3	Primary battery
4	Power and engine management system loads
5	Power Supply Distribution Box
6	Battery 1 connection on Power Supply Distribution Box - disconnected
7	Battery 2 connection on Power Supply Distribution Box - connected
8	Auxiliary battery
9	Sensitive loads

When the ECO start is required (cold climate vehicles with TDV6 3.0L diesel engines with stop/start system), the GWM (gateway module) sends a signal to the PSDB (power supply distribution box) via the LIN bus. The PSDB isolates the primary battery from sensitive loads, and the primary battery

supplies the starter motor and power loads only, to ensure the quick engine start. In same time the power supply distribution box connects, the auxiliary battery to supply the sensitive loads, while the ECO start in progress.

CONTROL DIAGRAM

CONTROL DIAGRAM - SINGLE BATTERY VEHICLES

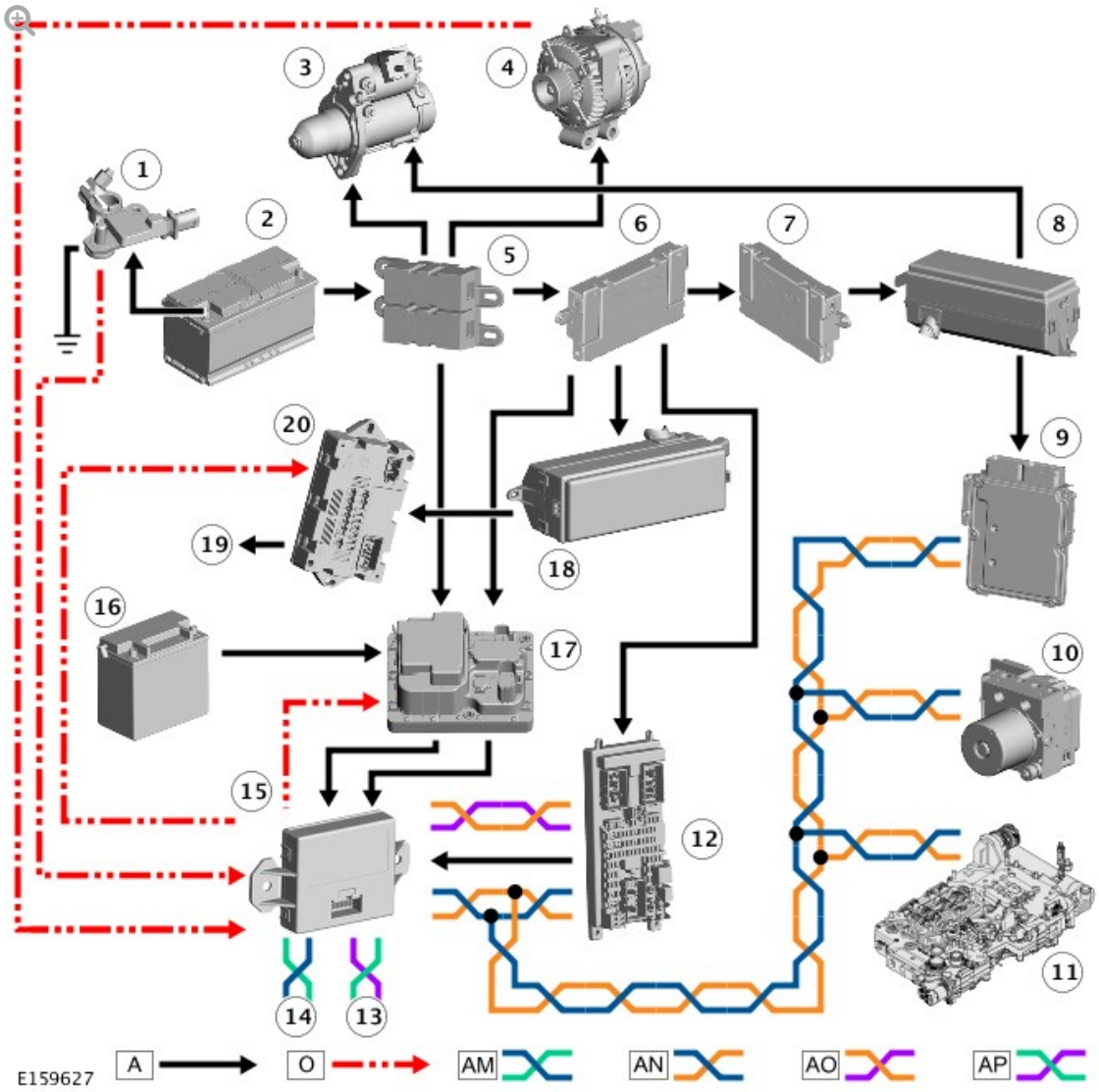


A = HARDWIRED; O = LIN BUS; AM = HS (HIGH SPEED) CAN CHASSIS BUS; HS CAN POWERTRAIN BUS; AO = MS (MEDIUM SPEED) CAN BODY BUS; AP = MS CAN COMFORT BUS.

ITEM	DESCRIPTION
1	Battery Monitoring System (BMS) control module

2	Primary battery
3	Starter motor
4	Generator
5	Battery Junction Box 2 (BJB2)
6	Battery Junction Box (BJB)
7	Auxiliary Junction Box (AJB)
8	Engine Junction Box (EJB)
9	Engine Control Module (ECM)
10	Anti-lock Brake System (ABS) control module
11	Transmission Control Module (TCM)
12	Central Junction Box (CJB)
13	Gateway Module (GWM)
14	Connection to control modules on MS CAN comfort bus
15	Connection to control modules on HS CAN chassis bus
16	Power supply to infotainment and climate control modules
17	Quiescent Current Control Module (QCCM)
18	Rear Junction Box (RJB)

CONTROL DIAGRAM - DUAL BATTERY VEHICLES



A = HARDWIRED; O = LIN BUS; AM = HS (HIGH SPEED) CAN CHASSIS BUS; HS CAN POWERTRAIN BUS; AO = MS (MEDIUM SPEED) CAN BODY BUS; AP = MS CAN COMFORT BUS.

ITEM	DESCRIPTION
1	Battery Monitoring System (BMS) control module
2	Primary battery
3	TSS motor (stop/start vehicles only) or Starter motor
4	Generator
5	Battery Junction Box 2 (BJB2)
6	Battery Junction Box (BJB)
7	Auxiliary Junction Box (AJB)

8	Engine Junction Box (EJB)
9	Engine Control Module (ECM)
10	Anti-lock Brake System (ABS) control module
11	Transmission Control Module (TCM)
12	Central Junction Box (CJB)
13	Connection to control modules on MS CAN comfort bus
14	Connection to control modules on HS CAN chassis bus
15	Gateway Module (GWM)
16	Secondary or auxiliary battery
17	Power Supply Distribution Box (PSDB)
18	Rear Junction Box (RJB)
19	Power supply to infotainment and climate control modules
20	Quiescent Current Control Module (QCCM)