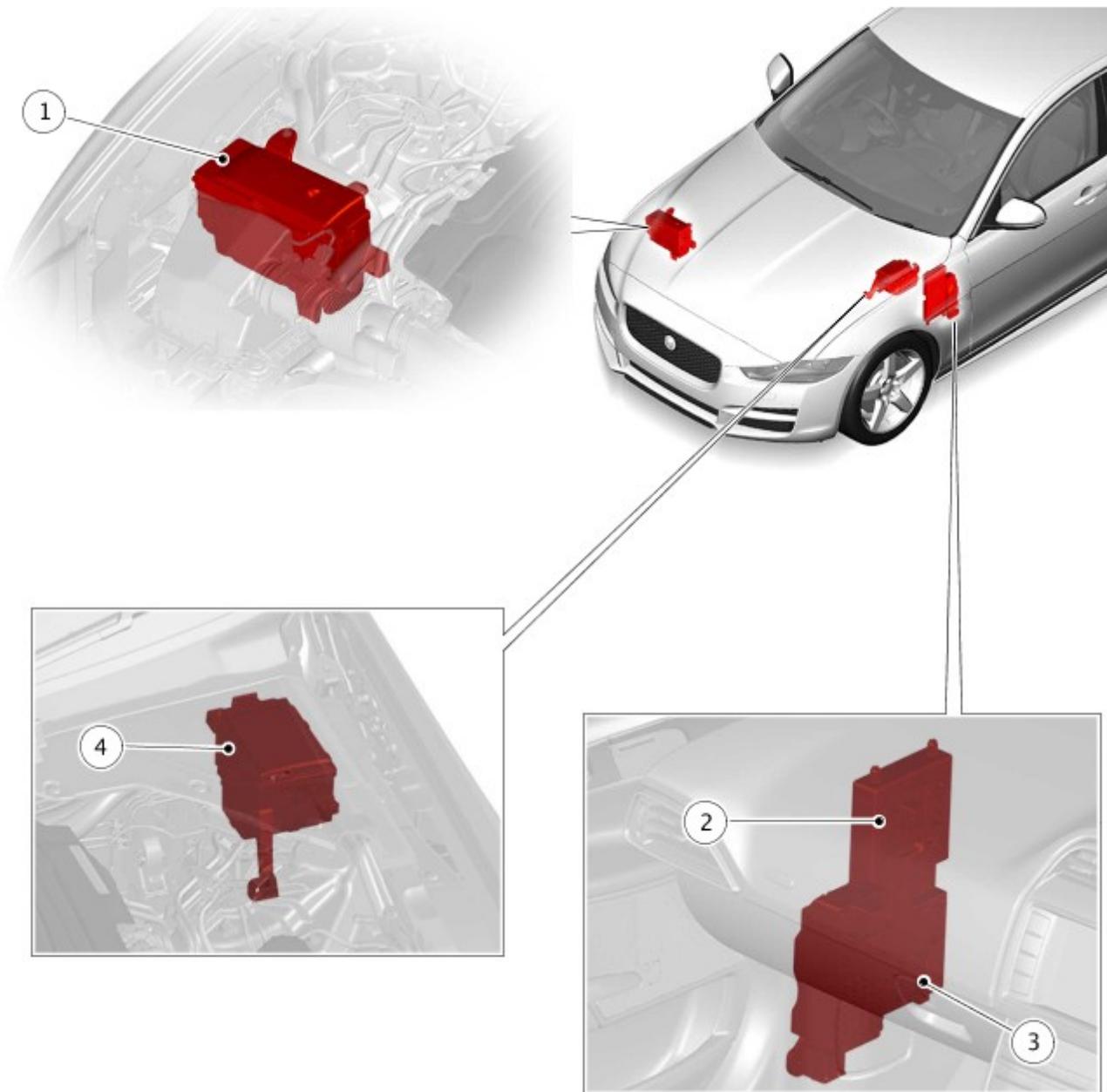


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## **BATTERY, MOUNTING AND CABLES**

**DESCRIPTION AND OPERATION**

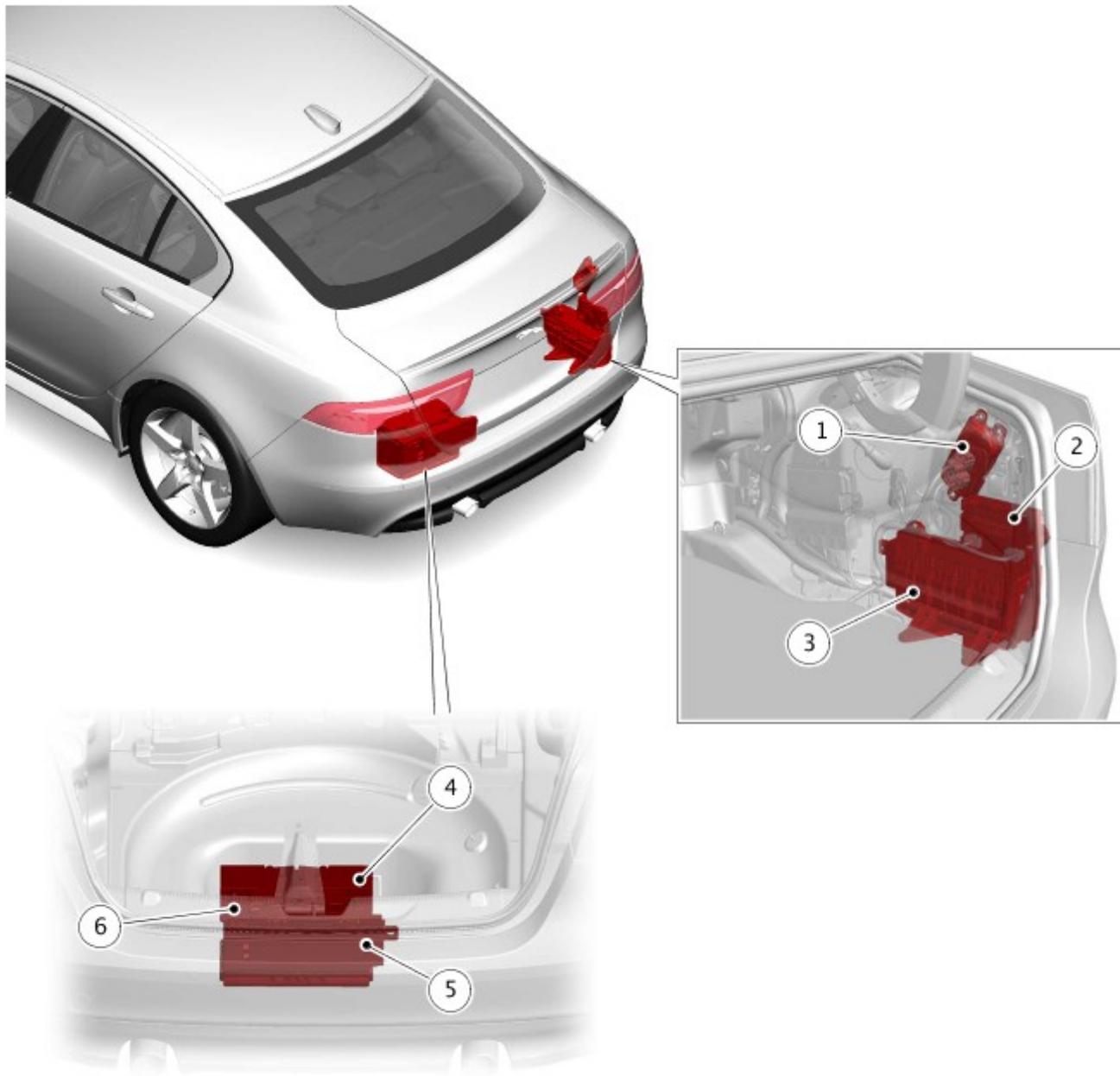
COMPONENT LOCATION - SHEET 1 OF 2 - BATTERY SYSTEM COMPONENTS



E174559

ITEM	DESCRIPTION
1	Right Engine Junction Box (EJB)

ITEM	DESCRIPTION
2	Body Control Module/Gateway Module (BCM/GWM) assembly
3	Passenger Junction Box (PJB)
4	Left Engine Junction Box (EJB)



E178387

ITEM	DESCRIPTION
1	Voltage Quality Module (VQM)

ITEM	DESCRIPTION
2	Quiescent Current Control Module (QCCM)
3	Rear Junction Box (RJB)
4	Battery
5	Battery Junction Box (BJB)
6	Battery Monitoring System (BMS) control module

## OVERVIEW

The battery is positioned in the luggage compartment floor and is secured in position with a clamp plate. The battery supplies electrical power to the Battery Junction Box (BJB). The BJB contains megafuses, delivering power to the starter motor and the generator, the Rear Junction Box (RJB), the Passenger Junction Box (PJB), and the left and right Engine Junction Box (EJB).

Three different type of battery is used, depending on the following:

- Vehicles without Telematics Control Module (TCU) and Fuel Fired Booster Heater (FFBH) - 70Ah, 760CCA Absorbed Glass Mat (AGM) Valve Regulated Lead-Acid (VRLA) battery
- Vehicles without FFBH, with TCU - 80 Ah, 800 CCA AGM VRLA battery
- Vehicles with FFBH - 90 Ah, 850 CCA AGM VRLA battery
- Cold market vehicles - 90 Ah, 850 CCA AGM VRLA battery

A Battery Monitoring System (BMS) control module is mounted on the battery negative terminal and provides battery status information for the Body Control Module/Gateway Module (BCM/GWM) assembly.

### CAUTION:

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

The BJB is located below the luggage compartment floor panel, adjacent to the battery. The RJB is located on the right side of the luggage compartment behind the trim panel. The BJB and RJB contain fusible links, fuses, and relays to distribute electrical power to various vehicle systems. The right and left EJBs are mounted adjacent to the appropriate front suspension top mount in the engine compartment.

A jump start terminal is located below a hinged cover, adjacent to the right EJB. An additional cover with a lanyard protects the terminal when not in use. If jump starting is required, the cover must be removed and the positive (+) jump lead attached securely. The negative (-) jump lead is attached to a jump start terminal stud located on the right side top mount. The cover must be fitted to the positive terminal when not in use.

The Voltage Quality Module (VQM) is used to prevent the vehicle electrical systems being subjected to undesirably low voltages during repeated engine restarts and produces a constant output voltage during engine restart operation. If the electrical systems are subject to low voltages the customer may notice degraded performance of components and systems and incorrect fault Diagnostic Trouble Code (DTC) may be stored.

The PJB is located behind the A-pillar lower trim panel on the passenger side and receives its main power supply from the BJB.

The BCM/GWM assembly is located adjacent to the PJB, and it is the main controller of the vehicle body systems. The BCM/GWM assembly controlled functions are outlined in the relevant sections.

The BCM/GWM assembly software will monitor the state of charge of the battery and will determine when a stop/start event can occur. It can also intervene 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 Engine Control Module (ECM). A brake pressure signal is received from the ECM which will indicate to the BCM/GWM assembly that an engine restart is required from driver operation of the foot brake. For additional information, refer to:

[Starting System](#) (303-06A Starting System - INGENIUM I4 2.0L Diesel, Description and Operation),

[Starting System](#) (303-06B Starting System - GTDi 2.0L Petrol, Description and Operation),

[Starting System](#) (303-06C Starting System - V6 S/C 3.0L Petrol, Description and Operation).

## **POWER MODES**

The BCM/GWM assembly controls the power supplies for the various vehicle functions. There are 9 power modes available to determine the operating condition of the vehicle.

Only five of these modes will be noticeable to the driver and technicians as follows:

- Power mode 0 - Ignition off
- Power mode 4 - Accessory
- Power mode 6 - Ignition on

- Power mode 7 - Engine running
- Power mode 9 - Crank before engine running.

## TRANSPORT MODE

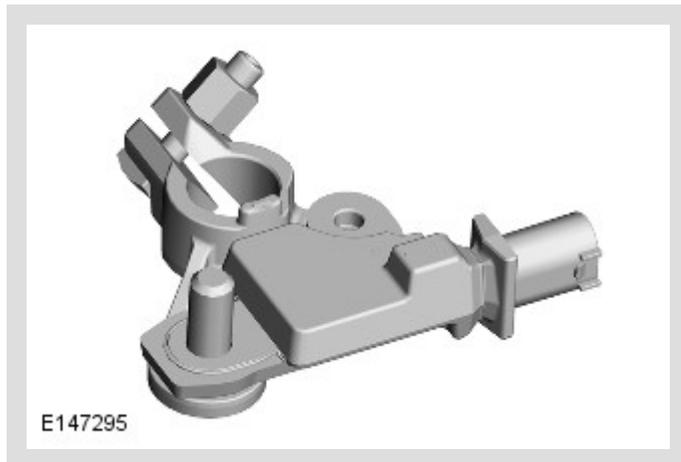
All new vehicles will be delivered from the factory in transport mode. Transport mode replaces the traditional transit relay and inhibits a number of electrical systems and features to eliminate quiescent drain from the battery during delivery. Transport mode also inhibits some electrical loads when the engine is running to ensure that the battery is never discharged while the engine is running.

When the vehicle is in transport mode 'TRANSP' will be displayed in the Instrument Cluster (IC) message center.

To remove the vehicle from transport mode, the Jaguar approved diagnostic system must be connected during the Pre-Delivery Inspection (PDI). For additional information, refer to: Preliminary (101-01, Description and Operation).

### DESCRIPTION

## BATTERY MONITORING SYSTEM (BMS) CONTROL MODULE



The Battery Monitoring System (BMS) control module is located on the battery negative (-) terminal and is clamped to the terminal with a bolt and nut. The battery negative ground cable is connected to the BMS control module and is 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 battery positive terminal. A Local Interconnect Network (LIN) bus connection provides communication between the BMS control module, the BCM/GWM assembly and the Quiescent Current Control Module (QCCM) for control and monitoring of the battery current drain and state of charge.

The BMS control module measures the battery current and voltage, which it communicates to the BCM/GWM assembly over the LIN bus connection. The BCM/GWM assembly also receives generator output information on a LIN bus connection. Based on the information received from the BMS control module, the BCM/GWM assembly will control the output from the generator and request the switching off of electrical loads if necessary.

#### **CAUTION:**

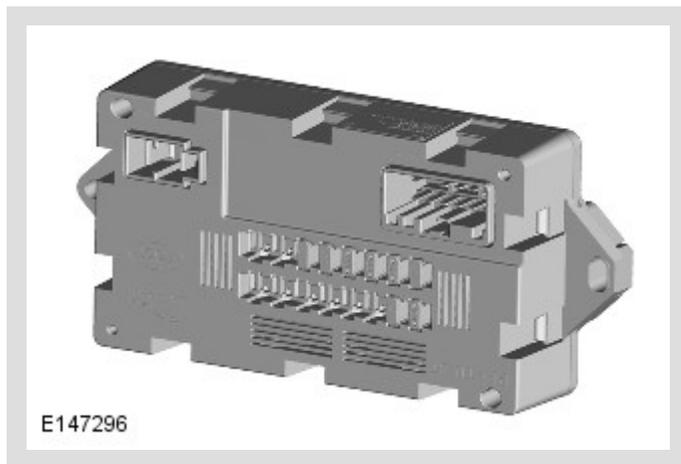
Due to the self-calibration routine, it is recommended that all power supply diagnostic testing is carried out using the Jaguar approved diagnostic system rather than a digital multimeter.

The BMS control module is able to generate DTCs to help diagnose battery or generator power supply issues. These DTCs can be read using the Jaguar approved diagnostic system. The Jaguar approved diagnostic system can also be used to implement a battery and generator self-test routine.

If a fault is detected, the BCM/GWM assembly 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 BCM/GWM assembly. The Jaguar 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.

#### **QUIESCENT CURRENT CONTROL MODULE (QCCM)**



The Quiescent Current Control Module (QCCM) is located in the right side of the luggage compartment adjacent to the RJB, behind the trim panel.

An addition to the BMS and using signals already transmitted by the BMS control module, the QCCM cuts the power supply to other non-essential control modules to avoid excessive discharge of the battery. The power supplies are cut by opening the contacts of relays internally within the QCCM. The systems supplied via the QCCM are the audio/entertainment systems and the climate control systems.

The QCCM in conjunction with the BCM/GWM assembly, monitor and control the systems power supply to prevent unnecessary battery drain due to the control modules are staying awake after the vehicle electrical system has been shut down.

The system comprises three components:

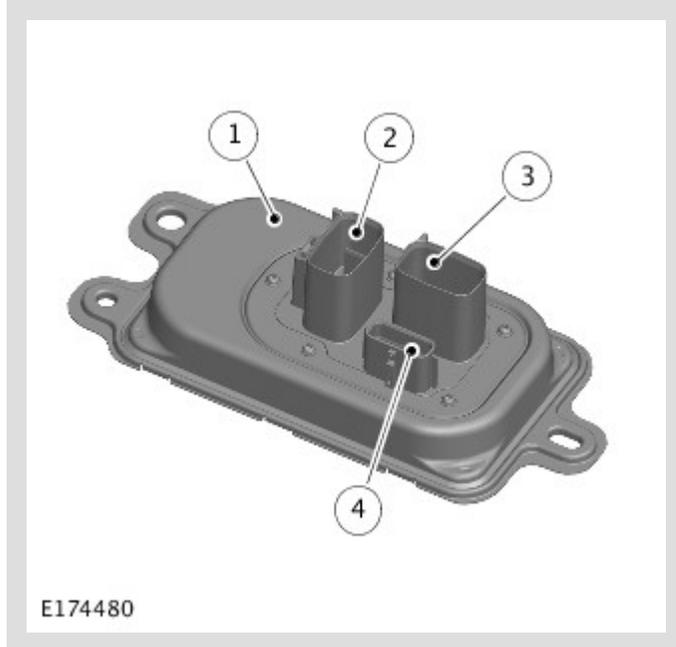
- The BMS control module
- The BCM/GWM assembly
- The QCCM.

The BMS checks the battery health by analyzing battery quiescent current, battery current drain or state of charge, and determines if any action is required to protect the battery. If action is required this is communicated to the BCM/GWM assembly. The BCM/GWM assembly control logic uses this information to determine if action is required to assist the battery protection. The QCCM control software is contained within the BCM/GWM assembly. The QCCM receives open and close command messages from the BCM/GWM assembly via the LIN bus and reacts accordingly.

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. The PDI process requires that the system have to be set from 'Transit mode' to 'Normal mode', which enables the QCCM operation before handing over the vehicle to the customer.

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

## **VOLTAGE QUALITY MODULE (VQM)**



ITEM	DESCRIPTION
1	Voltage Quality Module (VQM)
2	Power connector
3	Ground connector
4	Signal connector

The VQM is located adjacent to the RJB in the right side of the luggage compartment and attached to the side panel with three bolts. The VQM consists of a DC - DC (Direct Current) converter and an interface which controls its operation and provides the communication with the BCM/GWM assembly. The DC-DC converter can produce a constant 12V output voltage to crucial vehicle systems from the varying input voltage supplied by the battery during an engine restart.

The VQM supplies a constant voltage during an engine restart for the following:

- Instrument Cluster (IC)
- QCCM
- Infotainment system components - depends on equipment

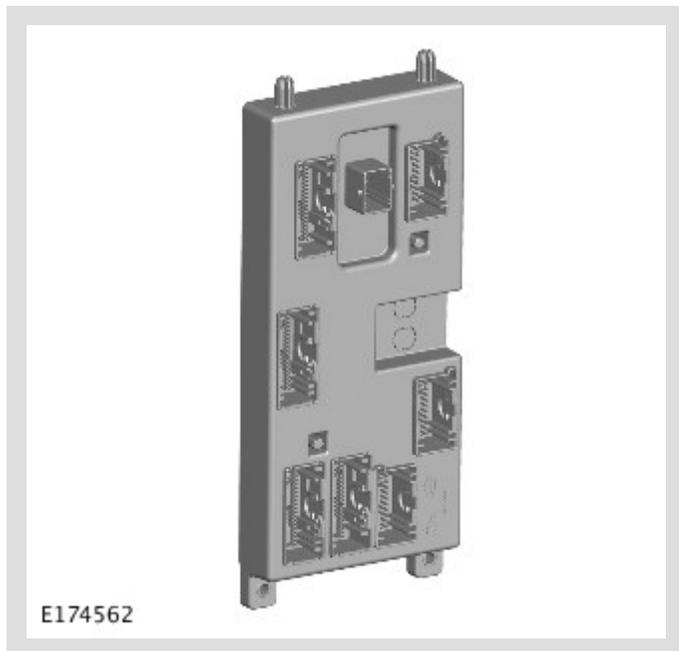
- Rear View Mirror (RVM) - if equipped
- Parking Aid Control Module (PACM) - if equipped
- Rear View Camera (RVC) - if equipped
- Left and right Blindspot Monitoring Control Module (BMCM) - if equipped.

The VQM has two power connectors which provide a battery feed connection from the BJB via a 60A fuse, and a power output connection to the QCCM and the RJB. An additional connector is located on the VQM to provide electrical connection to the other modules and ground. The VQM receives an ignition signal from the BCM/GWM, and a crank signal from the starter motor relay located in the left EJB. The VQM sends status and diagnostic messages to the BCM/GWM assembly via a LIN bus connection.

An additional connector is located on the VQM to provide electrical connection to the following:

- Ignition signal from the BCM/GWM assembly
- Crank signal from the starter motor relay located in the left EJB
- Status and diagnostic messages to the BCM/GWM assembly via the LIN bus
- Ground

#### **BODY CONTROL MODULE/GATEWAY MODULE (BCM/GWM) ASSEMBLY**



The BCM/GWM assembly is attached to a bracket, which is attached to the lower a-pillar on the passenger side of the vehicle.

The BCM/GWM assembly contains software to control the following functions:

- Determine the condition of the battery
- Control the output from the generator using load management software
- Controls the ECO stop/start system using power management to inhibit unnecessary electrical loads.

The BCM/GWM assembly communicates with other system control modules on the HS CAN powertrain and chassis systems buses and the medium speed CAN Body and Comfort systems buses.

The BCM/GWM assembly communicates with the BMS control module, the QCCM, and the generator via a LIN bus.

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## OPERATION

### **BATTERY MONITORING SYSTEM (BMS)**

When the ignition is switched off, the BMS control module records the battery state of charge and begins to monitor the battery condition.

If the battery state of charge falls by 7% from the critical start point, the BMS control module will start to monitor the battery for 5 minutes and sends a 'Warning' message on the LIN bus to the BCM/GWM assembly. If the battery charge has continued to fall below 50% due to the high quiescent drain current after the 5 minute monitoring period, the BMS control module will determine that the control modules are still 'awake'. The BMS control module sends a 'Shutdown' message on the LIN bus to the BCM/GWM assembly. The BCM/GWM assembly then transmits a 'Shutdown' message on both MS and HS CAN buses to all control modules, requesting them to shutdown.

The BMS control module will monitor the battery state of charge for a further 15 minutes and determine if the battery state of charge is still dropping due to the quiescent drain current. The BMS control module sends a 'Power Disconnect' signal to the BCM/GWM assembly on the LIN bus. The BCM/GWM assembly then sends a signal to the QCCM via the LIN bus to open its internal relays. When the QCCM relays are open, the power supply from the 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 the 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.

### **BATTERY MONITORING SYSTEM (BMS) LOW BATTERY WARNING AND ENERGY MANAGEMENT MESSAGES**

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

The BMS displays warning messages to inform the driver that the battery is either at a low level of charge or the engine-off power consumption limit has been exceeded. There are 3 messages that can be displayed; two on the Touch Screen (TS) and one on the IC message center.

Low Battery - Please switch engine on or system will shutdown in 3 minutes

This message will be displayed as a warning on the TS if the engine is not running. This indicates that the battery charge has fallen below a predefined threshold. As soon as the battery is charged above this threshold, the message will be removed.

Low Battery - Please start your engine

This message will be displayed on the IC message center if the engine is not running. This indicates that the battery charge has fallen below a predefined threshold. As soon as the battery is charged above this threshold, the message will be removed or it can be manually removed by pressing the 'OK' switch on the steering wheel switchpack.

System will shut down in 3 minutes

This message will be displayed as an energy management message on the TS if the engine is not running, and system features are causing excessive battery discharge. After 3 minutes the BCM/GWM assembly will begin shutting down vehicle systems. Normal system operation will resume when the engine is started.

These messages are based on a percentage of the battery capacity available for the customer to use the vehicle systems with the engine off. The percentage can change based upon several factors. Once activated, the resetting of these messages will not occur until the vehicle is driven for 10 minutes with the engine running (to allow the battery to replace any lost charge). However, if the engine is run for less than 10 minutes, the messages will only be displayed after an additional 5 minutes with the ignition is switched on but the engine is not running.

### **BMS CONTROL MODULE SELF CALIBRATION**

The BMS control module periodically initiates 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.

When 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.

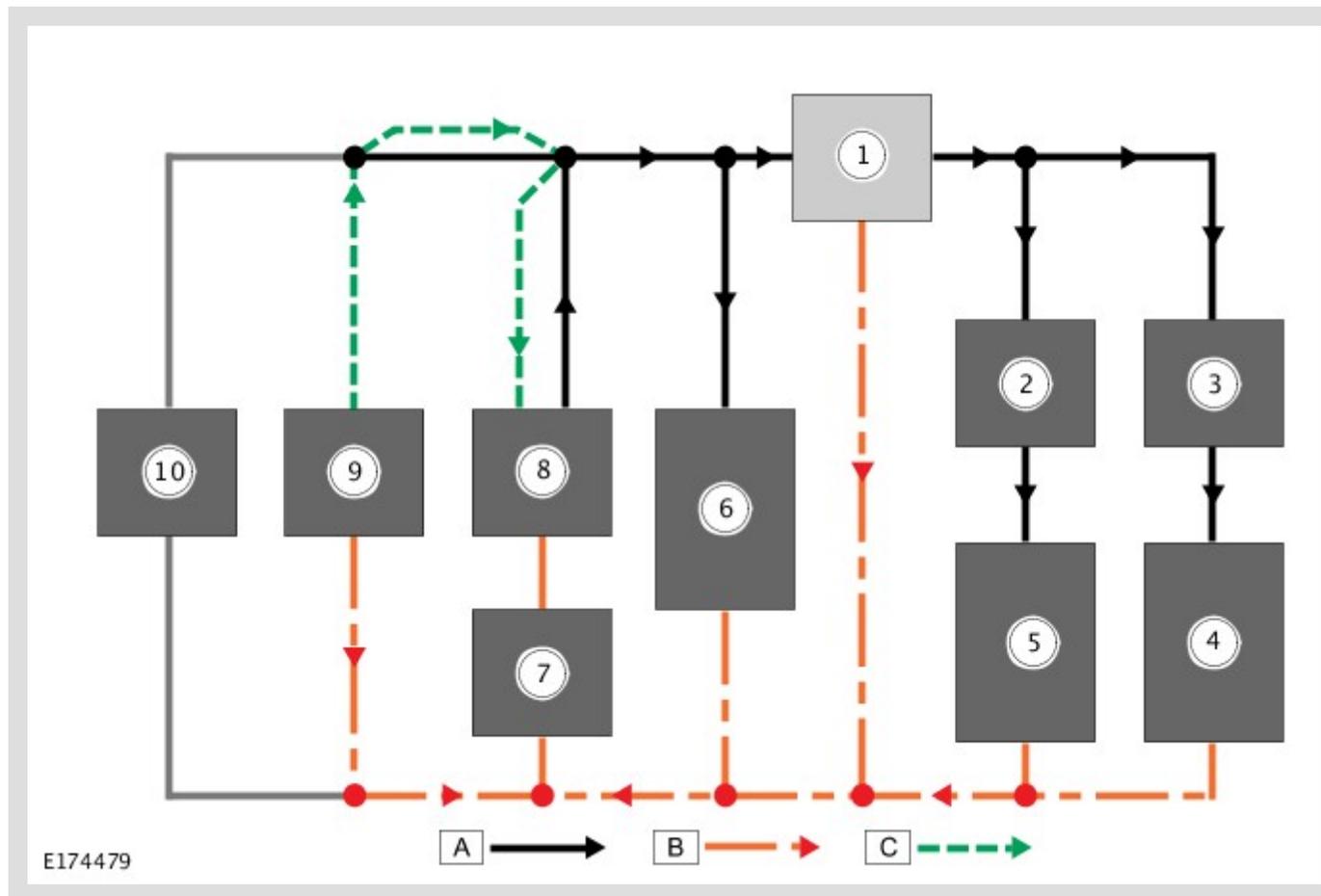
When the second part of the routine has been successfully completed, the BMS control module will return the battery to its optimum level of charge. The optimum level of charge will be between 12.6 V and 15 V, depending on battery condition, temperature and loading.

The BMS control module also monitors the 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.

### VOLTAGE QUALITY MODULE (VQM)

The VQM is a DC-DC converter and produce a constant 12V output voltage from a varying (and lower) input voltage. During a warm engine restart, significant low voltage transients occur in the vehicle electrical systems, and customer noticeable loads require the voltage to be boosted by the VQM.

### VQM BYPASS MODE

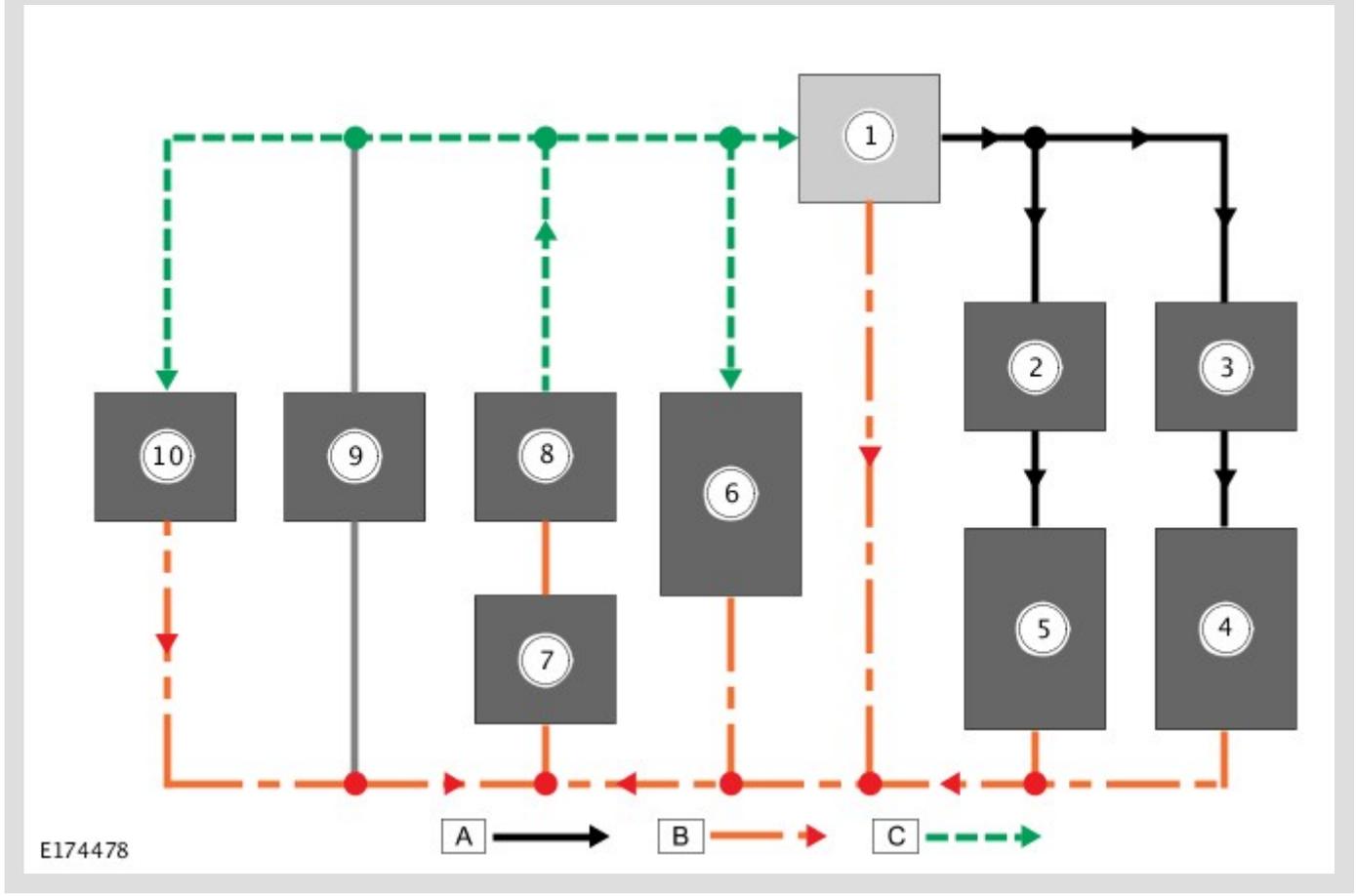


**A = BATTERY VOLTAGE; B = GROUND; C = BATTERY CHARGING VOLTAGE.**

ITEM	DESCRIPTION
1	Voltage Quality Module (VQM)
2	Rear Junction Box (RJB)
3	Quiescent Current Control Module (QCCM)
4	Voltage sensitive loads 1
5	Voltage sensitive loads 2
6	Electric loads
7	Battery Monitoring System (BMS) control module
8	Battery
9	Generator
10	Starter motor

Bypass mode is the VQM's normal operating mode. In this mode the power from the battery to the voltage sensitive loads passes through on the VQM without any intervention. The VQM can support 600W of continuous power in bypass mode.

#### **VQM BOOST MODE**



**A = CONSTANT OUTPUT VOLTAGE; B = GROUND; C = FLUCTUATING BATTERY VOLTAGE.**

ITEM	DESCRIPTION
1	Voltage Quality Module (VQM)
2	Rear Junction Box (RJB)
3	Quiescent Current Control Module (QCCM)
4	Voltage sensitive loads 1
5	Voltage sensitive loads 2
6	Electric loads

ITEM	DESCRIPTION
7	Battery Monitoring System (BMS) control module
8	Battery
9	Generator
10	Starter motor

During a warm engine restart a hardwired connection from the starter motor relay provides the crank signal to the VQM. At this point the VQM switches into boost mode, and activates the DC-DC converter. The DC-DC converter maintains a constant output voltage between 11V and 14V (depending on the input voltage) to the voltage sensitive loads for 5 seconds. The VQM can support 450W of continuous power in boost mode. After the engine has restarted, and the voltage at the battery terminal will ramp up, the VQM returns to bypass mode.

Boost mode is inhibited at ambient temperatures below 0°C (32°F), when Stop/start function is disabled.

#### **ELECTRICAL LOAD MANAGEMENT**

The electrical load management is hosted in the BCM/GWM assembly using IPMS functionality and is based on BMS control module inputs. The BCM/GWM assembly will monitor the vehicle system power loads before and during an ECO engine stop.

Before an ECO engine stop, the BCM/GWM assembly will transmit a signal to the system control modules on all CAN buses to request a power save on all electrical loads and set a minimum electrical value override. The BCM/GWM assembly monitors the vehicle electrical loads and will inhibit an ECO engine stop until the load current is at a value low enough to be supported by the battery. If the electrical loads cannot be reduced sufficiently, the BCM/GWM assembly will inhibit the ECO engine stop.

When the engine is stopped after an ECO engine stop, the BCM/GWM assembly will continue to monitor the battery state of charge. If battery voltage falls below 11.0V, a level which will result in degraded starting performance or possible battery damage, the BCM/GWM assembly will initiate an engine start.

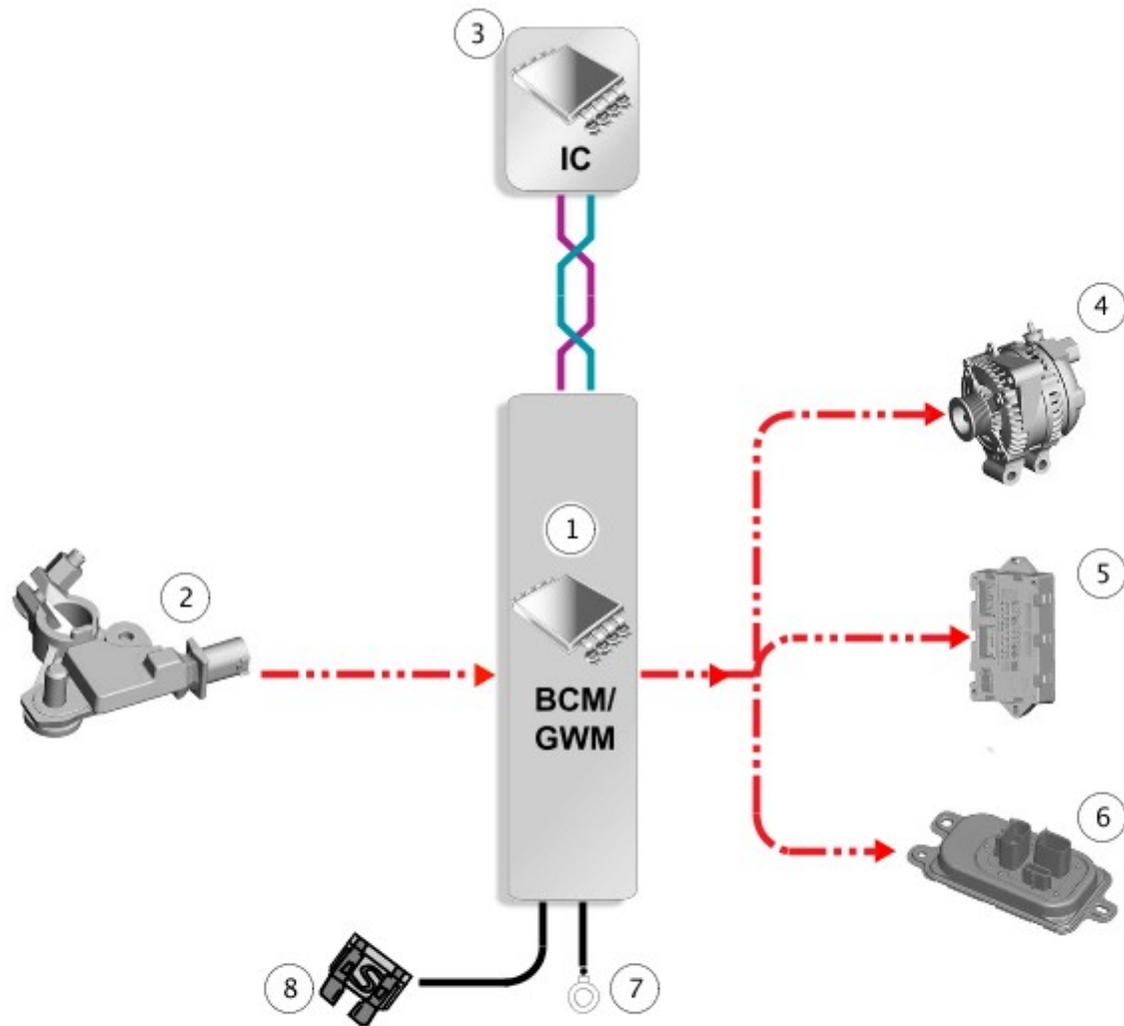
#### **SYSTEM INHIBITS**

The ECO stop/start system is inhibited if the battery system is not be capable of preventing electrical loads on the vehicle being subject to unacceptably low voltage levels during ECO stop/start operations due to a fault.

ECO stop/start inhibit monitoring of the battery is performed by the BMS control module. If the battery voltage is too low to support an ECO stop/start, then the BMS control module will send a message to the BCM/GWM assembly on the LIN bus to suspend ECO stop/start.

The GWM monitors the battery and the VQM. Any fault found will cause the BCM/GWM assembly to inhibit ECO stop/start and the BCM/GWM assembly will record a DTC.

#### **INPUT/OUTPUT DIAGRAM - SHEET 1 OF 2 - BATTERY SYSTEM**



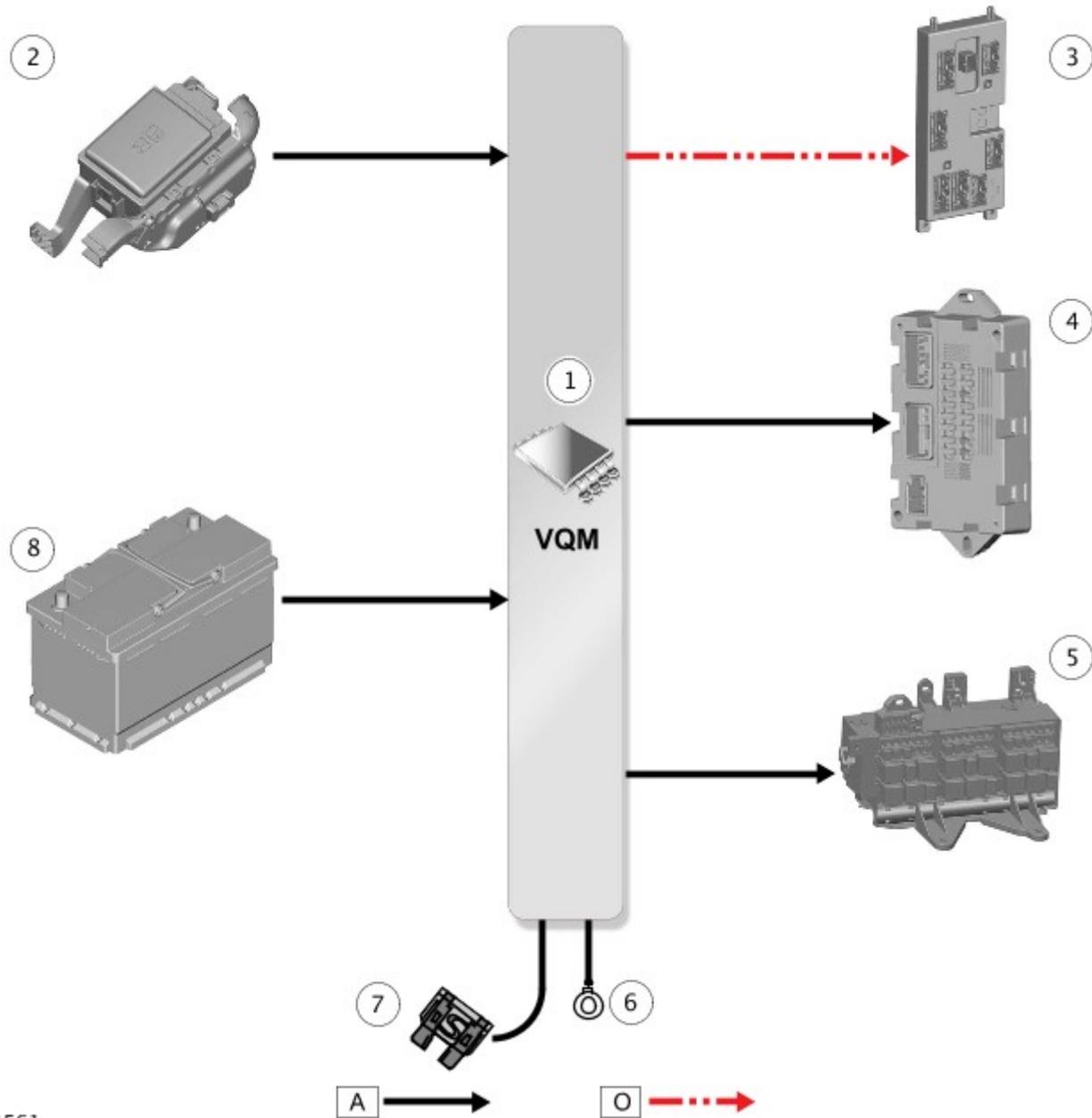
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**A = HARDWIRED; O = LIN (LOCAL INTERCONNECT NETWORK) BUS; AP = MS (MEDIUM SPEED) CAN (CONTROLLER AREA NETWORK) COMFORT SYSTEMS BUS.**

ITEM	DESCRIPTION
1	Body Control Module/Gateway Module (BCM/GWM) assembly
2	Battery Monitoring System (BMS) control module
3	Instrument Cluster (IC)
4	Generator
5	Quiescent Current Control Module (QCCM)
6	Voltage Quality Module (VQM)
7	Ground
8	Power supply - Rear Junction Box (RJB)

**INPUT/OUTPUT DIAGRAM - SHEET 2 OF 2 - VOLTAGE QUALITY MODULE (VQM)**



E174561

A = HARDWIRED; O = LIN (LOCAL INTERCONNECT NETWORK) BUS.

ITEM	DESCRIPTION
1	Voltage Quality Module (VQM)
2	Left Engine Junction Box (EJB) - Crank signal
3	Body Control Module/Gateway Module (BCM/GWM) assembly
4	Quiescent Current Control Module (QCCM)
5	Rear Junction Box (RJB)
6	Ground
7	Power supply - Body Control Module/Gateway Module (BCM/GWM) assembly
8	Battery