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2016 FORD Mondeo Sedan OEM Service and Repair Workshop Manual

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Battery charger coolant flow request	SOBDM (secondary on-board diagnostic control module A)	Coolant flow request to support cooling of the SOBDM (secondary on-board diagnostic control module A) .
EVSE power mode	SOBDM (secondary on-board diagnostic control module A)	Operational status of the EVSE while it is plugged into the vehicle charge port.
DC charge EVSE output voltage	OBCC (Off-Board Charger Controller)	This value represents the present DC charge EVSE output voltage.
DC charge EVSE output current	OBCC (Off-Board Charger Controller)	This value represents the present DC charge EVSE output current.
DC (direct current) charge isolation monitoring disable request	OBCC (Off-Board Charger Controller)	This signal notifies the BECM (battery energy control module) to disable isolation monitoring so the EVSE can monitor isolation.
DC charge EVSE isolation status	OBCC (Off-Board Charger Controller)	The value represents the DC (direct current) charge circuit isolation condition measured and reported by the EVSE.
DC charging ready status (not ready, initialization, charge ready, weld check, precharge, charging, charge complete)	OBCC (Off-Board Charger Controller)	This signal represents the DC (direct current) to DC (direct current) fast charge status.
DC charge EVSE voltage maximum	OBCC (Off-Board Charger Controller)	The maximum voltage the EVSE can deliver.
DC charge EVSE voltage minimum	OBCC (Off-Board Charger Controller)	The minimum voltage the EVSE can deliver.
DC charge EVSE power maximum	OBCC (Off-Board Charger Controller)	The maximum power the EVSE can deliver.
DC charge EVSE current maximum	OBCC (Off-Board Charger Controller)	The maximum current the EVSE can deliver.

High voltage battery drive sustain request (gateway)	SOBDMC (secondary on-board diagnostic control module C)	This signal indicates the request of required modules to remain awake to support high voltage battery drive conditioning while on-plug.
Cabin drive sustain request (gateway)	SOBDMC (secondary on-board diagnostic control module C)	This signal indicates the request of required modules to remain awake to support cabin drive pre-conditioning.
High battery charge now event status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	This signal indicates the required modules are awake due to the charge now event.
12V battery transfer sustain request (gateway)	SOBDMC (secondary on-board diagnostic control module C)	This signal indicates the request of required modules to remain awake to support 12-volt battery charging.
SOBDMC (secondary on-board diagnostic control module C) coolant flow request (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Coolant flow request to support cooling of the SOBDMC (secondary on-board diagnostic control module C) .
High voltage battery reserved State Of Charge (SOC) (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Used by the BECM (battery energy control module) to preserve the specified high voltage battery SOC.
High voltage interlock circuit status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Notifies the BECM (battery energy control module) if the high voltage interlock circuit is open which disables the high voltage system.
Target SOC (State Of Charge) request (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Target SOC (State Of Charge) request while charging.
A/C (air conditioning) compressor estimated current flow (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Estimated current flow into the A/C (air conditioning) compressor.
Hybrid DC/DC current usage	Direct Current/Direct Current (DC/DC)	Direct Current/Direct Current (DC/DC) converter control module high voltage

Vehicle operating mode status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Vehicle status: Off, start in progress, On (torque available), or On (torque not available).
Restraint impact event status (gateway)	RCM (restraints control module)	Used to disable the high voltage system during a crash.
Transmission selector (PRNDL) status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Used to determine transaxle gear state.
Vehicle speed (gateway)	PCM (powertrain control module)	Vehicle speed actual.
Odometer master value (gateway)	IPC (instrument panel cluster)	Vehicle odometer value.
Vehicle configuration data	BCM (body control module)	Vehicle configuration strategy.

High Voltage Battery System

The lithium-ion high voltage battery pack is the sole power source for the BEV (battery electric vehicle) vehicle. The high voltage battery pack supplies the energy required to drive the electric motors. An front an rear Inverter System Controller (ISC) mounted to the drive motors converts DC (direct current) from the high voltage battery to AC (alternating current) to drive the 3-phase AC (alternating current) electric motors. An Inverter System Controller (ISC) known as the SOBDMC (secondary on-board diagnostic control module C) and electric motor drive assembly propel the rear axle. An additional Inverter System Controller (ISC) known as the SOBDMB (Secondary On-Board Diagnostic Control Module B (SOBDMB)) and an electric motor drive assembly propel the front axle. The high voltage battery system supplies energy to other high voltage components including the cabin coolant heater, ACCM (air conditioning control module) , ACCMB (Air Conditioining Compressor Control Module B) (max trailer tow), DCDC (direct current/direct current converter control module) , Battery Charger Control Module (BCCM), Secondary Battery Charger Control Module (BCCM) (if equipped), DCACA (Direct Current/Alternating Current Converter Module A) and DCACB (Direct Current/Alternating Current Converter Module B) (if equipped).

The high voltage system incorporates hardwired interlock staples for the high voltage battery to Inverter System Controller (ISC) cables and connections. The interlock circuits consists of a staple at the high voltage cable connections that closes the circuit when it is fully connected and opens when the high voltage cable is disconnected. An interlock circuit fault at the high voltage battery and/or Inverter System Controller (ISC) prevents the vehicle from starting and results in power limiting if the vehicle is driving. The high voltage cable

48 hours. The ignition key must be cycled for the balancing to start a new 48 hour cell balancing period. When cell balancing is performed the BECM (battery energy control module) discharges individual cells with the highest voltage to match the remaining cells.

Vehicle Shut Down

A vehicle shut down signal is sent by the BECM (battery energy control module) when the BECM (battery energy control module) is about to open the contactors due to an internal fault or has just opened the contactors due to an external input (external module commanding contactors to be opened such as a crash event or interlock circuit failure). When vehicle shut down occurs, the Stop Safely warning indicator is illuminated warning that the vehicle will be shut down within a matter of seconds and the operator should pull off the road as soon as possible. Depending on the fault condition that lead to the shutdown, the vehicle may or may not restart if the condition has corrected itself. If the fault condition is severe enough, the fault will have to be repaired and Diagnostic Trouble Codes (DTCs) cleared before the vehicle will restart.

Component Description

High Voltage Battery

The vehicle is equipped with an 4P90S (standard range) or 5P96S (extended range) battery pack. The 4P90S battery pack has 90 series connected groups of 4 parallel cells and the 5P96S has 96 series connected groups of 5 parallel cells. Both high voltage battery designs consists of 3.7V lithium-ion cells packaged into modules which deliver approximately 400 volts DC (direct current) to the high voltage system. The high voltage battery pack contains 9 serviceable cell modules within the battery pack. Each cell module averages 30 - 41 volts and contains 40 or 55 cells (depending on cell module). The 4P90S battery pack contains 9 40 cell modules. The 5P96S battery pack contains 8 - 55 cell modules and 1 - 40 cell module. Each cell module and the cooling plate are serviced as an assembly. Each cell module contains cell voltage sense circuits that monitor 4 (standard range) or 5 (extended range) groups of parallel connected cells depending on the battery pack and are monitored by the BECM (battery energy control module) . Each cell module contains two internal temperature thermistors however not all of them are monitored by the BECM (battery energy control module) . The cell modules are liquid cooled using a cold plate that is fastened under each cell module. Coolant tubes connect the coolant plates together and coolant flows through the coolant plates to provide cooling and to keep the cells and cell modules at a consistent temperature. It is critical the battery pack cells stay within a ideal temperature range for maximum performance and longevity. The cell modules are connected together in series using bus bars. The bus bar connections have an orange plastic lid over them for additional safety. Anytime a bus bar is removed a safety cap **must** be installed over each of the cell module connections. The high voltage battery pack also contains the BECM (battery energy control module) , high voltage battery junction box - negative, high voltage battery junction box - positive, wiring harness, high voltage cables, coolant ports, and a connector header. The high voltage battery provides energy to the high-voltage electric motors to propel the vehicle and provides energy to auxiliary high voltage components to support climate control, high voltage battery cooling/heating, charge the 12-volt battery, and 110V and 220V (if equipped) AC (alternating current) power outlets located in the cargo compartment and bed.

Battery Energy Control Module (BECM)

- HEV (Hybrid Electric Vehicle) wakeup
- HS-CAN (high-speed controller area network) information

Direct Current/Alternating Current (DC/AC) Inverter(s)

The vehicle is equipped with a 2.4Kw DCACA (Direct Current/Alternating Current Converter Module A) and optionally equipped with a 7.2Kw DCACB (Direct Current/Alternating Current Converter Module B) also known as the GFM3 (generic function module 3) . The inverter(s) are/is an liquid-cooled component(s) that converts high voltage DC (direct current) from the high voltage battery to 120V (2.4Kw) and optionally a 240V (7.2Kw) AC (alternating current) power outlets and communicate on the HS-CAN (high-speed controller area network) . For further information,

Refer to: Direct Current/Alternating Current (DC/AC) Inverter - Electric, Vehicles With: Pickup Bed Power Outlet - System Operation and Component Description

(414-05 Voltage Converter/Inverter, Description and Operation).

Direct Current/Direct Current (DC/DC) Converter Control Module

The Direct Current/Direct Current (DC/DC) converter control module is an liquid-cooled component that converts high voltage DC (direct current) power to low voltage (12-volt) DC (direct current) power. The converter provides power to the vehicle 12-volt battery and low-voltage electrical systems. The PCM (powertrain control module) requests the Direct Current/Direct Current (DC/DC) converter control module to enable power conversion through an enable message over HS-CAN (high-speed controller area network) . The PCM (powertrain control module) sends a charging voltage setpoint request over HS-CAN (high-speed controller area network) to the DCDC (direct current/direct current converter control module) . For information on the DCDC (direct current/direct current converter control module) ,

Refer to: Direct Current/Direct Current (DC/DC) Converter Control Module - Electric - System Operation and Component Description

(414-05 Voltage Converter/Inverter, Description and Operation).

Electric Rear Axle Drive (eRAD)

The Electric Rear Axle Drive (eRAD) is a single 3-phase electric motor and primary drive assembly that is used to drive the rear wheels. The electric motor receives power from the rear Inverter System Controller (ISC) also known as the SOBDMC (secondary on-board diagnostic control module C) that is fastened directly to the assembly. The Inverter System Controller (ISC) receives DC (direct current) from the high voltage battery and converts it to AC (alternating current) to drive the motor. The electric motor is an internal part of the Electric Rear Axle Drive (eRAD) and it cannot be repaired, only installed new as an assembly. For information on the Electric Rear Axle Drive (eRAD) and its operation,

Refer to:

Rear Electric Drive Assembly - System Operation and Component Description

supplies the positive and negative polarity to the rear and front Inverter System Controller (ISC). The rear and front Inverter System controller (ISC) outputs are protected by a high voltage high current 2,200A circuit breaker internal to the high voltage battery junction box - negative. If the circuit breaker opens due to a high voltage overcurrent condition or short circuit it cannot be reset and the high voltage battery junction box - negative requires replacement. Four high voltage low current circuits supplies the negative and positive polarity to the DCDC (direct current/direct current converter control module) and Battery Charger Control Module (BCCM) also known as the SOBDM (secondary on-board diagnostic control module A) , cabin coolant heater and ACCM (air conditioning control module) . A 50A high voltage low current fuse protects the DCDC (direct current/direct current converter control module) and SOBDM (secondary on-board diagnostic control module A) . An additional 60A high voltage low current fuse protects the cabin coolant heater and ACCM (air conditioning control module) . Any fault resulting in excessive current on a low current circuit will open the affected 50A or 60A fuse first and stop power distribution to the components on that circuit. Any fault resulting in excessive current or short on a high current circuit to one or both Inverter System Controllers (ISC) opens the main circuit breaker and stop power distribution to all high voltage components. The high voltage battery junction box - negative contains the current sensor, high-voltage high current circuit breaker, 50A and 60A high-voltage low current fuses. Note the high voltage fuse current ratings reference the operating current of the circuit and not the faulted current to open the fuses. Only the high voltage low current fuses can be serviced separately. If a failure occurs with any of the other components a new high voltage battery junction box - negative must be installed.

The high voltage battery junction box - negative contains a current sensor that is hardwired to and monitored by the BECM (battery energy control module) . The current sensor helps determine the load or rate of charge of the high voltage battery by sensing current flow into or out of the high voltage battery. The high voltage battery junction boxes also contains voltage sense points downstream of each high voltage contactor that are used by the BECM (battery energy control module) to detect if the contactors open and close correctly.

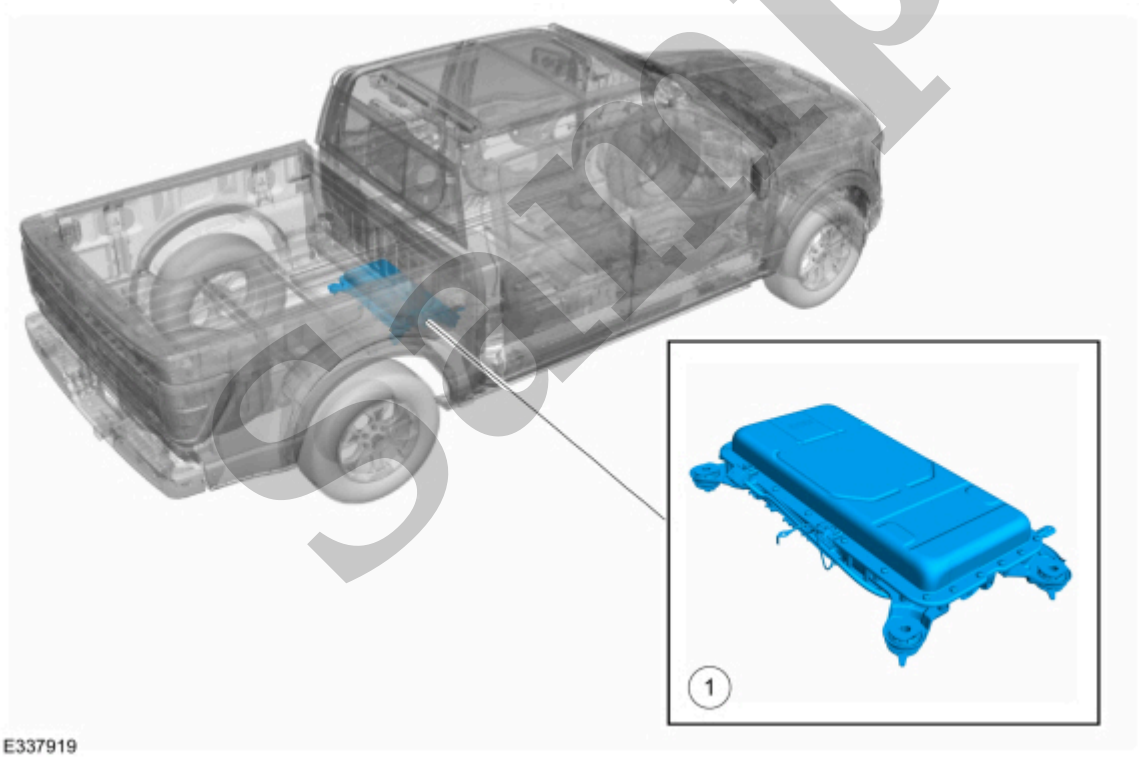
High Voltage Cable Assembly

All cables that carry high voltage are integrated into four high-voltage cable assemblies. On all applications a high voltage cable connects the high voltage battery to the rear Inverter System Controller (ISC) also known as the SOBDMC (secondary on-board diagnostic control module C) and a separate high voltage cable connects the high voltage battery to the front Inverter System Controller (ISC) also known as the SOBDMB (Secondary On-Board Diagnostic Control Module B (SOBDMB)) . The rear high voltage passes though a junction block that allows the main positive and negative circuits to split into several other circuits to suppling high voltage to the ACCMB (Air Conditioining Compressor Control Module B) (max trailer tow only), DCACA (Direct Current/Alternating Current Converter Module A) , Secondary Battery Charger Control Module (BCCM) also known as the GFM2 (generic function module 2) (if equipped), DCACA (Direct Current/Alternating Current Converter Module A) and the DCACB (Direct Current/Alternating Current Converter Module B) also known as the GFM3 (generic function module 3) (if equipped). If the vehicle is equipped with a Secondary Battery Charger Control Module (BCCM) the rear high voltage cable incorporates AC (alternating current) input circuits from the vehicle charge port to the Secondary Battery Charger Control Module (BCCM).

High Voltage Battery, Mounting and Cables - Full Hybrid Electric Vehicle (FHEV) - Component Location

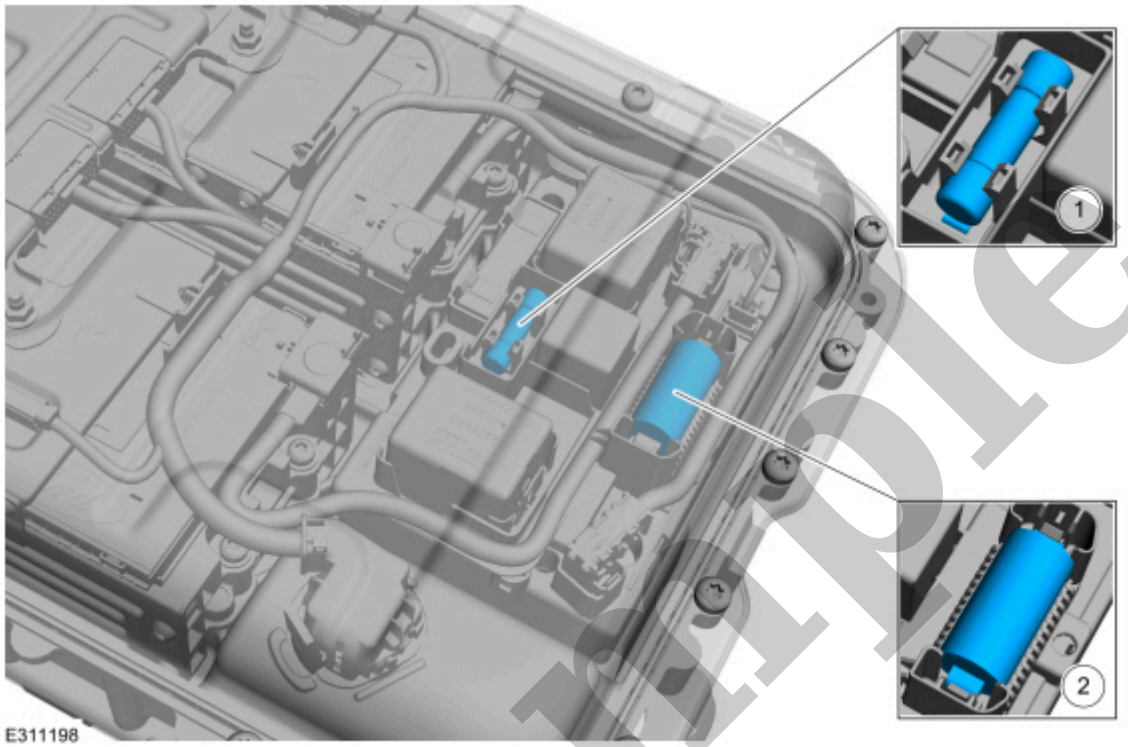
414-03A High Voltage Battery, Mounting and Cables	***2022 F-150***
Description and Operation	***Procedure revision date: 12/1/2022***

High Voltage Battery, Mounting and Cables - Full Hybrid Electric Vehicle (FHEV) - Component Location

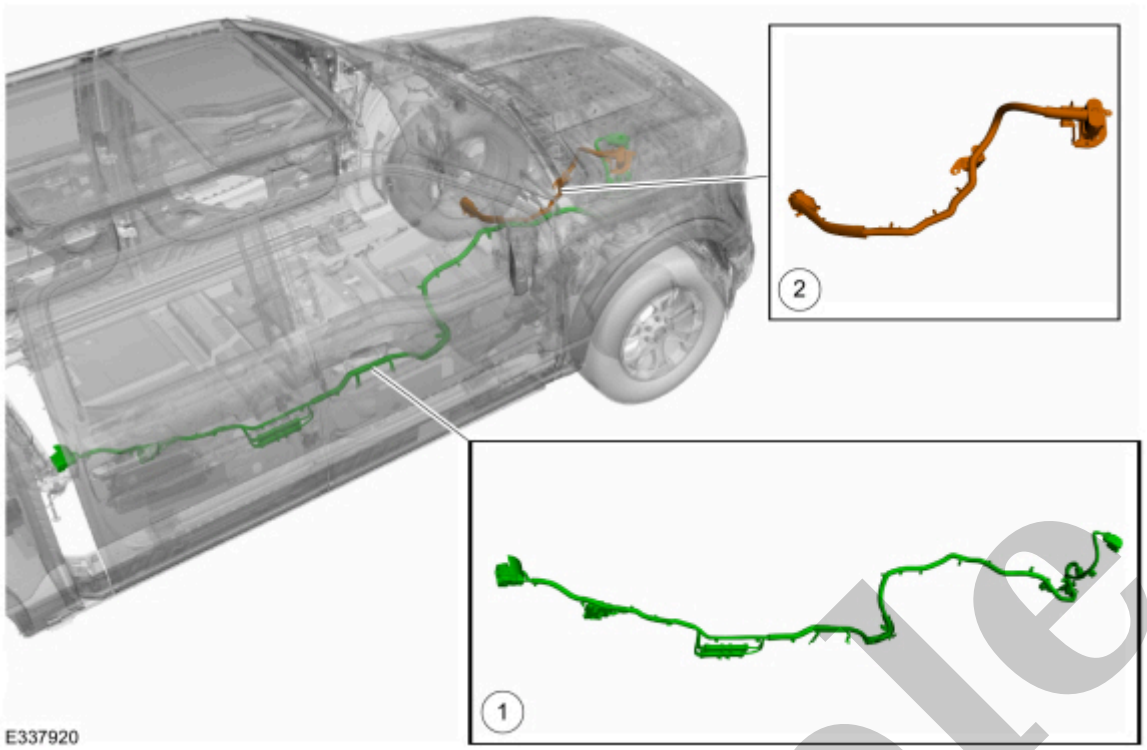


Item	Description
1	High voltage battery

Item	Description
1	BECM (battery energy control module)
2	High voltage battery junction box



Item	Description
1	High voltage low current fuse
2	High voltage high current fuse



Item	Description
1	High voltage battery cable
2	Electric motor 3 phase AC (alternating current) cable