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2015 FORD Mondeo Sedan OEM Service and Repair Workshop Manual

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In low-speed driving situations the vehicle may move under only battery power and without the internal combustion engine running. The internal combustion engine may automatically shut off when the vehicle is stopped/idling or when coasting under 100 km/h (62 mph). The engine may restart when the accelerator is pressed, when the electric motor needs assistance, or if the high voltage battery state of charge is low. This avoids using excess fuel when the vehicle is not in motion.

The energy provided by the engine and the regenerative braking, via the electric motor (used as a generator) charges the high voltage battery.

The high voltage battery pack consists of the following servicable components:

- BECM (battery energy control module)
- High voltage battery mounting brackets and isolators
- High voltage battery upper cover seal
- High voltage battery lower seal
- Coolant port assembly
- Vent patch
- High voltage battery electronics wiring harness (includes the high voltage cell array negative cable)
- High voltage battery junction box
- High voltage high current fuse (mounted in the high voltage battery junction box)
- High voltage low current fuse (mounted in the high voltage battery junction box)

All of the high voltage battery components listed above can be serviced separately. All other components are serviced as part of the high voltage battery pack and should not be removed. If the high voltage battery pack is replaced it includes all of the components in the list.

The high-voltage system consists of the following components:

- High-voltage battery cable
- High-voltage battery extension cable
- Electric motor 3 phase AC (alternating current) cable
- Inverter System Controller (ISC) also known as the SOBDMC (secondary on-board diagnostic control module C)
- Electric motor assembly (mounted to the front of the transmission)
- DCDC (direct current/direct current converter control module)

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

414-03A High Voltage Battery, Mounting and Cables	***2022 F-150***
Description and Operation	***Procedure revision date: 12/8/2021***

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

System Diagram

2	Precharge Contactor Coil
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5	Temperature Sensors
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7	DCDC (direct current/direct current converter control module)
8	Main 12 Volt Battery
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10	High Voltage Battery Coolant Diverter Valve
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12	Isolation Switch (BIB)
13	Auxiliary 12 Volt Battery
14	High Voltage Battery Coolant Pump
15	High Voltage Interlock Loop (HVIL)
16	12V Battery Monitoring Sensor
18	Coolant Temperature Sensor
19	DCACA (Direct Current/Alternating Current Converter Module A)
20	TCU (telematic control unit module)
21	HVAC (heating, ventilation and air conditioning)
22	BCM (body control module)
23	GWM (gateway module A)

High voltage battery estimated current flow (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Estimated electric current into or out of the high voltage battery.
High voltage battery contactor request (gateway)	PCM (powertrain control module)	Command to high voltage battery controller to open, close, or retain the high voltage contactor position.
High voltage battery contactor supply voltage status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Used to determine if the 12V contactor power is asserted or not asserted.
High voltage battery coolant flow request during high voltage battery coolant cooler operation (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Coolant flow request to support cooling of the high voltage batery during high voltage batttery coolant cooler operation.
SOBDMC (secondary on-board diagnostic control module C) coolant flow request	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 interlock circuit open status (gateway)	SOBDMC (secondary on-board diagnostic control module C)	Notifies the BECM (battery energy control module) if a high voltage interlock circuit is open which disables the high voltage system.
Hybrid DC/DC current usage	DCDC (direct current/direct current converter control module)	DCDC (direct current/direct current converter control module) high voltage current usage for Energy Management (includes all 12V loads).
Hybrid DC/DC high voltage measurement	DCDC (direct current/direct current converter control module)	Voltage of the high voltage bus as seen by the DCDC (direct current/direct current converter control module) .
Hybrid DC/DC low voltage measurement	DCDC (direct current/direct current converter control module)	Voltage of the 12 volt system as seen by the DCDC (direct current/direct current converter control module) .

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 high voltage battery consists of cells packaged into modules which deliver approximately 300 volts DC (direct current) to the high voltage system. The high voltage battery supplies electrical energy to the electric motor to move the vehicle when it is operating in electric mode only or to assist the gasoline engine (heavy acceleration). When the engine is operating or the vehicle is moving, the electric motor can be used as a generator creating high-voltage AC (alternating current) electricity. High-voltage AC (alternating current) generated by the electric motor is converted to high voltage DC (direct current) by the SOBDMC (secondary on-board diagnostic control module C) and transmitted through the high voltage cables to recharge the high voltage battery.

The high-voltage DC (direct current) electrical power is converted to low voltage DC (direct current) electrical power through the Direct Current/Direct Current (DC/DC) converter control module. This low-voltage high current DC (direct current) electrical power is then supplied to the 12-volt batteries through the low voltage battery cables.

The high-voltage system has a floating ground. The floating ground is designed to completely isolate the high-voltage system from the vehicle chassis. The high-voltage cables are fully insulated (isolated) from all vehicle components and circuits. There are no common connections (such as body grounds) used to conduct the high-voltage power. The BECM (battery energy control module) monitors this system for any leakage of current to the normal electrical system (similar to a household ground fault interrupter). There are high voltage circuits from the battery cell arrays to the BECM (battery energy control module) used to monitor isolation resistance between the high voltage battery and chassis.

Battery Energy Control Module (BECM)

The BECM (battery energy control module) manages the condition of the high voltage battery to control its charging and discharging. The BECM (battery energy control module) controls the high voltage battery coolant pump in conjunction with BCMC (body control module C) controlling the diverter valve. When additional high voltage battery cooling is needed (high ambient temperatures and/or during high current flow demand) the coolant diverter valve is energized to allow coolant to be diverted through the high voltage

The DCDC (direct current/direct current 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 DCDC (direct current/direct current 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 - Full Hybrid Electric Vehicle (FHEV)

(414-05 Voltage Converter/Inverter, Removal and Installation).

Direct Current/Alternating Current (DC/AC) Inverter

The DCACA (Direct Current/Alternating Current Converter Module A) is an liquid-cooled component that inverts high voltage DC (direct current) power to 120V and 240V AC (alternating current) power. The converter provides power to multiple electrical outlets that are located inside the bed of the vehicle. The PCM (powertrain control module) requests the DCACA (Direct Current/Alternating Current Converter Module A) to enable power conversion through an enable message over HS-CAN (high-speed controller area network) . For information on the DCACA (Direct Current/Alternating Current Converter Module A) ,

Refer to: Direct Current/Alternating Current (DC/AC) Inverter - Vehicles With: 110-120V 7.2kW Pickup Bed Power Outlet - System Operation and Component Description

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

Hybrid Electric Motor Assembly

The hybrid electric motor assembly is mounted to the front of the transmission assembly and is also used as an generator. The assembly also incorporates an electric operated engine disconnect clutch that engages or disengages the electric motor from the gasoline engine.

The electric motor generates high voltage electricity for charging the high voltage battery. The engine is started using either conventional engine block mounted starter (for cold starts only) and a Belt Integrated Starter Generator (BISG) for other starts during normal vehicle operation. The electric motor must be energized and rotated to match gasoline engine cranking speed during starting. If the high voltage system is shutdown due to a malfunction the gasoline engine will not start and the vehicle will be disabled.

The electric motor is used to accelerate the vehicle from a stop when driving under electric power. The electric motor is also used to recover energy during regenerative braking. The electric motor receives power from the high voltage battery after the high voltage battery junction box contactors have closed. For information on the electric motor and its operation,

Refer to: Electric Motor

(303-01F Electric Motor - 3.5L V6 PowerBoost (CN), Description and Operation).

ACCM (air conditioning control module) . There are 4 circuits that connect to the High Voltage Battery. Two main circuits supply high voltage to the SOBDMC (secondary on-board diagnostic control module C) and DCACA (Direct Current/Alternating Current Converter Module A) . Two auxillary circuits supply high voltage to the DCDC (direct current/direct current converter control module) . The DCDC (direct current/direct current converter control module) acts as a junction and sends high voltage to the ACCM (air conditioning control module) . There is a seperate 3 phase AC (alternating current) high voltage cable assembly that connects the Hybrid Electric Motor Assembly and the SOBDMC (secondary on-board diagnostic control module C) .

High Voltage System Service Disconnect Plug

The high voltage system uses a low voltage disconnect plug that opens the 12-Volt contactor control supply circuit and is located in the engine compartment. When the service disconnect plug is disconnected the high voltage battery contactors that supply high voltage to the vehicle are unable to close. The high voltage system must be depowered prior to disconnecting any high voltage cable (identified by orange color).

Refer to: High Voltage System De-energizing - Full Hybrid Electric Vehicle (FHEV)

(414-03A High Voltage Battery, Mounting and Cables, General Procedures).

BECM (battery energy control module)	B11D8:11	Restraint Event Notification: Circuit Short to Ground	GO to Pinpoint Test B
BECM (battery energy control module)	B11D8:15	Restraint Event Notification: Circuit Short to Battery or Open	GO to Pinpoint Test C
BECM (battery energy control module)	B11D8:29	Restraint Event Notification: Signal Invalid	GO to Pinpoint Test D
BECM (battery energy control module)	B11D8:36	Restraint Event Notification: Signal Frequency Too Low	GO to Pinpoint Test D
BECM (battery energy control module)	B11D8:37	Restraint Event Notification: Signal Frequency Too High	GO to Pinpoint Test D
BECM (battery energy control module)	B11D8:38	Restraint Event Notification: Signal Frequency Incorrect	GO to Pinpoint Test D
BECM (battery energy control module)	P0563:00	System Voltage High: No Sub Type Information	GO to Pinpoint Test Q
BECM (battery energy control module)	P062F:00	Internal Control Module EEPROM Error: No Sub Type Information	GO to Pinpoint Test E
BECM (battery energy control module)	P064F:00	Unauthorized Software/Calibration Detected: No Sub Type Information	GO to Pinpoint Test E
BECM (battery energy control module)	P0A06:00	Motor Electronics Coolant Pump "A" Control Circuit Low: No Sub Type Information	GO to Pinpoint Test F

BECM (battery energy control module)	P0AA2:00	Hybrid Battery Positive Contactor Circuit Stuck Open: No Sub Type Information	GO to Pinpoint Test Q
BECM (battery energy control module)	P0AA4:00	Hybrid Battery Negative Contactor Circuit Stuck Closed: No Sub Type Information	GO to Pinpoint Test R
BECM (battery energy control module)	P0AA5:00	Hybrid Battery Negative Contactor Circuit Stuck Open: No Sub Type Information	GO to Pinpoint Test R
BECM (battery energy control module)	P0AA6:00	Hybrid Battery Voltage System Isolation Fault: No Sub Type Information	GO to Pinpoint Test S
BECM (battery energy control module)	P0AA7:00	Hybrid/EV Battery Voltage Isolation Sensor Circuit: No Sub Type Information	GO to Pinpoint Test T
BECM (battery energy control module)	P0ABB:00	Hybrid/EV Battery Pack Voltage Sense "A" Circuit Range/Performance: No Sub Type Information	GO to Pinpoint Test V
BECM (battery energy control module)	P0ABC:00	Hybrid Battery Pack Voltage Sense A Circuit Low: No Sub Type Information	GO to Pinpoint Test V
BECM (battery energy control module)	P0ABD:00	Hybrid Battery Pack Voltage Sense A Circuit High: No Sub Type Information	GO to Pinpoint Test V
BECM (battery energy control module)	P0AC0:00	Hybrid Battery Pack Current Sensor A Circuit Range/Performance: No Sub Type Information	GO to Pinpoint Test W
BECM (battery energy control module)	P0AC1:00	Hybrid Battery Pack Current Sensor A Circuit Low: No Sub Type Information	GO to Pinpoint Test W