

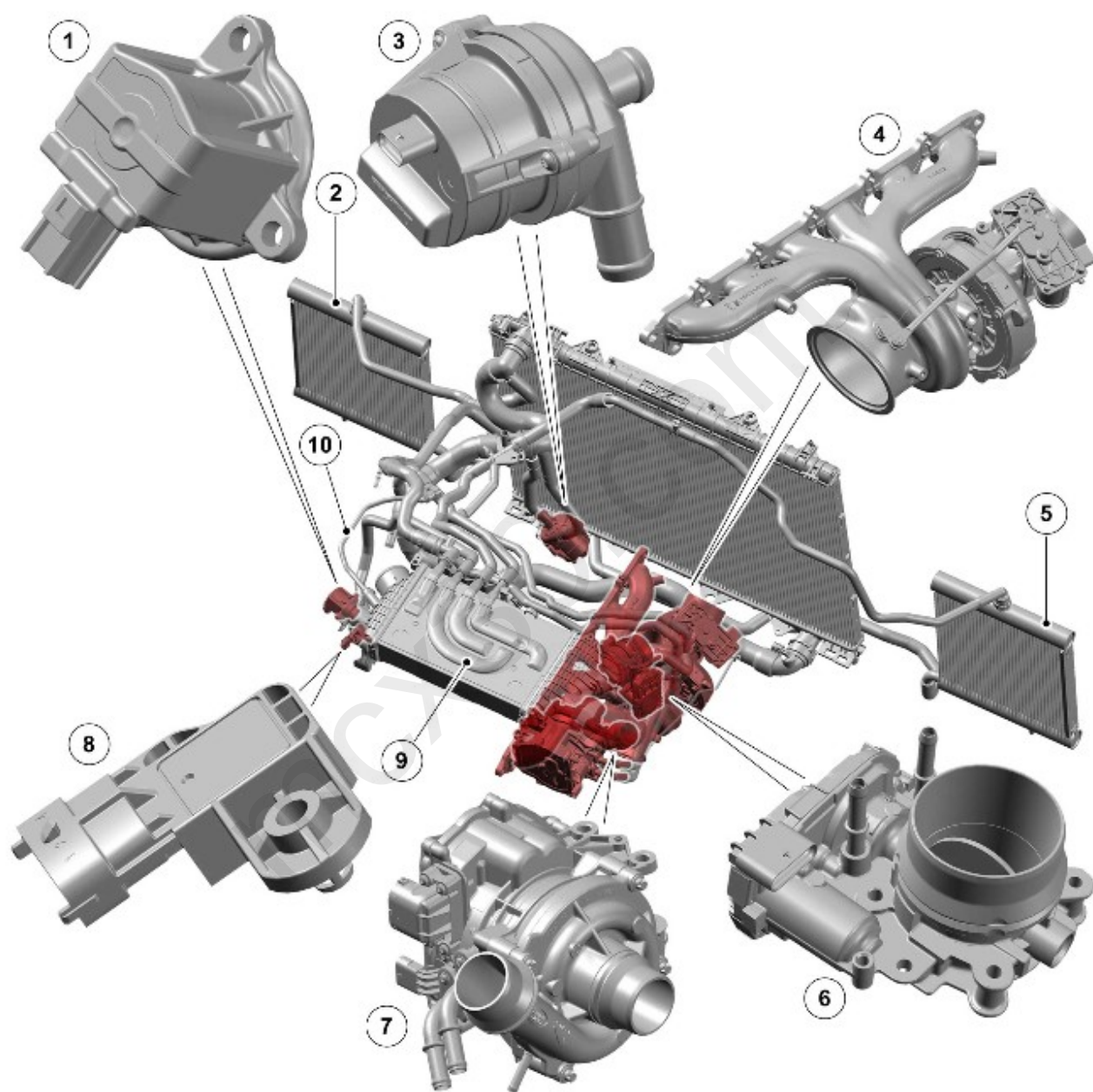
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2020.0 DEFENDER (LE), 303-03D

SUPERCHARGER COOLING – INGENIUM I6 3.0L PETROL (G2341928)

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COMPONENT LOCATION



E237920

ITEM	DESCRIPTION
1	Compressor Recirculation Valve (CRV)
2	Left charge air radiator
3	Charge air coolant pump

ITEM	DESCRIPTION
4	Turbocharger
5	Right charge air radiator
6	Electric supercharger bypass valve
7	Electric supercharger
8	Charge air pressure and temperature sensor
9	Charge air cooler
10	Evaporative emission pipe

OVERVIEW

The supercharger cooling system cools the pressurized charge air from the electric supercharger and turbocharger.

The charge air cooling system consists of:

- Charge air coolant pump
- Left charge air radiator
- Right charge air radiator
- Electric supercharger bypass valve
- Electric supercharger
- Charge air cooler
- Charge air pressure and temperature sensor

The charge air cooling system has a connection to the radiator upper hose. The connection with the engine cooling system accommodates thermal expansion and retraction of the coolant in the charge air cooling system. In addition, the connection enables the filling and draining of the charge air cooling system.

The charge air cooling is achieved by two separate coolant circuits within the charge air cooler.

- High temperature circuit which is driven by the variable coolant pump and using the radiator to cool the hot coolant.
- Low temperature circuit which is driven by the charge air coolant pump and using the auxiliary radiators to cool the coolant.

High temperature engine coolant circuit provides heating/cooling for:

- Engine
- Electric throttle
- Charge air cooler

- Turbocharger
- Engine oil cooler
- Automatic Transmission Fluid (ATF) cooler
- Heater core

Low temperature coolant circuit provides heating/cooling for:

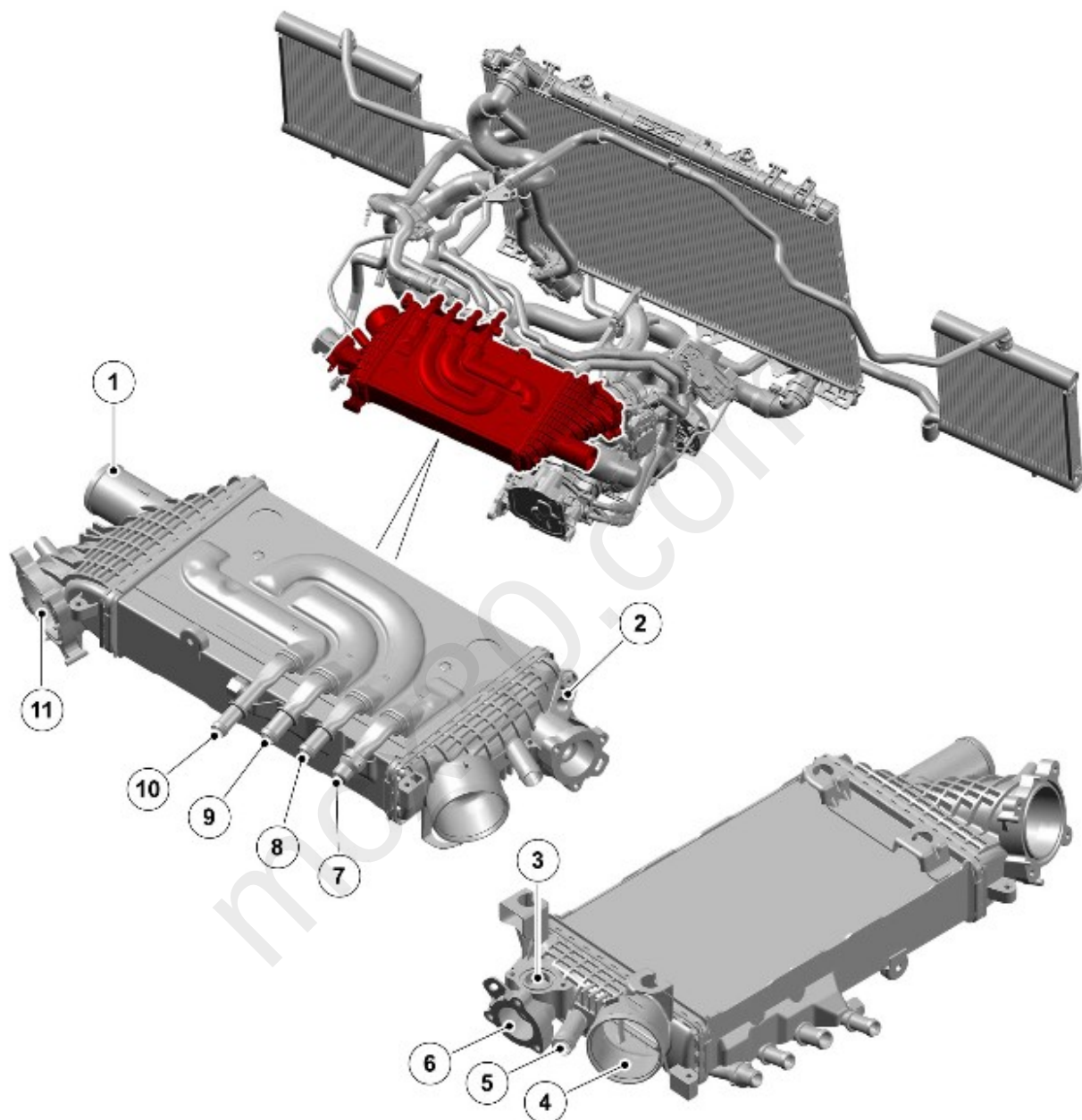
- Charge air cooler
- PCM
- Electric supercharger
- Electric supercharger bypass valve

For additional information, refer to: [Engine Cooling](#) (303-03C Engine Cooling - INGENIUM I6 3.0L Petrol, Description and Operation).

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DESCRIPTION

CHARGE AIR COOLER



E237921

ITEM	DESCRIPTION
1	Charge air inlet - From electric supercharger
2	Pressure and temperature sensor - Charge air cooler
3	Compressor Recirculation Valve (CRV) pipe connection
4	Charge air outlet - To electric throttle

ITEM	DESCRIPTION
5	Evaporative emission pipe
6	Compressor Recirculation Valve (CRV) connection
7	Engine coolant inlet - From charge air coolant pump
8	Engine coolant outlet - To cylinder head
9	Engine coolant outlet - To charge air radiator
10	Engine coolant inlet - From cylinder block
11	Charge air inlet - From turbocharger

The charge air cooler is an air-to-liquid heat exchanger, providing charge air cooling in combination with an electrical coolant pump. The charge air cooler is located on the top of the engine.

The turbocharger is designed to force more air mass into the engine intake manifold and combustion chambers. As the hot exhaust gases pass through the turbine, part of the heat is transmitted to the compressor thus the clean air heats up.

To counteract this, the charge air cooler is used to reduce the intake air temperature. The cooled intake air increases the density of the air, allowing more air molecules to be delivered to the combustion chamber.

The charge air cooler cools the charge air in 2 stages.

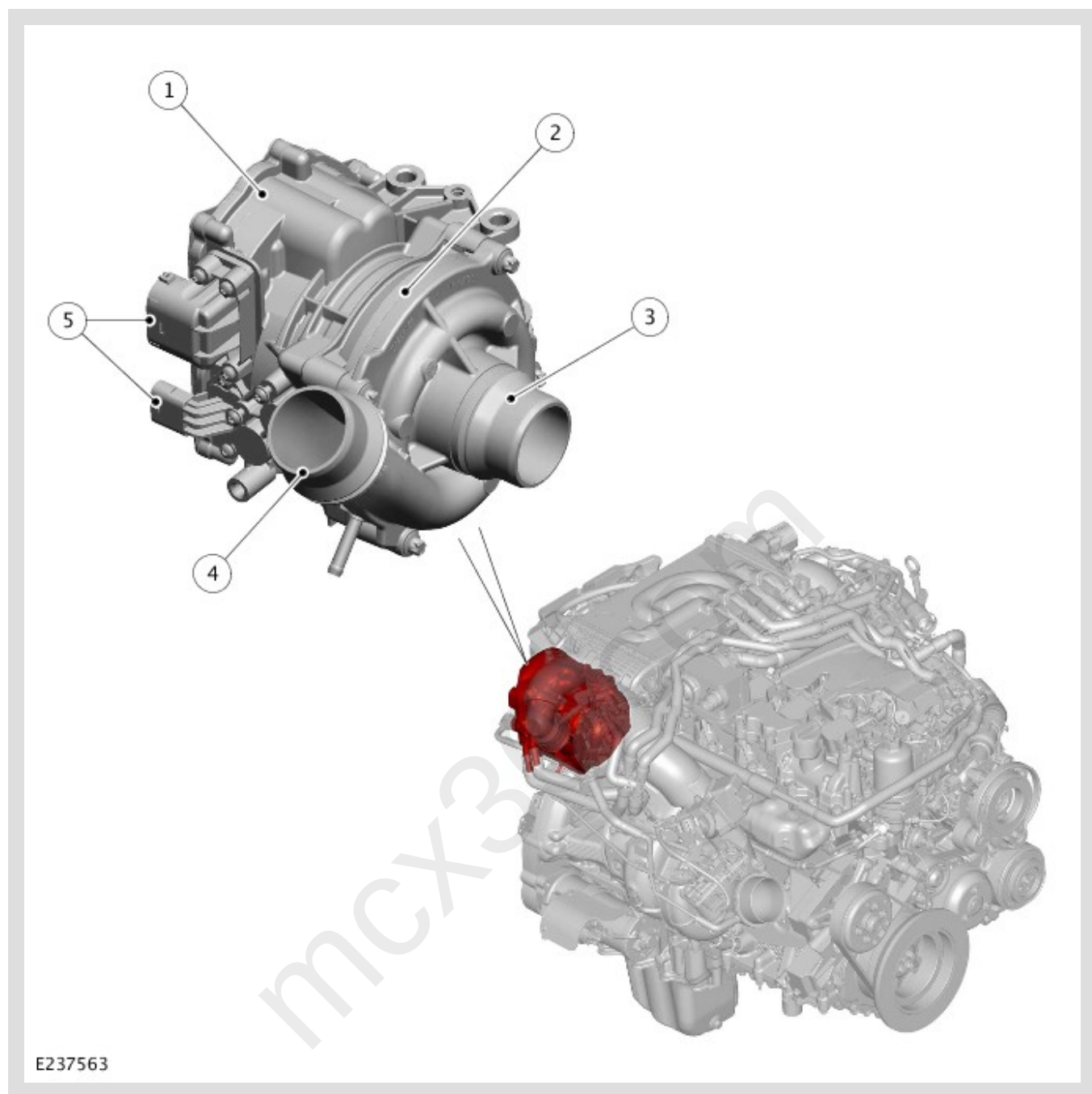
The first stage is cooling the high temperature charge air on the air intake side. This circuit using the radiator to cool the coolant and is driven by the variable coolant pump.

When the charge air arrives the second part of the charge air cooler, the charge air temperature already decreased. This is why the next circuit can named as Low temperature circuit.

In the second stage the charge air temperature decreasing further by the Low temperature circuit. The Low temperature circuit using the auxiliary radiator to cool the coolant which is driven by the charge air coolant pump.

Within the charge air cooler, the hot air and the coolant flow in the opposite direction. This is makes a more effective heat exchange.

ELECTRIC SUPERCHARGER



ITEM	DESCRIPTION
1	Electric motor
2	Compressor
3	Compressor air inlet
4	Compressor air outlet
5	Electrical connectors

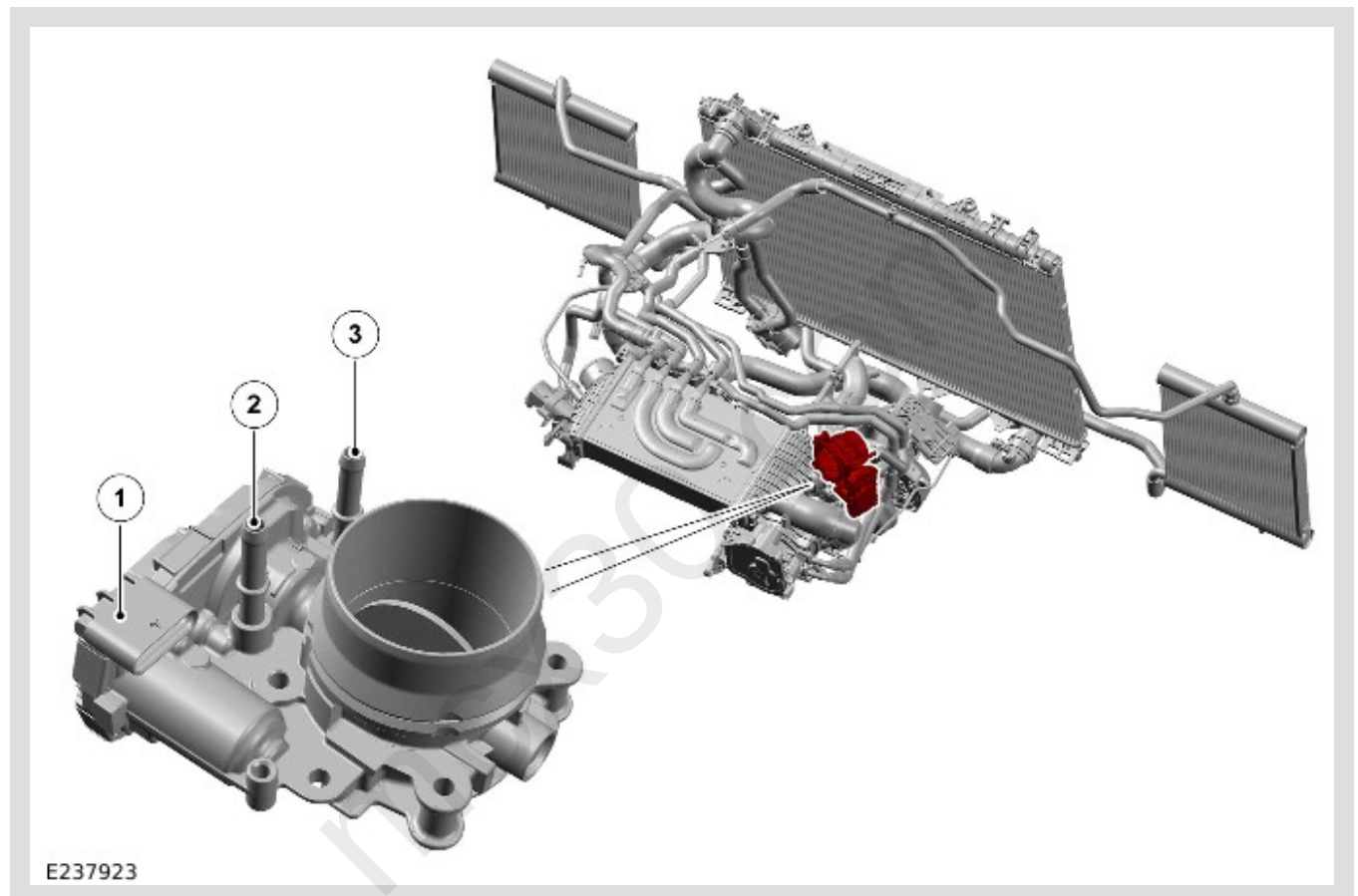
The electric supercharger comprises of a centrifugal compressor driven by a switched reluctance motor.

The turbocharger increases the pressure of the intake air. The electric supercharger also increases the pressure of the intake air from the turbocharger, which increases the power output of the engine.

The MHEV battery junction box supplies the 48V power to the electric supercharger. The Powertrain Control Module (PCM) controls the operation of the electric supercharger through the High Speed (HS) Controller Area Network (CAN) power mode zero systems bus.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - INGENIUM I6 3.0L Petrol, Description and Operation).

ELECTRIC SUPERCHARGER BYPASS VALVE

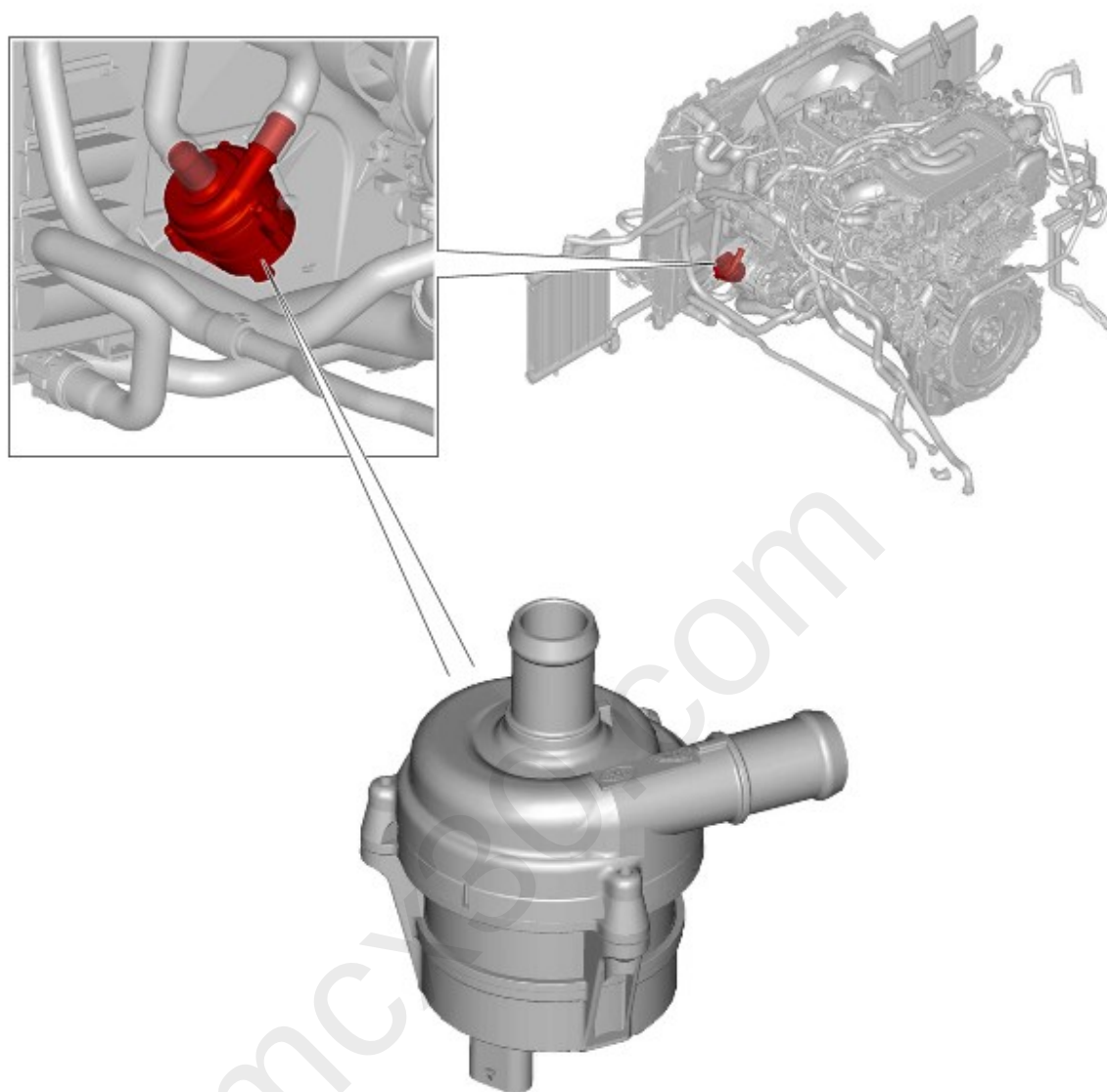


ITEM	DESCRIPTION
1	Electrical connector - Powertrain Control Module (PCM)
2	Engine coolant inlet - From charge air coolant pump
3	Engine coolant outlet - To charge air radiator

The electric supercharger bypass valve is installed on the charge air cooler. The electric supercharger bypass valve bypasses the intake air from the turbocharger to the charge air cooler.

The temperature of the intake air from the turbocharger increases. The charge air coolant pump circulates the engine coolant from the charge air radiator to cool the electric supercharger bypass valve. The PCM controls the electric supercharger bypass valve with a Pulse Width Modulation (PWM) signal.

CHARGE AIR COOLANT PUMP

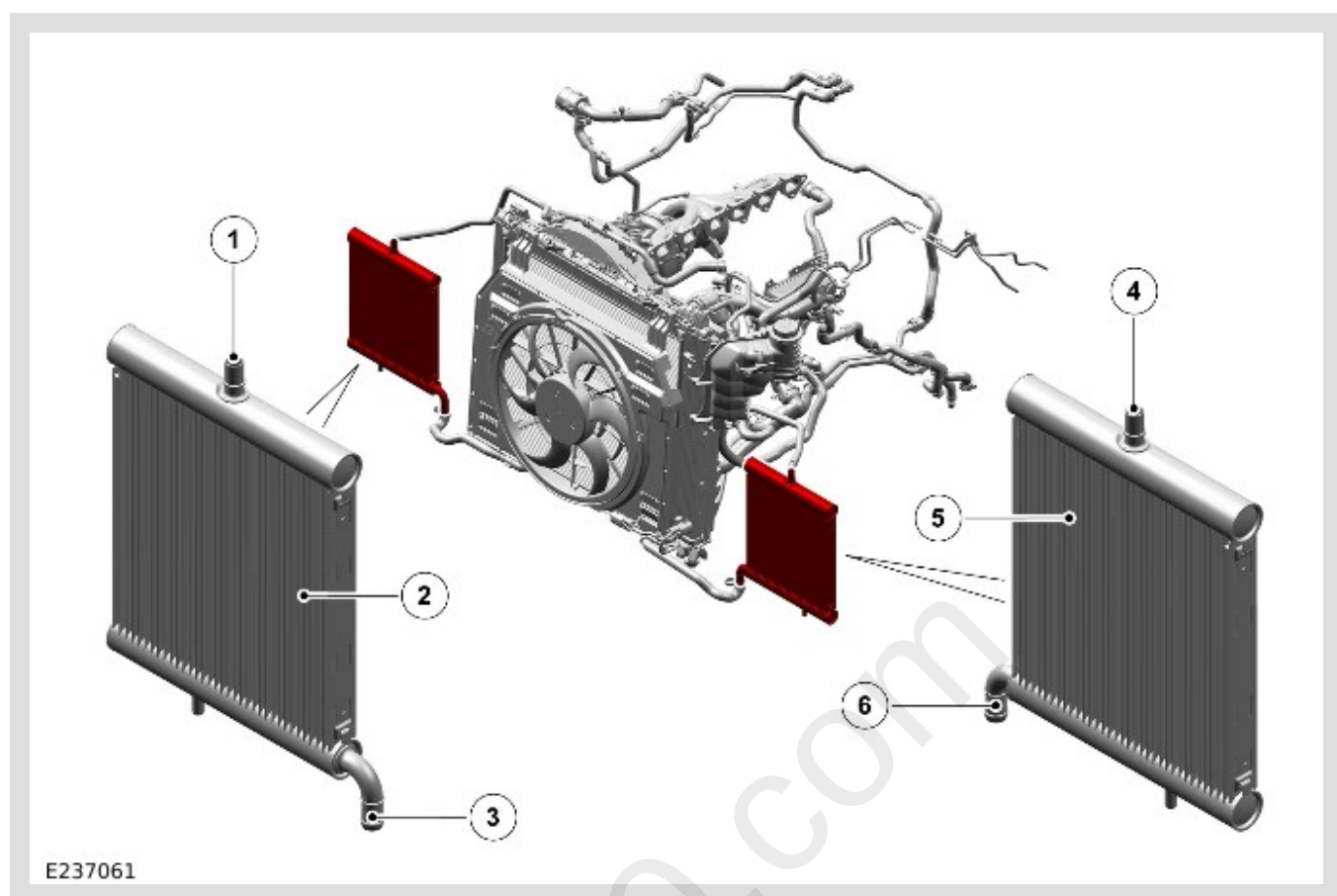


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The charge air coolant pump is installed on the electric cooling fan shroud.

Electrical power for the charge air coolant pump is supplied from the Powertrain Control Module (PCM) relay, located in the Engine Junction Box (EJB). When the PCM relay is energized, the PCM connects power supply to the charge air coolant pump. Operation of the charge air coolant pump is controlled by the PCM with a Pulse Width Modulation (PWM) signal.

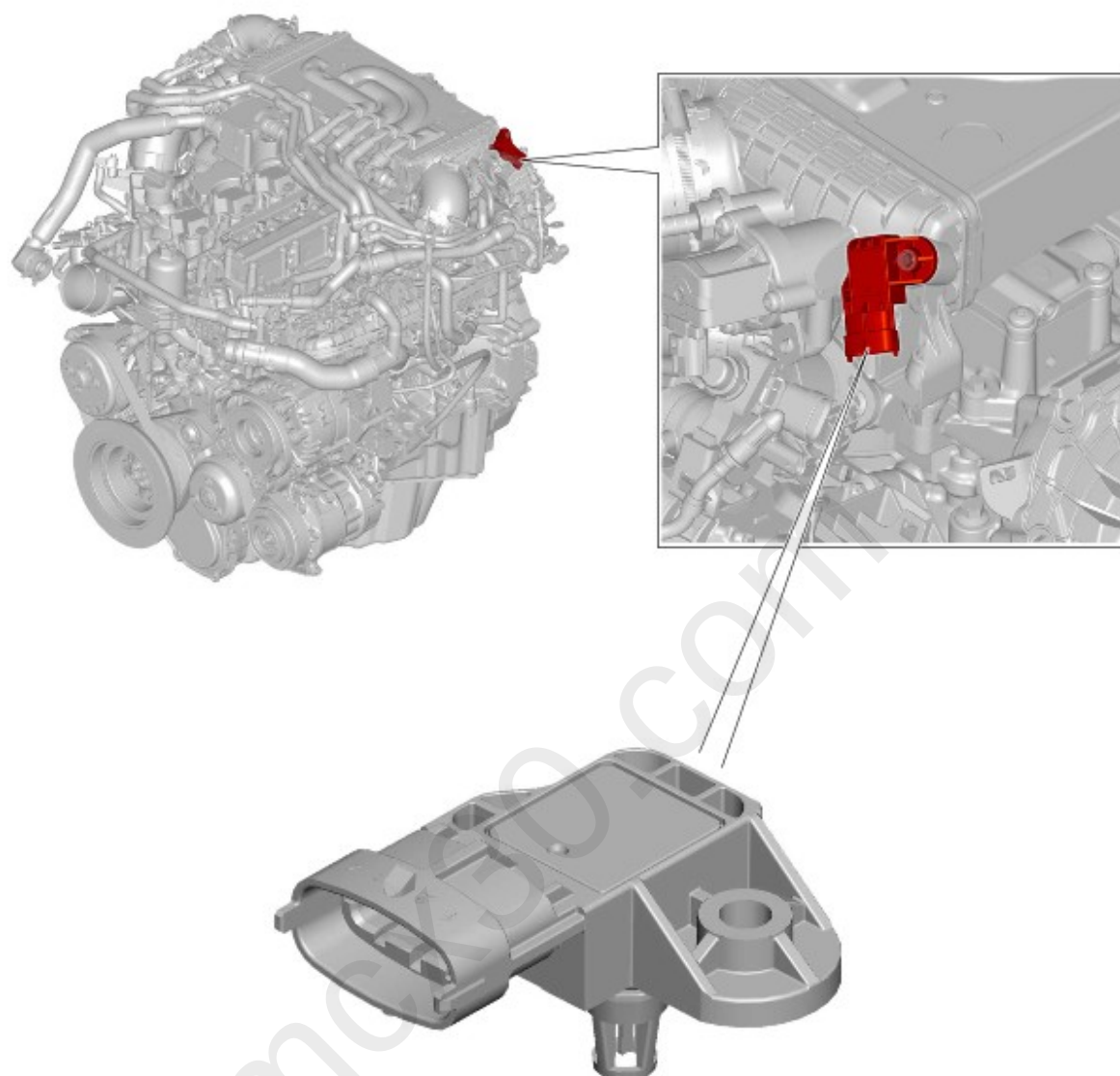
CHARGE AIR RADIATORS



ITEM	DESCRIPTION
1	Hose connection - Engine coolant inlet
2	Right charge air radiator
3	Hose connection - Engine coolant outlet
4	Hose connection - Engine coolant outlet
5	Left charge air radiator
6	Hose connection - Engine coolant inlet

The charge air radiators are located behind the front bumper. The charge air coolant pump circulates the engine coolant from the charge air radiators to the charge air cooler. The radiator is a vertical flow type with an aluminum core.

PRESSURE AND TEMPERATURE SENSOR – CHARGE AIR COOLER



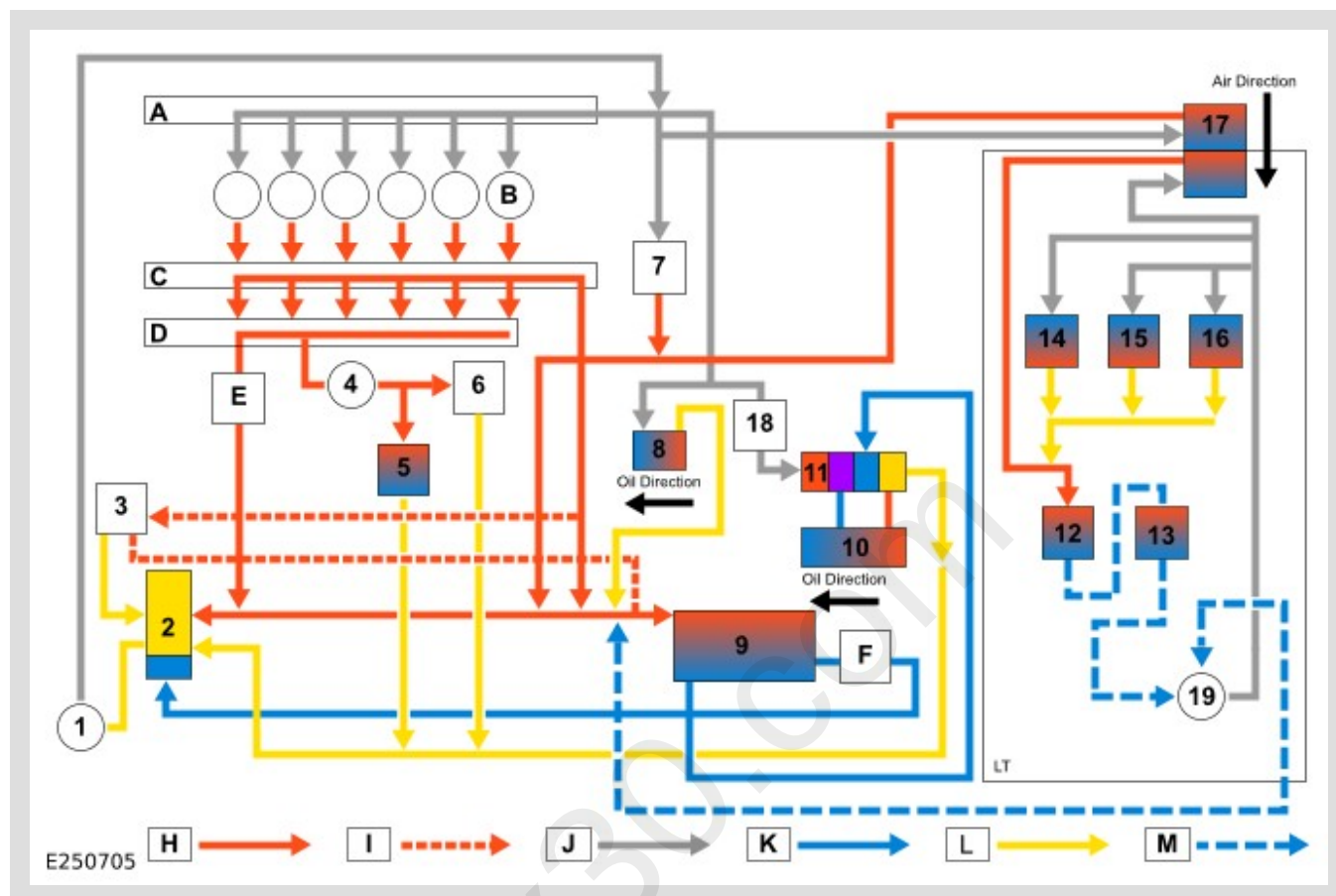
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The charge air pressure and temperature sensor is installed on the charge air cooler. The charge air pressure and temperature sensor measures the temperature and pressure of the intake air in the charge air cooler. The signals from the charge air pressure and temperature sensor are sent to the Powertrain Control Module (PCM).

The charge air pressure and temperature sensor allows the PCM to calculate the charge air density immediately before it enters the combustion chamber. This is used to adjust the ignition timing relative to the charge air pressure and to monitor the performance of the charge air cooler.

The charge air pressure and temperature sensor uses a diaphragm transducer to measure the air pressure. Also uses a Negative Temperature Coefficient (NTC) resistor type sensor to measure the temperature.

Engine Coolant Circuit Flow Diagram



H = HOT COOLANT: I = HOT COOLANT BLEED ROUTE: J = HIGH PRESSURE COOLANT FROM PUMP: K = LOW PRESSURE COLD COOLANT RETURN TO PUMP: L = HOT COOLANT RETURN: M = LOW PRESSURE COLD COOLANT RETURN AND BLEED ROUTE.

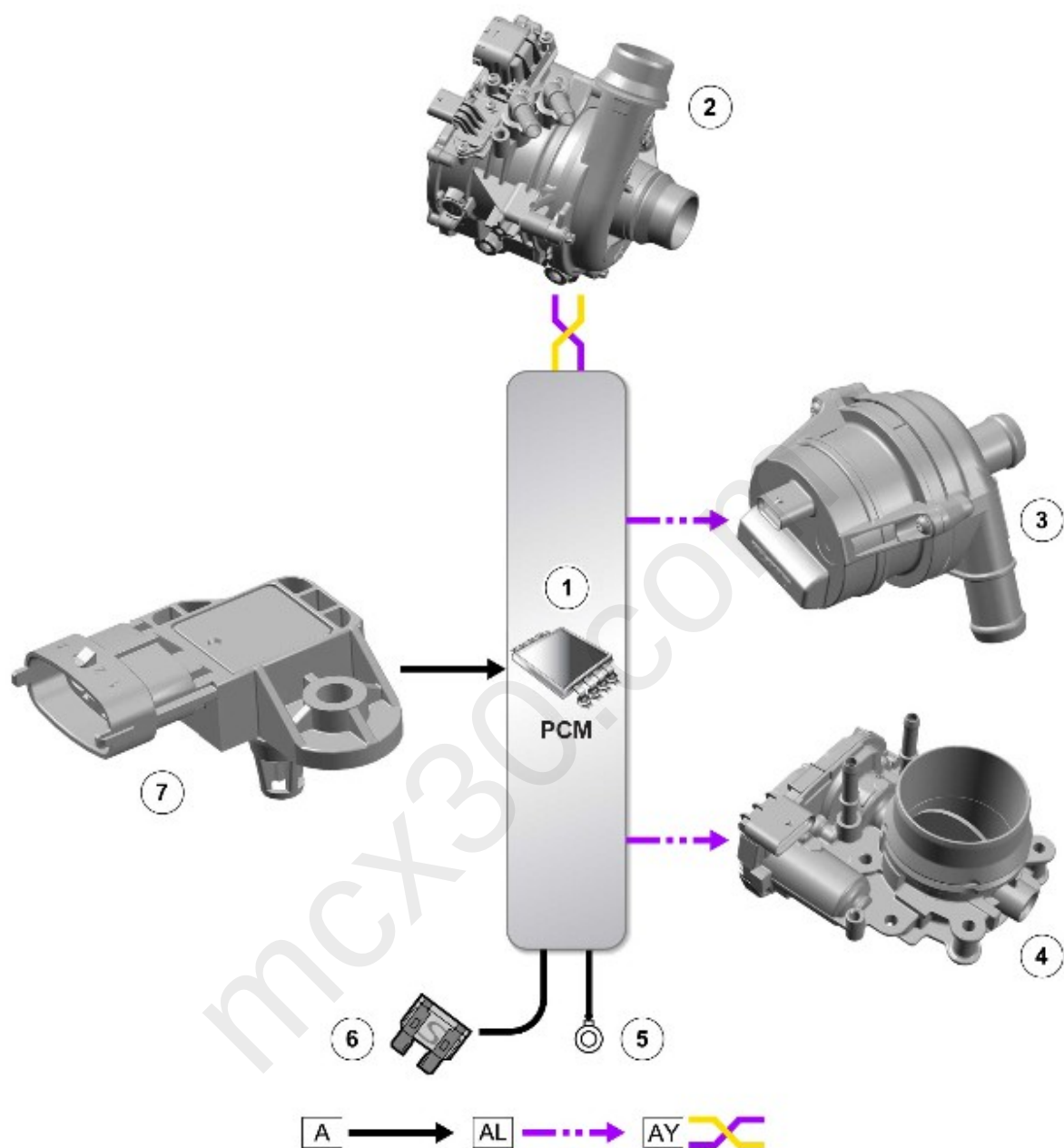
ITEM	DESCRIPTION
A	Cylinder head inlet rail
B	Cylinder 1 at the front of the engine
C	Cylinder head outlet rail
D	Cylinder block outlet
E	Engine Coolant Temperature (ECT) sensor - Cylinder block outlet
F	Radiator outlet temperature sensor
LT	Charge air cooling system Low temperature circuit
1	Variable coolant pump
2	Electric thermostat

ITEM	DESCRIPTION
3	Coolant expansion tank
4	Auxiliary coolant pump
5	Heater core
6	Turbocharger
7	Electric throttle
8	Engine oil cooler
9	Radiator
10	Automatic Transmission Fluid (ATF) cooler
11	ATF warming valve
12	Right charge air radiator
13	Left charge air radiator
14	Powertrain Control Module (PCM)
15	Electric supercharger
16	Electric supercharger bypass valve
17	Charge air cooler
18	ATF cooler thermostatic valve
19	Charge air cooler coolant pump

DIAGNOSTICS

The Powertrain Control Module (PCM) records any Diagnostic Trouble Codes (DTCs) and related data. Read the DTCs and related data with the Jaguar Land Rover (JLR) approved diagnostic equipment. The JLR approved diagnostic equipment can read live data and activate certain components.

CONTROL DIAGRAM



E237927

A = HARDWIRED: AL = PULSE WIDTH MODULATION (PWM): AY = HIGH SPEED (HS) CONTROLLER AREA NETWORK (CAN) POWER MODE ZERO SYSTEMS BUS.

ITEM	DESCRIPTION
1	Powertrain Control Module (PCM)
2	Electric supercharger
3	Charge air coolant pump
4	Electric supercharger bypass valve

ITEM	DESCRIPTION
5	Ground
6	Power supply
7	Pressure and temperature sensor - Charge air cooler

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