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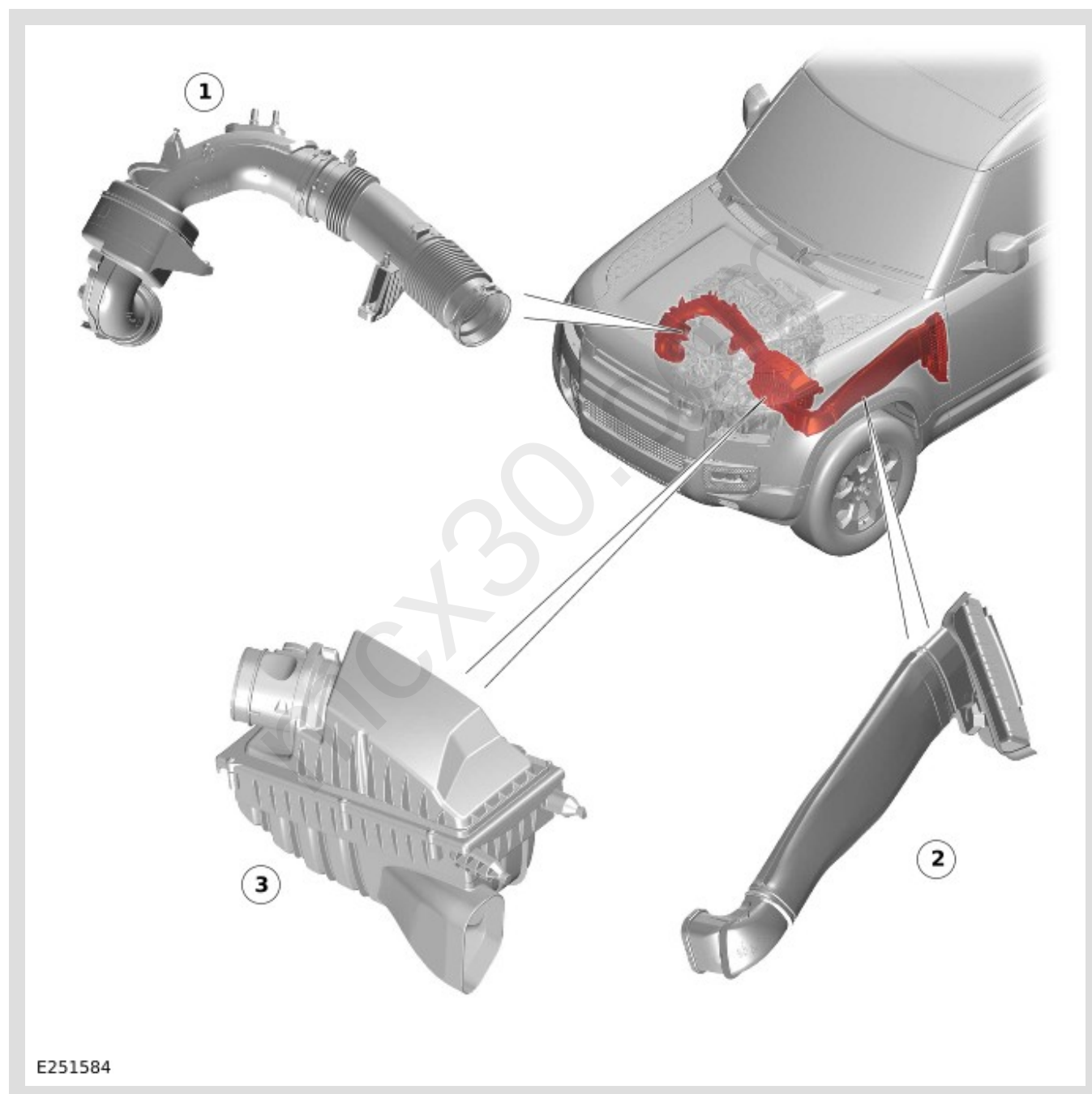
2020.0 DEFENDER (LE), 303-12C

INTAKE AIR DISTRIBUTION AND FILTERING - INGENIUM I6 3.0L PETROL (G2414467)

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COMPONENT LOCATION

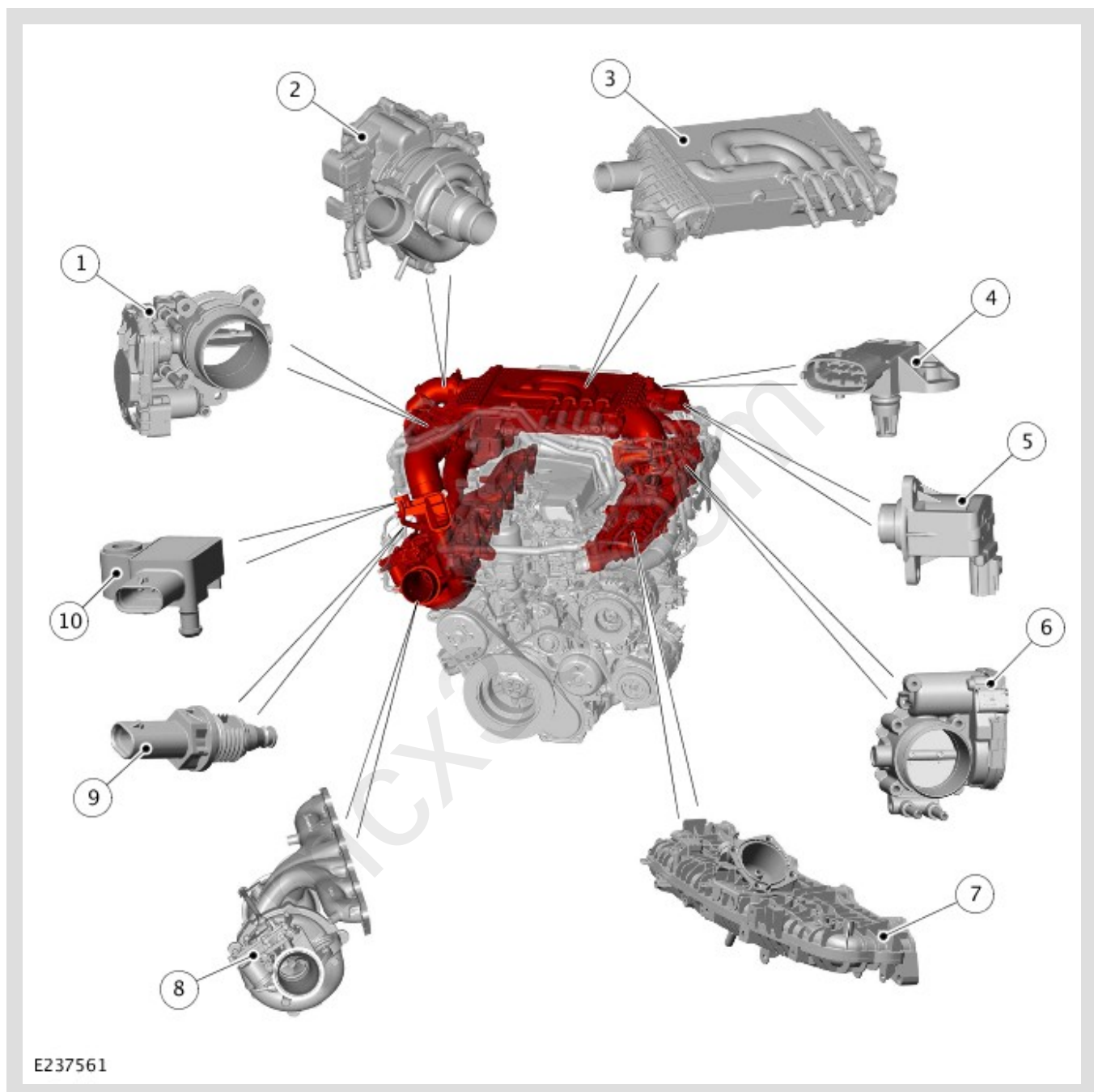
COMPONENT LOCATION - 1 OF 2 - LOW PRESSURE COMPONENTS



ITEM	DESCRIPTION
1	Clean air duct
2	Dirty air duct

ITEM	DESCRIPTION
3	Air filter housing

COMPONENT LOCATION - 2 OF 2 - HIGH PRESSURE COMPONENTS



ITEM	DESCRIPTION
1	Electric supercharger bypass valve
2	Electric supercharger
3	Charge air cooler
4	Charge air pressure and temperature sensor
5	Compressor Bypass Valve (CBV)

ITEM	DESCRIPTION
6	Electric throttle
7	Intake manifold
8	Turbocharger with exhaust manifold
9	Intake Air Temperature Sensor (IAT)
10	Charge air pressure and temperature sensor

OVERVIEW

The intake air distribution and filtering system cleans and cools the compressed intake air. Air flows through the dirty air duct, air filter and clean air duct to the compressor intake of the turbocharger. This design allows a bigger turbocharger by relying on electric supercharger for transient period.

The turbocharger will start to produce compressed air in the medium or high engine speed ranges. In the lower engine speed range the electric supercharger creates the necessary air pressure. The air cools down in the charge air cooler before being mixed with the injected fuel in the combustion chamber. This combination produces a high energy combustion, which increases the engine performance.

The intake air distribution and filtering system comprises of:

- Dirty air duct
- Air filter housing
- Clean air duct
- Turbocharger
- Electric supercharger
- Electric supercharger bypass valve
- Charge air cooler
- Electric throttle
- Intake manifold.

DESCRIPTION

DIRTY AIR DUCT

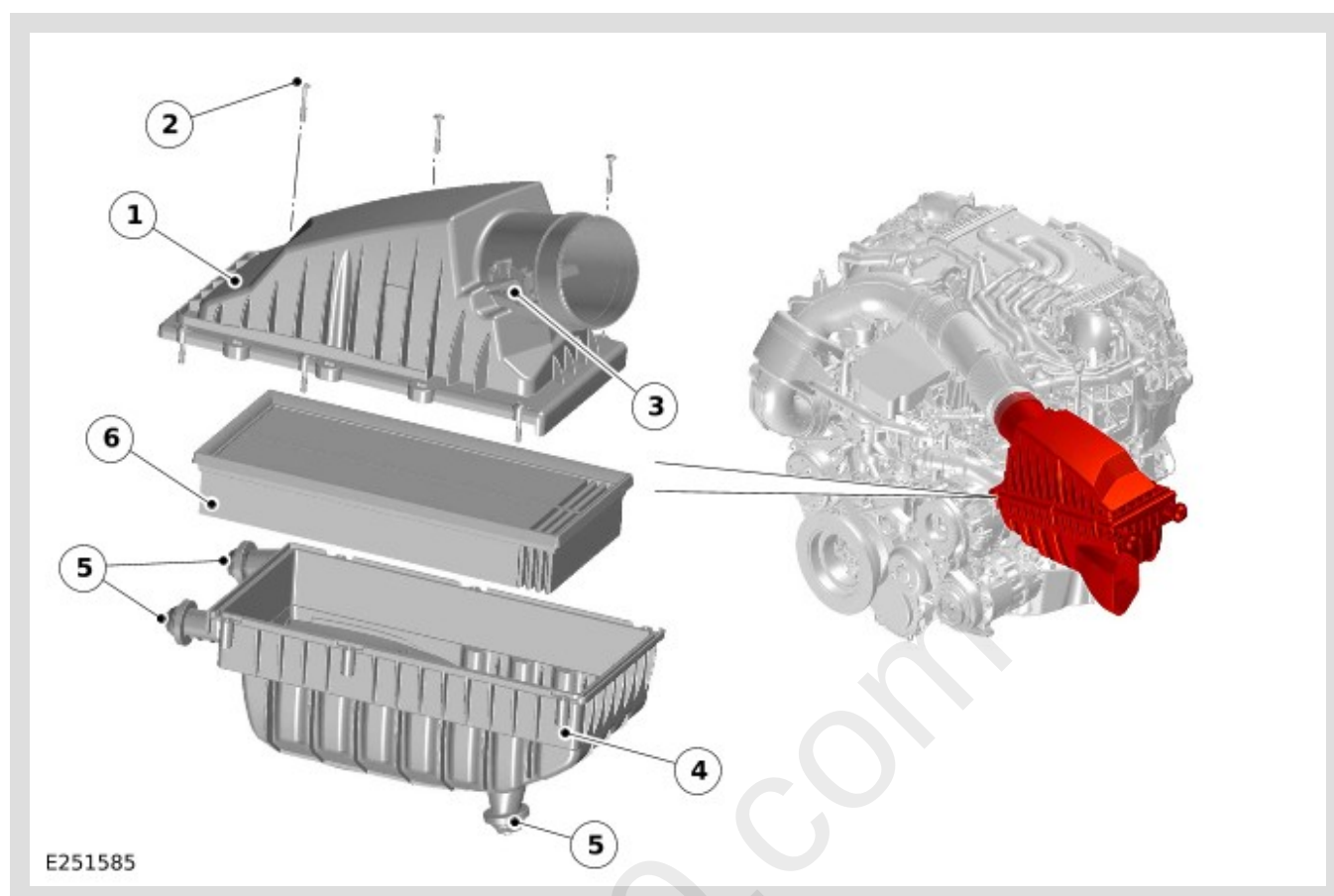


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The dirty air duct is installed in the left front fender to transfer ambient air through the exterior fender grille to the air filter.

The dirty air duct connects the intake of the air filter housing and is attached to the inner face of the front fender.

AIR FILTER HOUSING AND FILTER ELEMENT



ITEM	DESCRIPTION
1	Lid
2	Screw (quantity 6)
3	Mass Air Flow and Temperature (MAFT) sensor
4	Air filter housing
5	Rubber isolators (quantity 3)
6	Air filter element

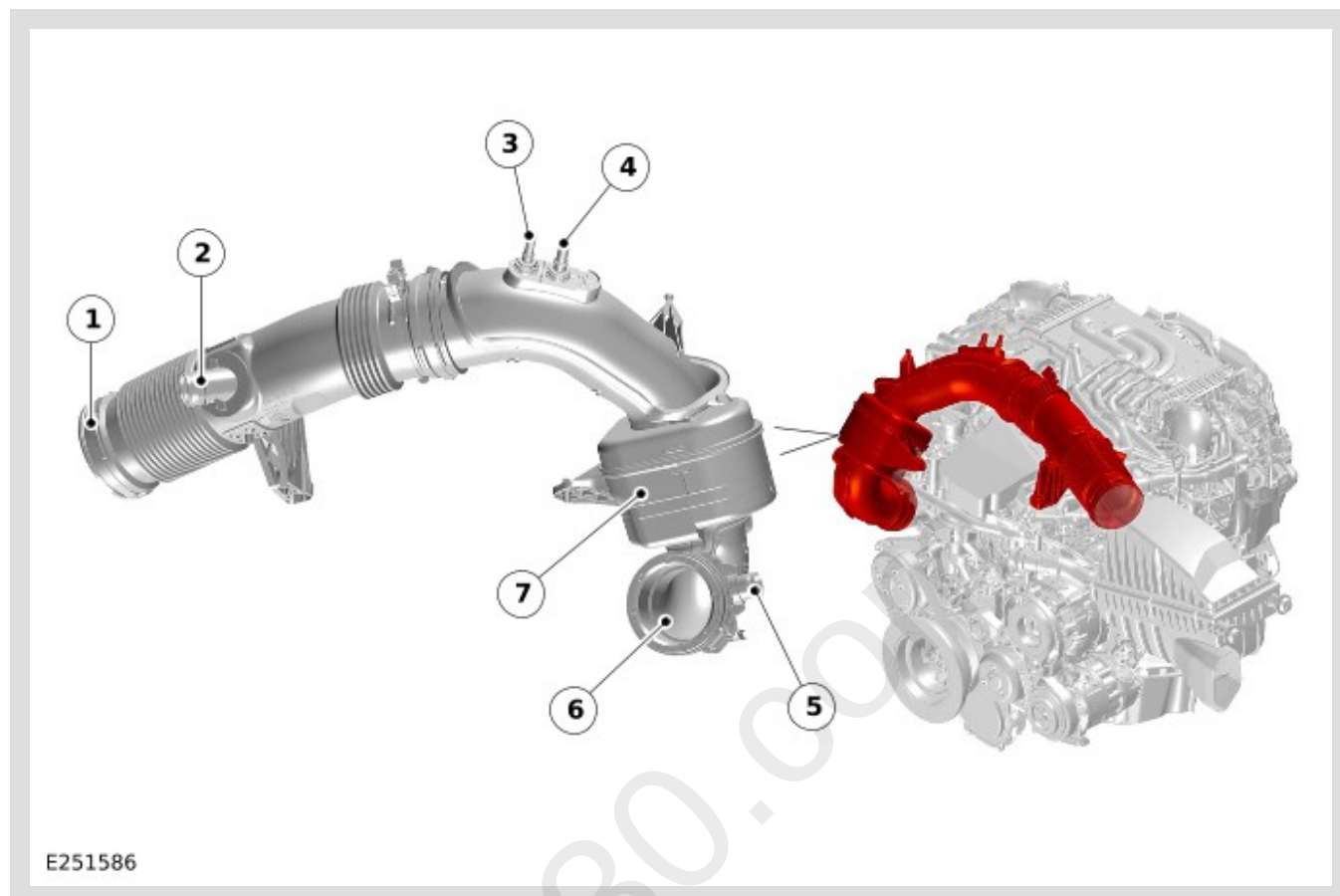
The air filter housing is located in the front left corner of the engine compartment. There are 3 spigots installed with rubber isolators to locate air filter housing in holes in the front inner fender and front suspension housing.

Air filter housing consists of a filter element, installed in a base and enclosed with a lid, which is secured by 6 screws. The air filter element is a pleated, paper type with an integral seal. Air intake and outlet connections are incorporated into the base and lid respectively. The bottom of the base incorporates a drain valve to prevent the accumulation of water in the air filter housing.

The air outlet connection of the air filter housing incorporates a MAFT sensor and is secured with 2 screws.

For additional information, refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - INGENIUM I6 3.0 L Petrol, Description and Operation).

CLEAN AIR DUCT



ITEM	DESCRIPTION
1	Clean air intake
2	Compressor Recirculation Valve (CRV) pipe connection
3	Charge air cooler pipe connection
4	Purge valve pipe connection
5	Engine breather pipe connection
6	Air outlet
7	Resonator

The clean air duct transfers air from the air filter housing outlet to the turbocharger. There are 2 flexible hose sections in the clean air duct to accommodate the relative movement between the turbocharger and the air filter housing.

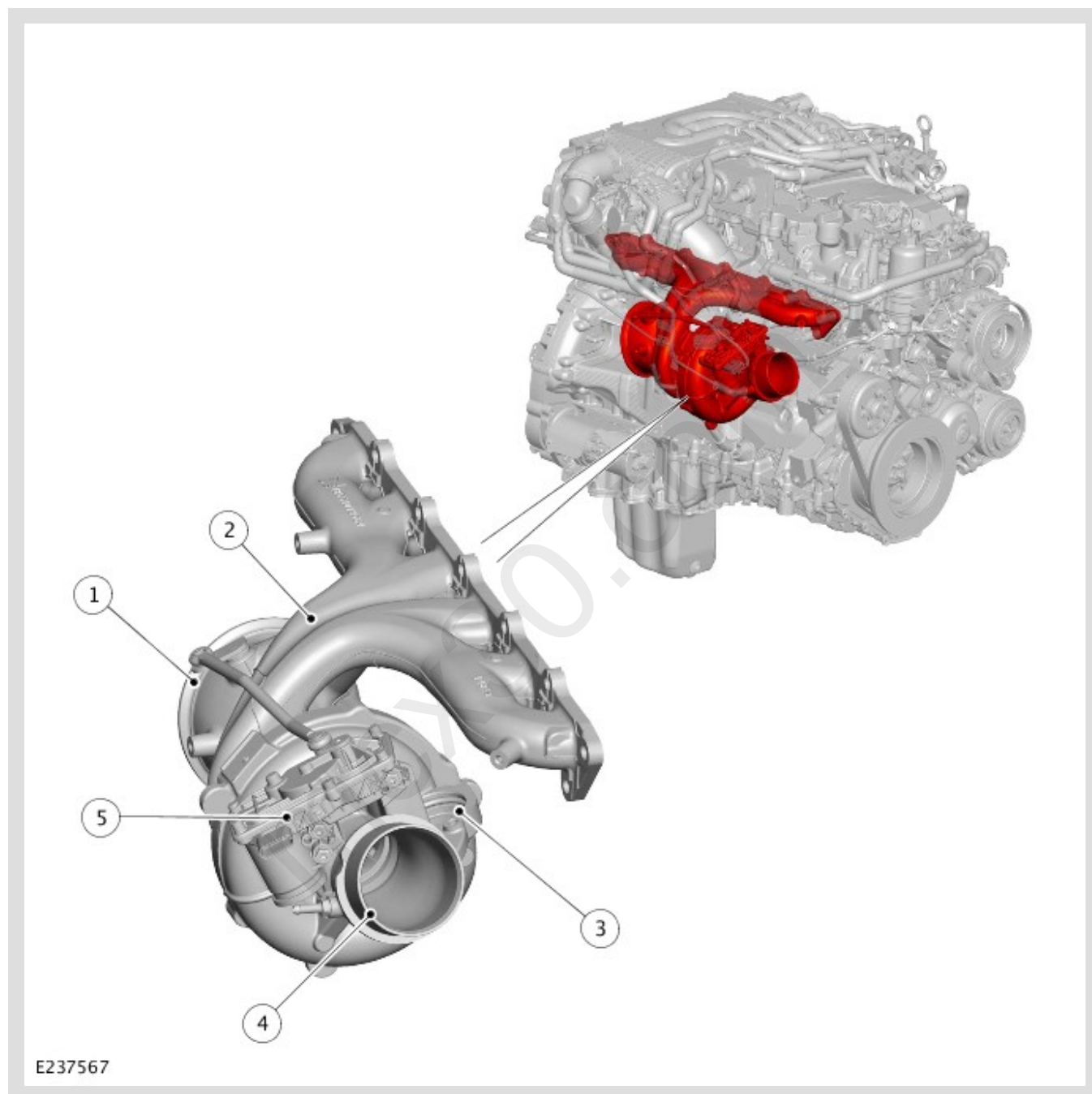
The clean air duct also incorporate the following:

- Resonator, to reduce air induction noise.

- A connector stub for the engine full load breather pipe.
- A connector stubs to the purge valve and charge air cooler connections.

The clean air duct is supported by the resonator housing which is attached to the cylinder head.

TURBOCHARGER



ITEM	DESCRIPTION
1	Turbocharger exhaust outlet
2	Exhaust manifold
3	Turbocharger compressor outlet
4	Turbocharger compressor inlet

ITEM	DESCRIPTION
5	Wastegate actuator

The turbocharger is located on the side of the cylinder head. The turbine housing and the exhaust manifold are 1 piece and made of cast iron. The turbocharger incorporates a wastegate flap, which is operated by the wastegate actuator. The wastegate actuator is a 12V unit, which is controlled by the Powertrain Control Module (PCM).

The turbocharger consists of 5 major sub assemblies:

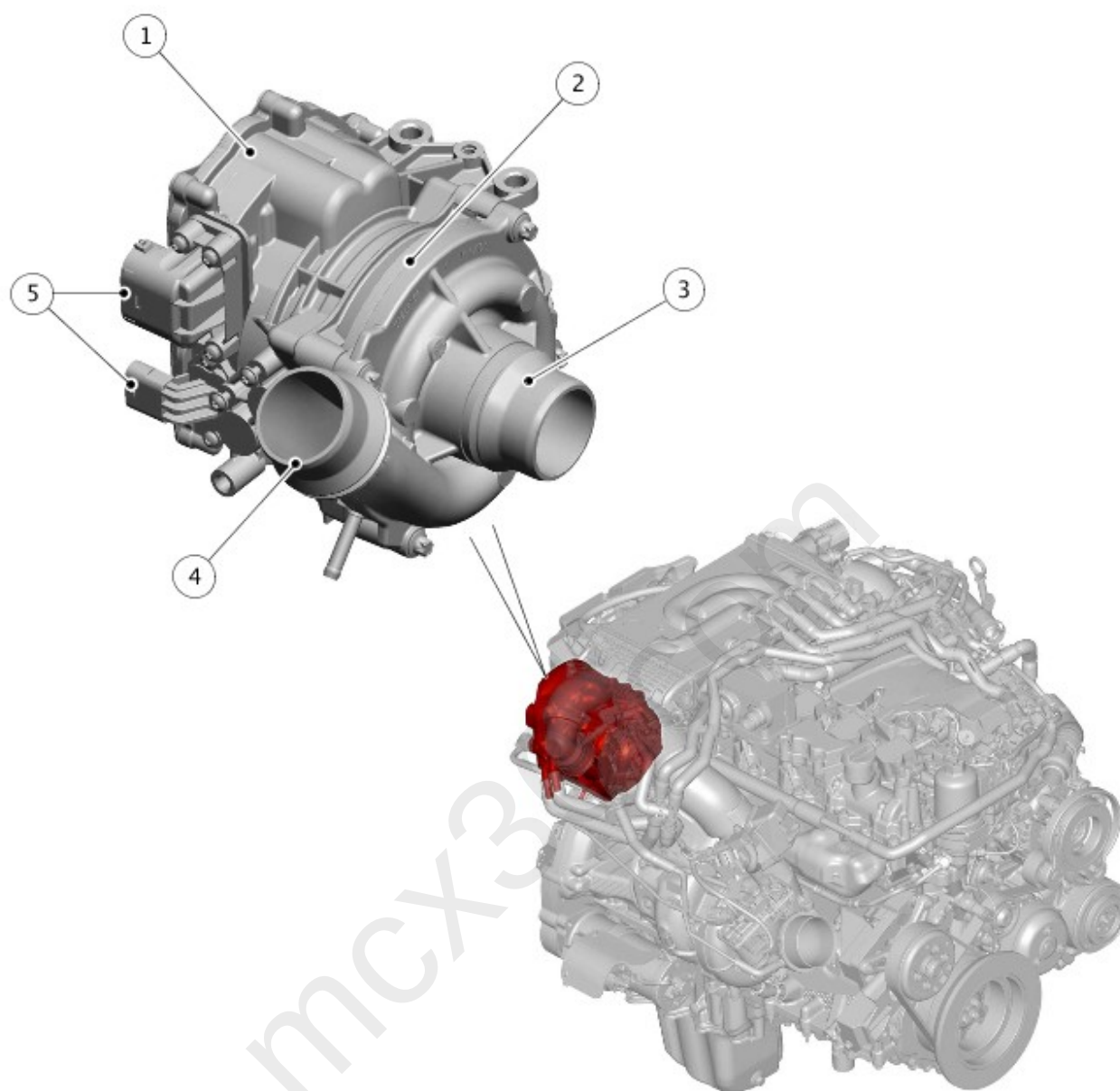
- The turbine housing
- The compressor housing
- The bearing housing
- The wastegate actuator
- The shaft and wheel assembly.

The bearing housing is cooled by the engine coolant and journal bearings are used.

The turbocharger and the electric supercharger complement each other to provide the necessary air pressure in a wider engine speed range for the required power.

For additional information, refer to: [Turbocharger](#) (303-04F Fuel Charging and Controls - Turbocharger - INGENIUM I6 3.0L Petrol, Description and Operation).

ELECTRIC SUPERCHARGER

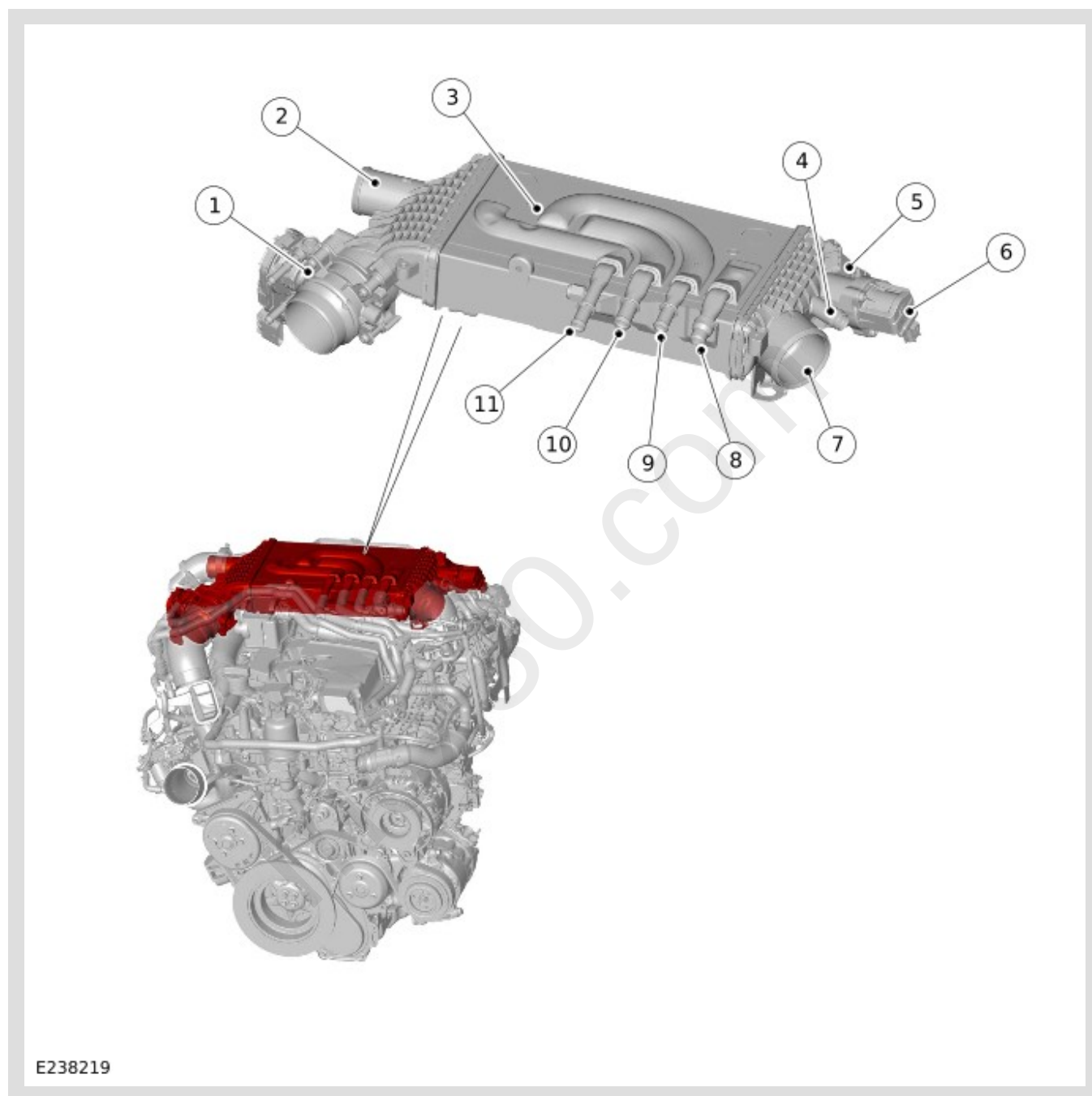


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ITEM	DESCRIPTION
1	Electric motor
2	Compressor
3	Compressor air inlet
4	Compressor air outlet
5	Turbocharger/Supercharger Control Module (TSCM) electrical connector (quantity 2)

The electric supercharger comprises of a centrifugal compressor driven by a switched reluctance motor. The electric supercharger and the turbocharger complement each other to provide the necessary air pressure in a wider engine speed range. The electric supercharger does not operate in steady state condition, its function is to improve engine low end torque and transient response.

CHARGE AIR COOLER



ITEM	DESCRIPTION
1	Electric supercharger bypass valve
2	Electric supercharger inlet
3	Charge air cooler
4	Air intake system hose connection

ITEM	DESCRIPTION
5	Charge air pressure and temperature sensor
6	CBV
7	Electric throttle hose connection
8	Coolant inlet from low temperature radiator
9	Coolant outlet to low temperature radiator
10	Coolant inlet from engine
11	Coolant outlet to main radiator

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. The heat reduces the performance gains of turbocharging. Thereby the density of the intake air decreases and the temperature in the cylinder combustion increases.

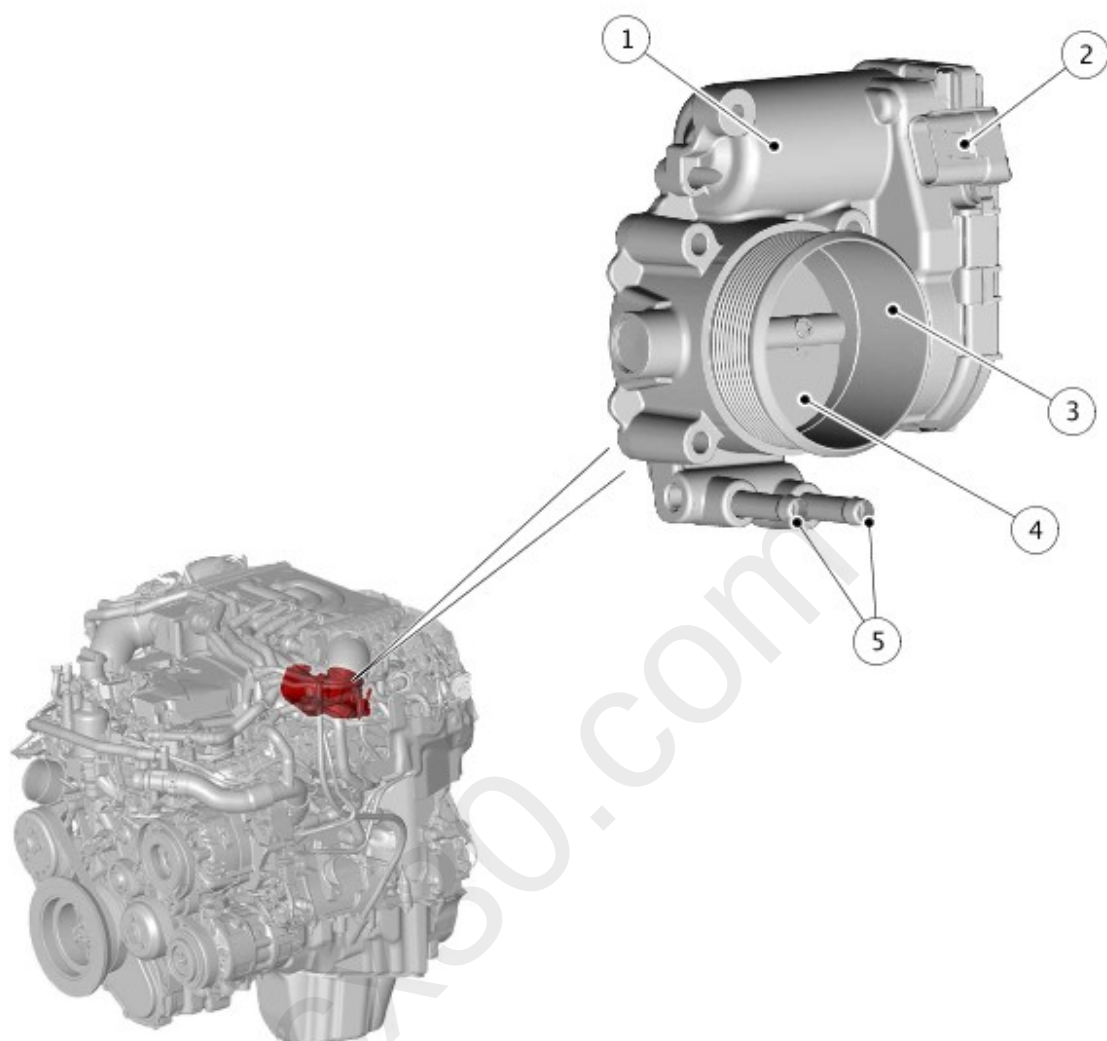
To counteract this, the charge air cooler is used to reduce the intake air temperature. The cooled intake air increases the density of the air allowing more air molecules to be delivered to the combustion chamber.

The electric supercharger does not produce significant amount of heat as it has no contact with the hot exhaust gases.

The right connection is the inlet for the compressed air, delivered from the turbocharger compressor and the electric supercharger. The left connection is the outlet for the cooled compressed air to be delivered by the electric throttle to the intake manifold. The charge air cooler is an air-to-liquid heat exchanger, and provides charge air cooling in combination with an electrical coolant pump.

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

ELECTRIC THROTTLE



E237566

ITEM	DESCRIPTION
1	Electric motor
2	Electrical connector
3	Air intake
4	Butterfly valve
5	Coolant hose connections

The electric throttle is located between the charge air cooler and the intake manifold. The electric throttle is secured to the manifold with 4 bolts and regulates the air flow into the intake manifold. A gasket seals the joint between the electric throttle and the intake manifold.

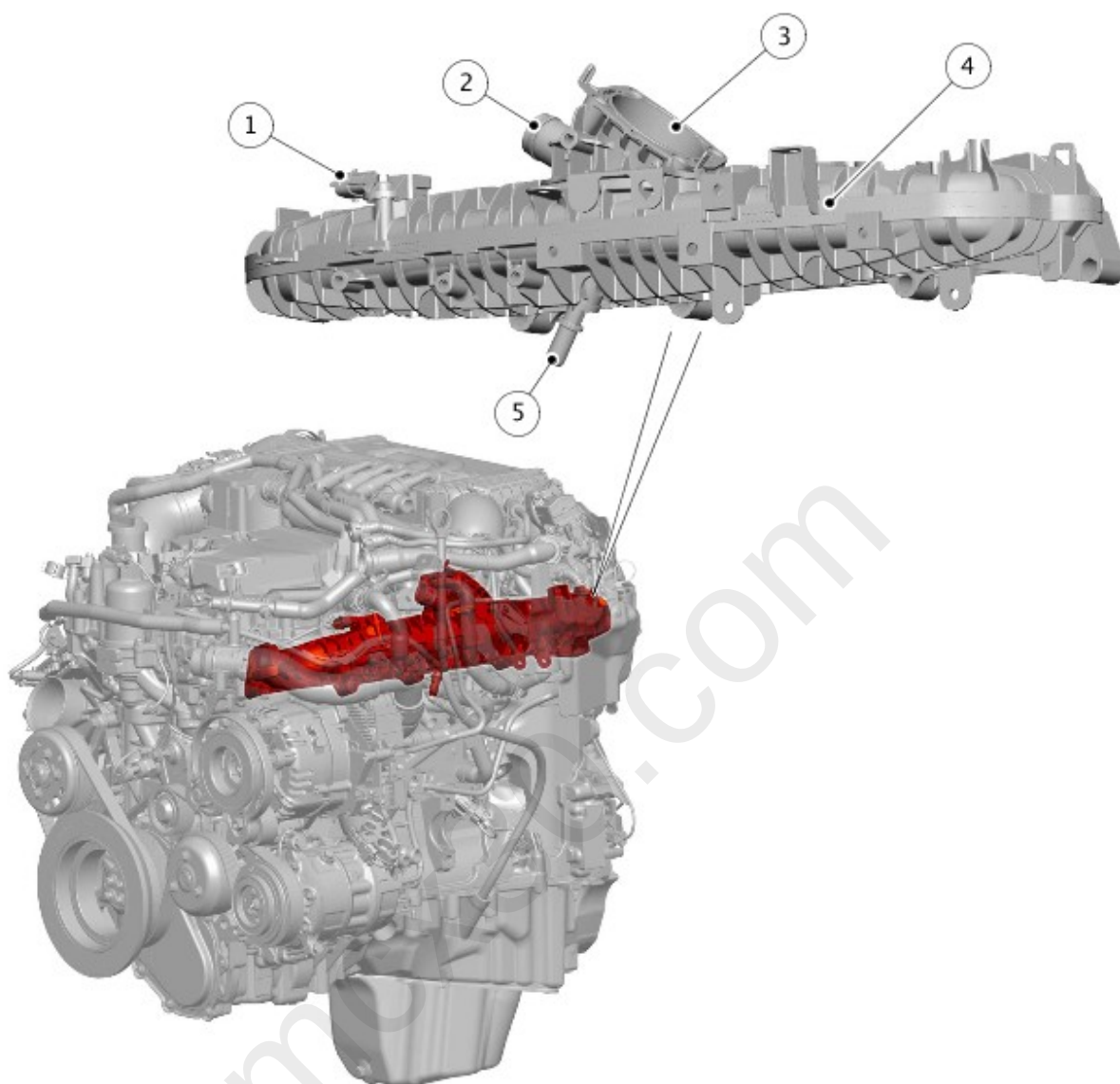
There is no mechanical linkage between the accelerator pedal and the butterfly valve with electronic throttle control. Instead, the position of the butterfly valve is fully controlled by the PCM through a Direct Current (DC) electric motor. The Pulse Width Modulated (PWM) signals from the PCM control the motor to adjust the position of the butterfly valve. The Throttle Position Sensor (TPS) is continually read by the PCM, which makes appropriate adjustments to reach the desired amount of engine power. This method allows a precisely controlled amount of air into the intake manifold.

To prevent icing, the coolant is circulated across the throttle body through coolant feed and return connections.

For additional information, refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - INGENIUM I6 3.0 L Petrol, Description and Operation).

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INTAKE MANIFOLD



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ITEM	DESCRIPTION
1	Manifold Absolute Pressure and Temperature sensor (MAPT)
2	Breather hose connection
3	Electric throttle adapter
4	Intake manifold
5	Purge valve hose connection

The intake manifold is attached to the left side of the cylinder head. The cylinder intake is sealed with a gasket. The main function is to evenly distribute intake air delivered from the electric throttle into the combustion chamber of each cylinder.

The MAPT is mounted on the top of the intake manifold. The MAPT is connected to the PCM through hardwired connection.

For additional information, refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - INGENIUM I6 3.0 L Petrol, Description and Operation).

OPERATION

The ambient air passes through the dirty air duct and the bottom of the air filter housing. The air is filtered through the filter element to remove particulate matter. The clean air from the air filter housing passes through the MAFT sensor.

The MAFT sensor measure the air flow and the air temperature going into the turbocharger. At the turbocharger the clean air is compressed by the turbine compressor impeller. The compressed air either enters the electric supercharger then the charge air cooler or to the charge air cooler through the electric supercharger bypass valve. In the charge air cooler the air is cooled which increases its density and passes from the charge air cooler to the electric throttle. The electric throttle controls the amount of air entering the intake manifold. The electric throttle is controlled by the PCM. The PCM controls the position of the butterfly valve to allow the correct amount of air into the intake manifold.

The MAPT measures the air pressure and air temperature in the intake manifold. The measured values are used by the PCM in conjunction with the MAFT sensor to calculate pressure and density of the air entering the engine. The PCM uses this input, as well as others, to calculate the proper amount of fuel to inject into the cylinders.

The MAPT provides air pressure and temperature signals to the PCM. The PCM uses these signals to make sure that the correct amount of fuel is delivered to the combustion system. The MAPT signal is also used by the PCM to calculate the engine actual torque output to compare against the desired engine torque output.

When the vehicle is in Power Mode 6 (Ignition ON), the PCM reads the signal of the MAPT to determine the barometric pressure. When the engine is stopped, the pressure inside the intake manifold is the same as the outside barometric pressure. The PCM then uses this information to adjust the air and fuel mixture to compensate for changes in air pressure due to elevation and weather.

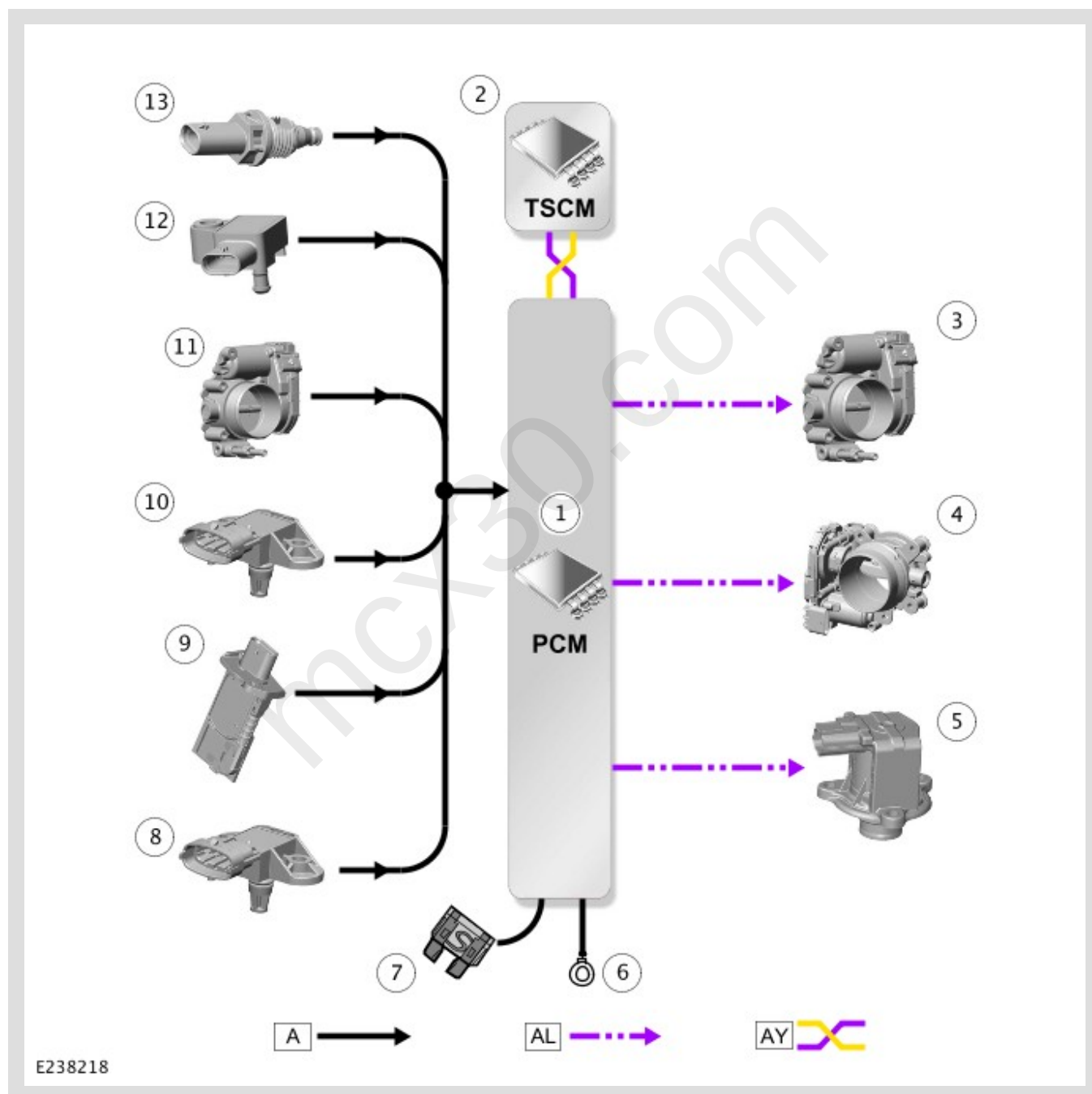
At engine start, vacuum is created inside the intake manifold by the pumping action of the pistons and the restriction created by the butterfly valve. At high engine loads the turbocharger generates pressure in the air intake system, thus the density of the air entering the cylinders is increased. The increased amount of air requires more fuel to keep the air and fuel ratio in balance.

When conditions are changed, for example, the vehicle decelerates, less power is needed from the engine. The MAPT senses when conditions are changed and the PCM responds by leaning out the fuel mixture to reduce fuel consumption. At the same time the PCM advances ignition timing to squeeze a little more fuel economy out of the engine.

ELECTRIC SUPERCHARGER

The electric supercharger does not use the engine torque like the belt driven superchargers. The air supply does not depend on the engine speed like the turbocharger. The electric supercharger is driven by a 48V electric motor which is powered by the Mild Hybrid Electric Vehicle (MHEV) battery. The air pressure is controlled by the Turbocharger /Supercharger Control Module (TSCM). The TSCM communicates with the PCM through the High Speed (HS) Controller Area Network (CAN) power mode zero systems bus.

CONTROL DIAGRAM



ITEM	DESCRIPTION
1	PCM

ITEM	DESCRIPTION
2	Turbocharger/Supercharger Control Module (TSCM)
3	Throttle actuator
4	Electric supercharger bypass valve
5	Compressor bypass valve
6	Ground
7	Power supply
8	Charge air pressure and temperature sensor
9	MAFT sensor
10	MAPT
11	Throttle Position Sensor (TPS)
12	Charge air pressure and temperature sensor
13	Intake Air Temperature Sensor (IAT)