
Turbocharger And Charge Air Cooler (CAC) Systems

Turbocharger System

A turbocharger is an exhaust gas driven device used to increase the power output of an engine by the turbocharger compressor increasing the pressure of the air entering the engine. The turbocharger uses exhaust gas energy to drive the turbine connected to the compressor. Compressing the air causes the temperature to increase. The CAC lowers the temperature of compressed air which increases the density of the air before entering the cylinder.

The 6 cylinder engine uses 2 turbochargers in a parallel arrangement with 1 turbine connected to the exhaust of each cylinder bank. This configuration improves engine responsiveness due to the reduced inertia of 2 small rotating assemblies in the place of 1 large rotating assembly while pumping adequate air to achieve the rated power. Emission compliance is achieved by mounting the catalysts very close to the turbo outlet.

The turbocharger bypass valve is used to create a path from the high pressure compressor outlet to the low pressure compressor inlet. This path recirculates airflow to reduce turbocharger lag and prevent unwanted air rush noise from the turbocharger on heavy throttle releases.

The wastegate on the turbocharger turbine side is opened to reduce exhaust gas flow through the turbine when boost pressure is not needed. Either a pneumatic actuator or an electric motor controls the wastegate valve opening. The turbocharger wastegate is controlled by the PCM by either a pulse width modulated (PWM) signal to the turbocharger wastegate regulating valve solenoid or by positive and negative voltage signals to the turbocharger wastegate motor.

The pneumatic wastegate may be pressure or vacuum actuated, and the poppet style wastegate valve could be normally opened or normally closed at idle or low engine airflow conditions depending on vehicle configuration and requirements such as fuel economy and boost performance. The turbocharger wastegate regulating valve solenoid supplies pressure or vacuum to the wastegate actuator to open or close the poppet style wastegate valve.

The turbocharger wastegate motor is an electric stepper motor. The PCM controls the turbocharger wastegate motor to change the position of the actuator linkage open or closed based on various engine airflow conditions depending on vehicle configuration and requirements such as fuel economy and boost performance. The turbocharger wastegate motor also contains an integral position sensor for turbocharger wastegate position feedback to the PCM.

The 6 cylinder pneumatic turbocharger wastegates are coupled by having one control output from the turbocharger wastegate regulating valve solenoid that drives both turbocharger wastegate actuators.

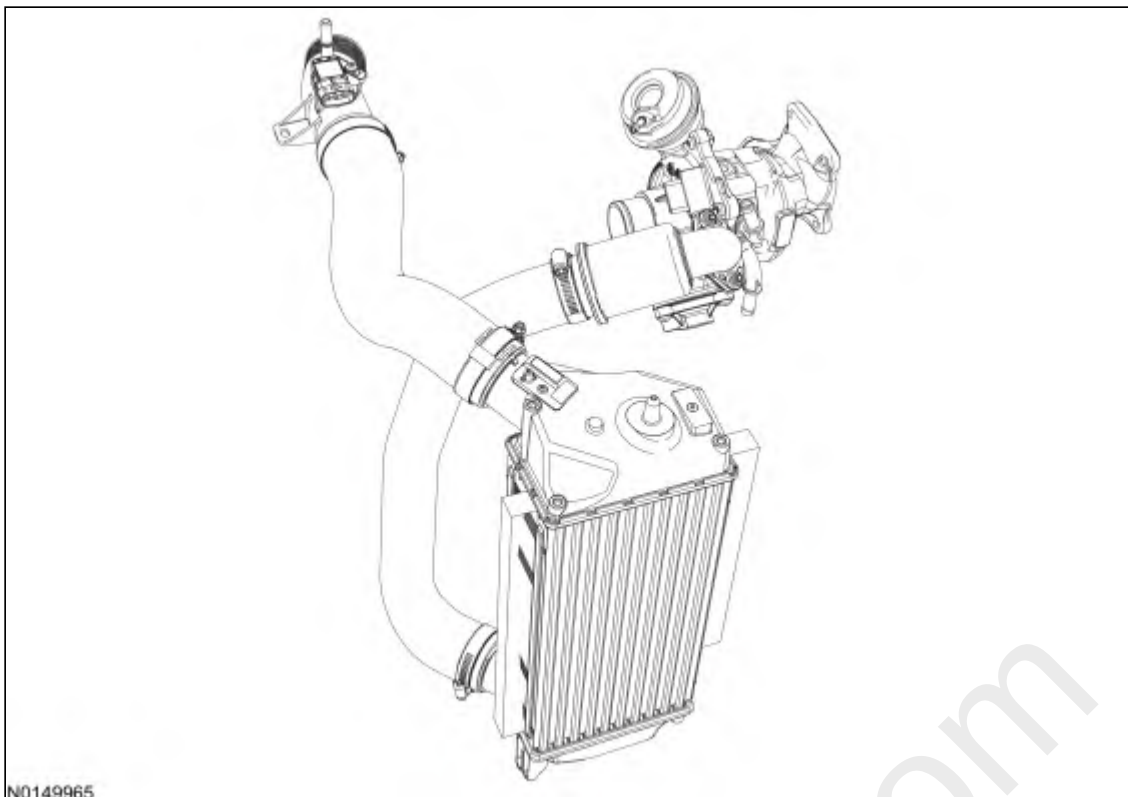
The 6 cylinder electric turbocharger wastegate motors may be controlled independently with separate PCM control circuits for each bank.

The 4 cylinder system uses only 1 turbocharger, 1 turbocharger wastegate and 1 turbocharger bypass valve. The turbocharger bypass valve can be electric or pneumatic and may be mounted in the intake air system or in the turbocharger housing.

The 3 cylinder system uses only 1 turbocharger, 1 turbocharger wastegate and 1 turbocharger bypass valve. The turbocharger bypass valve is mounted in the turbocharger housing and is PCM controlled.

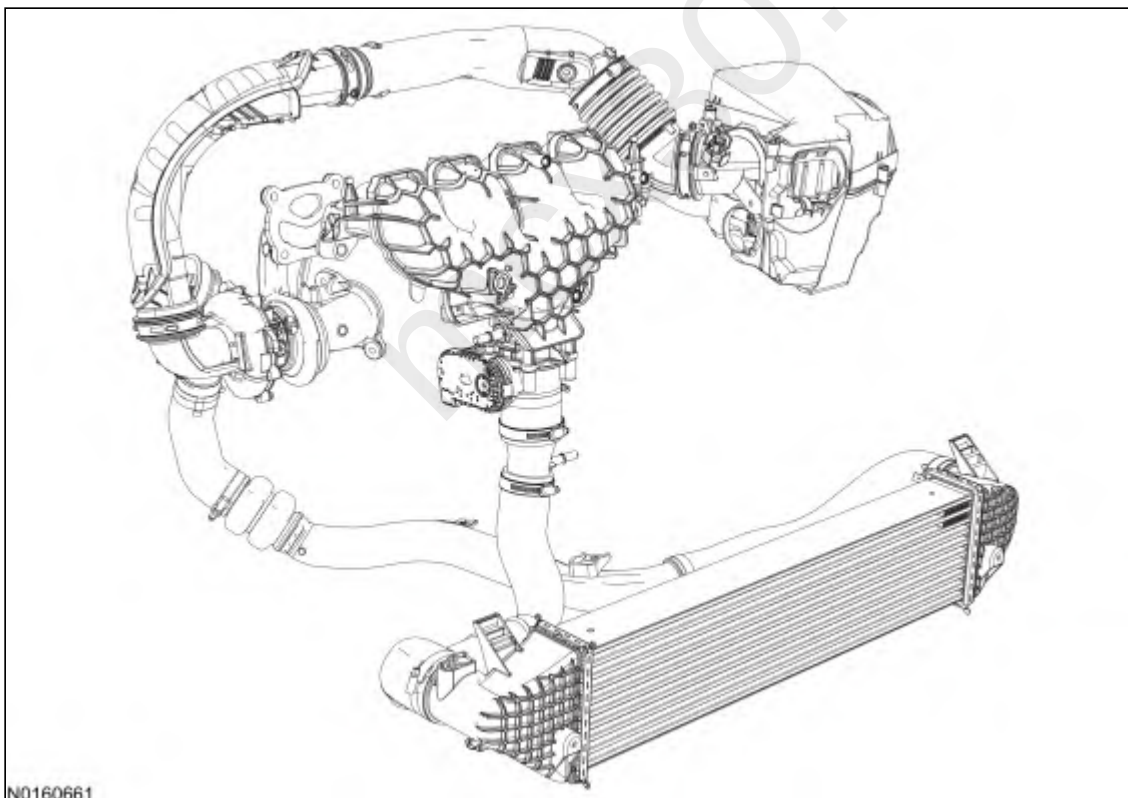
Charge Air Cooler (CAC) System — Air To Air Cooled

The CAC system cools the intake air which has been heated by the turbocharger. The removal of heat from the pressurized air going into the CAC increases the air density which improves combustion efficiency, engine horsepower, and torque. The system consists of a CAC radiator in the grille and tubing to interconnect these components. The CAC is positioned after the turbocharger directly in the flow of the intake air. As the heated air flows through the CAC, it is cooled by the airflow through the grille. The PCM maintains a desirable intake air temperature by monitoring the TCBP/CACT (located at the throttle body) and the MAP/IAT2 (located at the intake manifold) sensors.



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Typical 3 Cylinder Turbocharger System — Air To Air Cooled



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Typical 4 Cylinder Turbocharger System — Air To Air Cooled