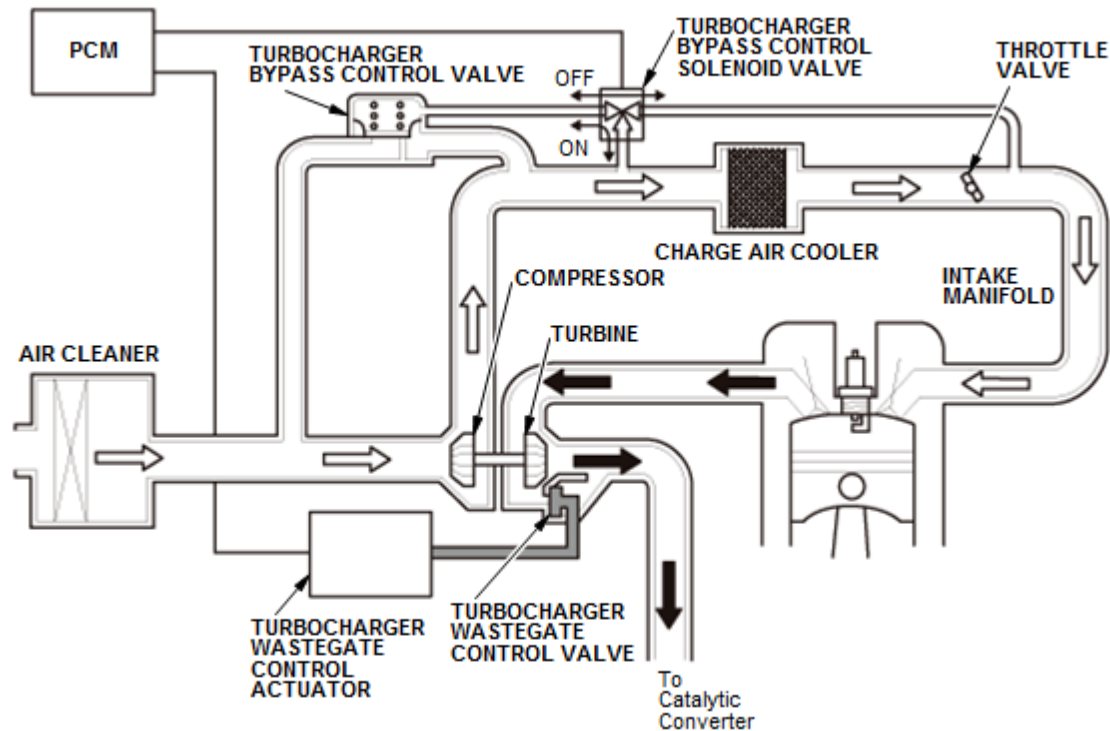


Turbocharger Control System Description - Control

Outline

The turbine in the turbocharger is turned by the exhaust gas, compresses the fresh intake air with the compressor mounted coaxially with the turbine, and discharges the air into the charge air cooler. The fresh intake air gets hot when compressed, is cooled in the charge air cooler, then enter the cylinders.

The turbocharger equips with the turbocharger wastegate control valve and the turbocharger bypass control valve to control the system pressure and gas flow rate. The turbocharger wastegate control valve is actuated by an electric actuator.



Operation

To control the boost pressure, the PCM changes the turbocharger wastegate control valve open ratio using the duty control of the stroke of the turbocharger wastegate control actuator.

When the turbocharger wastegate control valve closes, all the exhaust gas flows from the exhaust manifold to the turbine and serves the driving force for turning the turbine. This increases the turbine shaft speed and increases the compression pressure of the fresh intake air, causing the boost pressure to increase.

When the turbocharger wastegate control valve opens, some of the exhaust gas bypasses the turbine and flows directly into the catalytic converter mounted downstream of the turbocharger. This decreases the turbine shaft speed, causing the boost pressure to decrease. This mechanism prevents the boost pressure from increasing excessively, and protects the engine and turbocharger.

The turbocharger bypass control valve consists of a diaphragm, a return spring, and a valve and is connected to the turbocharger bypass control solenoid valve for control.

Normally, the turbocharger bypass control solenoid valve is kept ON by the PCM. Because equal pressure is applied to the both sides of the diaphragm, the turbocharger bypass control valve is kept closed by the return spring.

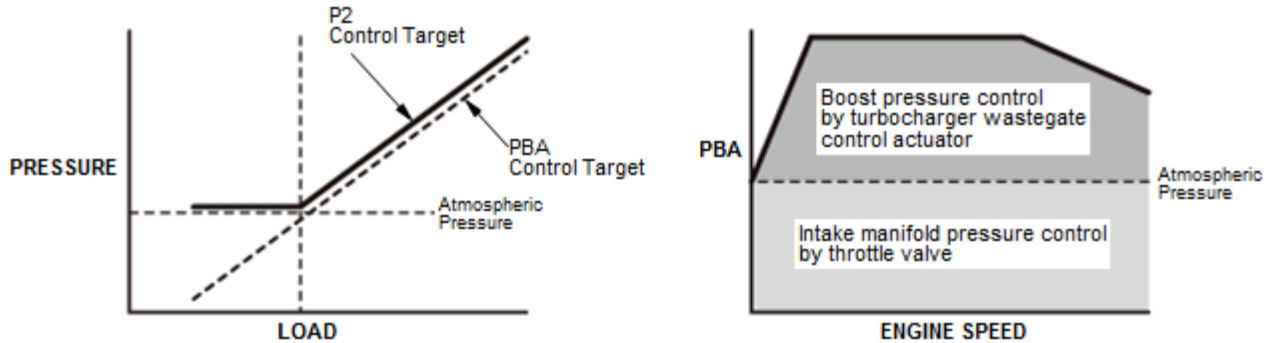
When the throttle valve is closed from the supercharged condition, the PCM turns OFF the turbocharger bypass control solenoid valve. At this time, the negative pressure in the downstream of the throttle valve, which has passed through the solenoid valve, is applied to the solenoid side of the diaphragm, causing a pressure difference between the both sides of the diaphragm. The differential pressure overcomes the return spring force and the valve opens, causing the fresh intake air which has passed through the compressor to leak into the upstream of the compressor. This adjusts the system internal pressure and at the same time prevents the intake air drag in the compressor from increasing and the turbine shaft speed from decreasing, which provides improved response at the time of re-acceleration.

Engine Output Control

The turbocharger wastegate control actuator is an electric type, which enables flexible and precise control of the turbocharger wastegate control valve open ratio regardless of the operating condition of the engine. This enables the turbocharger wastegate control valve to function as an engine output control device in cooperation with the throttle valve.

In the area where the intake manifold absolute pressure (PBA) is below the atmospheric pressure (NA area), the engine output is controlled by changing the throttle valve open ratio. In the NA area, the turbocharger wastegate control valve is opened to keep the pressure in the upstream of the throttle valve (P2) to almost the atmospheric pressure, which prevents the exhaust pressure increasing by the turbine operation and reduces exhaust loss.

In the area where the PBA is at or above the atmospheric pressure (supercharged area), the engine output is controlled by changing the turbocharger wastegate control valve open ratio to control the boost pressure.



In the supercharging response period, where the target PBA increases with the required torque to the engine and the internal pressure of the intake manifold increases from the NA area into the supercharged area, the throttle valve open ratio increases, the PBA increases, and the turbocharger wastegate control valve starts to close to ensure sufficient responsiveness. When the PBA reaches around the atmospheric pressure, the throttle valve is fixed in the fully-open position to minimize the air flow drag at the throttle valve. In the supercharged area, the turbocharger wastegate control valve open ratio is controlled so that the target PBA is achieved. After that, when the required torque to the engine decreases, the throttle valve closes and the turbocharger wastegate control valve opens to reduce the exhaust loss.

