Instrument Cluster Description and Operation

Displays Test

Certain instrument panel cluster (IPC) features are tested when the ignition is turned ON in order to verify the features are working properly. The following indicators illuminate briefly at key up unless otherwise noted:

- Antilock Brake System (ABS) Indicator
- Charge Indicator
- Brake System Indicator
- Coolant Temperature Indicator
- Engine Oil Pressure Indicator
- High Beam Indicator
- Tire Pressure Low Indicator
- Turn Signal Indicator
- Upshift Indicator

Indicators and Warning Messages

Refer to Indicator/Warning Message Description and Operation.

Engine Coolant Temperature Gauge

The engine control module (ECM) or the powertrain control module (PCM) monitors the coolant temperature sensor to determine the coolant temperature. The ECM/PCM sends the coolant temperature information to the instrument panel cluster (IPC) via class 2 serial data message for display. The engine coolant temperature gauge defaults to 0 or below if:

- The ECM/PCM detects a system malfuntion.
- The IPC detects a loss of class 2 communications with the ECM/PCM.

Fuel Gauge

The instrument panel cluster (IPC) displays the fuel level as determined by the powertrain control module (PCM)/engine control module (ECM). The IPC receives a class 2 message from the ECM/PCM indicating the fuel level percent. The fuel gauge defaults to empty (E) if:

- The PCM/ECM detects a malfunction in the fuel level sensor circuit.
- The IPC detects a loss of class 2 communications with the ECM/PCM.

When the fuel level is less than a certain low percentage, LOW FUEL message displays in the driver information center (DIC).

Odometer

The vehicle odometer is calculated and stored electronically in the body control module (BCM) and is sent via class 2 to the instrument panel cluster (IPC) for display. The BCM calculates and stores the mileage based on the vehicle speed class 2 message from the powertrain control module (PCM)/engine control module (ECM). The IPC displays the season odometer information from the BCM in the driver information center (DIC). The odometer will display error if the IPC detects an invalid odometer data from the BCM. After an invalid odometer data is received from the BCM, the

IPC will display the last known odometer reading for 1.5 seconds before error is displayed in the DIC.

Speedometer

The instrument panel cluster (IPC) displays the vehicle speed based on class 2 serial data message from the powertrain control module (PCM) or the engine control module (ECM). The speedometer will default to 0 km/h (0 mph) if:

- The PCM/ECM detects a malfunction in the vehicle speed sensor circuit.
- The IPC detects a loss of class 2 communications with the PCM/ECM.
- The transmission control module (TCM) detects a loss of GMLAN communications with the TCM.

Tachometer

The instrument panel cluster (IPC) displays the engine speed as determined by the powertrain control module (PCM)/engine control module (ECM). The IPC receives a class 2 message from the ECM/PCM indicating the engine speed. The tachometer will default to 0 RPM if:

- The PCM/ECM detects a malfunction in the engine speed sensor circuit.
- The IPC detects a loss of GMLAN communications with the PCM/ECM.

Boost Gauge

The boost gauge is a measure of the engine manifold air pressure. The powertrain control module (PCM) sends a PWM signal to the boost gauge indicating the manifold air pressure. The boost gauge displays the engine air intake above and below the ambient pressure. The PCM controls the engine boost pressure with the boost control solenoid. The engine boost system pumps more air than the engine would normally use into the intake manifold. The excess air pumped into the intake manifold, creates the engine boost effect. The maximum boost pressure is about 83 kPa (12 psi).

The boost gauge performs a self test by the gauge dial moving to 0 kPa (0 psi) when the ignition is turned ON and the boost gauge is also turned ON. Refer to Supercharger Description and Operation or Boost Control System Description for the 2.0L engine.

Engine RPM Indicator

The engine RPM indicator are a series of LEDs that are set to illuminate and indicate to the driver when the engine attains a certain engine RPM. The indicators are factory preset to illuminate at certain engine RPM ranges. The total engine RPM range available to set is 8500 RPM and there are only three possible RPM settings available for the transmission range.The factory RPM presets can be changed to any prefered RPM settings but are always available at the push of a button. Pushing the reset button reverts the RPM indicator to the factory presets. The factory presets are the default settings for the engine RPM indicator. The engine RPM indicator uses the engine speed signal circuit from the PCM to determine when the engine has attained a certain engine RPM.

The engine RPM indicator performs a self test by the when the ignition is turned ON. The engine RPM indicator LEDs briefly turns ON and OFF. Refer to Supercharger Description and Operation or Boost Control System Description for the 2.0L engine.

Supercharger Description and Operation

Description

The Eaton™ M62 is a fifth generation Roots™-type supercharger. The supercharger is a positive displacement pump that consists of 2 counter-rotating rotors in a housing with an inlet port and an outlet port. The rotors are designed with 3 lobes and a helical 60° twist from front to back. An air bypass valve is built into the housing. The rotors in the supercharger are designed to run at a minimal clearance, not in contact with each other or the housing. The rotors are timed to each other by a pair of precision spur gears which are pressed onto the rotor shafts. The forward end of the rotors are held in position by deep-groove ball bearings. The back end of the rotors are supported by sealed roller bearings.

The gears and ball bearings are lubricated by a synthetic oil. The oil reservoir is self-contained in the supercharger and does not rely on engine oil for lubrication. This oil reservoir is sealed for the life of the unit and is not serviceable.

The cover on the supercharger contains the input shaft which is supported by 2, deep-groove ball bearings and is coupled to the rotor drive gears. The pulley is pressed onto the input shaft and is not serviceable. These bearings are lubricated by the synthetic oil contained in the same reservoir as the gears and rotor bearings.

Operation

The supercharger is designed to pump more air than the engine would normally use. This excess air creates a boost pressure in the intake manifold. Maximum engine boost is 83 kPa (12 psi). Because the supercharger is a positive displacement pump and is directly driven from the engine drive belt system, boost pressure is available at all driving conditions.

When boost is not desired, such as during idle and light throttle cruising, the excess air that the supercharger is producing is routed through the bypass passage between the intake manifold and the supercharger inlet. This bypass circuit is regulated by a bypass valve which is similar to a throttle plate. The bypass valve is controlled by a vacuum actuator which is connected to the vacuum signal between the throttle and the supercharger inlet. Spring force from the actuator holds the valve closed to create boost, and vacuum pulls the valve open when the throttle closes to decrease boost. The open bypass valve reduces pumping loss thereby increasing fuel efficiency.

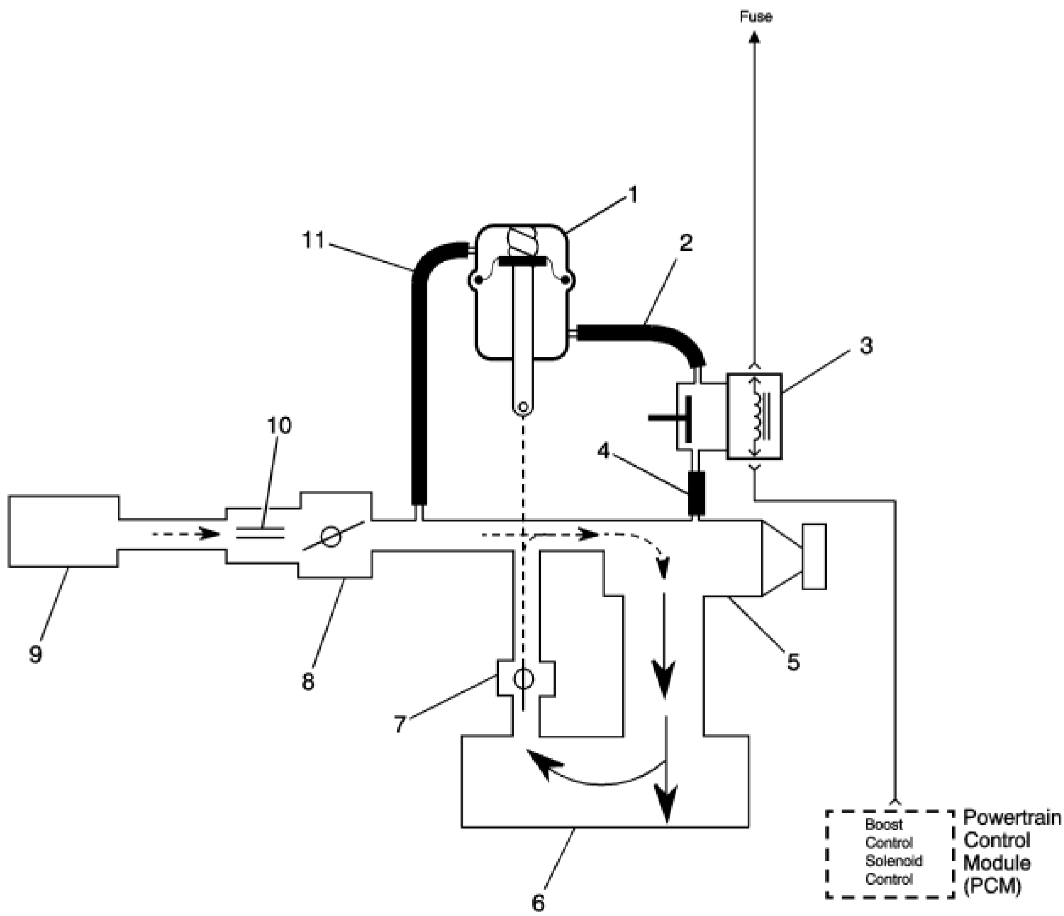
The solenoid valve attached to the bypass actuator is an electronically controlled, 3-way valve. This valve, controlled by the powertrain control module (PCM), determines whether pressure from the manifold is routed to the bypass actuator or closed off. The valve allows pressure from the manifold to open the bypass valve and regulate boost pressure during specific driving conditions.

Intercooler

The supercharger has an integrated intercooler. Cooling the air enhances the effectiveness of the supercharger. The intercooler uses conventional coolant in a separate sealed system from the engine cooling system. The intercooler system has a radiator, a reserve tank/filler neck, a pressure cap, attaching hoses, and a pump capable of a 26 liters (7 gallons) per minute flow rate. The pump is commanded ON, by the control module, whenever the engine is running.

Boost Control System Description

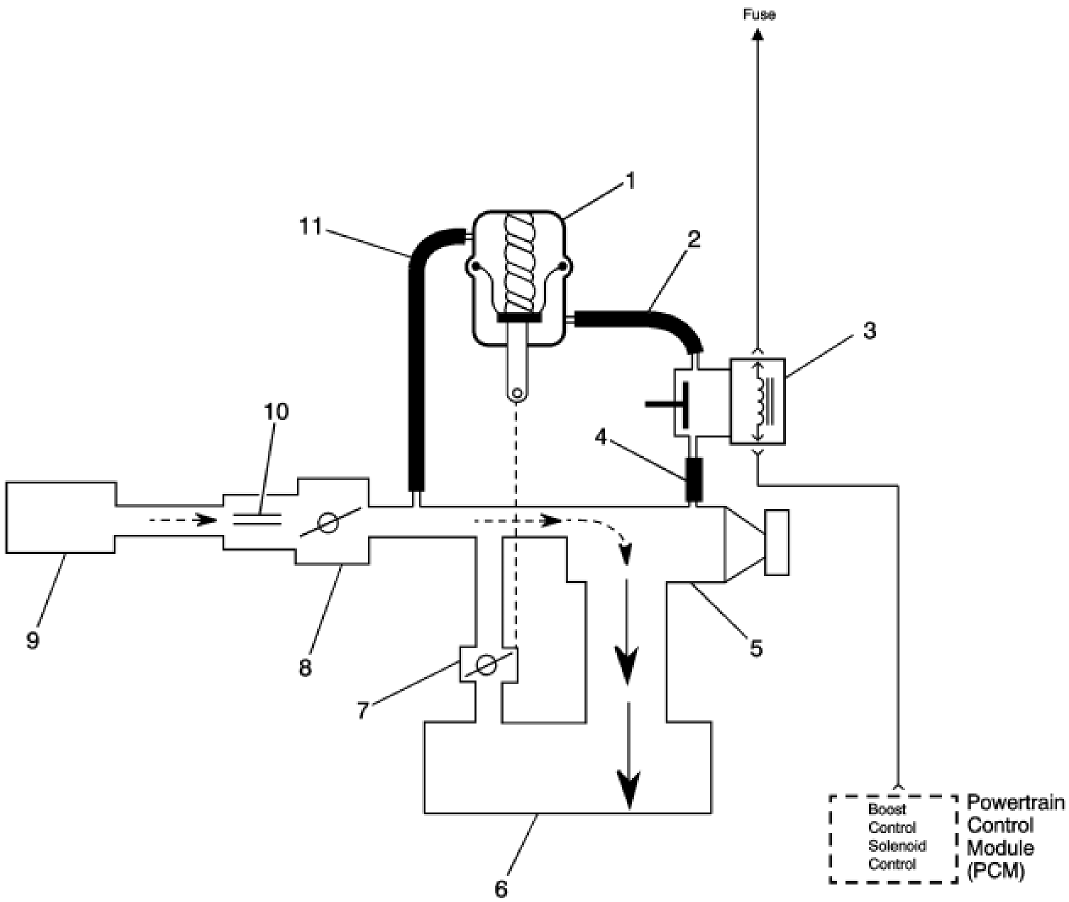
Bypass Valve Open



(1) By-Pass Valve Actuator
(2) Boost Signal
(3) Boost Control Solenoid
(4) Boost Source
(5) Supercharger
(6) Intake Plenum
(7) By–Pass Valve
(8) Throttle
(9) Air Cleaner
(10) MAF Sensor
(11) Inlet Vacuum Signal

Boost Control System Operation

Bypass Valve Closed



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Operation

Supercharger boost pressure is regulated to prevent engine and drive train damage. When the engine is operating under high boost conditions, the powertrain control module (PCM) limits boost pressure to 83 kPa (12 psi). The PCM disables boost under the following conditions:

- When reverse gear is selected
- When the engine coolant temperature (ECT) is excessively high

- When drivetrain abuse is detected
- When the vehicle is decelerating
- If an intercooler pump failure is detected
- If the intake air temperature (IAT) sensor 2 becomes excessively high
- Under heavy load in first and second gear at engine speeds above 5,800 RPM

The PCM controls boost pressure by using the boost control solenoid. The boost control solenoid is normally an open valve. Under most conditions, the PCM commands the boost control solenoid to operate at a 99–100 percent duty cycle. This keeps the solenoid valve closed and allows only inlet vacuum to control the position of the bypass valve. At idle, engine vacuum is applied to the upper side of the bypass valve actuator, counteracting spring tension to hold the bypass valve open. As engine load is increased, engine vacuum is decreased, causing the spring in the bypass valve actuator to overcome the applied vacuum, closing the bypass valve and allowing the boost pressure to increase. The bypass valve starts to close when the vacuum measures 250 mm Hg (10 in Hg) and is fully closed at 90 mm Hg (3.5 in Hg). When reduced boost pressure is desired, the PCM commands the boost control solenoid to operate at a 0 percent duty cycle. This opens the solenoid valve and allows boost pressure to enter the bypass valve actuator at the lower side to counteract the spring tension, opening the bypass valve and recirculating excess boost pressure back into the supercharger inlet.

Results of Incorrect Operation

An open boost control solenoid control circuit, an open ignition 1 circuit, or boost control solenoid valve stuck open will cause reduced engine power, especially during wide open throttle operation.

The boost control solenoid control circuit shorted to ground, boost control solenoid valve stuck closed or a restriction in the boost source or signal hoses will cause full boost to be commanded at all times and a possible overboost condition during high engine load situations.

A restriction in the vacuum signal hose to the bypass valve actuator or a stuck closed bypass valve will cause a rough idle and reduced fuel economy.