Throttle Actuator Control (TAC) System Description

Purpose

The throttle actuator control (TAC) system delivers improved throttle response and greater reliability and eliminates the need for mechanical cable. The TAC system performs the following functions:

- Accelerator pedal position sensing
- Throttle positioning to meet driver and engine demands
- Throttle position sensing
- Internal diagnostics
- Cruise control functions
- Manage TAC electrical power consumption

The TAC system includes the following components:

- The accelerator pedal position (APP) sensors
- The throttle body assembly
- The engine control module (ECM)

Accelerator Pedal Position (APP) Sensor

The accelerator pedal contains two individual accelerator pedal position (APP) sensors within the assembly. The APP sensors one and two are potentiometer type sensors each with three circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensors are used to determine the pedal angle. The engine control module (ECM) provides each APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensors provide the ECM with signal voltage proportional to the pedal movement. The APP sensor 1 signal voltage at rest position is less than 1 volt and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position above 4 volts and decreases as the pedal is actuated.

Throttle Body Assembly

The throttle assembly contains the following components:

- The throttle blade
- The throttle actuator motor
- The throttle position (TP) sensor one and two

The throttle body functions similar to a conventional throttle body with the following exceptions:

- An electric motor opens and closes the throttle valve.
- The throttle blade is spring loaded in both directions and the default position is slightly open.
- There are two individual TP sensors within the throttle body assembly.

The TP sensors are used to determine the throttle plate angle. The TP sensors provide the engine control module (ECM) with a signal voltage proportional to throttle plate movement. The TP signal voltage for both 1 and 2 at closed throttle is below 1 volt and increases as the throttle plate is opened.

Throttle Body Relearn Procedure

The engine Control Module (ECM) stores values that include the lowest possible throttle position (TP) sensor positions-0 percent, the rest positions-7 percent, and the return rate of both springs. These values will only be erased or overwritten if the ECM is reprogrammed or if a throttle body relearn procedure is performed. Observe, if the battery is disconnected, the ECM will immediately perform a throttle body relearn procedure when the ignition is turned ON.

A throttle body relearn procedure is performed any time the ignition is turned ON, with the engine OFF for longer than 29 seconds when the following conditions have been met:

- The engine speed is less than 40 RPM.
- The vehicle speed is 0 km/h (0 mph).
- The engine coolant temperature (ECT) is between 5-85°C (41-185°F).
- The intake air temperature (IAT) is between than 5-60°C (41-140°F).
- The accelerator pedal position (APP) sensor angle is less than 14.9 percent.
- The ignition 1 voltage is more than 10 volts.

After 29 seconds, the ECM commands the throttle plate from the rest position to full closed, then to around 10 percent open. This procedure takes about 6-8 seconds. If any faults occur in the throttle actuator control (TAC) system, a DTC sets. At the start of this procedure, the scan tool TAC Learn Counter parameter should display 0, then count up to 11 after the procedure is completed. If the counter did not start at 0, or if the counter did not end at 11, a fault has occurred and a DTC should set.

Engine Control Module

The engine control module (ECM) is the control centre for the throttle actuator control (TAC) system. The ECM determines the drivers intent and then calculates the appropriate throttle response. The ECM achieves throttle positioning by providing a pulse width modulated voltage to the TAC motor.

Modes of Operation

Normal Mode

During the operation of the throttle actuator control (TAC) system, several modes or functions are considered normal. The following modes may be entered during normal operation:

- Minimum pedal value. At first start-up, the engine control module (ECM) updates the learned minimum pedal value.
- Minimum throttle position (TP) values. At first start-up, the ECM updates the learned minimum TP value. In order to learn the minimum TP value, the throttle blade is moved to the closed position.
- Ice break mode. If the throttle is not able to reach a predetermined minimum throttle position, the ice break mode is entered. During the ice break mode, the ECM commands the maximum pulse width several times to the throttle actuator motor in the closing direction.
- Battery saver mode. After a predetermined time without engine RPM, the ECM commands the battery saver mode. During the battery saver mode, the TAC module removes the voltage from the motor control circuits, which removes the current draw used to maintain the idle position and allows the throttle to return to the spring loaded default position.

Reduced Engine Power Mode

When the ECM detects a condition with the TAC system, the ECM may enter a reduced engine power mode. Reduced engine power may cause one or more of the following conditions:

- Acceleration limiting. The ECM will continue to use the accelerator pedal for throttle control, however, the vehicle acceleration is limited.
- Limited throttle mode. The ECM will continue to use the accelerator pedal for throttle control, however, the maximum throttle opening is limited.
- Throttle default mode. The ECM will turn OFF the throttle actuator motor and the throttle will return to the spring loaded default position.
- Forced idle mode. The ECM will perform the following actions:
  - Limit engine speed to idle by positioning the throttle position, or by controlling the fuel and spark if the throttle is turned OFF.
  - Ignore the accelerator pedal input.
- Engine shutdown mode. The ECM will disable fuel and de-energize the throttle actuator.