Component Procedures: Electronic Throttle Actuator

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Throttle Actuator Control (TAC) System Description (Article 11089)

The engine control module (ECM) is the control center for the throttle actuator control (TAC) system. The ECM determines the driver's intent based on input from the accelerator pedal position sensor s, then calculates the appropriate throttle response based on the throttle position sensors. The ECM achieves throttle positioning by providing a pulse width modulated voltage to the throttle actuator motor. The throttle blade is spring loaded in both directions, and the default position is slightly open.

The throttle body actuator contains a contact-less inductive blade position sensing element that is managed by a customized integrated circuit. The throttle body actuator position sensor is mounted within the throttle body and is not serviceable. The ECM supplies the throttle body with a 5 V reference circuit, a low reference circuit, an H-bridge motor directional control circuit, and an asynchronous signal/ serial data circuit. Asynchronous means communication is only going from the throttle body to the ECM. The throttle body cannot receive data from the ECM over the signal/serial data circuit. The throttle body actuator position sensor provides a signal that changes relative to throttle blade angle. The customized integrated circuit translates the signal based position information into serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The throttle body actuator position sensor information is transmitted between the throttle body and the ECM on the signal/serial data circuit. The ECM decodes the serial data signal and the throttle position information is displayed on the scan tool.

Modes Of Operation

Normal Mode

During the operation of the TAC system, several modes, or functions, are considered normal. The following modes may be entered during normal operations:

- Minimum pedal value—At key-up, the ECM updates the learned minimum pedal value.
- Minimum throttle position values—At key-up, the ECM updates the learned minimum throttle position value. In order to learn the minimum throttle position value, the throttle blade is moved to the closed position.
- Ice break mode—If the throttle blade 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 speed, the ECM commands the battery saver mode. During the battery saver mode, the TAC system 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 actions listed below:
- Limit engine speed to the idle position
- Ignore the accelerator pedal input.

Engine Shutdown Mode

There are 4 reasons the ECM commands engine shutdown. All 4 reasons involve a throttle that has been commanded to default position – Reduced Engine Power. Default Throttle is latched for the key-cycle, disabling the throttle motor and letting the spring return the throttle to its default position. Default Throttle by itself does not cause a commanded shutdown. Shutdown will only occur with Default Throttle and another issue. A throttle is commanded to Default Throttle when any of the following occurs:

- SENT Sensor Communication Faults — P16A0–P16A2, U0606, or U0607
- Performance Faults — P0068, P2101, or P2176
- Sensor Reference Voltage Fault — P06A3
- Internal Sensor Faults — P0122, P0123, P0222, P0223, or P2135

The ECM commands engine shutdown when any of the following occurs:

- Default Throttle & Catalyst Temperature to high — In order to idle in Default Throttle the spark is often retarded quite a bit, dumping a lot of heat into the catalyst.
- Default Throttle & P2119 — The throttle sensors detect that the throttle position is higher than default position and throttle hasn’t safely returned to default position.

- Default Throttle & P16F3 or P0606 — The calibration does not trust the ECM to determine if the throttle has safely returned to default position.
- P0068 and any SENT Communication Fault, Reference Voltage Fault, or any of the 5 Sensor Faults — The ECM detects excess air flow based on expected default throttle position indicating the throttle position is higher than the default throttle position. The calibration does not trust the faulted throttle sensors to determine if the throttle has safely returned to default position.

Throttle/Idle Learn or Throttle Body Idle Air Flow Compensation Reset

The ECM learns the airflow through the throttle body to ensure the correct idle. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to unlearn the coking. To accelerate the process, the scan tool has the ability to reset the learned value back to zero. A new ECM will also have values set to zero. Cleaning the throttle body when the ECM is replaced can reduce the time it takes for the ECM to relearn the minimum idle speed.

The idle may be unstable or a DTC may set if the learned values do not match the actual airflow.

A un-metered air leak in the induction system or a small vacuum leak may not set a DTC. If the condition goes undetected, the ECM may learn an incorrect Throttle Body Idle Airflow Compensation value over time. The incorrectly learned value may cause various symptoms to occur such as rough or unstable idle speeds, and/or engine stall. If this condition is detected and repaired it will be necessary to perform the Throttle/Idle Learn or Throttle Body Idle Air Flow Compensation Reset procedure to ensure any symptoms are corrected.