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| Station | | Task | |
| 40 | | 4 | |
| Running 903 | | | |
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**

# Intelligent Throttle Control (iTC) Operation

## Task Objective

At the completion of this task the technician will demonstrate the capability of using available resources and knowledge of the Intelligent Throttle Control (iTC) to diagnose failures.

#### Repair order information

The customer states he suddenly was not able to ride his vehicle, because it would only idle. Pushing the accelerator lever did not advance the engine RPM. He had the unit towed in and is very upset.

**Introduction**

**SYSTEM DESCRIPTION (OPERATION)**

**The iTC is an electronic throttle control system that includes:**

– Throttle accelerator sensor (TAS)

– Electric throttle actuator (ETA)

– Throttle position sensor (TPS).

**The TAS is located in the right handle bar as the throttle lever.** The ETA and TPS are comprised in the throttle body. The iTC is often referred to as a "throttle by wire" system (no throttle cable is used). According to the accelerator pedal position and other EMS inputs, the ECM powers the ETA motor using pulse width modulation (PWM), to control the throttle plate. When the ECM detects through the TPS that the throttle plate has reached the targeted position, the ECM stops the throttle actuator. Depending on various conditions and the type of key used, the iTC can modify the ETA response, limit the engine torque or vehicle speed. For torque limitation, the ECM processes the TAS input differently depending on the specific mode. In other words, the driver's demand may not necessarily result in the corresponding throttle opening. For vehicle speed limitation, the iTC controls the throttle opening to maintain a maximum set speed even if the accelerator lever is fully depressed.

**Drowned Mode**

In case of a fuel flood, the engine can be cranked without fuel injection. To enter the drowned mode, depress and hold accelerator (at least 20% of the travel) while cranking the engine.

**Limp Home Mode**

When certain faults are occurring, the ECM will enter the limp home mode. In this mode, the engine will deliver less than the accelerator lever demand.

**THROTTLE ACCELERATOR SENSOR (TAS)**

**TAS Description**

The throttle accelerator sensor (TAS) is a double Hall Effect sensor that sends a signal to the ECM which is proportional to the accelerator lever. The redundancy is used for security purposes. The voltage outputs of the Hall Effect sensors are different.

**TAS Failure**

If one TAS signal fails, the vehicle will enter the limp home mode If both TAS signals fail, the engine speed will drop to idle. Depressing the override button will force the ECM to open the ETA to an angle that allows the vehicle to move.

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**TAS Wire Information**

|  |  |  |
| --- | --- | --- |
| **Function** | **Pin** | **Color** |
| Voltage input (5v) | A | VI-BU |
| Ground through ECM | B | BK |
| Signal | C | YL-BU |
| Voltage input (5v) | D | VI-GN |
| Ground through ECM | E | BK |
| Signal | F | YL-GY |

By comparing the TAS schematic to the chart, it can be determined the ECM supplies a 5 volt reference voltage to the dual sensors inside the TAS. Depending on lever position, a 0 to 5 volt signal is returned to the ECM through terminal locations C and F on the TAS connector.



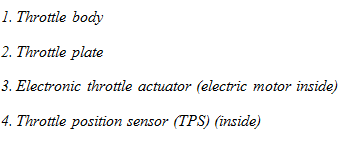
To check TAS operation, Connect to the latest applicable B.U.D.S. software. Select the Monitoring and ECM tabs. Turn on the vehicle key, **but do not start the engine.** Look at the TAS (%) window as you depress the accelerator lever.

The TAS signal should vary from near 0% to near 100% depending on the lever position, which confirms the TAS signal reaches the ECM. The TPS (%) should also rise near 100% as the throttle butterfly opens. This can also be heard and seen by observing the Throttle Body. **Caution: Keep fingers away from the butterfly valve as it is quite forceful and injury may occur.**

If either TAS sensor is not functioning or in circuit the TAS (%) reading will remain 0, but BUDS will report in the faults screen which half of the TAS sensor is at fault.

A simple quick test of the TAS is to monitor the TPS% while physically opening the throttle plate with a smooth blunt object. If B.U.D.S. shows TPS movement the TAS could be suspected

**THROTTLE BODY**

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**Throttle Body Description**

The throttle body is mounted on the front end of the plenum, aft of the air filter housing. Air for combustion, drawn in by the engine, flows through the air intake system, then through the throttle body where it is regulated by a throttle plate. Fitted on the throttle body, an electronic throttle actuator (ETA) allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine torque. There is no idle air control valve (IACV). The TPS is also incorporated in the throttle body. It provides a signal to the ECM of the actual throttle plate position. From input signals, the ECM acknowledges driver demands and converts them to an engine torque requirement through calculation of several variables. Then, the ECM controls the iTC, the injection system and the ignition system to meet the torque requirement. The ECM manages the engine torque requirements and controls engine operation to ensure it is delivering optimum performance and fuel economy. The ECM also controls idle RPM and limits maximum engine speed through the iTC system.

**THROTTLE POSITION SENSOR (TPS)**

**TPS description NOTE:**

The TPS is part of the throttle body. The throttle position sensor (TPS) is a double potentiometer that sends signals to the ECM that are proportional to the throttle plate angle. NOTE: As a first troubleshooting step, always check for applicable fault codes using B.U.D.S. software. Throttle Position Sensor Initialization NOTE: The TPS initialization procedure must be carried out whenever the throttle body is replaced, unless an ECM first initialization reset is carried out. This operation performs a reset of the TPS basic values in the ECM. This reset is very important as the TPS values are part of the basic parameters for all fuel mapping calculations and control of several settings such as for idle speed, LIMP HOME mode and maximum RPM of the engine. An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.

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| --- | --- | --- | --- |
|  | | | |
| **Function** | **Pin** | **Color** |
| Signal | 1 | BE-WH |
| Sensor + | 2 | BE-YL |
| Motor + | 3 | BE-RD |
| Signal | 4 | BE-GN |
| Motor - | 5 | BE-BK |
| Sensor - | 6 | BE-GY |

Terminal 3 and 5 of the Throttle Body connector are the motor driver wires. The remaining wires are related to the dual TPS system. The TPS sensors can be tested as shown below, but BUDS should also be used as described in detail in the shop manual.

**TPS Resistance Test**

1. Ensure the throttle body connector is properly connected.

2. Disconnect ECM connector A from the ECM and install it on the ECM ADAPTER TOOL (P/N 529 036 166).

3. Use the FLUKE 115 MULTIMETER and select Ohms .

4. Probe circuit as per following table while using your hand to manually move throttle plate.

**Note:** If any resistance value is incorrect, check wire continuity between ECM and throttle body before assuming the TPS is at fault.

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| --- |
| TPS table |
|  |

ECM ADAPTER TOOL (P/N 529 036 166).

**Procedures**

#### Place the switches on the switch box in the following positions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| A | X |  | X | X | X | X | X | X |
| B |  | X |  |  |  |  |  |  |

|  |
| --- |
| 1. Start the engine and push the accelerator lever. |
| 2. Does the engine RPM increase? YES NO |
| 3. Use B.U.D.S. to gather diagnostic information. |
| 4. What faults or other reactions can you observe?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 5. Using the monitoring page of B.U.D.S., observe the TAS% and TPS % openings. |
| 6. What are the reactions to lever movement?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 7. Using all of your available tools and knowledge. What can you determined to be wrong with the iTC system? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 8. How might you repair the problem?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

#### Place the switches on the switch box in the following positions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| A | X | X | X | X | X | X | X | X |
| B |  |  |  |  |  |  |  |  |

|  |
| --- |
| Clear any codes and disconnect BUDS. |

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| 9. Separate the air intake hose from the Throttle Body. |
| 10. Activate the ignition. |
| 11. Observe the throttle butterfly, operate the accelerator.  **Caution! Keep fingers away from throttle butterfly. Injury may result.** |
| 12. Does the throttle operate smoothly throughout its travel to 100%? YES NO |
| 13. Now check TAS and TPS in the Monitoring screen of B.U.D.S. Do you see close to 100% in both boxes? YES NO |
| 14. What is the maximum TPS %\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 15. **Re-install the air intake hose.** |
| 16. Start the engine. |
| 17. Does the engine accelerate? YES NO |
| 18. Accelerate several times and note engine reaction. |
| 19. Turn off key. |

#### Place the switches on the switch box in the following positions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| A | X | X |  | X | X | X | X | X |
| B |  |  | X |  |  |  |  |  |

|  |
| --- |
| 1. Start the engine and try to accelerate it. Try to restart it if it stalls a few times. |
| 2. STOP the engine by pressing the computer space bar. |
| 3. Describe the throttle response and engine reactions you observed.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 4. Use B.U.D.S. to gather diagnostic information. |
| 5. What Faults are active?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 6. Use the Monitoring Screen in the ECM tab to check the TAS% and TPS%. |
| 7. Does the TAS seem to operate? YES NO |
| 8. Does the TPS respond? YES NO |
| 9. Use your knowledge and resources to diagnose the problem. |
| 10. What have you determined to be at fault?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 11. What is the quickest way to identify this problem?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**QUESTIONS:**

1. What have you learned from this task?

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2. What tool should be used to check wire connections from the component to the ECM?

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3. What are the three major components of the ETC system?

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4. Why are there two TPS sensors and two TAS sensors?

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# Instructor sign off-- Go \_\_\_\_\_\_\_\_\_