Task: Electronic throttle body (cableless throttle body with Hall-sensors)

Required material:

- electronic throttle valve body (with Hall sensors)
- digital multimeter (DMM)
- 2 x adjustable power supply (0-5V)

In fuel injection engines, the throttle body is the part of the air intake system that controls the amount of air flowing into the engine in response to driver input. Inside the throttle body is the throttle valve that regulates the airflow. There are many different types of throttle bodies. In cars with electronic valve control (known as 'drive-by-wire'), an electric motor controls the position of the throttle valve. The engine control unit (ECU) determines the throttle opening. The throttle body used in this task is part of a 'drive-by-wire' system and has no cable. There is a motor that drives the throttle valve. The pedal position sensor sends its information to the engine-ECU. The ECU then calculates the optimal throttle valve opening appropriate for the driving condition and sends the signal to the throttle valve motor (fig. 1).

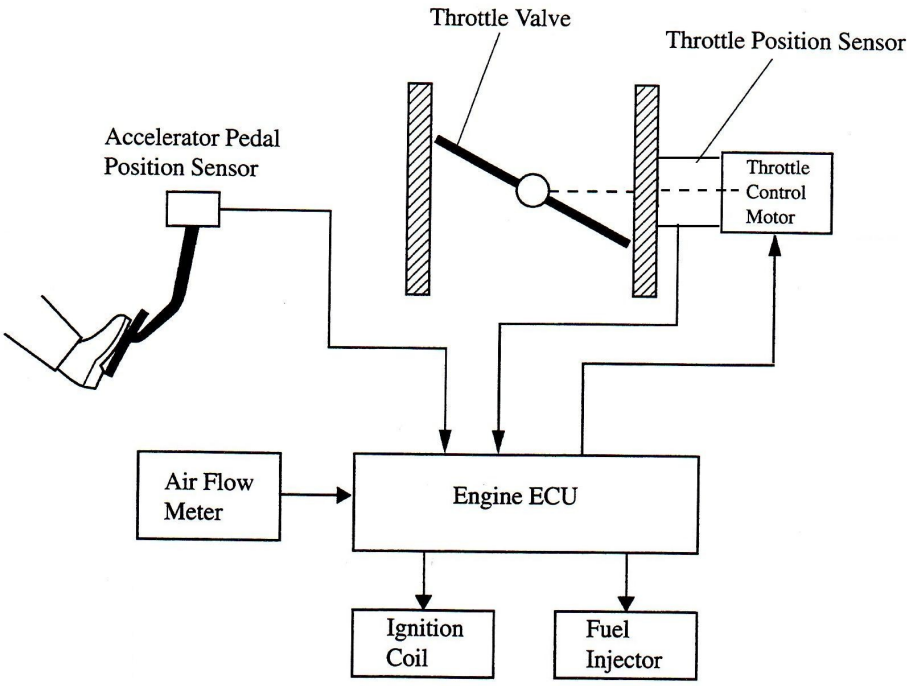


Fig.1 Overview of a 'drive-by-wire system' (Toyota)

Throttle Position Sensor (fig.2)
The throttle position sensor is part of the throttle body and detects the opening angle of the throttle valve. The throttle position sensor (Hall element type) consists of Hall ICs made of Hall elements and of magnets that rotate around them. The magnets rotate together with the throttle valve. When the throttle valve opens and the magnets change their position, the hall IC detects a change in the magnetic flux caused by the change in the magnet's position. The resulting Hall effect outputs voltage in accordance to the amount of change. This signal is sent to the engine ECU as the throttle valve opening signal. This type of sensor is very accurate in detecting the throttle valve opening. Moreover, the non-contact method has a simple construction so it does not break down easily.

  Made possible by the Toyota Fund for Europe

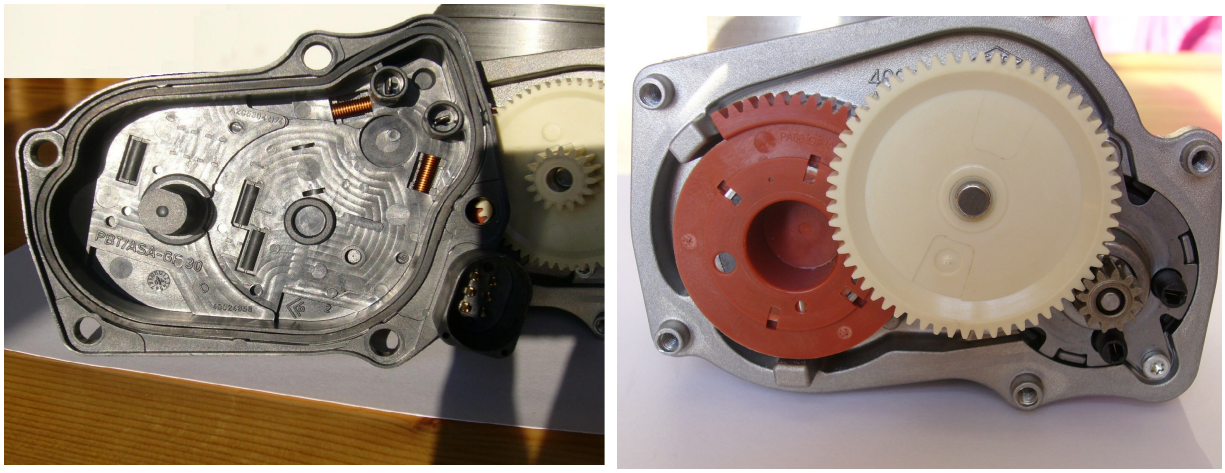


Fig. 2 View of an electronic throttle body with electro motor and two non-contact sensors (VDO).

To increase the reliability of this sensor, it outputs signals from two Hall systems with different output characteristics. Different makes can have different characteristics (see fig. 3) .

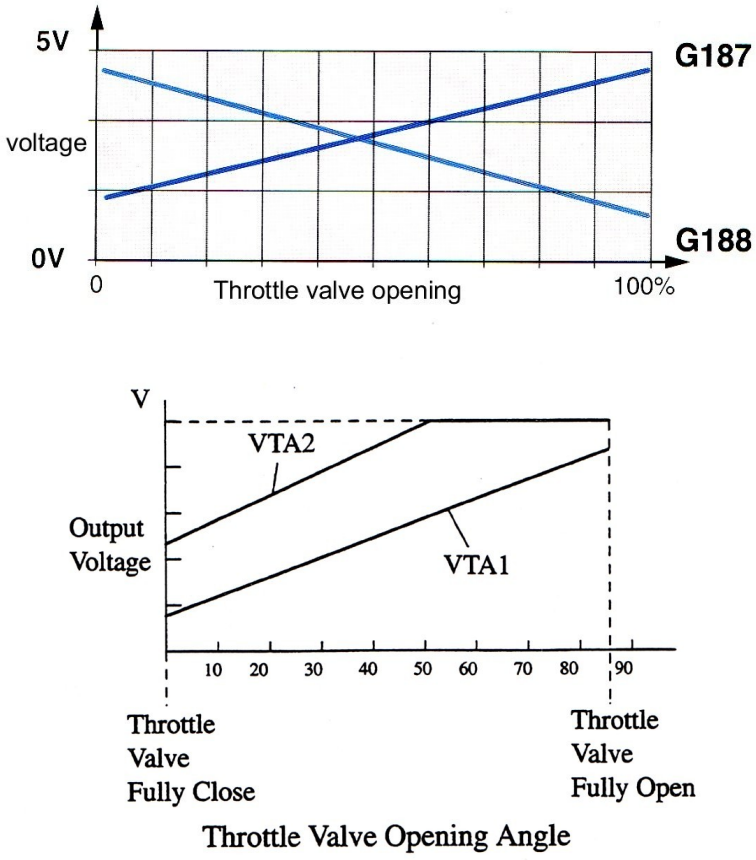
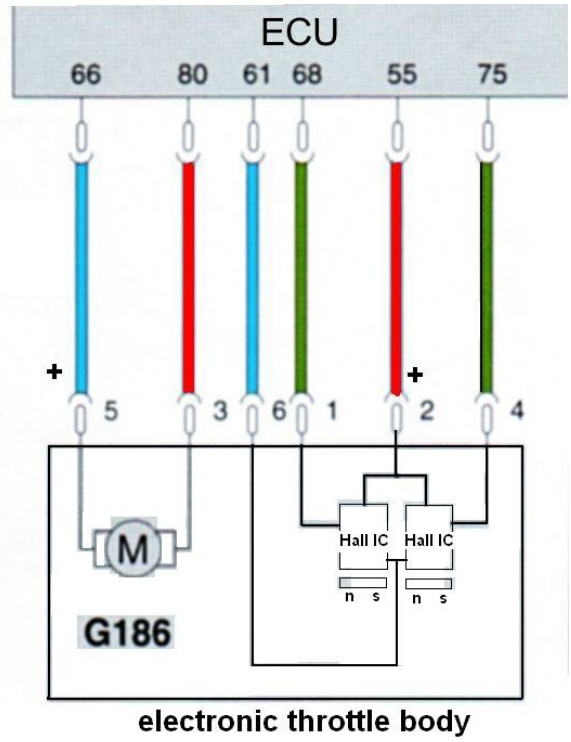


Fig. 3 The output signals of different electronic throttle valve bodies (above VDO, below Toyota)

  Made possible by the Toyota Fund for Europe

The inspection method here differs from the method for the throttle body with potentiometers. Fig. 4 shows us the connectors on the electronic throttle body. There are six electrical terminals situated on the throttle body numbered from 1 to 6 (fig. 4).



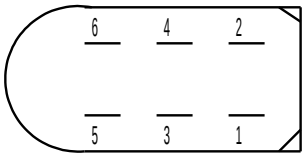


Fig. 4 (left) The electrical circuit and the terminals. The numbers are related to the connector (right)

Task 1 a

Because of the high resistance of electronic circuits, we cannot use an ohmmeter here. However, it is possible to connect a power supply to the Hall-IC circuits and measure the voltage on the output terminals while rotating the throttle valve.

1) Set the power supply at 5 V and connect it to the throttle body between pins 2 (+) and 6 (-).
2) Connect the voltmeter to the Hall output terminals. First between terminals 1 and 6 and then between 4 and 6.
2) Move the throttle valve and make a note of the voltage on both Hall-ICs. Fill in the values:

	Throttle valve closed	Throttle valve completely open
Hall-sensor terminal 1	V	V
Hall-sensor terminal 2	V	V

3) Which of the two types of electronic throttle valve bodies seen in fig. 3 are we dealing with?

  Made possible by the Toyota Fund for Europe

Task 1b Motor and Hall-sensor check

1) Keep the power supply used in task 1a connected to the voltmeter.
2) Now we need a second power supply to drive the electro motor. Be sure the power supply is turned back to zero volt. Connect the power supply to the motor (pins 5 + and pin 3 -).
3) Now turn up the voltage very slowly and notice how the throttle valve rotates. Make a note of the motor voltage and the voltage measured on the Hall-sensors. Fill in the table below

Motor voltage	potentiometer G187	potentiometer G188
0		
0.5		
1		
1.5		
2		
2.5		
3		
3.5		
4		

4) Question: At which voltage is the throttle valve wide open?

5) Place the measured results in the graph in fig. 5

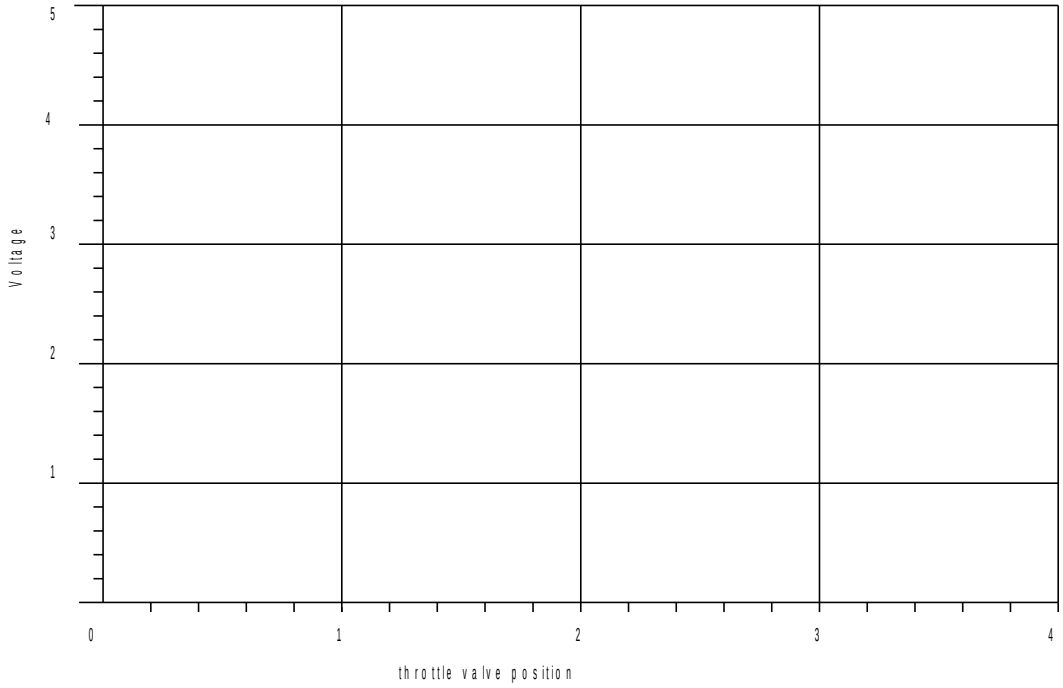


Fig. 5 The throttle valve position is measured here in voltage.

  Made possible by the Toyota Fund for Europe