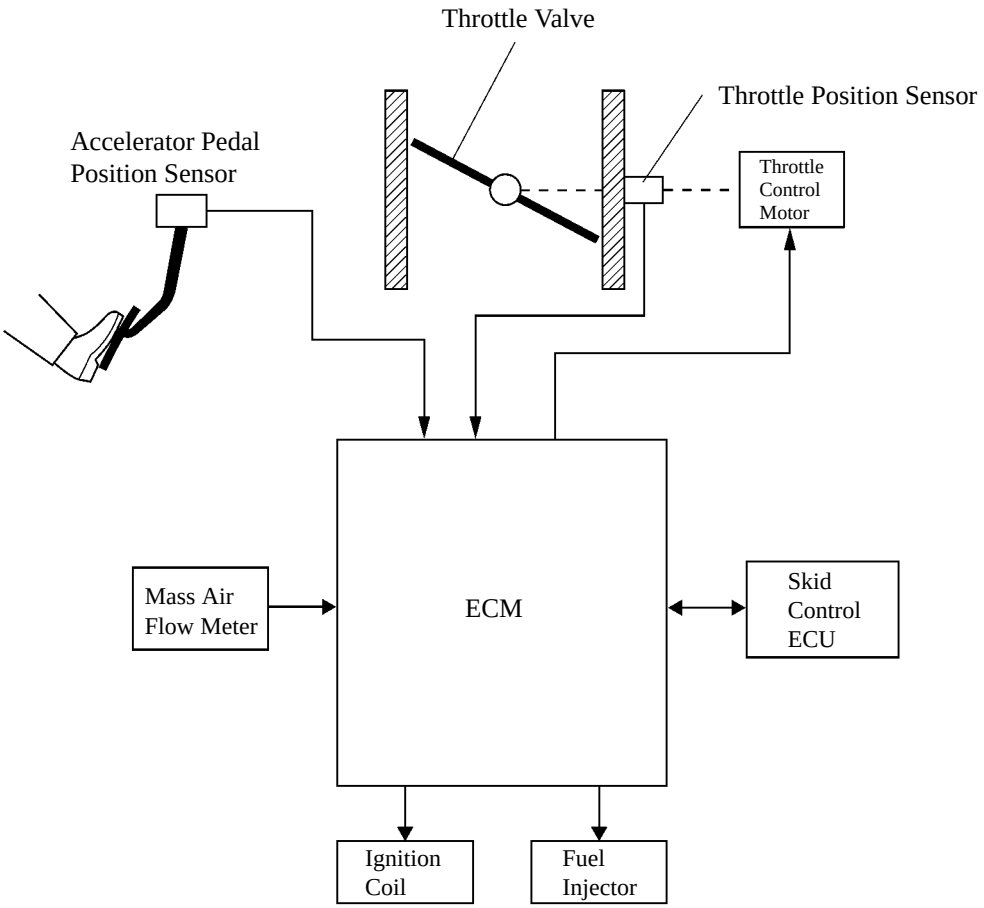
7. ETCS-i (Electronic Throttle Control System-intelligent)

General

- The ETCS-i is used, providing excellent throttle control in all the operating ranges.
  In the new 1GR-FE engine, the accelerator cable has been discontinued, and an accelerator position sensor has been provided on the accelerator pedal.
- In the conventional throttle body, the throttle valve opening is determined by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the ECM to calculate the optimal throttle valve opening that is appropriate for the respective driving condition and uses a throttle control motor to control the opening.
- The ETCS-i controls the ISC (Idle Speed Control) system, the cruise control system, the TRAC*1 (Traction Control)/A-TRAC*2 (Active-Traction Control), and the VSC (Vehicle Skid Control) system.
- In case of an abnormal condition, this system transfers to the limp mode.

*1: Only for the 2WD model
*2: Only for the 4WD model

▶ System Diagram ◀



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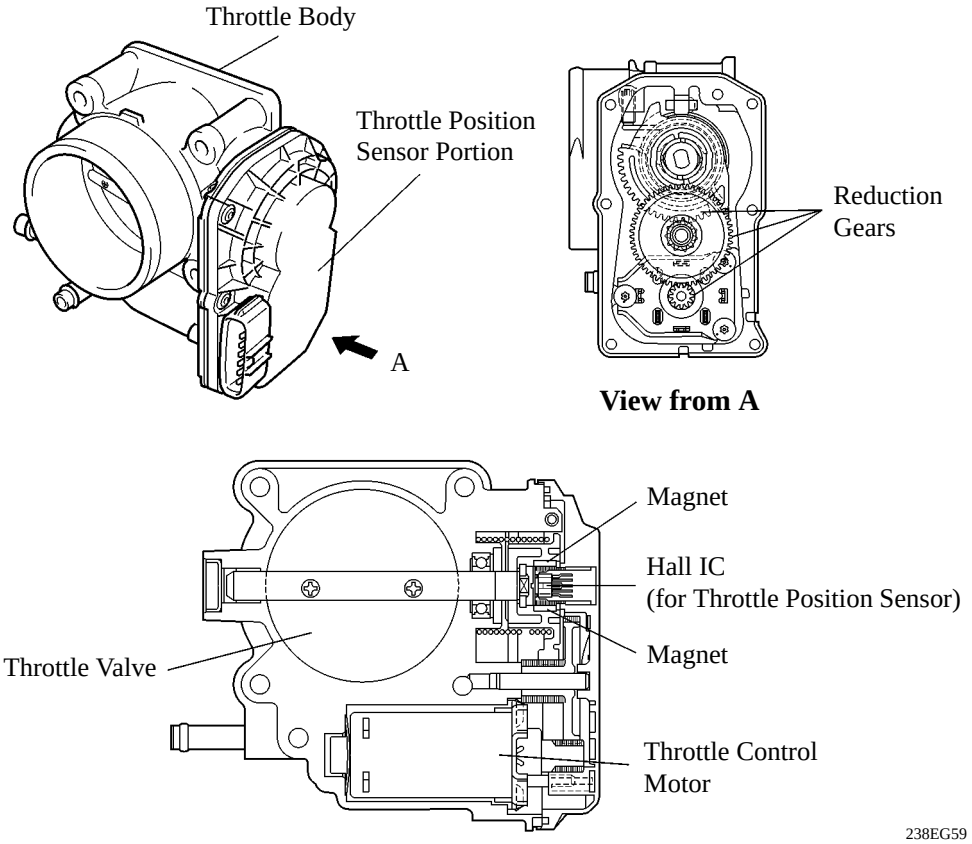
Construction



Cross Section

1) Throttle Position Sensor

The throttle position sensor is mounted on the throttle body, to detect the opening angle of the throttle valve. For details, refer to Main Components of Engine Control System section on page 48.

2) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The ECM performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the opening of the throttle valve.

Operation

1) General

The ECM drives the throttle control motor by determining the target throttle valve opening in accordance with the respective operating condition.

1) Non-Linear Control

2) Idle Speed Control

3) TRAC or A-TRAC* Throttle Control

4) VSC Coordination Control

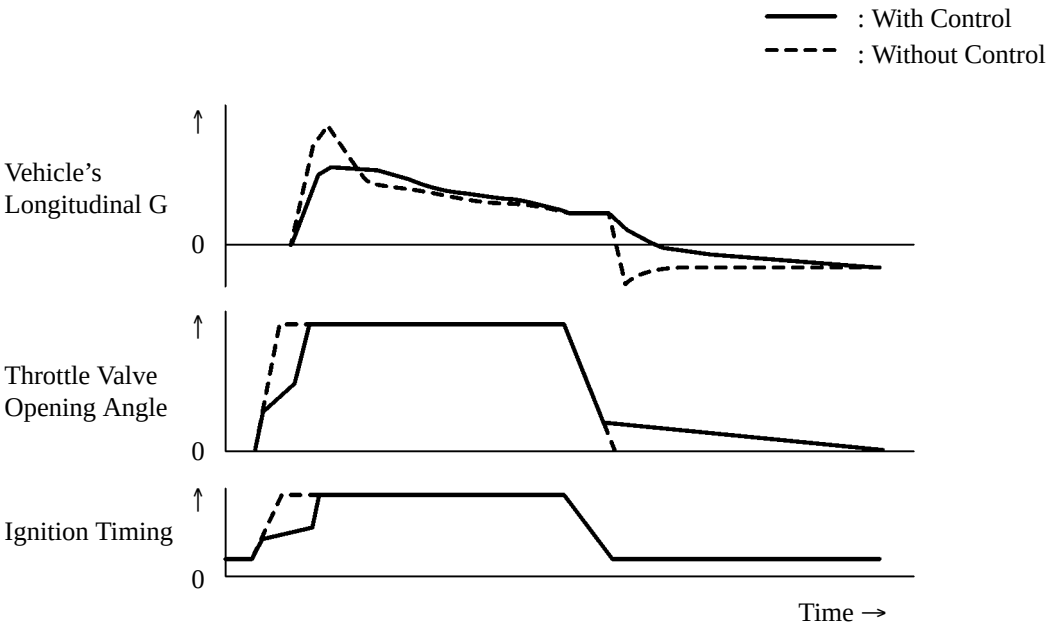
5) Cruise Control

*: with A-TRAC system (4WD model)

2) Non-Linear Control

Controls the throttle to an optimal throttle valve opening that is appropriate for the driving condition such as the amount of the accelerator pedal effort and the engine speed in order to realize excellent throttle control and comfort in all operating ranges.

▶ Control Examples During Acceleration and Deceleration ◀



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3) Idle Speed Control

The ECM controls the throttle valve in order to constantly maintain an ideal idle speed.

4) TRAC or A-TRAC* Control

As part of the TRAC or A-TRAC* system, the throttle valve is closed by a demand signal from the skid control ECU if an excessive amount of slippage is created at a driving wheel, thus facilitating the vehicle in ensuring stability and driving force.

*: with A-TRAC system (4WD model)

5) VSC Coordination Control

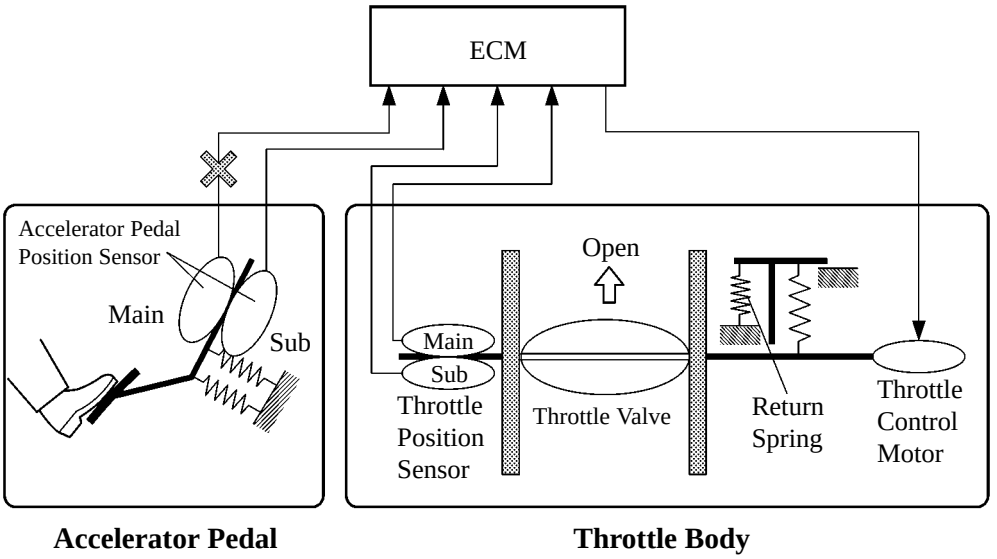
In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the skid control ECU.

6) Cruise Control

An ECM with an integrated cruise control ECU directly actuates the throttle valve for operation of the cruise control.

Fail-Safe of Accelerator Pedal Position Sensor

- The accelerator pedal position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the ECM detects the abnormal signal voltage difference between these two sensor circuits and switches to the limp mode. In the limp mode, the remaining circuit is used to calculate the accelerator pedal opening, in order to operate the vehicle under limp mode control.



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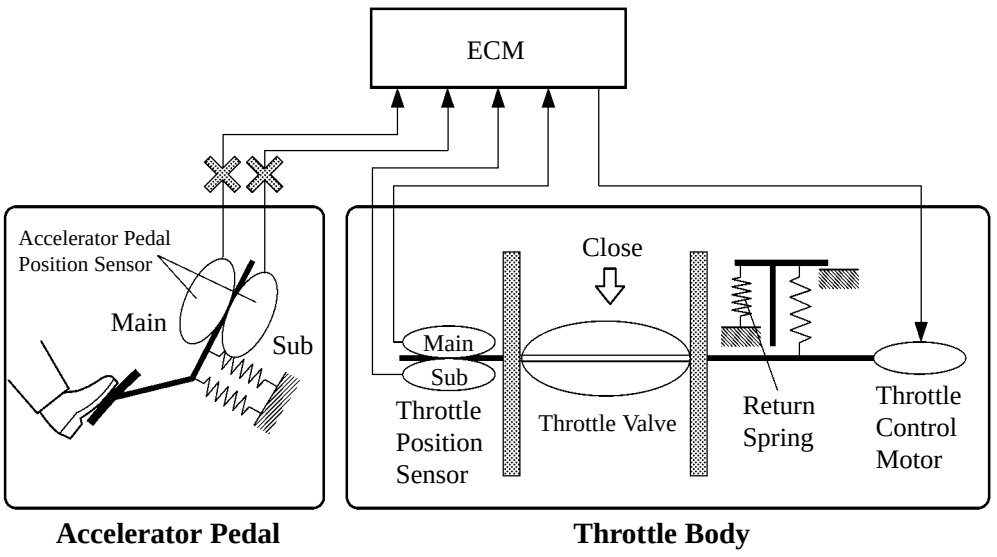
- If both circuits malfunction, the ECM detects the abnormal signal voltage between these two sensor circuits and regards that the opening angle of the accelerator pedal is fully closed and then continues the throttle control. At this time, the vehicle can be driven within its idling range.



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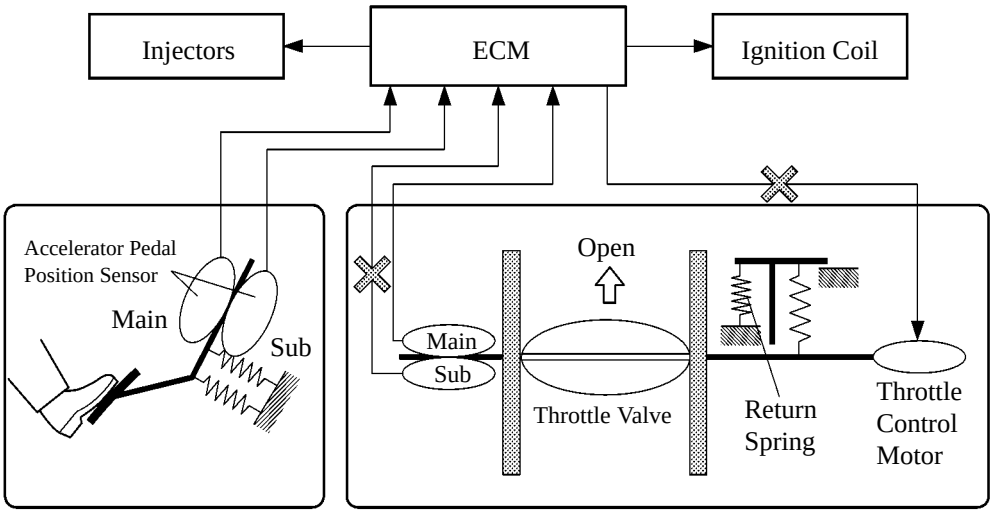
Fail-Safe of Throttle Position Sensor

- The throttle position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the ECM detects the abnormal signal voltage difference between these two sensor circuits, cuts off the current to the throttle control motor, and switches to the limp mode. Then, the force of the return spring causes the throttle valve to return and stay at the prescribed opening. At this time, the vehicle can be driven in the limp mode while the engine output is regulated through the control of the fuel injection and ignition timing in accordance with the accelerator opening.
- The same control as above is effected if the ECM detects a malfunction in the throttle control motor system.



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