■ENGINE CONTROL SYSTEM

1. General

The engine control system has newly adopted the ETCS-i and VVT-i systems and a function to communicate with the multiplex communication system. In addition, the fuel pump control system's fuel pump speed control has been changed from the 2-step to the 3-step type. Furthermore, the engine Immobiliser system and the cruise control system have been enclosed in the engine ECU.
The engine control systems of the new 2JZ-GE engine and previous 2JZ-GE engine are compared below.

System	Outline		New	Previous
EFI (Electronic Fuel Injection)	A L-type EFI system directly detects the intake air mass with a hot wire type air flow meter.		○	○
	The fuel injection system is a sequential multiport fuel injection system.		○	○
ESA (Electronic Spark Advance)	Ignition timing is determined by the engine ECU based on signals from various sensors. The engine ECU corrects ignition timing in response to engine knocking.		○	○
	2 knock sensors are used to improve knock detection.		○	○
	The torque control correction during gear shifting has been used to minimize the shift shock.		○	○
ISC (Idle Speed Control)	A step motor type ISC valve controls the fast idle and idle speeds.		—	○
VVT-i (Valiable Valve Timing-intelligent)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.		○	—
ETCS-i (Electronic Throttle Control System-intelligent)	Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the condition of the engine and the vehicle. In addition, comprehensively controls the ISC, cruise control, and TRC systems.		○	—
ACIS (Acoustic Control Induction System)	The intake air passages are switched according to the engine speed and throttle valve angle to increase performance in all speed ranges.		○	○
Fuel Pump Control	Under light engine loads, pump speed is low to reduce electric power loss.	2-Step Control	—	○
		3-Step Control	○	—
Fuel Pressure Control	In hot engine conditions, the fuel pressure is increased to improve restartability.		—	○
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.		○*1	○*2
Air Conditioning Cut-Off Control	By controlling the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.		○	○
EGR Cut-Off Control	Cuts off EGR according to the engine condition to maintain drivability of the vehicle and durability of the EGR components.		—	○*2

(Continued)

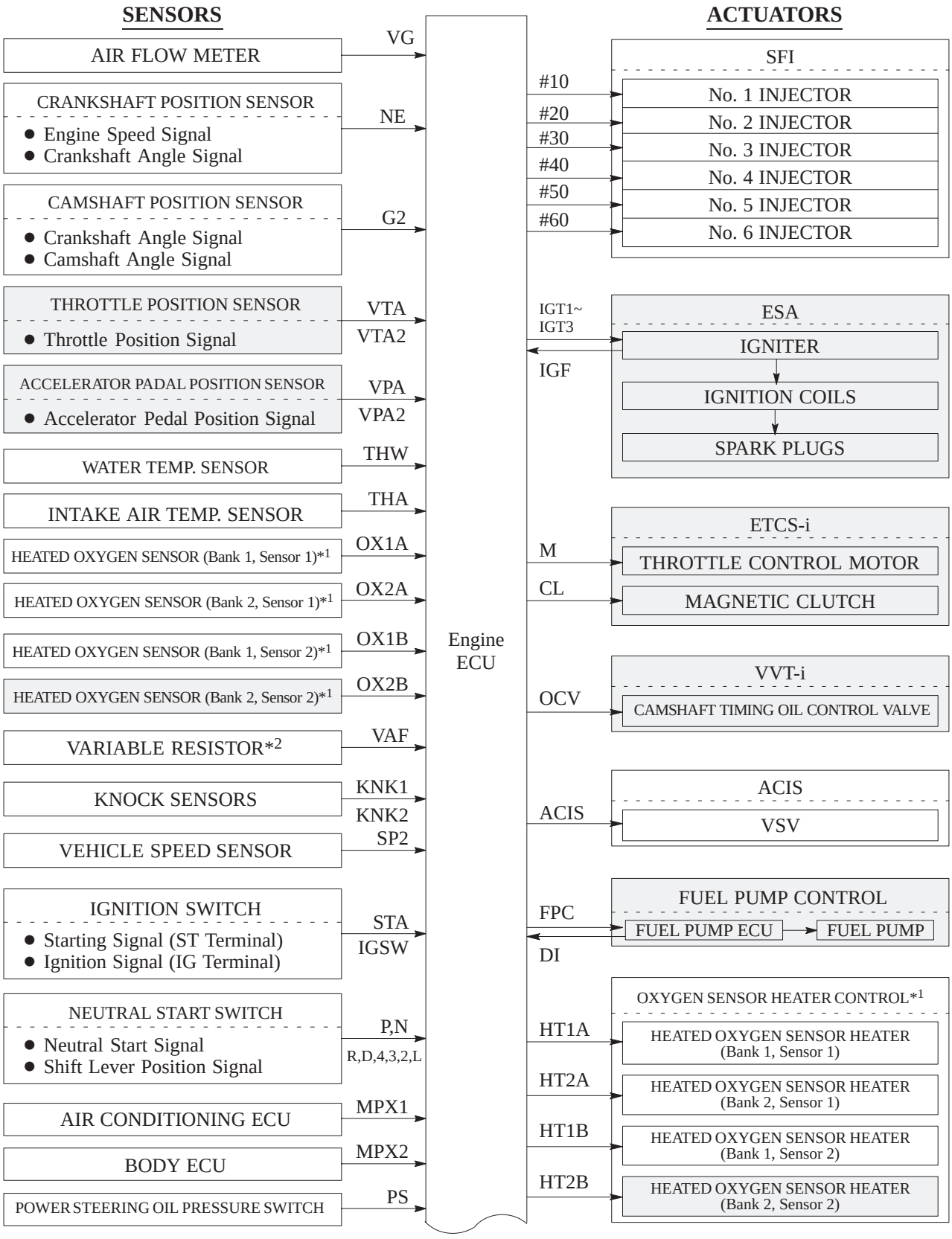
EG

System	Outline	New	Previous
Evaporative Emission Control	The engine ECU controls the purge flow of evaporative emissions (HC) in the charcoal canister in accordance with engine conditions.	○	○
Engine Immobiliser	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.	○	○*2
Function to communicate with multiplex communication system	Communicates with the body ECU, A/C ECU, etc., on the body side, to input/output necessary signals.	○	—
Diagnosis	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.	○	○
	A newly developed diagnostic system which utilizes a high speed bi-directional communication line to provide extended diagnostic capabilities and features.	○	—
Fail-Safe	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.	○	○

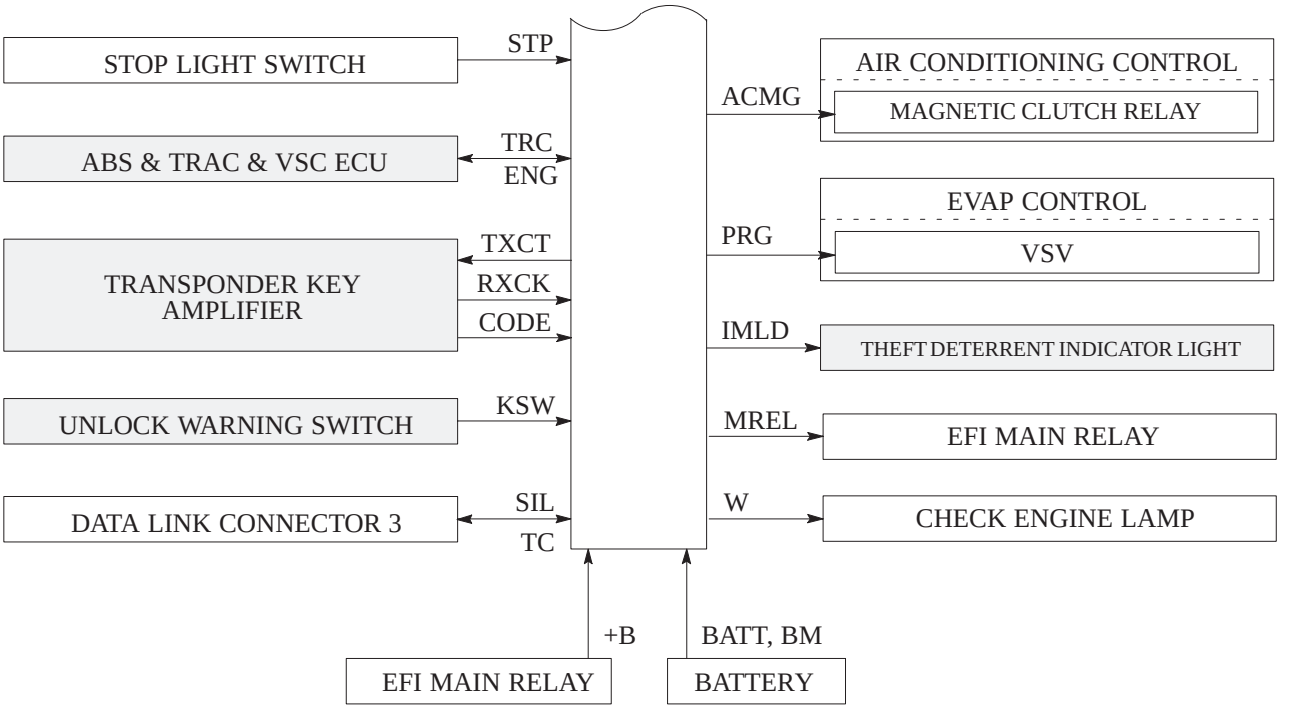
*1: Models for Europe and Australia
*2: Models for Europe

2. Construction

The configuration of the engine control system in the 2JZ-GE engine of the new GS300 is as shown in the following chart. Shaded portions ▭ differ from the 2JZ-GE engine of the previous GS300.

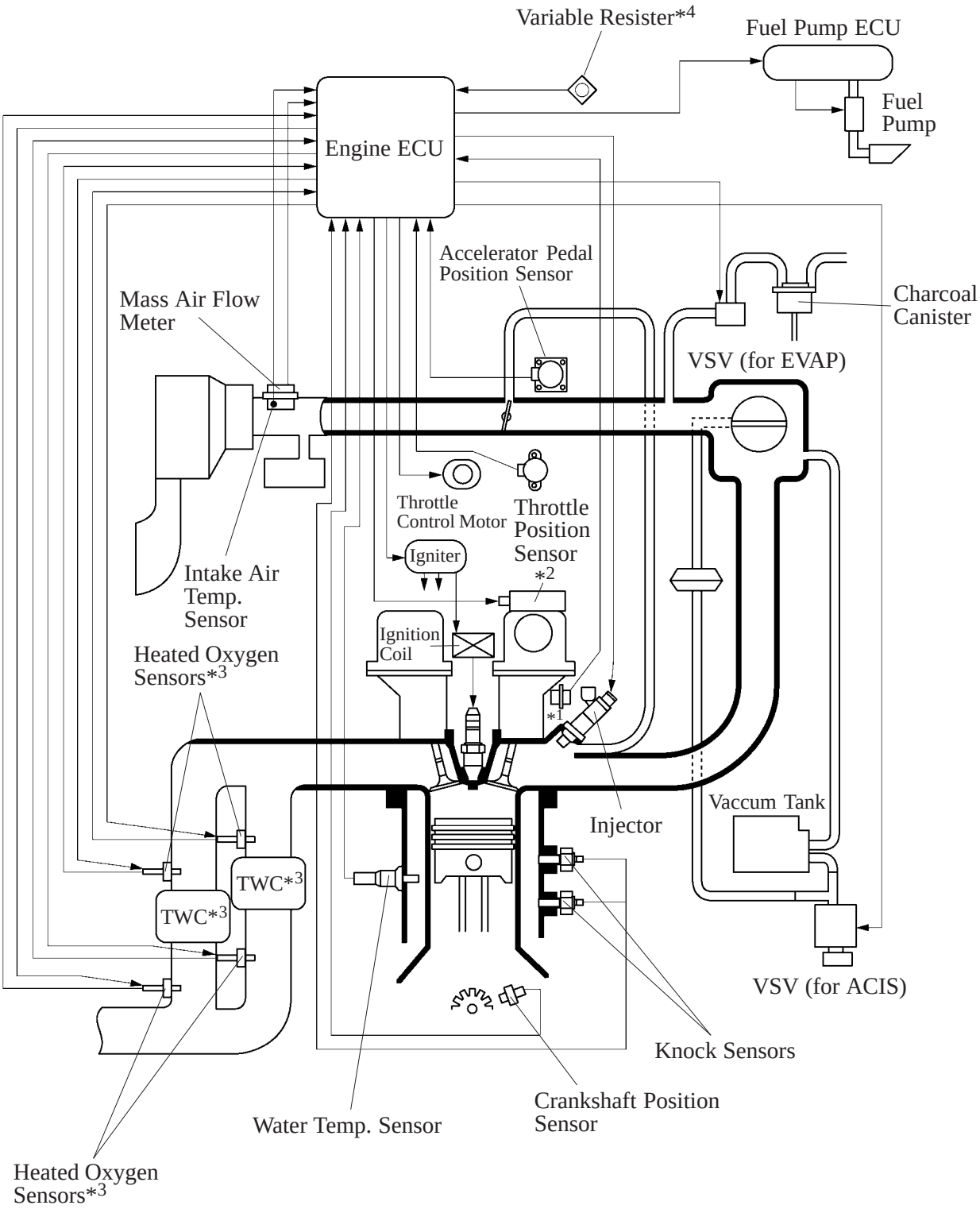


(Continued)



*1: Only for Europe and Australia Model
*2: Only for G.C.C. Countries Model

3. Engine Control System Diagram

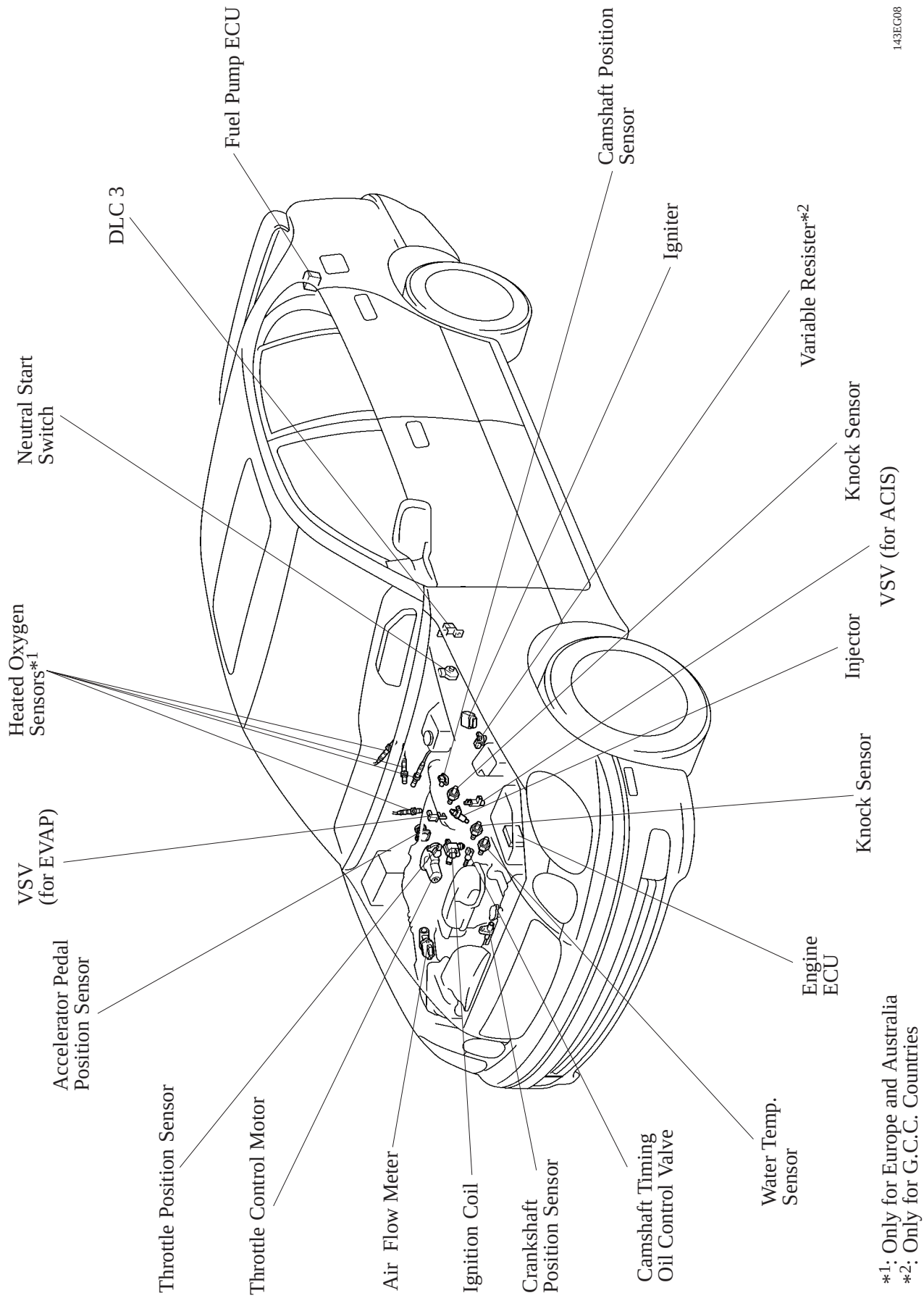


*1: Camshaft Position Sensor
*2: Camshaft Timing Oil Control Valve
*3: Only for Europe and Australia Model
*4: Only for G.C.C. Countries Model

143EG07

EG

4. Layout of Components



*1: Only for Europe and Australia
*2: Only for G.C.C. Countries

5. Main Components of Engine Control System

General

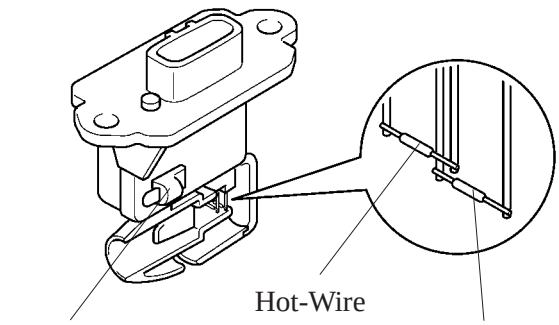
The following table compares the main components of the 2JZ-GE engine in the new and previous models.

Component \ 2JZ-GE Engine		New	Previous
Mass Air Flow Meter		Hot-Wire Type	←
Throttle Position Sensor		Linear Type, 2	Linear Type, 1
Accelerator Pedal Position Sensor		Linear Type, 2	—
Crankshaft Position Sensor		Pick-Up Coil Type, 1	←
Camshaft Position Sensor		Pick-Up Coil Type, 1	—
Distributor	Crankshaft Position Sensor	—	Pick-Up Coils Type, 1
	Camshaft Position Sensor	—	Pick-Up Coil Type, 2
Knock Sensor		Built-In Piezoelectric Element Type, 2	←
Oxygen Sensor*1		Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2) (Bank 2, Sensor 1) (Bank 2, Sensor 2)	Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2) (Bank 2, Sensor 1)
Injector		4-Hole Type with Air Assist	2-Hole Type with Air Assist*1 2-Hole Type without Air Assist*2
ISC Valve		—	Step Motor Type

*1: Only for Europe
*2: Only for G.C.C. Countries

Air Flow Meter

The hot wire type air flow meter has been changed to the plug-in type. Its basic operation is the same as that of the previous type.

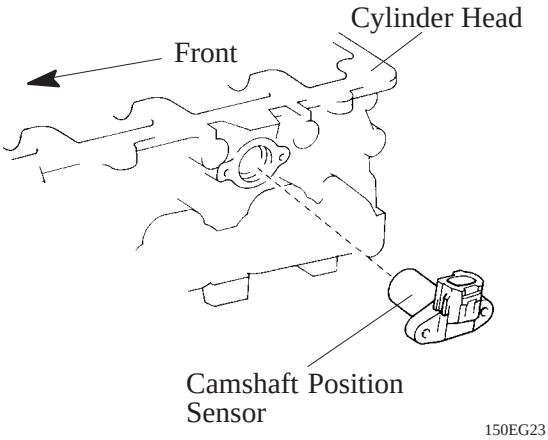


150EG29

EG

Camshaft Position Sensor

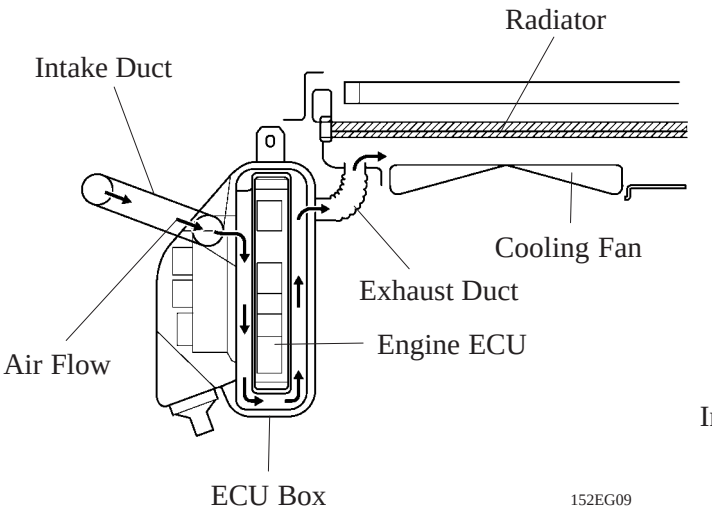
The camshaft position sensor is mounted on the intake side of the cylinder head.
The timing rotor is integrated with the intake camshaft.
The camshaft position sensor outputs 3 pulses for every 2 crankshaft revolutions.



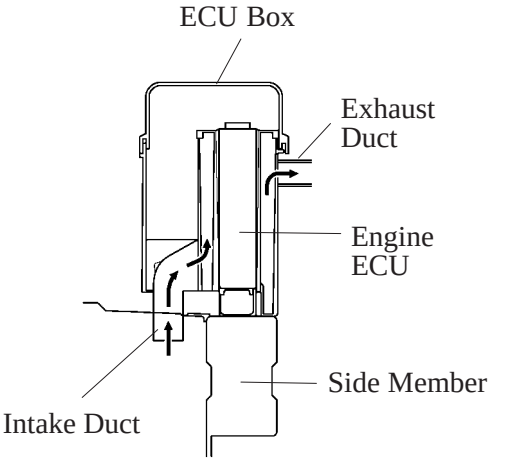
150EG23

Engine ECU

- On the previous model, the engine ECU was installed on the passenger's floor. However, on the new GS300, the engine ECU is installed in the ECU box in the engine compartment. As a result, the wiring harness has been shortened, thus realizing weight reduction.
- Utilizing the vacuum that is generated by the radiator coolingfan, airflow is introduced through the ECU box to restrain theincrease in the temperature in the ECU box.



152EG09

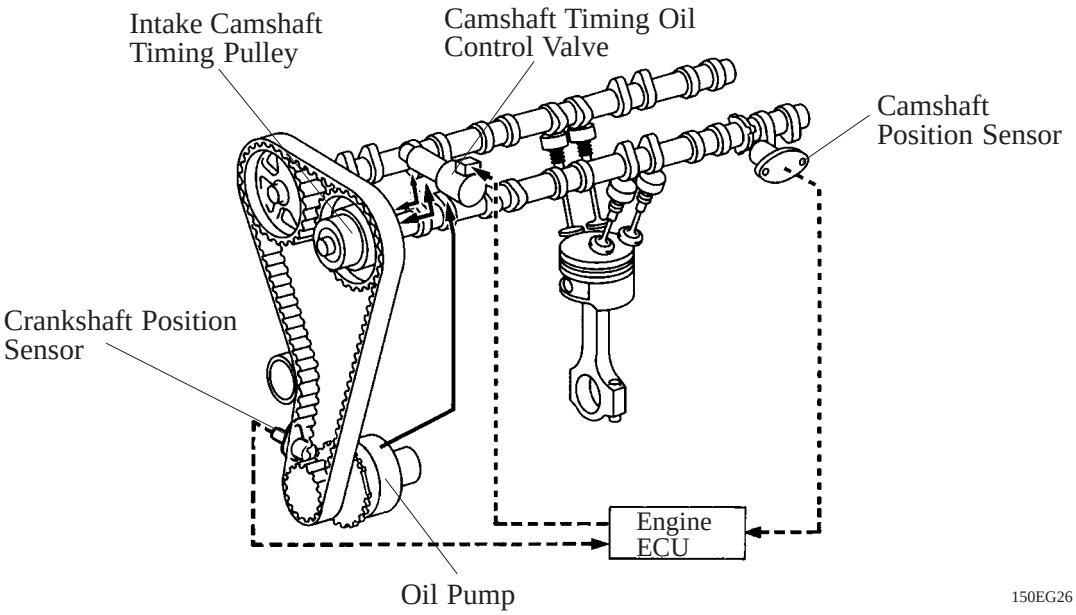


152EG10

6. VVT-i (Variable Valve Timing-intelligent) System

General

The VVT-i system is designed to control the intake camshaft within a wide range of 60° (of crankshaft angle) to provide a valve timing that is optimally suited to the engine condition, thus realizing improved torque in all the speed ranges and fuel economy, and reduce exhust emissions.

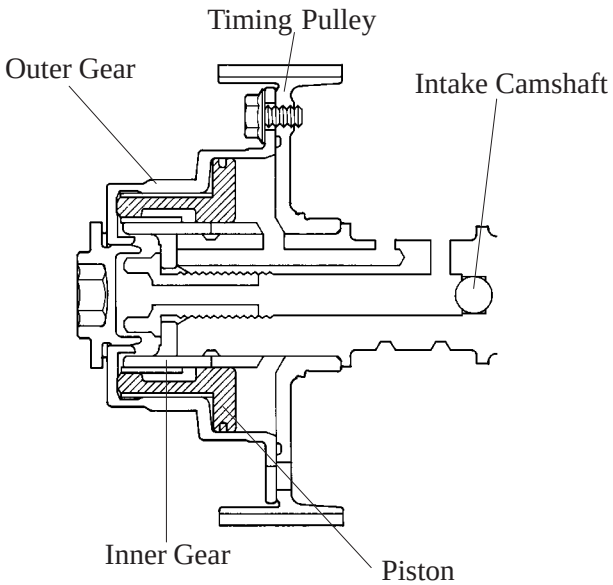


150EG26

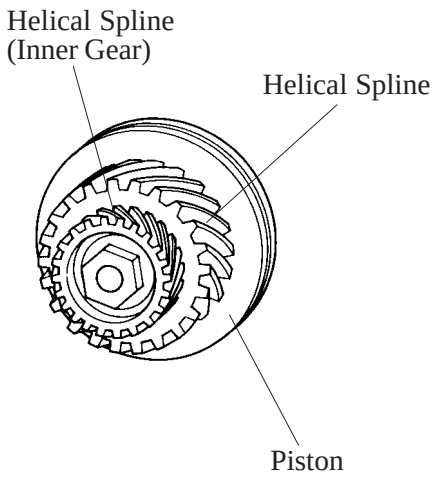
Construction and Operation

1) Intake Camshaft Timing Pulley

The intake camshaft timing pulley comprises the outer gear that is driven by the timing belt, the inner gear that is affixed to the camshaft and a movable piston that is placed between the outer gear and inner gear. Having helical splines (twisted, vertical grooves) on its inner and outer periphery, the piston moves in the axial direction to shift the phase of the outer gear and inner gear, thus causing the valve timing to change continuously.



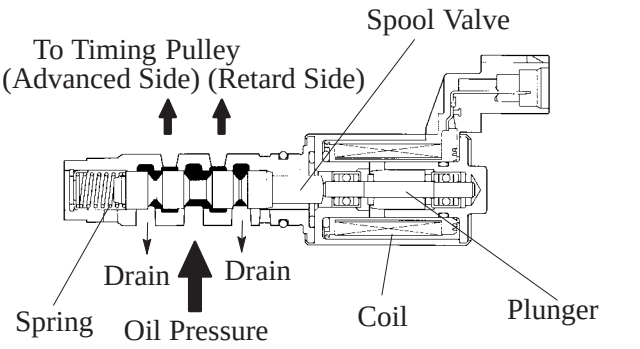
150EG27



150EG28

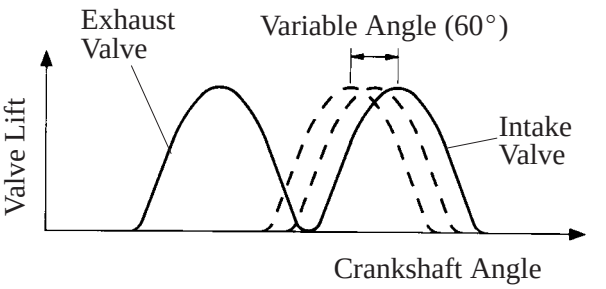
2) Camshaft Timing Oil Control Valve

- The camshaft timing oil control valve controls the spool valve position in accordance with the command of the engine ECU thus allocating the hydraulic pressure that is applied to the intake camshaft timing pulley to the advance and the retard side. When the engine is stopped, the camshaft timing oil control valve is in the most retarded state.



150EG30

- By the command of the engine ECU, when the camshaft timing oil control valve is in the position given in Fig. 1, hydraulic pressure is applied from the left side of the piston, which causes the piston to move to the right. Because of the twist in the helical splines that are cut out in the piston, the intake camshaft rotates in the advance direction in relation to the camshaft timing pulley. When the camshaft timing oil control valve is in the position given in Fig. 2, the piston moves to the left and rotates in the retard direction. Furthermore, the camshaft timing oil control valve shuts off the oil passages to maintain the hydraulic pressure at both sides of the piston, thus maintaining the phase at that position. This enables the phase to be set to a desired position.



Valve Timing

150EG31

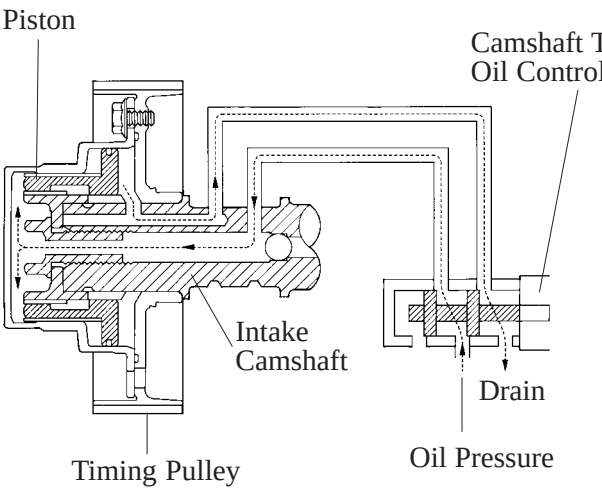


Fig. 1

150EG32

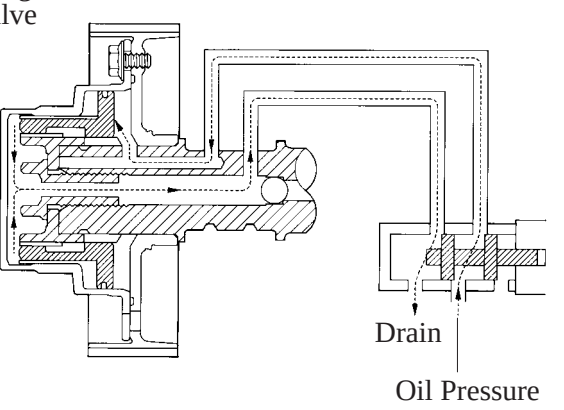


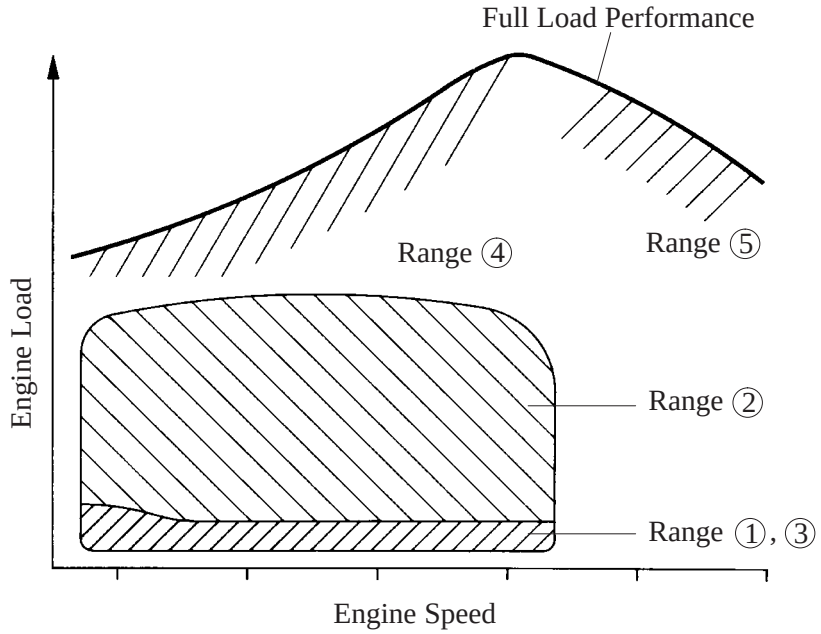
Fig. 2

150EG33

3) Engine ECU

In proportion to the engine speed, intake air volume, throttle position and coolant temperature, the engine ECU searches an optimal valve timing under each driving condition and control the camshaft timing oil control valve, in addition, the engine ECU uses signal from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus performing feedback control to achieve the target valve timing.

▶ Operation During Various Driving Conditions ◀



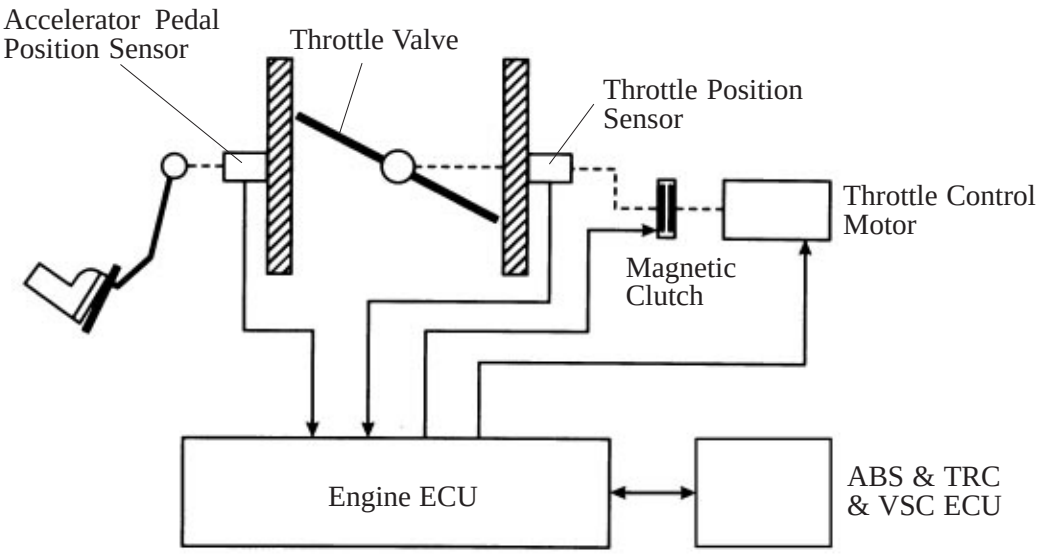
150EG34

Range	Conditions	Operation
①	Idle operation	The valve timing is set to the advance angle 0° (most retarded angle), and because of the lack of overlap, the idle rpm is stabilized.
②	Medium load range	The valve timing is advanced to increase the amount valve overlap. Thus, the internal EGR rate is increased and the pumping loss is decreased resulting in improved fuel economy.
③	Low load range	The valve timing is retarded to decrease the amount of valve overlap, thus ensuring the engine's stability.
④	High load, low- to medium-speed range	The valve timing is advanced to advance the timing of the closing of the intake valve. The volumetric efficiency is thus improved resulting in improved low- to medium-speed range torque.
⑤	High load, high speed range	The valve timing is retarded to retard the timing of the closing of the intake valve resulting in improved volumetric in the high-speed range.
—	Engine started and stopped	When the engine is started and stopped, the valve timing is at the most retarded state.
—	Low-temperature operation	The valve timing is at the advance angle 0° (most retarded angle) without any valve overlap. This prevents the fuel from flowing back and minimizes the need for transient increase of fuel. Furthermore, because the idle rpm is stabilized, the fast idle rpm can be lowered than that of the previous engine, thus improving fuel economy during low-temperature engine operation.

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

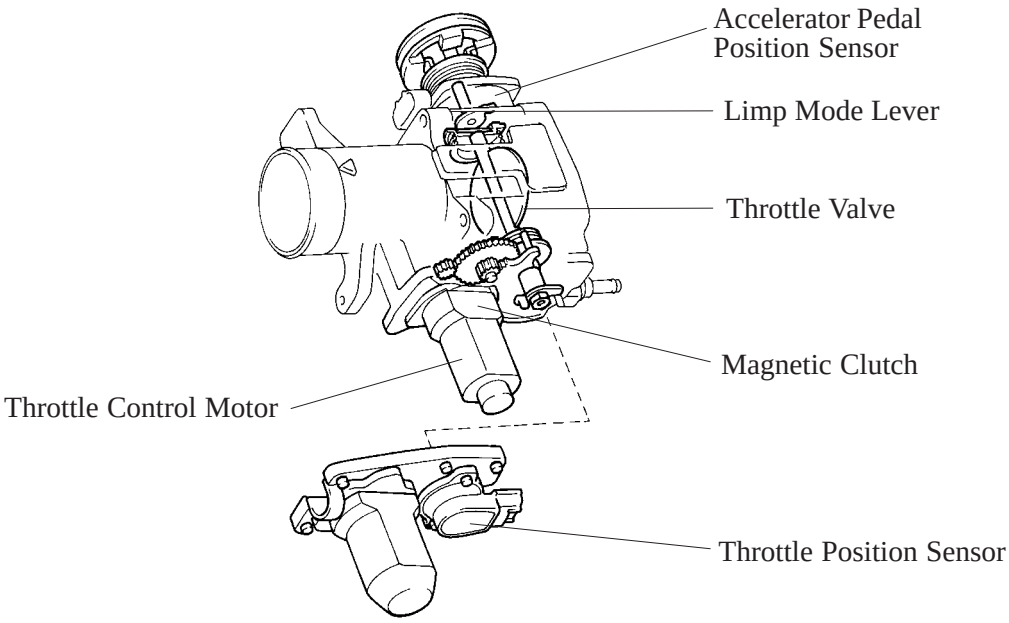
General

- The ETCS-i system, which realizes excellent throttle control in all the operating ranges, has been adopted.
- In the conventional throttle body, the throttle valve opening is determined invariably by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the engine ECU 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, and the VSC (Vehicle Stability Control).
- A duplicate system is provided to ensure a high level of reliability, and the system shuts off in case of an abnormal condition. Even when the system is shut off, the accelerator pedal can be used to operate the vehicle in the limp mode.



150EG41

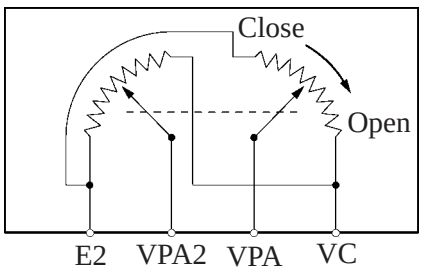
Construction



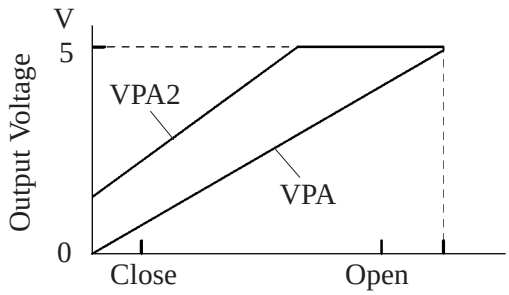
150EG36

1) Accelerator Pedal Position Sensor

The accelerator pedal position sensor, which is mounted on the throttle body, is integrated with the throttle lever, which is connected to the cable that extends from the accelerator pedal.
The accelerator pedal position sensor converts the amount of accelerator pedal effort into two types of electrical signals with distinct output characteristics. The signals are then input into the engine ECU.



150EG40



150EG39

Accelerator Pedal Depressed Angle

2) Throttle Position Sensor

The throttle position sensor converts the throttle valve opening into an electrical signal and inputs into the engine ECU. The output characteristics are the same as those of the accelerator pedal position sensor.

3) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The engine ECU 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.

4) Magnetic Clutch

Ordinarily, the magnetic clutch engages the clutch to enable the throttle control motor to open and close the throttle valve. In case that a malfunction occurs in the system, this clutch is disengaged to prevent the throttle control motor to open and close the throttle valve.

Operation

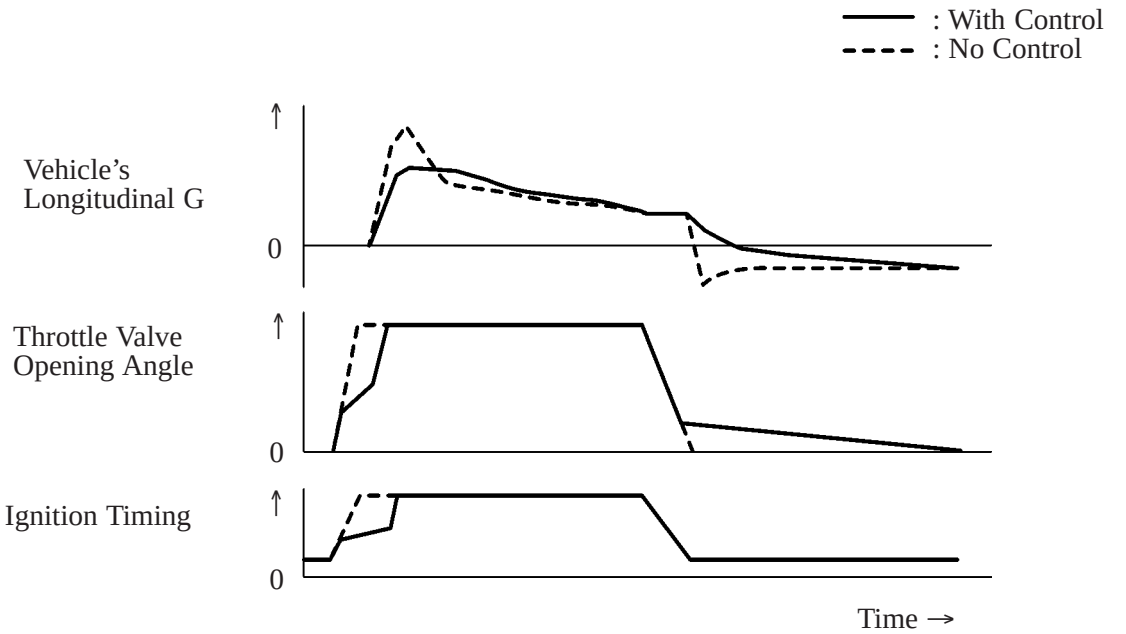
The engine ECU drives the throttle control motor by determining the target throttle valve opening in accordance with the respective operating condition.

1) Non-linear Control
2) Idle Speed Control
3) Shift Shock Reduction Control
4) TRC Throttle Control
5) VSC Coordination Control
6) Cruise Control

1) 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.

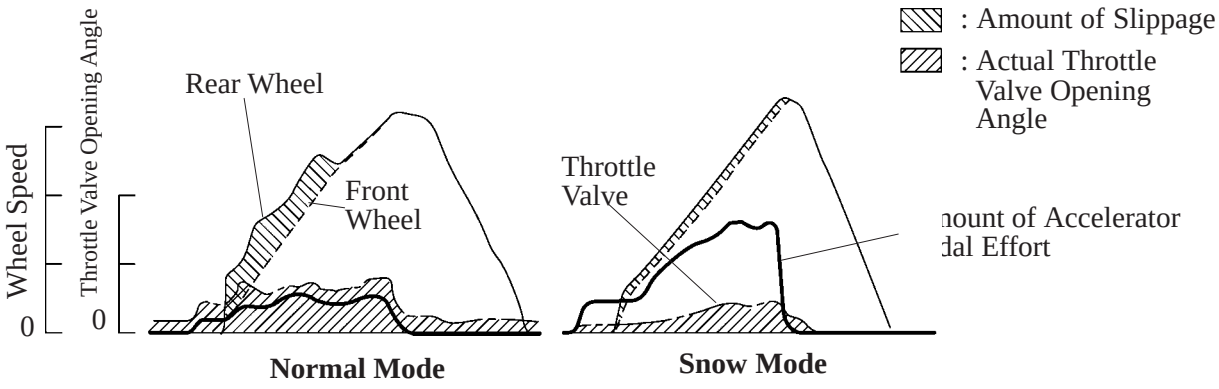
▶ Control Examples During Acceleration and Deceleration ◀



150EG37

- In situations in which low-μ surface conditions can be anticipated, such as when driving in the snow, the throttle valve can be controlled to help vehicle stability while driving over the slippery surface. This is accomplished by turning ON the SNOW switch, which, in response to the amount of the accelerator pedal effort that is applied, reduces the engine output from that of the normal driving level.*

▶ Control Example During Startoff Acceleration in 1st Gear on Packed Snow Surface (TRC OFF) ◀



*: Except for the G.C.C. Countries Models

151EG40

2) Idle Speed Control

Previously, a step motor type ISC valve was used to perform idle speed control such as fast idle during cold operating conditions and idle-up. In conjunction with the adoption of the ETCS-i, idle speed control is now performed by the throttle control motor, which controls the throttle valve opening.

3) Shift Shock Reduction Control

The throttle control is synchronized to the ECT (Electronically Controlled Transmission) control during the shifting of the transmission in order to reduce the shift shock.

4) TRC Throttle Control

As part of the TRC system, the throttle valve is closed by a demand signal from the ABS & TRC & VSC ECU if an excessive amount of slippage is created at a driving wheel, thus facilitating the vehicle in ensuring stability and driving force.

5) VSC Coordination Control

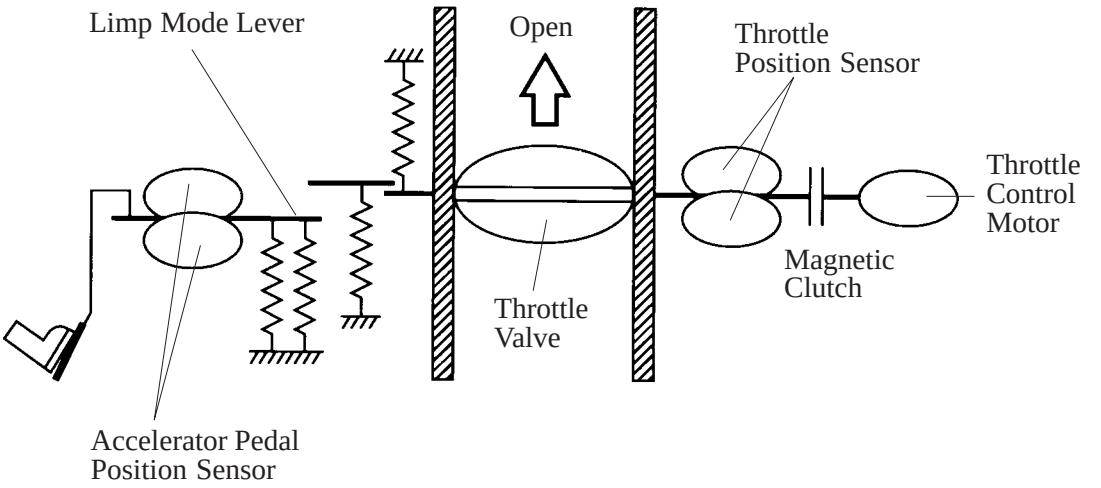
In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the ABS & TRC & VSC ECU.

6) Cruise Control

Previously, the vehicle speed was controlled by the cruise control actuator, which opened and closed the throttle valve. Along with the adoption of the ETCS-i, the vehicle speed is now controlled by the throttle control motor, which controls the throttle valve.

Fail-Safe

If an abnormal condition occurs with the ETCS-i, the Check Engine Lamp illuminates to alert the driver. At the same time, the current to the throttle control motor and magnetic clutch are cut off in order not to operate the ETCS-i. This enables the return spring to close the throttle valve.
Even in this situation, the accelerator pedal can be used to operate the limp mode lever, which operates the throttle valve to enable the vehicle to be driven in the limp mode.



150EG42

Diagnosis

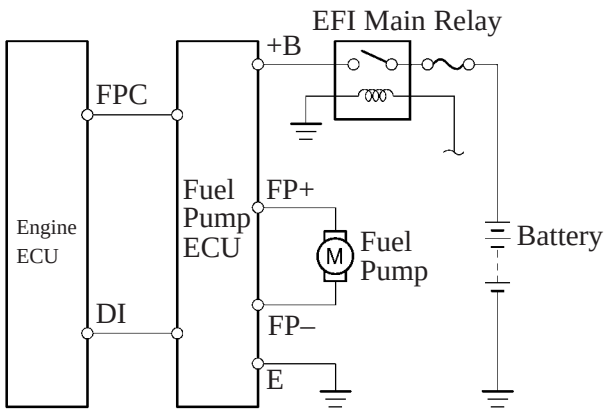
If the diagnostic trouble code 89 is being output to the check engine lamp, it means that the engine ECU has detected a malfunction in the ETCS-i, and outputs the diagnostic trouble code of the ETCS-i to the "Snow" indicator light*.
Also, the diagnostic trouble code can be output to a hand-held tester via the data link connector 3.
For details, refer to the Lexus GS300 Repair Manual (Pub. No. RM588E).

*: "ETCS" indicator light on the models for the G.C.C. countries.

8. Fuel Pump Control

The fuel pump speed control has been changed from the 2-step type of the previous model to the 3-step type.

▶ System Diagram ◀



152EG11

FPC Signal	Fuel Pump Speed
5V / 0V	Hi
8.2 ms, 5V / 0V	Mid
4.1 ms, 5V / 0V	Low
5V / 0V	Stop

152EG12

9. Engine Immobiliser System

The transponder key computer, which was previously separate, is now enclosed in the engine ECU. For details, see page 136.

10. Function to Communicate with Multiplex Communication System

The engine ECU communicates with the meter ECU, air conditioning ECU, body ECU, etc., of the multiplex communication system.

The main output signals from the engine ECU are as follows:

- Signals to the Indicator Lights in the Speedometer (Oil Pressure Signal, Oil Level Signal and Alternator L Terminal Signal)
- Engine Coolant Temp. Signal
- Engine Speed Signal
- Signals related to the Air Conditioning System (Refrigerant Pressure Signal and Compressor Speed Signal)

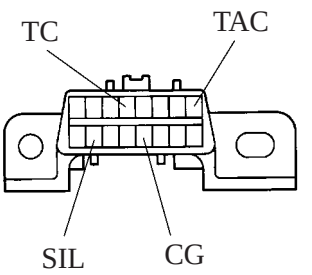
The main input signals to the engine ECU are as follows:

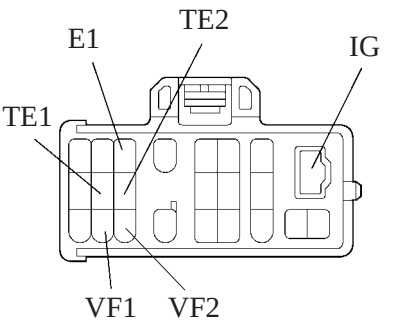
- Air Conditioning Signal
- Electrical Load Signal (Taillight and Rear Window Defogger System)
- Pattern Select Switch Signal (Power, Snow)

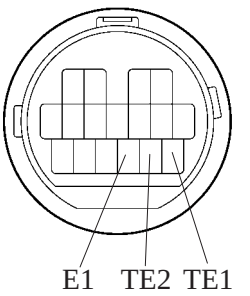
EG

11. Diagnosis System

The M-OBD (Multiplex On-Board Diagnostic) system that has been adopted in the 2JZ-GE engine is a system that has been improved upon the previous diagnostic system in order to perform troubleshooting in a more efficient and accurate manner.
The functions of the M-OBD system can be fully utilized through the use of a hand-held tester.
The following table compares the diagnostic system fo the new and previous 2JZ-GE engine.

<table>
<tr><th>Engine
Item</th><th>New</th><th>Previous</th></tr>
<tr><td>Check Connector and Data Link Connector</td><td>The TDCL has been discontinued, and a DLC3 (Data Link Connector 3) has been newly provided. In addition, the check connector terminals TE1, TE2, and IG have been discontinued.
▶ DLC3 ◀
 

140EG127
CG: Chassis Ground
SIL: Provides communication between the engine ECU and the hand-held tester.
TAC: Outputs the engine speed signal.
TC: Provides the same function as the previous TE1 terminal.</td><td>The check connector and TDCL are provided.
▶ Check Connector ◀
 

140EG39
▶ TDCL ◀
 

144EG05</td></tr>
<tr><td>Diagnostic Trouble Code Check Method</td><td>After connecting terminals TC and CG of the DLC3, displays the code on CHECK Engine Lamp in the combination meter.</td><td>After connecting terminals TE1 and E1 of the check connector or TDCL, displays the code on CHECK Engine Lamp in the combination meter.</td></tr>
<tr><td>Output Engine ECU Data</td><td>The engine ECU’s control data can be output by connecting the hand-held tester to the DLC3.
Output Data Speed: 9.6 kbps</td><td>The engine ECU’s control data can be output by connecting the hand-held tester to the check connector or TDCL.
Output Data Speed: 125 bps</td></tr>
</table>

Furthermore, on the 2JZ-GE engine, the functions listed below can be utilized by connecting the hand-held tester to the DLC3.

Function	Details
Diagnostic Trouble Code	The system can output 5-digit diagnostic trouble codes to the tester, which are more detailed than the previous 2-digit diagnostic trouble codes, thus making it easier to identify the location of the problem. Example: Code 28 (Oxygen Sensor) → P0130 (Oxygen Sensor) → P0135 (Oxygen Sensor Heater)
Freeze-Frame Data	The system can output freeze-frame data to the tester. This data (which depicts the condition of the engine control system and the vehicle) is stored in the engine ECU at the very moment when the engine ECU has detected its last data of malfunction.
Active Test	Through the use of the tester, the actuators (VSV, fuel pump, VVT-i system, etc.) can be activated to a desired state.
Trouble Code Clear	Through the use of the tester, trouble codes that are stored in the engine ECU can be cleared.

- For details on the diagnostic trouble codes, active test, etc. described above, refer to the Lexus GS300 Repair Manual (Pub. No. RM588E).
- For details of the hand-held tester, refer to the Hand-Held Tester Operator's Manual.