ENGINE CONTROL SYSTEM

1. General

The engine control system of the 1UR-FSE engine has the following features.

<table>
<tr><th colspan="2">System</th><th>Outline</th></tr>
<tr><td colspan="2">D-4S SFI
[Sequential Multiport Fuel Injection]
[See page EG-79]</td><td>● A D-4S SFI system directly detects the intake air mass with a hot-wire type mass air flow meters.
● The D-4S (Direct injection 4-stroke gasoline engine Superior version) system is a fuel injection system which combines direct injection injectors and port injection injectors.
● Based on signals from each sensor, the ECM controls the injection volume and timing of each type of injector (direct and port injection types) according to the engine speed and the engine load in order to optimize combustion conditions.</td></tr>
<tr><td colspan="2">ESA
[Electronic Spark Advance]</td><td>● Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.
● This system selects the optimal ignition timing in accordance with the signals received from the sensors and sends the ignition signal (IGT) to the igniters.</td></tr>
<tr><td colspan="2">ETCS-i
[Electronic Throttle Control System-intelligent]
[See page EG-82]</td><td>Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the conditions of the engine and the vehicle.</td></tr>
<tr><td colspan="2">Dual VVT-i
[Variable Valve Timing-intelligent]
[See page EG-85]</td><td>● Controls the intake and exhaust camshafts to an optimal valve timing in accordance with the engine conditions.
● The intake side is VVT-iE and uses an electric motors to control the valve timing. The exhaust side is VVT-i and uses engine oil pressure to control the valve timing.</td></tr>
<tr><td colspan="2">ACIS
[Acoustic Control Induction System]
[See page EG-95]</td><td>The intake air passages are switched according to the engine speed and throttle valve opening angle to provided high performance in all speed ranges.</td></tr>
<tr><td rowspan="2">Fuel Pump Control</td><td>For High Pressure Side</td><td>Regulates the fuel pressure within a range of 4 to 13 MPa in accordance with the driving conditions.</td></tr>
<tr><td>For Low Pressure Side
[See page EG-97]</td><td>● Fuel pump operation is controlled by signals from the ECM.
● The fuel pump is stopped, when the SRS airbag is deployed in a frontal, side, or rear side collision.</td></tr>
<tr><td colspan="2">Air Fuel Ratio Sensor and Heated Oxygen Sensor Heater Control</td><td>Maintains the temperature of the air fuel ratio sensors and heated oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.</td></tr>
<tr><td colspan="2">Air Conditioning Cut-off Control</td><td>By turning the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.</td></tr>
<tr><td colspan="2">Cooling Fan Control
[See page EG-98]</td><td>The cooling fan ECU steplessly controls the speed of the fans in accordance with the engine coolant temperature, vehicle speed, engine speed, and air conditioning operating conditions. As a result, the cooling performance is improved.</td></tr>
<tr><td colspan="2">Starter Control
[Cranking Hold Function]
[See page EG-100]</td><td>Once the engine switch is pushed, while the brake pedal is depressed, this control continues to operate the starter until the engine started.</td></tr>
</table>

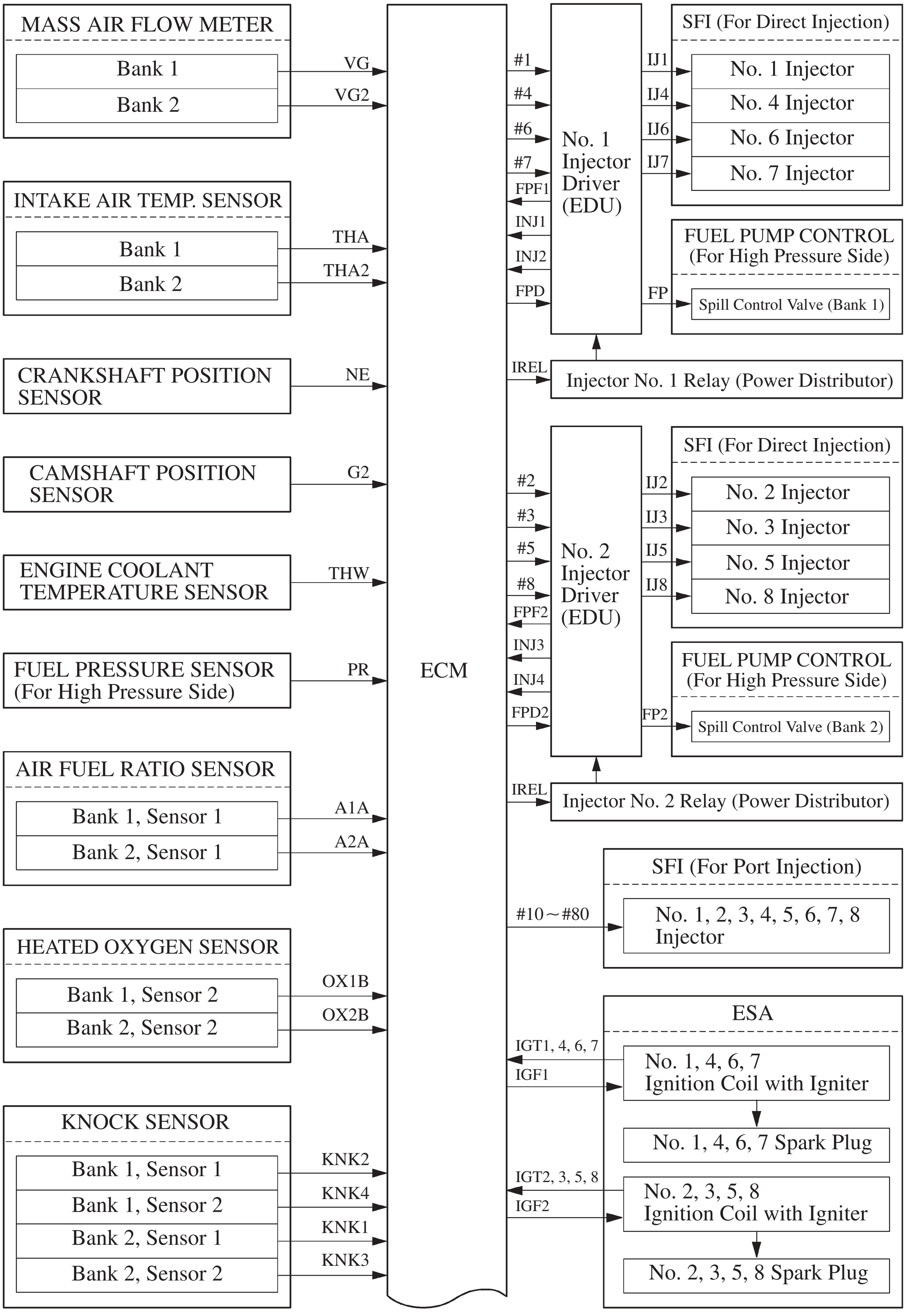
(Continued)

System	Outline
Charging Control Function	● The ECM lowers the generated voltage when the vehicle is idling or is being driven at a constant speed, and raises the generated voltage when the vehicle is decelerating. This reduces the load on the engine, contributing to the fuel economy of the engine. ● This function is one of the functions of the electric power control system. For details, see page BE-32.
Oil Replacement Reminder* [See page EG-102]	Based on the driven distance of the vehicle, the ECM reminds the driver of the need to replace the engine oil via the multi-information display.
Evaporative Emission Control [See page EG-104]	● The ECM controls the purge flow of evaporative emission (HC) in the canister in accordance with the engine conditions. ● Approximately five hours after the power source has been turned OFF, the ECM operates the pump module to detect any evaporative emission leakage occurring between the fuel tank and the canister through changes in the fuel tank pressure.
Engine Immobilizer	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid key.
Diagnosis [See page EG-116]	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.
Fail-Safe [See page EG-116]	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

*: Only for U.S.A. models

2. Construction

The configuration of the engine control system is as shown in the following chart.



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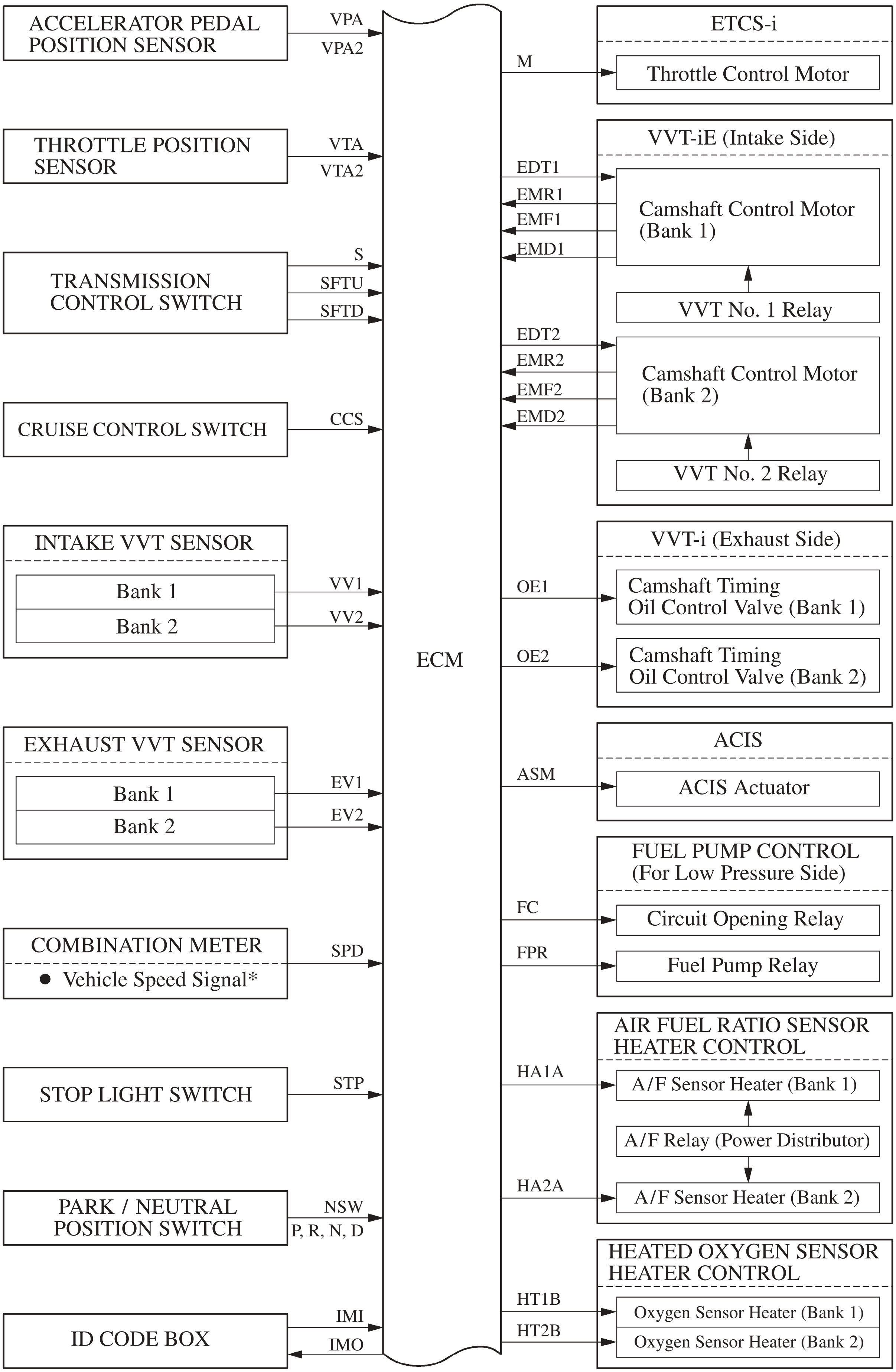

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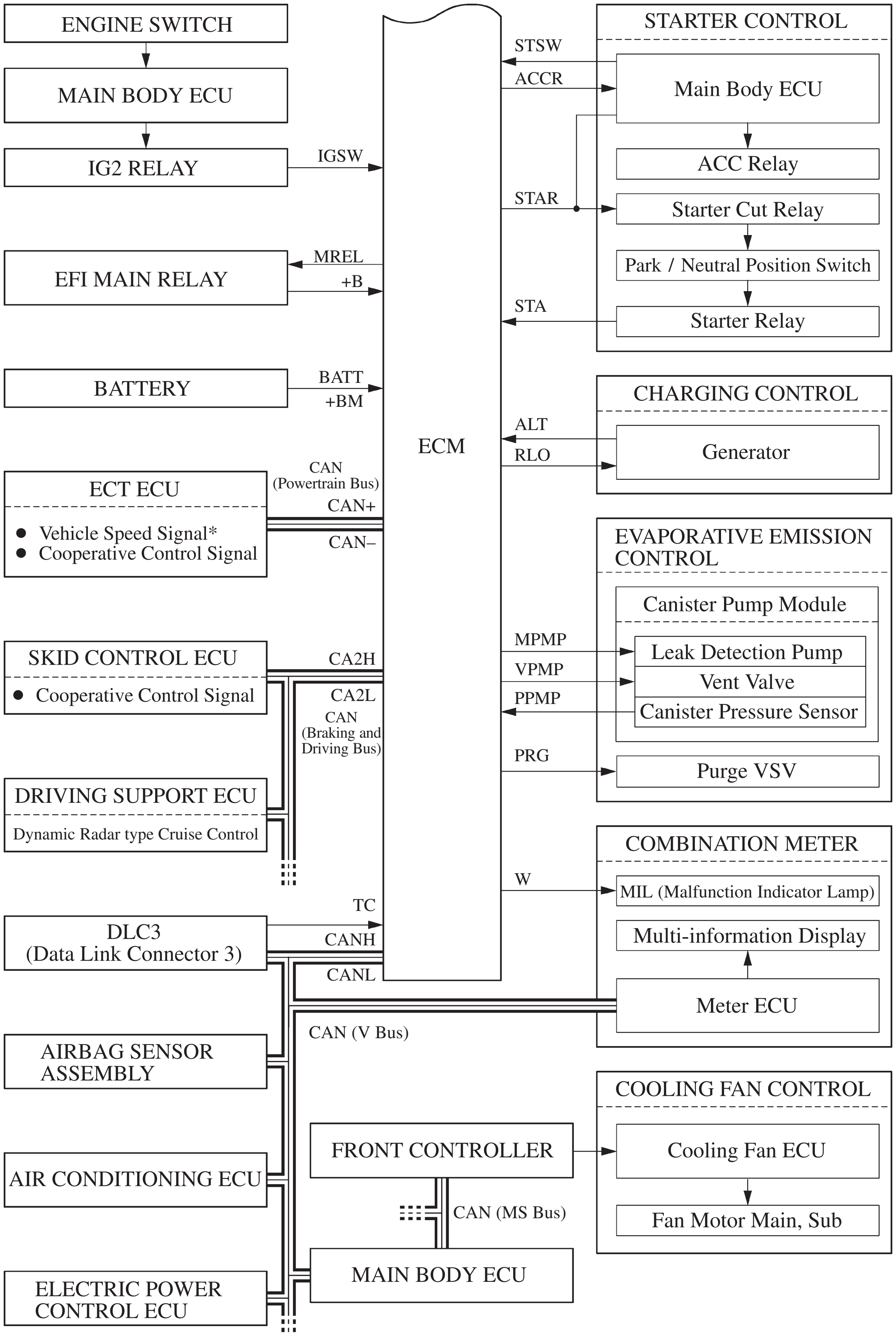
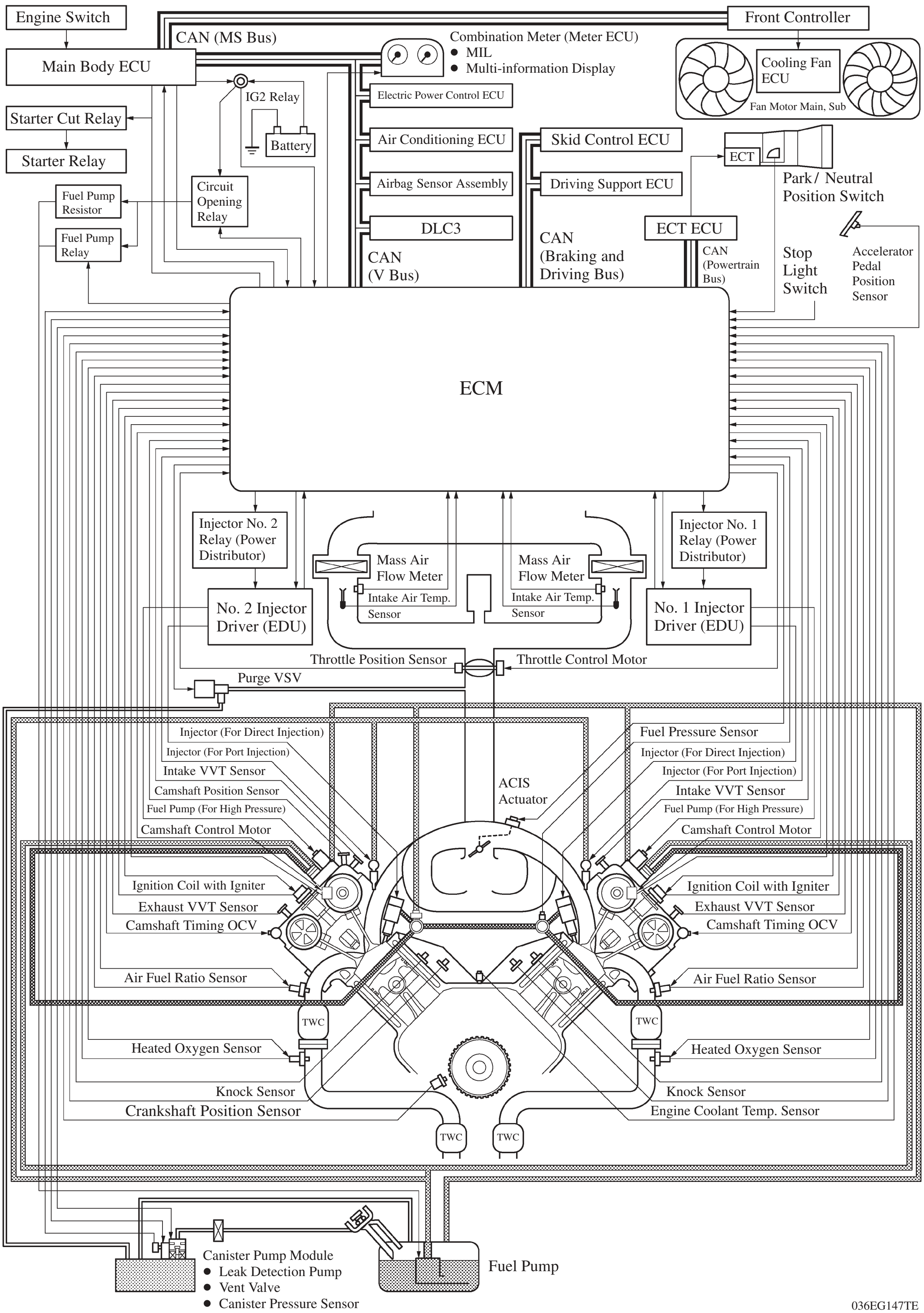
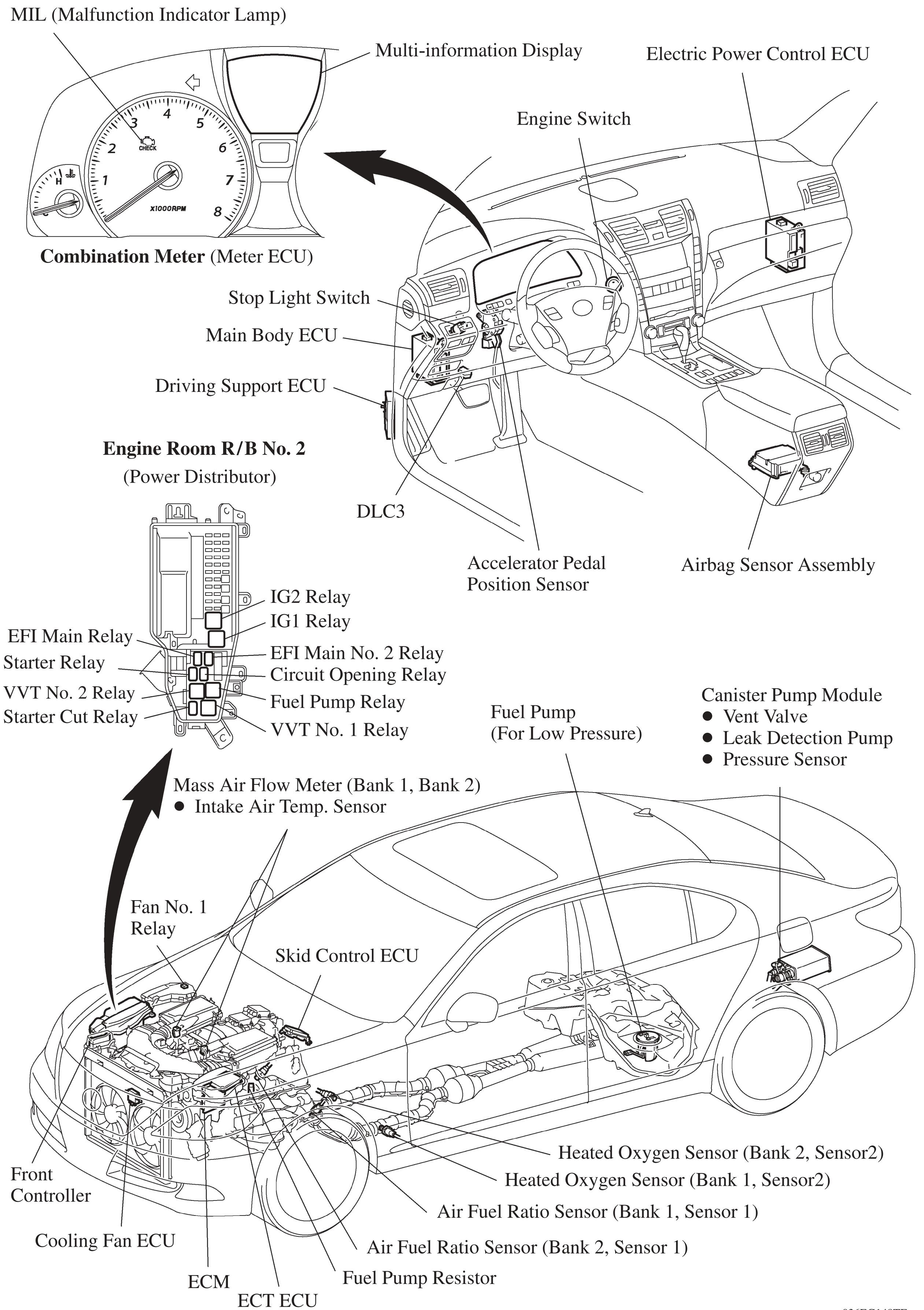


*: The vehicle speed signal which is used for the engine control is sent from the ECT ECU.

3. Engine Control System Diagram



4. Layout of Main Components



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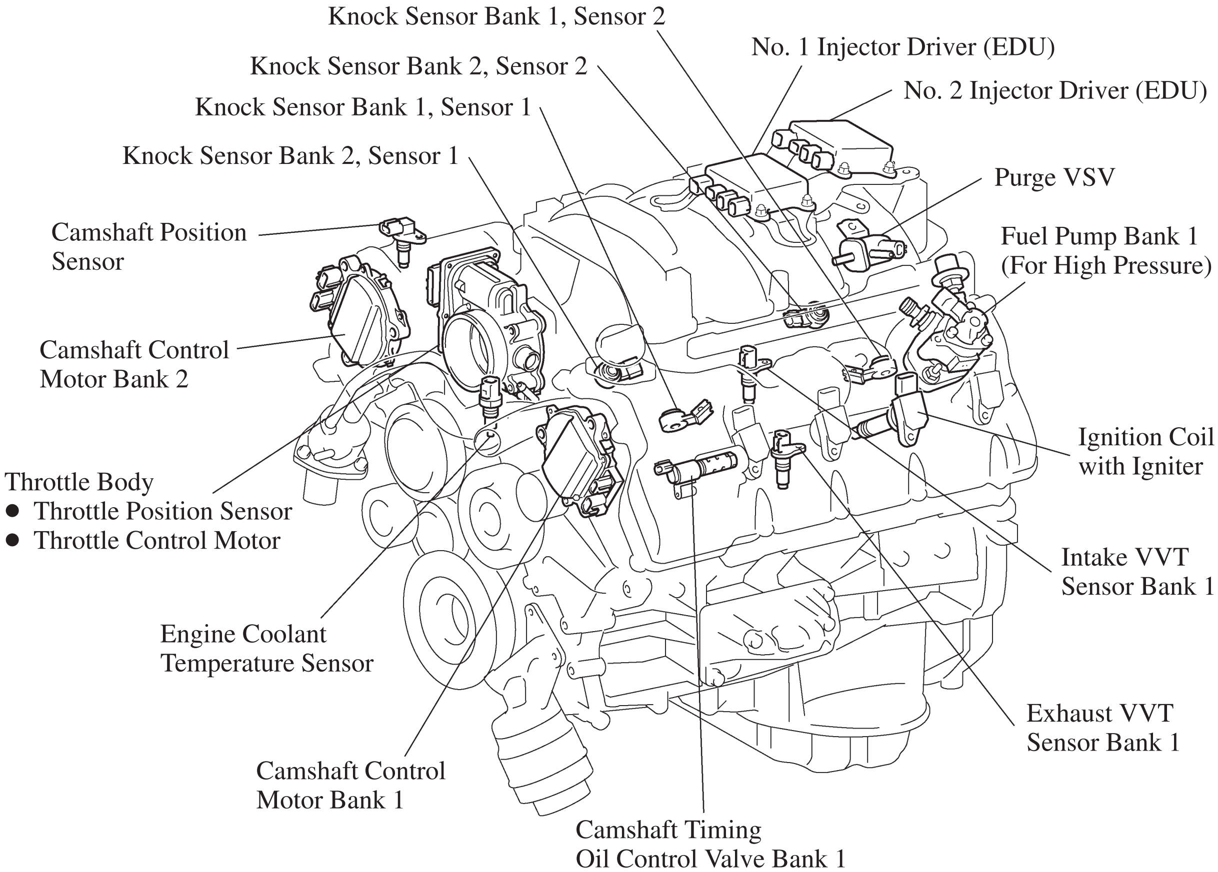
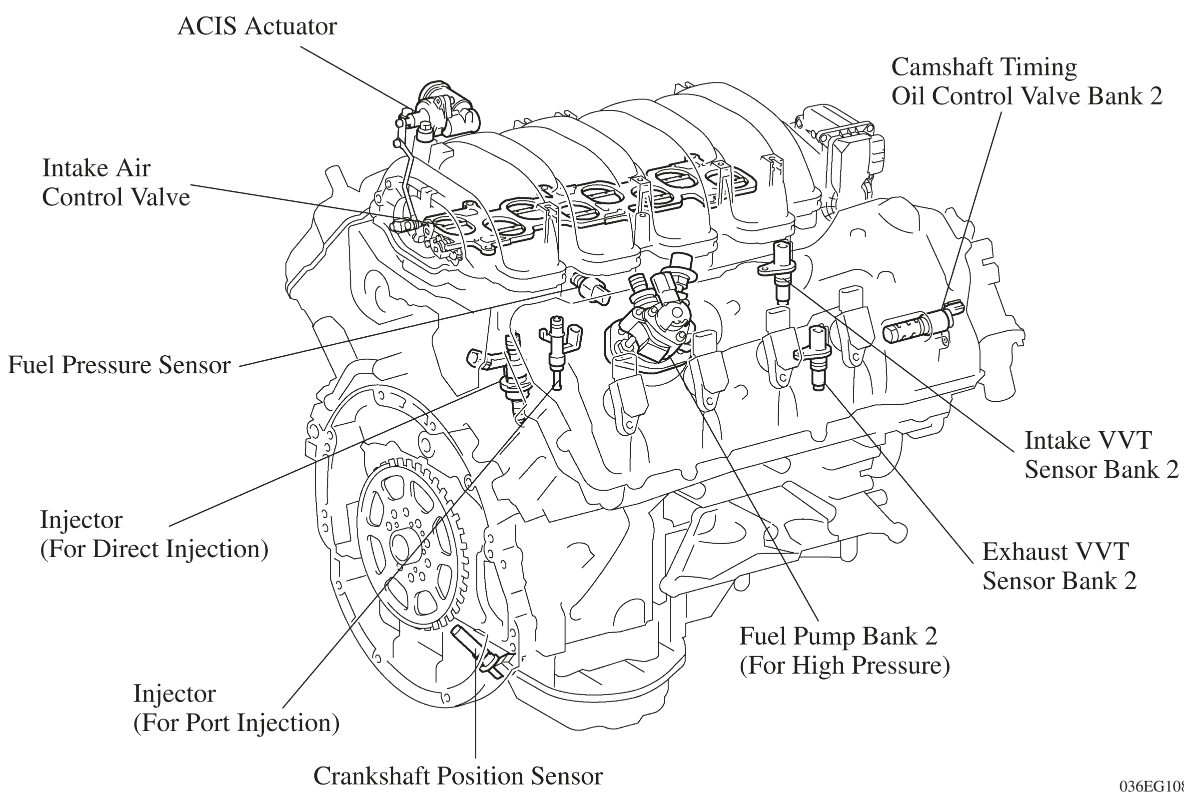

Knock Sensor Bank 1, Sensor 2
Knock Sensor Bank 2, Sensor 2
Knock Sensor Bank 1, Sensor 1
Knock Sensor Bank 2, Sensor 1
No. 1 Injector Driver (EDU)
No. 2 Injector Driver (EDU)
Purge VSV
Camshaft Position Sensor
Fuel Pump Bank 1 (For High Pressure)
Camshaft Control Motor Bank 2
Ignition Coil with Igniter
Throttle Body
● Throttle Position Sensor
● Throttle Control Motor
Intake VVT Sensor Bank 1
Engine Coolant Temperature Sensor
Exhaust VVT Sensor Bank 1
Camshaft Control Motor Bank 1
Camshaft Timing Oil Control Valve Bank 1


ACIS Actuator
Camshaft Timing Oil Control Valve Bank 2
Intake Air Control Valve
Fuel Pressure Sensor
Intake VVT Sensor Bank 2
Injector (For Direct Injection)
Exhaust VVT Sensor Bank 2
Fuel Pump Bank 2 (For High Pressure)
Injector (For Port Injection)
Crankshaft Position Sensor

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5. Main Component of Engine Control System

General

The main components of the 1UR-FSE engine control system are as follows:

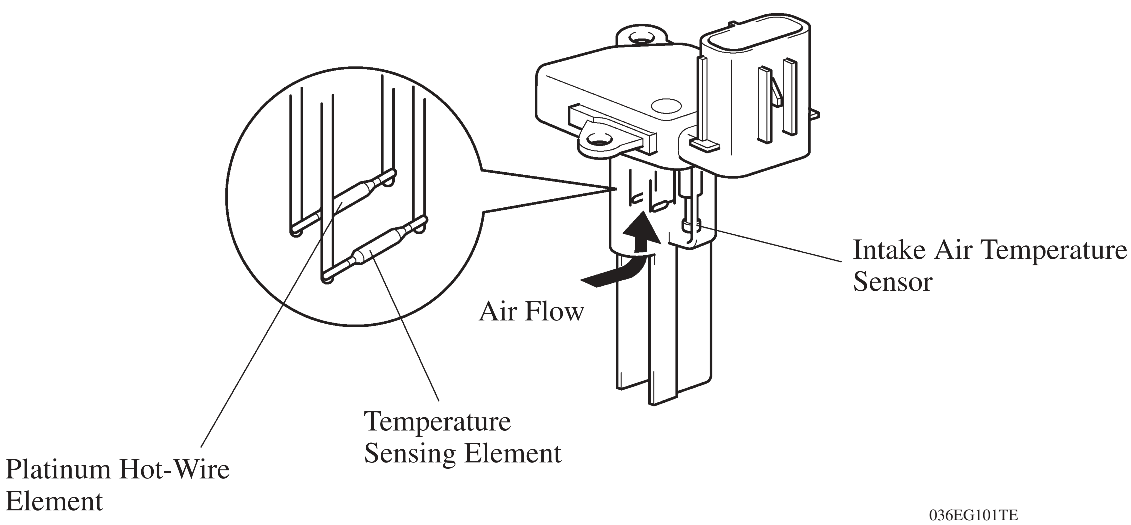
Components	Outline	Quantity	Function
ECM	32-bit CPU	1	The ECM optimally controls the SFI, ESA and ISC to suit the operating conditions of the engine in accordance with the signals provided by the sensors.
Mass Air Flow Meter [See page EG-69]	Hot-wire Type	2	This sensor has a built-in hot-wire to directly detect the intake air mass.
Intake Air Temperature Sensor	Thermistor Type	2	This sensor detects the intake air temperature by means of an internal thermistor.
Crankshaft Position Sensor [See page EG-70]	MRE Type (Rotor Teeth/36-2)	1	This sensor detects the engine speed and the crankshaft position.
Camshaft Position Sensor [See page EG-70]	MRE Type (Rotor Teeth/3)	1	This sensor detects the camshaft position and performs the cylinder identification.
Intake VVT Sensor [See page EG-70]	MRE Type (Rotor Teeth/3)	1 each bank	This sensor detects the actual valve timing.
Exhaust VVT Sensor [See page EG-70]	MRE Type (Rotor Teeth/3)	1 each bank	This sensor detects the actual valve timing.
Accelerator Pedal Position Sensor [See page EG-73]	Hall IC Type (No-contact Type)	1	This sensor detects the amount of pedal effort applied to the accelerator pedal.
Throttle Position Sensor [See page EG-74]	Hall IC Type (No-contact Type)	1	This sensor detects the throttle valve opening angle.
Knock Sensor [See page EG-75]	Built-in Piezoelectric Element (Flat Type)	2 each bank	This sensor detects an occurrence of the engine knocking indirectly from the vibration of the cylinder block caused by the occurrence of engine knocking.
Heated Oxygen Sensor [See page EG-77]	Cup Type with Heater	1 each bank	This sensor detects the oxygen concentration in the exhaust emission by measuring the electromotive force which is generated in the sensor itself.
Air Fuel Ratio Sensor [See page EG-77]	Planar Type with Heater	1 each bank	As with the oxygen sensor, this sensor detects the oxygen concentration in the exhaust emission. However, it detects the oxygen concentration in the exhaust emission linearly.
Engine Coolant Temperature Sensor	Thermistor Type	1	This sensor detects the engine coolant temperature by means of an internal thermistor.
Injector (For Port Injection) [See page EG-46]	12-hole Type	8	This injector contains an electro-magnetically operated nozzle to inject fuel into the intake port.
Injector (For Direct Injection) [See page EG-47]	High Pressure Double Slit Nozzle Type	8	This injector contains a high-pressure electro-magnetically operated nozzle to inject fuel directly into the cylinder.

(Continued)

Components	Outline	Quantity	Function
Injector Driver (EDU) [See page EG-47]	Built-in DC/DC Converter	2	The injector driver converts the signals from the ECM into high-voltage, high-amperage current in order to drive the direct injection injectors.
Camshaft Control Motor [See page EG-89]	EDU-integrated (Brushless Type DC Motor)	1 each bank	The rotational movement of the camshaft control motor changes the intake valve timing by operating the camshaft control actuator in accordance with the signals received from the ECM.
Camshaft Timing Oil Control Valve [See page EG-93]	Electro-Magnetic Coil Type	1 each bank	The camshaft timing oil control valve changes the exhaust valve timing by switching the oil passage that acts on the VVT-i controller in accordance with the signals received from the ECM.

Mass Air Flow Meter

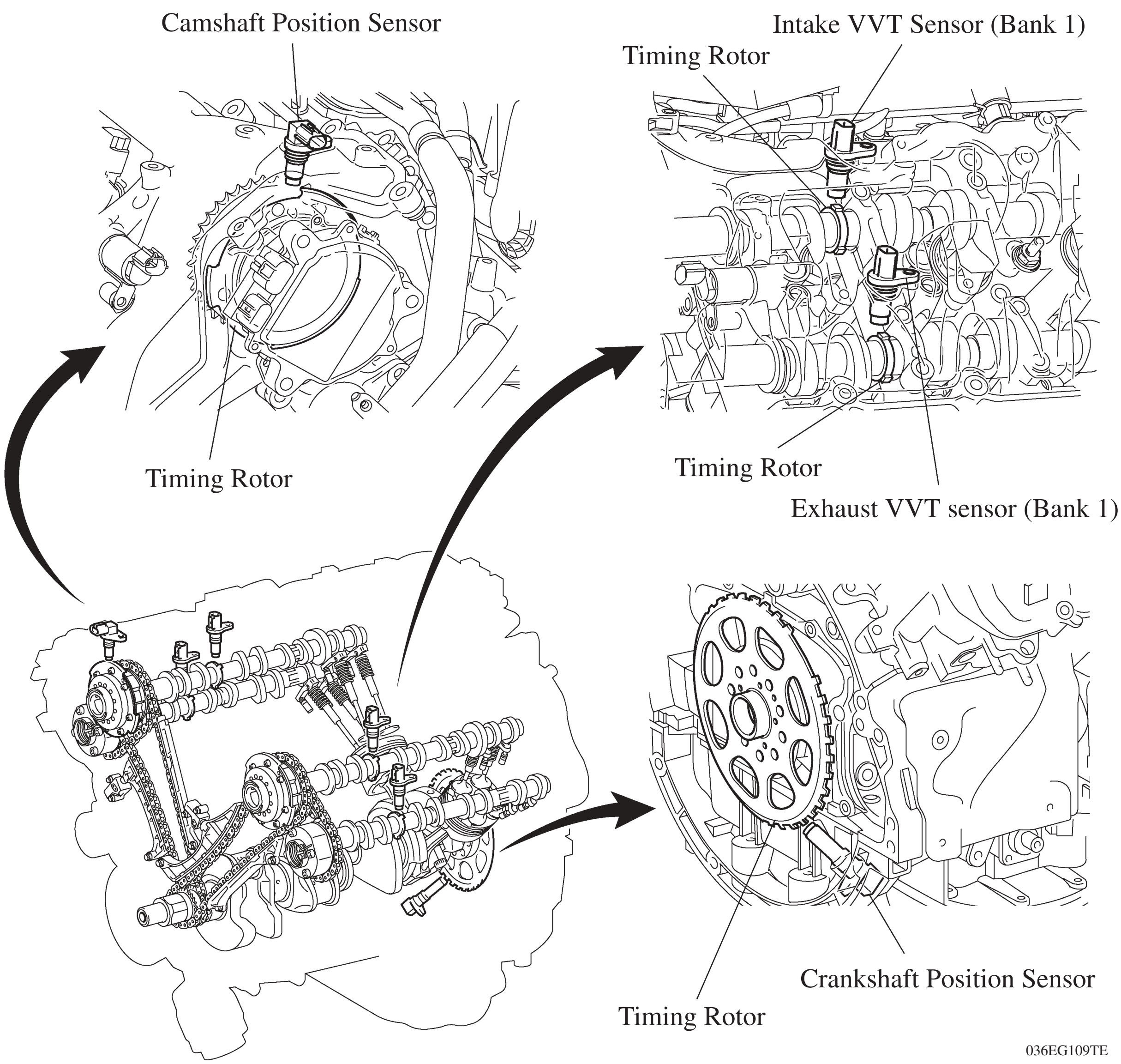
- This mass air flow meter, which is a plug-in type, allows a portion of the intake air to flow through the detection area. By directly measuring the mass and the flow rate of the intake air, the detection precision is improved and the intake air resistance is reduced.
- This mass air flow meter has a built-in intake air temperature sensor.



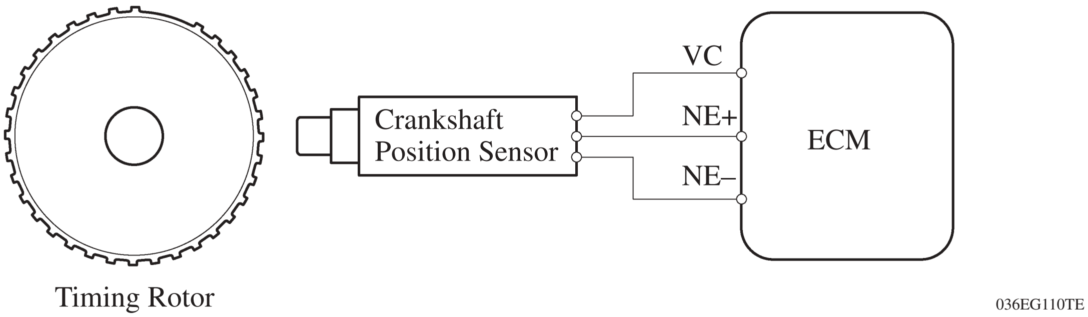
Crankshaft Position and Camshaft Position and VVT Sensors

1) General

- The MRE (Magnetic Resistance Element) sensors are used for the crankshaft position, camshaft position, and VVT sensors.
- The timing rotor for the crankshaft position sensor is installed on the back end of the crankshaft. The timing rotor has 34 teeth, with 2 teeth missing, at 10° intervals. Based on these teeth, the crankshaft position sensor transmits crankshaft position signals (NE signal) consisting of 33 Hi/Lo output pulses every 10° per revolution of the crankshaft, and 1 Hi/Lo output pulse every 30°. The ECM uses the NE signal for detecting the crankshaft position as well as for detecting the engine speed. It uses the missing teeth signal for determining the top-dead-center.
- The camshaft position sensor uses a timing rotor that is installed on the front end of the intake camshaft sprocket of the right bank. Based on the timing rotor, the sensor outputs camshaft position signals (G2 signal) consisting of 6 (3 Hi output, 3 Lo output) pulses for every 2 revolutions of the crankshaft. The ECM compares the G2 and NE signals to detect the camshaft position and identify the cylinder.
- The intake and exhaust VVT sensors use timing rotors that are installed on the intake and exhaust camshafts of each bank. Based on the timing rotors, the sensors output VVT position signals consisting of 6 (3 Hi output, 3 Lo output) pulses for every 2 revolutions of the crankshaft. The ECM compares these VVT position signals to the NE signal to detect the actual valve timing.

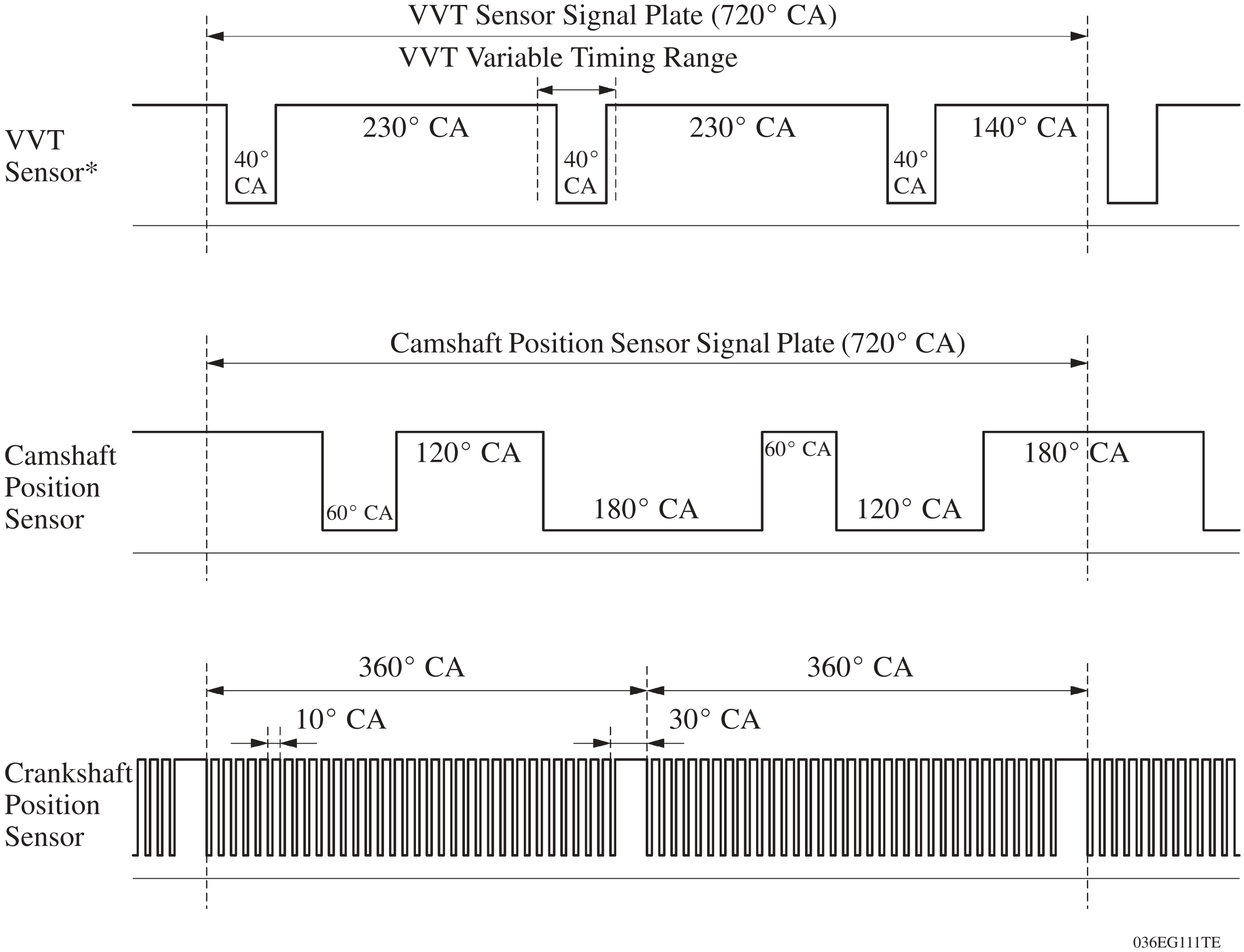


▶ Wiring Diagram ◀



Crankshaft Position Sensor Circuit

▶ Sensor Output Waveforms ◀

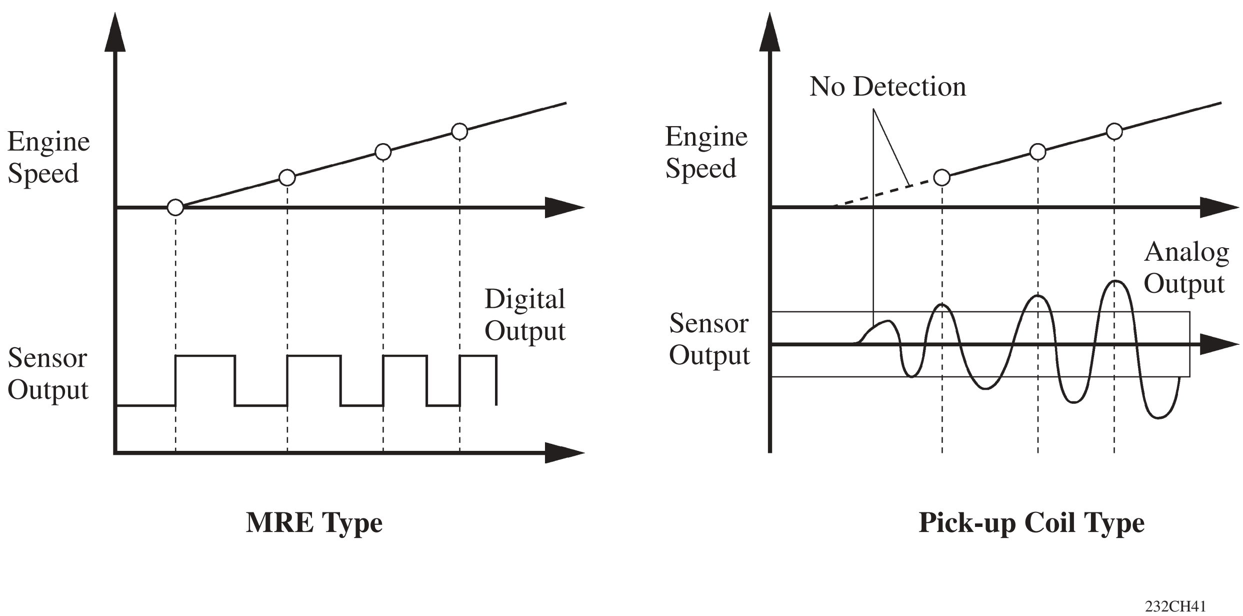


*: This is an example of an output waveform of the intake VVT sensor (bank 2).

2) MRE Type Sensor

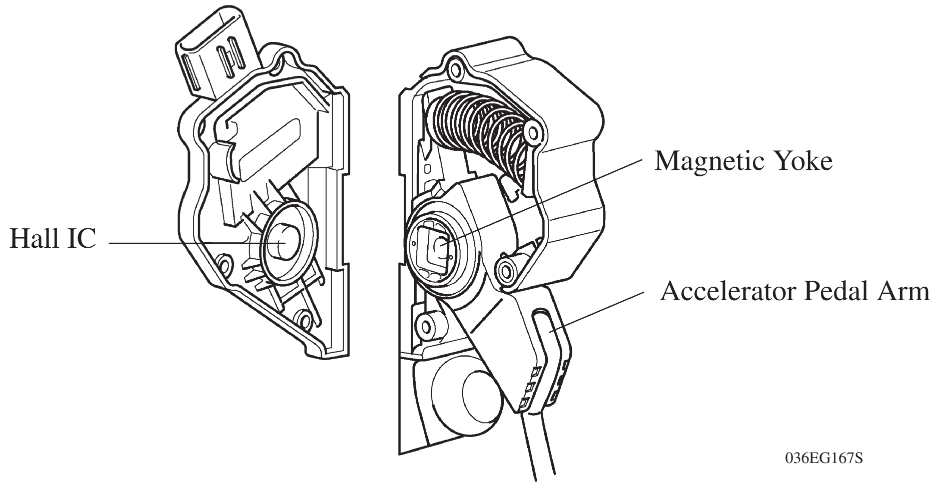
- The MRE type sensor consists of an MRE, a magnet and a sensor.
- The direction of the magnetic field changes due to the different shapes (protruded and non-protruded portions) of the timing rotor, which passes by the sensor. As a result, the resistance of the MRE changes, and the output voltage to the ECM changes to Hi or Lo. Based on the switching timing of the Hi/Lo output voltage, the ECM detects the positions of the crankshaft and camshaft.
- The differences between the MRE type sensor and the pick-up coil type sensor used on a conventional model are as follows.
  - An MRE type sensor outputs a constant level of Hi/Lo digital signals regardless of the engine speed. Therefore, an MRE type sensor can detect the positions of the crankshaft and camshaft at an early stage of cranking.
  - A pickup coil type sensor outputs analog signals with levels that change with engine speed.

▶ MRE Type and Pick-up Coil Type Output Waveform Image Comparison ◀



Accelerator Pedal Position Sensor

- The no-contact type accelerator pedal position sensor uses a Hall IC, which is mounted on the accelerator pedal arm.
- A magnetic yoke is mounted at the base of the accelerator pedal arm. This yoke rotates around the Hall IC in accordance with the amount of effort that is applied to the accelerator pedal. The Hall IC converts the changes that occur in the magnetic flux into electrical signals, and outputs them in the form of accelerator pedal position signals to the ECM.
- The Hall IC contains two circuits, one for the main signal, and one for the sub signal. It converts the accelerator pedal position (angle) into electric signals that have differing characteristics and outputs them to the ECM.



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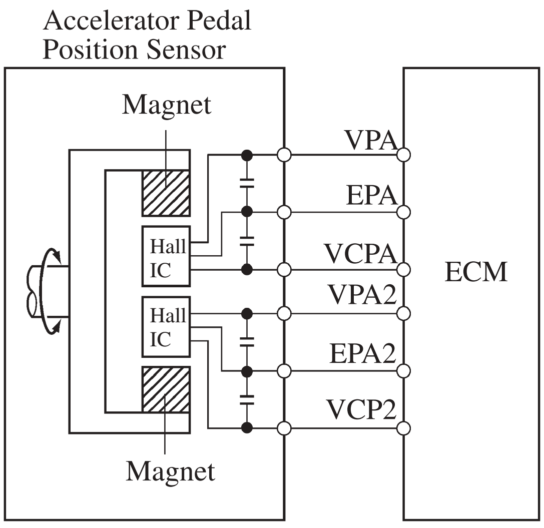

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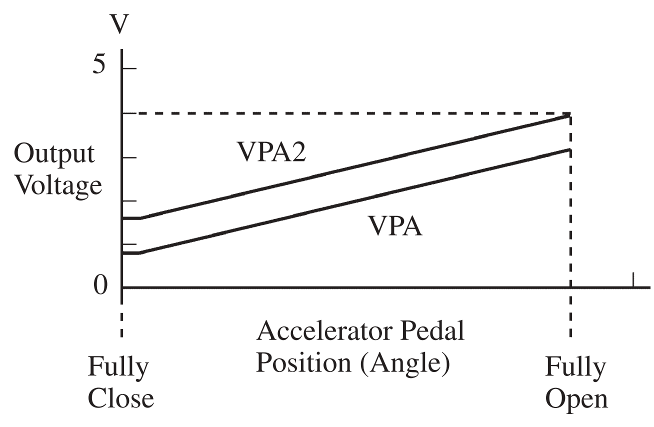

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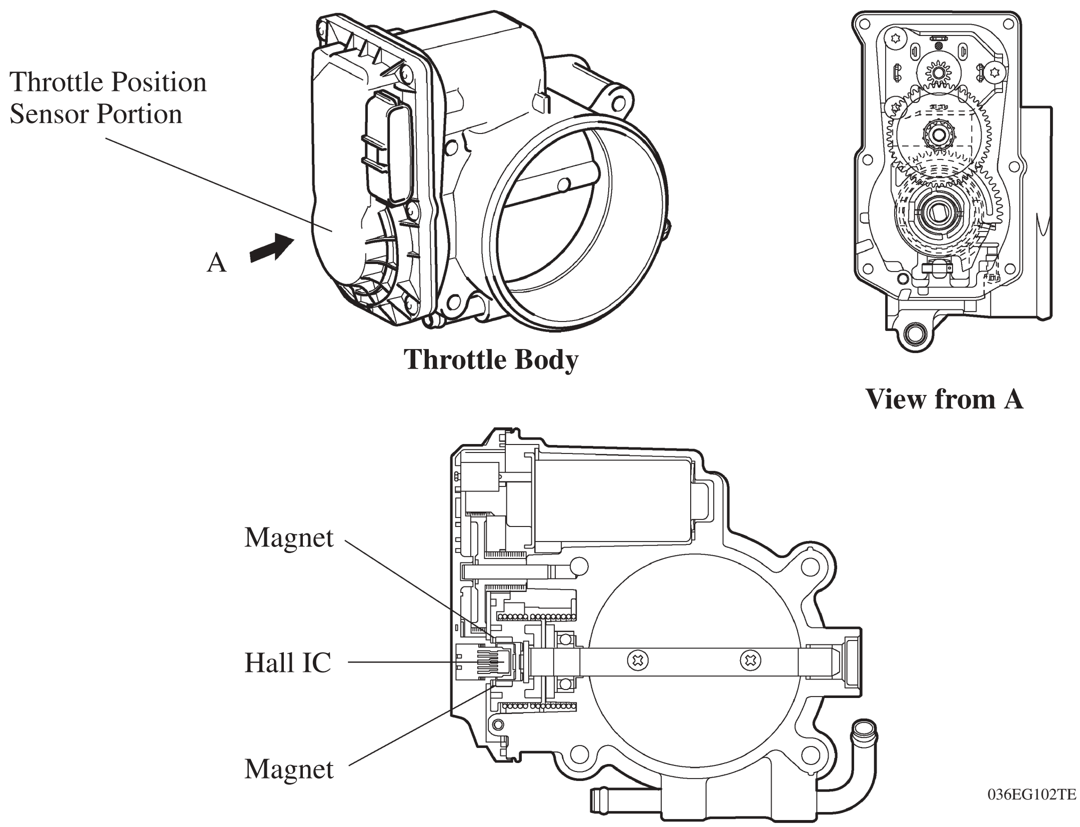
Service Tip

The inspection method differs from a conventional accelerator pedal position sensor because this sensor uses a Hall IC. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).

Throttle Position Sensor

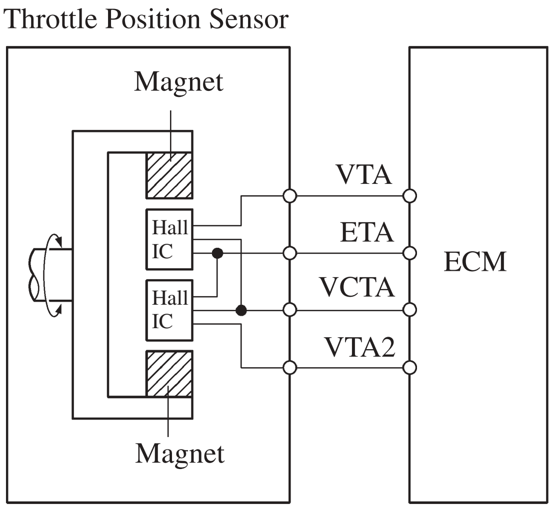
- The no-contact type throttle position sensor uses a Hall IC, which is mounted on the throttle body.
- The Hall IC is surrounded by a magnetic yoke. The Hall IC converts the changes that occur in the magnetic flux at that time into electrical signals and outputs them in the form of a throttle valve effort to the ECM.
- The Hall IC contains circuits for the main and sub signals. It converts the throttle valve opening angles into electric signals with two differing characteristics and outputs them to the ECM.

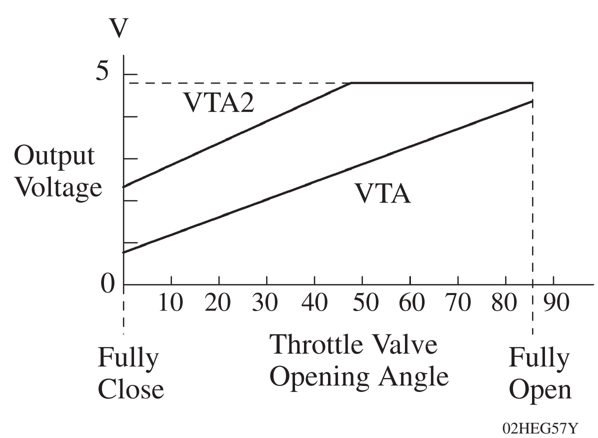


Throttle Body

View from A

Cross Section





Service Tip

The inspection method differs from a conventional throttle position sensor because this sensor uses a Hall IC. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).

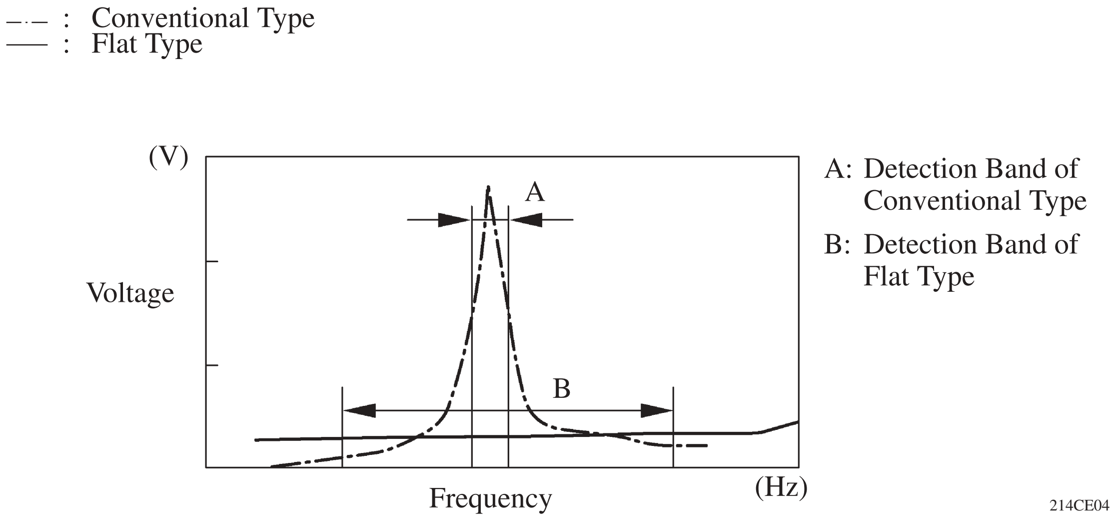
Knock Sensor (Flat Type)

1) General

In the conventional type knock sensor (resonant type), a vibration plate, which has the same resonance point as the knocking frequency of the engine, is built-in and can detect the vibration in this frequency band.

On the other hand, a flat type knock sensor (non-resonant type) has the ability to detect vibration in a wider frequency band from about 6 kHz to 15 kHz, and has the following features:

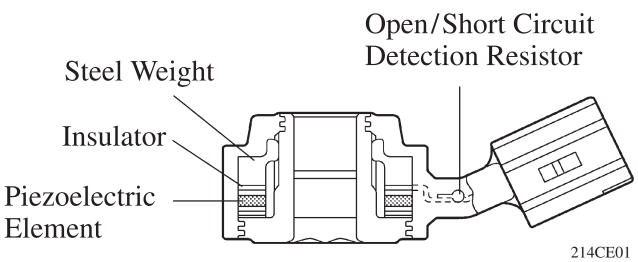
- The engine knocking frequency will change a bit depending on the engine speed. The flat type knock sensor can detect vibration even when the engine knocking frequency is changed. Thus the vibration detection ability is increased compared to the conventional type knock sensor, and a more precise ignition timing control is possible.



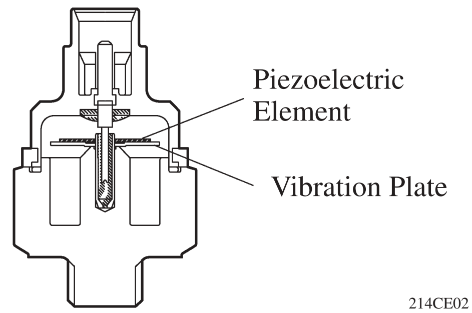
Characteristic of Knock Sensor

2) Construction

- The flat type knock sensor is installed on the engine through the stud bolt installed on the cylinder block. For this reason, a hole for the stud bolt is running through in the center of the sensor.
- Inside of the sensor, a steel weight is located on the upper portion and a piezoelectric element is located under the weight through the insulator.
- The open/short circuit detection resistor is integrated.



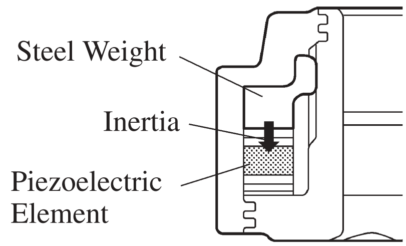
Flat Type Knock Sensor (Non-Resonant Type)



Conventional Type Knock Sensor (Resonant Type)

3) Operation

The knocking vibration is transmitted to the steel weight and its inertia applies pressure to the piezoelectric element. The action generates electromotive force.



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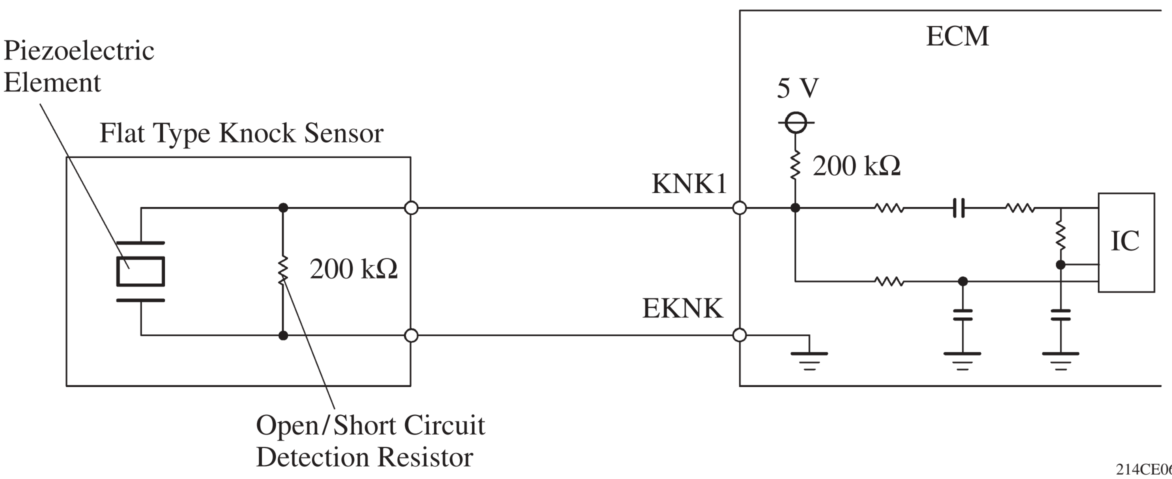
4) Open/Short Circuit Detection Resistor

During the power source is IG-ON, the open/short circuit detection resistor in the knock sensor and the resistor in the ECM keep the voltage at the terminal KNK1 of engine constant.
An IC (Integrated Circuit) in the ECM is always monitoring the voltage of the terminal KNK1. If the open/short circuit occurs between the knock sensor and the ECM, the voltage of the terminal KNK1 will change and the ECM detects the open/short circuit and stores DTC (Diagnostic Trouble Code).



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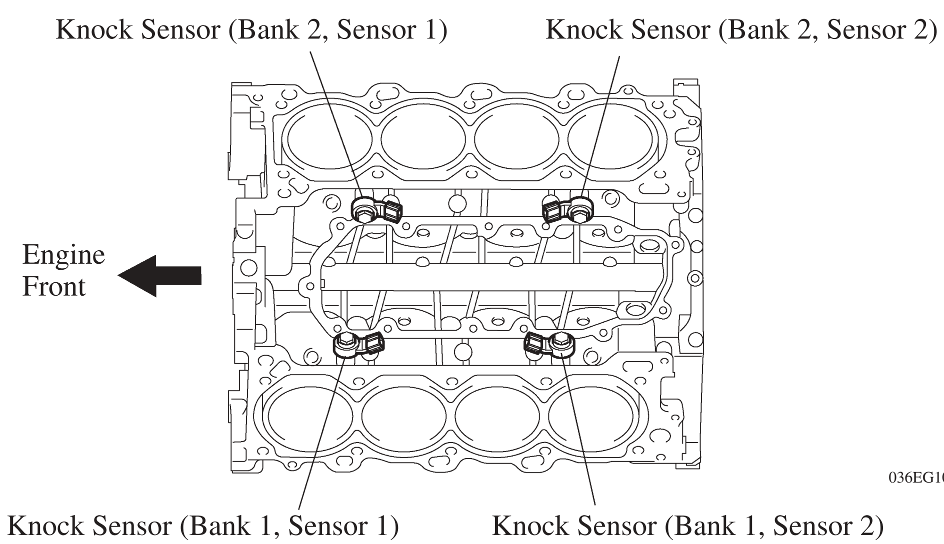
Service Tip

These knock sensors are mounted in the specific directions and angles as illustrated. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).



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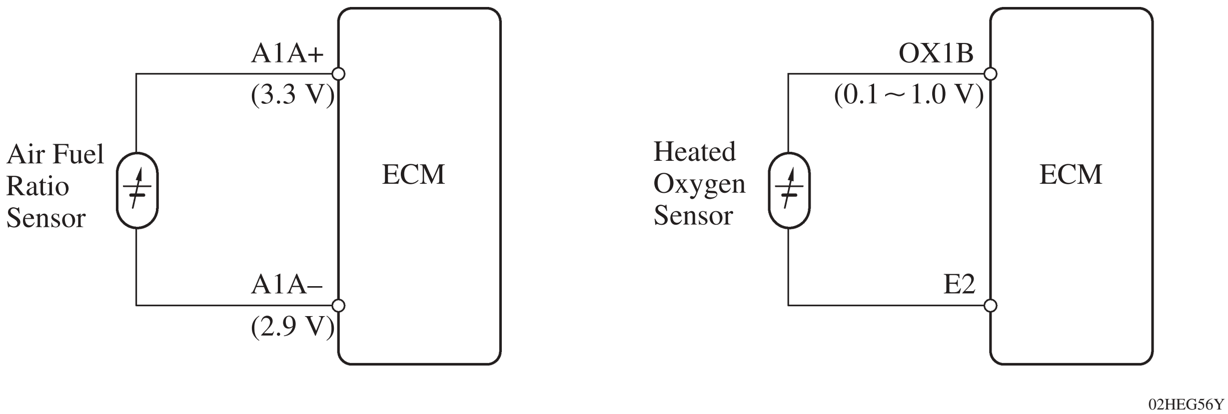
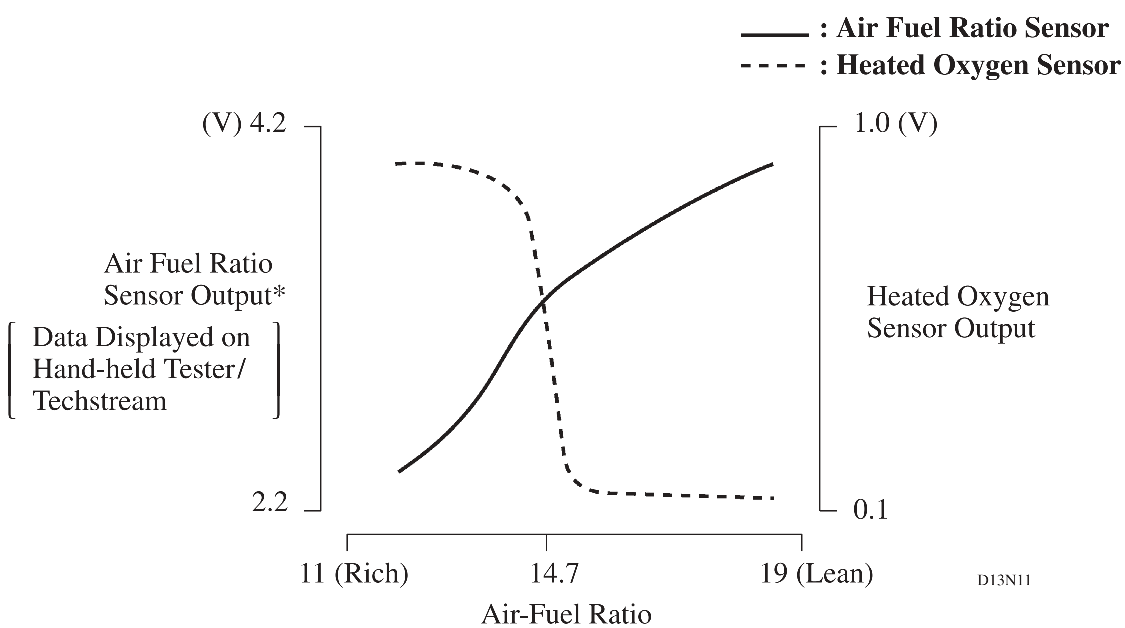
Air Fuel Ratio Sensor and Heated Oxygen Sensor

1) General

- The heated oxygen sensor and the air fuel ratio sensor differ in output characteristics.
- The output voltage of the heated oxygen sensor changes in accordance with the oxygen concentration in the exhaust gas. The ECM uses this output voltage to determine whether the present air-fuel ratio is richer or leaner than the stoichiometric air-fuel ratio.
- Approximately 0.4 V is constantly applied to the air fuel ratio sensor, which outputs an amperage that varies in accordance with the oxygen concentration in the exhaust gas. The ECM converts the changes in the output amperage into voltage in order to linearly detect the present air-fuel ratio.



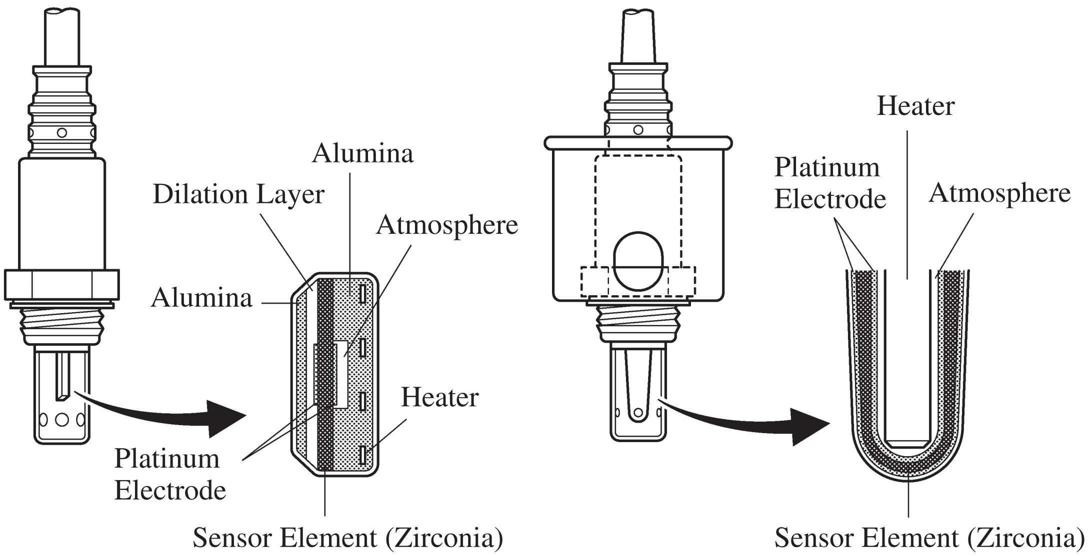
Air Fuel Ratio Sensor Circuit **Heated Oxygen Sensor Circuit**



*: This calculation value is used internally in the ECM, and is not an ECM terminal voltage.

2) Construction

- The basic construction of the heated oxygen sensor and the air fuel ratio sensor is the same. However, they are divided into the cup type and the planar type, according to the different types of heater construction that are used.
- The cup type sensor contains a sensor element that surrounds a heater.
- The planar type sensor uses alumina, which excels in heat conductivity and insulation, to integrate a sensor element with a heater, thus improving the warm up performance of the sensor.



Planar Type Air Fuel Ratio Sensor **Cup Type Heated Oxygen Sensor**

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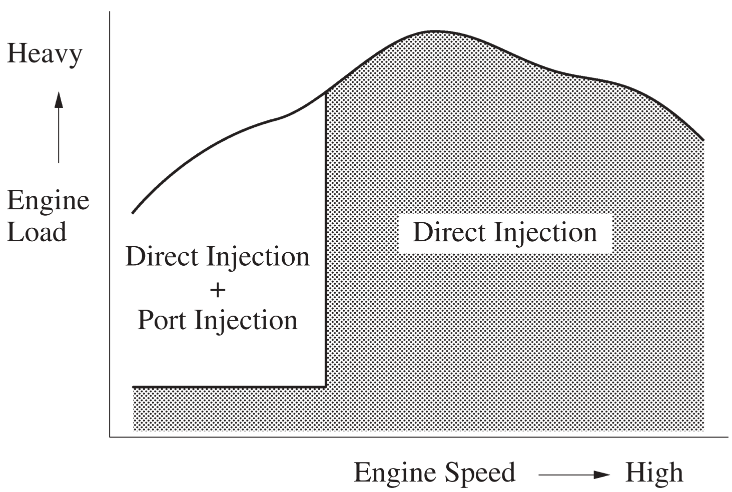
6. D-4S SFI (Sequential Multiport Fuel Injection) System

General

- A D-4S (Direct injection 4-stroke gasoline engine Superior version) SFI system directly detects the intake air mass with a hot-wire type mass air flow meters.
- The D-4S system is a fuel injection system which combines direct injection injectors and port injection injectors.
- Based on signals from each sensor, the ECM controls the injection volume and timing of each type of injector (direct and port injection types) according to engine load and engine speed in order to optimize combustion conditions.
- To promote warm up of the catalyst after a cold engine start, this system uses a stratified air-fuel mixture, that results in an area near the spark plug that is richer than the rest of the air-fuel mixture. This allows a retarded ignition timing to be used so the exhaust gas temperature can be increased. This results in more rapid heating of the catalytic converters, reducing exhaust emissions.



Fuel Injection System Activation Ranges

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Stratification Combustion

Immediately after a cold engine start, fuel is injected into the intake port from the port injection injector during the exhaust stroke. Fuel is also injected from the direct injection injector near the end of the compression stroke. This results in the air-fuel mixture that is stratified, the area near the spark plug is richer than the rest of the air-fuel mixture. This allows a retarded ignition timing to be used, raising the exhaust gas temperature. The increased exhaust gas temperatures promote rapid warm up of the catalysts, and significantly improve exhaust emission performance.

1) Exhaust stroke

Fuel is injected into the intake port from the port injection injector before the intake valves open.

2) Intake stroke

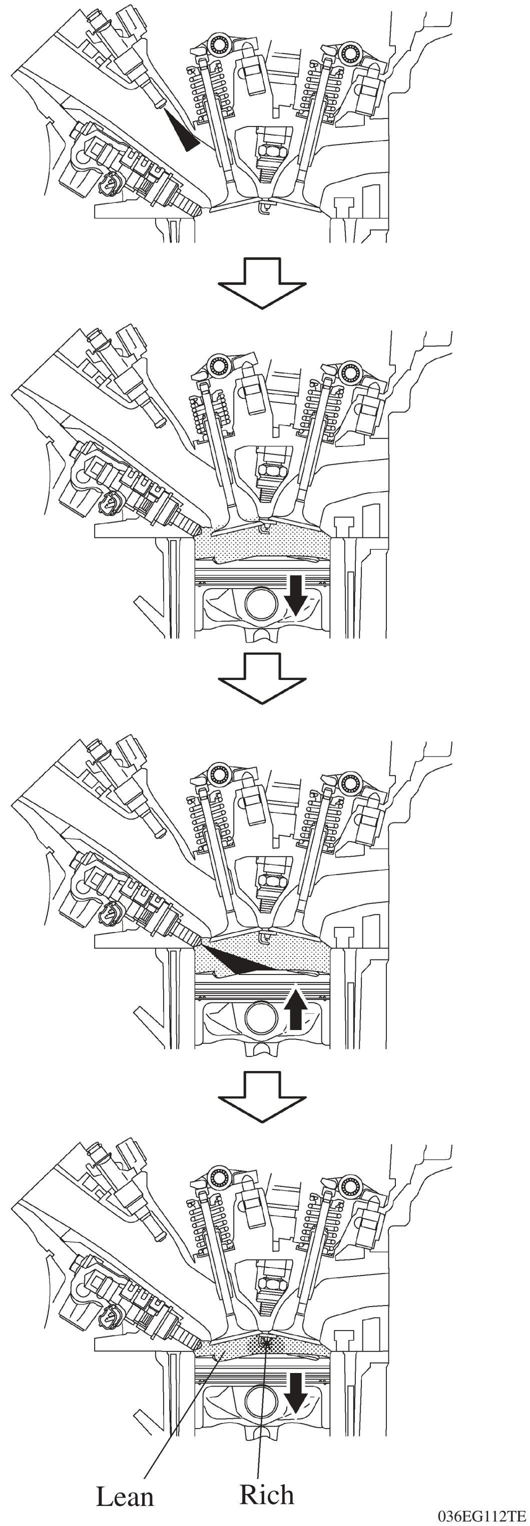
The intake valves open and a homogeneous air-fuel mixture is drawn into the combustion chamber.

3) Compression stroke

Fuel is injected into the combustion chamber from the direct injection injector near the end of compression stroke.

4) Ignition to combustion stroke

Injected fuel is directed along the piston contour to the area near the spark plug. This produces a combustible area of the rich air-fuel mixture that allows for easy ignition. This allows combustion of a lean air-fuel mixture to occur.

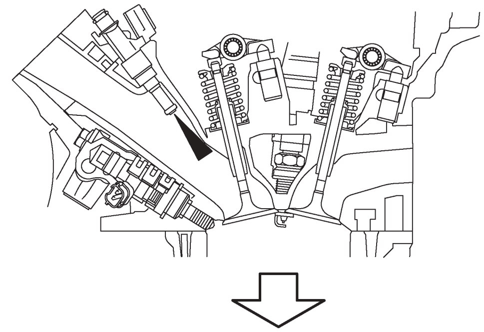


Homogeneous Combustion

To optimize combustion conditions, the ECM controls injection volume and timing of the port injection injectors which inject fuel into the intake ports during the expansion, exhaust, and intake strokes. The ECM also controls the injection volume and timing of the direct injection injectors which inject fuel during the first half of the intake stroke. The homogeneous air-fuel mixture is created by either combined or individual use of the two different types of injectors. This allows utilization of the heat of evaporation of the injected fuel to cool the compressed air, it also allows an increase of charging efficiency and power output.

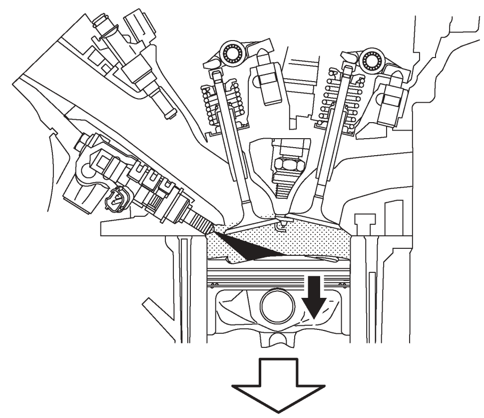
1) Exhaust stroke

Fuel is injected into the intake port from the port injection injector before the intake valves open.



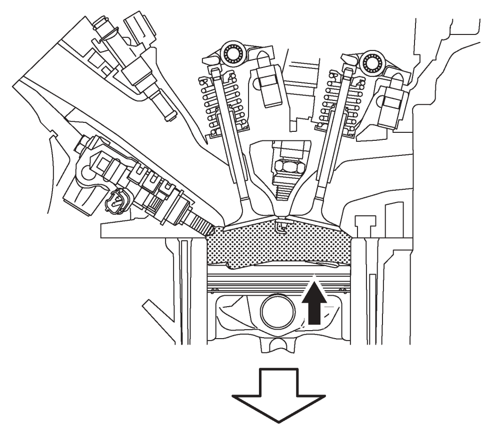
2) Intake stroke

The intake valves open to allow the homogeneous air-fuel mixture into the combustion chamber, and fuel is injected into the combustion chamber from the direct injection injector during the first half of the intake stroke. The injected fuel and air are evenly mixed by intake air force.



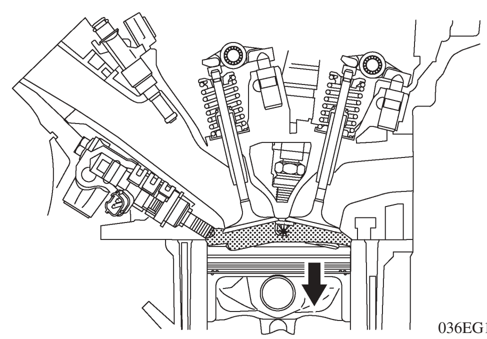
3) Compression stroke

The homogeneous air-fuel mixture is compressed.



4) Ignition to combustion stroke

The spark plug ignites the homogeneous air-fuel mixture.



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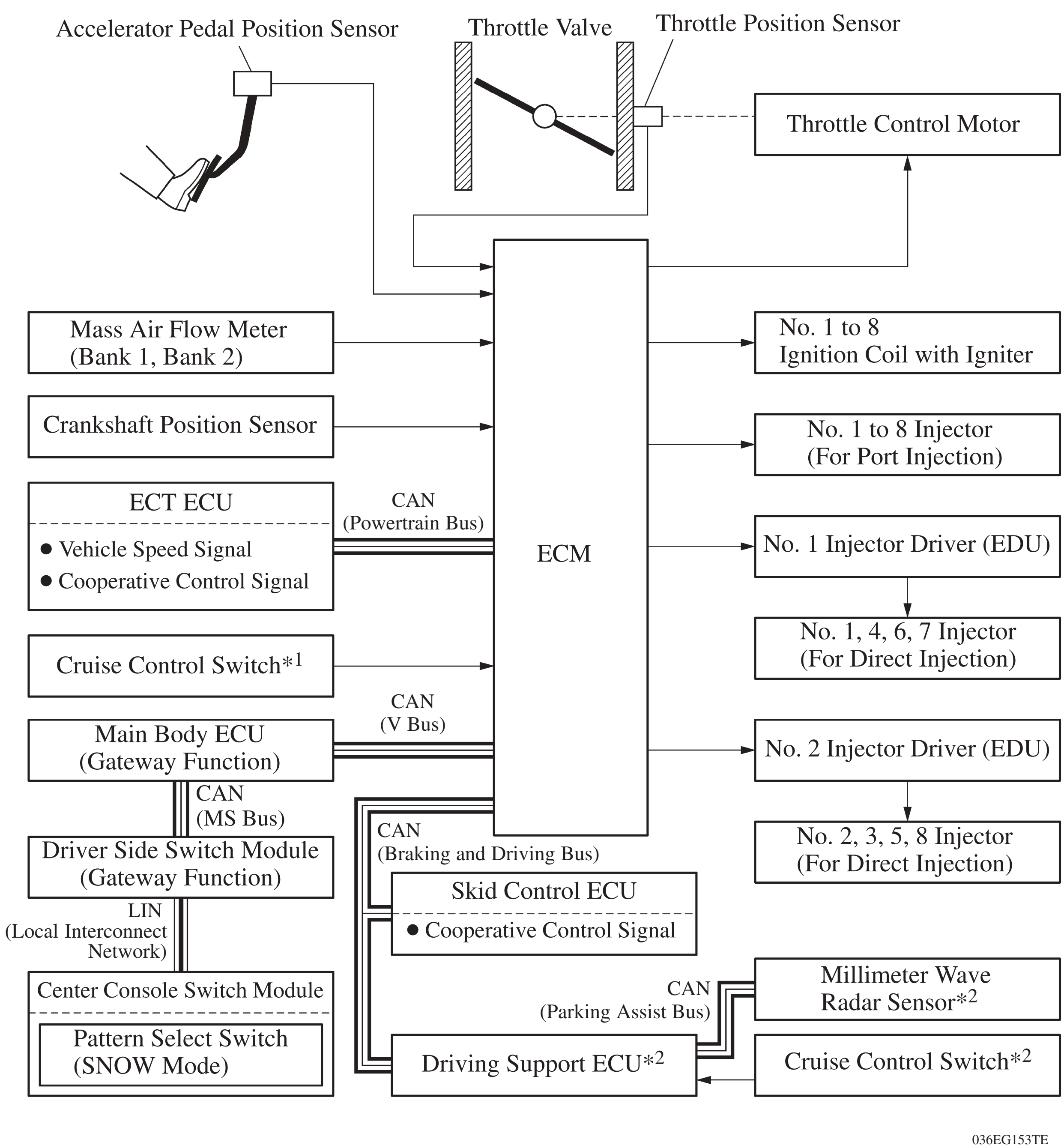
7. ETCS-i (Electronic Throttle Control System-intelligent)

General

- In the conventional throttle body, the throttle valve angle is determined invariably by the amount of the accelerator pedal effort. In contrast, ETCS-i uses the ECM to calculate the optimal throttle valve angle that is appropriate for the respective driving condition and uses a throttle control motor to control the angle.
- In case of an abnormal condition, this system transfers to the fail-safe mode. For details, see page EG-117.

▶ System Diagram ◀



*1: Without Dynamic Radar type Cruise Control system

*2: With Dynamic Radar type Cruise Control system

Control

1) General

The ETCS-i consists of the following functions:

- Normal Throttle Control (Non-linear Control)
- ISC (Idle Speed Control)
- Powertrain Cooperative Control
- TRAC (Traction Control)
- VSC (Vehicle Stability Control)
- Cruise Control
- Dynamic Radar type Cruise Control*

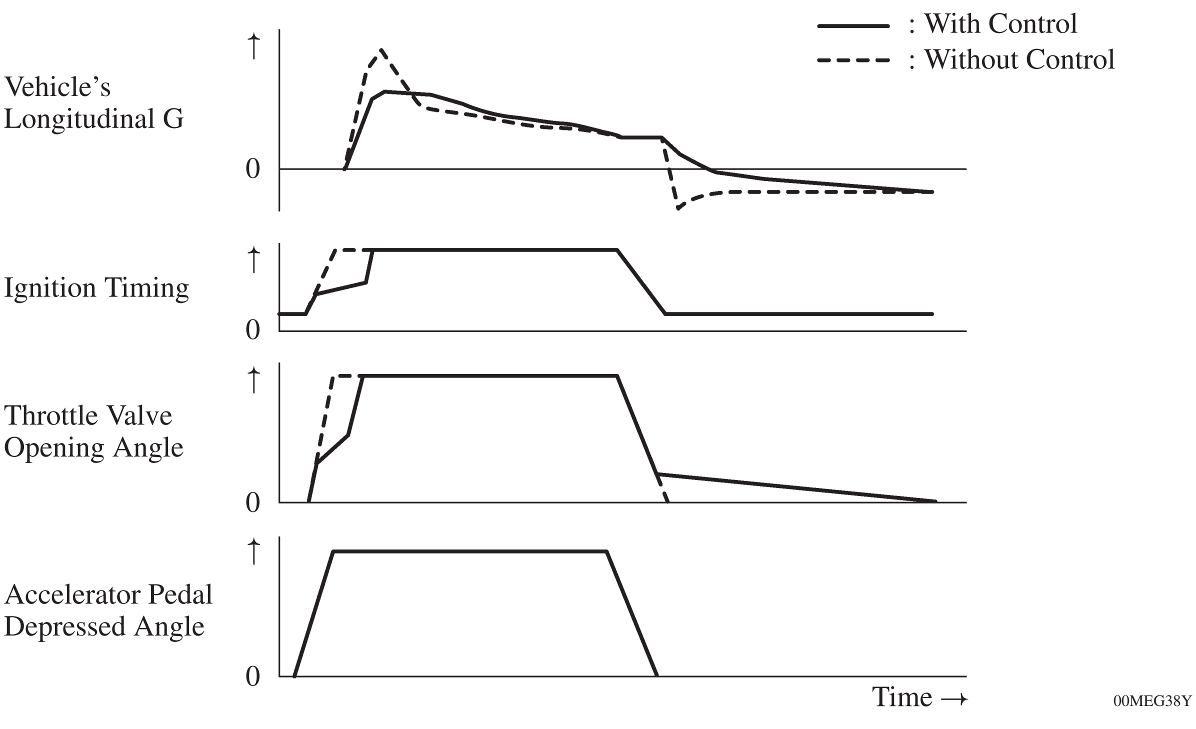
*: With Dynamic Radar type Cruise Control system

2) Normal Throttle Control (Non-linear Control)

a. Normal-mode Control

Controls the throttle to an optimal throttle valve angle 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.

▶ Conceptual Diagrams of Engine Control During Acceleration and Deceleration ◀



b. Snow-mode Control

In situations in which low-μ (low friction) road surface conditions can be anticipated, such as when driving in the snow, the rate of throttle valve opening can be controlled to help vehicle stability while driving on the slippery surface. This is accomplished by turning on SNOW mode. Pressing the SNOW side of the pattern select switch activates this mode. This mode modifies the relationship and reaction of the throttle to the accelerator pedal, and assists the driver by reducing the engine output from that of a normal level.

3) Idle Speed Control

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

4) Powertrain Cooperative Control

The ECM effects cooperative control with the ECT ECU in order to control the throttle valve at a position that is optimal for the driving conditions. Thus, it ensures a quick response to the driver's accelerator pedal effort and reduces shift shocks.

5) TRAC Throttle Control

As part of the TRAC function, 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 excellent vehicle stability and driving force.

6) VSC Coordination Control

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

7) Cruise Control

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

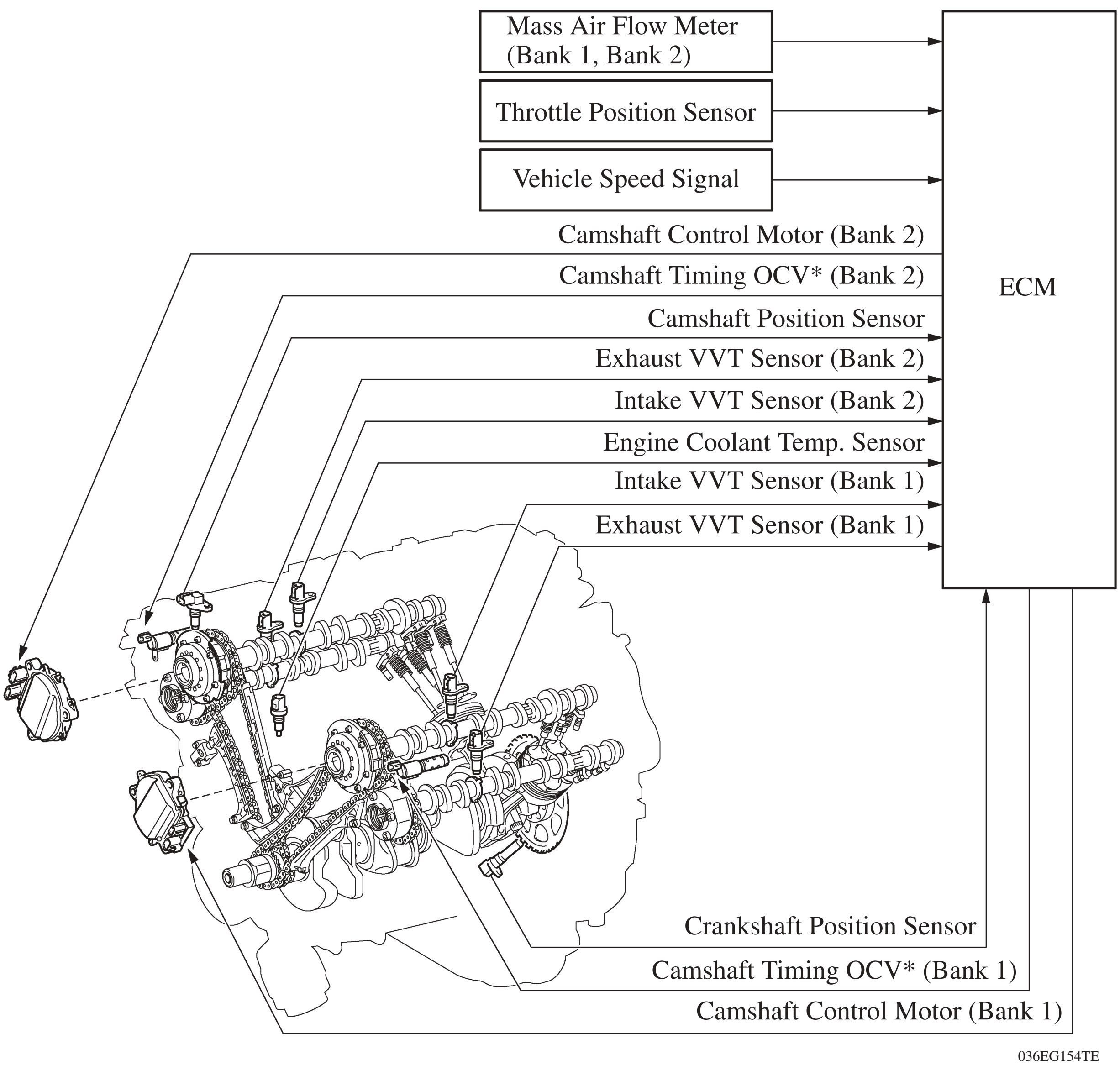
8) Dynamic Radar type Cruise Control

The dynamic radar type cruise control uses a millimeter wave radar sensor and the driving support ECU to determine the distance of the vehicle driven ahead, its direction, and relative speed. Thus, the system can effect deceleration cruising control, follow up cruising control, cruising at a fixed speed control, and acceleration cruising control. To make these controls possible, the ECM controls the throttle valve.

8. Dual VVT-i (Variable Valve Timing-intelligent) System

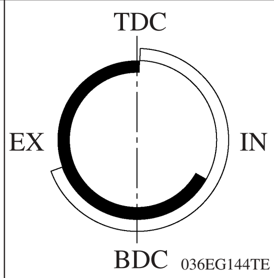
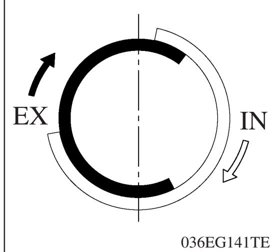
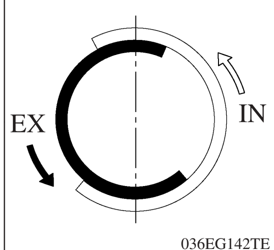
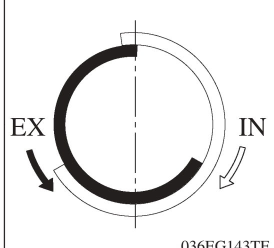
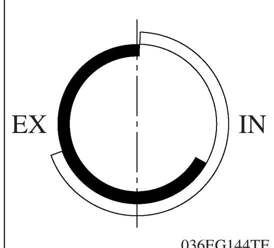
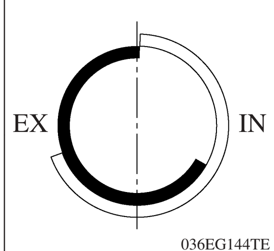
General

- The Dual VVT-i system is designed to control the intake and exhaust camshafts within a range of 40° and 35° respectively (of crankshaft angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.
- For the intake valves, the VVT-iE uses electric motors to control the valve timing. Because the VVT-iE is actuated by electric motors, it can affect optimal valve timing control even when the engine oil pressure is low, such as when the engine oil temperature or the engine speed is low. Because this system can control the valve timing from the time the engine is started, it can set the most retarded timing position to be more retarded than the starting valve timing.
- The exhaust side is VVT-i that uses engine oil pressure to control the valve timing.



*: Oil Control Valve

Effectiveness of the Dual VVT-i System

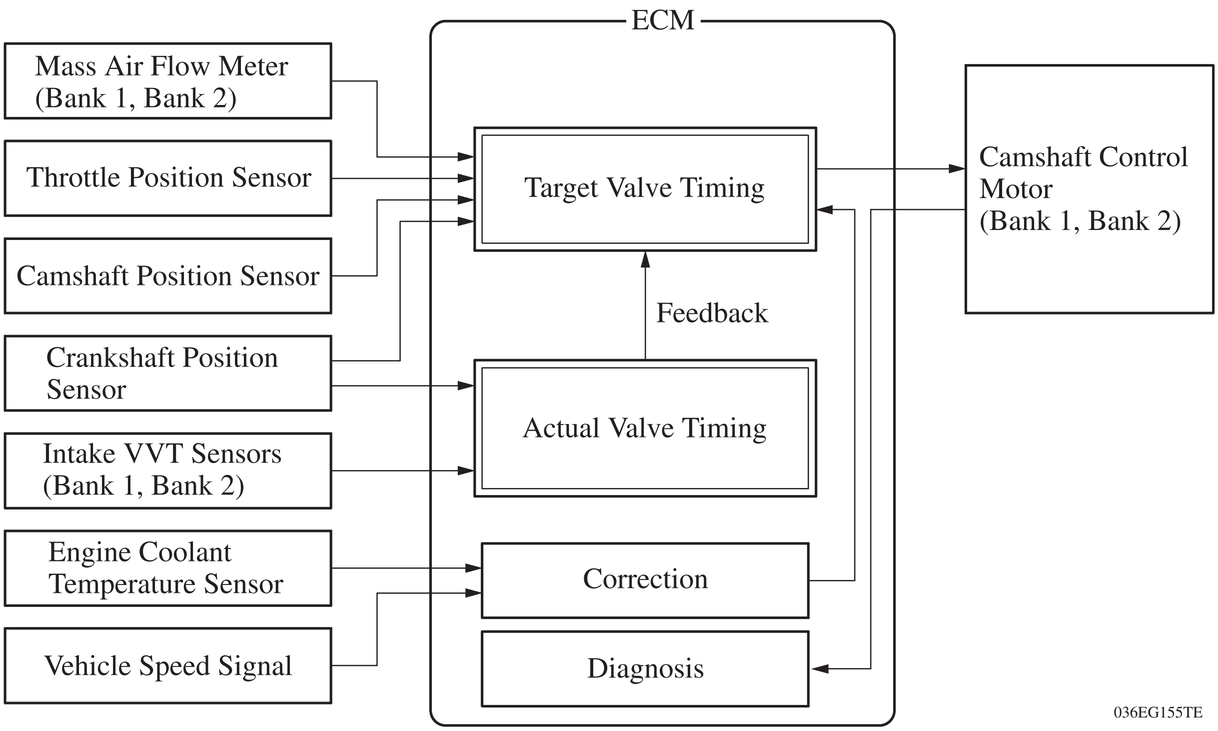
Condition	Operation		Timing/ Position	Objective	Effect
During Idling		IN	Neutral Position	Eliminating overlap to reduce blow back to the intake side.	● Stabilized idling rpm ● Better fuel economy
		EX	Most Advanced Position		
In Low Speed Range with Light to Medium Load		IN	Retarded	Retarding the intake valve close timing and reducing pumping loss. Increasing overlap and increasing internal EGR.	● Better fuel economy ● Improved emission control
		EX	Retarded		
In Low to Medium Speed Range with Heavy Load		IN	Advanced	Advancing the intake valve close timing, reducing intake air blow back to the intake side, and improving volumetric efficiency.	Improved torque in low to medium speed range
		EX	Advanced		
In High Speed Range with Heavy Load		IN	Retarded	Retarding the intake valve close timing and improving volumetric efficiency using the inertia force of the intake air.	Improved output
		EX	Advanced		
At Low Temperatures		IN	Neutral Position	Eliminating overlap to reduce blow back to the intake side. Fixing valve timing at extremely low temperatures and increasing the control range as the temperature rises.	● Stabilized fast idle rpm ● Better fuel economy
		EX	Most Advanced Position		
● Upon Starting ● Stopping the Engine		IN	Neutral Position	Controlling valve timing and fixing it to the optimal timing for engine start.	Improved startability
		EX	Most Advanced Position		

VVT-iE

1) General

- The VVT-iE consists of the camshaft control actuators that rotate the intake camshafts via a link mechanism and EDU-integrated the camshaft control motors that operate the link mechanism in accordance with the signals received from the ECM.
- Based on engine speed, intake air mass, throttle position, vehicle speed, and engine coolant temperature, the ECM calculates optimal valve timing for all driving conditions. The ECM uses the calculated valve timing as the target valve timing to control the camshaft control motors. In addition, the ECM uses signals from the intake VVT sensors and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.

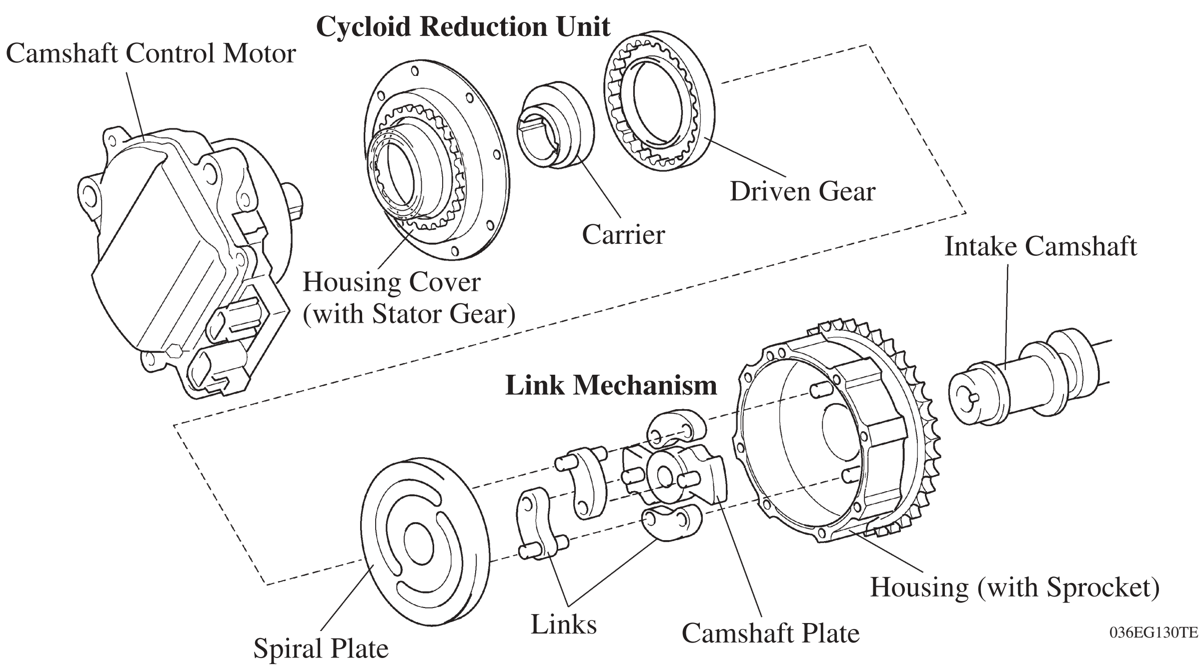
▶ System Diagram ◀



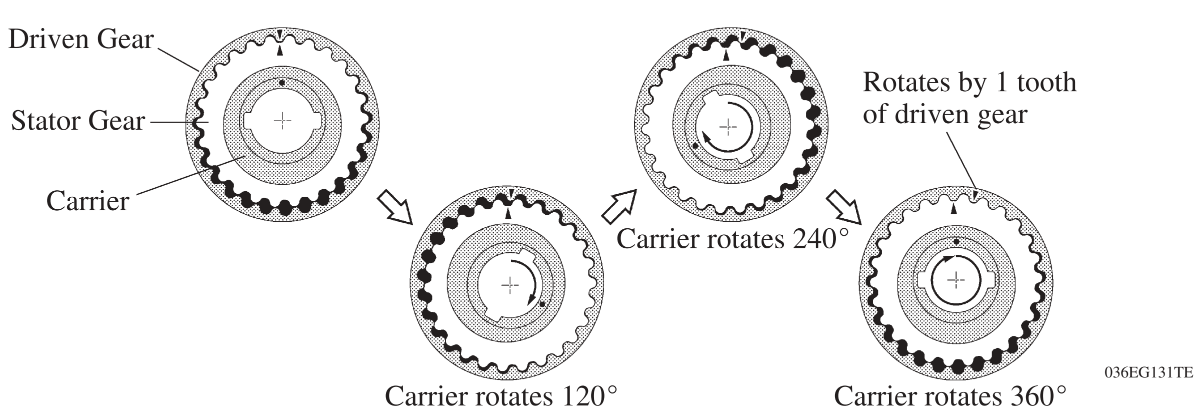
2) Camshaft Control Actuator

- The camshaft control actuator consists of a link mechanism that rotates the intake camshaft to the advance or retard side, and a cycloid reduction unit to reduce the rotational movement of the motor.
- The link mechanism consists of a housing (with sprocket) that is driven by the timing chain, a camshaft plate that is coupled to the intake camshaft, the links that connect them, and a spiral plate that moves the links.
- The cycloid reduction unit consists of a housing cover fitted with a stator gear, a carrier that is rotated by a motor, and a driven gear (which has 1 more tooth than the stator gear) that is engaged to the carrier. The illustration shows the mechanism of the cycloid reduction unit. When the motor rotates the carrier by 1 revolution, the driven gear moves in the same direction by only 1 tooth.
- Based on the advance or retard movement of the motor, the camshaft control actuator rotates via the cycloid reduction unit the spiral plate that is engaged to the driven gear. Then, the links allow the rotational movement of the spiral plate to rotate the camshaft plate, which changes the intake valve timing.

▶ Construction of Camshaft Control Actuator ◀

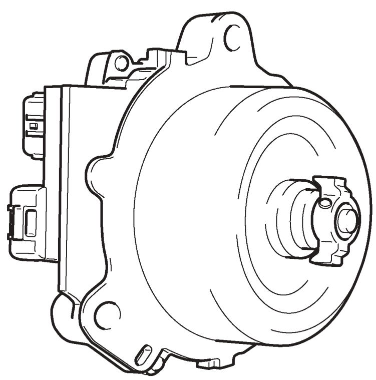


▶ Mechanism of Cycloid Reduction Unit ◀

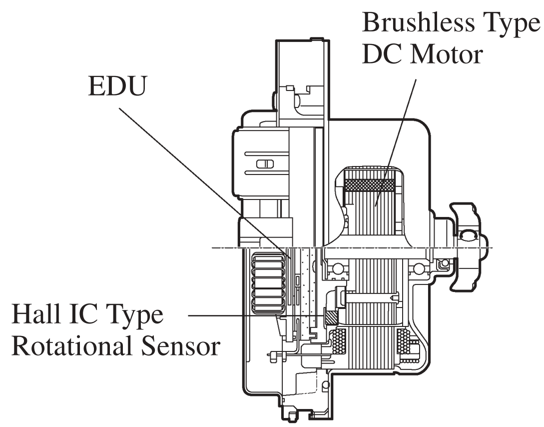


3) Camshaft Control Motor

- The camshaft control motor consists of a motor that operates the camshaft control actuator in the advance or retard direction, an EDU that controls the rotational condition of the motor, and a Hall IC type rotational sensor that detects the rotational condition of the motor.
- The motor is a brushless type DC motor that is installed in the engine front cover forward of the camshaft control actuator. It rotates coaxially with the intake camshaft.
- In accordance with the target valve timing, the ECM transmits the motor rotational speed instruction signals and the motor rotational direction instruction signals to the EDU. Based on those signals, the EDU drives the motor to rotate the intake camshaft in the advance or retard direction.
- The EDU always monitors the motor operating condition, and transmits the actual motor rotational speed signals, the actual motor rotational direction signals, and the operating state signals to the ECM. The ECM uses these signals to diagnose malfunctions.



Camshaft Control Motor



Cross Section

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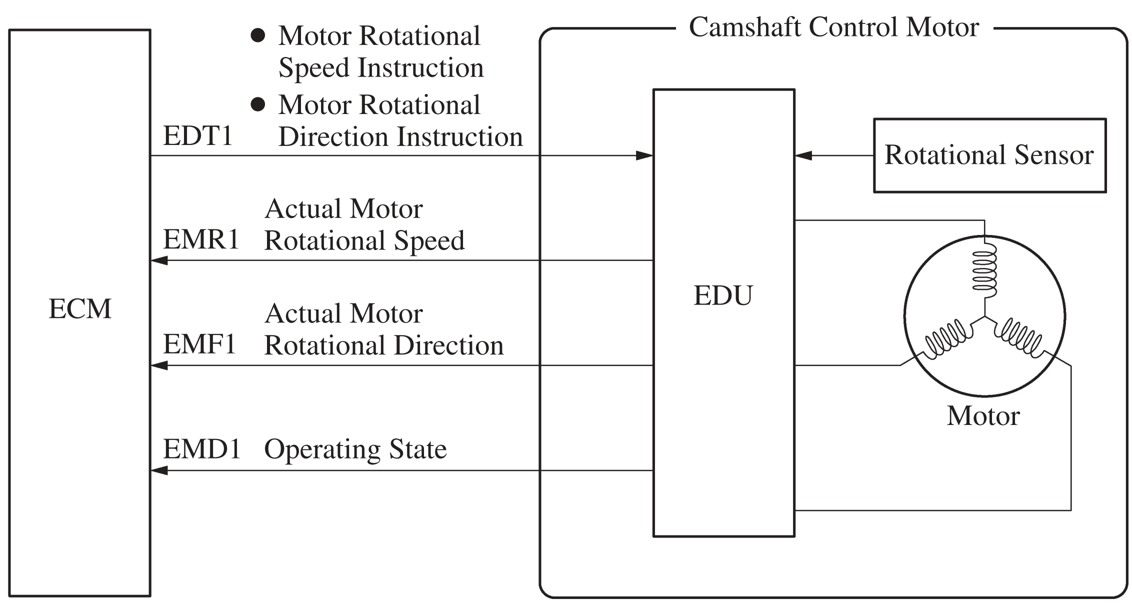
▶ System Diagram ◀



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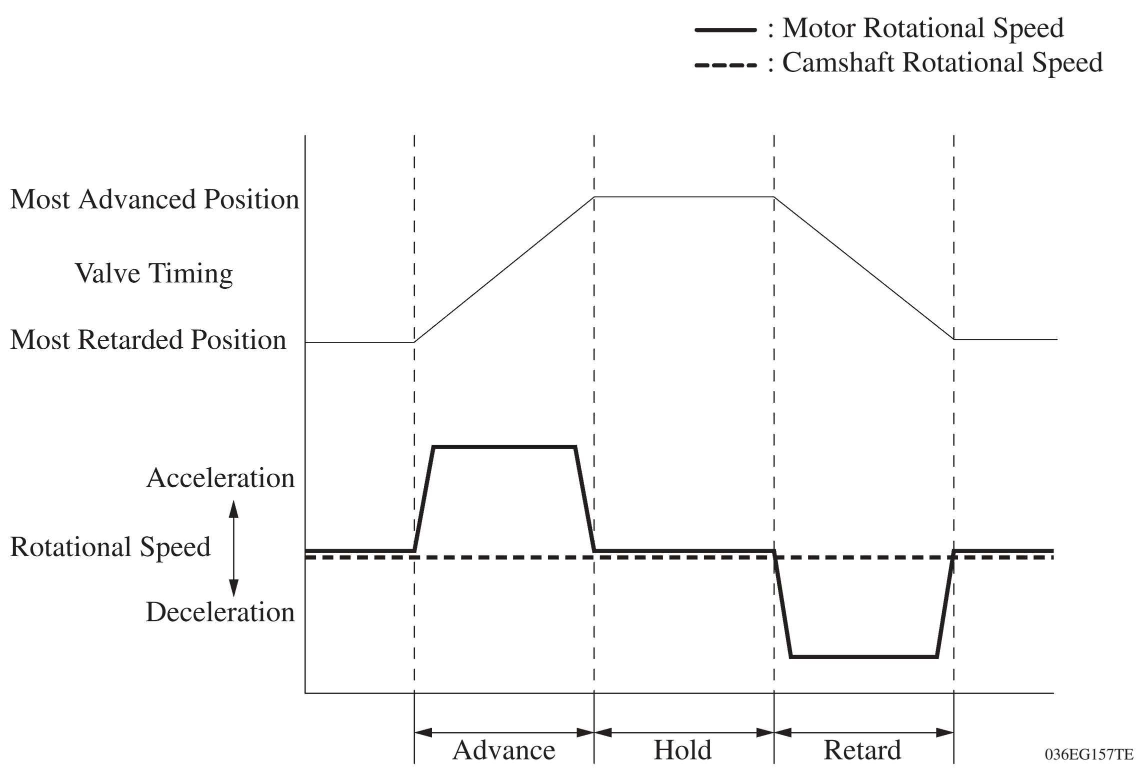
4) Operation

a. General

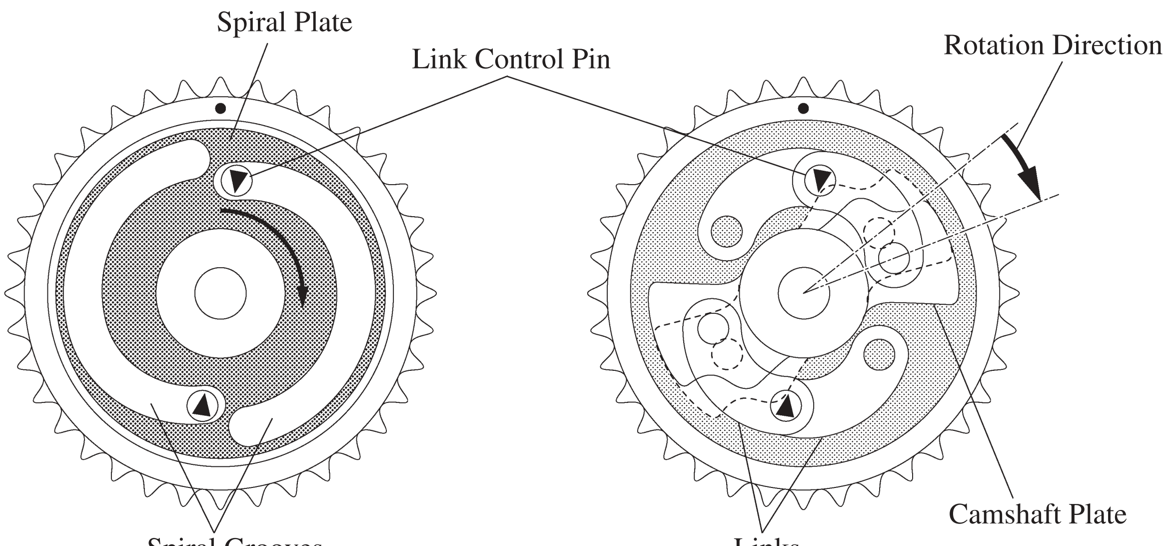
- The ECM controls the advance and retard operation by way of the rotational speed difference between the motor and the camshaft. The ECM maintains the valve timing by rotating the motor at the same rotational speed as the camshaft.
  - To advance, the motor rotational speed becomes faster than the camshaft rotational speed.
  - To retard, the motor rotational speed becomes slower than the camshaft rotational speed. (Depending on the camshaft rotational speed, the motor may rotate counterclockwise.)

▶ Relationship Between Motor Rotational Speed and Advance and Retard Timing ◀



b. Advance

As the advance signals from the ECM cause the motor to rotate faster than the camshaft, the spiral plate rotates clockwise via the reduction unit. The rotational movement of the spiral plate moves the link control pins (which are engaged in the spiral grooves) towards the axial center of the camshaft. As a result, the links rotate the camshaft plate, which is coupled with the intake camshaft, in the advance direction.



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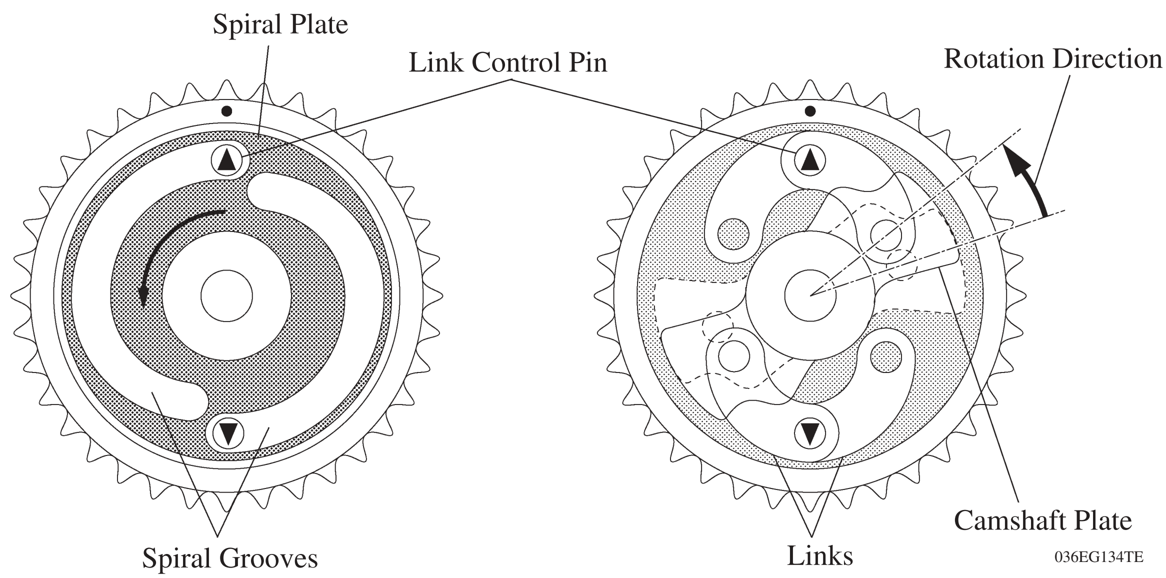
c. Retard

As the retard signals from the ECM cause the motor to rotate slower than the camshaft, the spiral plate rotates counterclockwise via the reduction unit. The rotational movement of the spiral plate moves the link control pins (which are engaged in the spiral grooves) outward of the axis of the camshaft. As a result, the links rotate the camshaft plate, which is coupled with the intake camshaft, in the retard direction.



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d. Hold

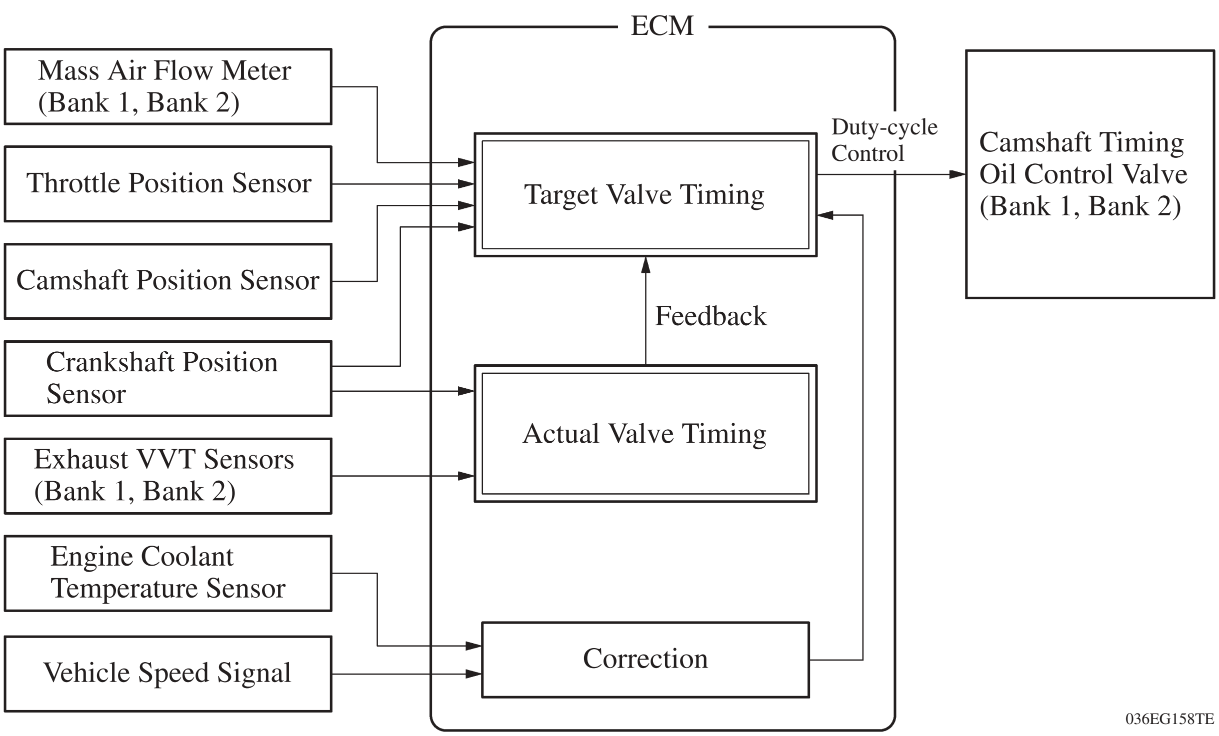
After the target valve timing has been reached, the ECM rotates the motor at the same rotational speed as the camshaft. As a result, the link mechanism of the camshaft control actuator becomes locked, thus holding the camshaft at the valve timing.

VVT-i

1) General

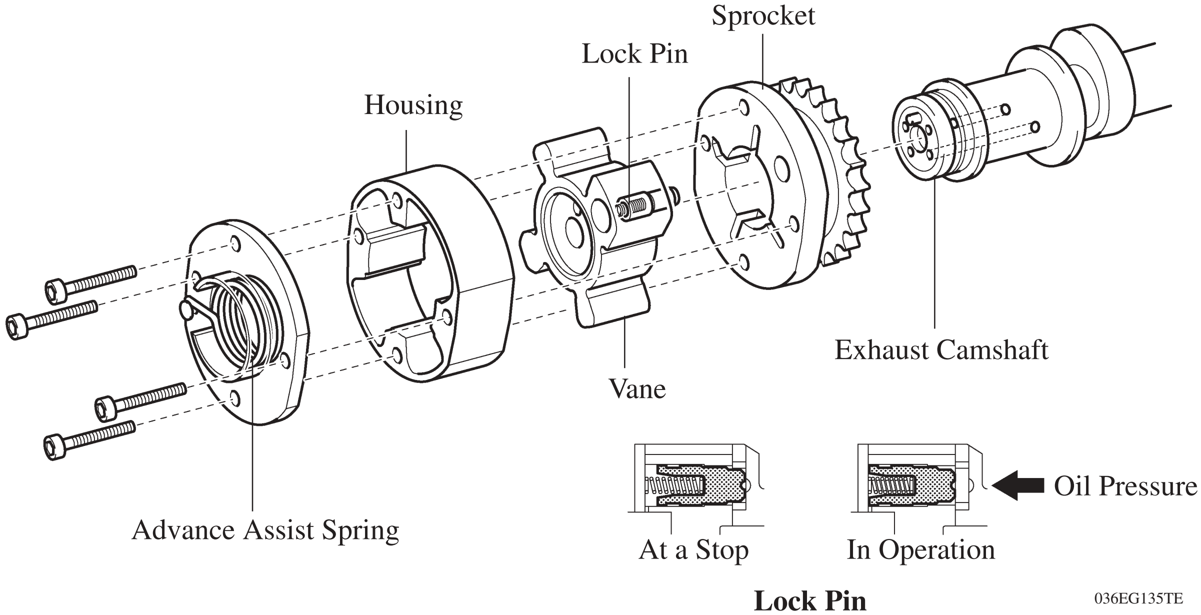
- The VVT-i consists of the VVT-i controllers that operate by engine oil pressure and the camshaft timing oil control valves that switches the engine oil pressure passages in accordance with the signals from the ECM.
- Based on engine speed, intake air mass, throttle position, vehicle speed, and engine coolant temperature, the ECM calculates optimal valve timing for all driving conditions. The ECM uses the calculated valve timing as the target valve timing to control the camshaft timing oil control valves. In addition, the ECM uses signals from the exhaust VVT sensors and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.

▶ System Diagram ◀



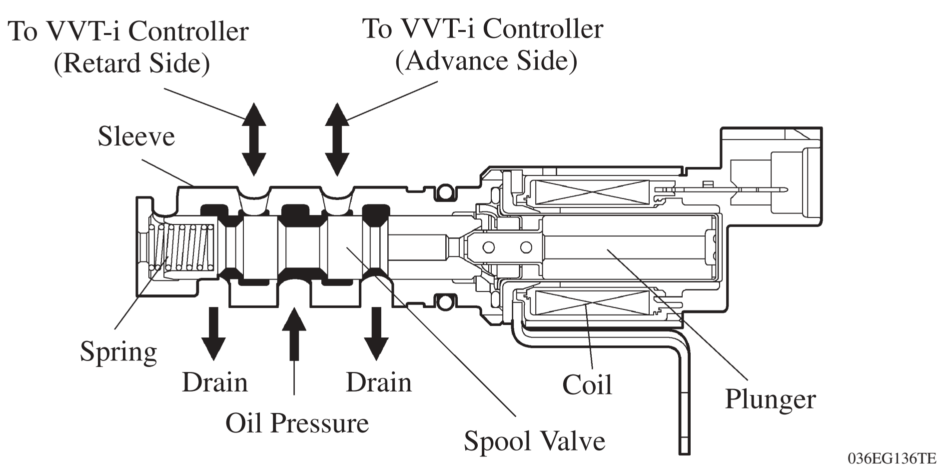
2) VVT-i controller

- The VVT-i controller consists of a sprocket driven by the timing chain, a housing coupled with the sprocket, and a vane coupled with the exhaust camshaft.
- The engine oil pressure sent from the advance or retard side path at the exhaust camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the exhaust valve timing continuously.
- As the engine stops, the advance assist spring moves the VVT-i controller to the most advanced position. Then, a lock pin locks the vane to the sprocket, in order to ensure engine startability. After the engine is started, engine oil pressure acts on the hole in which the lock pin is engaged, to release the lock.



3) Camshaft Timing Oil Control Valve

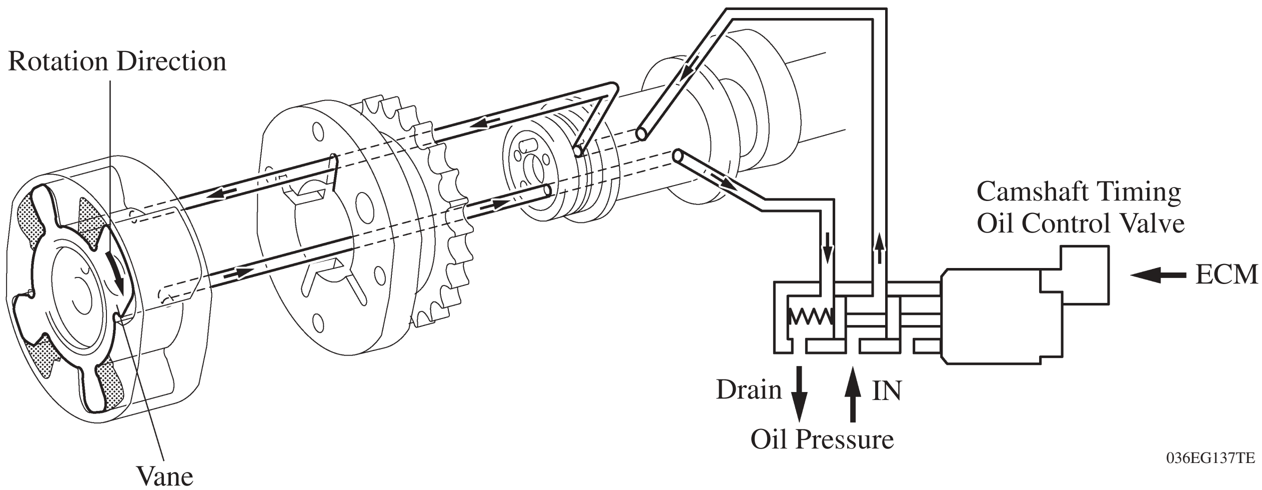
This camshaft timing oil control valve controls the spool valve using duty cycle control from the ECM. This allows engine oil pressure to be applied to the VVT-i controller advance or retard side. When the engine is stopped, the camshaft timing oil control valve is in the most advanced position.



4) Operation

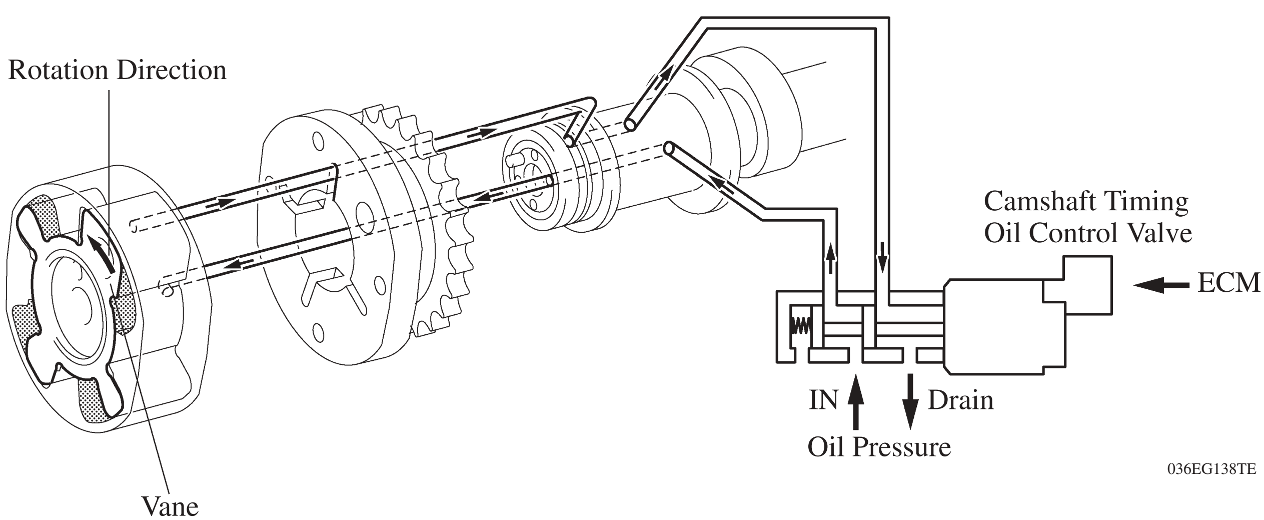
a. Advance

When the camshaft timing oil control valve is positioned as illustrated below by the advance signals from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



b. Retard

When the camshaft timing oil control valve is positioned as illustrated below by the retard signals from the ECM, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.



c. Hold

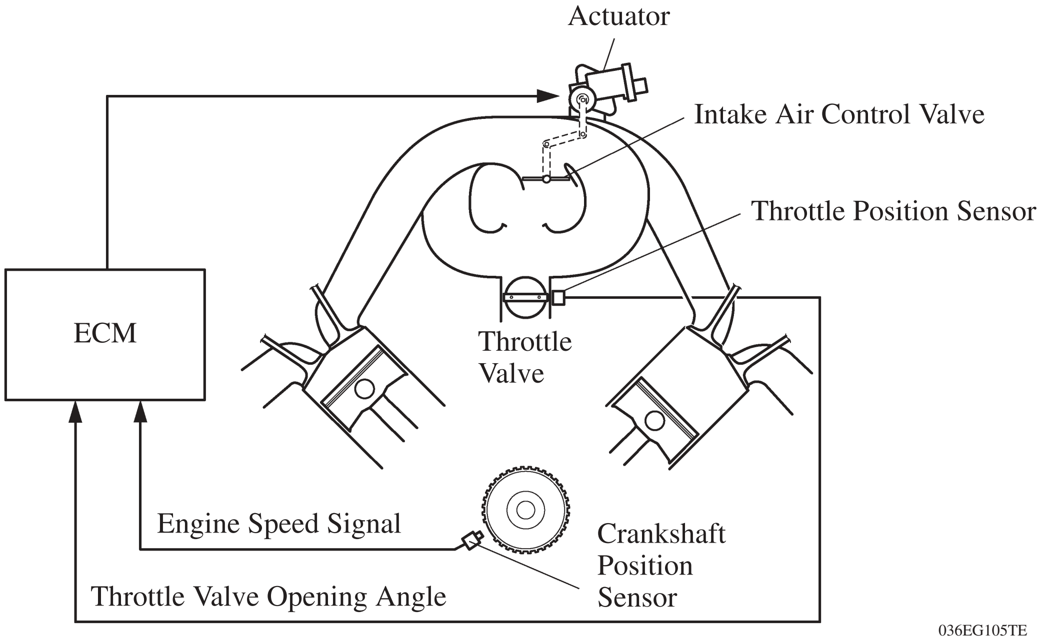
After reaching the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes.
This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

9. ACIS (Acoustic Control Induction System)

General

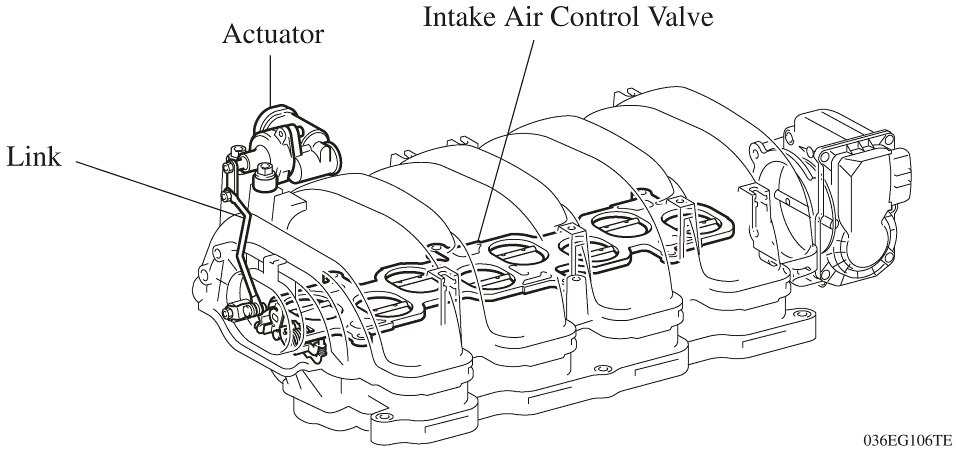
The ACIS uses a bulkhead to divide the intake manifold into two stages, with an intake air control valve in the bulkhead being opened and closed to vary the effective length of the intake manifold in accordance with the engine speed and throttle valve opening angle. This increases the power output in all ranges from low to high speed.

▶ System Diagram ◀



Intake Air Control Valve and Actuator

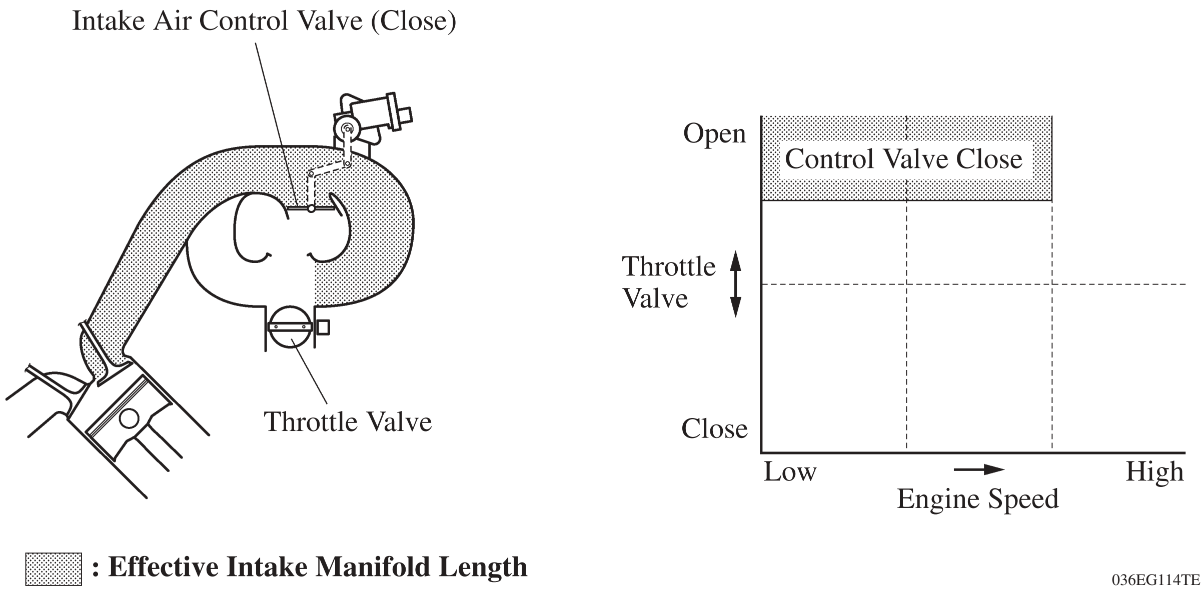
- The intake air control valve is installed in the intake manifold. It opens and closes to provide two effective lengths of the intake manifold.
- Based on the signals from the ECM, the actuator moves the intake air control valve via a link.



Operation

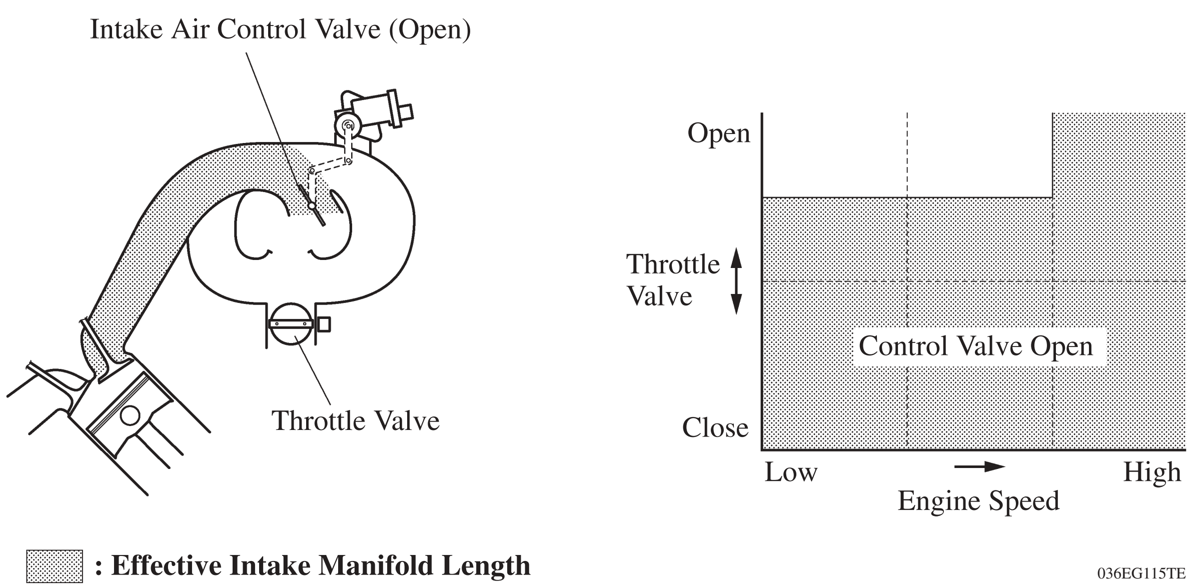
1) When the Intake Air Control Valve Closes

While the engine is running at low-to-medium speed under heavy load, the ECM causes the actuator to close the control valve. As a result, the effective length of the intake manifold is lengthened and the intake efficiency, in the low-to-medium speed range, is improved due to the dynamic effect (inertia) of the intake air, thereby increasing power output.



2) When the Intake Air Control Valve Open

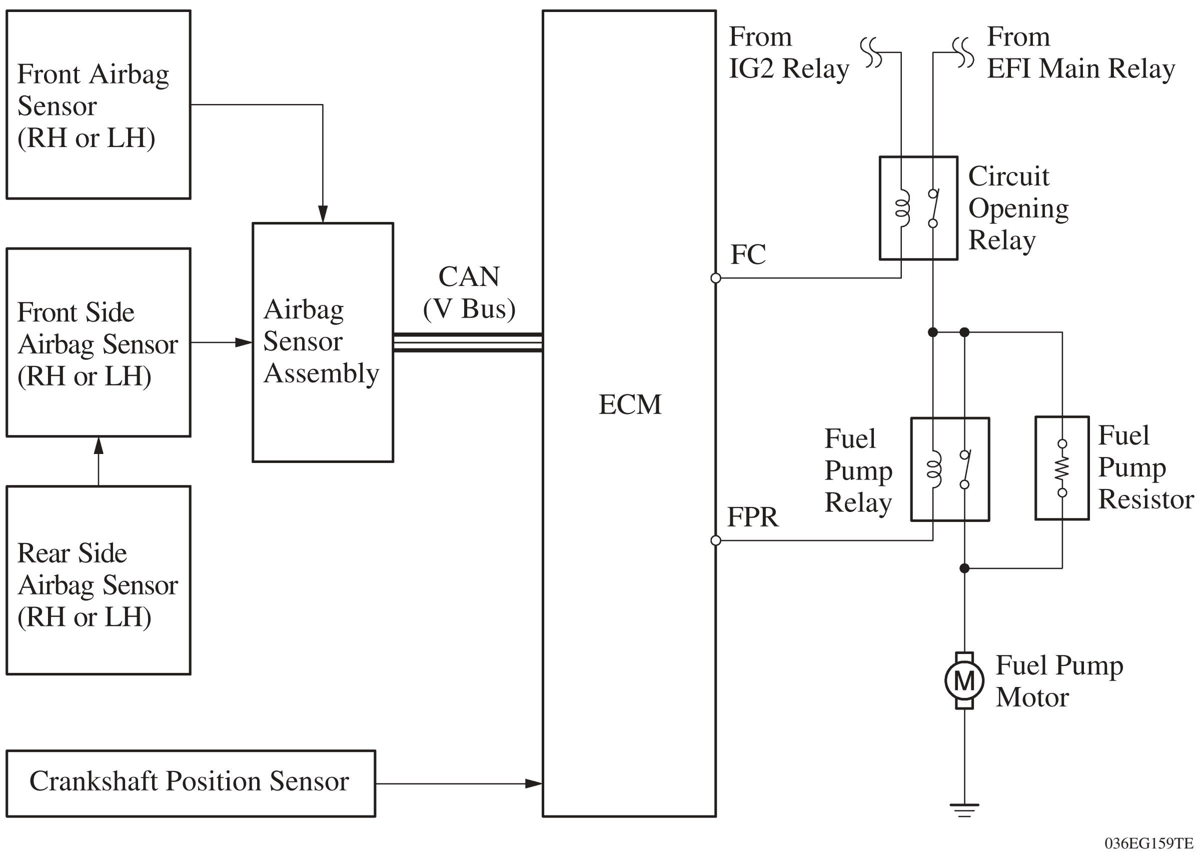
Under any condition except when the engine is running at low-to-medium speed under heavy load, the ECM causes the actuator to open the control valve. When the control valve is open, the effective length of the intake air chamber is shortened and peak intake efficiency is shifted to the low-to-high engine speed range, thus providing greater output at low-to-high engine speeds.



10. Fuel Pump Control

- A fuel cut function is used to stop the fuel pump once when any of the SRS airbags have deployed. In this system, the airbag deployment signal from the airbag sensor assembly is detected by the ECM, and it turns OFF the circuit opening relay. After the fuel cut function has been activated, turning the power source from OFF to ON cancels the fuel cut function, and the engine can be restarted.
- The ECM uses the fuel pump relay and the fuel pump resistor to control the fuel pump speed in accordance with driving conditions.

▶ System Diagram ◀

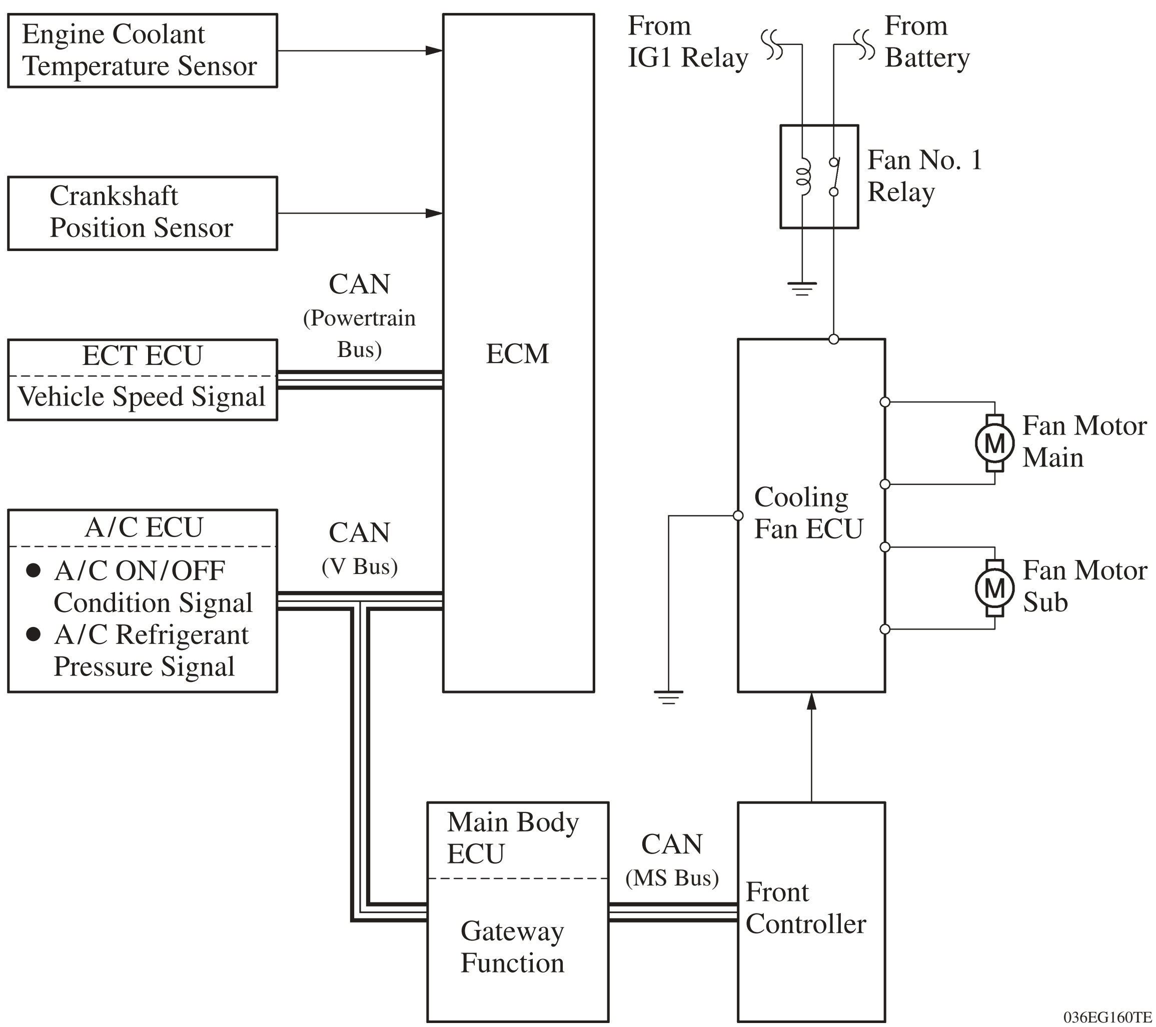


11. Cooling Fan Control System

General

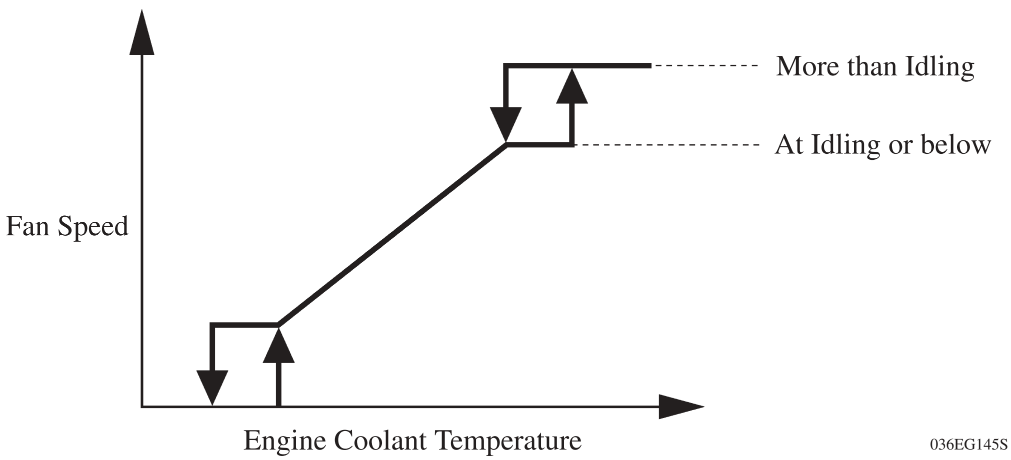
A cooling fan control system is used. To achieve an optimal fan speed in accordance with the engine coolant temperature, engine speed, vehicle speed, and air conditioning operating conditions, the ECM calculates an appropriate fan speed and sends signals to the cooling fan ECU via the main body ECU and the front controller. Upon receiving the signals from the ECM, the cooling fan ECU actuates the fan motors.

▶ System Diagram ◀

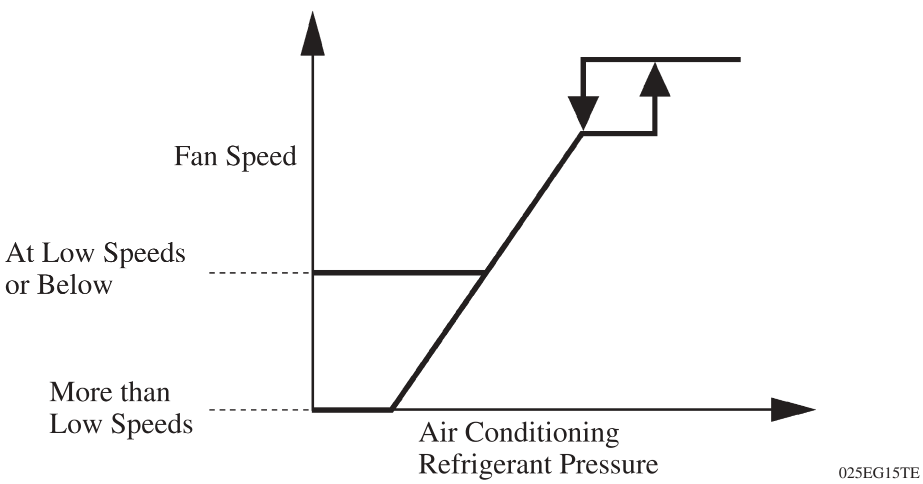


Operation

- The ECM controls the cooling fan speed in accordance with the value of the engine coolant temperature, as shown in the graph below. When the engine coolant temperature is higher than a specific value, the control differs depending on whether the engine speed is at idling and below or more.



- The ECM controls the cooling fan speed in accordance with the value of the air conditioning refrigerant pressure, as shown in the graph below. When the air conditioning refrigerant pressure is higher than a specific value, the control differs depending on whether the engine speed is at low speeds and below or more.

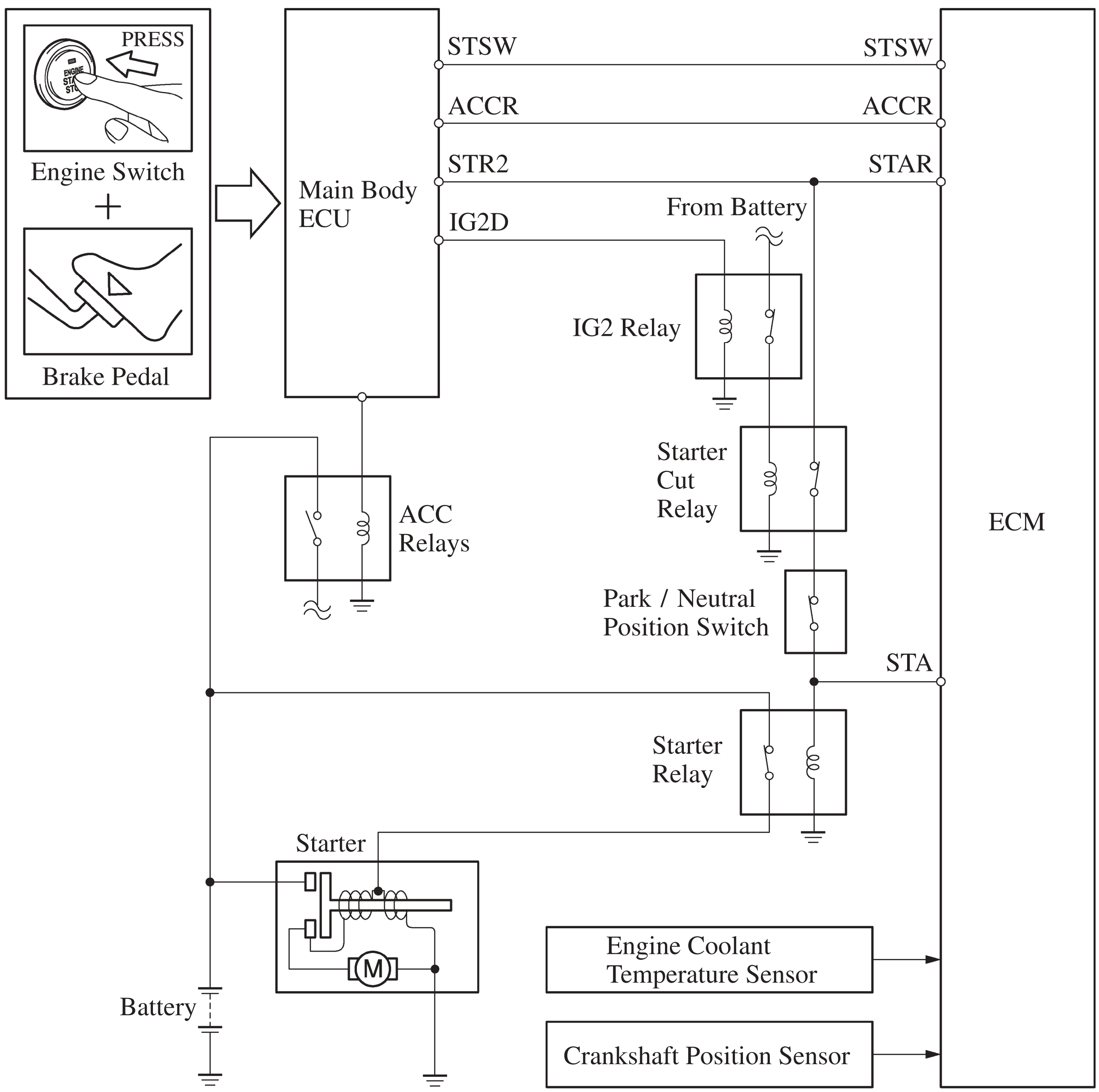


12. Cranking Hold Function

General

- Once the engine switch is pressed, this function continues to operate the starter until the engine has started, provided that the brake pedal is depressed. This prevents starting failure and the engine from being cranked after it has started.
- When the ECM detects a start signal from the main body ECU, this system monitors the engine speed (NE signal) and continues to operate the starter until it has determined that the engine has started. Furthermore, even if the ECM detects a start signal from the main body ECU, this system will not operate the starter if the ECM has determined that the engine has already started.

▶ System Diagram ◀



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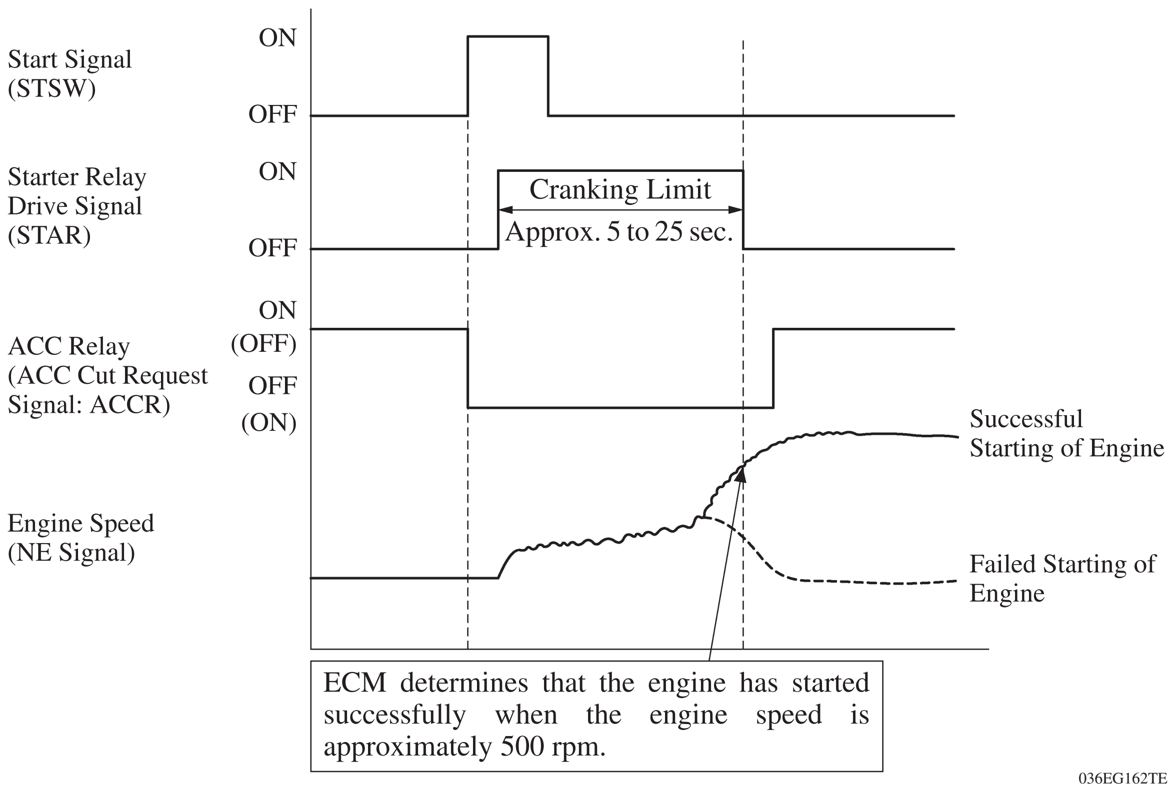
Operation

- As indicated in the below timing chart, when the ECM detects a STSW signal (start signal) from the main body ECU, the ECM outputs STAR signal (starter relay drive signal) through the starter cut relay to the starter relay and actuates the starter. The ECM also outputs ACCR signal (ACC cut request signal) to the main body ECU. Thus, the main body ECU will not energize the ACC relay.
- After the starter operates and the engine speed becomes higher than approximately 500 rpm, the ECM determines that the engine has started and stops the output of the STAR signal to the starter relay and the output of ACCR signal to the main body ECU. Thus, the starter operation stops and the main body ECU energize the ACC relay.
- If the engine has any failure and does not start, the starter operates as long as its maximum continuous operation time and stops automatically. The maximum continuous operation time is approximately 5 seconds through 25 seconds depending on the engine coolant temperature condition. When the engine coolant temperature is extremely low, it is approximately 25 seconds and when the engine is warmed up sufficiently, it is approximately 5 seconds.
- This system cuts off the current that powers the accessories while the engine is cranking to prevent the accessory illumination from operating intermittently due to the unstable voltage that is associated with the cranking of the engine.
- This system has following protection features:
  – While the engine is running normally, the starter does not operate.
  – Even if the driver keeps pressing the engine switch, the ECM stops the output of the STAR and ACCR signals when the engine speed becomes higher than 1200 rpm. Thus, the starter operation stops and the main body ECU energize the ACC relay.
  – In case the driver keeps pressing the engine switch and the engine does not start, the ECM stops the output of the STAR and ACCR signals after 30 seconds have elapsed. Thus, the starter operation stops and the main body ECU energize the ACC relay.
  – In case the ECM cannot detect an engine speed signal while the starter is operating, the ECM will immediately stop the output of the STAR and ACCR signals. Thus, the starter operation stops and the main body ECU energize the ACC relay.

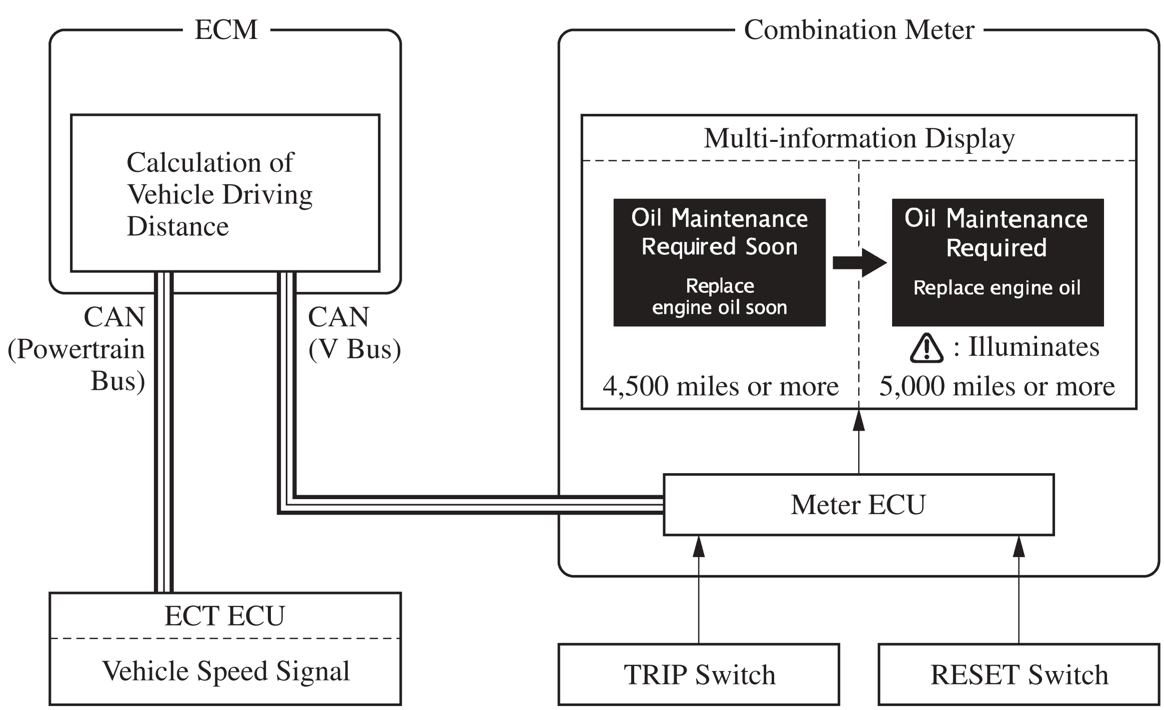
▶ Timing Chart ◀



13. Oil Replacement Reminder (Only for U.S.A. models)

- The oil replacement reminder function of the ECM reminds the driver of the need to replace the engine oil via the multi-information display in accordance with the vehicle driving distance.
- The ECM calculates the vehicle driving distance based on the signals from the ECT ECU. The ECM sends a warning display request signal to the meter ECU in accordance with the calculated distance. The meter ECU will display the warning on the multi-information display based on this signal.
- There are two types of warnings: one is displayed when the vehicle driving distance has reached 4,500 miles or more since the last time the system was reset, and the other is displayed when the driving distance has reached 5,000 miles or more.
  - The “Oil Maintenance Required Soon” warning will appear at 4,500 miles or more. The “Oil Maintenance Required Soon” warning appears for approximately 15 seconds after the power source is changed to IG-ON, and then goes off.
  - The “Oil Maintenance Required” warning will appear at 5,000 miles or more. The “Oil Maintenance Required” warning remains on while the power source is IG-ON.
- After the engine oil has been replaced, the accumulated vehicle driving distance is memorized in the ECM and should be reset through the operation of the RESET switch. At this point, the accumulated vehicle driving distance is reset to zero.

▶ System Diagram ◀



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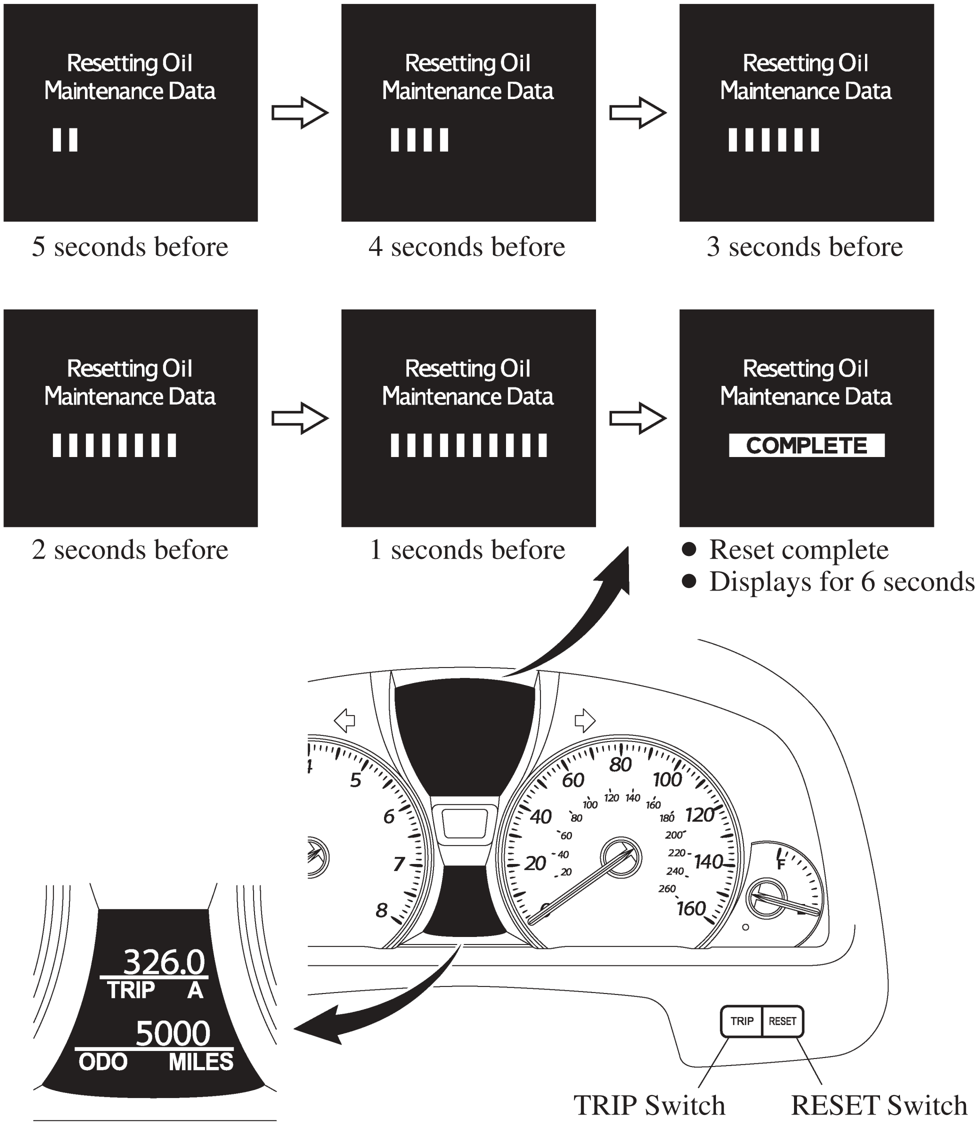
Service Tip

The accumulated vehicle driving distance is memorized in the ECM and can be reset using the following procedure.

1) Switch the power source to IG-ON. Then, use the TRIP switch to turn ON the “TRIP A” display on the multi-information display.
2) Switch the power source to OFF. While pushing the RESET switch, switch the power source to IG-ON.
3) With the power source in the IG-ON mode, keep holding the RESET switch (for at least five seconds) with the multi-information display counting down as shown below.
4) When the reset operation is complete, the multi-information display will display “COMPLETE”. At this time, release the RESET switch. After 6 seconds, the “COMPLETE” display will turn off, indicating that the resetting is complete.



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14. Evaporative Emission Control System

General

The evaporative emission control system prevents the fuel vapors that are created in the fuel tank from being released directly into the atmosphere.
The canister stores the fuel vapors that have been created in the fuel tank.

- The ECM controls the purge VSV in accordance with the driving conditions in order to direct the fuel vapors into the engine, where they are burned.
- In this system, the ECM checks for evaporative emission leaks and outputs DTC (Diagnostic Trouble Code) in the event of a malfunction. An evaporative emission leak check consists of an application of vacuum to the evaporative emissions system and monitoring the system for changes in pressure in order to detect a leakage.
- This system consists of the purge VSV, canister, refueling valve, canister pump module, and ECM.
- An ORVR (Onboard Refueling Vapor Recovery) function is provided in the refueling valve.
- The canister pressure sensor has been included to the canister pump module.
- A canister filter has been provided on the fresh air line. This canister filter is maintenance-free.
- The following are the typical conditions necessary to enable an evaporative emission leak check:

Typical Enabling Condition	● Five hours have elapsed after the power source has been turned OFF*. ● Altitude: Below 2400 m (8000 feet) ● Battery Voltage: 10.5 V or more ● Power Source: OFF ● Engine Coolant Temperature: 4.4 to 35°C (40 to 95°F) ● Intake Air Temperature: 4.4 to 35°C (40 to 95°F)

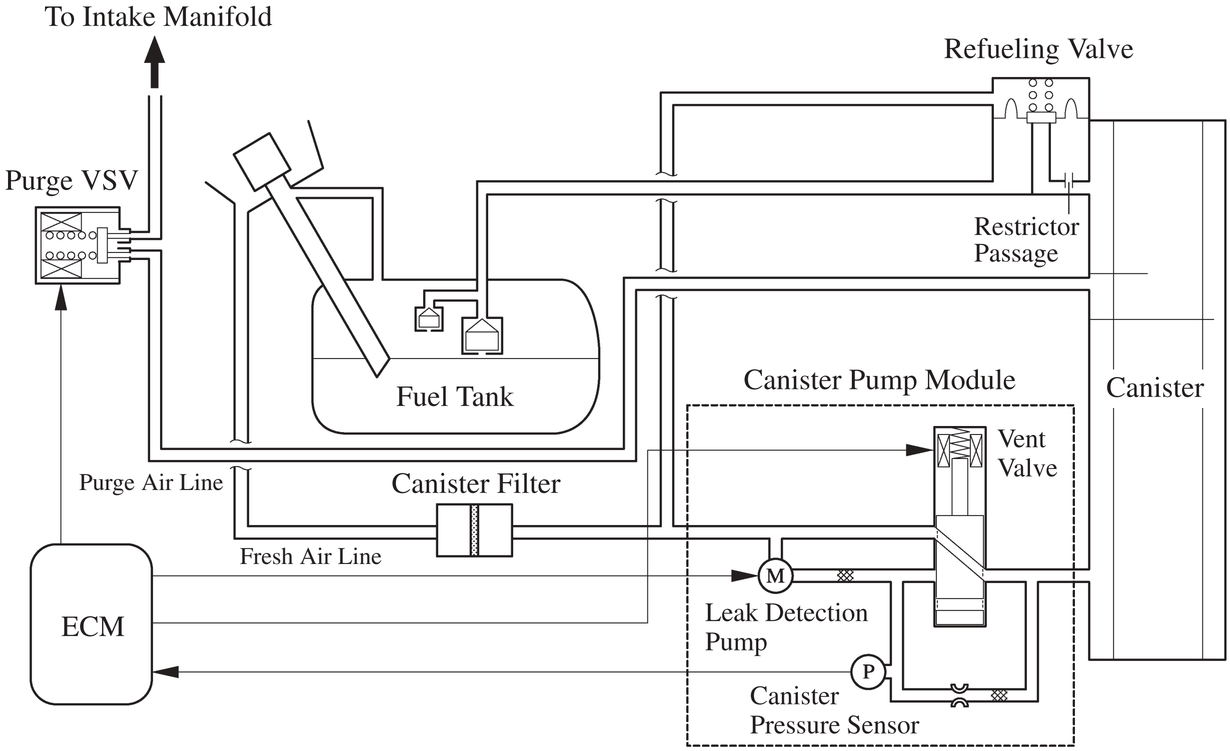
*: If engine coolant temperature does not drop below 35°C (95°F), this time should be extended to 7 hours. Even after that, if the temperature is not less than 35°C (95°F), the time should be extended to 9.5 hours.

Service Tip

The pump module performs a fuel evaporative emission leakage check. This check is done approximately five hours after the power source is turned off. Sound may be heard coming from underneath the luggage compartment for several minutes. This does not indicate a malfunction.

- Pinpoint pressure test procedure is adopted by pressurizing the fresh air line that runs from the canister pump module to the air filler neck. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).

System Diagram



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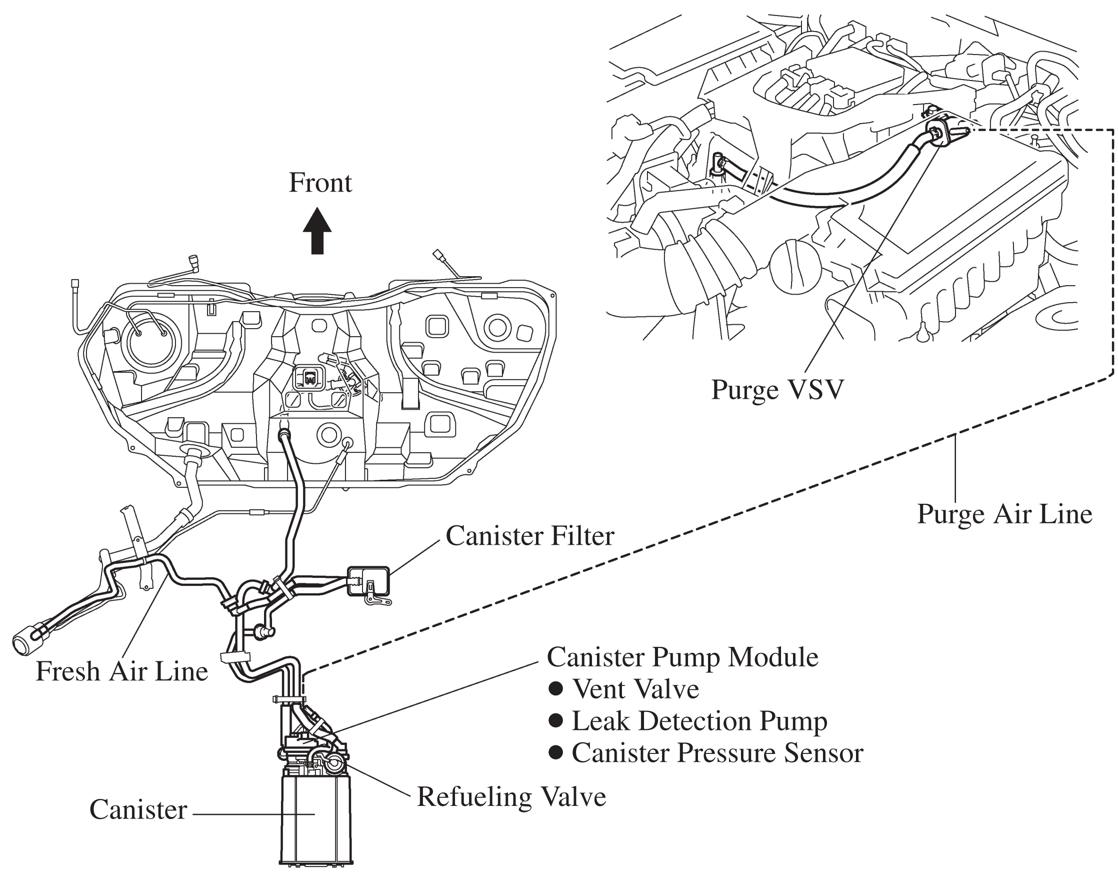
Layout of Main Components



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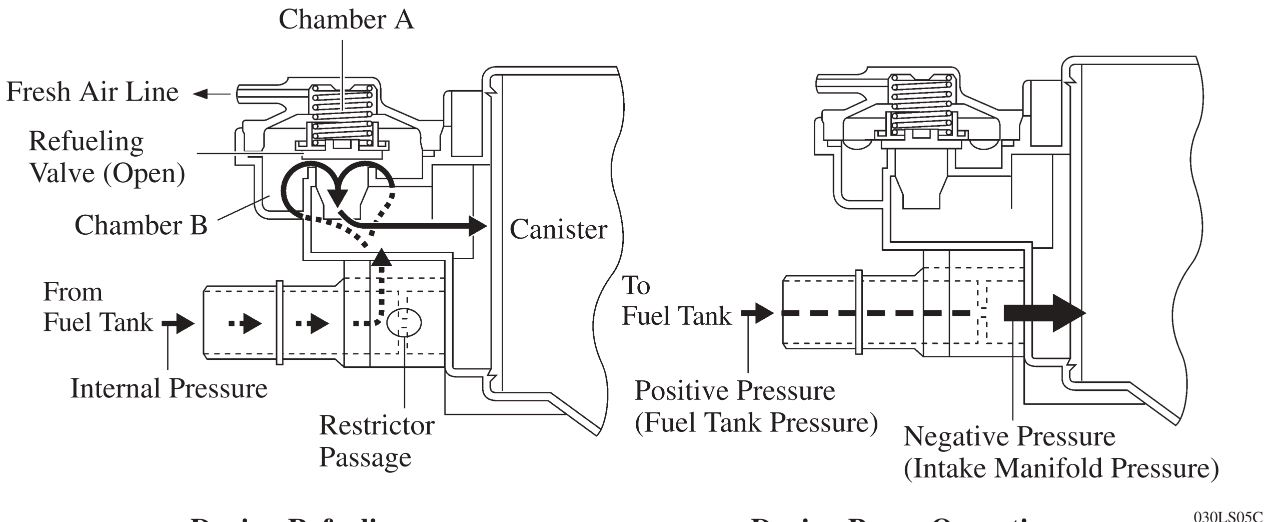
Function of Main Components

Component		Function
Canister		Contains activated charcoal to absorb the fuel vapors that are created in the fuel tank.
Refueling Valve		Controls the flow rate of the fuel vapors from the fuel tank to the canister when the system is purging or during refueling.
	Restrictor Passage	Prevents a large amount of vacuum during purge operation or system monitoring operation from affecting the pressure in the fuel tank.
Fresh Air Line		Fresh air goes into the canister and the cleaned drain air goes out into the atmosphere.
Canister Pump Module	Vent Valve	Opens and closes the fresh air line in accordance with the signals from the ECM.
	Leak Detection Pump	Applies vacuum pressure to the evaporative emission system in accordance with the signals from the ECM.
	Canister Pressure Sensor	Detects the pressure in the evaporative emission system and sends the signals to the ECM.
Purge VSV		Opens in accordance with the signals from the ECM when the system is purging, in order to send the fuel vapors that were absorbed by the canister into the intake manifold. In system monitoring mode, this valve controls the introduction of the vacuum into the fuel tank.
Canister Filter		Prevents dust and debris in the fresh air from entering the system.
ECM		Controls the canister pump module and the purge VSV in accordance with the signals from various sensors, in order to achieve a purge volume that suits the driving conditions. In addition, the ECM monitors the system for any leakage and outputs a DTC if a malfunction is found.

Construction and Operation

1) Refueling Valve

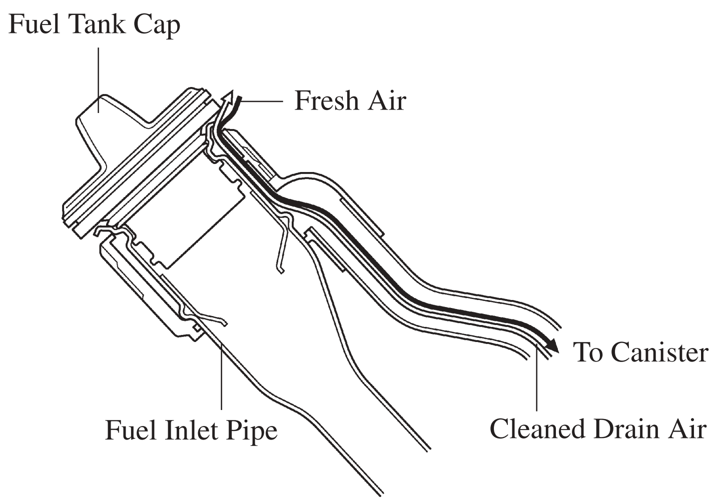
- The refueling valve consists of chamber A, chamber B, and the restrictor passage. A constant atmospheric pressure is applied to chamber A.
- During refueling, the internal pressure of the fuel tank increases. This pressure causes the refueling valve to lift up, allowing the fuel vapors to enter the canister.
- The restrictor passage prevents the large amount of vacuum that is created during purge operation or system monitoring operation from entering the fuel tank, and limits the flow of the fuel vapors from the fuel tank to the canister. If a large volume of fuel vapors enters the intake manifold, it will affect the air-fuel ratio control of the engine. Therefore, the role of the restrictor passage is to help prevent this from occurring.



During Refueling **During Purge Operation or System Monitoring Operation**

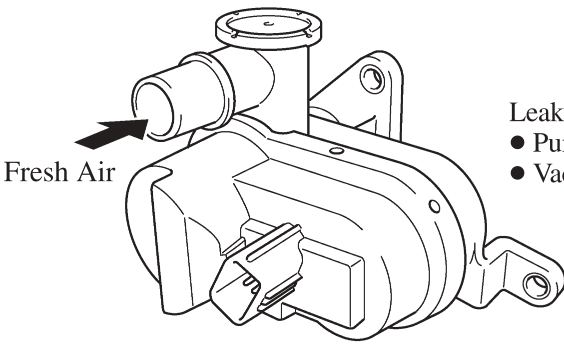
2) Fuel Inlet (Fresh Air Inlet)

In accordance with the change of structure of the evaporative emission control system, the location of the fresh air line inlet has been changed from the air cleaner to the near the fuel inlet. The fresh air from the atmosphere and drain air cleaned by the canister will go in or out of the system through the passages shown below.



3) Canister Pump module

- The canister pump module consists of the vent valve, canister pressure sensor, and leak detection pump (vacuum pump and pump motor).
- The vent valve switches the passages in accordance with the signals received from the ECM.
- A brushless type DC motor is used for the pump motor.
- A vane type vacuum pump is used.



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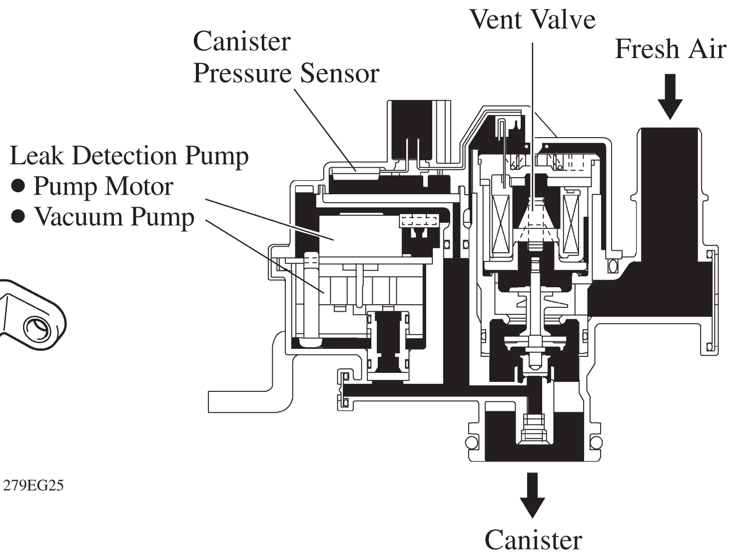

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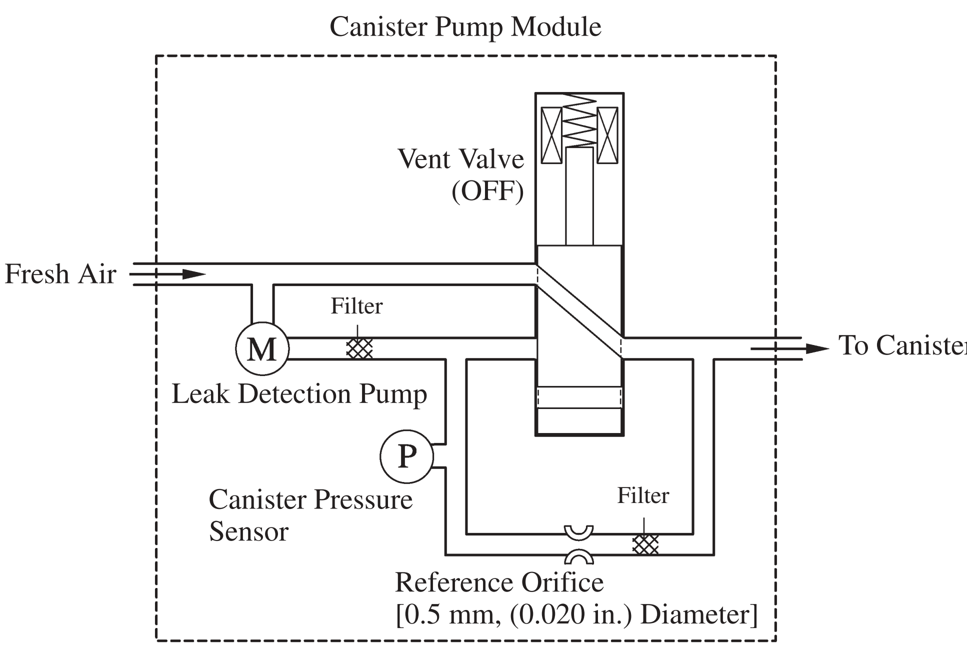
▶ Simple Diagram ◀



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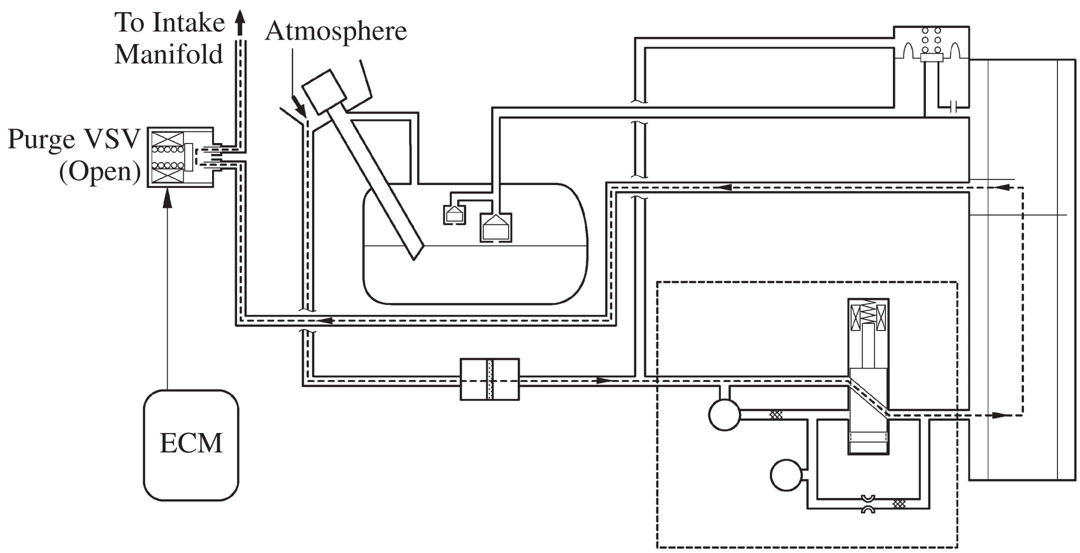
System Operation

1) Purge Flow Control

When the engine has reached predetermined parameters (closed loop, engine coolant temp. above 80°C (176°F), etc), stored fuel vapors are purged from the canister whenever the purge VSV is opened by the ECM.
The ECM will change the duty ratio cycle of the purge VSV, thus controlling purge flow volume. Purge flow volume is determined by intake manifold pressure and the duty ratio cycle of the purge VSV. Atmospheric pressure is allowed into the canister to ensure that purge flow is constantly maintained whenever purge vacuum is applied to the canister.



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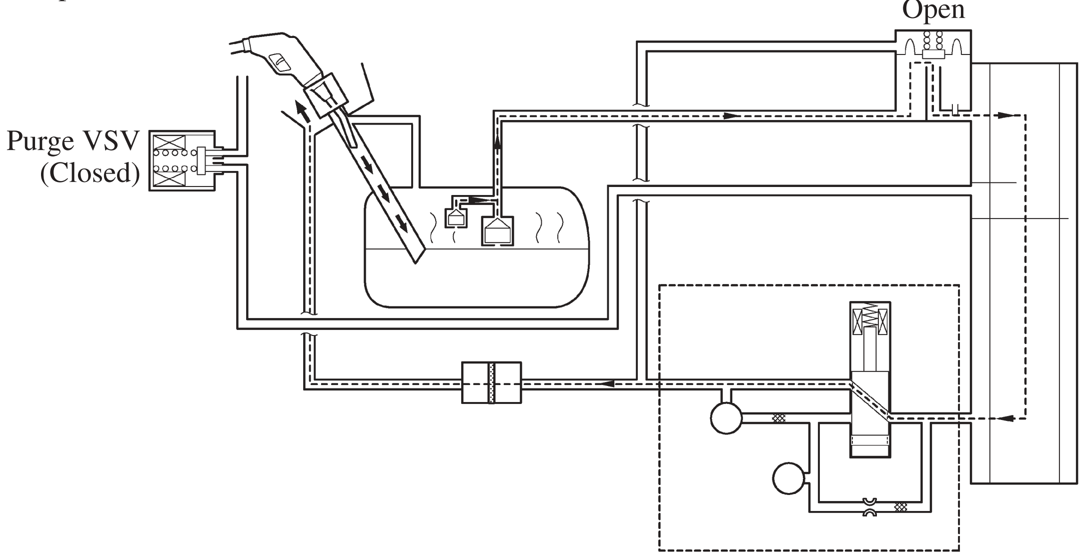
2) ORVR (On-Board Refueling Vapor Recovery)

When the internal pressure of the fuel tank increases during refueling, this pressure causes the diaphragm in the refueling valve to lift up, allowing the fuel vapors to enter the canister. The air that has had the fuel vapors removed from it will be discharged through the fresh air line. The vent valve is used to open and close the fresh air line, and it is always open (even when the engine is stopped) except when the vehicle is in monitoring mode (the valve will be open as long as the vehicle is not in monitoring mode). If the vehicle is refueled in system monitoring mode, the ECM will recognize the refueling by way of the canister pressure sensor, which detects the sudden pressure increase in the fuel tank, and the ECM will open the vent valve.



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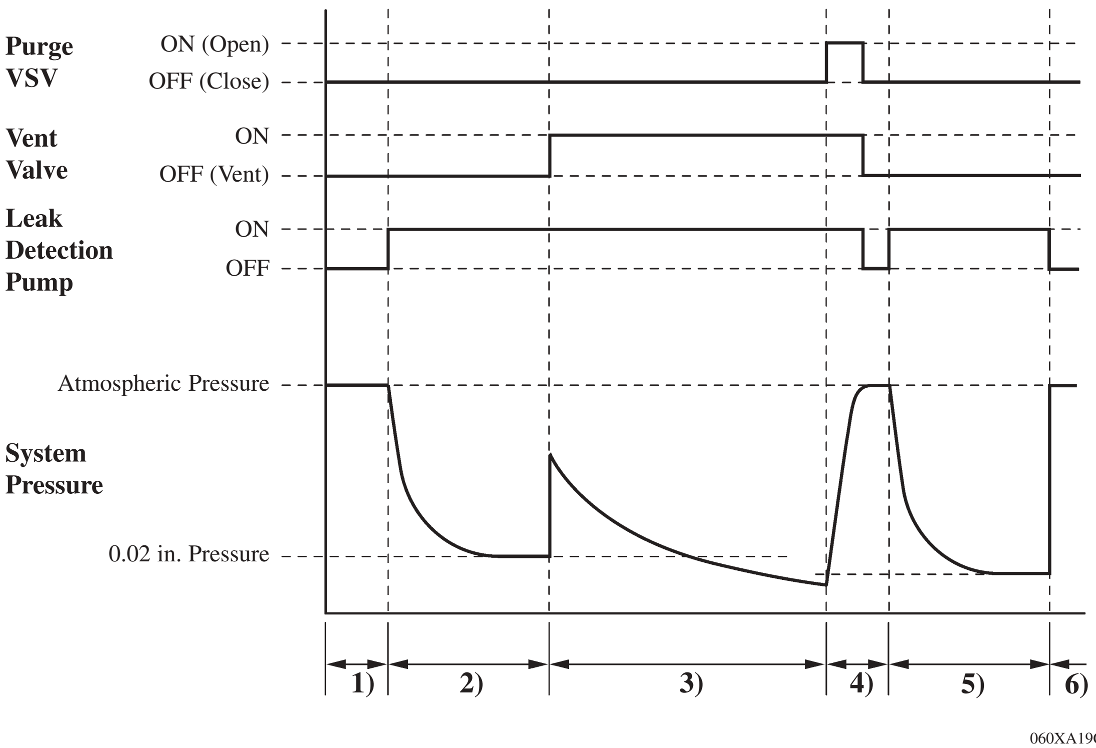
3) EVAP Leak Check

a. General

The EVAP leak check operates in accordance with the following timing chart:

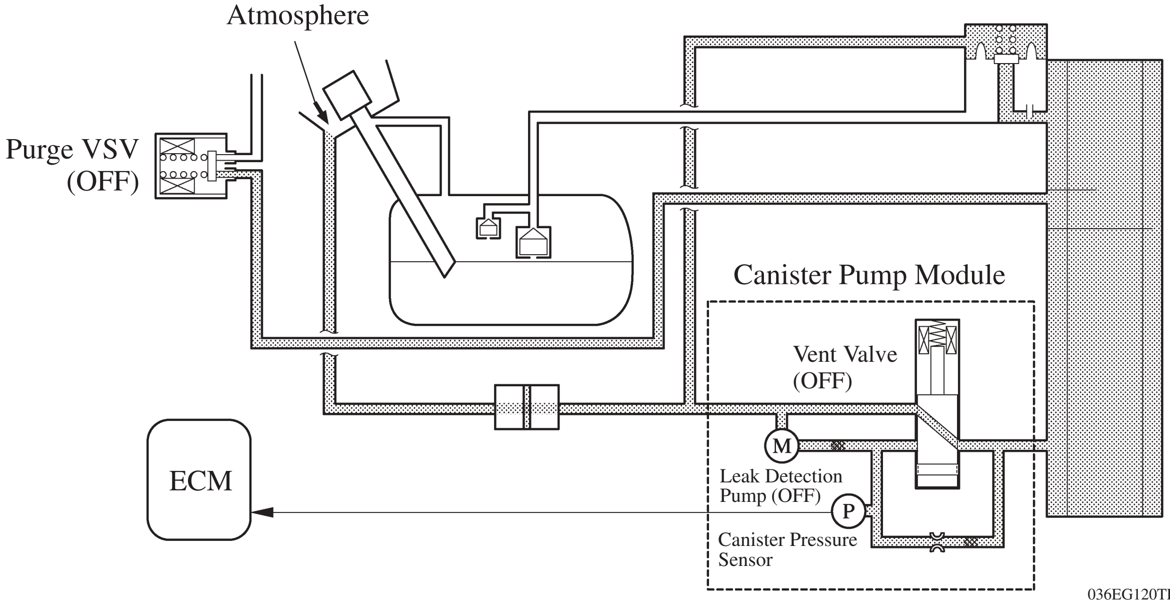
▶ Timing Chart ◀



Order	Operation	Description	Time
1)	Atmospheric Pressure Measurement	The ECM turns the vent valve OFF (vent) and measures EVAP system pressure to memorize the atmospheric pressure.	—
2)	0.02 in. Leak Pressure Measurement	The leak detection pump creates negative pressure (vacuum) through a 0.02 in. orifice and the pressure is measured. The ECM determines this as the 0.02 in. leak pressure.	20 sec.
3)	EVAP Leak Check	The leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized pressure is larger than the 0.02 in. leak pressure, ECM determines that the EVAP system has a leak. If the EVAP pressure does not stabilize within 15 minutes, the ECM cancels EVAP monitor.	Within 15 min.
4)	Purge VSV Monitor	The ECM opens the purge VSV and measures the EVAP pressure increase. If the increase is large, the ECM interprets this as normal.	10 sec.
5)	Repeat 0.02 in. Leak Pressure Measurement	The leak detection pump creates negative pressure (vacuum) through the 0.02 in. orifice and the pressure is measured. The ECM determines this as the 0.02 in. leak pressure.	20 sec.
6)	Final Check	The ECM measures the atmospheric pressure and records the monitor result.	—

b. Atmospheric Pressure Measurement

1) When the power source is turned OFF, the purge VSV and the vent valve are turned OFF. Therefore, atmospheric pressure is introduced into the canister.
2) The ECM measures the atmospheric pressure based on the signals provided by the canister pressure sensor.
3) If the measurement value is out of standards, the ECM actuates the leak detection pump in order to monitor the changes in the pressure.



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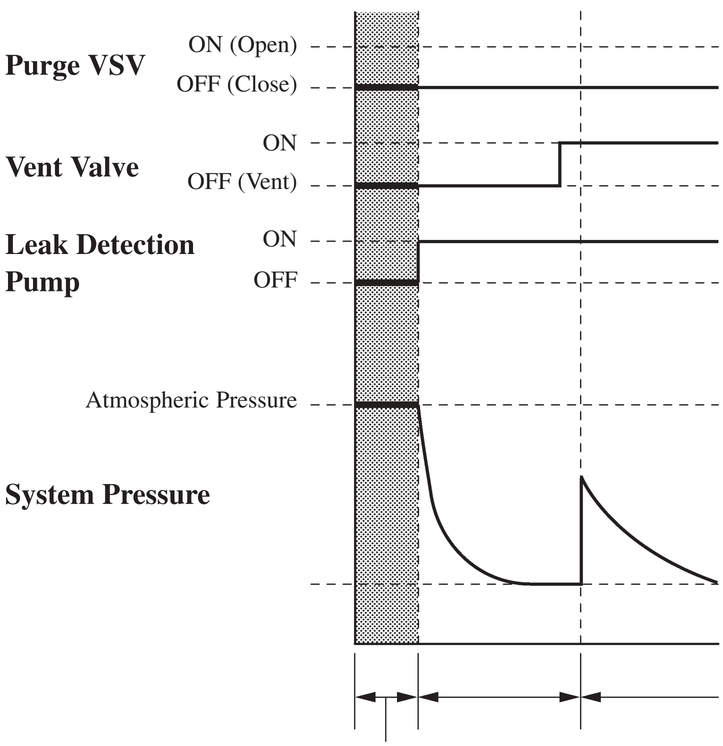

Atmospheric Pressure Measurement

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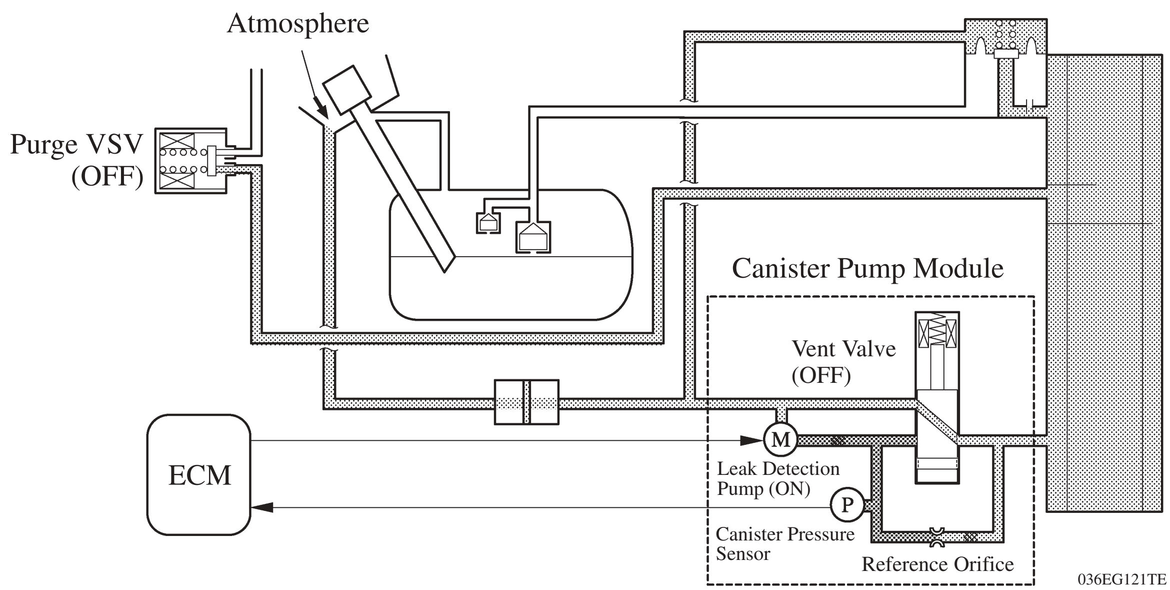
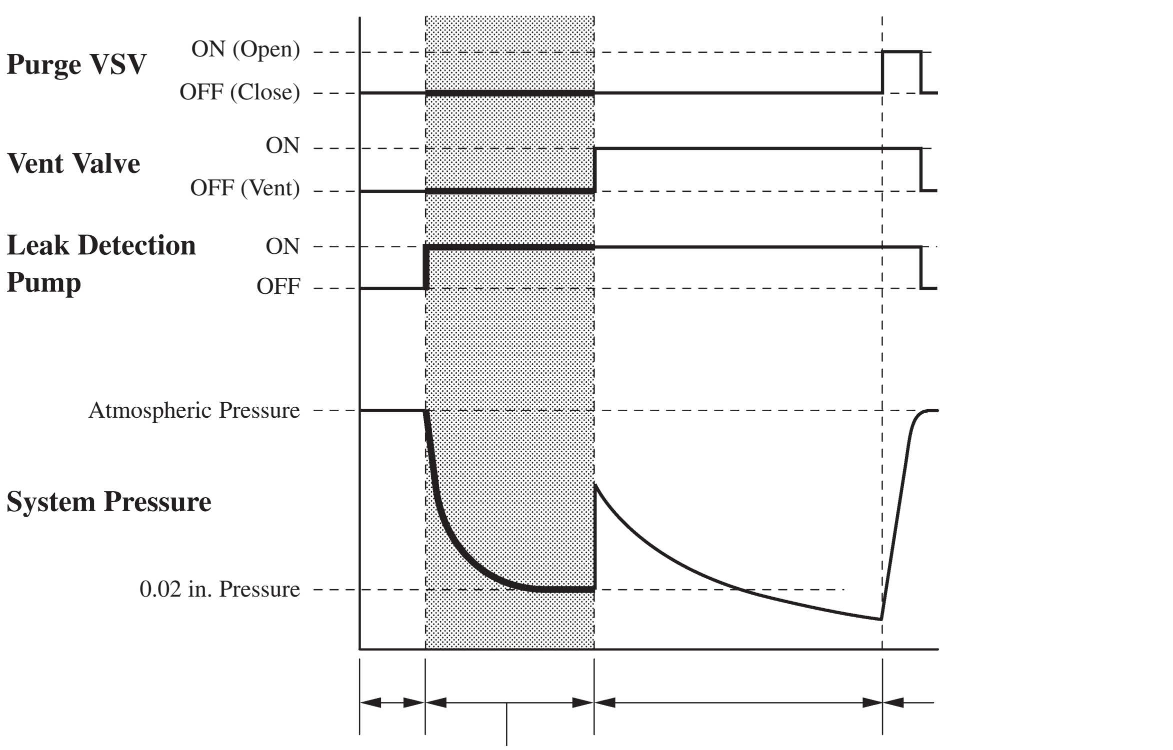
c. 0.02 in. Leak Pressure Measurement

1) The vent valve remains off, and the ECM introduces atmospheric pressure into the canister and actuates the leak detection pump in order to create a negative pressure.
2) At this time, the pressure will not decrease beyond a 0.02 in. pressure due to the atmospheric pressure that enters through a 0.02 in. diameter reference orifice.
3) The ECM compares the logic value and this pressure, and stores it as a 0.02 in. leak pressure in its memory.
4) If the measurement value is below the standard, the ECM will determine that the reference orifice is clogged and store DTC P043E in its memory.
5) If the measurement value is above the standard, the ECM will determine that a high flow rate pressure is passing through the reference orifice and store DTC P043F, P2401 and P2402 in its memory.





0.02 in. Leak Pressure Measurement

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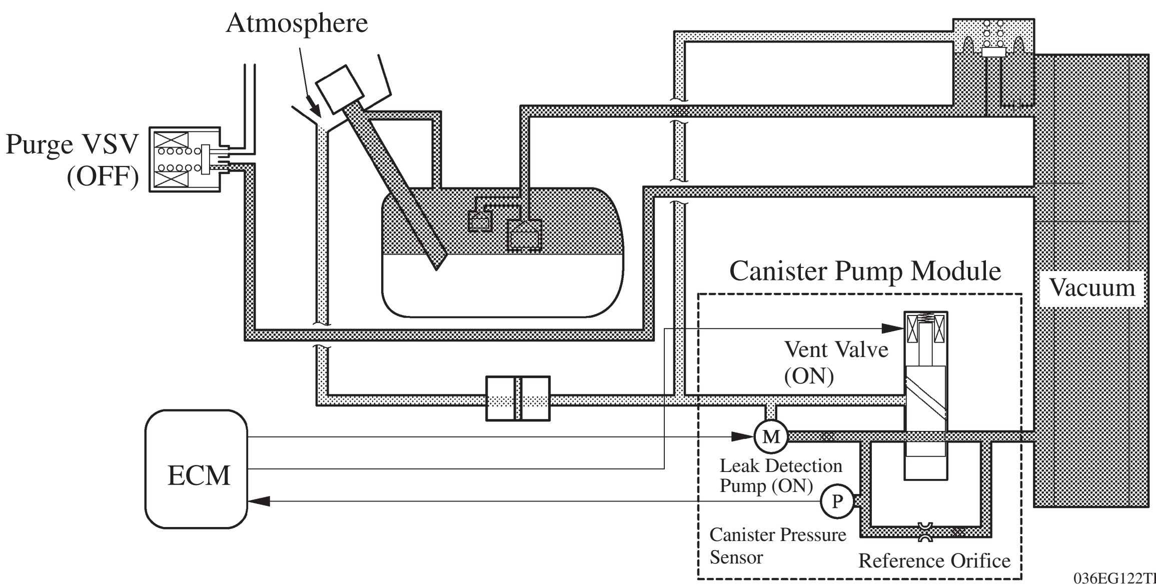
d. EVAP Leak Check

1) While actuating the leak detection pump, the ECM turns ON the vent valve in order to introduce a vacuum into the canister.
2) When the pressure in the system stabilizes, the ECM compares this pressure and the 0.02 in. pressure in order to check for a leakage.
3) If the detection value is below the 0.02 in. pressure, the ECM determines that there is no leakage.
4) If the detection value is above the 0.02 in. pressure and near atmospheric pressure, the ECM determines that there is a gross leakage (large hole) and stores DTC P0455 in its memory.
5) If the detection value is above the 0.02 in. pressure, the ECM determines that there is a small leakage and stores DTC P0456 in its memory.



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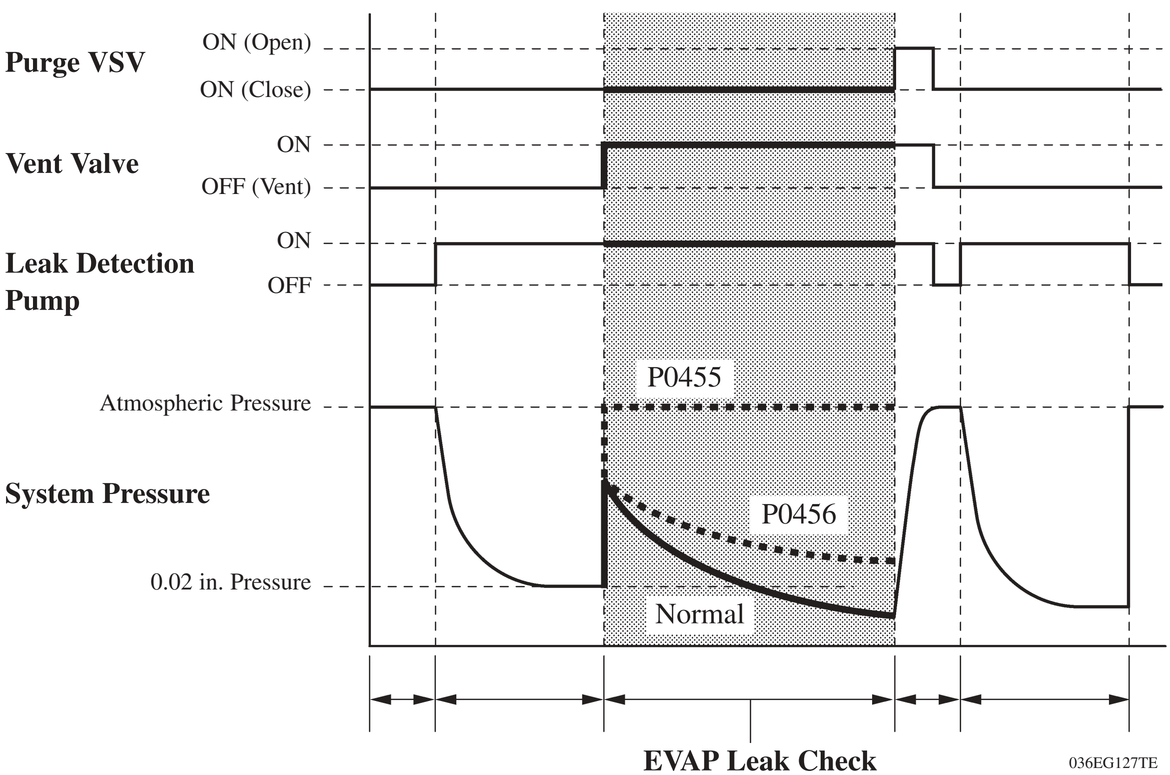

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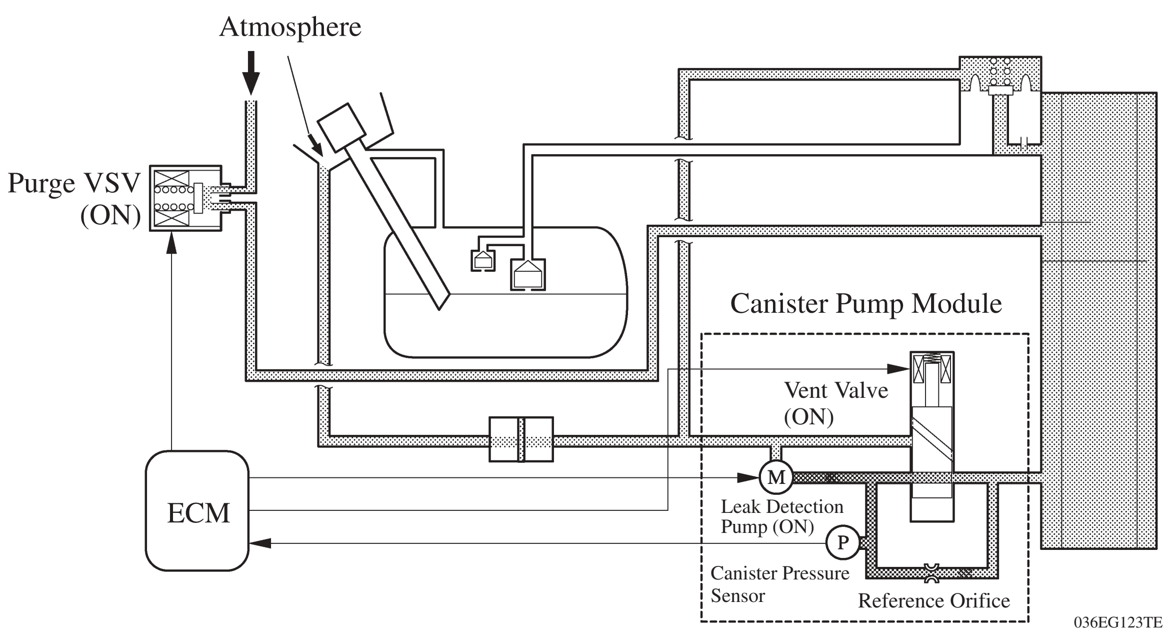
e. Purge VSV Monitor

1) After completing an EVAP leak check, the ECM turns ON (open) the purge VSV with the leak detection pump actuated, and introduces the atmospheric pressure from the intake manifold to the canister.
2) If the pressure change at this time is within the normal range, the ECM determines the condition to be normal.
3) If the pressure is out of the normal range, the ECM will stop the purge VSV monitor and store DTC P0441 in its memory.



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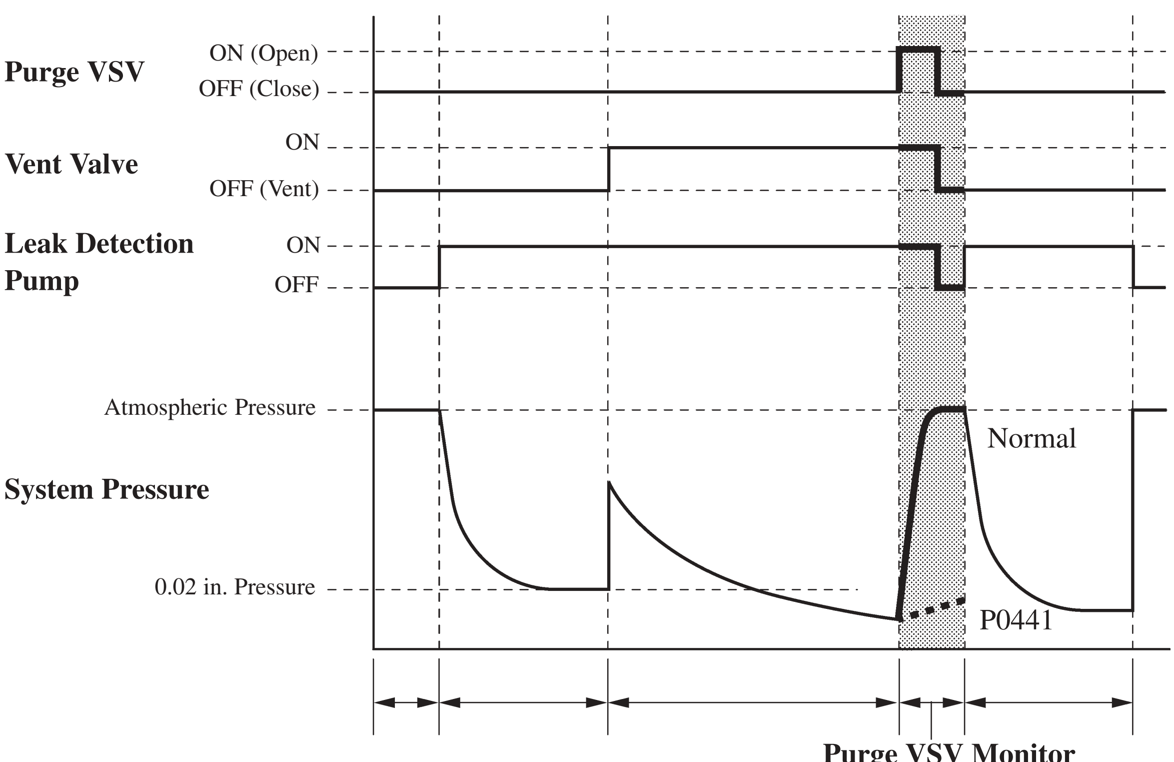

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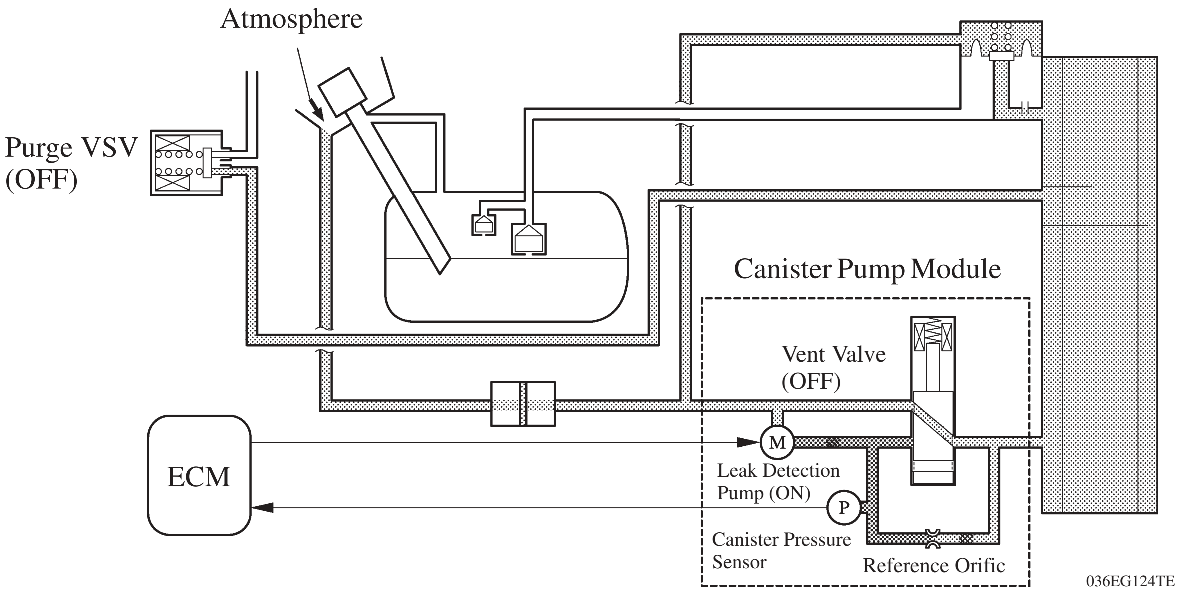
f. Repeat 0.02 in. Leak Pressure Measurement

1) While the ECM operates the leak detection pump, the purge VSV and vent valve turns off and a repeat 0.02 in. leak pressure measurement is performed.
2) The ECM compares the measured pressure with the pressure during EVAP leak check.
3) If the pressure during the EVAP leak check is below the measured value, the ECM determines that there is no leakage.
4) If the pressure during the EVAP leak check is above the measured value, the ECM determines that there is a small leak and stores DTC P0456 in its memory.



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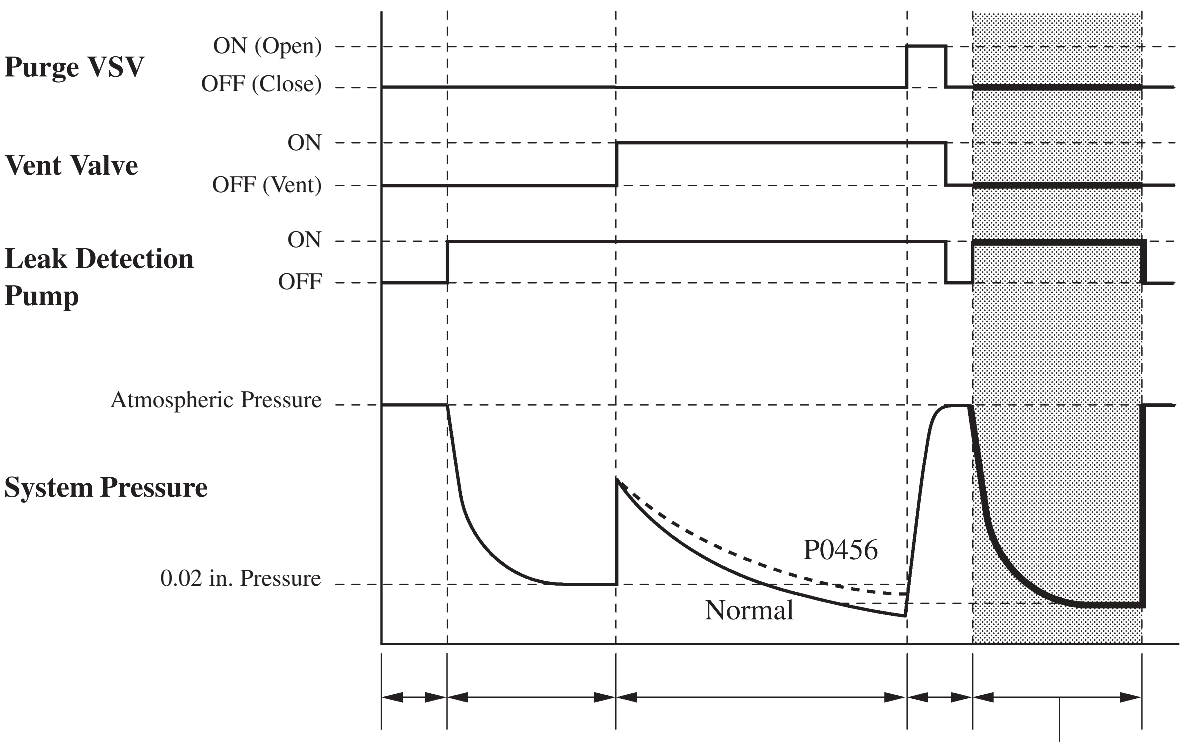

Repeat 0.02 in. Leak Pressure Measurement

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15. Diagnosis

- When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver.
- The ECM will also store the DTC (Diagnostic Trouble Code) of the malfunctions. The DTC can be accessed by using the hand-held tester or techstream.
- For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).

Service Tip

- The ECM of the ’07 LS460L/460 uses the CAN protocol for diagnostic communication. Therefore, When using a hand-held tester, a dedicated adapter [CAN VIM (Vehicle Interface Module)] must be connected between the DLC3 and the hand-held tester. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).
- To clear the DTC that is stored in the ECM, use the hand-held tester or techstream, disconnect the battery terminal or remove the EFI MAIN fuse and ETCS fuse for 1 minute or longer.

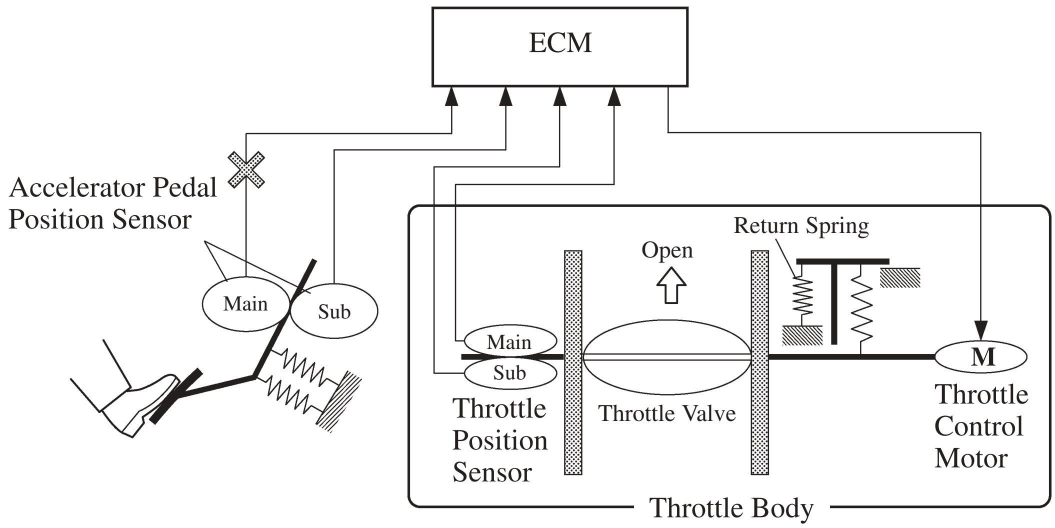
16. Fail-Safe

General

When a malfunction is detected at any of the sensors, there is a possibility of an engine or other malfunction occurring if the ECM were to continue to control the engine control system in the normal way. To prevent such a problem, the fail-safe function of the ECM either relies on the data stored in memory to allow the engine control system to continue operating, or stops the engine if a hazard is anticipated. For details, refer to the 2007 LEXUS LS460L/LS460 Repair Manual (Pub. No. RM0360U).

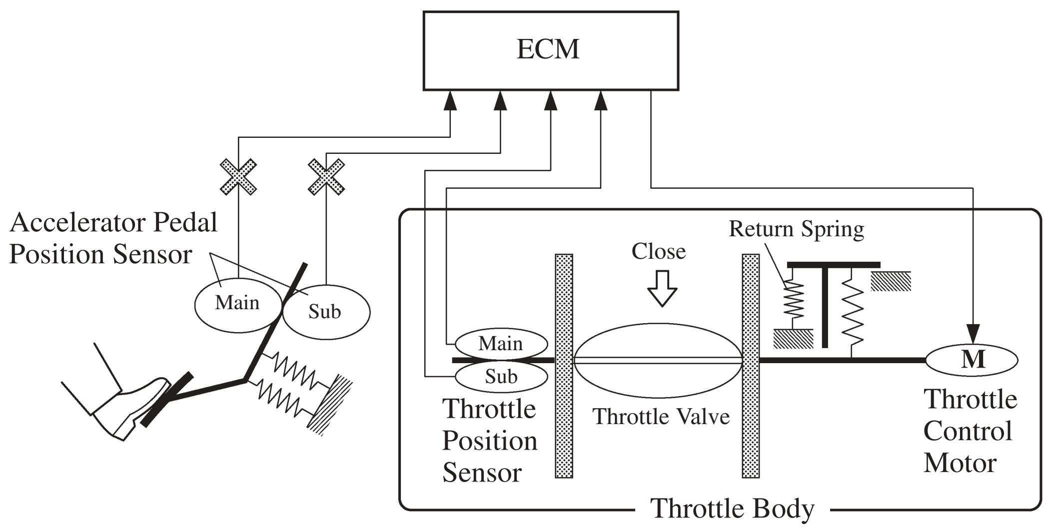
Fail-safe Operation due to Accelerator Pedal Position Sensor Trouble

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



D13N08

- If both circuits malfunction, the ECM detects the abnormal signal voltage from these two sensor circuits and discontinues the throttle control. At this time, the vehicle can be driven within its idling range.



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Fail-safe Operation due to Throttle Position Sensor Trouble

- The throttle position sensor comprises two (Main, Sub) sensor circuits.
- If a malfunction occurs in either 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 a fail-safe mode.
- Then, the force of the return spring causes the throttle valve to return and stay at the prescribed base opening position. At this time, the vehicle can be driven in the fail-safe mode while the engine output is regulated through control of the fuel injection and ignition timing in accordance with the accelerator pedal position.
- The same control as above is effected if the ECM detects a malfunction in the throttle control motor system.