■ENGINE CONTROL SYSTEM

1. General

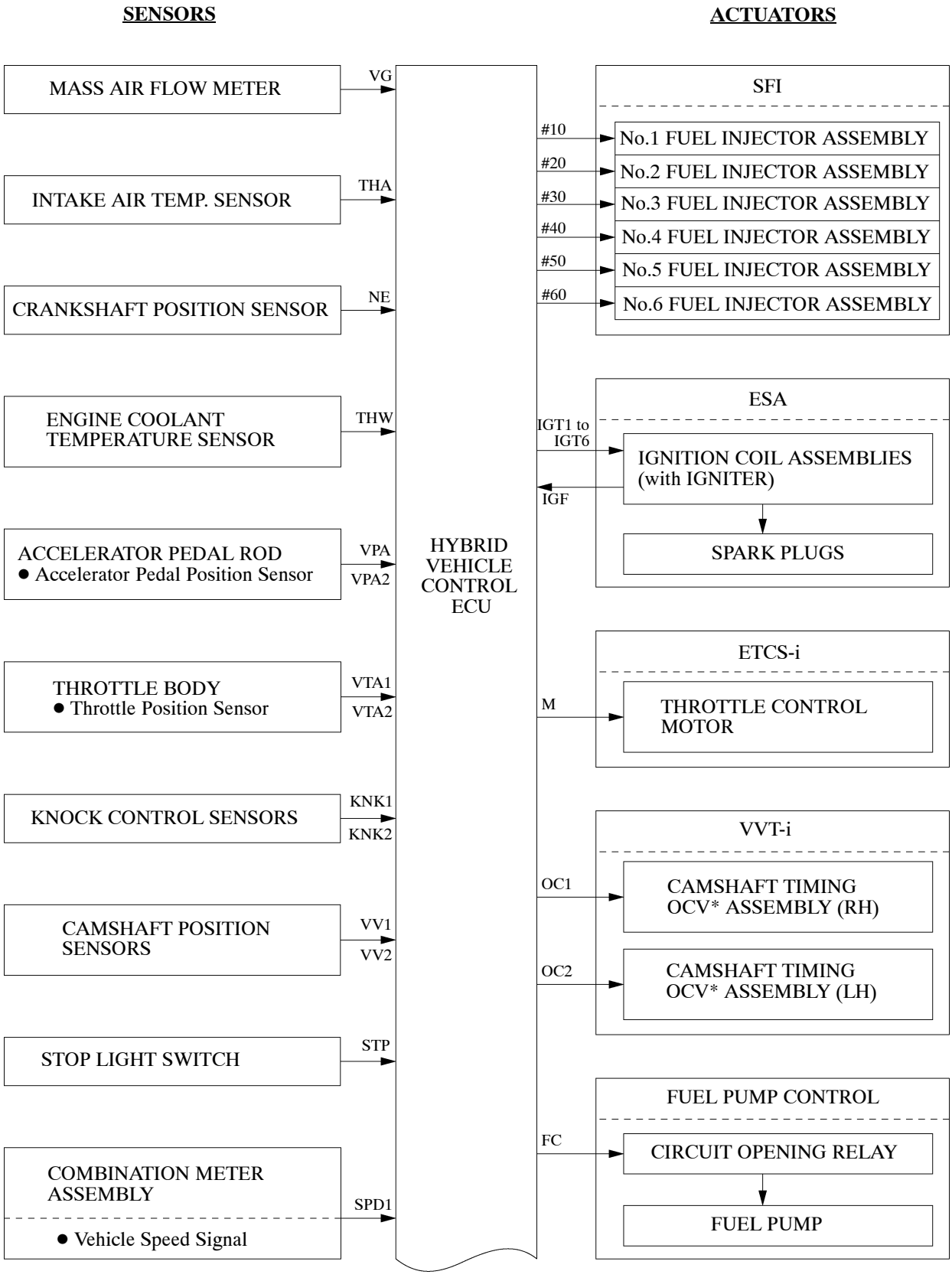
- The engine is controlled by the hybrid vehicle control ECU. The hybrid vehicle control ECU determines the motive force required by the driver in accordance with the pedal effort applied by the driver on the accelerator. Then, the hybrid vehicle control ECU determines the driving conditions of the vehicle in accordance with the vehicle speed, vehicle load, and various sensor signals. Furthermore, the hybrid vehicle control ECU starts and stops the engine in accordance with the motive force required by the driver, regardless of the driving conditions, and generates the required engine motive force.
- The engine control system of the 3MZ-FE engine has the following features. The hybrid vehicle control ECU is made by DENSO.

System	Outline
SFI (Sequential Multiport Fuel Injection) [See page EG-46]	An L-type SFI system directly detects the intake air volume with a hot-wire type mass air flow meter.
ESA (Electronic Spark Advance)	• Ignition timing is determined by the hybrid vehicle control ECU based on signals from various sensors. The hybrid vehicle control ECU 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 (IGT) ignition signals to the igniters.
ETCS-i (Electronic Throttle Control System-intelligent) [See page EG-47]	Optimally controls the opening angle of the throttle valve in accordance with the accelerator pedal input and the engine and vehicle conditions.
VVT-i (Variable Valve Timing-intelligent) [See page EG-49]	Controls the camshafts (intake) to an optimal valve timing in accordance with the engine operating conditions.
Fuel Pump Control [See page EG-55]	• Fuel pump operation is controlled by signals from the hybrid vehicle control ECU. • The fuel pump is stopped when an SRS airbag is deployed in a frontal, side, or rear side collision.
Cooling Fan Control [See page EG-56]	The cooling fan ECU steplessly controls the speed of the fans in accordance with the engine coolant temperature, vehicle speed, engine speed, air conditioning operating conditions, and hybrid system coolant temperature. As a result, the cooling performance is improved.
Air Fuel Ratio Sensor and Heated Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensors or heated oxygen sensors at an appropriate level to increase the ability of the sensor to accurately detect oxygen concentration.
Evaporative Emission Control [See page EG-58]	• A control system that functions as follows is used: When the engine is stopped while the vehicle is in motion or at rest, the fuel vapor-containment valve keeps the fuel tank assembly sealed to prevent fuel vapors from being discharged. Only when the engine is operating, the fuel tank close valve operates, allowing the charcoal canister assembly to absorb the fuel vapors, which is subsequently consumed by the engine. • A refueling control system that functions as follows is used: When the internal pressure of the fuel tank assembly is high because it is sealed, this system lowers the internal pressure of the fuel tank assembly before opening the fuel lid to refill the fuel tank assembly. • The hybrid vehicle control ECU controls the purge flow of fuel vapors from the charcoal canister assembly in accordance with engine conditions. • Approximately five hours after the power source is turned OFF, the hybrid vehicle control ECU operates the canister pump module to detect any fuel vapor leaks between the fuel tank assembly and the charcoal canister assembly through changes in the fuel tank pressure.

System	Outline
HV Immobilizer	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid key.
Diagnosis [See page EG-85]	When the hybrid vehicle control ECU detects a malfunction, the hybrid vehicle control ECU records the malfunction and information that relates to the fault.
Fail-safe [See page EG-85]	When the hybrid vehicle control ECU detects a malfunction, the hybrid vehicle control ECU stops or controls the engine according to the data already stored in the memory.

2. Construction

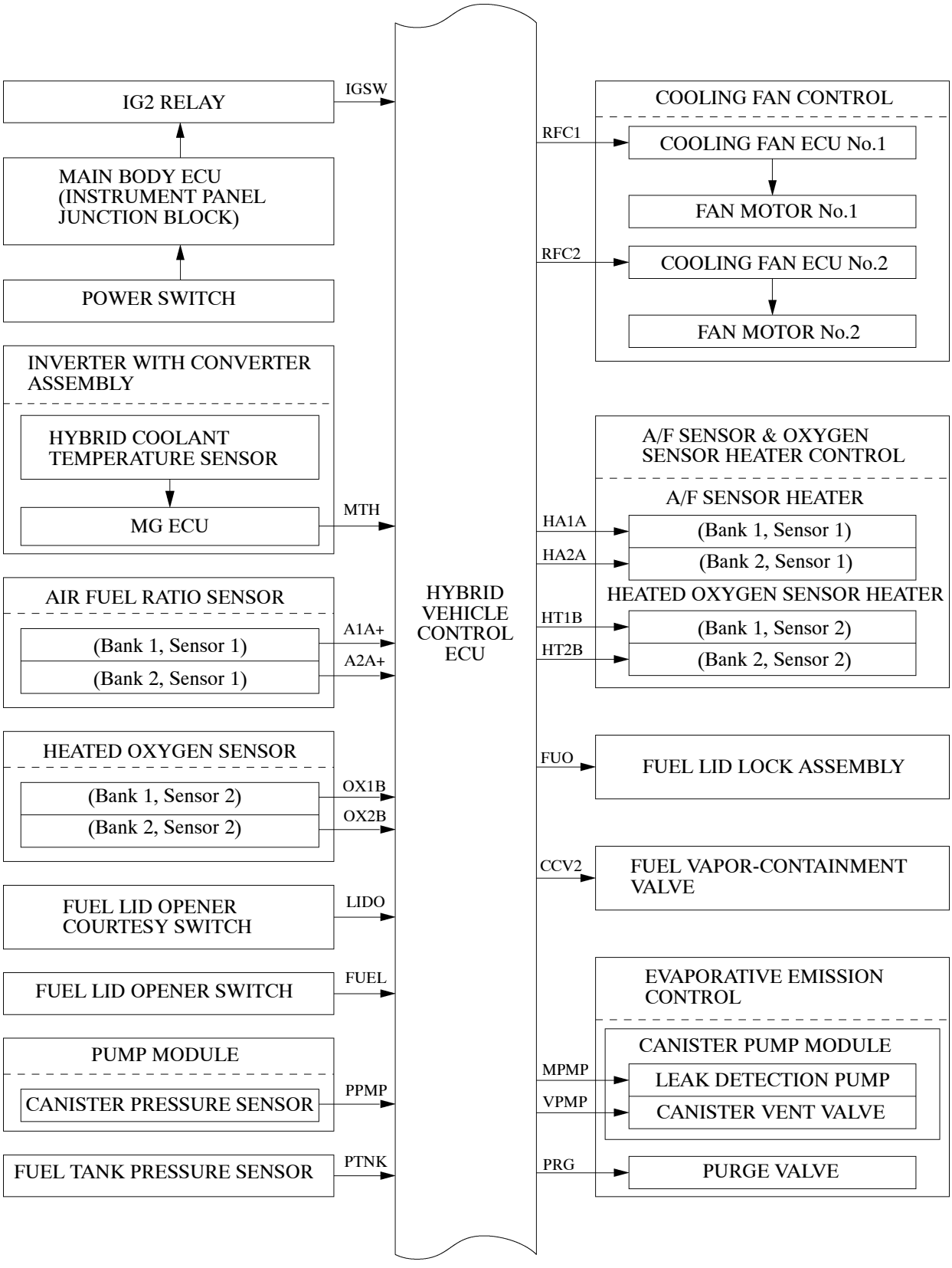
The configuration of the engine control system is as shown in the following chart.



*: Oil Control Valve

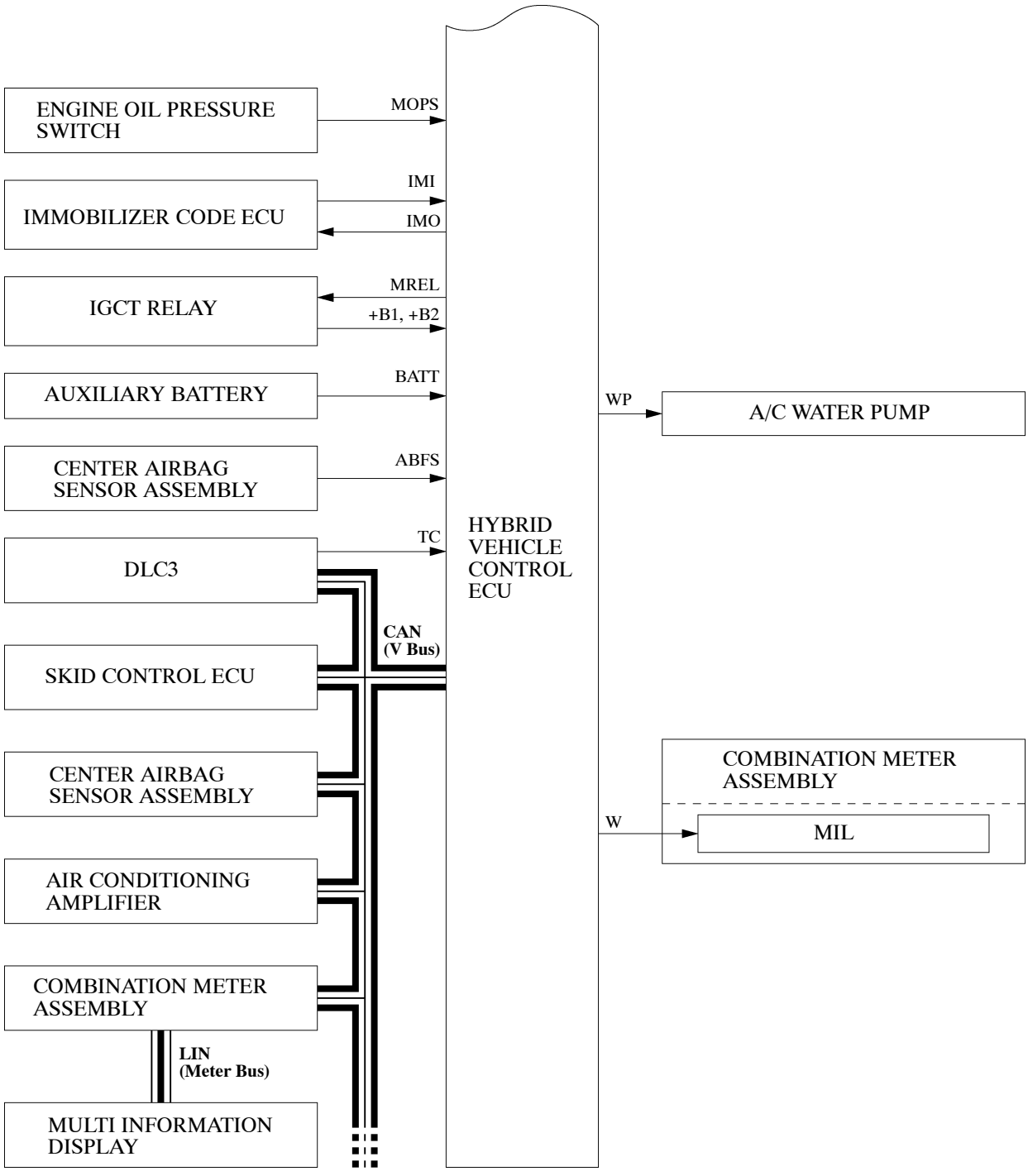
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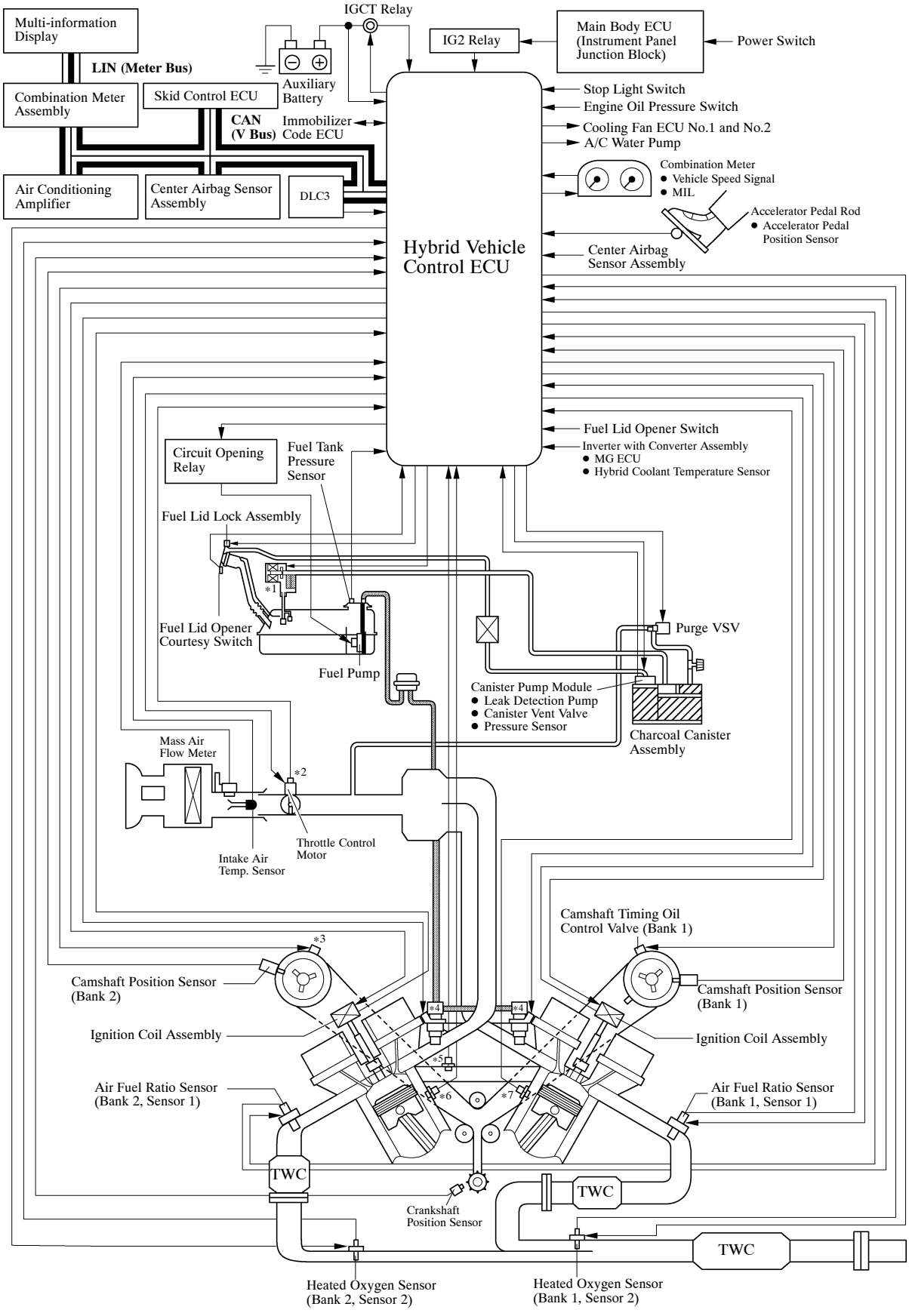


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ENGINE OIL PRESSURE SWITCH
MOPS
IMMOBILIZER CODE ECU
IMI
IMO
IGCT RELAY
MREL
+B1, +B2
AUXILIARY BATTERY
BATT
CENTER AIRBAG SENSOR ASSEMBLY
ABFS
DLC3
TC
CAN (V Bus)
SKID CONTROL ECU
CENTER AIRBAG SENSOR ASSEMBLY
AIR CONDITIONING AMPLIFIER
COMBINATION METER ASSEMBLY
LIN (Meter Bus)
MULTI INFORMATION DISPLAY
HYBRID VEHICLE CONTROL ECU
WP
A/C WATER PUMP
COMBINATION METER ASSEMBLY
W
MIL
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3. Engine Control System Diagram

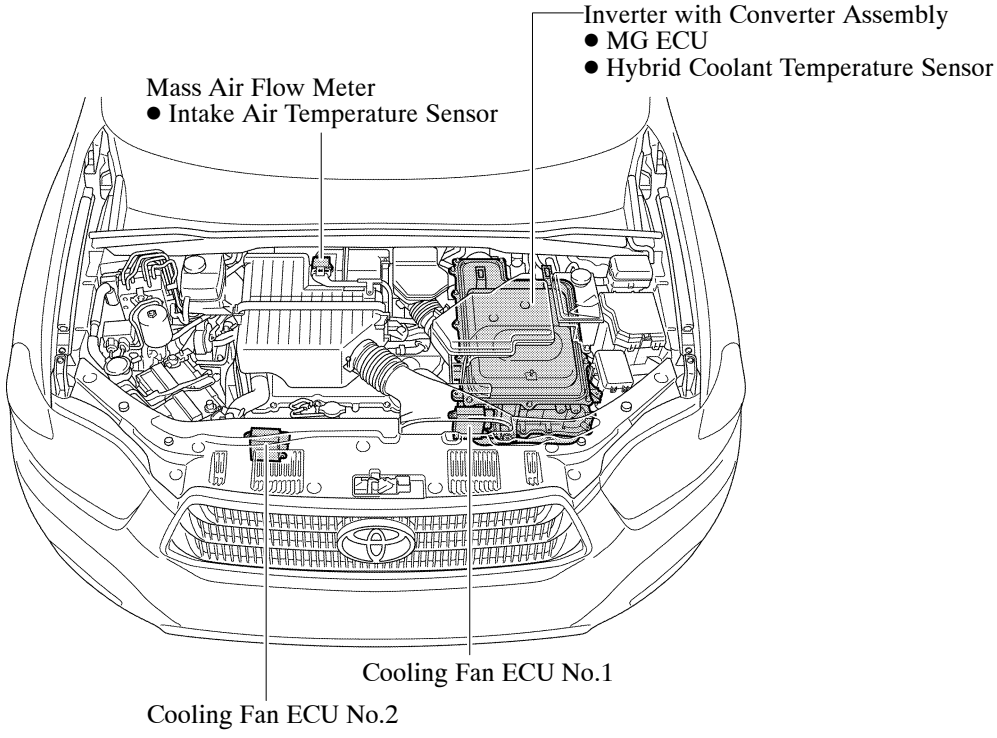


*1: Fuel Vapor-containment Valve *2: Throttle Position Sensor *3: Camshaft Timing Oil Control Valve (Bank 2)
*4: Fuel Injector Assembly *5: Engine Coolant Temp. Sensor *6: Knock Control Sensor (Bank 2) *7: Knock Control Sensor (Bank 1)

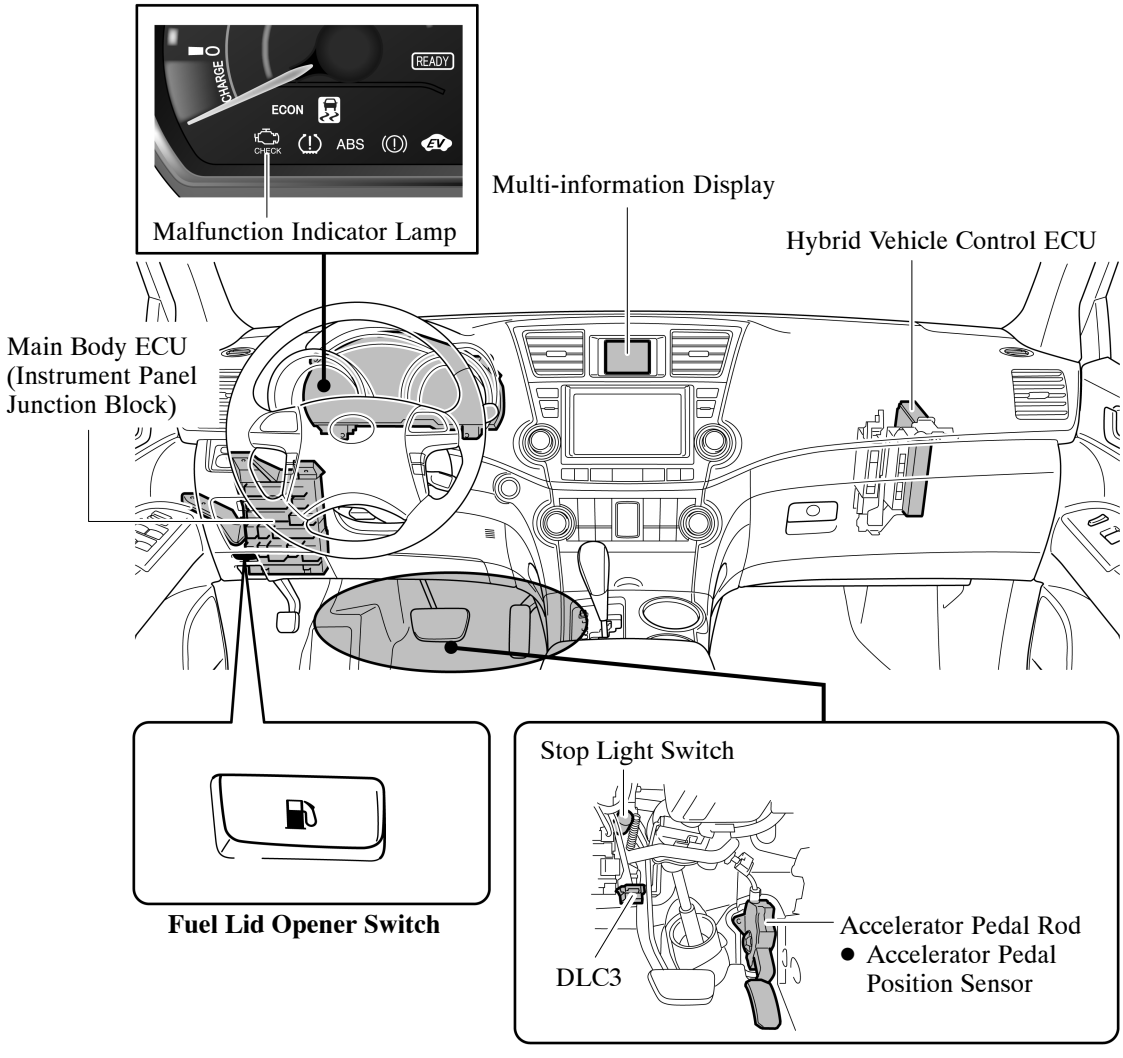
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EG

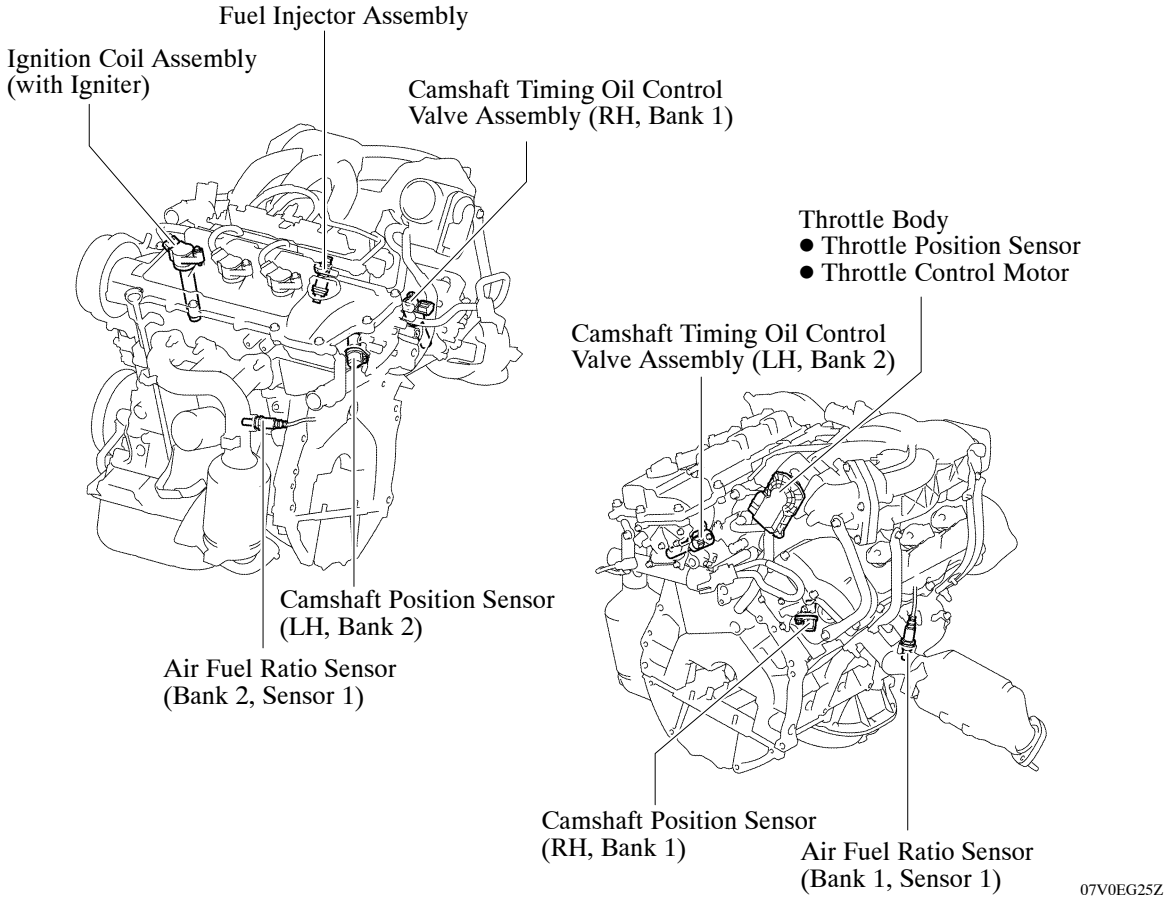
4. Layout of Main Components

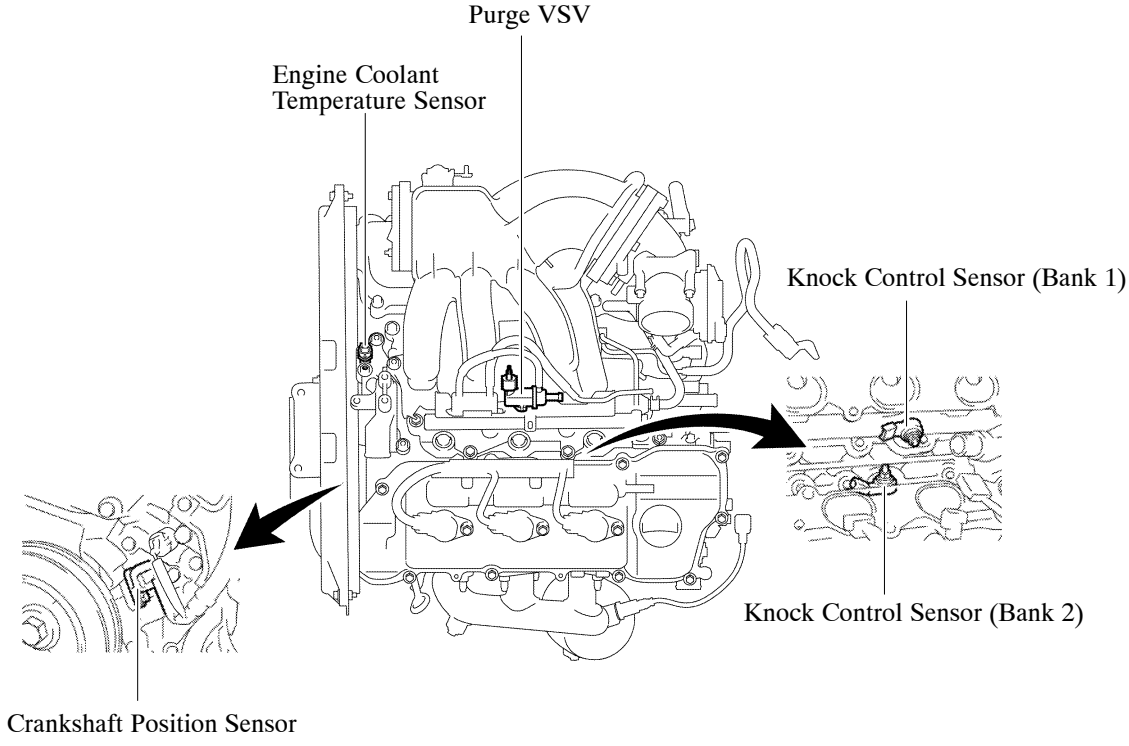


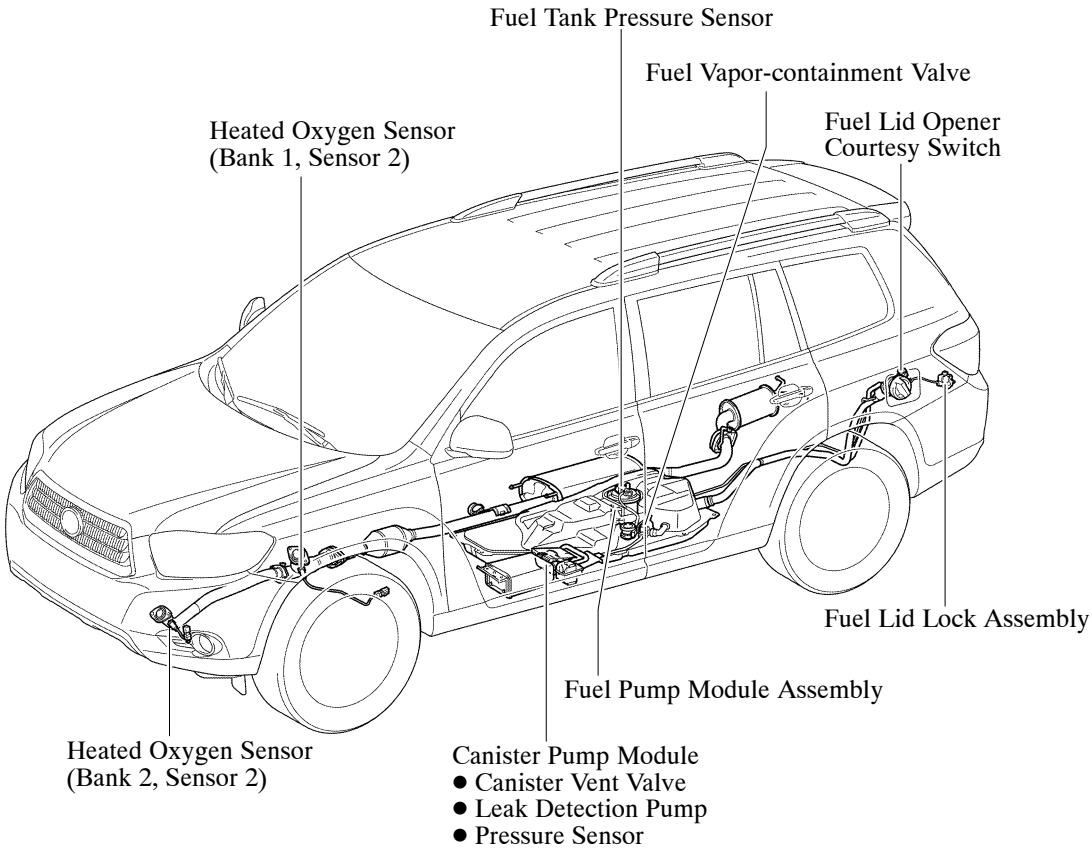
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Fuel Injector Assembly
Ignition Coil Assembly
(with Igniter)
Camshaft Timing Oil Control
Valve Assembly (RH, Bank 1)
Throttle Body
● Throttle Position Sensor
● Throttle Control Motor
Camshaft Timing Oil Control
Valve Assembly (LH, Bank 2)
Camshaft Position Sensor
(LH, Bank 2)
Air Fuel Ratio Sensor
(Bank 2, Sensor 1)
Camshaft Position Sensor
(RH, Bank 1)
Air Fuel Ratio Sensor
(Bank 1, Sensor 1)
07V0EG25Z


Purge VSV
Engine Coolant
Temperature Sensor
Knock Control Sensor (Bank 1)
Knock Control Sensor (Bank 2)
Crankshaft Position Sensor
07V0EG25Z


Fuel Tank Pressure Sensor
Fuel Vapor-containment Valve
Heated Oxygen Sensor
(Bank 1, Sensor 2)
Fuel Lid Opener
Courtesy Switch
Fuel Lid Lock Assembly
Fuel Pump Module Assembly
Heated Oxygen Sensor
(Bank 2, Sensor 2)
Canister Pump Module
● Canister Vent Valve
● Leak Detection Pump
● Pressure Sensor

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5. Main Components of Engine Control System

General

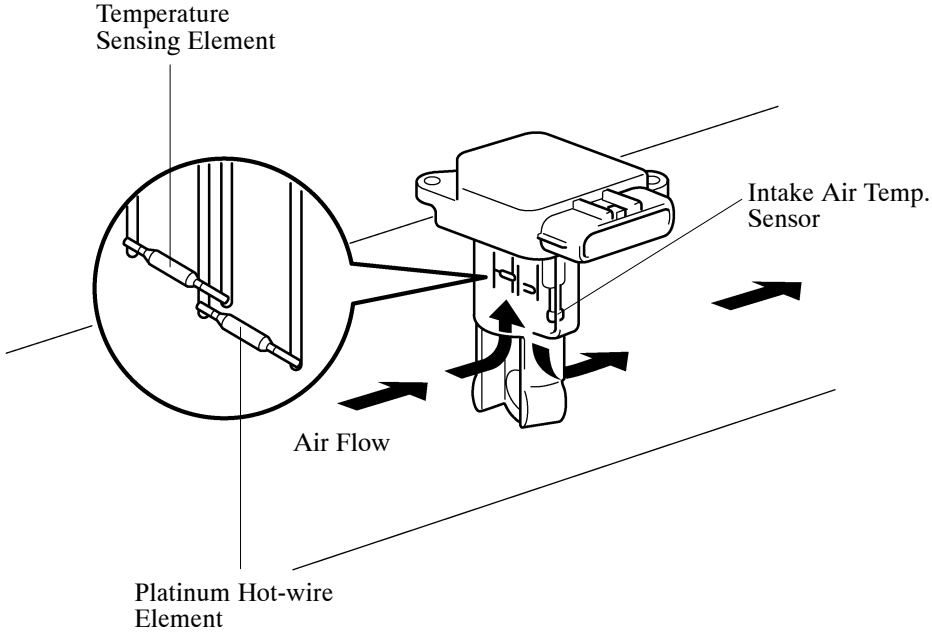
The main components of the 3MZ-FE engine control system are as follows:

Components	Outline	Quantity
Hybrid Vehicle Control ECU (Supplier)	32-bit CPU (DENSO)	1
Mass Air Flow Meter	Hot-wire Type (Built-in Intake Air Temperature Sensor)	1
Crankshaft Position Sensor [Rotor Teeth]	Pick-up Coil Type [36 - 2]	1
Camshaft Position Sensor [Rotor Teeth]	Pick-up Coil Type [3]	2 (1 each bank)
Accelerator Pedal Position Sensor	Linear (Non-contact) Type	1
Throttle Position Sensor	Linear (Non-contact) Type	1
Knock Control Sensor (Bank 1 and Bank 2)	Built-in Piezoelectric Type (Non-resonant Type/Flat Type)	2 (1 each bank)
Air Fuel Ratio Sensor (Bank 1, Sensor 1 and Bank 2, Sensor 1)	Heated Type (Planar Type)	2 (1 each bank)
Heated Oxygen Sensor (Bank 1, Sensor 2 and Bank 2, Sensor 2)	Heated Type (Cup Type)	2 (1 each bank)
Fuel Injector Assembly	12-hole Type	6

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Mass Air Flow Meter

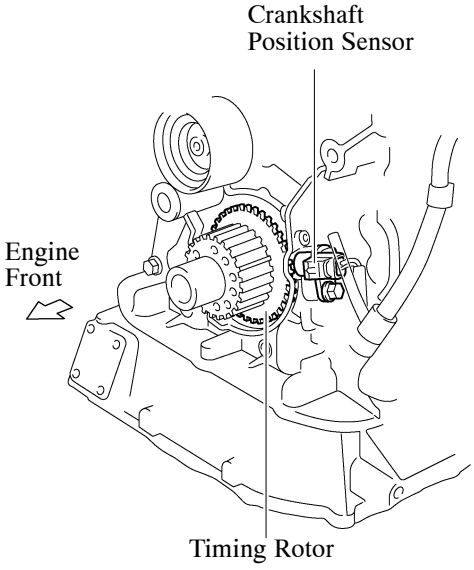
- This mass air flow meter, which is a plug-in type, allows a portion of the intake air to flow through the detection area. By directly measuring the mass and the flow rate of the intake air, the detection precision is improved and the intake air resistance is reduced.
- This mass air flow meter has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

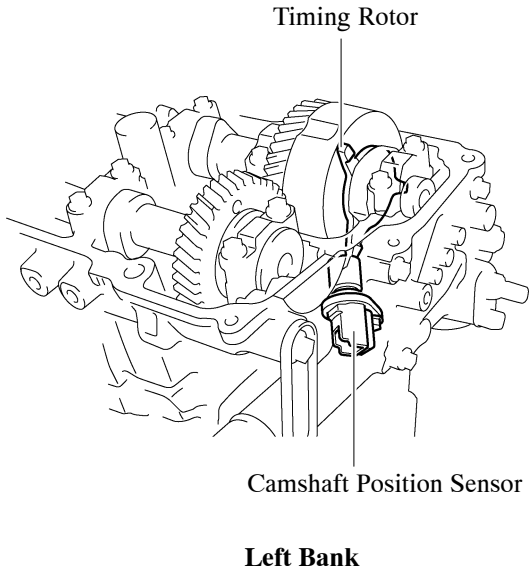


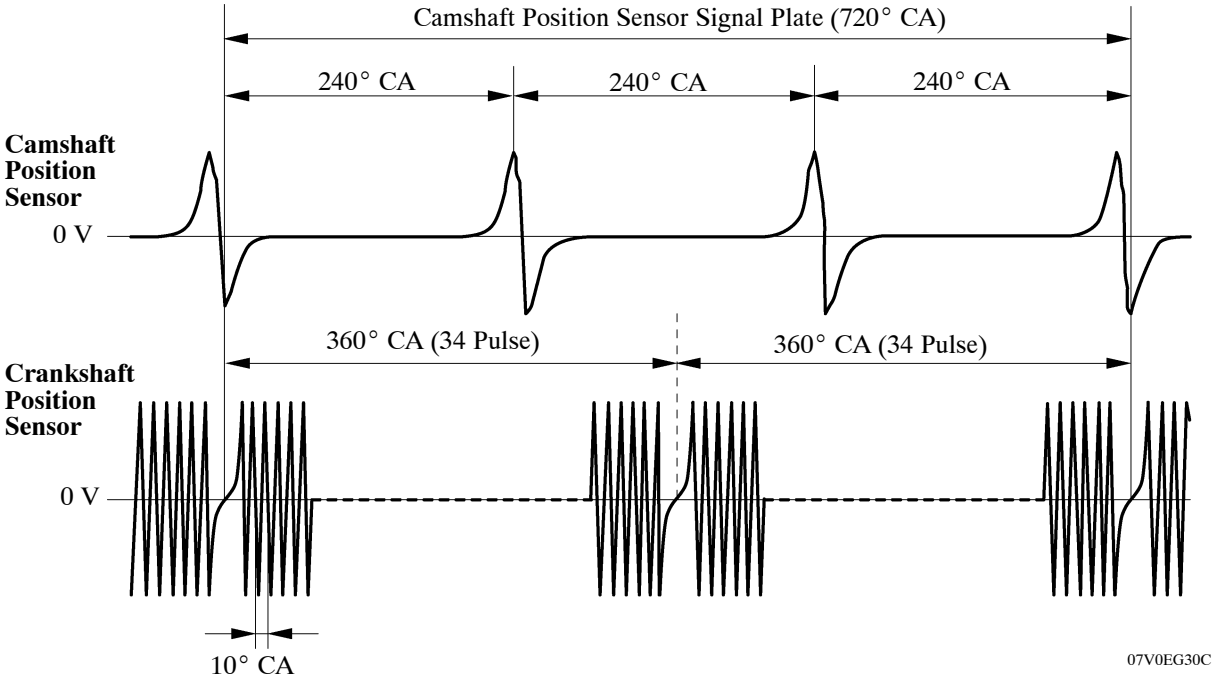
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Crankshaft Position Sensor and Camshaft Position Sensor

- The timing rotor of the crankshaft consists of 34 teeth with 2 teeth missing. The crankshaft position sensor outputs a crankshaft rotation signal every 10°, and the change of the signal due to the missing teeth is used to determine top-dead-center.
- The camshaft position sensors are mounted on the right (Bank 1) and left (Bank 2) banks of the cylinder head sub-assemblies. To detect the camshaft position, these sensors pick up the protrusions of the timing rotor that is secured to the camshaft in front of the camshaft timing gear assembly. In addition, each sensor generates 3 pulses for every 2 revolutions of the crankshaft.



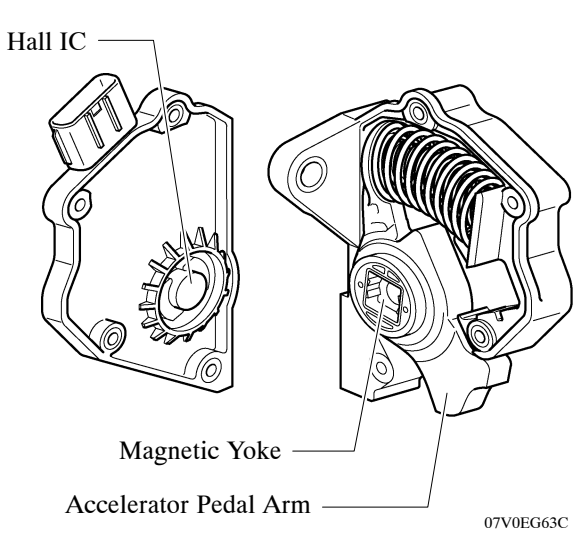


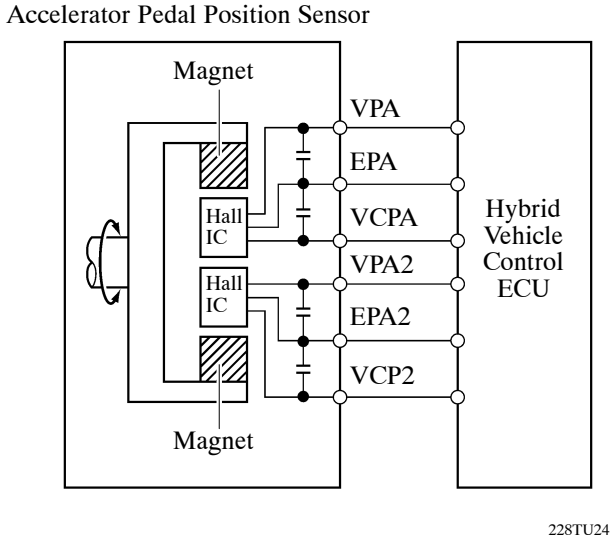


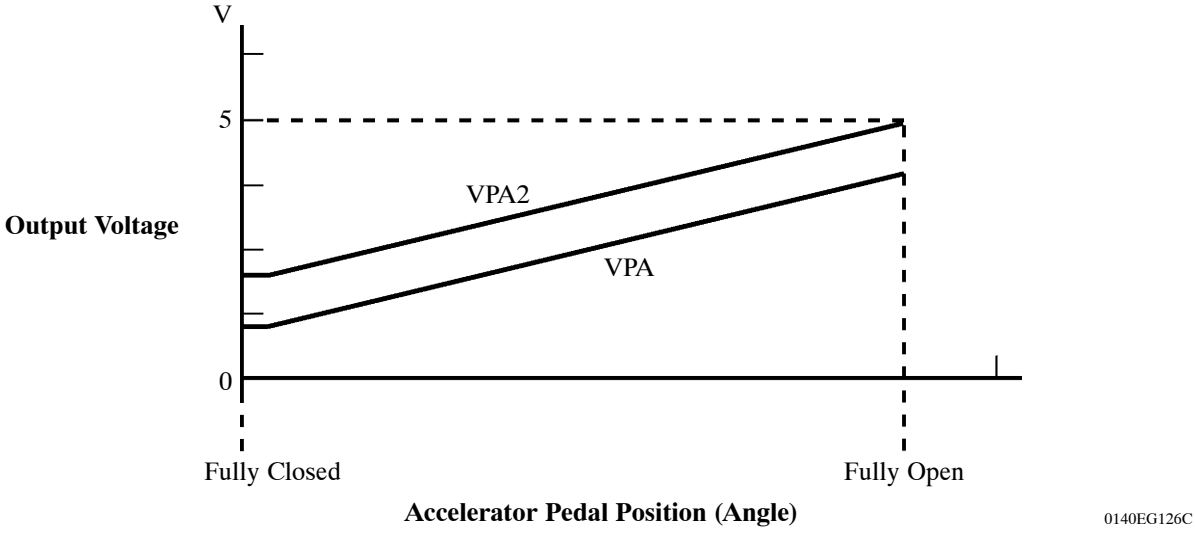
Accelerator Pedal Position Sensor

This non-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 in the magnetic flux that occur into electrical signals, and outputs accelerator pedal position signals to the hybrid vehicle control ECU.
- 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 hybrid vehicle control ECU.







Service Tip

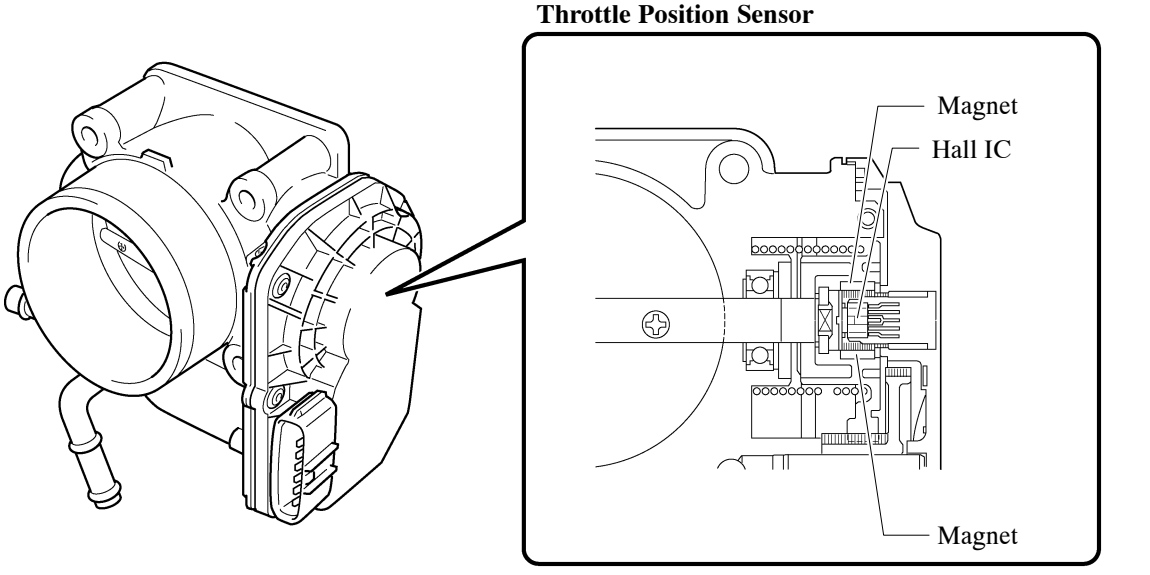
The inspection method differs from a contact type accelerator pedal position sensor because a non-contact type accelerator pedal position sensor uses a Hall IC. For details, refer to the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).

EG

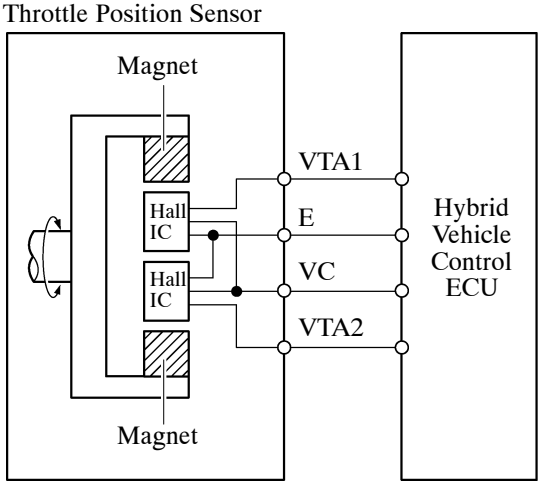
Throttle Position Sensor

This non-contact type throttle position sensor uses a Hall IC, which is mounted on the throttle body.

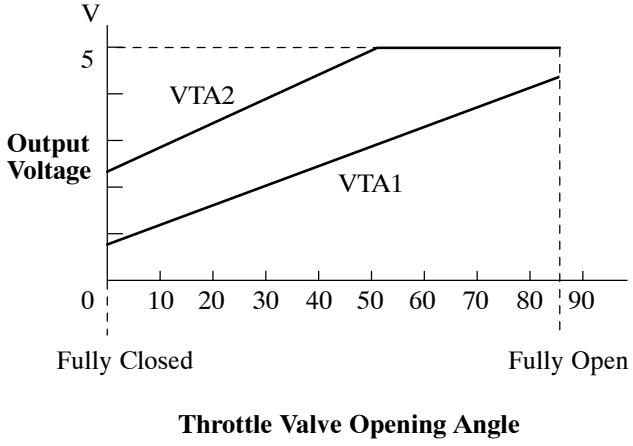
- The Hall IC is surrounded by a magnetic yoke. The Hall IC converts the changes that occur in the magnetic flux into electrical signals, and outputs them in the form of throttle valve position signals to the hybrid vehicle control ECU.
- The Hall IC contains circuits for the main and sub signals. It converts the throttle valve opening angle into electric signals that have differing characteristics, and outputs them to the hybrid vehicle control ECU.



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Service Tip

The inspection method differs from a potentiometer type throttle position sensor because this throttle position sensor uses a Hall IC. For details, refer to the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).

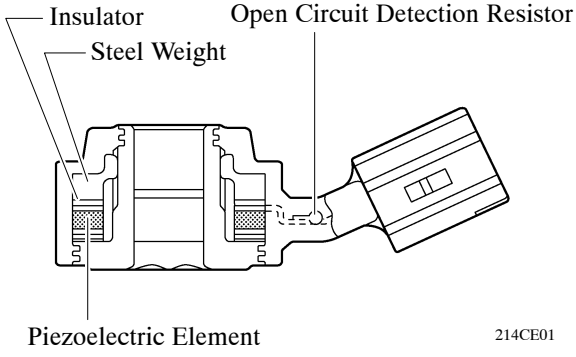
Knock Control Sensor (Flat Type)

1) General

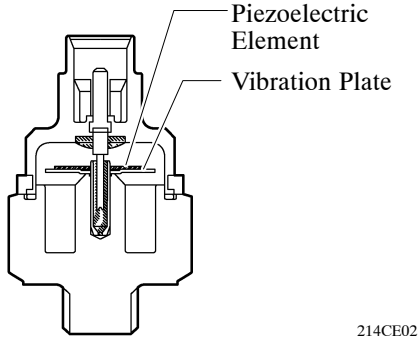
In a conventional knock control sensor (resonant type), a vibration plate is built into the sensor. This plate has the same resonance point as the knocking* frequency of the engine block. This sensor can only detect vibration in this frequency band.
A flat type knock control sensor (non-resonant type) has the ability to detect vibration in a wider frequency band (from about 6 kHz to 15 kHz). It has the following features:

- A flat type knock control sensor is installed to an engine by placing it over the stud bolt installed on the cylinder block sub-assembly. For this reason, a hole for the stud bolt exists in the center of the sensor.
- In the sensor, a steel weight is located in the upper portion. An insulator is located between the weight and a piezoelectric element.
- An open/short circuit detection resistor is integrated in the sensor.

*: The term "Knock" or "Knocking" is used in this case to describe either preignition or detonation of the air fuel mixture in the combustion chamber. This preignition or detonation refers to the air fuel mixture being ignited earlier than is advantageous.
This use of "Knock" or "Knocking" is not primarily used to refer to a loud mechanical noise that may be produced by an engine.



Flat Type Knock Control Sensor (Non-resonant Type)

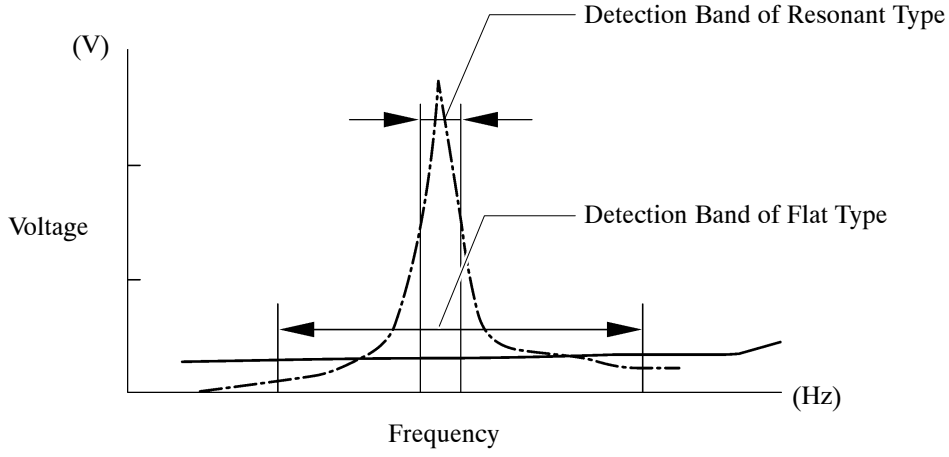


Conventional Type Knock Control Sensor (Resonant Type)

2) Resonance Characteristic

The engine knocking frequency will vary slightly depending on the engine speed. The flat type knock control sensor can detect vibration even when the engine knocking frequency changes. Due to the use of the flat type knock control sensor, the vibration detection ability is increased compared to a conventional type knock control sensor, and more precise ignition timing control is possible.

—·— : Resonance Characteristic of Conventional Type (Resonant)
——— : Resonance Characteristic of Flat Type (Non-resonant)

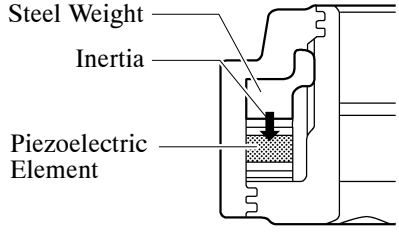


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Characteristics of Knock Control Sensor

3) Operation

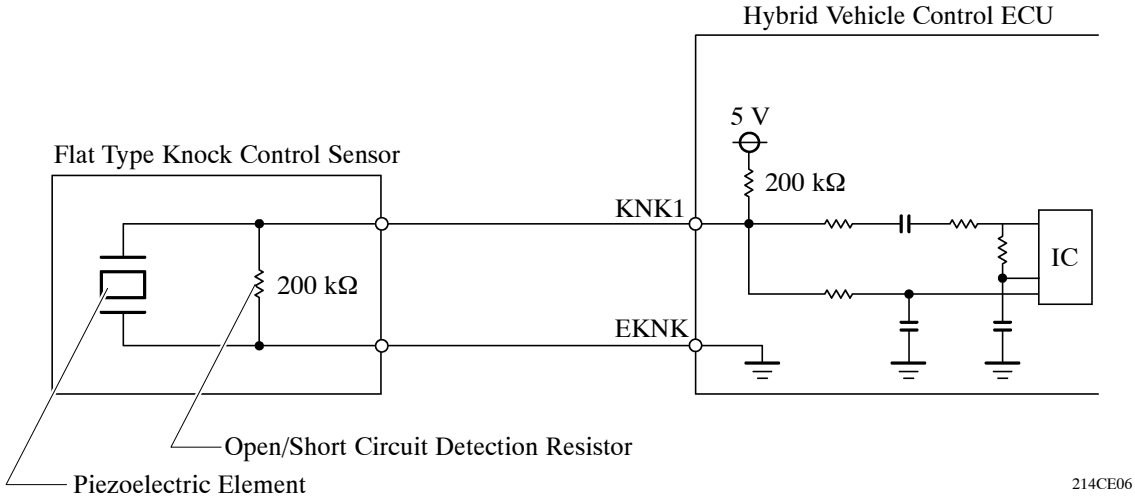
Vibrations caused by knocking are transmitted to the steel weight. The inertia of this weight applies pressure to the piezoelectric element. This action generates electromotive force.



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4) Open/Short Circuit Detection Resistor

When the ignition is ON, the open/short circuit detection resistor in the knock control sensor and the resistor in the hybrid vehicle control ECU keep the voltage at terminal KNK1 constant.
An IC (Integrated Circuit) in the hybrid vehicle control ECU constantly monitors the voltage of terminal KNK1. If the open/short circuit occurs between the knock control sensor and the hybrid vehicle control ECU, the voltage of terminal KNK1 will change and the hybrid vehicle control ECU will detect the open/short circuit and store a DTC (Diagnostic Trouble Code).



Service Tip

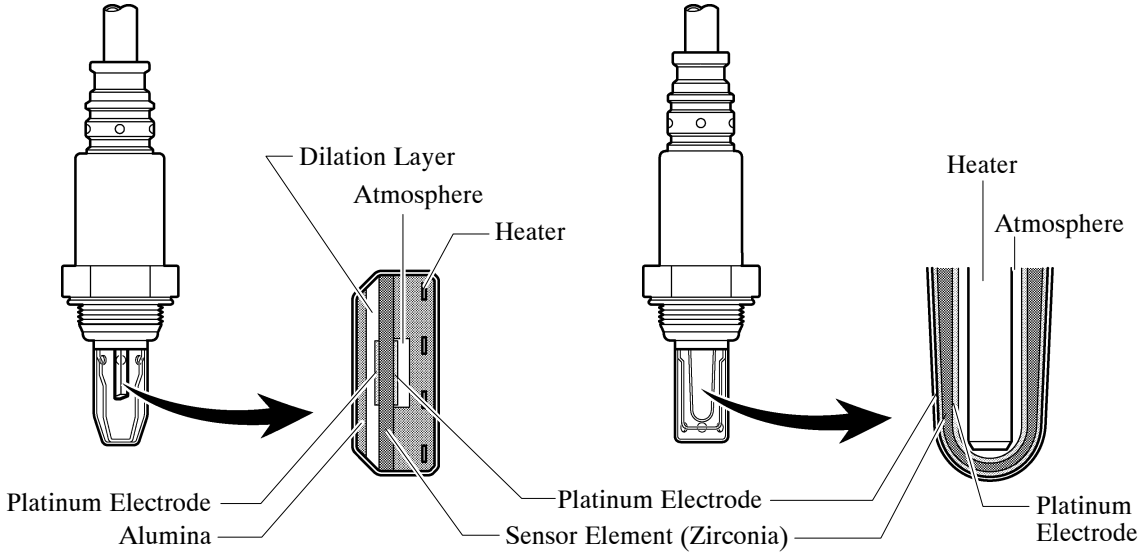
These knock control sensors are mounted in the specific directions and angles as illustrated. To prevent the right and left bank connectors from being interchanged, make sure to install each sensor in its prescribed direction. For details, refer to the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).

Air Fuel Ratio Sensor and Heated Oxygen Sensor

1) General

A planar type air fuel ratio sensor and a cup type heated oxygen sensor are used. 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 used.

- The planar type air fuel ratio sensor uses alumina, which excels in heat conductivity and electrical insulation, to integrate a sensor element with a heater, thus improving the warm-up performance of the sensor.
- The cup type heated oxygen sensor contains a sensor element that surrounds a heater.

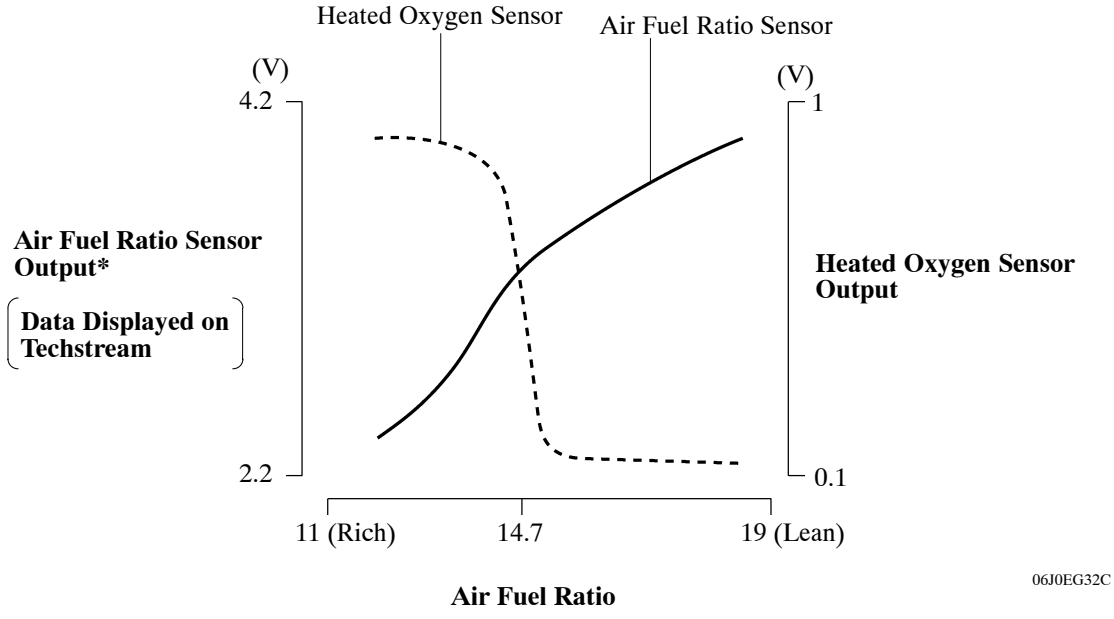


Air Fuel Ratio Sensor (Planar Type) **Heated Oxygen Sensor (Cup Type)**

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2) Characteristics

As illustrated below, the conventional heated oxygen sensor is characterized by a sudden change in its output voltage at the threshold of the stoichiometric air-fuel ratio (14.7:1). In contrast, the air fuel ratio sensor data is approximately proportional to the existing air-fuel ratio. The air-fuel ratio sensor converts the oxygen density to current and sends it to the hybrid vehicle control ECU. As a result, the detection precision of the air-fuel ratio has been improved. The air fuel ratio sensor data can be viewed using Techstream.

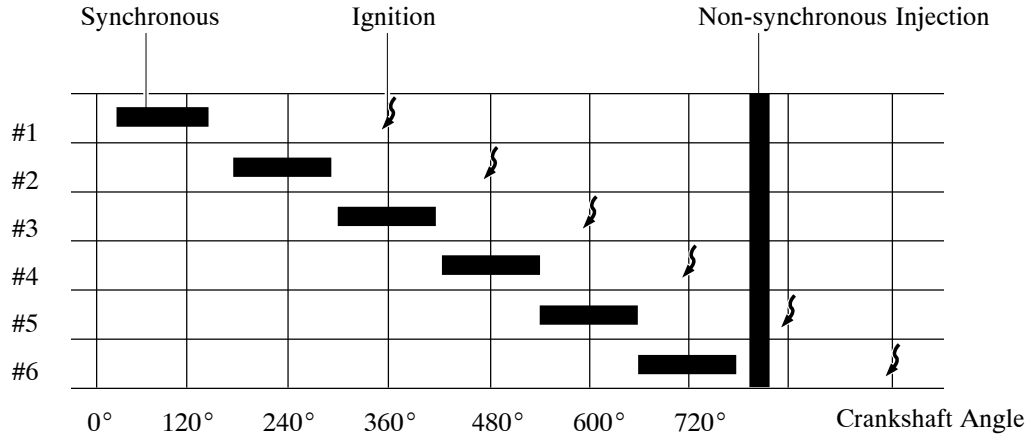


*: This value is calculated internally in the hybrid vehicle control ECU and is not a hybrid vehicle control ECU terminal voltage.

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6. SFI System

- The L-type SFI (Sequential Multiport Fuel Injection) system directly detects the intake air mass using a hot-wire type mass air flow meter.
- An independent injection system (in which fuel is injected once into each intake port for each two revolutions of the crankshaft) is used.
- There are two (synchronous and non-synchronous) injections:
  a) Synchronous injection, in which injection always occurs at the same timing relative to the firing order.
  b) The non-synchronous injection in which injection is effected regardless of the crankshaft angle.
  Furthermore, to protect the engine and achieve lower fuel consumption, the system uses a fuel cutoff in which the injection of fuel may be stopped temporarily in accordance with the driving conditions.
- This system performs group injection when the engine coolant temperature is extremely low and the engine is operating at a low speed.



Independent Injection

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7. ESA System

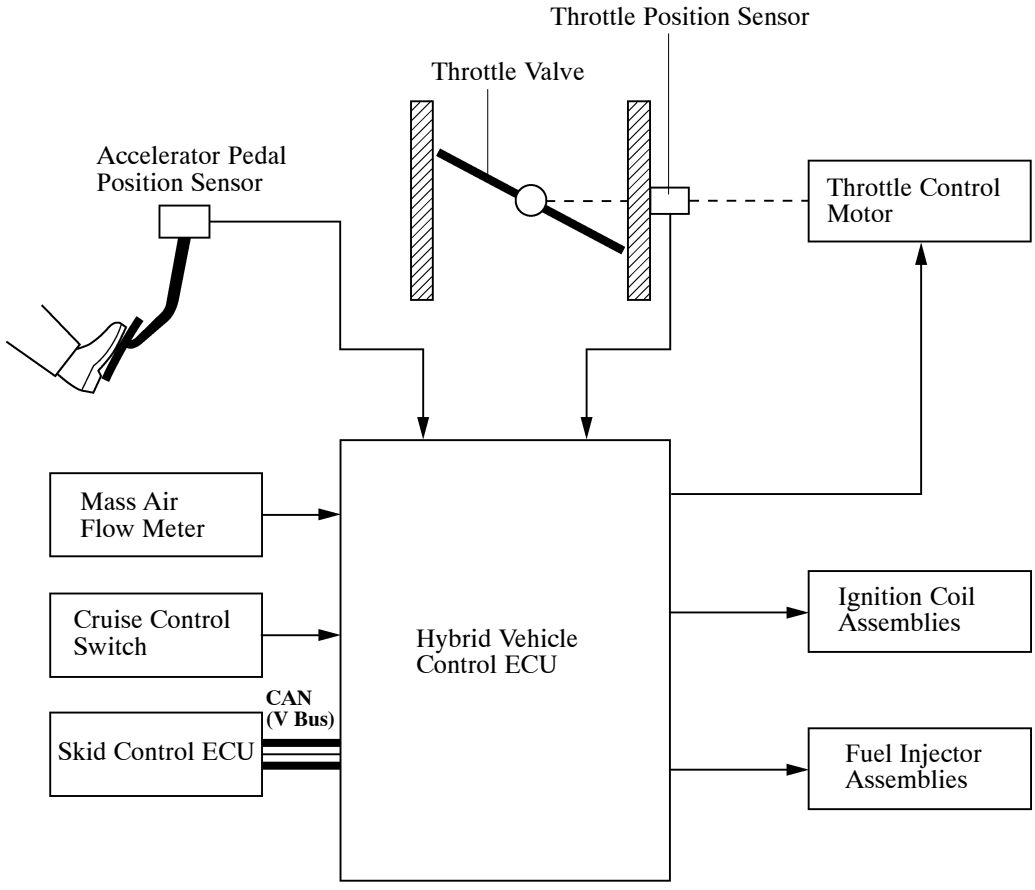
The ESA (Electronic Spark Advance) system selects the optimal ignition timing in accordance with the signals received from the sensors and sends (IGT) ignition signals to the igniters.

8. ETCS-i

General

- The ETCS-i (Electronic Throttle Control System-intelligent) uses the hybrid vehicle control ECU to calculate the optimal throttle valve angle that is appropriate for the corresponding driving conditions. The ETCS-i throttle uses a throttle control motor to control the throttle valve angle.
- In case of an abnormal condition, this system transfers to the fail-safe mode.

▶ System Diagram ◀



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Control

1) General

The ETCS-i includes the following functions:
- ISC (Idle Speed Control)
- TRAC (Traction Control)
- VSC (Vehicle Stability Control)
- Cruise Control

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2) Idle Speed Control

The hybrid vehicle control ECU controls the throttle valve in order to constantly maintain an ideal idle speed.

3) TRAC Throttle Control

As part of the TRAC, the throttle valve is closed by a demand signal from the skid control ECU if an excessive amount of slippage occurs at a drive wheel, thus facilitating excellent vehicle stability and driving force.

4) VSC Coordination Control

In order to bring the effectiveness of the VSC control into full play, the throttle valve angle is controlled by performing coordinated control with the skid control ECU.

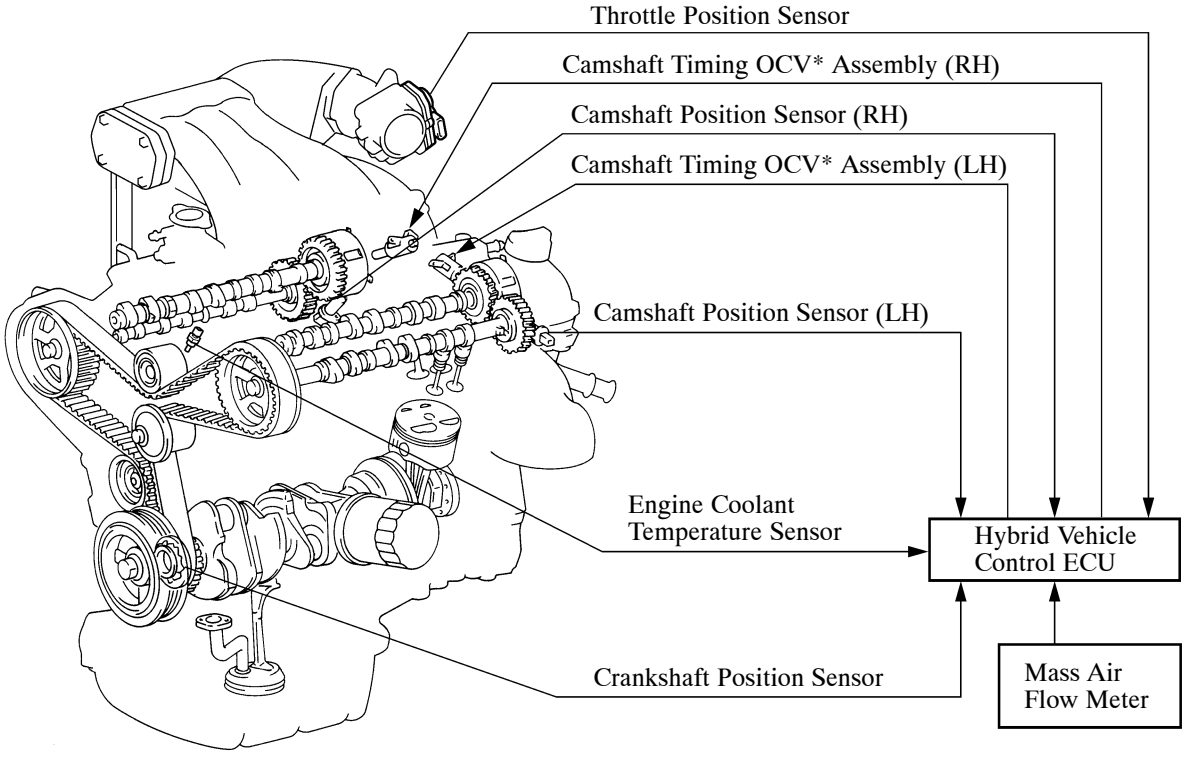
5) Cruise Control

The hybrid vehicle control ECU directly actuates the throttle valve to control engine power for cruise control.

9. VVT-i System

General

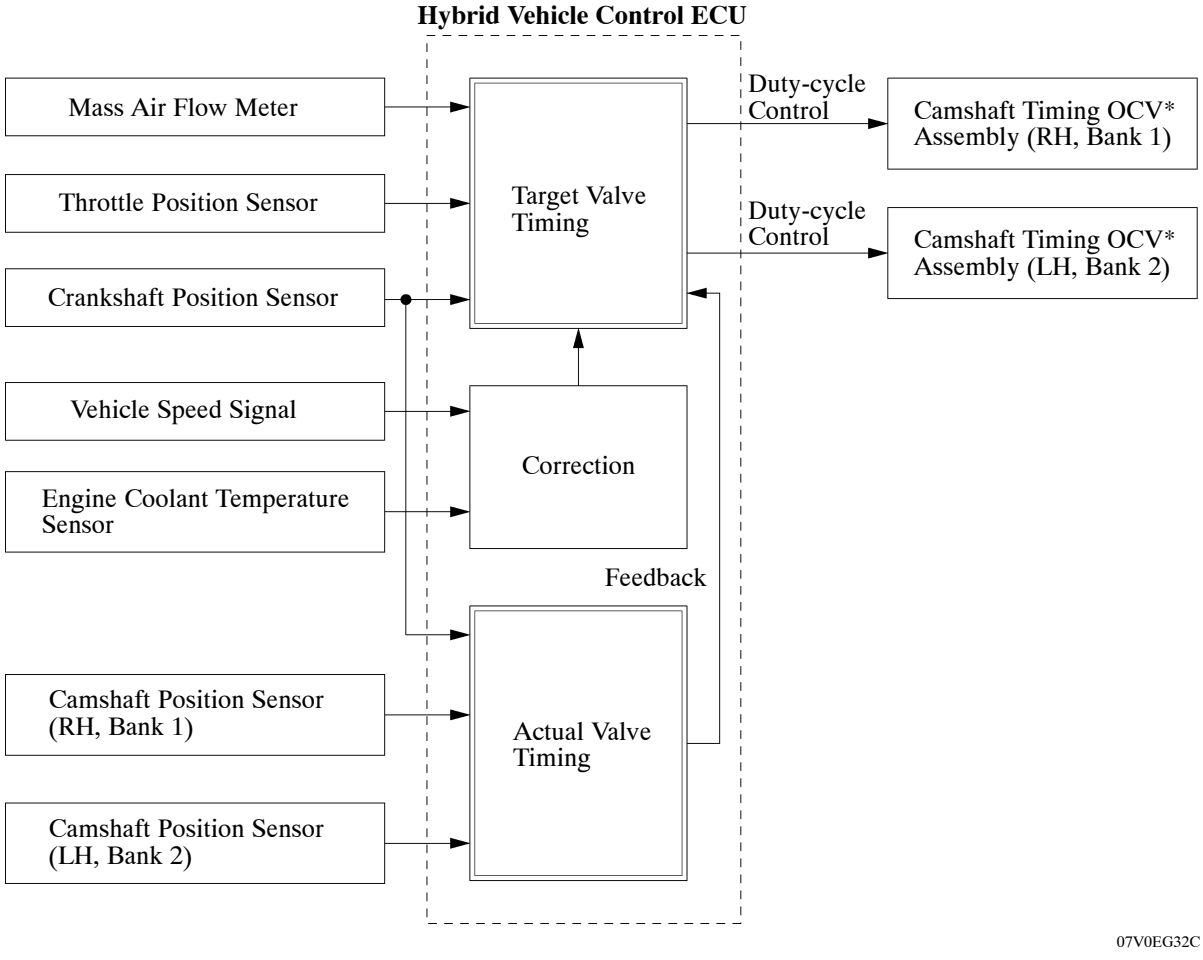
The VVT-i (Variable Valve Timing-intelligent) system is designed to control the intake camshafts within a range of 60° (of crankshaft angle) to provide valve timing that is optimally suited to the engine operating condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



*: Oil Control Valve

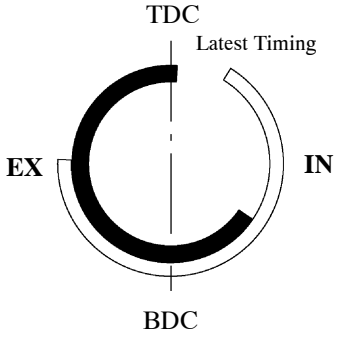
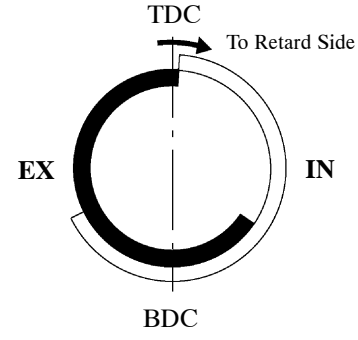
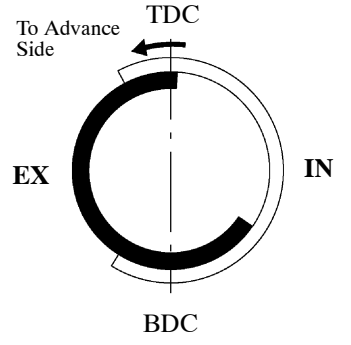
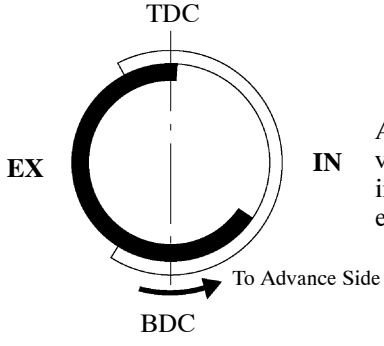
277EG33

- Based on engine speed, intake air volume, throttle position and engine coolant temperature, the hybrid vehicle control ECU calculates optimal valve timing for all driving conditions. The hybrid vehicle control ECU also controls the camshaft timing oil control valve assemblies. In addition, the hybrid vehicle control ECU uses signals from the camshaft position sensors and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.



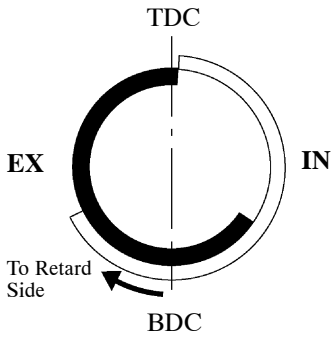
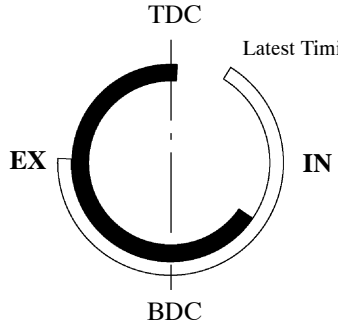
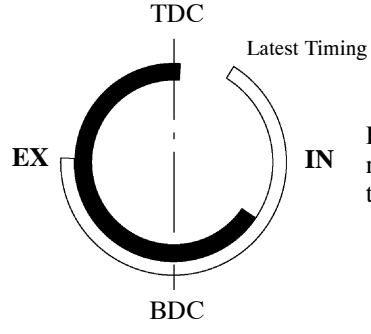
*: Oil Control Valve

Effectiveness of the Dual VVT-i System

Operation State	Objective	Effect
During Idling	 Eliminating overlap reduces blow back to the intake side.	• Stabilized idling rpm • Better fuel economy
At Light Load	 Eliminating overlap reduces blow back to the intake side.	Engine stability is ensured
At Medium Load	 Increasing overlap increases internal EGR, reducing pumping losses.	• Better fuel economy • Improved emission control
In Low to Medium Speed Range with Heavy Load	 Advancing the intake valve closing timing improves volumetric efficiency.	Improved torque in low to medium speed range

(Continued)

EG

Operation State	Objective	Effect
In High Speed Range with Heavy Load	 277EG31 Retarding the intake valve closing timing improves volumetric efficiency.	Improved output
At Low Temperatures	 277EG27 Eliminating overlap to prevent blow back to the intake side stabilizes combustion to reduce fast idle speed.	• Stabilized fast idle rpm • Better fuel economy
• Upon Starting • Stopping the Engine	 277EG27 Eliminating overlap minimizes blow back to the intake side.	Improved startability

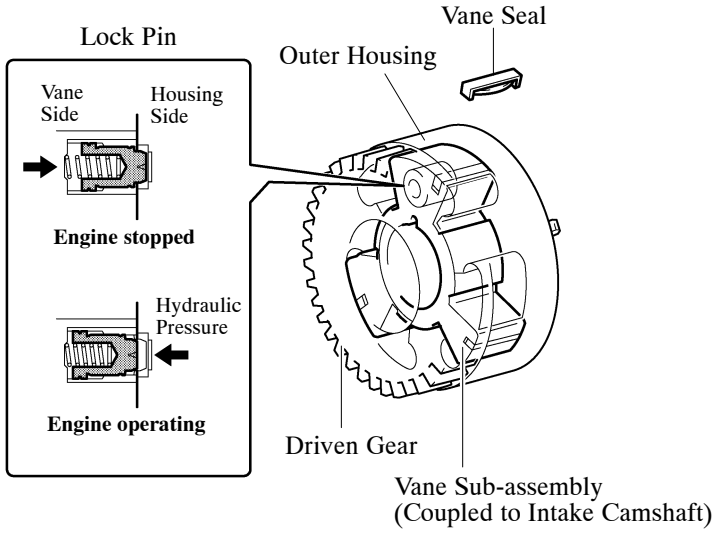
Construction

1) Camshaft Timing Gear Assembly

The camshaft timing gear assembly consists of an outer housing that is driven by the exhaust camshaft, and a vane sub-assembly that is coupled to the intake camshaft.

- The oil pressure sent from the advance or retard side passage of the camshaft causes rotation of the vane sub-assembly relative to the driven gear to vary the valve timing continuously (steplessly).
- When the engine stops, the camshaft timing gear assembly is locked to the most retarded angle by its lock pin. This ensures engine startability.
- When hydraulic pressure is not applied to the camshaft timing gear assembly immediately after the engine has been started, the lock pin locks the movement of the camshaft timing gear assembly to prevent a knocking noise.

▶ Camshaft Timing Gear Assembly ◀

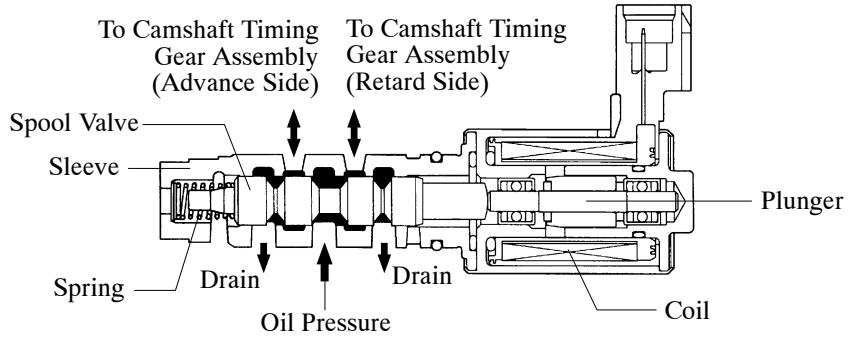


07V0EG36C

2) Camshaft Timing Oil Control Valve Assembly

This camshaft timing oil control valve assembly controls its spool valve using duty-cycle control from the hybrid vehicle control ECU. This allows hydraulic pressure to be applied to the camshaft timing gear assembly advance or retard side. When the engine is stopped, the camshaft timing oil control valve assembly will move to the retard position.

▶ Camshaft Timing Oil Control Valve Assembly ◀

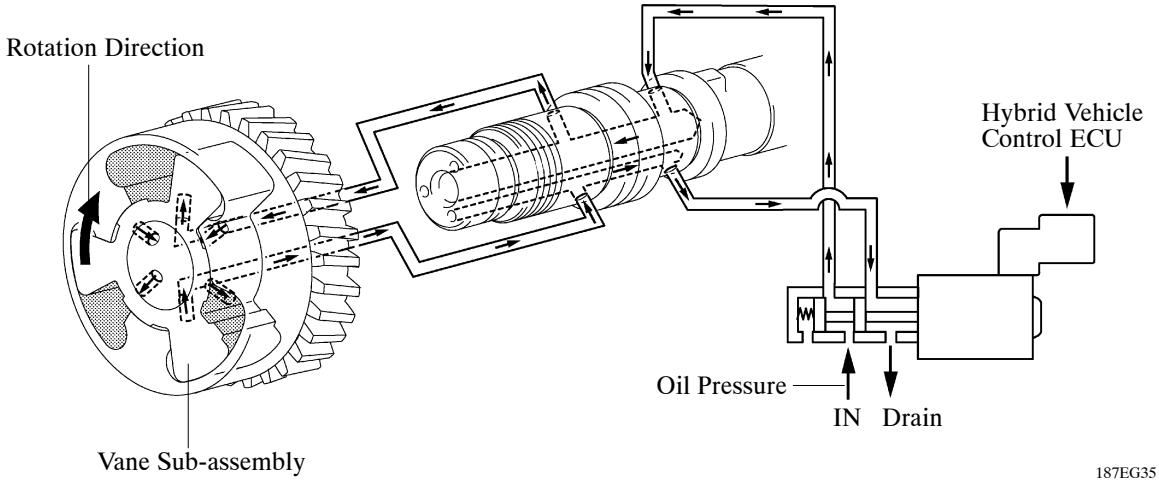


170EG06

Operation

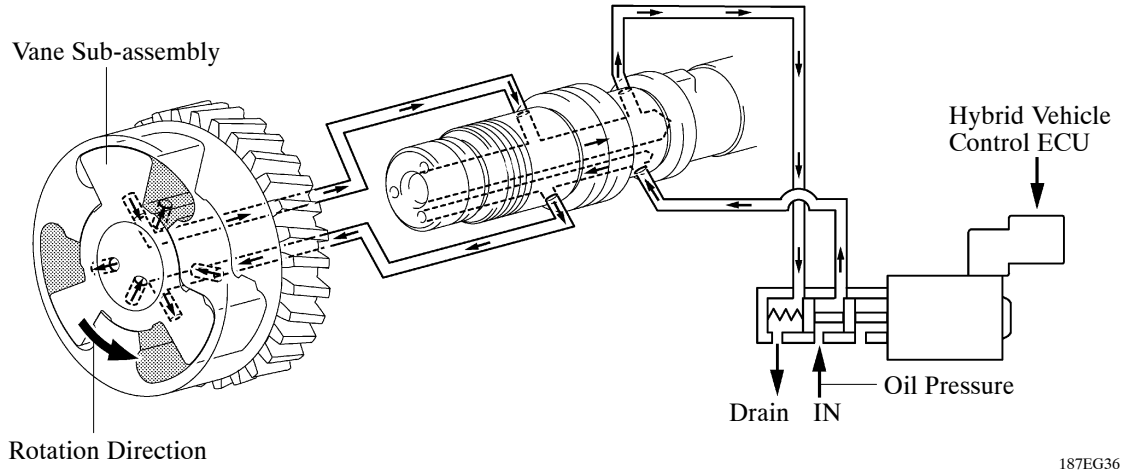
1) Advance

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



2) Retard

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



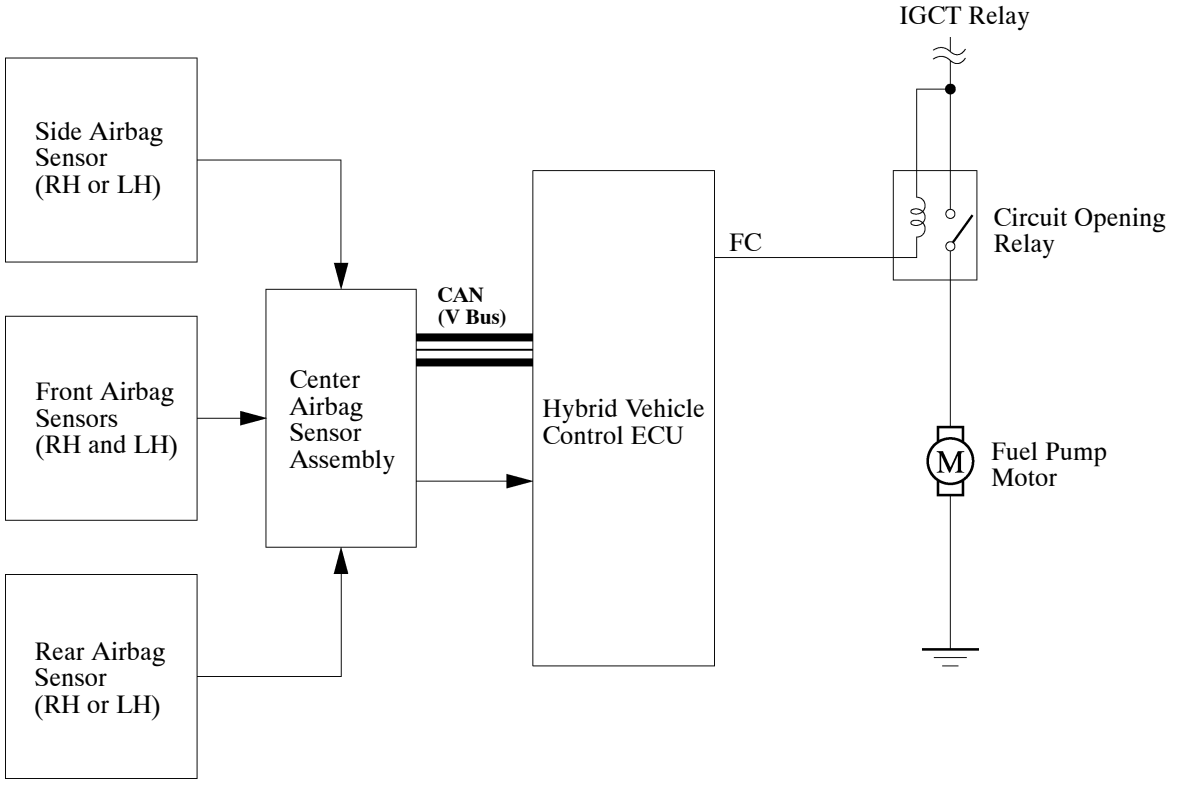
3) Hold

After reaching the target timing, the engine valve timing is maintained by keeping the camshaft timing oil control valve assembly in the neutral position unless the engine operating conditions change.
This maintains the engine valve timing at the desired target position by preventing the engine oil from running out of the camshaft timing oil control valve assembly.

10. Fuel Pump Control

Fuel pump operation is controlled by signals from the hybrid vehicle control ECU, using the circuit opening relay. The fuel pump control has a fuel cut control. A fuel cut control stops the fuel pump when any of the SRS airbags have deployed.

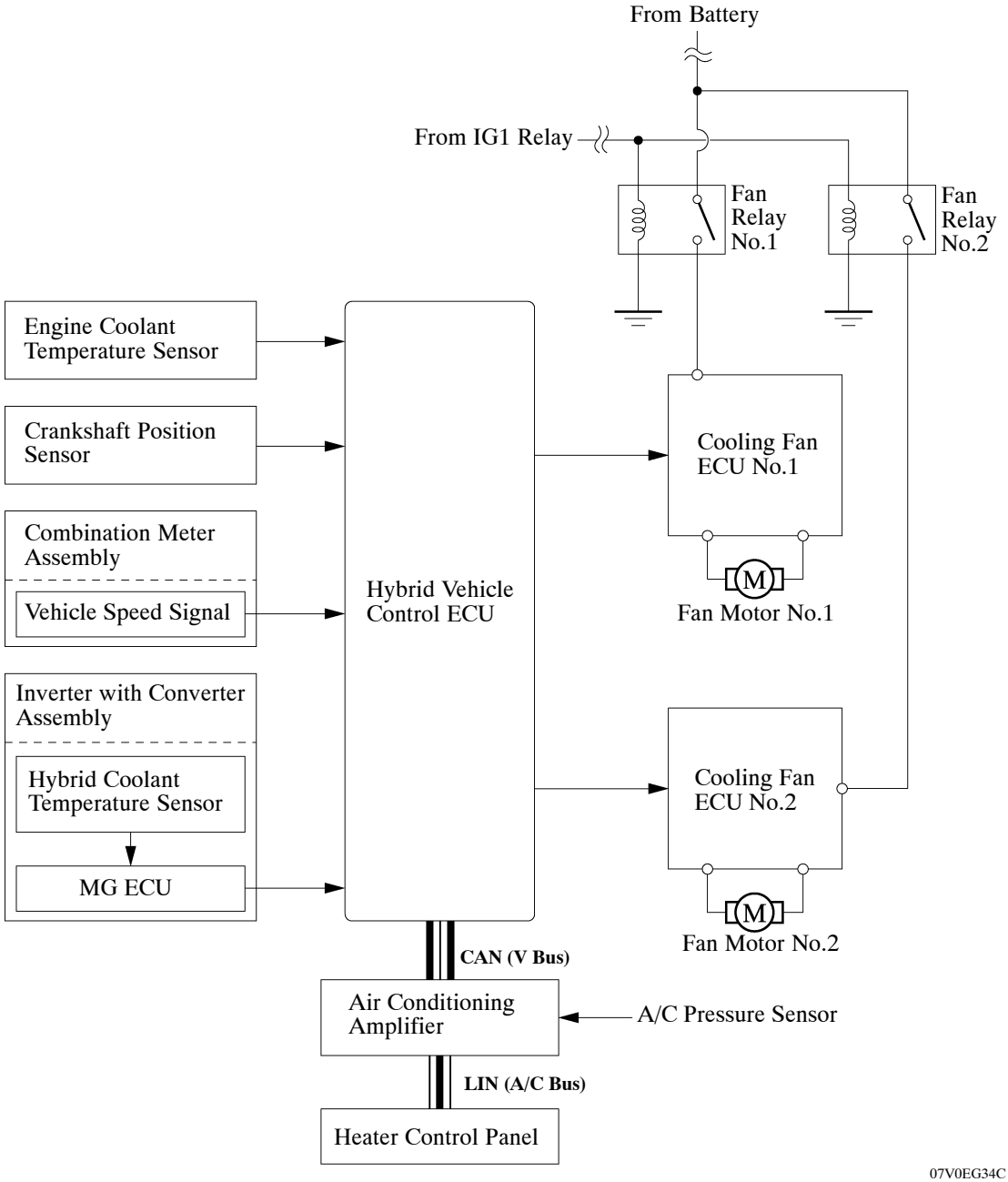
- When the hybrid vehicle control ECU detects the airbag deployment signal from the center airbag sensor assembly, the hybrid vehicle control ECU will turn the circuit opening relay off. After the fuel cut control has been activated, turning the power switch from OFF to the IG-ON position cancels the fuel cut control, and the engine can be restarted.



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, vehicle speed, engine speed, air conditioning operating conditions and hybrid system coolant temperature. The hybrid vehicle control ECU calculates the appropriate fan speed and sends signals to cooling fan ECU No.1 and No.2. Upon receiving signals from the hybrid vehicle control ECU, cooling fan ECU No.1 and No.2 independently actuates the No.1 and No.2 fan motors.

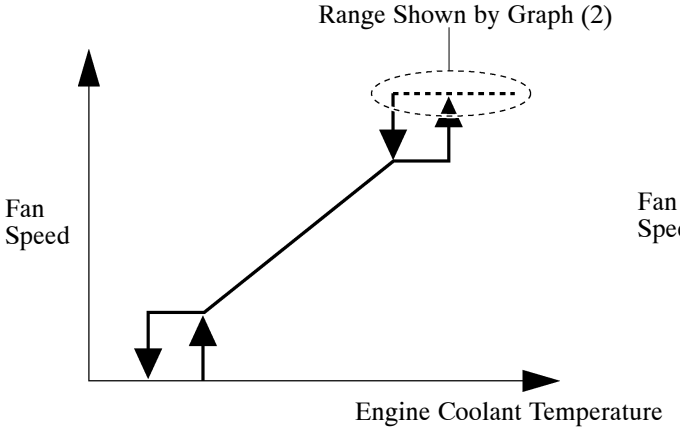


Operation

- As illustrated below, the hybrid vehicle control ECU determines the required cooling fan speed by selecting the fastest fan speed from among the following:

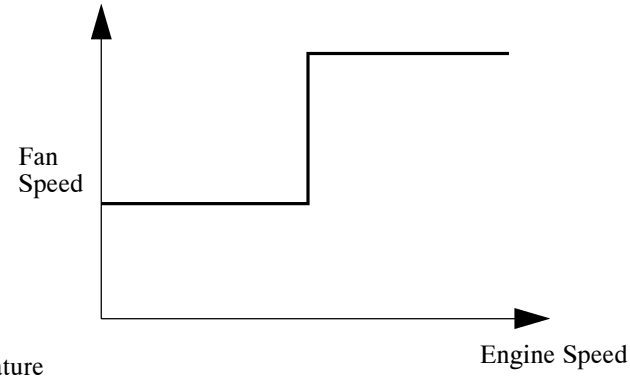
(1) The fan speed required according to the engine coolant temperature.
(2) The fan speed required according to the engine speed (when the engine coolant temperature is high).
(3) The fan speed required based on the air conditioning refrigerant pressure.
- When the air conditioning refrigerant pressure is within the lower part of the normal operating range with the A/C switch on, the required fan speed differs according to the vehicle speed.
- When the air conditioning refrigerant pressure is higher than a specified upper limit, the hybrid vehicle control ECU will increase the fan speed.

(4) The fan speed required according to the hybrid system coolant temperature.



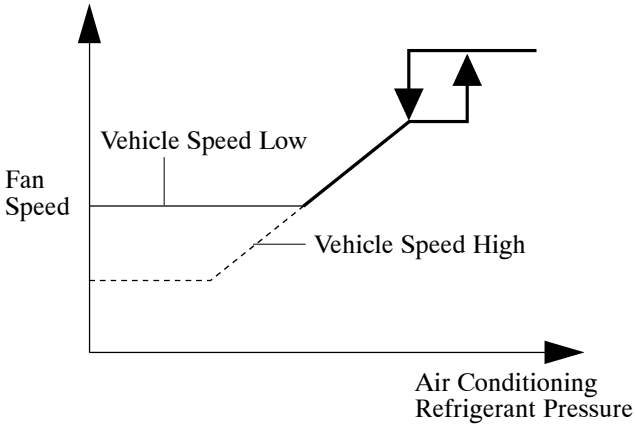
(1) Fan Speed Required according to Engine Coolant Temperature

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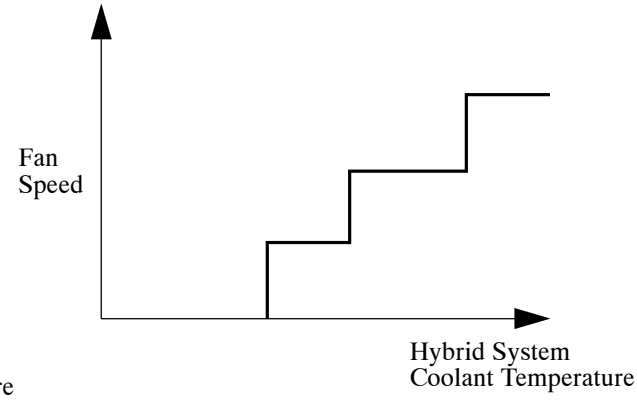
(2) Fan Speed When Engine Coolant Temperature is High

06J0EG49C



(3) Fan Speed Required according to Air Conditioning Refrigerant Pressure

06J0EG50C



(4) Fan Speed Required according to Hybrid System Coolant Temperature

07V0EG35C

- If the hybrid vehicle control ECU detects that the following conditions are met, the cooling fans will be operated for 180 seconds after the power switch is turned off, in order to cool the fuel system in consideration of the subsequent restarting of a hot engine.

• Ambient temperature is high. • Engine coolant temperature (at the engine coolant outlet) is high. • The engine has been running at high load (detected based on the vehicle speed and intake air volume).	When all conditions are met for a total of 90 seconds or more during the period of 180 seconds immediately before the engine stops, the cooling fan is operated for 3 minutes after the power switch is turned off.

12. Evaporative Emission Control System

General

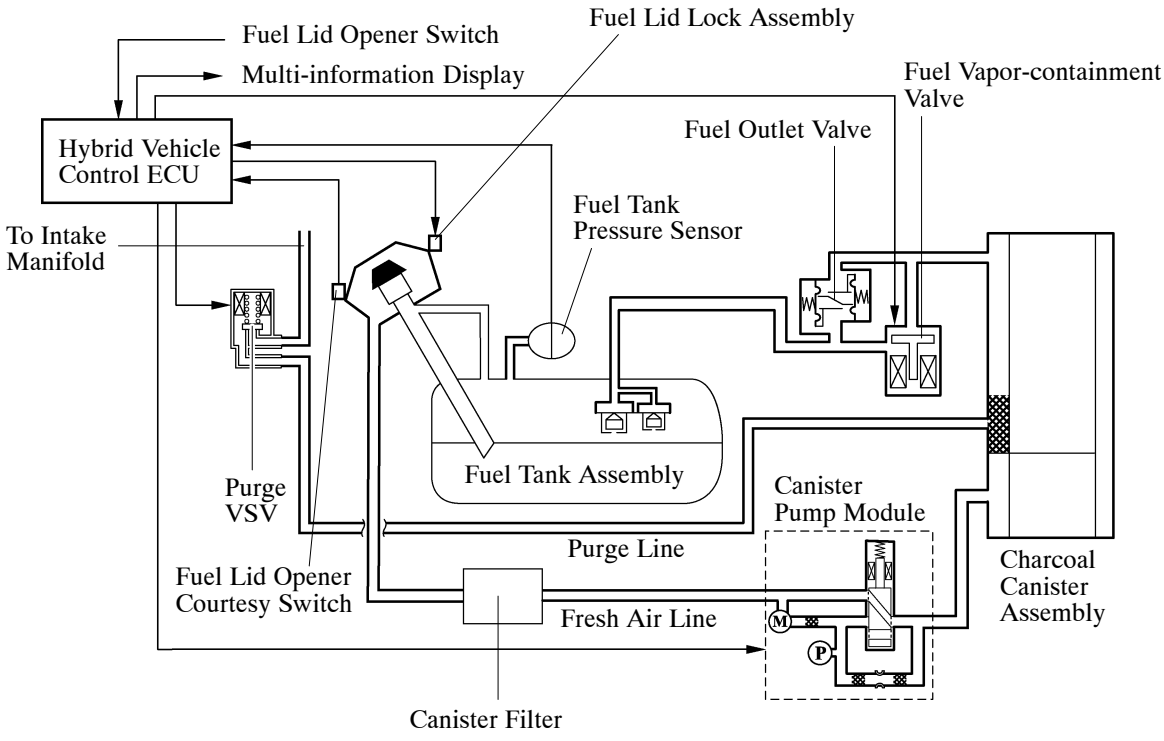
The evaporative emission control system prevents the fuel vapors from being released from the fuel tank when the engine is stopped (and the vehicle is parked).
Hybrid vehicles control the engine to make it operate intermittently, making the operation time of the engine shorter than that of conventional gasoline engine models. Due to the engine being unable to burn the fuel vapors sufficiently, the fuel vapors that are created exceed the capacity of normal-sized charcoal canisters. Therefore, this system releases the fuel vapors from the fuel tank assembly only when the engine is running, and burns it in the engine, in order to comply with the LEV II*1 and Tier 2*2 evaporative emission regulations.

- The evaporative emission control system on the '08 Highlander Hybrid Vehicle consists of a fuel vapor-containment system (to prevent fuel vapors escaping into the atmosphere), purge flow control (to purge fuel vapors), and the EVAP leak check (to check for leaks from the evaporative emission control system).

*1: CARB (California Air Resources Board)
*2: EPA (Environmental Protection Agency)

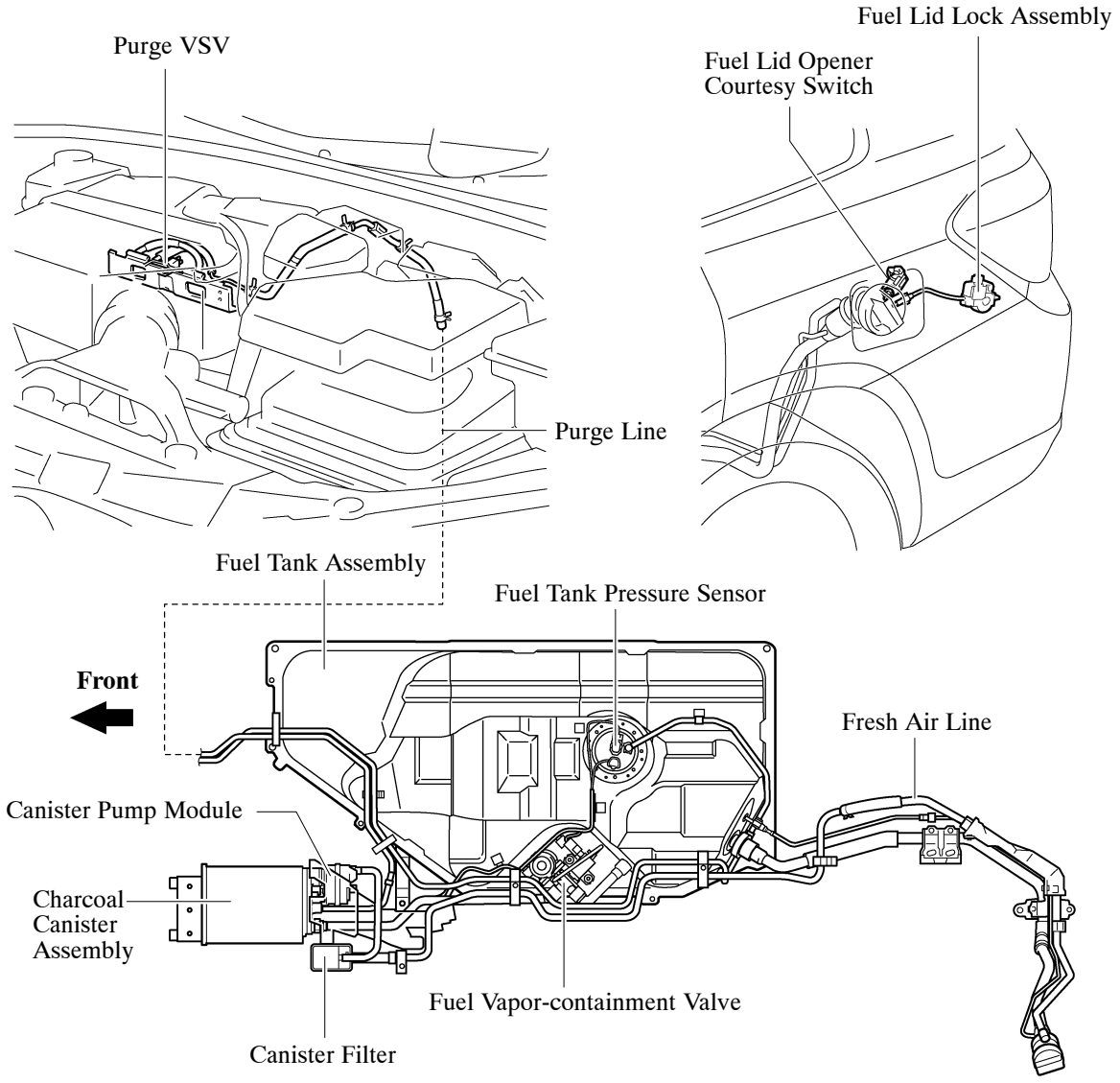
Function	Outline
Fuel Vapor-containment System [See page EG-68]	• When the vehicle is parked (with engine stopped), the system closes the fuel vapor-containment valve to seal the fuel tank assembly. • For refueling, the system opens the fuel vapor-containment valve, allowing the fuel vapors to be absorbed by the canister and reducing the pressure in the fuel tank assembly. • When the engine is operating, the system controls the fuel vapor-containment valve to release the fuel vapors and perform purge flow control.
Purge Flow Control [See page EG-71]	Opens the purge VSV when the engine is running, allowing the engine vacuum to draw the fuel vapors absorbed by the canister and burn them in the engine.
	The hybrid vehicle control ECU opens the fuel vapor-containment valve when the purge VSV is open and the internal pressure of the fuel tank is high. Thus, the fuel vapors in the fuel tank assembly and the fuel vapors absorbed by the charcoal canister assembly are drawn into the engine to be burned.
EVAP Leak Check [See page EG-73]	When the engine is stopped, the hybrid vehicle control ECU operates the canister pump module to perform a leak check in the evaporative emission control system and check the functions of the parts.
	Depending on the internal pressure of the fuel tank assembly, the hybrid vehicle control ECU performs two types of leak check operations: • When the internal pressure of the fuel tank assembly is equal to the atmospheric pressure. • When the internal pressure of the fuel tank assembly is higher [3 kPa (0.03 kgf/cm^2, 0.44 psi) minimum] or lower [-2 kPa (-0.02 kgf/cm^2, -0.29 psi) maximum] than the atmospheric pressure.

System Diagram



EG

Layout of Main Components



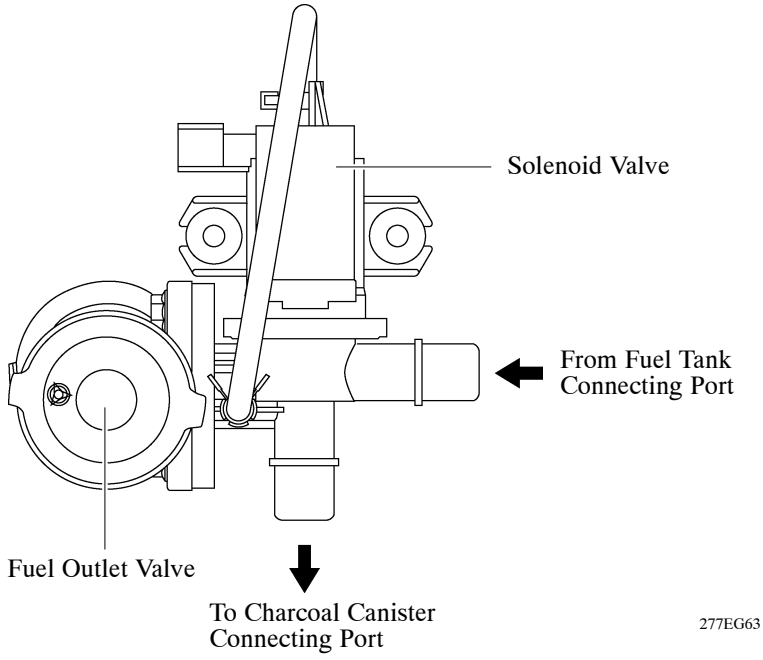
Function of Main Components

Components		Function
Fuel Tank Pressure Sensor		Detects the internal pressure of the fuel tank assembly and sends a signal to the hybrid vehicle control ECU.
Fuel Vapor-containment Valve		This valve opens or closes in accordance with a signal provided by the hybrid vehicle control ECU, in order to seal the fuel tank assembly or release its internal pressure.
Fuel Lid Lock Assembly		• The fuel lid lock assembly consists of a built-in motor that opens the fuel lid via a linkage. • If the fuel lid lock assembly malfunctions, the fuel lid can be opened manually by pulling on the emergency opener that is provided on the fuel lid lock assembly.
Fuel Lid Opener Courtesy Switch		Whether the fuel lid is open or closed can be determined by the state (on or off) of this switch.
Multi-information Display		Displays information concerning refueling.
Charcoal Canister Assembly		Contains activated charcoal to absorb the vapors that are created in the fuel tank assembly as well as during refueling.
Purge VSV		Opens in accordance with the signals from the hybrid vehicle control ECU when the system is purging, in order to send the fuel vapors that were absorbed by the charcoal canister assembly into the intake manifold. During the system monitoring mode, this valve controls the introduction of vacuum into the fuel tank assembly.
Canister Pump Module	Canister Vent Valve	Opens and closes the fresh air line in accordance with the signals from the hybrid vehicle control ECU.
	Leak Detection Pump	Applies vacuum to the evaporative emission system in accordance with the signals from the hybrid vehicle control ECU.
	Canister Pressure Sensor	Detects the pressure in the evaporative emission system and sends the signals to the hybrid vehicle control ECU.
Hybrid Vehicle Control ECU		• The hybrid vehicle control ECU determines the results of the canister pump module's system leak check, effects purge control through the fuel vapor-containment valve and the purge VSV, and controls the internal pressure of the fuel tank assembly. • The hybrid vehicle control ECU monitors the system for any leaks and outputs a DTC if a malfunction is found.

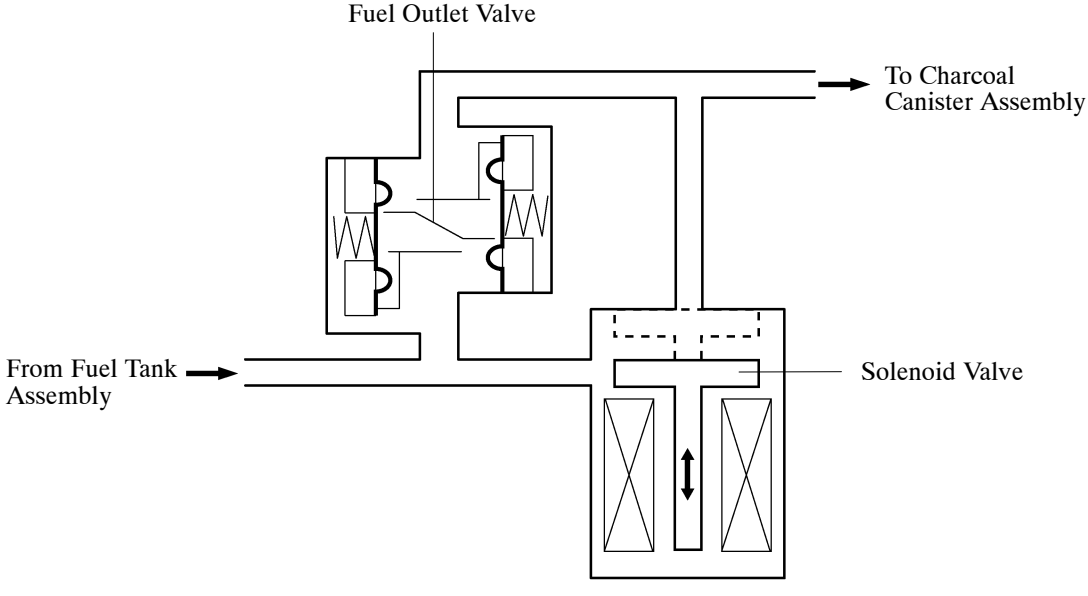
Construction and Operation

1) Fuel Vapor-containment Valve

- Installed between the fuel tank assembly and the charcoal canister assembly, the fuel vapor-containment valve consists of a solenoid valve that turns ON/OFF to seal the fuel tank assembly or release its internal pressure. This valve is normally closed; the fuel vapor passage opens when the valve is turned ON.
- In addition to the solenoid valve, this valve contains a fuel outlet valve. When the solenoid valve malfunctions or is inoperative due to the power source mode being OFF, the fuel outlet valve opens to release pressure if the fuel tank internal pressure becomes higher than standard. In addition, if the fuel tank pressure drops below a specified level (to a specified level of vacuum), the fuel outlet valve will open to admit air to the fuel tank assembly.

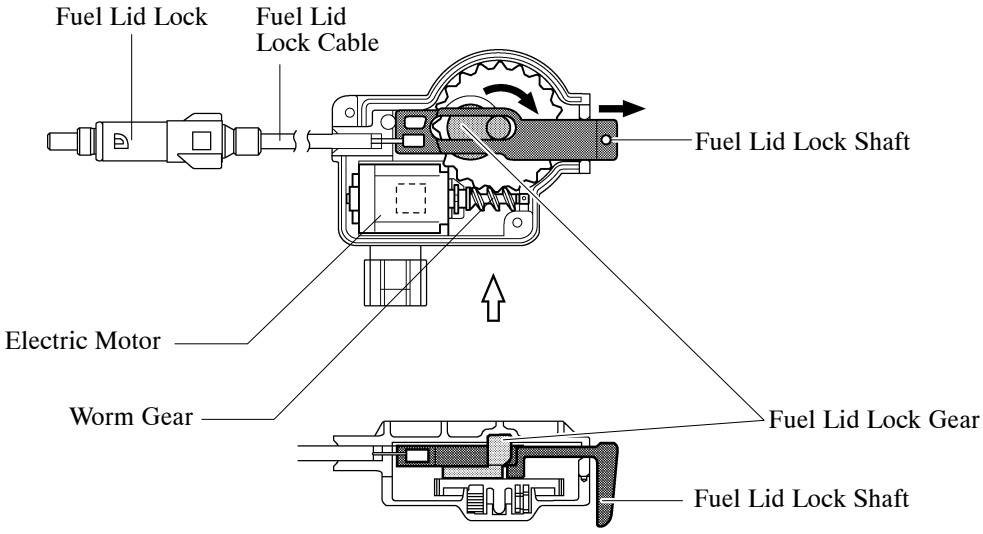


▶ System Diagram ◀



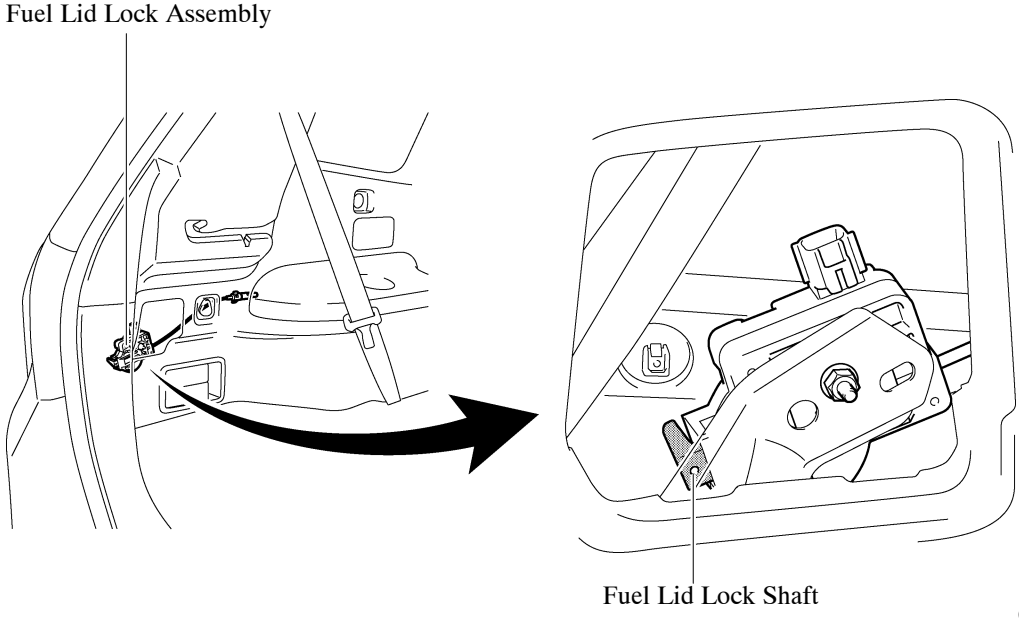
2) Fuel Lid Lock Assembly

- The fuel lid lock assembly consists of an electric motor, worm gear, fuel lid lock gear and fuel lid lock shaft.
- The rotational movement of the electric motor is converted into a sliding movement of the fuel lid lock shaft by the worm gear and the fuel lid lock gear. This movement pulls on the fuel lid lock cable, causing the fuel lid to open. If the fuel lid does not open due to a malfunction in this mechanism, the fuel lid can be opened by operating (pulling) the fuel lid lock shaft from inside the luggage room.



View from A

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07V0EG70C

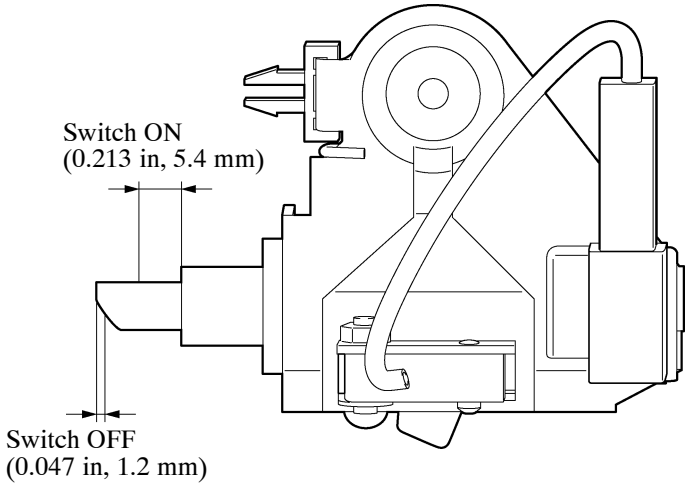
CAUTION

Do not operate the emergency opener when the fuel lid opener is working properly. If the fuel filler is opened using the emergency opener, the hybrid vehicle control ECU will not open the fuel vapor-containment valve, and the pre-release of the internal fuel tank pressure will not take place. Therefore, the internal pressure of the fuel tank assembly may remain high. Opening the fuel cap or refueling the fuel tank assembly in this state could cause fuel to overflow from the filler inlet. For this reason, be extremely careful when opening the fuel cap or refueling.

EG

3) Fuel Lid Opener Courtesy Switch

The fuel lid opener courtesy switch, which is mounted on the inside of the fuel filler door, determines whether the fuel filler door is open or closed by way of the state of the switch. When the door is open, the switch will be OFF. When the door is closed, the switch will be ON.

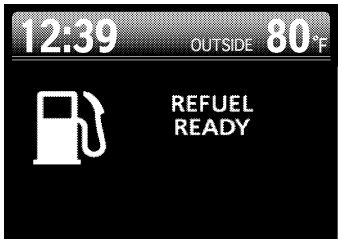
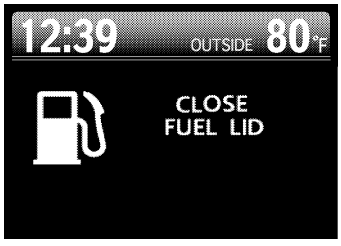


Fuel Lid Opener Courtesy Switch

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4) Multi-information Display

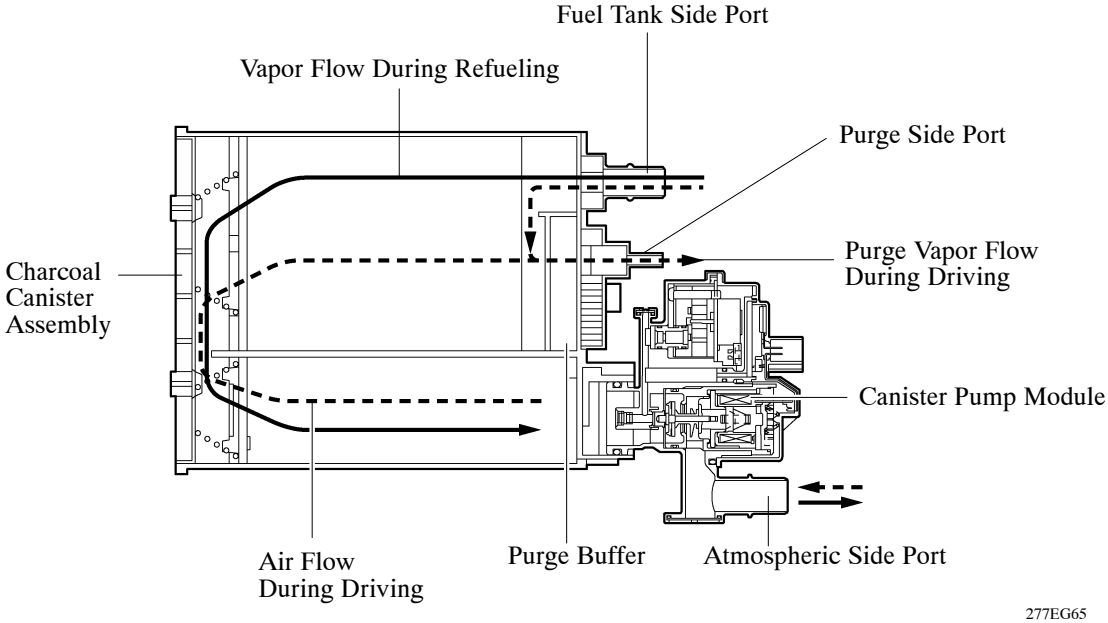
- In this system, if the internal pressure of the fuel tank assembly is high before the fuel lid is opened by operating the fuel lid opener switch, the hybrid vehicle control ECU opens the fuel vapor-containment valve to release the fuel vapors. Thus, it reduces the internal pressure of the fuel tank to a level close to the atmospheric pressure.
  While the pressure is being released, images shown in the table below will appear on the multi-information display. Thus, it informs the driver of the standby state from the time the fuel lid opener switch is pressed until the fuel lid opens.
- In addition, this display will inform the driver if the fuel lid is open.

Multi-information Display Indication	Indication Conditions
 07V0EG67C	The standby state that occurs while the pressure is being released from the fuel tank assembly appears on the display under the following conditions: • The fuel lid opener switch was operated and the fuel vapor-containment valve is open. • The internal pressure of the fuel tank assembly is higher than atmospheric pressure. • After the fuel lid opener switch is operated, the 10 bars illuminate, 1 appearing every second. If it takes longer than 9 seconds, nine bars will remain illuminated.
 07V0EG68C	The refueling-ready state appears on the display under the following conditions: • Fuel vapor-containment valve is ON. • The internal pressure of the fuel tank assembly is near atmospheric pressure.
 07V0EG69C	If one of the conditions described below has been met while the fuel lid is open, the fuel lid open state appears on the display. • The vehicle speed is higher than 50 km/h (31 mph). • The vehicle has traveled more than 1 km (0.6 mile). • 30 minutes have elapsed since the fuel vapor-containment valve was opened.

EG

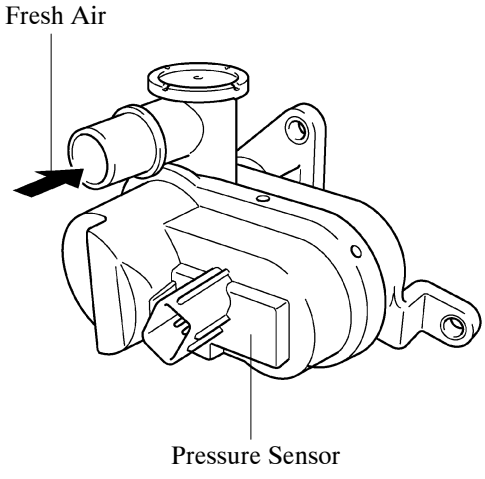
5) Charcoal Canister Assembly

- The canister absorbs fuel vapors during refueling standby or purge flow control.
- In addition to the conventional charcoal canister assembly construction, this charcoal canister assembly contains a purge buffer, which uses highly concentrated activated charcoal, in front of the purge side port. The function of the purge buffer is to moderate the concentrated fuel vapors that are discharged from the fuel tank assembly when the fuel vapor-containment valve is opend.

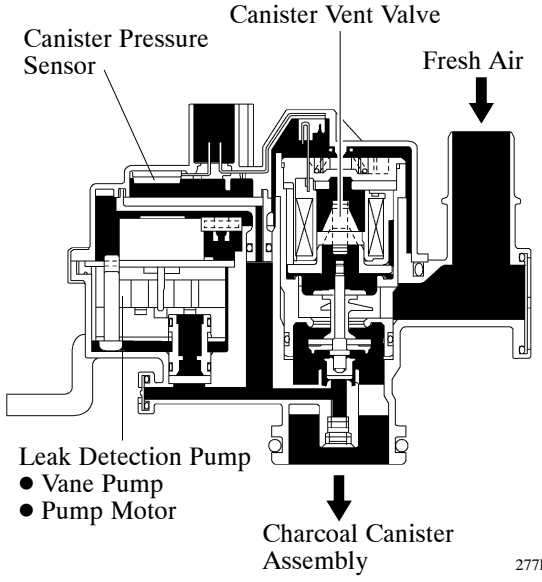


6) Canister Pump Module

- This canister pump module is used for checking the EVAP system pipe, charcoal canister assembly, and fuel tank assembly for leaks, and for checking the functions of the parts.
- The canister pump module consists of the canister vent valve, canister pressure sensor and leak detection pump.
- The pump motor, which is a brushless DC motor, drives the leak detection pump. This is a vane type leak detection pump.
- When the EVAP leak check function is operating, the canister pump module actuates the canister vent valve and the leak detection pump in accordance with the signals received from the hybrid vehicle control ECU, in order to create a vacuum in the fuel tank assembly, charcoal canister assembly, and pipes of the evaporative emission control system.
- The canister pressure sensor detects the pressure of the evaporative emission control system during a leak check, and sends a signal to the hybrid vehicle control ECU.

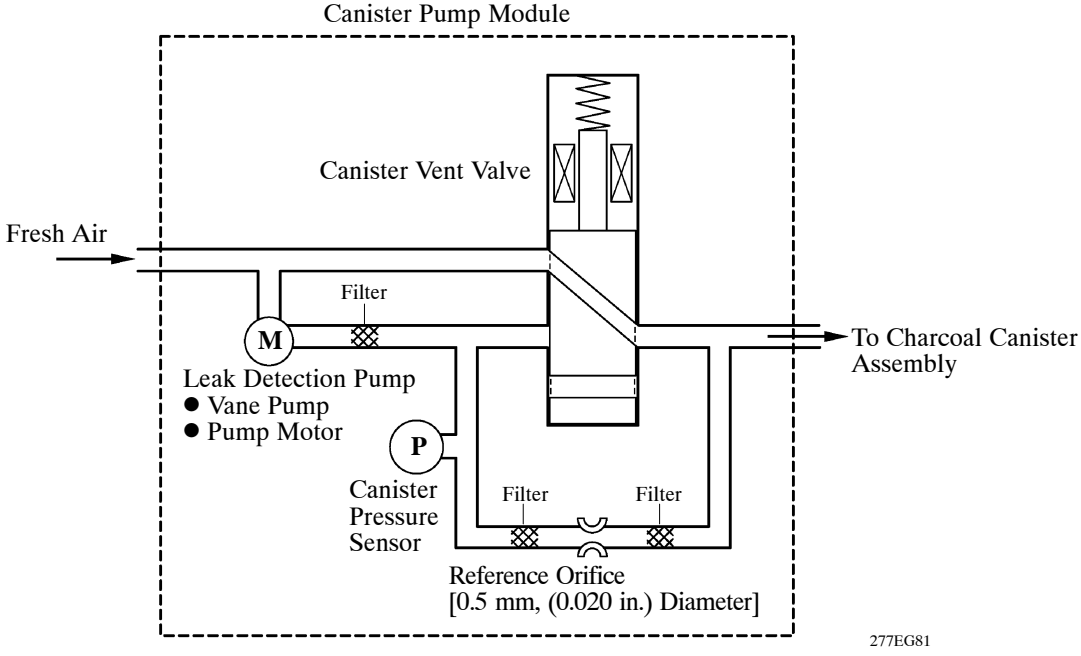


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▶ System Diagram ◀



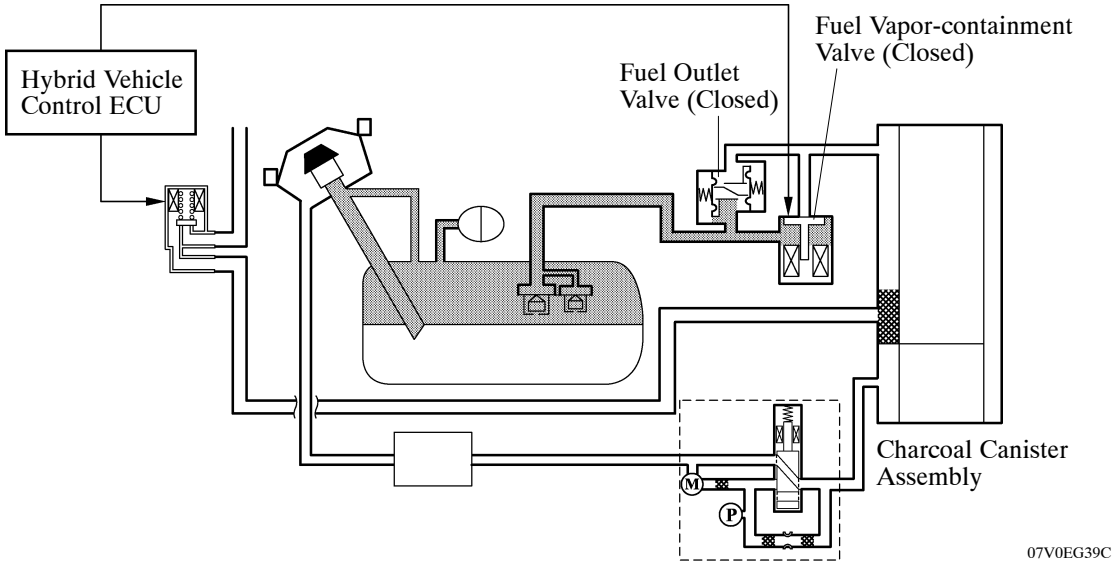
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System Operation

1) Fuel Vapor-containment System

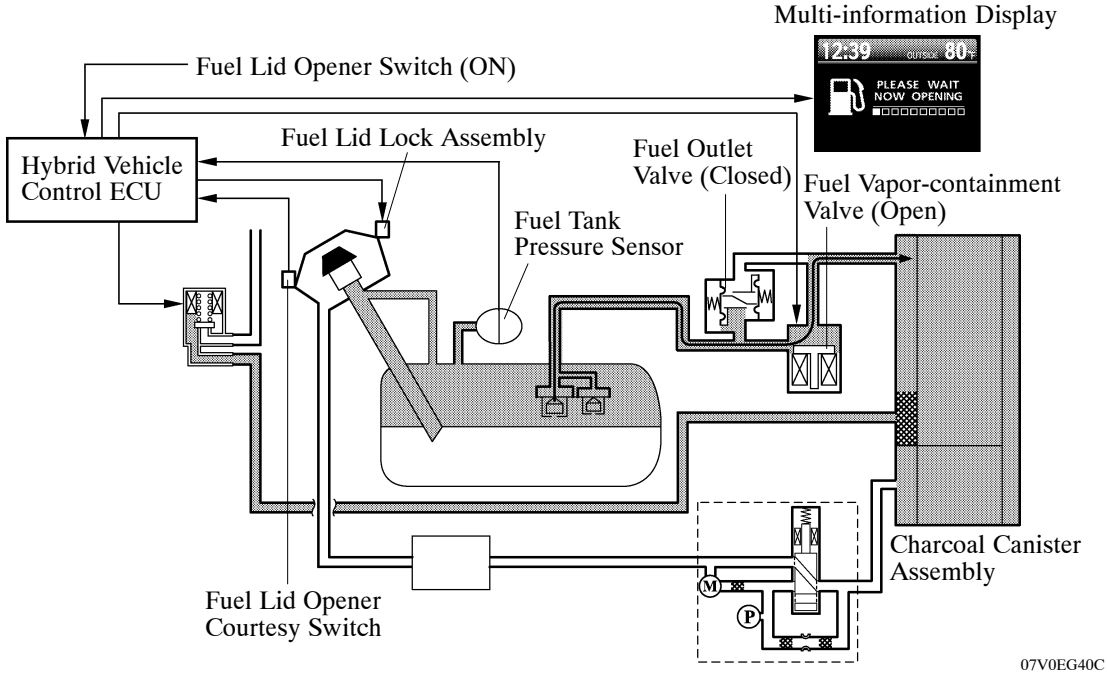
a. Parked (Power Source Mode OFF)

The hybrid vehicle control ECU seals the fuel vapors in the fuel tank assembly by closing the fuel vapor-containment valve. If, at this time, the internal pressure of the fuel tank assembly increases to a level that activates the fuel outlet valve located in the fuel vapor-containment valve, the fuel outlet valve opens to release the internal pressure of the fuel tank assembly. This prevents the internal pressure in the fuel tank assembly from increasing abnormally.



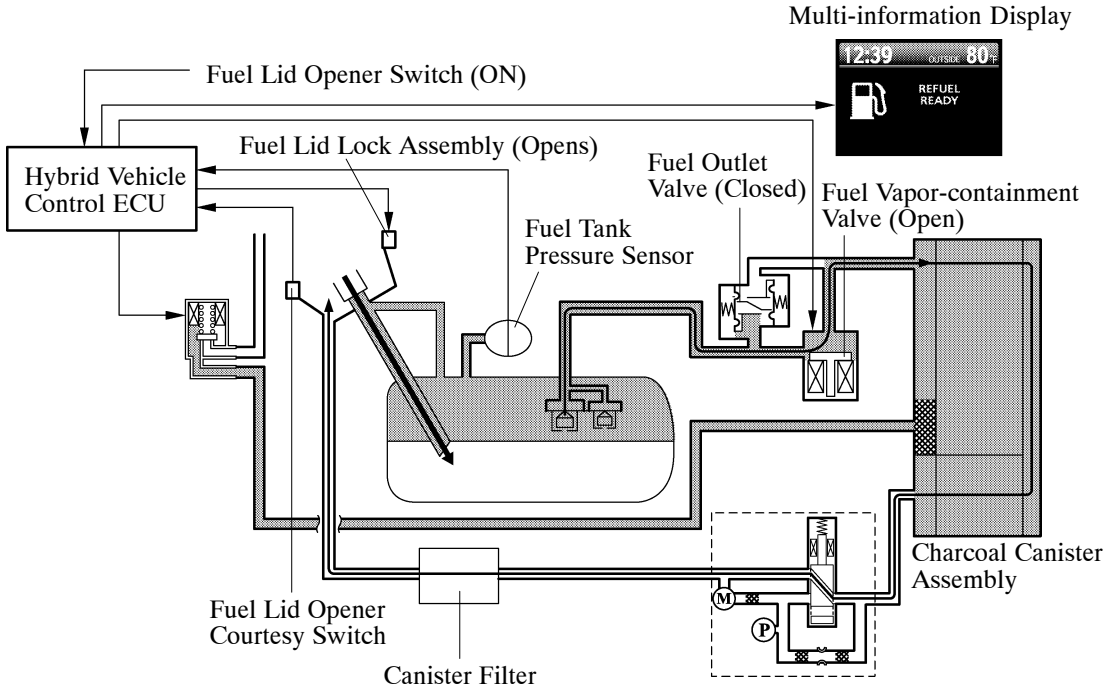
b. Refueling Wait

When the lid opener switch is operated (turned ON), the hybrid vehicle control ECU opens the fuel vapor-containment valve, allowing the fuel vapors to be absorbed by the charcoal canister assembly and reducing the pressure in the fuel tank assembly. The fuel lid will not open unless the internal pressure of the fuel tank assembly decreases to a level close to atmospheric pressure. In addition, the multi-information display will show the “PLEASE WAIT NOW OPENING”.



c. Refueling Ready

- When the internal pressure of the fuel tank assembly decreases to a level close to atmospheric pressure, the hybrid vehicle control ECU opens the fuel lid. At this time, the multi-information display will show “REFUEL READY”. Because the hybrid vehicle control ECU keeps the fuel vapor-containment valve open during refueling, the fuel vapors that are created during refueling pass through the fuel vapor-containment valve and are absorbed by the charcoal canister assembly. When the fuel lid is closed after refueling, the fuel vapor-containment valve closes in order to seal the fuel tank assembly.
- If 30 minutes elapse after the fuel lid is opened, the hybrid vehicle control ECU closes the fuel vapor-containment valve to seals the fuel tank assembly in order to prevent the fuel vapors from escaping, even if the fuel lid is not closed.

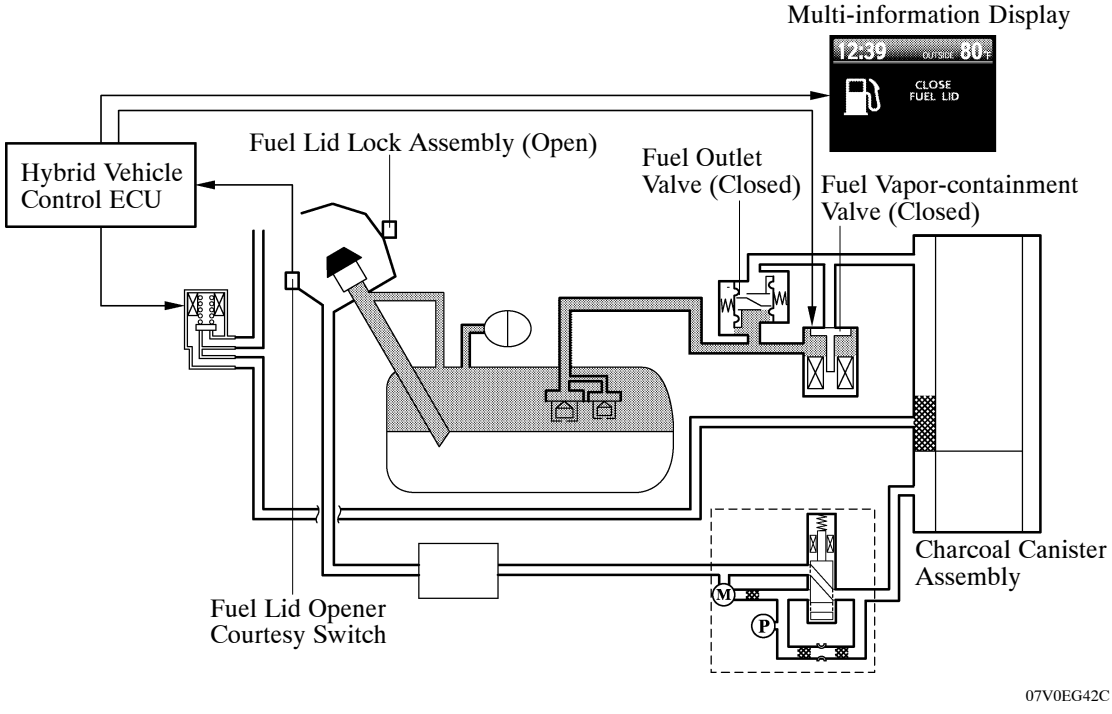


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d. Fuel Lid Open Warning

If one of the conditions listed below is met while the fuel lid is open, the hybrid vehicle control ECU will show a “CLOSE FUEL LID” warning message on the multi-information display to warn the driver.

- The vehicle speed is higher than 50 km/h (31 mph).
- The vehicle has traveled more than 1 km (0.6 mile).
- 30 minutes have elapsed since the fuel vapor-containment valve was opened.



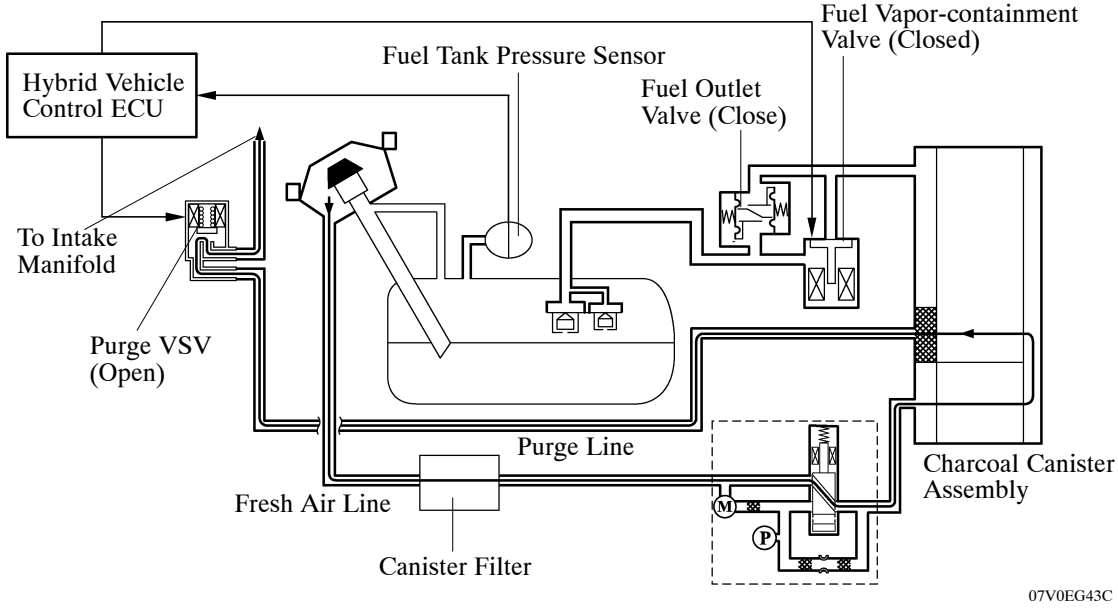
2) Purge flow Control

a. General

- When the engine has reached predetermined parameters (closed loop, engine coolant temp. above 70°C (162°F), etc), stored fuel vapors are purged from the canister whenever the purge VSV is opened by the hybrid vehicle control ECU.
  The hybrid vehicle control ECU will change the duty ratio cycle of the purge VSV thus controlling purge flow volume. The purge flow volume depends on the intake manifold pressure and the duty ratio cycle of the purge VSV. Atmospheric pressure is allowed into the charcoal canister assembly to ensure that purge flow is constantly maintained whenever purge vacuum is applied to the charcoal canister assembly.
- Due to the adoption of a fuel vapor-containment system, purge flow control occurs following two patterns, depending on the internal pressure of the fuel tank assembly.

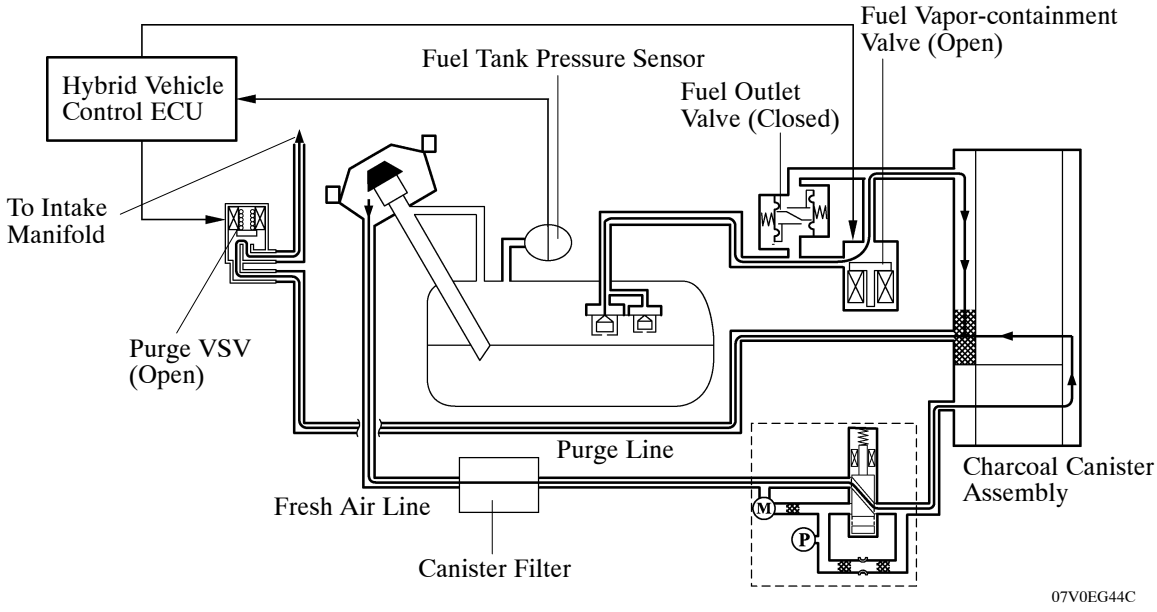
b. Fuel Tank Internal Pressure is Near Atmospheric Pressure

If the internal pressure in the fuel tank assembly is near atmospheric pressure, the hybrid vehicle control ECU will not open the fuel vapor-containment valve even if the purge VSV is open. At this time, the fuel vapors that are absorbed in the charcoal canister assembly are drawn inside the engine and burned.



c. Fuel Tank Internal Pressure is High

If the internal pressure in the fuel tank assembly is high and the purge valve is open, the hybrid vehicle control ECU opens the fuel vapor-containment valve in order to release the pressure from the fuel tank assembly. At this time, the fuel vapors that are absorbed in the charcoal canister assembly are drawn inside the engine by intake vacuum and burned.



3) EVAP Leak Check

a. General

- The following are the typical conditions for enabling an evaporative emission leak check:

Typical Enabling Conditions	• 5 hours have elapsed after the engine has been turned OFF.* • Altitude: Below 2400 m (8000 feet) • Battery Voltage: 10.5 V or more • Power Switch: 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.

- The hybrid vehicle control ECU performs evaporative emission leak checks using two types of judgment methods.

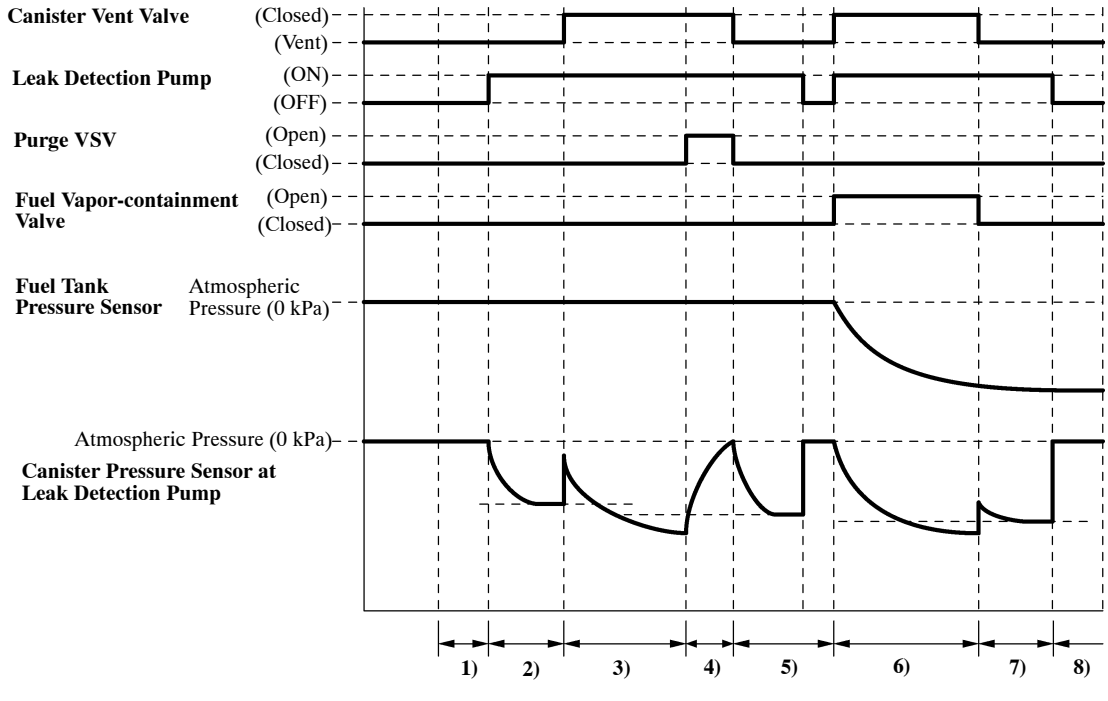
1) When the internal pressure in the fuel tank assembly is equal to atmospheric pressure:
- The hybrid vehicle control ECU actuates the leak detection pump to introduce a vacuum into the EVAP system pipes and the charcoal canister assembly, in order to check for leaks and check the function of parts.
- The hybrid vehicle control ECU actuates the leak detection pump and opens the fuel vapor-containment valve to introduce a vacuum into the fuel tank assembly, in order to check the fuel tank assembly for leaks and determine whether the fuel vapor-containment valve is stuck closed.

2) When the internal pressure in the fuel tank assembly is higher or lower than atmospheric pressure:
- If the internal pressure of the fuel tank assembly is high or low, the hybrid vehicle control ECU determines that there are no leaks in the fuel tank assembly, based on the holding state of the internal pressure in the fuel tank assembly.
- The hybrid vehicle control ECU actuates the leak detection pump to introduce a vacuum into EVAP system pipes and the charcoal canister assembly, in order to check for leaks and check the function of parts.
- With the leak detection pump stopped, the hybrid vehicle control ECU opens the fuel vapor-containment valve to introduce the pressure from the fuel tank assembly into EVAP system pipes and the charcoal canister assembly, in order to determine whether the fuel vapor-containment valve is stuck closed.

Service Tip

The canister pump module performs the fuel evaporative emission leak check. This check is done approximately 5 hours after engine is turned off. A sound may be heard coming from underneath the luggage compartment for several minutes. This sound does not indicate a malfunction.

▶ When Fuel Tank Internal Pressure Equals Atmospheric Pressure ◀



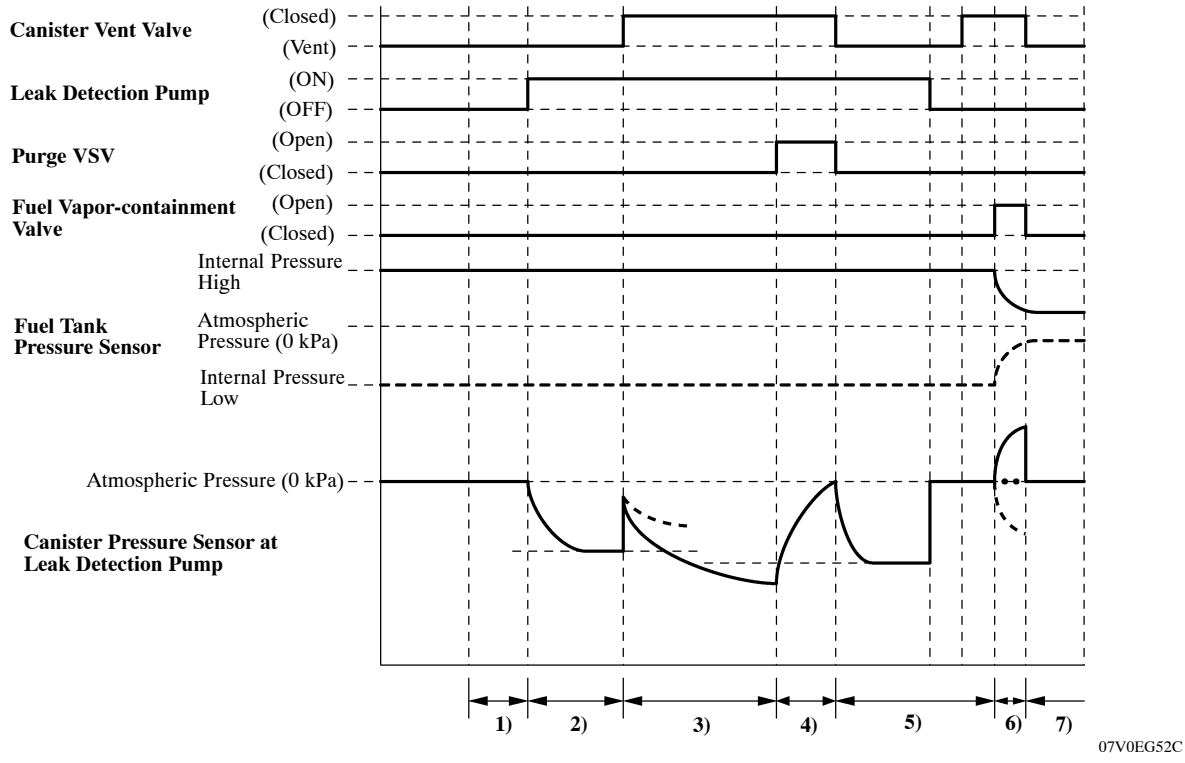
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Order	Operation	Description	Time
1)	Atmospheric Pressure Measurement	The hybrid vehicle control ECU turns the canister vent valve OFF (vent) and measures evaporative emission control system pressure to memorize the atmospheric pressure.	10 sec.
2)	0.02 in. Leak Pressure Measurement	The leak detection pump creates negative pressure (vacuum) through a 0.02 in. orifice and this pressure is measured. The hybrid vehicle control ECU determines this as the 0.02 in. leak pressure.	60 sec.
3)	EVAP Leak Check	The leak detection pump creates negative pressure (vacuum) to check for leaks in the canister and this pressure is measured. If the stabilized pressure is larger than the 0.02 in. leak pressure, the hybrid vehicle control ECU determines that the evaporative emission control system has a leak. If the pressure does not stabilize within 15 minutes, the hybrid vehicle control ECU cancels evaporative emission control system monitoring.	Within 15 min.
4)	Purge VSV Monitor and Fuel Vapor-containment Valve Stuck Closed Judgment	The hybrid vehicle control ECU opens the purge VSV and monitors the vacuum created by the leak detection pump. If the pressure change is large (the pressure changes from vacuum to near atmospheric pressure), the hybrid vehicle control ECU interprets this as normal function of the purge VSV.	10 sec.
5)	0.02 in. Leak Pressure Measurement	First, the leak detection pump creates negative pressure (vacuum) through a 0.02 in. orifice and this pressure is measured. The hybrid vehicle control ECU determines this as the 0.02 in. leak pressure. Then, the hybrid vehicle control ECU turns the leak detection pump OFF and measures the pressure to memorize atmospheric pressure.	60 sec. and 10 sec.

(Continued)

Order	Operation	Description	Time
6)	Fuel Vapor-containment Valve Stuck Closed Judgment and Fuel Tank Leak Judgment	When the fuel vapor-containment valve is open, the leak detection pump creates a negative pressure (vacuum) in the fuel tank assembly and the hybrid vehicle control ECU measures the pressure at this time.	Approx. 15 min.
7)	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 hybrid vehicle control ECU determines this as the 0.02 in. leak pressure.	60 sec.
8)	Final Check	The hybrid vehicle control ECU measures atmospheric pressure and then records the monitor result.	—

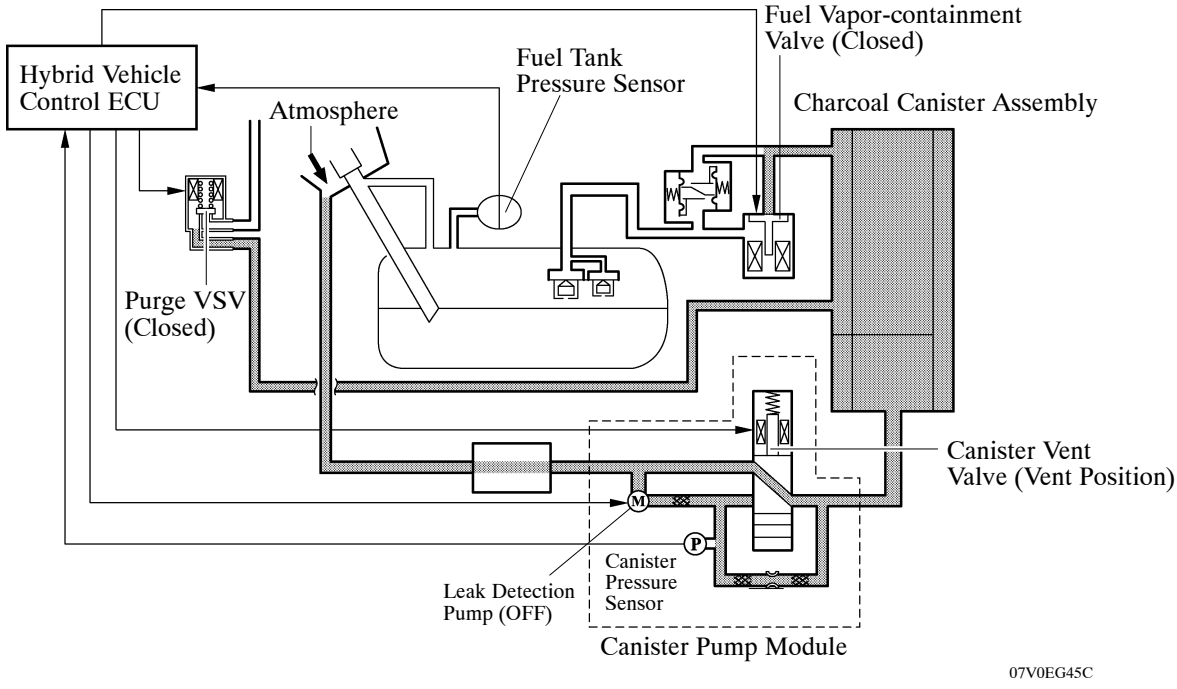
▶ When Fuel Tank Internal Pressure is High or Low ◀



Order	Operation	Description	Time
1)	Atmospheric Pressure Measurement	The hybrid vehicle control ECU turns the canister vent valve OFF (vent) and measures evaporative emission control system pressure to memorize the atmospheric pressure.	10 sec.
2)	0.02 in. Leak Pressure Measurement	The leak detection pump creates negative pressure (vacuum) through a 0.02 in. orifice and this pressure is measured. The hybrid vehicle control ECU determines this as the 0.02 in. leak pressure.	60 sec.
3)	EVAP Leak Check	The leak detection pump creates negative pressure (vacuum) to check for leaks in the canister and the pressure is measured. If the stabilized pressure is larger than the 0.02 in. leak pressure, the hybrid vehicle control ECU determines that the evaporative emission control system has a leak. If the leak detection pump pressure does not stabilize within 15 minutes, the hybrid vehicle control ECU cancels evaporative emission control system monitoring.	Within 15 min.
4)	Purge VSV Monitor	The hybrid vehicle control ECU opens the purge VSV and monitors the vacuum created by the leak detection pump. If the pressure change is large (the pressure changes from vacuum to near atmospheric pressure), the hybrid vehicle control ECU interprets this as normal function of the purge VSV.	10 sec.
5)	0.02 in. Leak Pressure Measurement	First, the leak detection pump creates negative pressure (vacuum) through a 0.02 in. orifice and the pressure is measured. The hybrid vehicle control ECU determines this as the 0.02 in. leak pressure. Then, the hybrid vehicle control ECU turns the leak detection pump OFF and measures the pressure to memorize atmospheric pressure. Following this, the canister vent valve is switched to the ON position (vent).	60 sec. and 10 sec.
6)	Fuel Vapor-containment Valve Stuck Closed Judgment	Using the pre-existing pressure or vacuum in the fuel tank assembly, the hybrid vehicle control ECU monitors the pressure at the time the fuel vapor-containment valve is opened.	Approx. 0.1sec.
7)	Final Check	The hybrid vehicle control ECU measures atmospheric pressure and then records the monitor result.	—

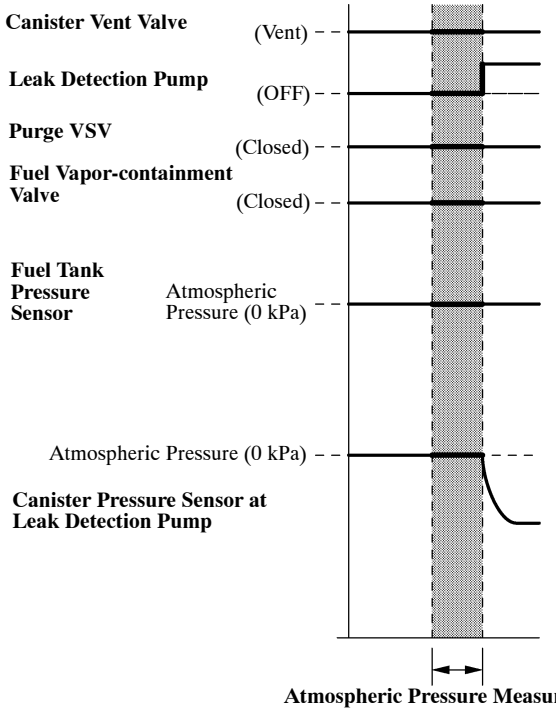
b. Atmospheric Pressure Measurement

1) When the power source is turned OFF, the purge VSV and the fuel vapor-containment valve are OFF (closed). Therefore, atmospheric pressure is introduced into the charcoal canister assembly.
2) The hybrid vehicle control ECU measures the atmospheric pressure through the signals provided by the canister pressure sensor.
3) If the measurement value is out of standards, the hybrid vehicle control ECU actuates the leak detection pump in order to monitor the pressure changes.
4) If the hybrid vehicle control ECU does not detect pressure changes, it stops the leak check and it will store DTC (Diagnostic Trouble Codes) P0450, P0451 in its memory.



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▶ When Fuel Tank Internal Pressure Equals Atmospheric Pressure* ◀



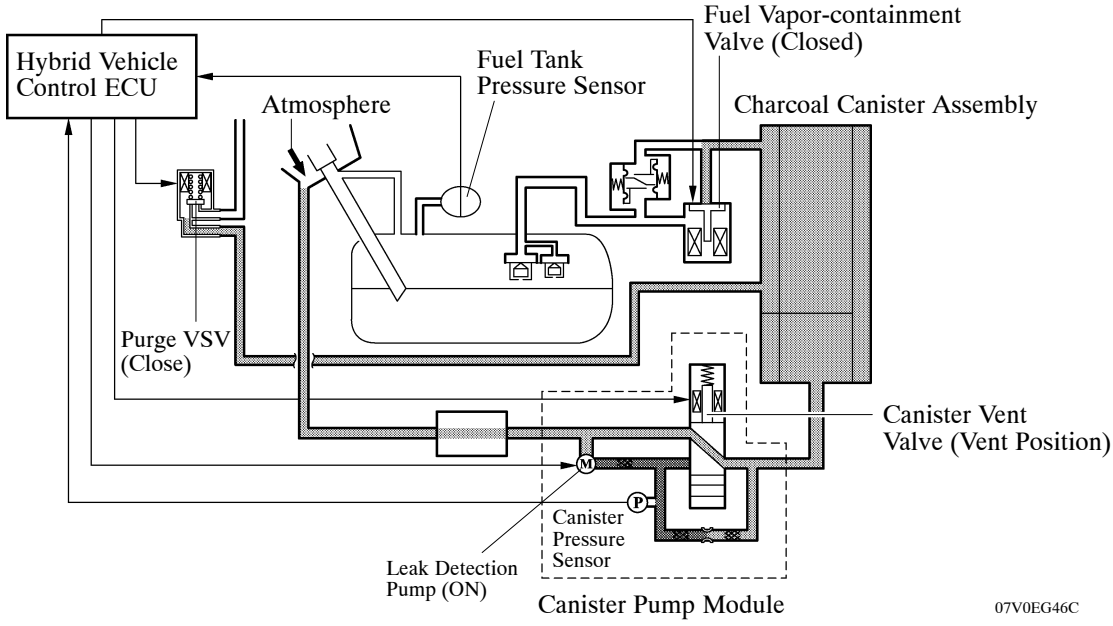
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*: Two check patterns exist depending on fuel tank pressure, however, for clarity only one pattern is shown here.

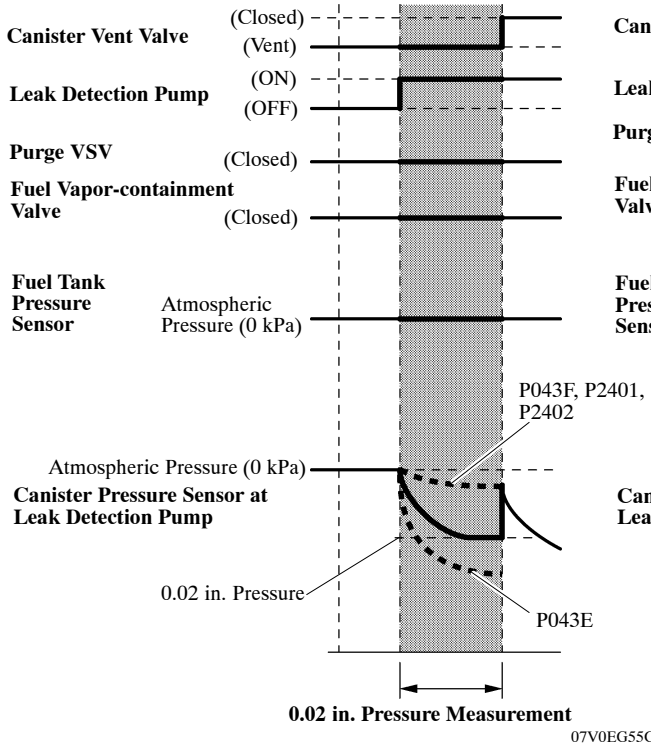
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c. 0.02 in. Leak Pressure Measurement

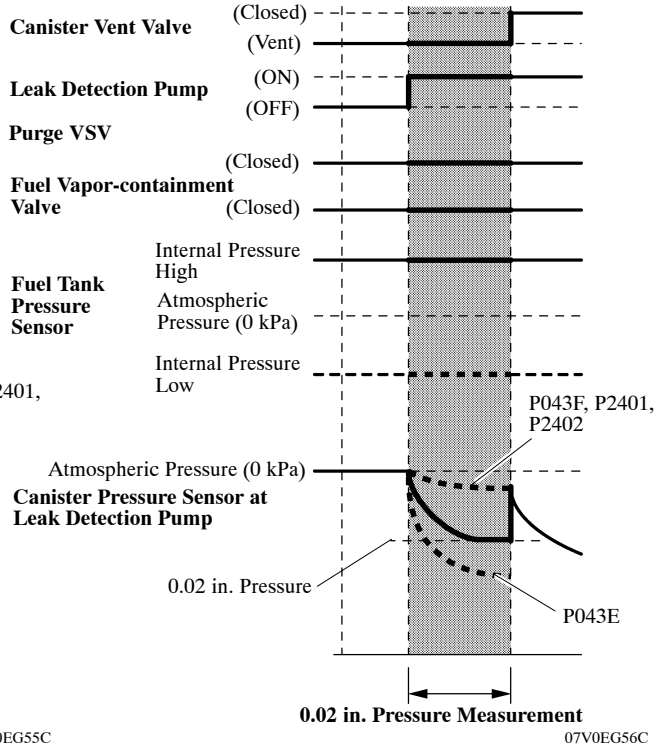
1) The hybrid vehicle control ECU turns the canister vent valve OFF (vent), introducing atmospheric pressure into the charcoal canister assembly, and actuates the leak detection pump, in order to create a negative pressure.
2) At this time, the pressure will not decrease beyond a certain level due to the atmospheric pressure that enters through a 0.02 in. (0.5 mm) diameter reference orifice.
3) The hybrid vehicle control ECU compares the logic value and this pressure, and stores the measured pressure as the 0.02 in. leak pressure.
4) If the measurement value is below the standard (pressure is too low, too much vacuum), the hybrid vehicle control ECU will determine that the reference orifice is clogged and it will store DTC P043E in its memory.
5) If the measurement value is above the standard (pressure is too high, not enough vacuum), the hybrid vehicle control ECU will determine that a high flow rate of pressure is passing through the reference orifice and it will store DTC P043F, P2401 and P2402 in memory.



▶ When Fuel Tank Internal Pressure Equals Atmospheric Pressure ◀

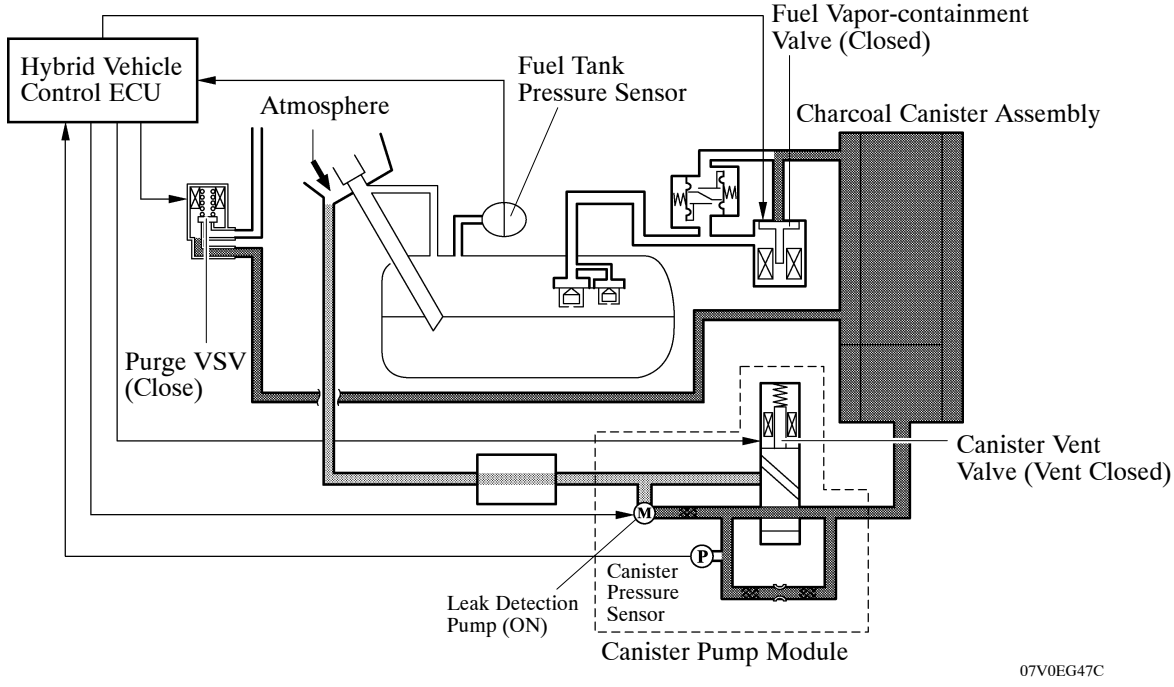


▶ When Fuel Tank Internal Pressure is High or Low ◀

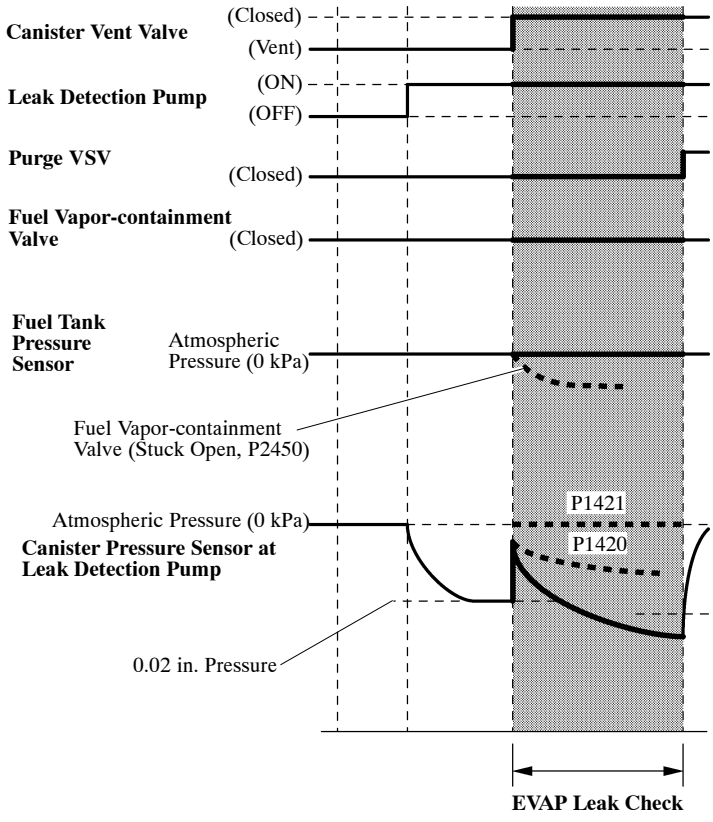


d. EVAP Leak Check

1) While actuating the leak detection pump, the hybrid vehicle control ECU turns the canister vent valve ON (closes the vent) in order to introduce a vacuum into the charcoal canister assembly.
2) When the pressure in the system stabilizes, the hybrid vehicle control ECU compares this pressure and the 0.02 in. pressure in order to determine if a leak is occurring.
3) If the detection value is below the 0.02 in. pressure, the hybrid vehicle control ECU determines that there is no leak.
4) If the detection value is above the 0.02 in. pressure and near atmospheric pressure, the hybrid vehicle control ECU determines that there is a gross leak (large hole) and it will store DTC P1421 in its memory.
5) If the detection value is above the 0.02 in. pressure and still below atmospheric pressure, the hybrid vehicle control ECU determines that there is a small leak and it will store DTC P1420 in its memory.
6) When the fuel tank internal pressure equals atmospheric pressure, if there is fluctuation in the fuel tank pressure sensor value, the hybrid vehicle control ECU determines that the fuel vapor-containment valve is stuck open and it will store DTC P2450 in memory.

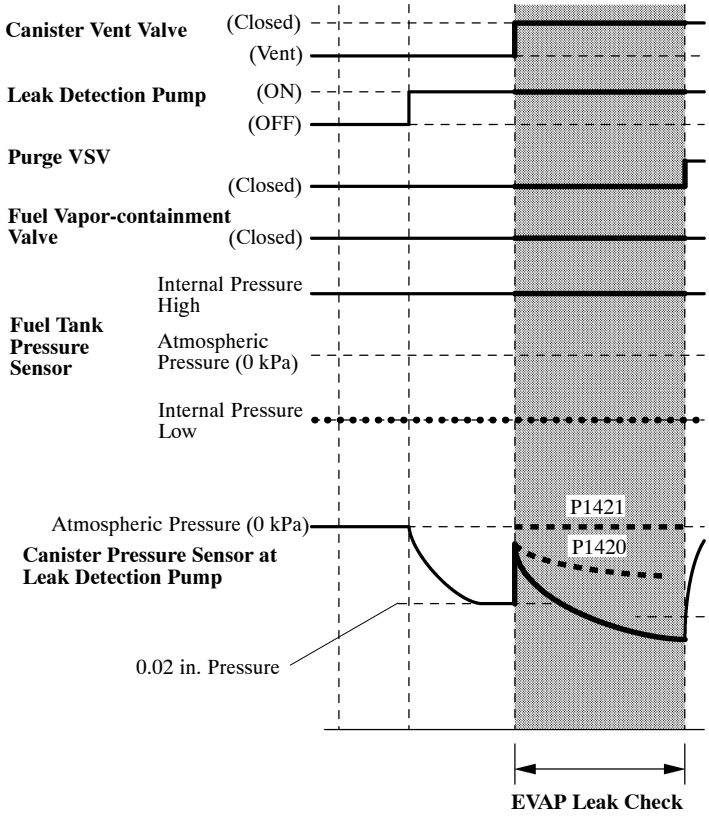


▶ When Fuel Tank Internal Pressure Equals Atmospheric Pressure ◀



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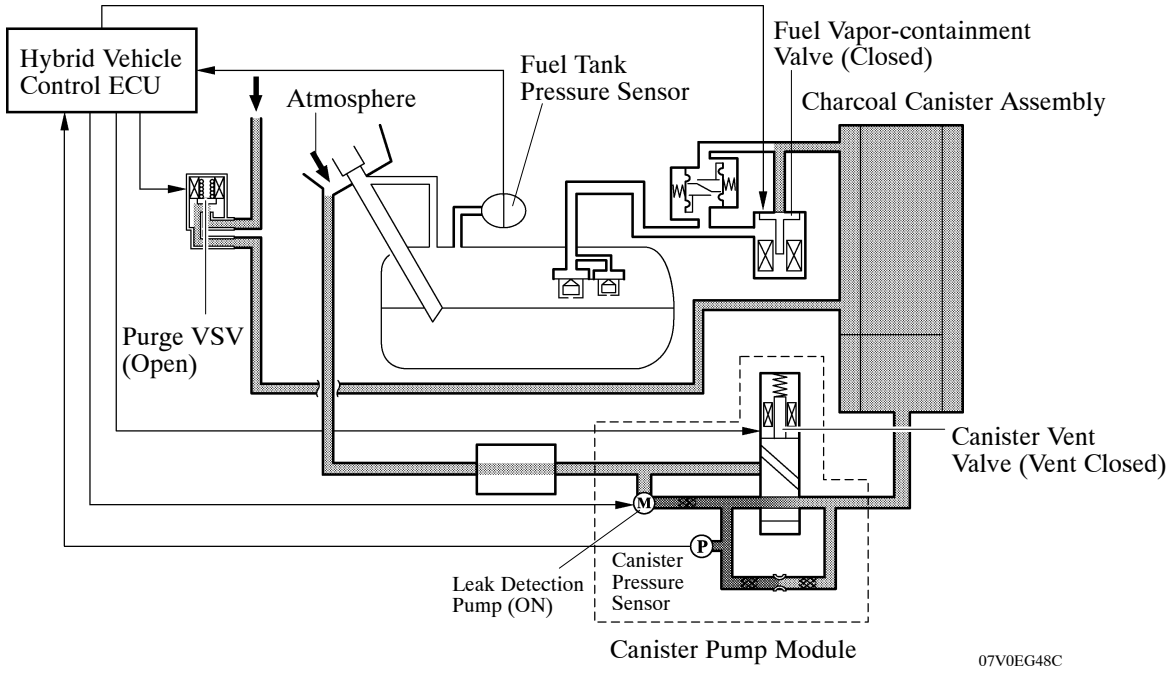
▶ When Fuel Tank Internal Pressure is High or Low ◀



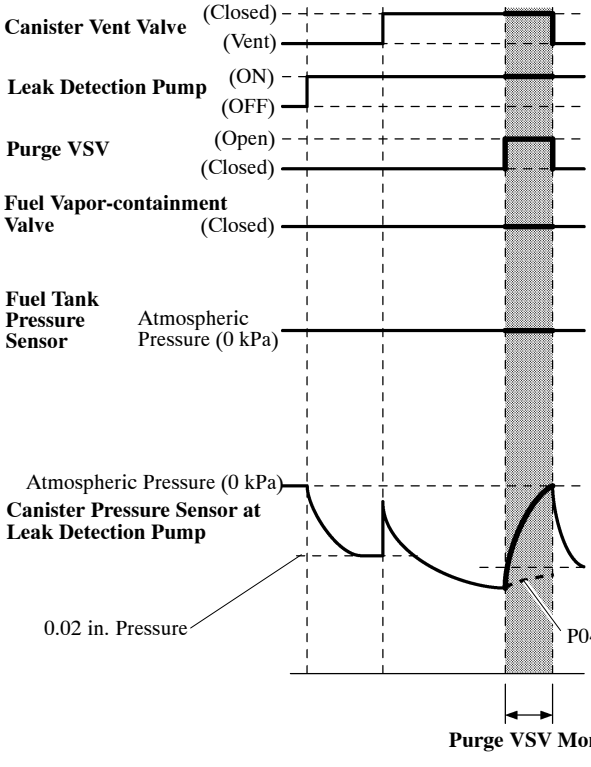
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e. Purge VSV Monitor

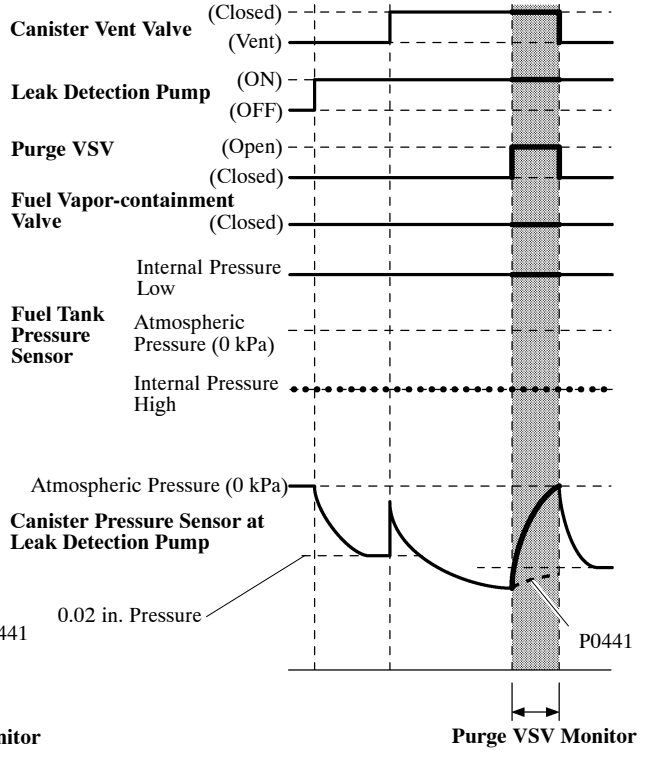
1) After completing an EVAP leak check, the hybrid vehicle control ECU turns the purge VSV ON (open) with the leak detection pump actuated, and introduces atmospheric pressure into the charcoal canister assembly from the intake manifold.
2) If the pressure change at this time is within the normal range,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



▶ When Fuel Tank Internal Pressure Equals Atmospheric Pressure ◀



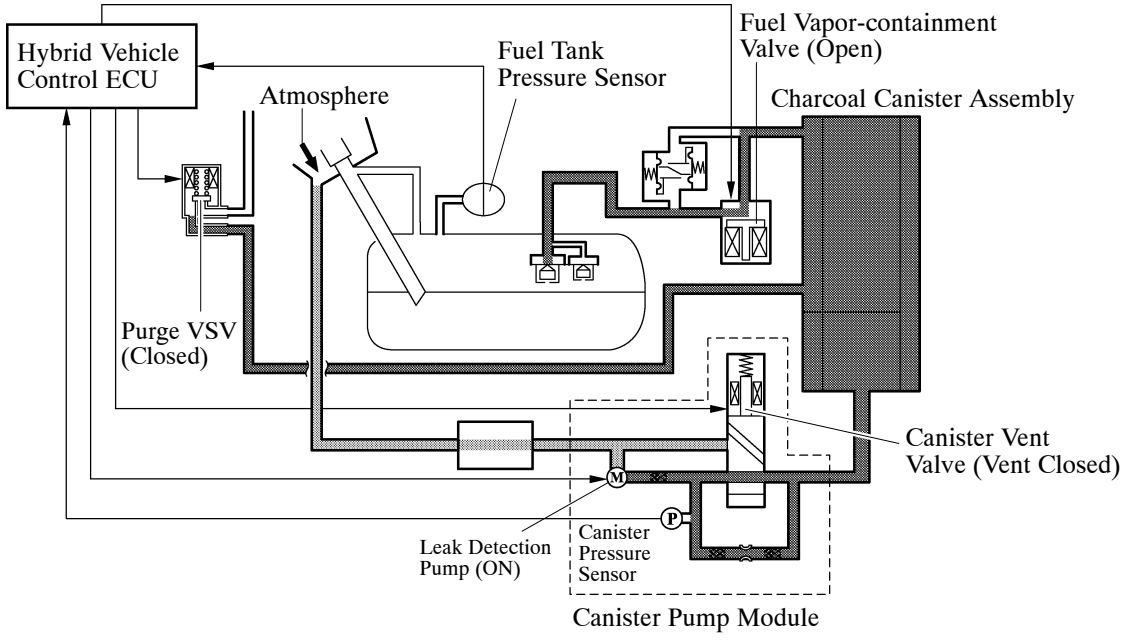
▶ When Fuel Tank Internal Pressure is High or Low ◀

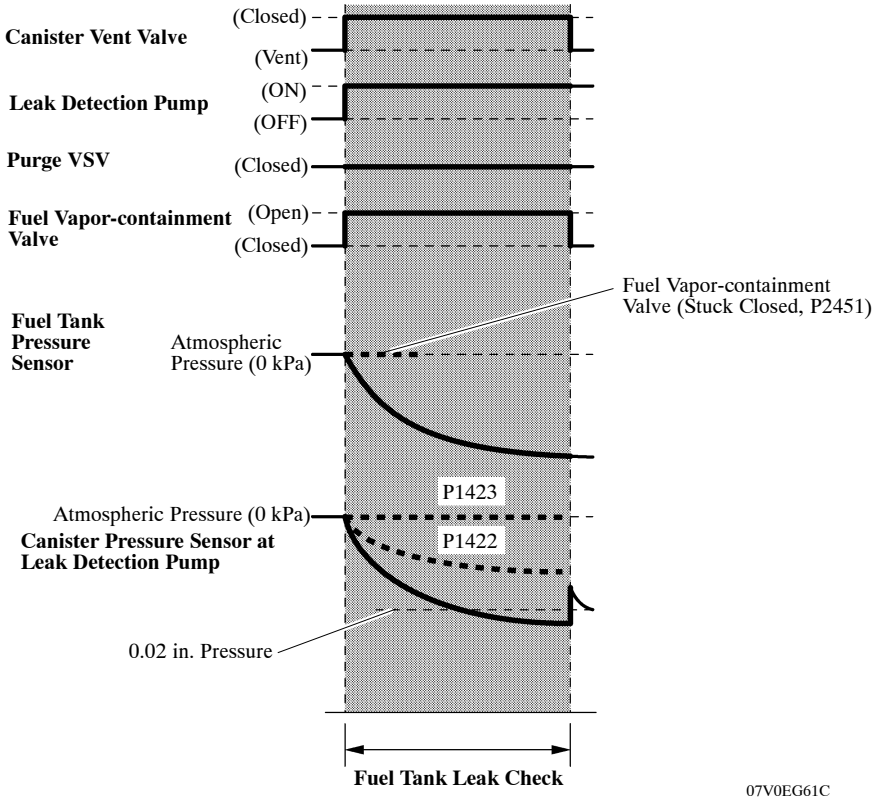


f. Fuel Vapor-containment Valve Stuck Closed Judgment and Fuel Tank Leak Check

i) When Fuel Tank Internal Pressure Equals Atmospheric Pressure

1) The hybrid vehicle control ECU actuates the leak detection pump, and turns ON the canister vent valve (vent is closed) and the fuel vapor-containment valve (valve opens), in order to introduce a vacuum into the fuel tank assembly, pipes, and charcoal canister assembly.
2) When the pressure in the system stabilizes, the hybrid vehicle control ECU compares this pressure and the 0.02 in. pressure in order to determine if a leak is occurring.
3) If the detection value is below the 0.02 in. pressure, the hybrid vehicle control ECU determines that there is no leak.
4) If the detection value is above the 0.02 in. pressure and near atmospheric pressure, the hybrid vehicle control ECU determines that there is a gross leak (large hole) and stores DTC P1423 in its memory.
5) If the detection value is above the 0.02 in. pressure and still below atmospheric pressure, the hybrid vehicle control ECU determines that there is a small leak and stores DTC P1422 in its memory.
6) At this time, if there is no fluctuation in the fuel tank pressure sensor value, the hybrid vehicle control ECU determines that the fuel vapor-containment valve is stuck closed and it will store DTC P2451 in memory.



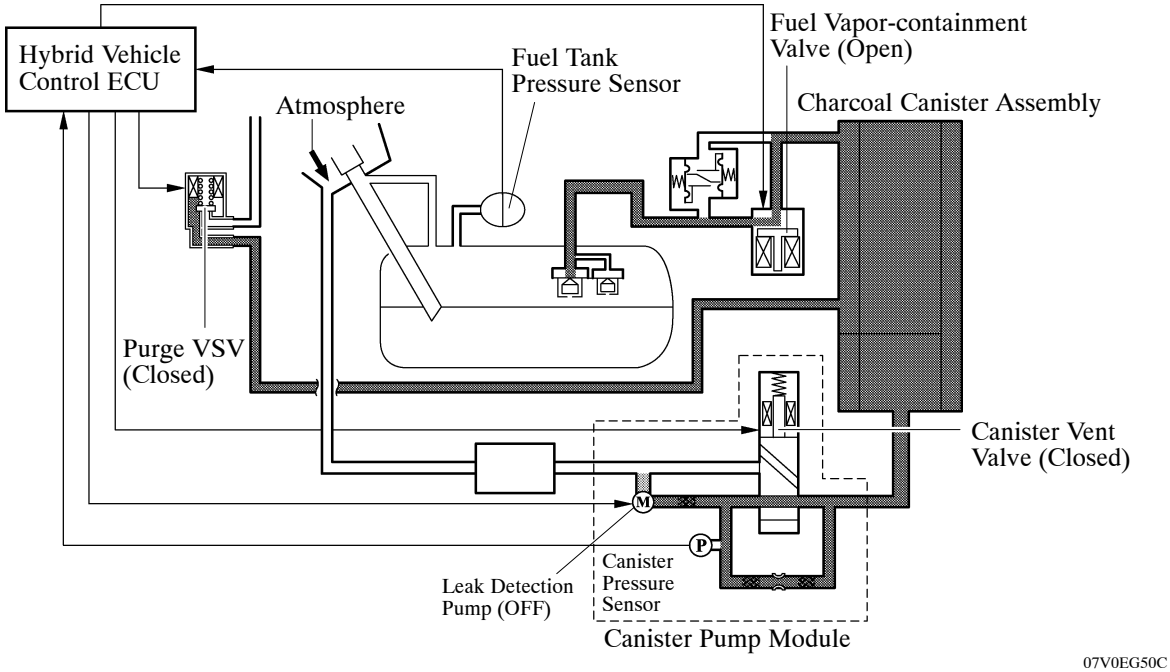

Canister Vent Valve
(Closed)
(Vent)
Leak Detection Pump
(ON)
(OFF)
Purge VSV
(Closed)
Fuel Vapor-containment Valve
(Open)
(Closed)
Fuel Vapor-containment Valve (Stuck Closed, P2451)
Fuel Tank Pressure Sensor
Atmospheric Pressure (0 kPa)
P1423
Atmospheric Pressure (0 kPa)
Canister Pressure Sensor at Leak Detection Pump
P1422
0.02 in. Pressure
Fuel Tank Leak Check
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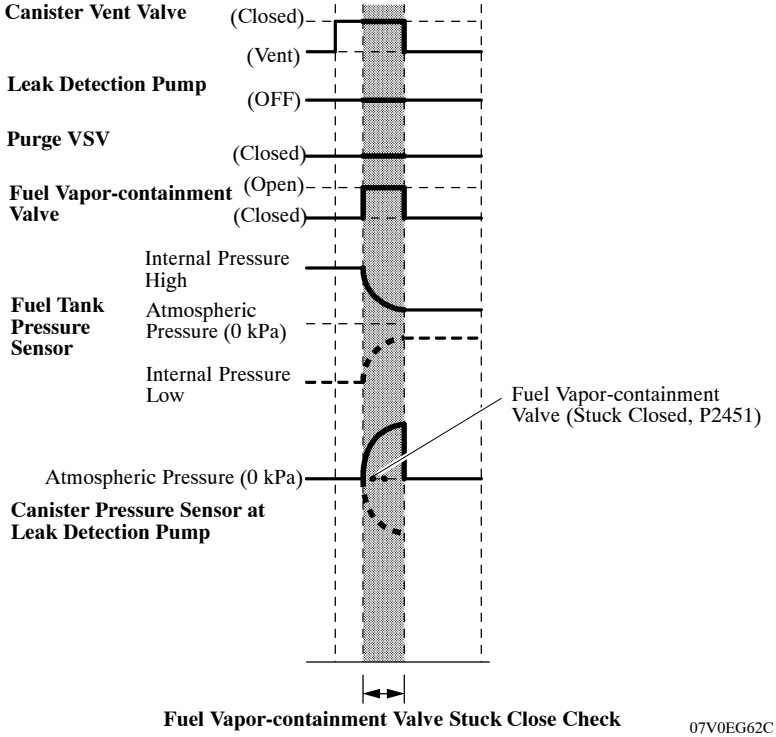
ii) When Fuel Tank Internal Pressure is Higher or Lower than Atmospheric Pressure

If the internal pressure in the fuel tank assembly is high or low, the hybrid vehicle control ECU determines that there is no leak in the fuel tank assembly. Thus, it is only necessary to determine if the fuel vapor-containment valve is stuck closed, without performing a fuel tank leak check.

1) With the leak detection pump stopped, the hybrid vehicle control ECU turns the fuel vapor-containment valve ON (the valve opens) to introduce the internal pressure of the fuel tank assembly into the pipes and the charcoal canister assembly.
2) The hybrid vehicle control ECU measures the atmospheric pressure through the signals provided by the canister pressure sensor.
3) If the value detected by the canister pressure sensor stays within a specified range, the hybrid vehicle control ECU determines that the fuel vapor-containment valve is stuck closed and it will store DTC P2451 in memory.



07V0EG50C



Fuel Vapor-containment Valve Stuck Close Check

07V0EG62C

13. Diagnosis

- When the hybrid vehicle control ECU detects a malfunction, the hybrid vehicle control ECU stores the fault and information that relates to the fault. Furthermore, the hybrid vehicle control ECU illuminates the MIL (Malfunction Indicator Lamp) in the combination meter assembly to inform the driver.
- The hybrid vehicle control ECU will also store the DTCs (Diagnostic Trouble Codes) of the malfunctions. The DTCs can be accessed using Techstream.
- For details, see the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).

Service Tip

- The hybrid vehicle control ECU uses the CAN protocol for diagnostic communication. Therefore, Techstream is required for accessing diagnostic data. For details, see the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).
- To clear a DTC that is stored in the hybrid vehicle control ECU, use Techstream, disconnect the battery terminal or remove the EFI No.1 fuse for 1 minute or longer.

14. Fail-safe

When a malfunction is detected at any of the sensors, there is a possibility of an engine or other malfunction occurring if the hybrid vehicle control ECU were to continue to control the engine control system in the normal way. To prevent such a problem, the fail-safe function of the hybrid vehicle control ECU 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 of the fail-safe chart, see the 2008 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).