■ ENGINE CONTROL SYSTEM

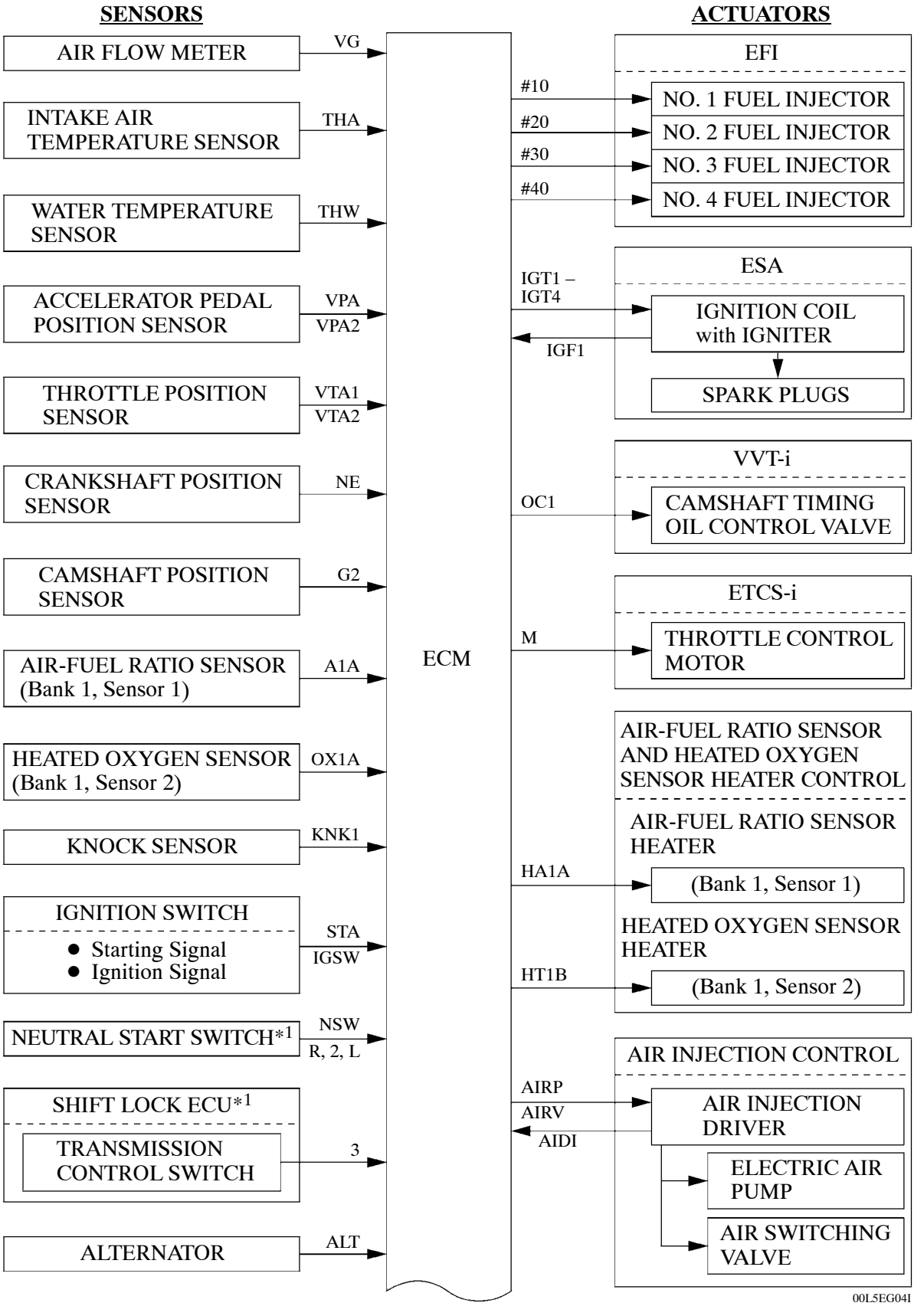
1. General

The following engine control systems of the 2TR-FBE engine have been changed from the 2TR-FE engine to allow the use of alcohol fuel:

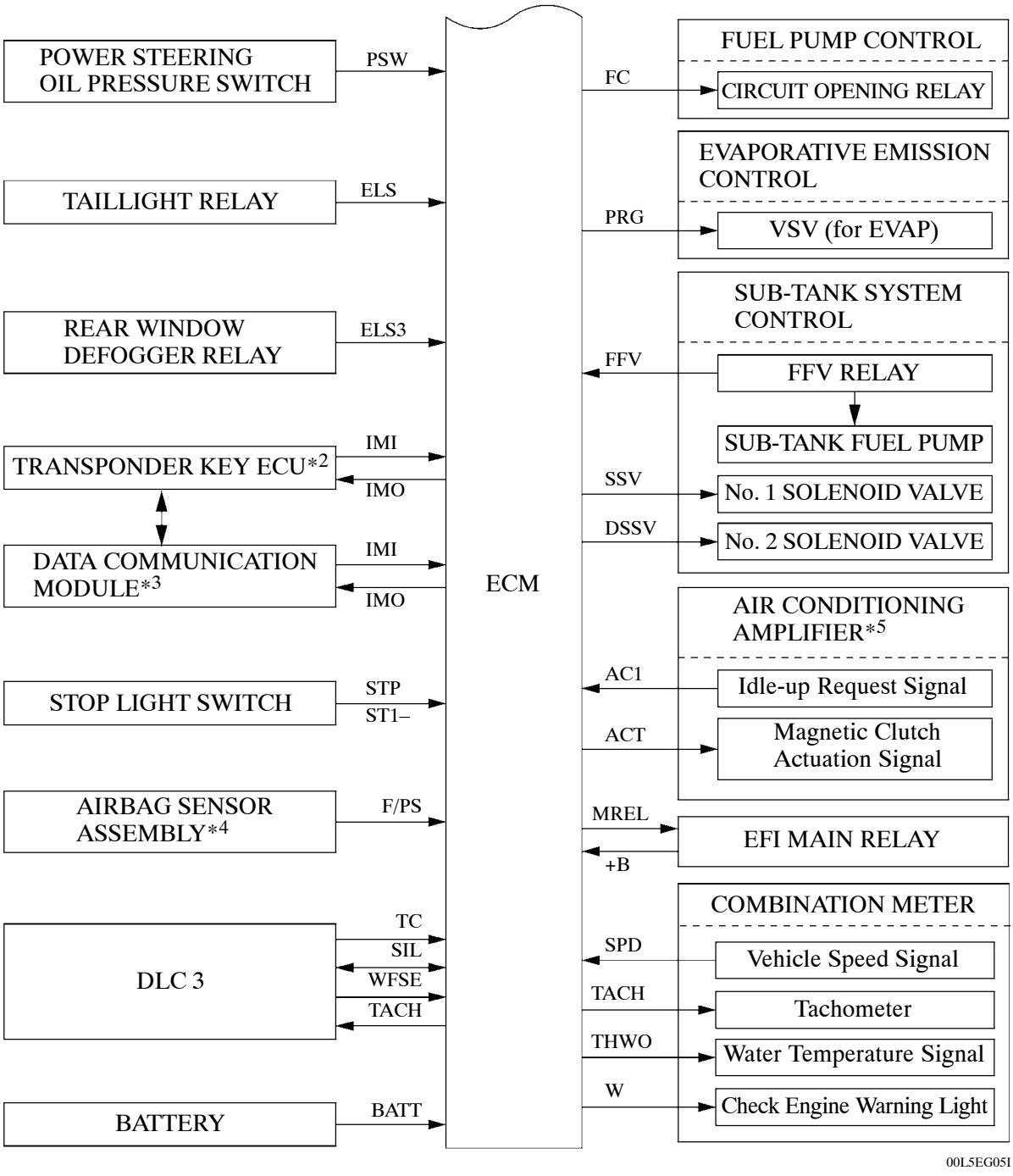
System	Outline	2TR-FBE	2TR-FE
EFI [Electronic Fuel Injection] (See page EG-80)	● An L-type EFI system directly detects the intake air mass with a hot wire type air flow meter. ● The fuel injection system is a sequential multiport fuel injection system. ● Fuel injection takes two forms: ● Synchronous injection, which always takes place with the same timing in accordance with the basic injection duration and an additional correction based on the signals provided by the sensors. ● Non-synchronous injection, which takes place at the time an injection request based on the signals provided by the sensors is detected, regardless of the crankshaft position. ● Synchronous injection is further divided into group injection during a cold start, and independent injection after the engine is started.	○	○
	Injection volume correction is performed depending on the ethanol concentration of the fuel in the fuel tank.	○	—
ESA [Electronic Spark Advance] (See page EG-82)	● 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 (IGT) ignition signal to the igniter.	○	○
	Ignition timing correction is performed depending on the ethanol concentration of the fuel in the fuel tank.	○	—
Sub-tank System Control (See page EG-83)	Injects the fuel which is in the fuel sub-tank during cold engine starting when the ethanol concentration of the fuel in the fuel main tank is high, and assists engine starting.	○	—

2. Construction

The configuration of the engine control system in the 2TR-FBE engine is as shown in the following chart:

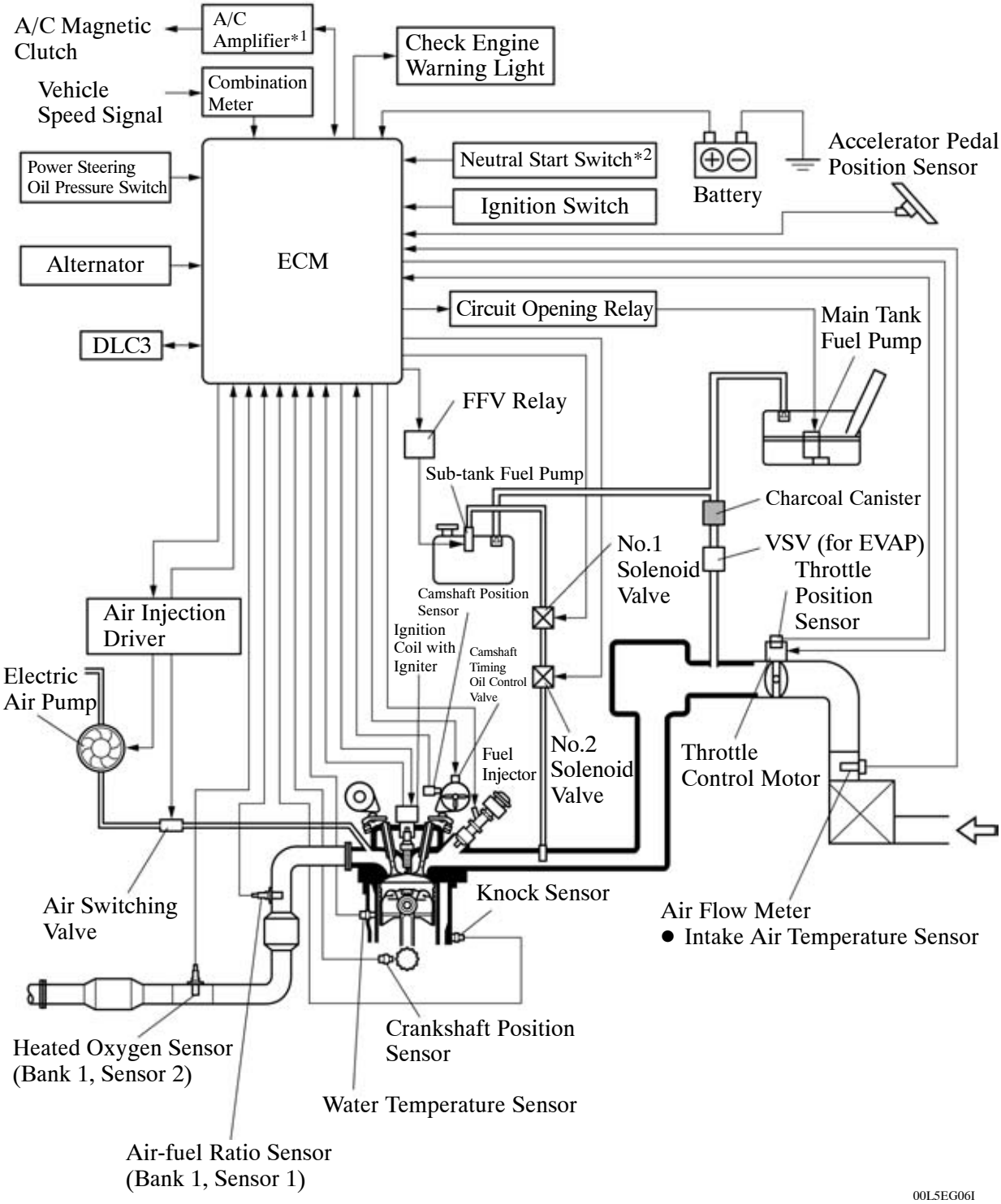


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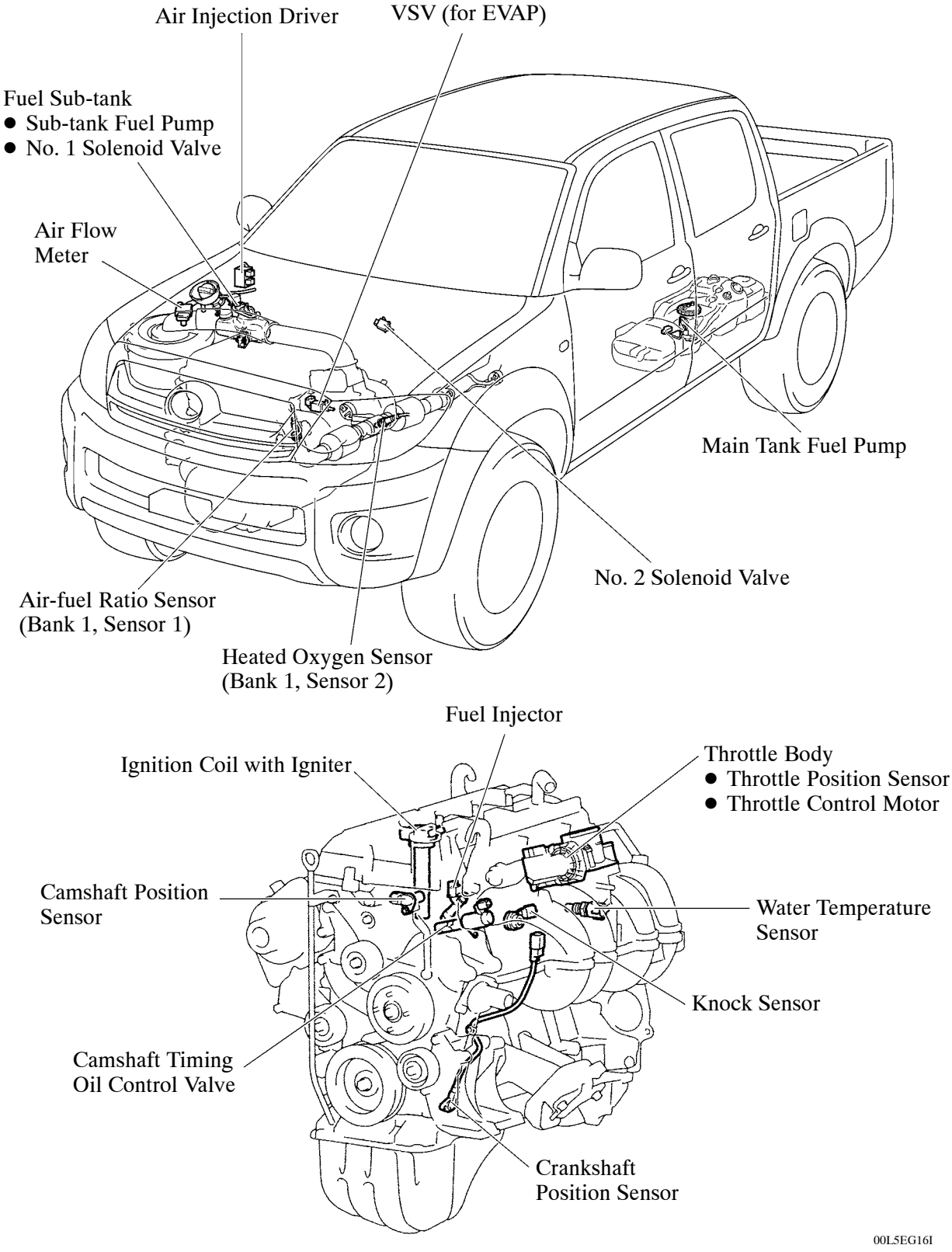
*1: Models with automatic transmission
*2: Models with engine immobiliser system
*3: Models with blocking system
*4: Models with SRS airbag system
*5: Models with air conditioning system

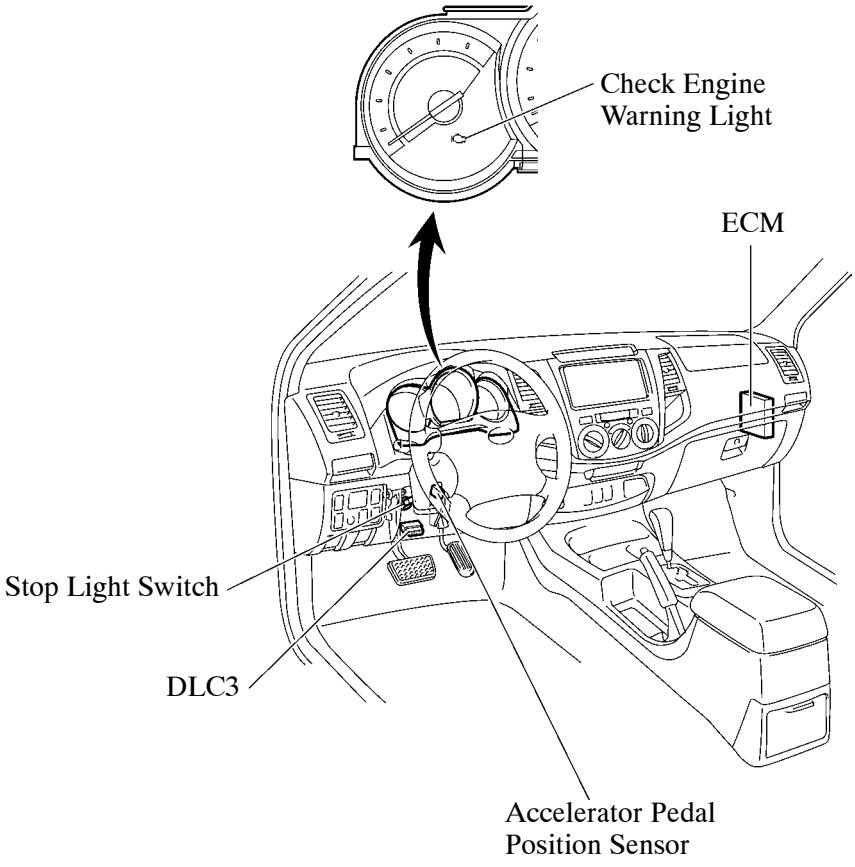
3. Engine Control System Diagram



*1: Models with air conditioning system
*2: Models with automatic transmission

4. Layout of Main Components

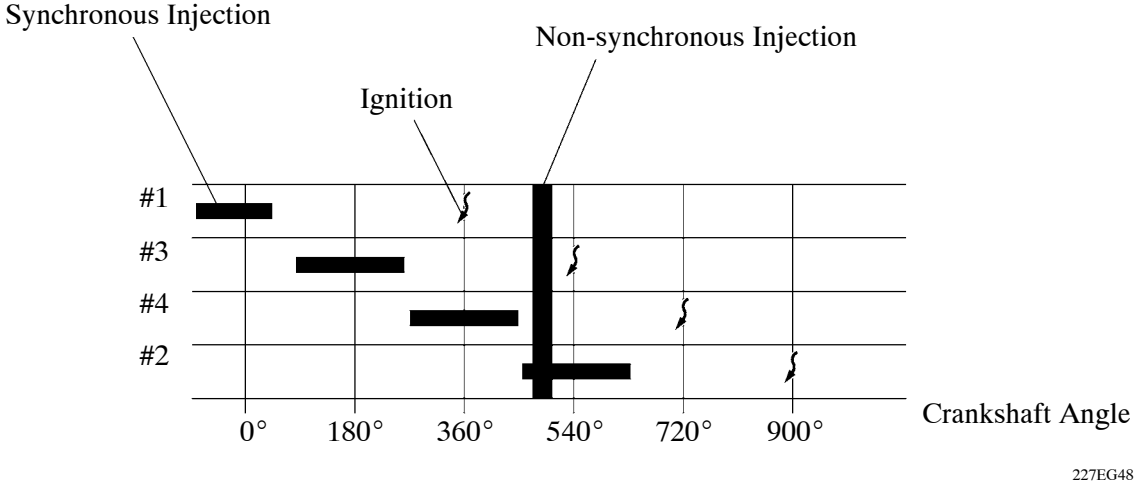



Check Engine
Warning Light
ECM
Stop Light Switch
DLC3
Accelerator Pedal
Position Sensor
00L5EG24I

5. EFI (Electronic Fuel Injection) System

General

- An L-type EFI system directly detects the intake air mass with a hot wire type air flow meter.
- An independent injection system (in which fuel is injected once into each cylinder for each two revolutions of the crankshaft) is used.
- There are two types of injections (synchronous and non-synchronous):
  a) The synchronous injection, in which corrections based on the signals from the sensors are added to the basic injection time, so that injection always occurs at the same position.
  b) The non-synchronous injection, in which injection is effected by detecting the requests from the signals of the sensors regardless of the crankshaft angle.
- This system performs group injection when the water temperature is extremely low and the engine speed is low.



— Change From 2TR-FE Engine —

Injection volume correction which is performed depending on the ethanol concentration of the fuel in the fuel main tank is added to the conventional controls.

Injection Volume Correction Depending on Ethanol Concentration in Fuel

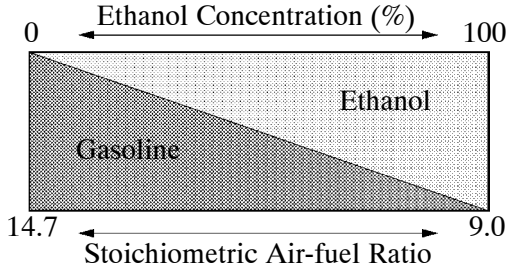
1) General

When ethanol concentration in fuel changes, the stoichiometric air-fuel ratio also changes. Therefore, injection volume correction is performed depending on the ethanol concentration of the fuel to ensure starting performance and driveability at various ethanol concentrations.

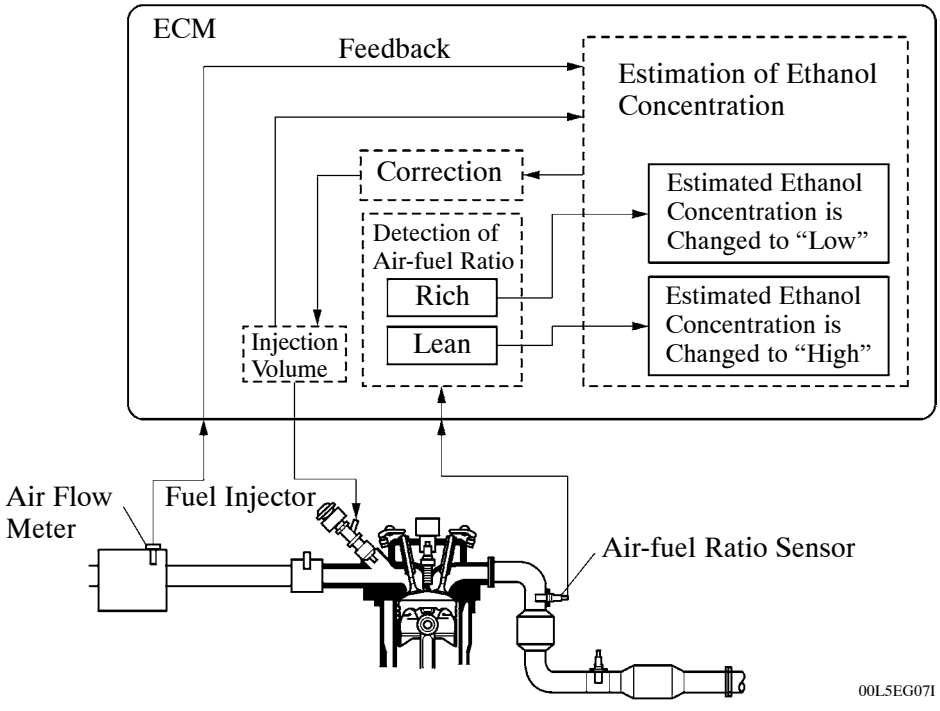
2) Operation

The stoichiometric air-fuel ratio for the gasoline engine vehicle is basically constant. On the other hand, the stoichiometric air-fuel ratio for the FFV (Flexible Fuel Vehicle) changes depending on the ethanol concentration of the fuel.
The stoichiometric air-fuel ratio for the FFV increases when the ethanol concentration of the fuel is low, and decreases when ethanol concentration of the fuel is high.
The ECM calculates the stoichiometric air-fuel ratio of the fuel in the fuel main tank based on the intake air mass, the signal from the air-fuel ratio sensor, and the feedback value of the injection volume. Then, the ECM compares the calculated stoichiometric air-fuel ratio of the fuel in the fuel main tank with that of gasoline, and estimates ethanol concentration of the fuel in the fuel main tank.
The estimated value of ethanol concentration is updated as necessary.
The ECM performs injection volume correction depending on the estimated ethanol concentration.

▶ Ethanol Concentration and Stoichiometric Air-fuel Ratio ◀



▶ System Diagram ◀



6. ESA (Electronic Spark Advance)

General

Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.

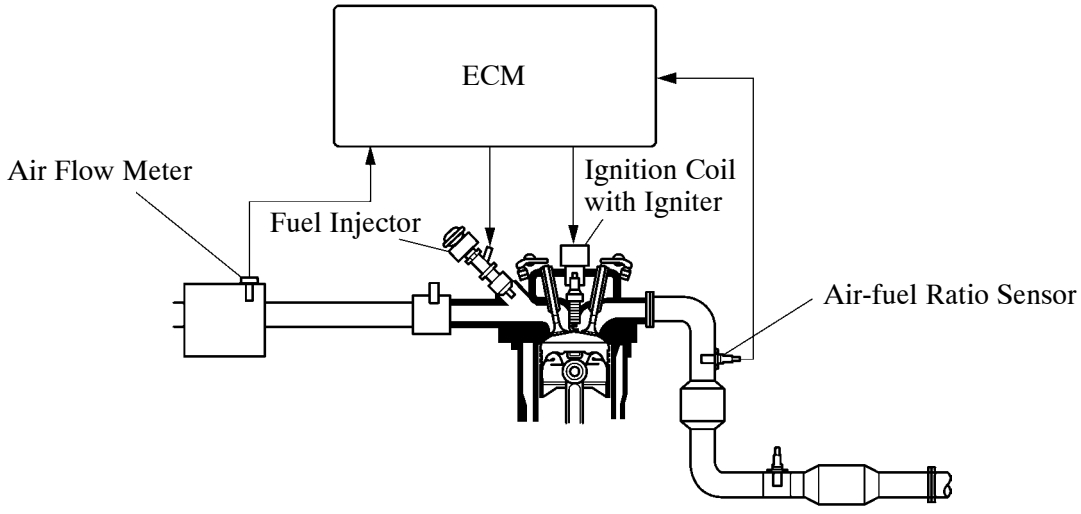
— Change From 2TR-FE Engine —

Ignition timing correction which is performed depending on the ethanol concentration of the fuel in the fuel main tank is added to the conventional controls.

Ignition Timing Correction Depending on Ethanol Concentration in Fuel

The ECM performs the correction to make optimum ignition timing based on the estimated ethanol concentration of the fuel in the fuel main tank. As a result, starting performance and driveability at various ethanol concentrations of the fuel in the fuel main tank are ensured. For details of estimation of ethanol concentration of the fuel in the main fuel tank, see page EG-81.

▶ System Diagram ◀



7. Sub-tank System Control

General

When the engine is cold and the ethanol concentration of the fuel in the fuel main tank is high, the evaporation of fuel becomes difficult. As a result, the engine may not start or be difficult to start only with fuel injection by the fuel injectors. Therefore, the sub-tank system control operates to inject fuel (E22) in the fuel sub-tank depending on the ethanol concentration of the fuel in the fuel main tank during cold engine starting, thus assisting engine starting and ensuring driveability immediately after the engine starts.

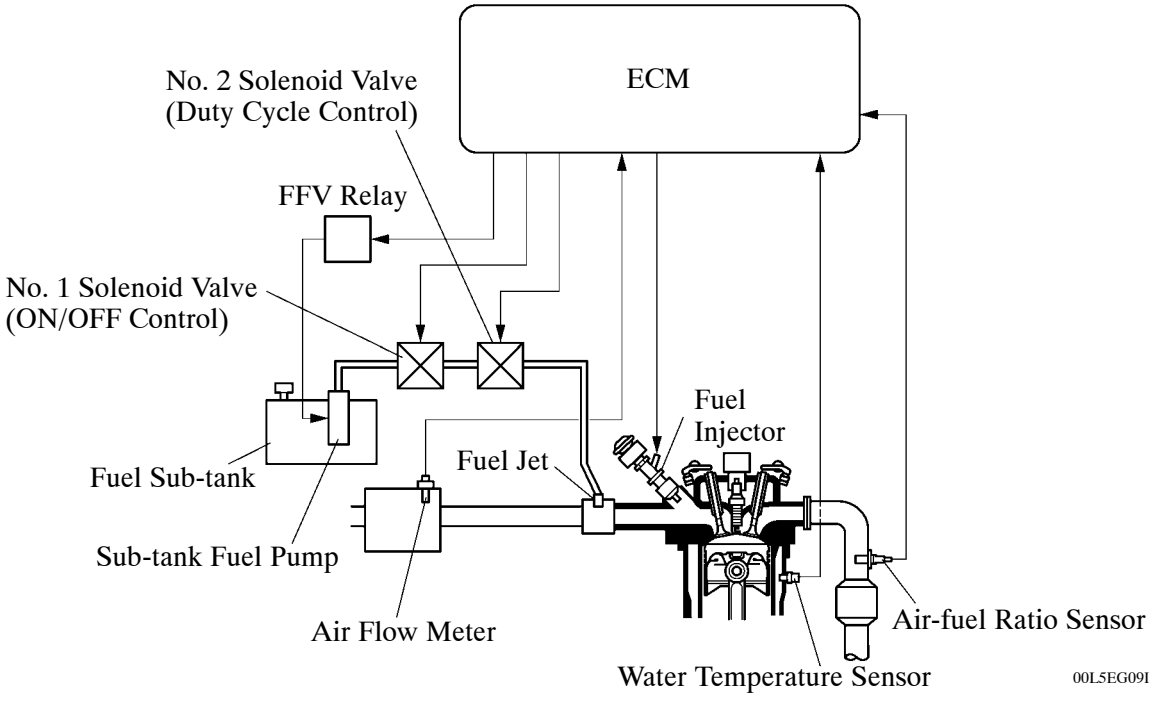
Construction

This system consists of the ECM, FFV relay, fuel sub-tank, sub-tank fuel pump, No. 1 solenoid valve, No. 2 solenoid valve, air-fuel ratio sensor, and water temperature sensor.

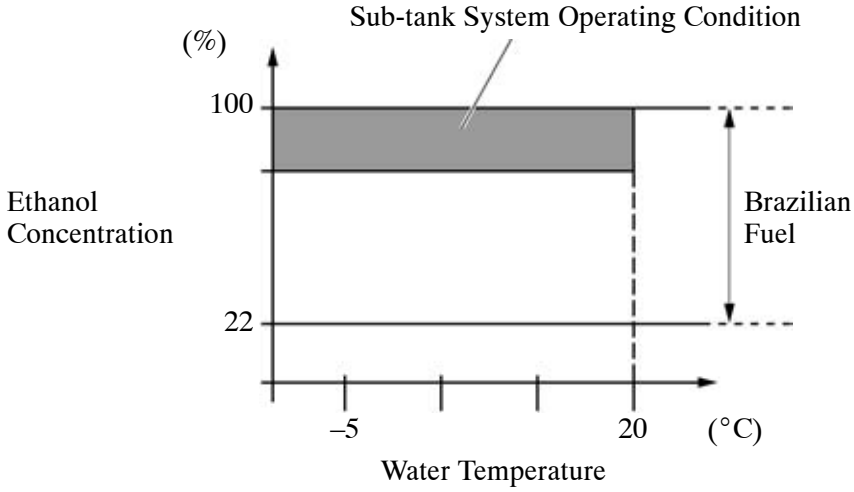
Operation

- The ECM estimates the ethanol concentration of the fuel in the fuel main tank based on signals from the air-fuel ratio sensor. For details of estimation of ethanol concentration, see page EG-81.
  When the engine is stopped, the ECM stores the ethanol concentration in the memory.
  When the engine is started, the ECM actuates the sub-tank fuel pump and solenoid valves depending on the water temperature and ethanol concentration in the memory to inject the fuel which is in the fuel sub-tank to the intake ports.
- Injection volume is determined based on water temperature and ethanol concentration of the fuel in the fuel main tank.
- Two solenoid valves are used for safety: the No. 1 solenoid valve is used for fuel cut-off for the fuel sub-tank; the No. 2 solenoid valve is used for fuel cut-off and injection volume control for the fuel sub-tank. The No. 1 solenoid valve is operated by ON/OFF control, and the No. 2 solenoid valve is operated by duty cycle control.

▶ System Diagram ◀



▶ Sub-tank System Operating Condition ◀



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