13. Engine Control System

General

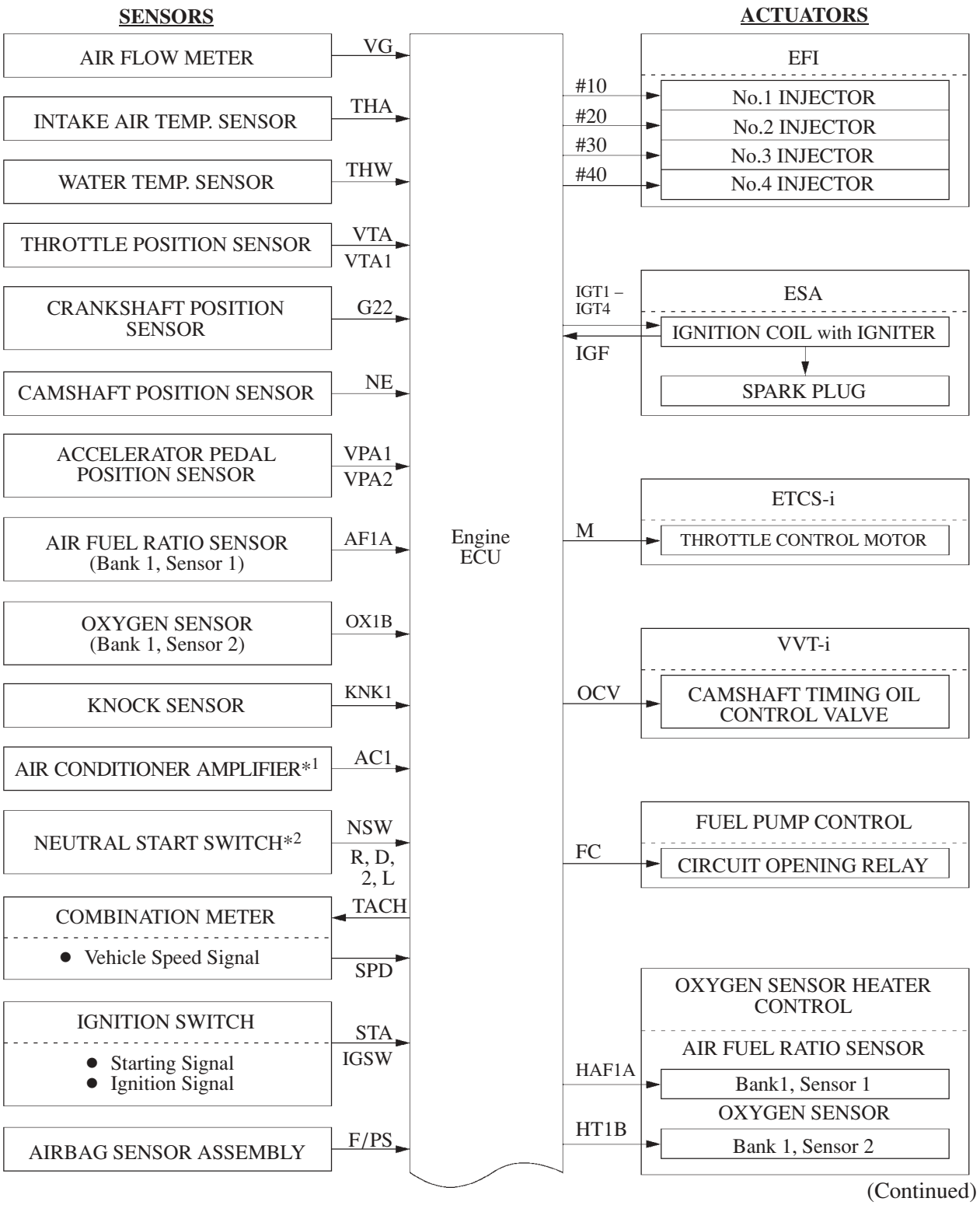
The engine control system of the 2AZ-FE engine has following system.

System	Outline
EFI (Electronic Fuel Injection)	An L-type EFI system directly detects the intake air mass with a hot wire type air flow meter.
ESA (Electronic Spark Advance)	Ignition timing is determined by the engine ECU based on signals from various sensors. The engine ECU corrects ignition timing in response to engine knocking.
ETCS-i (Electronic Throttle Control System-intelligent) (See page 478)	● Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the condition of the engine and the vehicle. ● A link-less type is used, without an accelerator cable. ● A linear type accelerator pedal position sensor is provided on the accelerator pedal. ● A no-contact type throttle position sensor is used. ● Controls the fast idle and idle speed.
VVT-i (Variable Valve Timing-intelligent) (See page 479)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.
Air Fuel Ratio Sensor and Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Air Conditioner Cut-off Control*1	By turning the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.
Cooling Fan Control (See page 480)	Radiator cooling fan operation is controlled by water temperature sensor signal (THW) and the condition of the air conditioner operation.
Fuel Pump Control	Fuel pump operation is controlled by signal from the engine ECU.
	A fuel cut control is adopted to stop the fuel pump when any airbag is deployed during front or side collision.
Evaporative Emission Control	The engine ECU controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.
Engine Immobilizer*2	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.
	The ID code stored in the transponder key ECU is compared with that of the transponder tip in the ignition key.
Diagnosis (See page 480)	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.
	All the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes.
Fail-Safe (See page 481)	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.

*1: With Air Conditioner Model
*2: With Engine Immobilizer Model

Construction

The configuration of the engine control system in the 2AZ-FE engine in the new RAV4 is as shown in the following chart.



(Continued)

*1: With Air Conditioner

*2: Only for Automatic Transaxle

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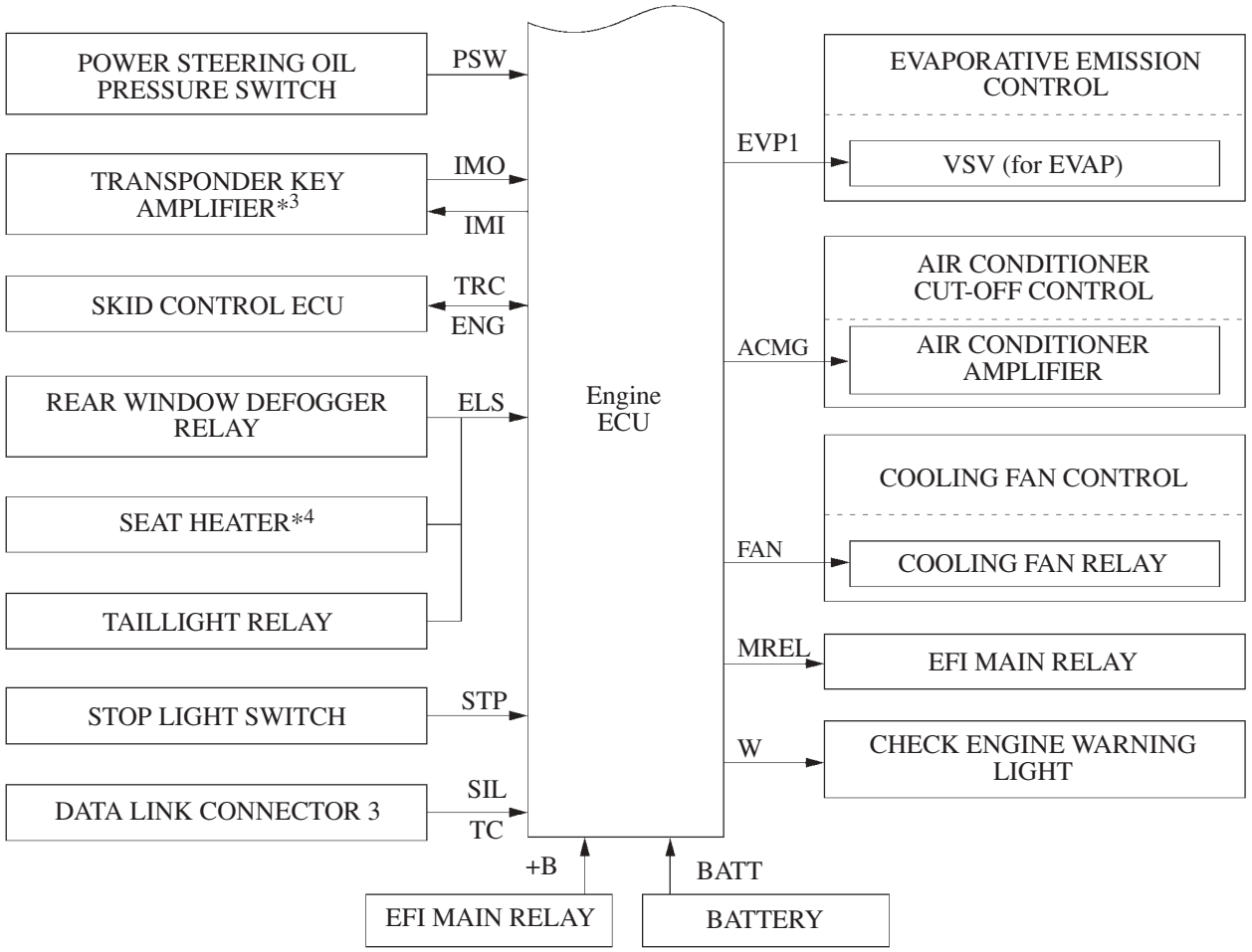

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*3: With Engine Immobilizer
*4: With Seat Heater

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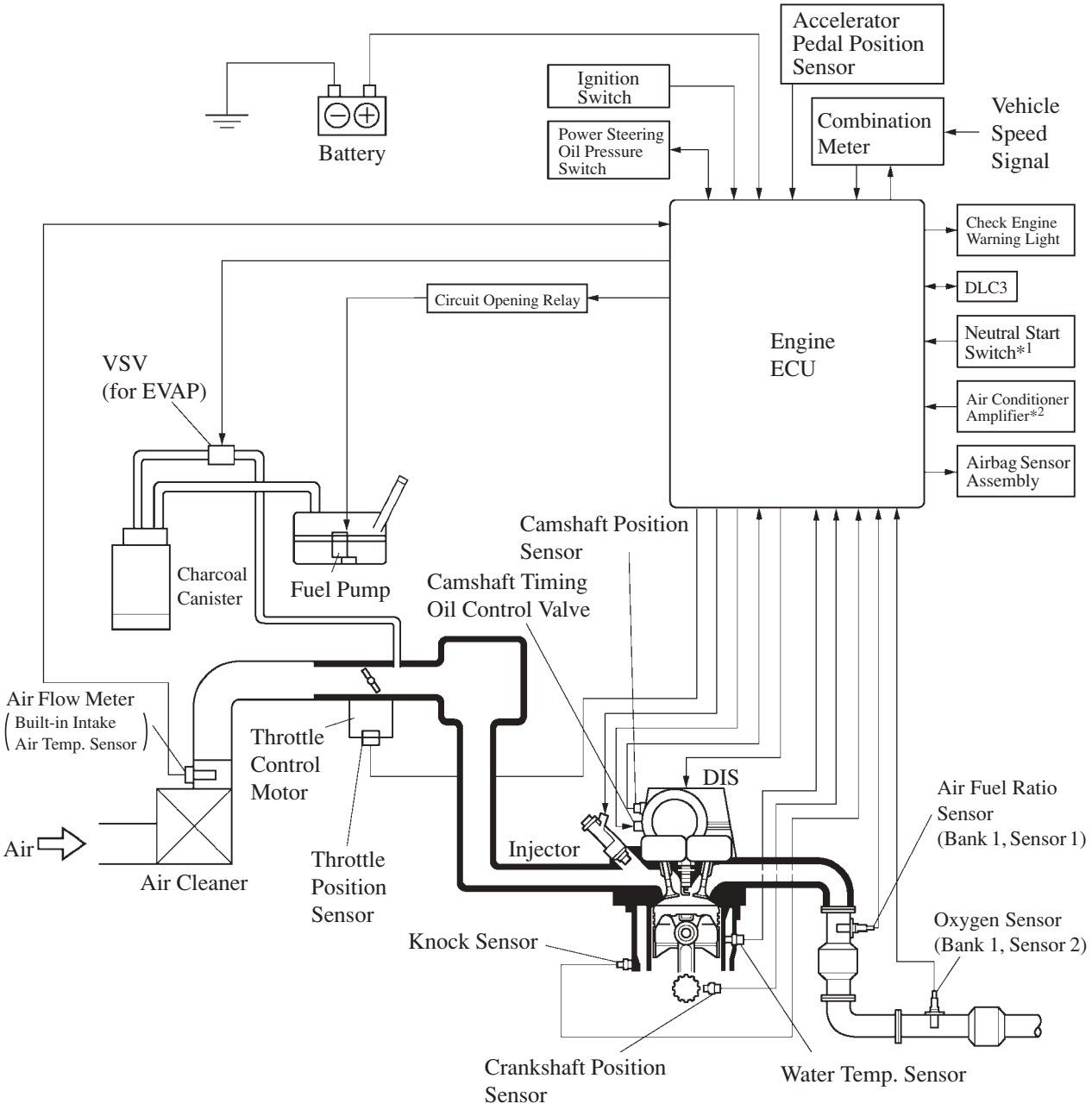
Engine Control System Diagram



*1: Only for Automatic Transaxle
*2: With Air Conditioner

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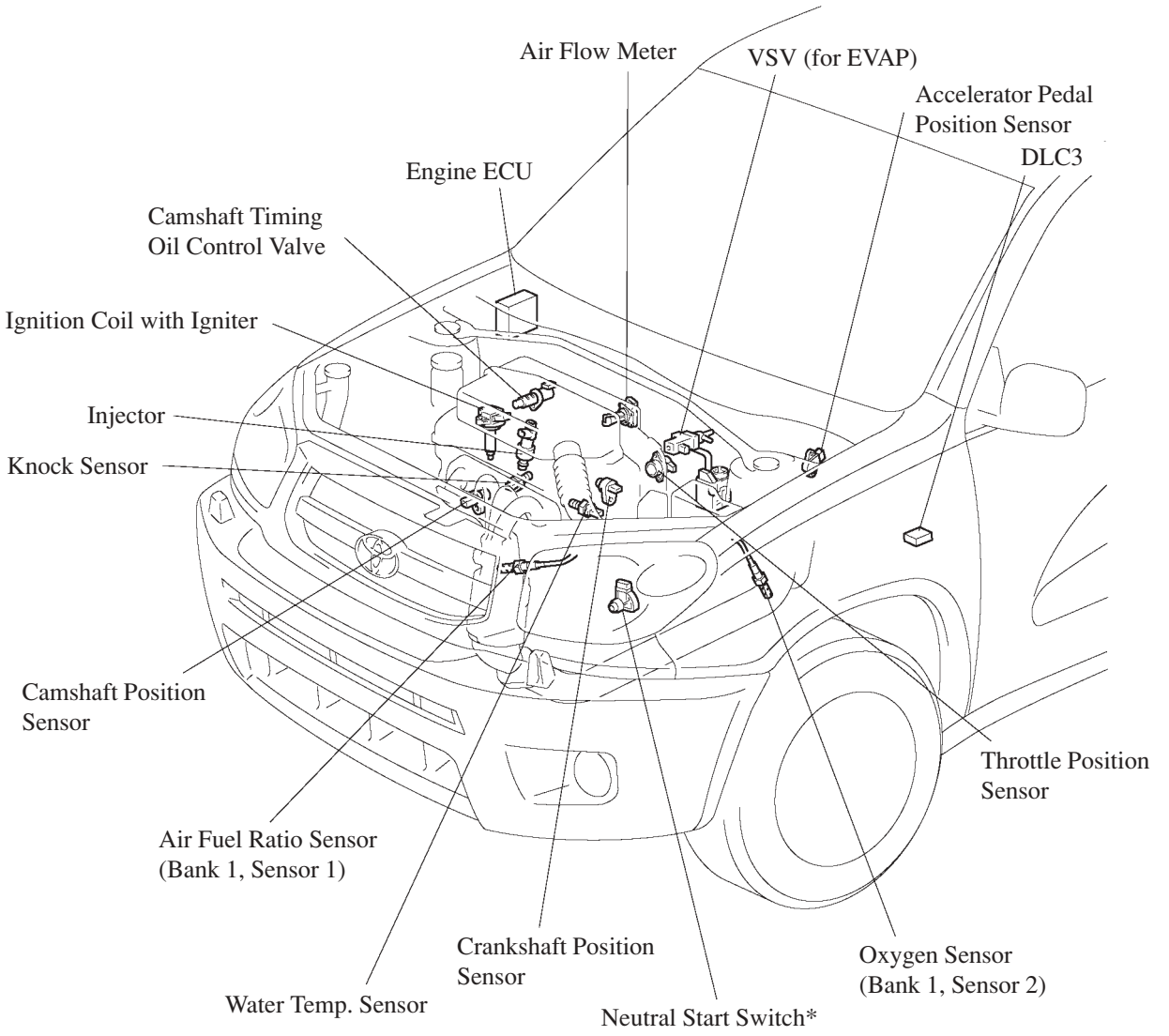
Layout of Main Components



*: Only for Automatic Transaxle

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Main Components of Engine Control System

1) General

The following table shows the main components.

Components	Outline	Quantity
Engine ECU	32-bit CPU	1
Air Fuel Ratio Sensor (Bank 1, Sensor 1)	with Heater Type (Planar Type)	1
Oxygen Sensor (Bank 1, Sensor 2)	with Heater Type (Cup type)	1
Air Flow Meter	Hot-wire Type	1
Crankshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (36-2)	1
Camshaft position Sensor (Rotor Teeth)	Pick-up Coil Type (3)	1
Knock Sensor	Built-in Piezoelectric Element Type (Flat Type)	1
Accelerator Pedal Position Sensor	Linear Type	1
Throttle Position Sensor	No-contact Type	1

2) Air fuel ratio sensor (Planar type)

The same air fuel ratio sensor as in the 1AZ-FE engine has been adopted. For details, see page 432.

3) Knock Sensor (Flat type)

The same knock sensor as in the 1AZ-FE engine has been adopted. For details, see page 433.

4) Accelerator pedal position sensor (Linear type)

The same accelerator pedal position sensor as in the 1AZ-FE engine has been adopted. For details, see page 436.

5) Throttle position sensor (no-contact type)

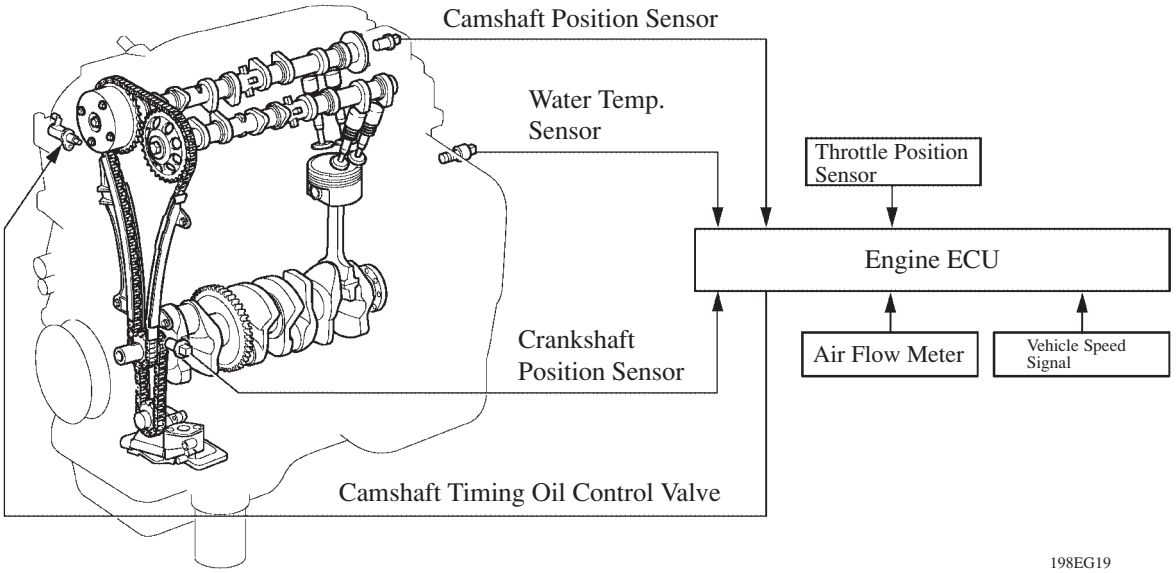
The same throttle position sensor as in the 1AZ-FE engine has been adopted. For details, see page 437.

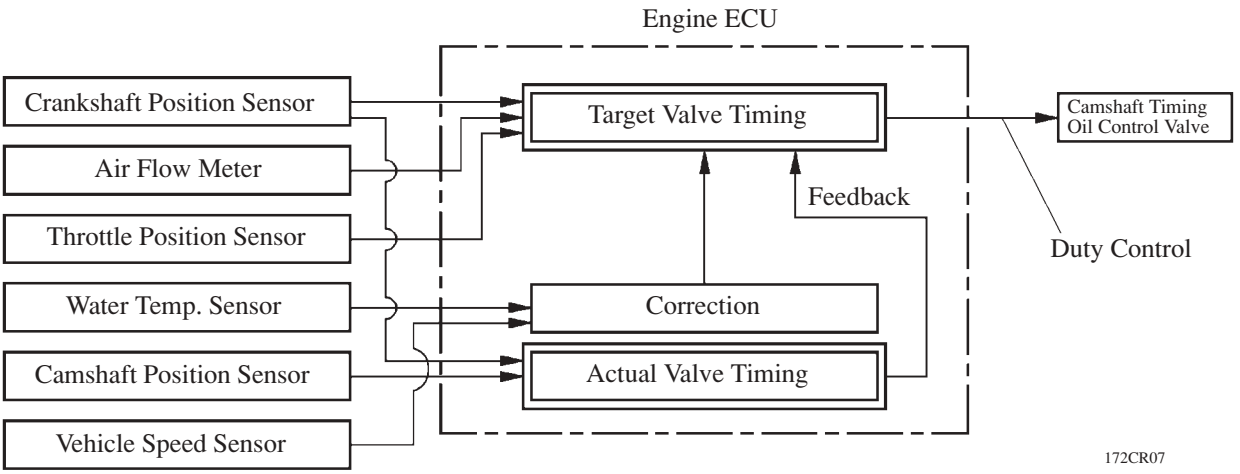
ETCS-i (Electronic Throttle Control System-intelligent)

The ETCS-i of the 2AZ-FE engine effects the same control as in the 1AZ-FE engine. For details, see page 438.

VVT-i (Variable Valve Timing-intelligent) System

The VVT-i system designed to control the intake camshaft within a wide range of 50° (of crankshaft angle) to provide a valve timing that is optimally suited to the engine condition, thus realizing improved torque in all the speed ranges and fuel economy, and reduce exhaust emission. The actual intake valve timing is feedback by means of the camshaft position sensor for constant control to the target valve timing.





Cooling Fan Control

The cooling fan control is the same as the control on the 1AZ-FE engine. For details, see page 443.

Purge VSV

The purge flow rate has been set to 60 liters per minute.

Diagnosis

When the engine ECU detects malfunction, the engine ECU makes a diagnosis and memorizes the failed section. Furthermore, check engine warning light in the combination meter illuminates or blinks to inform the driver. The engine ECU will also store the DTC (Diagnostic Trouble Code) of the malfunctions. The DTC can be read by connecting a hand-held tester (5-digit code). For detail, see page the 2AZ-FE Repair Manual Supplement (Pub No. RM1079E).
As a result of the adoption of the SAE controlled codes, the DTCs have been changed as described below.

▶ Diagnostic Trouble Code ◀

DTC No.	Detection Item	DTC No.	Detection Item
P0010	Camshaft Position “A” Actuator Circuit (Bank 1)	P0123	Throttle/Pedal Position Sensor/Switch “A” Circuit High Input
P0011	Camshaft position “A” – Timing Over-Advanced or System performance (Bank 1)	P0220	Throttle/Pedal Position Sensor/Switch “B” Circuit
P0012	Camshaft Position “A” – Timing Over-Retarded (Bank 1)	P0222	Throttle/Pedal Position Sensor/Switch “B” Circuit Low Input
P0016	Camshaft Position – Camshaft Position Correlation (Bank 1 Sensor A)	P0223	Throttle/Pedal Position Sensor/Switch “B” Circuit High Input
P0031	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 1)*	P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)
P0032	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 1)*	P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)
P0102	Mass or Volume Air Flow Circuit Low Input	P0339	Crankshaft Position Sensor “A” Circuit Intermittent
P0103	Mass or Volume Air Flow Circuit High Input	P0341	Camshaft Position Sensor “A” Circuit Range/performance (Bank 1 or Single Sensor)
P0112	Intake Air Temperature Circuit Low Input	P0351	Ignition Coil “A” Primary/Secondary Circuit
P0113	Intake Air Temperature Circuit High Input	P0352	Ignition Coil “B” Primary/Secondary Circuit
P0117	Water Temperature Circuit low Input	P0353	Ignition Coil “C” Primary/Secondary Circuit
P0118	Water Temperature Circuit High Input	P0354	Ignition Coil “D” Primary/Secondary Circuit
P0122	Throttle/Pedal Position Sensor/Switch “A” Circuit Low Input	P0504	Brake Switch “A”/“B” correlation

(Continued)

*: Although the title (DTC description) says “oxygen sensor”, this DTC is related to the “air fuel ratio sensor”.

DTC No.	Detection Item	DTC No.	Detection Item
P0604	Internal Control Module Random Access Memory (RAM) Error	P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input
P0606	ECU/PCM Processor	P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit
P0607	Control Module Performance	P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input
P0657	Actuator Supply Voltage Circuit/Open	P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input
P2102	Throttle Actuator Control Motor Circuit Low	P2135	Throttle Pedal Position Sensor/Switch "A"/"B" Voltage Correlation
P2103	Throttle Actuator Control Motor Circuit High	P2138	Throttle Pedal Position Sensor/Switch "D"/"E" Voltage Correlation
P2111	Throttle Actuator Control System – Stuck Open	P2237	Oxygen Sensor Pumping current Circuit/Open (for A/F sensor) (Bank 1 Sensor 1)
P2112	Throttle Actuator Control System – Stuck Closed	P2238	Oxygen Sensor Pumping current Circuit/Low (for A/F sensor) (Bank 1 Sensor 1)
P2118	Throttle Actuator Control Motor Current Range/Performance	P2239	Oxygen Sensor Pumping current Circuit/ High (for A/F sensor) (Bank 1 Sensor 1)
P2119	Throttle Actuator Control Throttle Body Range/Performance	P2251	Oxygen Sensor Reference Ground Circuit/ Open (for A/F sensor) (Bank 1 Sensor 1)
P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit	P2252	Oxygen Sensor Reference Ground Circuit Low (for A/F sensor) (Bank 1 Sensor 1)
P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance	P2253	Oxygen Sensor Reference Ground Circuit High (for A/F sensor) (Bank 1 Sensor 1)
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	B2799	Engine Immobilizer System Malfunction

*: Although the title(DTC description) says "oxygen sensor", this DTC is related to the "air fuel ratio sensor".

Fail-Safe

When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in memory. The fail-safe control list and the actual fail-safe control are the same as on the 1AZ-FE engine. For details, see page 446.