

PERFORMANCE

Power Train

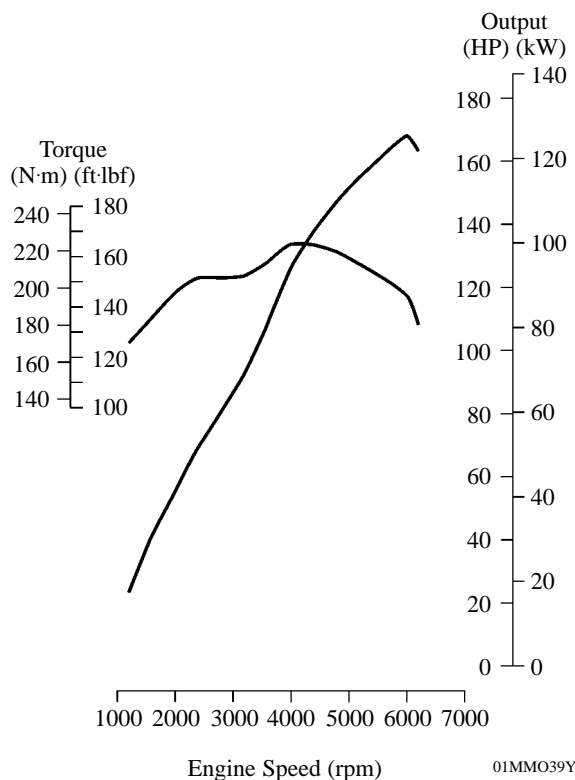
Engine

- The 2AZ-FE engine has been carried over from the '05 model. This engine realizes high performance, quietness, fuel economy, and clean emissions through the use of the VVT-i (Variable Valve Timing-intelligent) system, DIS (Direct Ignition System), and ETCS-i (Electronic Throttle Control System-intelligent).
- A new 2GR-FE engine is used. It realizes high performance, quietness, fuel economy, and clean emission through the use of the Dual VVT-i (Dual Variable Valve Timing-intelligent) system, DIS, and ETCS-i.

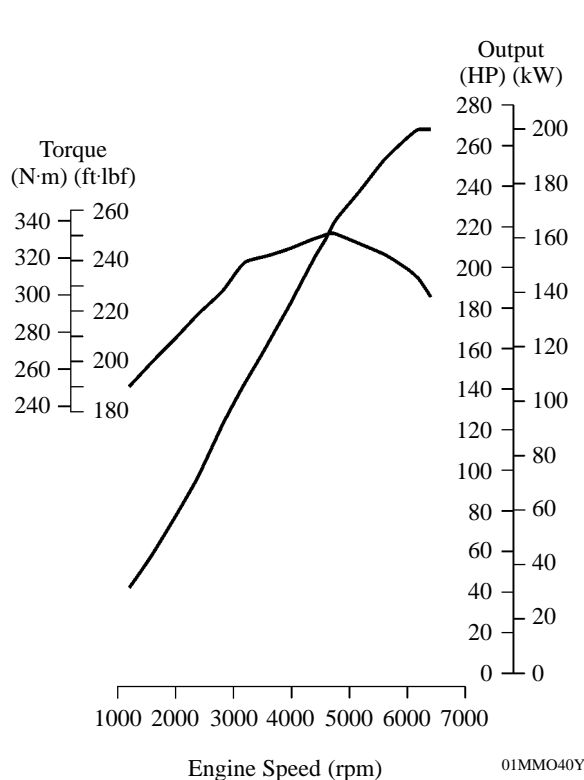
Engine Type	2AZ-FE	2GR-FE
No. of Cyls. & Arrangement	4-cylinder, In-line Type	6-cylinder, V Type
Valve Mechanism	16-valve DOHC, Chain Drive (with VVT-i)	24-valve DOHC, Chain Drive (with Dual VVT-i)
Displacement cm ³ (cu. in.)	2362 (144.2)	3456 (210.9)
Bore x Stroke mm (in.)	88.5 x 96.0 (3.48 x 3.78)	94.0 x 83.0 (3.70 x 3.27)
Compression Ratio	9.8 : 1	10.8 : 1
Maximum Output [SAE-NET]*	124 kW @ 6000 rpm (166 HP @ 6000 rpm)	200 kW @ 6200 rpm (268 HP @ 6200 rpm)
Maximum Torque [SAE-NET]*	224 N·m @ 4000 rpm (165 ft·lbf @ 4000 rpm)	336 N·m @ 4700 rpm (248 ft·lbf @ 4700 rpm)

*: Maximum output and torque rating are determined by revised SAE J1349 standard.

► 2AZ-FE Engine ◀



► 2GR-FE Engine ◀



Transaxle

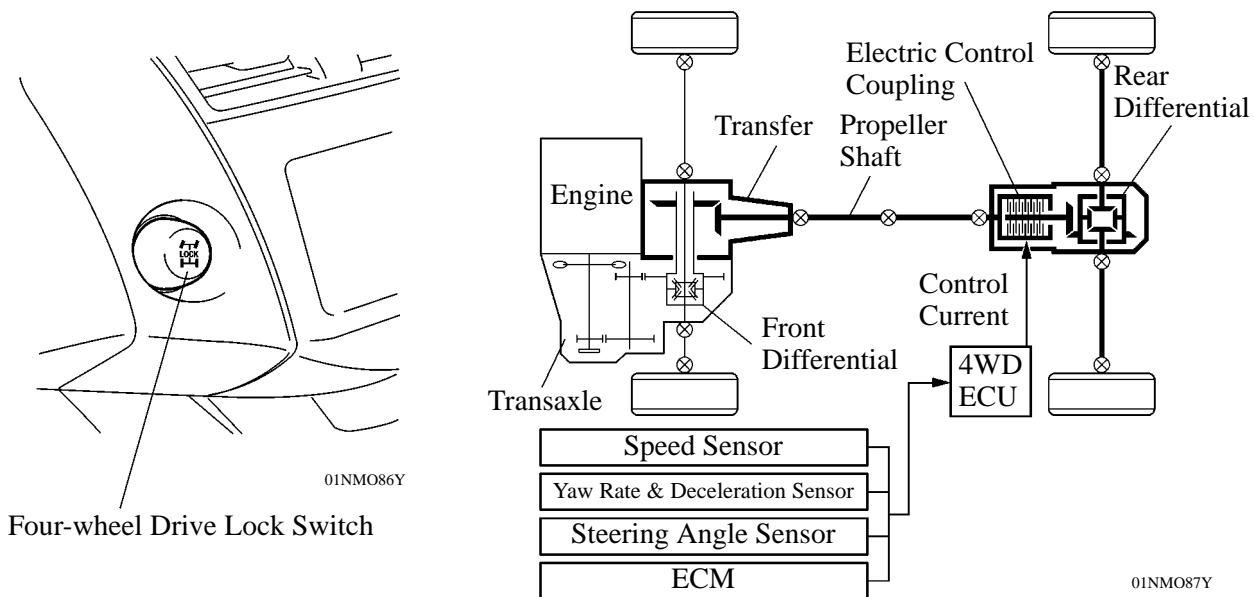
- The U140F and U241E 4-speed automatic transaxles have been carried over from the '05 model.
- New U151E and U151F 5-speed automatic transaxles are used.
- A new GF1A transfer is used.

Transaxle Type		4-speed Automatic		5-speed Automatic	
		U140F	U241E	U151F	U151E
Transfer Type		GF1A	—	GF1A	—
Combination with Engine		2AZ-FE		2GR-FE	
Drive Type		4WD	2WD	4WD	2WD
Gear Ratio*	1st	3.938	3.943	4.235	←
	2nd	2.194	2.197	2.360	←
	3rd	1.411	1.413	1.517	←
	4th	1.019	1.020	1.047	←
	5th	—	—	0.756	←
	Reverse	3.141	3.145	3.378	←

*: Counter Gear Ratio Included

Active Torque Control 4WD System

- A new active torque control 4WD system with an electric control coupling is used.
- The active torque control 4WD system, which has an electric control coupling in the front part of the rear differential, transmits torque to the rear wheels when needed, and only in the amount needed, based on information provided by various sensors.
- By operating the four-wheel drive lock switch provided on the instrument panel, the driver can select the following modes: the AUTO mode to optimally control the torque that is transmitted to the rear wheels, and the LOCK mode that locks the torque that is transmitted to the rear wheels to the maximum amount.



System Configuration Diagram

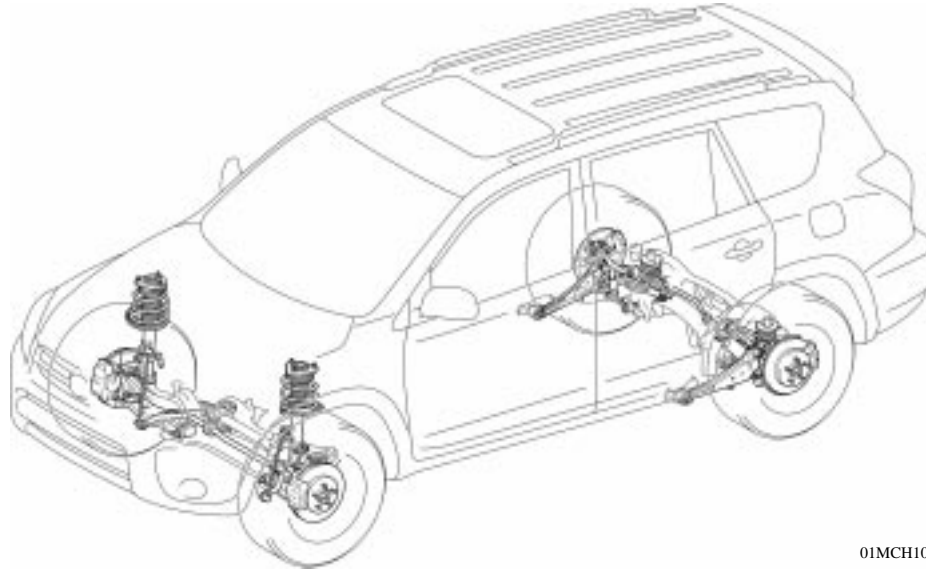
Chassis

Front Suspension

Type	MacPherson Strut Type Independent Suspension
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Rear Suspension

Type	Double Wishbone Type Independent Suspension
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01MCH100Y

Steering

Type	EPS (Electronic Power Steering)
Gear Type	Rack & Pinion

Brake

Front Brake Type	Ventilated Disc
Front Rotor Size	15 inch: 275 x 25 mm (10.82 x 0.87 in.)* ¹ 16 inch: 296 x 28 mm (11.84 x 1.10 in.)* ²
Rear Brake Type	Solid Disc
Rear Rotor Size	15 inch: 281 x 12 mm (11.24 x 0.48 in.)
Parking Brake Type	Lever Type
Brake Control	ABS (Anti-lock Brake System) with EBD (Electronic Brake force Distribution) & Brake Assist & TRAC (Traction Control) & Hill-start Assist Control* ³ & DAC (Downhill Assist Control)* ³ & VSC (Vehicle Stability Control)* ⁴

*¹: 2AZ-FE Engine Models with Rear No. 1 Seat Only

*²: 2GR-FE Engine Models and Models with Rear No. 2 Seat

*³: Standard Equipment on 2GR-FE Engine Models and Models with Rear No. 2 Seat

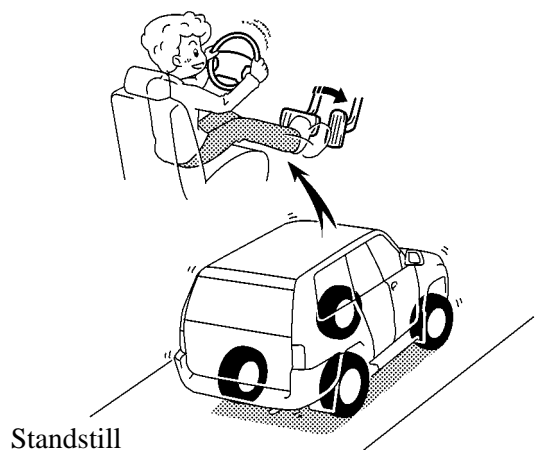
*⁴: 2WD models have been provided with Auto LSD (Limited Slip Differential).

Enhanced VSC System

- The enhanced VSC (Vehicle Stability Control) system is standard equipment on all models.
- In addition to the ABS, TRAC, and VSC controls provided by the conventional system, the enhanced VSC system effects cooperative control with the EPS (Electric Power Steering) and active torque control 4WD system in order to realize excellent driving stability and maneuverability.
- See CH-92 for details on the enhanced VSC system.

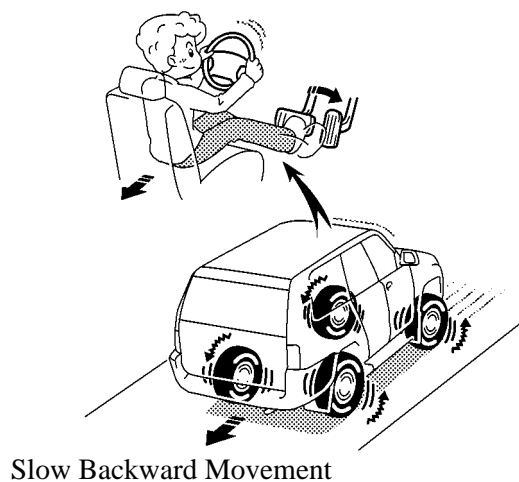
Hill-start Assist Control

- The hill-start assist control is standard equipment on the 2GR-FE engine models and the models with rear No. 2 seat.
- When the driver transfers his/her foot from the brake pedal to the accelerator pedal while starting off on an uphill, the hill-start assist control momentarily maintains the hydraulic pressure in the wheel cylinders of the four wheels, in order to prevent the vehicle from rolling backward.
- The hill-start assist control used on the '06 model effects control to prevent the vehicle from rolling backward. This control has evolved further from the hill-start assist control of the '05 model, which slowed the backward rolling of the vehicle while starting off on a hill.
- See CH-120 for details on the hill-start assist control.



'06 Model

01NMO88Y



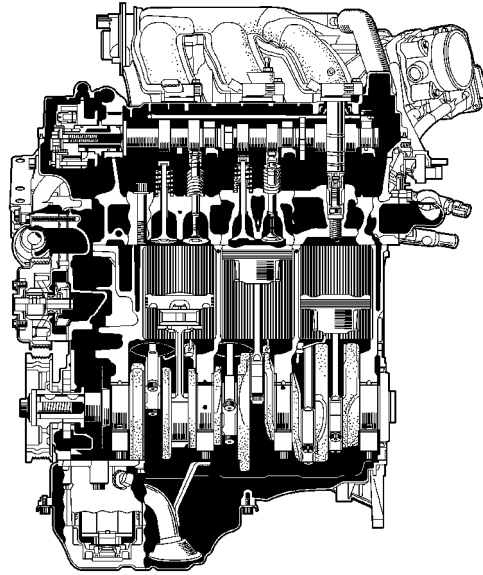
'05 Model

01NMO89Y

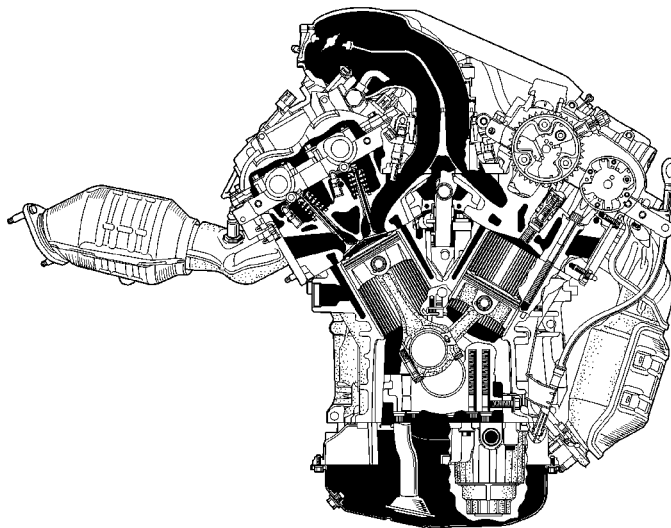
2GR-FE ENGINE

■ DESCRIPTION

The 2GR-FE engine on the '06 RAV4 is a newly developed, V6 3.5-liter, 24-valve DOHC engine. This engine uses the Dual VVT-i (Variable Valve Timing-intelligent) system, DIS (Direct Ignition System), ACIS (Acoustic Control Induction System), and ETCS-i (Electronic Throttle Control System-intelligent). These control functions achieve improved engine performance, fuel economy, and reduced exhaust emissions.



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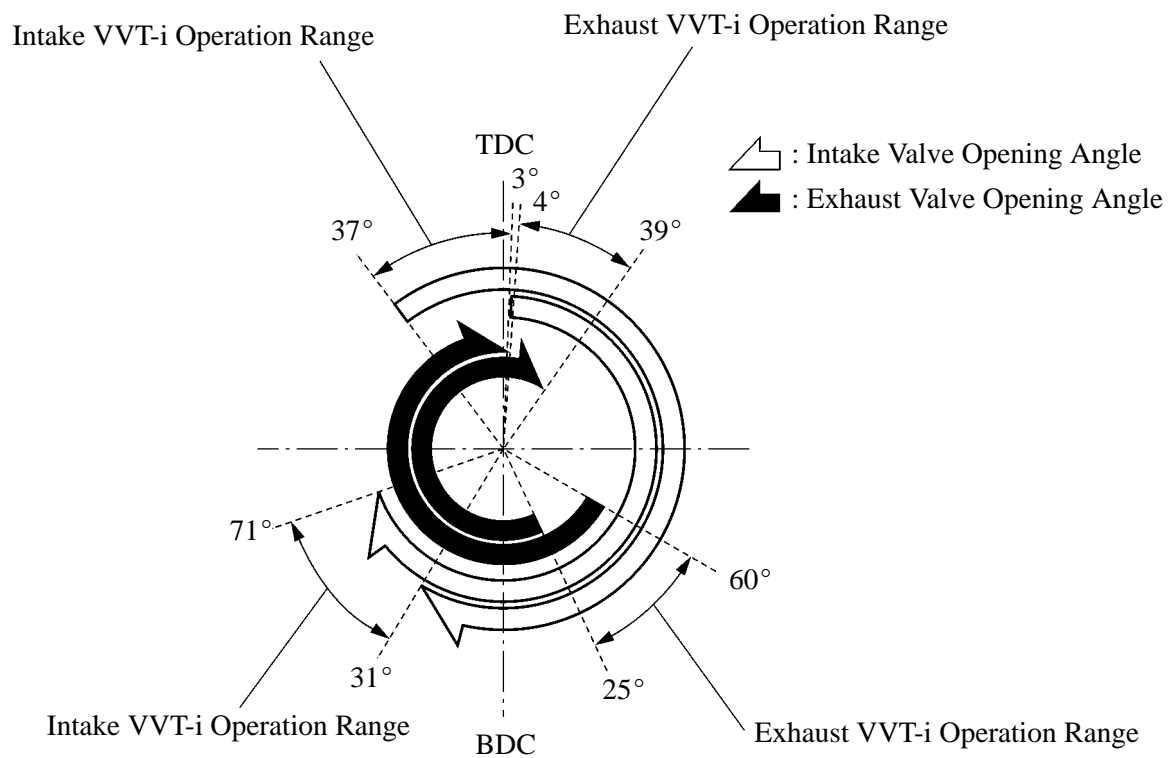
► Engine Specifications ◀

No. of Cyls. & Arrangement			6-cylinder, V Type
Valve Mechanism			24-valve DOHC, Chain Drive (with Dual VVT-i)
Combustion Chamber			Pentroof-type
Manifolds			Parallel-flow
Fuel System			SFI
Ignition System			DIS
Displacement		cm ³ (cu. in.)	3456 (210.9)
Bore x Stroke		mm (in.)	94.0 x 83.0 (3.70 x 3.27)
Compression Ratio			10.8 : 1
Max. Output (SAE-NET)* ¹			201 kW @ 6200 rpm (269 HP @ 6200 rpm)
Max. Torque (SAE-NET)* ¹			333 N·m @ 4700 rpm (247 ft·lbf @ 4700 rpm)
Valve Timing	Intake Valve	Open	- 3° to 37° BTDC
		Close	71° to 31° ABDC
	Exhaust Valve	Open	60° to 25° BBDC
		Close	4° to 39° ATDC
Firing Order			1 - 2 - 3 - 4 - 5 - 6
Octane Rating			91 or higher
Engine Oil Grade			ILSAC multigrade engine oil
Emission Regulation	Tailpipe	California	ULEVII, SFTP
		Except California	Tier2-Bin5, SFTP
	Evaporative		LEVII, ORVR
Engine Service Mass* ² (Reference)		kg (lb)	163 (359)

*¹: Maximum output and torque rating is determined by revised SAE J1349 standard.

*²: Weight shows the figure with the oil and engine coolant fully filled.

► Valve Timing ◀

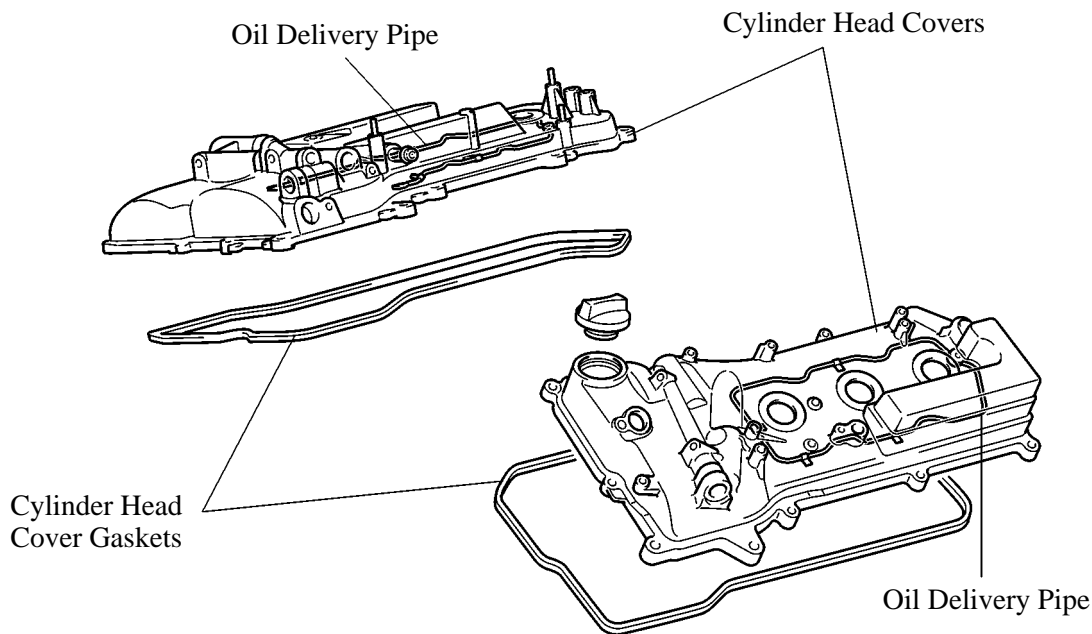


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ENGINE PROPER

1. Cylinder Head Cover

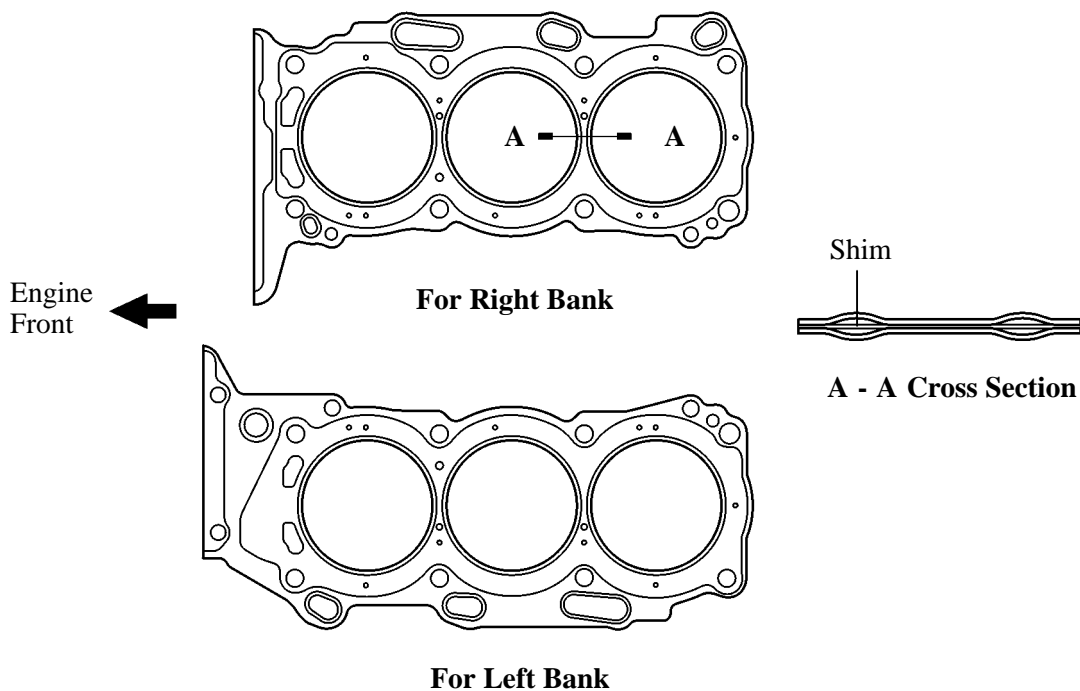
- Lightweight yet high-strength aluminum cylinder head covers are used.
- An oil delivery pipe is installed inside the cylinder head cover. This ensures lubrication to the sliding parts of the roller rocker arm, improving reliability.



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2. Cylinder Head Gasket

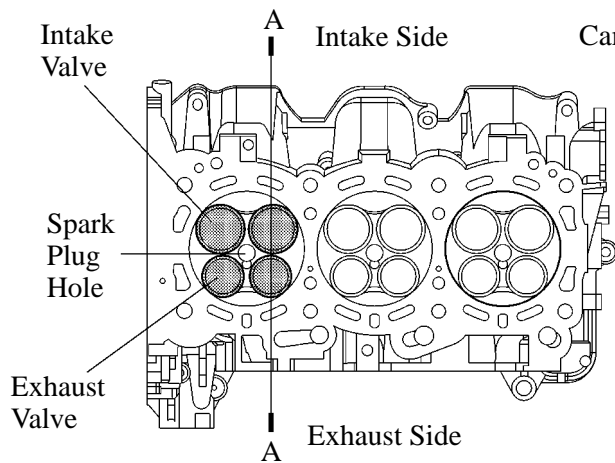
A steel-laminate type cylinder head gasket is used. A shim is used around the cylinder bore of the gasket to help enhance sealing performance and durability.



285EG06

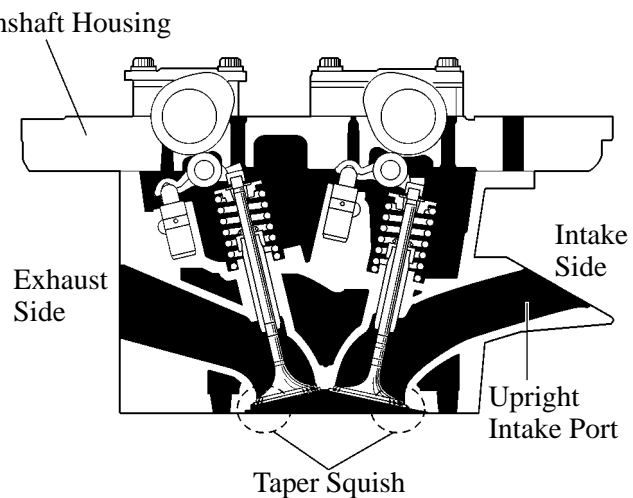
3. Cylinder Head

- The cylinder head structure has been simplified by separating the cam journal portion (camshaft housing) from the cylinder head.
- The cylinder head, which is made of aluminum, contains a pentroof-type combustion chamber. The spark plug is located in the center of the combustion chamber in order to improve the engine's anti-knocking performance.
- The intake ports are on the inside and the exhaust ports are on the outside of the left and right banks respectively.
- Upright intake ports are used to improve the intake efficiency.
- A taper squish combustion chamber is used to improve anti-knocking performance and intake efficiency. In addition, engine performance and fuel economy have been improved.
- The siamese type intake port is used to reduce the overall surface area of the intake port walls. This prevents the fuel from adhering onto the intake port walls, thus reducing HC exhaust emissions.



View from Back Side

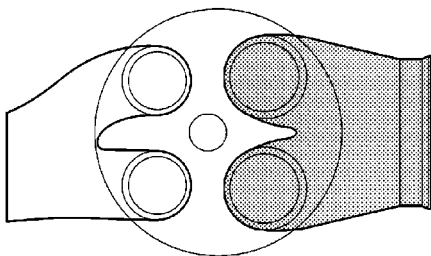
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A - A Cross Section

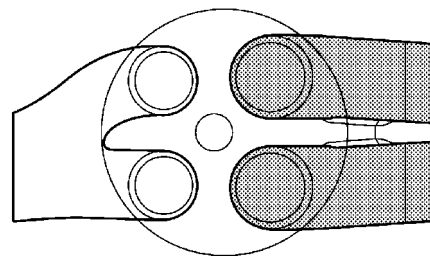
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— REFERENCE —



215EG18

Siamese Type

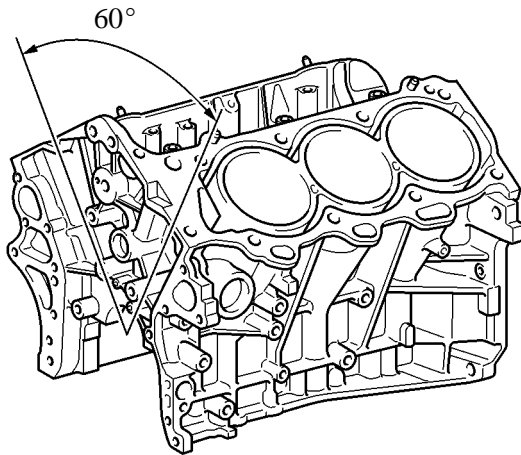


215EG19

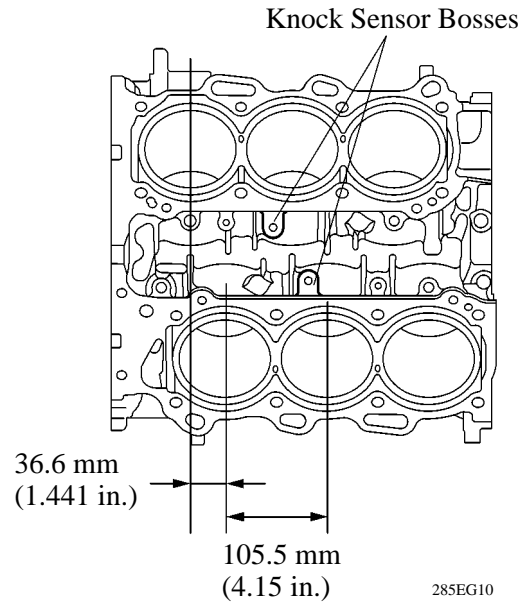
Independent Type

4. Cylinder Block

- The cylinder block is made of aluminum alloy, so it is lightweight.
- The cylinder block has a bank angle of 60° , a bank offset of 36.6 mm (1.441 in.) and a bore pitch of 105.5 mm (4.15 in.), resulting in a compact block in its length and width even for its displacement.
- Installation bosses of the two knock sensors are located on the inside of left and right banks.



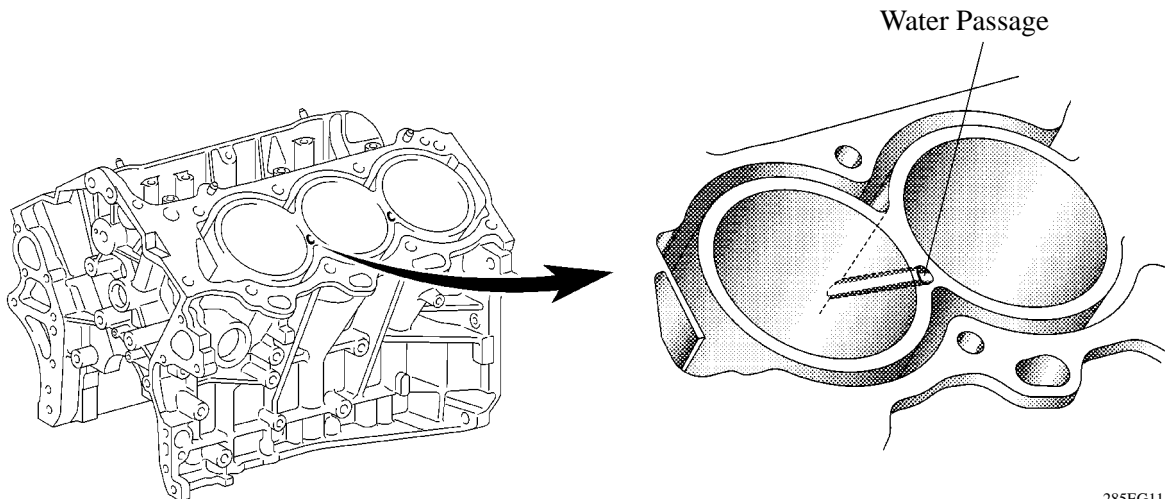
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285EG10

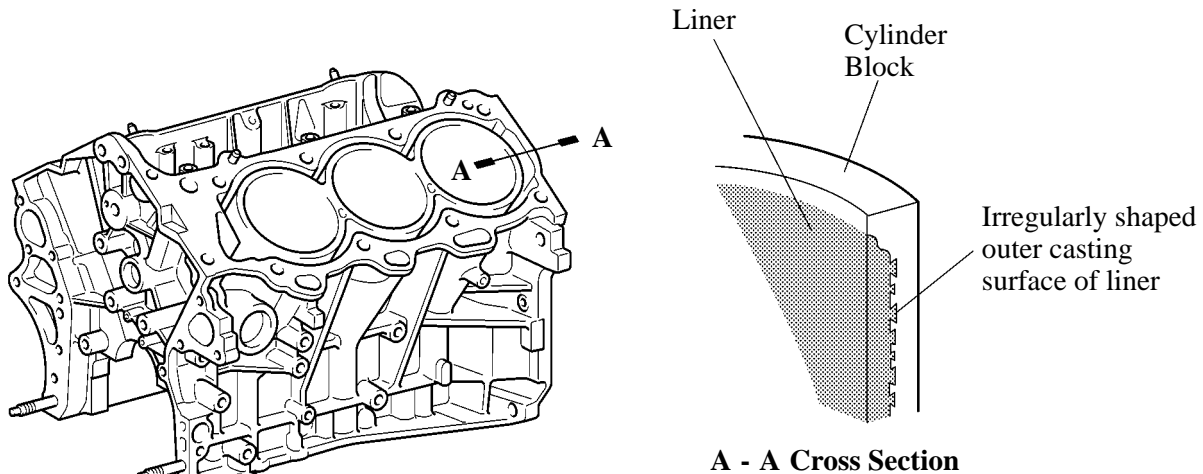
View from Top Side

- A water passage has been provided between the cylinder bores. By allowing the engine coolant to flow between the cylinder bores, this construction enables the temperature of the cylinder walls to be kept uniform.



285EG11

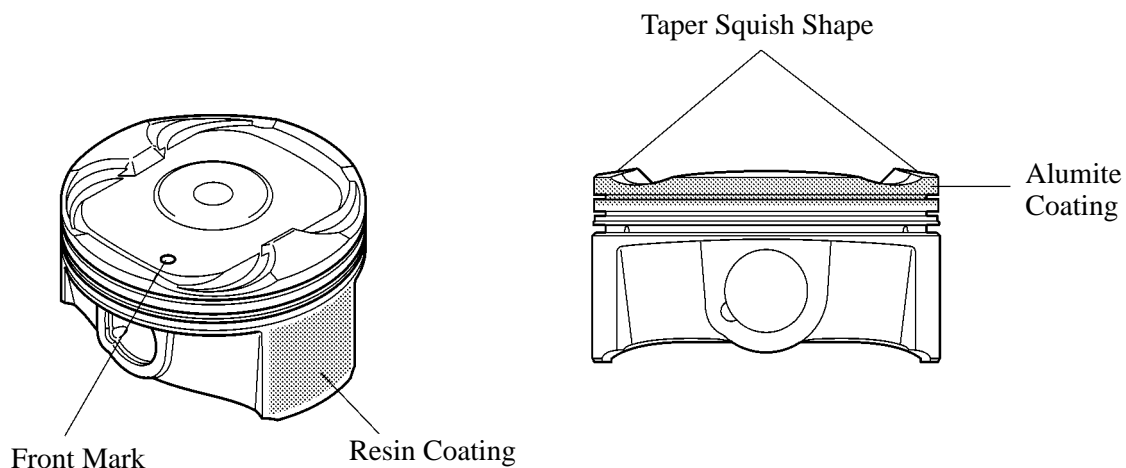
- A compact block has been achieved by producing the thin cast-iron liners and cylinder block as a unit. It is not possible to bore the block with this liner.
- The liners are the spiny-type, which have been manufactured so that their casting exteriors form large irregular surfaces in order to enhance the adhesion between the liners and the aluminum cylinder block. The enhanced adhesion helps improve heat dissipation, resulting in a lower overall temperature and heat deformation of the cylinder bores.



285EG12

5. Piston

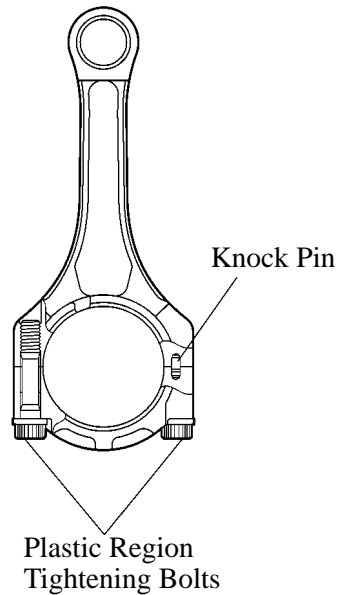
- The piston is made of aluminum alloy.
- The piston head portion uses a taper squish shape to accomplish fuel combustion efficiency.
- The piston skirt is coated with resin to reduce the friction loss.
- The groove of the top ring is coated with alumite to ensure wear resistance.
- By increasing the machining precision of the cylinder bore diameter, the outer diameter of the piston is made into one size.



285EG13

6. Connecting Rod and Connecting Rod Bearing

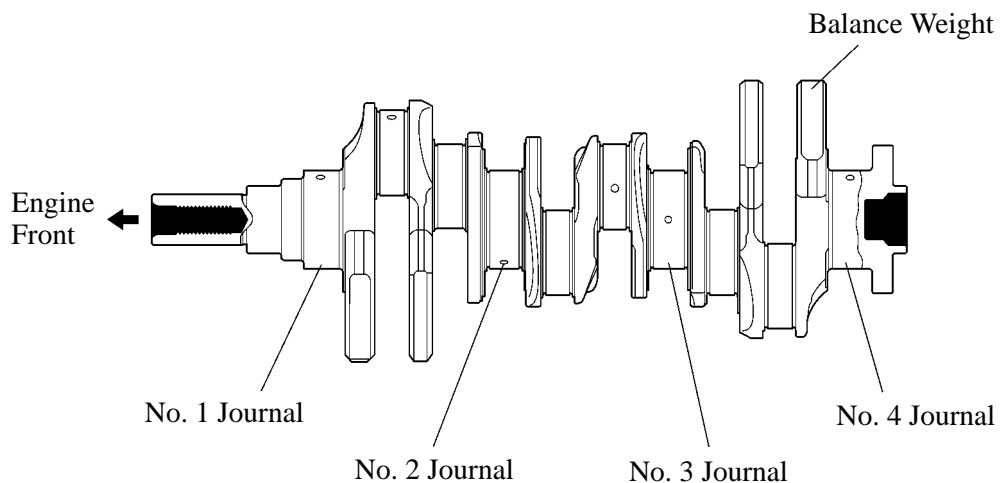
- Connecting rods that have been forged for high strength are used for weight reduction.
- Knock pins are used at the mating surfaces of the bearing caps of the connecting rod to minimize the shifting of the bearing caps during assembly.
- The connecting rods and caps are made of high-strength steel for weight reduction.
- Nutless-type plastic region tightening bolts are used on the connecting rods for a lighter design.
- An aluminum bearing is used for the connecting rod bearings.
- The connecting rod bearings are reduced in width to reduce friction.



285EG14

7. Crankshaft

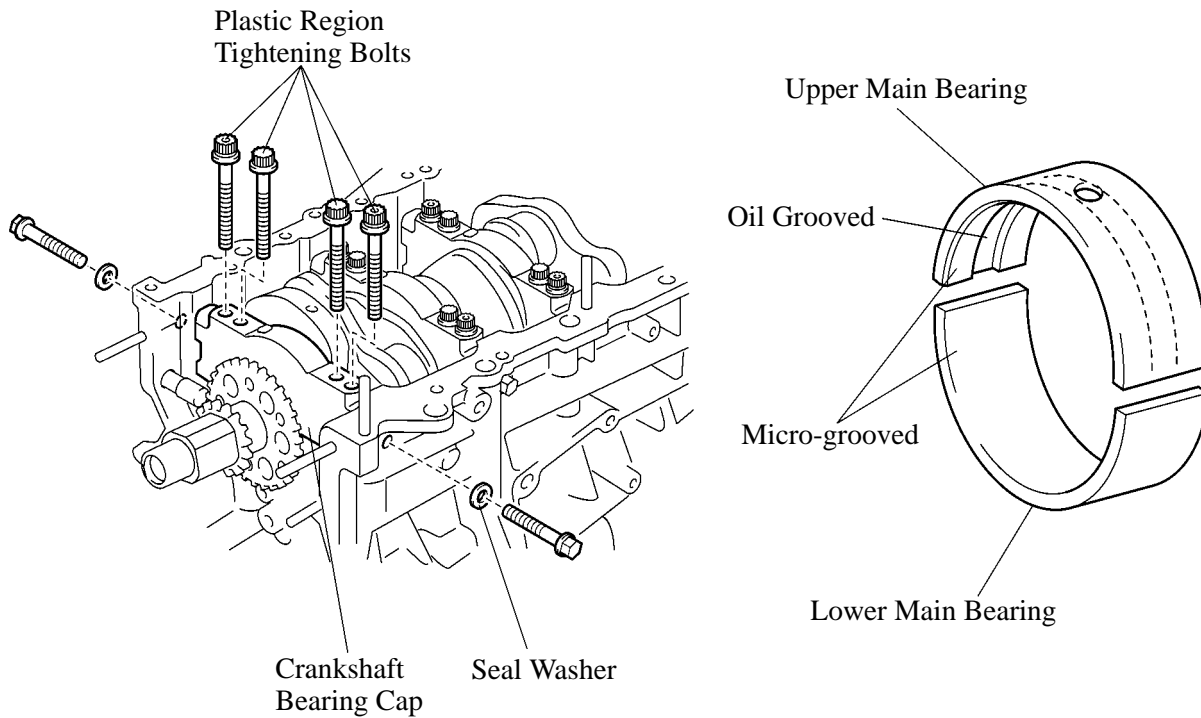
- A crankshaft made of forged steel, which excels in rigidity and wear resistance, is used.
- The crankshaft has 4 journals and 5 balance weights.
- All pin and journal fillets are IH-finished to maintain adequate strength.



285EG15

8. Crankshaft Bearing and Crankshaft Bearing Cap

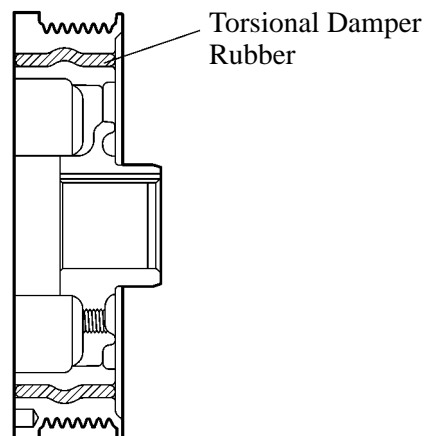
- The crankshaft bearing is made of aluminum alloy.
- As the connecting rod bearings, the lining surface of the crankshaft bearings is micro-grooved to realize an optimal amount of oil clearance. As a result, cold-engine cranking performance is improved and engine vibration is reduced.
- The upper main bearing has an oil groove around its inside circumference.
- The crankshaft bearing caps are tightened using 4 plastic region tightening bolts for each journal. In addition, each cap is tightened laterally to improve its reliability.



285EG81

9. Crankshaft Pulley

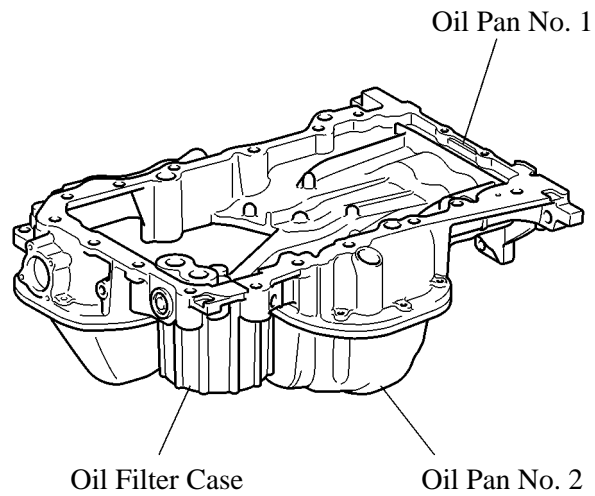
The rigidity of the crankshaft pulley with its built-in torsional damper rubber reduces noise.



285EG80

10. Oil Pan

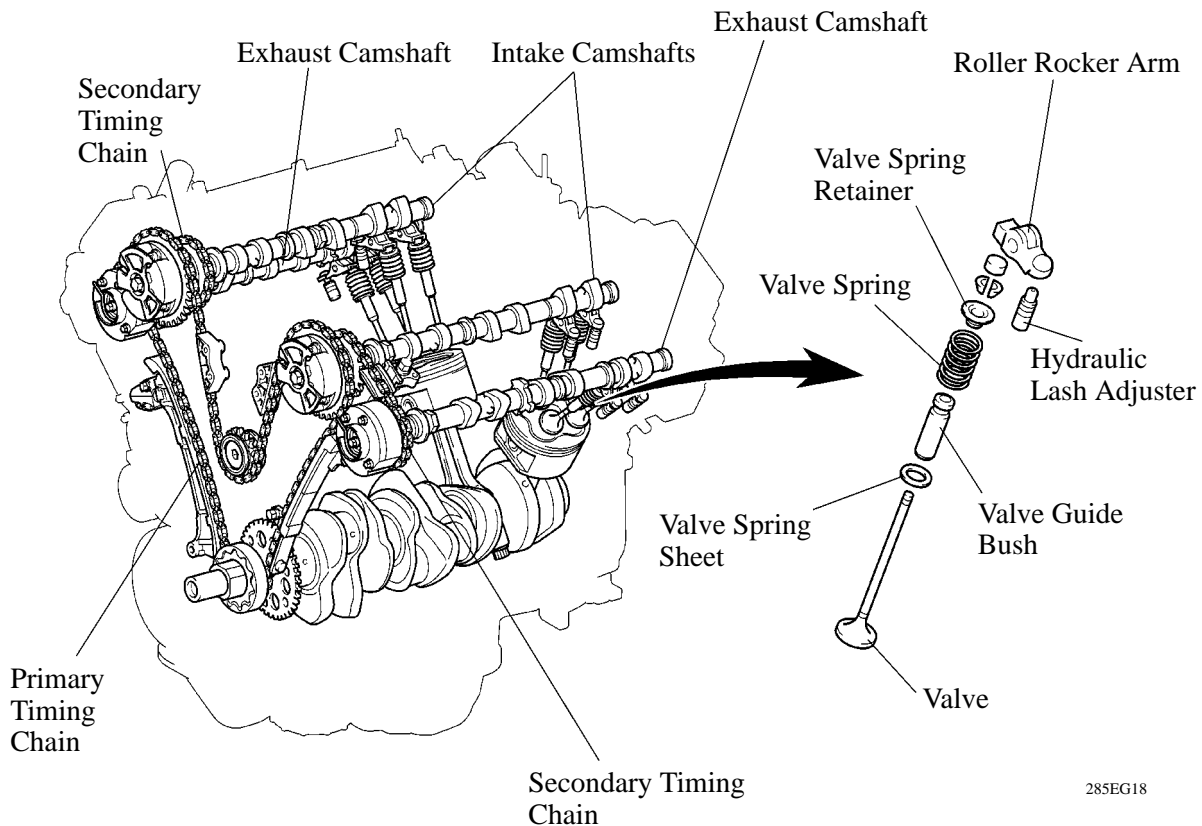
- The oil pan No. 1 is made of aluminum alloy.
- The oil pan No. 2 is made of steel.
- The oil pan No. 1 is secured to the cylinder block and the transmission housing and is increasing rigidity.
- The oil filter case is integrated with the oil pan No. 1.



■ VALVE MECHANISM

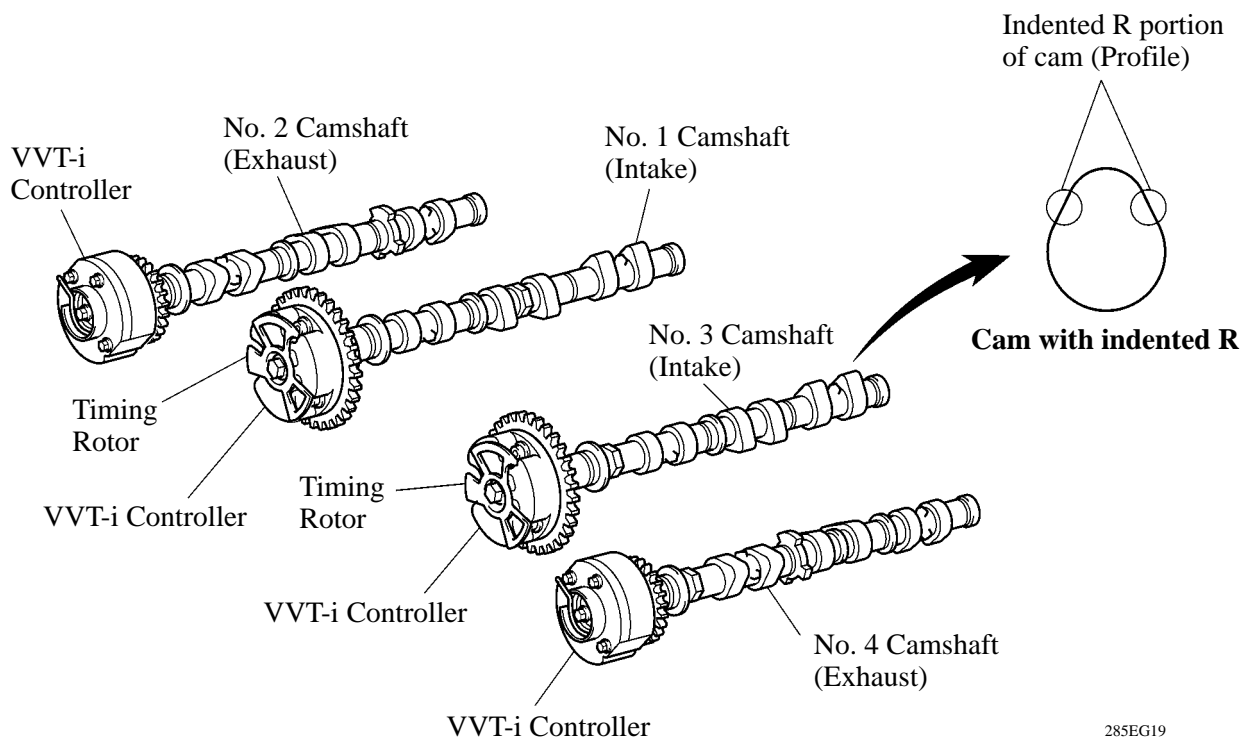
1. General

- Each cylinder of this engine has 2 intake valves and 2 exhaust valves. Intake and exhaust efficiency is increased due to the larger total port areas.
- This engine uses roller rocker arms with built-in needle bearings. This reduces the friction that occurs between the cams and the areas (roller rocker arms) that push the valves down, thus improving fuel economy.
- A hydraulic lash adjuster, which maintains a constant zero valve clearance through the use of oil pressure and spring force, is used.
- The intake camshafts are driven by the crankshaft via the primary timing chain. The exhaust camshafts are driven by the intake camshaft of the respective bank via the secondary timing chain.
- This engine uses a Dual VVT-i (Variable Valve Timing-intelligent) system which controls the intake and exhaust camshafts to provide optimal valve timing according to driving conditions. With this adoption, lower fuel consumption, higher engine performance, and fewer exhaust emissions have been achieved. For details of Dual VVT-i control, see page EG-120.



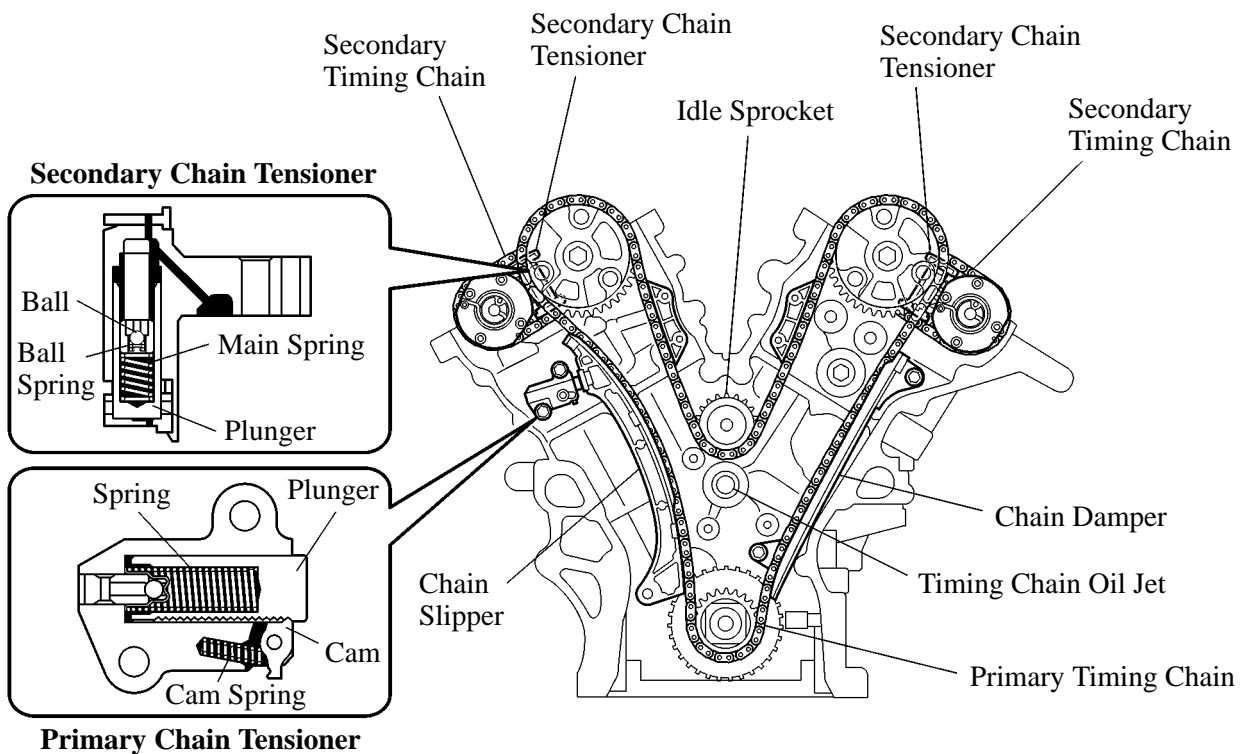
2. Camshaft

- The camshafts are made of cast iron alloy.
- An oil passage is provided on the intake and exhaust camshafts in order to supply engine oil to the VVT-i system.
- A VVT-i controller has been installed on the front of the intake and exhaust camshafts to vary the timing of the intake and exhaust valves.
- Together with the use of the roller rocker arm, the cam profile has been designed with an indented R (radius). This results in increased valve lift when the valve begins to open and finishes closing, helping to achieve enhanced output performance.



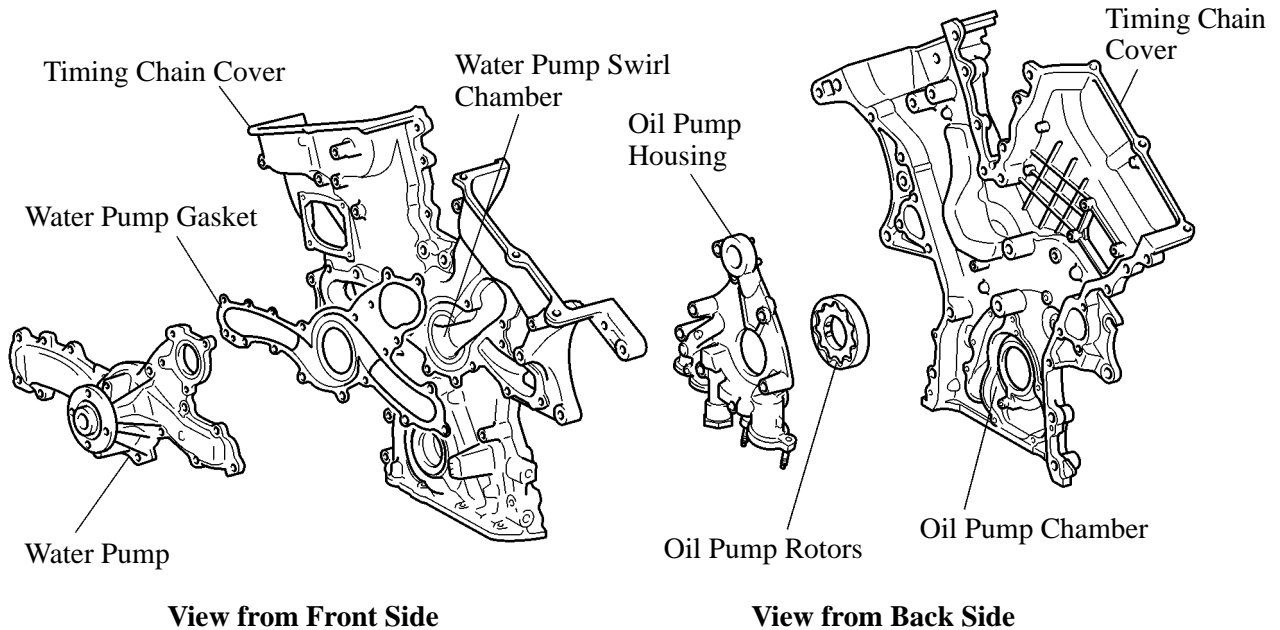
3. Timing Chain and Chain Tensioner

- Both the primary and secondary timing chains use roller chains with a pitch of 9.525 mm (0.375 in.).
- The timing chain is lubricated by an oil jet.
- The primary timing chain uses one chain tensioner, and each of the secondary timing chains for the right and left banks uses one chain tensioner.
- Both the primary and secondary chain tensioners use a spring and oil pressure to maintain proper chain tension at all times. They suppress noise generated by the timing chains.
- The primary chain tensioner is the ratchet type with a non-return mechanism.



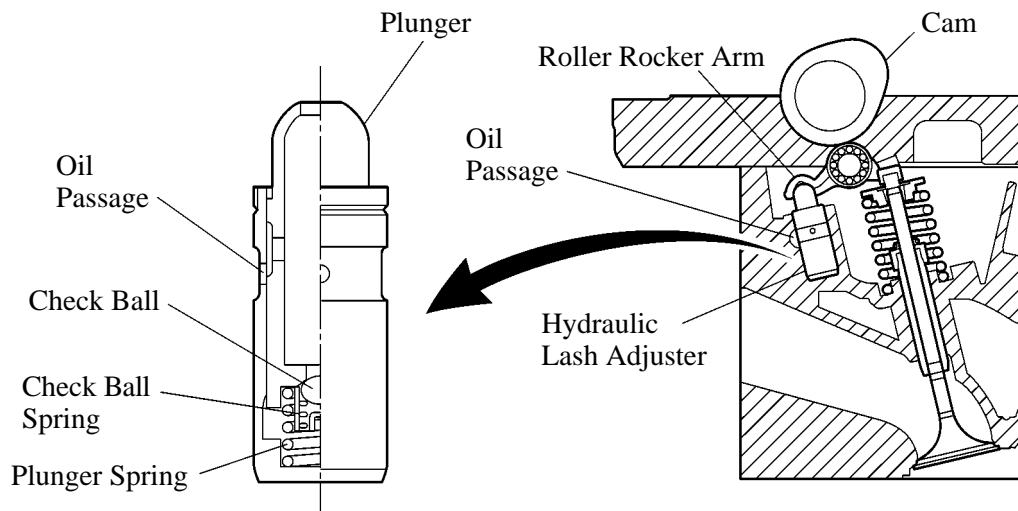
4. Timing Chain Cover

The timing chain cover has an integrated construction consisting of the cooling system (water pump and water passage) and the lubrication system (oil pump and oil passage). Thus, the number of parts has been reduced to reduce weight.



5. Hydraulic Lash Adjuster

- The hydraulic lash adjuster, which is located at the fulcrum of the roller rocker arm, consists primarily of a plunger, plunger spring, check ball, and check ball spring.
- The engine oil that is supplied by the cylinder head and the built-in spring actuates the hydraulic lash adjuster. The oil pressure and the spring force that act on the plunger push the roller rocker arm against the cam, in order to adjust the valve clearance that is created during the opening and closing of the valve. As a result, engine noise is reduced.



285EG22

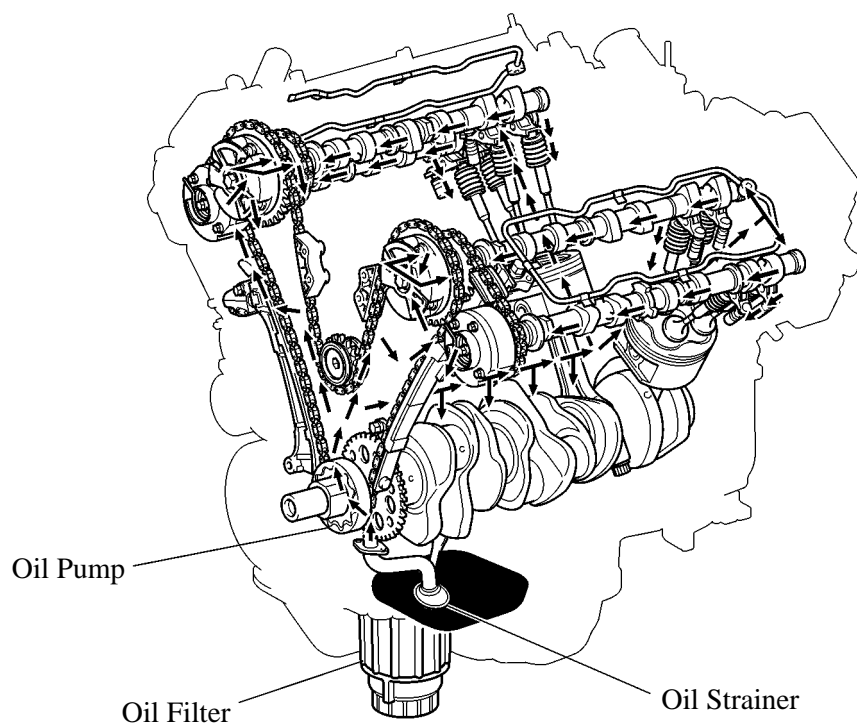
Service Tip

Valve clearance adjustment is not necessary because a hydraulic lash adjuster is used in this model.

■ LUBRICATION SYSTEM

1. General

- The lubrication circuit is fully pressurized and all oil passes through an oil filter.
- A cycloid rotor type oil pump is used.

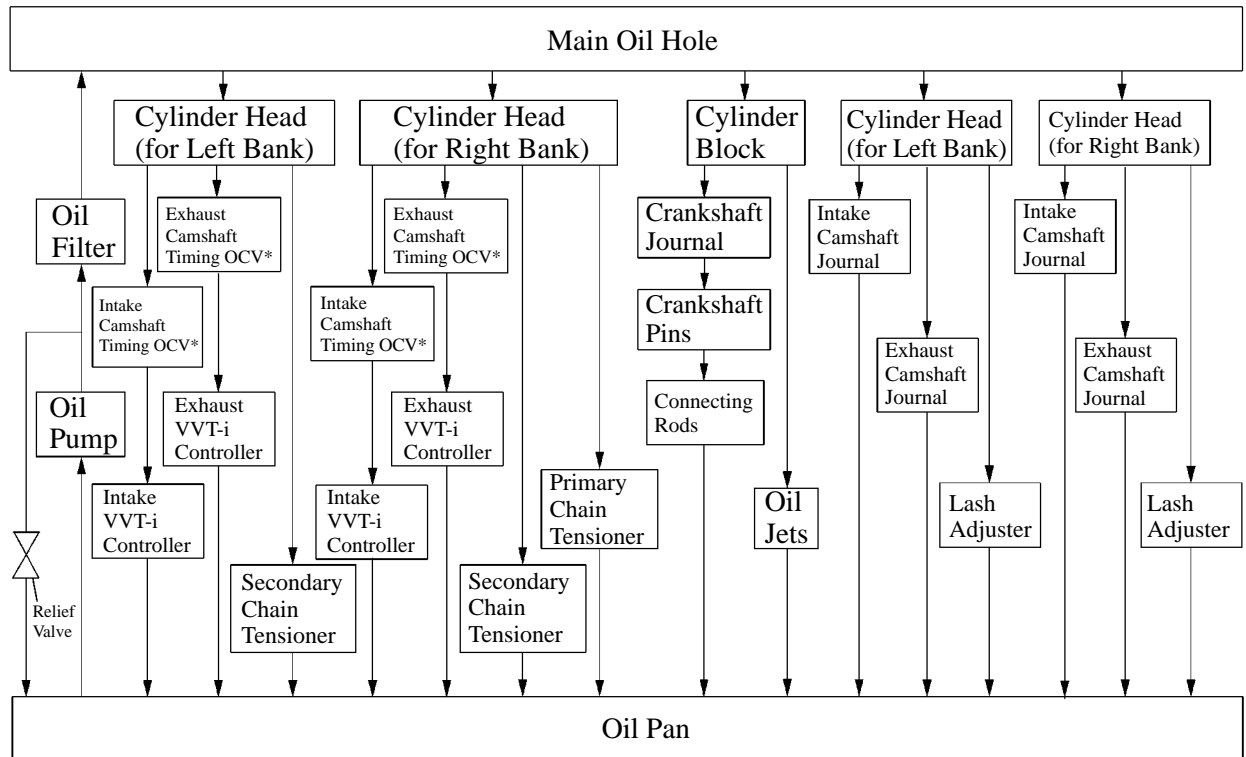


285EG23

► Oil Capacity ◀

Dry	6.5 Liters (6.9 US pts, 5.7 Imp. qts)
With Oil Filter	6.1 Liters (6.4 US pts, 5.4 Imp. qts)
Without Oil Filter	5.7 Liters (6.0 US pts, 5.0 Imp. qts)

► Oil Circuit ◀

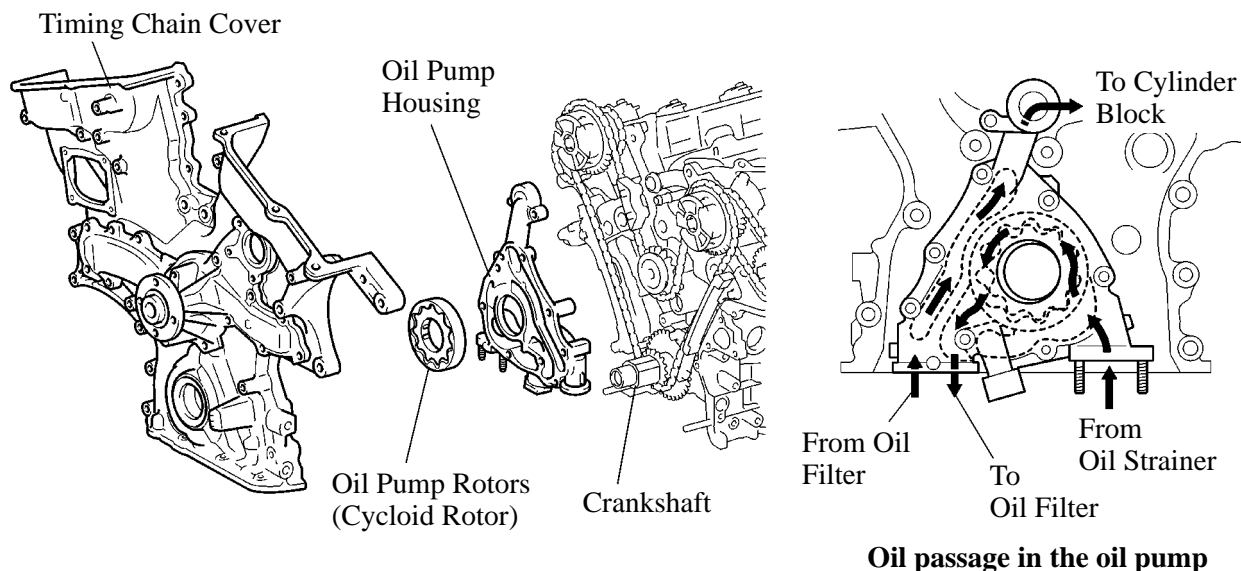


*: Oil Control Valve

285EG77

2. Oil Pump

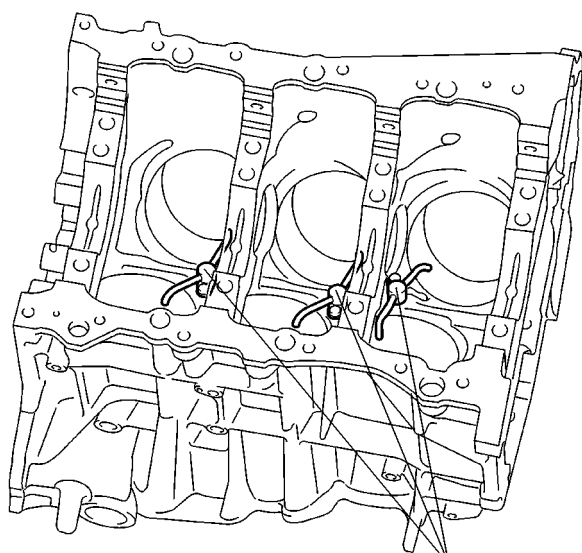
- A compact cycloid rotor type oil pump directly driven by the crankshaft is used.
- This oil pump has used an internal relief method which circulates relief oil to the suction passage in the oil pump. This aims to minimize oil level change in the oil pan, reduce friction, and reduce air mixing rate in the oil.



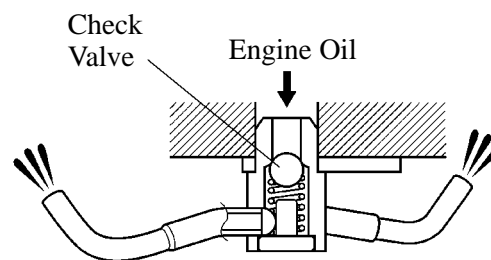
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3. Oil Jet

- Oil jets for cooling and lubricating the pistons have been provided in the cylinder block, in the center of the right and left banks.
- These oil jets contain a check valve to prevent oil from being fed when the oil pressure is low. This prevents the overall oil pressure in the engine from dropping.



Oil Jets

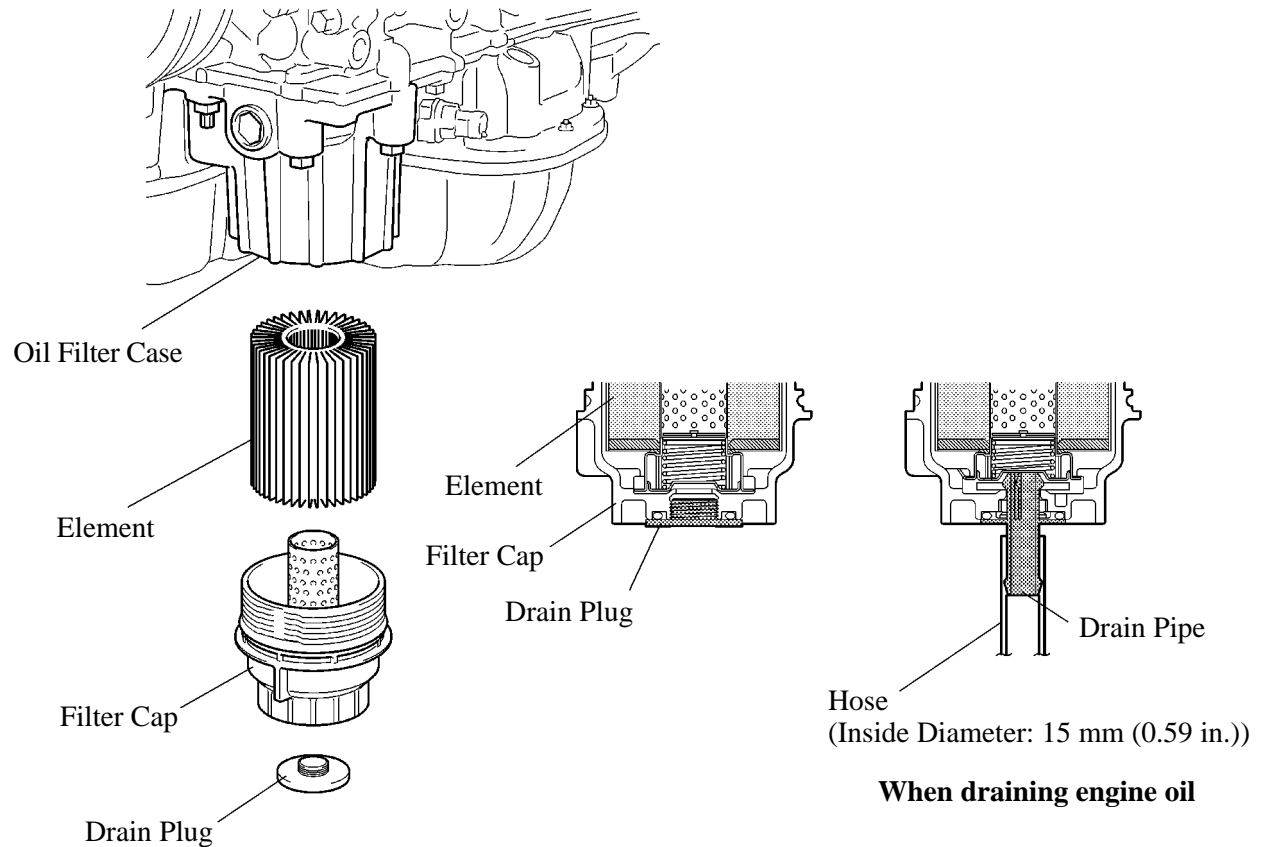


Oil Jet Cross Section

285EG25

4. Oil Filter

- An oil filter with a replaceable element is used. The element uses a high-performance filter paper to improve filtration performance. It is also combustible for environmental protection.
- An aluminum alloy filter cap is used to extend its life.
- This oil filter has a structure which can drain the engine oil remaining in the oil filter. This prevents engine oil from spattering when replacing the element and allows the technician to work without touching hot engine oil.



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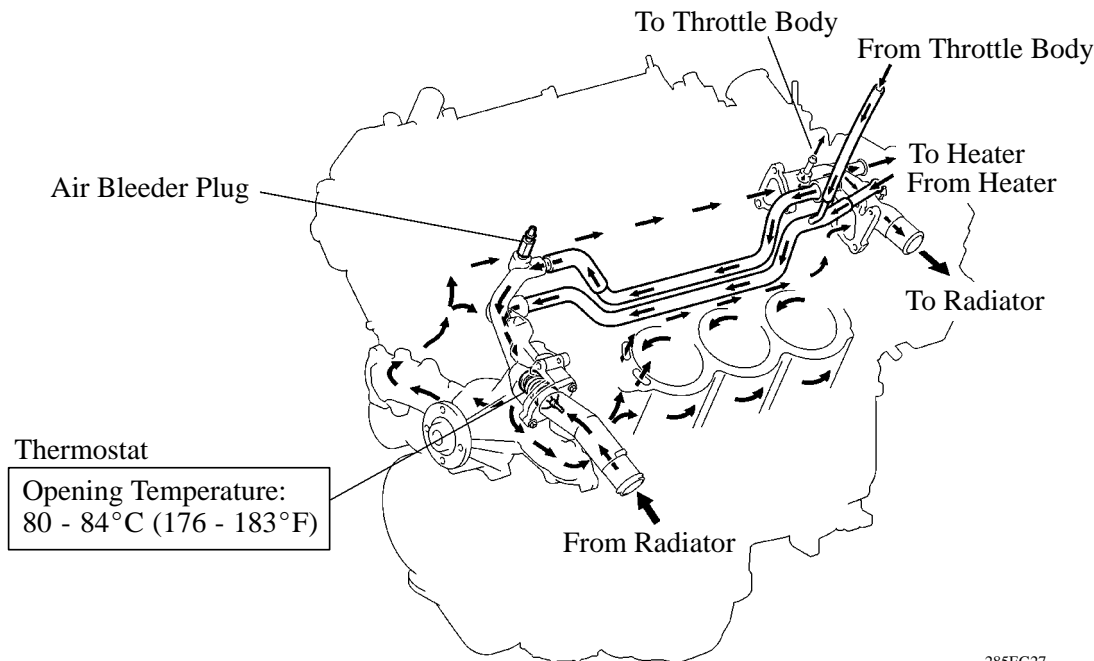
Service Tip

- The engine oil in the oil filter can be drained by removing the drain plug and inserting the drain pipe supplied with the element into the oil filter. For details, refer to the 2006 RAV4 Repair Manual (Pub. No. RM01M1U).
- The engine oil maintenance interval for a model that has an oil filter with a replaceable element is the same as that for the conventional model.

■ COOLING SYSTEM

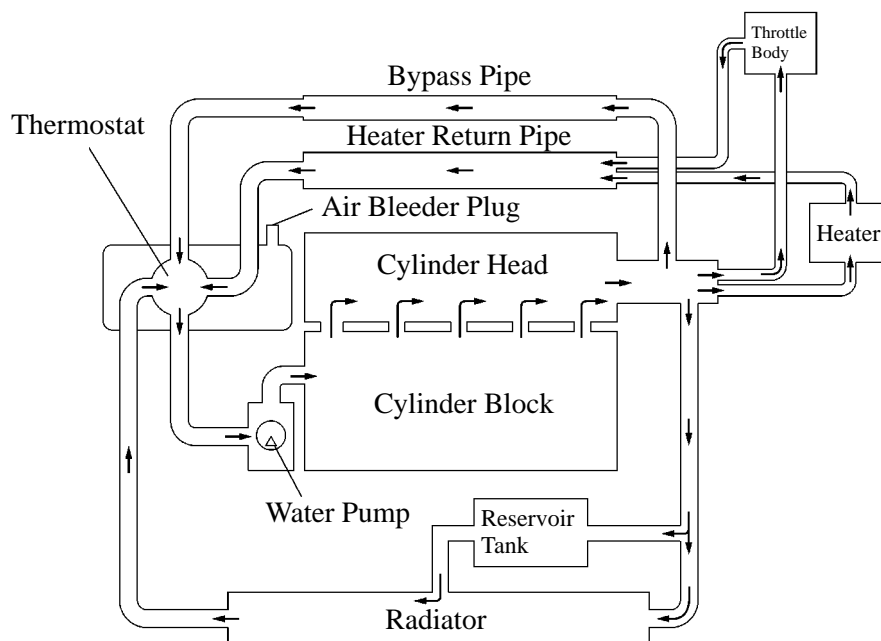
1. General

- The cooling system is a pressurized, forced-circulation type.
- A thermostat with a bypass valve is located on the water inlet housing to maintain suitable temperature distribution in the cooling system.
- A cooling fan control system in which the ECM optimally controls cooling fan speed is used. For details, see page EG-129.
- An air bleeder plug is provided on the water inlet assembly to improve the efficiency of changing the engine coolant. For details, refer to the 2006 RAV4 Repair Manual (Pub. No. RM01M1U).
- The TOYOTA genuine SLLC (Super Long Life Coolant) is used for the engine coolant.



285EG27

► System Diagram ◀



01MEG35Y

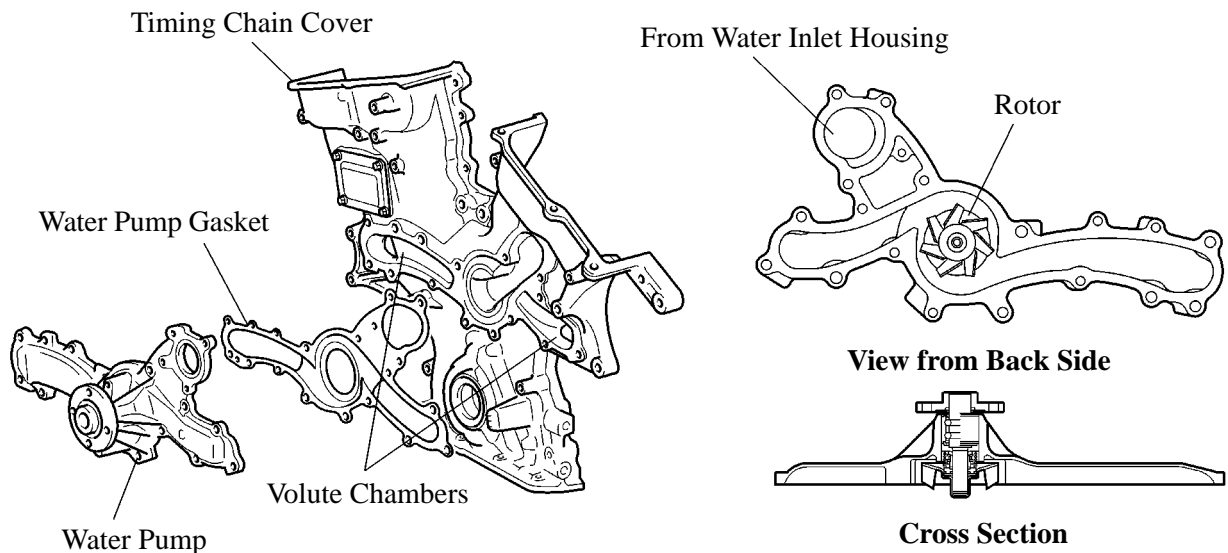
► Engine Coolant Specifications ◀

Engine Coolant	Type		TOYOTA genuine Super Long Life Coolant (SLLC) or similar high quality ethylene glycol based non-silicate, non-amine, non-nitrite and non-borate coolant with long-life hybrid organic acid technology (coolant with long-life hybrid organic acid technology is a combination of low phosphates and organic acids.) Do not use plain water alone.
	Color		Pink
	Capacity	Except Towing Package Models	8.9 Liters (9.4 US qts, 7.8 Imp. qts)
		Towing Package Models	9.2 Liters (9.7 US qts, 8.1 Imp. qts)
	Maintenance Intervals	First Time	100,000 miles (160,000 km)
		Subsequent	Every 50,000 miles (80,000 km)

- SLLC is pre-mixed (the U.S.A. models: 50 % coolant and 50 % deionized water, the Canada. models: 55 % coolant and 45 % deionized water), so no dilution is needed when SLLC in the vehicle is added or replaced.
- If LLC is mixed with SLLC, the interval for LLC (every 25,000 miles (USA), 32,000 km (CANADA) or 24 months whichever comes first) should be used.

2. Water Pump

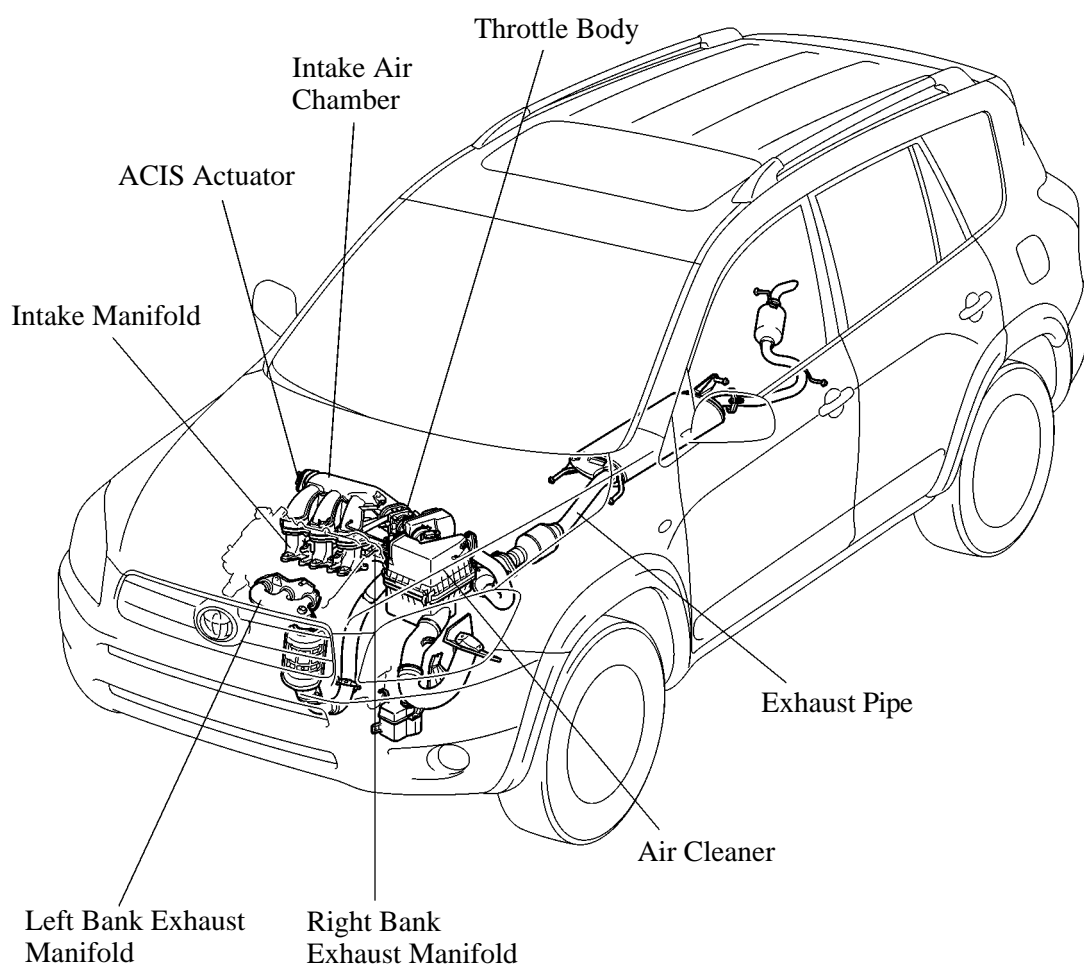
The water pump has two volute chambers, and circulates coolant uniformly to the left and right banks of the cylinder block.



■ INTAKE AND EXHAUST SYSTEM

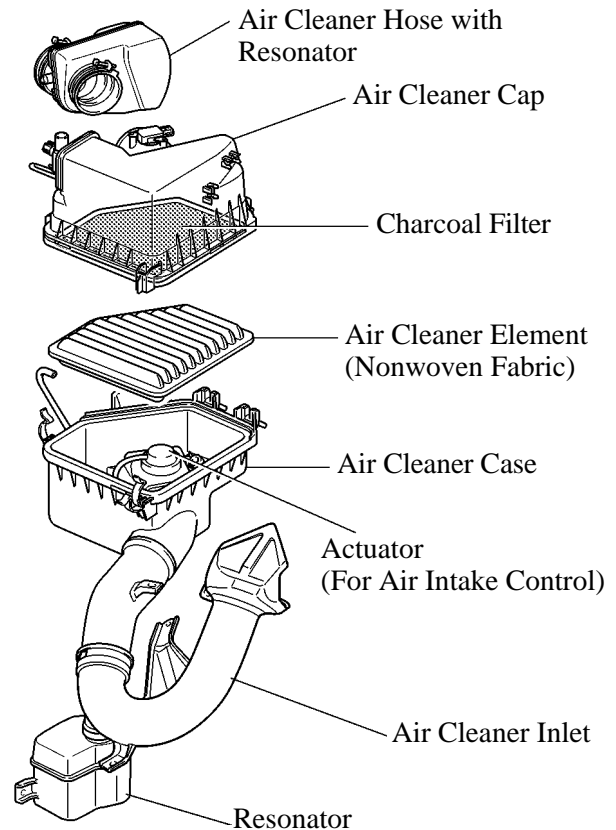
1. General

- The linkless-type throttle body is used and it realizes excellent throttle control.
- The intake air chamber made of plastic is used.
- A stainless steel exhaust manifold is used for weight reduction.
- ETCS-i (Electronic Throttle Control System-intelligent) provides excellent throttle control. For details, see page EG-118.
- ACIS (Acoustic Control Induction System) has improved the engine performance. For details, see page EG-126.
- The air intake control system is used to reduce engine noise. For details, see page EG-128.



2. Air Cleaner

- A nonwoven, full-fabric type air cleaner element is used.
- A charcoal filter, which adsorbs the HC that accumulates in the intake system when the engine is stopped, is used in the air cleaner case in order to reduce evaporative emissions. This filter is maintenance-free.
- Along with the use of the air intake control system, an air intake control valve is provided on the air cleaner case. For details, see page EG-128.
- Resonators have been provided to reduce the amount of intake air sound.

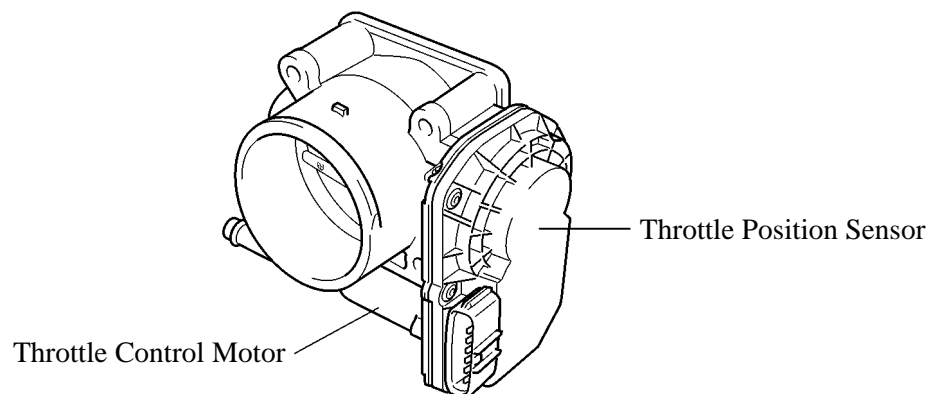


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3. Throttle Body

A linkless-type throttle body in which the throttle position sensor and the throttle control motor are integrated is used. It realizes excellent throttle valve control. For details, see page EG-118.

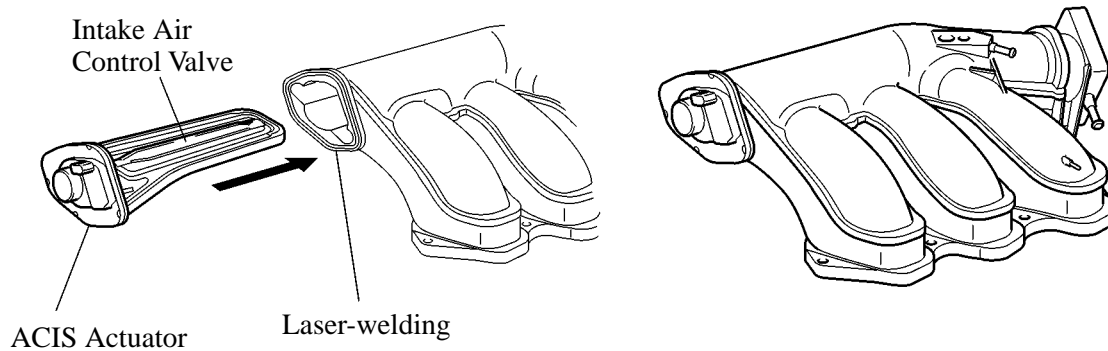
- In the throttle control motor, a DC motor with excellent response and minimal power consumption is used. The ECM performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the throttle valve angle.



285EG32

4. Intake Air Chamber

- The intake air chamber is made of plastic to realize lightweight.
- The intake air chamber contains an intake air control valve. This valve is activated by ACIS (Acoustic Control Induction System) and is used to alter the intake pipe length to improve the engine performance in all speed range. For details, see page EG-126.
- The ACIS actuator uses an electric actuator and is laser-welded onto the intake air chamber. Many of the components are made of plastic for weight reduction.



285EG33

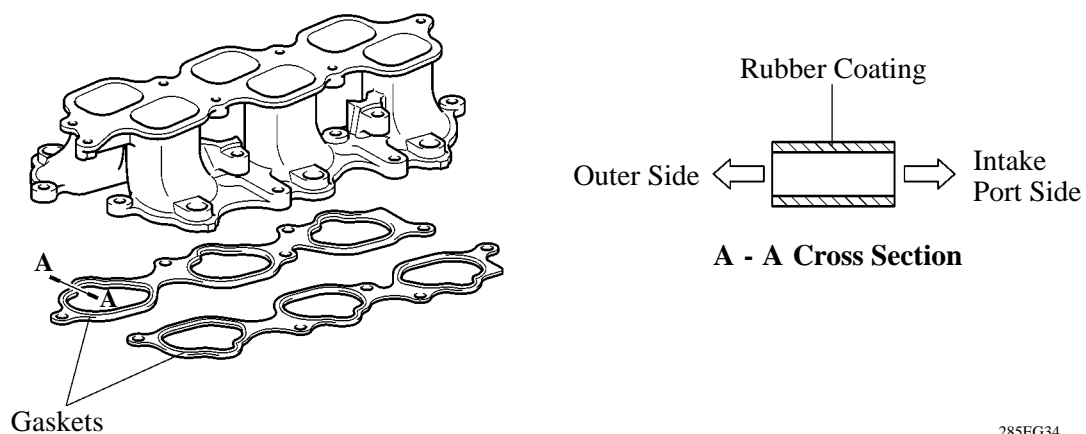
— REFERENCE —

Laser-welding:

In laser-welding, a laser-absorbing material (for the intake air chamber) is joined to a laser-transmitting material (for the ACIS actuator). Laser beams are then irradiated from the laser-transmitting side. The beams penetrate the laser-transmitting material to heat and melt the surface of the laser-absorbing material. Then, the heat of the laser-absorbing material melts the laser-transmitting material and causes both materials to become welded.

5. Intake Manifold

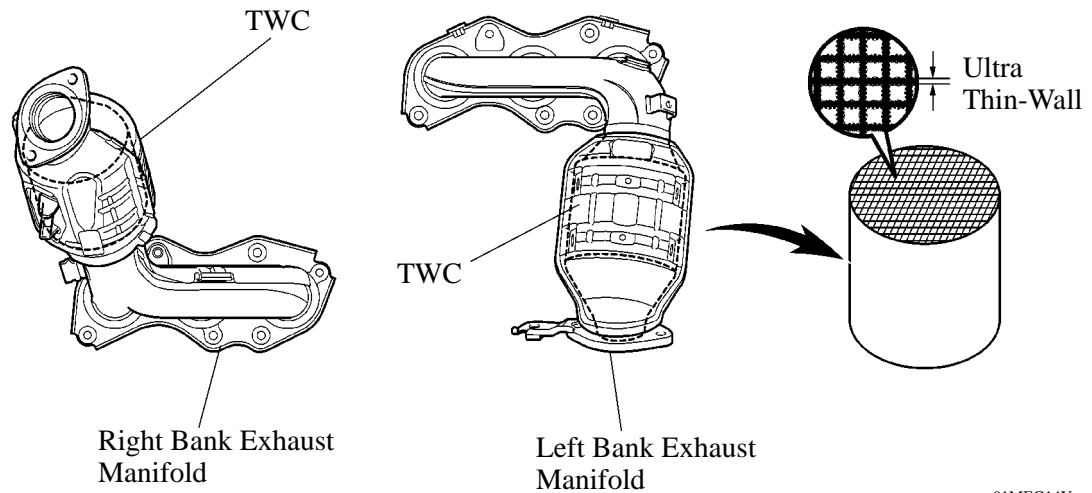
- Lightweight aluminum alloy is used for the intake manifold.
- The intake manifold gaskets have rubber coating applied onto surface, and provide superior durability.



285EG34

6. Exhaust Manifold

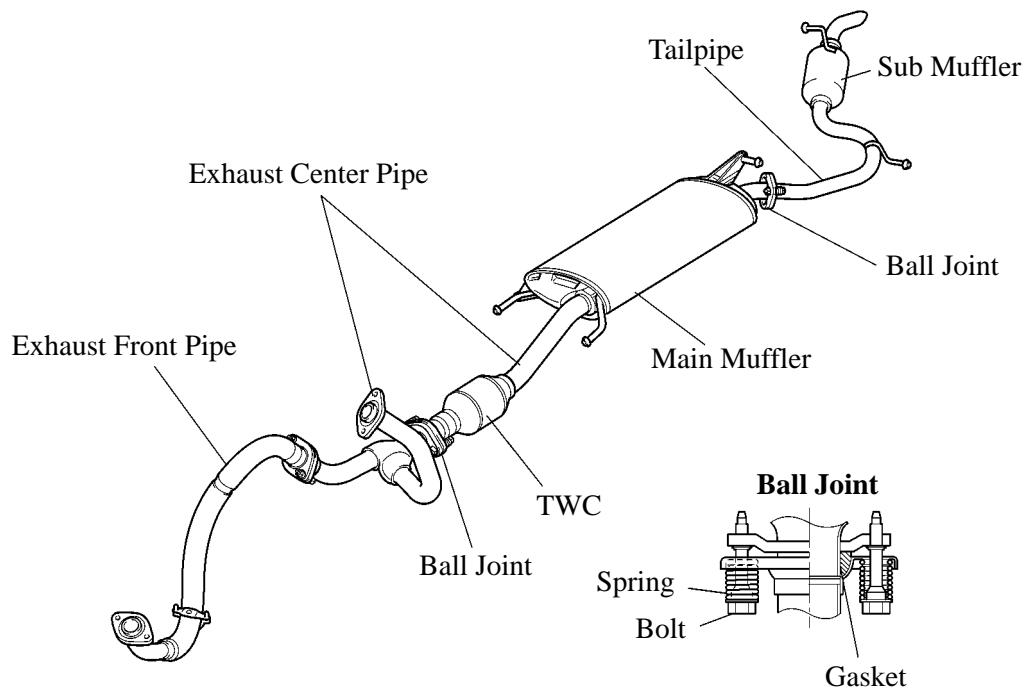
- A stainless steel exhaust manifold with an integrated TWC (Three-Way Catalytic converter) is used for warm-up of the TWC and for weight reduction.
- An ultra thin-wall, high-cell density, ceramic type TWC is used. This TWC is incorporated on each of the right and left banks.
- This TWC improves exhaust emissions by optimizing the cells density and the wall thickness.



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7. Exhaust Pipe

- The exhaust pipe is made of stainless steel for improved rust resistance.
- A thin-wall, ceramic type TWC is used.
- Ball joints are used at two places: one at the exhaust center pipe joint, and the other between the exhaust center pipe and the tailpipe. As a result, a simple construction and reliability are realized.

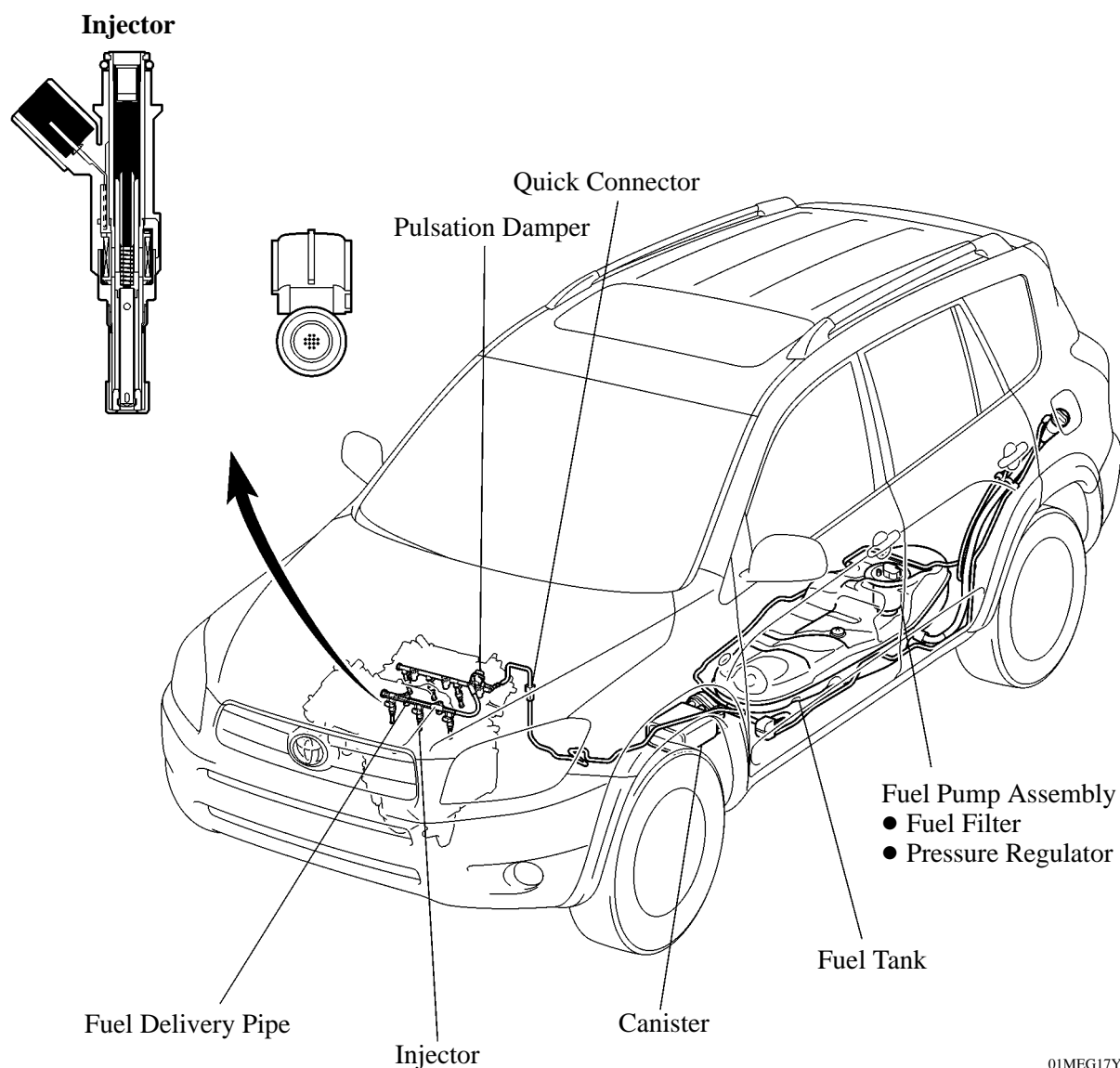


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■ FUEL SYSTEM

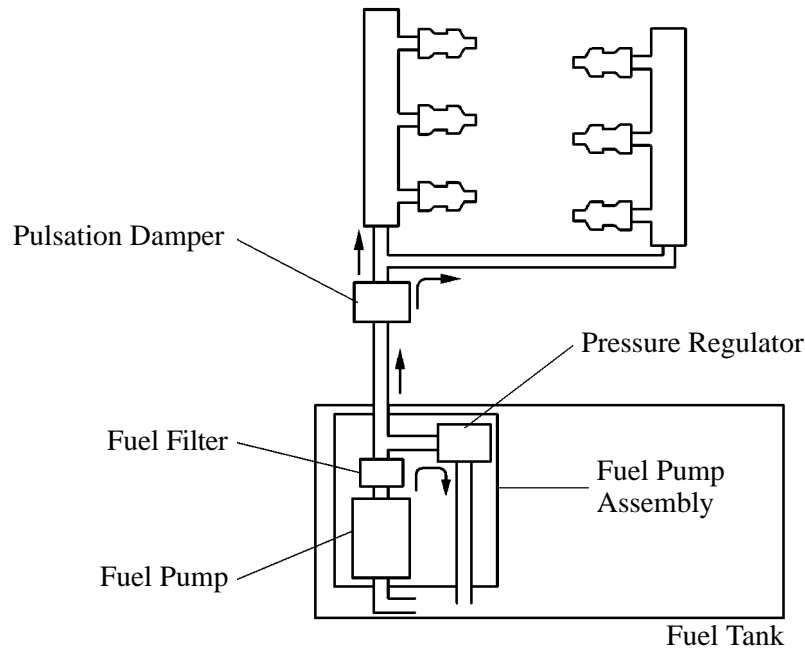
1. General

- The fuel returnless system is used to reduce evaporative emissions.
- A fuel cut control is used to stop the fuel pump when the SRS airbag is deployed in a frontal or side collision. For details, see page EG-53.
- The fuel delivery pipe made of plastic is used.
- A quick connector is used to connect the fuel pipe with the fuel hose for excellent serviceability.
- Compact 12-hole type injectors are used to increase atomization of the fuel.
- A compact fuel pump in which a fuel filter is integrated in the fuel pump assembly is used.
- The ORVR (On-board Refueling Vapor Recovery) system is used. For details, see page EG-131.



2. Fuel Returnless System

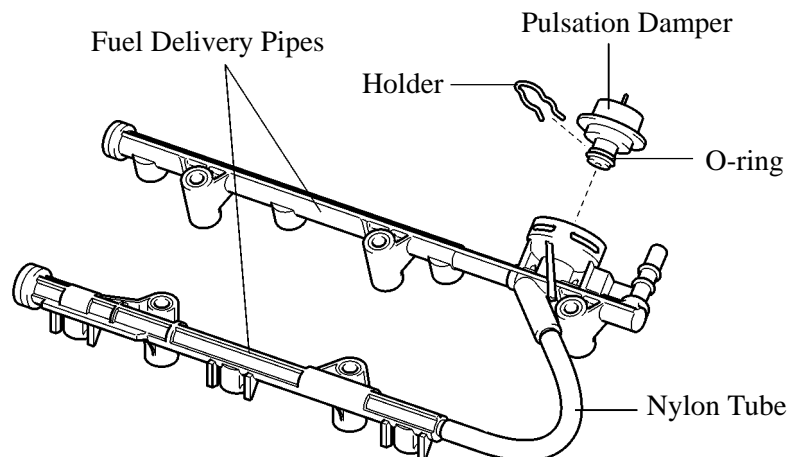
This type of fuel system is used to reduce the evaporative emission. As shown below, by integrating the fuel filter and pressure regulator with fuel pump assembly, the fuel return system in which the fuel returns from the engine area is discontinued and temperature rise inside the fuel tank is prevented.



01MEG34Y

3. Fuel Delivery Pipe

- The fuel delivery pipe made of plastic is used to realize lightweight.
- The right and left fuel delivery pipes are connected by a nylon tube.
- The pulsation damper is sealed with an O-ring and secured with a holder.



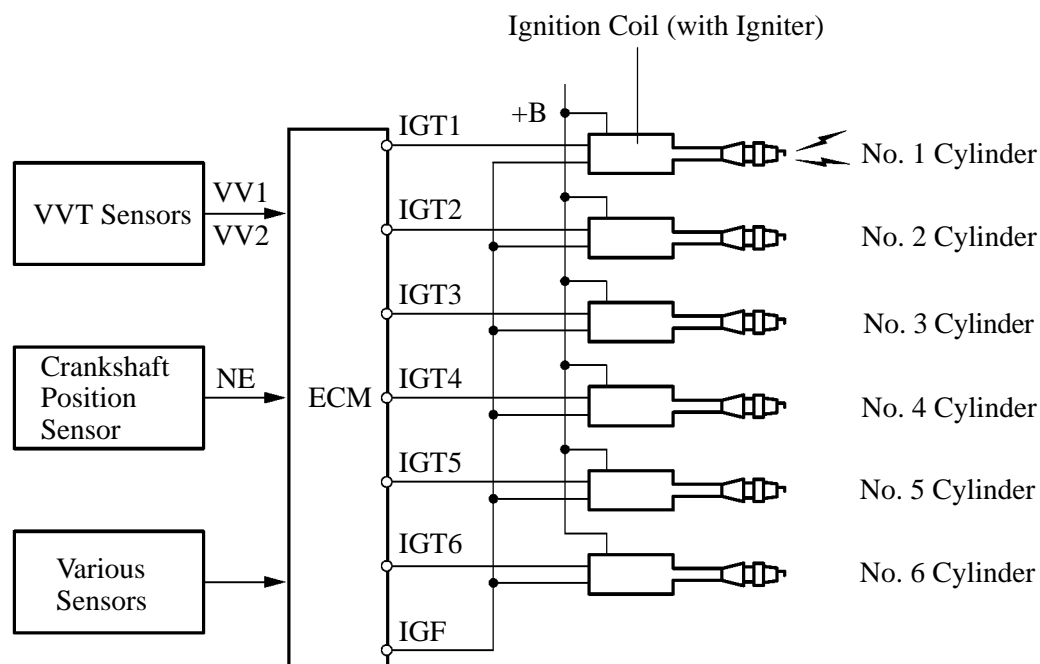
285EG38

■ IGNITION SYSTEM

1. General

A DIS (Direct Ignition System) is used. The DIS improves the ignition timing accuracy, reduces high-voltage loss, and enhances the overall reliability of the ignition system by eliminating the distributor.

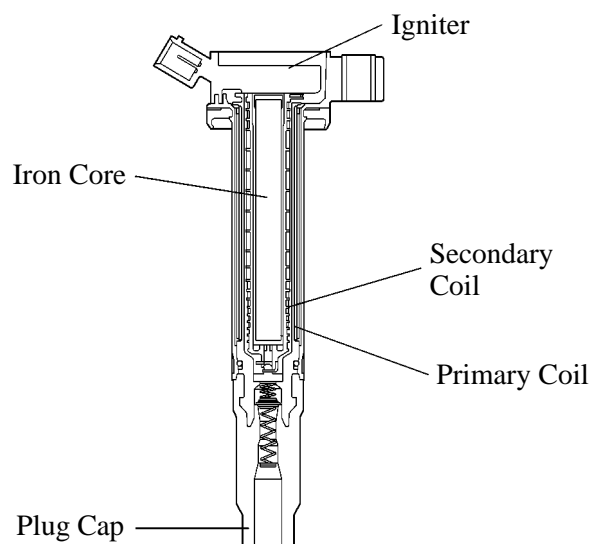
The DIS is an independent ignition system which has one ignition coil (with igniter) for each cylinder.



238EG68

2. Ignition Coil

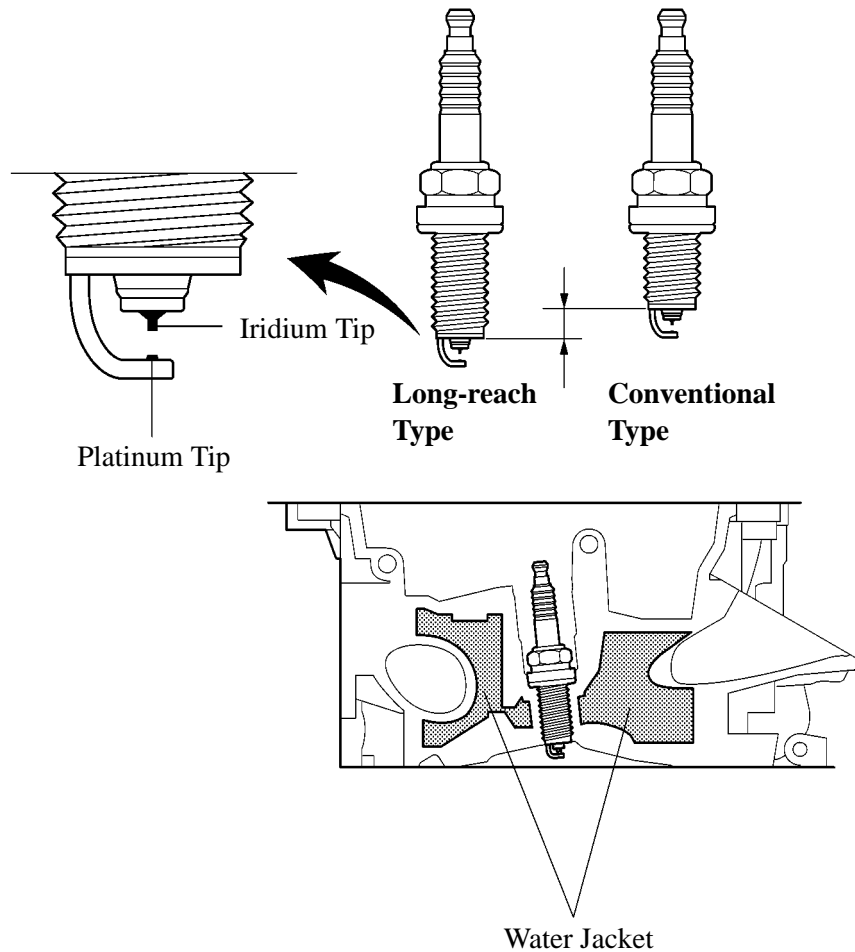
The DIS provides 6 ignition coils, one for each cylinder. The spark plug cap, which provides contact to the spark plug, are integrated with an ignition coil. Also, an igniter is enclosed to simplify the system.



285EG39

3. Spark Plug

- Long-reach type spark plugs are used. This type of spark plugs allow the area of the cylinder head to receive the spark plugs to be made thick. Thus, the water jacket can be extended near the combustion chamber, which contributes to cooling performance.
- Iridium-tipped spark plugs are used to achieve a 120,000 miles (193,000 km) maintenance interval. By making the center electrode of iridium, the superior ignition performance as platinum-tipped spark plugs is achieved and durability has been increased.



■ CHARGING SYSTEM

1. General

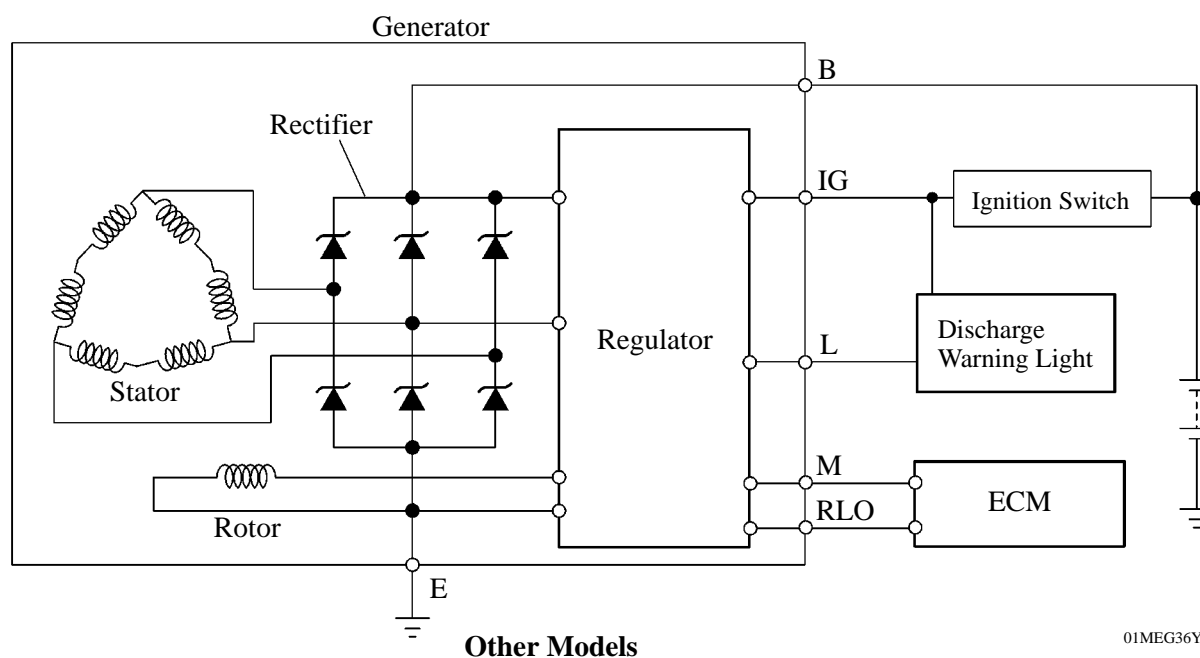
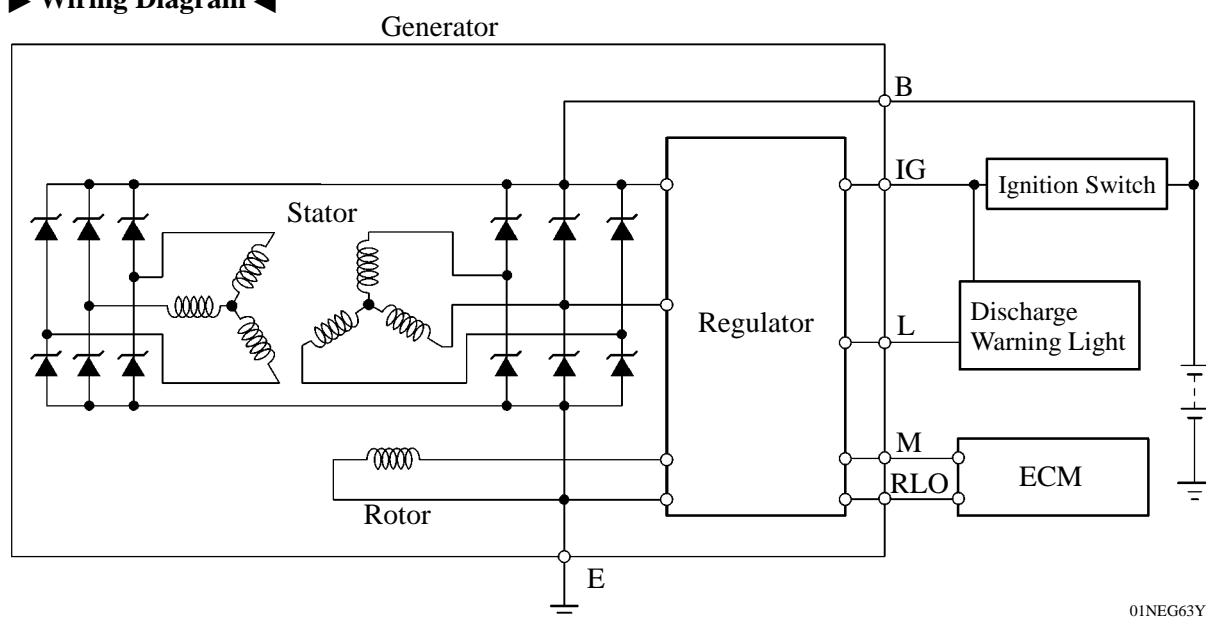
A compact and lightweight segment conductor type generator is used. For details of the segment conductor type generator, see page EG-25.

► Specification ◀

Model	Towing Package	With RSES*	Others
Type	SC2		SE0
Rated Voltage	12 V		12 V
Output Rated	150 A		100 A

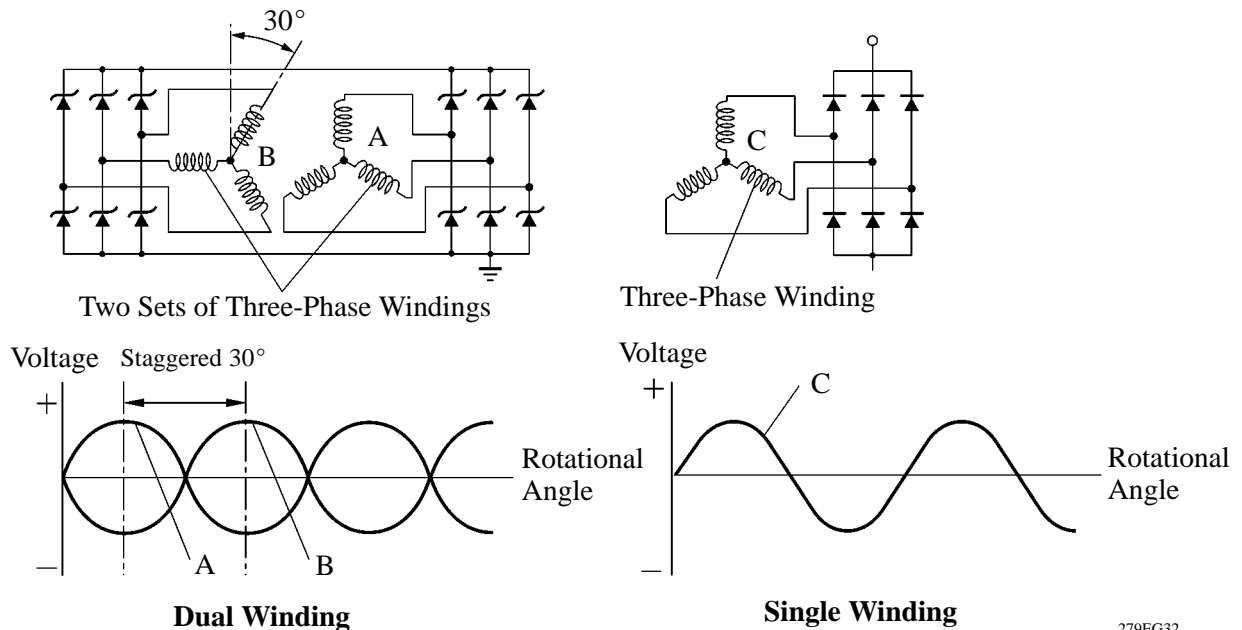
*: Rear Seat Entertainment System

► Wiring Diagram ◀



2. Dual Winding System (For Towing Package Models and Models with RSES)

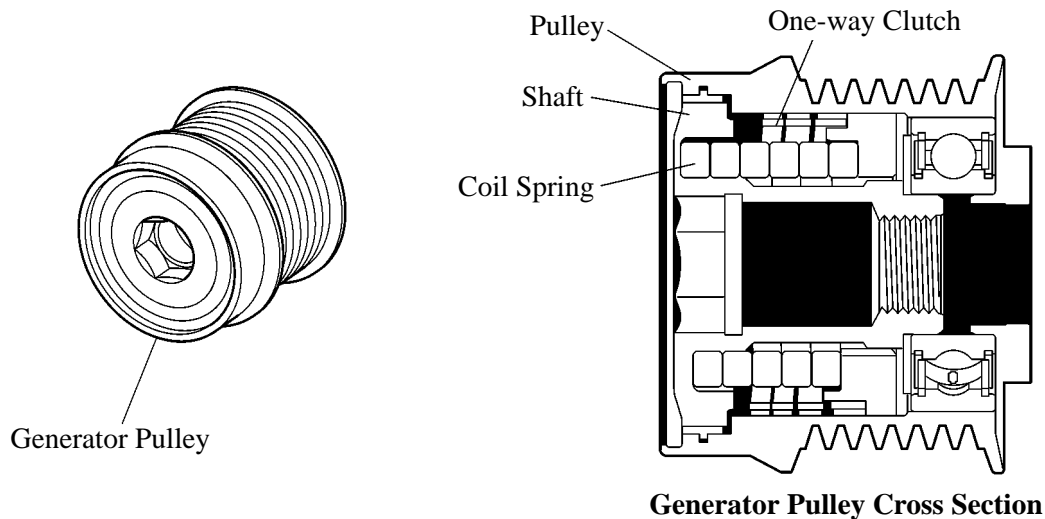
A dual winding system is used. This system consists of two sets of three-phase windings whose phases are staggered 30° . Because the generated waves from the respective windings cancel out each other, magnetic noise is reduced.



279EG32

3. Generator Pulley

A one-way clutch is set to the generator pulley. Operation of the one-way clutch cancels generator pulley inertia and helps to prevent slipping of the V-ribbed belt. This realizes a low tension V-ribbed belt that achieves reduced friction.



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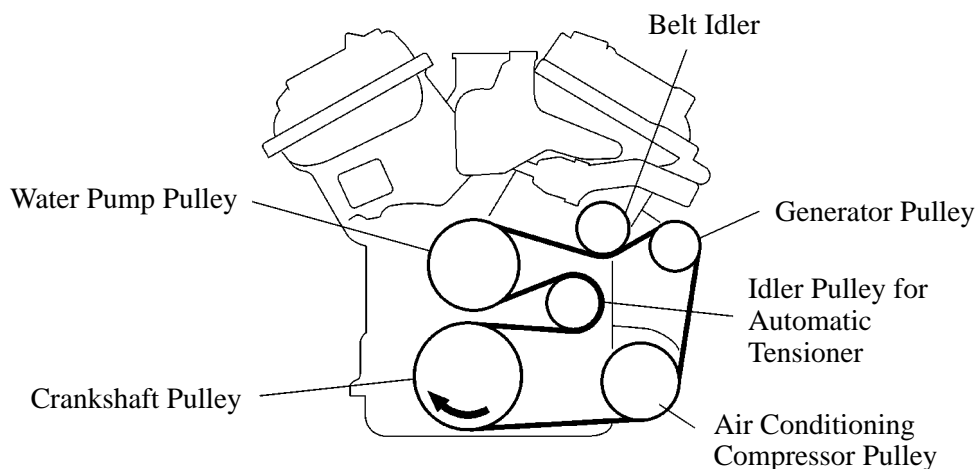
■ STARTING SYSTEM

The 2GR-FE engine uses the same starter as the 2AZ-FE engine. For details, see page EG-27.

■ SERPENTINE BELT DRIVE SYSTEM

1. General

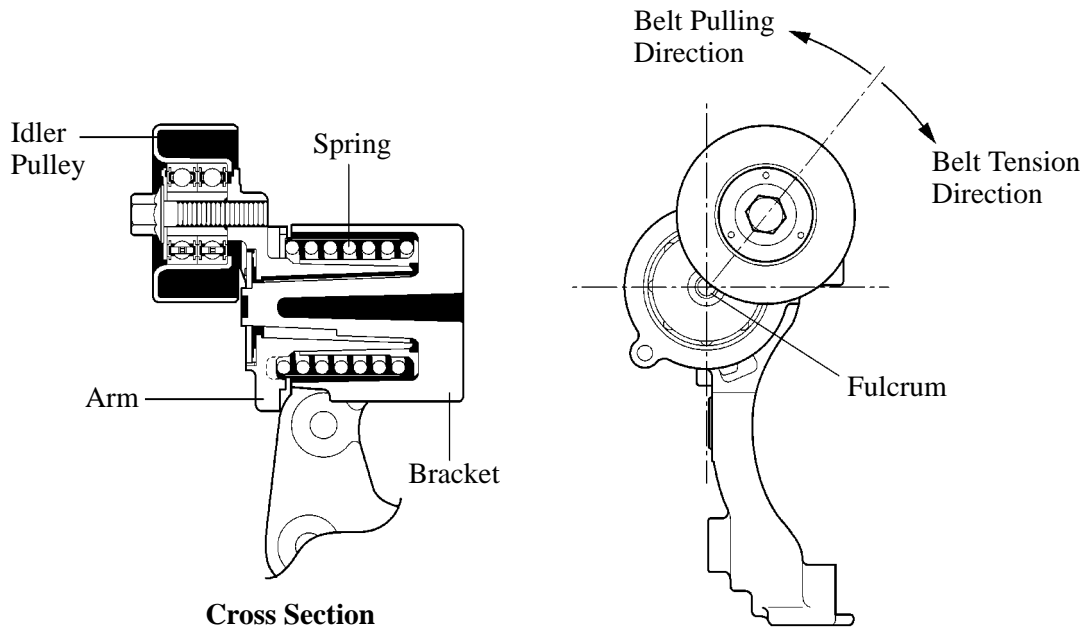
- Accessory components are driven by a serpentine belt consisting of a single V-ribbed belt. It reduces the overall engine length, weight and the number of engine parts.
- An automatic tensioner eliminates the need for tension adjustment.



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2. Automatic Tensioner

The tension of the V-ribbed belt is properly maintained by the tension spring that is enclosed in the automatic tensioner.



285EG78

■ ENGINE CONTROL SYSTEM

1. General

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

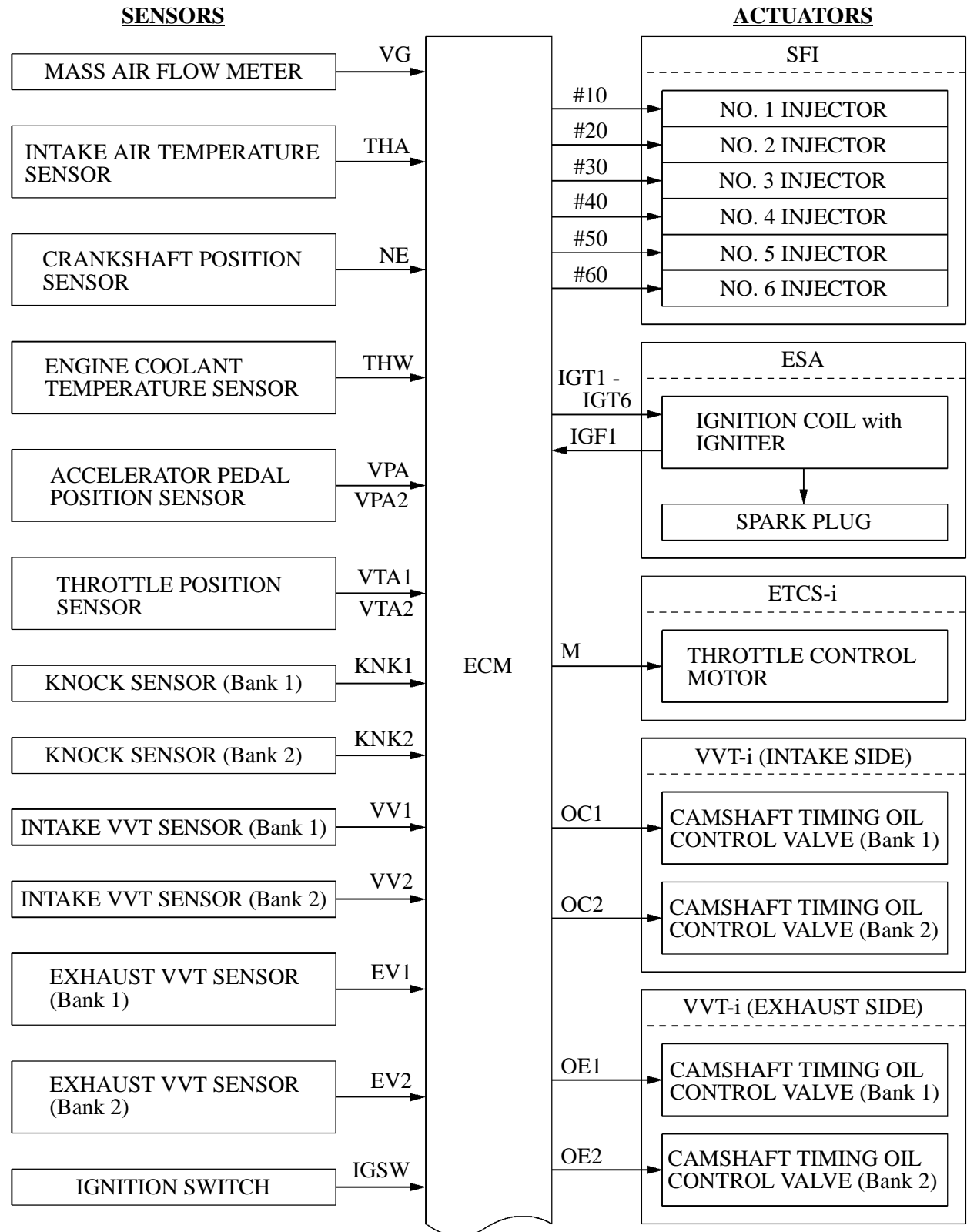
System	Outline
SFI (Sequential Multiport Fuel Injection) [See page EG-117]	An L-type SFI system detects the intake air mass with a hot-wire type air flow meter.
ESA (Electronic Spark Advance)	<ul style="list-style-type: none"> ● Ignition timing is determined by the ECM based on signals from various sensors. 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.
ETCS-i (Electronic Throttle Control System-intelligent) [See page EG-118]	Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the condition of the engine and the vehicle.
Dual VVT-i (Variable Valve Timing-intelligent) System [See page EG-120]	Controls the intake and exhaust camshafts to an optimal valve timing in accordance with the engine condition.
ACIS (Acoustic Control Induction System) [See page EG-126]	The intake air passages are switched according to the engine speed and throttle valve opening angle to provided high performance in all speed ranges.
Air Intake Control System [See page EG-128]	The intake air duct is divided into two areas, and the ECM controls the air intake control valve and the actuator that are provided in one of the areas to reduce the amount of engine noise.
Fuel Pump Control [See page EG-53 in 2AZ-FE section]	<ul style="list-style-type: none"> ● Fuel pump operation is controlled by signals from the ECM. ● The fuel pump is stopped, when the SRS airbag is deployed in a frontal, side, and rear side collision.
Air Conditioning Cut-off Control	By turning the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.
Charging Control [See page EG-65 in 2AZ-FE section]	The engine ECU regulates the charging voltage of the generator in accordance with the driving conditions and the charging state of the battery.
Cooling Fan Control [See page EG-129]	The cooling fan ECU steplessly controls the speed of the fans in accordance with the engine coolant temperature, vehicle speed, engine speed, and air conditioning operating conditions. As a result, the cooling performance is improved.

(Continued)

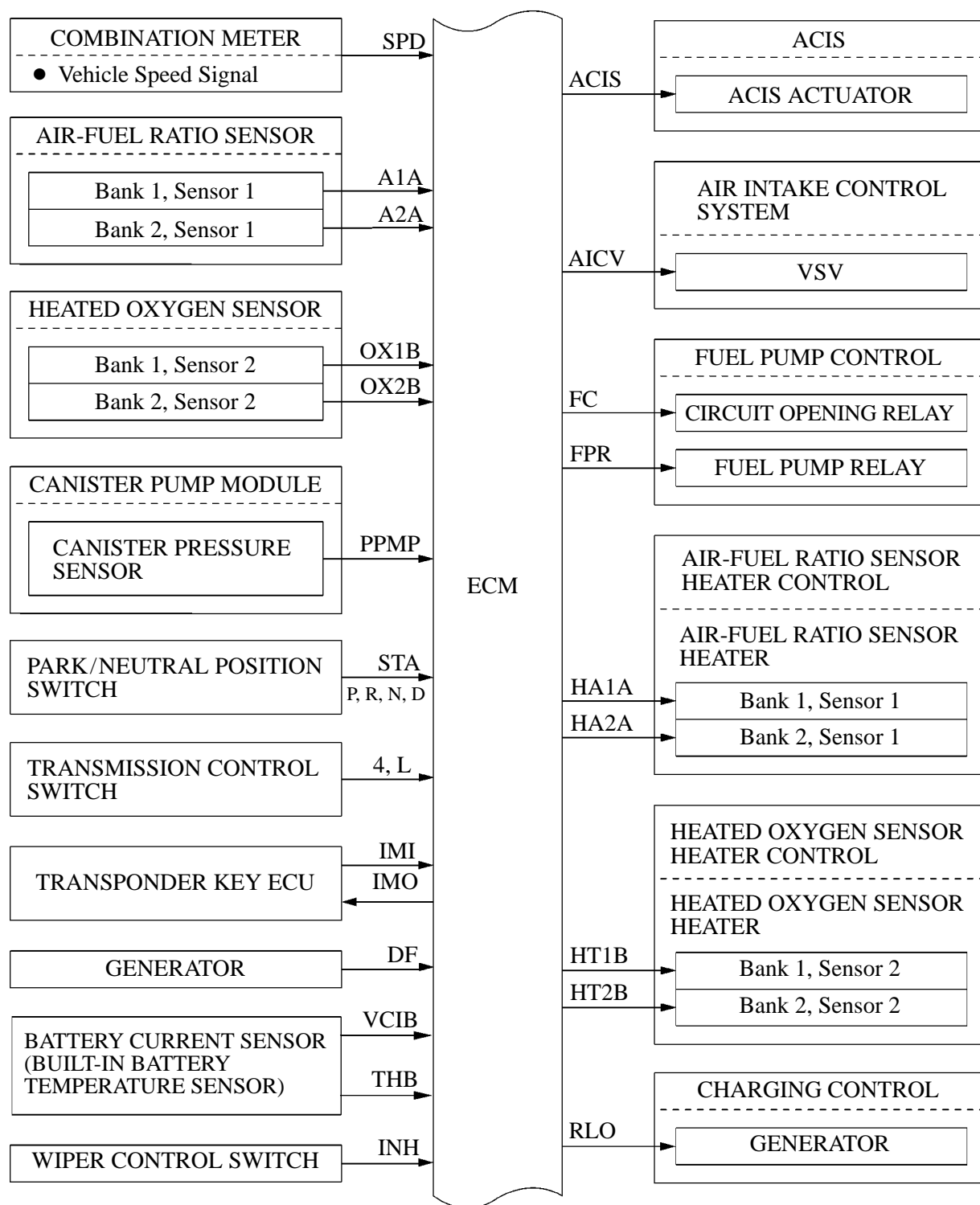
System	Outline
Air-fuel Ratio Sensor and Oxygen Sensor Heater Control	Maintains the temperature of the air-fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Evaporative Emission Control [See page EG-131]	<ul style="list-style-type: none">● The ECM controls the purge flow of evaporative emission (HC) in the canister in accordance with engine conditions.● Approximately five hours after the ignition switch has been turned OFF, the ECM operates the canister pump module to detect any evaporative emission leakage occurring in the EVAP (evaporative emission) control system through changes in the EVAP control system pressure.
Engine Immobilizer	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.
Diagnosis [See page EG-132]	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.
Fail-safe [See page EG-133]	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

2. Construction

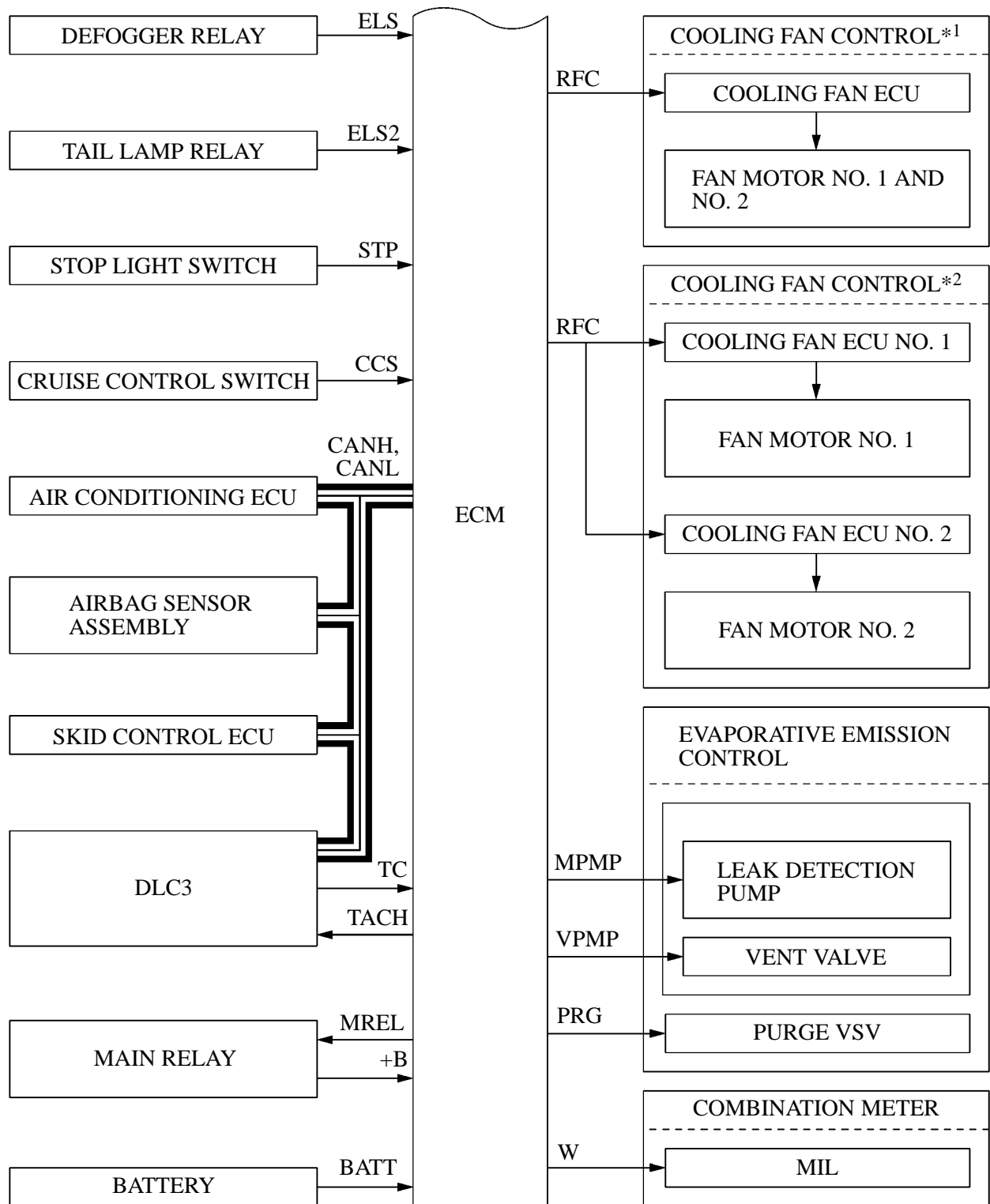
The configuration of the engine control system is as shown in the following chart.



(Continued)



(Continued)

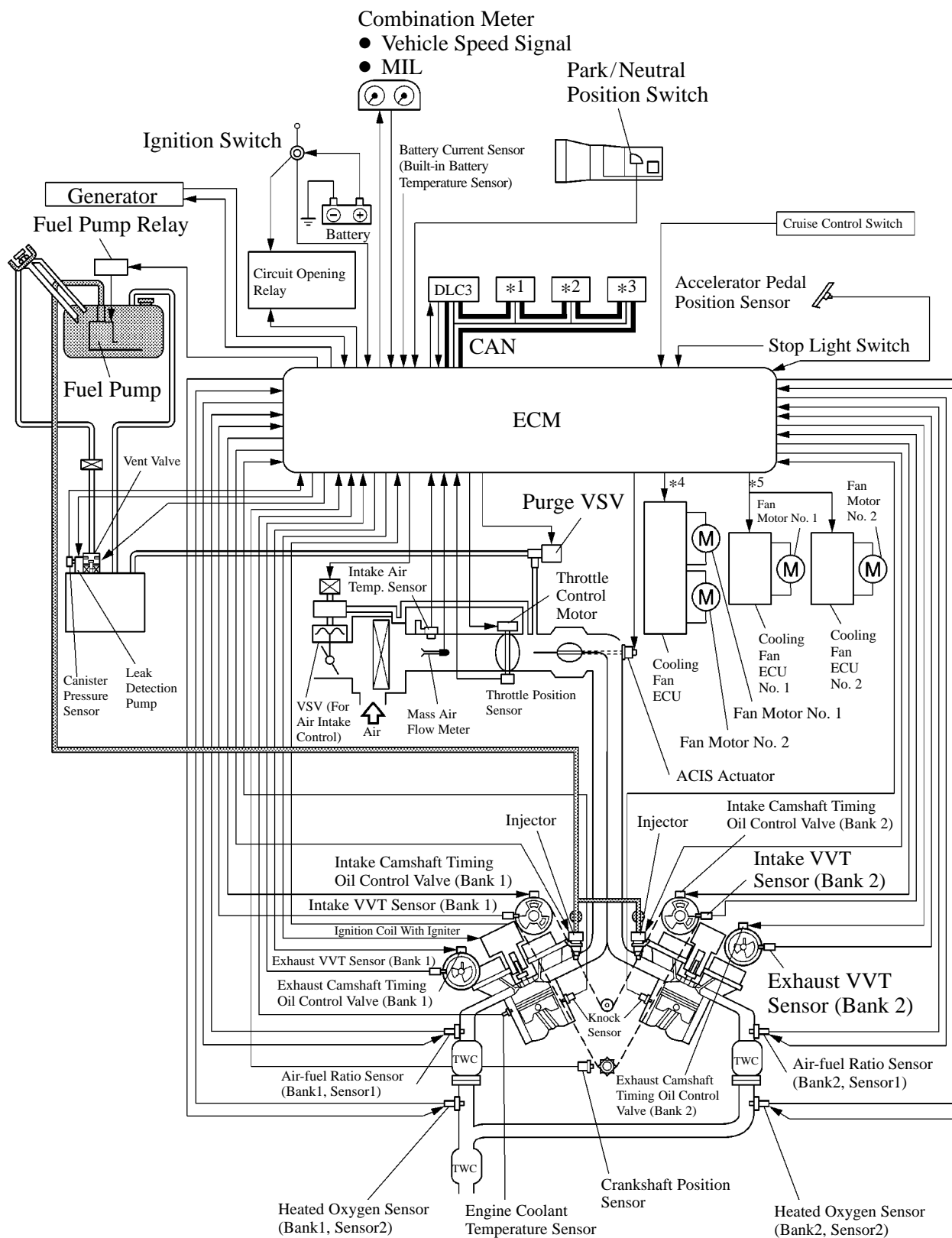


≡ : CAN

*1: Except Towing Package Models

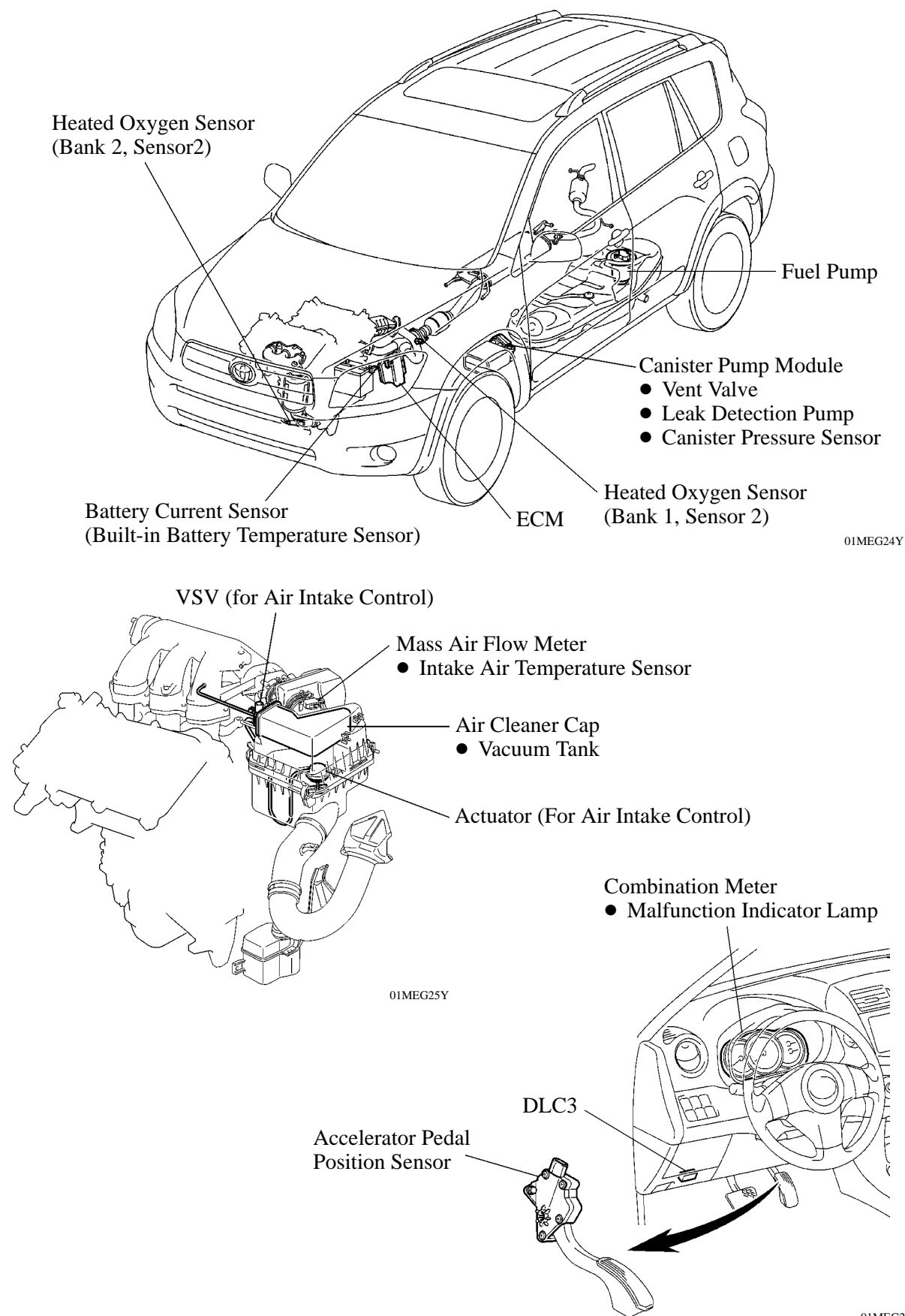
*2: Towing Package Models

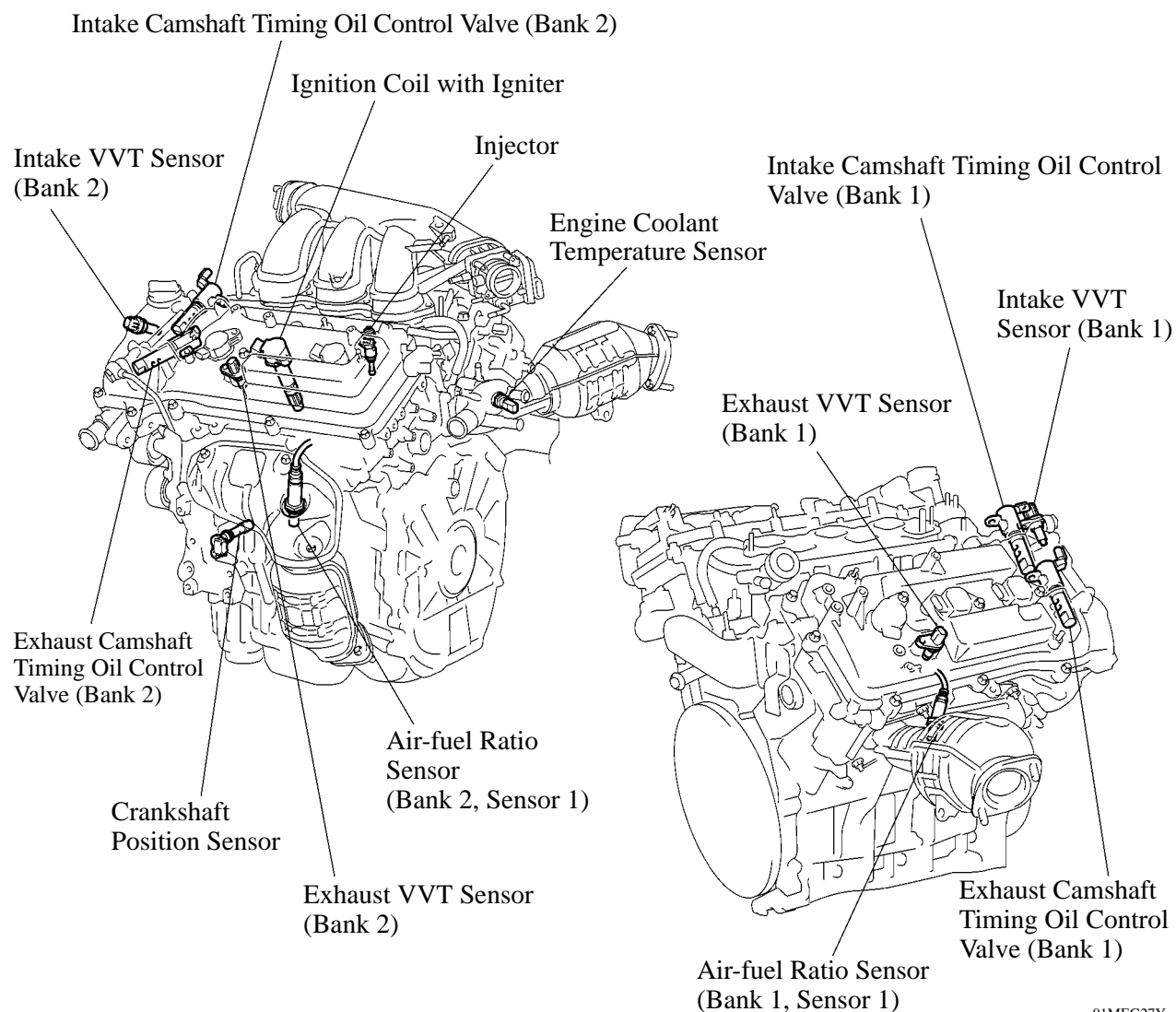
3. Engine Control System Diagram



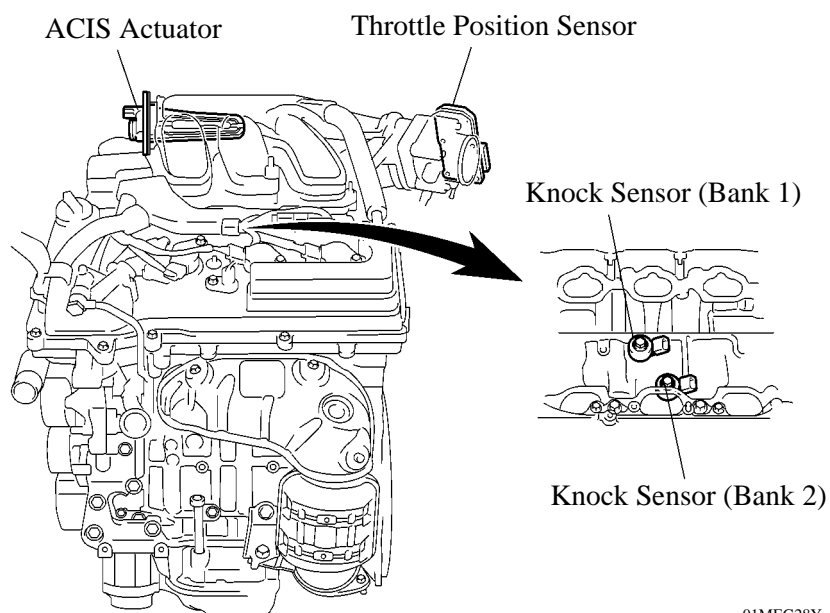
- *1: Air Conditioning ECU
- *2: Airbag Sensor Assembly
- *3: Skid Control ECU
- *4: Except Towing Package Models
- *5: Towing Package Models

4. Layout of Main Components





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5. Main Components of Engine Control System

General

The main components of the 2GR-FE engine control system are as follows:

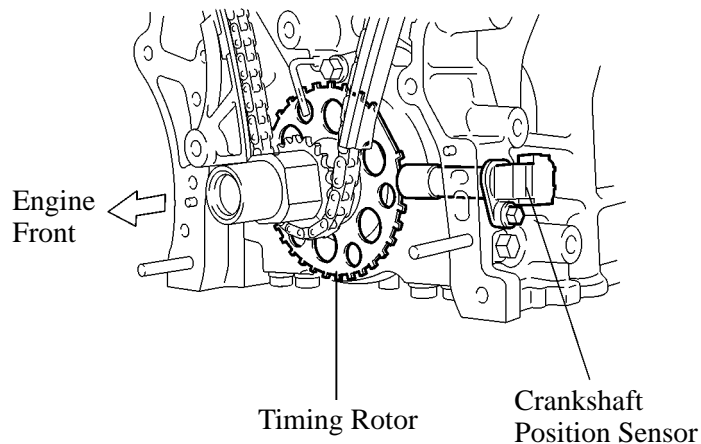
Component		Outline	Quantity
ECM		32-bit CPU	1
Mass Air Flow Meter		Hot-wire Type	1
Crankshaft Position Sensor (Rotor Teeth)		Pick-up Coil Type (36 - 2)	1
Intake VVT Sensor (Rotor Teeth)		MRE (Magnetic Resistance Element) Type (3)	2
Exhaust VVT Sensor (Rotor Teeth)		MRE (Magnetic Resistance Element) Type (3)	2
Accelerator Pedal Position Sensor		Non-contact Type	1
Throttle Position Sensor		Non-contact Type	1
Knock Sensor		Built-in Piezoelectric Type (Non-resonant Type/Flat Type)	2
Air-fuel Ratio Sensor	(Bank 1, Sensor 1)	Type with Heater (Planar Type)	1 each
	(Bank 2, Sensor 1)		
Heated Oxygen Sensor	(Bank 1, Sensor 2)	Type with Heater (Cup Type)	1 each
	(Bank 2, Sensor 2)		
Injector		12-hole Type	6

Mass Air Flow Meter

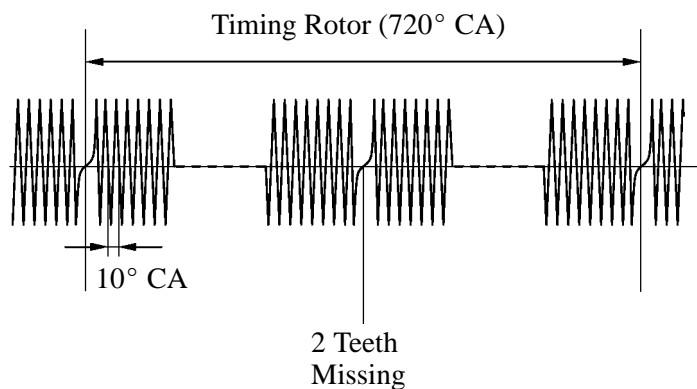
The 2GR-FE engine uses the same mass air flow meter as the 2AZ-FE engine. For details, see page EG-38.

Crankshaft Position Sensor

The timing rotor of the crankshaft consists of 34 teeth, with 2 teeth missing. The crankshaft position sensor outputs the crankshaft rotation signals every 10° , and the missing teeth are used to determine the top-dead-center.



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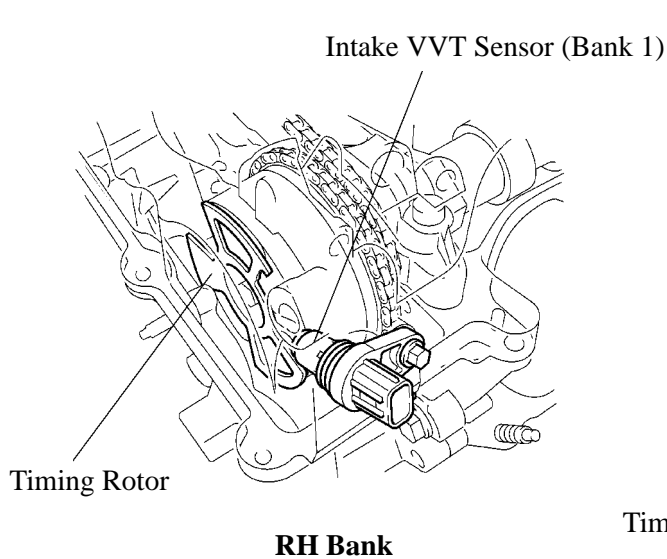


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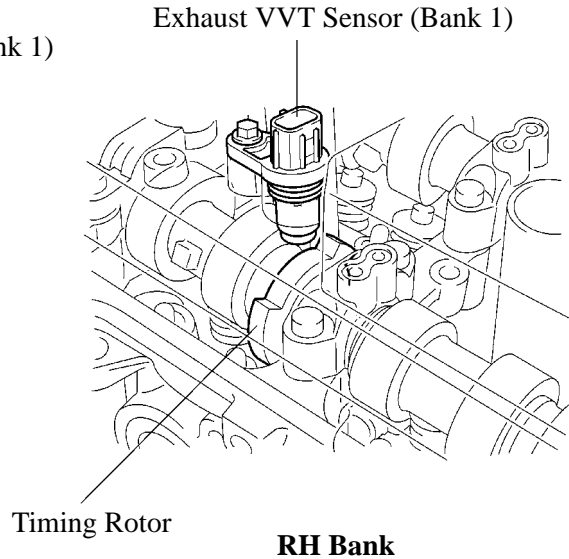
Intake and Exhaust VVT Sensors

1) General

The MRE (Magnetic Resistance Element) type intake and exhaust VVT sensors are used. To detect the camshaft position, a timing rotor that is secured to the camshaft in front of the VVT controller is used to generate 6 (3 Hi Output, 3 Lo Output) pulses for every 2 revolutions of the crankshaft.

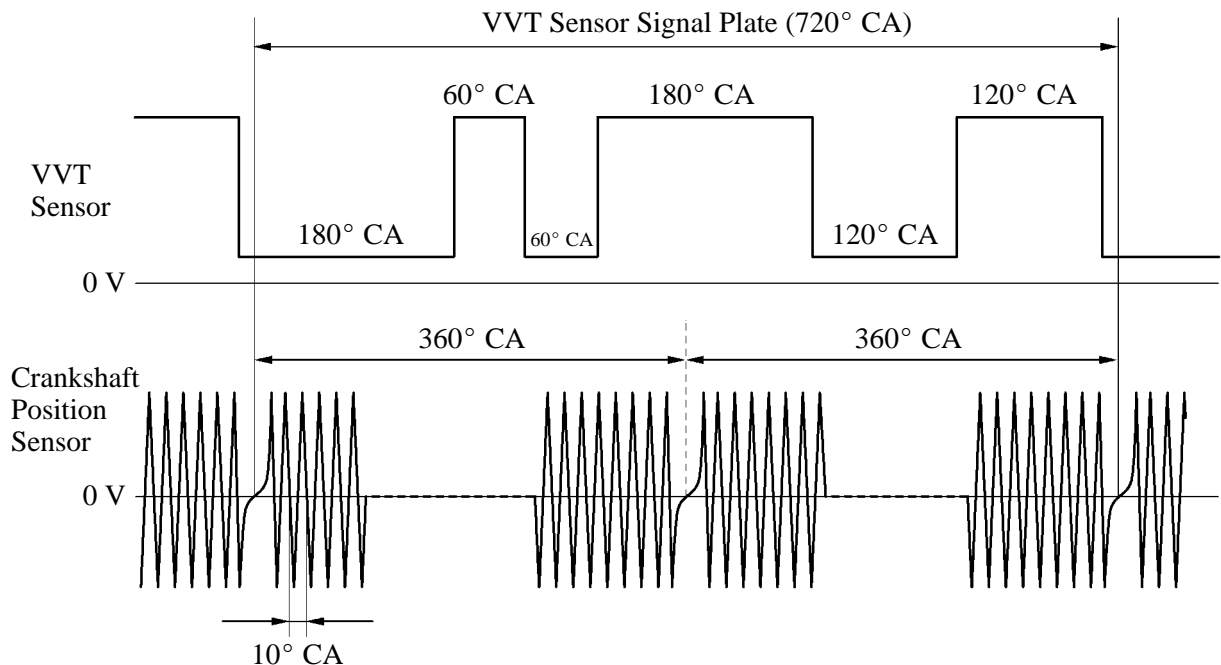


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► Sensor Output Waveforms ◀



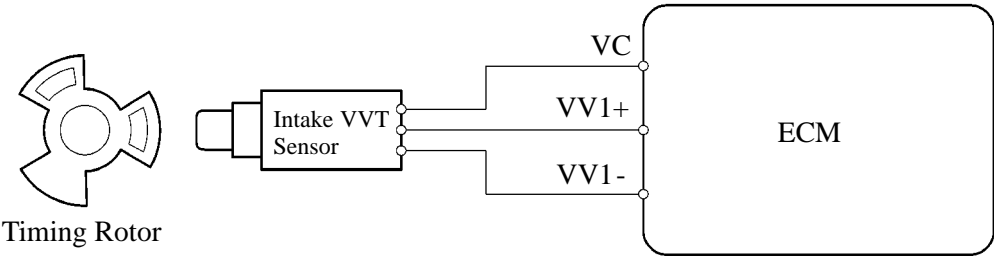
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2) MRE Type VVT Sensor

- The MRE type VVT sensor consists of an MRE, a magnet and a sensor. The direction of the magnetic field changes due to the different shapes (protruded and non-protruded portions) of the timing rotor, which passes by the sensor. As a result, the resistance of the MRE changes, and the output voltage to the ECM changes to Hi or Lo. The ECM detects the camshaft position based on this output voltage.
- The differences between the MRE type VVT sensor and the pick-up coil type VVT sensor used on the conventional models are as follows.

Item	Sensor Type	
	MRE	Pick-up Coil
Signal Output	Constant digital output starts from low engine speeds.	Analog output changes with the engine speed.
Camshaft Position Detection	Detection is made by comparing the NE signals with the Hi/Lo output switch timing due to the protruded/non-protruded portions of the timing rotor, or made based on the number of the input NE signals during Hi/Lo outputs.	Detection is made by comparing the NE signals with the change of waveform that is output when the protruded portion of the timing rotor passes.

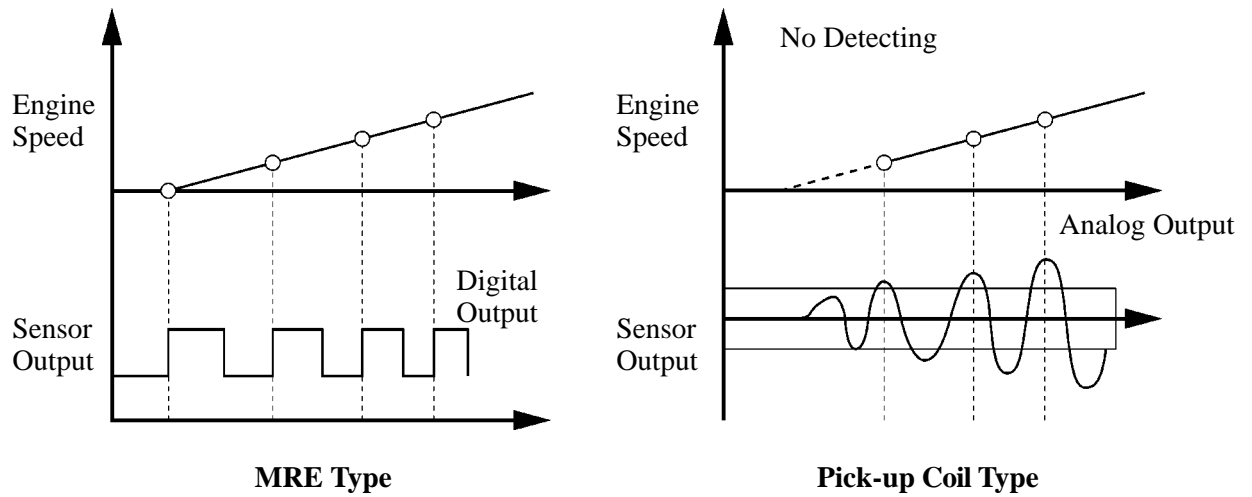
► Wiring Diagram ◀



Intake VVT Sensor (Bank 1)

271EG160

► Comparison between MRE Type and Pick-up Coil Type Output Waveform Images ◀



232CH41

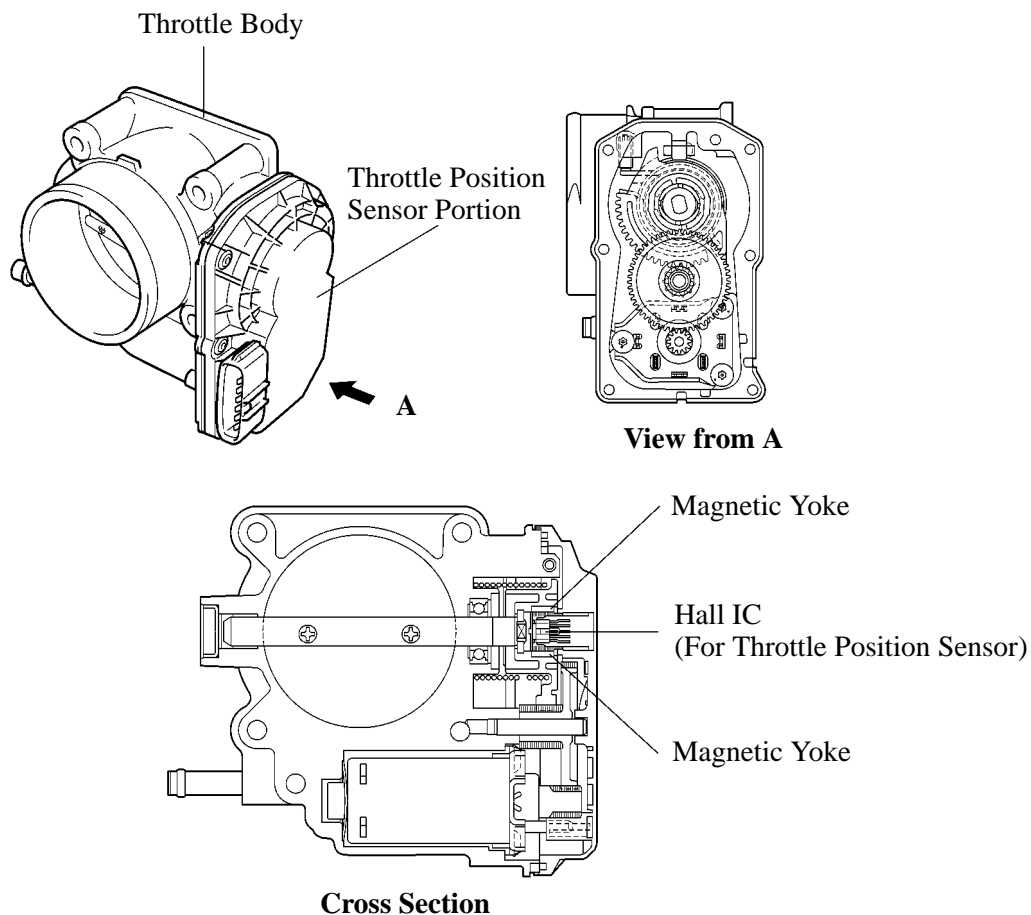
Accelerator Pedal Position Sensor

The 2GR-FE engine uses the same accelerator pedal position sensor as the 2AZ-FE engine. For details, see page EG-42.

Throttle Position Sensor

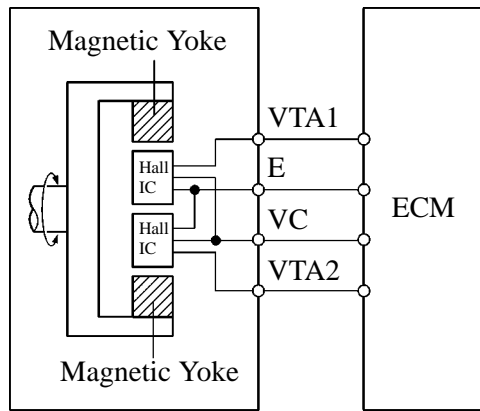
The non-contact type throttle position sensor uses a Hall IC, which is mounted on the throttle body.

- The Hall IC is surrounded by a magnetic yoke. The Hall IC converts the changes that occur in the magnetic flux at that time into electrical signals and outputs them in the form of a throttle valve effort to the ECM.
- The Hall IC contains circuits for the main and sub signals. It converts the throttle valve opening angles into electric signals with two differing characteristics and outputs them to the ECM.

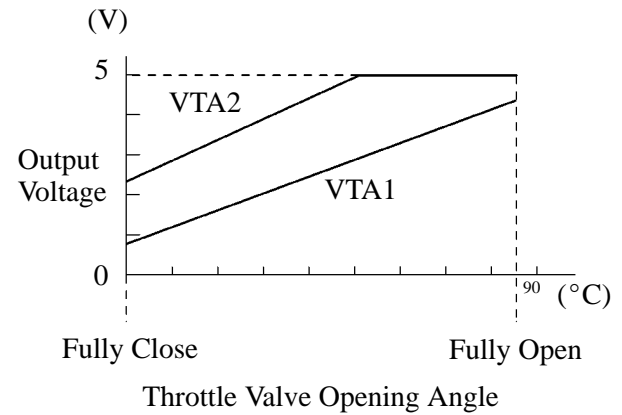


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Throttle Position Sensor



230LX12



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Service Tip

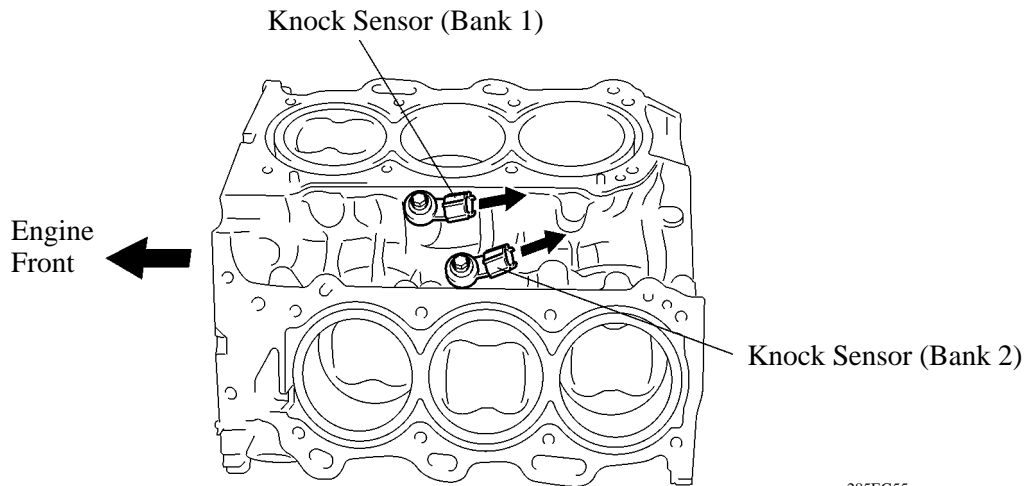
The inspection method differs from the conventional contact type throttle position sensor because this non-contact type sensor uses a hall IC. For details, refer to the 2006 RAV4 Repair Manual (Pub. No. RM01M1U).

Knock Sensor (Flat Type)

The 2GR-FE engine uses the same knock sensor as the 2AZ-FE engine. For details, see page EG-39.

Service Tip

These knock 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.



Air-fuel Ratio Sensor and Heated Oxygen Sensor

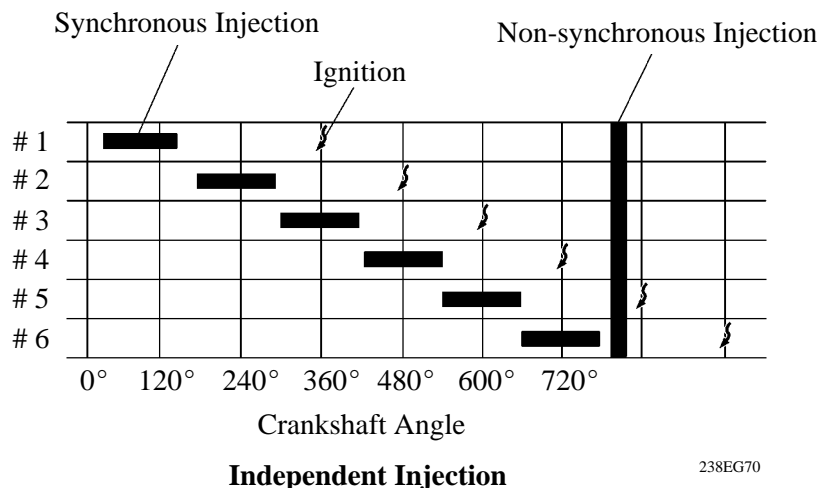
The planar type air-fuel ratio sensor and the cup type heated oxygen sensor are used. For details, see page EG-37.

6. SFI (Sequential Multiport Fuel Injection) System

- An L-type SFI system directly detects the intake air mass with a hot wire type mass air flow meter.
- An independent injection system (in which fuel is injected once into each cylinder for each two revolution of the crankshaft) is used.
- There are two (synchronous and non-synchronous) injections:
 - a) The synchronous injection in which corrections based on the signals from the sensors are added to the basic injection time so that injection occurs always 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.

Furthermore, to protect the engine and achieve lower fuel consumption, the system uses a fuel cutoff in which the injection of fuel is 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.



7. ESA (Electronic Spark Advance) System

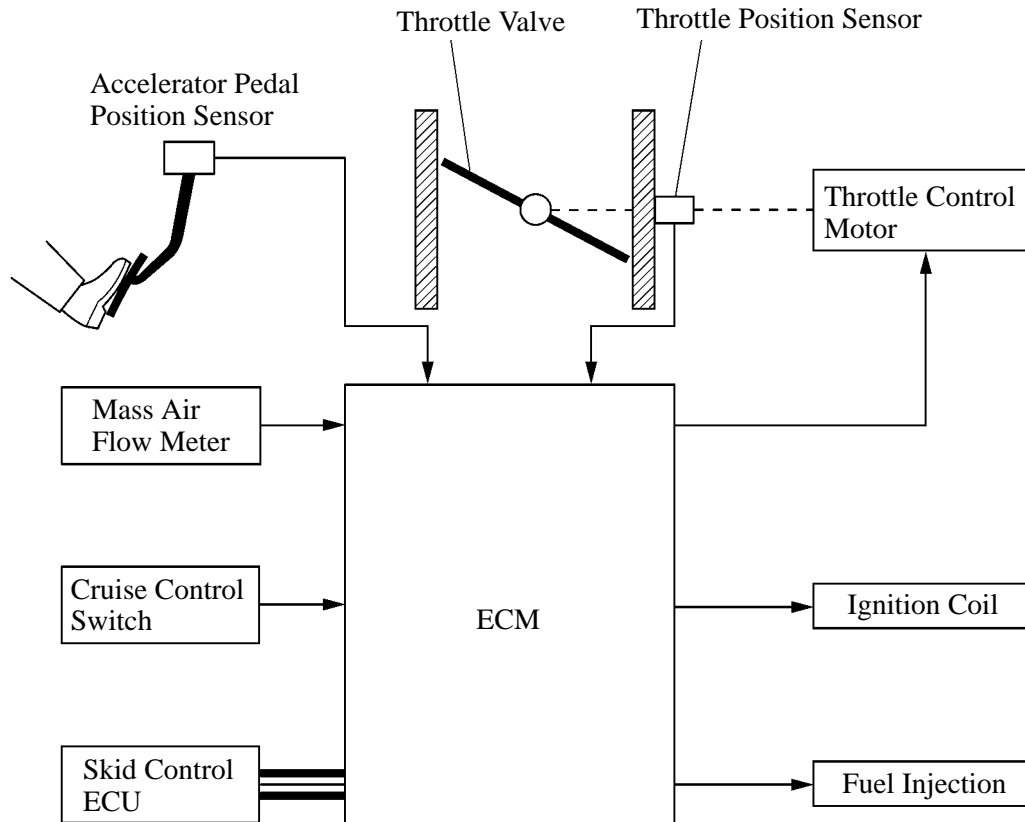
This system selects the optimal ignition timing in accordance with the signals received from the sensors and sends the (IGT) ignition signal to the igniter.

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

General

In the conventional throttle body, the throttle valve angle is determined invariably by the amount of the accelerator pedal effort. In contrast, ETCS-i uses the ECM to calculate the optimal throttle valve angle that is appropriate for the respective driving condition and uses a throttle control motor to control the angle.

► System Diagram ◀



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Control

1) General

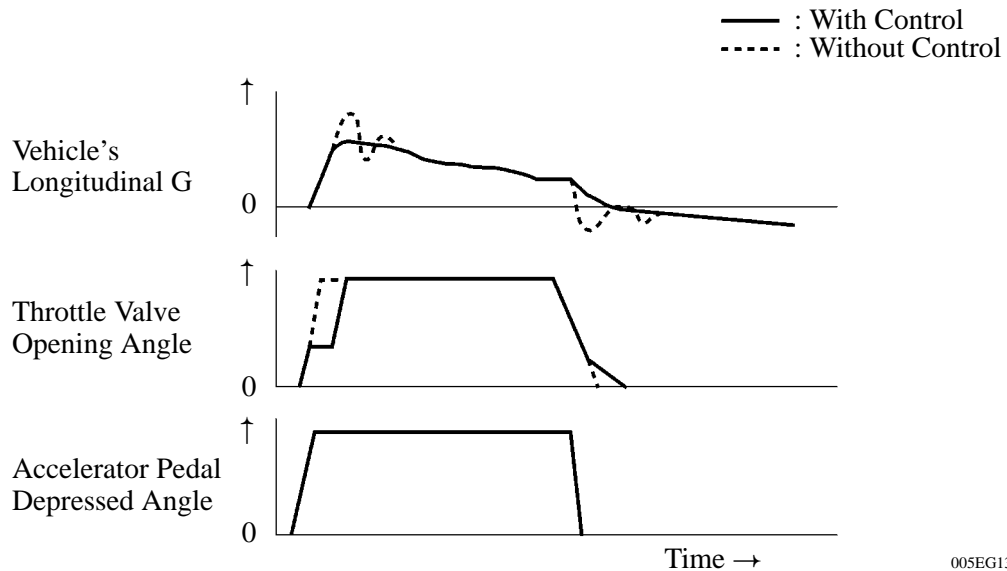
The ETCS-i consists of the following five functions:

- Normal Throttle Control (Non-linear Control)
- IAC (Idle Air Control)
- TRAC (Traction Control)
- VSC (Vehicle Stability Control)
- Cruise Control

2) Normal Throttle Control (Non-linear Control)

The ECM controls the throttle to an optimal throttle valve angle that is appropriate for the driving condition such as the amount of the accelerator pedal effort and the engine speed in order to realize excellent throttle control and comfort in all operating ranges.

► Control Examples during Acceleration and Deceleration ◀



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3) Idle Air Control

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

4) TRAC Throttle Control

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

5) VSC Coordination Control

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

6) Cruise Control

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

Fail-safe of Accelerator Pedal Position Sensor

For details, see page 46 in 2AZ-FE engine section.

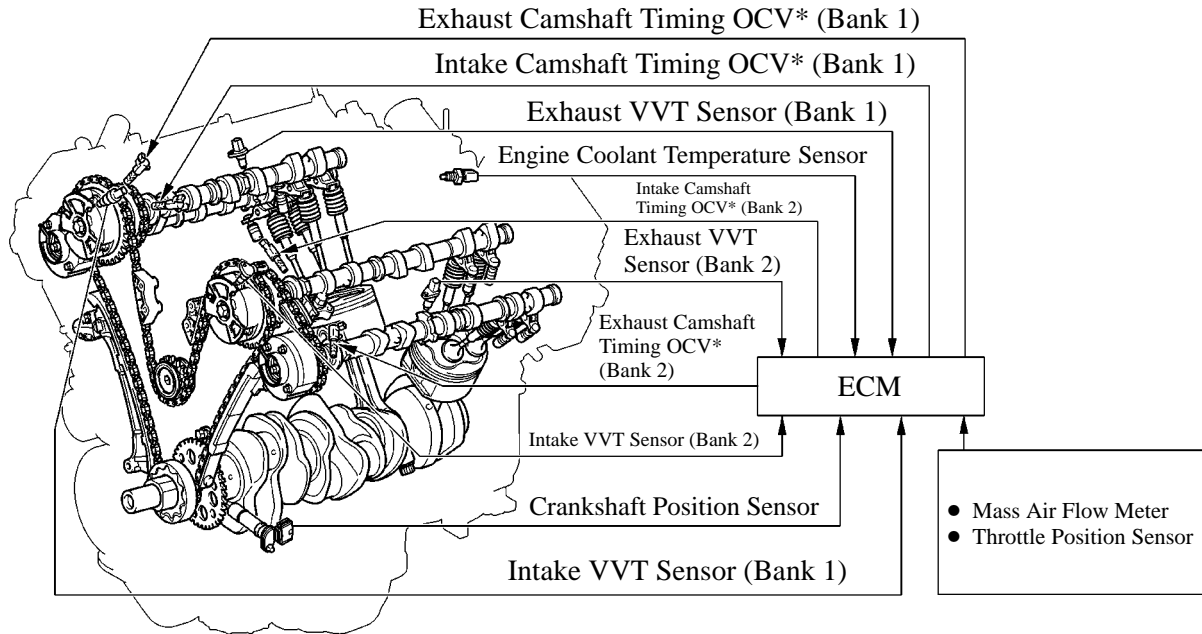
Fail-safe of Throttle Position Sensor

For details, see page 47 in 2AZ-FE engine section.

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

General

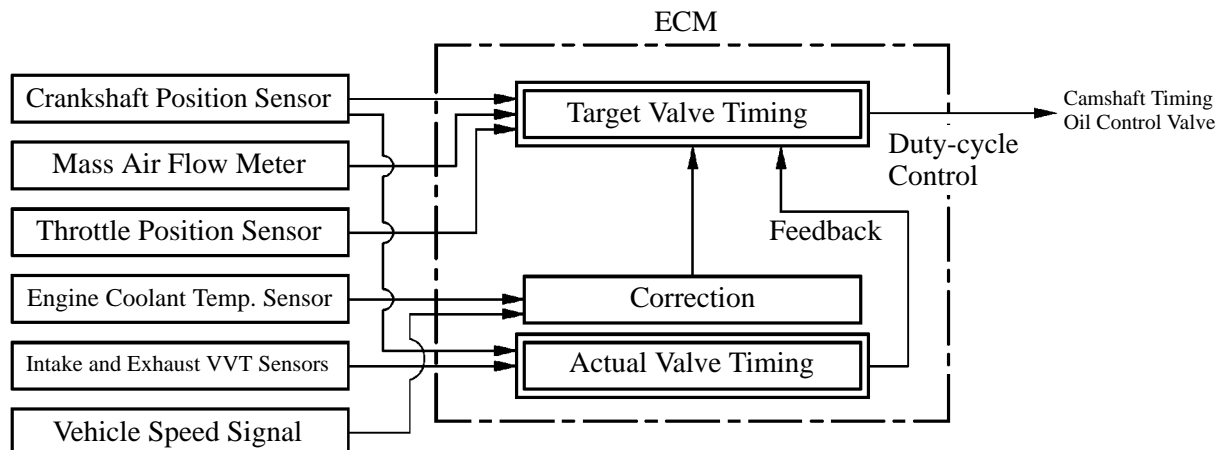
- The Dual VVT-i system is designed to control the intake and exhaust camshafts within a range of 40° and 35° respectively (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



285EG57

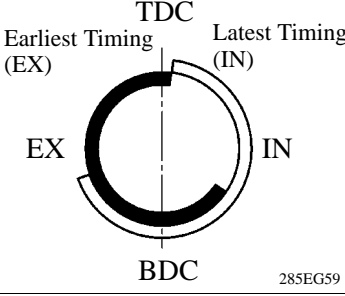
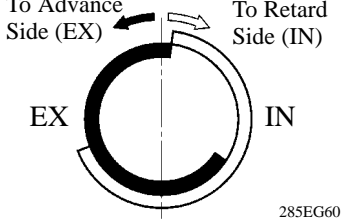
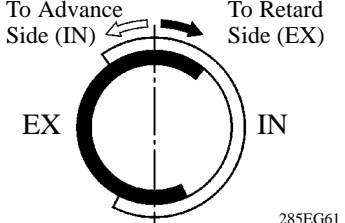
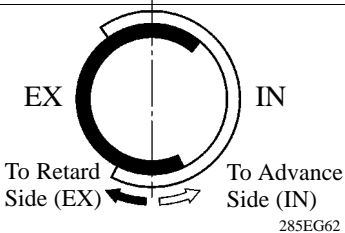
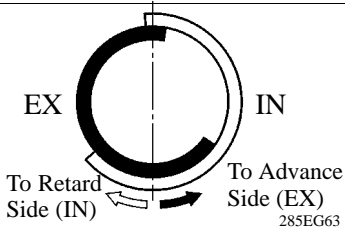
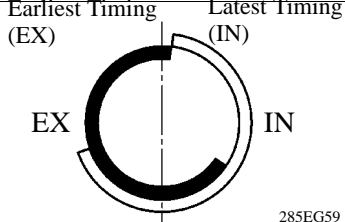
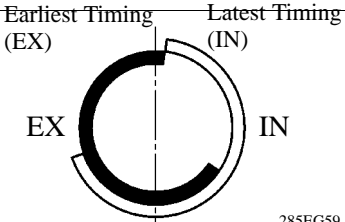
*: Oil Control Valve

- Using the engine speed signal, vehicle speed signal, and the signals from mass air flow meter, throttle position sensor and engine coolant temperature sensor, the ECM calculates optimal valve timing for each driving condition and controls the camshaft timing oil control valve. In addition, the ECM uses signals from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.



221EG16

Effectiveness of the VVT-i System

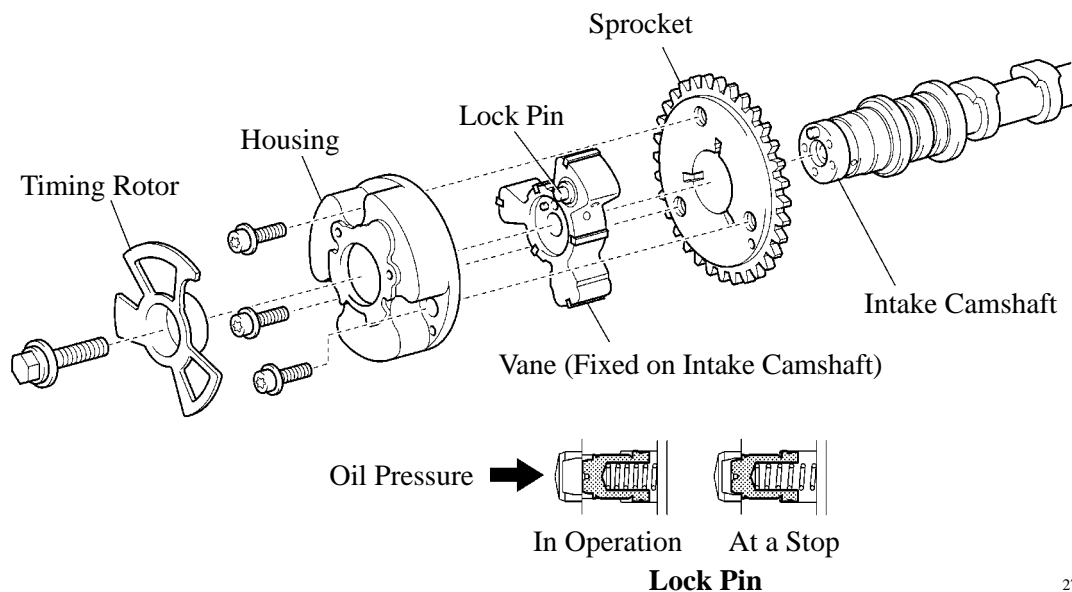
Operation State	Objective	Effect
During Idling	 <p>Eliminating overlap to reduce blow back to the intake side.</p>	<ul style="list-style-type: none"> ● Stabilized idling rpm ● Better fuel economy
At Light Load	 <p>Eliminating overlap to reduce blow back to the intake side.</p>	Ensured engine stability
At Medium Load	 <p>Increasing overlap increases internal EGR, reducing pumping loss.</p>	<ul style="list-style-type: none"> ● Better fuel economy ● Improved emission control
In Low to Medium Speed Range with Heavy Load	 <p>Advancing the intake valve close timing for volumetric efficiency improvement.</p>	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	 <p>Retarding the intake valve close timing for volumetric efficiency improvement.</p>	Improved output
At Low Temperatures	 <p>Eliminating overlap to reduce blow back to the intake side leads to the lean burning condition, and stabilizes the idling speed at fast idle.</p>	<ul style="list-style-type: none"> ● Stabilized fast idle rpm ● Better fuel economy
<ul style="list-style-type: none"> ● Upon Starting ● Stopping the Engine 	 <p>Eliminating overlap to minimize blow back to the intake side.</p>	Improved startability

Construction

1) VVT-i Controller

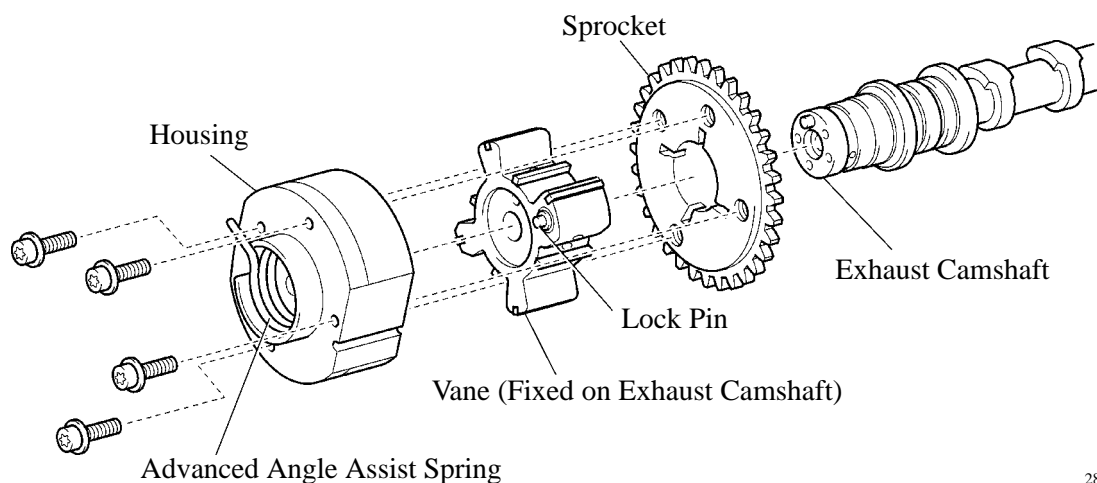
- This controller consists of the housing driven by the timing chain and the vane coupled with the intake and exhaust camshafts.
- The intake side uses a VVT-i controller with 3 vanes, and the exhaust side uses one with 4 vanes.
- When the engine stops, the intake side VVT-i controller is locked on the most retarded angle side by the lock pin, and the exhaust side VVT-i controller is locked on the most advanced angle side. This ensures excellent engine startability.
- The oil pressure sent from the advance or retard side path at the intake and exhaust camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.
- An advanced angle assist spring is provided on the exhaust side VVT-i controller. This helps to apply torque in the advanced angle direction so that the vane lock pin securely engages with the housing when the engine stops.

► Intake Side VVT-i Controller ◀



271EG93

► Exhaust Side VVT-i Controller ◀

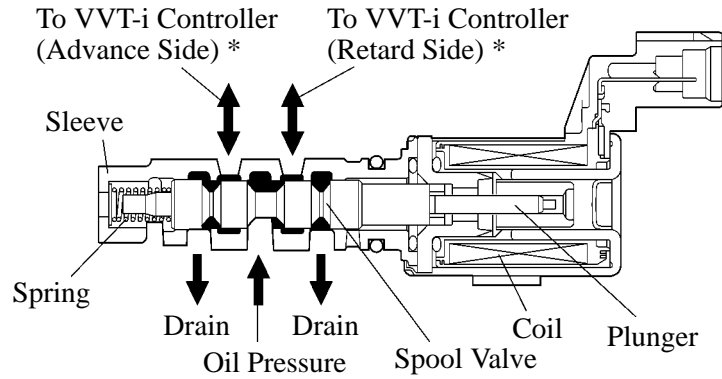


281EG47

2) Camshaft Timing Oil Control Valve

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

► Intake Camshaft Timing Oil Control Valve ◀



238EG62

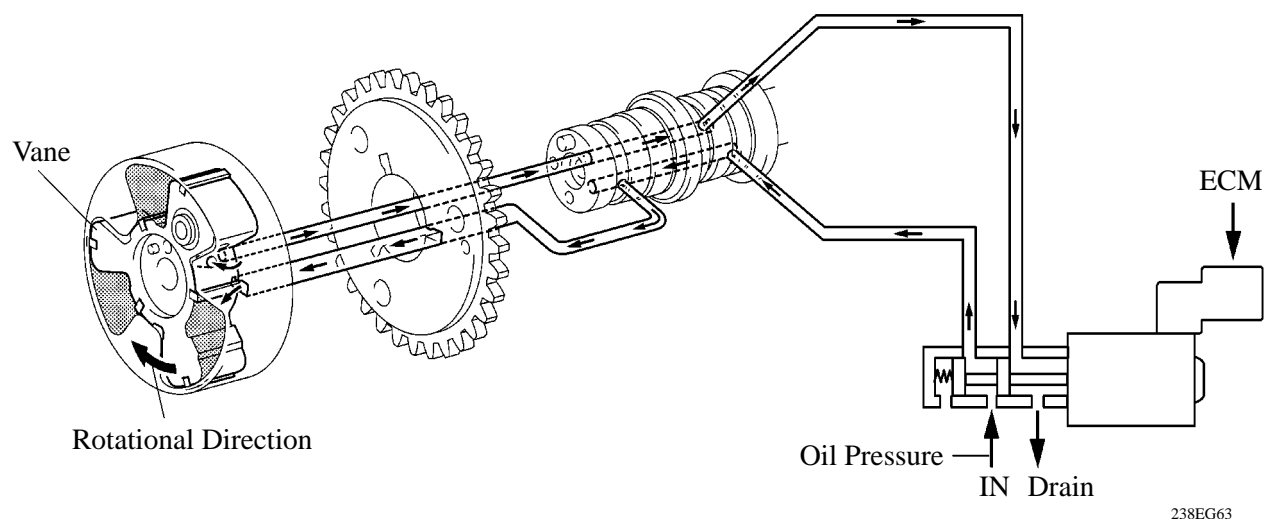
*: The advance and retard sides of the exhaust camshaft timing oil control valve are reverse of the intake side.

Operation

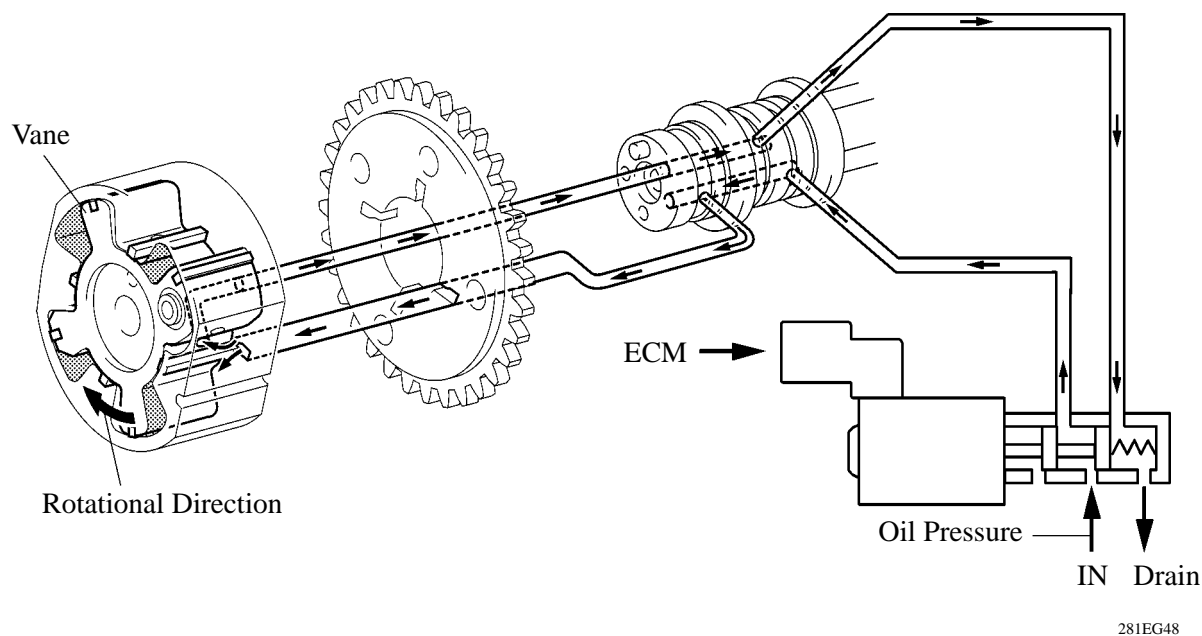
1) Advance

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

► Intake Side ◀



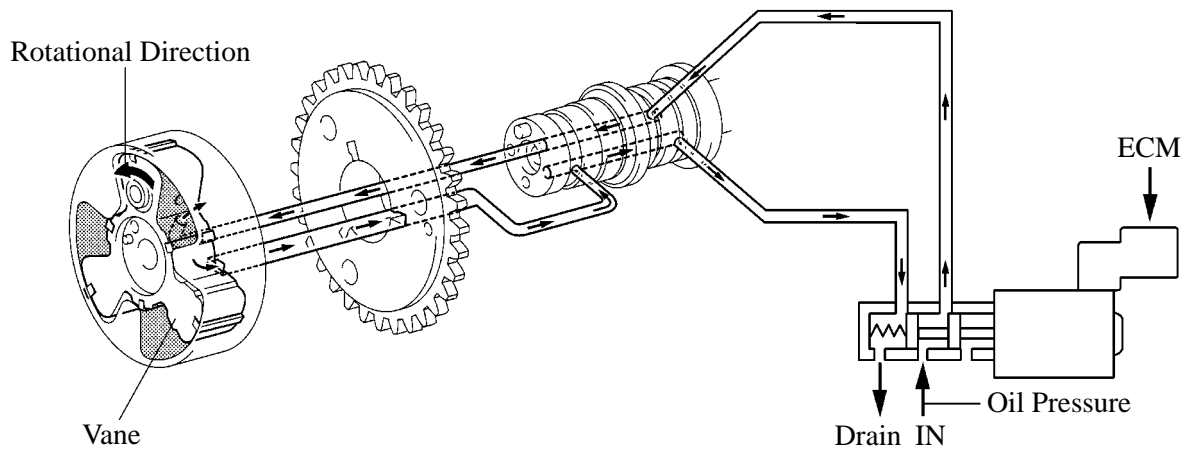
► Exhaust Side ◀



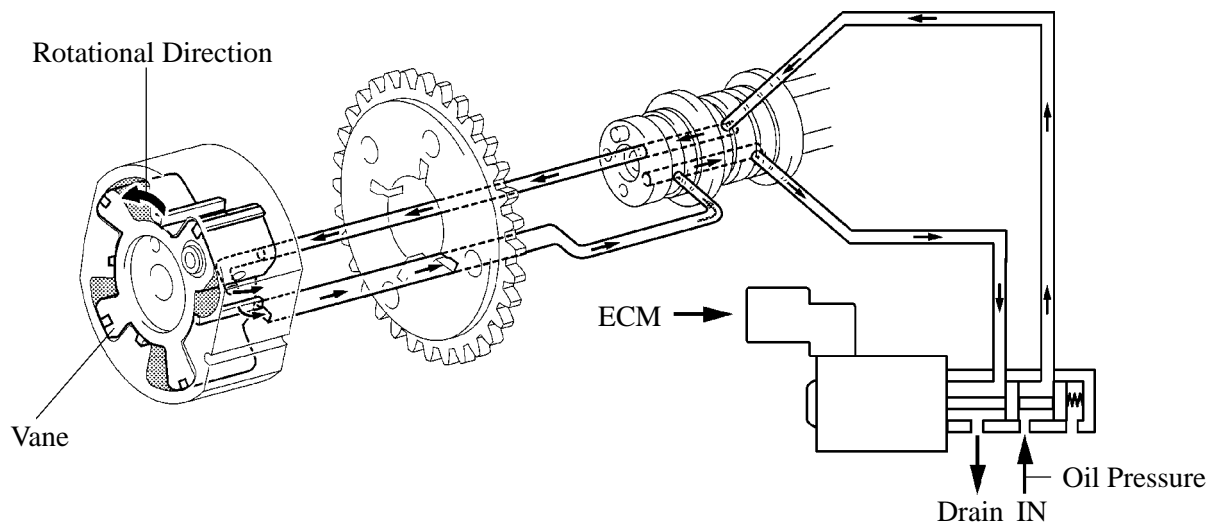
2) Retard

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

► Intake Side ◀



► Exhaust Side ◀



3) Hold

After reaching the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes.

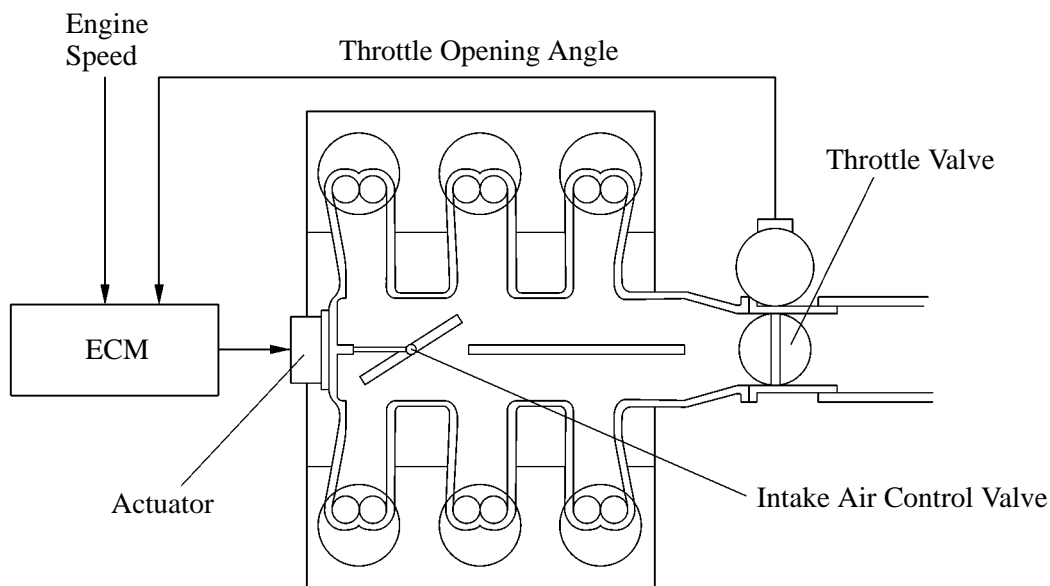
This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

10. ACIS (Acoustic Control Induction System)

General

The ACIS consists of a bulkhead to divide the intake manifold into 2 stages, and an intake air control valve in the bulkhead which opens and closes to vary the effective length of the intake manifold in accordance with the engine speed and throttle valve opening angle. This increases the power output in all ranges from low to high speed.

► System Diagram ◀



285EG58

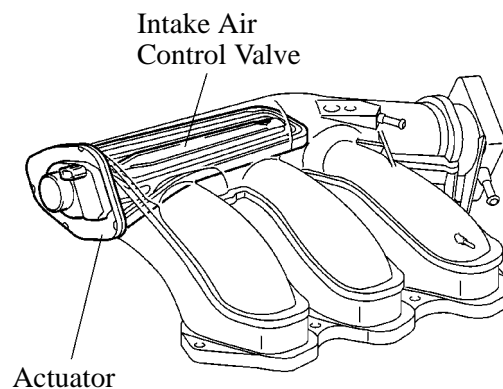
Construction

1) Intake Air Control Valve

The intake air control valve, which is provided in the intake air chamber, opens and closes to change the effective length of the intake manifold in 2 stages.

2) Actuator (Motor)

The actuator activates the intake air control valve based on signals from the ECM.

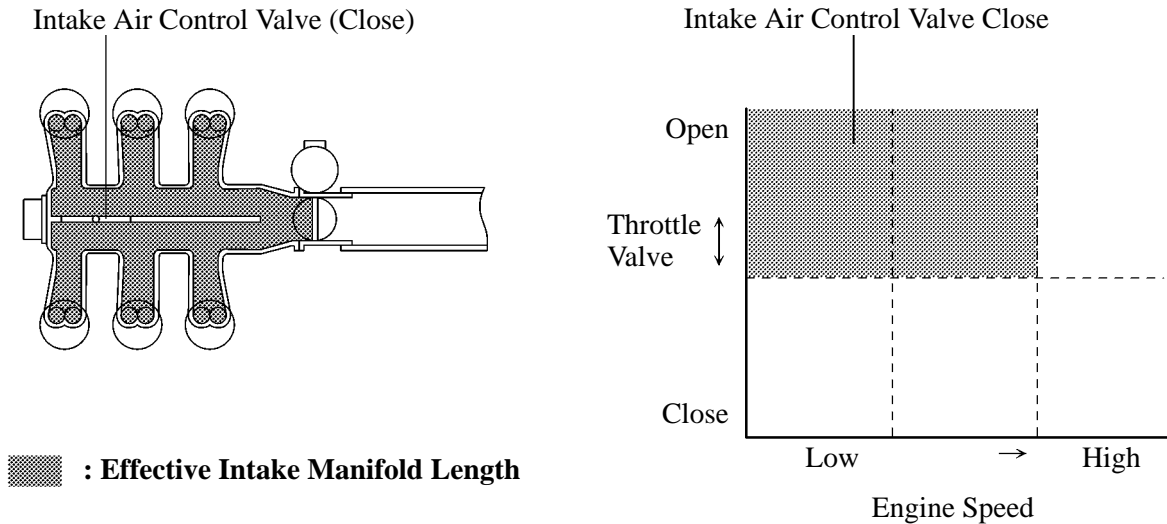


285EG64

Operation

1) When the Intake Air Control Valve Closes

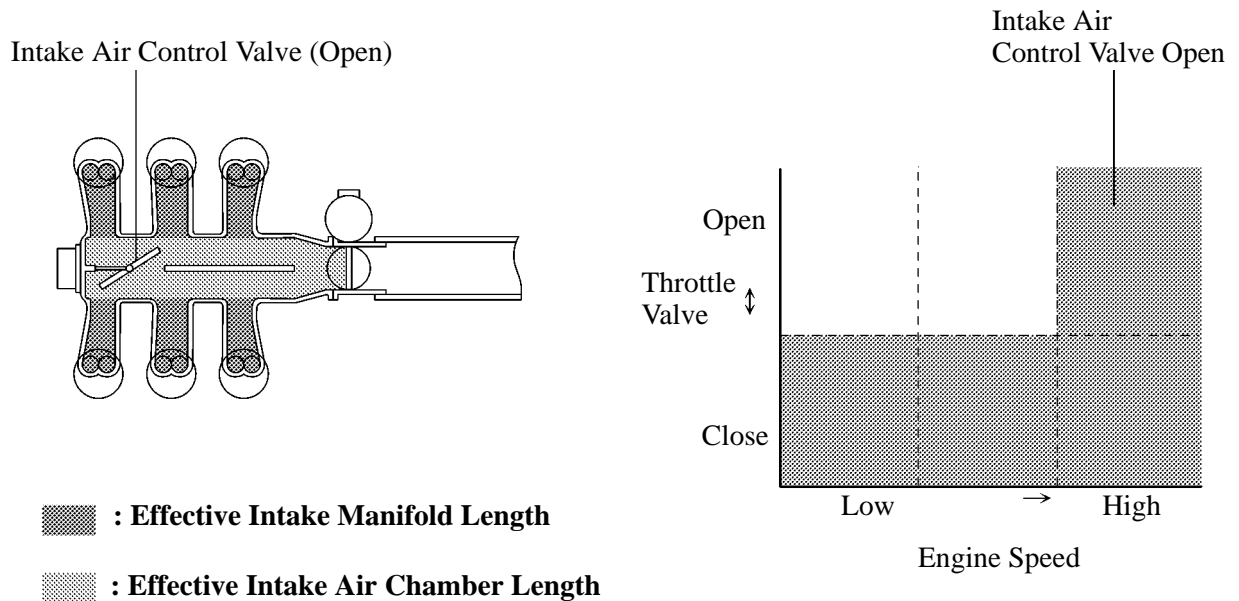
While the engine is running at middle speed under high load, the ECM controls the actuator to close the intake air control valve. As a result, the effective length of the intake manifold is lengthened and the intake efficiency, in the medium speed range, is improved due to the dynamic effect of the intake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



285EG65

2) When the Intake Air Control Valve Open

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



285EG66

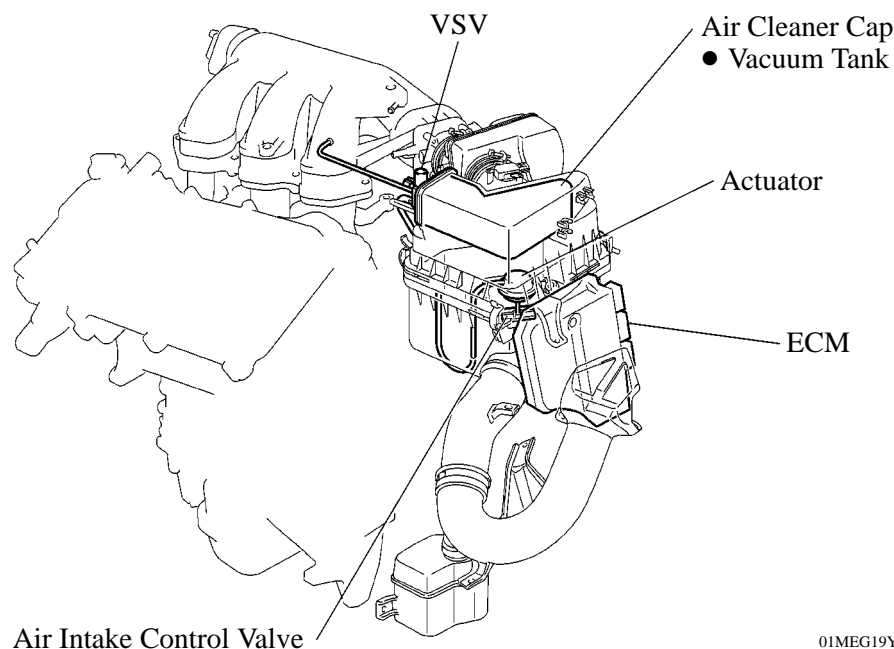
11. Air Intake Control System

General

The system has a dual path design for air intake. An air intake control valve and actuator control the air flow path.

As a result, a reduction in intake noise in the low-speed range and an increase in the power output in the high-speed range are realized.

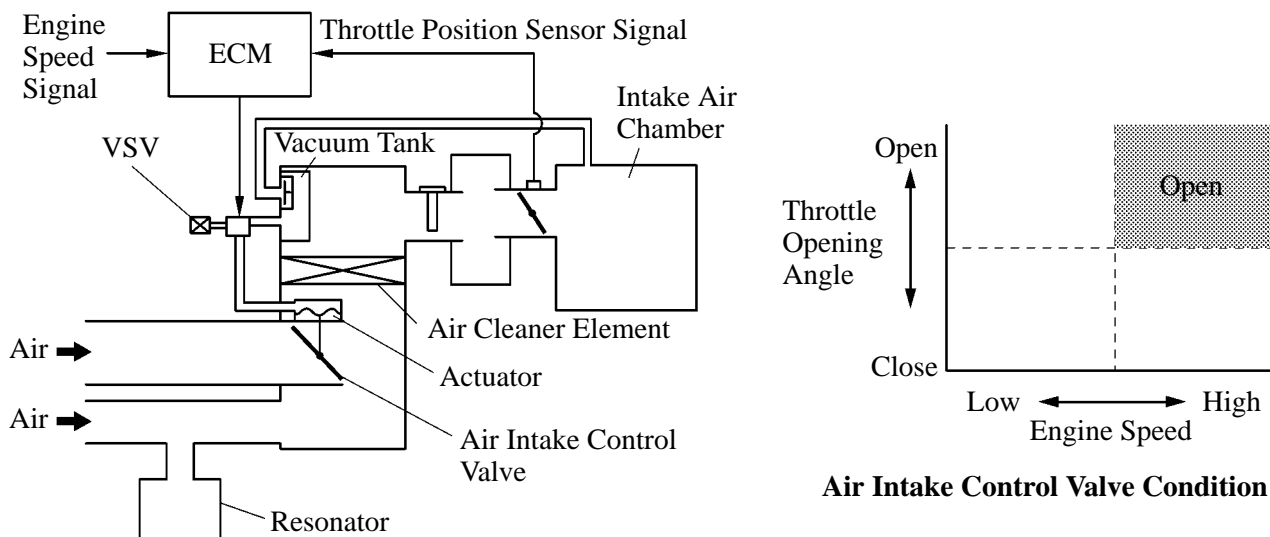
► Layout of Components ◀



01MEG19Y

Operation

- When the engine is operating in the low-to-mid speed range, this control operates the air intake control valve to close one side of the air cleaner inlet. As a result, the intake area has been minimized and the intake noise is reduced.
- When the engine is operating in the high-speed range, this control operates the air intake control valve to open both sides of the air cleaner inlet. As a result, the intake area has been maximized and the intake efficiency is improved.



01MEG20Y

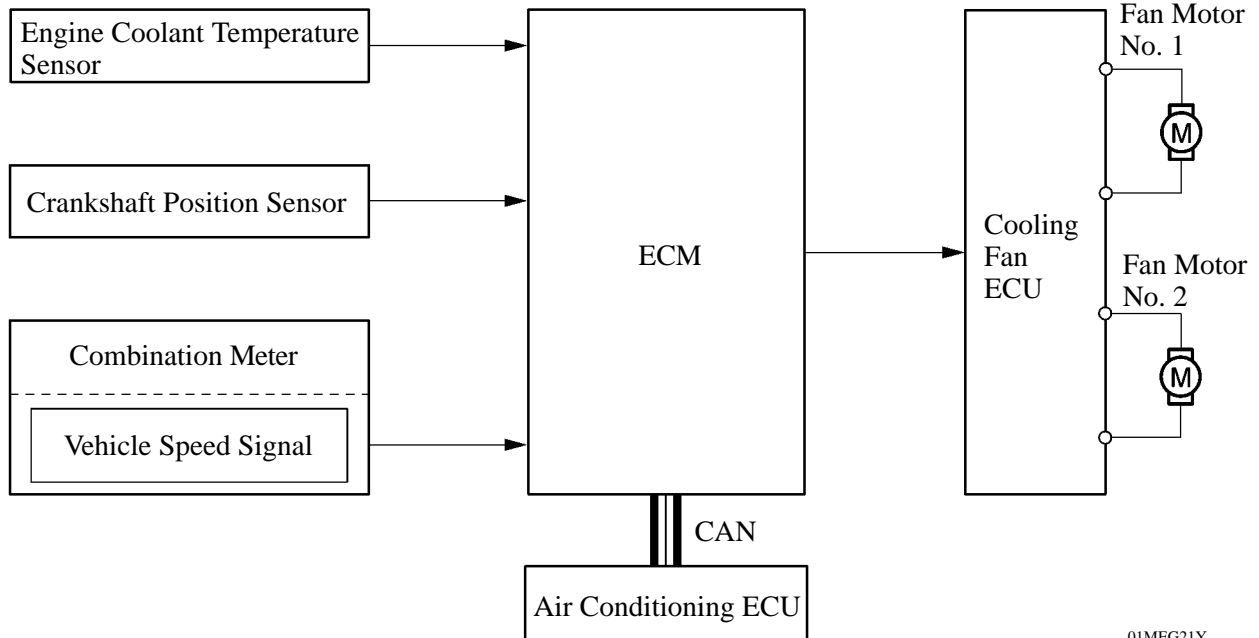
12. Cooling Fan Control System

General

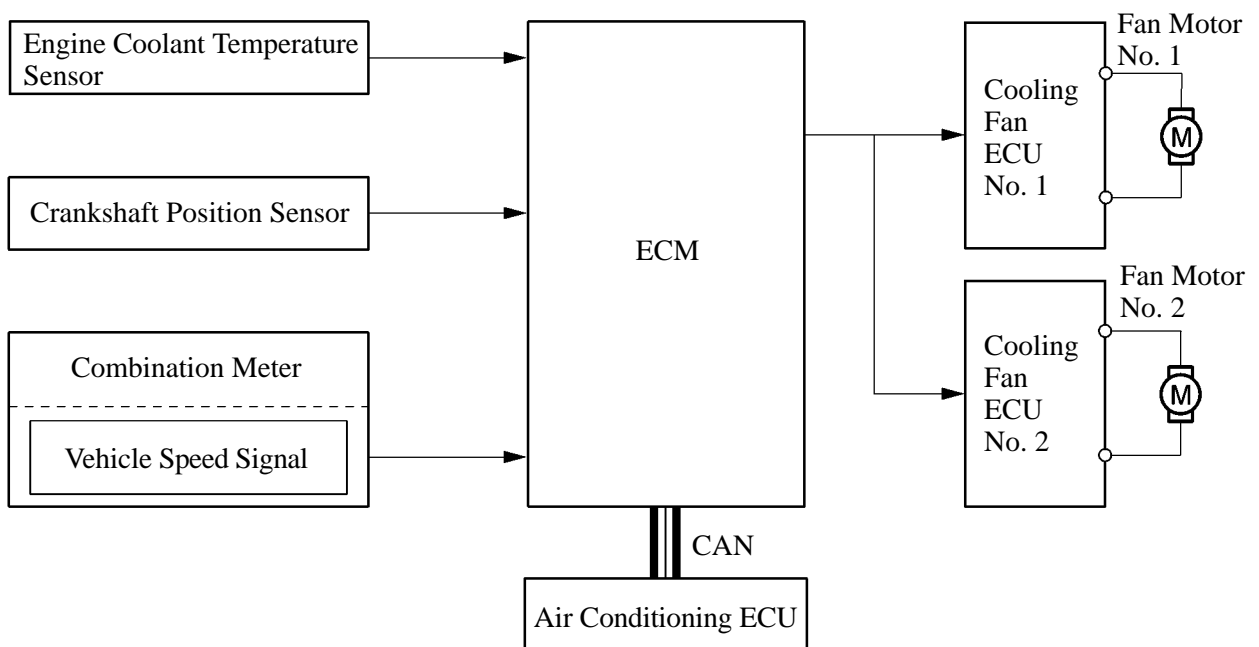
A cooling fan control system is used. To achieve an optimal fan speed in accordance with the engine coolant temperature, vehicle speed, engine speed, and air conditioning operating conditions, the ECM calculates the proper fan speed and sends the signals to the front controller. By receiving the signals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

Upon receiving the signals from the front controller, the cooling fan ECU actuates the fan motors.

► Wiring Diagram ◀



Except Towing Package Models

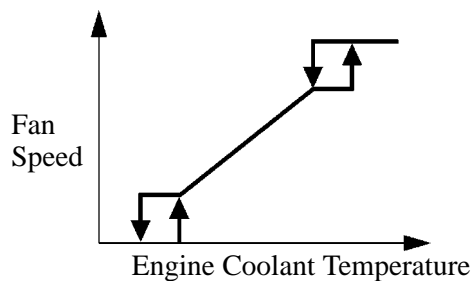


Towing Package Models

Operation

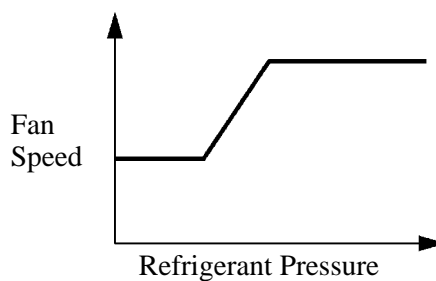
As illustrated below, the ECM determines the required fan speed by selecting the fastest fan speed from among the following:

- (A) Fan speed required by the engine coolant temperature
- (B) Fan speed required by the air conditioning refrigerant pressure
- (C) Fan speed required by the engine speed
- (D) Fan speed required by the vehicle speed



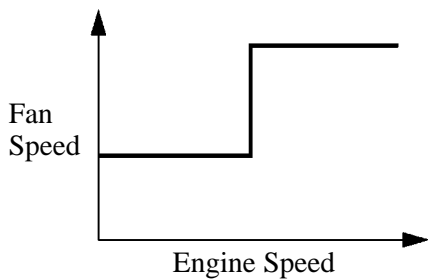
(A) Fan speed required by engine coolant temperature

189EG13



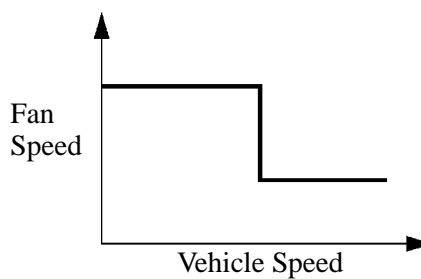
(B) Fan speed required by air conditioning refrigerant pressure

189EG14



(C) Fan speed required by engine speed

189EG15



(D) Fan speed required by vehicle speed

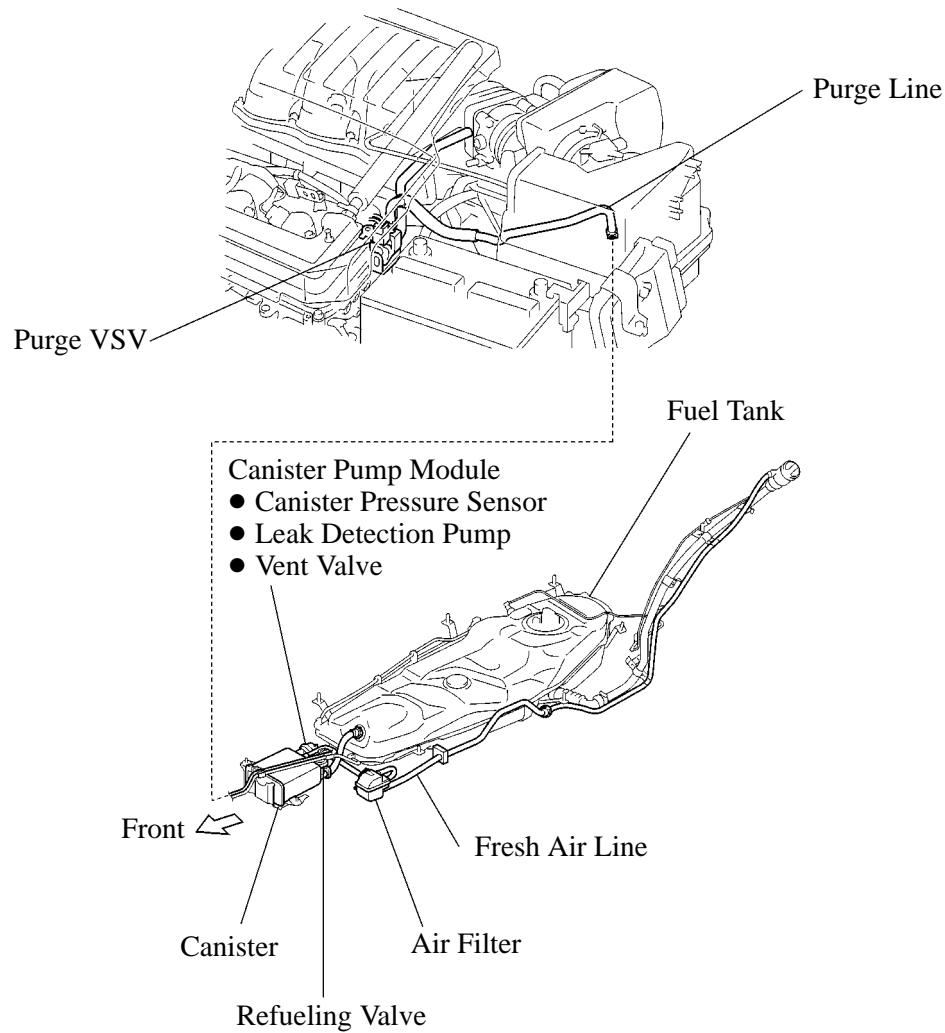
189EG16

13. Evaporative Emission Control System

General

The 2GR-FE engine uses the same type of evaporative emission control system as the 2AZ-FE engine. For details, see page EG-54.

Layout of Main Components



14. Diagnosis

- When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver.
- The ECM will also store the DTCs (Diagnostic Trouble Codes) of the malfunctions. The DTCs can be accessed by using the hand-held tester.
- For details, refer to the 2006 RAV4 Repair Manual (Pub. No. RM01M1U).

Service Tip

- The ECM of the '06 RAV4 uses the CAN protocol for diagnostic communication. Therefore, a hand-held tester and a dedicated adapter [CAN VIM (Vehicle Interface Module)] are required for accessing diagnostic data. For details, refer to the 2006 RAV4 Repair Manual (Pub. No. RM01M1U).
- To clear the DTC that is stored in the ECM, use a hand-held tester, and disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

15. Fail-safe

When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

► Fail-safe Chart ◄

DTC No.	Fail-safe Operation	Fail-safe Deactivation Conditions
P0031, P0032, P0051, P0052	ECM turns off air-fuel ratio sensor heater.	Ignition switch OFF.
P0037, P0038, P0057, P0058	ECM turns off heated oxygen sensor heater.	Ignition switch OFF.
P0100, P0102, P0103	Ignition timing is calculated from engine speed and throttle angle.	“Pass” condition detected.
P0110, P0112, P0113	Intake air temperature is fixed at 20°C (68°F).	“Pass” condition detected.
P0115, P0117, P0118	Engine coolant temperature is fixed at 80°C (176°F).	“Pass” condition detected.
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0604, P0606, P0607, P0657, P2102, P2103, P2111, P2112, P2118, P2119, P2135	If ETCS-i (Electronic Throttle Control System-intelligent) has a malfunction, ECM cuts off current to throttle control motor. Throttle control valve returns to predetermined opening angle (approximately 6.5°) by force of return spring. ECM then adjusts engine output by controlling fuel injection (intermittent fuel-cut) and ignition timing in accordance with accelerator pedal opening angle to enable vehicle to continue driving at minimal speed. If accelerator pedal is depressed firmly and slowly, vehicle can be driven slowly. If accelerator pedal is depressed quickly, vehicle may speed up and slow down erratically.	If “Pass” condition is detected and then the ignition switch is turned OFF, fail-safe operation will stop and system will return to normal operating conditions.
P0327, P0328, P0332, P0333	Max. timing retardation.	Ignition switch OFF.
P0351, P0352, P0353, P0354, P0355, P0356	Fuel is cut.	“Pass” condition detected.
P2120, P2121, P2122, P2123, P2125, P2127, P2128, P2138	Accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of sensor circuits, ECM detects abnormal signal voltage difference between two sensor circuits and switches into limp mode. In limp mode, remaining circuit is used to calculate accelerator pedal opening to allow vehicle to continue driving. If both circuits malfunction, ECM regards opening angle of accelerator pedal to be fully closed. In this case, throttle valve will remain closed as if engine is idling.	If “Pass” condition is detected and then the ignition switch is turned OFF, fail-safe operation will stop and system will return to normal operating conditions.

■ FEATURES OF 2GR-FE ENGINE

The 2GR-FE engine has achieved the following performance through the use of the items listed below.

- (1) High performance and reliability
- (2) Low noise and vibration
- (3) Lightweight and compact design
- (4) Good serviceability
- (5) Clean emission and fuel economy

Item		(1)	(2)	(3)	(4)	(5)
Engine Proper	A steel laminate type cylinder head gasket is used.	○				
	An upright intake port is used.	○		○		
	A taper squish shape is used for combustion chamber.	○				○
	A cylinder block made of aluminum alloy is used.			○		
	The skirt portion of the piston is applied with resin to reduce friction.	○	○			○
	An oil pan No. 1 made of aluminum alloy is used.		○	○		
Valve Mechanism	The Dual VVT-i (Variable Valve Timing-intelligent) system is used.	○				○
	Hydraulic lash adjusters are used.	○	○		○	
	Timing chains and chain tensioners are used.		○	○	○	
	Roller rocker arms are used.	○				○
Lubrication System	An oil filter with a replaceable element is used.				○	
Cooling System	The TOYOTA Genuine SLLC (Super Long Life Coolant) is used for the engine coolant.				○	
Intake and Exhaust System	The linkless-type throttle body is used.			○	○	
	The intake air chamber made of plastic is used.			○		
	A stainless steel exhaust manifold is used.			○		○
	An ultra thin-wall, high-cell density ceramic type TWC (Three-Way Catalytic converter) is used.					○
Fuel System	The fuel delivery pipe made of plastic is used.			○		
	A compact 12-hole type injector is used.	○				○
	Quick connectors are used to connect the fuel hose with the fuel pipe.				○	
Ignition System	The DIS (Direct Ignition System) makes ignition timing adjustment unnecessary.	○			○	○
	The long-reach type spark plugs are used.	○				

(Continued)

Item		(1)	(2)	(3)	(4)	(5)
Charging System	A segment conductor type generator is used.	○		○		
	A generator pulley with a clutch is used.					○
Starting System	The PS (Planetary reduction-Segment conductor motor) type starter is used.			○		
Serpentine Belt Drive System	A serpentine belt drive system is used.			○	○	
Engine Control System	The MRE (Magnetic Resistance Element) type VVT sensors are used.	○				
	The ETCS-i (Electronic Throttle Control System-intelligent) is used.	○				○
	The ACIS (Acoustic Control Induction System) is used.	○				○
	The air intake control system is used.	○	○			
	The charging control is used.	○				
	Evaporative emission control system is used.					○