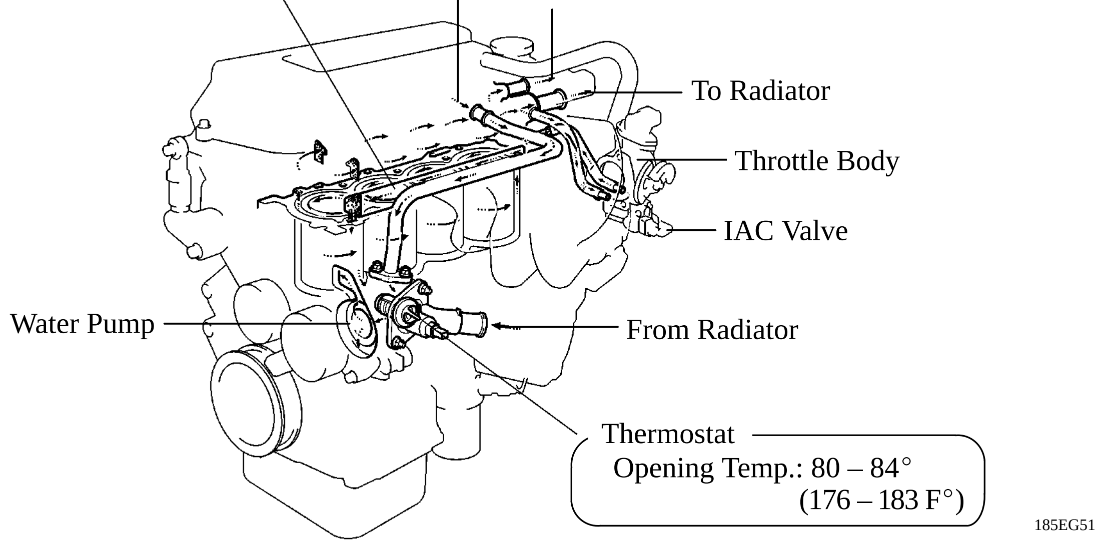
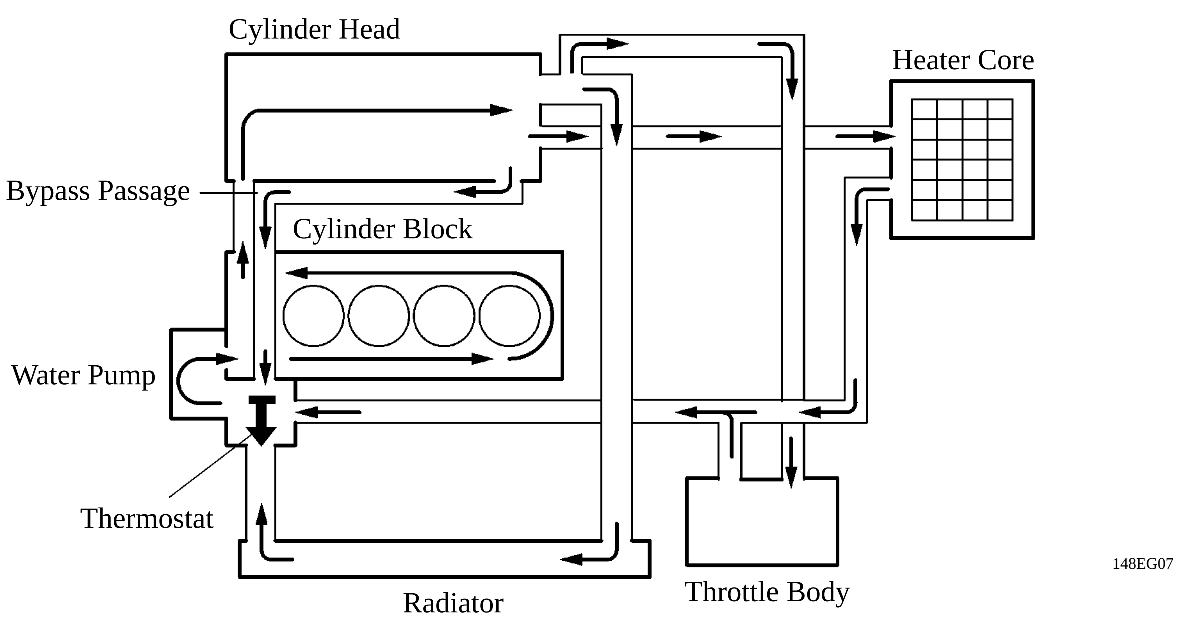
■ COOLING SYSTEM

- The cooling system is a pressurized, forced-circulation type.
- A thermostat with a bypass valve is located in the water inlet housing to maintain a suitable temperature in the cooling system.
- An aluminum radiator core is used for weight reduction.
- The flow of the engine coolant makes a U-turn in the cylinder block to ensure a smooth flow. In addition, a bypass passage is enclosed in the cylinder head and the cylinder block.
- Warm water from the engine is sent to the throttle body to prevent freeze-up.
- A single cooling fan is used for both the cooling and air conditioning systems.



▶ Engine Coolant ◀

Capacity	6.5 liters (6.9 US qts, 5.7 Imp. qts)
Type	TOYOTA Long Life Coolant or equivalent



ENGINE

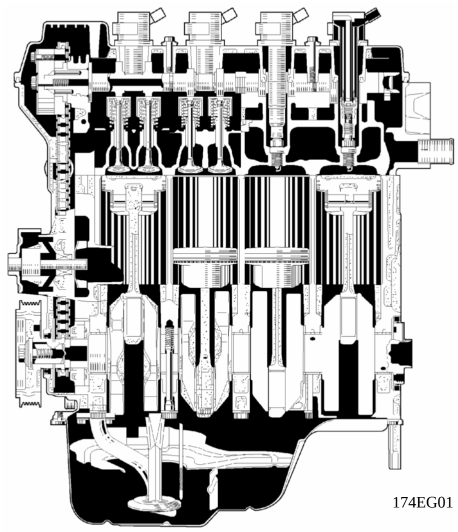
1ZZ-FE ENGINE

■ DESCRIPTION

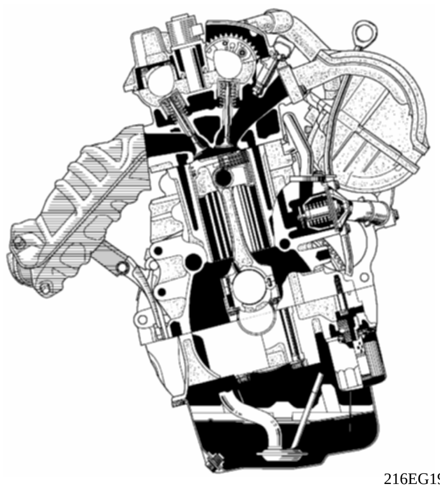
The VVT-i (Variable Valve Timing-intelligent) system, the DIS (Direct Ignition System), and a plastic intake manifold have been used on the 1ZZ-FE engine in order to achieve higher engine performance and lower fuel consumption and to reduce exhaust emissions.

- The engine (for 2WD) meets the U-LEV (Ultra-Low Emission Vehicle) regulations. This engine is based on the 1ZZ-FE engine equipped on the ’02 Corolla. See page EG-4 for the major differences of this engine from the ’02 Corolla.
- The engine (for 4WD) meets the LEV (Low Emission Vehicle) regulations. This engine is based on the 1ZZ-FE engine equipped on the 2WD models. However, slight differences in specifications exist between the 2WD and 4WD models. For details, see page EG-4.

▶ 2WD Model ◀

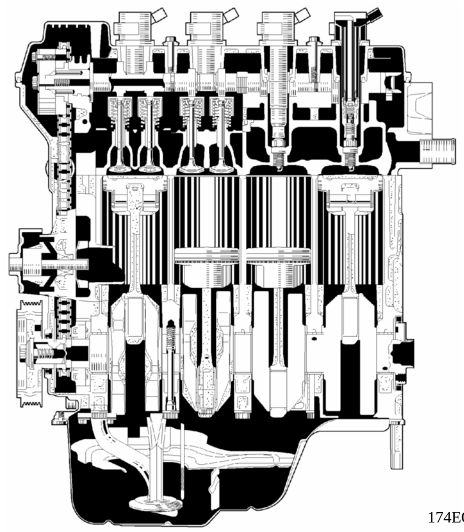


174EG01

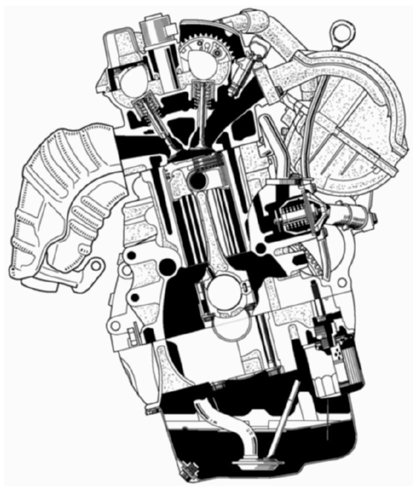


216EG19

▶ 4WD Model ◀



174EG01

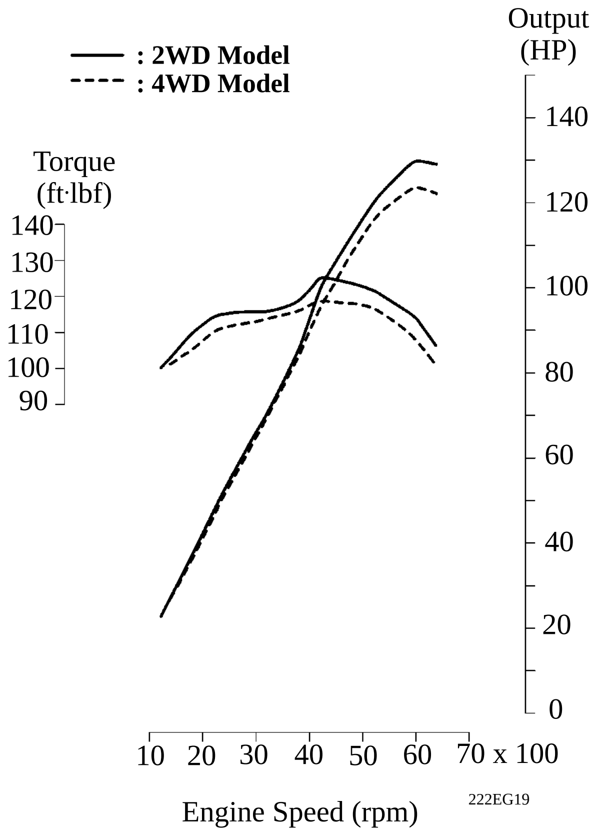


221EG02

▶ Engine Specification ◀

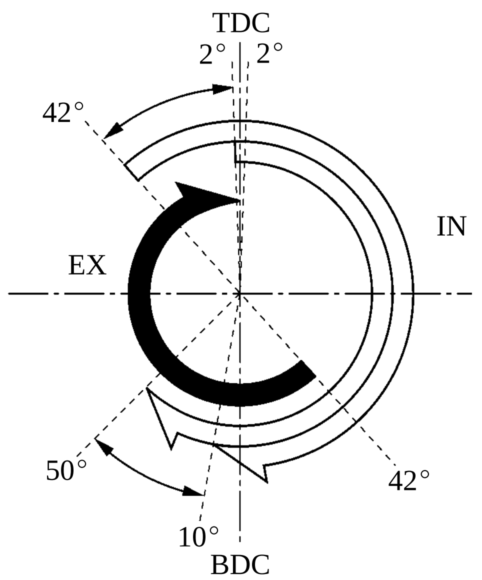
Model			2WD Model	4WD Model
No. of Cyls. & Arrangement			4-Cylinder, In-line	←
Valve Mechanism			16-Valve DOHC, Chain Drive	←
Combustion Chamber			Pentroof Type	←
Manifolds			Cross-Flow	←
Fuel System			SFI	←
Displacement cm^3 (cu. in.)			1794 (109.5)	←
Bore x Stroke mm (in.)			79.0 x 91.5 (3.11 x 3.60)	←
Compression Ratio			10.0 : 1	←
Max. Output [SAE-NET]			97.0 kW @ 6000 rpm (130 HP @ 6000 rpm)	92.0 kW @ 6000 rpm (123 HP @ 6000 rpm)
Max. Torque [SAE-NET]			170 N·m @ 4200 rpm (125 ft·lbf @ 4200 rpm)	161 N·m @ 4200 rpm (118 ft·lbf @ 4200 rpm)
Valve Timing	Intake	Open	2° ∼ 42° BTDC	←
		Close	50° ∼ 10° ABDC	←
	Exhaust	Open	42° BBDC	←
		Close	2° ATDC	←
Firing Order			1 – 3 – 4 – 2	←
Octane Rating			87 or more	←
Oil Grade			API SL-EC or ILSAC	←
Engine Service Mass kg (lb)			106 (233.7)	105 (231.5)

▶ Performance Curve ◀



222EG19

▶ Valve Timing ◀



221EG21

■ MAJOR DIFFERENCE

1. From ’02 Corolla

Item	Outline
Valve Mechanism (See pa0ge EG-10)	Change of the valve timing (cam profile) of the intake camshaft
Intake and Exhaust System (See Page EG14)	● Change of the throttle valve diameter ● Change of the intake manifold shape and material ● Change of the exhaust manifold and heat insulator shapes ● Change of the exhaust pipe construction ● Addition of the TWC with excellent warm-up performance ● Disconnect of the 2-way exhaust control system
Starting System (See page EG-22)	PS type starter has been adopted.
Engine Control System (See page EG-25)	● Change of the knock sensor structure ● Adoption of the cooling fan control ● Adoption of 32-bit ECM
Other	Configuration and structure are the same as ’02 Corolla

2. 2WD and 4WD Models

- Exhaust manifold shape (See page EG-16)
- No.1 TWC construction (See page EG-17)
- ECM software

■FEATURES OF 1ZZ-FE ENGINE

The 1ZZ-FE engine has been able to achieve the following performance through the adoption of the items listed below.

(1) High performance and fuel economy

(2) Low noise and vibration

(3) Lightweight and compact design

(4) Good serviceability

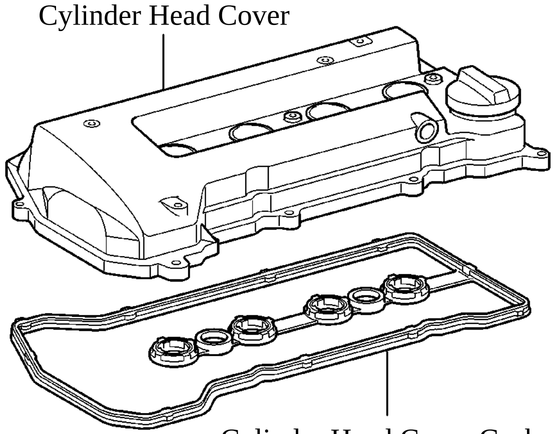
(5) Clean emission

Item	(1)	(2)	(3)	(4)	(5)	’03 Corolla Matrix	’02 Corolla
The VVT-i system is used.	○				○	○	○
Intake manifold made of plastic has been adopted.			○			○	—
A cylinder block made of aluminum alloy has been used.			○			○	○
A stainless steel exhaust manifold is used.			○			○	○
The DIS (Direct Ignition System) makes ignition timing adjustment unnecessary.				○		○	○
Iridium-tipped spark plugs have been used.				○		○	○
A rearward exhaust layout has been used to realize an early activation of the TWC (Three-Way Catalytic Converter).					○	○	○
Upright intake port has been used.	○					○	○
The fuel returnless system has been used.			○	○	○	○	○
Quick connectors are used to connect the fuel hose with the fuel pipe.				○		○	○
12-hole type fuel injectors have been used.	○				○	○	○
ORVR (On-Board Refueling Vapor Recovery) system has been used.					○	○	○
A timing chain and chain tensioner have been used.		○		○		○	○
2-way exhaust control system is used.	○					—	○
PS type starter has been adopted.			○			○	—
Two TWCs have been adopted.					○	○	—

■ENGINE PROPER

1. Cylinder Head Cover

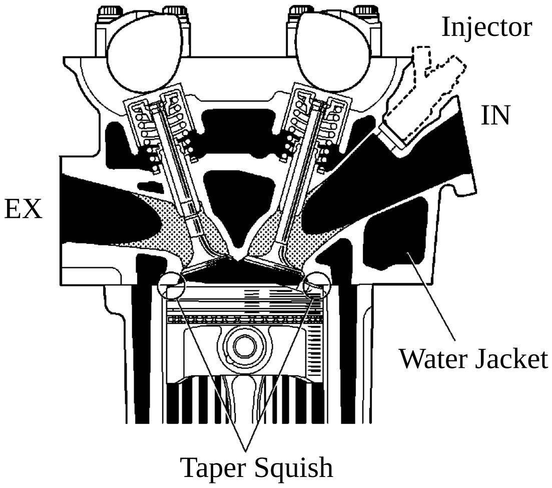
- Lightweight yet high-strength aluminum die-cast cylinder head cover is used.
- The cylinder head cover gasket and the spark plug gasket have been integrated to reduce the number of parts.
- Acrylic rubber, which excels in heat resistance and reliability, has been adopted for the cylinder head cover gasket.



222EG17

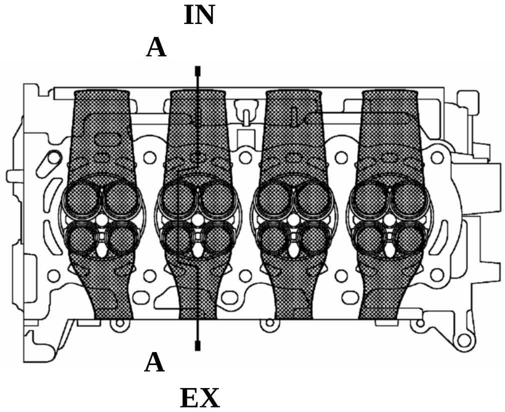
2. Cylinder Head

- Upright intake ports are used to increase intake efficiency.
- The injectors have been installed in the cylinder head to prevent the fuel from adhering to the intake port walls, thus reducing exhaust emissions.
- The routing of the water jacket in the cylinder head has been optimized to achieve higher cooling performance. In addition, a water bypass passage has been provided below the intake ports to reduce the number of parts and to reduce weight.
- Through the using of the taper squish combustion chamber, the engine's knocking resistance and fuel efficiency have been improved.



A – A Cross Section

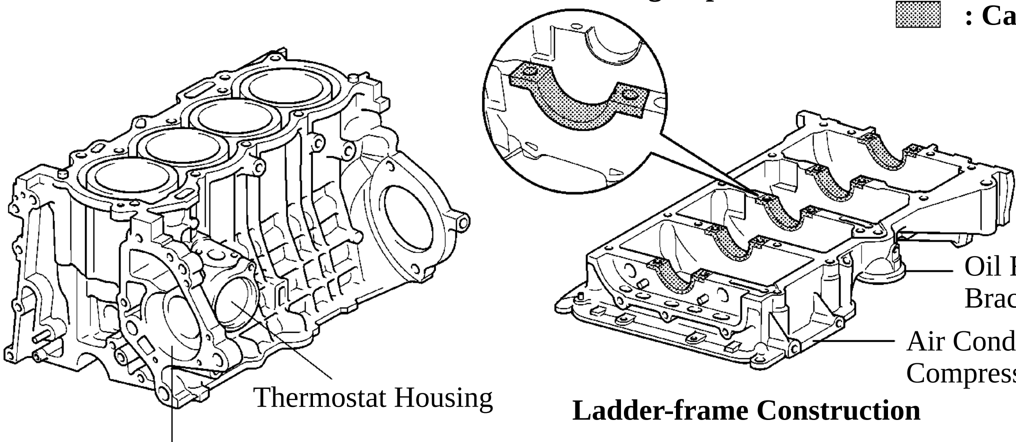
216EG36



216EG37

3. Cylinder Block

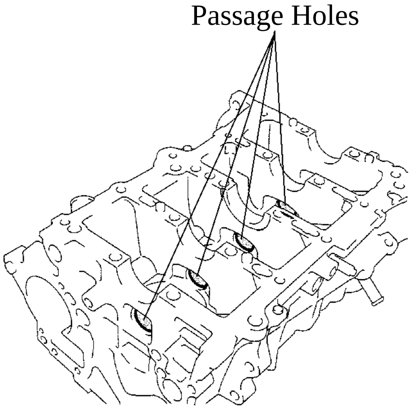
- Lightweight aluminum alloy is used for the cylinder block.
- The crankshaft bearing caps with ladder-frame construction have been used to increase the rigidity, to reduce noise, and to increase the coupling rigidity with the transaxle.
- Cast-iron is used as a material for part of the bearing journal of the crankshaft bearing cap and thus help prevent heat deformation. In addition, the oil filter bracket, the air conditioning compressor bracket, the water pump swirl chamber, the thermostat housing and the rear oil seal retainer have been integrated to reduce the number of parts.



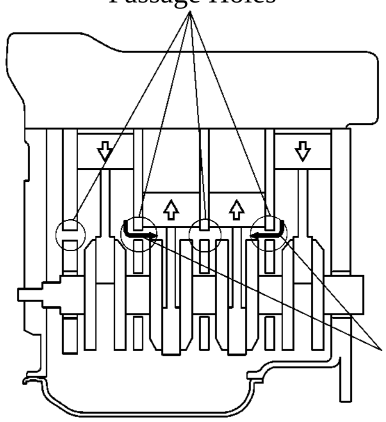
Ladder-frame Construction

222EG20

- Passage holes are provided in the crankshaft bearing area of the cylinder block. As a result, the air at the bottom of the cylinder flows smoother, and pumping loss (back pressure at the bottom of the piston generated by the piston’s reciprocal movement) is reduced to improve the engine’s output.



218EG15



Air Flow During Engine Revolution

218EG16

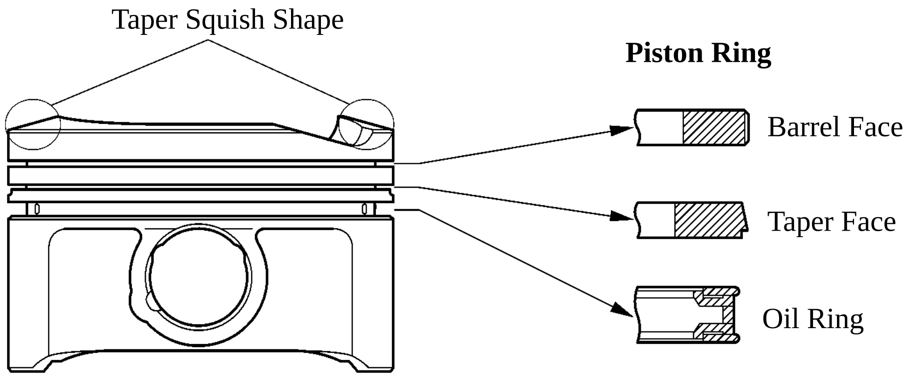
- A thin cast-iron liner is press-fitted inside the cylinder to ensure an added reliability.

NOTICE

Never attempt to machine the cylinder because it has a thin liner thickness.

4. Piston

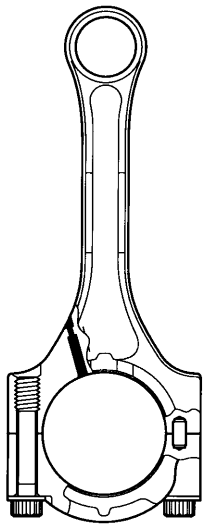
- The piston is made of aluminum alloy to be compact and lightweight.
- The piston head portion uses a taper squish shape to accomplish fuel combustion efficiency.
- Full floating type piston pins are used.
- By increasing the machining precision of the cylinder bore diameter, only one diameter of piston is available.



221EG29

5. Connecting Rod

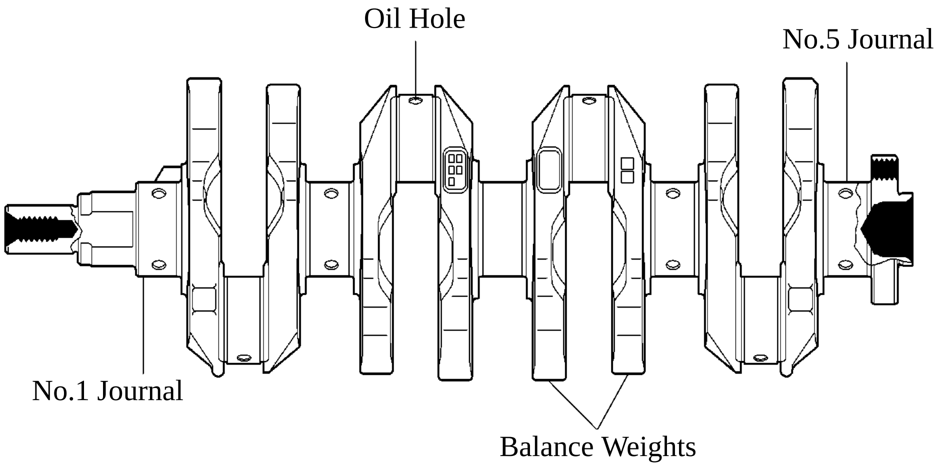
- The connecting rods are made of high-strength material for weight reduction.
- The connecting rod bearings have been reduced in width to reduce friction.
- Nutless-type plastic region tightening bolts are used for a lighter design.



178EG29

6. Crankshaft

- The forged crankshaft has 5 journals and 8 balance weights.
- The crankshaft bearings have been reduced in width to reduce friction.
- The pins and journals have been machined with increased precision and the surface roughness minimized to reduce friction.



216EG38

■ENGINE CONTROL SYSTEM

1. General

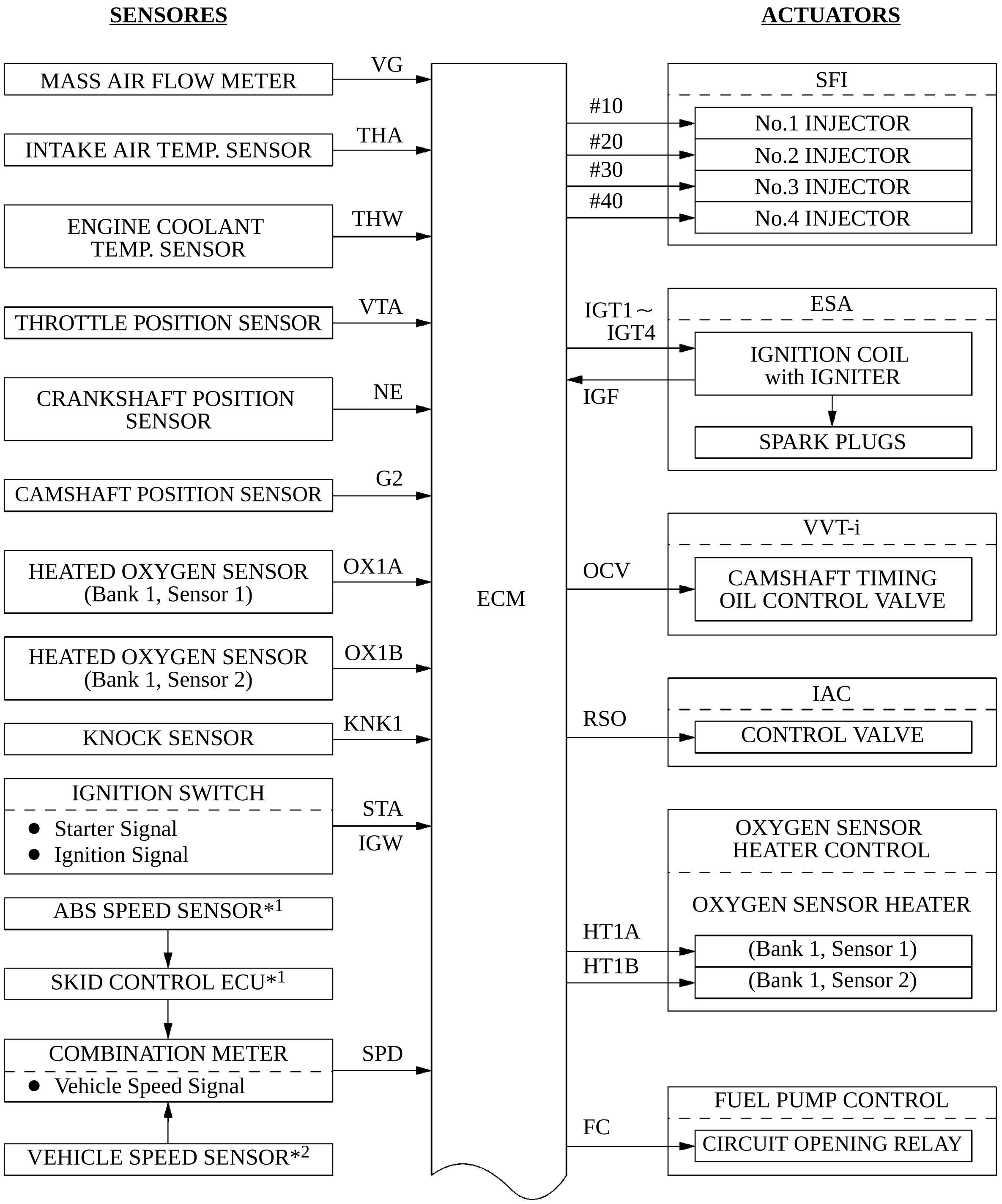
The engine control system for the 1ZZ-FE in the ’03 Corolla Matrix and ’02 Corolla are compared below.

System	Outline	’03 Corolla Matrix	’02 Corolla
SFI (Sequential Multiport Fuel Injection) [See page EG-35]	An L-type SFI system detects the intake air volume with a hot-wire type air flow meter.	○	○
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.	○	○
IAC (Idle Air Control)	A rotary solenoid type IAC valve controls the fast idle and idle speeds.	○	○
VVT-i (Variable Valve Timing-intelligent) [See page EG-36]	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.	○	○
Fuel Pump Control [See page EG-40]	● Fuel pump operation is controlled by signals from the ECM. ● The fuel pump is stopped when the SRS airbag is deployed in a front or side collision.	○	○
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	○	○
Evaporative Emission Control [See page EG-41]	● The ECM controls the purge flow of evaporative emissions (HC) in the charcoal canister in accordance with engine conditions. ● Using 3 VSVs and a vapor pressure sensor, the ECM detects any evaporative emission leakage occurring between the fuel tank and charcoal canister through changes in the fuel tank pressure.	○	○
Air Conditioning Cut-off Control*	By turning the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.	○	○
Cooling Fan Control [See page EG-46]	Cooling fan operation is controlled by signals from the ECM based on the engine coolant temperature sensor signal and the condition of the air conditioner operation.	○	—
Diagnosis [See page EG-47]	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.	○	○
Fail-Safe [See page EG-47]	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in memory.	○	○

*: with Air Conditioning Model

2. Construction

The configuration of the engine control system in the 1ZZ-FE engines in the ’03 Corolla Matrix is as shown in the following chart.



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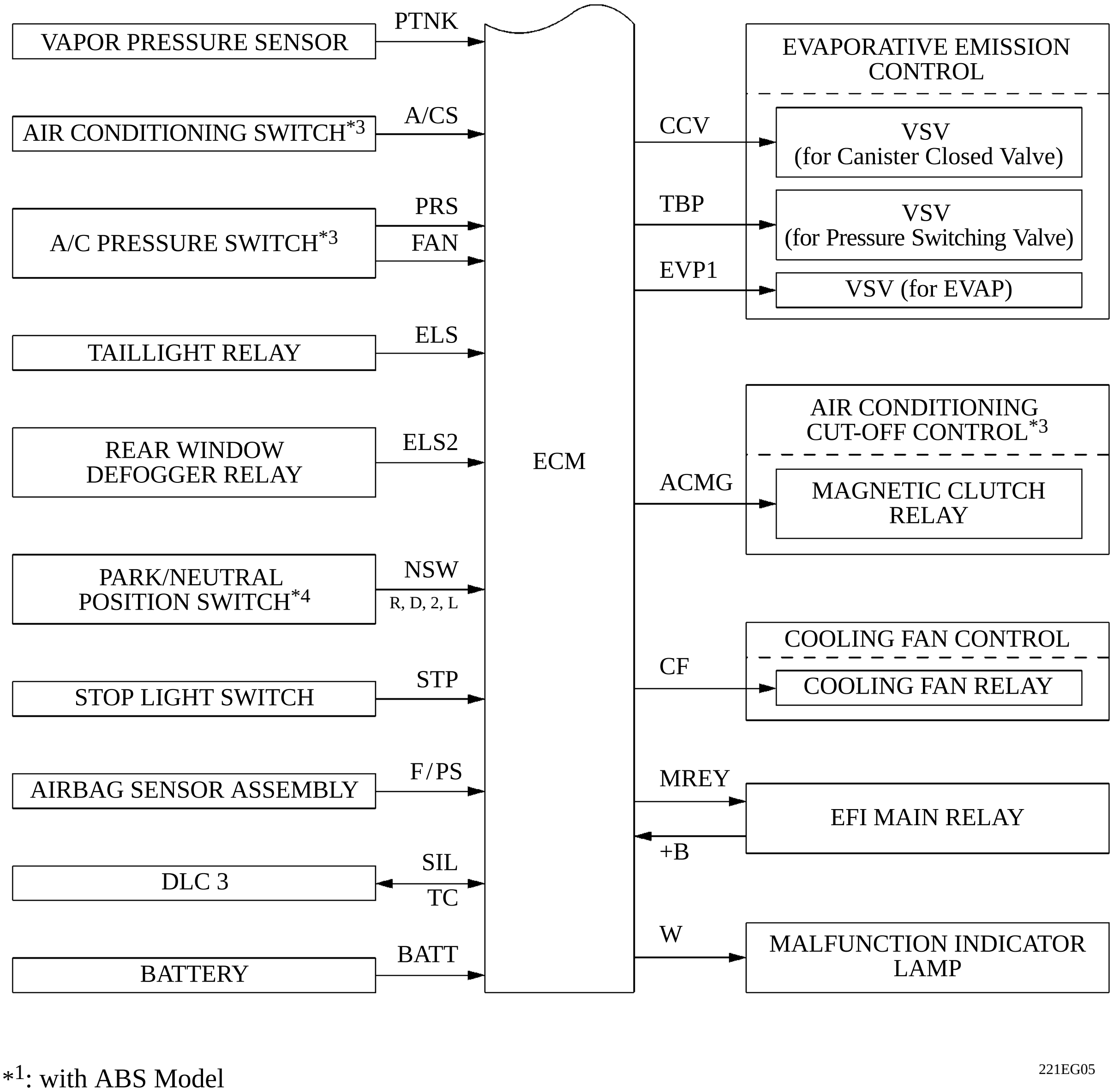
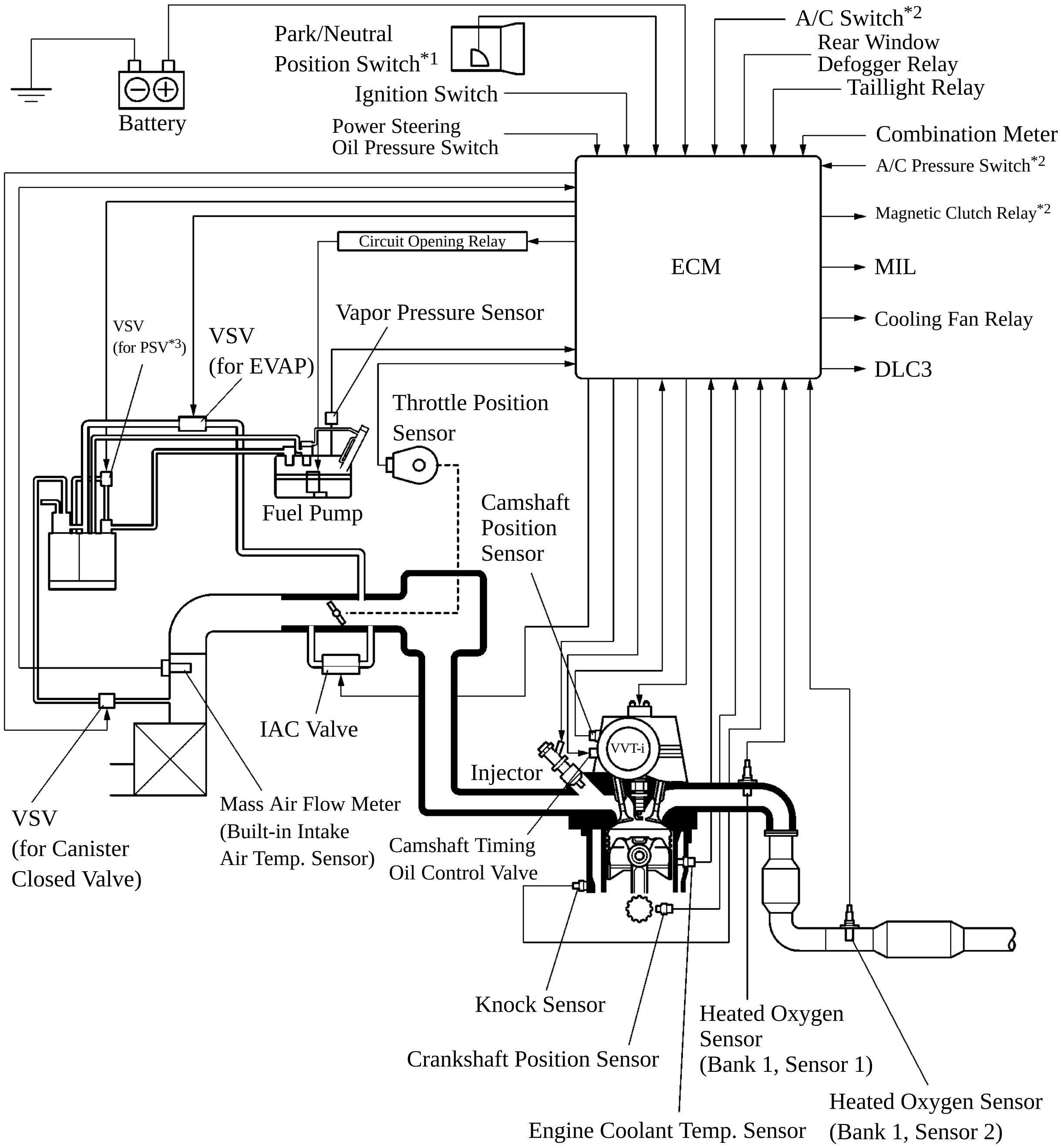
221EG04



*1: with ABS Model
*2: without ABS Model
*3: with A/C Model
*4: Only for Automatic Transaxle Model

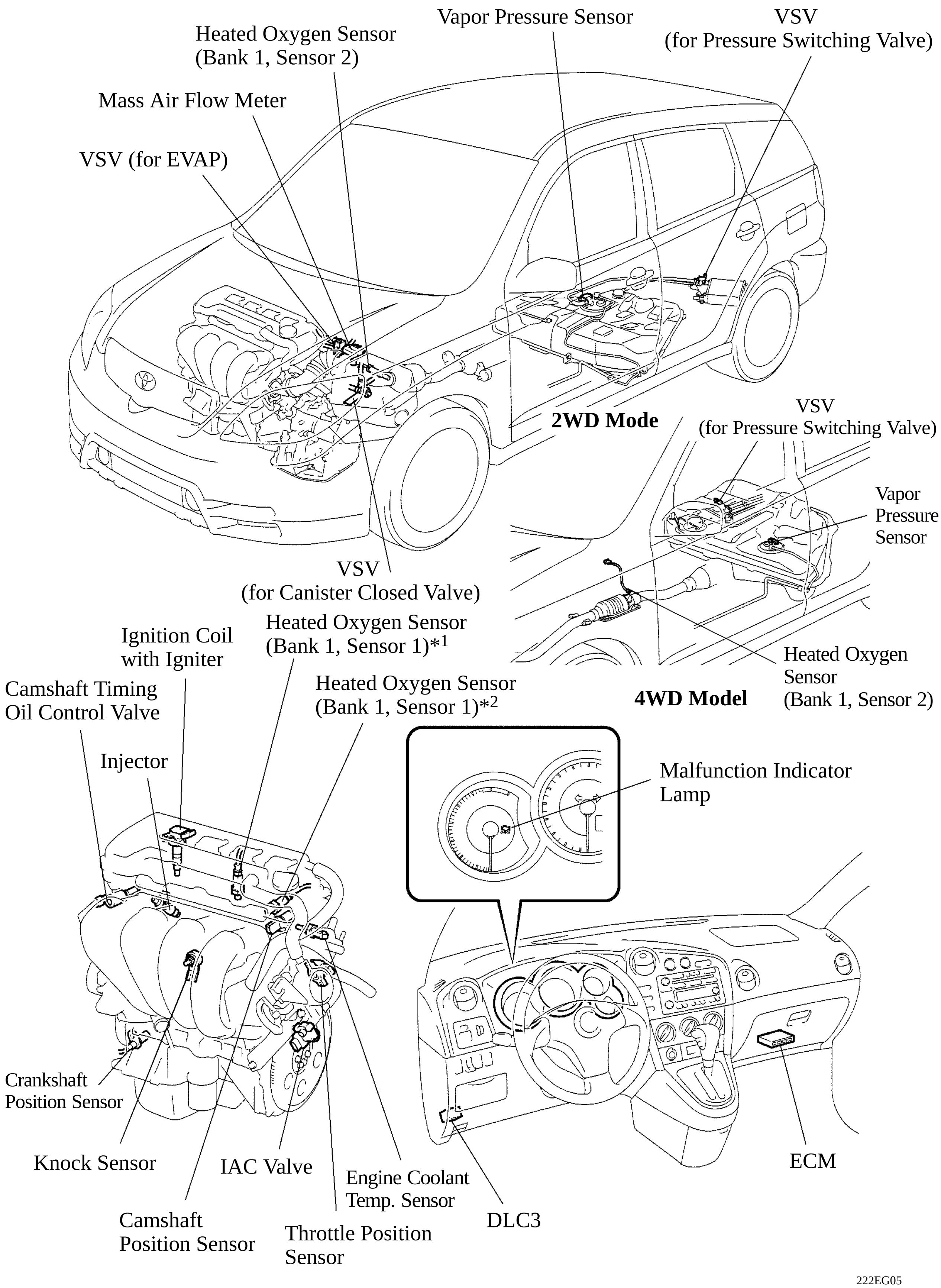
3. Engine Control System Diagram



*1: Only for Automatic Transaxle Model
*2: with Air Conditioning Model
*3: PSV (Pressure Switching Valve)

221EG06

4. Layout of Main Component



*1: for 2WD Model
*2: for 4WD Model

5. Main Component of Engine Control System

General

The main components of the 1ZZ-FE engine control system are as follows:

: Change

Components	Outline	Quantity
ECM	32-bit	1
Mass 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
Throttle Position Sensor	Linear Type	1
Knock Sensor	Built-in Piezoelectric Element Type (Flat Type)	1
Oxygen Sensor (Bank 1, Sensor 1 and 2)	with Heater	2
Injector	12-Hole Type	4
IAC Valve	Rotary Solenoid Type (1-coil Type)	1

ECM

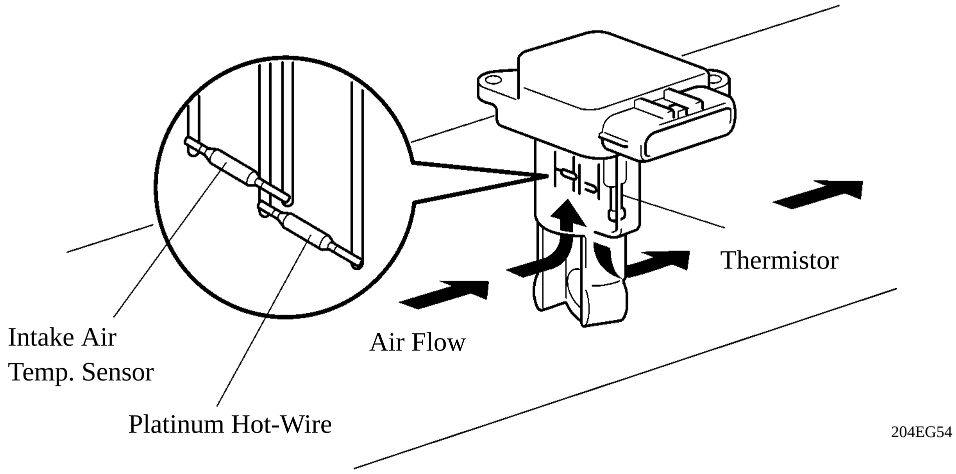
- The 32-bit CPU of the ECM has been changed from the 16-bit CPU to increase the speed for processing the signals.
- This ECM has a built-in air conditioning amplifier.

Service Tip

The length of time to clear the DTC via the battery terminal has been changed from the previous 10 seconds to 1 minute.

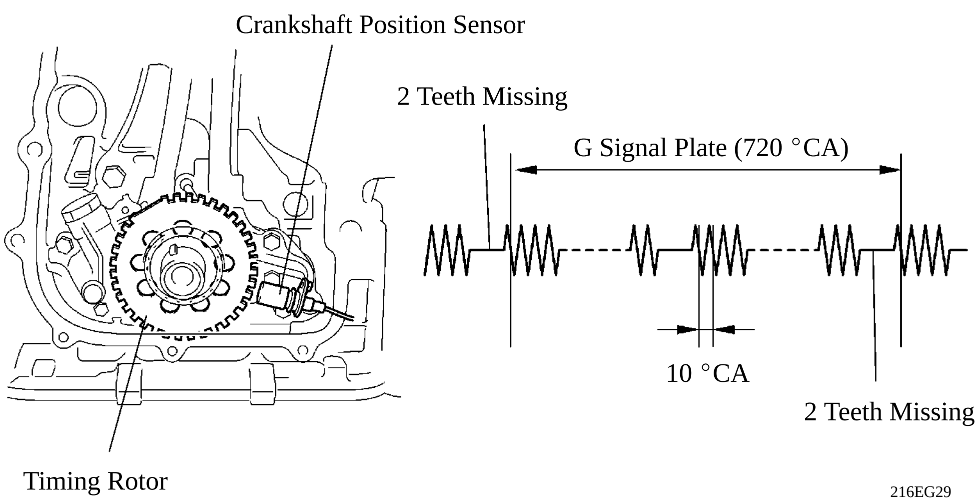
Mass Air Flow Meter

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



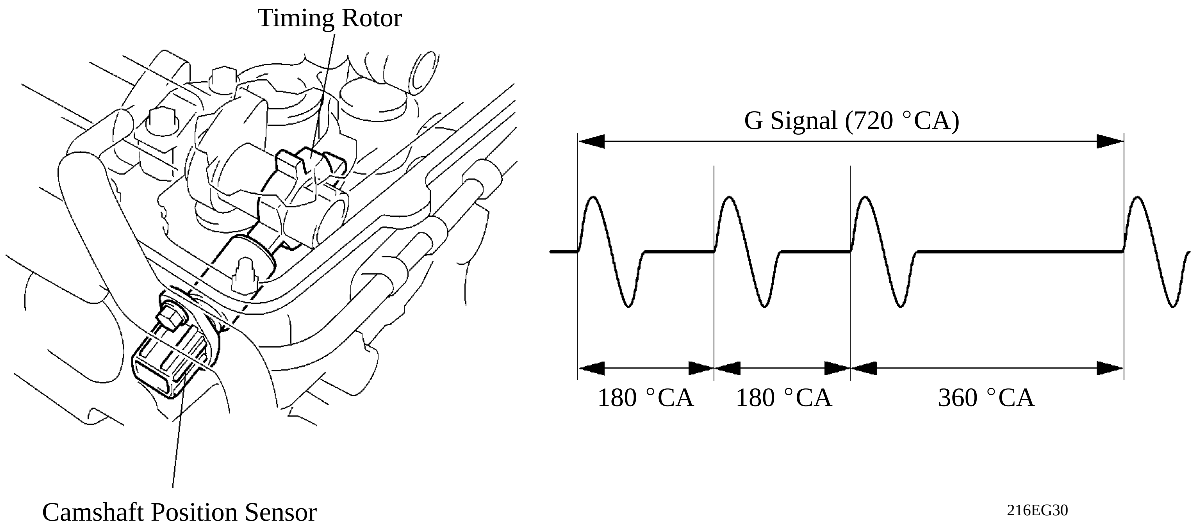
Crankshaft Position Sensor

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.



Camshaft Position Sensor

To detect the camshaft position, a timing rotor on the intake camshaft is used to generate 3 pulses for every 2 revolutions of the crankshaft.



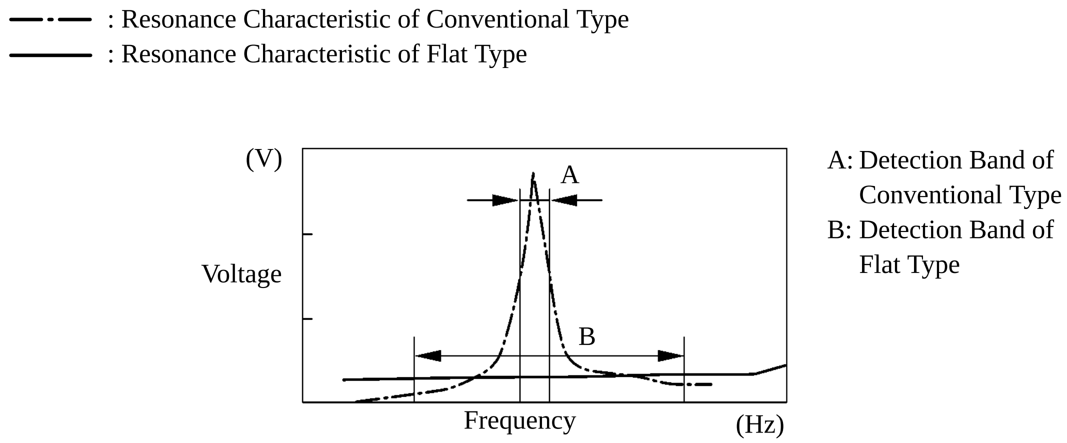
216EG30

Knock Sensor (Flat Type)

1) General

In the conventional type knock sensor (resonant type), a vibration plate which has the same resonance point as the knocking frequency of the engine is built in and can detect the vibration in this frequency band.
On the other hand, a flat type knock sensor (non-resonant type) has the ability to detect vibration in a wider frequency band from about 6 kHz to 15 kHz, and has the following features.

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

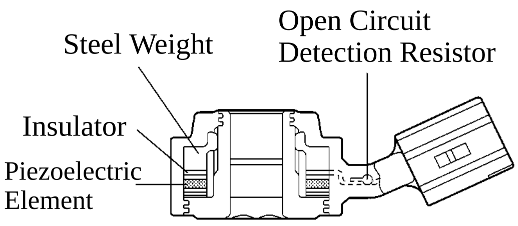


Characteristic of Knock Sensor

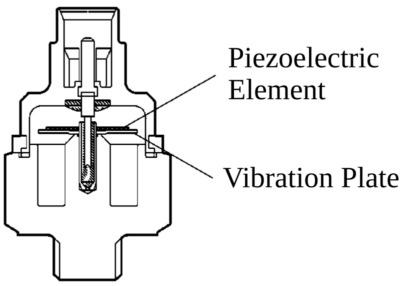
214CE04

2) Construction

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



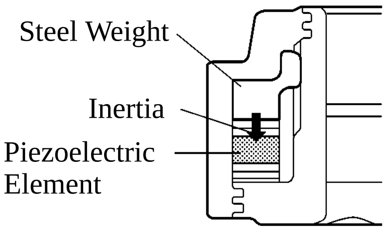
Flat Type Knock Sensor
(Non-Resonant Type) 214CE01



Conventional Type Knock Sensor
(Resonant Type) 214CE02

3) Operation

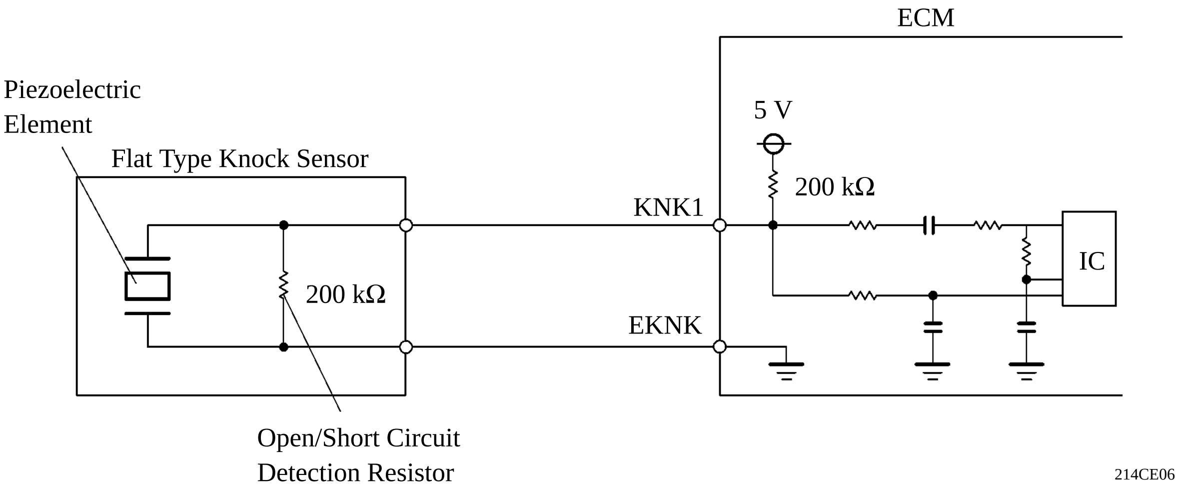
The knocking vibration is transmitted to the steel weight and its inertia applies pressure to the piezoelectric element.
The action generates electromotive force.



214CE08

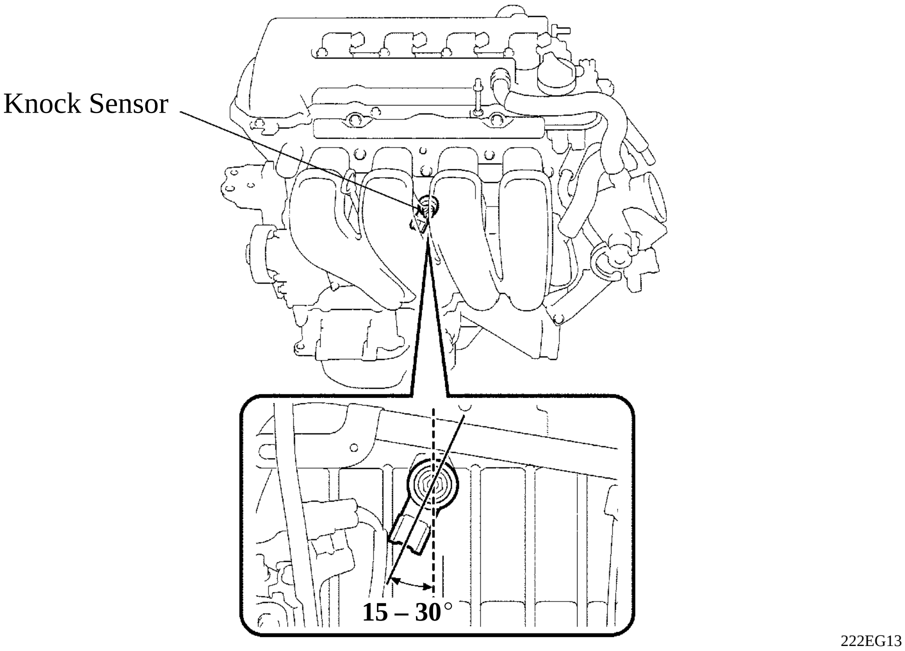
4) Open/Short Circuit Detection Resistor

During the ignition is ON, the open/short circuit detection resistor in the knock sensor and the resistor in the ECM keep the voltage at the terminal KNK1 of engine constant.
An IC (Integrated Circuit) in the ECM is always monitoring the voltage of the terminal KNK1. If the open/short circuit occurs between the knock sensor and the ECM, the voltage of the terminal KNK1 will change and the ECM detects the open/short circuit and stores DTC (Diagnostic Trouble Code) P0325.



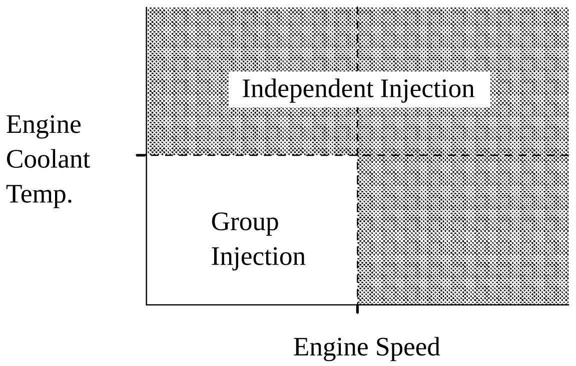
Service Tip

- In accordance with the adoption of an open/short circuit detection resistor, the inspection method for the sensor has been changed. For details, refer to 2003 Corolla Repair Manual (Pub. No. RM938U).
- To prevent the water accumulation in the connecter, make sure to install the flat type knock sensor in the position as shown in the following illustration.



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 revolutions of the crankshaft) has been adopted.
  Also, when the engine is starting, a group injection (in which fuel is injected once into two cylinders for each one revolution of the crankshaft) is used. This changes to an independent injection when the engine speed or the engine coolant temperature become higher than a prescribed value.



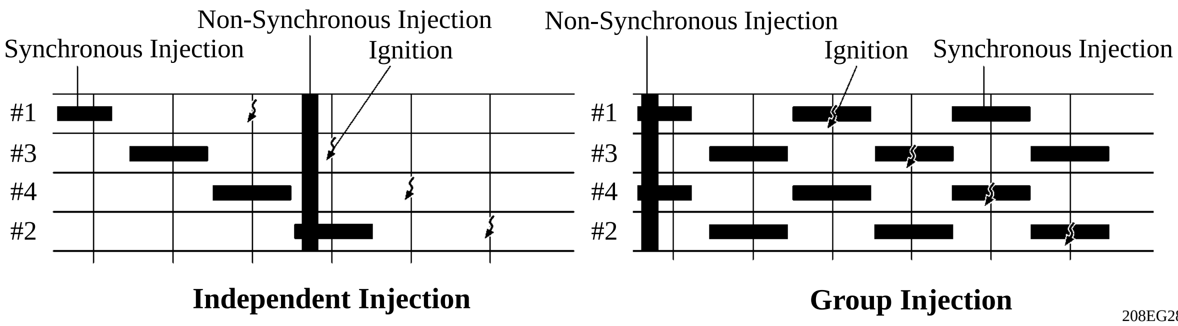
208EG29

- 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 use a fuel cutoff in which the injection of fuel is stopped temporarily in accordance with the driving conditions.

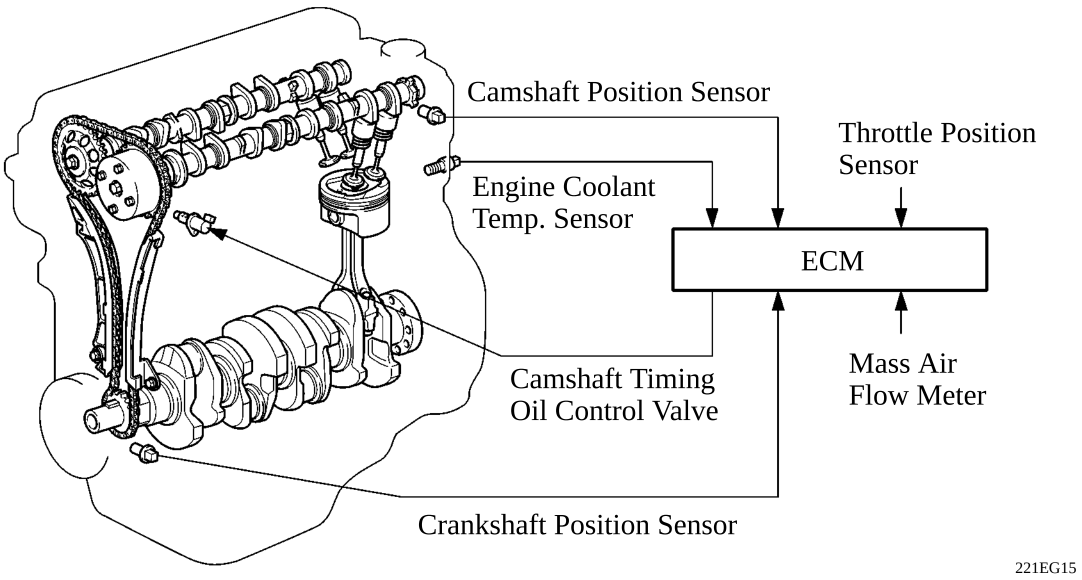


208EG28

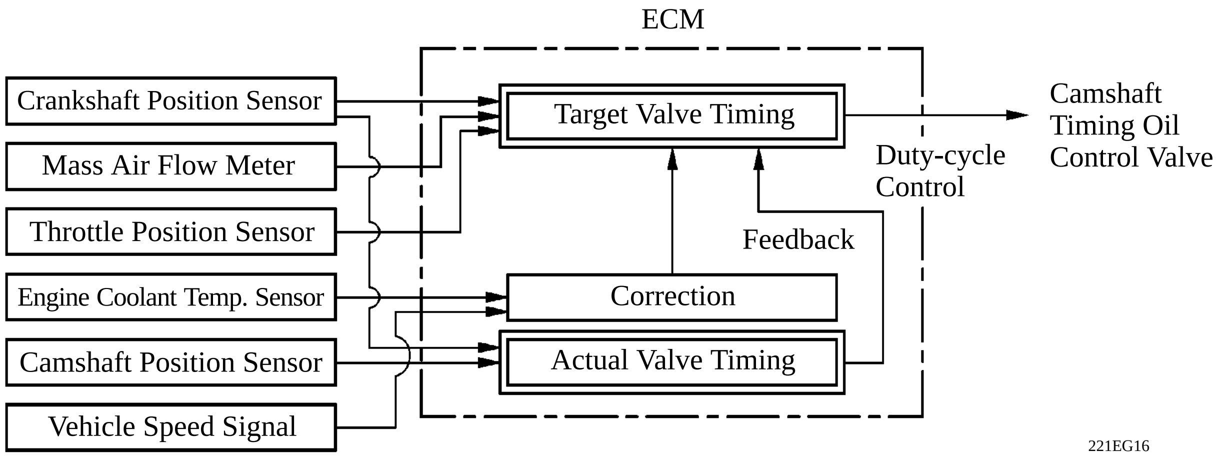
7. VVT-i (Variable Valve Timing-intelligent) System

General

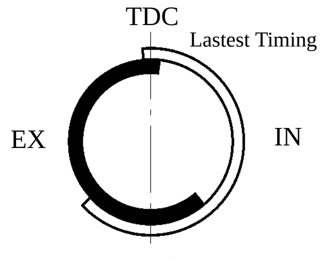
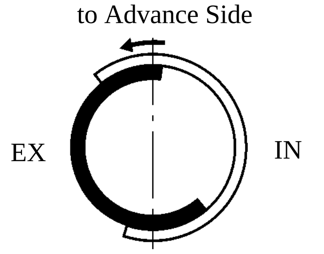
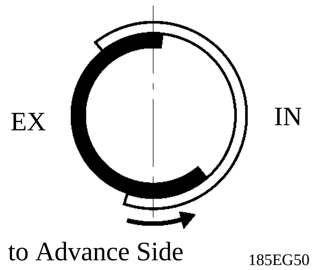
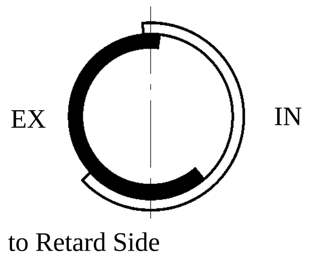
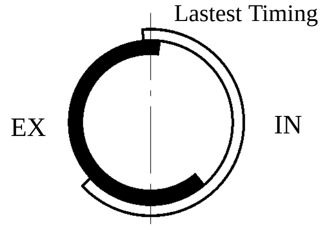
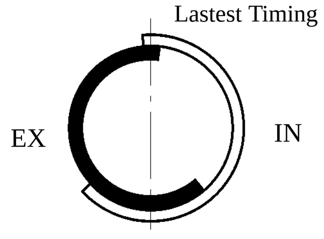
- The VVT-i system is designed to control the intake camshaft within a range of 40 ° (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



- Using the engine speed, intake air volume, throttle position and engine coolant temperature, the ECM can calculate 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.



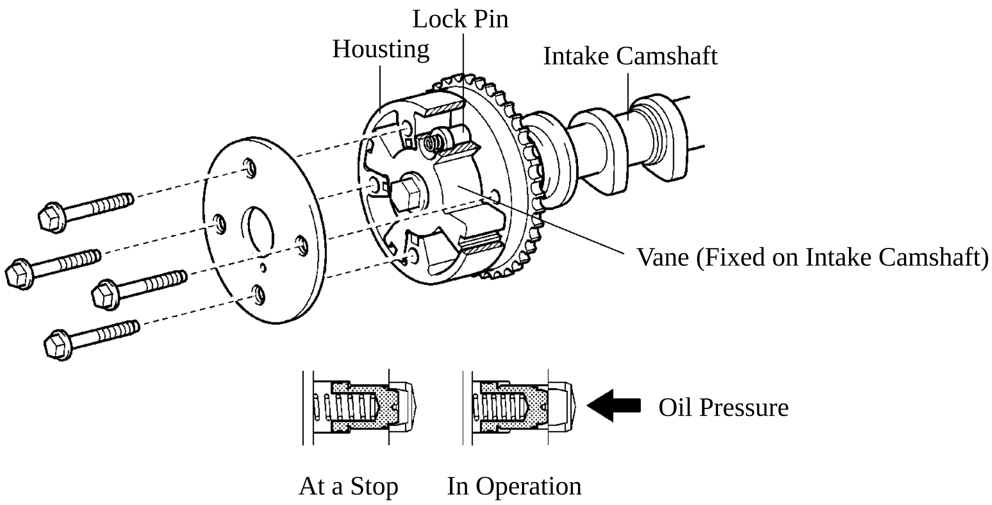
Effectiveness of the VVT-i System

Operation State	Objective		Effect
● During Idling ● At Light Load	 185EG48	Minimizing overlap to reduce blow back to the intake side	● Stabilized idling rpm ● Better fuel economy
At Medium Load	 185EG49	Increasing overlap to increase internal EGR to reduce pumping loss	● Better fuel economy ● Improved emission control
In Low to Medium Speed Range with Heavy Load	 185EG50	Advancing the intake valve close timing for volumetric efficiency improvement	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	 185EG48	Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temp.	 185EG48	Minimizing overlap to prevent blow back to the intake side leads to the lean burning condition, and stabilizes the idling speed at fast idle	● Stabilized fast idle rpm ● Better fuel economy
● Upon Starting ● Stopping the Engine	 185EG48	Minimizing overlap to minimize blow back to the intake side	Improved starability

Construction

1) VVT-i Controller

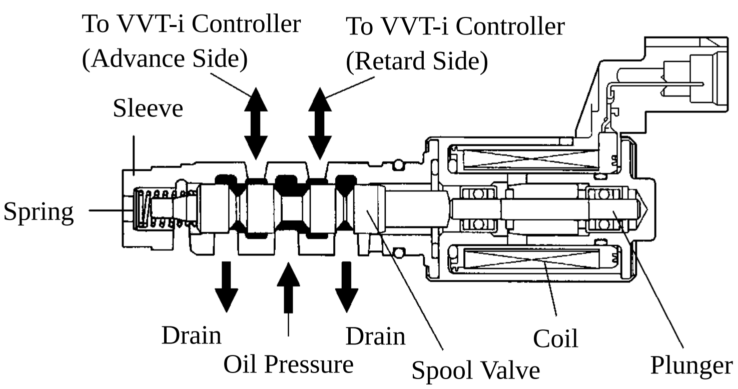
This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft.
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.
When the engine is stopped, the intake camshaft will be in the most retarded state to ensure startability.
When hydraulic pressure is not applied to the VVT-i controller immediately after the engine has been started, the lock pin locks the movement of the VVT-i controller to prevent a knocking noise.



Lock Pin 169EG36

2) Camshaft Timing Oil Control Valve

This camshaft timing oil control valve controls the spool valve position in accordance with the duty-cycle control from the ECM. This allow 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 state.

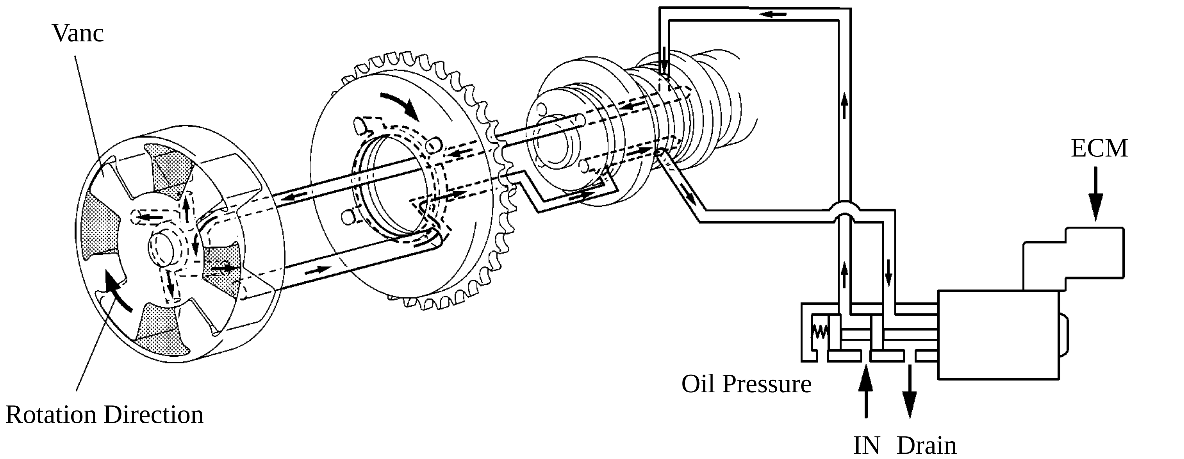


221EG17

Operation

1) Advance

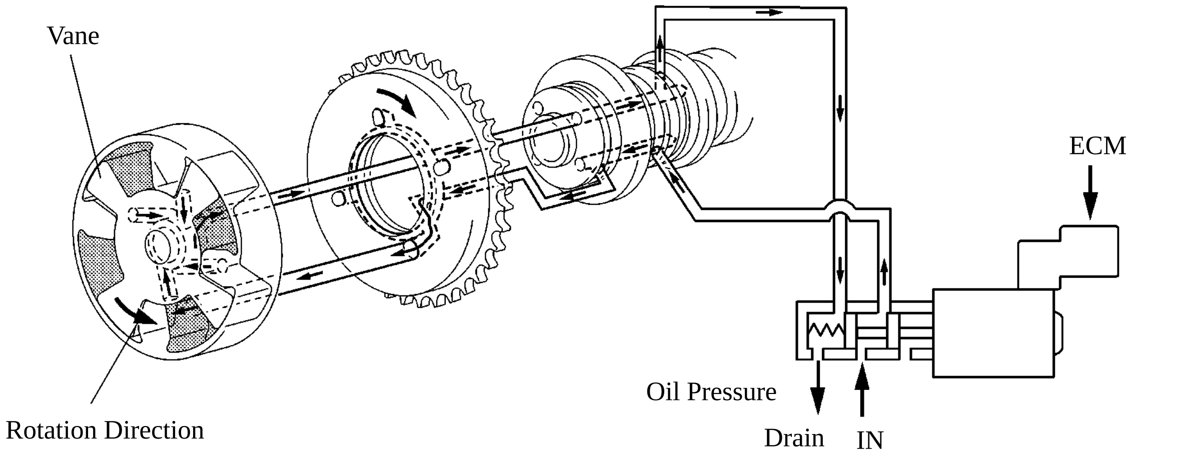
When the camshaft timing oil control valve is positioned as illustrated below by the advance signals from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



221EG19

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.



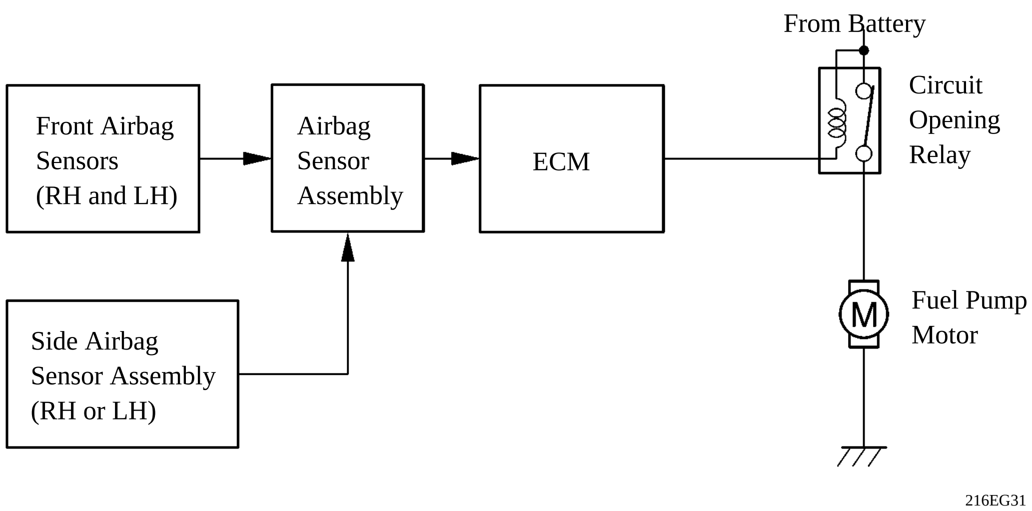
221EG20

3) Hold

After reaching at 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.

8. Fuel Pump Control

A fuel cut control is adopted to stop the fuel pump once when the SRS airbag is deployed in a front or side collision.
In this system, the airbag deployment signal from the airbag assembly is detected by the ECM, and it turns OFF the circuit opening relay.
After the fuel cut control has been activated, turning the ignition switch from OFF to ON cancels the fuel cut control, and the engine can be restarted.

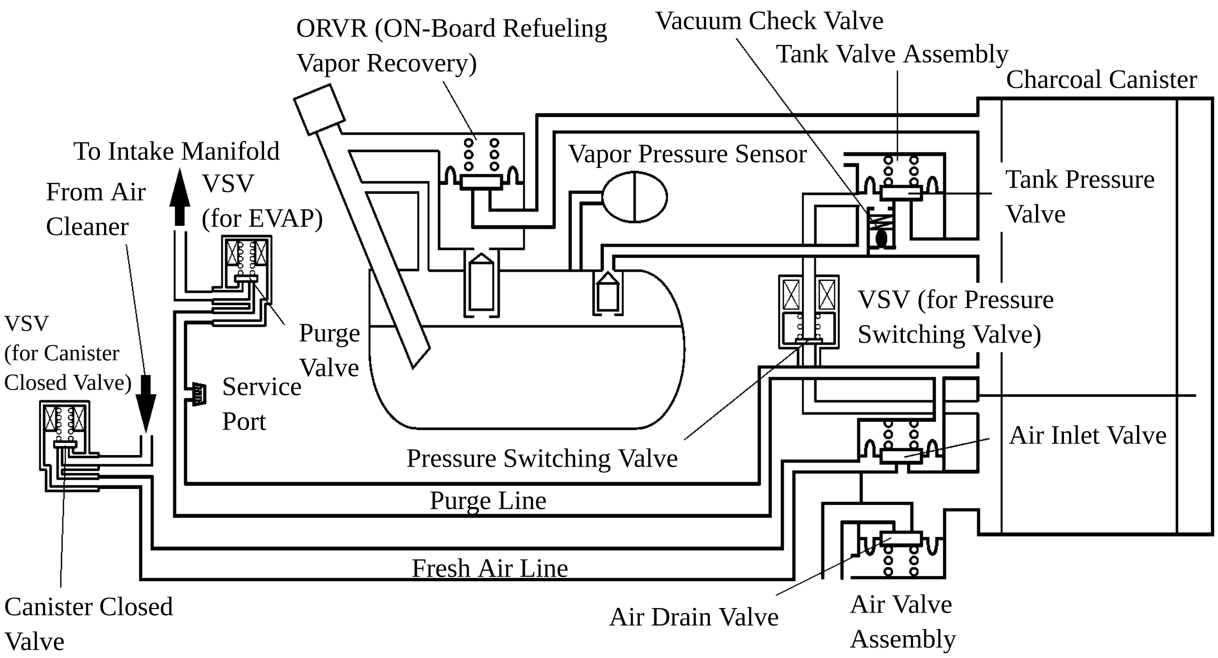


9. Evaporative Emission Control System

General

The ’03 Corolla Matrix uses the same vacuum type system used on the ’02 Corolla to detect leaks in the evaporative emission control system. It forcefully introduces the purge vacuum into the entire system and monitors the changes in the pressure to detect leaks. It consists of the following main components:

- A VSV (for canister closed valve) that closes the fresh air line from the air cleaner to the charcoal canister has been adopted.
- A VSV (for pressure switching valve) that opens the evaporative line between the fuel tank and the charcoal canister
- A function to close the purge line from the air intake chamber to the charcoal canister for this system is added to the original functions of VSV (for EVAP).
- A vapor pressure sensor that measures the pressure in the fuel tank while checking for evaporative emission leaks and sends signals to the ECM

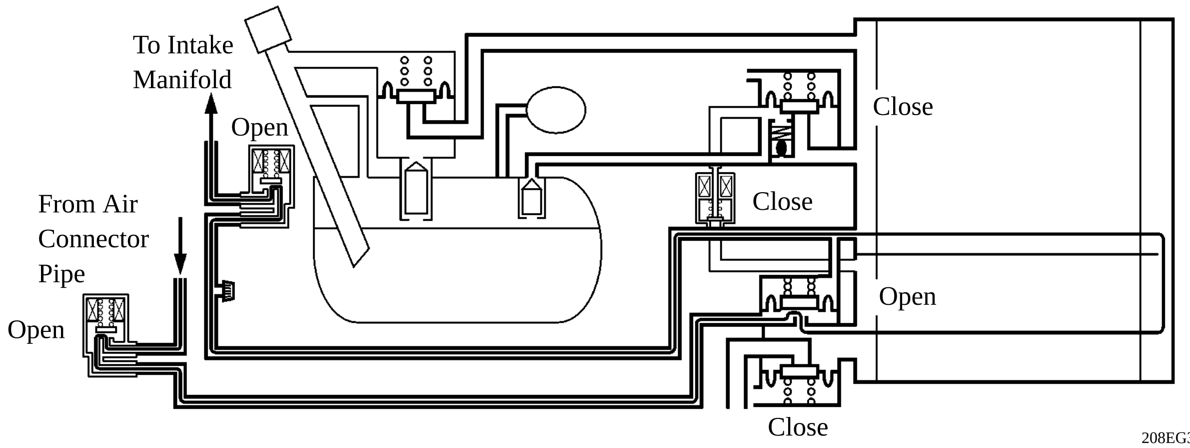


221EG01

Operation

1) Purge Flow

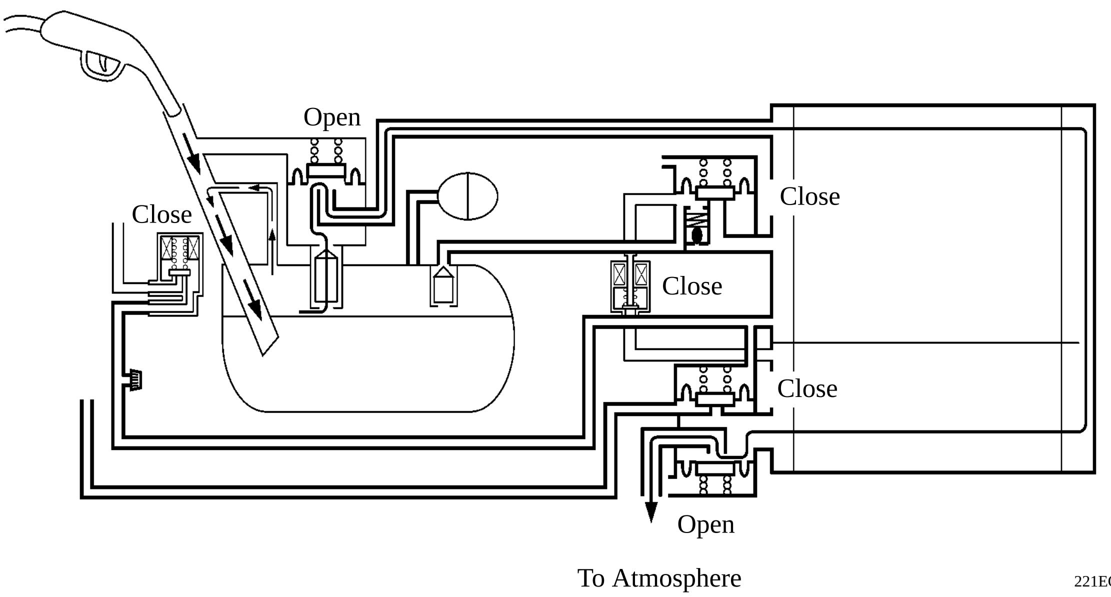
When the engine has reached the predetermined parameters (closed loop, engine coolant temp. above 74 °C (165 °F), etc.), stored fuel vapors are purged from the charcoal canister when the purge valve is opened by the ECM. At the appropriate time, the ECM will turn on the VSV (for EVAP).
The ECM will change the duty ratio cycle of the VSV (for EVAP) thus controlling purge flow volume. Purge flow volume is determined by manifold pressure and the duty ratio cycle of the VSV (for EVAP). Atmospheric pressure is allowed into the canister to ensure that purge flow is constantly maintained whenever purge vacuum is applied to the canister.



208EG32

2) ORVR (On-Board Refueling Vapor Recovery)

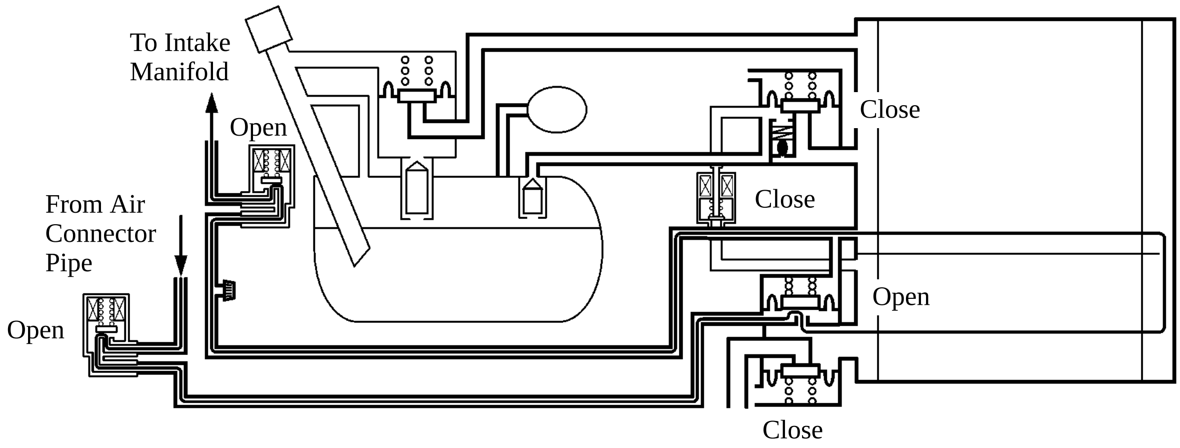
During refueling, low pressure above the diaphragm in the on-board recovery valve lifts allowing fuel vapors into the charcoal canister. At the same time, the air drain valve opens and the charcoal absorbs the fuel vapors.



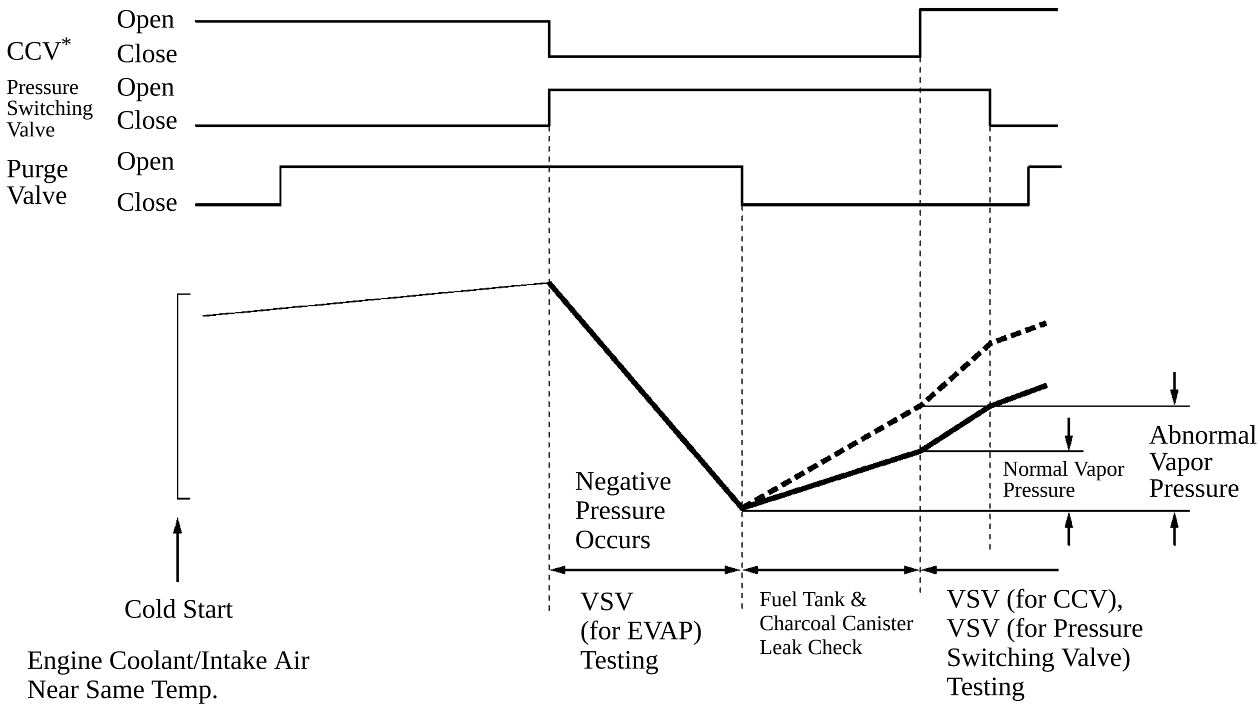
221EG26

3) Monitor

The monitor sequence begins with a cold engine start. The intake air temp. and engine coolant temp. sensors must have approximately the same temperature reading. The ECM is constantly monitoring fuel tank pressure. As the temperature of the fuel increases, pressure slowly rises. The ECM will purge the charcoal canister at the appropriate time. With VSV (for pressure switching valve) closed, pressure will continue to rise in fuel tank.



208EG34



221EG23

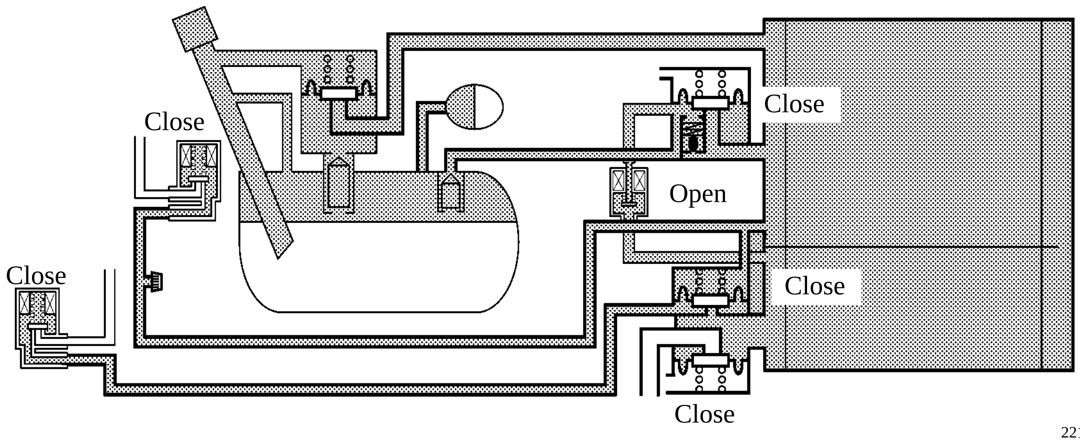
CCV: Canister Closed Valve

4) DTC P0440, P0442 (Evaporative Emission Control System Malfunction)

Initially, when the canister closed valve is closed, and the pressure switching valve and the purge valve are opened, a vacuum is applied to the purge line from the air intake to the charcoal canister and to the evaporative line from the charcoal canister to the fuel tank. Next, the purge valve is closed in order to maintain a vacuum from the VSV (for EVAP) to the inside of the fuel tank. Then, any subsequent changes in the pressure are monitored by the vapor pressure sensor in order to check for evaporative emission leaks.

If a leak is detected, the MIL (Malfunction Indicator Lamp) illuminates to inform the driver. Also, the DTC (Diagnostic Trouble Code) can be accessed through the use of a hand-held tester.

For details on the DTCs, refer to the 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

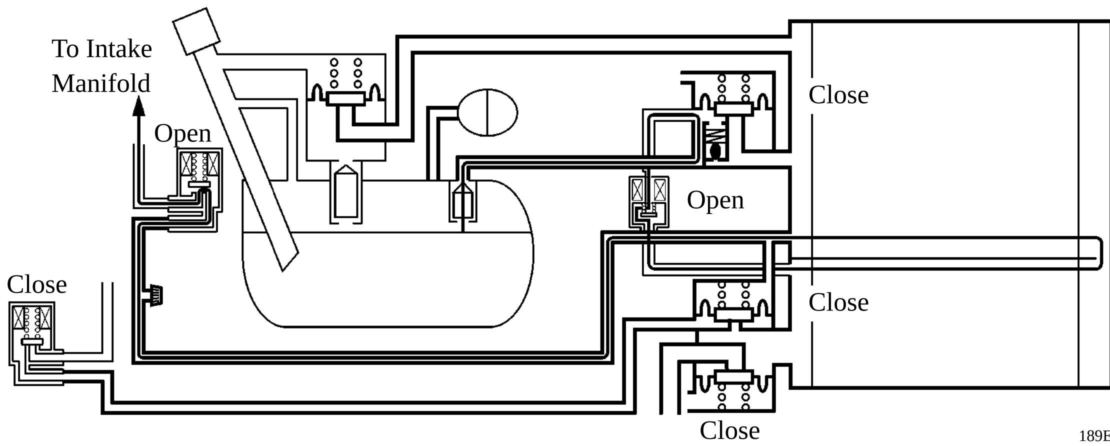


221EG24

5) DTC P0441 (Evaporative Emission Control System Incorrect Purge Flow)

At a predetermined point, the ECM closed the canister closed valve and opens the pressure switching valve causing a pressure drop in the entire EVAP system. The ECM continues to operate the VSV (for EVAP) until the pressure is lowered to a specified point at which time the ECM closed the purge valve. If the pressure did not drop, or if the drop in pressure increase beyond the specified limit, the ECM judges the VSV (for EVAP) and related components to be faulty and the MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester.

For details on the DTCs, refer to the 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

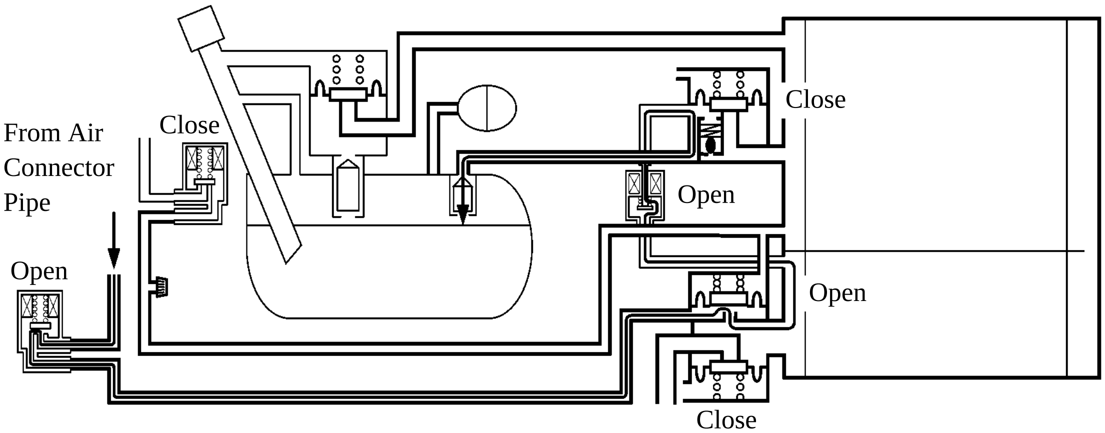


189EG35

6) DTC P0446 (Evaporative Emission Control System Vent Control Malfunction)

a. Canister Closed Valve

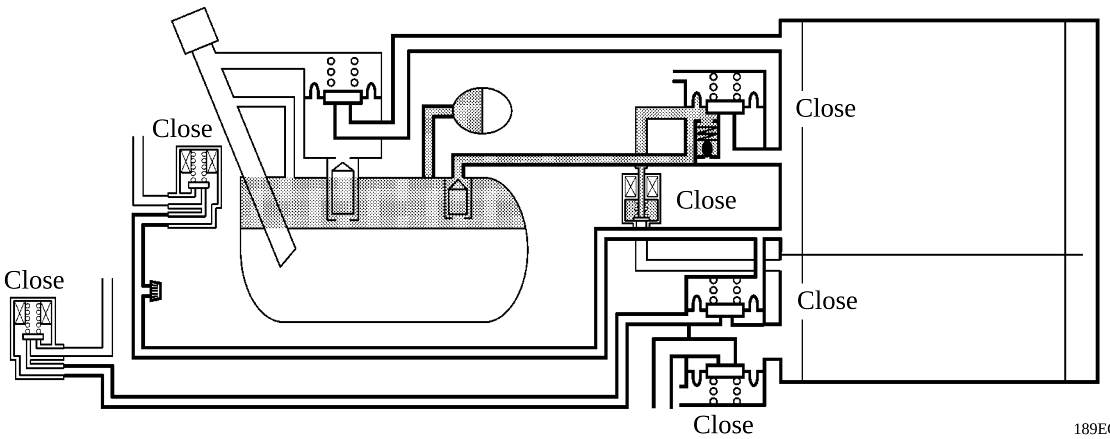
This stage checks the VSV (for canister closed valve) and vent (air inlet side) operation. When the vapor pressure rises to a specified point, the ECM opens the canister closed valve. Pressure will increase rapidly because of the air allowed into the system. No increase or an increase below specified rate of pressure increase indicates a restriction on the air inlet side. If a malfunction is detected, the MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester. For details on the DTCs, refer to the 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).



221EG25

b. Pressure Switching Valve

The ECM closes the pressure switching valve. This action blocks air entering the tank side of the system. The pressure rise is no longer as great. If there was no change in pressure, the ECM will conclude the pressure switching valve did not close. If a malfunction is detected, the MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester.
For details on the DTCs, refer to the 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

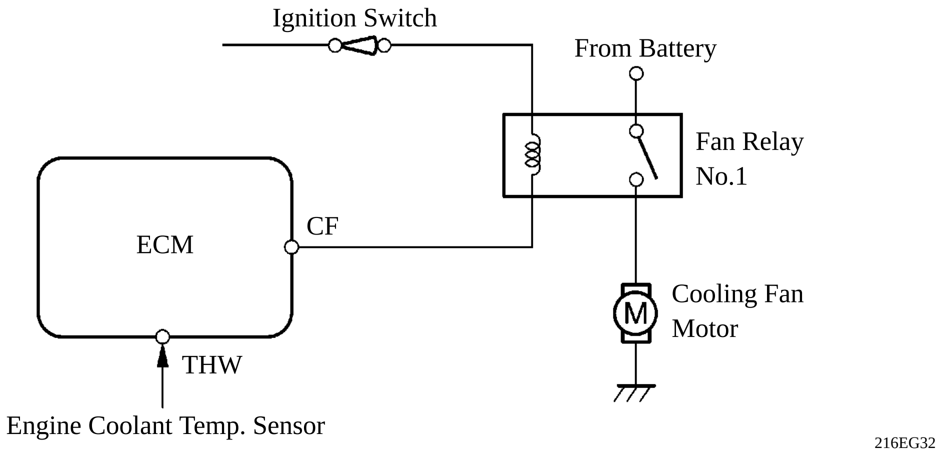


189EG37

10. Cooling Fan Control

- On the models without air conditioning, the ECM controls the operation of the cooling fan based on the engine coolant temp. sensor singal.

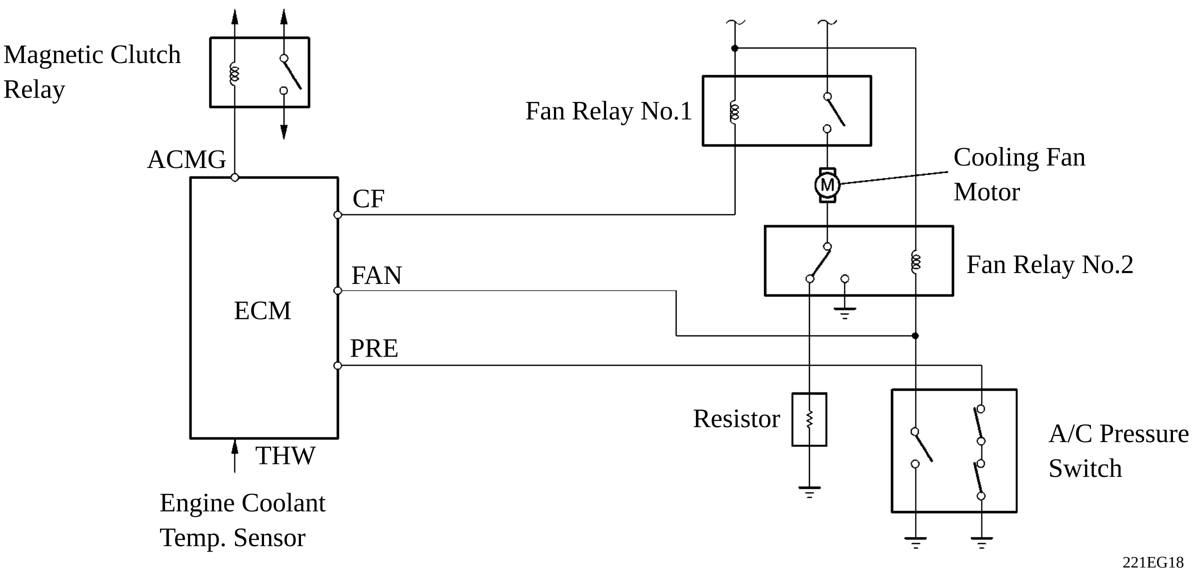
▶ Wiring Diagram ◀



Cooling Fan Operation	OFF	ON
Engine Coolant Temp. °C (°F)	94.5 (202.1) or lower	96 (204.8) or higher

- On the models with air conditioning, the ECM controls the operation of the cooling fan in two speeds (Lo and Hi) based on the engine coolant temp. sensor signal and the A/C pressure switch signal.
  The Lo speed operation in accomplished by applying the current through a resistor, which reduces the speed of the cooling fan.

▶ Wiring Diagram ◀



▶ Cooling Fan Operation ◀

Air Conditioning Condition		Engine Coolant Temp °C (°F)	
Compressor	Refrigerant Pressure MPa (kgf/cm^2, PSI)	94.5 (202.1) or lower	96 (204.8) or higher
OFF	1.2 (12.5, 178) or lower	OFF	High
ON	1.2 (12.5, 178) or lower	Low	High
	1.5 (15.5, 220) or higher	High	High

11. 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.
- At the same time, the DTCs (Diagnostic Trouble Codes) are stored in memory. The DTCs can be read by connecting a hand-held tester.
- For details, see the 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

12. Fail-Safe

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

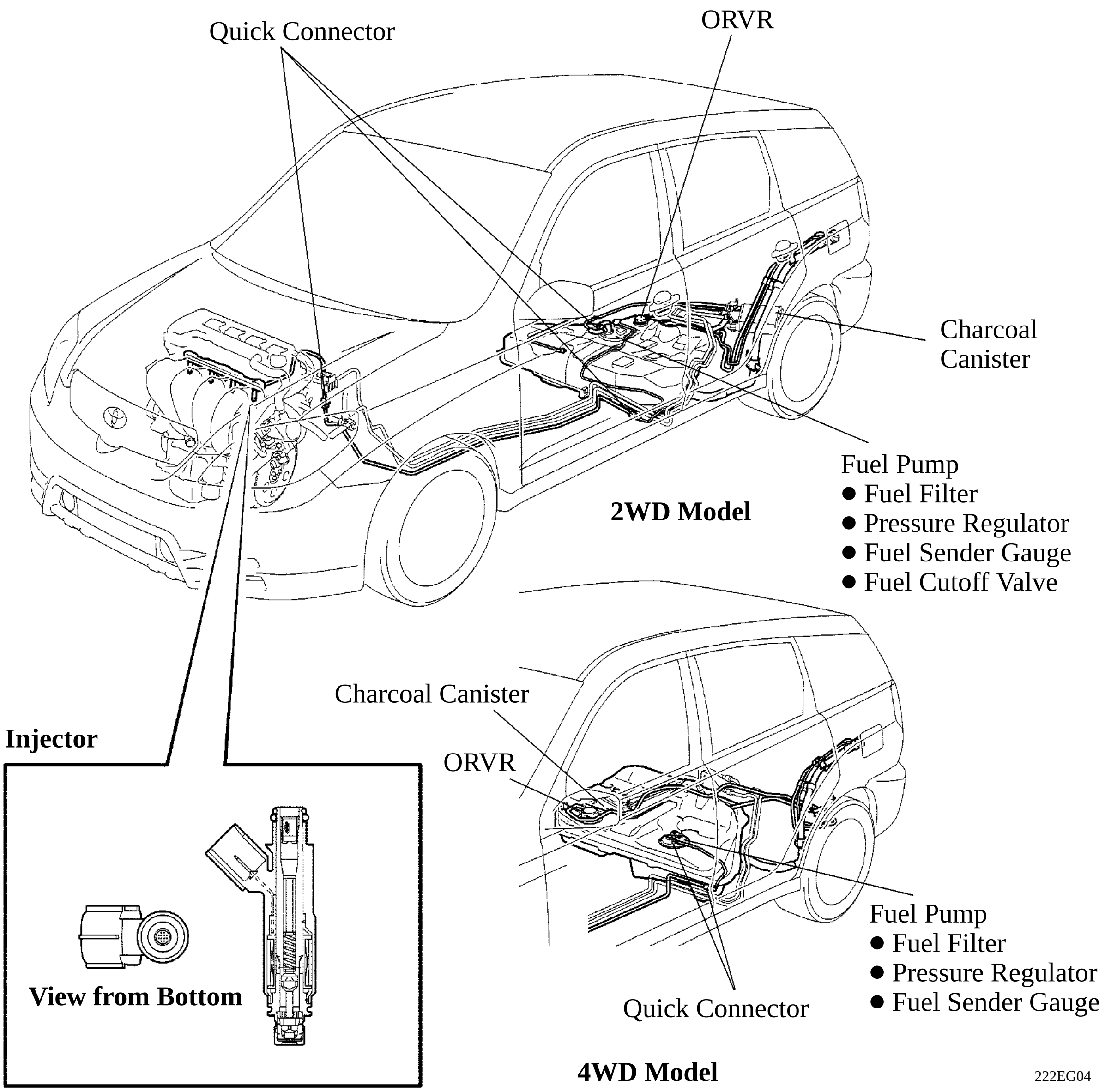
▶ Fail-Safe Control List ◀

Location of Malfunction	Description of Control
Mass Air Flow Meter	In case of a signal malfunction, the engine could operate poorly or the catalyst could overheat if the engine continues to be controlled with the signals from the sensors. Therefore, the ECM effects control by using the values in the ECM or stops the engine.
Throttle Position Sensor	In case of a signal malfunction, the ECM effects control by rendering the throttle valve opening angle as being fully closed.
Engine Coolant Temp. Sensor and Intake Air Temp. Sensor	In case of a signals malfunction, the use of the values from the sensors will make the air-fuel ratio become too rich or too lean, which could cause the engine to stall or to run poorly during cold operation. Therefore, the ECM fixes the air-fuel ratio to the stoichiometric raito and uses the constant values of 80 °C engine coolant temperature and 20 °C intake air temperature to perform the calculation.
Knock Sensor	In case of a malfunction in the knock sensor or in the knocking signal system (open or short circuit), the engine could become damaged if the timing is advanced despite the presence of knocking. Therefore, if a malfunction is detected in the knock sensor system, the ECM turns the timing retard correction of the knock sensor into the maximum retard value.
Ignition Coil (with Igniter)	In case of a malfunction in the ignition system, such as an open circuit in the ignition coil, the catalyst could become overheated due to engine misfire. Therefore, if the (IGF) ignition signal is not input twice or more in a row, the ECM determines that a malfunction occurred in the ignition system and stops only the injection of fuel into the cylinder with malfunction.
Camshaft Position Sensor	In case of a signal malfunction (open or short circuit) or a mechanical malfunction, the ECM stops the VVT-i control.

■FUEL SYSTEM

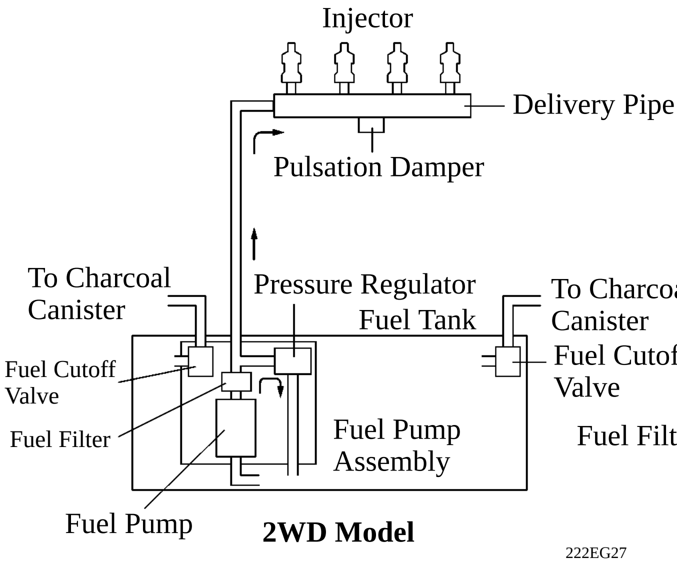
1. General

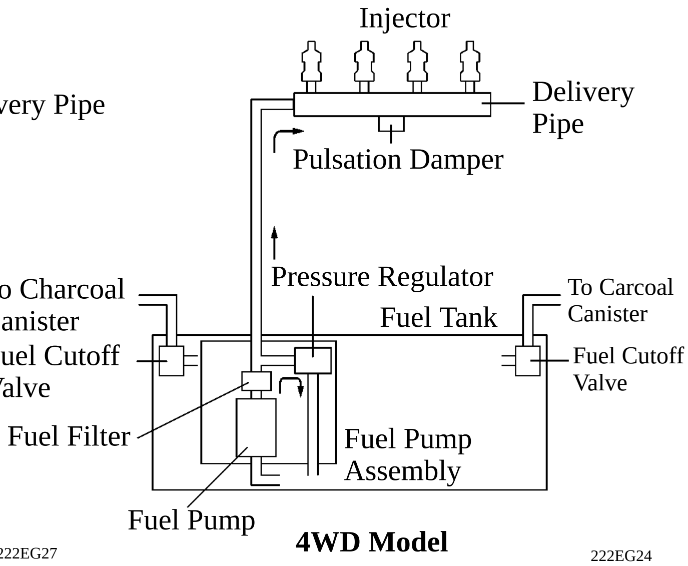
- A fuel returnless system is used to reduce evaporative emissions.
- A fuel cut control is used to stop the fuel pump when the SRS airbag is deployed in a front or side collision. For details, see page EG-40.
- A quick connector is used to connect the fuel pipe with the fuel hose for excellent serviceability.
- A compact fuel pump (for 2WD) in which fuel filter, pressure regulator, fuel sender gauge, and fuel cutoff valve are all integrated in the fuel pump assembly is now used.
- A compact fuel pump (for 4WD) in which fuel filter, pressure regulator, and fuel sender gauge all integrated in the fuel pump assembly is now used.
- A compact 12-hole type injector is used to increase the atomization of the fuel.
- The ORVR (On-Board Refueling Vapor Recovery) system is used.



2. Fuel Returnless System

This system is used to reduce evaporative emissions and makes it possible to discontinue the return of fuel from the engine area and prevents the temperature from rising inside the fuel tank.

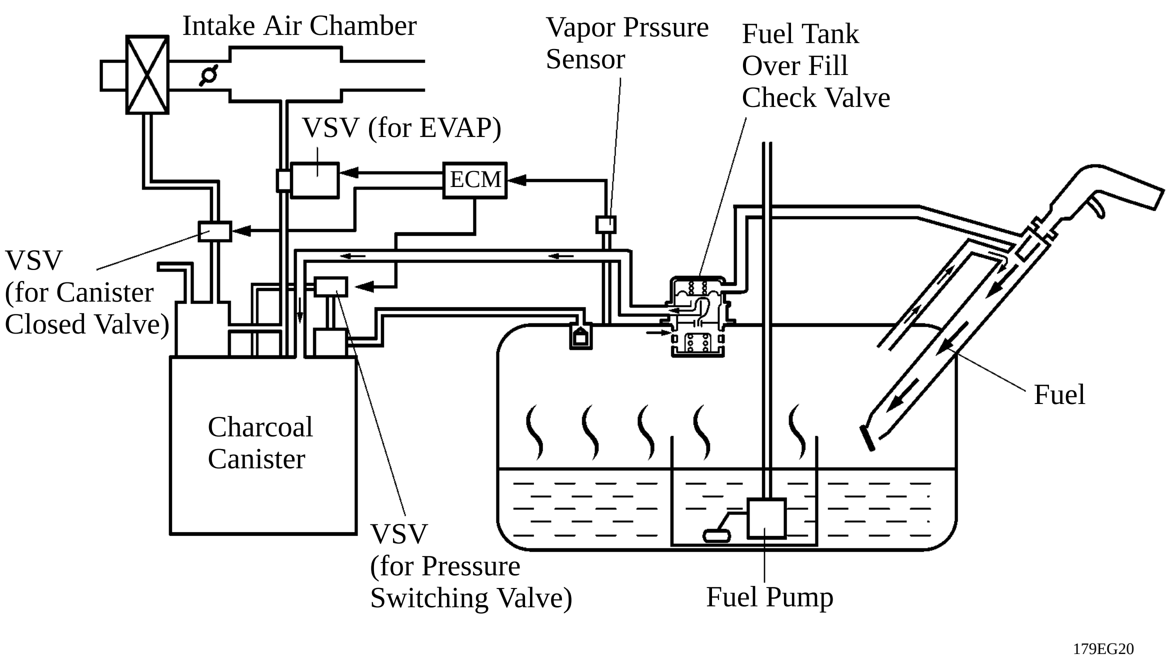




3. ORVR System

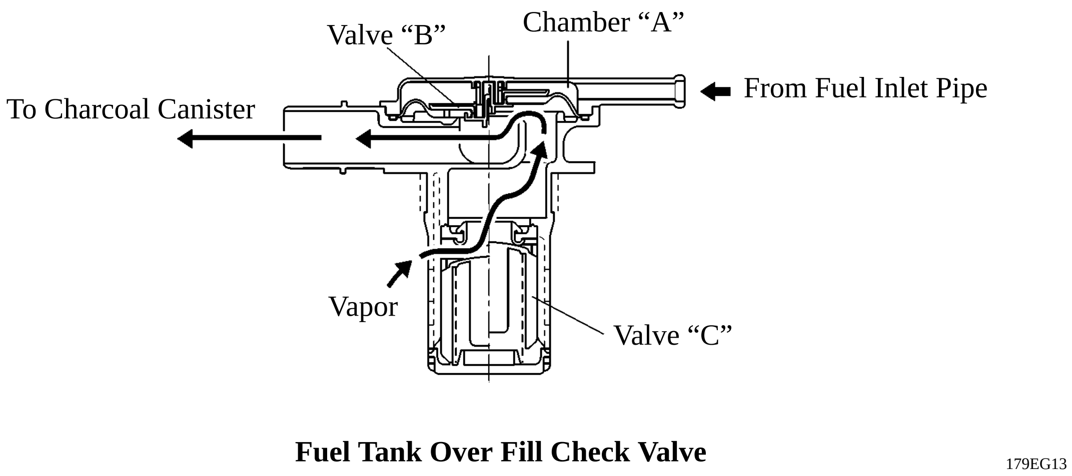
General

The ORVR system uses a charcoal canister, which is provided onboard, to recover the fuel vapor that is generated during refueling. This reduces the discharge of fuel vapor into the atmosphere.



Operation

When the fuel tank cap is removed, atmosphere is applied to the fuel tank over fill check valve’s chamber “A”. Refueling causes the internal pressure of the fuel tank to increase. The vapor flows to the charcoal canister while valve “B” is closed, thus allowing the vapor to become absorbed by the charcoal canister. When the tank is full, valve “C” closes, thus shutting off the passage to the charcoal canister.

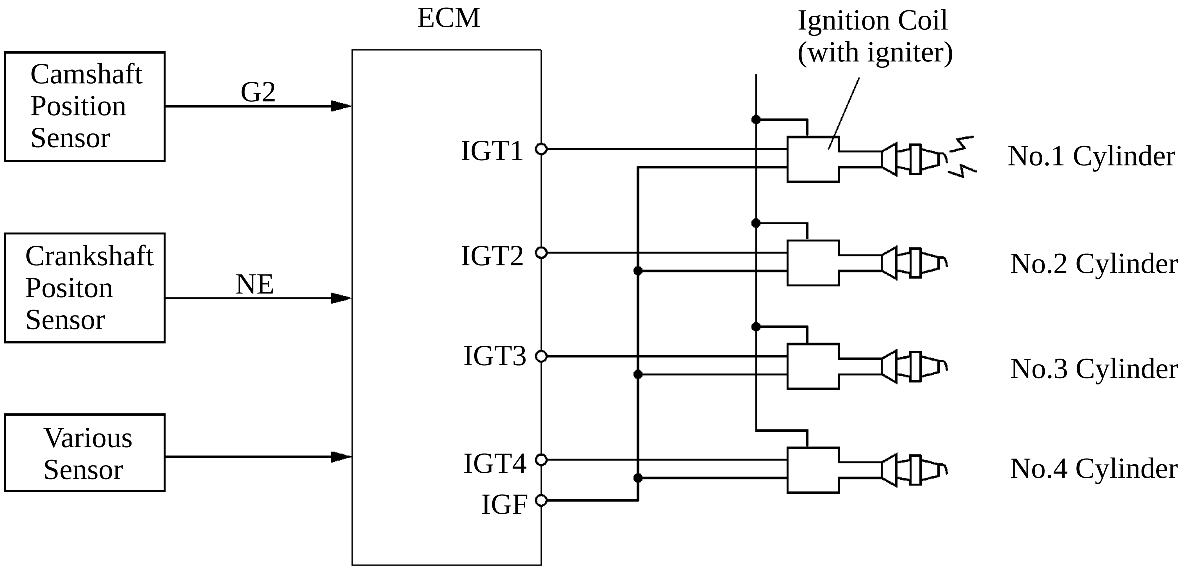


Fuel Tank Over Fill Check Valve

■ IGNITION SYSTEM

1. General

- A DIS (Direct Ignition System) is been 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.
- Iridium-tipped spark plugs are used.



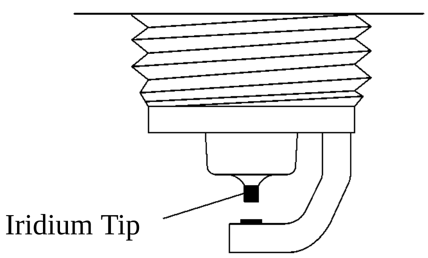
165EG25

2. Ignition Coil

The DIS has 4 ignition coils, one for each cylinder. The spark plug caps, which connect to the spark plugs, are integrated with the ignition coil. Also, the igniter is enclosed to simplify the system.

3. Spark Plug

Iridium-tipped spark plugs are used to achieve a 120,000 miles (192,000 km) maintenance interval. By making the center electrode of iridium, the same ignition performance as of the platinum-tipped spark plugs is achieved and durability has been increased.



208EG70

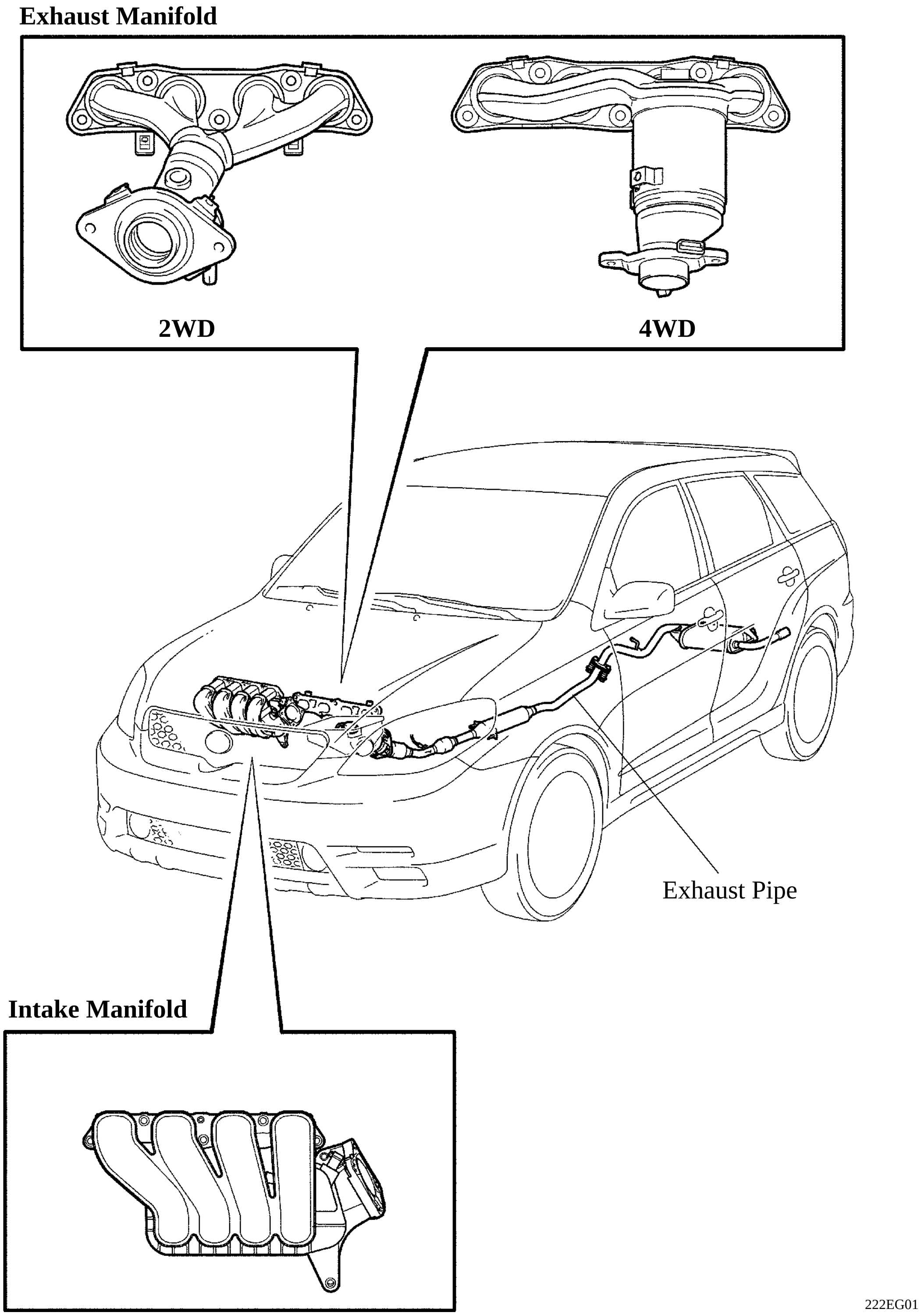
▶ Specification ◀

DENSO	SK16R11
NGK	IFR5A11
Plug Gap	1.0 - 1.3 mm (0.0394 - 0.0512 in.)

■INTAKE AND EXHAUST SYSTEM

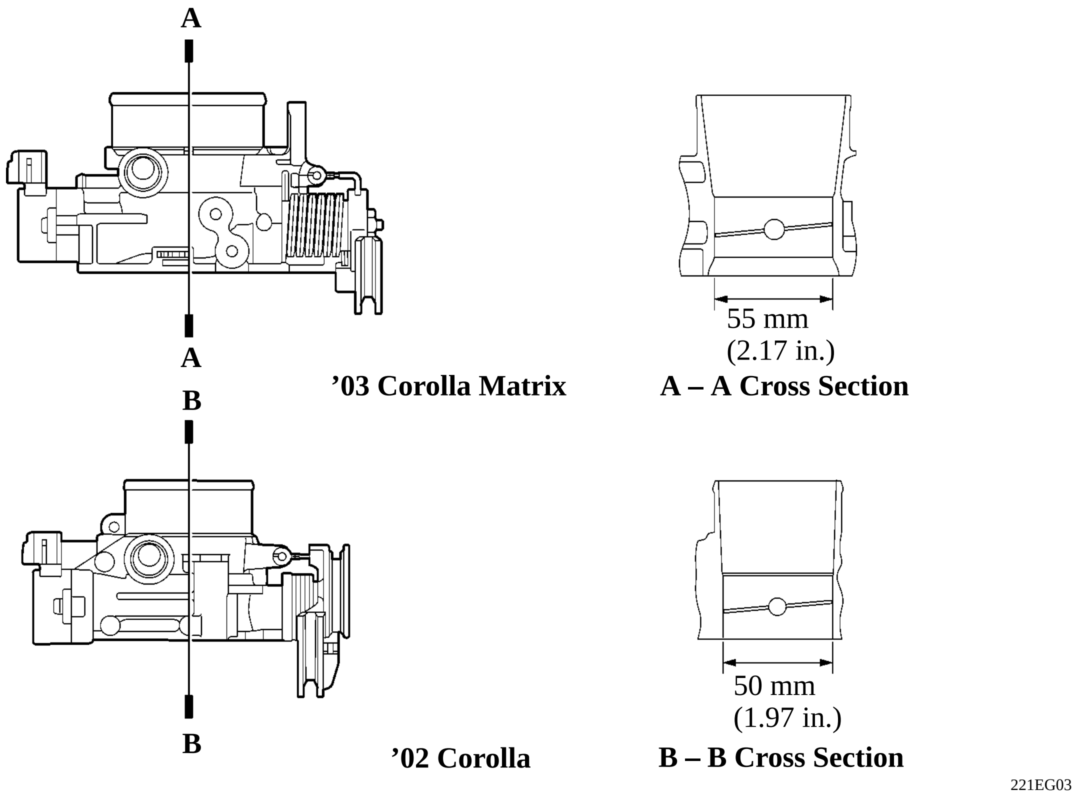
1. General

- A plastic intake manifold is adopted for weight reduction.
- A stainless steel exhaust manifold is used for weight reduction.
- By routing the exhaust rearward, the front exhaust pipe has been shortened and higher warm-up performance of the TWC (Three-Way Catalytic Converter) has been achieved.



2. Throttle Body

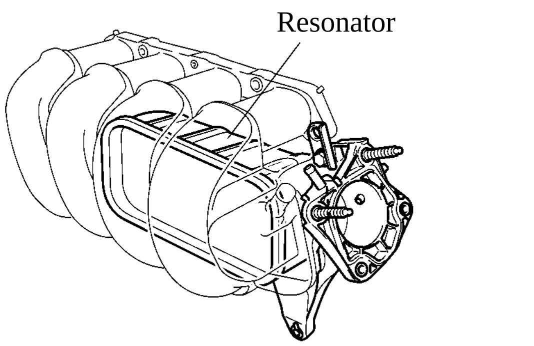
The diameter of the throttle valve of the ’03 Corolla Matrix has been increased from the ’02 Corolla for increased output.



3. Intake Manifold

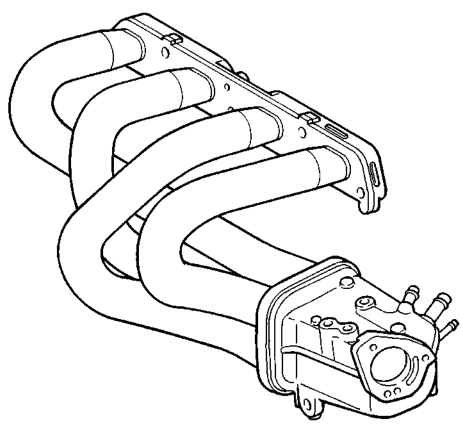
On the ’03 Corolla Matrix, the material (aluminum → plastic) and the shape of the intake manifold have been changed from the ’02 Corolla.

- The intake manifold is manufactured of plastic to reduce the weight and the amount of heat transferred from the cylinder head. As a result, it has become possible to reduce the intake air temperature and improve the intake volumetric efficiency.
- A resonator is provided in the air intake chamber to optimize the intake pulsation in order to improve the engine performance in the mid-speed range.



’03 Corolla Matrix

221EG08



’02 Corolla

148EG11

4. Exhaust Manifold

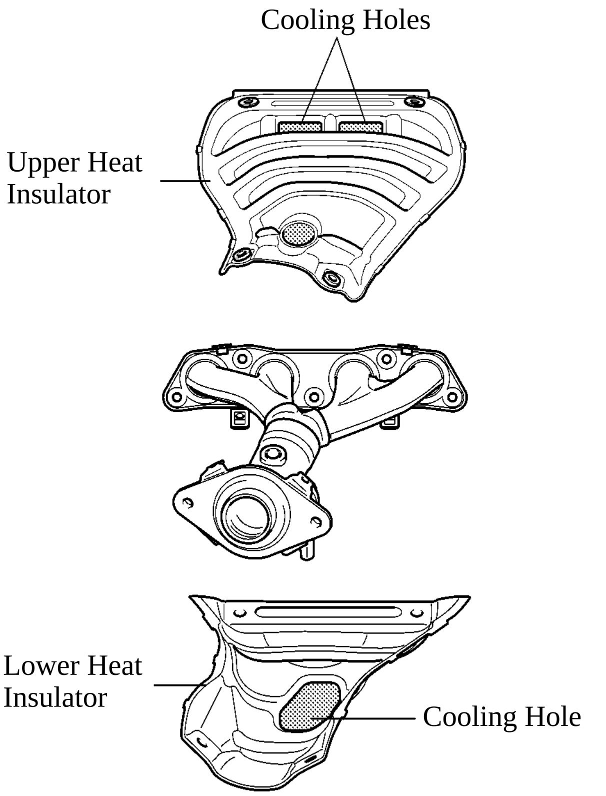
The shape of the exhaust manifold differs between the 2WD and 4WD models due to installation differences.

- The exhaust manifold for the 2WD model uses shorter branches and a convergence area that is constructed of dual pipe in order to ensure the proper warm-up performance of the No.1 TWC (Three-Way Catalytic Converter).
- The exhaust manifold for the 4WD model is directly joined to the No.1 TWC (Three-Way Catalytic Converter) to ensure the proper warm-up performance.
  In addition, a heat insulator has been provided to protect the heated oxygen sensor.

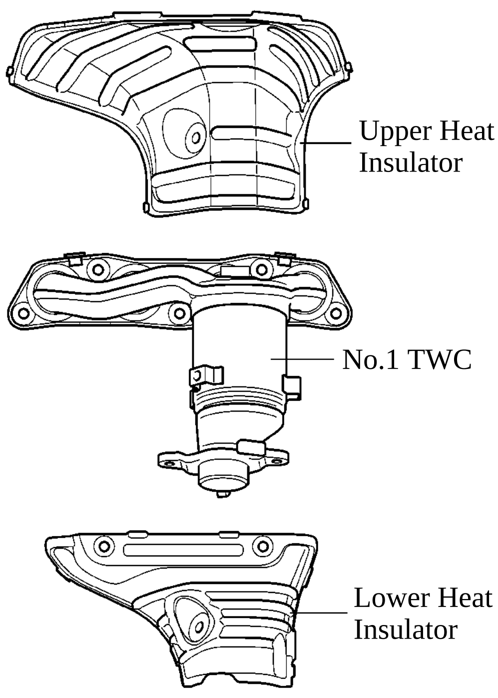
Service Tip

An SST (09224-00010/O2 Sensor Wrench) has been newly adopted for the exhaust manifold (for 4WD). For details, refer to 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

- This heat insulator contains holes that facilitate the flow of the cooling air, which act as a radiation temperature countermeasure and ensure exhaust manifold cooling performance.



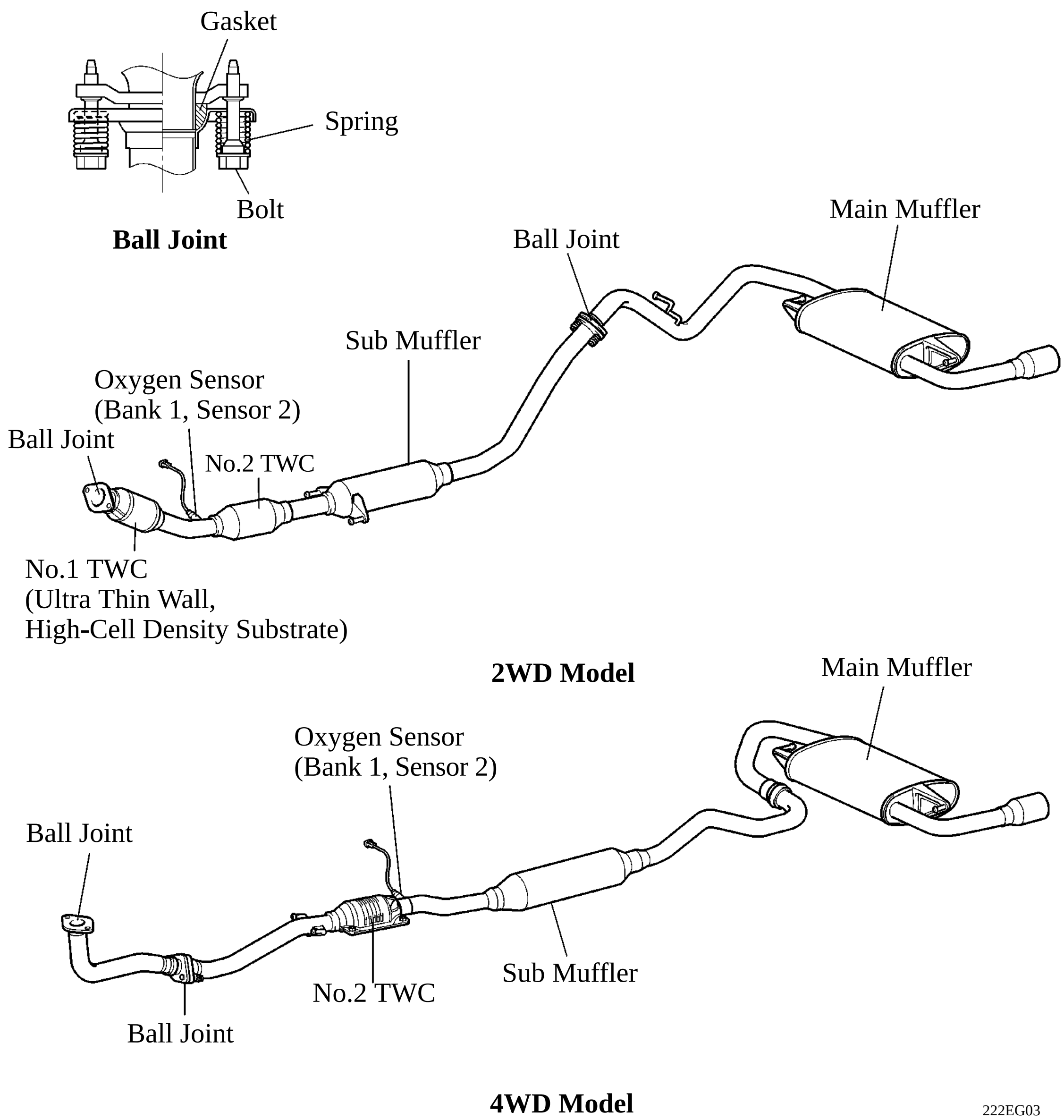
2WD Model 221EG09



4WD Model 222EG02

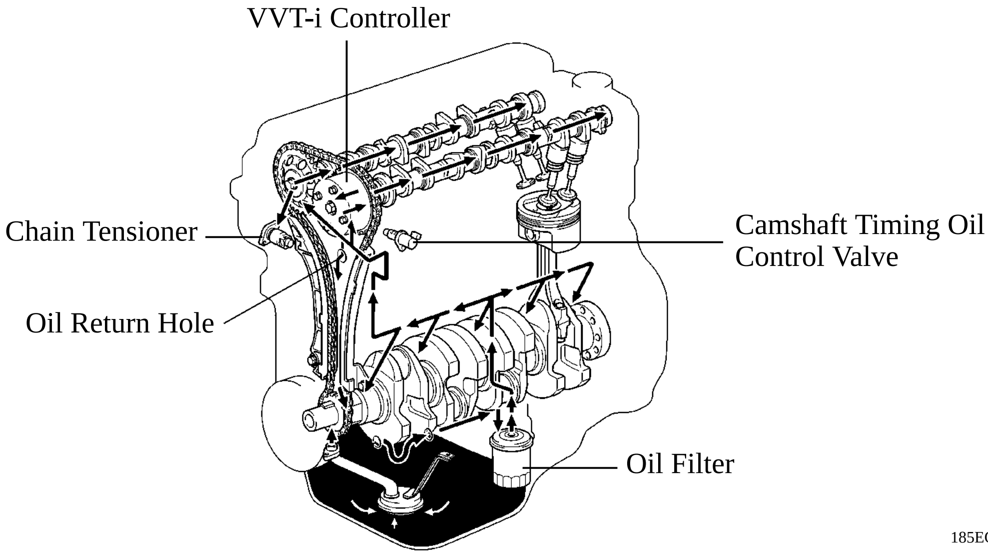
5. Exhaust Pipe

- This exhaust pipe uses two ball joints in order to achieve a simple construction and improved reliability.
- The 2WD model has adopted an ultra thin wall, high cell density substrate No.1 TWC to improve warm-up performance.



■ LUBRICATION SYSTEM

- The lubrication circuit is fully pressurized and oil passes through an oil filter.
- The cycloid gear type oil pump is driven directly by the crankshaft.
- This engine has an oil return system in which the oil is force-fed to the upper cylinder head and returns to the oil pan through the oil return hole in the cylinder head.
- The oil filter is attached downward from the crankshaft bearing cap to realize serviceability.
- The cylinder head is provided with a VVT-i controller and a camshaft timing oil control valve. This system is operated by the engine oil pressure.

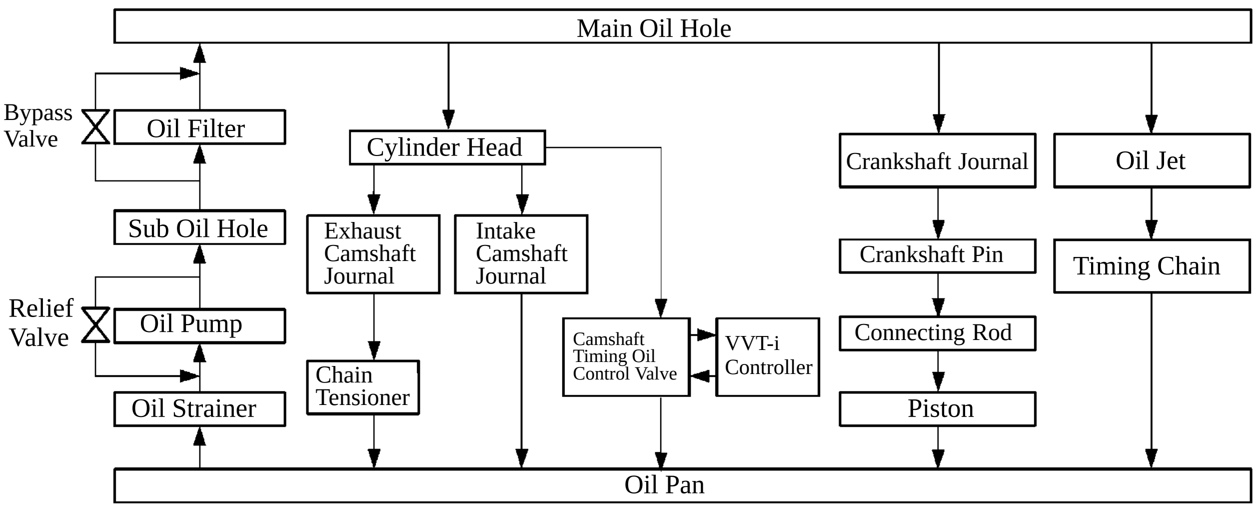


185EG34

▶ Oil Capacity ◀

liters (US qts, Imp. qts)

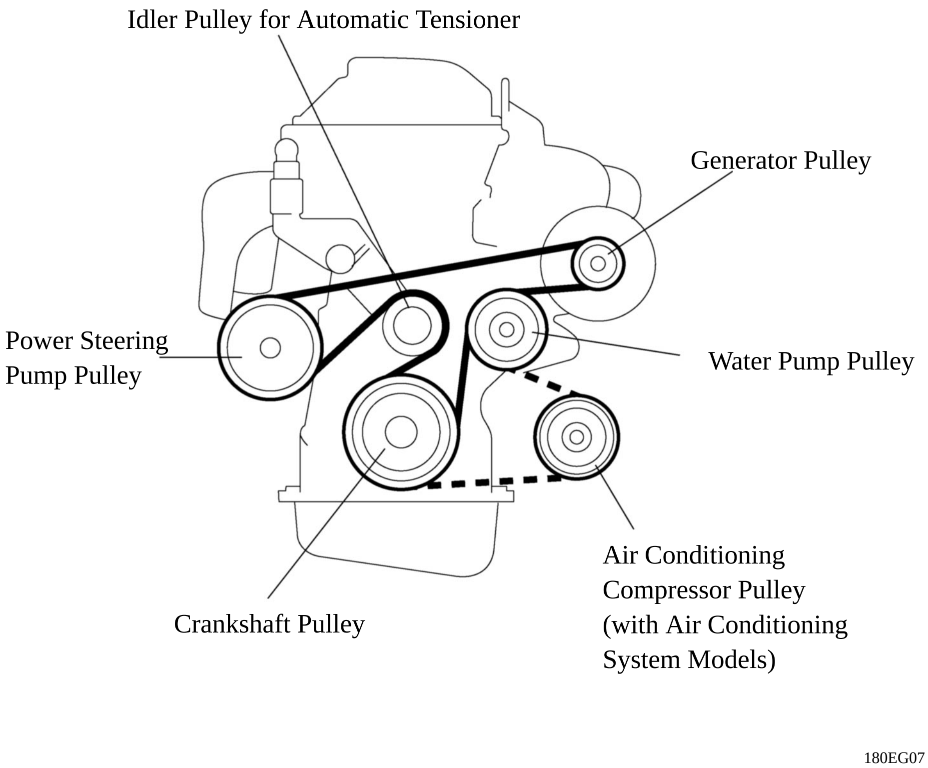
Dry	4.2 (4.4, 3.7)
with Oil Filter	3.7 (3.9, 3.3)
without Oil Filter	3.5 (3.7, 3.1)



216EG40

■SERPENTINE BELT DRIVE SYSTEM

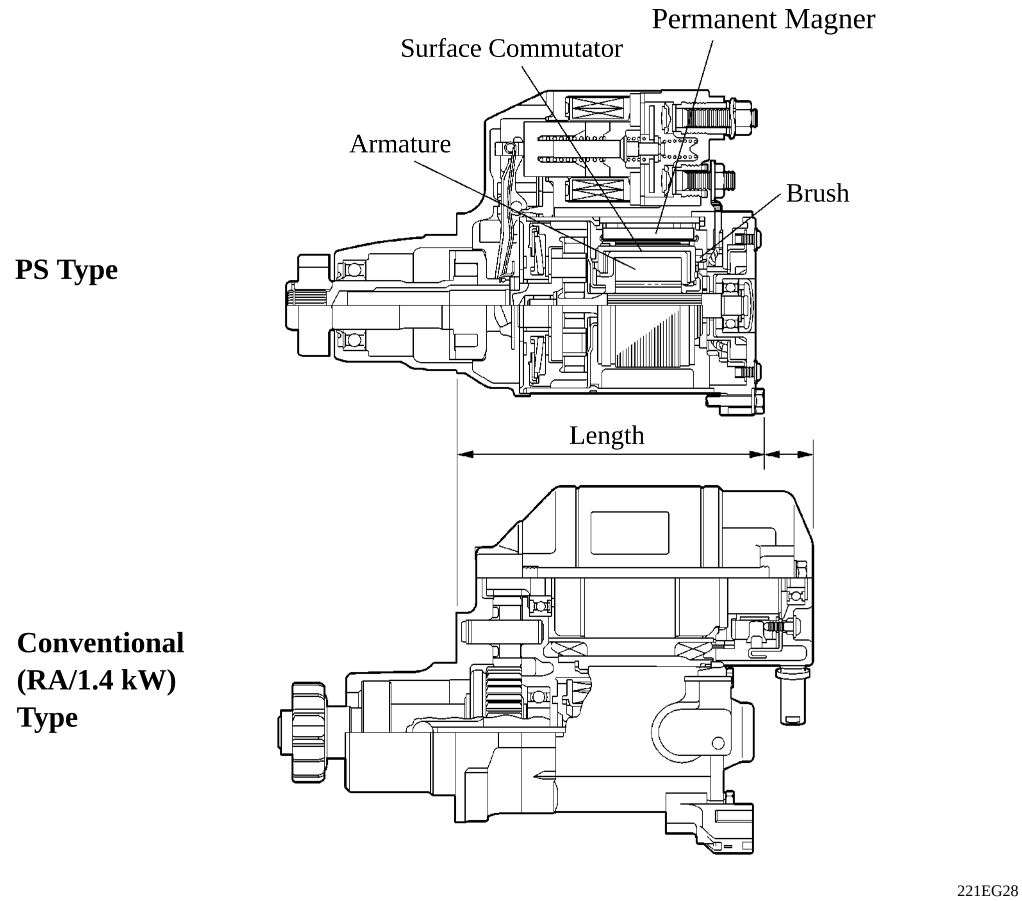
- Accessory components are driven by a serpentine belt consisting of a single V-ribbed belt. It reduces the overall engine length, weight and number of engine parts.
- An automatic tensioner eliminates the need for tension adjustment.



■ STARTING SYSTEM

1. General

- A compact and lightweight PS (Planetary reduction-Segment conductor motor) type starter has been adopted.
- Because the PS type starter contains an armature that uses square-shaped conductors, and its surface functions as a commutator, it has resulted in both improving its output torque and reducing its overall length.
- In place of the field coil used in the conventional type starter, the PS type starter uses two types of permanent magnets: main magnets and interpolar magnets. The main magnets and interpolar magnets have been efficiently arranged to increase the magnetic flux and to shorten the length of the yoke.



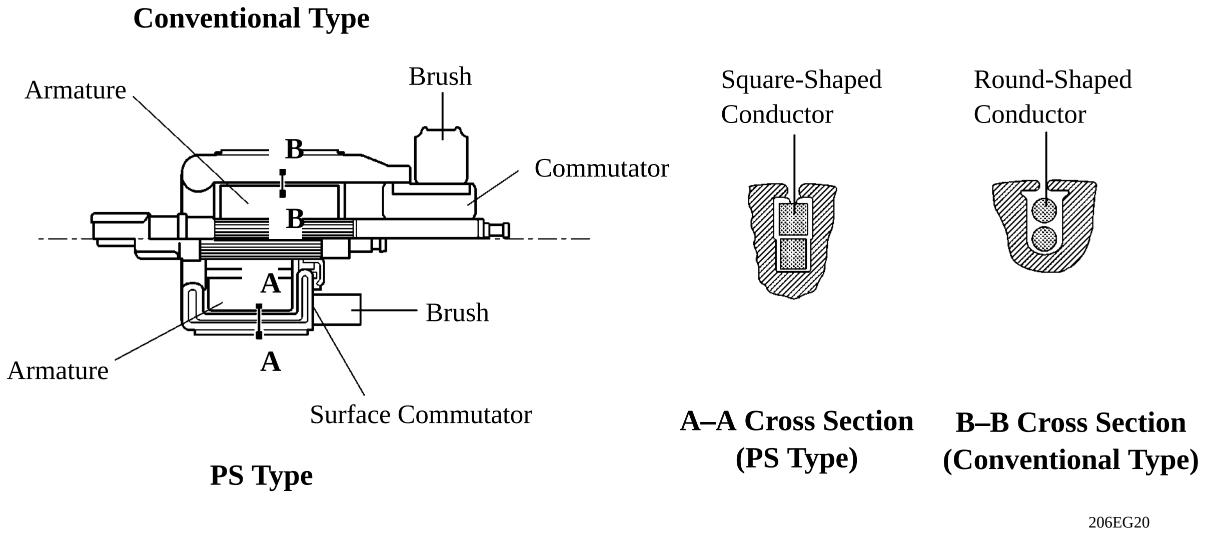
▶ **Specification** ◀

Starter Type	PS Type	Conventional (RA) Type
Rating Output	1.6 kW	1.4 kW
Rating Voltage	12 V	←
Length	132 mm (5.20 in.)	160 mm (6.30 in.)
Weight	2800 g	3600 g
Rotating of Direction*	Counterclockwise	←

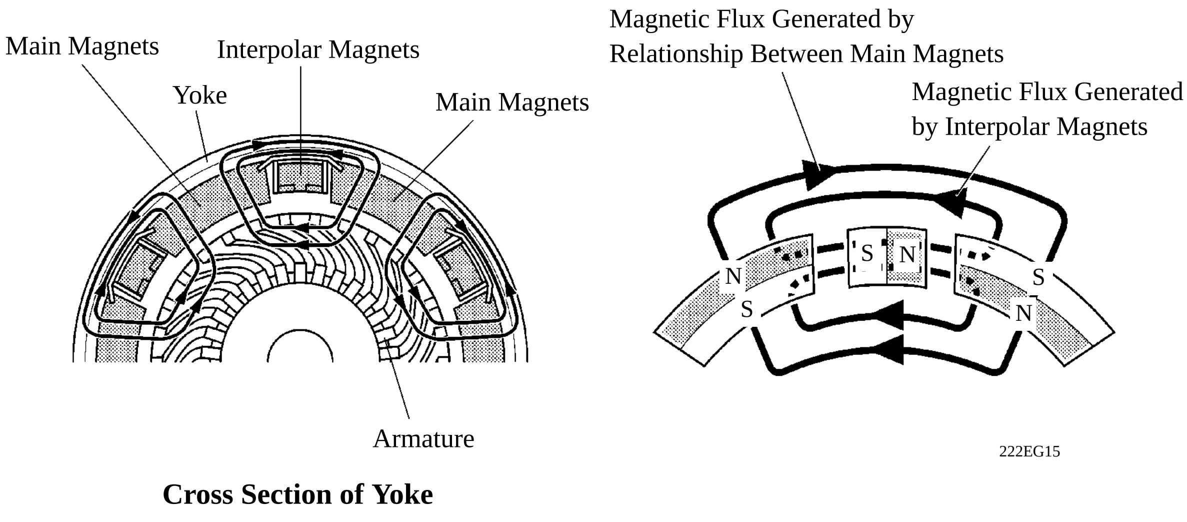
*: Viewed from Pinion Side

2. Construction

- Instead of the constructing of the armature coil with conventional type round-shaped conductor wires, the PS type starter uses square conductors. With this type of construction, the same conditions that are realized by winding numerous round-shaped conductor wires can be achieved without increasing the mass. As a result, the output torque has been increased, and the armature coil has been made more compact.
- Because the surface of the square-shaped conductors that are used in the armature coil functions as a commutator, the overall length of the PS type starter has been shortened.



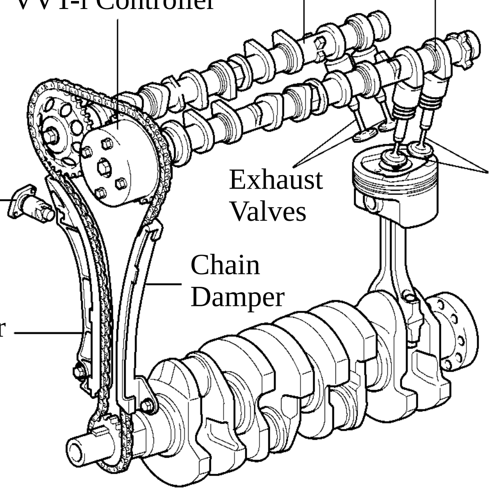
- Instead of the field coils used in the conventional type starter, the PS type starter has adopted two types of permanent magnets: the main magnets and the interpolar magnets. The main and interpolar magnets are arrnged alternately inside the yoke, allowing the magnetic flux that is generated between the main and interpolar magnets to be added to the magnetic flux that is generated by the main magnets.
  In addition to increasing the amount of magnetic flux, this construction shortens the overall length of the yoke.



■ VALVE MECHANISM

1. General

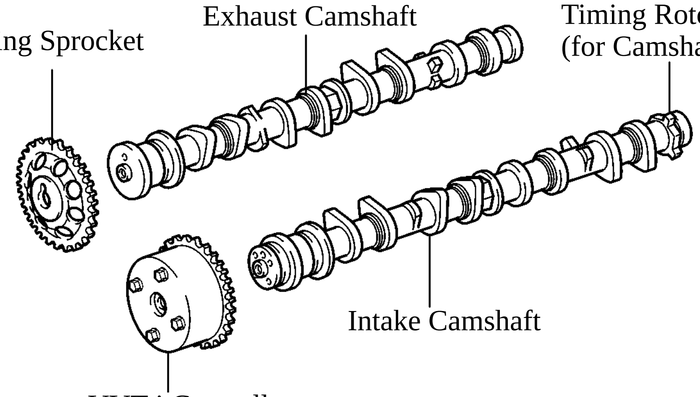
- Intake and exhaust efficiency has been increased due to the larger total port areas.
- The shimless type valve lifter is used.
- The intake and exhaust camshafts are driven by a timing chain.
- The VVT-i system is used to achieve low fuel consumption, higher engine performance and reduce exhaust emissions. For details of VVT-i control, refer to page EG-36.



169EG11

2. Camshaft

- An oil passage is provided in the intake camshaft in order to supply engine oil pressure to the VVT-i system.
- A VVT-i controller has been installed on the front of the intake camshaft to vary the timing of the intake valves.



169EG12

– Change (from ’02 Corolla) –

The valve timing (cam profile) of the intake camshaft has been changed for the low-to medium-speed range.

Model		’03 Corolla Matrix	’02 Corolla
Valve Timing (IN)	Open	2° – 42° BTDC	5° – 48° BTDC
	Close	50° – 10° ABDC	55° – 12° ABDC

3. Valve Lifter

Along with the increase in the amount of valve lift, the valve adjusting shims have been discontinued and a shimless type of valve lifter is used. This valve lifter increases the cam contact surface.

Service Tip

The adjustment of the valve clearance is accomplished by selecting and replacing the appropriate valve lifters. Adjusting valve lifters are available in 35 increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).
For details, refer to 2003 Corolla Matrix Repair Manual (Pub. No. RM940U).

4. Timing Chain and Chain Tensioner

- A roller chain with an 8 mm pitch has been used to make the engine more compact.
- The timing chain is lubricated by an oil jet.
- The chain tensioner uses a spring and oil pressure to maintain proper chain tension at all times. The chain tensioner suppresses noise generated by the timing chain.
- A ratchet type non-return mechanism is also used.
- To achieve excellent serviceability, the chain tensioner is constructed so that it can be removed and installed from the outside of the timing chain cover.