■ENGINE CONTROL SYSTEM

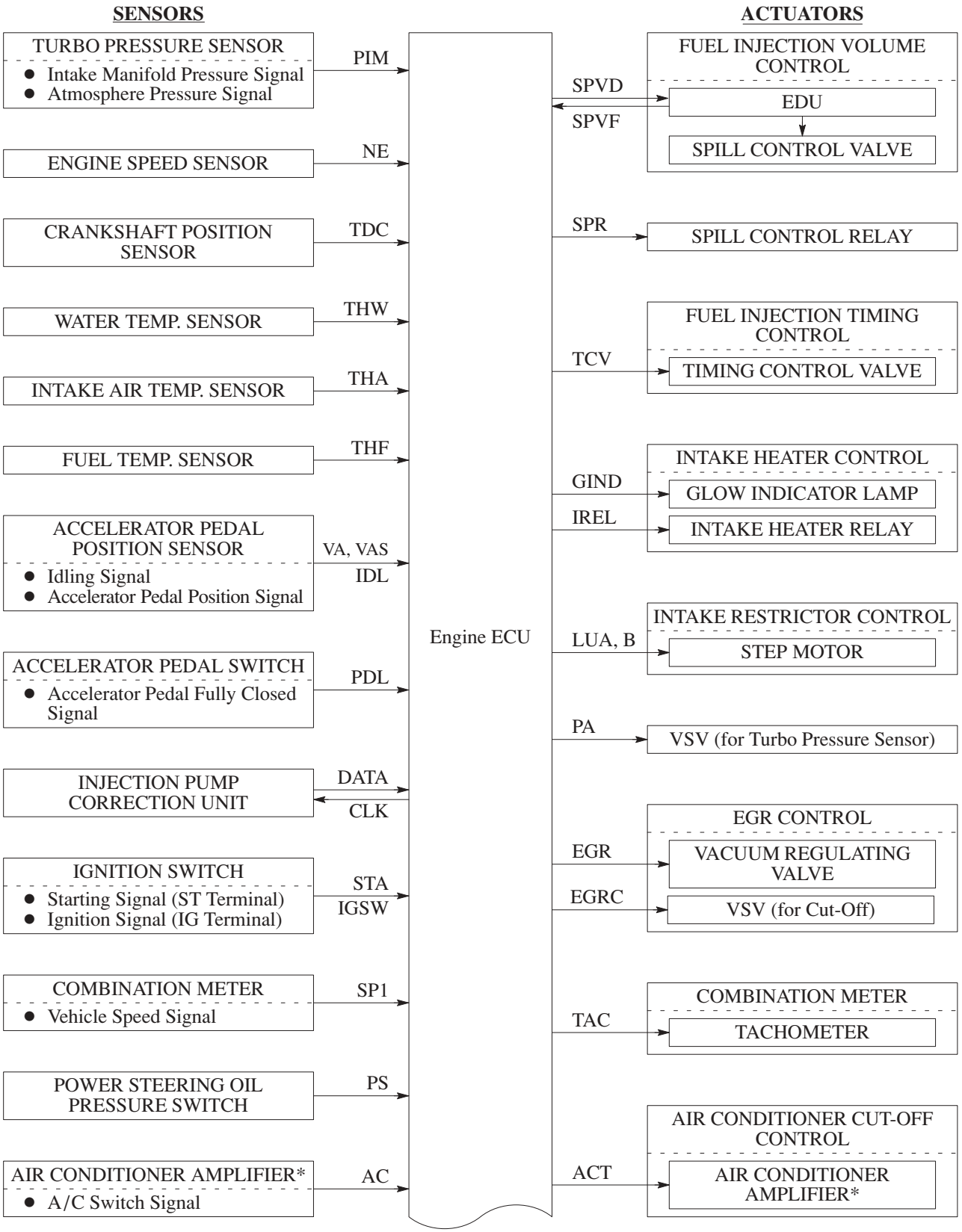
1. General

The engine control system of the 15B-FTE engine perform the following types of control:

Basic Control	Fuel Injection Volume Control
	● Basic Injection Volume Control ● Maximum Injection Volume Control ● Starting Injection Volume Control ● Engine Torque Control
	Fuel Injection Timing Control
	● Basic Injection Timing Control ● Injection Timing Correction ● Starting Injection Timing Control
Low Noise & Vibration	Idle Speed Control
	● Feed Back Control ● Warm Up Control ● Engine Speed Change Estimate Control
	Stable Idling Control
	Intake Restrictor Control
Drivability	Air Conditioner Cut-Off Control
Low Emission	EGR Control
Startability	Intake Heater Control
Serviceability & Reliability	Diagnosis
	Fail-Safe

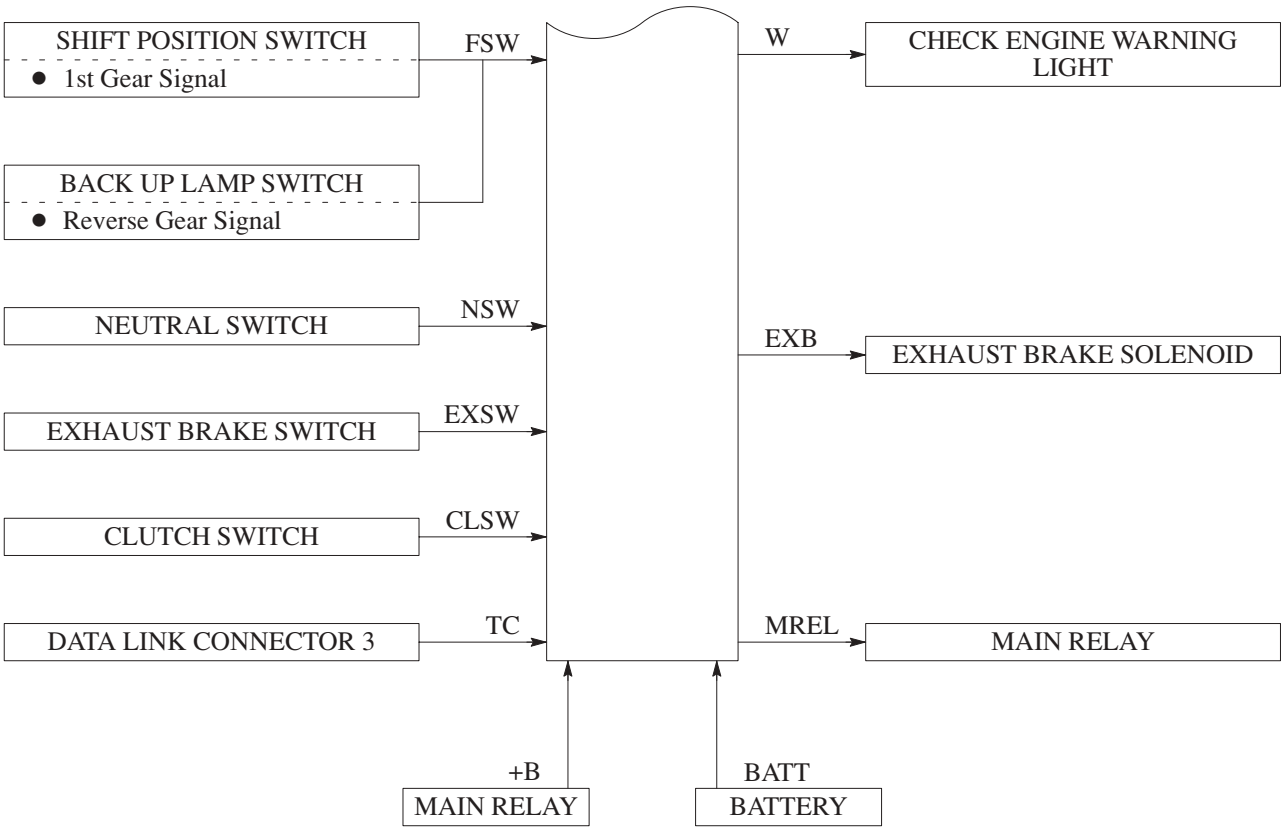
2. Construction

The configuration of the engine control system in the 15B-FTE engine in the new Coaster is shown in the following chart.



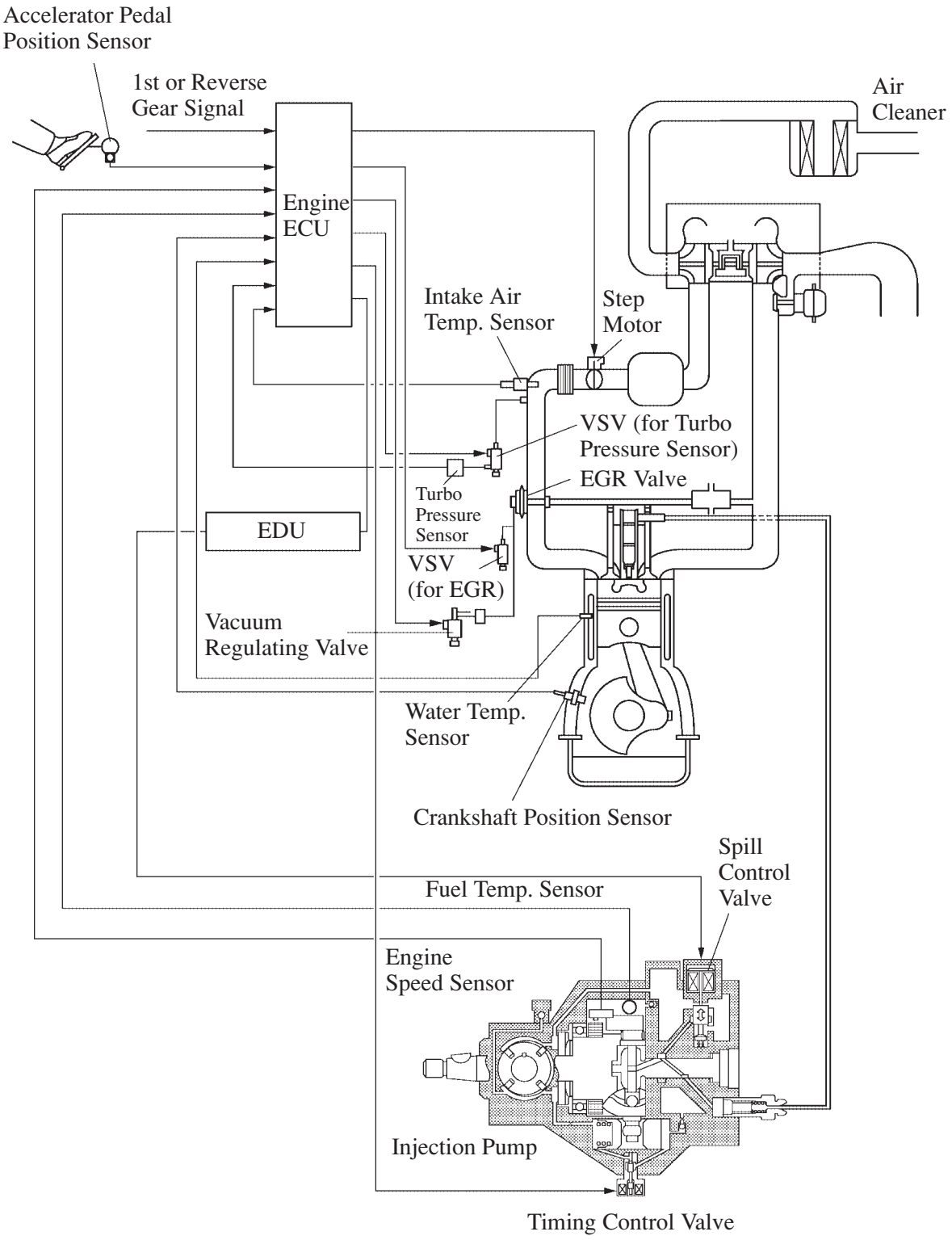
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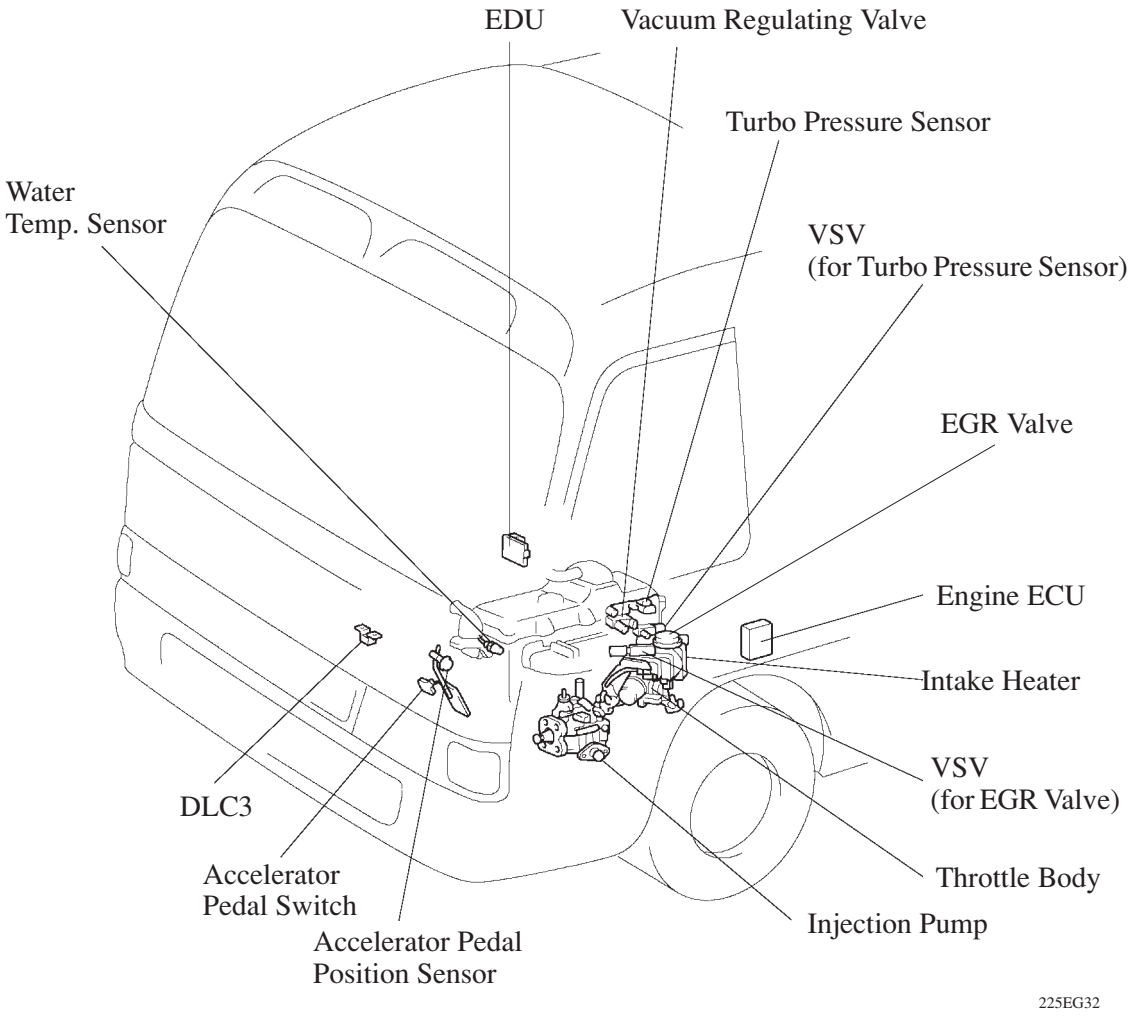


*: With Air Conditioner

3. Engine Control System Diagram



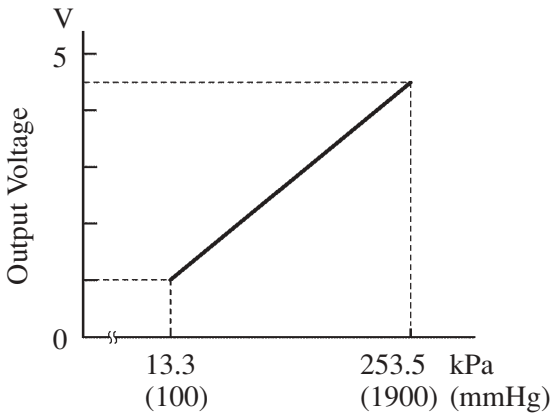
4. Layout of Main Components



5. Main Components for Engine Control System

Turbo Pressure Sensor

The turbo pressure sensor consists of a semiconductor which utilizes the characteristic of a silicon chip that changes its electrical resistance when pressure is applied to it. The sensor converts the intake air pressure into an electrical signal, and sends it to the engine EDU in an amplified form.
In addition, the atmospheric pressure can be detected by switching the piping passage through the operation of the VSV.

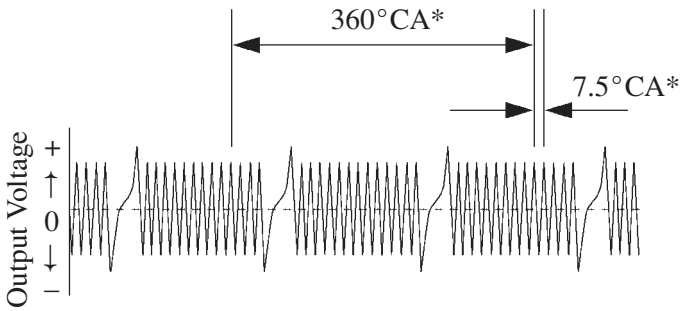


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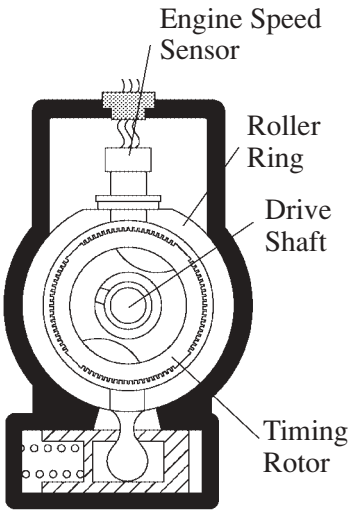
Turbo Pressure Sensor Output Characteristics

Engine Speed Sensor

The engine speed sensor is attached to the roller ring in the injection pump to detect the engine speed. The timing rotor is attached to the drive shaft. Missing 3 teeth at each of the 4 locations, the timing rotor generates a signal every 7.5° (crankshaft angle) with its 84 teeth.



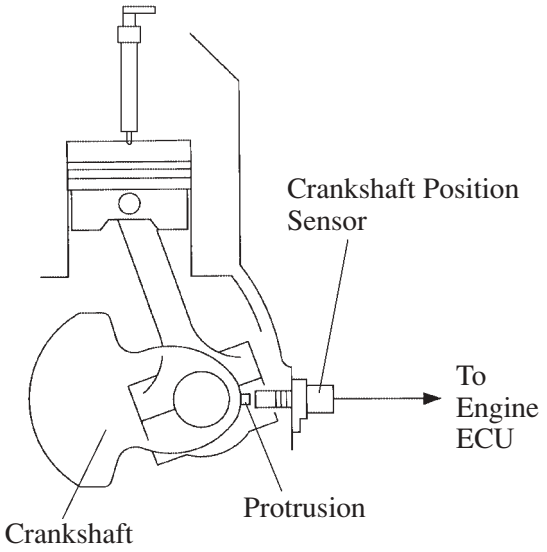
*: CA (Crankshaft Angle)



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Crankshaft Position Sensor

The crankshaft position sensor is attached to the cylinder block. Using the protrusion that is provided on the crankshaft, the sensor generates 1 signal for every revolution. This signal is then sent to the engine ECU as a crankshaft position signal.



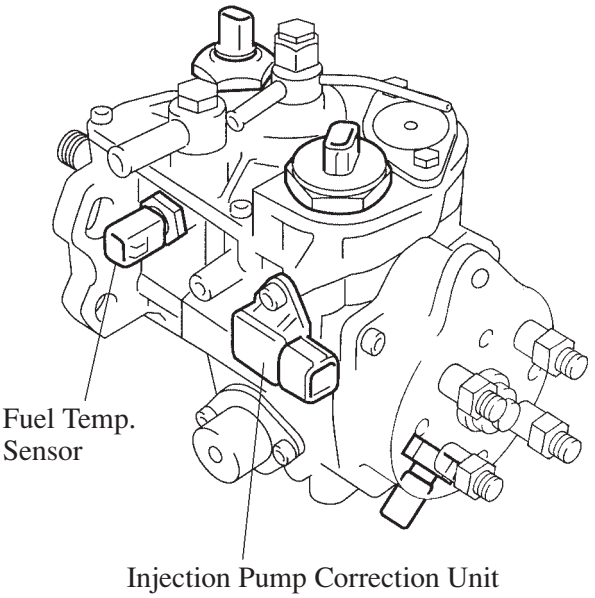
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Fuel Temperature Sensor

The fuel temperature sensor is attached to the injection pump, and uses an internal thermistor to detect the fuel temperature.

Injection Pump Correction Unit

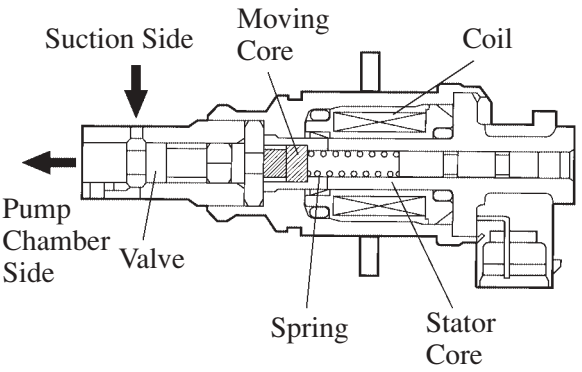
To compensate for the shift in injection volume and injection timing caused by the variances in the injection pump itself, a correction is made by using the data that is stored in the ROM in the injection pump correction unit.



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Timing Control Valve

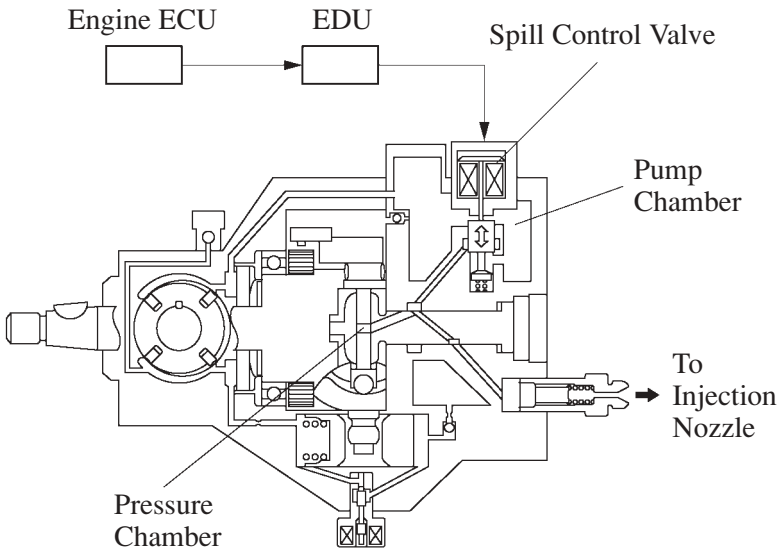
The timing control valve is attached to the injection pump.
In accordance with the signals from the engine ECU, timer control valve opens and closes timer piston to the fuel passage between the pump chamber side and the suction side, thus controlling the injection timing. When the current flows to the coil of the timing control valve, the stator core becomes an electromagnet to push and compress the spring.
This causes the moving core to retract and open the fuel passage.

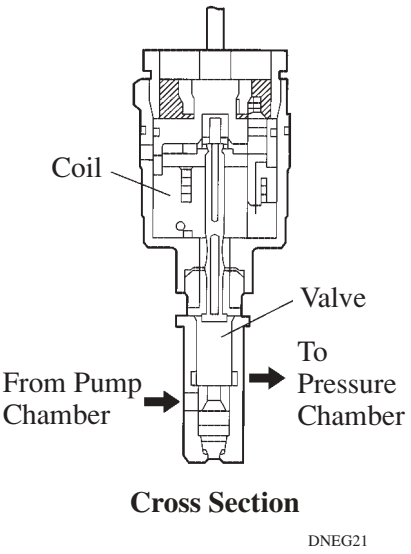


147EG99

Spill Control Valve

The spill control valve is attached to the injection pump to control the fuel injection volume in accordance with the signals received from the engine ECU.
When the spill control valve is turned OFF, the passage between the high-pressure chamber and the pump chamber opens, causing the pressure in the high-pressure chamber to drop. This completes the injection of the fuel from the injection nozzle.
The length of time till the spill control valve is turned OFF becomes the fuel injection time. Thus, the fuel injection volume is controlled by increasing or decreasing the length of time till the spill control valve is turned OFF.





Accelerator Pedal Position Sensor

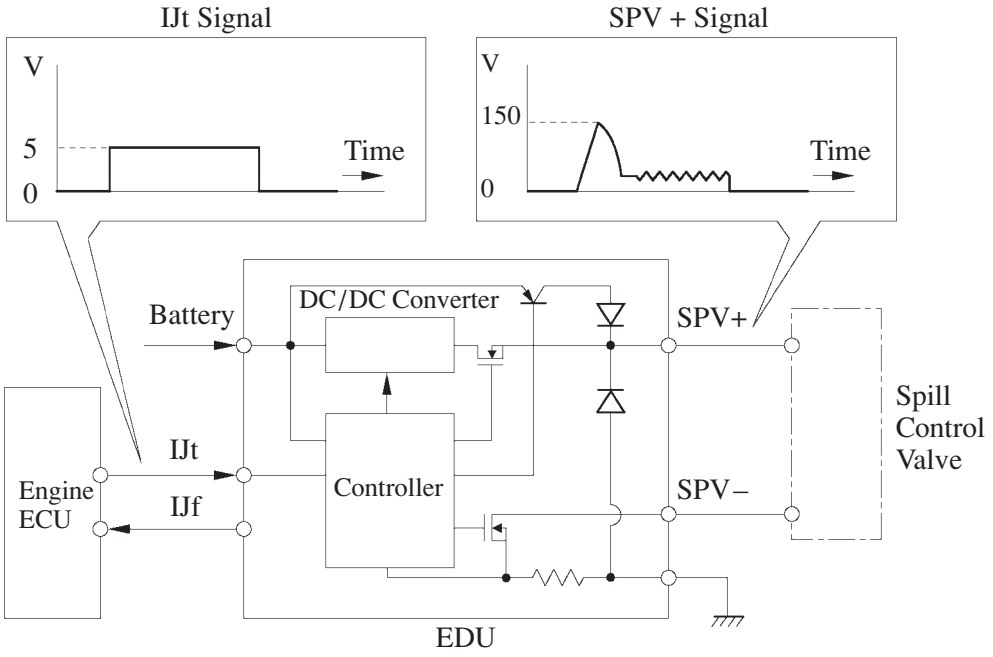
- The accelerator pedal position sensor uses a hall element that outputs voltage that changes linearly in relation to the amount of pedal effort that is applied to the accelerator pedal.
  The accelerator pedal position sensor uses a duplex system to ensure its reliability.
- An idle switch that detects the fully closed condition of the accelerator pedal is enclosed in the accelerator pedal position sensor.

Accelerator Pedal Switch

Attached to the accelerator pedal in addition to the accelerator pedal position sensor, the accelerator pedal switch detects the fully closed condition of the accelerator pedal.

EDU (Electronic Driver Unit)

- The EDU has been adopted to drive the spill control valve at high-speeds. The EDU achieves high-speed driving of the SPV under high fuel pressure conditions through the use of a DC/DC converter that provides a high-voltage, quick-charging system.
- The engine ECU constantly monitors the EDU and shut off the engine in case of an abnormal condition detected.



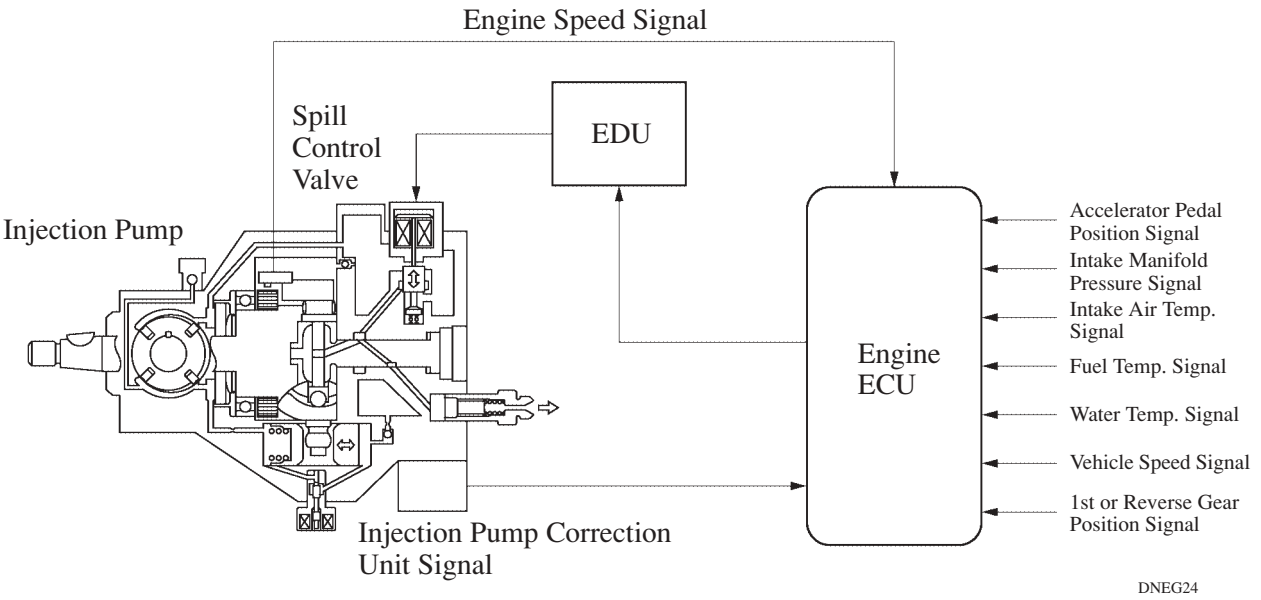
147EG126

Operation

The battery voltage is increased by the DC/DC converter. A voltage of approximately about 150 V is applied to the spill control valve in accordance with the IJt signal received from the engine ECU. Also at this time, the injection verification signal (IJf) is sent to the engine ECU.

6. Fuel Injection Volume Control

Based on the sensor signals, the engine ECU controls the fuel injection volume by calculating the fuel injection volume that is appropriate for the engine condition.



Function of Engine ECU

The engine ECU calculates the basic injection volume based on the acceleration pedal position and engine speed, and the maximum injection volume for the engine condition. The two injection volumes are then compared, and the lesser of the two is selected. A correction value, which is obtained via the injection pump correction unit, is added to that injection volume, thus determining the final injection volume.

1) Basic Injection Volume

Determined in accordance with the acceleration pedal position and the engine speed.

2) Maximum Injection Volume

Based on the signals received from the sensors, correction values are added to the theoretically required injection volume (basic maximum injection volume) to determine the maximum injection volume during engine operation.

a. Basic Maximum Injection Volume

Determined in accordance with the engine speed.

b. Intake Manifold Pressure Correction

Corrects the basic maximum injection volume in accordance with intake manifold pressure. The higher the intake manifold pressure becomes, the larger the injection volume becomes.

c. Intake air Temperature Correction

Corrects the variance in the injection volume that is created by the difference in the density of the intake air in accordance with the intake air temperature.

d. Fuel Temperature Correction

Corrects the variance in the injection volume that is created by the difference in the density of the fuel in accordance with the fuel temperature. The higher the fuel temperature becomes, the smaller the injection volume becomes.

e. Water Temperature Correction

The lower the water temperature, the greater the injection volume becomes in order to ensure drivability immediately following cold-starting.

3) Starting Injection Volume Control

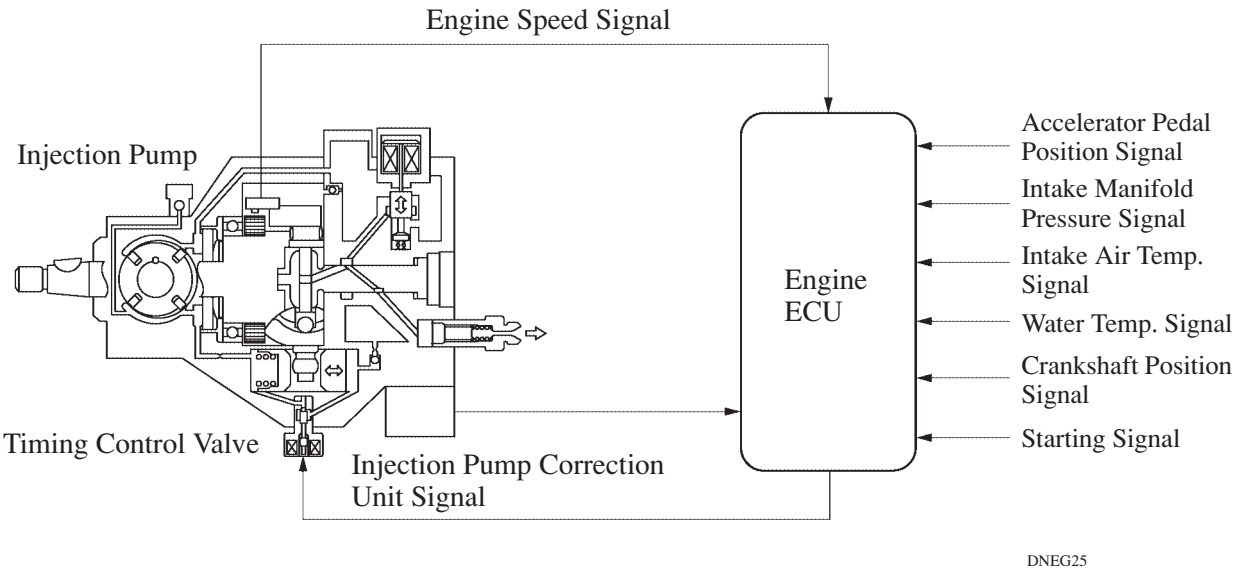
Determines the fuel injection volume during engine starting in accordance with the starting signal and the water temperature signal. When the engine is cold, the lower the water temperature becomes, the larger the injection volume becomes.

4) Engine Torque Control

When the engine ECU detects the signal from the 1st gear position switch or backup lamp switch, the fuel injection volume is controlled to reduce the engine torque.

7. Fuel Injection Timing Control

Based on the signals received from the sensors, the engine ECU calculates and controls the fuel injection timing to be optimal for the engine condition.



Function of Engine ECU

The engine ECU adds the corrections from the sensor signals to the basic fuel injection timing to calculate the fuel injection timing that is optimal for the engine condition.

1) Basic Injection Timing

The basic injection timing is determined in accordance with the fuel injection volume and the engine speed.

2) Injection Timing Correction

a. Intake Manifold Pressure Correction

Corrects the basic fuel injection timing in accordance with the intake air pressure. The injection timing is advanced when the intake air pressure is low in such the case as of high altitude areas.

b. Intake Air Temperature Correction

Corrects the basic fuel injection timing in accordance with the intake air temperature.

c. Water Temperature Correction

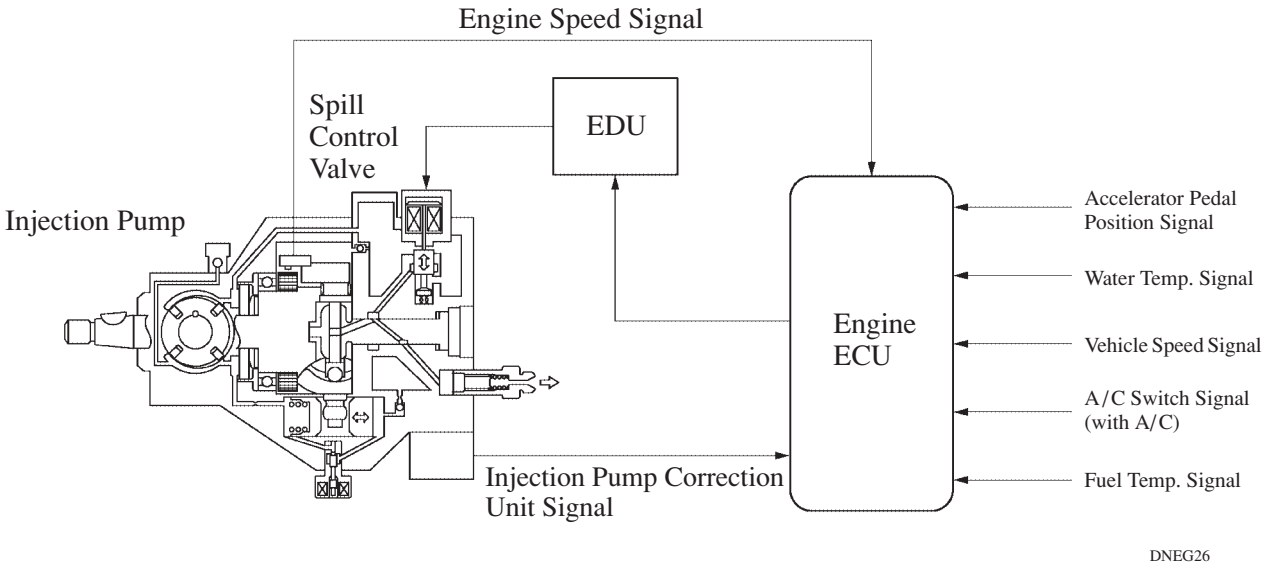
Corrects the basic fuel injection timing in accordance with the water temperature. The injection timing is advanced when the water temperature is low.

3) Starting Injection Timing Control

The starting injection timing is determined in accordance with the starting signal, water temperature signal, and engine speed.

8. Idle Speed Control

In this system, the engine ECU calculates the target engine speed in accordance with the engine condition, and determined the fuel injection volume, thus controlling the idle speed.



Function of Engine ECU

1) Feedback Control

During idling, the feedback control controls the injection volume to achieve the target idle speed, if there is a difference between the target idle speed calculated by the engine ECU and the actual idle speed.

2) Engine Speed Change Estimate Control

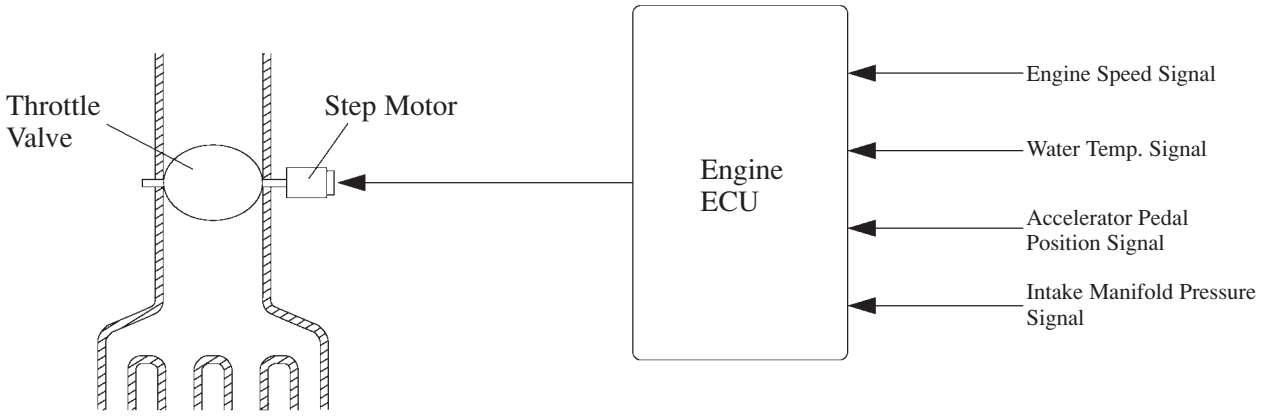
Immediately after the air conditioner switch is engaged, the idle speed can be affected by the change in the load that is applied to the engine. To prevent this symptom, the engine speed-change estimate control increases or decreases the injection volume before the idle speed changes.

9. Stable Idling Control

During idling, the stable idling control detects the engine speed differences based on each cylinder and corrects the injection volume that is directed to each cylinder.
Accordingly, the variances between the cylinders are reduced, which are caused by the disparity in the operation of the injection pump and the injection nozzle.
As a result, vibration during idling is reduced.

10. Intake Restrictor Control

The opening of the throttle valve that is installed on the intake manifold is controlled by the engine ECU in accordance with the engine condition to reduce the noise and vibration of the engine at the moment of stopping.

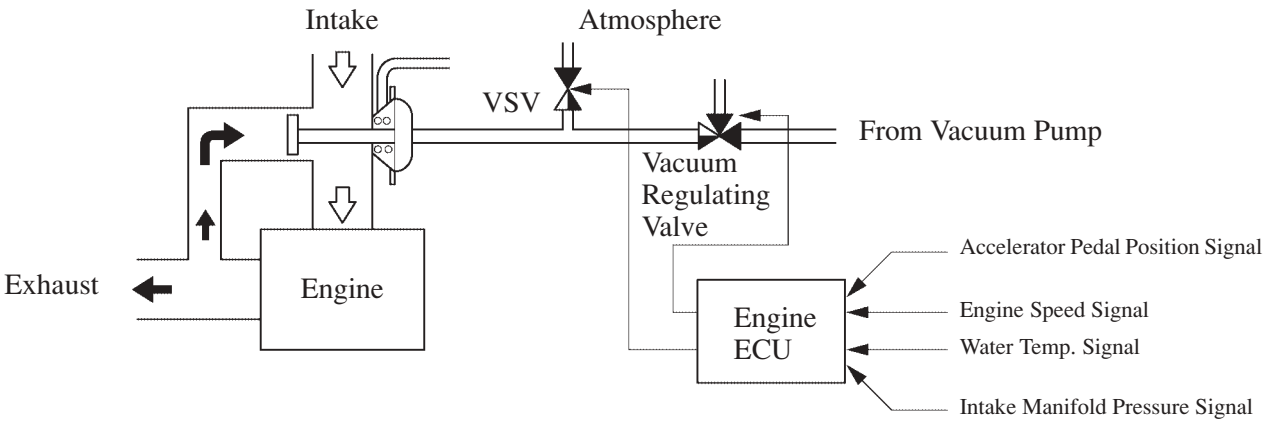


DNEG27

11. EGR Control

In the EGR control system, the engine ECU controls the vacuum regulating valve to recirculate an appropriate amount of exhaust gas to the combustion chamber in accordance with engine condition. This results in slower combustion rate, lower combustion temperature, and reduced NOx emissions.

▶ System Diagram ◀

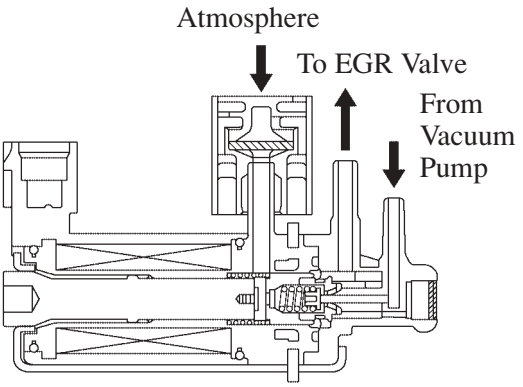


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Construction

1) Vacuum Regulating Valve

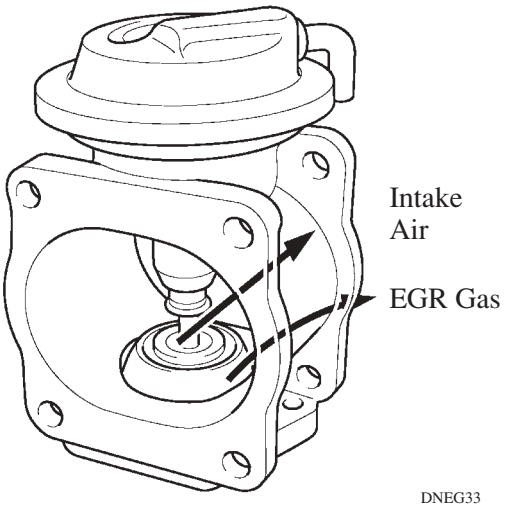
Controls the vacuum that is applied by the vacuum pump to the EGR valve in accordance with the signals from the engine ECU.



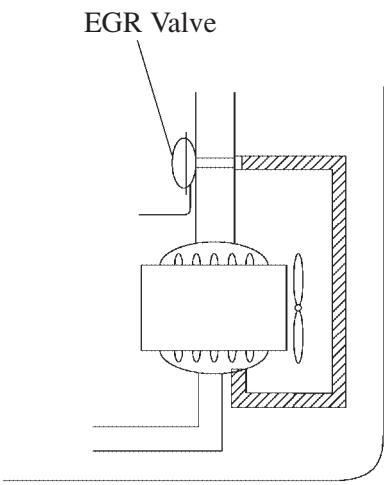
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2) EGR Valve

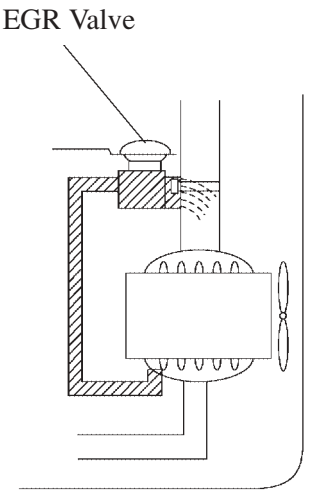
- Using the vacuum from the vacuum regulating valve, the EGR valve opens and closes the valve to introduce exhaust gas into the intake manifold.
- By providing the EGR valve in the intake passage, the various parts in the EGR valve are cooled by the intake air, thus enabling EGR control at higher load conditions.



DNEG33



15B-FTE Engine

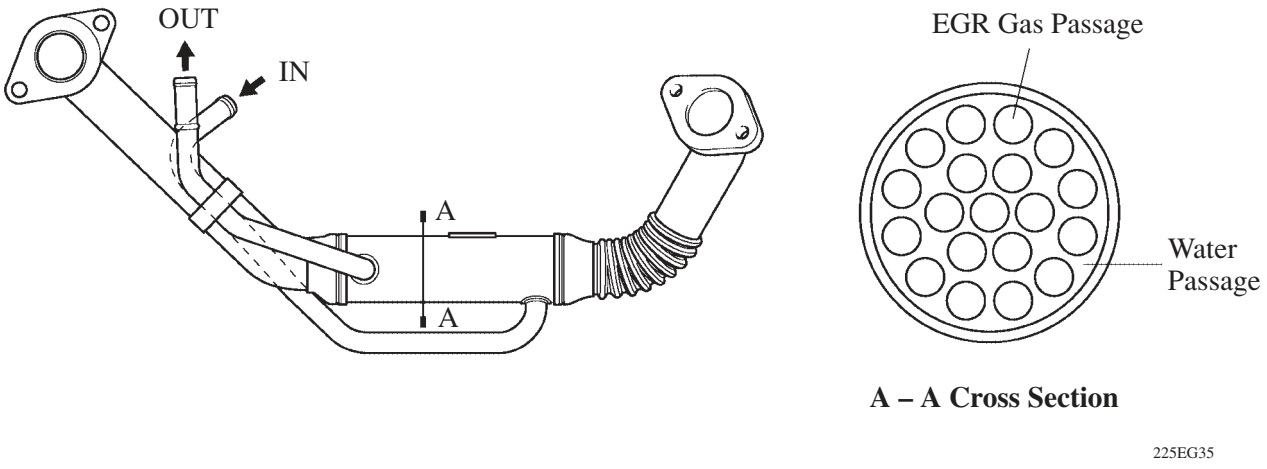


Ordinary Engine

147EG112

3) EGR Pipe

The EGR pipe has adopted a double-pipe construction, which allows the coolant water to flow through the outer pipe to cool the EGR gas. This improves the EGR rate and helps restrain the rise in the intake air temperature when the EGR is operating.



A – A Cross Section

225EG35

Replacement Interval	300,000 km (180,000 mile) or 10 years

Operation

1) Based on the signals from the sensors, the engine ECU applies duty control to the current that is applied to the vacuum regulating valve, thus regulating the vacuum that is applied to the EGR valve.
Then, the EGR valve opening is controlled to provide the volume of EGR gas that is appropriate for the engine condition.

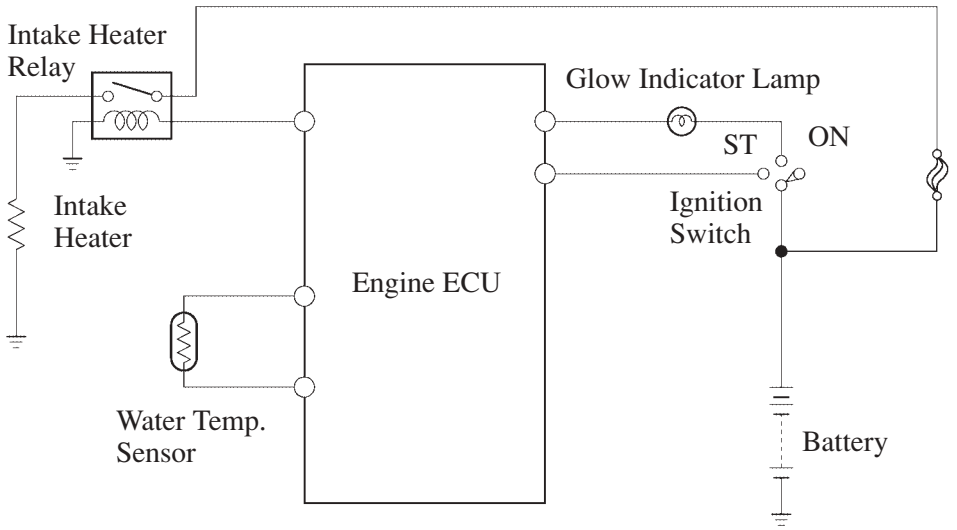
2) The EGR is shut off under the conditions given below to ensure drivability and to reduce diesel smoke.

- The water temperature is low.
- The vehicle is driven under high load condition.
- During deceleration (The EGR operates at idle)
- The engine speed is low.

12. Intake Heater Control

Applies current to the intake heater during cold-starting to increase the intake air improve the engine's startability.

▶ System Diagram ◀



147EG109

Operation

- When the water temperature is below 20°C, turning the ignition switch, ON causes the intake heater relay to turn ON, allowing the intake heater to operate. The intake heater operates until the water temperature becomes higher than 20°C, or the maximum of 77 seconds.
- At the same time, the glow indicator lamp is illuminated in accordance with the water temperature (maximum 10 seconds).

13. Diagnosis

- The voltage of the power source for the engine ECU of this Coaster is 24 V. For this reason, a special adapter must be used when using a conventional hand-held tester. Refer to the 15B-FTE Engine Repair Manual Supplement (Pub. No. DR077E).
- If the engine ECU detects any problem with a sensor or an electrical circuit, it turn ON the check engine warning light in the combination meter to inform the driver. In addition, the malfunction code will be stored in memory.
- An M-OBD (Multiplex On-Board Diagnostic) system has been adopted to improve serviceability. For details of the diagnostic trouble codes, active test, etc. described above, refer to the 15B-FTE Engine Repair Manual Supplement (Pub. No. DR077E).