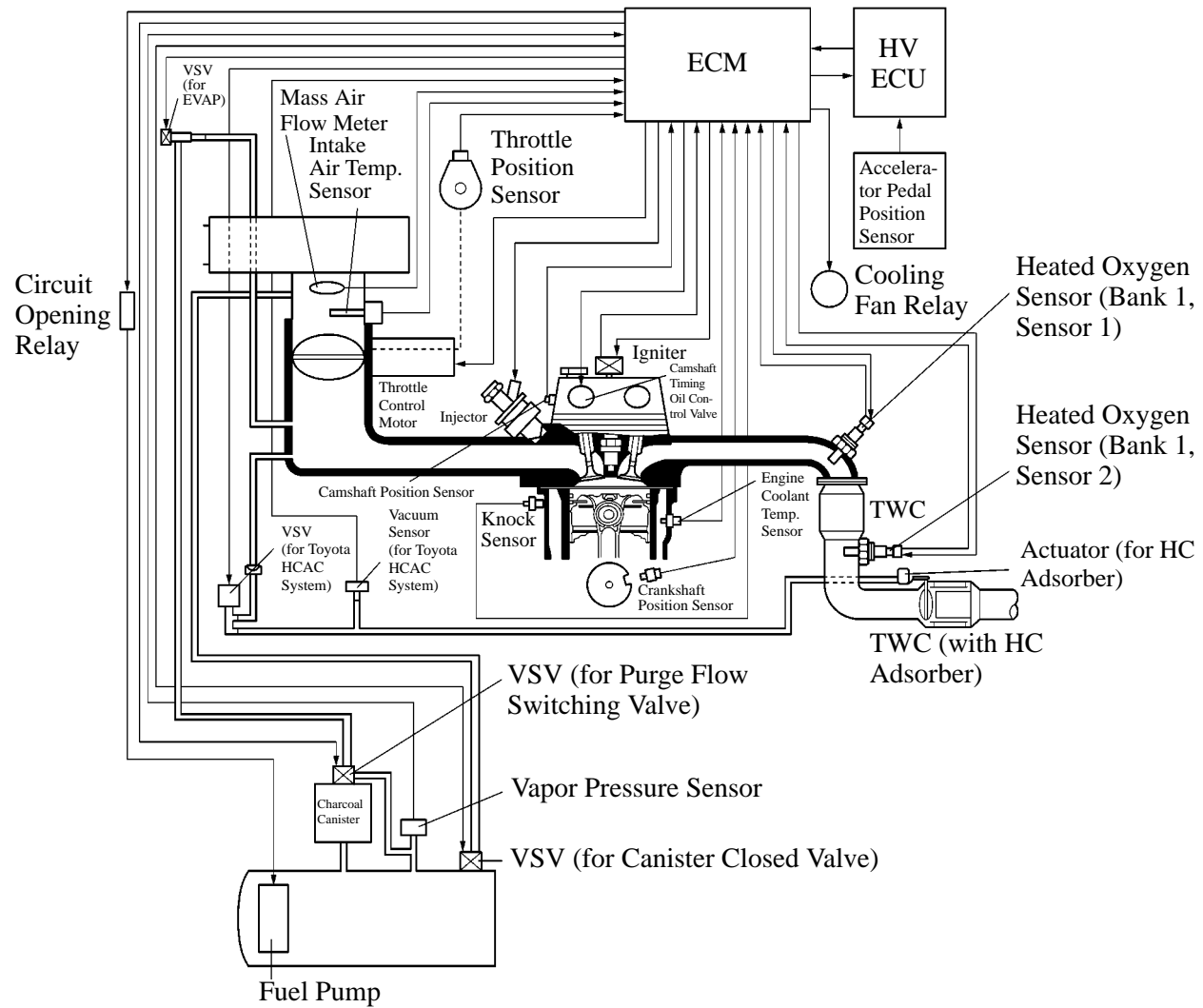
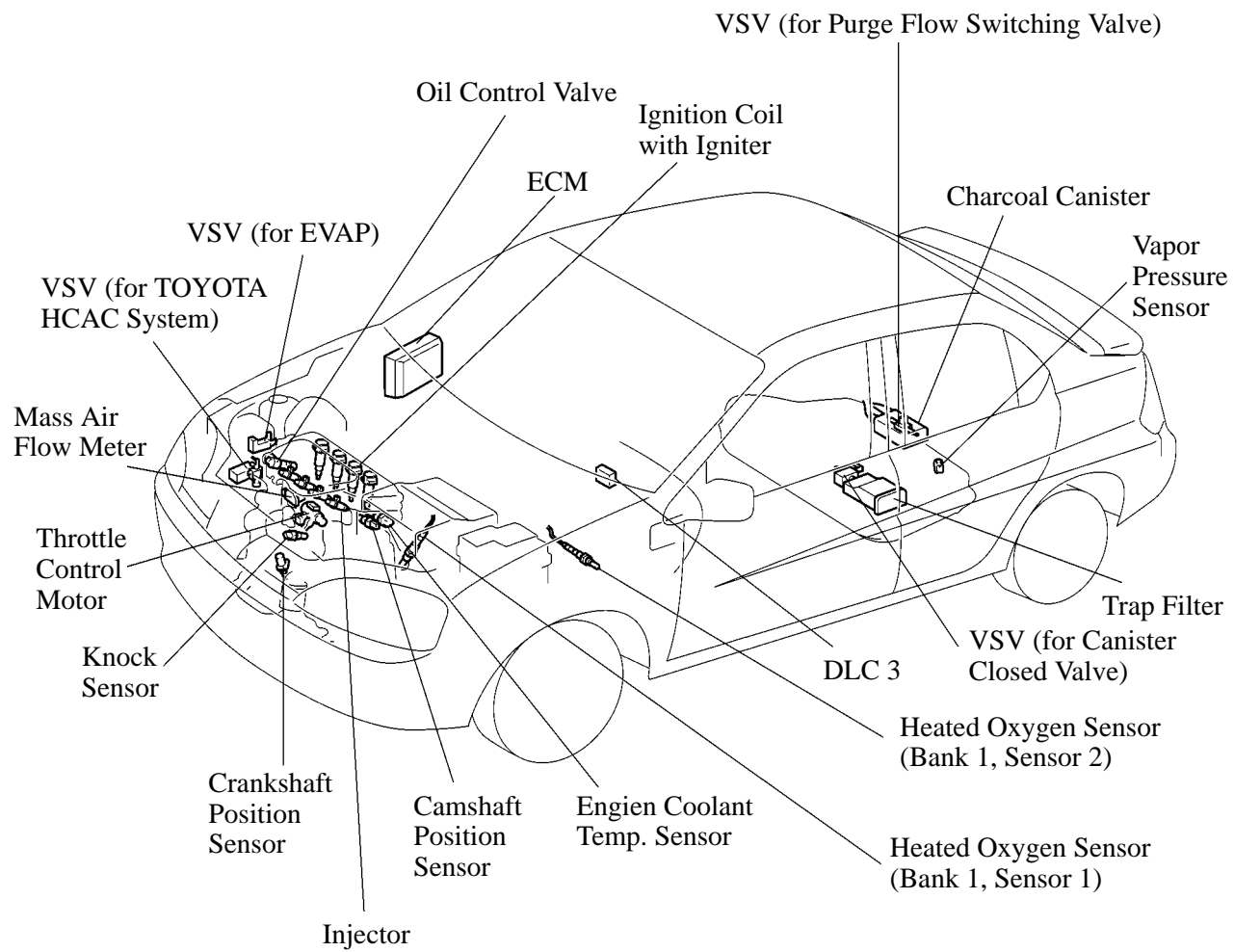


3. Engine Control System Diagram



4. Layout of Components



5. Main Components of Engine Control System

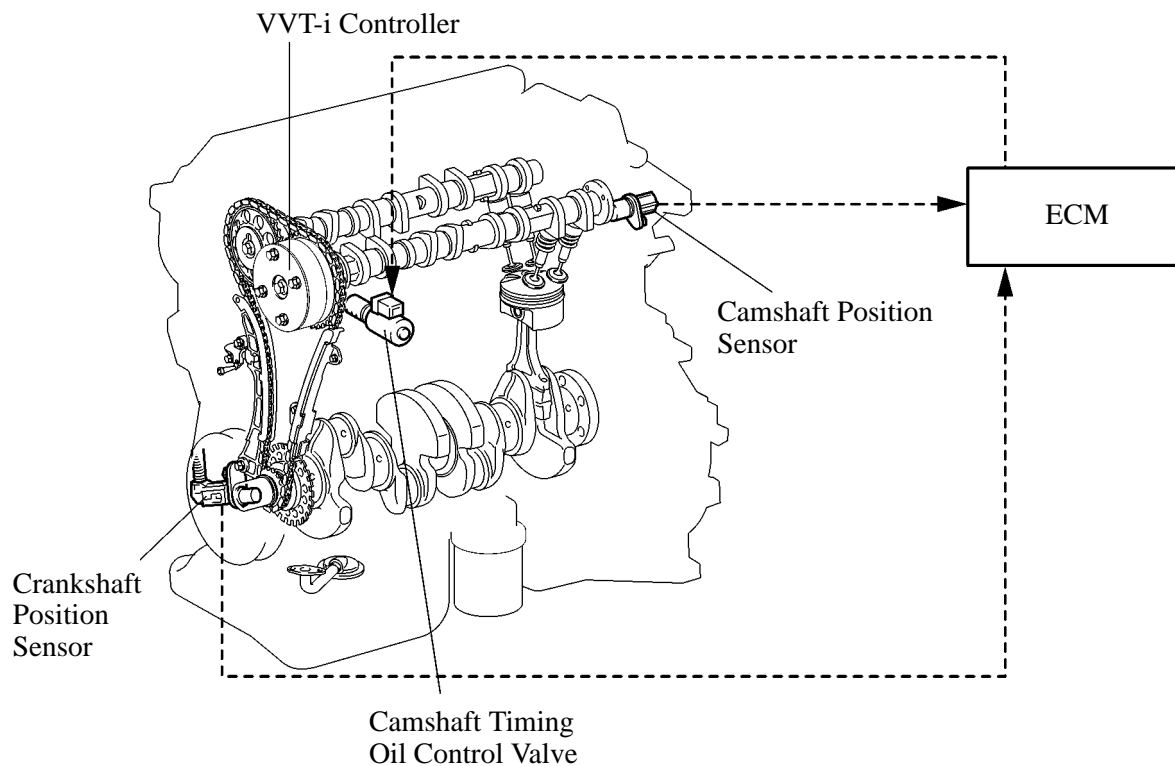
The main components of the 1NZ-FXE engine control system are as follows:

Components	Outline	Quantity
Mass Air Flow Meter	Hot-Wire Type	1
Crankshaft Position Sensor (Rotor's Teeth)	Pick-Up Coil Type (36-2)	1
Camshaft Position Sensor (Rotor's Teeth)	Pick-Up Coil Type (3)	1
Throttle Position Sensor	Linear Type (Double)	1
Knock Sensor	Built-In Piezoelectric Element Type	1
Oxygen Sensor	Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2)	2
Injector	12-Hole Type	4

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

General

The VVT-i system is designed to control the intake camshaft within a wide range of 43° (of crankshaft angle) to provide a valve timing that is optimally suited to the engine condition, thus realizing improved torque in all the speed ranges and fuel economy, and reduce exhaust emissions.

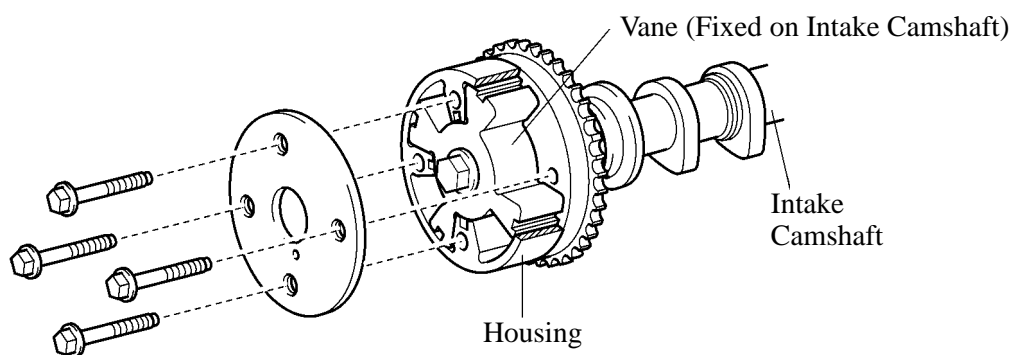


Construction

1) VVT-i Controller

This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft.

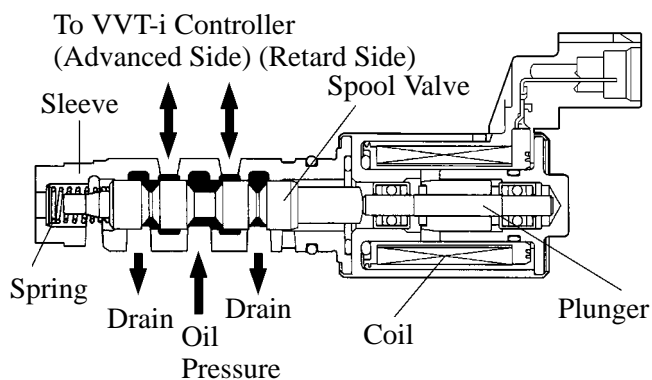
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.



182EG40

2) Camshaft Timing Oil Control Valve

The camshaft timing oil control valve controls the spool valve position in accordance with the duty control from the ECM thus allocating the hydraulic pressure that is applied to the VVT-i controller to the advance and the retard side. When the engine is stopped, the camshaft timing oil control valve is in the most retarded state.



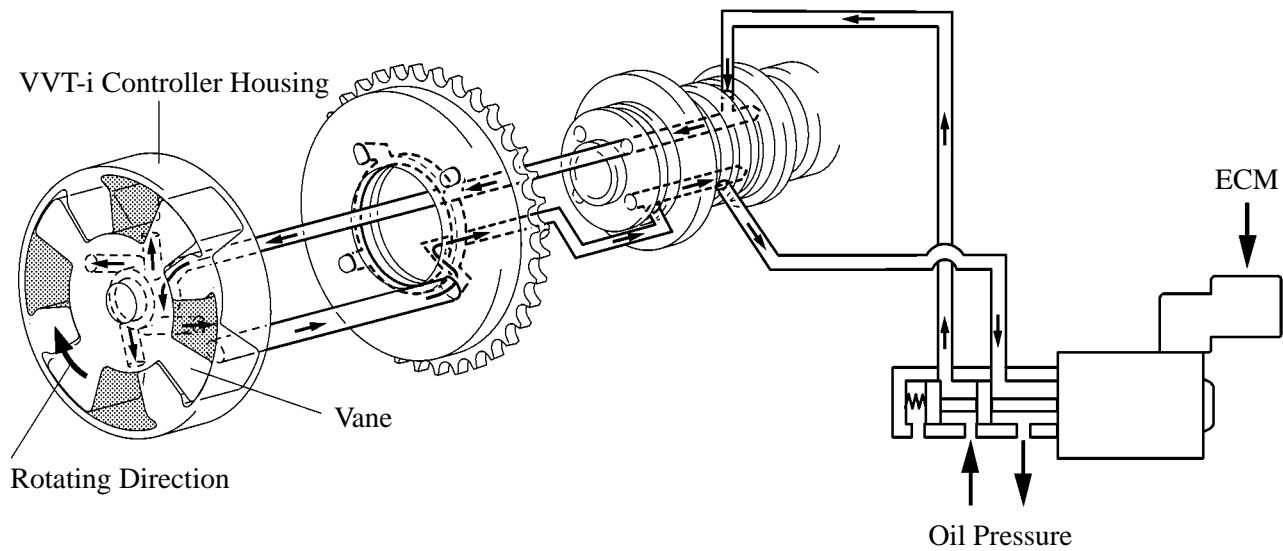
165EG34

Operation

The camshaft timing oil control valve selects the path to the VVT-i controller according to the advance, retard or hold signal from the ECM. The VVT-i controller rotates the intake camshaft in the timing advance or retard position or holds it according to the position where the oil pressure is applied.

1) Advance

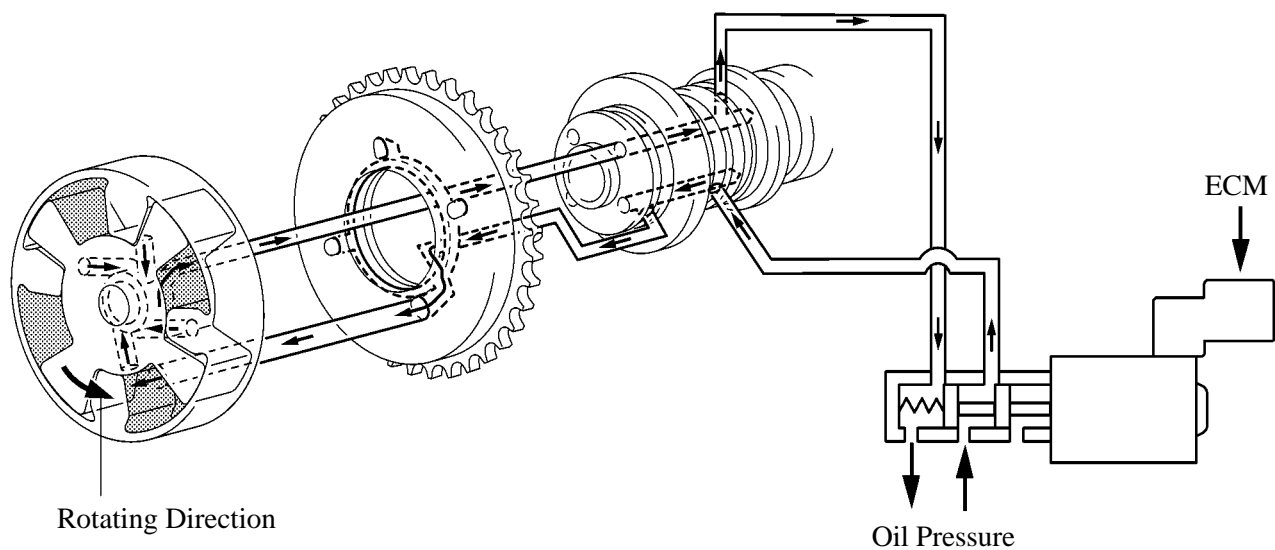
When the camshaft timing oil control valve is positioned as illustrated below by the advance signal from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



185EG18

2) Retard

When the camshaft timing oil control valve is positioned as illustrated below by the retard signal 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.

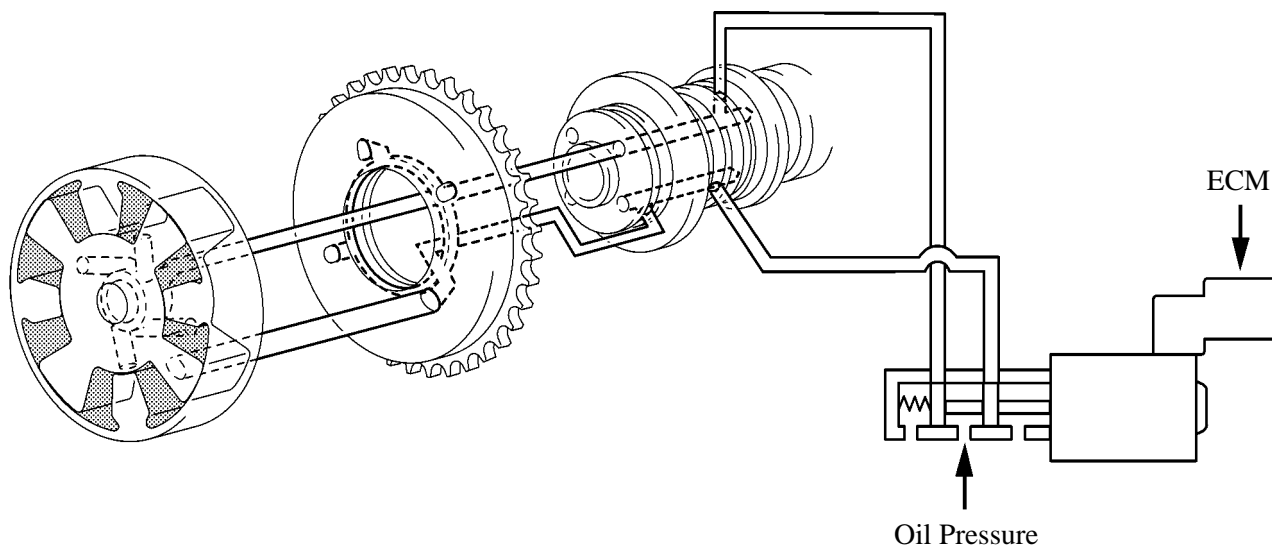


185EG19

3) Hold

The ECM calculates the target timing angle according to the traveling state to perform control as described in the previous page. After setting 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.

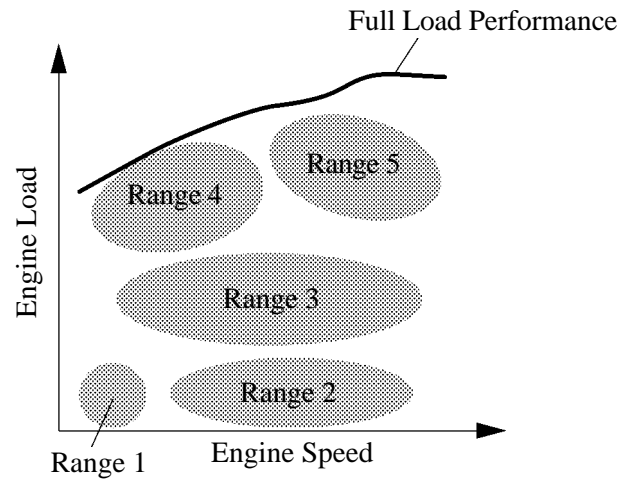
This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.



185EG10

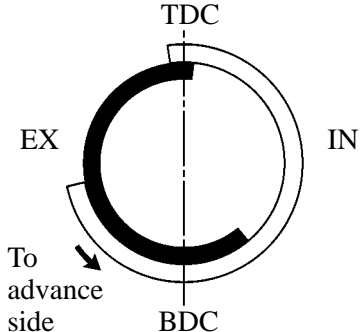
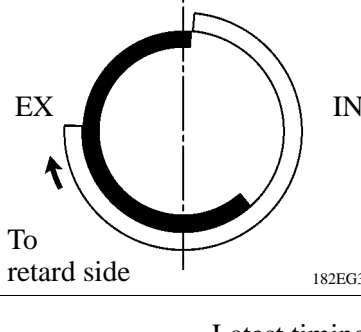
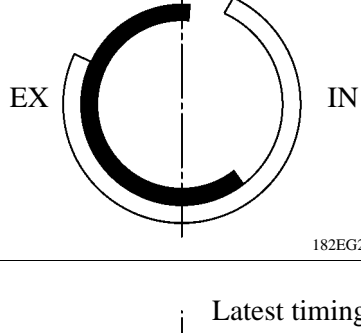
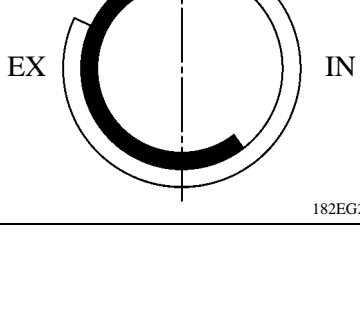
In proportion to the engine speed, intake air volume, throttle position and water temperature, the ECM calculates an optimal valve timing under each driving condition and control the camshaft timing oil control valve. In addition, ECM uses signal from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus performing feedback control to achieve the target valve timing.

► Operation During Various Driving Condition (Conceptual Diagram) ◀



182EG25

Operation State	Range	Valve Timing	Objective	Effect
During Idling	1	<p>182EG26</p>	Eliminating overlap to reduce blow back to the intake side	Stabilized idling rpm Better fuel economy
At Light Load	2	<p>182EG27</p>	Decreasing overlap to eliminate blow back to the intake side	Ensured engine stability
At Medium load	3	<p>182EG28</p>	Increasing overlap to increase internal EGR for pumping loss elimination	Better fuel economy Improved emission control

Operation State	Range	Valve Timing	Objective	Effect
In Low to Medium Speed Range with Heavy Load	4	 <p>182EG29</p>	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	5	 <p>182EG30</p>	Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temperatures	—	 <p>182EG26</p>	Eliminating overlap to prevent blow back to the intake side for reduction of fuel increase at low temperatures, and stabilizing the idling rpm for decreasing fast idle rotation	Stabilized fast idle rpm Better fuel economy
Upon Starting/ Stopping the Engine	—	 <p>182EG26</p>	Eliminating overlap to eliminate blow back to the intake side	Improved startability