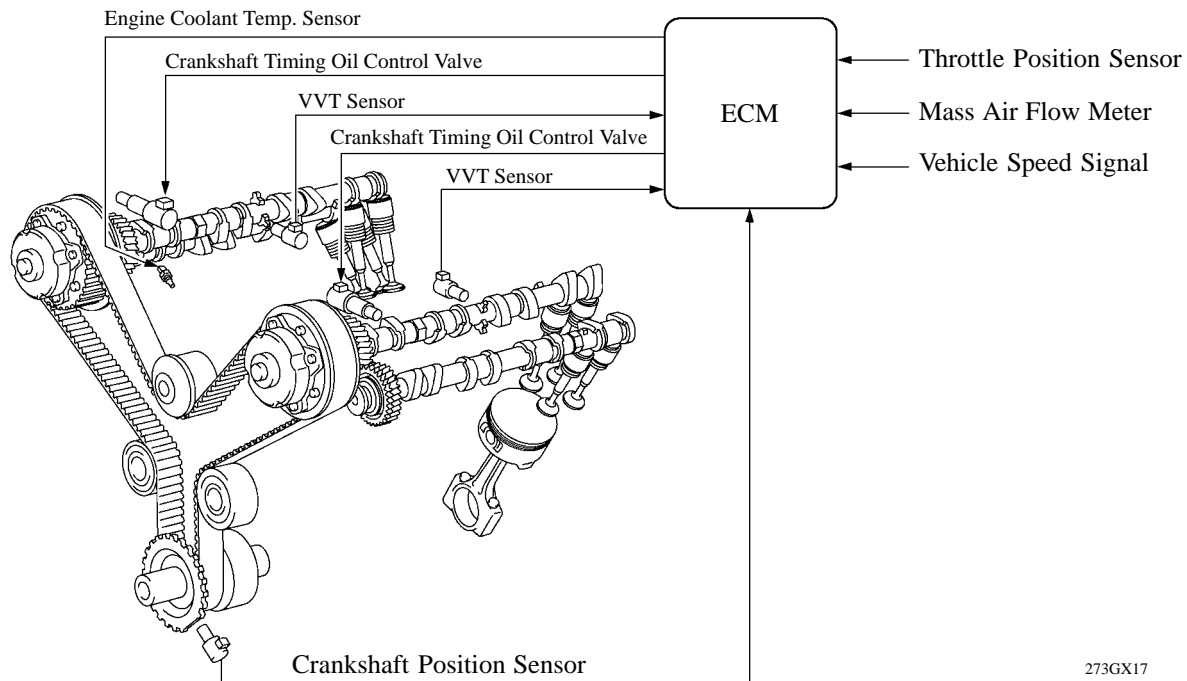


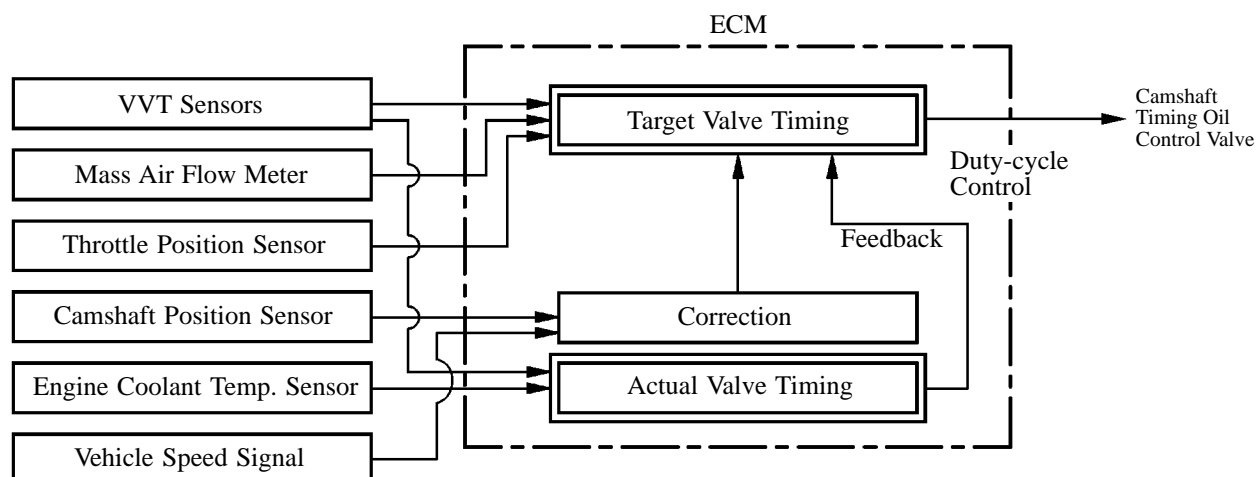
## VVT-i (Variable Valve Timing-intelligent) System

### 1) General

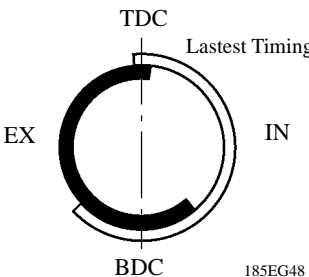
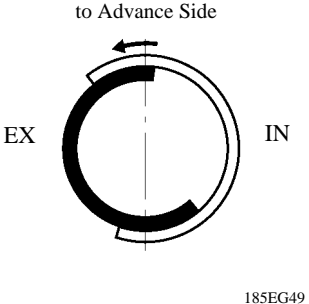
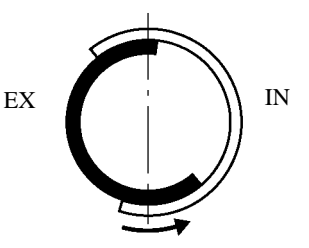
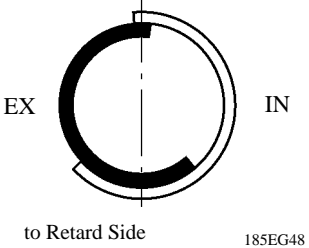
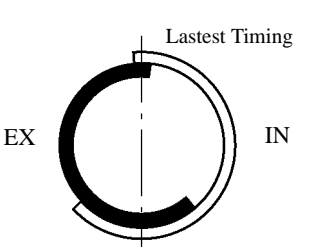
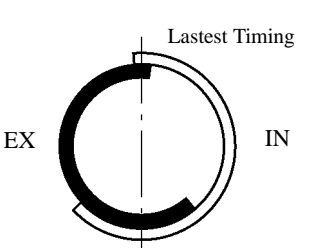
- The VVT-i system is designed to control the intake camshaft within a range of  $44^\circ$  (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



- By using the engine speed, intake air volume, throttle position and engine coolant temperature, 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 two VVT sensors and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.



2) Effectiveness of the VVT-i System

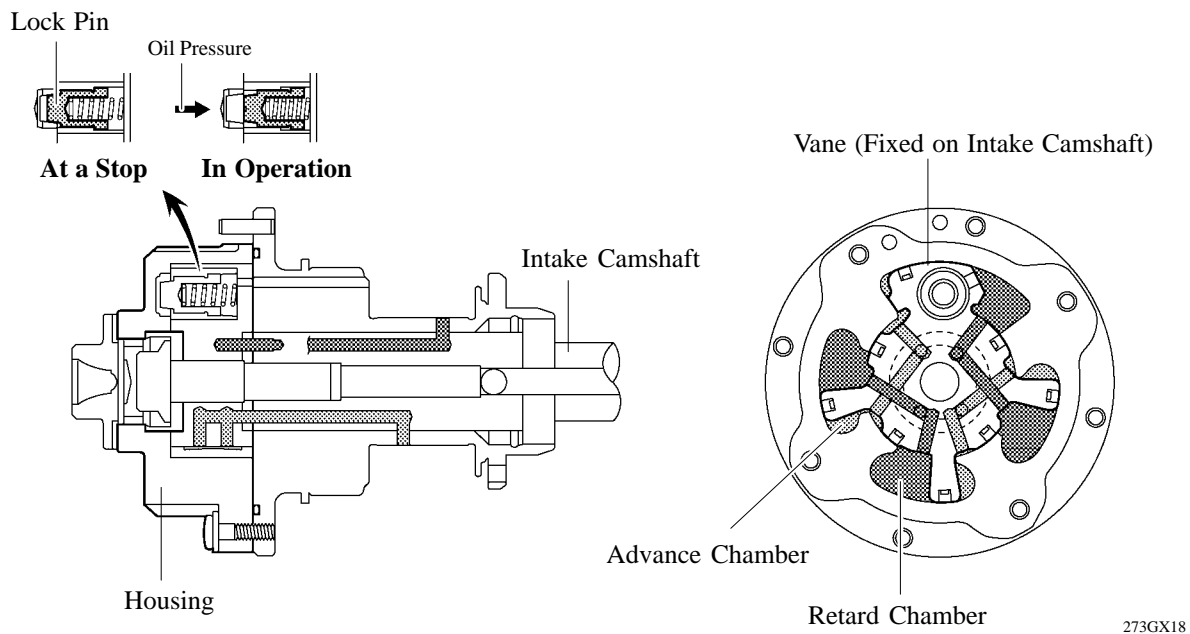
Operation State	Objective	Effect
<ul style="list-style-type: none"> <li>• During Idling</li> <li>• At Light Load</li> </ul>	 <p>Minimizing overlap to reduce blowback to the intake side</p>	<ul style="list-style-type: none"> <li>• Stabilized idling rpm</li> <li>• Better fuel economy</li> </ul>
At Medium Load	 <p>Increasing overlap increases internal EGR, reducing pumping loss</p>	<ul style="list-style-type: none"> <li>• Better fuel economy</li> <li>• Improved emission control</li> </ul>
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 Temp.	 <p>Minimizing overlap to prevent blowback 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"> <li>• Stabilized fast idle rpm</li> <li>• Better fuel economy</li> </ul>
<ul style="list-style-type: none"> <li>• Upon Starting</li> <li>• Stopping the Engine</li> </ul>	 <p>Minimizing overlap to minimize blowback to the intake side</p>	Improved startability

3) Construction

a. VVT-i Controller

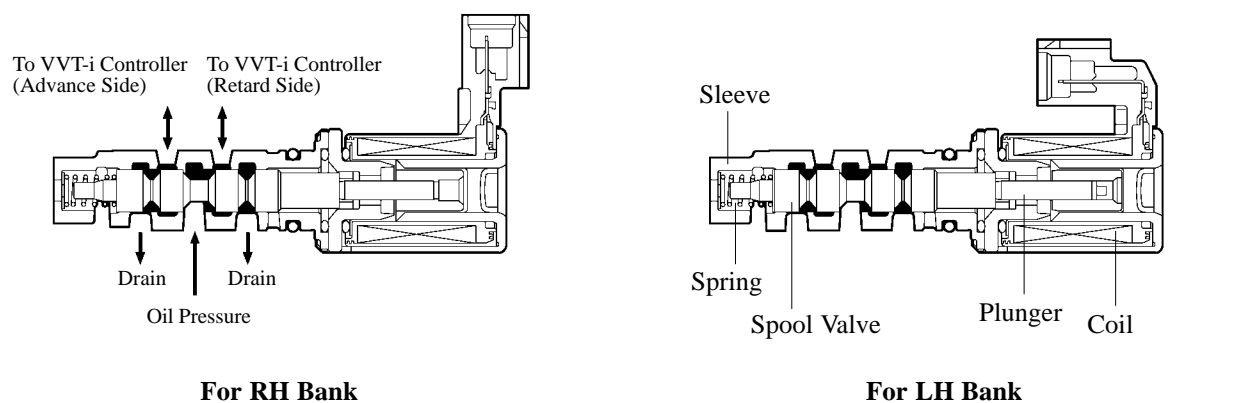
VVT-i controller consists of the housing, four vanes, and lock pin. The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.

When the engine is stopped, the intake camshaft will be in the most retarded state to ensure startability. When oil 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.



b. Camshaft Timing Oil Control Valve

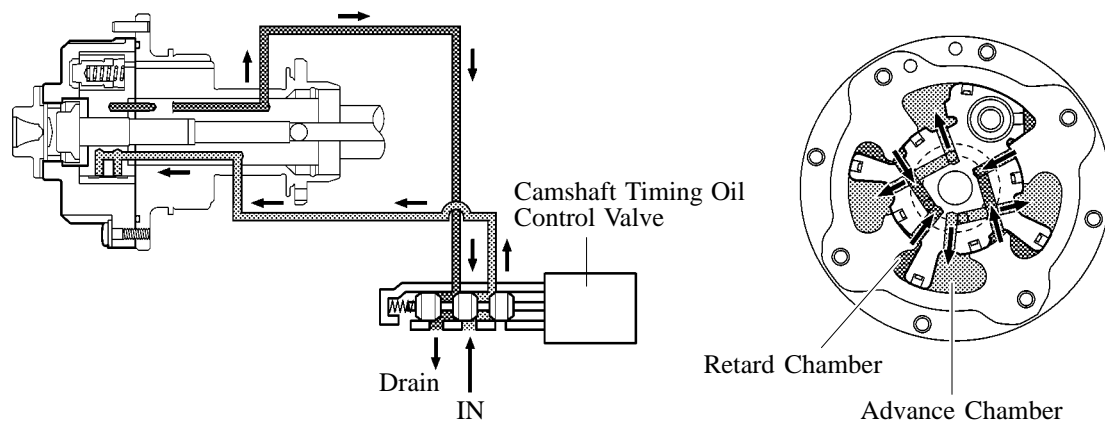
The camshaft timing oil control valve controls the spool valve position in accordance with the duty control from the ECM thus allocating the hydraulic pressure that is applied to the VVT-i controller to the advance and the retard side. When the engine is stopped, the camshaft timing oil control valve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



**4) Operation**

**a. Advance**

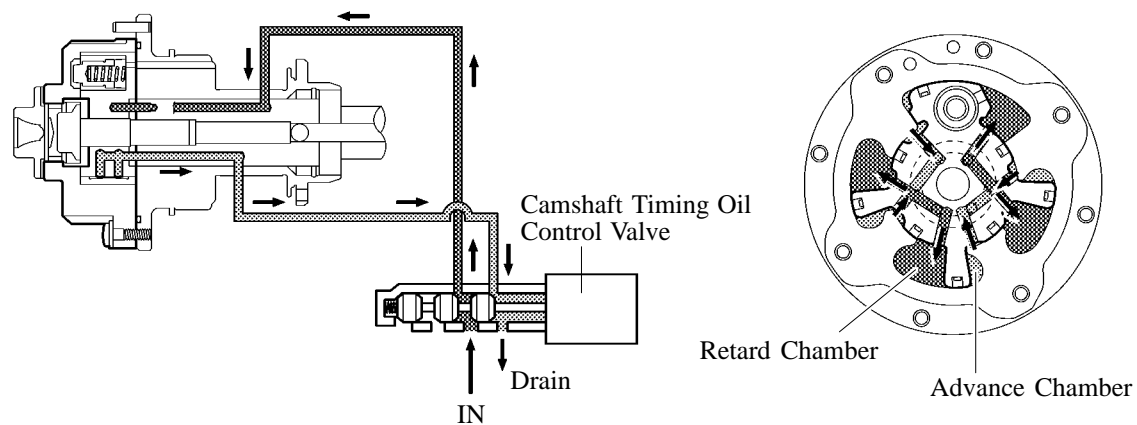
When the camshaft timing oil control valve is positioned as illustrated below by the advance signal from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



273GX19

**b. 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.



273GX20

**c. 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.