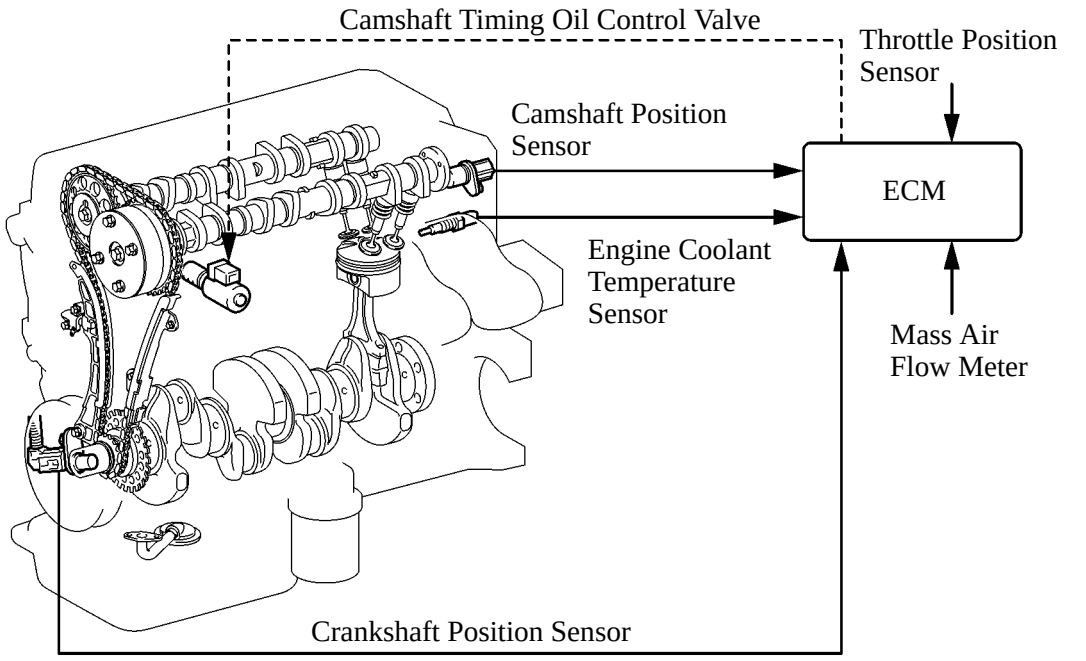
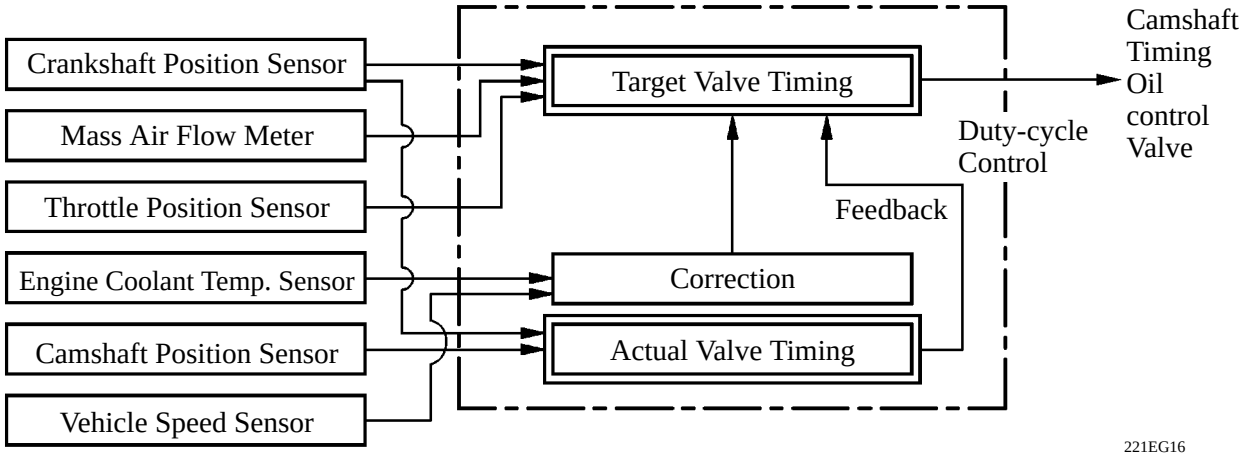
7. VVT-i (Variable Valve Timing-intelligent) System

General

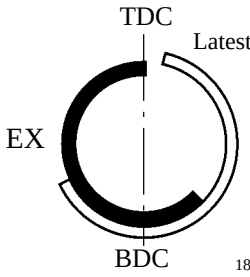
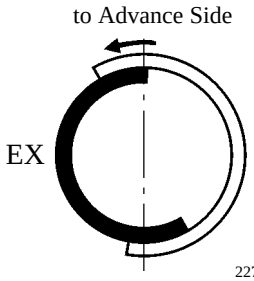
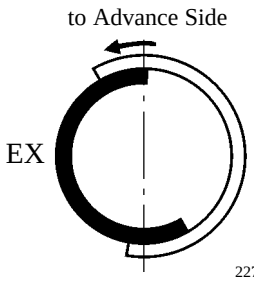
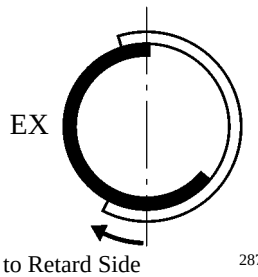
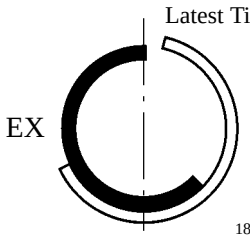
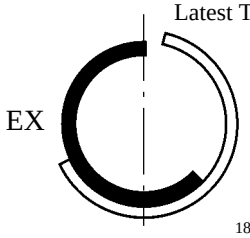
- The VVT-i system is designed to control the intake camshaft within a range of 40° (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This realizes proper torque in all the speed ranges as well as realizing excellent fuel economy, and reducing exhaust emissions.



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



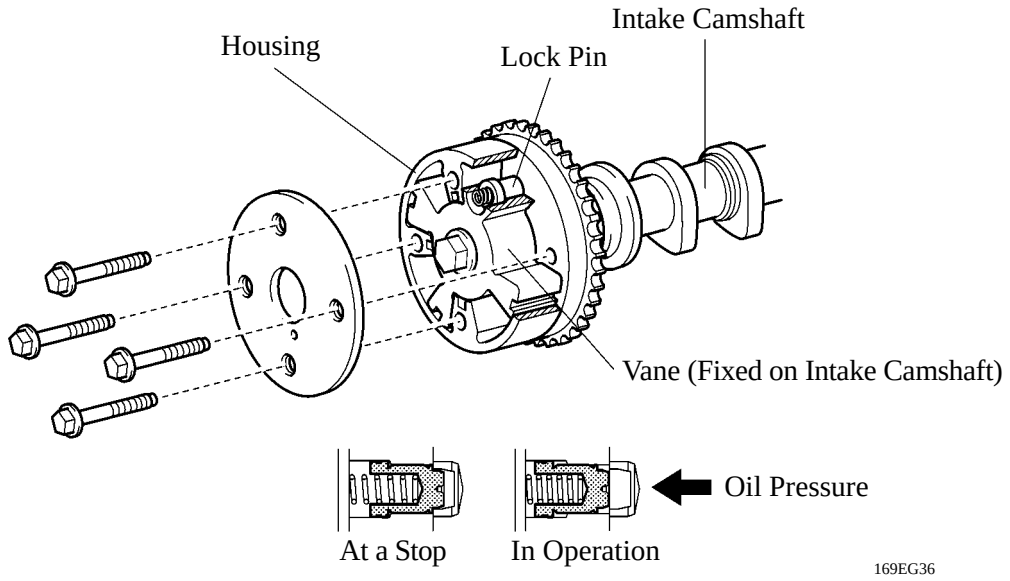
Effectiveness of the VVT-i System

Operation State	Objective	Effect
● During Idling ● At Light Load	 Eliminating overlap to reduce blow back to the intake side	● Stabilized idling rpm ● Better fuel economy
At medium Load	 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	 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	 Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temperature	 Eliminating 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	 Eliminating overlap to reduce blow back to the intake side	Improved startability

Construction

1) VVT-i Controller

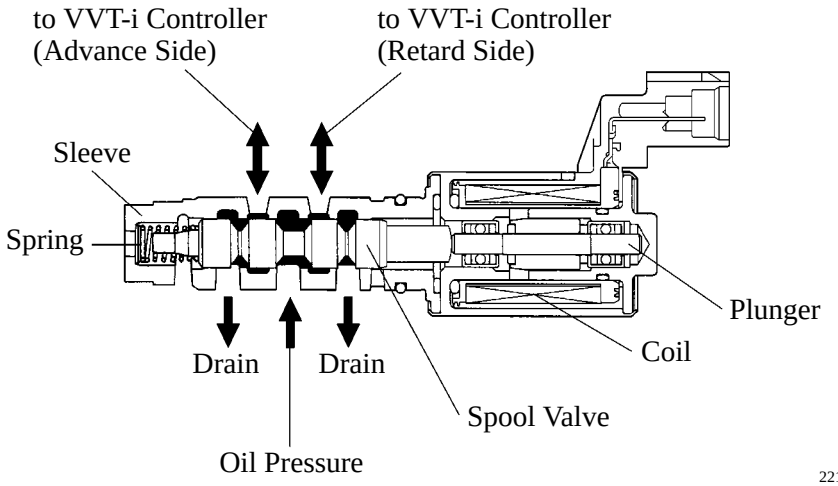
This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft.
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing 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

2) Camshaft Timing Oil Control Valve

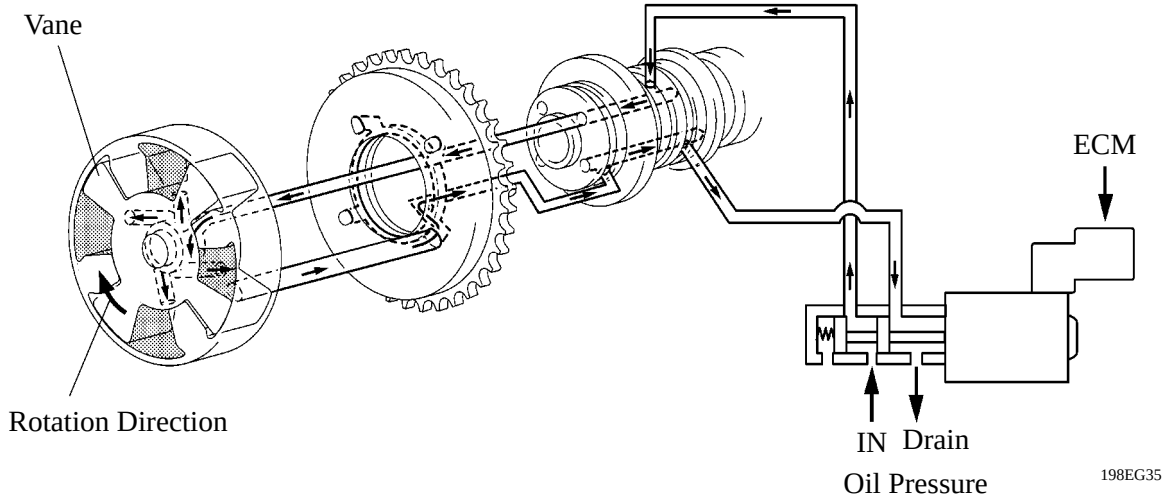
This camshaft timing oil control valve controls the spool valve position in accordance with the duty-cycle control from the ECM. This allows hydraulic pressure to be applied to the VVT-i controller advance or retard side. When the engine is stopped, the camshaft timing oil control valve is in the most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



Operation

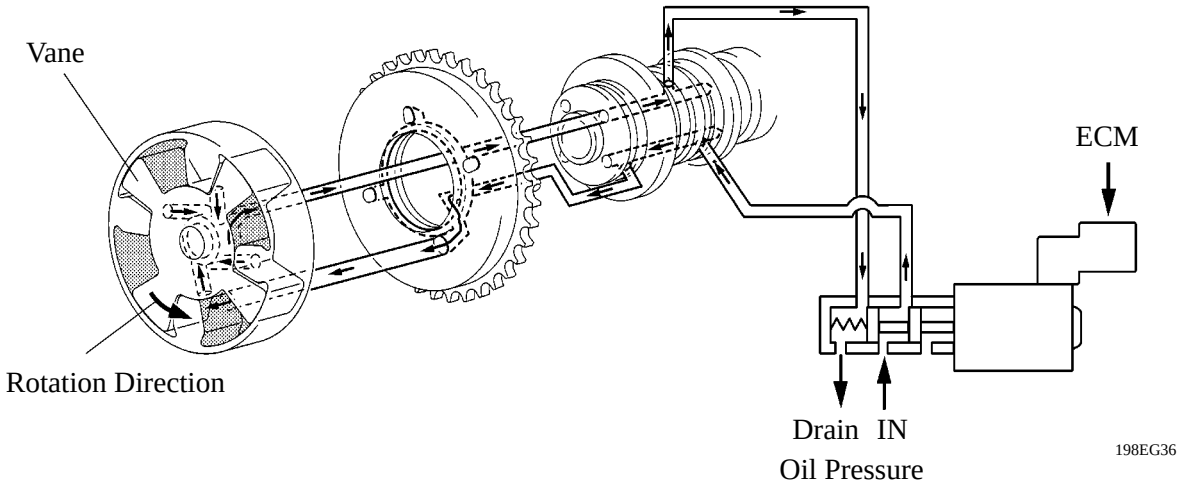
1) Advance

When the camshaft timing oil control valve is operated 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.



2) Retard

When the camshaft timing oil control valve is operated 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.



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.