

Delphi Variable Cam Phaser

Delphi's Variable Cam Phaser (VCP) replaces the standard pulley, sprocket or gear in an engine's valve train. It enables the cam lobe (lift event) timing to crank shaft timing to be changed while the engine is operating, based on the parameters of the engine.

The cam lobe angular position, or phase relationship, is controlled by the internal vane mechanism of the VCP. Commands from the engine control module adjust the position of the oil control valve (See schematic.), which is mounted in the cylinder head and regulates engine oil flow to either side of the vanes.

Delphi's variable cam phasing system includes an oil control valve, which controls the flow of oil to advance, retard or hold the camshaft position. Its high flow capacity provides fast phasing rates, and its integral filtration keeps it debris-free avoiding the need for a separate filter while providing increased packaging flexibility.

Variable cam phasing changes the timing of the valve lift event. It can be used to shift the intake cam, the exhaust cam, or both on dual overhead cam engines. This helps increase engine efficiency, improving idle stability while delivering more torque and horsepower. It also helps boost fuel economy and reduces hydrocarbon emissions.

▶ Benefits

- Optimized size versus torque for dynamic stability
- Packaging flexibility on the engine is enabled by a standard rotor/stator pack in the VCP and a remote mounted oil control valve
- Mechanical lock pin maintains default positions when parked at low pressure conditions
- Low-restriction four-way control valve provides low pressure operation and continuously variable position operation
- High precision manufacturing processes enable low leakage and low lash for improved performance and noise free operation
- System integration capability to assist customers with base engines and engine management system development and implementation

▶ Typical Applications

A Delphi Variable Cam Phaser can be applied to virtually any engine to help broaden the torque curve, increase peak power at high rpm, reduce hydrocarbon and NOx emissions and help increase fuel economy. VCP benefits are application-specific and are derived by increasing volumetric efficiency, reducing pumping losses and in-cylinder internal dilution control associated with varying the cam timing.



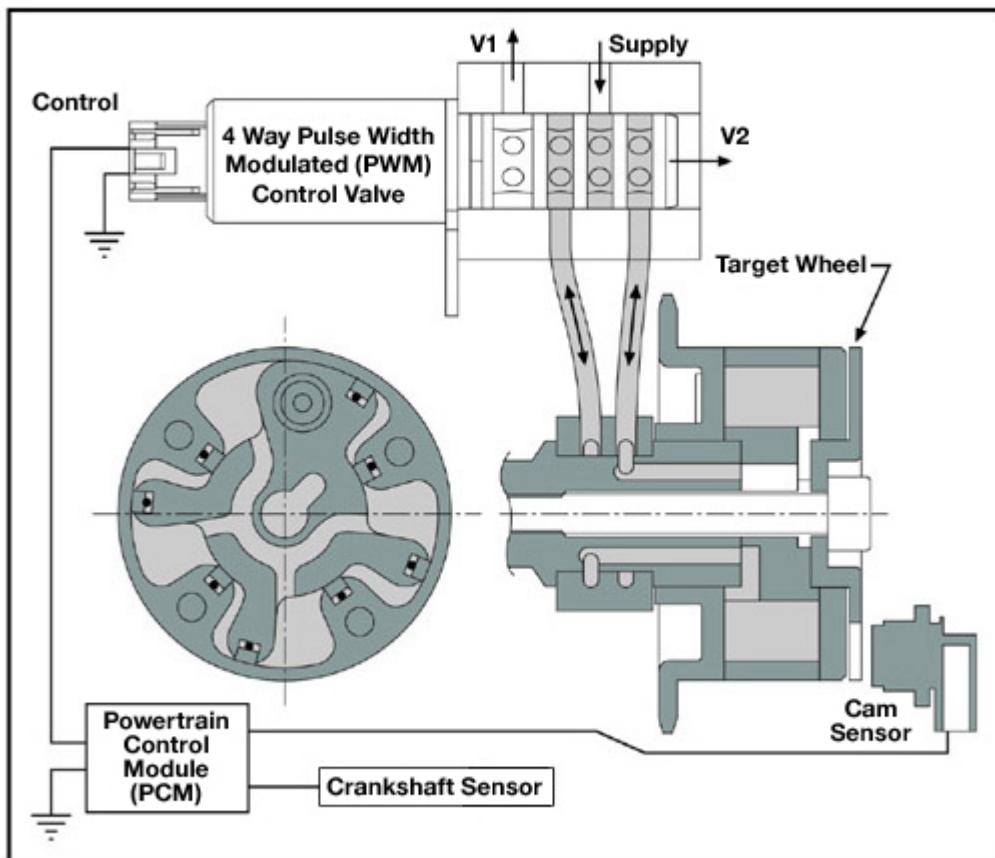
Delphi Variable Cam Phaser with Oil Control Valve

▶ **Phaser Position**

| Control Valve | Intake | Exhaust | Valve Overlap |
|---------------|--|---------|---------------|
| Off | Retard | Advance | Minimum |
| 50% | Intermediate: Flow is restricted to "hold" position. | | |
| 100% | Advance | Retard | Maxi |

This chart indicates the control logic between the variable cam phaser and the oil control valve.

▶ **Hydraulic System Schematic**



This diagram shows the system-level mechanization of the variable cam phaser, oil control valve, control module, crank sensor and cam sensor to the engine.

► Performance Advantages

Delphi's variable cam phasing technology achieves a balance of response times, torque capacity and optimal packaging. Further optimization can be achieved to meet application-specific goals. The construction of the cam phaser and the oil control valve permits either two-position or continuously variable operation. Advantages of Delphi's variable cam phasing technology include:

- Intermediate lock pin feature enables improved fuel economy and performance in dual independent cam phasing applications
- Flexible packaging and compact size for pulley, sprocket or gear drive
- Optimized design and process to provide low cost components
- System-level support with integration of software, capability to supply engine hydraulics designs and control algorithms, including diagnostics

Delphi is a leading manufacturer of cam phasers and has received numerous patents for these technologies. Delphi can tailor cam phasing systems to help achieve the optimal balance of efficiency and power. Implementation is simplified because of the vane configuration, which reduces mass and contributes to packaging flexibility.

Delphi manufactures cam phasing systems in North America, Europe and Asia, with additional product development and customer support facilities worldwide to enable exceptional on-time delivery.

► The Delphi Advantage

Delphi offers the benefits of more than 75 years' experience in valve train systems and its high-quality conventional valve train products have earned industry-wide respect. Our deep understanding of the combustion process, vast research and development capabilities have enabled continuing innovation. Delphi offers one of the industry's most comprehensive lines of valve train products and we support our customers at many levels, from components to valve train design and optimization.

As a global leader in engine management systems technology, Delphi can help manufacturers around the world meet emissions requirements, improve fuel economy and enhance performance. Delphi is a source for high value solutions and our systems approach is built into every product. Delphi's flexible engineering approach encourages collaboration. And, Delphi has a thorough understanding of automotive markets around the world and a global network of resources.



Delphi produces a wide variety of variable cam phasers and oil control valves to meet individual customer requirements.