

Document title Camshaft adjustment, function

Document number gf0710p1016mm

Engine276.8 in model 207, 212
as of model year 2014

Engine276.8 in model 218
as of model year 2015

Engine276.9 in model 204, 207, 212 (except 212.095), 218


Function requirements for camshaft adjustment, general points

- Circuit 87M (Engine management ON)

Camshaft adjustment, general points

With camshaft adjustment all four camshafts can be adjusted continuous for up to 40° CKA (CrankAngle) and thus the valve overlap is varied for a charge change within wide limits.

This optimizes engine torque characteristics and improves the exhaust characteristics.

 Valve overlap

The intake valves open before the exhaust valves close.


For camshaft adjustment the ME-SFi [ME] control unit (N3/10) reads in the following signals for camshaft adjustment:

Function sequence for camshaft adjustment

- Function sequence for release of the camshaft adjustment
- Function sequence for oil pressure
- Function sequence for adjustment
- Function sequence for adjustment range

Function sequence for release of the camshaft adjustment

Camshaft adjustment is enabled by the ME-SFi [ME] control unit dependent on engine speed and engine oil temperature.

 The engine oil temperature is important, even when the oil is hot, to ensure that there is sufficient oil pressure (> 1.5 bar) for adjusting the camshafts.

Release of adjustment of the exhaust camshafts takes place by means of a comparison to the intake camshafts, at first at a high rotational speed. In this way for exhaust, also at a low oil pressure level, reaching the locking position against the "retard" operating reaction torques of the camshaft are secured.

There is a return spring located for support in each camshaft positioner.

- Engine runs

- Left and right intake camshaft hall sensors (B6/4, B6/5), intake camshaft positions
- Left and right exhaust camshaft hall sensors (B6/6, B6/7), exhaust camshaft positions
- Coolant temperature sensor (B11/4) (model 204, 207, 212), coolant temperature sensor (B11/4) (model 218)
- Pressure sensor downstream of throttle valve (B28/7), engine load
- Crankshaft Hall sensor (B70), engine rpm

- Function sequence for start position
- Function sequence for valve overlap
- Function sequence for camshaft positions monitoring
- Function sequence: diagnosis

If all four camshafts are adjusted, adjustment of the exhaust camshafts takes place after a delay (later). Oil supply problems are prevented and secure functioning of the locking mechanism achieved.

Release of the camshaft adjustment occurs load-dependent:

- For an engine oil temperature of 80 °C from about 600 rpm
- For an engine oil temperature of 120 °C (intake side) from about 800 rpm
- For an engine oil temperature of 120 °C (exhaust side)from about 1050 rpm

Function sequence for oil pressure

The engine oil pressure is regulated via the engine oil pump valve (Y130) in order to ensure an adequate oil supply and to lower the oil pressure if necessary (a saving on fuel).

Function sequence for adjustment

The left and right intake camshaft solenoids (Y49/4, Y49/5) and the left and right exhaust camshaft solenoids (Y49/6, Y49/7) are actuated by the ME-SFi [ME] control unit by means of a pulse width modulated signal. The control plungers are adjusted via the characteristics map-dependent duty cycle. The oil filling capacities (engine oil) for the camshaft positioners are controlled according to their position. The vane pistons which are firmly connected to the camshafts are thus turned by the engine oil in the camshaft positioners.

With engine 276.9:

Intake camshaft: a 4° CKA before TDC (Top Dead Center) up to a 36° CKA after TDC (intake open)

Exhaust camshaft: 25° CKA BTDC up to 15° CKA after TDC (exhaust closes)

With engine 276.9:

Intake camshaft: 36° CKA ATDC (intake opens)

Exhaust camshaft: 25° CKA BTDC (exhaust closes)

The camshafts are locked in a fixed position for starting by catch bolts (locked). This start position is unlocked hydraulically at the first actuation of the left and right intake camshaft and exhaust camshaft solenoids.

Function sequence for adjustment range

With engine 276.8:

Intake camshaft: a 7° CKA before TDC (Top Dead Center) up to a 33° CKA after TDC (intake open)

Exhaust camshaft: 25° CKA BTDC up to 15° CKA after TDC (exhaust closes)

Function sequence for start position

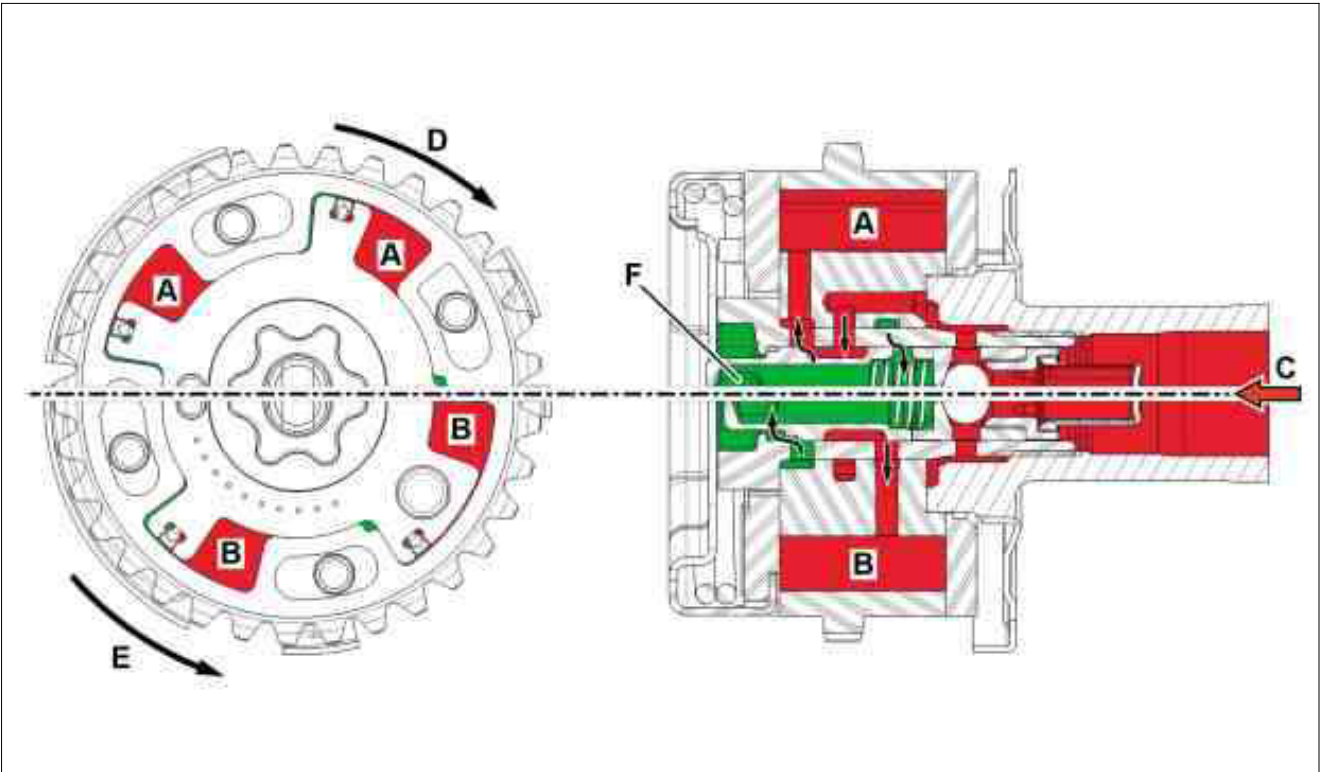
With engine 276.8:

Intake camshaft: 33° CKA ATDC (intake opens)

Exhaust camshaft: 25° CKA BTDC (exhaust closes)

Shown is oil flows in the intake camshaft camshaft positioner

- A Pressure chamber for retarding the ignition timing
- B Pressure chamber for timing advance
- C Engine oil from the intake camshaft
- D Direction of rotation for timing advance
- E Direction of rotation for retarding the ignition timing
- F Control plunger



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The upper half of the illustration shows:

Fill the pressure chamber for timing advance (A), pressure chamber for retarding the ignition timing (B) open.

Function sequence for valve overlap

At low engine speed and load, the ME-SFI [ME] control unit sets a large valve overlap in order to produce internal exhaust gas recirculation. Less fresh air is admitted, as exhaust gases with low oxygen content are still present in the cylinders. This lowers the combustion temperature and reduces the formation of nitrogen oxides (NO_x).

The lower half the illustration shows:

Fill the pressure chamber for retarding the ignition timing (B), pressure chamber for timing advance (B) open.

The intake air mass is reduced by the amount of exhaust gases present. The ME-SFI [ME] control unit shortens the injection period accordingly. The smallest valve overlap for gas exchange occurs if the exhaust camshaft are adjusted to the maximum BTDC (advanced) and the intake camshaft to the maximum ATDC (retarded). The resulting increased fresh air content produces more engine torque and engine power.

Function sequence for camshaft positions monitoring

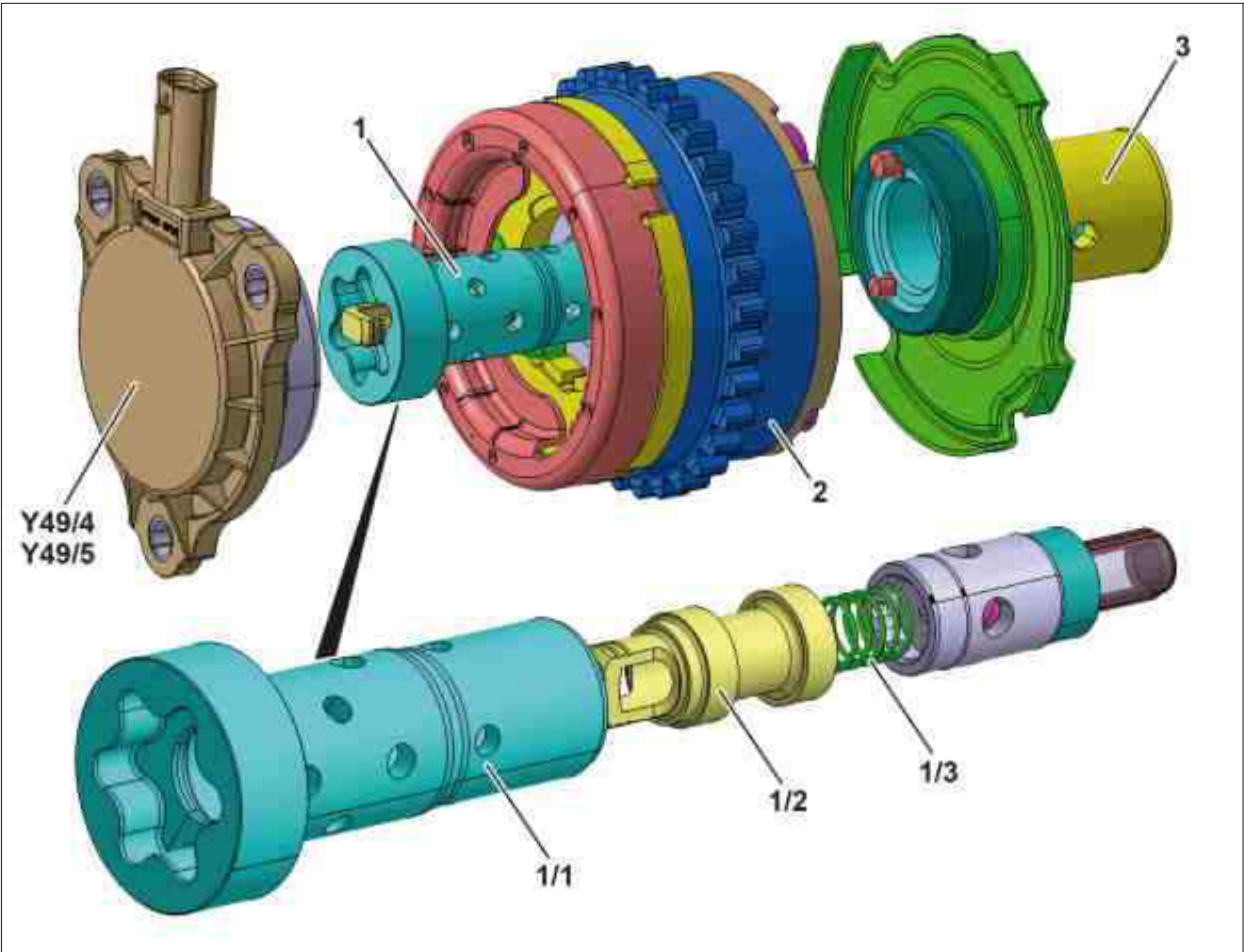
The camshafts positions are detected by the intake camshaft Hall sensors and the exhaust camshaft Hall sensors, and communicated to the ME-SFI [ME] control unit. Acquisition of the positions takes place through detection of the positions of pulse wheels which are located at the front on the camshafts.

Function sequence: diagnosis

During diagnosis of the camshaft adjustment, the ME-SFI [ME] control unit checks whether the camshafts are in start position at engine start and whether the requested adjustment has been reached after the engine has been running for a short time. Output stage errors in the camshaft solenoids (integrated with the ME-SFI [ME] control unit) and defective camshaft Hall sensors are also detected.

Shown on intake camshaft adjustment

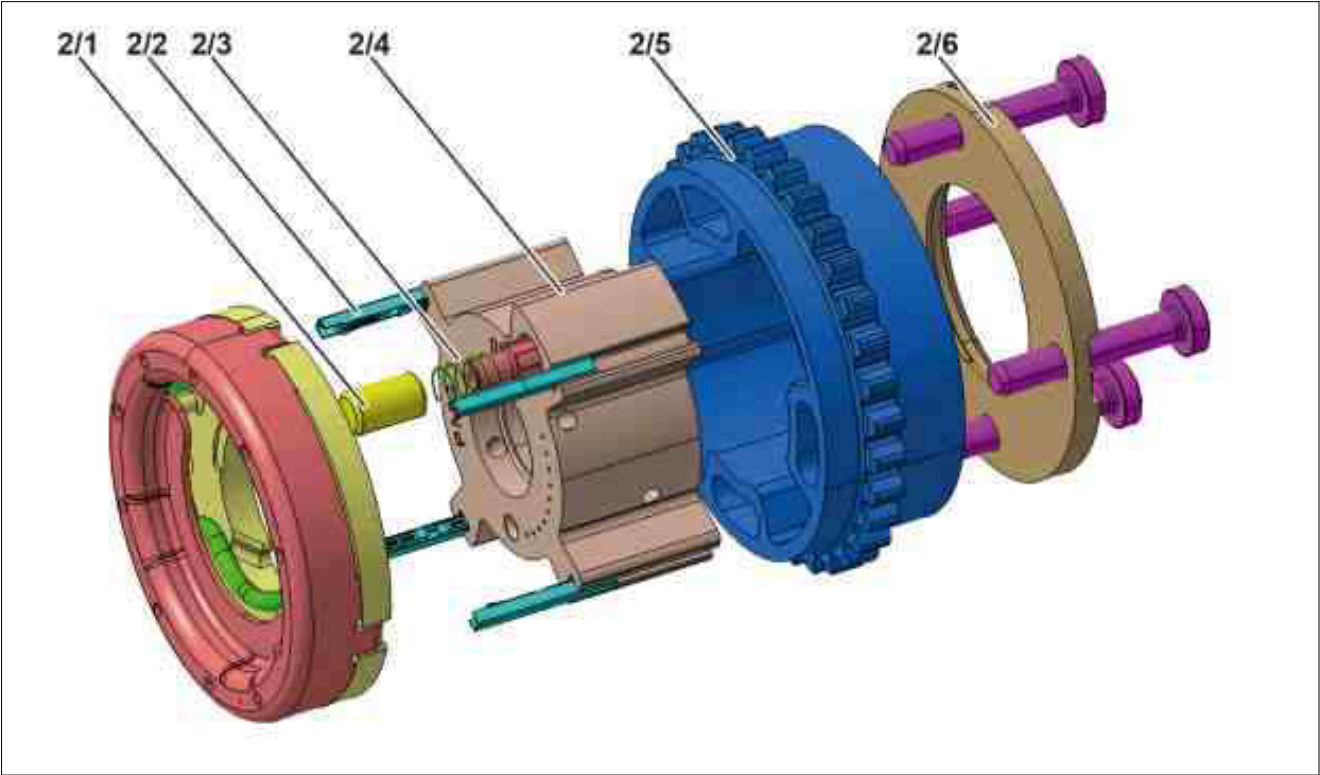
- 1 Control valve
- 1/1 Valve body
- 1/2 Control plunger
- 1/3 Return spring
- 2 Camshaft positioner
- 3 Intake camshaft
- Y49/4 Left intake camshaft solenoid
- Y49/5 Right intake camshaft solenoid



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Shown: intake camshafts camshaft positioner

- 2/1 Catch bolt
- 2/2 Seal strips with leaf springs
- 2/3 Compression spring
- 2/4 Vane-cell piston
- 2/5 Drive gear
- 2/6 Cover



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	Electrical function schematic for camshaft adjustment	model 204	PE07.10-P-2716-97FAK
		MODEL 207	PE07.10-P-2716-97EAH
		MODEL 212	PE07.10-P-2716-97DAI
		Model 218	PE07.10-P-2716-97XAB
	Overview of system components for gasoline injection and ignition system with direct injection	Engine 276.9 in model 204, 207, 212 (except 212.095), 218	GF07.70-P-9998MM
		Engine 276.8 in model 207, 212 as of model year 2014	GF07.70-P-9998MMP
		Engine 276.8 in model 218 as of model year 2015	