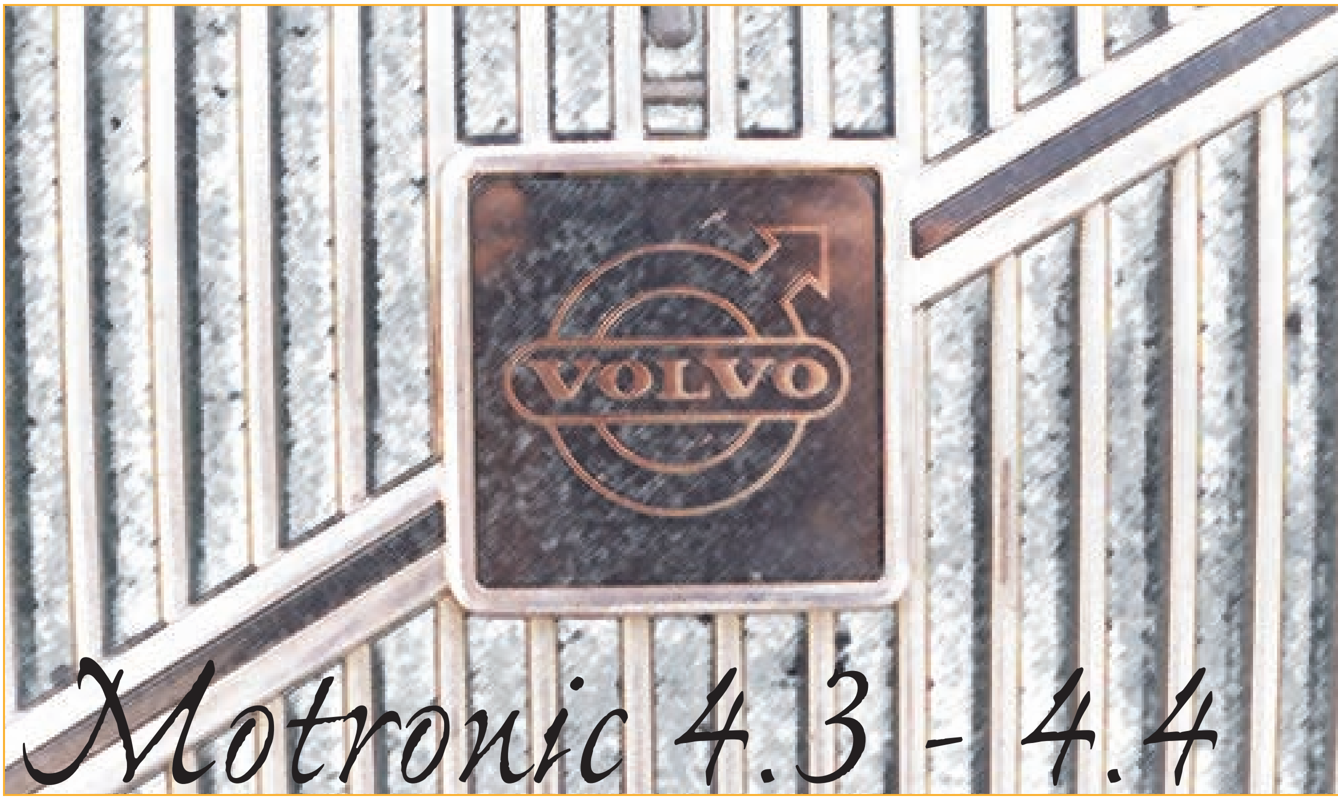


Motronic 4.3 - 4.4

The Motronic 1.8 engine management system was introduced with the 1992 Volvo 960. The primary difference between this Motronic system and the previous generation of Volvo LH-Jetronic engine management systems is the fact that ignition timing is controlled directly by the Motronic PCM. Earlier Volvo engine management systems had separate control units for fuel and spark.

Motronic 1.8 was followed by Motronic 4.3-4, which added the ability to perform OBD-II systems fault monitoring. While the Motronic control unit on all of these systems controls ignition timing, it also ensures that the ignition coil is optimally charged, regardless of engine speed. The two knock sensors on the Volvo's five cylinder engine, along with other sensors, allow the PCM to compute ignition timing for any engine load, temperature, or speed.

The electronic transmission control module (TCM) AW-50-42 interfaces with the Motronic PCM to ensure smooth shifting of the transmission. When the TCM is getting ready to shift gears, it sends a torque reduction request signal to the Motronic unit. Ignition timing is then momentarily retarded, thus reducing engine torque and load on the transmission, resulting in a smooth shift. The TCM waits for an acknowledgment signal from the Motronic unit before shifting gears.

Misfire detection is carried out by monitoring the interval between two segments on the flywheel via the CKP sensor. This interval may vary depending upon misfire, driveline oscillations, or poor road conditions. To keep a rough road from falsely triggering a misfire code, Motronic 4.3 utilizes an acceleration sensor. This signal is used to determine the amount of vertical movement of the vehicle, which allows the PCM to differentiate between a rough road and an actual misfire condition. It also performs catalyst monitoring by using a front and rear H0$_2$S, which is part of the OBD-II requirement.

EGR is monitored and controlled by the Motronic PCM. The PCM uses a temperature sensor located on the EGR valve to determine if flow is occurring. The temperature sensor is a negative temperature coefficient (NTC) device, so its resistance lowers as temperature increases. The PCM controls the flow of exhaust gas by sending electrical signals to the EGR vacuum controller. The controller converts this electrical signal into a modulated vacuum signal that controls the amount of lift to the EGR valve and hence the flow of exhaust gases into the intake system.

Leak detection for the EVAP system was not originally part of the Motronic 4.3 system, but was introduced when these systems became OBD-II compliant. Leak detection on OBD-II systems is performed by utilizing a MAP sensor connected to the EVAP system. By opening and closing the purge system, the rate of change in this MAP signal is used to determine whether the system is sealed. EVAP purge has always been carried out by these systems, even before leak detection was added. The PCM controls a duty cycled pulse to the purge valve, which allows the gas vapors stored in the carbon canister to be drawn into the engine.

The A/C system is integrated into the Motronic system via the A/C relay, a linear A/C pressure sensor and A/C compressor ON/OFF input. The Motronic control unit controls the activation of the A/C relay depending on engine parameters. Once approval has been granted, the Motronic unit grounds the A/C relay, which sends battery voltage to the "Pressostat." This sensor controls the actual cycling of the A/C compressor. The Motronic control unit can override the activation of the A/C compressor by de-energizing the A/C relay. Deactivation occurs during engine starting, WOT, if A/C system pressure is too high or if engine temperature is above 257 deg F. The Motronic control unit also controls a two-speed engine cooling fan.

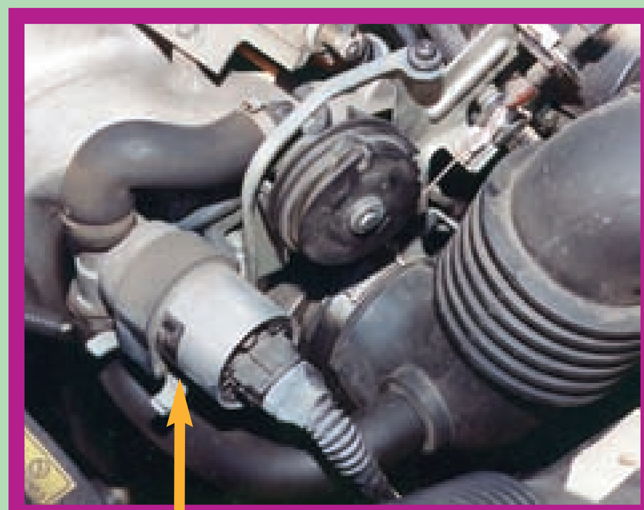
In the photos and captions that follow, we'll tell you more about Volvo's most recent Motronic system.

—By Lester Bravek

Input signals to the Motronic 4.3 system include:

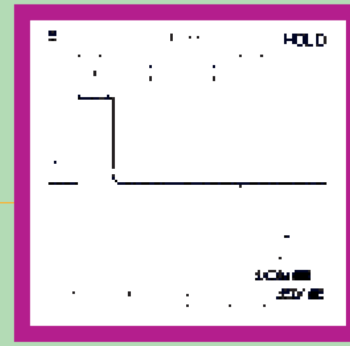
- Crankshaft Position Sensor (CKP),
- Camshaft Position Sensor (CMP),
- Mass Air Flow Sensor (MAF),
- Engine Coolant Temperature Sensor (ECT),
- Throttle Position Sensor (TPS),
- Front And Rear Heated Oxygen Sensors (H02S),
- Knock Sensor (KS),
- Vehicle Speed Sensor (VSS),
- EGR Temperature Sensor,
- Acceleration Sensor,
- A/C Pressure Sensor,
- A/C Compressor ON/OFF Input.

The MAF sensor determines engine load by measuring changes in the temperature of the hot film element as it is cooled by the intake air flow. The working temperature of the element is a hot 340 degrees F, so no burn-off is required to clean the film after shutdown. The output voltage generated by the MAF sensor is a variable DC voltage. The KOEO reading is 0.1-0.2 VDC. At warm idle it is 0.9-1.0 VDC.



Idle speed control is maintained by a standard Bosch idle valve. Ground signals from the PCM control the rotary vane opening angle and allow the PCM to control idle speed under all operating conditions. Two coil and single coil idle valve designs have been used on different Volvo models. Approximately 25-35 percent negative dwell represents a typical idle value.

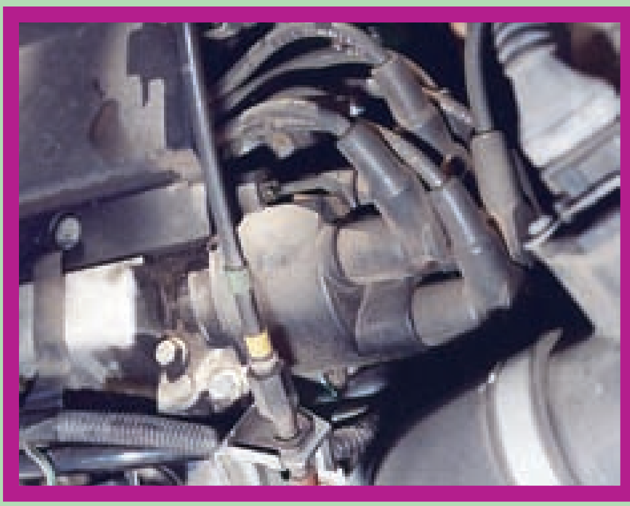
The coolant temperature sensor is mounted on the thermostat housing, just below the upper radiator hose. The sensor is not easily visible, but its resistance value can be checked by accessing the harness connector. This is a NTC-type sensor with a cold resistance of 2.4k ohms. Look for a resistance of approximately 300 ohms when the engine is at operating temperature.



The voltage supplied to the coolant temperature sensor is very unusual. The PCM internally switches to a smaller resistance value every 0.6 seconds. This, in turn, causes the voltage to pull up. The change can be easily viewed on an oscilloscope. However, this voltage switching will not affect the ECT's DC voltage readings when it is viewed on a DMM.

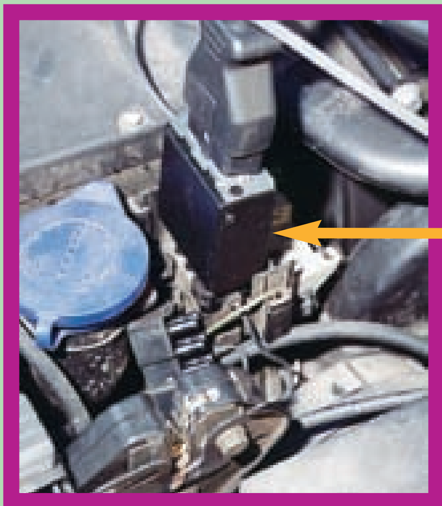
The PCM controls the on-time of individual fuel injectors by controlling the ground circuit of each injector. At warm idle, the injector on-time is approximately 4.0-4.2 msec. All five injectors are mounted to a common fuel rail and are easily accessible. A fuel pressure regulator is connected to the rail to maintain a 42 psi pressure drop across the injectors.

The injectors are high resistance type and should measure 17 ohms each. This eliminates the need for dropping resistors to control current flow. This is a sequential electronic fuel injection (SEFI) system, so each injector is controlled by a separate transistor inside the PCM. The system utilizes adaptive "self learning" to optimize fuel injector on-time under various running conditions.



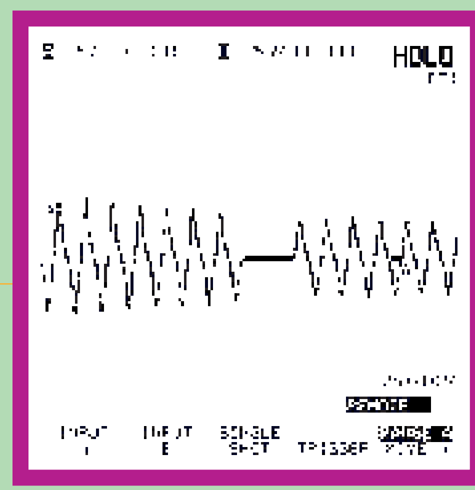
With the introduction of Motronic 4.3, the PCM now controls ignition timing directly. The need for a separate ignition computer has been eliminated. The power transistor mounted below the ignition coil is controlled by the Motronic PCM. The distributor shaft is driven by the camshaft and the rotor delivers spark to each spark plug. Two knock sensor inputs allow the PCM to selectively adjust ignition timing for any affected cylinder.

The Motronic unit handles all aspects of engine management based on the information received from the sensors listed earlier in this article. We used the Autodiagnos Multi-Tester plus and the company's Volvo serial communications kit to access the PCM's input and output serial data available at the vehicle's diagnostic connector. ABS, SRS, instrument cluster, power seats are other systems that can also be accessed with the serial communication kit.



Serial communication allows engine parameters to be displayed in plain English. This started with Motronic 1.8 on the 1992 960 and continues with the 1996 Motronic 4.4 system, which is OBD II compliant. Fault codes can still be retrieved through the Volvo diagnostic connector. This consisted of push buttons and LED readouts on earlier systems.

On this Volvo 850, transmission, engine management, and ABS computers are stored in an E-box in the engine compartment. Volvo previously stored the ECUs inside the passenger compartment area. The PCM monitors the ambient air temperature of this compartment via an NTC thermistor. The temperature value is available through serial data.



The magnetic CKP sensor utilizes a missing tooth sequence as a synchronization signal. Combining this information with inputs from a CMP sensor and an acceleration sensor allows the PCM to determine engine misfire for individual cylinders. The acceleration sensor is used to determine the difference between a faulty road, driveline oscillations, or cylinder misfire.