

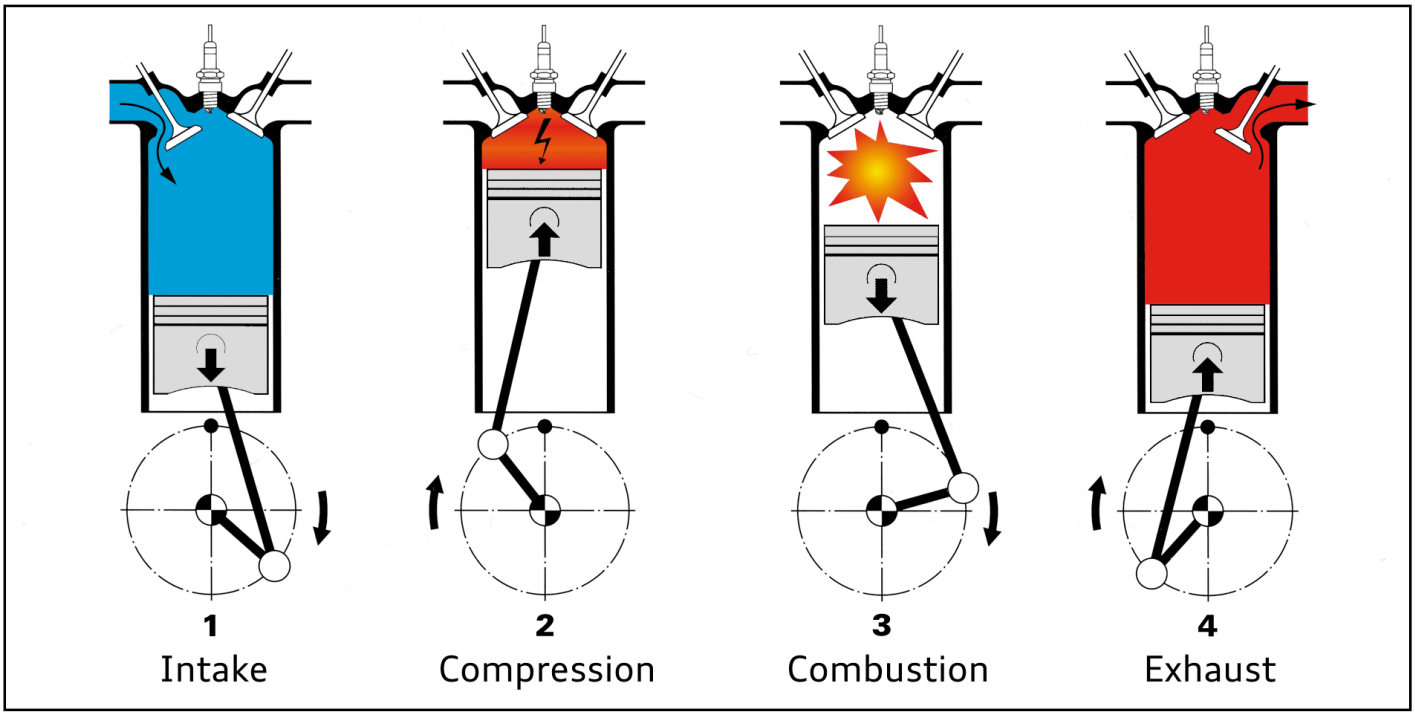
Audi Engine Management Systems

Instructional Video Study Guide

Audi Academy

Video 3: Principles of Engine Operation

An internal combustion engine requires the proper ratios of air and fuel, combined with a properly timed spark, for efficient combustion. Operation of most automotive engines is described in two upward and two downward movements of the piston, called strokes. These four strokes occur during two revolutions of the crankshaft and one revolution of the camshaft. The complete process of cyclic external spark ignition resulting in internal combustion is called the “Otto cycle.”



All four-stroke engines operate in the same manner, regardless of the number of cylinders, although an engine with multiple cylinders has more firing pulses, resulting in a smoother running engine.

Intake stroke (1)

The first phase of engine operation begins with the intake valve opening and the piston moving down into the cylinder. This draws air and atomized fuel into the cylinder.

Compression stroke (2)

Operation continues with the piston at the bottom of its stroke, and the intake valve closing. The piston moves up in the cylinder, com- pressing the air/fuel mixture. Near the end of the stroke the air/fuel mixture is ignited by the ignition system.

Combustion (power) stroke (3)

As the air/fuel mixture burns it expands, creating pressure within the cylinder, pushing the piston down. This provides the motion, which turns the crankshaft.

Exhaust stroke (4)

The exhaust valve opens near the end of the power stroke and the piston moves up. The burned gases are pushed up and out the exhaust port, and the cycle is repeated

Video 4: Overview of Engine Management Components

Government mandates require automakers to increase fuel economy while decreasing exhaust emissions. By controlling various engine systems and how they interact, Audi's Engine Management Systems provide ideal performance and fuel economy, while minimizing harmful emissions.

The major exhaust emissions

Hydrocarbons (HC): organic compounds made of hydrogen and carbon atoms. Hydrocarbons are the world's primary energy source, predominantly used as a combustible fuel. Most of the hydrocarbons occurring naturally on Earth are found in crude oil, and are key components of gasoline and diesel fuel. Hydrocarbons contribute to the formation of ozone and greenhouse gasses, and can enter the atmosphere due to unburned fuel.

Carbon Monoxide (CO): a colorless, odorless gas that is a little less dense than air. Carbon Monoxide is highly poisonous, and even though it 's presence in the air is short-lived, it can contribute to the formation of ground level ozone. Carbon Monoxide results from partially burned fuel (incomplete combustion)

Oxides of Nitrogen (NOx): produced when nitrogen, oxygen and hydrocarbons react during combustion, especially at high temperatures. NOx also occurs naturally in nature, produced by lightning. Significant amounts of NOx can be emitted where there are high volumes of motor vehicle traffic. NOx gasses contribute to the formation of smog, acid rain and ozone. NOx gasses are a byproduct of excessive combustion temperatures.

Basic Engine Management Components

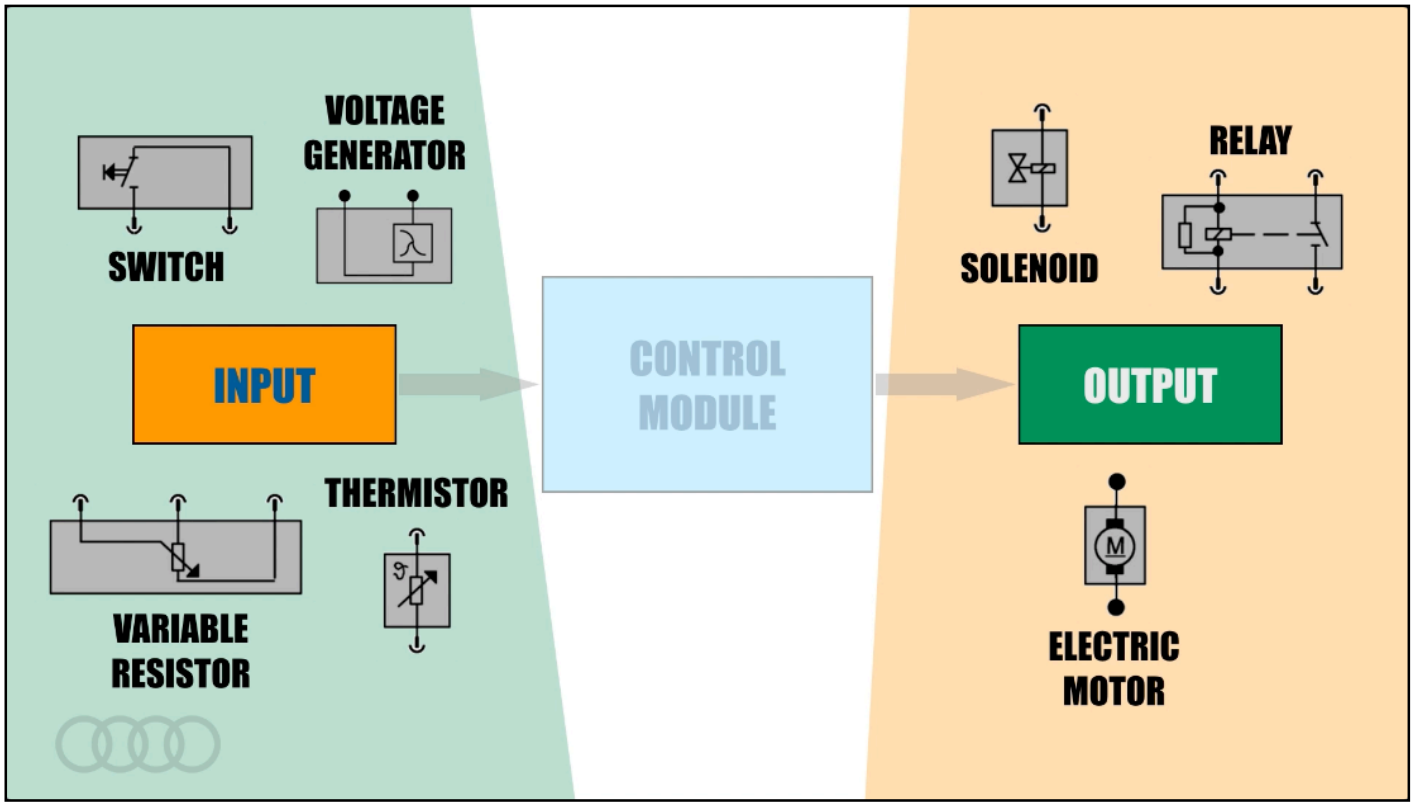
Below is a simplified diagram of the basic Engine Management Components. The control module, the brain of the system, receives input signals from sensors that describe operating conditions. The control module processes the input, activates sequence according to its programming, and provides power, ground or signals to actuators to maintain or change operating conditions.

Types of inputs to the control module:

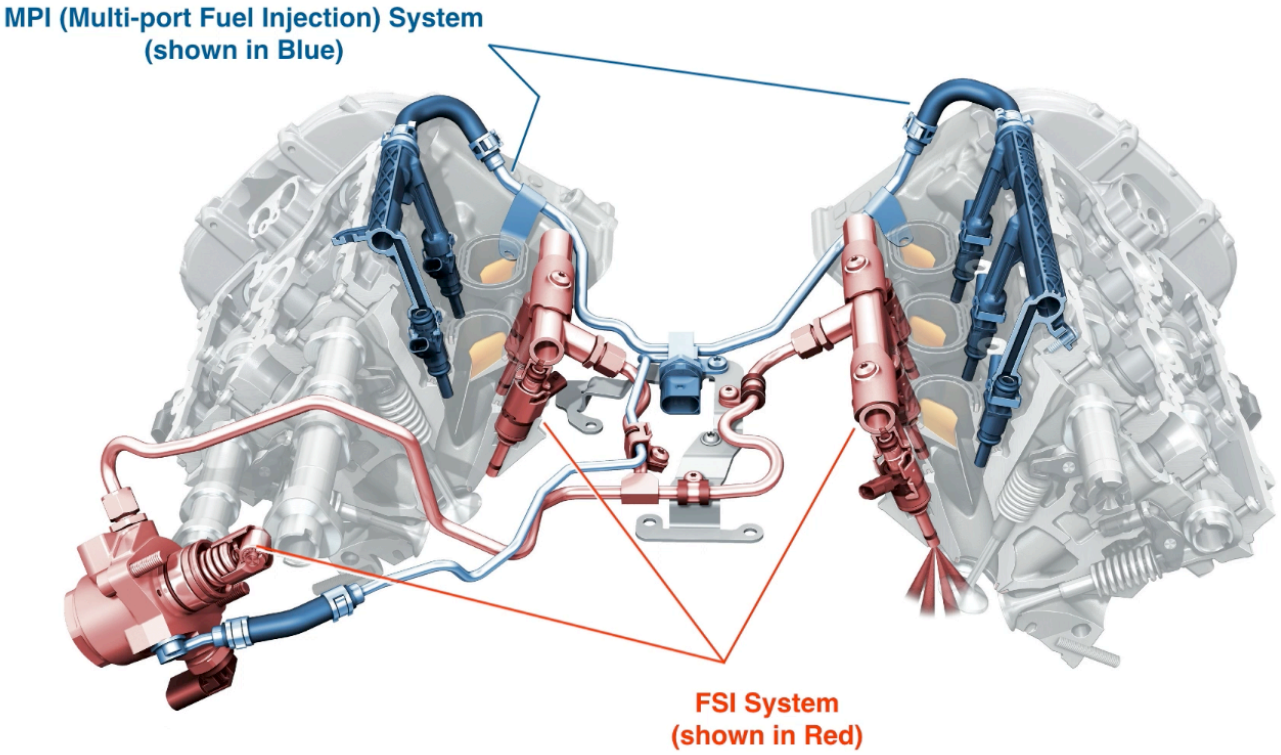
- Switches, such as a Brake Pedal Position Switch
- Thermistors, such as a Coolant Temperature Sensor
- Variable Resistors, such as a Throttle Position Sensor
- Voltage Generators, such as an Oxygen Sensor

Types of outputs to the control module

- Electric Motors, such as an Intake Flap Motor
- Relays, such as a starter relay
- Solenoids, such as a fuel injector



Video 10: Fuel Systems - Dual Injection



The dual injection system was developed to reduce the particulate emissions normally associated with FSI engines. This new fuel system is composed of a MPI (multi-port injection) system and an FSI system.

Dual injection meets these objectives:

- Increase in system pressure from 2175 psi to 2900 psi (150 bar to 200 bar)
- Reduced operational noise
- Compliance with stringent emission limits for particulate mass and volume (significant reduction in soot emissions by a factor of 10)
- Reduction of exhaust emissions, particularly CO2, compliance with current and future exhaust emission standards
- Adaptation of an additional port injection system
  ▸ Improved fuel efficiency at partial throttle through use of MPI injection system

MPI injection system

The MPI system is supplied via a flushing connection on the high pressure pump. During MPI operation, the high pressure pump is automatically flushed with fuel, cooling the pump.

A restrictor is integrated into the flushing connection on the high pressure pump to minimize pulsation that can be transmitted to the rail by the pump.

The MPI system has its own pressure sensor - Low Pressure Fuel Sensor G410. Pressure is supplied on demand by the fuel Transfer Pump G6. The Transfer Pump is activated by the Fuel Pump Control Module J538 via the ECM. The MPI rail is made of plastic. The MPI valves (N532 – N535) are integrated into the plastic intake manifold and optimally aligned for fuel injection.

High pressure injection system

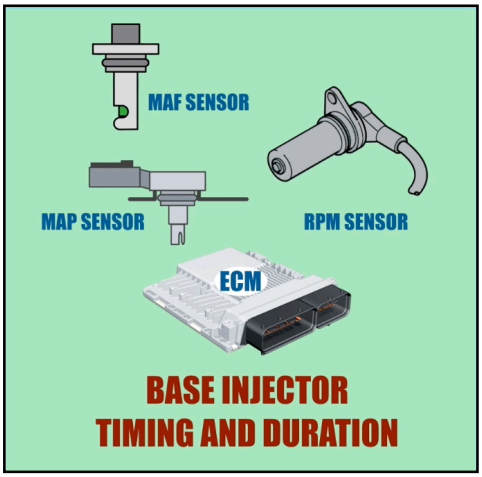
All parts in the high pressure tract have been adapted for system pressures of up to 2900 psi (200 bar). The injectors have been sound insulated from the cylinder head using steel spring discs. Likewise, the high pressure rail has been separated from the intake manifold and bolted onto the cylinder head. The position of the high pressure injectors has been slightly retracted. This improves homogenization of the air-fuel mixture and reduces the thermal stress on the valves.

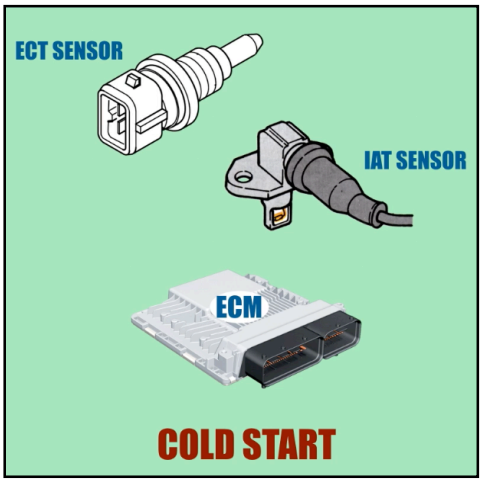
The fuel injection control concept has been modified to ensure harmonized control for all future engines. This rule of thumb applies: if the plug from Fuel Pressure Control Valve N276 is disconnected, pressure is no longer built up in the high pressure system.

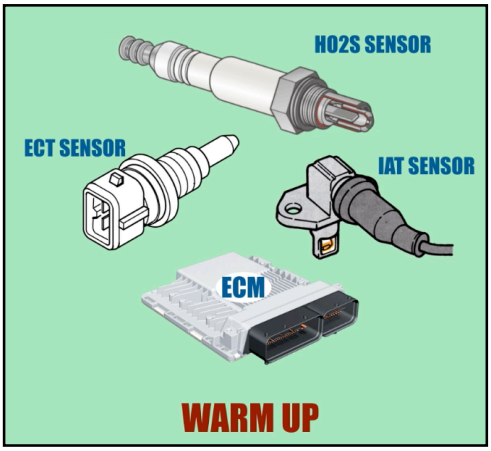
Video 35: System Authority

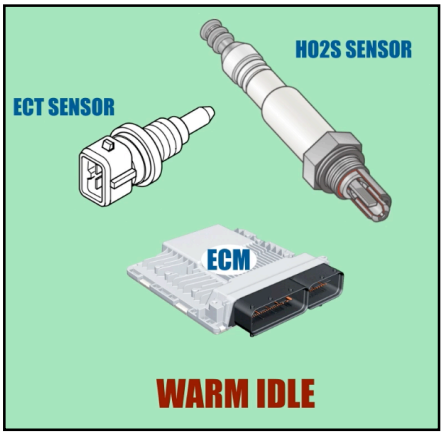
Another important tool for no-code diagnosis is system authority. The influence that engine management components have on mixture control varies based on engine operating conditions. Think of it like a clutch application chart used during automatic transmission diagnosis, you focus on the clutches and brakes that are applied in a particular gear range.

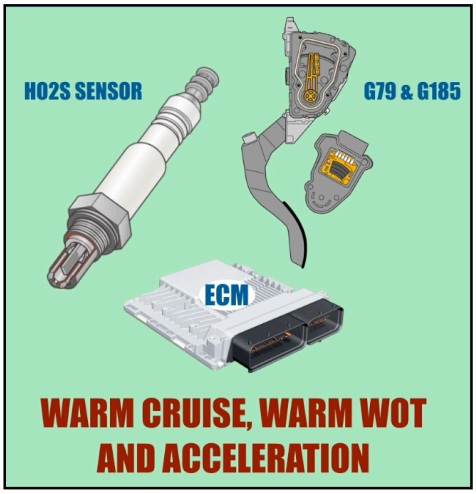
Remember that this overview is intended only as an aid to diagnostic thinking about sensors that most influence mixture control under broad operating conditions. While sensors with the most influence on mixture control are discussed, in reality all sensors are used by the ECM to some extent at all times.

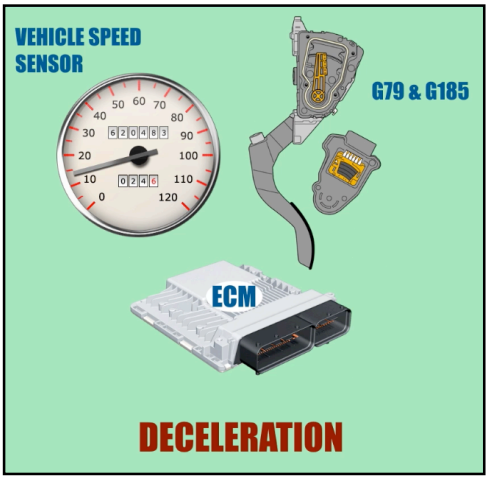




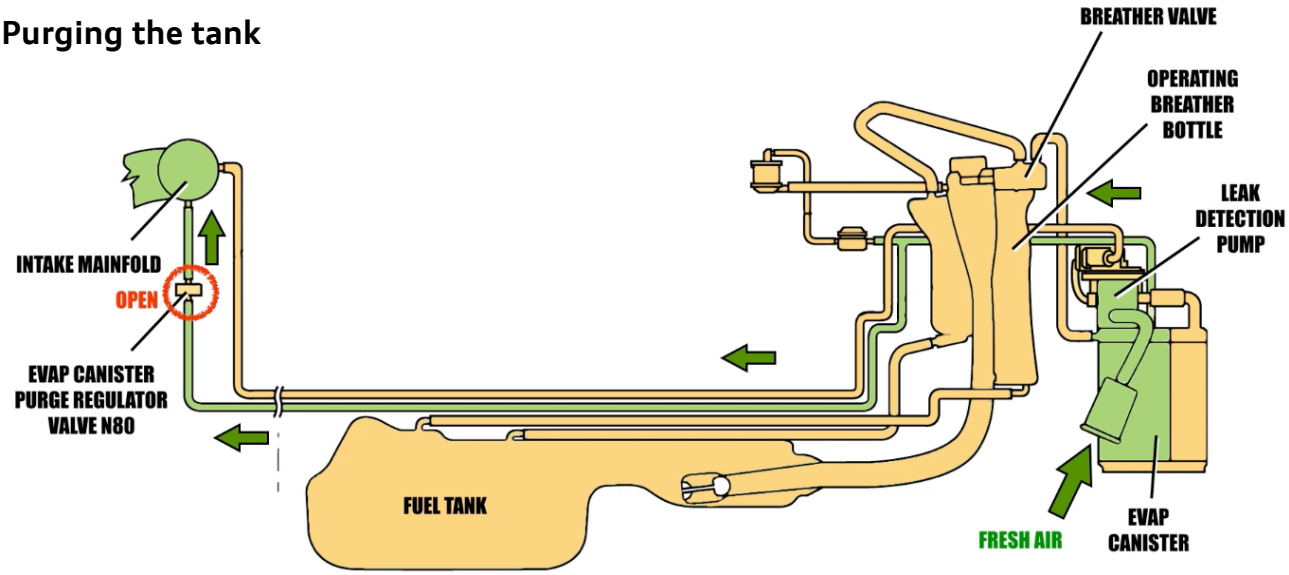








Purging the tank



- Verify that the charcoal canister is not filled with fuel or is not breaking up internally.
- Verify that the line between the charcoal canister and the Leak Detection Pump is not restricted, kinked, or leaking.
- Verify that the line on either side of the Leak Detection Pump filter is not restricted.

Venting

The Evaporative Emissions Purge Regulator Valve N80 is closed. Fuel vapor expands (heat, etc.) Pressurized air with vapor travels through the EVAP lines to the Charcoal Canister. The Charcoal Canister absorbs the fuel vapor and air without fuel vapor escapes to the outside air, relieving pressure in the EVAP system. Venting or lack of venting can be a concern when the vehicle is standing and not operational, due to fuel expansion or contraction because of temperature changes, or when filling the fuel tank.

When the Tank Won't Vent, as indicated by a DTC or high pressure present when removing fuel cap:

- Verify that the line between the charcoal canister and the purge valve is not leaking.
- Verify that the charcoal canister is not filled with fuel or is breaking up internally.
- Verify that the line between the charcoal canister and the LDP is not restricted, kinked, or leaking.
- Verify that the line on either side of the LDP filter is not restricted, kinked, or leaking.
- Verify that the Leak Detection Pump filter itself is not restricted.

Venting the tank

