

# E - THEORY/OPERATION - CIS-E

## Article Text

1991 Volkswagen Passat  
For Volkswagen Technical Site  
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Wednesday, August 25, 1999 07:55PM

### ARTICLE BEGINNING

#### 1990-91 ENGINE PERFORMANCE

#### Volkswagen Theory & Operation - CIS-E Motronic

1990-91 Passat

1991 GTI 2.0L, Jetta GLI

### INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

### COMPUTERIZED ENGINE CONTROLS

#### ELECTRONIC CONTROL UNIT

The Electronic Control Unit (ECU) continually corrects air/fuel mixture, based on signals from oxygen sensor. The ECU sends signals to differential pressure regulator, located on the fuel distributor. See Fig. 1.

The CIS-E Motronic engine management system uses a single control unit for fuel injection, idle speed control, ignition, and emission controls. The oxygen sensor in the CIS-E Motronic system can adjust its range in response to changes in operating conditions.

#### ECU LOCATION TABLE

Application		Location
Passat	.....	Behind Firewall In Rear Center Of Engine Compartment
GTI 2.0L & Jetta GLI	.....	Behind Firewall In Left Rear Of Engine Compartment.

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage signals monitored by the control unit. The second category covers OUTPUT SIGNALS, which are components controlled by the control unit.

#### INPUT DEVICES

NOTE: All vehicles are equipped with different combinations of input devices. Not all devices are used on all models. To determine the input usage on a specific model, see WIRING DIAGRAMS article.

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#### Airflow Sensor Potentiometer

Airflow sensor potentiometer is connected to the air sensor plate actuating lever. It returns a voltage signal to the ECU based on engine load. The ECU uses this signal to calculate fuel mixture adjustments.

#### Coolant Temperature Sensor

Feeds a return signal to ECU for fuel control.

#### Heated/Exhaust Gas Oxygen Sensor

Located in exhaust manifold, the heated/exhaust gas oxygen sensor measures amount of unburned oxygen in exhaust. If oxygen is low (rich mixture), higher voltage will be generated by sensor. If oxygen is high (lean mixture), lower voltage will be generated. Voltage signal from oxygen sensor is sent to ECU which controls fuel mixture through the differential pressure regulator. The heated portion is used to rapidly warm the oxygen sensor for more effective emission controls.

#### Hall Effect Sensor

See IGNITION SYSTEM in this article.

#### Idle Switch

With the throttle closed, the idle switch supplies the ECU inputs for the following.

- \* Idle Air Stabilizer
- \* Deceleration Fuel Shutoff
- \* Electronic Control Unit (ECU)

The idle switch supplies ECU with information to cut fuel during deceleration, and activate idle stabilizer to control idle speed.

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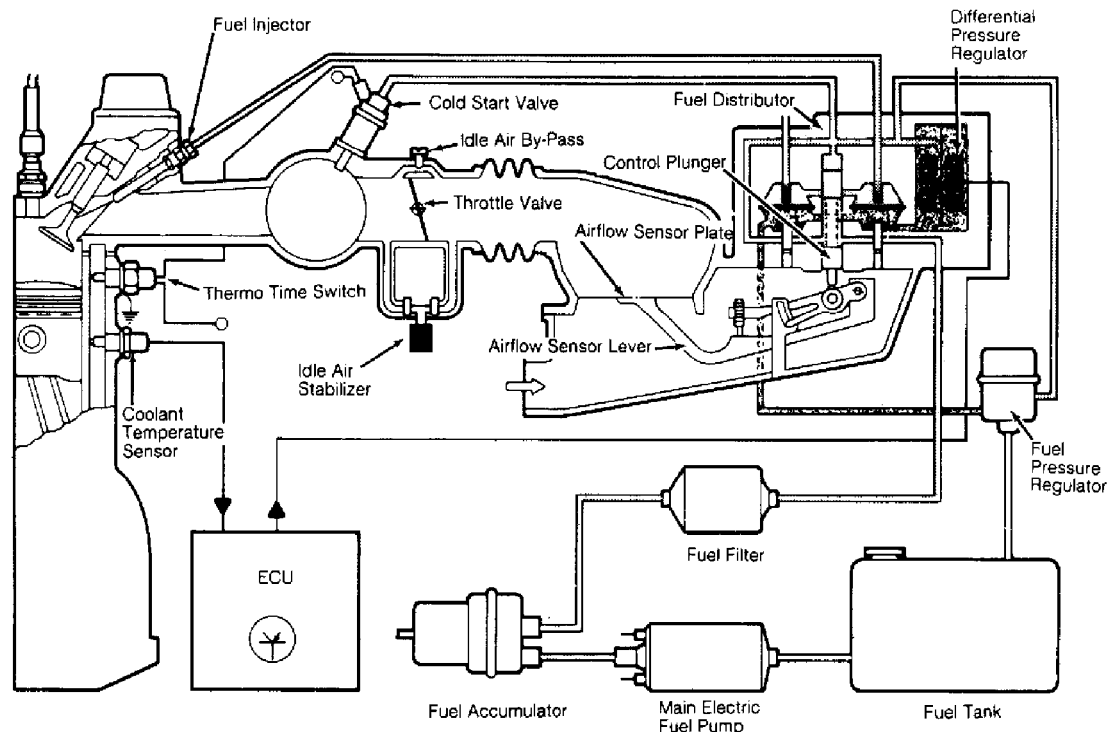


Fig. 1: Identifying CIS-E Motronic Components  
Courtesy of Volkswagen United States, Inc.

#### OUTPUT SIGNALS

- \* Idle Air Stabilizer - See IDLE SPEED.
- \* Cold Start Valve - See FUEL CONTROL.
- \* Differential Pressure Regulator - See FUEL CONTROL.
- \* Fuel Injectors - See FUEL CONTROL.

#### FUEL SYSTEM

##### FUEL DELIVERY

###### Fuel Pump

Main pump is located to rear of vehicle on frame crossmember. A transfer pump is located inside fuel tank. Main fuel pump assembly, has a pressure damper at the suction end. Fuel pumps are activated during start-up and when engine is running.

The main electric fuel pump provides fuel system pressure of 88-95 psi (6.2-6.7 kg/cm<sup>2</sup>). The transfer pump pulls fuel from the tank and pushes it to the main fuel pump. Fuel pump control relay prevents continued operation of fuel pumps if engine stalls. To aid in starting, a fuel accumulator and check valves in the pump and at fuel filter maintain line pressure when engine is not running.

###### Fuel Pressure Regulator

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System pressure is created by the fuel pump and controlled by fuel pressure regulator. The fuel pressure regulator returns fuel to fuel tank when system pressure exceeds need. System is self-adjusting.

#### Fuel Pump Relay

Fuel pump relay switches off fuel pumps when ignition signal is cut off.

### FUEL CONTROL

#### Cold Start Valve

Cold start valve, mounted on intake manifold, sprays fuel to enrich mixture during starting so engine will start easily. The cold start valve is powered through starter circuits and grounded through thermo time switch. It operates for 3-10 seconds when cold engine is being cranked only.

#### Differential Pressure Regulator (DPR)

The DPR, mounted on side of fuel distributor, is an electrically operated plate valve. Combined with fixed outlet orifice, the DPR governs pressure in lower chamber. Pressure change in lower chamber moves diaphragm and adjusts fuel volume flow to injectors. Actuating signal comes from ECU and ranges from 9-15 mA (after idle stabilization) with engine at an idle condition. The actuating signal will change depending upon engine operating conditions.

#### Fuel Distributor

The fuel distributor mechanically controls fuel to the injectors. Air being drawn over the sensor plate raises or lowers the fuel distributor control plunger. Differential pressure is the difference between upper (injector supply) and lower (fuel return) chambers of the fuel distributor, controlled by the differential pressure regulator. This controls the pressure differential at the fuel distributor metering ports, which determines the fuel flow to the injectors and air/fuel mixture.

#### Fuel Injectors

Fuel injectors in CIS-E system open at a preset pressure. Fuel is always present in lines between fuel distributor and injectors to ensure good starting. As pressure from fuel distributor increases (when engine is started), valves open and spray constantly. Amount of fuel injected will be determined by position of control plunger in fuel distributor and amount of voltage to differential pressure regulator.

#### Thermo Time Switch

Energizes the cold start valve to provide cold start enrichment when engine temperature is below 86°F (30°C).

### IDLE SPEED

#### Idle Air Stabilizer Valve

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The electronic idle air stabilizer valve adjusts the amount of air by-passing the throttle valve to control engine idle speed under all operating conditions. The stabilizer valve receives signals from ECU based on engine RPM, idle switch and other inputs. Adjustment is not necessary with idle air by-pass adjusting screw. The idle air by-pass adjusting screw should be turned in all the way against its stop.

## **IGNITION SYSTEM**

### **ELECTRONIC IGNITION SYSTEM**

The Hall Effect sending unit in the distributor uses a shutter window wheel mounted on the distributor shaft. The shutter blades pass in and out of the air gap of the hall effect sender resulting in signal pulses. There is one shutter window for each engine cylinder.

Signals from distributor hall sender are sent to the ECU. The ECU sends a switching voltage signal to the ignition coil primary circuit to discharge secondary spark voltage.

### **IGNITION TIMING CONTROL SYSTEM**

#### **Ignition Timing Control**

The Transistorized Coil Ignition with Hall Sender (TCI-h) ignition system uses engine load, engine RPM, ignition quality (knock) and coolant temperature to control ignition timing. Two knock sensors are used to control spark knock. Using 2 knock sensors the ECU is able to determine which pair of cylinders is knocking and adjust ignition timing appropriately.

## **EMISSION SYSTEMS**

#### **Evaporative Emissions Systems**

As fuel expands in fuel tank, vapor is forced out of the fuel tank to the expansion tank. In the expansion tank liquid fuel condenses and returns to fuel tank as temperature drops. Fuel vapor then flows from expansion tank through gravity/vent valve, and into the charcoal canister.

When engine is running, solenoid valve I (closest to charcoal canister) operates as a duty solenoid. The ECU varies the on-off time of solenoid valve I according to engine operating conditions. Solenoid valve II (farthest from charcoal canister) functions as a simple on-off valve. With engine speed more than 300 RPM, solenoid valve II opens allowing charcoal canister to purge. Canister vapor is drawn from canister through solenoid valve I and solenoid valve II into intake manifold for burning.

## **MISCELLANEOUS CONTROLS**

**NOTE:** Although not considered true engine performance-related

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systems, some controlled devices may affect driveability if they malfunction.

#### COOLING FAN

**NOTE:** If detonation is a problem, it is possible the cooling fan is not coming on at proper temperature and should be considered as a possible cause.

##### Cooling Fan Motor

The cooling fan is either a 1- or 2-speed motor. If vehicle is equipped with single-speed motor, the fan comes on at 198-207°F (92-97°C) and off at 183-196°F (84-91°C). If equipped with a 2-speed motor, low speed of cooling fan should come on at 198-208°F (92-98°C) on vehicles without A/C, or 183-207°F (84-97°C) on vehicles with A/C. Low speed will shut off at 183-196°F (84-91°C) on all vehicles. High speed comes on at 210-226°F (99-108°C) on vehicles without A/C, or 201-226°F (94-108°C) on vehicles with A/C. High speed will shut off at 196-220°F (91-104°C) on all vehicles.

**END OF ARTICLE**