

E - THEORY/OPERATION - DIGIFANT

Article Text

1990 Volkswagen Corrado

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Thursday, March 23, 2000 09:43PM

ARTICLE BEGINNING

1990 ENGINE PERFORMANCE

Theory & Operation - Digifant II

Volkswagen; Cabriolet, Corrado, Fox, Golf GL/GTI,
Jetta, Vanagon

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.

AIR INDUCTION SYSTEM

SUPERCHARGER (CORRADO)

The supercharger works like an air pump. Driven constantly off the crankshaft by a toothed belt the supercharger compresses air. This compressed or boosted air is cooled by an intercooler before entering intake manifold.

Excess boost air is controlled by a mechanically operated boost control valve and idle stabilizer. The boost control valve moves in the opposite direction of the throttle valve. As throttle valve opens boost control closes, directing most of the boost air back to the supercharger intake. See Fig. 1.

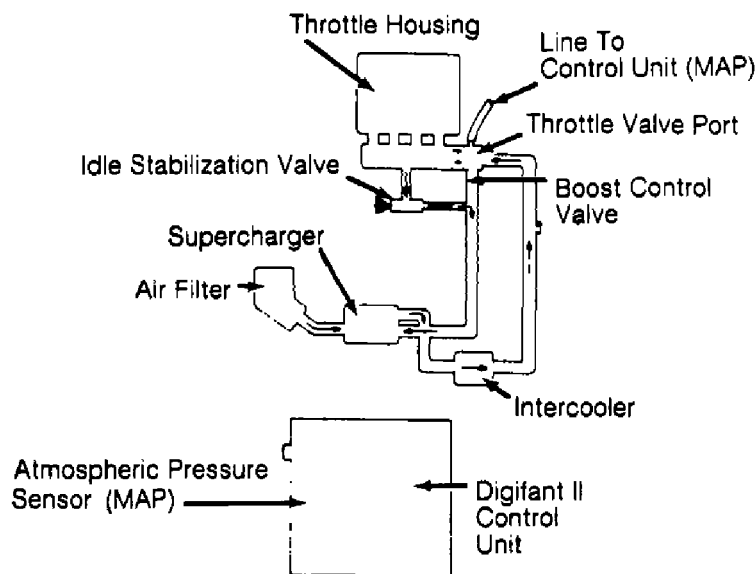


Fig. 1: Identifying Supercharger System Components
Courtesy of Volkswagen United States, Inc.

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COMPUTERIZED ENGINE CONTROLS

The Bosch AFC Digifant II system is a computer-controlled fuel injection system. The system does not use cold start injector or thermo time switch for cold start enrichment. Different sensors and switches, along with Electronic Control Unit (ECU), regulate fuel injection and ignition timing.

ELECTRONIC CONTROL UNIT

These units cannot be repaired. The ECU controls all engine operations, and limits maximum engine speed. The ECU receives information from various input devices.

ECU LOCATIONS TABLE

ECU LOCATION

AA

Application

Location

Except Vanagon Behind Glove Box Passenger Side
or Under Engine Compartment Hood,
Behind Plenum Panel on Driver's Side

Vanagon On Right Side of Engine Compartment

AA

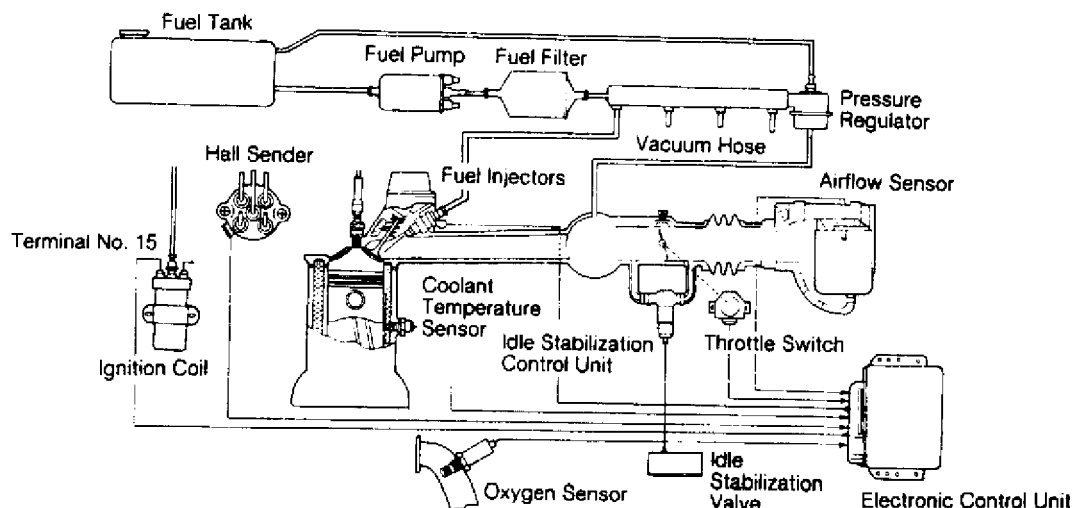


Fig. 2: Identifying Digifant II System Components
Courtesy of Volkswagen United States, Inc.

IDLE STABILIZATION CONTROL UNIT (VANAGON)

The idle stabilization control unit is located in front of the right-hand taillight assembly. If engine idle speed differs from the value stored in the idle stabilization control unit, the idle stabilizer valve adjusts the volume of air entering the engine at idle. The idle stabilization control unit receives information from

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the following:

- * Coolant Temperature Sensor
- * ECU Control Relay
- * ECU
- * Oxygen Sensor
- * Power Steering Oil Pressure Switch

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

AIRFLOW SENSOR (EXCEPT CORRADO)

All intake air is drawn through the airflow sensor. The airflow sensor contains a tunnel with a measuring flap and dampening flap. The measuring flap swings with intake air stream against pressure of a spiral spring and is connected to a potentiometer.

The potentiometer transmits an electrical signal determined by measuring flap position to inform ECU of engine load. At idle, the measuring flap is almost closed due to spring pressure. See Fig. 3.

The potentiometer within the airflow sensor prevents loss of engine power during engine load or sudden acceleration (along with engine speed and coolant temperature) by signaling the ECU of necessary enrichment and timing requirements.

The airflow sensor contains an intake air temperature sensor. An adjustable idle air by-pass screw influences CO levels at low engine speeds. A tamper-proof plug is installed over this screw.

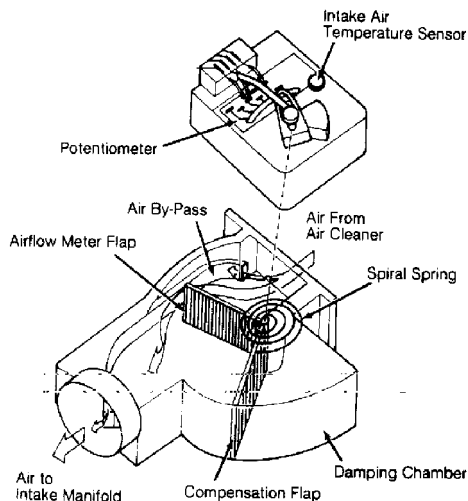


Fig. 3: Cross-Sectional View of Airflow Meter
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COOLANT TEMPERATURE SENSOR

Is a temperature sensitive variable resistor sensor (less resistance as temperature increases). This sensor returns signals to the ECU to determine amount of cold start enrichment, ignition timing and idle stabilization during warm-up. The sensor return signal has input to the ECU when the oxygen sensor, idle stabilization, and full throttle enrichment functions are activated.

CO POTENTIOMETER (CORRADO)

The CO potentiometer adjusts CO mixture. Located on the intake air duct before the throttle housing. The adjustment screw has a tamper-proof plug. An air temperature sensor located within the potentiometer housing is used to calculate air density.

ECU CONTROL RELAY

When energized by ignition switch, the ECU control relay provides battery voltage to ECU.

FULL THROTTLE (FUEL) ENRICHMENT SWITCH

The full throttle enrichment switch supplies the control unit with information to increase amount of fuel injected during full throttle operation.

HALL EFFECT SENSOR

See ELECTRONIC IGNITION SYSTEM under IGNITION SYSTEM in this article.

INTAKE AIR TEMPERATURE SENSOR

Intake air temperature sensor is a thermistor-type variable resistor (resistance decreases with increase of temperature). This sensor voltage signal varies to ECU in relation to engine air temperature. Sensor is located inside the airflow meter.

KNOCK SENSOR(S)

Pick-up engine vibrations before knock occurs. The ECU compensates timing as needed and controls timing advance or retard for maximized engine performance.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR (CORRADO)

MAP is located inside the ECU. The MAP sensor signal is used by ECU to determine engine load and manifold boost pressure. This signal along with RPM and intake air temperature is used to calculate fuel injection quantity.

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OXYGEN (O2) SENSOR

The O2 sensor detects oxygen content in the exhaust gas and sends this information to the ECU. In operation, the ECU receives signals from the O2 sensor and varies the duration during which fuel is injected. A high voltage signal indicates a rich mixture. A low voltage signal indicates a lean mixture.

The O2 sensor is heated electrically for rapid warm-up and constant operating temperature. Power to the heating element is supplied whenever ignition switch is turned to ON position.

POWER STEERING (P/S) OIL PRESSURE SWITCH

The P/S oil pressure switch signals the ECU when the power steering load is high. The ECU then sends a voltage signal to the idle stabilization valve to increase idle speed with power steering load.

THROTTLE VALVE SWITCH (VANAGON ONLY)

Throttle valve switch supplies ECU with information that throttle valve is closed. If engine is above 1500 RPM with throttle closed, fuel will be shut off to the injectors. At idle speed, this switch signals control unit to regulate amount of fuel injected.

OUTPUT SIGNALS

NOTE: Each vehicle may be equipped with different combinations of computer controlled components. The following listed components may NOT be used on all models. For theory and operation on each output component, refer to the system indicated in brackets, to the right of each component.

- * Fuel Injectors (Fuel Control)
- * Idle Air Stabilizer Valve (Idle Speed)
- * Ignition Coil Control (Ignition System)

FUEL DELIVERY

ELECTRIC FUEL PUMP

The fuel pump provides fuel under pressure to the fuel pressure regulator. Power for operation during cranking mode is provided from starter relay via the fuel pump relay. After the engine has started, control of the fuel pump is through the ignition signal. The fuel pump is sealed unit.

FUEL PUMP RELAY

When energized by the ignition switch and grounded by the ECU. The fuel pump relay provides battery voltage to the fuel pumps, injectors, idle stabilization control unit, oxygen sensor heating

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element and the power steering pressure switch.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is a sealed, spring loaded diaphragm with connection for intake manifold vacuum. Fuel pressure is maintained at about 36 psi (2.5 kg/cm²) pressure.

A connection for intake manifold vacuum provides a constant pressure differential which ensures that the amount of fuel injected is solely dependent upon injector open ON time. Excess fuel is returned to fuel tank. No service of pressure regulator is required. The pressure regulator is located on or near fuel rail.

FUEL CONTROL

Data on engine temperature, engine speed, intake air volume, throttle position, exhaust oxygen content and intake air temperature are used by ECM to determine injection pulse width.

FUEL INJECTORS

A fuel rail links the fuel pressure regulator with the fuel injectors. Each cylinder is provided with a solenoid-operated injector which sprays fuel toward backside of each inlet valve. Each injector is energized through the ignition coil and grounded through the ECU to complete the circuit

Each injector is linked to a resistor (resistor may be external or integral with injector or ECU) to reduce operating voltage to 3 volts and to protect injectors from power surges. The ECU controls length of time each injector is open. The ON time of the injector governs the amount of fuel delivered. The injector delivers 1/2 the amount of fuel required for an operating cycle each time they open (twice per cycle).

FUEL PUMP AFTER-RUN RELAY (CORRADO)

The purpose of the After-Run Fuel Pump relay system is to reduce the chance of fuel vaporizing in fuel rail. Both transfer pump and fuel pump are used to recirculate fuel. The after-run relay switches the pumps on for 2 minutes after ignition is turned off or when under hood temperature exceeds 194°F (90°C) and fuel pressure is above 17 psi (1.2 kg/cm²). The pumps operate a maximum of 8 minutes.

IDLE SPEED

Engine idle speed is controlled by the ECU and idle speed control unit depending upon engine operating conditions. The ECU and Idle speed control unit are fed information on engine operating conditions and determine the best idle speed.

IDLE AIR STABILIZER VALVE

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The idle air stabilizer valve is ECU controlled. On Vanagon idle stabilizer valve is controlled by a separate idle stabilizer controller. The idle air stabilizer operates to continuously maintains engine idle at a computed engine idle speed.

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 (engine speed signal). There is one shutter window for each engine cylinder. Signals from distributor hall sender are sent to the ECU.

ELECTRONIC IGNITION SYSTEM

IGNITION COIL CONTROL

Signals from distributor hall sender are sent to the ECU, which produces a pulsating signal to the ignition coil. This computed signal from ECU to ignition coil, control ignition timing according to engine load (airflow sensor signal), engine speed (Hall Effect signal) and engine coolant temperature.

IGNITION TIMING ADVANCE CONTROL SYSTEM

Timing is ECU controlled.

EMISSION SYSTEMS

EVAPORATIVE EMISSIONS SYSTEM

Fuel vapors are collected in the expansion tank. Any liquid gasoline collect in expansion tank flows back to the fuel tank through vent lines. See Fig. 4. Fuel vapors are drawn from tops of the expansion tanks and flow into the carbon canister where the vapors are stored. When the engine is not running.

After engine is started, the control valve is opened by throttle vacuum. Fresh air is drawn into bottom of the canister. Fuel vapors from the canister are drawn into the intake manifold.

EXHAUST GAS RECIRCULATION

Information is not available. See M - VACUUM DIAGRAMS for system components and vacuum hose routings.

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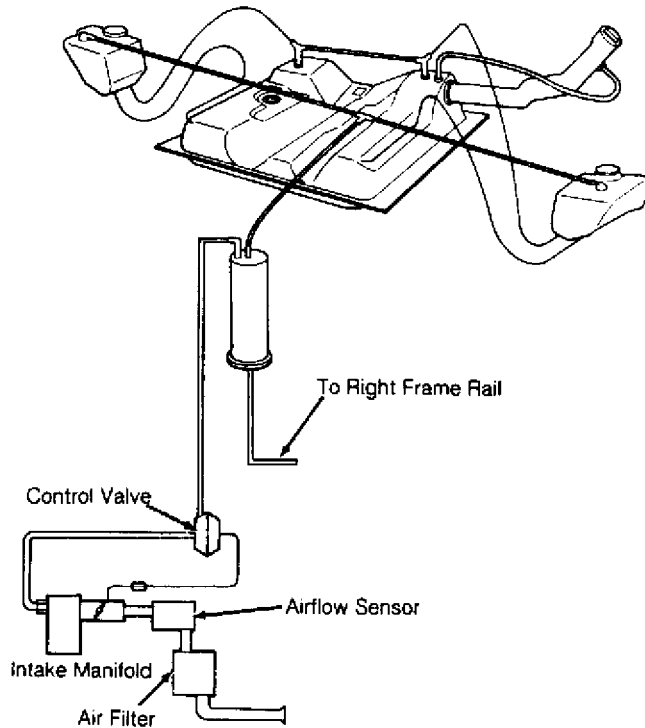


Fig. 4: Identifying Evaporative Emissions System Components
Courtesy of Volkswagen United States, Inc.

SELF-DIAGNOSTIC SYSTEM

O2 SENSOR WARNING LIGHT

All vehicles are equipped with an O2 sensor warning light located on the instrument panel. The light will illuminate when a mileage counter reaches 60,000 miles (on Vanagon 90,000 miles) indicating recommended O2 sensor replacement and mileage counter reset.

CHECK ENGINE LIGHT (CALIF MODELS)

Some California vehicles are equipped with a CHECK engine light and rocker switch on the instrument panel. The light will illuminate when the ignition switch is turned to the ON position (for bulb check) and when engine management systems are malfunctioning during normal operation with the engine running. For additional information see appropriate SELF-DIAGNOSTICS article.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true Engine Performance related systems, some controlled devices may affect driveability if they malfunction.

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CRANKCASE VENT LINE HEATING ELEMENT

A heating element is used in the crankcase vent line to prevent icing during cold engine operation, this element has a 5.5-mm hole in the restrictor plate. The circuitry to operate the heating element is protected by an in-line 5 amp fuse located in the wiring connector box located in the engine compartment.

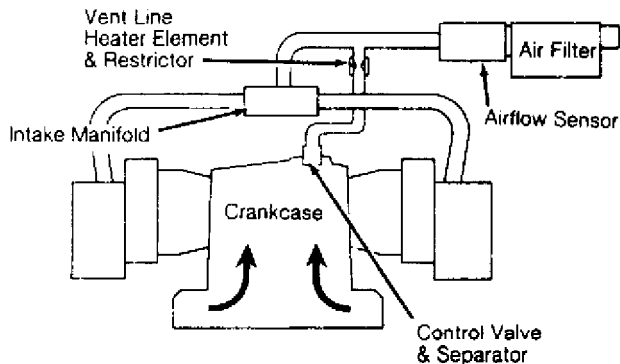


Fig. 5: Locating Crankcase Vent Line Heating Element
Courtesy of Volkswagen United States, Inc.

COOLING FAN MOTOR

The cooling fan is either a one or two 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 two speed motor. The first speed of cooling fan should come on at 197°F (91°C) and go off at 98°F (18°C). Second speed comes on at 203-121°F (95-100°C) and off at 188°F (87°C).

AFTER-RUN THERMOSWITCH (CORRADO)

An after-run switch is used to help prevent fuel vaporization. The thermoswitch turns the cooling fan on when temperatures in the engine compartment exceed 230°F (110°C) and off at 217°F (103°C).

END OF ARTICLE