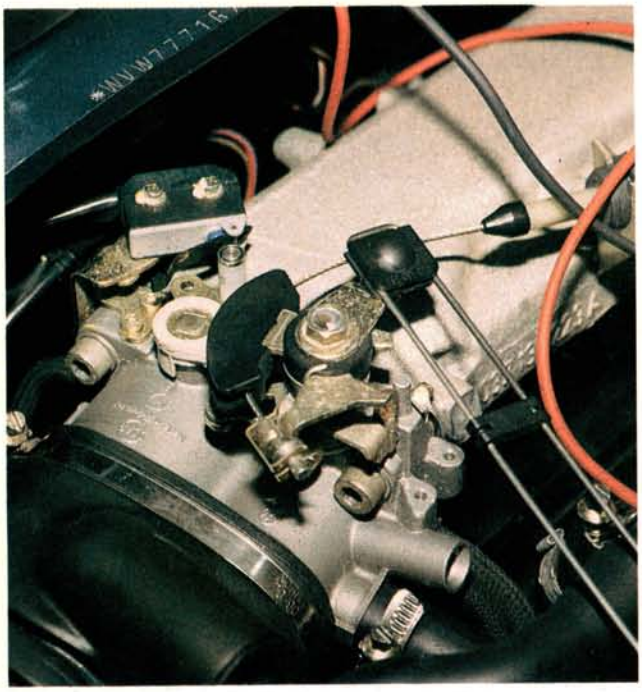
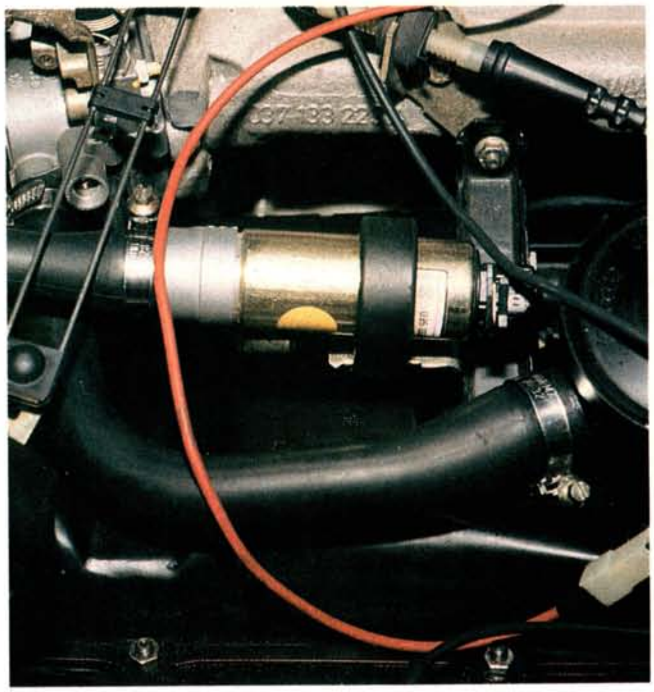
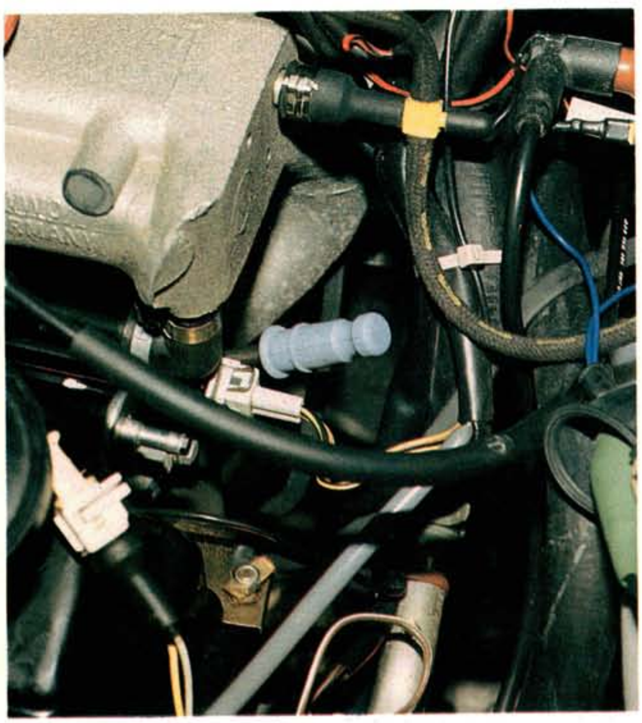
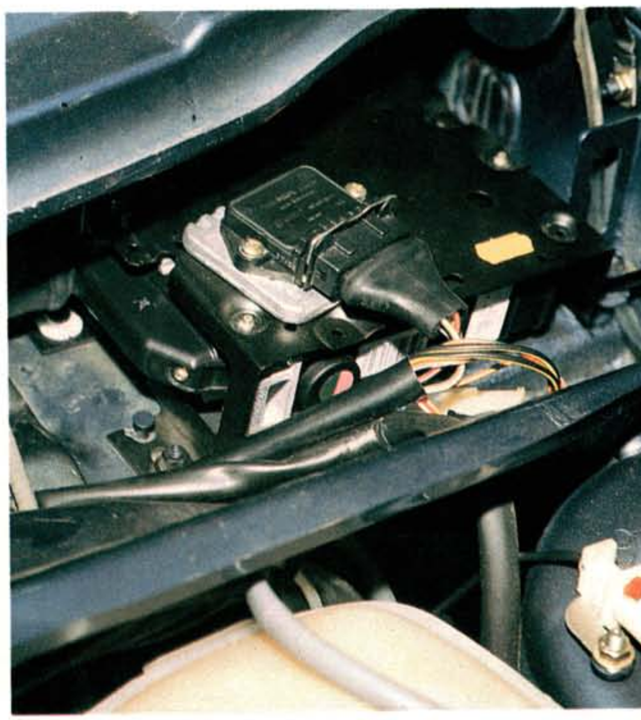




VW Digifant

PART ONE





It seems like every time you turn around, there's another "totally new and improved" fuel system on the market. Over the years we've seen an alphabet soup of fuel systems. We've had CIS, CIS-E, D, L, LH, K, KE, and so on. A recent addition to this ever-lengthening list is a new system Volkswagen calls Digifant II.

We'll begin our two-part look at VW's Digifant II engine management system with a system overview. We'll be looking at the system's major components, including their operation, function, and location. Next month's installment will cover troubleshooting, adjustment, and repair information.

Volkswagen first installed the Digifant II system on 1988 Volkswagen Golfs and Jettas. To avoid possible confusion, we should point out that Digifant II is a further development of the Digifant I system used on

Vanagon models. We'll be concentrating on the Digifant II system in these articles. It's a more advanced system than Digifant I. You're also likely to see more Golfs and Jettas than Vanagons in your shop.

Maybe you've noticed that we're referring to Digifant II as an "engine management system." That's because Digifant II does more than control the engine's fuel injection system. Before beginning our photo sequence, we'll describe the two additional systems that are directly controlled by the Digifant II ECU.

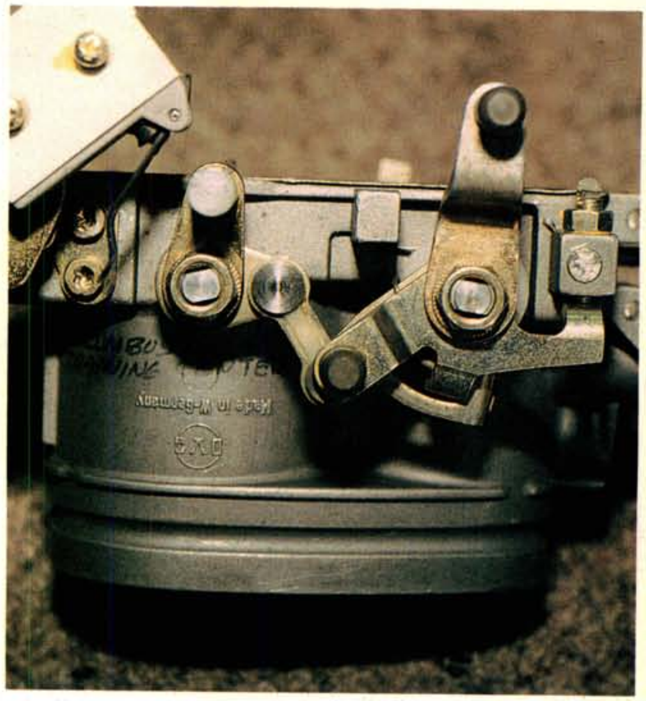
Ignition Timing

Engine timing settings have always been a compromise between acceptable performance and reliable operation. Have you ever tried to see how far you could advance an engine's timing before it started to knock? You probably noticed a big difference in the engine's performance. The only problem was, you ran the risk of permanent engine damage if the timing wasn't put back where it belonged.

Digifant II's knock sensor system eliminates this risk. The ECU uses a sensor to determine proper ignition timing and squeeze the best all around performance out of the engine without the risk of damaging engine knock.

When the ECU receives a knock signal from the knock sensor, it marks the knocking cylinder's position in the firing order. The next time the knocking cylinder reaches its compression stroke, the ECU retards timing to that cylinder by three degrees. This allows the ECU to control the timing to all four cylinders individually.

If the cylinder stops knocking after the initial three degree timing retard, the ECU gradually advances the



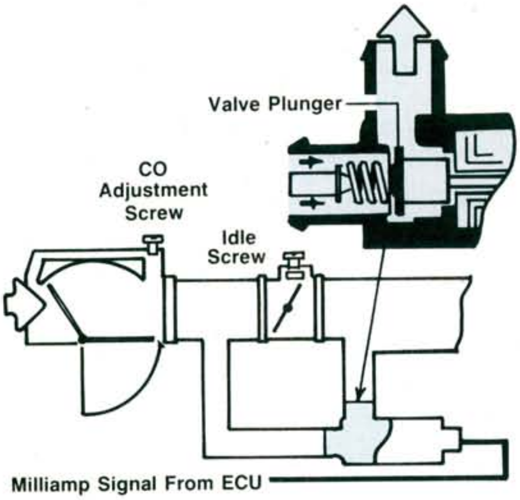
timing in that cylinder a third of a degree at a time, until it returns to its pre-programmed value.

The pre-programmed timing values are contained in a timing map stored in the ECU's memory. The map includes 256 possible timing settings based on engine load (determined by the air flow sensor signal) and engine RPM (determined by the distributor Hall sender signal).

If a three degree retard wasn't enough and the cylinder keeps knocking, the ECU can retard the timing to that cylinder by up to 15 degrees. To keep the engine running as smoothly as possible, the maximum timing difference between any two cylinders is limited to nine degrees.

Idle Stabilization

Idle air stabilizer valves have been used on previous Volkswagen models. In the Digifant II system,



the stabilizer valve is also directly controlled by the ECU. The ECU supplies a variable milliamp current to the stabilizer valve to provide a stable engine idle speed under different load conditions.

The ECU monitors the idle switch position, engine RPM, and coolant temperature to determine the correct milliamp current level. This energizes a set of windings inside the valve, which regulate the position of the stabilizer valve's plunger.

The open stabilizer valve plunger allows a controlled amount of air to bypass the throttle plate, raising the idle speed. The position of the plunger constantly varies, depending on idle speed. If a load on the engine causes the idle speed to drop, current to the stabilizer increases, opening the valve further and raising the idle speed.

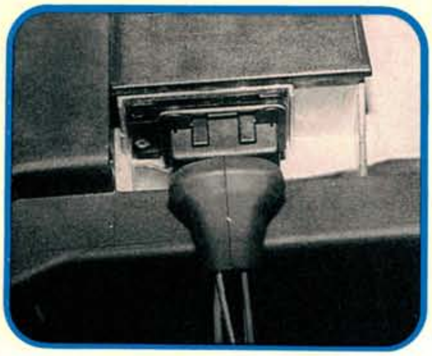
—By Karl Seyfert

1

The Digifant II ECU is located under a plastic shield in the left corner of the cowl area. The ECU controls all fuel, idle, and ignition system functions. Limited self-diagnosis of the system is possible on California models. The ignition control unit is mounted over the ECU.

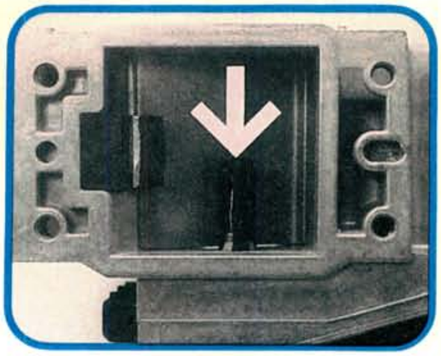
2

The coolant temperature sensor is mounted under the blue connector closer to the block. Resistance curves for the air and coolant temperature sensors should be nearly identical. The ECU needs the temperature sensor signal to determine cold start enrichment and ignition timing.



3

The Digifant II system uses a potentiometer style air flow sensor. Air passing through the sensor on its way to the intake manifold opens the air flow sensor's air flap. A potentiometer linked to the flap converts the flap's movement into a voltage signal which can be understood by the ECU.



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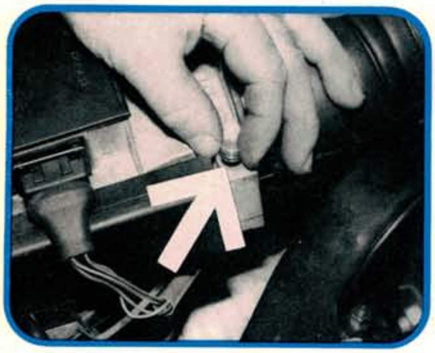
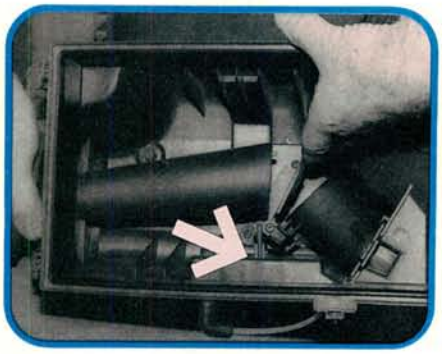
The negative temperature coefficient (NTC) air temperature sensor (arrow) is located in the inlet side of the air flow sensor. The air temperature sensor is permanently attached to the air flow sensor, so the air flow sensor must be replaced if the temperature sensor fails.



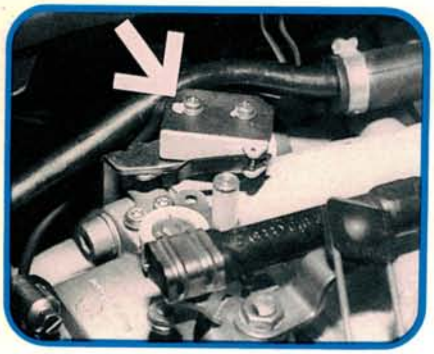
5

The engine's CO is adjusted at the air flow sensor. A tamper-proof plug (arrow) covers the allen-headed adjustment screw. The screw controls the amount of air allowed to pass through an air bypass circuit in the air flow sensor. Loosening the screw adds more air, which leans the air/fuel ratio.



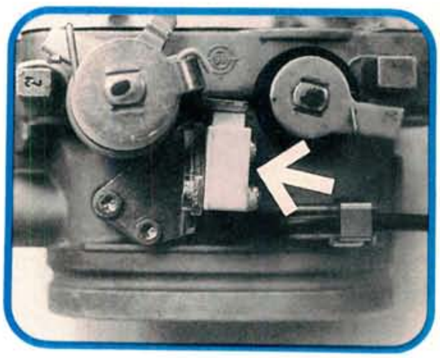
6

A preheat valve and air door mounted in the air filter assembly adjust the mix of heated or outside air supplied to the intake manifold. The vacuum thermoswitch controls vacuum to the preheat valve (arrow) to maintain intake manifold air temperature at a steady 30 degrees C (86 degrees F).



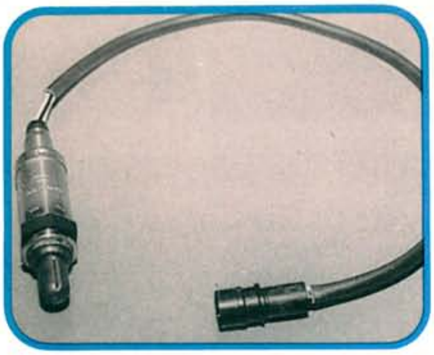
7

The full throttle switch (arrow) is on the top side of the throttle housing. The switch closes about 10 degrees before full throttle. The full throttle switch signals the ECU to provide full throttle enrichment to the injectors.



8

The idle switch (arrow) on the bottom of the throttle housing opens after one degree of throttle opening. The ECU needs the idle switch signal to control the idle stabilization valve, deceleration fuel shutoff, and deceleration timing map. Proper switch adjustment is important for system operation.



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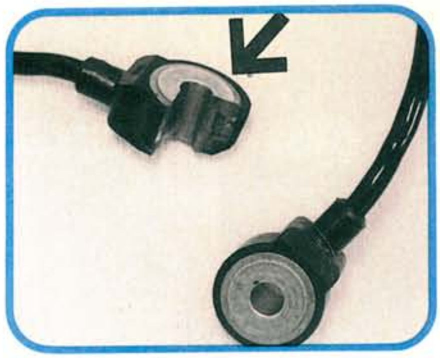
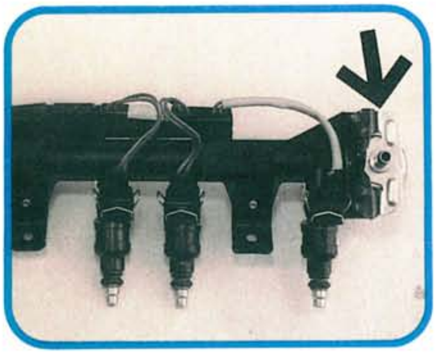
A heating element in the oxygen sensor brings it to operating temperature quickly. The sensor replacement interval has been extended to 60,000 miles. The sensor is located in the exhaust manifold on 100 hp Golfs, and at the catalytic converter inlet on 105 hp Jettas.



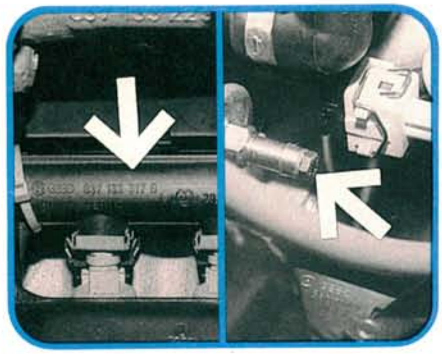
10

Here are two knock sensor views. The inner collar (arrow) prevents overtorque damage which was possible on earlier sensors. Engine vibrations cause the sensor to generate a small voltage. Keep the knock sensor wiring at least 4 mm clear of the distributor to prevent electromagnetic interference.



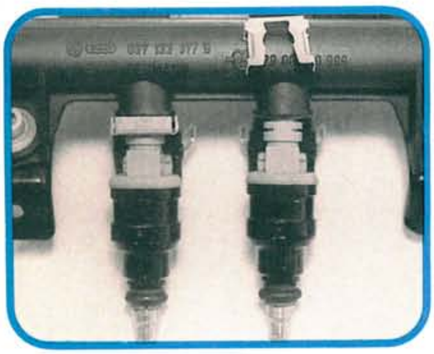
11

The fuel rail, pressure regulator, and injectors are combined in a compact package. The fuel pressure regulator (arrow) maintains system pressure at 2.5 bar at idle and up to 3.0 bar under full engine load. The system should hold 2.0 bar residual pressure for 15 minutes after engine shutdown.



12

The injectors receive their fuel supply through the plastic fuel rail (arrow left photo). The injector electrical connector is at the left end of the fuel rail (right photo). Use the service port (arrow) for pressure testing.



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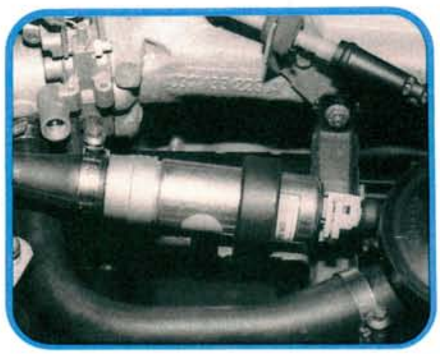
The electromagnetic solenoids in the injectors are supplied with battery voltage through the power supply relay. A ground signal from the ECU opens all four injectors at once, twice per combustion cycle. The ECU adjusts total fuel delivery by regulating injector open time.



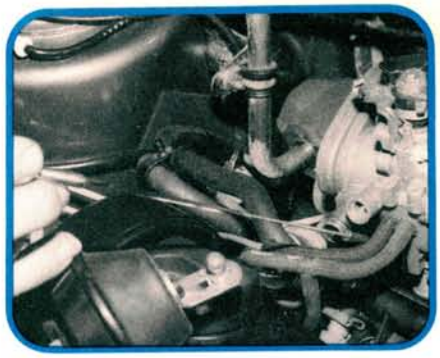
14

The ECU controls the idle air stabilizer valve to maintain engine idle speed within a predetermined range. The stabilizer's plunger is constantly adjusted to allow a controlled amount of air to bypass the throttle plate. This keeps the idle speed steady as engine loads change.

15

The Hall effect unit in the distributor (arrow) sends engine speed and crankshaft position signals to the ECU. All spark timing decisions are made by the ECU. The distributor contains no vacuum or centrifugal advance mechanisms. The ECU relays its decision to the ignition control unit.

16

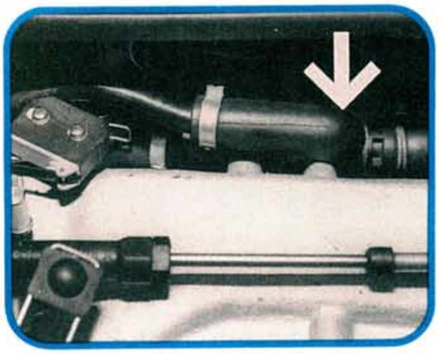


Don't reverse the fuel pressure regulator and vapor canister control valve vacuum supply hoses (pointer). The fuel pressure regulator receives manifold vacuum, while the canister control valve must receive ported vacuum. Reversed hoses will purge canister vapors at idle, causing a rough idle.

17

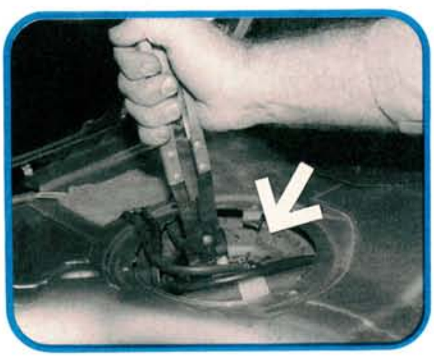
The crankcase emissions system is a closed system (no surprises there). This control valve in the valve cover (arrow) allows crankcase vapors to enter the intake manifold whenever the engine is running. Disconnect and plug the hose between the crankcase valve and intake manifold when adjusting CO.

18



A vacuum amplifier (arrow) attached to the intake manifold on automatic transmission models increases vacuum to the power brake booster at idle. The carbon canister vent line should be left connected when checking or adjusting CO on automatic and manual transmission models.

19



Two fuel pumps are used to deliver fuel to the injectors. The low pressure, high volume, in-tank transfer pump can be reached beneath an access plate in the trunk. Fuel is relayed to an externally mounted high pressure pump and fuel filter. The system operates at lower pressures than CIS systems.

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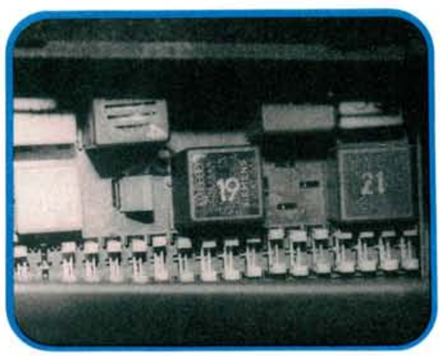

The fuel pump and power supply relays are in the lower left-hand side of the instrument panel. The ignition switch energizes the power supply relay to power the ECU and fuel injectors. The fuel pump relay is energized by the ECU and supplies power to both fuel pumps and the oxygen sensor heater.