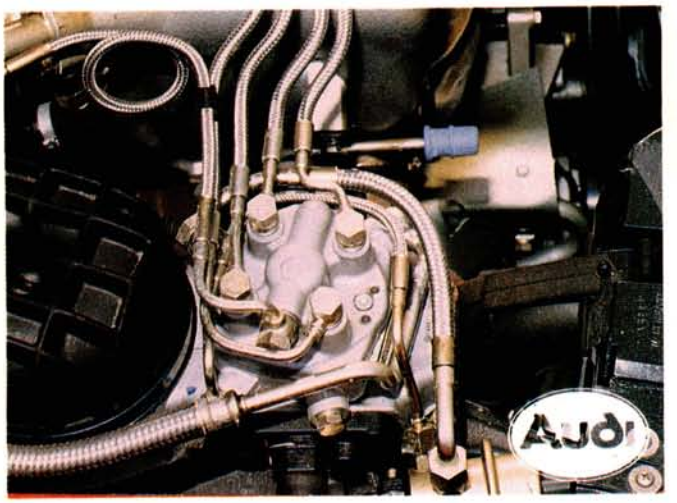


CIS Motronic

PART TWO

In June 1990 we started to show you the Audi and Volkswagen CIS Motronic system. In our first installment, we covered fuel control components and their adjustments. Now we'll look at some of the other functions of this Motronic system, including diagnostic and repair procedures. We'll even look into the "magic box" and show you how to "talk" with the computer.

Remember that the Motronic ECU controls fuel and ignition systems, as well as idle and canister purge controls. All sensor inputs go to the same place, so fewer sensors are needed. And since all output signals come from the same place, the engine controls can work together.

The Magic Window

Before attempting to retrieve codes from the system, perform the following checks:

- **Power supply check**. All fuses supplying power to the ECU must be good. Checking all of the fuses and power supplies may work better than two aspirin for preventing future headaches, and your customer won't call you back in the morning. And as always, it's a good idea to check battery and charging voltage.
- **Ground check**. The ground connection for the harness at the intake manifold, as well as all other ECU grounds, must be good. (See *Ohm's Law* in this issue if you have any doubts about the importance of good grounds.) Testing all of the vehicle grounds may save some diagnostic time, whether they are attached directly to the ECU or not. Feedback and "noise" from a poor ground can confuse the ECU.
- **Coolant temperature check**. The engine coolant temperature must be at least 80 degrees C (176 degrees F).
- **Engine speed signal check**. The ECU must detect 3000 RPM at least one time after the last engine startup.
- **Throttle signal check**. On Audi, the gas pedal must be depressed completely at least one time, tripping the wide open throttle switch. The engine must idle for a minimum of two minutes after WOT. Volkswagen doesn't require a throttle signal for code retrieval.

Drive the car for five minutes to reset any codes if the memory has been erased. Trouble codes may be read with the engine running or stalled with the ignition on. Volkswagen will allow you to shut off the key to stop the engine, then turn the key back on before retrieving codes. Don't shut off the key in an Audi to stop the engine, or you'll need to start over.

Don't Be Fooled

Watch out for false codes. It's possible to set two or more codes with one problem, depending on the original failure.

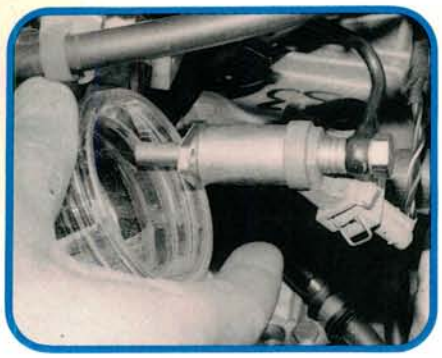
We disconnected an ECU ground wire on our Passat, and set six codes at once. Without a ground reference, the sensors can't operate properly.

The ECU can only tell you what it "sees" through its wiring. It can't tell you about other problems under the hood.

—By Ken Styer and George Donaldson

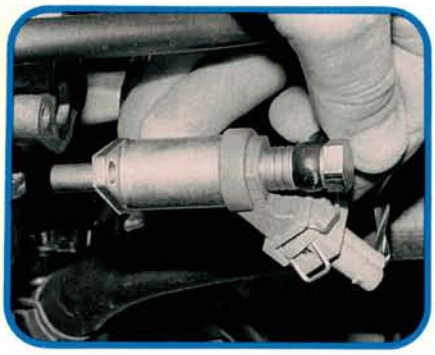
1

What used to be thought of as the cold start valve, or fifth injector, now operates during warm starts as well as cold starts. The ECU detects cold operation and calls for a 50 to 100 percent duty cycle for a varying length of time. Warm operation calls for a 10 percent duty cycle for seven to eight seconds.



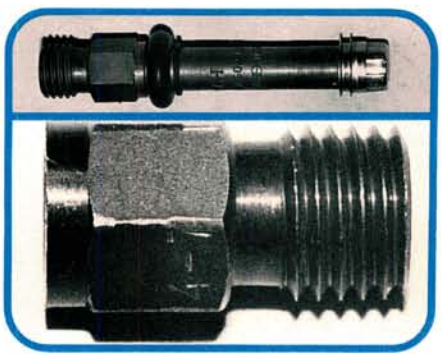
2

Disconnect the power output stage and coolant temperature sensor harness connector to test the cold start injector. Attach a 15K ohm resistor to the temperature sensor harness connector. Remove the cold start injector from the manifold. Place the end of the injector into a beaker to collect fuel spray.



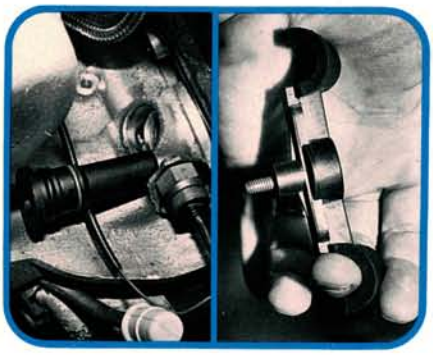
3

Crank the engine. The injector should spray a cone shaped fuel pattern for seven seconds. Dry off the injector tip and watch for leakage. The tip must remain dry for a minimum of one minute. Use an LED tester to check for power from the ECU and repeat the test if the injector did not spray.



4

Motronic injectors (top) have a finer thread than other CIS injectors. Bench testing procedures are the same, but an adapter (bottom) is needed to attach the injector to the tester. Opening pressure is 4.3 to 4.6 bar. Fuel delivery rates for all four injectors should be within 10 percent.

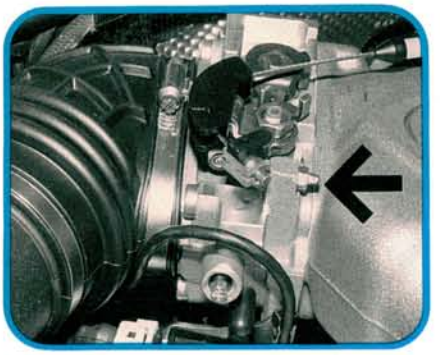


5

When reinstalling Audi injectors, be sure to replace the o-rings on the injector inserts (left) as well as the injector o-rings. Use a light lubricant on the o-rings to prevent nicked or torn seals. A retainer bolts to the intake manifold to hold the non-threaded inserts in place.

6

Volkswagen uses a retaining clip to hold the injectors in place (left). Remove the clip with a screwdriver and pull the injector (right). You don't need to remove the insert, unless it needs to be cleaned or resealed. Like the Audi, always replace the injector o-rings when the injectors are removed.



7

The throttle valve stop shouldn't be adjusted unless it's been moved. If you do need to adjust it, loosen the lock nut and back off the adjusting screw until there's a gap between the stop and screw. Retighten the screw until it touches the stop, then go an additional half turn and tighten the locknut.

8

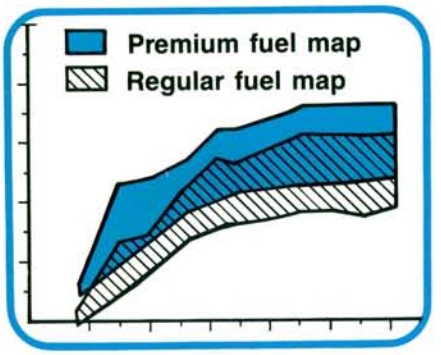
Ignition timing can be checked through a view port with a standard timing light or by connecting a magnetic probe to the mag probe port (arrow). Unless someone has tampered with the setting, or a distributor is being removed for service or replacement, you shouldn't need to change timing.

9

Audi's single knock sensor is mounted on the driver side of the engine block. Using crank position information, timing for each cylinder is adjusted for maximum advance without engine knock. This allows for the best performance without the possibility of engine damage.

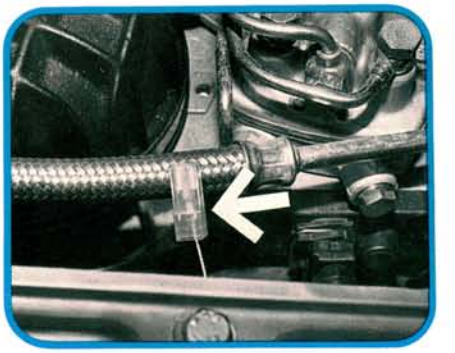
10

Volkswagen uses two knock sensors. An ignition sensor is molded around the number four spark plug wire, and is used as a reference signal by the ECU to identify individual cylinder knock. Timing can then be advanced or retarded by the ECU for each cylinder.



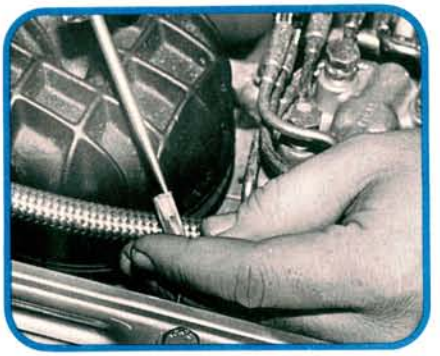
11

Volkswagen's ECU has two separate ignition timing maps. The ECU starts on a premium fuel map, but changes to a regular fuel map if engine knock causes ignition timing to retard past a preset limit for more than five seconds. The engine must be shut off and restarted to return to the premium fuel map.



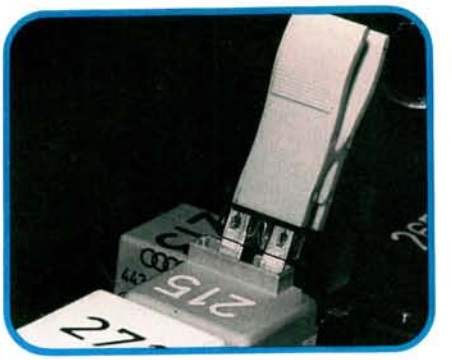
12

To retrieve Audi fault codes, connect one lead of an LED test light to the test connector next to the fuel distributor, and the other lead to the positive battery terminal. The LED should stay lit with the ignition on. Install a fuse in the fuel pump relay for four seconds, then remove the fuse.



13

The LED should begin flashing. Count the flashes to read the codes. Faults are displayed in a four digit code. Reinsert the fuse for four seconds and remove it to read the next stored code. Repeat the sequence until 0000 is displayed, signaling the end of stored codes.

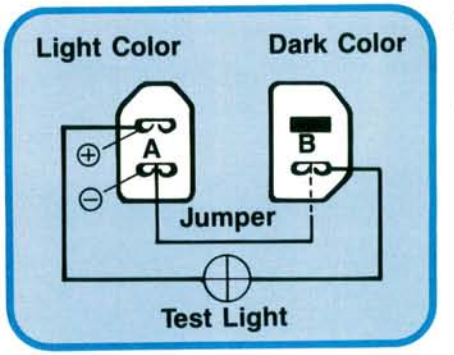


14

To erase Audi codes, leave the LED test light connected. Turn off the ignition. Install a fuse in the fuel pump relay, then turn the ignition on. Remove the fuse four seconds after the LED lights. Code 0000 will flash. Reinstall the fuse for ten seconds, then remove it. A steady light will be displayed.

15

Beginning in 1989, Audi has two connectors under the driver side dash for retrieving codes. Connect the positive lead on the LED tester to the positive terminal in the dark colored "A" connector (arrow) and the other end to the single terminal in the light colored "B" connector.



16

Use a jumper wire to connect the negative terminal of connector "A" to the single terminal in connector "B" for four seconds. The LED will flash to display the codes. Connect and disconnect the jumper wire as we did with the relay fuse on pre '89 cars to follow the code retrieving and clearing sequence.

17

At this time, VW requires a dedicated tester to retrieve codes for both hard failures and intermittent codes. One code may represent several problems, but the tester will tell you which problem it is. The tester is also used for code clearing. When we find an alternate method, we'll pass it along.

18

The Passat's test connectors are under the shifter trim panel. The black connector is power for the tester. The white connector sends codes for the Motronic system and the automatic transaxle. The blue connector is not used at present. The gray connector is the diagnostic terminal for ABS.

VOLKSWAGEN AND AUDI FAULT CODE INDEXES

AUDI FAULT CODE INDEX	
Flash code	**Function**
1111*	Control Unit.
2113*	No speed signal from Hall sensor, or air flow plate not moving freely.
2121	Idle switch.
2123*	Full throttle switch.
2141*	Knock control is at control limit.
2142*	Knock sensor signal.
2231	Adjustment limits of idle stabilization exceeded.
2232*	Air flow sensor potentiometer.
2312*	Coolant temperature sensor.
2341*	Oxygen sensor control at limit. (Cannot correct mixture.)
2342*	Oxygen sensor control.
2343	Adjustment limit of fuel mixture exceeded, mixture too lean.
2344	Adjustment limits of fuel mixture exceeded, mixture too rich.
4431	Idle stabilizer valve.
4444	No faults recognized.
0000	End of fault output display sequence.
*Stored in permanent fault memory. Note: Codes not marked with an asterisk are sent to temporary fault storage only.	

VOLKSWAGEN FAULT CODE INDEX	
Flash code VAG 1551 display	**Function**
1111	Control unit defective.
1231	Transmission speed sensor, defective. *No signal.
2112	Ignition reference signal, defective. *No signal.
2113	Hall sender.
2121	Idle switch, defective, always closed. *Short circuit to ground.
2141	First knock regulator.
2312	Coolant temperature sensor, defective. *Short circuit to ground. *Open/short circuit to positive (+).
2341	Oxygen sensor control limit exceeded.
2342	Oxygen sensor, no signal. *Adjustment limit fuel mixture regulation adaptation limit not reached. *Adjustment limit fuel mixture regulation adaptation limit exceeded.
2142	Knock sensor #1, open or short. *No signal.
2144	Knock sensor #2, open or short. *No signal.
2231	Idle speed regulation adaptation limit not reached. *Idle speed regulation adaptation limit exceeded.
2232	Airflow sensor, defective. *Open/short circuit to ground. *Open/short circuit to positive (+).
2411	EGR short to ground. *EGR system implausible signal.
4431	Idle stabilizer valve, open/short circuit. *Open/short circuit to ground. *Short circuit to positive (+).
4444	No fault registered.
*Indicates additional problems identified by a displayed trouble code. Individual problems for each code are displayed as needed by the Volkswagen VAG 1551 tester.	