

## **BOSCH CIS-E SYSTEM**

### **Article Text**

1987 Volkswagen Quantum/Quantum Syncro

For Volkswagen Technical Site

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Sunday, March 19, 2000 01:02AM

### **ARTICLE BEGINNING**

1987 Computerized Engine Controls  
BOSCH CIS-E (ELECTRONIC CONTROL) SYSTEM

Volkswagen: Fox, Golf, GTI, Jetta,  
Quantum, Quantum Syncro, Scirocco

### **DESCRIPTION**

Bosch CIS-E exhaust emission system uses CIS (Continuous Injection System) for fuel delivery and electronic controls for mixture adjustment.

Mechanical portion of CIS-E system consists of Mixture Control Unit (MCU), diaphragm pressure regulator, auxiliary air regulator, cold start valve, fuel injectors, fuel pump and filter. The MCU is comprised of the airflow sensor and fuel distributor.

Electronic controls consist of airflow sensor position indicator (potentiometer), differential pressure regulator, thermo time switch, coolant temperature sensor, Electronic Control Unit (ECU), Transistor Controlled Ignition (TCI), knock sensor, knock sensor control unit, throttle valve microswitch, altitude (barometric) sensor, lambda control and oxygen sensor.

If partial system failure occurs, the ECU will switch to a back-up or "limp-home" mode to allow vehicle operation until system can be repaired.

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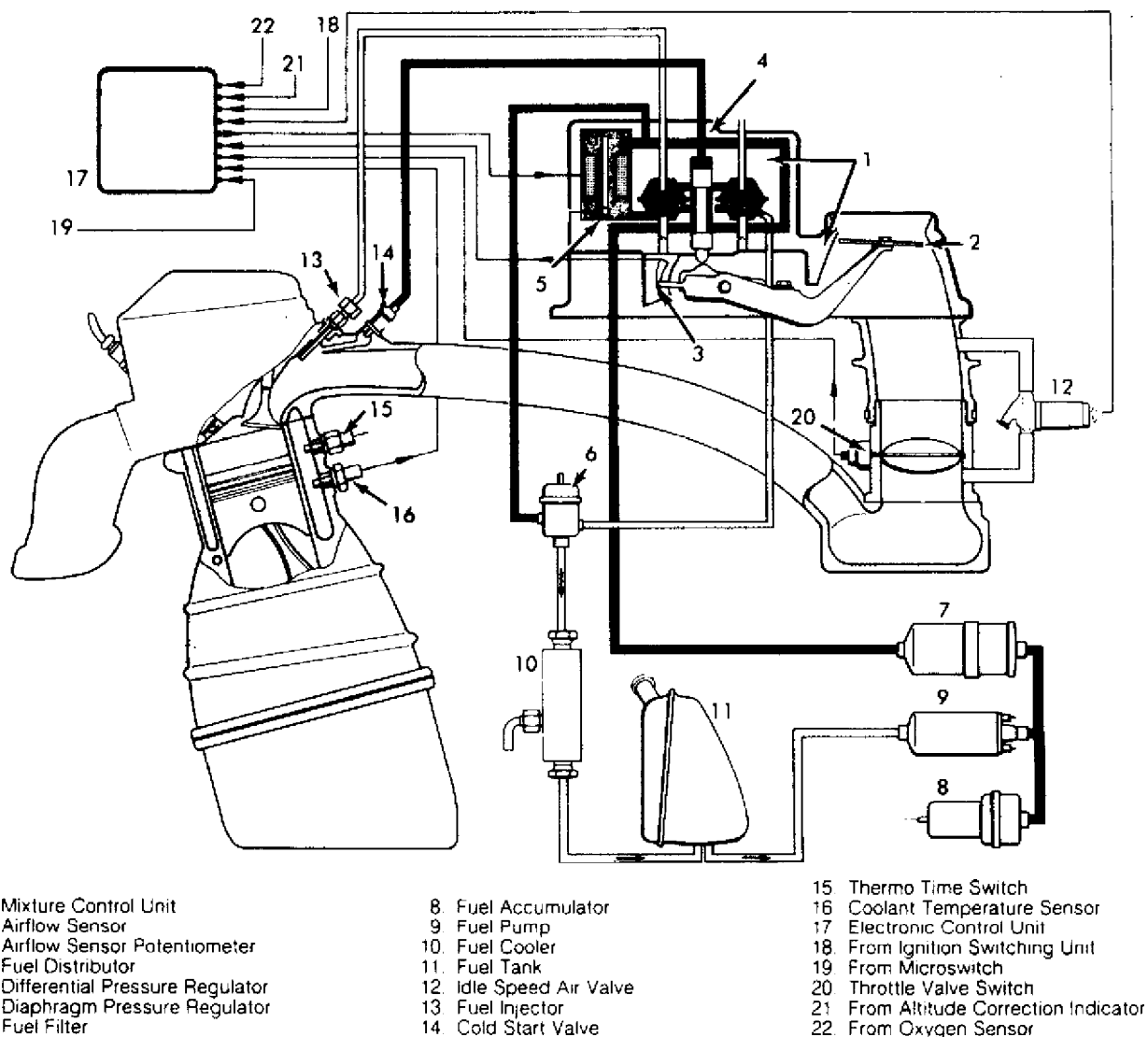


Fig. 1: Bosch CIS-E Component Diagram

## OPERATION

### FUEL SUPPLY

#### CIS-E FUEL PUMP LOCATIONS

XX

Make/Model

Location

Volkswagen

Fox, Golf, GTI

Jetta, Scirocco ..... (1) Rear/Underneath

Quantum ..... In Fuel Tank

(1) - These models have 2 fuel pumps. Transfer pump is mounted inside fuel tank with fuel gauge sender.

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#### Fuel Pump & Relay

The fuel pump assembly, is equipped with a pressure damper at the suction end. Mounting location varies with model and manufacturer. Fuel pump is activated during start-up and when engine is running. Fuel pump relay switches off fuel pump in absence of signal from ignition control unit and provides voltage for oxygen sensor heating element.

#### Mixture Control Unit (MCU)

Fuel is metered and delivered to individual cylinders dependent on air intake quantity which is metered by airflow sensor. MCU consists of fuel distributor with differential pressure regulator and airflow sensor with potentiometer (sensor position indicator).

#### Airflow Sensor

Rest position of airflow sensor plate is angled in relation to air inlet venturi. Airflow sensor potentiometer is attached to the side of the MCU and connected to the air sensor plate actuating lever. It generates a voltage signal based on the position of the airflow sensor plate. The ECU uses this signal to adjust cold acceleration enrichment.

#### Fuel Distributor

The fuel distributor controls the flow of fuel to the injectors. A control plunger, operated by the airflow sensor regulates the control pressure differential between the injector supply (upper chamber) and the lower chamber (fuel return). This differential in pressure controls the amount of fuel flow to the injectors. The electrically controlled, differential pressure regulator also controls fuel flow from the lower chamber.

#### Differential Pressure Regulator

Differential pressure regulator is mounted on side of fuel distributor. An electrically operated plate valve combined with fixed outlet orifice, governs pressure in lower chamber. See Fig. 2. Pressure change in lower chamber causes movement of diaphragm and controls fuel volume flow to injectors.

Actuating signal comes from ECU and can range from 60 to 120 mA, depending upon engine operating conditions. With engine running, system pressure at fuel inlet is 75-82 psi (5.3-5.8 kg/cm<sup>2</sup>).

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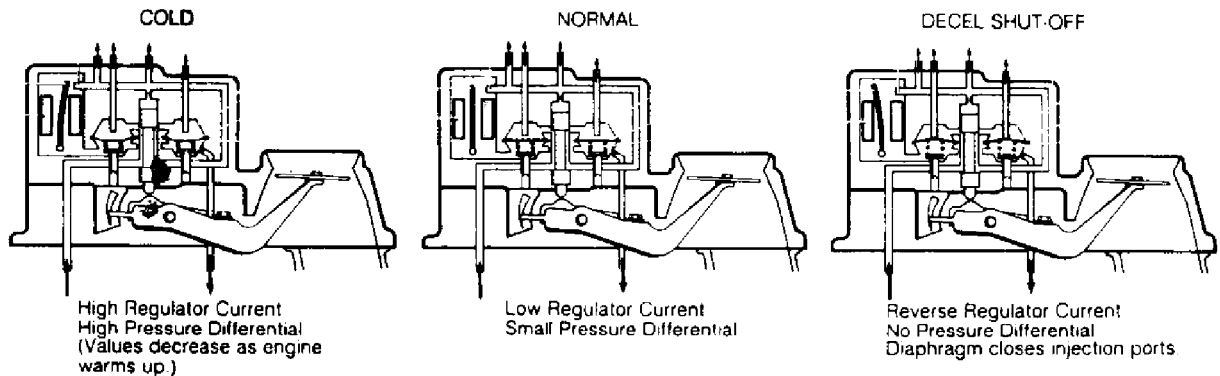


Fig. 2: Effect Of Differential Pressure Regulator Plate Position On Fuel Distributor

#### Electronic Control Unit (ECU)

ECU of Volkswagen models is found behind plenum panel on driver's side of vehicle. Ambient temperature around ECU must not exceed 180°F (85°C).

With ignition switched on, ECU is connected to battery voltage. To prevent voltage fluctuations when vehicle components are switched on, ECU is provided with voltage stabilizer circuit. Operating voltage is 8 volts.

ECU unit utilizes various input signals to control fuel delivery and control exhaust emissions. Output signals are sent to differential pressure regulator and to idle speed control valve.

#### Cranking Enrichment

During engine cranking, a signal from the starter relay is sent to the ECU to enrich the fuel mixture. The amount of enrichment or activation of the cold start valve is controlled by a coolant temperature sensor. When the enrichment amount is determined by the ECU it remains constant during that cranking cycle. A thermo timer controls enrichment cycle time after starting.

#### Warm-Up Enrichment

Fuel enrichment during warm-up is controlled by the differential pressure regulator. When cold, the signal from the coolant temperature sensor allows more current to be supplied to the pressure regulator. This will provide greater fuel enrichment.

#### Maximum Engine Speed Limiter

ECU senses engine speed based on impulses from terminal "TD" of ignition switching unit. Maximum engine speed is controlled by adjusting current supply to the differential pressure regulator from ECU. Lower chamber pressure in the fuel distributor is increased to limit fuel flow to the injectors. When maximum engine speed is reached a signal from the ECU will interrupt the fuel pump relay signal and shut off the fuel pump.

#### Altitude Correction

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Injection control is influenced by altitude. With ignition switched on or with engine running, altitude sensor will receive constant voltage signal of approximately 8 volts from ECU. As altitude increases (air pressure decreases), the signal from the ECU reduces current to the differential pressure regulator. This leans out the fuel mixture.

#### Lambda Control

Lambda control is integrated in ECU and sensor input signals. After input signals are amplified, output signal adjust differential pressure regulator.

Control range of differential pressure regulator current is 0-16 mA. Regulator pressure change at 8 mA or above.

Lambda control is non-operational under these conditions: oxygen sensor not ready for operation or defective, during deceleration shut-off, under full load conditions, during acceleration enrichment, when starting engine at coolant temperatures below 60°F (15°C) or until coolant temperature reaches 105°F (40°C).

#### Oxygen Sensor

Oxygen sensor is mounted in exhaust pipe in front of catalytic converter. Oxygen sensor measures oxygen content in exhaust gas. Heating element, energized through terminal No. 87 of fuel pump relay, is used to ensure constant operating temperature of oxygen sensor. When operating temperature range, which starts at 572°F (300°C), is reached, oxygen sensor sends voltage signal to ECU. A rich mixture will send a signal in excess of .5 volt while a lean mixture will give signal of less than .5 volt.

#### Throttle Valve Microswitch

Throttle valve microswitch is activated by ECU with constant voltage signal of 8 volts. During deceleration, circuit to ECU is closed by microswitch.

Time period of deceleration shut-off depends upon engine coolant temperature. Injection of fuel will restart at 900 RPM if engine is at operating temperature. If coolant temperature is lower than operating temperature, injection of fuel will begin at higher speed than 900 RPM.

Throttle valve microswitch opens before throttle valve. This allows deceleration shut-off to be interrupted before throttle valve opens, preventing cut-in hesitation.

Deceleration input signals received by ECU result in change of current direction to differential pressure regulator coils. Plate valve opens and causes pressure in lower chamber to increase. Increased fuel pressure, combined with spring tension, forces diaphragm to cover injector ports in fuel distributor. This interrupts fuel supply to injectors.

## IGNITION & IDLE CONTROL

#### Knock Sensor

The knock sensor is mounted at the front of the cylinder

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block. A 3 wire connector transmits signals to the knock sensor control unit and to the TCI. The sensor mounting bolt torque influences sensor function. See REMOVAL & INSTALLATION section of this article. The knock sensors signal will advance or retard ignition timing to control combustion chamber pre-ignition.

#### **Knock Sensor Control Unit**

The knock sensor control unit receives signals from the knock sensor and also a vacuum signal from the inlet manifold. It transmits signals to the TCI control unit to adjust ignition timing.

#### **Electronic Idle Speed Control**

Idle speed ECU is integrated in CIS-E ECU but is functionally separate from CIS-E. Idle speed air valve, located in throttle valve by-pass hose, receives signals from idle speed ECU.

The idle speed control system also is influenced by the airflow sensor voltage signal. The control unit measures the airflow rate. In combination with engine speed, the position of the airflow sensor potentiometer and the coolant temperature, the idle speed air valve controls the idle speed.

When ignition is switched on, idle speed ECU is energized. Electronic control system generates a frequency of 100 Hz.

#### **Idle Speed Air Control Valve**

With ignition switched off, idle speed air control valve is opened to maximum by a set of return springs. This is the same position as that of "limp-home" engine operation. With ignition on and engine off, idle speed air control valve is activated. This provides a valve opening which is determined by coolant temperature.

ECU supplies specific voltage to air control valve which determines correct opening for setting engine speed. A/C operation will also send a signal to the ECU which will modify the signal to the air control valve. Engine speed is controlled by temperature from 1000 RPM at 0°F (-20°C) to low of 720 RPM at 68°F (20°C).

#### **Idle Speed Boost Valves**

Idle speed boost valves are used on 4-cylinder Volkswagen models. Vehicles without A/C use only one valve, called Idle Speed Boost Valve No. I. Vehicles with A/C also use second valve, called Idle Speed Boost Valve No. II.

With ignition on, constant voltage is supplied to idle speed boost valve No. I. If engine speed drops below 700 RPM, idle speed boost control (on relay board) completes ground circuit for boost valve No. I. Above 1050 RPM, control unit shuts off ground circuit to boost valve No. I.

Idle speed boost valve No. II is always grounded. When A/C is turned on, voltage is supplied to boost valve No. II.

## **TESTING**

### **COLD START ENRICHMENT**

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#### Thermo Time Switch

1) Check thermo time switch at connector on cold start valve when engine coolant temperature is less than 86°F (30°C). Disconnect and ground high tension lead at distributor cap end.

2) Disconnect connector from cold start valve. Connect test light across 2 terminals of cold start connector. Crank starter motor for 10 seconds. Test light must light up for 1-8 seconds, depending upon temperature. Thermo time switch cut-off temperature rating is stamped on switch.

#### Cold Start Valve

1) Check cold start valve with engine coolant temperature below 86°F (30°C). Disconnect and ground high tension lead at distributor cap end. Remove cold start valve from intake manifold with wiring and fuel line connected. Point tip into safe container.

2) Crank starter for 10 seconds. Valve should emit cone-shaped spray for time allowed by thermo time switch. Dry off tip and check for leaks. Acceptable leakage rate of cold start valve is one drip per minute or less.

#### Auxiliary Air Valve

1) Engine coolant must be below 86°F (30°C) for cold condition testing. Ignition must have been off so element in regulator has not been warmed up. Disconnect wiring connector from air regulator. Start cold engine and let it idle. Measure voltage across connector terminals. Voltage must be 11.5 volts.

2) Pinch either regulator hose. If idle does not decrease, replace auxiliary regulator. Attach wiring to regulator. Allow engine to idle for a minimum of 5 minutes. Pinch either regulator hose. If idle speed changes replace auxiliary air valve.

## FUEL DELIVERY & SYSTEM PRESSURES

CAUTION: When working on fuel system, always follow these precautions on cleanliness:

- \* Thoroughly clean all unions and area near connections before disconnecting.
- \* Place removed parts on a clean surface and cover over. Use paper or plastic sheet. Use only lint-free cloths.
- \* Components which have been opened or disassembled must be covered or sealed carefully if repair cannot be carried out immediately.
- \* Only install clean components.
- \* Only unpack replacement parts immediately before they are installed.
- \* Do not use parts which have been stored loose (for instance, in toolboxes).
- \* When fuel system is open, do not work with compressed air if this can be avoided or move car unless absolutely necessary.

WARNING: Fire hazard. Do not smoke or have anything in area that can ignite fuel.

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#### System Pressure (Golf & Jetta)

1) Connect pressure gauge (VW 1318) between line from fuel distributor of cold start valve and test port connection on lower chamber of fuel distributor, using adapter fittings (VW 1318/5). Test port is sealed by threaded plug. Bridge fuel pump relay with jumper switch (US 4480/3).

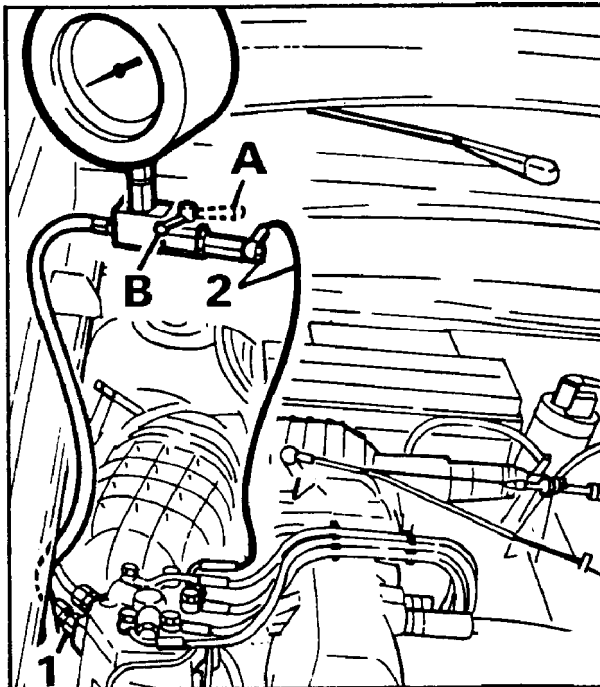
2) Disconnect wiring from differential pressure regulator. Open valve on pressure gauge (points at cold start valve line when open) and activate fuel pump. System pressure must be 68-78 psi (4.7-5.4 kg/cm<sup>2</sup>). If pressure reading is low and fuel pump delivery quantity is good, replace pressure regulator.

3) If pressure reading is high, disconnect fuel tank return line from diaphragm pressure regulator. Repeat test. If reading is correct, check for plugged return line. If reading is incorrect with line open, replace diaphragm pressure regulator.

4) If pressure is not within specification and pressure regulator valve has been replaced adjust system pressure at fuel distributor. Refer to SYSTEM PRESSURE in ADJUSTMENTS section of this article.

#### System Pressure (Quantum & Quantum Syncro)

1) Using new sealing washers and line adapter (VW 1318/5), connect pressure gauge (VW 1318) between fuel cold start valve and lower chamber connection of fuel distributor. Gauge lever positions: A - open, B - closed. See Fig. 3.



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Fig. 3: Checking Fuel System Pressure  
Courtesy of Volkswagen United States, Inc.



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2) Switch OFF (US 4480/3) remote control. Remove fuel pump relay and jump socket with (US 4480/3) remote control. Remove harness connector from differential pressure regulator. Open valve on pressure gauge (VW 1318). Turn ON remote control (US 4480/3). System pressure reading should be 75-82 psi (5.2-5.7 kg/cm<sup>2</sup>).

3) If pressure reading is low, check fuel pump delivery quantity. If okay, replace fuel pressure regulator.

4) If pressure is above specifications, disconnect fuel tank return line from fuel pressure regulator and repeat test. System pressure must be 75-82 psi (5.2-5.7 kg/cm<sup>2</sup>). If pressure is okay, check for plugged fuel return line. If pressure is not within specifications, replace fuel pressure regulator.

NOTE: System pressure is NOT adjustable on Quantum/Quantum Synchro models.

#### Differential (Control) Pressure

1) Close valve on pressure gauge. Activate fuel pump with jumper switch. Leave differential pressure regulator disconnected. Differential pressure reading should be 2.9-7.0 psi (.2-.5 kg/cm<sup>2</sup>) less than system pressure. If pressure is incorrect, disconnect lower chamber return line and measure volume.

2) Close open port to diaphragm pressure regulator. Activate fuel pump with jumper switch. Fuel volume should be .14-.16 qts. (.13-.15L) for period of one minute. If volume is correct, replace differential pressure regulator. If volume is incorrect, replace fuel distributor.

3) Close valve on pressure gauge. Install Test Harness (1315A/1) between differential pressure regulator and vehicle harness. Set multimeter to DCA 200 mA scale. Connect multimeter to test harness. Disconnect wiring to coolant temperature sensor. Connect 15, 000-ohm side of Test Resistor (VW 1490) to sensor wiring.

4) Turn on ignition and fuel pump. Differential pressure should be 10-17.5 psi (.7-1.2 kg/cm<sup>2</sup>) less than system pressure. Differential pressure regulator current should be 50-80 mA. If pressure is incorrect and current is correct, replace differential pressure regulator.

5) If both pressure and current readings are incorrect, remove test harness from differential pressure regulator. Check resistance of differential pressure regulator, which should be 17.5-21.5k ohms. If reading is incorrect, replace differential pressure regulator.

6) If reading is correct, check ground from temperature sensor to cold start valve. If ground is good, check power supply fuse. If fuse is okay, check terminals on ECU connector. If connector is okay, replace ECU.

#### Residual Pressure & Internal Leak Testing

1) Open valve on pressure gauge. Operate fuel pump for 30 seconds. Pressure can drop to a minimum of 38 psi (2.7 kg/cm<sup>2</sup>) after 10 minutes. If pressure drops below specification, inspect fuel pump check valve and all fuel fittings for leakage.

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NOTE: Pressure and leak testing does not include checking cold start valve.

2) If there are no leaks, check sensor plate clearance. If plate clearance is correct, replace diaphragm pressure regulator and repeat leak test. If pressure drop is not within specification, replace fuel distributor "O" rings.

#### Transfer Pump Delivery Volume

1) Check voltage supply to pumps. Connect Jumper Switch (US 4480/3) in place of fuel pump relay, on relay panel. Remove fuel filler cap. Disconnect and plug off Black fuel line from sending unit.

2) Connect hose to sender port and place opposite end in measuring container. Turn on fuel pumps. Minimum transfer pump delivery volume should be .42 qts. (.4L) in 10 seconds. Reconnect fuel line to sender.

#### Main Pump Delivery Volume

1) Check transfer pump (if equipped) and fuel filter. Disconnect fuel return line and place open end in measuring container. Switch on fuel pump with jumper switch. Check fuel pump delivery volume for 30 second period. Delivery rates are given with voltage reading at pump as volume will change with different voltages.

2) Minimum delivery volume for Volkswagen Quantum models is .71 qts. (.68L) for 30 seconds with reading of 11.4 volts at fuel pump. Minimum delivery volume for Volkswagen models using 52 mm fuel pump is .62 qts. (.59L) for 30 seconds with reading of 11.4 volts at fuel pump. Voltage is measured with engine off and fuel pump activated by jumper switch.

#### Injector Quantity Comparison

1) Remove fuel pump relay, from relay panel, and install Jumper Switch (US 4480/3) in off position in place of relay. Attach Fuel Quantity Analyzer (US 4480) to bumper and secure in place. Remove injectors from cylinder head with fuel lines attached. Check and replace fuel injector "O" rings as necessary.

2) Check tightness of injector insert (2-piece inserts). If inserts are loose, remove and clean threads. Use sealing compound when installing upper insert. Replace sealing washer that goes against cylinder head below lower portion of insert. Lubricate injector "O" rings with gasoline and install injectors, with fuel lines connected, into fuel quantity analyzer tubes.

3) Ensure lines are not kinked or bent. Loosen fittings to align fuel lines and retighten. Remove rubber boot from airflow sensor housing above sensor plate. Turn and lift setting screw and adjusting slide of Sensor Plate Adjustable Holder (VW 1348/1) into upper position. This simulates full throttle operation. See Fig. 4.

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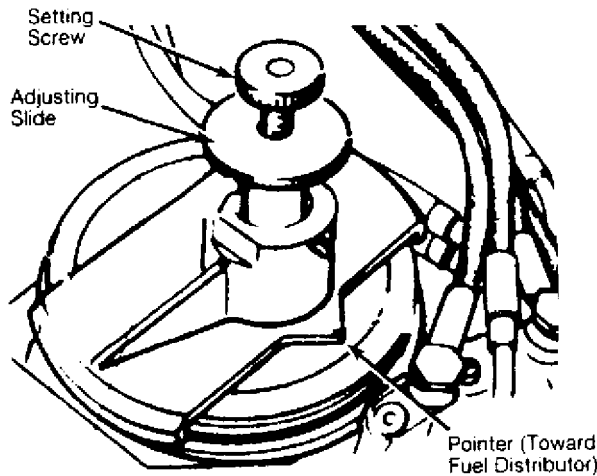


Fig. 4: Sensor Plate Adjustable Holder (VW 1348/1)  
Pointer must face toward center of fuel distributor.

4) Place sensor plate adjustable holder on airflow sensor housing with holder centered over plate. Pointer on edge of holder base must point toward center of fuel distributor. Push adjusting slide of holder down onto stop.

5) Turn adjusting screw clockwise until magnetic end touches sensor plate retaining bolt. Activate fuel pump with jumper switch. Turn adjusting screw of holder counterclockwise until any one injector starts to deliver fuel. Turn off jumper switch and empty fuel quantity analyzer into fuel tank.

6) Idle injection quantity is measured first. Lifting adjusting slide of holder to first stop simulates idle position of sensor plate. Activate fuel pump with jumper switch until fuel level reaches 20 ml on scale of any tube for quantity comparison.

7) Check that all injectors have identical spray patterns that are even and cone-shaped. If not, raise sensor plate up quickly to full lift position and release. Repeat idle quantity test. Compare amounts of fuel delivered by all injectors with analyzer held level. Maximum difference in delivery quantity between injectors is 3.0 ml of fuel.

8) If fuel delivery quantity differs between high and low levels by more than 3.0 ml, interchange injectors and repeat test. If difference of delivery quantity changes with injectors, replace injectors. If difference of delivery quantity does not change with movement of injectors, either fuel lines are pinched or fuel distributor is defective.

9) Measure full throttle injection quantity. Empty analyzer into fuel tank and reinstall injectors in analyzer. Lift adjusting slide of holder to last stop to simulate full throttle position of sensor plate. Activate fuel pump with jumper switch until fuel level reaches 80 ml on scale of any tube of analyzer.

10) Check that all injectors have identical spray patterns that are even and cone-shaped. If not, raise sensor plate up quickly to full lift position and release. Repeat full throttle quantity test. Compare amounts of fuel delivered by all injectors with analyzer held level. Maximum difference in delivery quantity between injectors is 8.

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0 ml of fuel.

11) If fuel delivery quantity differs between high and low levels by more than 8.0 ml, interchange injectors and repeat test. If difference of delivery quantity changes with injectors, replace injectors. If difference of delivery quantity does not change with movement of injectors, either fuel lines are pinched or fuel distributor is defective.

12) Check fuel injectors for leakage immediately after delivery quantity test is complete. Set sensor plate in rest position. Activate fuel pump with jumper switch for 2 minutes. Injectors should not drip. Replace injectors that do drip.

## ELECTRICAL COMPONENTS

### System Testing

Following VOLTAGE CHECKS and RESISTANCE CHECKS charts show procedure for checking CIS-E system components from ECU connector. ECU connector terminal numbers are called out in testing procedures. Ignition MUST be off whenever ECU connector is disconnected or reconnected. Use care to avoid any terminal damage when testing, removing or attaching connectors.

Always check all connections used in test procedure. If readings are incorrect, disconnect terminals and determine if wiring or components are at fault. High tension lead should be disconnected at ignition distributor end and connected to ground. Use Digital Multimeter (US 1119).

### THERMO-TIME SWITCH - OPERATIONAL TIME

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Temperature	Seconds
-------------	---------

-40°F (-20°C)	5-11
---------------	------

14°F (-10°C)	4-9
--------------	-----

32°F (0°C)	3-7.5
------------	-------

50°F (10°C)	2-6.5
-------------	-------

68°F (20°C)	1-4
-------------	-----

86°F (30°C)	0-2
-------------	-----

104°F (40°C)	0
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### FOX CIS-E INJECTION - RESISTANCE CHECKS (1)

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Ohmmeter Between Terminals	No. 2 & No. 15
----------------------------	----------------

Components Checked	Ground Connection
--------------------	-------------------

Specifications	Reading of zero ohms
----------------	----------------------

Ohmmeter Between Terminals	No. 9 & No. 15
----------------------------	----------------

Components Checked	Ground Connection
--------------------	-------------------

Specifications	Reading of zero ohms
----------------	----------------------

Ohmmeter Between Terminals	No. 7 & No. 8
----------------------------	---------------

Components Checked	O2 Sensor Shield
--------------------	------------------

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(1) - TESTING CONDITIONS: Always disconnect ECU with ignition off. Disconnect main ECU connector behind glove box. Wiring connectors on temperature sensor, potentiometer, and differential pressure regulator must be connected. Set multimeter to 20k ohm scale. Prevent ohmmeter damage by checking ONLY terminals listed.

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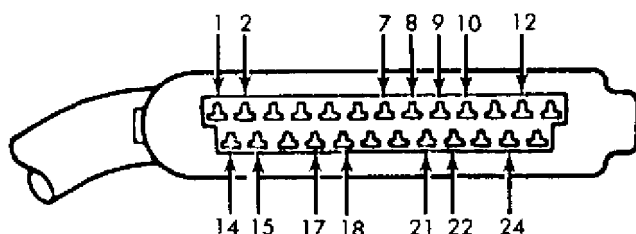
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Terminal Pin No. 1 = 12 Volts (+) From Ignition Switch  
Terminal Pin No. 2 = Ground (-) Connection at Intake Manifold

Fig. 5: Fox - ECU Connector

#### VOLKSWAGEN - (16 VALVE) INJECTION VOLTAGE CHECKS (1)

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Voltmeter Between Terminals ..... No. 1 & 2  
Test Conditions ..... Ignition on  
Specifications ..... Battery voltage

Voltmeter Between Terminals ..... No. 2 & 3  
Test Conditions ..... Ignition on  
Specifications ..... Battery voltage

Voltmeter Between Terminals ..... No. 2 & 4  
Test Conditions ..... Ignition on  
Specifications ..... Battery voltage

Voltmeter Between Terminals ..... No. 2 & 5  
Test Conditions ..... Ignition on, operate full throttle  
switch to full on position.  
Specifications ..... Battery voltage

Voltmeter Between Terminals ..... No. 2 & 13  
Test Conditions ..... Ignition on. Throttle at idle  
position, ensure idle switch is on.  
Specifications ..... Battery Voltage

Voltmeter Between Terminals ..... No. 2 & 24  
Test Conditions ..... Operate Starter  
Specifications ..... Minimum 8 Volts

Voltmeter Between Terminals ..... No. 2 & 25  
Test Conditions ..... Use LED Tester (US 1115),  
operate starter.  
Specifications ..... LED must flicker. Test Hall signal  
from ignition control unit.

Voltmeter Between Terminals ..... (2) No. 2 & 6  
Test Conditions ..... With ignition on, switch on A/C.  
Specifications ..... Battery voltage

Voltmeter Between Terminals ..... (2) No. 2 & 16  
Test Conditions ..... With ignition on, switch on A/C.

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Specifications ..... Battery voltage

Voltmeter Between Terminals ..... (2) No. 2 & 19

Test Conditions ..... With ignition on, switch on A/C.

Specifications ..... Battery voltage

- (1) - TESTING CONDITIONS: Disconnect CIS-E ECU connector with ignition off. Remove high tension lead from ignition distributor coil and connect to ground. Set multimeter to 20-volt DC scale.

- (2) - Vehicles With A/C.

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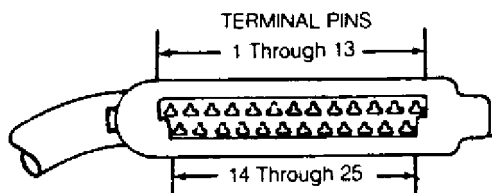


Fig. 6: ECU Connector - Terminal PIN Numbering

### VOLKSWAGEN - (16 VALVE), INJECTION RESISTANCE CHECKS (1)

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Ohmmeter Between Terminals ..... No. 2 & 7

Components Checked .....

Specifications ..... Continuity

Ohmmeter Between Terminals ..... No. 2 & (2) 9

Components Checked .....

Specifications ..... Continuity

Ohmmeter Between Terminals ..... No. 2 & 15

Components Checked .....

Specifications ..... Continuity

Ohmmeter Between Terminals ..... No. 2 & 20

Components Checked .....

Specifications ..... Continuity

Ohmmeter Between Terminals ..... No. 2 & 8

Components Checked ..... Disconnect O2 sensor,  
ground Green wire

Specifications ..... Continuity

Ohmmeter Between Terminals ..... No. 2 & 8

Components Checked ..... Reconnect O2 sensor

Specifications ..... Infinity ohms

Ohmmeter Between Terminals ..... No. 10 & 12

Components Checked .....

Specifications ..... 17.5-21.5 ohms

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Ohmmeter Between Terminals ..... No. 14 & 17  
Components Checked .....  
Specifications ..... Less than 1K ohms

Ohmmeter Between Terminals ..... No. 17 & 18  
Components Checked .....  
Specifications ..... Greater than 4K ohms

Ohmmeter Between Terminals ..... No. 2 & 21  
Components Checked ..... (Temperature Sensor)  
Specifications ..... See Temp. Sensor Testing

(1) - TESTING CONDITIONS: Disconnect CIS-E ECU connector with  
ignition off. Set multimeter ohm scale.

(2) - Connect to terminal No. 22 on Jetta GLI (16 Valve).

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#### GOLF GTI & JETTA GLI - INJECTION SYSTEM VOLTAGE CHECKS (1)

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Voltmeter Between Terminals ..... No. 1 & No. 2  
Components Checked ..... Voltage Supply To ECU  
Specifications ..... Battery voltage with ignition on. If  
not, check fuse 18. If fuse good, check open  
ground circuit between intake manifold and ECU.

Voltmeter Between Terminals ..... No. 1 & No. 2  
Components Checked ..... Voltage Supply From Starter  
Specifications ..... Minimum of 8 volts with starter  
cranking. If not, check wiring to 15 and  
"X" terminals reversed on relay board. See  
wiring diagram.

Voltmeter Between Terminals ..... No. 2 & No. 3/No.2 & No. 4  
Components Checked ..... Idle Stabilizer Control Valve & Wiring  
Specifications ..... Battery voltage with ignition on. If not,  
check middle (voltage supply) wire of connector  
for control valve. If center wire good, wire 3 or  
4 to control valve is open. If wiring is good,  
control valve is defective and should be replaced.

Voltmeter Between Terminals ..... No. 2 & No. 5  
Components Checked ..... Full Throttle Switch & Wiring  
Specifications ..... Battery voltage with ignition on and  
full throttle switch actuated. If not, check  
middle (voltage supply) wire of connector for  
throttle switch. If center wire good, wire 5  
to full throttle switch is open. If wiring is  
good, full throttle switch is defective (due  
to no continuity) and should be replace.

Voltmeter Between Terminals ..... No. 2 & No. 13  
Components Checked ..... Idle Switch & Wire 13



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Specifications ..... Battery voltage with ignition on and idle switch activated by throttle lever. If not, wire 13 to idle switch is open. If wire good, idle switch is incorrectly adjusted or bade.

Voltmeter Between Terminals ..... No. 2 & No. 6  
Components Checked ..... A/C Voltage Signal  
Specifications ..... Battery voltage with ignition and A/C on.  
If not, check A/C fuse. If good, check wiring bridge between wires 6 and 16. Check wires 16 and 19 to A/C.

Voltmeter Between Terminals ..... No. 2 & No. 16  
Components Checked ..... A/C Voltage Signal  
Specifications ..... Battery voltage with ignition and A/C on.  
If not, check A/C fuse. If good, check wiring bridge between wires 6 and 16. Check wires 16 and 19 to A/C.

Voltmeter Between Terminals ..... No. 2 & No. 19  
Components Checked ..... A/C Voltage Signal  
Specifications ..... Battery voltage with ignition and A/C on.  
If not, check A/C fuse. If good, check wiring bridge between wires 6 and 16. Check wires 16 and 19 to A/C.

Voltmeter Between Terminals ..... No. 2 & No. 24  
Components Checked ..... Wiring Between Starter & ECU  
Specifications ..... Minimum 8 volts with starter cranking. If not, check wire 24 for open. If wire is good, starter solenoid switch is defective and should be replaced.

Voltmeter Between Terminals ..... No. 2 & No. 25  
Components Checked ..... Hall RPM Signal & Ignition ECU  
Specifications ..... Voltage display must fluctuate with starter cranking. If not, check wire 25 to ignition ECU for open. If wire 25 good, check wiring between ignition distributor and ignition ECU. If wiring is good, Hall sensor is defective and should be replaced. If wiring and Hall sensor are good, ignition ECU is defective and should be replaced.

(1) - TESTING CONDITIONS: Disconnect and ground high tension lead at ignition distributor end. Unplug ECU connector with ignition off. Set multimeter to 20-volt DC scale.

AA

GOLF GTI & JETTA GLI - INJECTION SYSTEM RESISTANCE CHECKS (1)

AA

Ohmmeter Between Terminals ..... No. 2 & No. 15  
Components Checked ..... Ground Cable Bridge  
Specifications ..... Reading of zero ohms

Ohmmeter Between Terminals ..... No. 2 & No. 9  
Components Checked ..... M/T Models Only

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Specifications ..... Reading of zero ohms

Ohmmeter Between Terminals ..... No. 2 & No. 22

Components Checked ..... A/T Models Only

Specifications ..... Reading of zero ohms

Ohmmeter Between Terminals ..... No. 7 & No. 2

Components Checked ..... O2 Sensor Wire Shield

Specifications ..... Reading of infinity ohms

Ohmmeter Between Terminals ..... No. 2 & No. 8

Components Checked ..... O2 Sensor & Wiring

Specifications ..... Reading of zero ohms with Green O2  
lead disconnected and grounded. If  
not, Green wire has open.

Ohmmeter Between Terminals ..... No. 2 & No. 8

Components Checked ..... O2 Sensor & Wiring

Specifications ..... Reading of infinity ohms with Green  
O2 lead connected to harness. If not,  
O2 is defective and should be replaced.

Ohmmeter Between Terminals ..... No. 10 & No. 12

Components Checked ..... Differential Pressure Reg. & Wiring

Specifications ..... Reading of 17-22 ohms. If not, check  
wire 10 or 12 for open. If wires are  
good, differential pressure regulator  
is defective and should be replaced.

Ohmmeter Between Terminals ..... No. 14 & No. 17

Components Checked ..... Potentiometer & Wiring (2)

Specifications ..... Reading of less than 1000 ohms with  
airflow sensor plate in rest position. If not,  
check wires 14, 17 and 18 for open. If wires  
are good, adjust or replace potentiometer.

Ohmmeter Between Terminals ..... No. 17 & No. 18

Components Checked ..... Potentiometer & Wiring (2)

Specifications ..... Reading of more than 4000 ohms with airflow  
sensor plate lifted away from rest position.  
If not, check wires 14, 17, and 18 for open. If  
wires are good, adjust or replace potentiometer.

Ohmmeter Between Terminals ..... No. 2 & No. 21

Components Checked ..... Temperature Sensor & Wiring

Specifications ..... Reading of 6k ohms at 32°F (0°C). Reading of  
2.5K ohms at 68°F (20°C). Reading of 300 ohms at  
176°F (80°C). If readings are incorrect, check  
ground line (wire 21) between intake manifold and  
ECU. If wiring is good, temperature sensor is  
defective and should be replaced.

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- (1) - TESTING CONDITIONS: Disconnect and ground high tension lead at ignition distributor end. Unplug ECU connector with ignition off. Set multimeter to 20k ohm scale. Prevent ohmmeter damage by checking ONLY terminals listed.
- (2) - Potentiometer terminals No. 1, 2 and 3 are connected respectively to terminals No. 18, 17 and 14 on ECU connector.

AA

#### QUANTUM 5-CYLINDER RESISTANCE CHECKS (1)

AA

Ohmmeter Between Terminals ..... No. 2 & No. 22  
Components Checked ..... Ground Bridge  
Specifications ..... Reading of zero ohms. If not, check  
for open in bridge across terminals.

Ohmmeter Between Terminals ..... No. 2 & No. 15  
Components Checked ..... Ground Bridge  
Specifications ..... Reading of zero ohms. If not, check  
for open in bridge across terminals.

Ohmmeter Between Terminals ..... No. 7 & No. 8  
Components Checked ..... O2 Sensor Wire  
Specifications ..... Reading of infinity ohms. If not, check  
for open circuit in O2 sensor lead.

Ohmmeter Between Terminals ..... No. 2 & No. 8  
Components Checked ..... O2 Sensor Wiring  
Specifications ..... Reading of zero ohms with Green O2 sensor  
lead unplugged and grounded. If not, check  
for open in circuit in Green O2 sensor lead.

Ohmmeter Between Terminals ..... No. 10 & No. 12  
Components Checked ..... Differential Pressure Reg. & Wiring  
Specifications ..... Reading of 17.5-21.5 ohms. If not, check for  
open in circuit between regulator and ECU. If wiring  
is good, replace differential pressure regulator.

Ohmmeter Between Terminals ..... No. 14 & No. 17  
Components Checked ..... Potentiometer & Wiring  
Specifications ..... Reading below 12 k/ohms with airflow sensor  
plate in rest position and altitude sensor  
unplugged. If not, check wiring to terminals  
No. 14 and 17 for opens. If wiring is good,  
adjust or replace airflow sensor plate  
potentiometer.

Ohmmeter Between Terminals ..... No. 17 & No. 18  
Components Checked ..... Potentiometer & Wiring  
Specifications ..... Reading above 35 k/ohms with airflow sensor  
plate in rest position and altitude sensor  
unplugged. If not, check wiring to terminals  
No. 14 and 17 for opens. If wiring is good,

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adjust or replace airflow sensor plate  
potentiometer.

Ohmmeter Between Terminals ..... No. 18 & No. 14  
Components Checked ..... Altitude Sensor  
Specifications ..... Reading of 21-26 k/ohms with potentiometer  
unplugged. If not, check for open circuit in  
wiring. If wiring is good, replace altitude  
sensor.

Ohmmeter Between Terminals ..... No. 11 & No. 14  
Components Checked ..... Altitude Sensor  
Specifications ..... Reading of 200-38,000 ohms with potentiometer  
unplugged. If not, check for open circuit in  
wiring. If wiring is good, replace altitude  
sensor.

Ohmmeter Between Terminals ..... No. 21 & No. 2  
Components Checked ..... Temperature Sensor  
Specifications ..... Reading of 2.5 k/ohms at 68°F (20°C).  
Resistance reading should be higher at lower  
temperatures and lower at higher temperatures.  
If not, check for open circuit in wiring. If  
wiring is good, replace temperature sensor.

Ohmmeter Between Terminals ..... No. 1 & No. 5  
Components Checked ..... Full Throttle Switch  
Specifications ..... Reading of zero ohms with switch in full  
throttle position. Reading of infinity with full  
throttle switch in closed position. If not, check  
wiring for open circuit. If wiring is good, adjust  
or replace full throttle switch.

Ohmmeter Between Terminals ..... No. 1 & No. 13  
Components Checked ..... Idle Switch  
Specifications ..... Reading of zero ohms with switch in idle  
position. Reading of infinity with switch in any  
open throttle position. If not, check wiring for  
open circuit. If wiring is good, adjust or replace  
idle switch.

(1) - TESTING CONDITIONS: Disconnect and ground high tension lead  
at ignition distributor end. Unplug ECU connector with  
ignition off. Set multimeter to 20-k/ohm scale. Prevent  
ohmmeter damage by checking ONLY terminals listed.

AA

Fuel Pump Relay - 4-Cylinder Models

NOTE: No testing procedure was available from manufacturer for  
5-cylinder Volkswagen models.

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1) Remove fuel pump relay from relay board. Turn ignition on. Using multimeter, measure voltage at following relay board sockets: between terminal No. 2 and ground, between terminals No. 2 and 1 and between terminals No. 4 and 1. Reading should be battery voltage or slightly less.

2) If reading is low or zero, check wiring. Refer to appropriate WIRING DIAGRAM in this article to check circuits. Measure voltage between relay board sockets No. 5 and 1. Battery voltage should be present. If reading is correct, ground middle wire of ignition distributor connector.

3) Voltage reading should drop for short time. If reading does drop, replace relay. Reading should be battery voltage or slightly less.

4) If reading is low or zero, check wiring. Refer to appropriate WIRING DIAGRAM in this article to check circuits. Measure voltage between relay board sockets No. 5 and 1. Battery voltage should be present. If reading is correct, ground middle wire of ignition distributor connector.

5) Voltage reading should drop for short time. If reading does drop, replace fuel pump relay and check Hall sender. If reading does not drop, check Hall ignition ECU.

#### Cold Start Enrichment

Connect test harness between differential pressure regulator and vehicle harness. See Fig. 7. Connect multimeter to test harness. Disconnect wiring from coolant temperature sensor. Turn ignition on. Differential pressure regulator current should be 80-110 mA. If not, replace ECU.

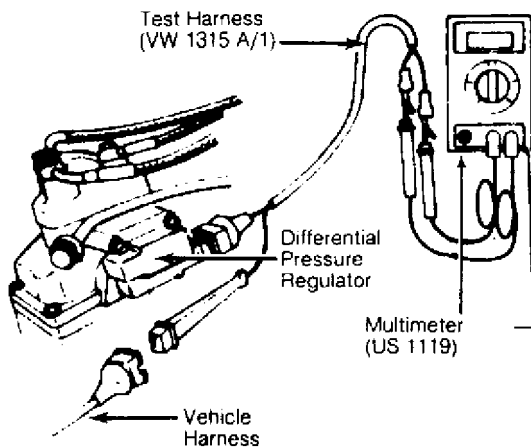


Fig. 7: Connecting Multimeter to Differential Pressure Regulator

#### Cold Acceleration Enrichment

1) Connect test harness between differential pressure regulator and vehicle harness. Connect multimeter to test harness. Disconnect wiring from coolant temperature sensor. Remove intake air boot.

2) Turn ignition on and lift sensor plate quickly to full open position. Differential pressure regulator current should increase to more than 110 mA, and drop back to 80-110 mA range. If not, check

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potentiometer and wiring to ECU. If potentiometer and wiring are good, replace ECU.

#### **After Start Enrichment**

1) Connect test harness between differential pressure regulator and vehicle harness. Connect multimeter to test harness. Disconnect wiring from coolant temperature sensor. Ground high tension lead (terminal No. 4) from ignition distributor.

2) Crank starter for 3 seconds. Return key to "ON" position. Differential pressure regulator current reading should increase to more than 120 mA for 20-50 seconds, and return to 80-110 mA range.

3) If not, check starter signal to terminal No. 24 of ECU connector. Check signal from relay board to starter motor (terminal No. 15a on starter). On 5-cylinder models, check voltage between ECU terminals No. 2 and 21. See VOLTAGE CHECKS and RESISTANCE CHECKS CHARTS in this article for appropriate testing procedure. If all wiring is okay, replace ECU.

#### **Starting Enrichment - 5-Cylinder Models**

1) Connect test harness between differential pressure regulator and vehicle harness. Connect multimeter to test harness. Disconnect wiring from coolant temperature sensor. Plug jumper end of Test Resistor (VW 1490) into harness connector of temperature sensor. Activate starter for 3 seconds.

2) Current reading should be more than 70 mA for first 1.5 seconds of starter operation. If not, check for open circuit between terminal No. 24 on ECU connector and terminal No. 15a on starter. If starter circuit is okay, check between terminals No. 2 and 21 on ECU connector. If wiring is okay, replace ECU.

#### **Full Throttle Enrichment**

1) Connect test harness between differential pressure regulator and vehicle harness. Connect multimeter to test harness. Disconnect wiring from coolant temperature sensor. Plug jumper end of test resistor into harness connector of temperature sensor. Unplug oxygen sensor. Turn ignition on.

2) Activate full throttle switch. Current reading should increase 3 mA when switch is activated. If not, check full throttle switch. See ADJUSTMENTS in this article.

3) If switch is functioning and adjusted correctly, check for open circuit between terminals No. 5 and 2 on ECU connector and terminals on full throttle switch. If wiring is good, replace ECU.

#### **Deceleration Fuel Shut-Off Check**

1) Engine oil temperature must be at minimum of 120°F (50°C). Reconnect wiring to temperature sensor. Start engine and run it at 2000 RPM briefly. Release throttle.

2) Differential pressure regulator current reading should briefly be negative (-30 to -60 mA) and return to positive when engine reaches approximately 1300 RPM. If not, check for open idle switch signal at ECU connector terminals No. 2 and 13. If switch is good, replace ECU.

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#### Altitude Sensor

- 1) Disconnect distributor high tension lead from distributor and connect to ground. Remove glove compartment and disconnect main connector from MCU. Disconnect connector terminal from potentiometer.
- 2) Measure resistance between connector pins No. 14 and 18 of the main connector. Resistance should be 2.1-2.6K ohms.
- 3) Measure resistance between connector pins No. 11 and 14. Resistance should be 200-3.6K ohms.
- 4) If resistance is not to specification check wiring continuity. If wires have continuity replace altitude sensor.

#### Idle Speed Stabilizer Valve

- 1) Connect Tester (VW 1367) using Cable Adapter (US 1112). Connect ohmmeter between terminal No. 1 of test connector and terminal No. 15 of main ECU connector. With stabilizer valve disconnected there should be continuity between these terminals.
- 2) Connect ohmmeter to terminal No. 2 of the test connection and terminal No. 3 of the central connector. With stabilizer valve disconnected there should be continuity between these terminals. Check and repair any open circuits using wiring diagrams for reference.
- 3) With stabilizer valve disconnected, connect voltmeter between terminal No. 2 of the idle stabilizer valve connector and ground. With ignition on, battery voltage should be present. See Fig. 8.
- 4) With ignition off, check for continuity between terminal No. 3 of the of the idle stabilizer valve connector and terminal No. 3 of the main ECU connector. Check for continuity between stabilizer connector terminal No. 1 and ECU connector No. 4.
- 5) Correct any open circuits and reconnect idle stabilizer valve connector. Connect ohmmeter between terminals No. 3 and 4 of the main ECU connector. Resistance specification is 24-30 ohms. Replace idle stabilizer valve if not within specification.

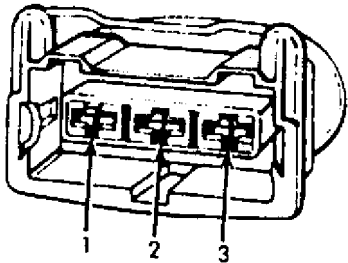


Fig. 8: Terminal Pins Idle Stabilizer Valve Connector ID

#### Oxygen Sensor

- 1) Before testing oxygen sensor, ensure the following conditions are met: engine oil temperature is at 176°F (80°C) minimum, radiator fan must cycle at least once, pressure gauges NOT connected, exhaust system free of leaks, oxygen sensor control working correctly, oxygen sensor heating element functional, all electrical units turned off (radiator fan and A/C must be off during test), and engine speed at 3000 RPM for 2 minutes.

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2) Connect test harness between differential pressure regulator and vehicle harness. Connect multimeter to test harness. Run engine at idle. After 2 minutes running time, oxygen sensor will be operational.

3) Check current reading at 3000 RPM. If reading fluctuates, oxygen sensor is good. If reading does not fluctuate at 3000 RPM, replace oxygen sensor.

#### Idle Speed Boost Valves

1) To test boost valve No. I, engine oil temperature must be at 176°F (80°C) minimum. If equipped, A/C system must be off. Run engine at idle speed. Turn on all electrical units except A/C system. Turn in idle speed adjusting screw to lower idle. At 750 RPM, boost valve No. I should open and idle speed will increase.

2) Pinch shut outlet air hose after "T" connector. Engine speed should drop. Leaving air hose pinched shut, raise engine idle speed to 870-930 RPM. Open air hose. Idle speed should increase. When 1050 RPM is reached, boost valve No. I should close and engine speed should drop to 870-930 RPM.

3) To check boost valve No. II (A/C equipped only), ensure A/C is off. Run engine at idle speed and pinch outlet air hose shut. Engine speed should not change. When A/C is switched on with air hose pinched shut, idle speed should drop.

#### Idle Speed Stabilization System

1) Engine oil temperature must be at 176°F (80°C) minimum. Ignition timing point is 4-8 degrees BTDC. A/C must be off. Connect Dwell Meter (VW 1367) using Adapter Cable (US 1112). Set "%" button on dwell meter and check duty cycle.

2) Reading should be 26-30% with oxygen sensor connected. Idle speed should be 800-900 RPM. If not, adjust duty cycle.

3) If reading shows 33% or 40%, ensure A/C is switched off. If A/C is off, check idle throttle switch function. Check for open circuit between idle switch and ECU connector.

4) If reading is fluctuating between 20-25%, check for open circuit in RPM signal from ignition ECU. If reading is steady 25%, and idle speed is high. Check for air leaks in throttle body. If no leaks are found, check for open circuit between ECU and idle stabilizer control valve. If circuit is correct, replace idle stabilization valve.

5) Turn A/C on. Idle speed should increase by 100 RPM. If not, check for open circuit between A/C switch on dash and terminals No. 6 and 16 on ECU connector. Check for RPM increase of 100 RPM when A/C compressor cycles off.

6) If idle speed goes over 1000 RPM when A/C compressor switches off, check compressor signal wire to ECU. Wire should go to ECU connector terminal No. 19. Ensure it is connected to the correct terminal and not terminal No. 16. Check wiring diagram and correct.

#### Knock Sensor

1) With ignition off, disconnect knock sensor from control unit. Measure resistance between terminals No. 13 and 14. Type I



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sensor should have 300K ohms resistance. A Type II sensor should measure infinity. Reconnect sensor to control unit.

2) Connect LED Test Light (US 1115) to single lead (Brown) connector and to battery (+) voltage. LED must light.

CAUTION: Do not use a standard test light to test knock sensor. Higher voltage type light may damage control unit.

3) With engine running, LED should go out (may glow slightly). Increase engine RPM one time to 3000 RPM. If LED lights again connect a jumper wire between outside terminals of knock sensor connector and momentarily (3 seconds) ground (-) center terminal.

4) The LED light will blink on and off in a pattern. Blinking twice at intervals indicates a fault in the knock sensor (sensor defective, wiring, mounting torque) or defective control unit.

5) If the LED light blinks three times in intervals it indicates a break in the vacuum hose to the control unit or the control unit vacuum sensor is defective.

#### **Knock Sensor Control Unit**

1) Ensure ignition coil and TCI unit are okay. Remove connector from knock sensor and turn ignition on. Check for battery voltage between connector pins No. 3 and 5.

2) Measure battery voltage between terminals No. 6 and 3. Open throttle valve, voltage should drop to zero volts. If voltage does not drop to zero check throttle idle switch.

3) Measure voltage between terminals No. 8 and 3 while opening throttle. Battery voltage should be present at full throttle. If battery voltage is not present check full throttle switch.

4) Remove harness connector from TCI (Hall sender) at distributor. Turn ignition on and measure voltage between outer terminals of connector. Voltage should be 5 volts minimum. Turn ignition off.

5) With ignition on, check voltage between terminals No. 1 (-) and 15 (+) of ignition coil. Touch center terminal of connector from TCI to ground. Voltage should increase briefly to 2 volts minimum. If it does not, replace knock sensor control unit.

#### **Throttle Valve Switch**

See ADJUSTMENTS in this article for checking and adjusting procedure for idle and full throttle valve switches.

NOTE: CIS-E fuel injection maintains constant fuel pressure throughout system. Relieve pressure before opening system. DO NOT allow fuel to leak on engine or electrical parts. DO NOT allow any open flame near fuel system being serviced.

## **REMOVAL & INSTALLATION**

### **FUEL DISTRIBUTOR**

#### **Removal**

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1) Disconnect battery and remove air cleaner. Disconnect all fuel and injector lines from fuel distributor. Plug fuel supply and return lines. Catch any fuel spillage with rag.

2) Disconnect wiring from differential pressure regulator. Remove screws holding fuel distributor to airflow sensor housing. Remove fuel distributor by turning back and forth while lifting up.

#### **Installation**

1) Lightly lubricate new sealing "O" ring and mount on fuel distributor. Install fuel distributor. Ensure "O" ring is not damaged or air leaks will result. Connect all fuel lines except those to fuel injectors. Check sensor plate adjusting lever and fuel distributor control piston for smooth operation.

2) Remove fuel pump relay and bridge fuel pump circuit. Use Jumper Switch (US 4480/3) in place of fuel pump relay. When pressure has built up, turn off fuel pump. Move sensor plate from rest position to end of travel.

3) Uniform resistance should be felt during entire movement. No resistance should be felt on quick return to rest position. Connect injector lines. Install fuel pump relay. Start engine and check complete fuel system for leaks.

## **FUEL INJECTORS**

#### **Removal**

Remove injectors from inserts in head with fuel lines attached. Using 13 mm hex head socket, remove inserts from head. Use 2 wrenches to remove injectors from lines.

#### **Installation**

To install, reverse removal procedures. Use 2 wrenches when tightening injector lines to injectors. Always use new "O" rings and lubricate them to ease installation. On Volkswagen models with 2-piece inserts, replace insert sealing washer (against head) and use sealing compound on upper insert threaded portion.

## **THROTTLE VALVE HOUSING (TVH)**

#### **Removal**

1) Disconnect accelerator cable from linkage. Disconnect return spring on throttle valve housing. On vehicles with cruise control, remove connecting rod on throttle valve housing. Pull off vacuum hoses for ignition advance and fuel evaporation system purge line. Remove nuts holding throttle valve housing to airflow sensor housing.

2) Disconnect throttle valve switch. Remove 2 nuts holding throttle valve housing to metallic front vibration mounts. Disconnect fuel return hose from diaphragm pressure regulator. Lift sensor housing upward and remove throttle valve housing. Remove gasket between intake manifold and throttle valve housing.

#### **Installation**

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To install, reverse removal procedure. Use new gasket. Adjust accelerator linkage and idle speed.

#### **AIRFLOW SENSOR PLATE**

##### **Removal**

Remove air filter and unscrew stop bracket. Heat fastening bolt for airflow sensor plate with hot air blower to loosen locking compound. Remove bolt carefully to ensure threads are not damaged. Use a 6 mm tap to clean out threads for airflow sensor plate fastening bolt.

##### **Installation**

Insert airflow sensor plate (identified by 5 punch marks) in upward direction. Lightly tighten self-locking screw. Check that sensor plate is centered and rest position is correct. See ADJUSTMENTS in this article. To complete installation, reverse removal procedure.

#### **AIRFLOW SENSOR POTENTIOMETER**

##### **Removal & Installation**

Remove diaphragm pressure regulator. Remove insulating compound to uncover screws holding potentiometer to housing. Remove potentiometer. Do not touch or damage slide contact and conductor. To install, reverse removal procedure. Adjust potentiometer. See ADJUSTMENTS in this article.

#### **KNOCK SENSOR**

##### **Removal & Installation**

1) The knock sensor is attached at the front of the engine block. There are 2 types of sensors. The Type I sensor has its cable connection molded off center from the side of the sensor. No washers are used on fastening bolt. Tighten to 7-9 ft. lbs. (10-12 N.m).

2) The Type II sensor has its connector cable molding centered on the side of the connector. It is tight end to 11-18 ft. lbs. (15-25 N.m) without washers.

#### **ADJUSTMENTS**

##### **AIRFLOW SENSOR PLATE**

1) Check basic adjustment of sensor plate lever. With fuel distributor removed from airflow sensor housing, measure distance between roller on sensor plate lever and contact points of fuel distributor on top of airflow sensor housing.

NOTE: Always check sensor plate lever adjustment if fuel distributor or airflow sensor has been replaced.

2) Use a depth gauge or vernier caliper for measuring distance. See Fig. 9. Distance should be .74-.75" (18.9-19.1 mm). If

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distance is out of specified range, correct it with adjustment of mixture screw.

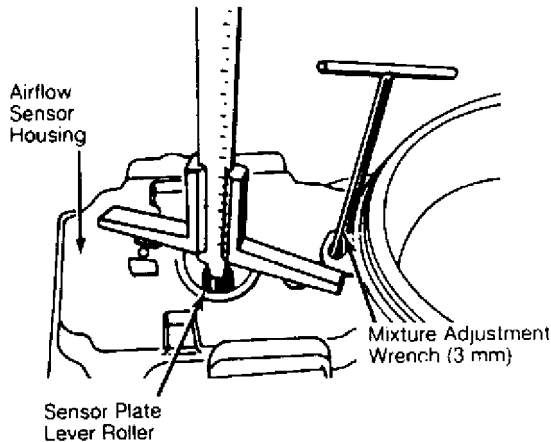


Fig. 9: Adjusting Sensor Plate Lever

#### Centering Sensor Plate & Lever

1) Check sensor plate for centered position in airflow sensor housing. If plate binds on housing or is off-center, remove 6 mm bolt holding plate to lever. Coat bolt with locking compound and install finger tight.

2) Use Centering Gauge (US 1109) or .004" (.10 mm) feeler gauges to set plate equidistant from sensor housing. If plate cannot be centered, remove airflow sensor housing to center sensor lever.

3) Turn housing upside-down and remove bolt clamping counterweight to sensor lever. Coat bolt with locking compound and install finger tight. Center sensor plate lever in housing and tighten clamping bolt. Complete centering of plate.

#### Sensor Plate Rest Position

Upper edge of sensor plate must be below lower edge of sensor cone .070-.080" (1.80-2.10 mm). See Fig. 10. If rest position is incorrect, raise sensor plate. Open or close wire clip to change position of sensor plate. DO NOT bend leaf spring.

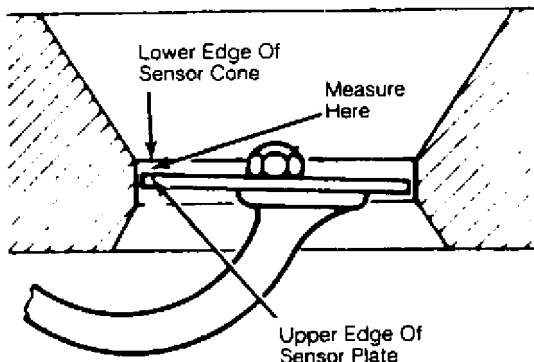


Fig. 10: Sensor Plate Rest Position

#### Sensor Plate Free Play

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1) Free play is between control piston and adjusting lever. Differential pressure regulator must have 4-16 mA current. Position of sensor plate lever must be correct. Measure free play on side of sensor cone closest to fuel distributor. See Fig. 11.

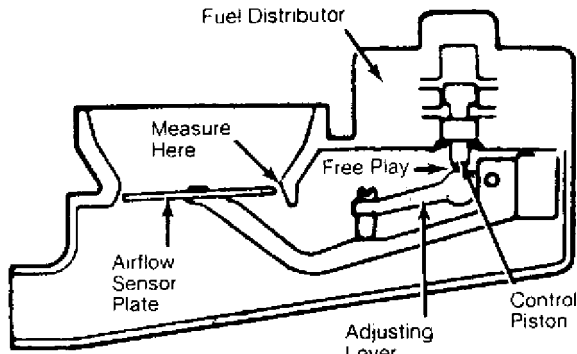


Fig. 11: Sensor Plate Free Play

2) Crank starter motor or use Jumper Switch (US 4480/3) for 10 seconds to develop fuel pressure. Lift sensor plate slightly until resistance is felt. Minimum clearance is any noticeable free play. Maximum clearance is .078" (2 mm) up to sensor cone.

3) If free play clearance is incorrect, remove fuel distributor. Check basic adjustment of sensor plate lever. Install fuel distributor and repeat free play clearance check. If still incorrect, adjust sensor plate clearance with control piston stop screw.

#### Sensor Plate Clearance Adjustment

1) Remove fuel distributor from airflow sensor housing. Turn distributor upside-down to access stop screw for control piston. This will adjust free play travel range of sensor plate lever.

2) Turning screw clockwise will increase clearance by keeping control piston higher in fuel distributor during operation. Turning screw counterclockwise will decrease clearance by allowing control piston to extend further out of fuel distributor during operation.

3) Adjusting stop screw 1/4 turn (90 degrees) will make .05" (1.3 mm) difference at sensor plate. Idle speed and CO (current reading) must be checked.

#### AIRFLOW SENSOR POTENTIOMETER

1) Check sensor plate rest position and adjust if necessary. Edge of plate closest to fuel distributor must be .069-.079" (1.75-2.05 mm) below lower edge of sensor housing venturi cone. Disconnect wiring from potentiometer. Connect Test Harness (VW 1501) to potentiometer, leaving vehicle harness plug disconnected.

2) Using Digital Multimeter (US 1119), measure resistance of potentiometer at terminals of test harness. Harness terminal No. 1 corresponds to potentiometer terminal No. 18; terminal No. 2 corresponds to potentiometer terminal No. 17; terminal No. 3 corresponds to potentiometer terminal No. 14.

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3) Reading should be greater than 4000 ohms with meter between harness terminals No. 1 and 2. Reading should be less than 1000 ohms with meter between terminals No. 2 and 3. Reading should increase evenly up to 4000 ohms as sensor plate is lifted smoothly. If readings are not correct, replace potentiometer.

4) Using Sensor Plate Adjustable Holder (VW 1348/1), lift sensor plate to lower edge (fuel distributor side) of airflow sensor housing. Install potentiometer. Partially tighten screws so that adjustment is possible. Connect multimeter between test harness terminal No. 2 and ground.

5) Set multimeter on 20 DCV scale and turn on ignition. Reading should be .2-.3 volts. If not, move potentiometer until reading is correct. Tighten mounting screws. To check adjustment, lift sensor plate to stop. Reading should be 7 volts. If correct, secure mounting screws with Loctite.

### THROTTLE VALVE HOUSING

NOTE: Stop screw is set by manufacturer and should not be moved.

If basic factory setting has been changed, turn throttle stop screw counterclockwise until there is a gap between stop and screw. Turn screw in until it just touches stop. Turn screw 1/2 turn (180 degrees) further. Check and adjust idle speed and CO.

Idle Switch - Volkswagen GLI/GTI

1) Connect Test Harness (VW 1501) between vehicle harness and throttle switch lead. Turn ignition on. Connect voltmeter between terminal No. 1 of test harness and ground. If battery voltage is NOT present, check voltage supply between terminal No. 2 of test harness and ground.

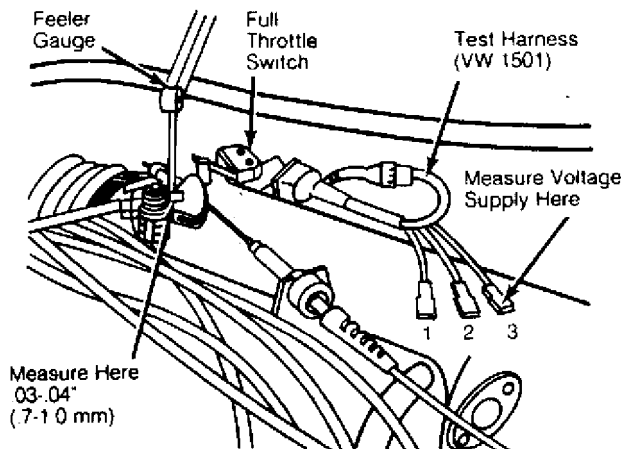


Fig. 12: Checking Throttle Idle Switch Adjustment

2) If battery voltage is NOT present, check and repair wiring. See VOLKSWAGEN GLI or GTI CIS-E WIRING DIAGRAM for wiring color and terminal numbers. Recheck voltage between terminal No. 1 and ground if wiring is repaired. If battery voltage is present, open and

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slowly close throttle valve.

3) Check switch-on point of idle switch, using feeler gauge between throttle lever and idle stop. Switch-on point gap should be .006-.002" (.15-.05 mm) before idle stop. If switch-on point is incorrect, loosen and adjust idle switch position. Idle switch is on underside of throttle valve housing, opposite idle stop.

#### Idle Switch - (Except Fox)

1) To check and adjust idle switch, loosen upper left bolt on throttle valve housing. Attach Protractor Pointer (3084) under bolt. Attach Protractor (3084) on primary throttle valve shaft, removing shaft nut if necessary. See Fig. 13.

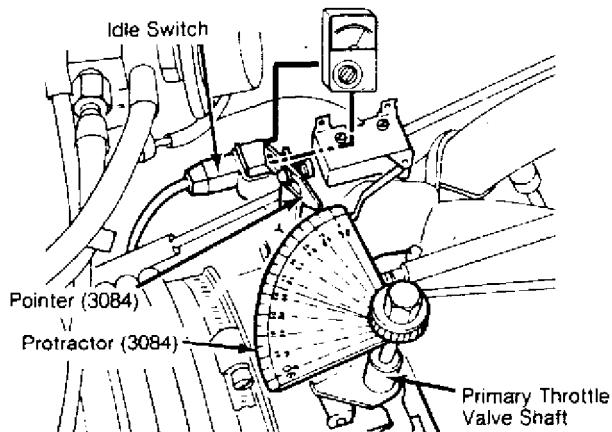


Fig. 13: Checking Throttle Valve Idle Switch Adjustment

2) Disconnect wiring to switch. Connect ohmmeter between terminals of switch. Set protractor so pointer is on "0" degrees. Open throttle to 20 degrees and close it slowly. Switch must have continuity from one degree to 2.5 degrees when opening.

3) If reading is incorrect, remove throttle valve housing. Loosen idle switch mounting screws and adjust switch position. See Fig. 14. Switch must close (continuity) before throttle control reaches idle stop position.

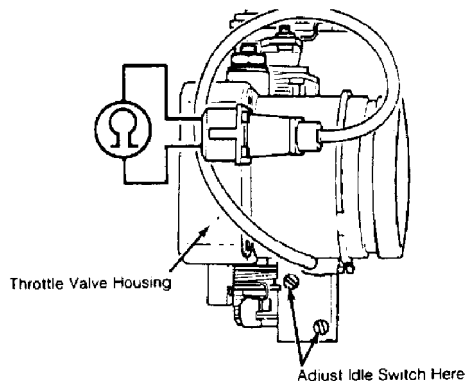


Fig. 14: Idle Switch Adjustment

Full Throttle Switch

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1) Attach protractor pointer to upper left bolt on throttle valve housing. Attach protractor to secondary throttle valve shaft. Remove shaft nut if necessary. Disconnect throttle switch wiring. Connect ohmmeter between switch terminals. See Fig. 15.

2) Set secondary throttle plate in full open position and move protractor until pointer is on "0" degrees. Allow secondary throttle valve to close about 30 degrees and reopen to full throttle position.

3) Ohmmeter must read zero ohms at 8-12 degrees before full throttle. Loosen mounting screws and adjust switch. Reading must be zero ohms (continuity) at full throttle position.

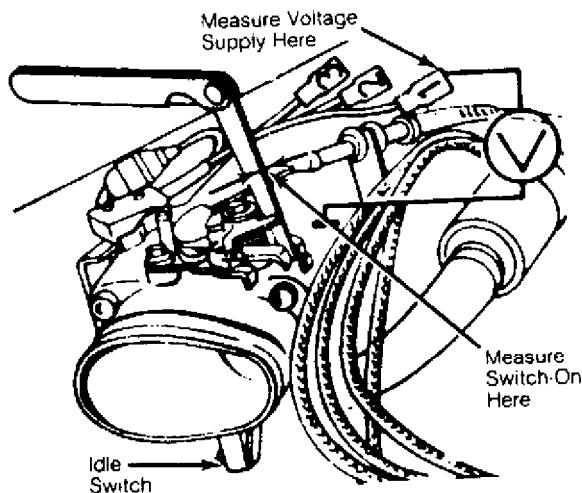


Fig. 15: Adjusting Full Throttle Switch

#### System Pressure

1) Check and note existing pressure. Remove pressure regulating valve from fuel distributor. See Fig. 16.

2) Adjust pressure by changing shims in shim stack. Add shims to raise system pressure. Remove shims to lower system pressure.

3) A shim change of .020" (.5 mm) will change system pressure approximately 4.2 psi (.3 kg/cm<sup>2</sup>). Ensure any replacement shims are identical in diameter to existing shims.

## WIRING DIAGRAMS

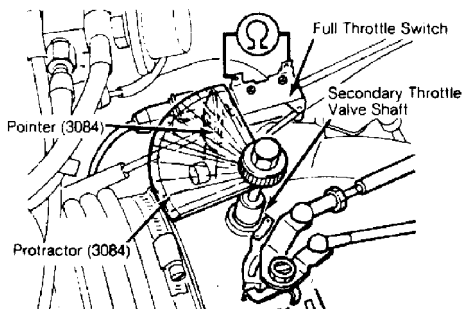


Fig. 16: Adjusting System Pressure



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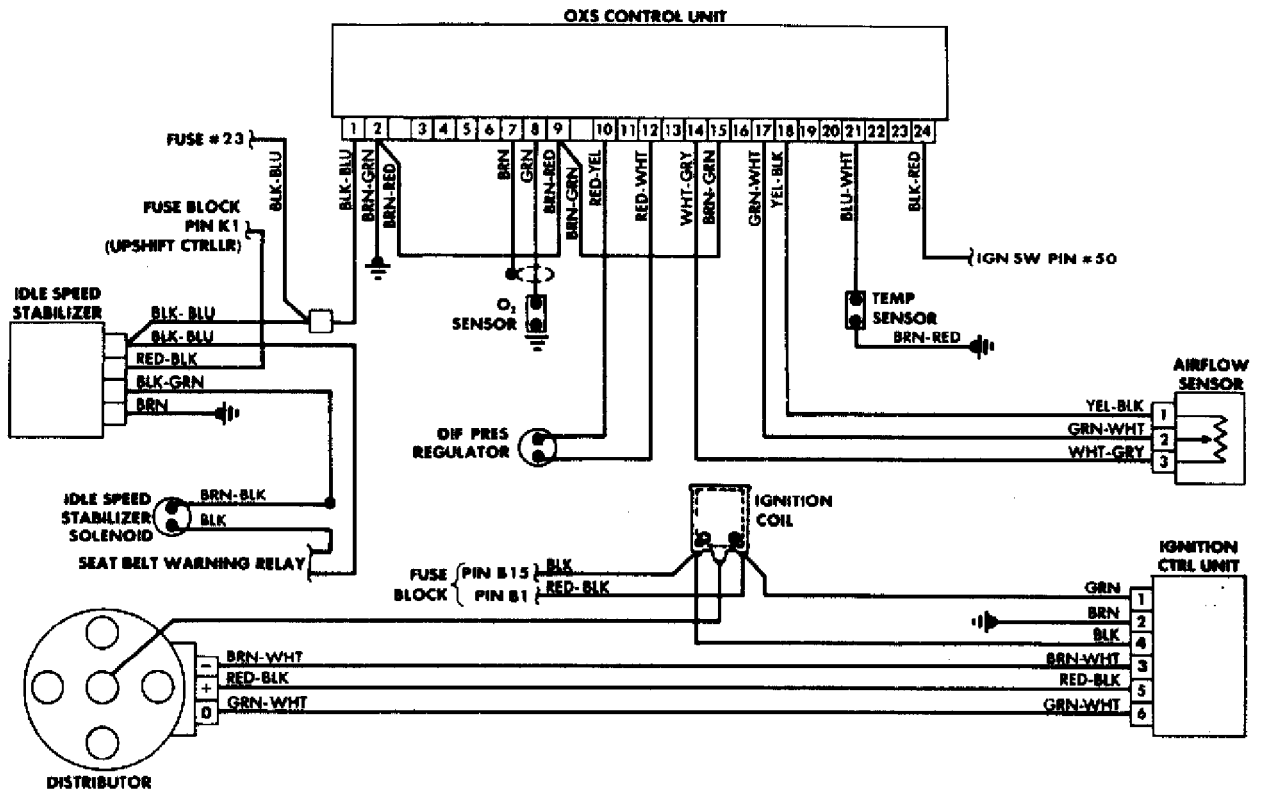


Fig. 17: Fox CIS-E Wiring Diagram

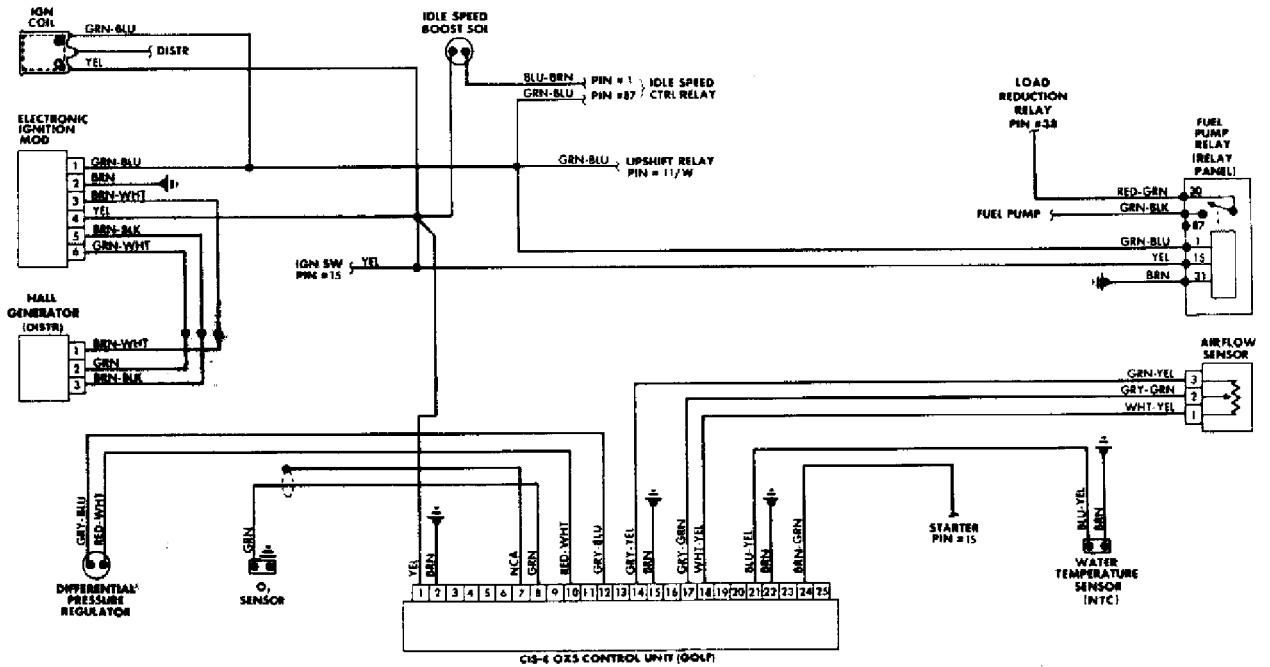


Fig. 18: Golf CIS-E Wiring Diagram

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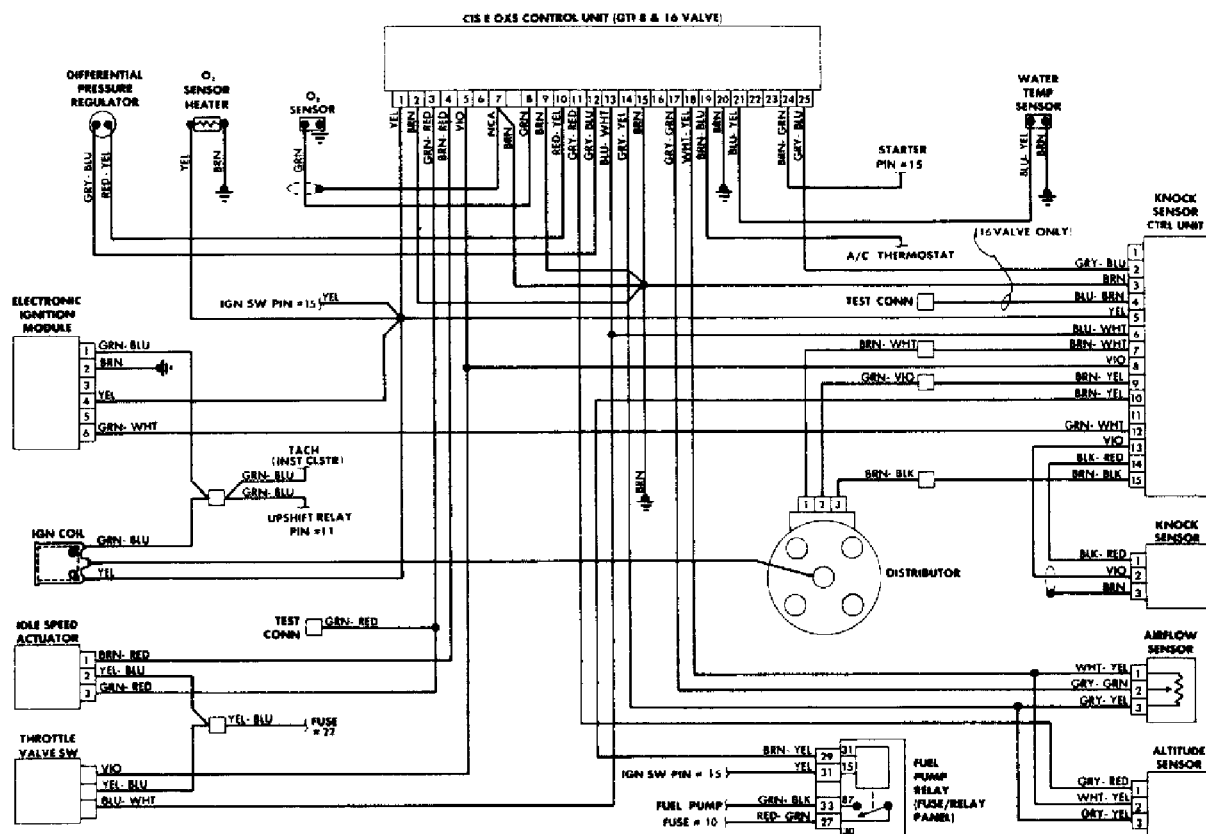


Fig. 19: Volkswagen GTI CIS-E Wiring Diagram

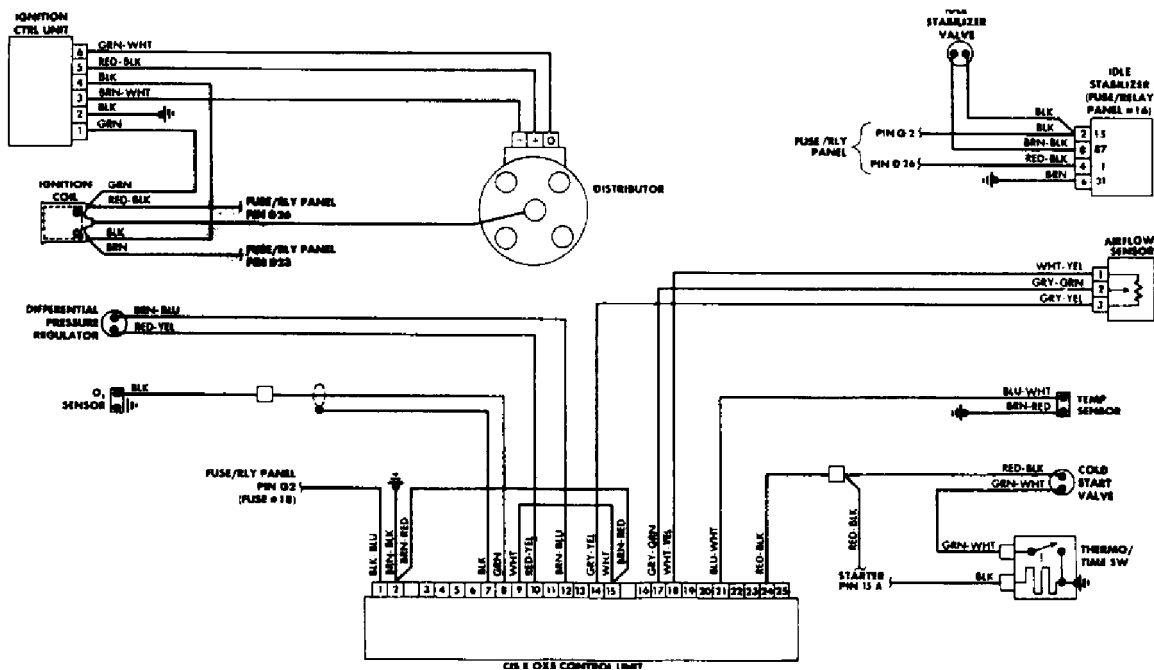


Fig. 20: Jetta & Jetta GLI (8-Valve) CIS-E Wiring Diagram

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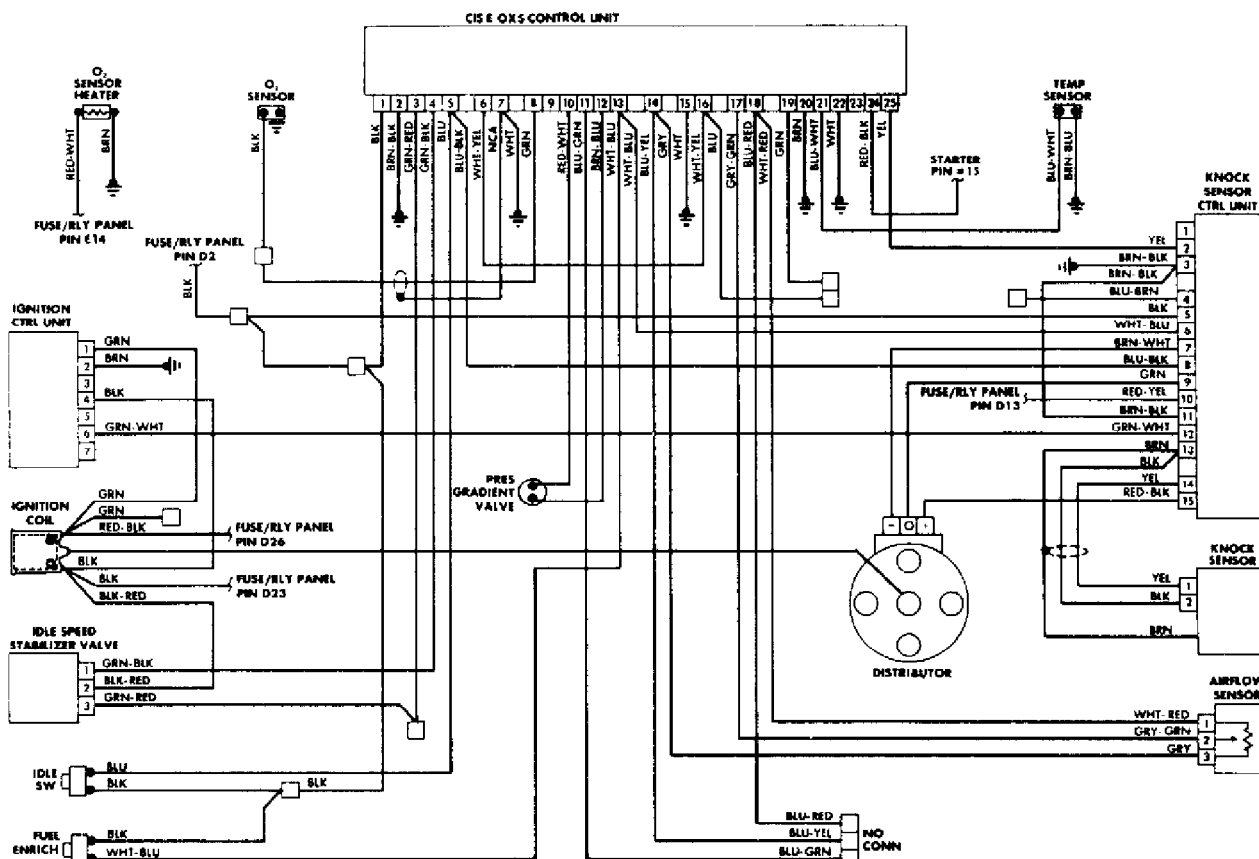


Fig. 21: Jetta GLI (16-Valve) CIS-E Wiring Diagram

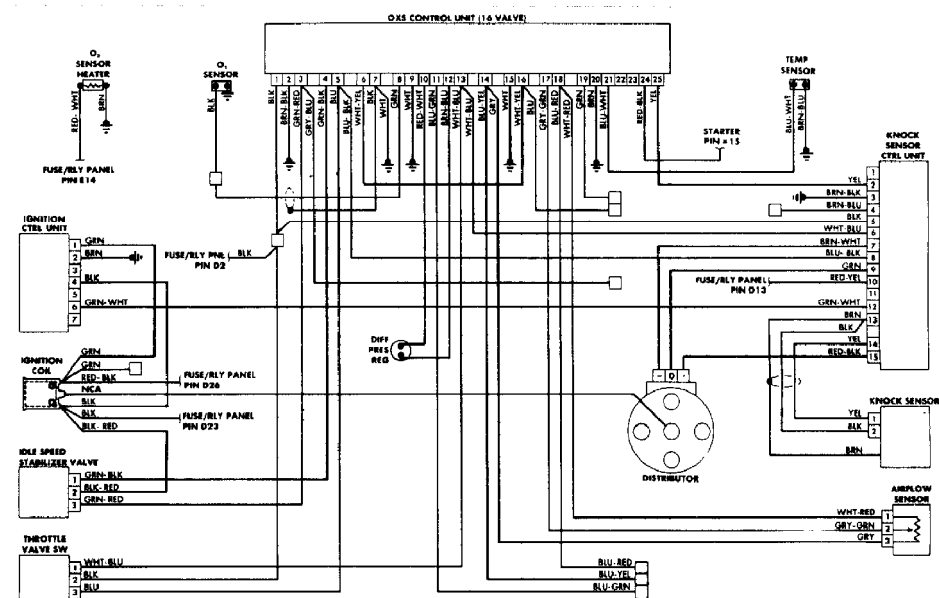


Fig. 22: Scirocco (16-Valve) CIS-E Wiring Diagram

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