

IGNITION SYSTEM - BOSCH HALL EFFECT

Article Text

1987 Volkswagen Quantum/Quantum Syncro

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ARTICLE BEGINNING

DISTRIBUTORS & IGNITION SYSTEMS

Bosch Hall Effect Electronic Ignition

DESCRIPTION

The typical Bosch Hall Effect electronic ignition system consists of an ignition coil, distributor with Hall Effect sending unit, Hall Ignition Control Unit (ICU) vacuum and centrifugal advance mechanisms (some models).

The Volkswagen Jetta GLI, GTI and 16-valve models also incorporate a knock control unit.

OPERATION

The Hall Effect sending unit in the distributor receives voltage from the knock control unit or directly from the electronic Ignition Control Unit (ICU). A trigger wheel (shutter blades) mounted on the distributor shaft passes in and out of the air gap of the Hall Effect sending unit, resulting in signal pulses. See Fig. 6. There is one trigger wheel shutter/window for each engine cylinder.

On models without timing/knock control units, vacuum and centrifugal advance mechanisms are used. Signals from the distributor Hall sending unit are sent back to the Hall control unit, which opens and closes the primary circuit to the ignition coil, firing the spark plugs.

On models utilizing a knock control unit, vacuum and centrifugal advance mechanisms are not used. The distributor Hall sending unit signal goes directly to the knock control unit which modifies the trigger signal to the ignition coil based on RPM, knock sensor input, and vacuum. On Volkswagen 16-valve models, throttle switch position signal is also used.

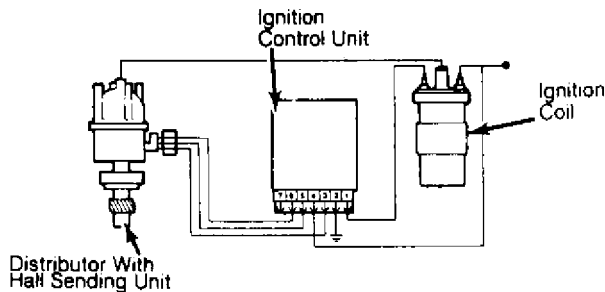


Fig. 1: Typical Hall Effect System Schematic (W/O Knock Unit)
Courtesy of Audi of America, Inc.

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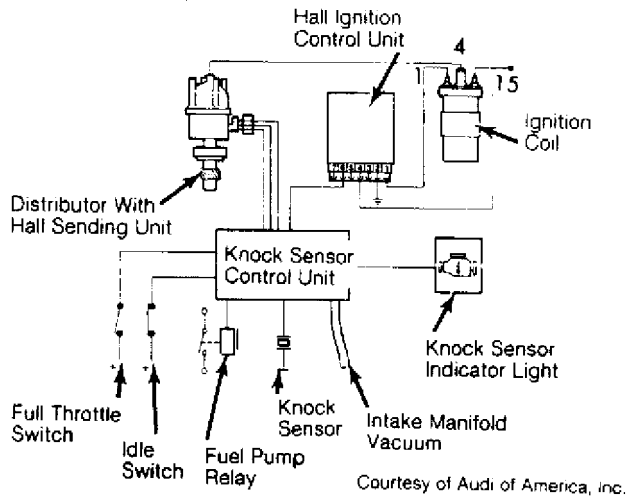


Fig. 2: Typical Hall Effect System Schematic (With Knock Unit)
Courtesy of Audi of America, Inc.

ADJUSTMENTS

No adjustments, except spark plug gap and base timing, are necessary as all advance functions are computer controlled.

PRE-TEST PROCEDURES

- 1) Ensure battery is fully charged before making tests. Ensure there is fuel in tank. Check all ignition wiring. Remove any spark plug wire and connect test spark plug to wire. Test spark plug must have electrode gap set at .16" (4 mm). Ensure spark plug is well grounded.
- 2) Crank engine. If spark is present, check ignition timing and adjust if necessary. Check fuel system to ensure engine is receiving sufficient fuel. If not, repair fuel system.
- 3) DO NOT connect any condenser to terminal No. 1 of ignition coil. Connect and disconnect test instruments only when ignition is off. DO NOT touch or remove high tension wires when engine is running or cranking.
- 4) Disconnect ignition wires only when ignition is off. DO NOT crank engine unless high tension wire is removed from distributor cap and grounded with a jumper wire.
- 5) DO NOT use a battery charger for more than one minute with battery cables connected or exceed 16.5 volts while charging.

TROUBLE SHOOTING

NOTE: See the TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

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TESTING

NOTE: To eliminate possible damage to electronic components, a voltmeter with minimum 10 megaohm input impedance should be used for all voltage checks.

VACUUM ADVANCE TEST

Connect timing light to engine. Start and run engine at idle. Verify idle speed and base timing are set to specification. Disconnect and plug vacuum hoses at distributor advance and retard diaphragms (if equipped). Increase engine speed to 2500 RPM. Check ignition timing. Connect vacuum hose and verify that ignition timing advances.

CENTRIFUGAL ADVANCE TEST

Connect timing light to engine. Start and run engine at idle. Verify idle speed and base timing are set to specification. Disconnect and plug vacuum hoses from distributor vacuum advance and retard diaphragms (if equipped). Check ignition timing. Gradually increase engine speed and check that ignition timing advances.

VACUUM RETARD TEST

1) Connect tachometer and timing light to engine. Connect Vacuum Advance Tester (VAG 1368) according to manufacturer's instructions. Remove both plugs from idle stabilizer (if equipped) and connect together.

2) Start and run engine at 900 RPM. Disconnect vacuum advance hose from unit and check ignition base timing and idle speed. Adjust if necessary. Disconnect vacuum retard hose from unit. Plug hose.

3) Bring base timing mark back to pointer by using dial on timing light and read vacuum retard. Retard should be 8-11 degrees. After testing, reconnect idle stabilizer plugs. Reconnect vacuum hoses.

IGNITION COIL RESISTANCE CHECK

1) Using ohmmeter, check ignition coil primary and secondary resistance. Disconnect coil primary and secondary ignition leads. Connect ohmmeter leads across primary terminals No. 1 and 15 at coil. Note primary resistance value.

2) Move ohmmeter lead from positive terminal (No. 15) and insert into coil high voltage tower. Note secondary resistance value. If resistance values are not to specification, replace ignition coil.

IGNITION COIL RESISTANCE (Ohms) TABLE

AA

Application	Primary	Secondary
Except 16-Valve52-.76	2400-3500
16-Valve6-.8	6500-8500

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AA

0.52-0.76 Ohms



2.4-3.5 Ohms



Fig. 3: Ignition Coil Resistance Check
Courtesy of Audi of America, Inc.

SPARK PLUG WIRES & ROTOR

1) Check coil wire resistance. If radio suppression wires are used, reading should be 1200-2800 ohms. If not, reading should be zero ohms.

2) Check resistance of spark plug wires. If radio suppression wires are used, reading should be 4600-7400 ohms. If not, reading should be 600-1400 ohms. Check spark plug connectors. If radio suppression connectors are used, reading should be 4000-6000 ohms. If not, reading should be 600-1400 ohms.

3) Check rotor and spark plug wire distributor cap connectors. Resistance should be 600-1400 ohms. Ensure rotor is marked "R1".

IGNITION CONTROL UNIT (ICU)

1) Remove connector from Ignition Control Unit (ICU) located above glove box or behind left kick panel and connect voltmeter to connector terminals No. 2 and 4. Turn ignition on. Voltage should read about 12 volts. If voltage is not present, repair open in terminal No. 2 (ground circuit) or open or short in circuit No. 15 (wire from positive side of ignition coil).

2) Reconnect ICU connector. Disconnect coil wire from distributor cap center terminal and connect to ground using a jumper wire. Remove protective cover to gain access to rear of control unit connector.

3) Connect digital voltmeter across rear of connector at terminals No. 3 and 6 of the control unit (4 and 6 on models with knock control unit, 2 and 6 on Volkswagen 16-valve). Turn ignition switch to "START" position. Voltage should be displayed while cranking engine. If NO voltage is displayed, see HALL EFFECT SENDING UNIT test.

4) Turn ignition off. On Volkswagen 16-valve models, disconnect 15-wire connector of knock control unit. Disconnect 3-wire connector from distributor on all other models. Connect positive

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voltmeter lead to terminal No. 15 of coil. Connect negative voltmeter lead to terminal No. 1 of coil.

5) Turn ignition on. Voltmeter should show voltage and must drop to zero volts within 1-2 seconds. If voltage does not drop, replace Hall control unit. If voltage drops, install short jumper lead to center terminal of distributor 3-wire connector (terminal No. 12 of knock control unit on Volkswagen 16-valve models). Lightly tap lead to ground. Voltage must rise to a minimum of 2 volts for a short time. If voltage rise is not indicated, replace Hall control unit.

HALL SENDING UNIT

Voltage Supply Check (Without Knock Control Unit)

1) Remove 3-wire connector from Hall sending unit at distributor. Connect voltmeter to the outside connector terminals. With ignition on, 9-12 volts should be indicated.

2) If voltage is not correct, check harness between control unit and hall sending unit for open or short. If no open or short exists, access rear of ignition control unit connector. With ignition on, check voltage on terminals No. 4 and 5 of ignition control unit. See Fig. 4. If no voltage is present at either terminal, check voltage supply to and from ignition coil terminal No. 15. of knock control unit.

Voltage Supply Check (With Knock Control Unit)

1) Remove 3-wire connector from distributor unit. Connect voltmeter to the outside terminals. With ignition on, 5-12 volts should be indicated.

2) If voltage is not correct, check Hall Effect harness for open or short. Check terminal No. 3 of knock control unit for continuity to ground. Check voltage supply from terminal No. 15 of knock control unit.

3) If voltage is present on both terminals, check ignition control module terminal No. 2 for continuity to ground. If voltage is indicated on terminal No. 4 only, control unit is faulty.

Hall Sending Unit Test (Without Knock Control Unit)

1) Perform Hall sending unit VOLTAGE SUPPLY CHECK. Turn ignition off. With 3-wire connector installed at distributor, move protective cover to gain access to rear of connector.

2) Remove distributor cap, rotor and dust cover. Connect voltmeter across terminals No. 1 and 2 at rear of 3-wire connector. Turn ignition on.

3) Turn crankshaft until trigger wheel blade blocks Hall sender. See Fig. 5. Voltmeter reading should be greater than 4.0 volts. Turn crankshaft until trigger wheel slot is fully aligned with Hall sending unit. Voltmeter should read 0-.5 volts.

4) If voltmeter readings do not show a voltage difference while testing, replace Hall sending unit. If voltmeter readings are correct, check for same voltage readings at terminals No. 5 and 6 of the Hall ignition control unit (4 and 6 on models with knock control unit, 2 and 6 on Volkswagen 16-valve). If readings are not identical,

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check wire harness from Hall sending unit to ignition control unit.

Hall Sending Unit Test (With Knock Control Unit)

1) Perform Hall sending unit VOLTAGE SUPPLY CHECK. Turn ignition off. With 3-wire connector installed at distributor, move protective cover to gain access to rear of connector.

2) Connect voltmeter across terminals No. 1 and 2 at rear of 3-wire connector. Remove coil high voltage lead and ground with jumper wire.

3) Turn ignition switch to "START" position. Voltage should be indicated while starter is actuated.

4) If voltmeter does not show voltage reading while cranking, replace Hall sending unit. If voltmeter shows voltage while cranking, check for same voltage readings at Hall Ignition Control Unit terminals No. 4 and 6 (2 and 6 on Volkswagen 16-valve).

5) If readings are not identical, check wire harness from Hall sending unit to knock control unit and from knock control unit to Hall ignition control unit. See Fig. 4.

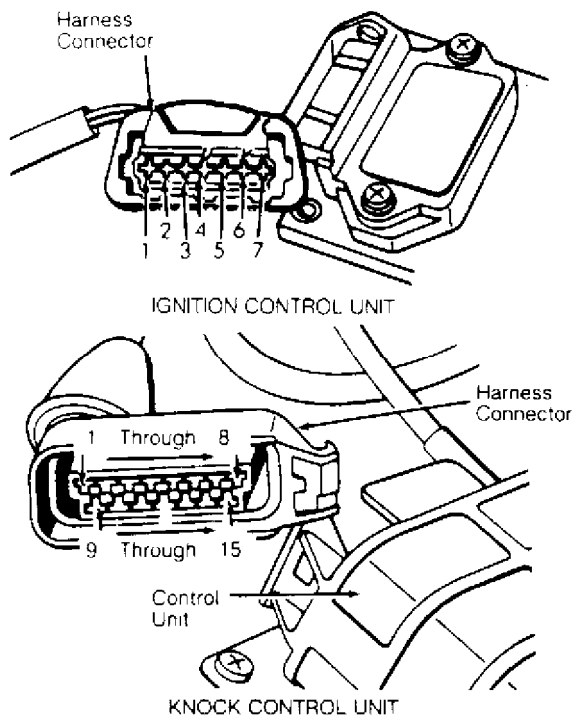


Fig. 4: 7-Pin ICU Connector & 15-Pin Knock Sensor Connector
Courtesy of Volkswagen United States, Inc.

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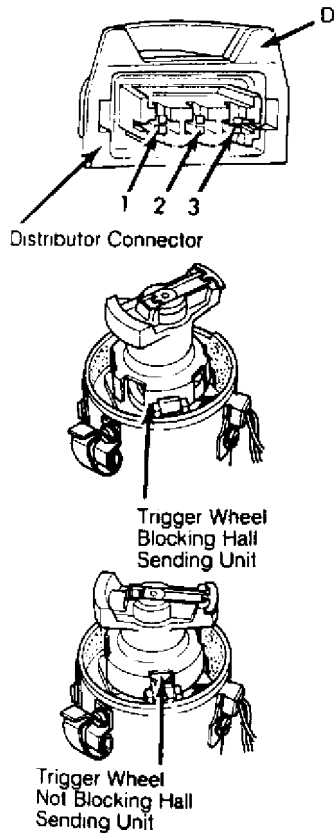


Fig. 5: Positioning Distributor for Hall Effect Testing
Courtesy of Audi of America, Inc.

KNOCK SENSOR CONTROL UNIT

NOTE: For complete testing of Volkswagen knock control system (except Volkswagen 16-valve models), manufacturer recommends the use of Special System Tester.

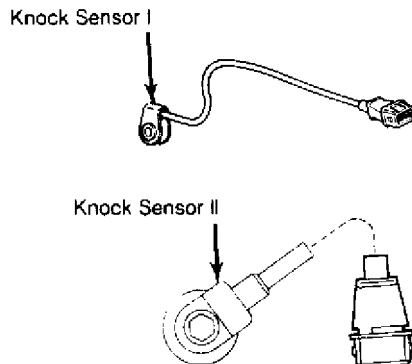


Fig. 6: Knock Sensor Identification
Courtesy of Audi of America, Inc.

Voltage Tests (Volkswagen 16-Valve)

1) Perform HALL ELECTRONIC IGNITION CONTROL UNIT (ICU) test.

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Turn ignition off. Disconnect knock sensor control unit 15-wire connector. Turn ignition on. Check voltage between terminals No. 3 and 5 of 15-wire connector. Reading should be approximately battery voltage.

2) Measure voltage between terminals No. 3 and 6 of 15-wire connector. Voltage should read about battery voltage. Open throttle valve. Voltage should drop to zero volts. If voltage does not drop, check idle switch.

3) Measure voltage at terminals No. 3 and 8 while slowly opening throttle. As throttle reaches full open position, battery voltage should be indicated. If battery voltage is not indicated, check full throttle switch.

4) Turn ignition off. Reconnect knock control unit 15-wire connector. Disconnect Hall distributor sending unit 3-wire connector.

5) Connect positive voltmeter lead to terminal No. 15 of coil. Connect negative voltmeter lead to terminal No. 1 of coil. Install short jumper lead to center terminal of distributor 3-wire connector.

6) Turn ignition on. Voltmeter should show voltage and should drop to zero volts within 1-2 seconds. Lightly tap lead to ground. Voltage should rise to a minimum of 2 volts for a short time. If voltage rise is not indicated, replace knock control unit.

Continuity & Resistance Tests (Volkswagen GLI & GTI)

1) With ignition off, disconnect knock sensor control unit. Connect voltmeter negative lead to terminal No. 3 and positive lead to terminal No. 5 at connector. Turn ignition on.

2) Meter should indicate battery voltage. If no voltage is present, check fuse No. 18 on fuse block. If okay, check ground connection at intake manifold. Check wire No. 5 to ignition switch.

3) Connect voltmeter negative lead to terminal No. 3 and positive lead to terminal No. 8 at connector. Turn ignition on. Actuate full throttle switch. Meter should indicate battery voltage.

4) If no voltage is present, voltage supply (center wire) to throttle switch is open. If not, full throttle switch is defective. Replace full throttle switch.

5) Connect voltmeter negative lead to terminal No. 3 and positive lead to terminal No. 6 at connector. Turn ignition on. Meter should indicate battery voltage. If no voltage is present, wire to idle switch is open. If not, idle switch is improperly adjusted and/or defective.

6) Connect voltmeter negative lead to terminal No. 3 and positive lead to terminal No. 10 at connector. Turn ignition on. Meter should indicate battery voltage. If no voltage is present, wire to fuel pump relay is open. Repair wire as necessary.

7) Turn ignition off. Connect ohmmeter between connector terminals No. 2 and 3. Ensure CIS-E fuel control unit is connected. Ohmmeter reading must be 90,000-100,000 ohms. If reading is incorrect, wire No. 2 to CIS-E control unit is open. If not, CIS-E control unit is defective.

8) Connect ohmmeter between connector terminals No. 3 and 4. Connect test connector in engine compartment to ground. Ohmmeter

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should indicate continuity to ground.

9) Connect ohmmeter between connector terminals No. 3 and 11. Ohmmeter should indicate continuity. If no continuity is indicated, ground wire between terminals No. 3 and 11 is open. On some models terminal No. 11 may not be used.

10) Connect ohmmeter between connector terminals No. 3 and 12. Disconnect Hall control unit and install a jumper wire between terminals No. 2 and 6. Ohmmeter should indicate continuity.

11) Connect ohmmeter between connector terminals No. 3 and 13. Ohmmeter should indicate one milliohm. If reading is incorrect, wires to knock sensor are open or knock sensor is defective.

12) Connect ohmmeter between connector terminals No. 13 and 14 to measure the resistance of the knock sensor. Ohmmeter should indicate approximately 300,000 ohms for a type I sensor and approximately infinity for a type II sensor. If reading is incorrect, wires to knock sensor are open or knock sensor is defective.

13) Connect ohmmeter between connector terminals No. 7 and 15. Disconnect Hall Effect sending unit and install a jumper wire between terminals No. 1 and 3. Ohmmeter should indicate continuity.

14) Connect ohmmeter between connector terminals No. 7 and 9. Disconnect Hall Effect sending unit and install a jumper wire between middle terminal (Green/Purple wire) and outer terminal (Brown/White wire). Ohmmeter should indicate continuity.

Fault Diagnosis (Volkswagen 16-Valve)

1) Connect voltmeter positive lead to positive post of battery. Connect voltmeter negative lead to single Blue/Brown or Brown/Blue wire connector in engine compartment (pin No. 4 of knock control unit). Turn ignition on. Voltmeter should indicate near battery voltage. Start engine. Voltage on meter should drop (a slight voltage signal may remain).

2) Accelerate engine to 3000 RPM (one time only). If voltage remains near zero volts, test is completed. If higher voltage signal returns, a knock fault has been detected. Connect a jumper wire to Blue/Brown connector. Hold jumper to ground for a minimum of 3 seconds and then remove. Voltmeter should start pulsing at this time.

3) If meter pulses in a pattern of 2 per interval, the knock sensor control unit or knock sensor circuit is faulty. Check knock sensor torque. Check for open or short circuit in knock sensor wiring. If knock sensor torque is correct and wiring is okay, knock sensor is defective. Connect ohmmeter across connector to knock sensor. Resistance should measure 300,000 ohms on type-1 knock sensor. Resistance should measure infinity on type-2 knock sensor.

4) If meter pulses in a pattern of 3 per interval, fault exists in pressure sensor (vacuum) circuit. Check White vacuum hose to knock sensor control unit for damage. If no faults are found, internal pressure sensor in knock unit is faulty.

Timing Advance Test (Volkswagen 16-Valve)

1) Perform KNOCK CONTROL FAULT DIAGNOSIS test. If knock sensor circuit is okay, ensure terminal No. 11 at ignition control unit is being used and grounded. Connect Timing Tester (VW 1367).

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Start and run engine at idle. Base ignition timing will be indicated on tester. Adjust if necessary.

2) With engine running, pull vacuum hose off ignition control unit. Increase engine speed to 4300 RPM (engine code RD). Note reading on tester. To determine ignition timing advance, subtract base ignition timing from reading.

3) Ignition timing advance should be 14-16 degrees. If timing is incorrect, check ground wire at terminal No. 11 of ignition control unit connector. If wire is okay, ignition control unit is defective.

IDLE & FULL THROTTLE SWITCH (VOLKSWAGEN 16-VALVE)

Switch Voltage Supply Test

1) Unplug common connector (Black wire) to throttle switches. Turn ignition on. Check voltage between ground and terminal from CIS-E control unit.

2) Voltmeter reading should be 12 volts. Turn ignition off. If reading is incorrect, check for open circuit in wiring between throttle switches and terminal No. 1 of CIS-E control unit. Repair as necessary.

3) If wiring is not faulty, check voltage supply to terminal No. 1 of CIS-E control unit (relay panel pin D2).

Switch Continuity Test

1) Ensure ignition is off. Remove electrical connector CIS-E control unit. Connect ohmmeter between idle switch terminals No. 1 and No. 5.

2) Manually operate throttle linkage from closed to half-throttle positions. When throttle is closed continuity should exist. When throttle is open continuity should not exist.

3) Reconnect ohmmeter leads across CIS-E connector full throttle switch terminals No. 1 and 13. Manually operate throttle linkage from closed to full throttle. When full throttle is reached, continuity should exist.

4) If continuity does not change as indicated or continuity is constant, inspect wiring from control unit to throttle switches. If wiring is not faulty, replace defective switches.

END OF ARTICLE