

# ANTI-LOCK BRAKE SYSTEM

## Article Text

1991 Volkswagen Passat

For Volkswagen Technical Site

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### ARTICLE BEGINNING

1990-92 BRAKES

Volkswagen Anti-Lock Brake System

Corrado, Jetta, Passat

### DESCRIPTION

All models use a Teves Anti-Lock Brake System (ABS). See Fig. 1. This system reduces the chance of wheel lock-up during heavy braking. The system consists of 4 wheel speed sensors, Electronic Control Unit (ECU), hydraulic modulator/pump and solenoid valves, ANTI-LOCK warning light and BRAKE warning light. There are 2 relays located at fuse/relay panel, to protect the hydraulic modulator and ECU.

NOTE: For more information on brake system, see appropriate BRAKE SYSTEM article.

### OPERATION

When pressure is applied to brake pedal, the ECU monitors input signals from each wheel speed sensor. If ECU measures a rate of reduction greater than what is programmed in ECU, the ECU will output a signal to appropriate solenoid valve. Each solenoid valve allows hydraulic pressure to increase or decrease to the appropriate wheel cylinder.

If a system failure occurs, the ANTI-LOCK warning light, located on instrument panel, will come on. System will be deactivated, but conventional brake system will still operate. If brake fluid level drops too low, BRAKE warning light, located on instrument panel, will come on.

### ANTI-LOCK BRAKE SAFETY PRECAUTIONS

- \* NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized,
- \* NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
- \* Only use specially designed brake hoses/lines on ABS equipped vehicles.
- \* DO NOT tap on speed sensor components (sensor, sensor rings). Speed rings must be pressed, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
- \* DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires (and spare tire also). Some manufacturers recommend tires of the same brand,

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 2)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.

- \* DO NOT contaminate speed sensor components with grease. Only use recommended anti-corrosion coating.
- \* When speed sensor components have been removed, ALWAYS check sensor-to-ring gap when applicable. These specifications can be found in WHEEL SPEED SENSOR under ADJUSTMENTS.
- \* ONLY use recommended brake fluids. DO NOT use silicone brake fluids in an ABS equipped vehicle.
- \* When installing transmitting devices (CB's, telephones, ect.) on ABS equipped vehicles, DO NOT locate antenna near the ABS control unit or any control unit.
- \* Disconnect all on-board computers when using electric welding equipment.
- \* DO NOT expose the ABS control unit to prolonged periods of high heat (185°F/85°C for 2 hours is generally considered a maximum limit).

**CAUTION:** The ABS system is under extremely high pressure. Depressurize the brake system before loosening or removing any hydraulic component.

### DEPRESSURIZING BRAKE SYSTEM

Turn ignition off. Depress and release brake pedal 25-35 times, or until there is a noticeable increase in the effort to depress the brake pedal. Do not turn ignition on until all hydraulic lines and components are fully tighten.

### BLEEDING BRAKE SYSTEM

#### FRONT BRAKES

Depressurize brake system. See DEPRESSURIZING BRAKE SYSTEM. Connect a container with hose to left front bleeder screw. Have assistant depress and release brake pedal a few times. Holding brake pedal down, open bleeder screw and allow fluid to enter container. Close bleeder screw and then release brake pedal. Continue this method until no air is present in fluid. Check master cylinder fluid level to make sure it does not go below minimum level mark. Use same procedure for right front brake.

#### REAR BRAKES

**CAUTION:** When bleeding rear brakes, accumulator pressure (about 3100 psi) is used to assist in procedure. Use eye protection when performing this procedure. DO NOT allow pump to run longer than 2 minutes. See ANTI-LOCK BRAKE SAFETY PRECAUTIONS in this article.

Attach hose and container to right rear bleeder screw.

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 3)

1991 Volkswagen Passat

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Wednesday, August 25, 1999 07:51PM

Position actuator lever on load-sensing pressure regulator toward rear of vehicle. Depress brake pedal and turn ignition on. Open bleeder screw and allow fluid to exit until no air is present in fluid. Close bleeder screw. Turn ignition off and release brake pedal. Perform same procedure for left rear brake. Ensure fluid level does not go below minimum level mark.

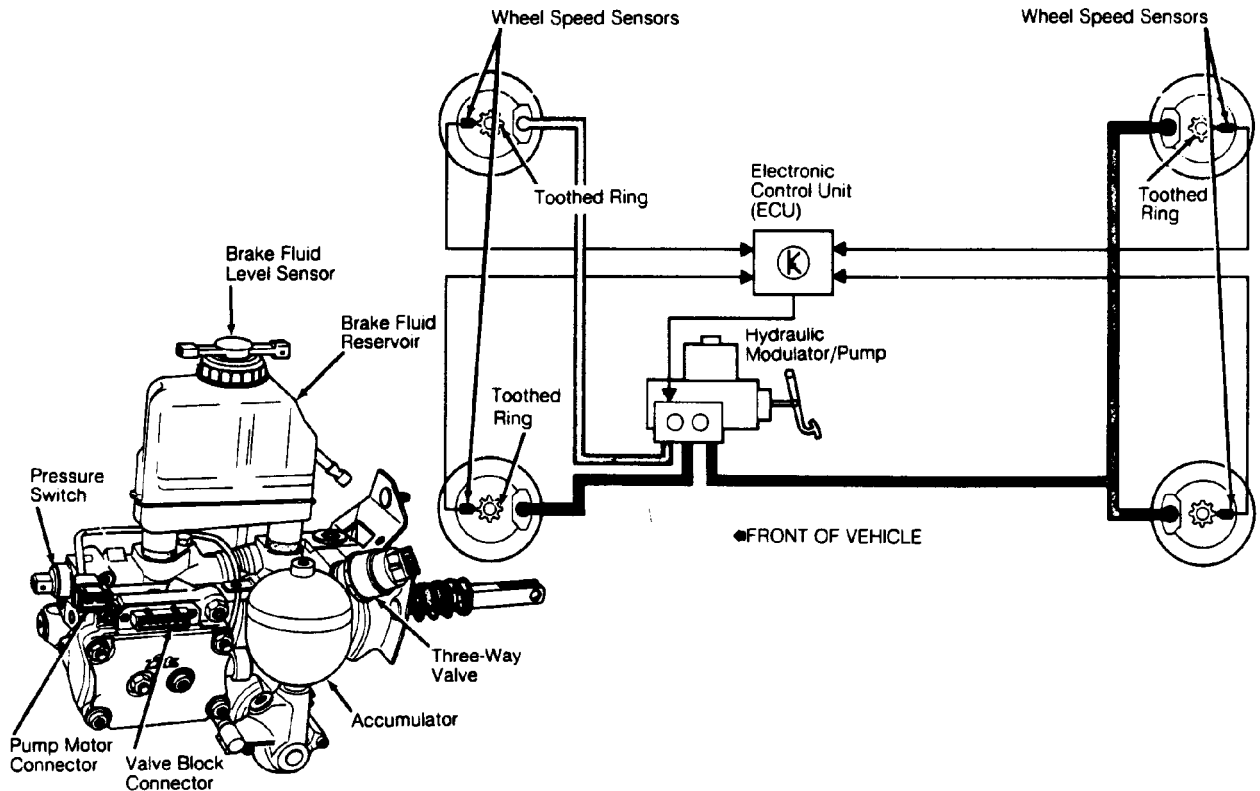


Fig. 1: Locating ABS Components  
Courtesy of Volkswagen United States, Inc.

## ADJUSTMENTS

### PARKING BRAKE

Raise vehicle and support securely. Release parking brake lever. Apply brake pedal once. Loosen lock nuts. Tighten each adjusting nut until lever on respective caliper lifts off stop. Measure gap between stop and lever. Do not move lever off stop more than .040" (1 mm). Tighten lock nuts. Ensure wheels lock at 3 notches.

NOTE: No other information on adjustments is available.

## TROUBLE SHOOTING

### HYDRAULIC MODULATOR/PUMP

Depressurize brake system. See DEPRESSURIZING BRAKE SYSTEM

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 4)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

Turn ignition on. Hydraulic modulator/pump should operate for 60 seconds maximum and then stop. Depress brake pedal a few times; pump should operate again for a few seconds. If pump motor does not operate, check electrical system. If pump motor operates for more than 60 seconds, internal or external hydraulic leak may be indicated. Check for external leaks. If external leak is not found, further testing may be needed to check for internal leaks.

### ANTI-LOCK WARNING LIGHT

Start engine. ANTI-LOCK warning light should come on, then turn off after a few seconds. If light does not come on when engine is started, check electrical system. If light comes on and stays on, fault has been detected by the ECU and testing will be needed. See SYSTEM TESTING under DIAGNOSIS & TESTING.

### DIAGNOSIS & TESTING

#### SYSTEM TESTING

**NOTE:** Check battery condition, brake fluid level, electrical connections and wiring for damage. If fluid level is incorrect or battery and/or electrical connections are faulty, correct problem before preceding. Perform each step, in sequence, to test entire system, except for ECU. If faulty ECU is suspected, replace with a known good one, and retest system. Unplug ECU connector for all test steps.

#### Power Voltage-To-ECU Test

Turn ignition off. Unplug ECU connector. Turn ignition on. Using a voltmeter, check voltage between ECU connector terminals No. 1 and 2. See Fig. 2. If voltage is 10 volts or more, go to next test. If voltage is less than 10 volts, check battery, ground, ABS fuse, relay and wiring. Repair as necessary.

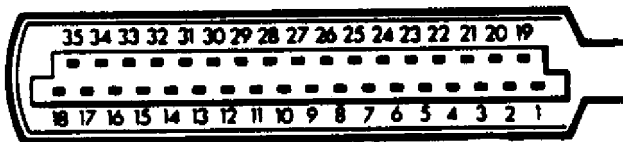


Fig. 2: Identifying ECU Connector Terminals  
Courtesy of Volkswagen United States, Inc.

#### ECU Relay Voltage Test

Connect a jumper wire between ECU connector terminals No. 2 and 8. See Fig. 2. Turn ignition on. Using a voltmeter, check voltage between ECU connector terminals No. 1 and 3. If voltage is 10 volts or more, go to next test. If voltage is less than 10 volts, check ABS fuse. If fuse is faulty, replace and retest. If fuse is okay, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest.

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 5)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

### Brakelight Switch

Turn ignition on. Apply brakes. Check for 12 volts between terminals No. 12 and 1. If 12 volts are present, brakelight switch is okay. If 12 volts are not present, check fuse, brakelight switch and Black/Red wire from brakelight switch to ECU.

### Hydraulic Modulator/Pump Relay Voltage Test

1) Turn ignition off. Unplug hydraulic modulator/pump connector. Depress brake pedal 25 times. Turn ignition on. Using a voltmeter, measure voltage between ECU connector terminals No. 1 and 32. See Fig. 2. If voltage is 10 volts or more, go to RIGHT REAR WHEEL SPEED SENSOR VOLTAGE TEST under SYSTEM TESTING.

2) If voltage is less than 10 volts, check hydraulic modulator/pump fuse. If fuse is okay, check wiring between ECU connector terminal No. 32 and hydraulic modulator/pump connector terminal No. 1 (large gauge Red/Black wire). See Figs. 2 and 4-9. If wiring is not okay, repair wiring, and retest. If wiring is okay, replace relay, and retest.

### Right Rear Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 4 and 22. See Fig. 2. Rotate right rear wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

### Left Rear Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 6 and 24. See Fig. 2. Rotate left rear wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

### Right Front Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 7 and 25. See Fig. 2. Rotate right front wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and improper installation. If damage or wear is found, replace faulty component, and retest. If component is improperly installed, reposition component, and retest. If components are okay, replace wheel speed sensor, and retest.

### Left Front Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 5

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 6)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

and 23. See Fig. 2. Rotate left front wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

### ECU Relay Continuity Test

Turn ignition off. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 3, and between terminals No. 1 and 20. See Fig. 2. If there is continuity at both test points, go to next test. If there is no continuity at either or both test points, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest.

### Solenoid Valves Ground Circuit Continuity Test

1) Turn ignition off. Remove jumper wire from previous test. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 11. See Fig. 2. If there is continuity, go to next step.

2) If continuity does not exist, check for continuity between ECU connector terminal No. 1 and valve block housing and between hydraulic modulator and valve block housing. If continuity does not exist between ECU connector terminal No. 1 and valve block housing, repair wiring, and retest. If continuity does not exist between housings, repair as necessary.

3) Reconnect jumper wire between ECU connector terminals No. 1 and 11. Check for continuity between ECU connector terminal No. 11 and valve block connector terminal No. 1 (Brown wire). See Figs. 2, 4-9. If there is no continuity, repair wiring and retest.

### Hydraulic Modulator/Pump Relay Ground Circuit Test

Turn ignition off. Reconnect pressure switch connector. Depress brake pedal 20 times. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 14. If continuity exists, go to next test. If continuity does not exist, check for continuity between pressure switch terminals No. 1 (Brown wire) and 4 (Red/Yellow or White wire). See Figs. 1 and 4-9. If continuity does not exist, replace pressure switch, and retest. If continuity exists, check wiring between ECU terminal No. 14 and pressure switch terminal No. 4. Repair wiring, and retest.

### Low Pressure Warning Switch Test

Turn ignition off. Ensure brake fluid level is okay and fluid level sensor switch float is in correct position (switch is in closed position). Ensure accumulator is fully charged and pump is not operating. Using an ohmmeter, check for continuity between ECU connector terminals No. 9 and 10. See Fig. 2. If there is continuity, switch is okay. If continuity does not exist, check wiring. If wiring is okay, replace switch, and retest.

# **ANTI-LOCK BRAKE SYSTEM**

## **Article Text (p. 7)**

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

### **Right Rear Wheel Speed Sensor Resistance Test**

Turn ignition off. Using an ohmmeter, measure resistance between ECU connector terminals No. 4 and 22. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at right rear wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor and retest.

### **Left Rear Wheel Speed Sensor Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 6 and 24. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at left rear wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor, and retest.

### **Right Front Wheel Speed Sensor Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 7 and 25. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at right front wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor and retest.

### **Left Front Wheel Speed Sensor Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 5 and 23. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at left front wheel speed sensor. If resistance is correct, repair wiring, and retest. If resistance is not correct, replace wheel speed sensor, and retest.

### **Right Rear Wheel Speed Sensor Shielding Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 4 and 1. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damage is found and retest.

### **Left Rear Wheel Speed Sensor Shielding Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 6 and 1. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damage is found and retest.

### **Right Front Wheel Speed Sensor Shielding Resistance Test**

Using an ohmmeter, measure resistance between ECU connector terminals No. 7 and 1. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damaged, and retest.

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 8)

1991 Volkswagen Passat

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Wednesday, August 25, 1999 07:51PM

### Left Front Wheel Speed Sensor Shielding Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 5 and 1. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damaged, and retest.

### ECU Relay Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 1 and 8. See Fig. 2. If resistance is 50-100 ohms, go to next test. If resistance is not as specified, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest. See Fig. 3.

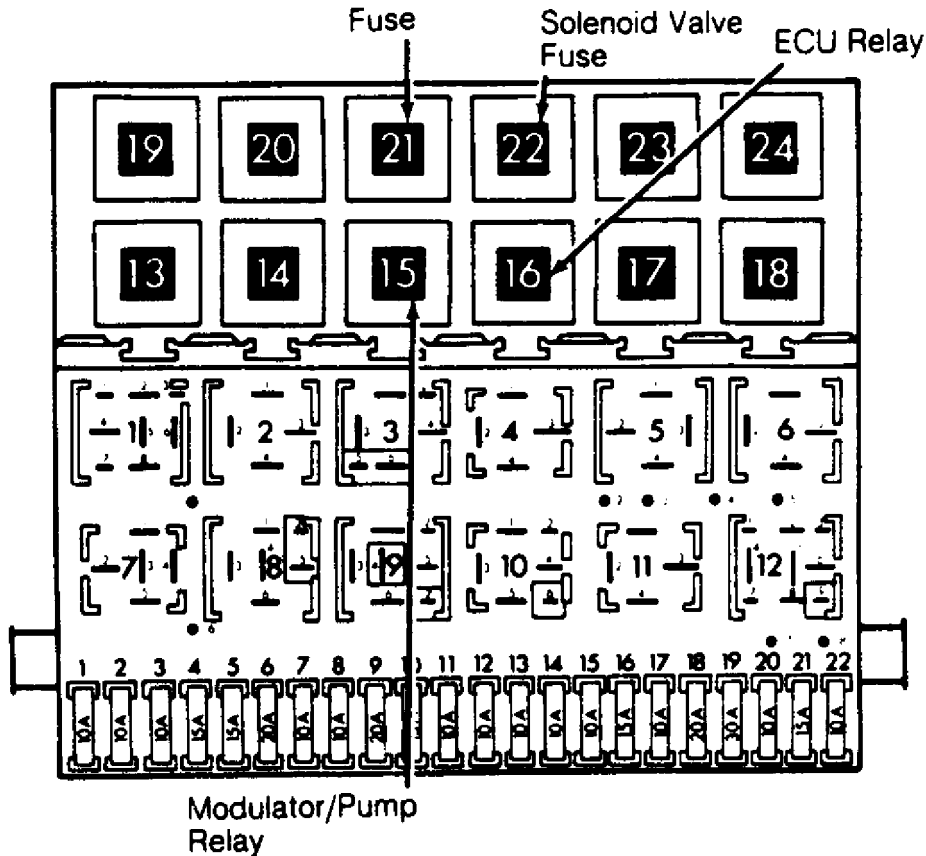


Fig. 3: Locating Relays

Courtesy of Volkswagen United States, Inc.

### ABS Main Valve Resistance Test

Using an ohmmeter, measure resistance between terminals at ABS main valve terminals. See Figs. 1 and 4-9. If resistance is 2-5 ohms, ABS main valve is okay. If resistance is not 2-5 ohms, replace hydraulic modulator.

### ABS Main Valve Continuity Test

Using an ohmmeter, check for continuity between ABS main valve terminal No. 1 (Black wire) and ECU connector terminal No. 18,

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 9)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

and between ABS main valve terminal No. 2 (Brown wire) and ground. See Figs. 1, 2, 4-9. There should be continuity at both test points. If there is no continuity at both test points, repair wiring and retest.

### Rear Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 17. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator block terminals No. 1 (Brown wire) and 5 (Gray wire). See Fig. 4-9. If resistance is 5-7 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

### Right Front Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 15. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and 2 (Yellow wire). See Fig. 4-9. If resistance is 5-7 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

### Left Front Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 35. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and 7 (Blue or Black/Green wire). See Figs. 4-9. If resistance is 5-7 ohms, check wiring between valve block and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

### Rear Hydraulic Modulator Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 33. See Fig. 2. If resistance is 3-5 ohms, go to next test. If resistance is not 3-5 ohms, measure between valve block terminals No. 1 (Brown wire) and 4 (White wire). See Fig. 4-9. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

### Right Hydraulic Modulator Block Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 34. See Fig. 2. If resistance is 3-5 ohms, go to next test. If resistance is not 3-5 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and 3 (Green wire). See Fig. 4-9. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

### Left Front Hydraulic Modulator Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 16. See Fig. 2. If resistance is 3-5 ohms, go to

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 10)

1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

next test. If resistance is not 3-5 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and 6 (Black/Blue wire). See Fig. 4-9. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

### Hydraulic Modulator/Pump Relay Resistance Test

Turn ignition off. Unplug pressure switch connector from hydraulic modulator. Using an ohmmeter, measure resistance between ECU connector terminals No. 2 and 14. See Fig. 2. If resistance is 50-100 ohms, go to next test. If resistance is not 50-100 ohms, check wiring. If wiring is faulty, repair wiring and retest. If wiring is okay, replace relay and retest.

### ABS Main Valve Function Test

Connect a jumper wire between ECU connector terminals No. 2 and 18. See Fig. 2. Depress brake pedal. Turn ignition on. Brake pedal should rise slightly. If brake pedal did not rise slightly, check wiring between terminals and hydraulic modulator. If wiring is okay, replace hydraulic modulator.

### Hydraulic Modulator/Pump Test

Turn ignition off. Depress brake pedal 25 times. Turn ignition on. BRAKE and ANTI-LOCK lights should come on for 2-60 seconds. Pump should operate for 2-60 seconds, then turn off. If lights do not come on, check wiring and warning light bulbs, and retest. Also check bulb(s). If lights come on, then turn off, and pump operates for 60 seconds maximum, then turns off, go to next test. If pump does not operate and all other preceding tests have been performed, replace hydraulic modulator/pump.

**CAUTION:** During VALVE BLOCK FUNCTION TESTS, DO NOT turn ignition on longer than 60 seconds during any test.

### Rear Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 17 and 33. See Fig. 2. Depress brake pedal. Rear wheels should be locked up. Turn ignition on. Rear wheels should rotate. If wheels do not rotate, replace hydraulic modulator. Turn ignition off.

### Right Front Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 15 and 34. See Fig. 2. Depress brake pedal. Right front wheel should be locked up. Turn ignition on. Right front wheel should rotate. If wheel do not rotate, replace hydraulic modulator. Turn ignition off.

### Left Front Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 16 and 35. See Fig. 2. Depress brake pedal. Left front wheel should be locked up. Turn ignition on. Left front wheel should rotate. If wheel do not rotate, replace hydraulic modulator. Turn ignition off.

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 11)

1991 Volkswagen Passat

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Wednesday, August 25, 1999 07:51PM

## REMOVAL & INSTALLATION

### HYDRAULIC MODULATOR/PUMP

#### Removal & Installation

1) Depressurize brake system. See **DEPRESSURIZING BRAKE SYSTEM**. Disconnect negative battery cable. Unplug all electrical connectors from hydraulic modulator/pump. Identify and disconnect all hydraulic lines from hydraulic modulator/pump. Plug all line openings.

2) From inside passenger compartment, remove push rod clevis pin. Remove hydraulic modulator/pump retaining nuts. Remove hydraulic modulator/pump. To install, reverse removal procedure. Tighten all fittings to specification. See **TORQUE SPECIFICATIONS TABLE** at end of article. Bleed brake system. See **BLEEDING BRAKE SYSTEM**.

### WHEEL SPEED SENSORS

**NOTE:** To protect magnetic part of sensor, always leave new wheel speed sensor in special packaging until ready for installation.

#### Removal & Installation

Remove bolt retaining wheel speed sensor. Unplug connector. Remove wheel speed sensor. To install, apply Lubricant (G-000-650) to sensor. Install sensor, and tighten retaining bolt to 84 INCH lbs. (10 N.m).

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS TABLE

Applications Ft. Lbs. (N.m)

Brake Lines-To-Hydraulic Modulator/Pump .....	11 (15)
Hydraulic Modulator/Pump Retaining Nuts .....	18 (25)

INCH Lbs. (N.m)

Wheel Sensor Retaining Bolt .....	84 (9.5)
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## WIRING DIAGRAMS

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 12)

### 1991 Volkswagen Passat

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Wednesday, August 25, 1999 07:51PM

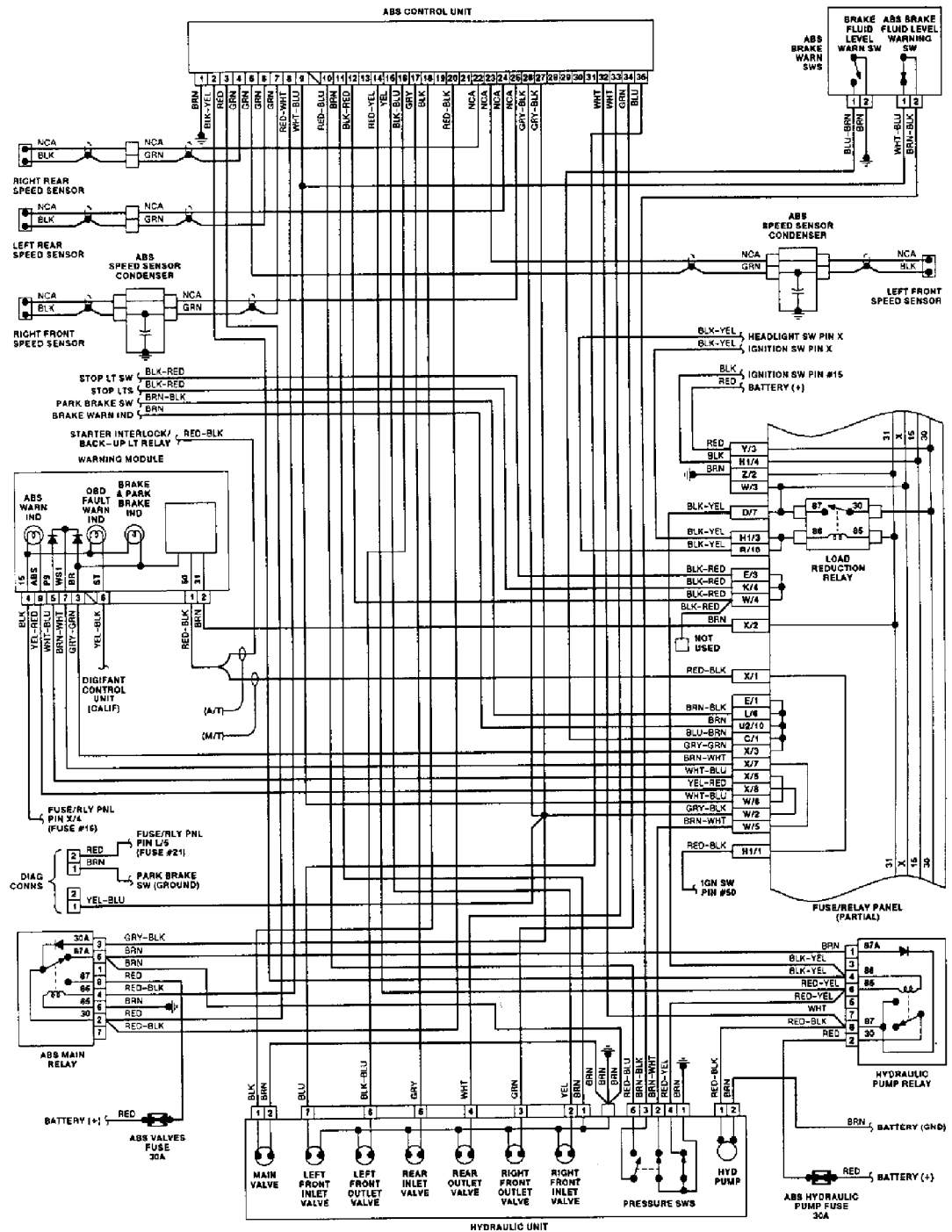


Fig. 4: Corrado ABS Wiring Diagram (1991)

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 13)

1991 Volkswagen Passat  
For Volkswagen Technical Site  
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Wednesday, August 25, 1999 07:51PM

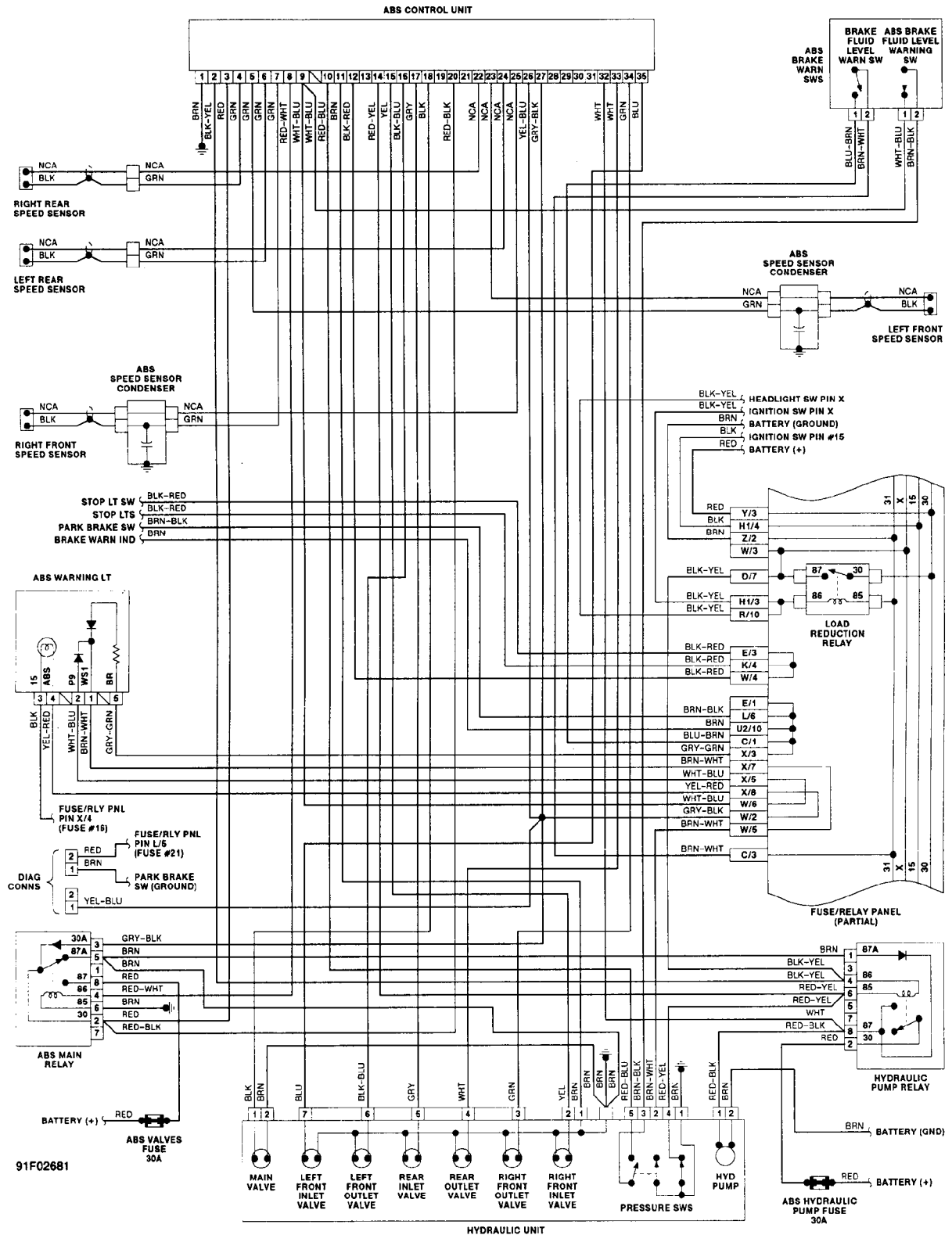


Fig. 5: Corrado ABS Wiring Diagram (1990)

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 14)

### 1991 Volkswagen Passat

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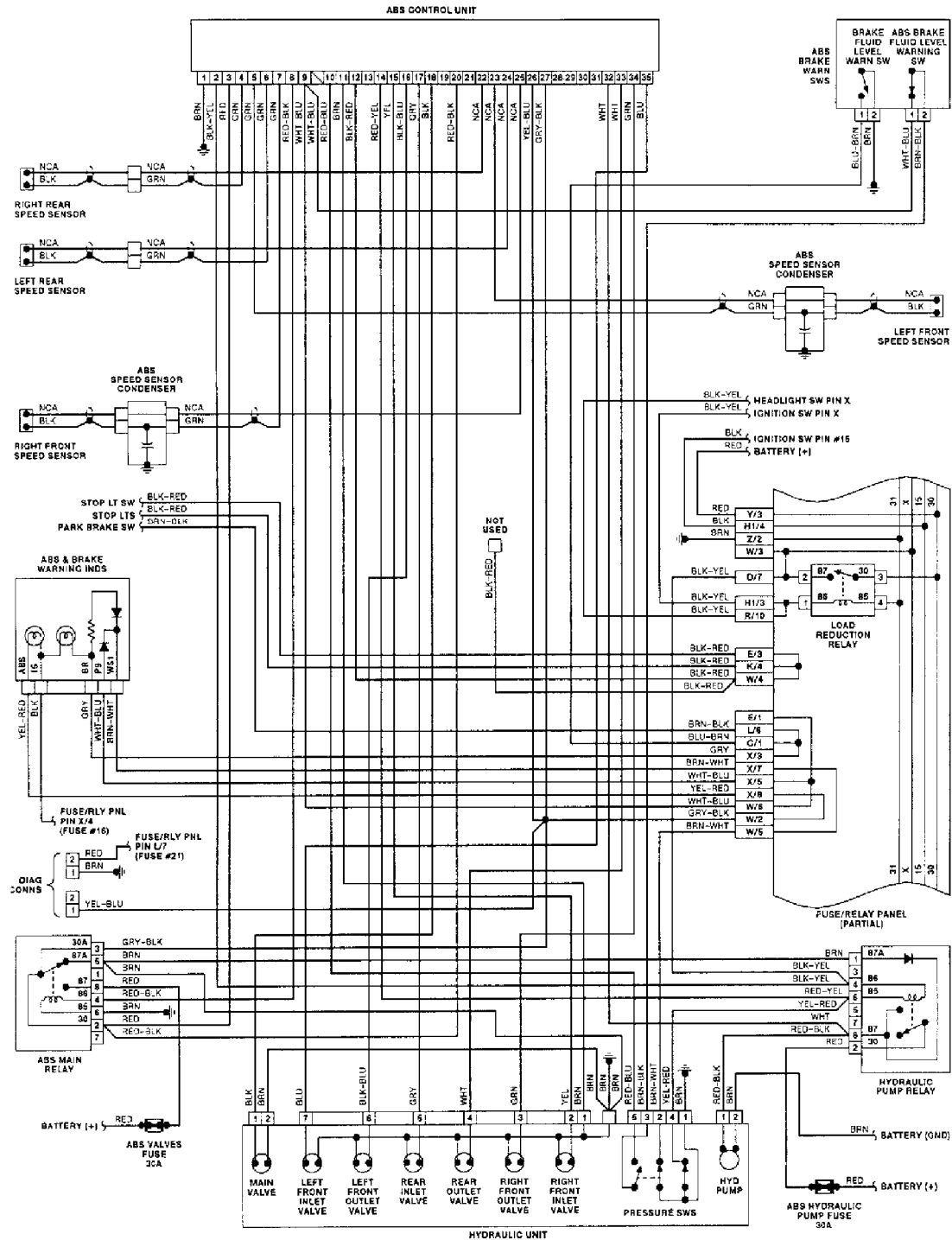


Fig. 6: Jetta ABS Wiring Diagram (1990-91)

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 15)

### 1991 Volkswagen Passat

For Volkswagen Technical Site

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Wednesday, August 25, 1999 07:51PM

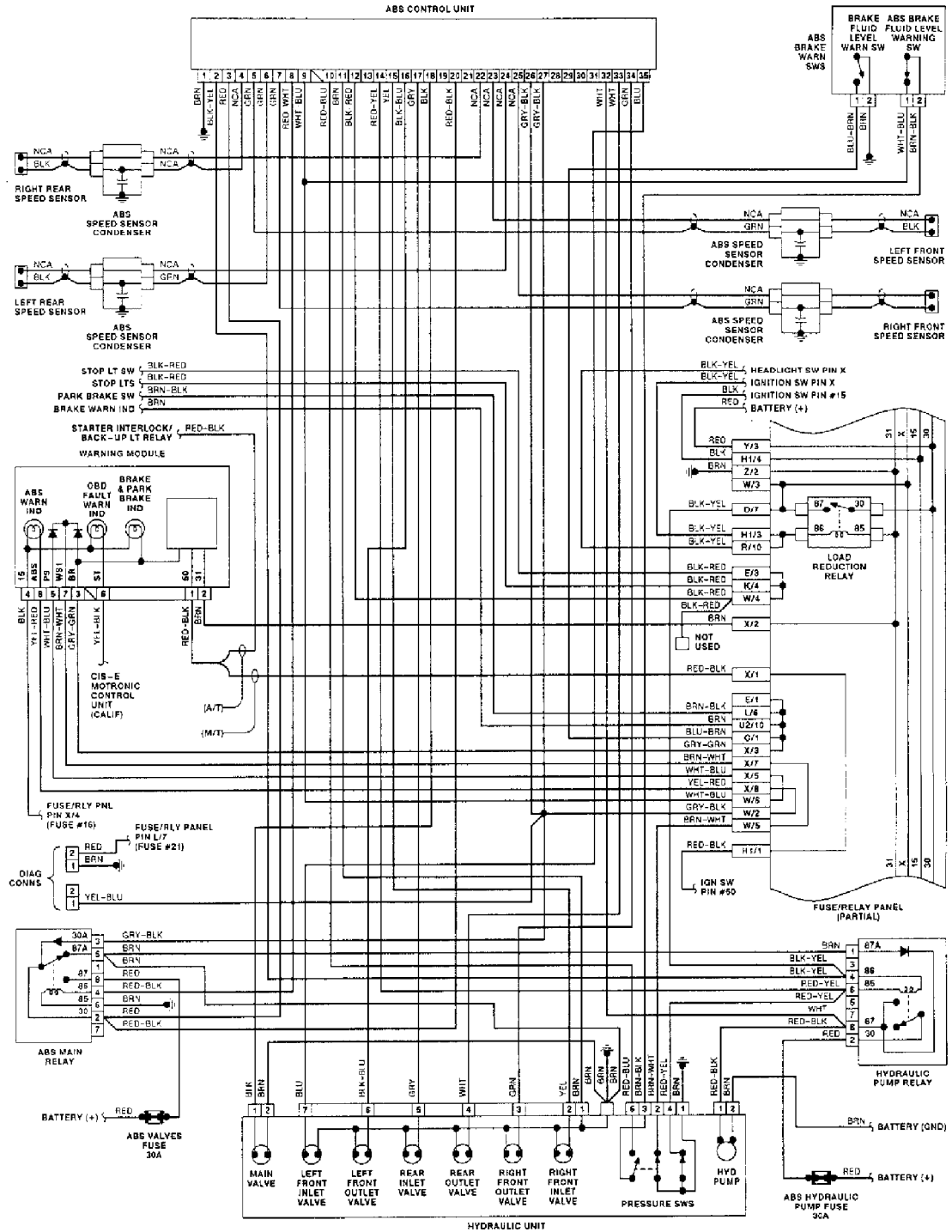
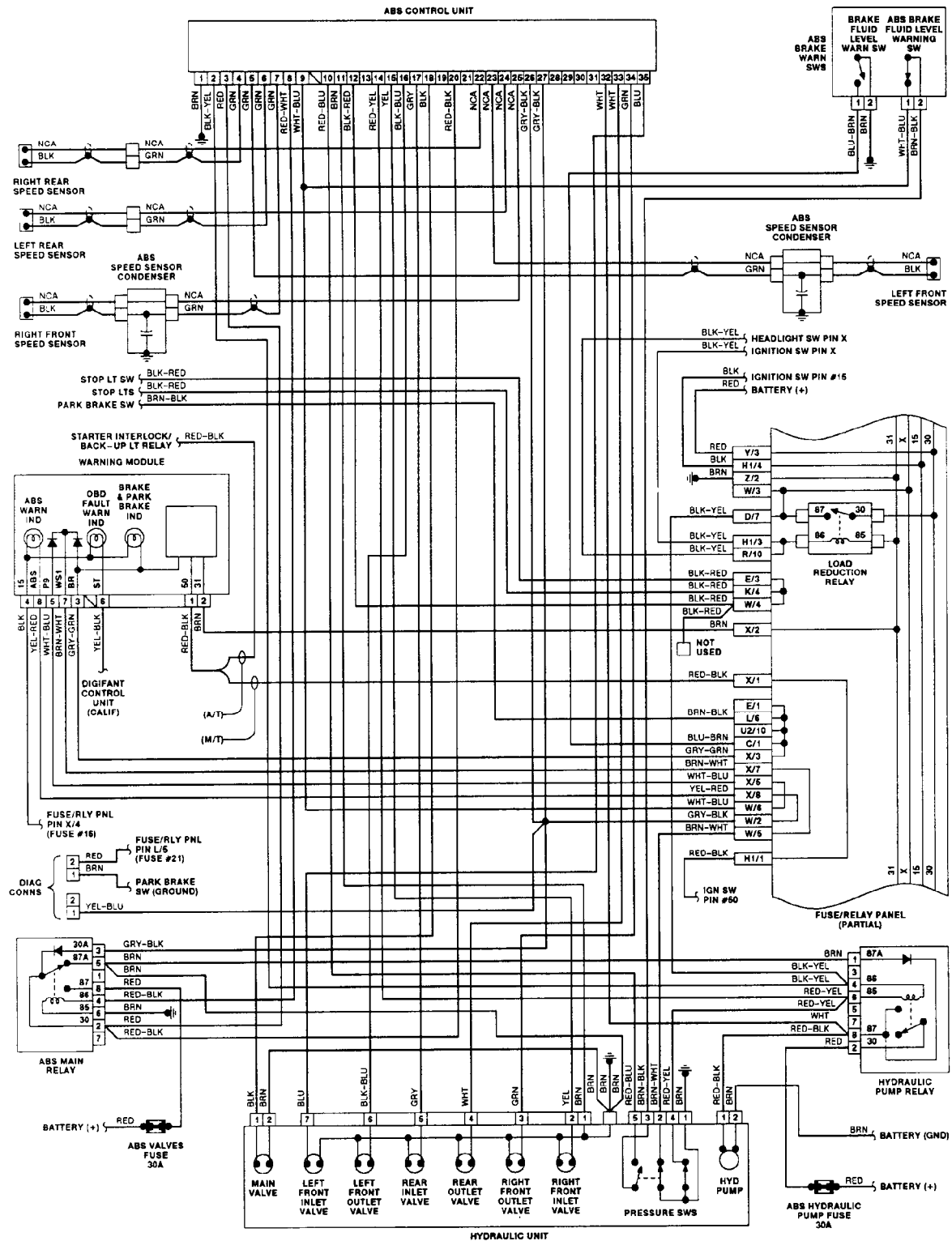


Fig. 7: Passat ABS Wiring Diagram (1990-91)

**ANTI-LOCK BRAKE SYSTEM**  
**Article Text (p. 16)**  
 1991 Volkswagen Passat  
 For Volkswagen Technical Site  
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 Wednesday, August 25, 1999 07:51PM



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Fig. 8: Corrado ABS Wiring Diagram (1992)

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 17)

### 1991 Volkswagen Passat

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Wednesday, August 25, 1999 07:51PM

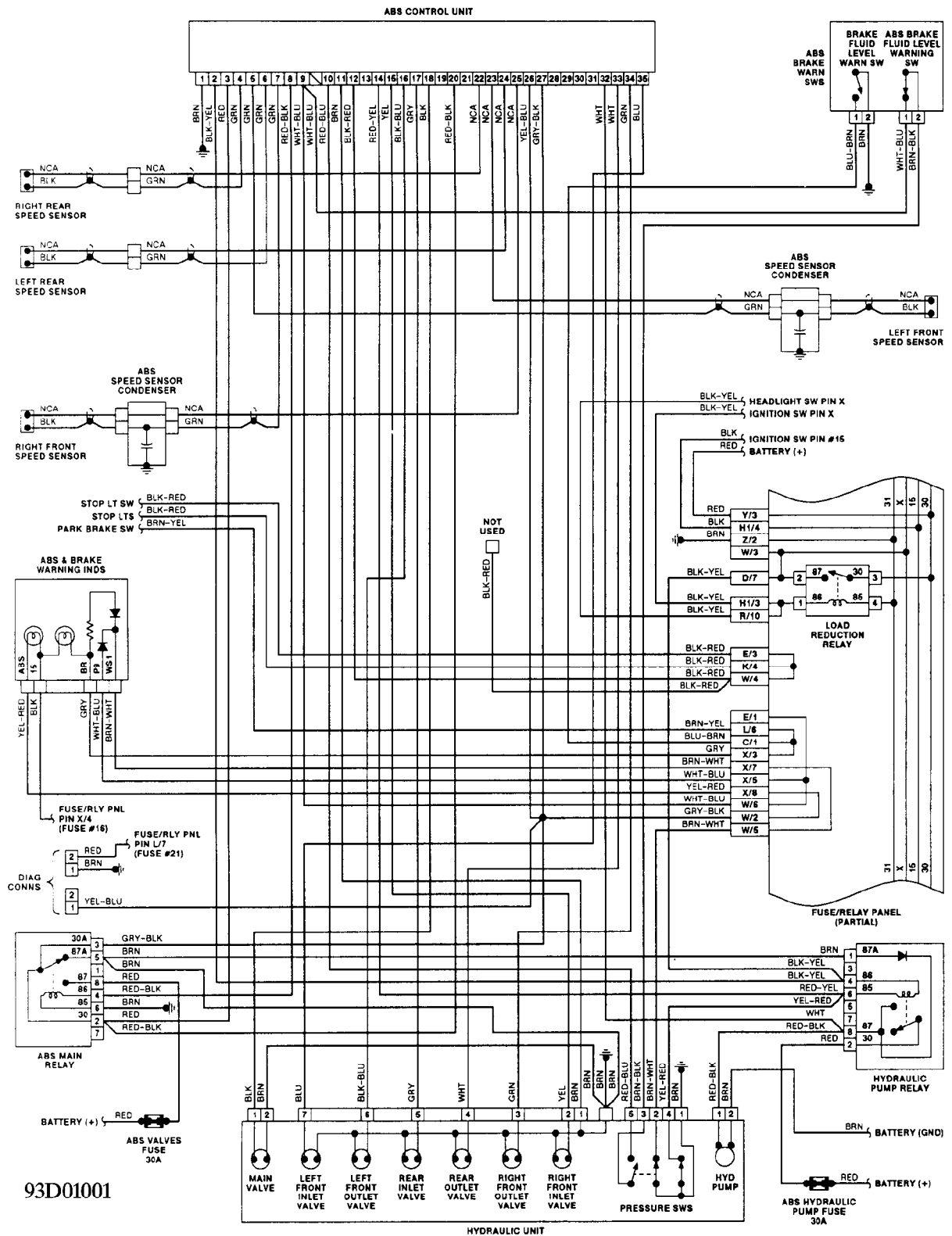


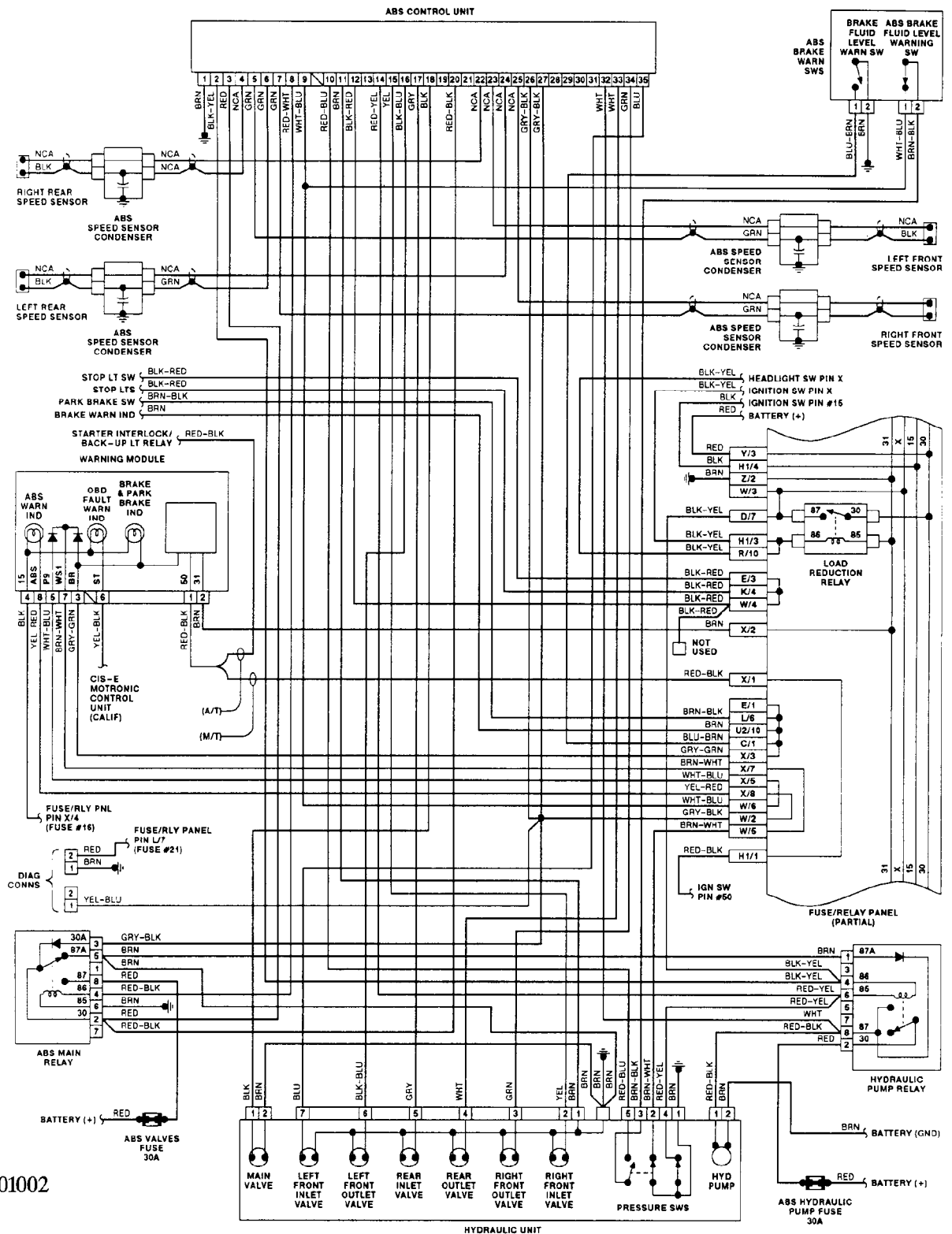
Fig. 9: Jetta ABS Wiring Diagram (1992)

# ANTI-LOCK BRAKE SYSTEM

## Article Text (p. 18)

### 1991 Volkswagen Passat

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Fig. 10: Passat ABS Wiring Diagram (1992)

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