ANTI-LOCK BRAKE SYSTEM
Article Text
1989 Mercedes-Benz 190E
For

Monday, August 09, 1999 06:27PM

ARTICLE BEGINNING

1989-90 BRAKE SYSTEMS
Mercedes Benz Anti-Lock Brakes

190E, 260E, 300 Series, 420SEL, 560 Series

DESCRIPTION

The Mercedes-Benz Anti-Lock Brake System (ABS) is a Bosch design. It operates from the interaction of a hydraulic unit with 3 fast-switching solenoid valves, 3 speed sensors, an electronic control unit with overvoltage protection and a wire harness with relays.

A Yellow warning light with the "ABS" symbol, on instrument panel, lights as the ignition is turned on. The ABS warning light will go out once the engine is running. The ABS system is programmed to activate after 7.5 MPH.

When vehicle speed is more than 3 MPH, Built-In Test Equipment (BITE) will begin check of ABS. If any fault is found, the warning light will again go on. When warning light goes on, ABS is switched off and vehicle will brake without ABS control. The conventional brake system remains operational.

If battery is less than 10.5 volts, when ignition is turned on and test speed exceeded, ABS will remain off until alternator increases voltage to more than 10.5 volts. Warning light will then go out.

Following repair, during which no direct components of ABS were involved, a simple light test will check system. Check that light goes out after 7 MPH.

NOTE: The entire ABS system must be checked if repair includes any ABS component or if units are replaced following an accident. Use ABS Test Adapter 126-859-09-21-00 together with brake test bench.

HYDRAULIC UNIT OPERATION

Independent of master cylinder pressure, hydraulic unit will compensate brake fluid pressure to wheel cylinders during regulation. Pressure increase more than master cylinder pressure is not possible.

The 3 hydraulic unit solenoid valves control left front, right front and rear brakes. By activating valves with current of varying amperage, brake fluid pressure in individual calipers may be increased, held or decreased.

In pressure "build-up" stage, pressure increases by opening intake valve to pressure supplied by master cylinder. In pressure "holding" stage, which preceeds "reduction" stage, pressure from hydraulic unit to wheels is constant. Output and input valves in solenoid valve are closed.

During pressure "reduction" stage, brake fluid flows from reservoir to return pump. To maintain fluid volume, pump returns fluid to main cylinder against prevailing pressure.

To dampen delivery noise, each circuit has a silencer. Relays for solenoid valves and return pump are on 12-pole socket of hydraulic unit. A diode is soldered in socket. Hydraulic unit is connected to ground by cable.

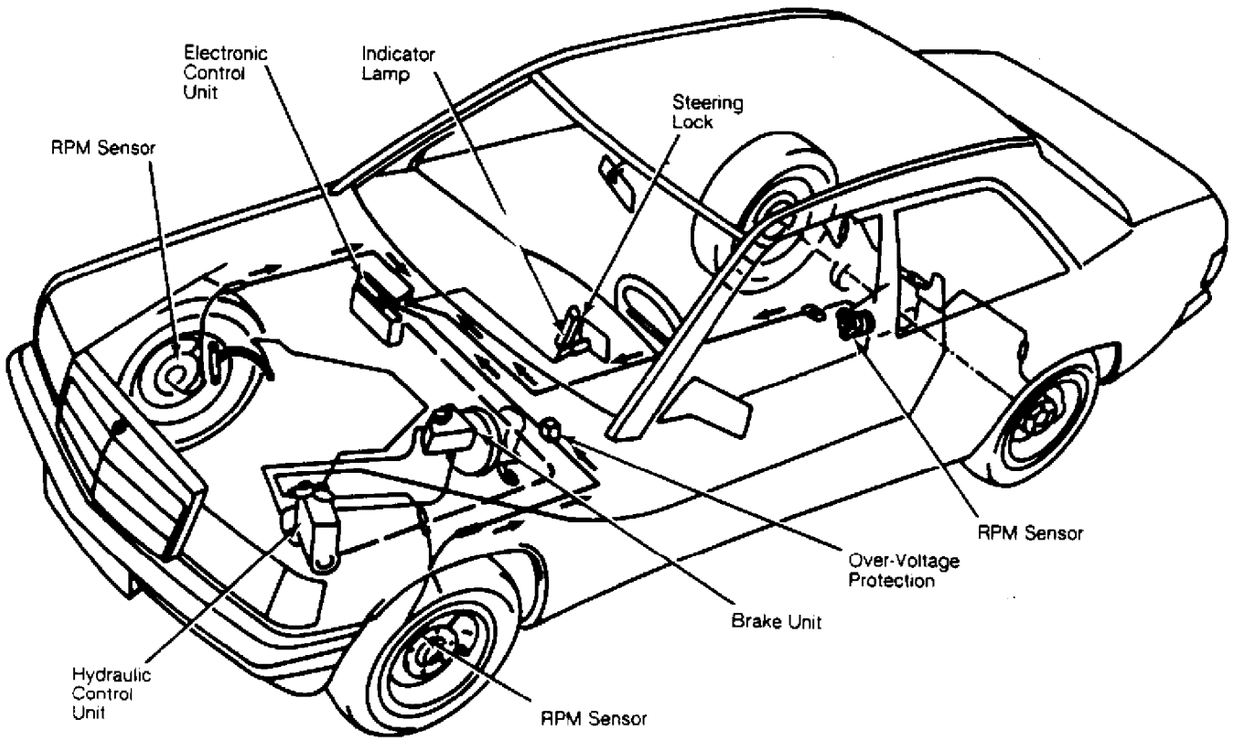

Fig. 1: Mercedes-Benz ABS Component Location
Courtesy of Mercedes-Benz of North America.

SPEED SENSOR OPERATION

Rod shaped speed sensors (impulse transmitters) measure wheel speeds. The 3 channel system, with 3 speed sensors, separately measures wheel speed of each front wheel and both rear wheels. Speed sensors for front axle are on steering knuckles. Speed sensor for rear axle is on axle housing. Drive pinion serves to measure rear wheel speed.

Speed sensor measures wheel speeds by sensing rotor teeth movement. On front axle, rotor teeth are machined into front wheel hub. Speed sensors for front axle are double-edged with diameter of .71" (18 mm). See Fig. 2.

On rear axle, toothed rotor is pressed on drive pinion. Axles with different ratios have gear wheels with different numbers of teeth. The speed sensor for the rear axle is single-edged with a diameter of .59" (15 mm).

Speed sensors consist of magnetic core and coil. Rotation of rotor, set specific distance from sensor, causes alternating voltage in coil. This alternating voltage changes frequently in proportion to wheel speed and number of rotor teeth.

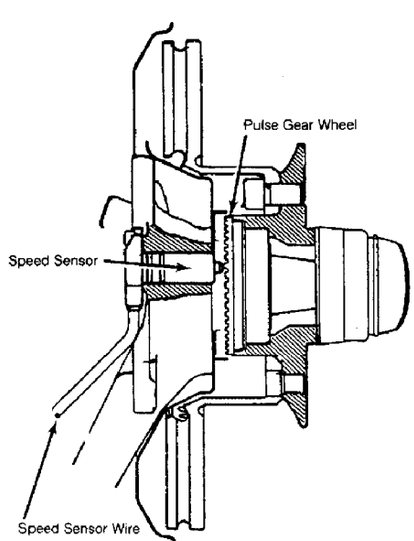

Fig. 2: Cutaway View Of Mercedes-Benz ABS Front Speed Sensor Assembly
Courtesy of Mercedes-Benz of North America.

ELECTRONIC CONTROL UNIT OPERATION

Electronic control unit is a 2-board design. The circuit boards are stacked inside control unit enclosed in light alloy housing. The control unit processes signals of speed sensors and contacts valves in hydraulic unit. Signal conditioning and processing is digital. The electronic control unit is subdivided by the signal conditioning section, logic section and safety circuit.

SIGNAL CONDITIONING SECTION

In signal conditioning section, signals supplied by speed sensors are converted for logic section. While measuring wheel speed, trouble caused by production tolerances or movements in steering knuckle is prevented by filtering input signals prior to use. Deceleration and acceleration signals obtained from wheel speed signals are processed in logic section.

LOGIC SECTION

Logic section of the electronic control unit employs wheel slip, wheel speed acceleration and deceleration signals for each controlled front wheel or rear wheels. Output signals of logic section control the solenoid valves of hydraulic unit.

SAFETY CIRCUIT

The safety circuit recognizes faulty signals inside and outside electronic control unit. Safety circuit intervenes in control sequence during extreme driving conditions, such as hydroplaning. When fault is recognized, system is switched off. The condition is indicated to driver by illumination of the warning light.

The safety circuit continuously monitors battery voltage. If voltage is less than specified requirements, system is switched off until voltage is within specified range. In addition to the monitoring function, safety circuit also includes active test cycle section or BITE (Built In Test Equipment).

TEST CYCLE (BITE)

Test cycle begins when wheel speed in all 3 speed channels exceeds 3 MPH. Test cycle, which is activated by speed sensor voltage, also monitors safety circuit and logic section. The electronic control unit is given test signals to check whether correct output signals are available.

HARNESS WITH RELAY & OVERVOLTAGE PROTECTION OPERATION

The ABS system includes a supplementary harness. To ensure function of ABS, power is supplied by an ignition switch activated relay. An overvoltage protection unit, between battery and relay, protects electronic control unit. The harness is connected to control unit by a 35-pole plug. The harness with 12-pole plug leads to hydraulic unit. Ground cable for hydraulic unit is mounted to inner fender well.

Front axle speed sensors connect to harness by coaxial cable. Speed sensor cable from steering knuckle-to-coaxial cable routes through tubing to bracket on firewall and on through inner front fender well.

Rear axle speed sensor connects to harness under rear seat by a cable connector. Two relays are located under hydraulic unit cover. One relay contacts return pump. The other relay flows current to solenoid valves. Diode in plug socket lights instrument panel warning light when multi-point plug on control unit is pulled off.

CONTROL CYCLE (ONE WHEEL) OPERATION

Wheel speed measured by speed sensor provides wheel deceleration and acceleration for electronic control unit. Linking individual wheel speed provides approximate vehicle reference speed.

Comparison of wheel speed with reference speed supplies slip

signals. If wheel locks from too much pressure in caliper, a condition recognized by wheel speed sequence (wheel slip), pressure is held constant with no additional increase possible.

If there is a tendency toward locking because constant pressure is still too high, output solenoid valve will open to lower pressure. If pressure is low enough for wheel acceleration, pressure is not lowered but instead held constant.

When re-acceleration of wheel passes a given value, pressure is increased in between by opening input valve in solenoid valve. Signals from control unit allow hydraulic unit to actuate pressure maintenance, reduction and build-up.

Control sequence is repeated during controlled braking until brake pedal is released or until just before vehicle stops.

PRE-DIAGNOSIS INSPECTION

Perform a comprehensive visual inspection on system components which could create an apparent anti-lock system malfunction. Performing this inspection of system prior to diagnosing specific symptoms may result in isolation of a simple failure which may cause an inoperative system.

TROUBLE SHOOTING

ABS CONTROL LIGHT

Control Light Illuminates Intermittently (Will Not Go Out Unless Ignition Switch Is Cycled "OFF" & "ON")

If no fault can be detected with test adapter, the problem may be an interrupted wire or loose connection on one of the speed sensor cables or the ABS wiring harness.

Perform TEST 4, 5 and 6 with test adapter and multimeter (internal resistance of speed sensors). While testing, move cable at coaxial plug at cable connector and at speed sensor. If the ohmmeter indicates a break or loose connection, replace the speed sensor and coaxial cable or tighten connections at cable connector.

Control Light Illuminated,
ABS Operates Brake System Normally

Check alternator output. Alternator control light comes on but only very dim (hardly visible). Alternator charges but not to full capacity. When applying a load on the alternator, a humming noise can be heard.

Control Light Illuminates Intermittently

When switching on several electrical consumers, the battery voltage drops to less than 10.5 volts and the ABS control light illuminates. If the battery voltage increases again to more than 10.5 volts, the control light goes out.

This type of failure will switch off the ABS system only during low voltage periods. Perform battery test.

Light Braking Pedal Pulsation
(ABS Control Light Does Not Illuminate)

Speed sensor or electronic control unit defective. This will cause the return pump in the hydraulic unit to operate. Check voltage signal from speed sensors. Perform test steps 4, 5 and 6 with test adapter and multimeter (Set to AC volts position).

Remove speed sensors and check for dirt accumulation (metal chips at sensor tip). If steps 1 and 2 are in order, replace electronic control unit.

TESTING

NOTE: DO NOT drive vehicle with tester connected.

CONNECTING TESTER

1) With ignition off, disconnect 35-pole connector of cable harness from electronic control unit.

2) Connect 35-pole connector to plug of ABS Test Adaptor (126-589-09-21-00). Make sure that all other electrical components are

off before turning ignition on.
3) Connect multimeter to test adapter. This adapter permits testing the complete ABS system, except the electronic control unit.

TEST 1

Testing Relay & Valve Relay In De-Energized Position
Set rotary switch to position 1, ignition off. All LED's in tester should be off. If LED battery symbol in tester lights up, replace relay and valve relay.

TEST 2

Testing Voltage Supply
1) Set rotary switch to position 1, ignition on. LED battery symbol on tester will come on, if okay. LED light will not come on if battery voltage is less than 10.5 volts. Check battery and charging system.
2) If ABS indicator light is off, check connecting line, check indicator light and replace if necessary.

TEST 3

Testing Valve Relay
Ignition on. Rotary switch position 2. ABS indicator light on, LED not lit. Valve relay defective or connecting lines interrupted.

TEST 4

Testing Diode In Hydraulic Unit
1) Ignition on. Rotary switch to position 2. Multimeter set to DC volts position.
2) Reading should be 0.4-1.5 volts. If less than 0.4 volts or greater than 1.5 volts, go to step 3).
3) Check and replace valve relay or diode of hydraulic unit. Check connecting lines.

NOTE: If ABS indicator light goes out upon replacement of hydraulic unit with the ignition on and engine not running, replace Electronic Control Unit.

TEST 5

Testing Internal Resistance Of Speed Sensor
1) Multimeter set to "OHMS" position. Ignition on. Rotary switch moved successively to positions 4 (left front wheel), 5 (right front wheel) and 6 (rear differential).
2) Internal resistance:

* Front Wheel 1100-2300 ohms.
* Rear Differential 600-1600 ohms.

3) If resistance is less than or more than step 2), check coaxial plug or cable connector and connecting lines. Replace speed sensor or adjust wheel bearing play.

TEST 6

Testing Insulation Resistance Of Speed Sensor
1) Follow TEST 5, step 1). Push ground button. Insulation resistance should be greater than 20,000 ohms.
2) If not, check for grounded speed sensor, cable and line connector, or coaxial plug.

TEST 7

NOTE: When testing speed sensor of rear differential, hold one wheel in place.

Testing For Interchangeability
1) Set multimeter to "AC VOLTS" position. Turn ignition on. Rotary switch moved successively to positions 4 (left front wheel), 5

(right front wheel) and 6 (rear differential). Spin respective wheel approximately one revolution per second.
2) Resistance should be greater than or equal to approximately 0.1 volt. If not, check coaxial plug, connecting lines, wheel bearing play adjustment or replace speed sensor.

TEST 8

Testing Internal Resistance Of Solenoid Valves
1) Set multimeter to "OHMS" position. Ignition off. Push ground button. Rotary switch moved successively to positions 8, 9 and 10.
2) Resistance should be 0.7-1.7 ohms. If internal resistance is less than .07 ohms or more than 1.7 ohms, go to step 3).
3) Check for poor contact at plug connector on hydraulic unit, interrupted connecting wires or defective hydraulic unit.

TEST 9

Testing Pressure Holding Of Solenoid Valves
1) Ignition on. Rotary switch moved successively to positions 8, 9 and 10. Spin respective wheel. Press "P" push button. Actuate brake pedal.
2) Wheel should permit turning and no brake force should build up. If not okay, go to step 3).
3) Check for defective motor relay, return pump, or solenoid valve. Replace as necessary.

TEST 10

Testing Pressure Reduction Of Solenoid Valve
1) Ignition on. Rotary switch moved successively to positions 8, 9 and 10. Actuate brake pedal. Press "P" button. Turn respective wheel.
2) Introduced brake force should be reducing. Return pump should be running. If not, proceed to step 3).
3) Check for defective motor relay, return pump, or solenoid valve. Replace as necessary.

TEST 11

NOTE: Stoplight switch is connected to 35-pole plug at pin No. 25.

Testing Overvoltage Protection Relay
Ignition on. Actuate brake pedal. LED indicator "0" should come on. If not, check connecting wires or replace stoplight switch.

HYDRAULIC UNIT R & I

REMOVAL

With ignition off, disconnect battery. Remove lines from hydraulic unit. Plug openings. Remove hydraulic unit mounting bolt and cover. Detach ground strap from pump motor. Remove 12-pole plug socket. Remove mounting nuts and hydraulic unit.

NOTE: DO NOT loosen sealed center bolt or 2 hex socket bolts next to cover and brake lines.

INSTALLATION

1) To install, reverse removal procedure. Connect brake lines to hydraulic unit fittings. Brake line identification codes are as follows: Code "V" is line from master cylinder to front brake circuit. Code "H" is line from master cylinder to rear brake circuit.
2) Code "L" is line from hydraulic unit to left front brake. Code "R" is line from hydraulic unit to right front brake. Code "H" is line from unit to rear brakes. Bleed brake system. Check for leaks.

FRONT WHEEL SPEED SENSOR R & I

REMOVAL

1) Remove front wheel and tire. With ignition off, separate coaxial cable in engine compartment. Remove from bracket. Pull cable downward from grommet in wheelhousing.

NOTE: When removing right speed sensor, remove windshield washer reservoir. Loosen partition in engine compartment near coaxial cable. Lift partition slightly and pull out cable.

2) Speed sensors have different protective tubes at left and right, identified in holder by "L" or "R". Before installing, ensure NO metal is on magnetic edges of sensor. Coat sensor and steering knuckle bore with Molykote Longterm 2 lubricant.

3) Remove protective tube from cover plate. As they may be used once, remove hex head socket bolt and discard. Pull speed sensor out of steering knuckle bore.

INSTALLATION

1) Replace "O" ring on sensor. Mount unit on steering knuckle. Ensure "O" ring is not damaged. Do not force. Attach sensor to knuckle with new bolt. Tighten to 72 INCH lbs. (8 N.m).

2) Attach protective tube to cover plate. Clip cable to holder. Pull through grommet into engine compartment. Replace "O" ring. Connect coaxial cable. Mount front wheel and tire. Complete test program.

REAR AXLE SPEED SENSOR R & I

REMOVAL

Remove rear seat and backrest. With ignition off, remove cable at connector. Remove clips from cable to sensor. Pull cable down through grommets in frame floor and axle carrier. Remove hex head bolt and discard. Remove sensor from rear axle housing.

INSTALLATION

To install, reverse removal procedure. Replace "O" ring on sensor. Do not damage "O" ring. Insert sensor into rear axle housing. Using new bolt, attach sensor to rear axle housing and tighten.

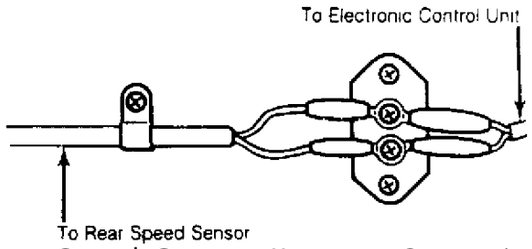

Fig. 3: Rear Speed Sensor Harness Connector (Under Rear Seat) Courtesy of Mercedes-Benz of North America.

ELECTRONIC CONTROL UNIT R & I

NOTE: Turn ignition off before removing or installing electronic control unit. Unit is located on front wall in engine compartment.

Push back holding springs. Remove electronic control unit from bracket. Actuate lock. Pull plug from unit. To install, reverse removal procedure. When mounting on unit, ensure plug engages audibly in lock.

RELAYS & OVERVOLTAGE PROTECTION R & I

Turn ignition off. To replace ABS components, pull units from connectors. Note location for proper installation. Engine and valve relays are mounted at hydraulic unit. Relays for electronic control unit and overvoltage protection unit are mounted at fusebox. Install relay or unit into circuit.

WIRING DIAGRAMS

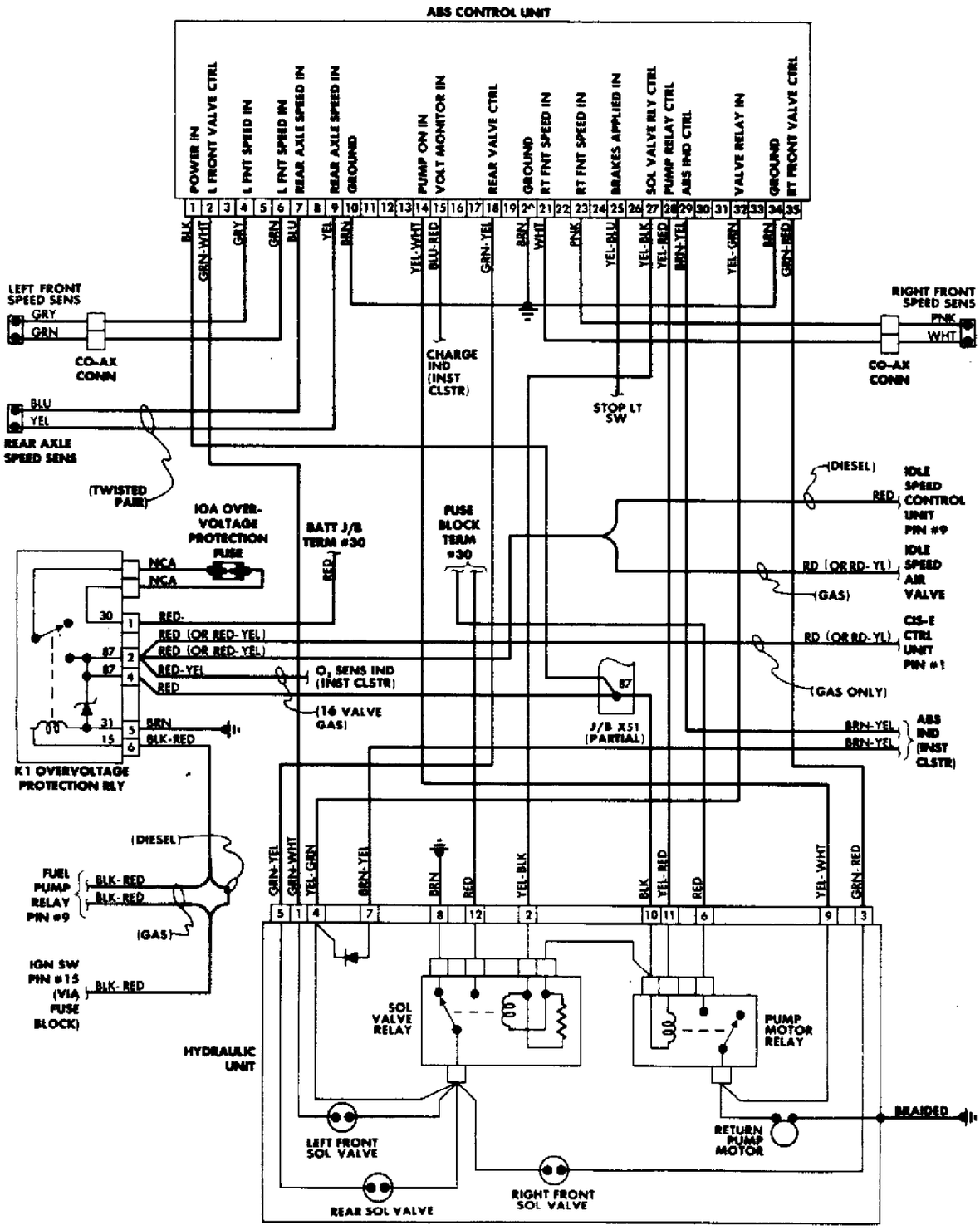

Fig. 4: Mercedes-Benz 190E Anti-Lock Brake System Wiring Diagram

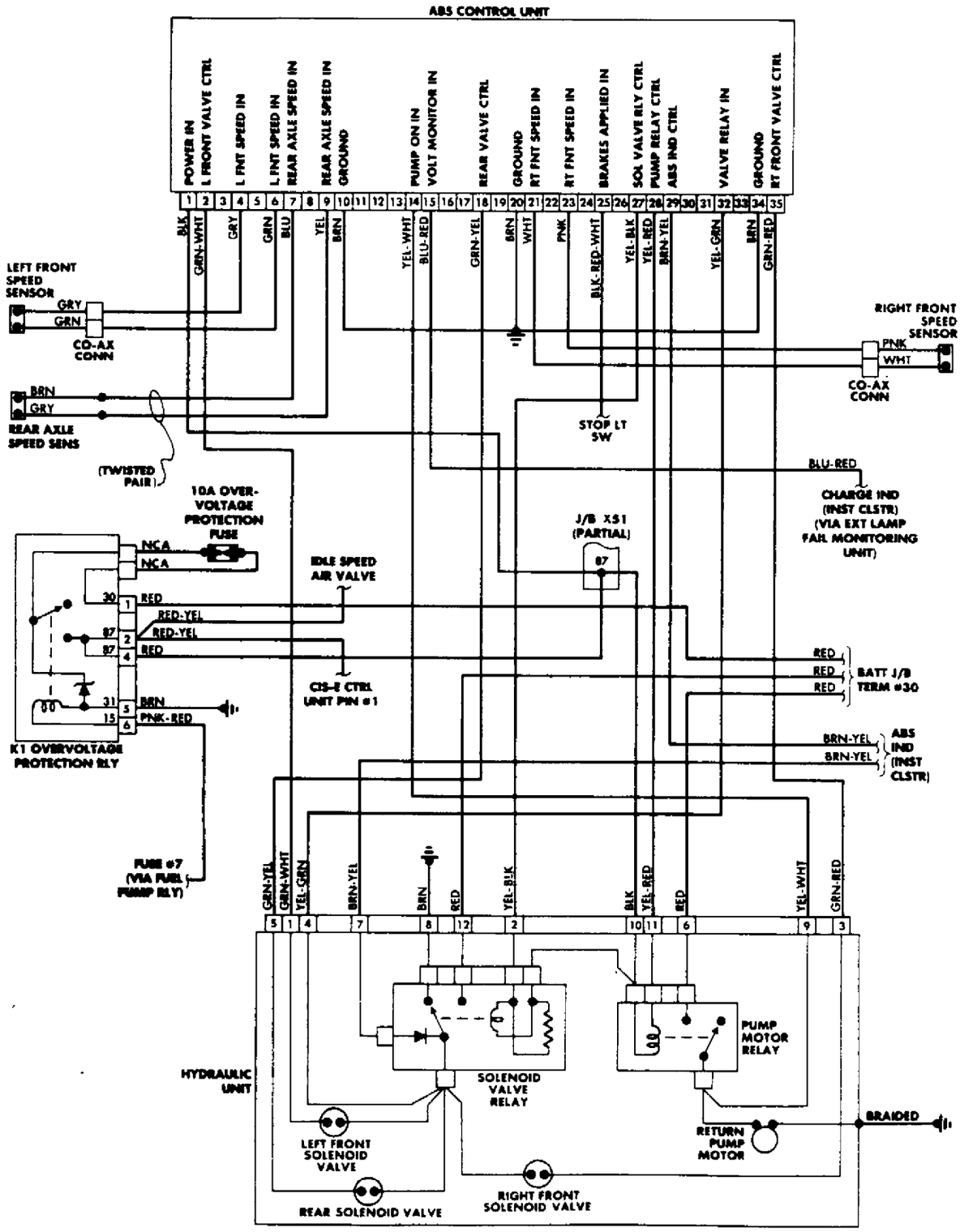

Fig. 5: Mercedes-Benz 260E & 300 Series Anti-Lock Brake System Wiring Diagram

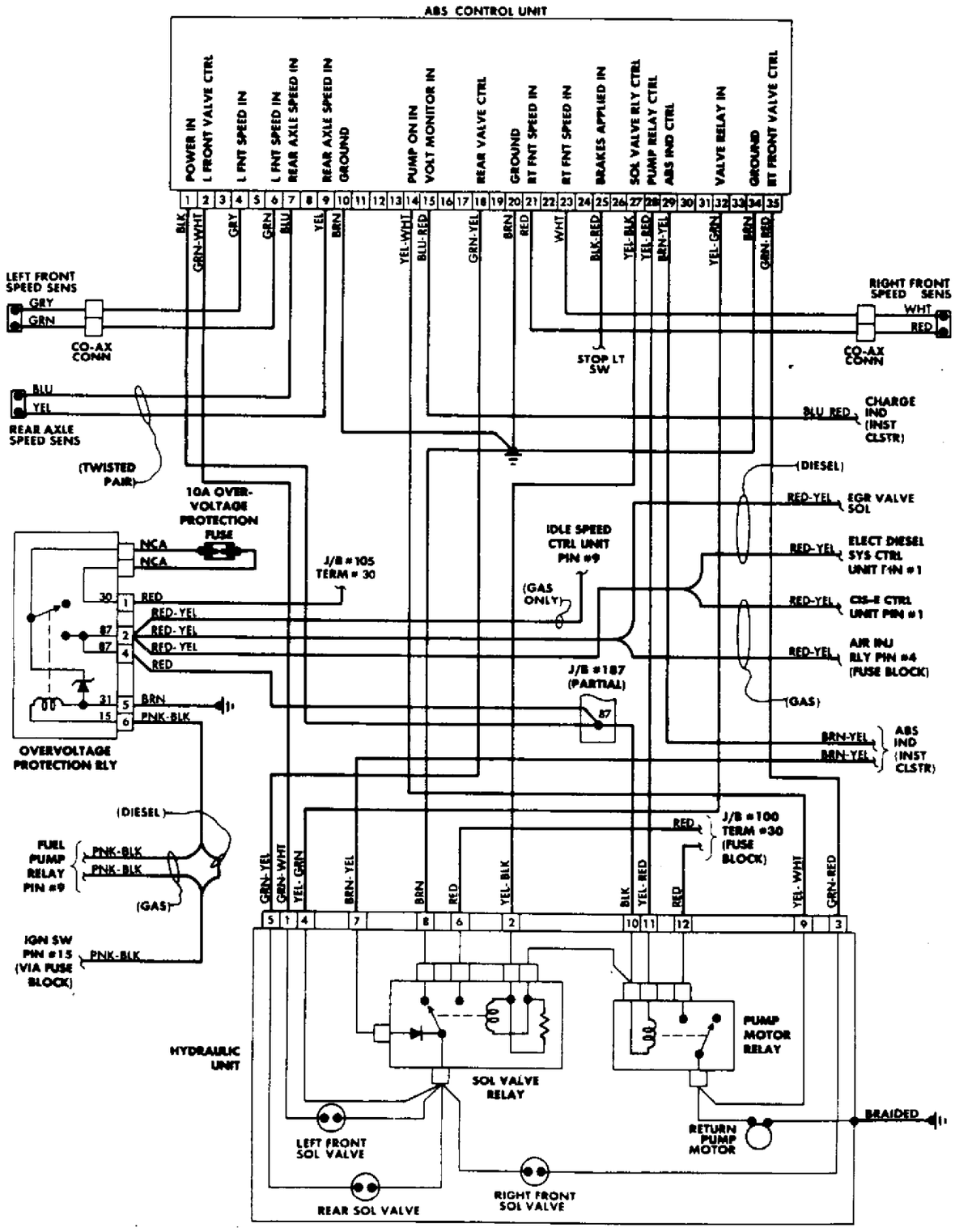

Fig. 6: Mercedes-Benz 420SEL Anti-Lock Brake System Wiring Diagram

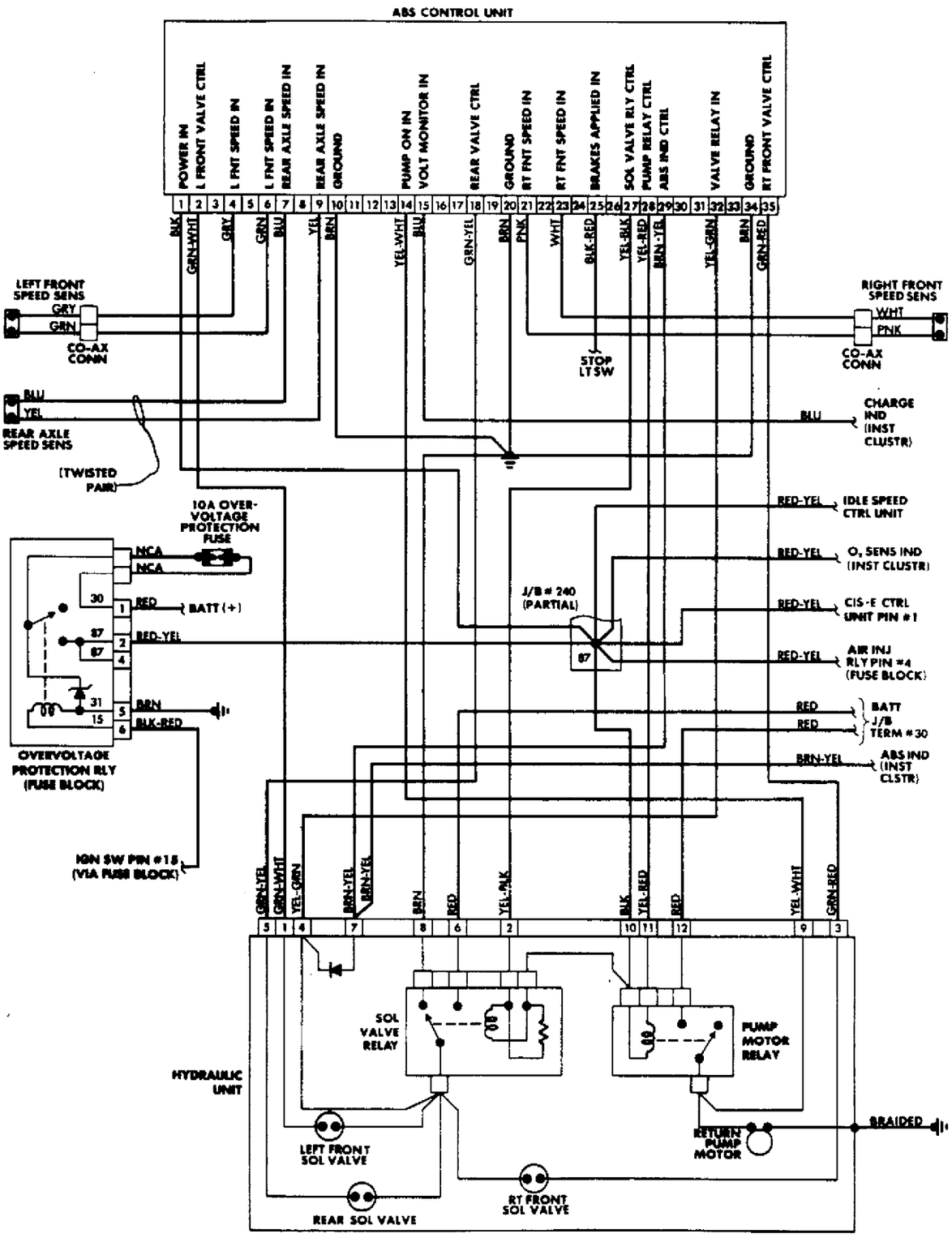

Fig. 7: Mercedes-Benz 560 Series Anti-Lock Brake System Wiring Diagram

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