SERVICE

928 S
928 S4

TEST PLAN ABS

944
944 S
944 Turbo

INFORMATION

TECHNIK

WKD 493 721

CONTENTS

INTRODUCTION

This manual describes testing procedures and serves as a troubleshooting guide for the ABS systems installed in Porsche 928 and 944 series vehicles.

The troubleshooting program consists of **two** test plans.

Test Plan No. 1 is required for testing procedures using the **Bosch K7-ETT 016.00 or VAG 1516 ABS Testing Unit.**

Test Plan No. 2 is required for testing procedures using the **Bosch ABS-2-LED Testing Unit.**

Both testing units can be used for all Porsche vehicles fitted with ABS.

The testing program is valid for all 8-cylinder vehicles from '84 models onwards and all 4-cylinder vehicles from '87 models onwards.

***Note:**

Test data for 928 S – USA, Model Year '86

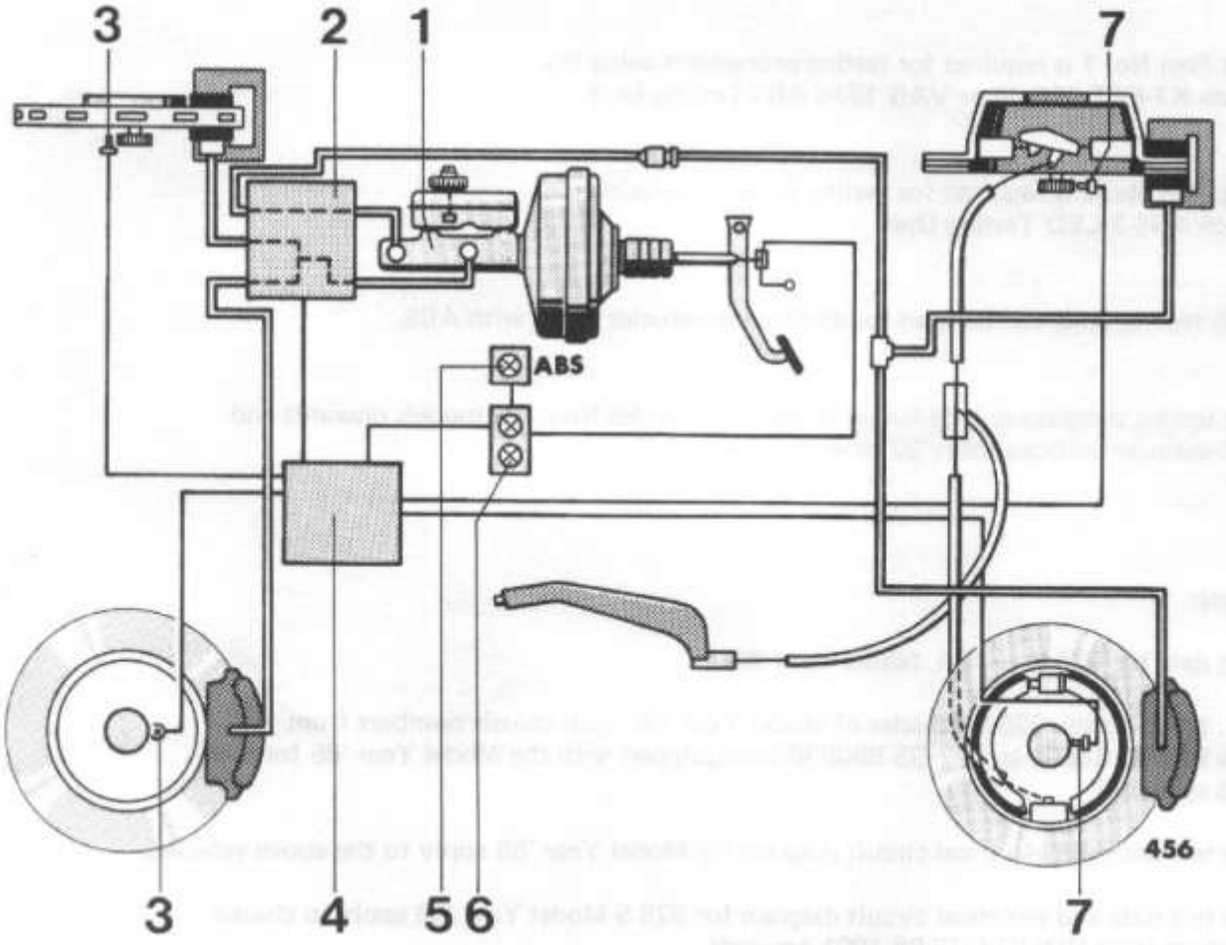
U.S. specification 928 S vehicles of Model Year '86, with chassis numbers from VIN 929 GS 80061 to 922 GS 860936 are equipped with the Model Year '85 form of ABS system.

The test data and electrical circuit diagram for Model Year '85 apply to the above vehicles.

The test data and electrical circuit diagram for 928 S Model Year '86 apply to chassis numbers from VIN 927 GS 86 1001 onwards.

ABS SYSTEM

The (Bosch) three-channel ABS system is provided with one speed sensor per wheel. The braking system is divided front and rear (black/white division), i.e. one brake circuit operates on the front axle (push rod circuit) and the second on the rear axle (floating circuit).



1 – Tandem brake master cylinder
2 – Hydraulic unit
3 – Speed sensors (cross-pole), front
4 – ABS control unit
5 – ABS indicator lamp
6 – Stop lights
7 – Speed sensors (flat pole), rear

IMPORTANT GUIDELINES FOR REPAIR OPERATIONS ON VEHICLES WITH ABS

When working on vehicles with ABS the following must be observed:

Multiple-pin plug in electronic control unit

Never disconnect or connect the multi-pin plug from the electronic control unit with ignition switched on.

Welding

Disconnect plug from electronic control unit before carrying out any welding operations with an electric welder.

Painting

During painting operations, the electronic control unit may be exposed briefly up to 95 °C max. and for a longer period (approx. 2 hours) up to 85 °C max.

Battery charging

Disconnect battery from vehicle electrical system before boost-charging battery.

Battery installation

If battery has been removed, both leads must be properly secured to battery terminals on reinstallation.

Assisted start

Do not use a boost battery charger to start engine.

Function testing

A simple function test is all that is necessary after repairs to components of the braking system not directly related to the ABS system have been made. This means that, with the ABS system intact, the indicator lamp in the combination instrument must go out when the engine is started. Operations of this nature include changing or reconditioning of brake linings, brake hoses, brake discs, brake assemblies, tandem master cylinders, brake cables and parking brake components, together with brake lines not connected to the hydraulic unit.

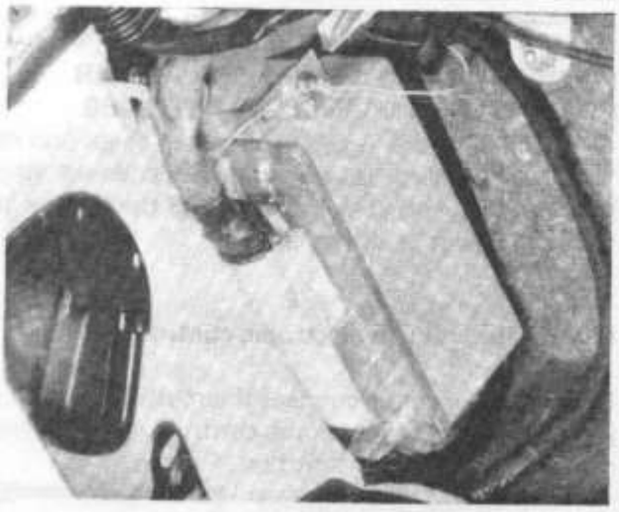
If operations are carried out on the hydraulic unit (*, **), electronic control unit (*, **), speed sensors or cable set, or if any assemblies are replaced in the course of e.g. accident repairs, a function test must be carried out with the ABS test unit (* in conjunction with a brake test on a brake dynamometer).

*) (ABS testing with Bosch K7-ETT 016.00 or VAG 1516 ABS-Testing Unit).

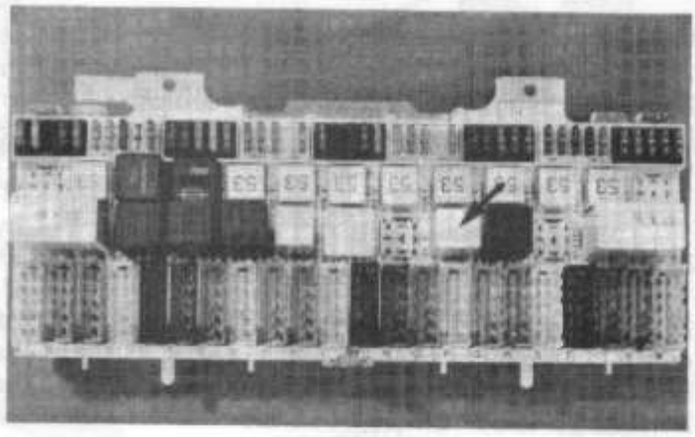
**) Do not attempt to repair or disassemble the hydraulic unit or electronic control unit.

LOCATIONS OF ABS COMPONENTS
– 928 Series –

The control unit is located against the wheel housing in the driver's side (left) footwell (above the central warning unit).

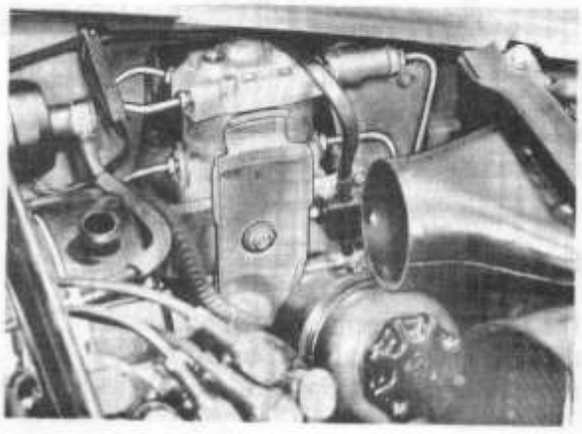


The ABS relay is located on the CEB –
Model Year '84: relay No. XI
Model Year '85: relay No. XVII.

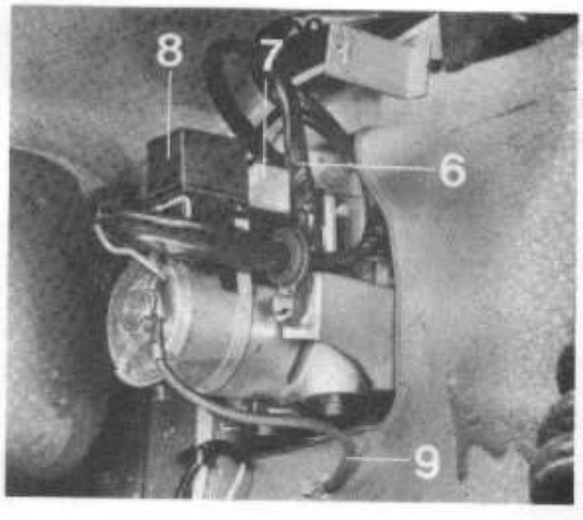


The hydraulic unit is located under the front left fender in the opening leading from the wheel housing to the engine compartment.

Brake line connections are accessible from the engine compartment.



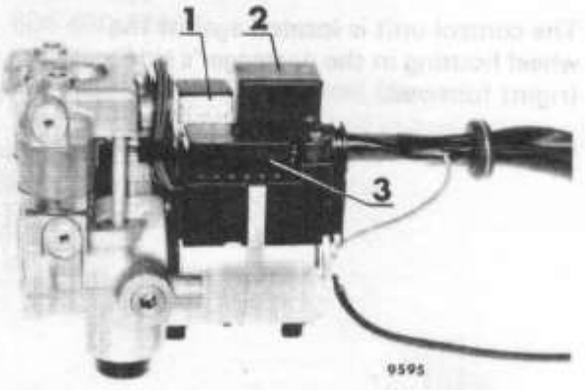
The pump motor, complete with pump motor relay and solenoid valve relay with electrical connections, is accessible from the wheel housing side after removal of the cover plate.



6 – Cable (battery +)
7 – Relay for solenoid valves
8 – Relay for pump motor
9 – Ground lead

LOCATIONS OF COMPONENTS – 928 Seires –

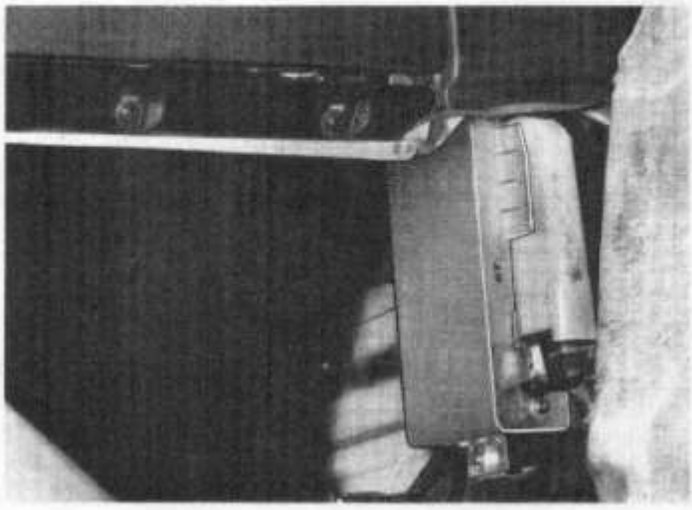
The solenoid valve and pump motor relays are located on the hydraulic unit.



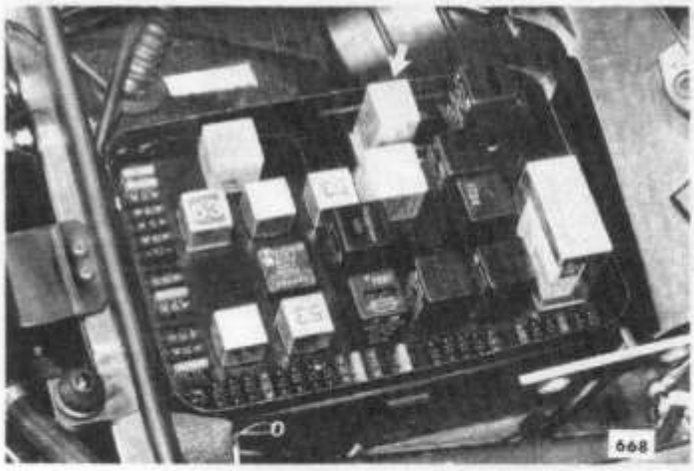
1 – Solenoid valve relay
2 – Pump motor relay
3 – 12-pole wiring harness plug

LOCATIONS OF ABS COMPONENTS
– 944 Series –

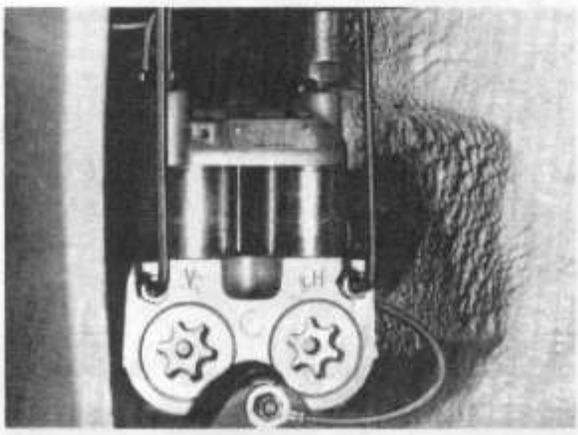
The control unit is located against the wheel housing in the passenger's side (right) footwell.



The ABS relay is located on the central electric relay G 20.

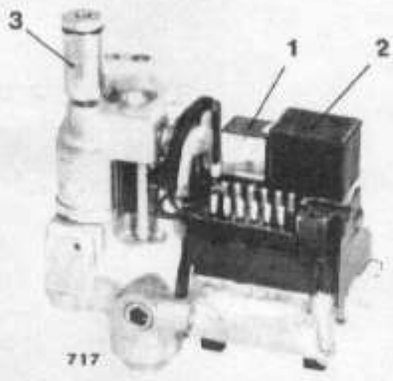


The hydraulic unit is installed in the rear of the right front fender.



The solenoid valve and pump motor relay are located on the hydraulic unit.

1 – Solenoid valve relay
2 – Pump motor relay
3 – Brake pressure regulator



ABS TEST UNIT, Bosch K7-ETT 016.00 (Order No. 0684 101 600)
or VAG 1516

Adapter lead, to connect to ABS Test Unit, Order No. 1 684 460 120

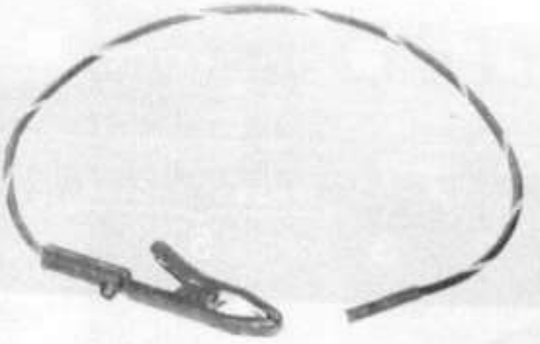
Note: The overvoltage protection relay supplied with the adapter lead cannot be used for operations on Porsche vehicles. A separate relay,
No. 928.615.124.00 (relay with fuse, '84 models) or
No. 928.615.124.01 (relay without fuse, '85 models onwards)
must be used for Test Stage 5 as laid down in the Testing Program.

Additional test equipment and tools required:

Brake dynamometer

Standard tools and instruments

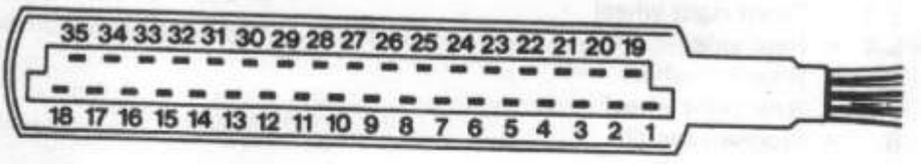
2 Control unit plug test leads, approx. 60 cm long with 2 insulated alligator clips and 2 flat pin plugs N 17.457.2.



The test lead must be used for testing the control unit plug.

Plug terminal designations

Control unit multiple-pin plug, looking towards plug terminals.

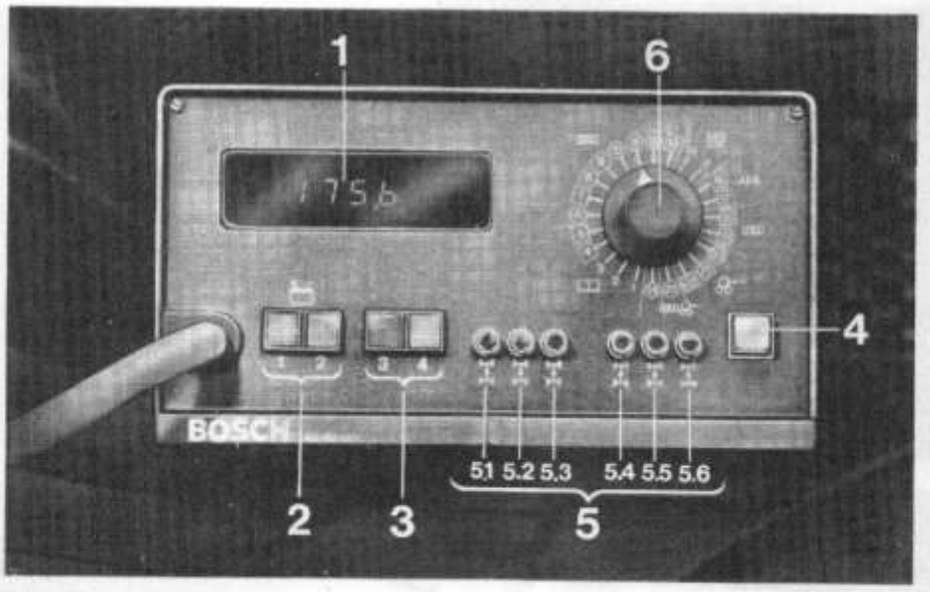


NOTES ON TEST UNIT K7

The test unit is used for function tests on the control unit, hydraulic unit, cable harness and peripheral sub-assemblies of the Anti-lock Braking System.

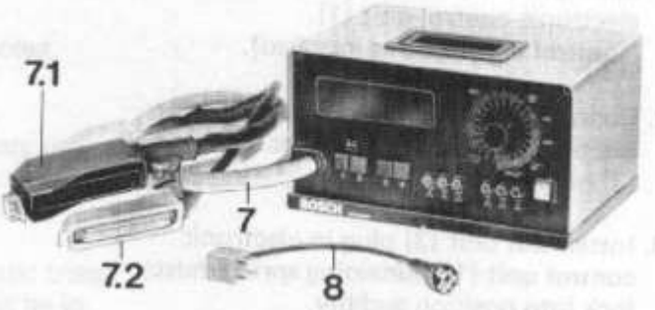
Actual values recorded by the test unit must be compared with the respective specified values.

If the actual value deviates from the specified value, the fault should be located in accordance with instructions in the troubleshooting program.



1 = Digital LED display unit, 3 1/2 positions
2 = Lamp 1 (green): battery voltage OK
= Lamp 2 (red): low battery voltage
3 = Lamp 3 (green): motor and valve relay and overvoltage protection OK
= Lamp 4 (red): motor and valve relay and overvoltage protection faulty
4 = LED pushbutton (yellow): to activate individual test stages
5 = Pushbutton channel selector (wheel selection)
5.1 = Front axle
5.2 = Front left wheel
5.3 = Front right wheel
5.4 = Rear axle
5.5 = Rear left wheel
5.6 = Rear right wheel
6 = Program switch

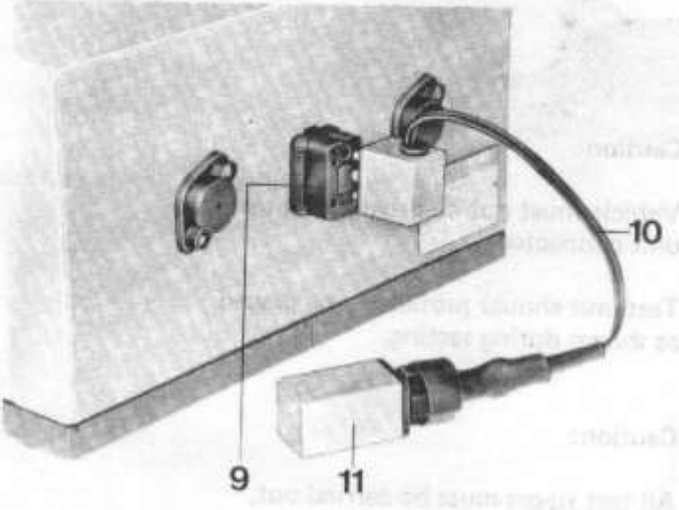
7 – Connecting lead
7.1 – Connection to wiring harness
7.2 – Connection to control unit
8 – Adapter lead



Adapter lead for Porsche

The adapter lead serves to connect and test the electronic relay with overvoltage protection at the socket in back of the test unit.

9 – Plug socket in ABS test unit
10 – Adapter lead
11 – Porsche electronic relay with overvoltage protection



The overvoltage protection relay supplied with the test unit must not be used for Porsche. It is necessary to use the Porsche-Relay with overvoltage protection (see page 7).

Caution:

It is essential to fit the adapter lead for testing the electronic relay for Porsche vehicles in accordance with the diagram.

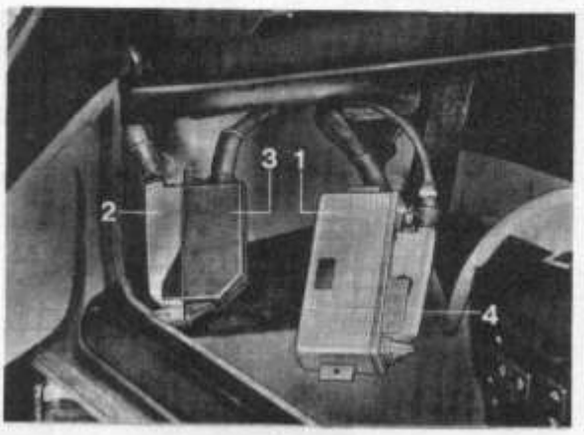
Connecting the test unit

1. With ignition switched off, disconnect multi-pin (35-pole) plug (2) from electronic control unit (1). (Control unit remains installed).

2. Connect multi-pin plug (2) of electronic control unit to test unit (3) plug.

3. Install test unit (3) plug in electronic control unit (1). Retaining spring must lock into position audibly.

4. Switch ignition on. All other power-consuming systems must be switched off.



Caution:

Vehicle must not be driven with test unit connected.

Test unit should preferably be placed as shown during testing.

Caution:

All test stages must be carried out, beginning with stage 1.

Test stages 23 and 24 must be carried out before stages 20, 21 and 22.

A brake dynamometer is necessary for test stages 20 to 23*).

The following points must be observed:

1. Do not drive with test unit connected.

2. During testing, dynamometer rollers and vehicle tires must be dry.

3. When testing vehicles with automatic transmission, the selector lever must not be in PARK position for rear axle testing.

4. Do not use a brake pedal winch to adjust braking force.

5. Allow at least 20 seconds to elapse between test repeats and channel changes.

*) Test stage 23 can also be carried out on car hoist by rotating individual wheels.

Display	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
Lamps 1 and 2	Lamp 1 (green) must be on (throughout entire test)	**No display:** 1. Check power supply at ABS relay (on CEB*). Passage between terminals 30 and 31. (Due to diode, passage in one direction only). 2. Multi-pin plug in control unit incorrectly connected. 3. Electronic relay defective, replace. 4. Positive lead to electronic relay terminal 87 interrupted. 5. Positive lead from battery + CEB to electronic relay terminal 30 or lead from electronic relay terminal 87 to control unit terminal 1 interrupted. **Lamp 2 (red) on** or lights up intermittently during testing: Break off testing and rectify fault. Cause of fault: 1. Battery insufficiently charged; charge battery or run engine. 2. Excessive voltage drop at ground terminals to control unit or relay for control unit, including plug connections. Ground lead to control unit terminal 10 subject to excessive transfer resistance, or interrupted. Ground lead from electronic relay subject to excessive transfer resistance, or interrupted. After rectifying fault, carry out complete test program.
Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Ground lead subject to excessive transfer resistance, or interrupted. 2. Switch off ignition, disconnect control unit plug and check following leads for continuity: from ground to terminal 8, hydraulic unit; from terminal 8 to terminal 32 control unit plug, or with test lamp on positive and test prod at terminal 32, test lamp must light up. 3. Valve relay defective.
Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Switch off ignition, disconnect control unit plug and check following leads for continuity: from terminal 27, control unit plug to terminal 28 and from terminal 27 to terminal 87, electronic relay frame. Connect control unit plug terminal 1 to positive and terminal 27 to negative. With test lamp at terminal 32; lamp must light up. 2. Valve relay defective. * **Location of ABS relay (electronic relay):** 928 S, model year '84 = Relay XI on CEB 928 S, '85 model onwards, 928 S 4 = Relay XVII on CEB 944, 944 S, 944 Turbo, '87 models onwards = Relay G20 on CEB

TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshoo Refer to cir
All	Power supply available in all program switch positions		Lamps 1 and 2	Lamp 1 (green) must be on (throughout entire test)	**No display:** 1. Check po Passage b only). 2. Multi-pin 3. Electroni 4. Positive l 5. Positive l electronic **Lamp 2 (rec** Break off te Cause of fa 1. Battery i 2. Excessive unit, incl Ground lea or interrupt Ground lea interrupted After rectif
1	Valve relay, OFF position		Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (rec** 1. Ground l 2. Switch o continuit terminal terminal 3. Valve rel
2	Valve relay function		Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (rec** 1. Switch o continuit terminal terminal 32; lamp 2. Valve rel * **Location** 928 S, m 928 S, '8 944, 944

Display	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
Lamps 1 and 2	Lamp 1 (green) must be on (throughout entire test)	**No display:** 1. Check power supply at ABS relay (on CEB*). Passage between terminals 30 and 31. (Due to diode, passage in one direction only). 2. Multi-pin plug in control unit incorrectly connected. 3. Electronic relay defective, replace. 4. Positive lead to electronic relay terminal 87 interrupted. 5. Positive lead from battery + CEB to electronic relay terminal 30 or lead from electronic relay terminal 87 to control unit terminal 1 interrupted. **Lamp 2 (red) on** or lights up intermittently during testing: Break off testing and rectify fault. Cause of fault: 1. Battery insufficiently charged; charge battery or run engine. 2. Excessive voltage drop at ground terminals to control unit or relay for control unit, including plug connections. Ground lead to control unit terminal 10 subject to excessive transfer resistance, or interrupted. Ground lead from electronic relay subject to excessive transfer resistance, or interrupted. After rectifying fault, carry out complete test program.
Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Ground lead subject to excessive transfer resistance, or interrupted. 2. Switch off ignition, disconnect control unit plug and check following leads for continuity: from ground to terminal 8, hydraulic unit; from terminal 8 to terminal 32 control unit plug, or with test lamp on positive and test prod at terminal 32, test lamp must light up. 3. Valve relay defective.
Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Switch off ignition, disconnect control unit plug and check following leads for continuity: from terminal 27, control unit plug to terminal 28 and from terminal 27 to terminal 87, electronic relay frame. Connect control unit plug terminal 1 to positive and terminal 27 to negative. With test lamp at terminal 32; lamp must light up. 2. Valve relay defective. * **Location of ABS relay (electronic relay):** 928 S, model year '84 = Relay XI on CEB 928 S, '85 model onwards, 928 S 4 = Relay XVII on CEB 944, 944 S, 944 Turbo, '87 models onwards = Relay G20 on CEB

	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
3	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Switch off ignition, disconnect control unit plug. Check following leads for continuity: connect control unit terminal 1 to positive and terminal 28 to negative. With test lamp at terminal 14, lamp must light up. Test lamp must go out if terminal 1 or 28 is disconnected. 2. Motor relay defective. 3. Check that ground terminals and positive connecton from pump motor are properly secured. 4. Check pump motor for continuity. If pump motor defective, replace hydraulic unit.
3	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** See test stage 3.
3	Lamp 3 (green) must light up	**Lamp 4 (red) lights up:** 1. Repeat test stage. 2. Electronic relay connected to adapter lead is defective.

* **Location of ABS relay (electronic relay):**

928 S, model year '84	= Relay XI	on CEB
928 S, '85 model onwards, 928 S 4	= Relay XVII	on CEB
944, 944 S, 944 Turbo, '87 models onwards	= Relay G 20	on CEB

TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshooting, if spe Refer to circuit diagra
3	Motor relay OFF position		Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up** 1. Switch off ignition, Check following lea and terminal 28 to Test lamp must go 2. Motor relay defecti 3. Check that ground properly secured. 4. Check pump motor unit.
4	Motor relay function (pump motor running)	LED pushbutton pos. 4 lights up; depress button	Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up** See test stage 3.
5	Electronic relay with overvoltage protection for control unit	1. Switch off ignition. Disconnect plug from control unit. 2. Remove electronic relay* from CEB and with adapter lead install in test plug in back of test unit. 3. Plug (new) electronic relay* into CEB. 4. Switch on ignition, wait approx. 1 sec., them depress LED pushbutton pos. 4 (lights up). 5. Display OK. Electronic relay on adapter lead OK. Reinstall tested relay in CEB. 6. Switch off ignition. Reinstall control unit plug for further tests.	Lamps 3 and 4	Lamp 3 (green) must light up	**Lamp 4 (red) lights up** 1. Repeat test stage. 2. Electronic relay co * **Location of ABS re** 928 S, model year 928 S, '85 model o 944, 944 S, 944 Tu

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshoo Refer to circ
6	6.1 Valve FL internal resistance	Ignition on, depress button FL (pos. 5.2)	Digital display unit	0.7 . . . 1.7 Ω	1. Check int terminals 2. Repeat te 3. If specifi
	6.2 Valve FR internal resistance	Depress button FR (pos. 5.3)	Digital display unit	0.7 . . . 1.7 Ω	1. Check int terminals 2. Repeat te 3. If specifi
	6.3 Valve RA internal resistance	Depress button RA (pos. 5.4)	Digital display unit	0.7 . . . 1.7 Ω	1. Check int terminals 2. Repeat te 3. If specifi
7	Ground connection, terminal 10	Ignition on LED pushbutton, pos. 4 lights up, depress button	Digital display unit	< 300 mV (60 . . . 200 mV)*	1. Check gr 2. Check lea unit plug
8	Ground connection, terminal 34	LED pushbutton, pos. 4 lights up, depress button	Digital display unit	< 250 mV (30 . . . 150 mV)*	1. Check gr 2. Check lea unit plug
9	Ground connection, terminal 20 FL = front left FR = front right RA = rear axle	Ignition on LED pushbutton, pos. 4 lights up, depress button	Digital display unit	< 250 mV (30 . . . 150 mV)*	1. Check gr 2. Check lea unit plug * Values in 928 S fro

Display	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
Digital display unit	0.7 . . . 1.7 Ω	1. Check internal resistance and continuity at removed control unit plug between terminals 2 and 32. 2. Repeat test on hydraulic unit between terminals 4 and 1. 3. If specified value not met, replace hydraulic unit.
Digital display unit	0.7 . . . 1.7 Ω	1. Check internal resistance and continuity at removed control unit plug between terminals 35 and 32. 2. Repeat test on hydraulic unit between terminals 4 and 3. 3. If specified value not met, replace hydraulic unit.
Digital display unit	0.7 . . . 1.7 Ω	1. Check internal resistance and continuity at removed control unit plug between terminals 18 and 32. 2. Repeat test on hydraulic unit between terminals 4 and 5. 3. If specified value not met, replace hydraulic unit.
Digital display unit	< 300 mV (60 . . . 200 mV)*	1. Check ground terminal for excessive transfer resistance and interruption. 2. Check lead for breakage, from ground – steering bracket to removed control unit plug terminal 10.
Digital display unit	< 250 mV (30 . . . 150 mV)*	1. Check ground terminal for excessive transfer resistance and interruption. 2. Check lead for breakage, from ground – steering bracket to removed control unit plug terminal 34.
Digital display unit	< 250 mV (30 . . . 150 mV)*	1. Check ground terminal for excessive transfer resistance and interruption. 2. Check lead for breakage, from ground – steering bracket to removed control unit plug terminal 20.

* **Values in () apply to 928 S from '86 model onwards, 928 S 4, and 944 from '87 model onwards.**

	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
display	0.8 . . . 1.8 kΩ	1. Check internal resistance and continuity at removed control unit plug between terminals 4 and 6. 2. Check plug connection. 3. If specified value not met, replace speed sensor.
display	0.8 . . . 1.8 kΩ	As under 10.1, but check terminals 21 and 23 (11)*.
display	0.8 . . . 1.8 kΩ	As under 10.1, but check terminals 8 and 9.
display	0.8 . . . 1.8 kΩ	As under 10.1, but check terminals 24 and 26.
display	> 20 kΩ	Plug connection OK? Disconnect sensor plug. Bridge coupling plug (sleeve side). Repeat test: if display now OK, replace speed sensor. If display still below specified value, leads from control unit plug terminals 4 and 6 to coupling plug are defective. Inspect all leads for chafing.
display	> 20 kΩ	As under 11.1, but applies to leads from control unit terminals 21 and 23 (11)*.
display	> 20 kΩ	As under 11.1, but applies to leads from control unit terminals 8 and 9.
display	> 20 kΩ	As under 11.1, but applies to leads from control unit terminals 24 and 26.

* Values in () apply to
928 S from '86 model onwards, 928 S 4, and 944 from '87 model onwards.

TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshooting, if sp Refer to circuit diagra
10	10.1 Speed sensor FL, internal resistance	Depress button FL (pos. 5.2)	Digital display unit	0.8 . . . 1.8 kΩ	1. Check internal resi terminals 4 and 6. 2. Check plug connec 3. If specified value n
	10.2 Speed sensor FR, internal resistance	Depress button FR (pos. 5.3)	Digital display unit	0.8 . . . 1.8 kΩ	As under 10.1, but ch
	10.3 Speed sensor RL internal resistance	Depress button RL (pos. 5.5)	Digital display unit	0.8 . . . 1.8 kΩ	As under 10.1, but ch
	10.4 Speed sensor RR, internal resistance	Depress button RR (pos. 5.6)	Digital display unit	0.8 . . . 1.8 kΩ	As under 10.1, but ch
11	11.1 Speed sensor FL, insulation resistance	Depress button FL (pos. 5.2)	Digital display unit	> 20 kΩ	Plug connection OK? Disconnect sensor plu Repeat test: if display value, leads from con Inspect all leads for ch
	11.2 Speed sensor FR, insulation resistance	Depress button FR (pos. 5.3)	Digital display unit	> 20 kΩ	As under 11.1, but ap
	11.3 Speed sensor RL, insulation resistance	Depress button RL (pos. 5.5)	Digital display unit	> 20 kΩ	As under 11.1, but ap
	11.4 Speed sensor RR, insulation resistance FL = front left FR = front right RL = rear left RR = rear right	Depress button RR (pos. 5.6)	Digital display unit	> 20 kΩ	As under 11.1, but ap * Values in () apply t 928 S from '86 mo

TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshoo Refer to cir
12	DC voltage in leads from				
	12.1 Speed sensor FL	Depress button FL (pos. 5.2)	Digital display unit	0 . . . 100 mV	Disconnect Repeat test. value, leads leads for ch
	12.2 Speed sensor FR	Depress button FR (pos. 5.3)	Digital display unit	0 . . . 100 mV	As under 12 21.
	12.3 Speed sensor RL	Depress button RL (pos. 5.5)	Digital display unit	0 . . . 100 mV	As under 12
	12.4 Speed sensor RR	Depress button RR (pos. 5.6)	Digital display unit	0 . . . 100 mV	As under 12
13	Control unit supply voltage	LED pushbutton pos. 4 lights up, depress button	Digital display unit	4.75 – 5.25 V	Replace cor
14	Diode in conduction direction: indicator lamp	**Note:** ABS indicator lamp lights up	Digital display unit	< 1.5 V	**Indicator la** 1. Indicator 2. Switch o at remov must reg right-han 3. Check lea **Display out** 1. Switch o terminals (see abov 2. Check lea (928 S, '8 terminal 3. Check in connectio If diode c

FL = front left
FR = front right
RL = rear left
RR = rear right

* **Values in 928 S fro**

Display	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
Digital display unit	0 . . . 100 mV	Disconnect sensor plug and bridge coupling plug (sleeve side). Repeat test. If display now OK, replace speed sensor. If display still above specified value, leads from control unit plug terminals 6 and 4 are defective. Inspect all leads for chafing.
Digital display unit	0 . . . 100 mV	As under 12.1 but applies to leads from control unit plug terminals 23 (11)* and 21.
Digital display unit	0 . . . 100 mV	As under 12.1 but applies to leads from control unit plug terminals 8 and 9.
Digital display unit	0 . . . 100 mV	As under 12.1 but applies to leads from control unit plug terminals 24 and 26.
Digital display unit	4.75 – 5.25 V	Replace control unit.
Digital display unit	< 1.5 V	**Indicator lamp does not light up:** 1. Indicator lamp defective. 2. Switch off ignition. With ohmmeter, check diode between terminals 29 and 32 at removed control unit plug, in conducting and reverse directions. Display must register high resistance, then low resistance. For this operation, pull off right-hand multi-pin plug from combination instrument. 3. Check leads between terminals 29 and 32 for breakage. **Display out of tolerance:** 1. Switch off ignition. Inspect leads from removed control unit plug between terminals 29 and 32 for breakage, also diode in conducting and reverse directions (see above). 2. Check lead between control unit plug terminal 29 and combination instrument (928 S, '84 model, terminal 2; 928 S '85 model onwards, terminal 3; 944, terminal 14, plug L) for breakage. 3. Check indicator lamp plug connection, also ground lead and valve relay plug connection for voltage drop. If diode defective, replace hydraulic unit.

* **Values in () apply to**
928 S from '86 model onwards, 928 S 4, and 944 from '87 model onwards.

	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
display	2.5 . . . 8.5 V	**Display out of tolerance, indicator lamp does not light up:** 1. Check indicator lamp and leads. 2. Pull out valve relay; lamp lights up; diode defective; replace hydraulic unit.
dicator vehicle	Indicator lamp must go out within 3 secs.	**Indicator lamp does not go out:** 1. Repeat test stage with engine running. 2. Replace control unit.
dicator	Indicator lamp must remain on while button depressed	**Indicator lamp goes out:** 1. Repeat test stage with engine running. 2. Replace control unit.
display	1.9 . . . 2.3 A	1. Repeat test stage with engine running. 2. Replace control unit.
display	1.9 . . . 2.4 A	1. Repeat test stage with engine running. 2. Replace control unit.
display	1.9 . . . 2.3 A	1. Repeat test stage with engine running. 2. Replace control unit. FL = front left FR = front right RA = rear axle

TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshooting, Refer to circuit d
15	Diode in reverse direction; indicator lamp	Note: ABS indicator lamp glows less brightly, valve relay trips	Digital display unit	2.5 . . . 8.5 V	Display out of to 1. Check indicato 2. Pull out valve r
16	Control unit bite triggered	LED pushbutton pos. 4 lights up, depress button minimum 3 secs. Note: Lamp may flash twice while button depressed: pump motor startup	ABS indicator lamp in vehicle	Indicator lamp must go out within 3 secs.	Indicator lamp do 1. Repeat test sta 2. Replace contro
17	Control unit bite triggered with fault simulation	LED pushbutton pos. 4 lights up, depress button minimum 3 secs. Note: Lamp may flash twice while button depressed.	ABS indicator lamp in vehicle	Indicator lamp must remain on while button depressed	Indicator lamp go 1. Repeat test sta 2. Replace contro
18	Control unit valve flows — pressure holding	LED pushbutton pos. 4 lights up; depress button again after each selected valve. Touching is suffient, with display at zero, press button again Note: Pump motor starts twice.			
	18.1 Valve FL	Depress button FL (pos. 5.2); depress LED pushbutton pos. 4	Digital display unit	1.9 . . . 2.3 A	1. Repeat test sta 2. Replace control
	18.2 Valve FR	Wait until display registers zero! Depress button FR (pos. 5.3), depress LED pushbutton pos. 4.	Digital display unit	1.9 . . . 2.4 A	1. Repeat test sta 2. Replace control
	18.3 Valve RA	Wait until display registers zero! Depress button RA (pos. 5.4), depress LED pushbutton item 4.	Digital display unit	1.9 . . . 2.3 A	1. Repeat test sta 2. Replace control FL = front left FR = front right RA = rear axle

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Display	Specified response/value	Troubleshoo Refer to circ
19	Control unit valve flows – pressure reduction	LED pushbutton pos. 4 lights up; depress button again after each selected valve. Touching is sufficient, with display at zero, press button again. **Note:** Pump motor starts twice.			
	19.1 Valve FL	Depress button FL (pos. 5.2); depress LED pushbutton pos. 4.	Digital display unit	4.8 . . . 6.0 A	1. Repeat te 2. Replace c
	19.2 Valve FR	Wait until display registers zero! Depress button FR (pos. 5.3), depress LED pushbutton pos. 4.	Digital display unit	4.8 . . . 6.0 A	1. Repeat te 2. Replace c
Caution: changed sequence	19.3 Valve RA	Wait until display registers zero! Depress button RA (pos. 5.4), depress LED pushbutton pos. 4.	Digital display unit	4.8 . . . 6.0 A	1. Repeat te 2. Replace c
24	Stop light switch **Note:** Display of 0.00 – 0.25 V without pedal applied is of no significance	Apply brake pedal	Digital display unit	10 . . . 15 V	**If no display** Check stop and lead co **Display less** Correct tra switch.
23	Speed sensor signal **Note:** see also page 11 FL = front left FR = front right RA = rear axle RL = rear left RR = rear right	• Drive vehicle with front axle, then rear axle in sequence, on dynamometer • Engage brake rollers for front and rear wheels separately. • Speed sensor selection occurs by depressing appropriate button FL, FR and RL, RR (pos. 5.2, 5.3 and 5.5, 5.6).	Digital display unit	> 1.5 (2.5)* Take lowest value if display fluctuates **Note:** If display registers 1.5 (2.5)*, check air gap. < 1.0	• **Display o** Dynamo **Display 0** • Speed se Check as control i • Air gap b • Check wh • Replace s • Check nu 928 S bef 928 S '86 **Caution:** * **Values in 928 S '86**

Display	Specified response/value	Troubleshooting, if specified value not met. Refer to circuit diagram when troubleshooting.
Digital display unit	4.8 . . . 6.0 A	1. Repeat test stage with engine running. 2. Replace control unit.
Digital display unit	4.8 . . . 6.0 A	1. Repeat test stage with engine running. 2. Replace control unit.
Digital display unit	4.8 . . . 6.0 A	1. Repeat test stage with engine running. 2. Replace control unit.
Digital display unit	10 . . . 15 V	**If no display:** Check stop light switch, adjustment, power supply to switch, plug connections and lead connection from control unit plug terminal 25 to stop light switch. **Display less than 10 V:** Correct transfer resistance in plug and lamp connections or replace stop light switch.
Digital display unit	> 1.5 (2.5)* Take lowest value if display fluctuates **Note:** If display registers 1.5 (2.5)*, check air gap. < 1.0	• **Display of 999 signifies:** Dynamometer speed excessive (over 15 kph) **Display 0 or less than 1.5 (2.5)*** • Speed sensor wrongly connected? Check assignments. Speed sensors must correspond to specific wheels and control instrument inputs. • Air gap between speed sensor and ring gear excessive. Check installation. • Check wheel bearing clearance on front wheels. • Replace speed sensors. • Check number of teeth of pulse gear: 928 S before '86 = 90 teeth 928 S '86 model onwards and 944 '87 model onwards = 45 teeth **Caution:** Carry out test stages 20 – 22 when test stage 23 passed satisfactorily. * **Values in () applicable to:** **928 S '86 model onwards, 928 S 4, and 944 '87 model onwards.**

	Specified response/value	Troubeshooting, if specified value not met
e not obtained with the foot. 21/22 is 2000 N (200 kp)	**Front axle** < 1500 N < (150 kp)	• Repeat test stages with engine running, making sure that braking force is not changed during testing.
	Lamp 1 (green) must remain on throughout	• If lamp 2 (red) lights up, charge battery and run engine.
0 N (200 kp), rear axle		• Existing braking system OK? Properly bleded? Brake line connections not leaking? Brake linings must not be badly worn. Brake discs OK? Master and wheel brake cylinder OK? Wheel brake cylinders and linings. Must move freely, clean if necessary.
pushbutton. meter display stabilizes. conds. ight up. If it does, repeat	**Rear axle** < 800 N < (80 kp)	
conds, i. e. wait approx. ushbutton (internal test		
n er. pushbutton, pos. 5.2.	After a period of low pressure, braking force display rises again to: **at front axle:** < 2000 N < (200 kp)	• Brake lines wrongly connected to hydraulic unit? • Re-check asignment of brake rollers to pushbutton FL, FR and RA.
rce display registers		• Check ground terminals at pump motor and vehicle body. Re-check positive terminal of pump motor.
left) must occur. ess FR button and	Lamp 1 (green) must remain on throughout	• Replace hydraulic unit.
ndbrake; test stages 20,	**at rear axle:** < 1000 N < (100 kp)	**Notes on test stage 21:** **A noticeable reduction in pressure must have occurred before the registered specified value is reached (wheel braking force reduced).**
wheel about to be tested, n constant 2000 N. **Do not** **!** meter display stabilizes	After dropping pressure twice without recirculating pump, the pump will switch on briefly. Braking force display must then drop below < 600 N < (60 kp)	**If pressure rises immediately after application of reset button on test unit, the hydraulic lines assignment or cable harness must be checked for correct connection. If necessary, replace hydraulic unit.**
onstant at other running wheel. Force are permissible, but do n on both wheels.		
20, 21 and 22	Brake pedal resists slightly.	**Notes on test stage 22:** **Yellow button must be kept depressed until braking force rises again (approx. 5 secs.).**
ivated, facilitating brake d maintain constant **h to adjust braking force!** meter display stabilizes	Lamp 1 (green) must remain on throughout.	**End of test stage is signified by a steep rise in braking force.**

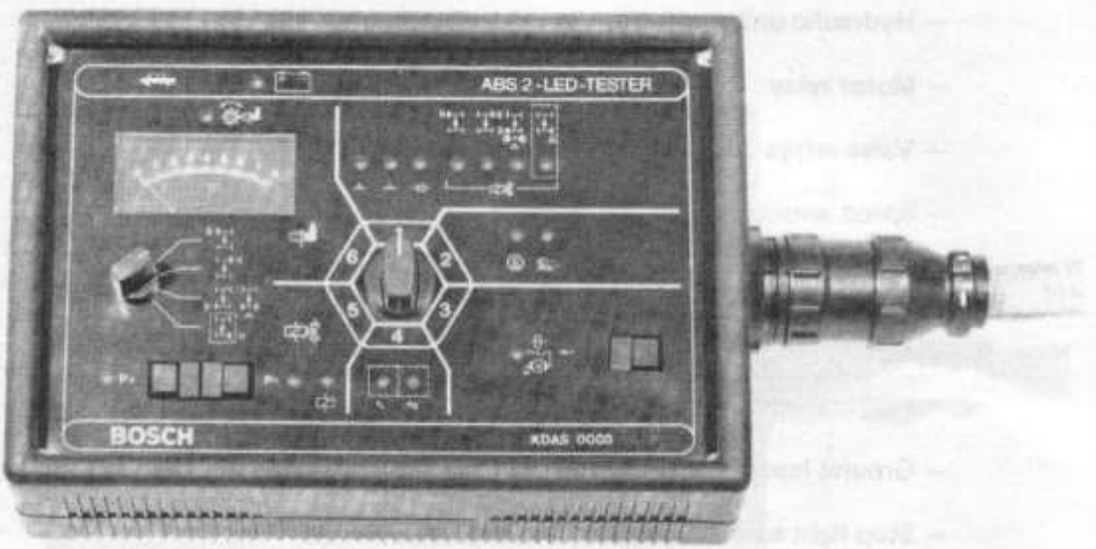
TEST PLAN 1 ABS

Switch ignition ON for all program switch positions

Program switch position	Item tested	Additional operations Ignition on	Specified response/value
20	Hydraulic unit, pressure reduction in brake lines	Run engine if undervoltage occurs or braking force not obtained with the foot. Braking force on dynamometer for test stages 20/21/22 is 2000 N (200 kp) for front axle, 1000 N (100 kp) for rear axle. **1. Observe correct sequence of operations** • Select test stage (program switch position). • Select channel (wheel). • Set braking force with the foot, front axle 2000 N (200 kp), rear axle 1000 N (100 kp). • After short delay (approx. 0.5 s), depress LED pushbutton. • Keep LED pushbutton depressed until dynamometer display stabilizes. The internal test unit program runs for a few seconds. • During test procedure, lamp 2 (red) must not light up. If it does, repeat test with engine running. • Resume or repeat test only after approx. 20 seconds, i. e. wait approx. 20 seconds between two applications of LED pushbutton (internal test unit program must be concluded).	**Front axle** < 1500 N < (150 kp) Lamp 1 (green) must remain on throughout **Rear axle** < 800 N < (80 kp)
21	Hydraulic unit, pressure build-up in brake lines	**2. Check brake lines for correct connection** • Drive vehicle with front wheels on dynamometer. • Select test stage 20, then front left wheel with pushbutton, pos. 5.2. • Engage front left brake roller. • Apply brake pedal, keep down until braking force display registers 2000 N (200 kp) on dynamometer. • Depress LED pushbutton. • Reduction in pressure to selected wheel (front left) must occur. • Carry out same test on front right wheel. Depress FR button and engage only the front right brake roller. **3. Front axle hydraulic unit test;** apply handbrake; test stages 20, 21 and 22 • Set test stage. • Select one wheel (front left or front right). • Engage both brake rollers.	After a period of low pressure, braking force display rises again to: **at front axle:** < 2000 N < (200 kp) Lamp 1 (green) must remain on throughout **at rear axle:** < 1000 N < (100 kp)
22	Hydraulic unit, pump output	• Preapply **2000 N (200 kp)** braking force to the wheel about to be tested, with brake pedal. Throughout the test, maintain constant 2000 N. **Do not use a brake pedal winch to adjust braking force!** • Keep LED pushbutton depressed until dynamometer display stabilizes and value has been read off (approx. 6 secs.). • During test, check that braking force remains constant at other running wheel. If pedal travel varies: minor variations in braking force are permissible, but do affect the display! • Carry out test stages 20, 21 and 22 in succession on both wheels. **4. Rear axle hydraulic unit test:** test stages 20, 21 and 22 • Drive vehicle with rear axle on dynamometer. • Set test stage. • Depress pushbutton for rear axle. • Engage both brake rollers. • Run engine (braking force reinforcement is activated, facilitating brake application). • Preapply 1000 N (100 kp) with brake pedal and maintain constant throughout test: Do not use a brake pedal **winch to adjust braking force!** • Keep LED pushbutton depressed until dynamometer display stabilizes (test duration approx. 6 secs.).	After dropping pressure twice without recirculating pump, the pump will switch on briefly. Braking force display must then drop below < 600 N < (60 kp) Brake pedal resists slightly. Lamp 1 (green) must remain on throughout.

ABS TEST UNIT Bosch ABS-2-LED TEster, order No. KDAS 0003

Adapter lead, order No. KDAS 0003/2
(supplied as standard with tester)



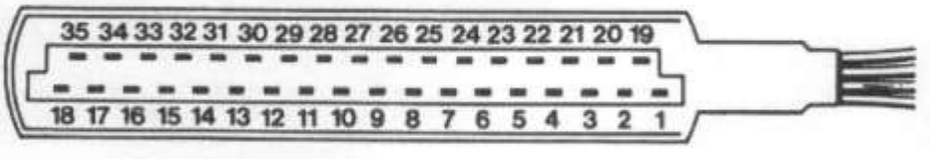
Standard tools and instruments

2 Control unit plug test leads, approx. 60 cm long with 2 insulated alligator clips and 2 flat pin plugs N 17.457.2.

The test lead must be used for testing the control unit plug.

Plug terminal designations

Control unit multiple-pin plug, looking towards plug terminals.



EXPLANATION OF THE ABS-2-LED Test Unit

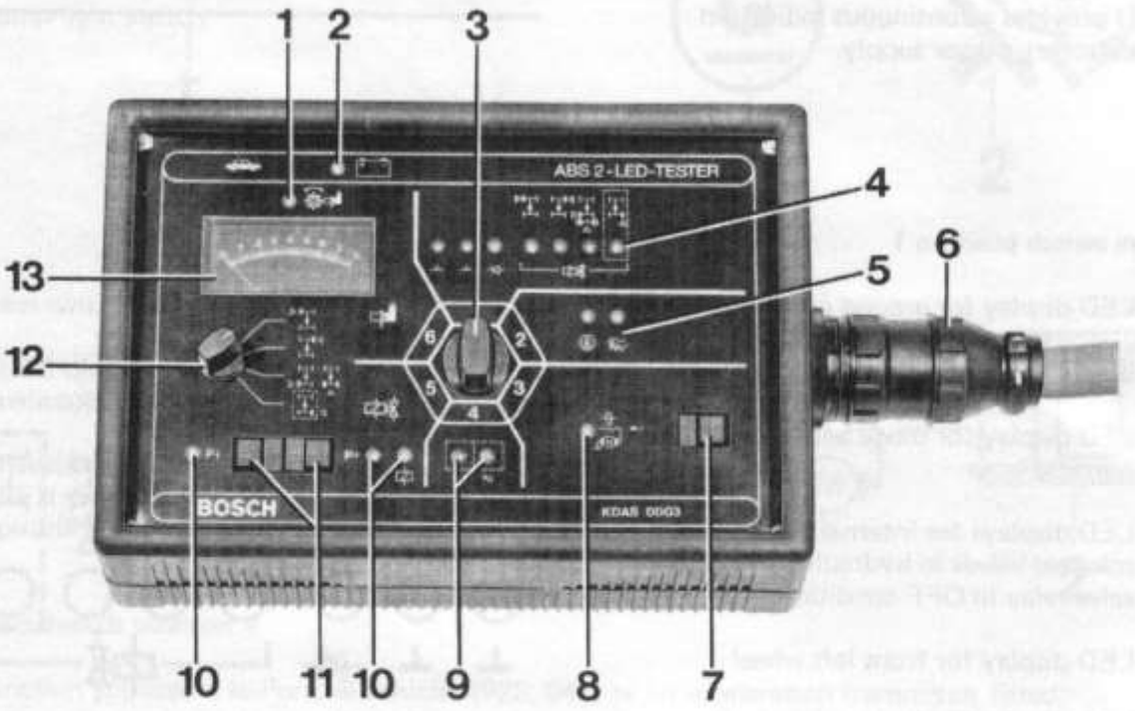
This tester can be used to test the following peripheral system components in six program stages.

- Hydraulic unit
- Motor relay
- Valve relays
- Speed sensors
- Warning lamp
- Wiring harness
- Plug connections
- Ground leads
- Stop light switch signal
- Generator signal

If a fault is present, it will be indicated by the various LED displays on the tester. Speed sensor signals can be evaluated by the deflection registered by the pointer-type instrument. The ABS regulating unit is not included in this Test Plan. This is a self-diagnostic unit which does not require additional testing with this test equipment.

ABS testing with this tester does not require a dynamometer. The tests can be carried out on a vehicle hoist of the type which leaves the wheels free to rotate.
If, in spite of this, a dynamometer is used, there is a danger that the vehicle may jump off the rollers. The responsibility for using a dynamometer rests with the personnel carrying out the tests.

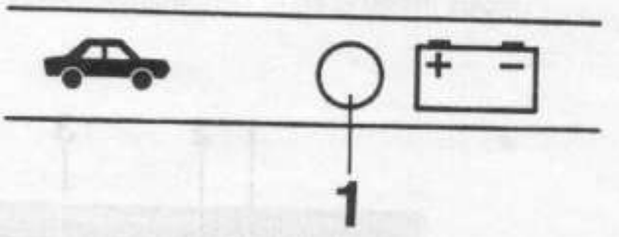
ABS-2-LED Tester Layout



1 – 1 LED display for wheel speed in program switch position 6
2 – 1 LED display for battery voltage
3 – Program switch
4 – 7 LED displays for program switch position 1
5 – 2 LED displays for program switch position 2
6 – Adapter lead for connection to ABS wiring harness in vehicle
7 – Pushbutton for motor relay activation in program switch position 3
8 – 1 LED display for program switch position 3
9 – 2 LED displays for program switch position 4
10 – 3 LED displays for program switch position 5
11 – 2 Pushbuttons ro release solenoid valve functions, pressure-holding and pressure-reduction in program switch position 5
12 – Rotary switch for selection of individual wheels; functions in program switch positions 5 and 6
13 – Pointer-type instrument for program switch position 6

Description of symbols

The tester draws its power supply from the vehicle battery. The supply voltage is monitored in all program switch positions throughout the entire test procedure. An LED (1) provides a continuous indication of a satisfactory power supply.



Program switch position 1

1 = LED display for ground connection 1

2 = LED display for ground connection 2

3 = LED display for diode activating warning lamp

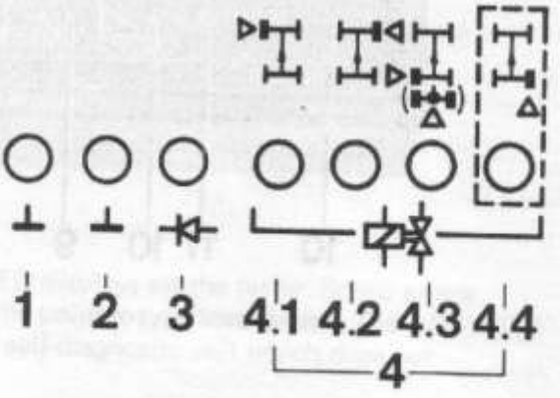
4 = LED displays for internal resistance of solenoid valves in hydraulic unit and valve relay in OFF condition.

4.1 = LED display for front left wheel

4.2 = LED display for front right wheel

4.3 = LED display for rear axle of vehicles with 3-channel hydraulic unit (figures in () apply).

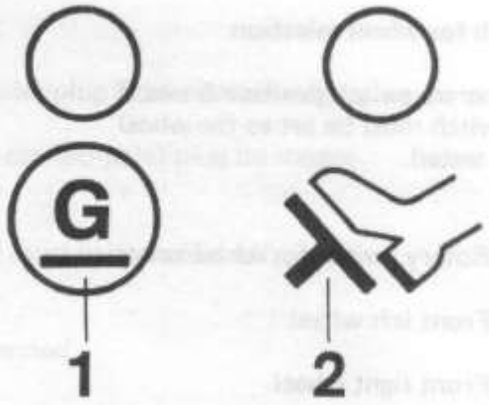
4.4 = No function applicable to Porsche vehicles (broken line signifies that LED must only light up for 4-channel hydraulic units).



Program switch position 2

1 – LED display for connection to generator terminal 61

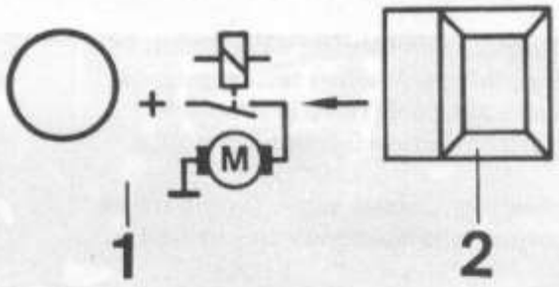
2 – LED display for connection to stop light switch



Program switch position 3

1 – LED display for motor relay and recirculating pump in hydraulic unit.

2 – Pushbutton to activate motor relay. LED display lights up only after pushbutton has been depressed.



Program switch position 4

No function applicable to Porsche vehicles (928, 944) as no acceleration transmitter fitted.

Program switch position 5

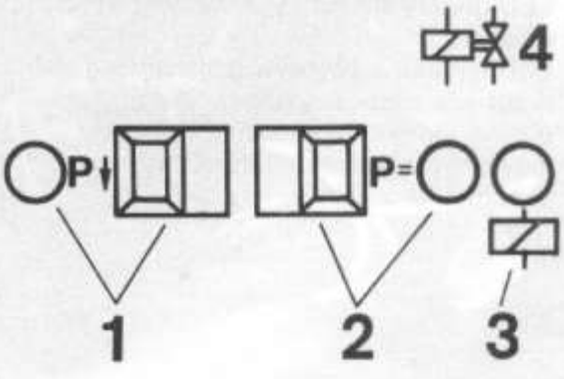
Function testing of solenoid valves and valve relay in hydraulic unit.
Testing of channel assignments of solenoid valves (interchange test).

1 – Pushbutton and LED display for pressure reduction function. LED must light up when button depressed.

2 – Pushbutton and LED display for pressure-holding function. LED must light up when button depressed.

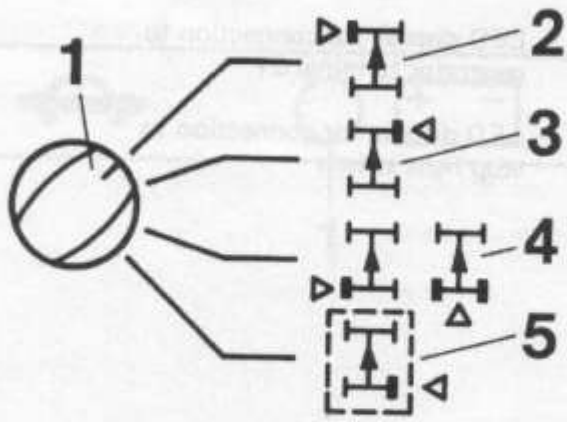
3 – LED display for valve relay function. LED must remain lit continuously in program switch position 5.

4 – Symbol for solenoid valves.



Switch for wheel selection

In program switch position 5 and 6, the switch must be set to the wheel to be tested.



1 – Rotary switch for wheel selection

2 – Front left wheel

3 – Front right wheel

4 – Rear left wheel, when testing speed sensor in program switch position 6 (left signal represents rear left)

Rear axle on vehicles with 3-channel hydraulic unit when testing solenoid valve and valve relay in program switch position 5 (right symbol).

5 – Rear right wheel, when testing speed sensor in program switch position 6.

Program switch position 6

Testing of speed sensor signal and change in dynamic air gap between speed sensor and ring gear. Test for incorrect assignment of speed sensors.

1 – Pointer-type instrument

2 – LED display for rotary movement of wheels.
LED remains on continuously so long as sufficient wheel speed exists for testing. Do not take reading from indicating instrument before this condition is obtained.

ABS-2-LED Tester connection

1. **With ignition switched OFF,** disconnect multi-pin (35-pole) plug from control unit.

2. Connect ABS-2-LED tester to ABS wiring harness multi-pin (35-pole) plug by means of adapter lead plug.

3. Switch ignition ON. All other power-consuming systems must be switched off.

CAUTION: Vehicle must not be driven with test unit connected.

Tester connection
928 Series

Tester connection
944 Series

Preparations for tests using the ABS-2-LED Tester

- Check ground connection of recirculating pump and overvoltage protection relay terminal 31 for secure attachment and corrosion.

- Check hydraulic connections and junctions on hydraulic unit for leaks (visual inspection).

- If, when driving, the ABS warning lamp lights up intermittently (e.g. when items of electrical equipment are switched on) and goes out of its own accord, check battery and power supply (generator, regulator and voltage drops).

- If the ABS warning light remains on and does not go out, check the following points:

  – Is multi-pin plug correctly installed (and locked) in control unit?

  – Are all plug contacts OK?

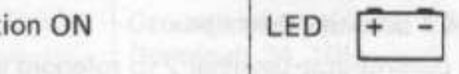
  – Are spring-loaded contacts locked in position?

  – Are V-belts cracked? (generator produces no voltage, charging and ABS warning lamp lights up).

- For testing operations, switch ignition ON in all program switch positions (tester operates on power supply from vehicle battery).

- Observe LED for power supply in all program switch positions.

Switch ignition ON for all program switch positions

Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault Refer to circuit diagrar
All	Power supply (terminal 20/ground and terminal 1/positive)	Ignition ON	LED  remains on continuously	**LED does not remain c** • Battery insufficientl • Fuse blown (928 S ' 944: fuse 26 on CEE • No ground at termin • No voltage at termin – Lead from termin – No voltage at tern terminal 30 interr – No voltage at tern – Relay or diode in 31, passage in one • Excessive voltage dr 928 S, '84 model 928 S, '85 model on 944, '87 model onw
1	Ground connections (terminals 34, 10), diode for warning lamp (terminals 29, 32) solenoid valves, internal resistances (terminals 2, 35, 18) valve relay OFF condition and ground connection	Ignition ON	First 6 LEDs glow with uniform brightness	• **LED ⊥ does not** Check ground conne • **LED ⊣◁⊢ does not** – ABS warning lamp – Lead between con '84 model: termin interrupted. – Excessive voltage or valve relay plug – Test with ohmmet switched OFF. Display must regis direction. (Pull out yellow p **If specified results** – The diode is de – Leads from con

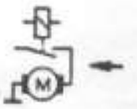
ecified response isplay)	Possible causes of fault. Refer to circuit diagram when troubleshooting.
ED [+ −] mains on ntinuously	**LED does not remain on continuously:** • Battery insufficiently charged (low voltage) < 9.9 V • Fuse blown (928 S '84 model: fuse in ABS relay; '85 model onwards: fuse 16 cm CEB; 944: fuse 26 on CEB). • No ground at terminal 20 of control unit plug (test with ohmmeter). • No voltage at terminal 1 of control unit plug. – Lead from terminal '87 of ABS relay* to terminal 1 of control unit plug interrupted. – No voltage at terminal 30 of ABS relay, as positive lead from battery + to ABS relay terminal 30 interrupted. – No voltage at terminal 15 to ABS relay. – Relay or diode in relay defective (test diode with ohmmeter between terminals 30 and 31, passage in one direction only). • Excessive voltage drop in supply leads. 928 S, '84 model = relay XI 928 S, '85 model onwards = relay XVI 944, '87 model onwards = relay G 20
st 6 LEDs w with uniform ghtness	• **LED ⊥ does not light up:** Check ground connections between terminals 34, 10 and MP. • **LED ⊣◇⊢ does not light up:** – ABS warning lamp defective. – Lead between control unit plug terminal 29 and combination instrument (928 S, '84 model: terminal 2; 928 S, '85 model onwards: terminal 3; 944 terminal 14, plug L) interrupted. – Excessive voltage drop at indicator lamp plug connection, valve relay ground connection or valve relay plug connection. – Test with ohmmeter between terminals 29 and 32 of control unit plug with ignition switched OFF. Display must register low resistance in conducting direction, high resistance in reverse direction. (Pull out yellow plug from central information board for this test). **If specified results not met, either:** – The diode is defective, replace hydraulic unit, or: – Leads from control unit plug terminals 29 or 32 to hydraulic unit interrupted.

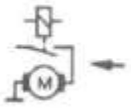
response	Possible causes of fault. Refer to circuit diagram when troubleshooting.
Eds glow form ss	• **LED 4.1 does not light up:** – Lead from control unit terminal 2 to solenoid valve terminal 1, hydraulic unit or plug connection interrupted. – Solenoid valve defective, test with ohmmeter between control unit plug terminal 2 and ground (specified value 0.7 . . . 1.7 Ω). • **LED 4.2 does not light up:** – Lead from control unit terminal 35 to solenoid valve terminal 3, hydraulic unit or plug connection interrupted. – Solenoid valve defective, test with ohmmeter between control unit plug terminal 35 and ground (specified value 0.7 . . . 1.7 Ω). • **LED 4.3 does not light up:** – Lead from control unit terminal 18 to solenoid valve terminal 5, hydraulic unit or plug connection interrupted. – Solenoid valve defective, test with ohmmeter between control unit plug terminal 18 and ground (specified value 1.7 . . . 1.7 Ω). • **If all LEDs and LEDs do not light up:** – Check valve relay ground connection. – Valve relay defective. • **If one LED glows weakly, this signified excessive transfer resistance in the corresponding circuit.** **CAUTION: 4.4 does not light up, due to 3-channel only system.**
G	• **LED does not light up:** – Cable connection from control unit plug terminal 15 to generator terminal 61 (D+ interrupted.
s out with nning	• **LED does not go out:** – Open throttle once; sometimes LED goes out only in response to a single application of throttle. – Generator or regulator defective.
	• **LED does not go out:** – Stop light fuse blown (928 S, '84 model: fuse 7; 928 S, '85 model onwards: fuse 4; 944: fuse 19) – No voltage at stop light switch. – Cable connection from control unit plug terminal 25 to stop light switch interrupted. – Stop light switch defective.

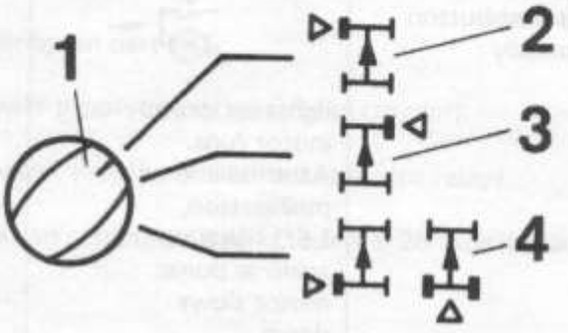
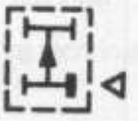
TEST PLAN 2 ABS

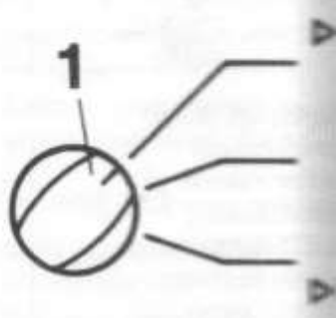
Switch ignition ON for all program switch positions

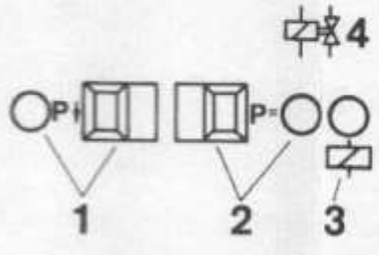
Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault. Refer to circuit diagram when
1	Ground connections (terminals 34, 10), diode for warning lamp (terminals 29, 32) solenoid valves, internal resistances (terminals 2, 35, 18) valve relay OFF condition and ground connection	Ignition ON	First 6 LEDs glow with uniform brightness	• **LED 4.1 does not lig** – Lead from control unit te connection interrupted. – Solenoid valve defective, t ground (specified value 0. • **LED 4.2 does not lig** – Lead from control unit te connection interrupted. – Solenoid valve defective, t ground (specified value 0. • **LED 4.3 does not lig** – Lead from control unit te connection interrupted. – Solenoid valve defective, t ground (specified value 1. • **If all LEDs and LE** – Check valve relay ground – Valve relay defective. • **If one LED glows weakly, th circuit.** **CAUTION: 4.4 does not light**
2	Generator voltage from terminal 61 (terminal 15)	Ignition ON	LED (G) lights up	• **LED does not light up:** – Cable connection from co interrupted.
		Start engine	LED goes out with engine running	• **LED does not go out:** – Open throttle once; some throttle. – Generator or regulator de
	Stop light switch (terminal 25)	Ignition ON	LED lights up	• **LED does not go out:** – Stop light fuse blown (92 fuse 4; 944: fuse 19) – No voltage at stop light sw
		Operate brake pedal	LED goes out	– Cable connection from co interrupted. – Stop light switch defectiv

Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault. Refer to circuit diagran
3	Motor relay, pump motor in hydraulic unit (terminal 28)	Ignition ON Depress pushbutton continuously	LED  lights up, pump motor runs. After release of pushbutton, LED lights up again as pump motor slows down	**If pump motor does no** – Hydraulic unit has n – No voltage at hydrau – No voltage at hydrau – Control lead from hy – Motor relay defectiv – Pump motor defecti
4	Acceleration transmitter			Program switch positio with four-wheel drive.
5	Valve relay function (terminal 27)	Ignition ON	LED  remains on continously	**LED does not light up:** – Check lead connecti – Check lead connecti 87 for continuity. – Valve relay defective

Specified response (display)	Possible causes of fault. Refer to circuit diagram when troubleshooting.
LED  Lights up, pump motor runs. After release of pushbutton, LED lights up again as pump motor slows down	If pump motor does not start, and LED does not light up: – Hydraulic unit has no ground connection (program part 1). – No voltage at hydraulic unit termial 12 (power supply motor relay'load current). – No voltage at hydraulic unit terminal 10 (power supply control circuit motor relay). – Control lead from hydraulic unit terminal 11 to control unit plug terminal 28 interrupted. – Motor relay defective. – Pump motor defective.
	Program switch position not required, as acceleration transmitter only fitted to vehicles with four-wheel drive.
LED  Remains on continously	LED does not light up: – Check lead connection between control unit plug terminal 27 and 28 for continuity. – Check lead connection between control unit plug terminal 27 and ABS relay terminal 87 for continuity. – Valve relay defective.

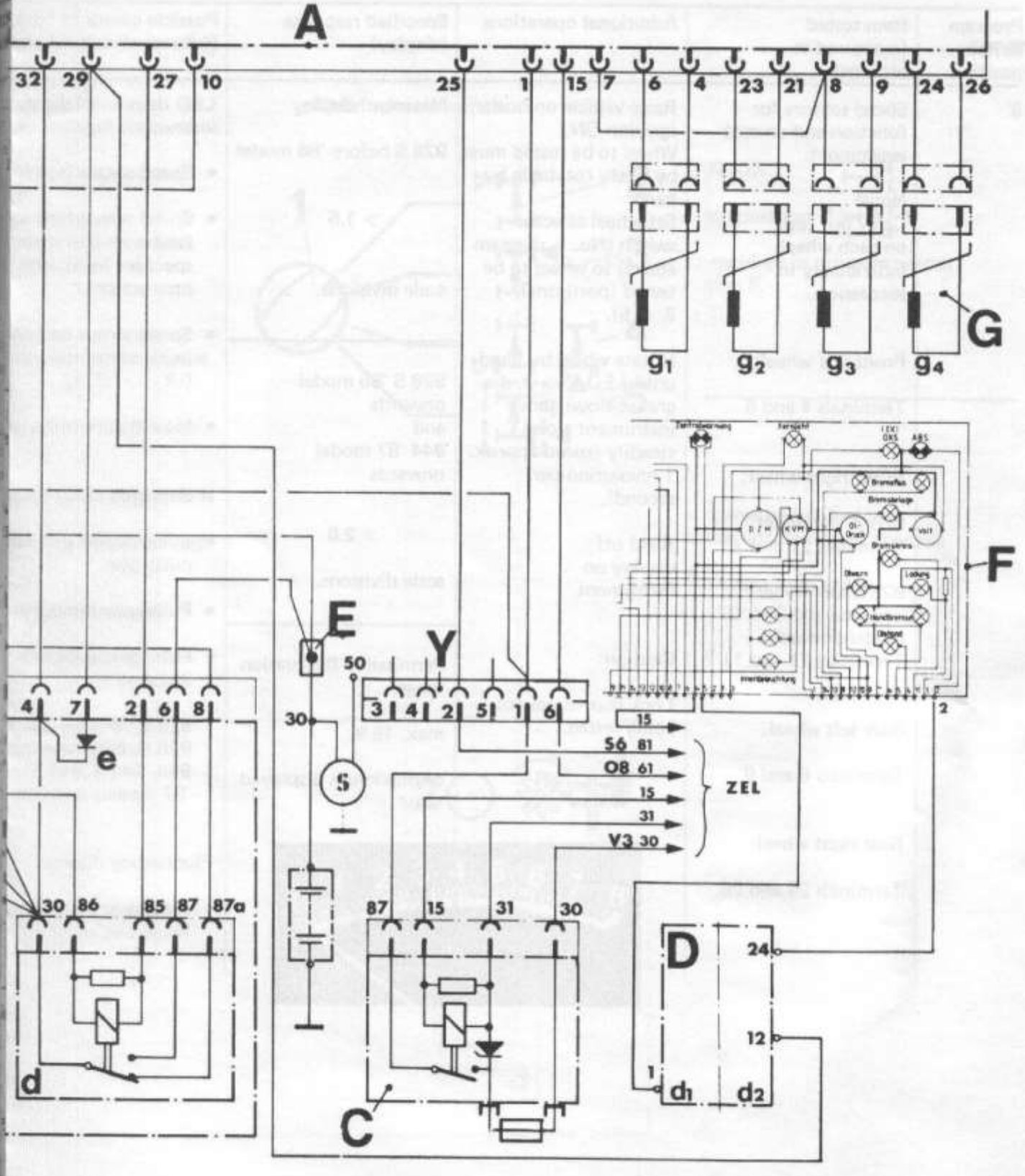
d response	Possible causes of fault. Refer to circuit diagram when troubleshooting.
on continuously am switch 5.	 **CAUTION:** Switch position  Not required in program switch position 5.
P= s up --- wheel e by --- P= out, cked. --- P↓ ressure- n lights up, tatable by --- P↓ ressure- n goes out, cked --- n box	**LED does not light up:** • Low battery voltage: repeat test with engine running. **Characteristic:** Current requirement not met, LED P ↓ for pressure-holding or P = for pressure-reduction goes out, as battery insufficiently charged. • If a wheel other than that set on the test unit responds, the brake lines at the hydraulic unit have been incorrectly connected. • Check ground terminals on hydraulic unit and vehicle body. • Check hydraulic unit positive lead. • Hydraulic unit defective.

Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault. Refer to circuit diagram when
5	Solenoid valves in hydraulic unit for function and correct assignment. Note: Carry out tests on each front wheel individually in succession. Rear axle testing can be carried out on either the left or right wheel.	Raise vehicle on hoist. Ignition ON. Wheel to be tested must be freely rotatable by hand. Set wheel selector switch to appropriate wheel (position 2, 3, 4 in diagram). Carry out operations in specified sequence.	LED  remains on continuously in program switch position 5.	
	Function pressure-holding	1. Depress push-button (2) continuously	LED P= (2) lights up	**LED does not light up:** • Low battery voltage: repeat **Characteristic:** Current requ P = for press • If a wheel other than that se hydraulic unit have been inco • Check ground terminals on h • Check hydraulic unit positive • Hydraulic unit defective.
		2. Depress brake pedal continuously	Tested wheel rotatable by hand	
		3. Release push-button (2)	LED P= (2) goes out, wheel locked.	
	Function pressure-reduction	4. Depress push-button (1) for pressure reduction	LED P↓ (1) for pressure-reduction lights up, wheel rotatable by hand	
		5. Release push-button (1) for pressure-reduction	LED P↓ (1) for pressure-reduction goes out, wheel locked	
		6. Release brake pedal		
		Pushbuttons and LED designated in box headed "Additional operations":		



Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault. Refer to circuit diagram
6	Speed sensors for function and correct assignment. **Note:** Carry out tests on each wheel individually in succession. **Front left wheel:** Terminals 4 and 6 **Front right wheel:** 928 S '84 model Terminals 21 and 23 928 S '86 model onwards and 944 '87 model onwards Terminals 21 and 11 **Rear left wheel:** Terminals 8 and 9 **Rear right wheel:** Terminals 24 and 26	Raise vehicle on hoist. Ignition ON. Wheel to be rested must be freely rotatable by hand. Set wheel selector switch (No. 1, diagram above) to wheel to be tested (position 2, 3, 4, 5). Rotate wheel by hand until LED (No. 2, diagram below) above instrument glows steadily (speed approx. 1 revolution per second). Read off display on instrument. **Caution:** Lock rear wheel not being tested.	Minimum display 928 S before '86 model > 1.5 scale divisions. 928 S '86 model onwards and 944 '87 model onwards > 2.0 scale divisions. Permissible fluctuation range: max. 15 % of maximum displayed value.	**LED does not light up / instrument registers no** • Speed sensor lead in • Speed sensor lead in (test with ohmmeter specified in column 2 connection). • Speed sensor defecti (with ohmmeter, me 0.8 . . . 1.8 Ω). • No effective pulse ge **If displayed value belov** • Excessive air gap bet pulse gear. • Pulse gear loose, dan • Pulse gear with incor installed 928 S, '84 and '85 m 928 S, '86 model on 944, 944 S, 944 Turl '87 models onwards **Fluctuating display:** • Pulse gear or gear hu (excessive eccentricit

Program switch position	Item tested (measured at terminals)	Additional operations	Specified response (display)	Possible causes of fault: Refer to circuit diagram
6	Speed sensors for function and correct assignment. **Note:** Carry out tests on each wheel individually in succession. **Front left wheel:** Terminals 4 and 6 **Front right wheel:** 928 S '84 model Terminals 21 and 23 928 S '86 model onwards and 944 '87 model onwards Terminals 21 and 11 **Rear left wheel:** Terminals 8 and 9 **Rear right wheel:** Terminals 24 and 26	Raise vehicle on hoist. Ignition ON. Wheel to be rested must be freely rotatable by hand. Set wheel selector switch (No. 1, diagram above) to wheel to be tested (position 2, 3, 4, 5). Rotate wheel by hand until LED (No. 2, diagram below) above instrument glows steadily (speed approx. 1 revolution per second). Read off display on instrument. **Caution:** Lock rear wheel not being tested.	Minimum display 928 S before '86 model **> 1.5** scale divisions. 928 S '86 model onwards and 944 '87 model onwards **> 2.0** scale divisions. Permissible fluctuation range: max. 15 % of maximum displayed value.	**LED does not light up / instrument registers no** • Speed sensor lead in • Speed sensor lead in (test with ohmmeter specified in column 2 connection). • Speed sensor defecti (with ohmmeter, me 0.8 . . . 1.8 Ω). • No effective pulse ge **If displayed value belov** • Excessive air gap bet pulse gear. • Pulse gear loose, dam • Pulse gear with incor installed 928 S, '84 and '85 m 928 S, '86 model on 944, 944 S, 944 Tur '87 models onwards **Fluctuating display:** • Pulse gear or gear hu (excessive eccentricit

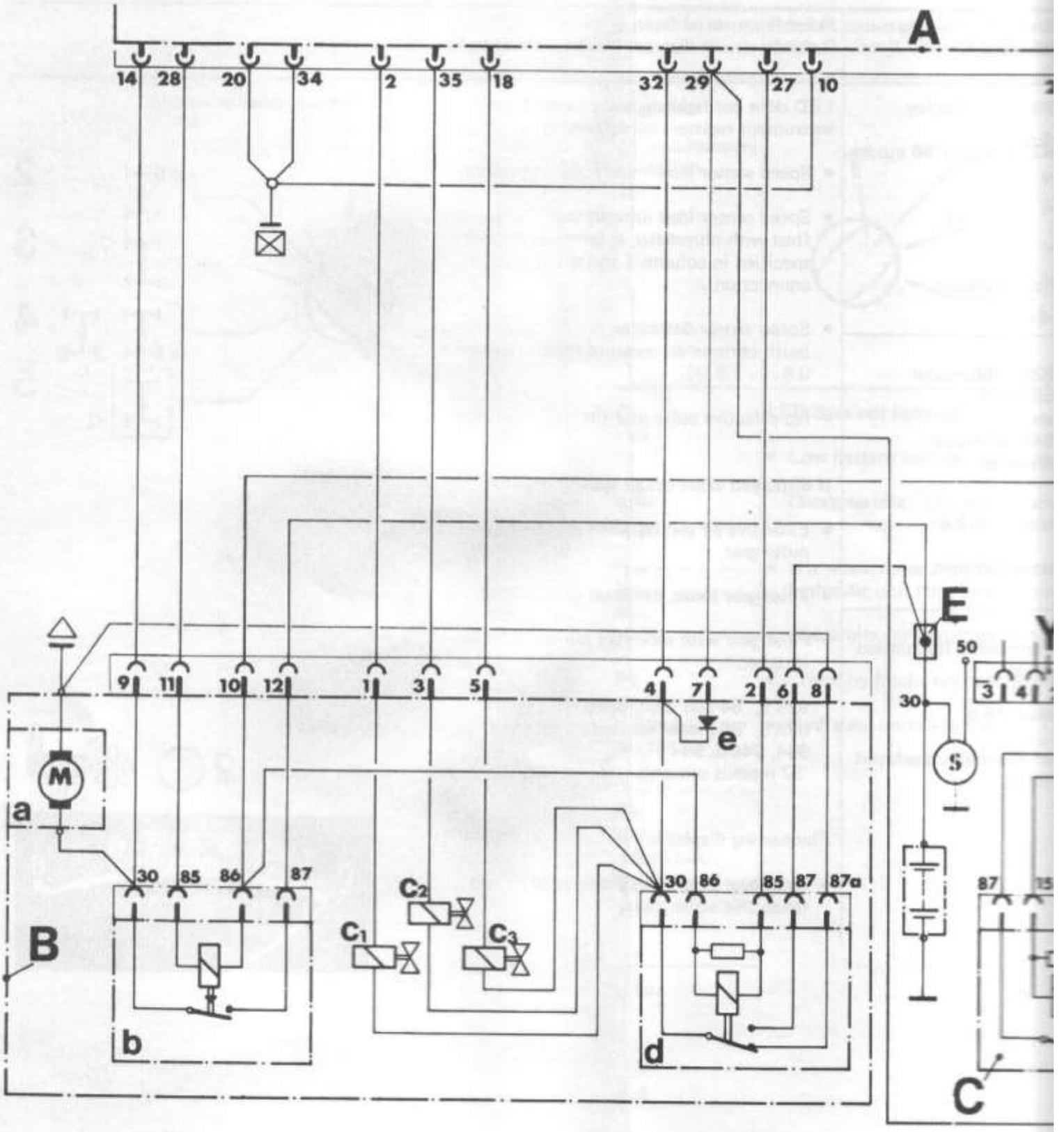


a — Pump motor
b — Pump relay
c_1 — Solenoid valve, front left
c_2 — Solenoid valve, front right
c_3 — Solenoid valve, rear

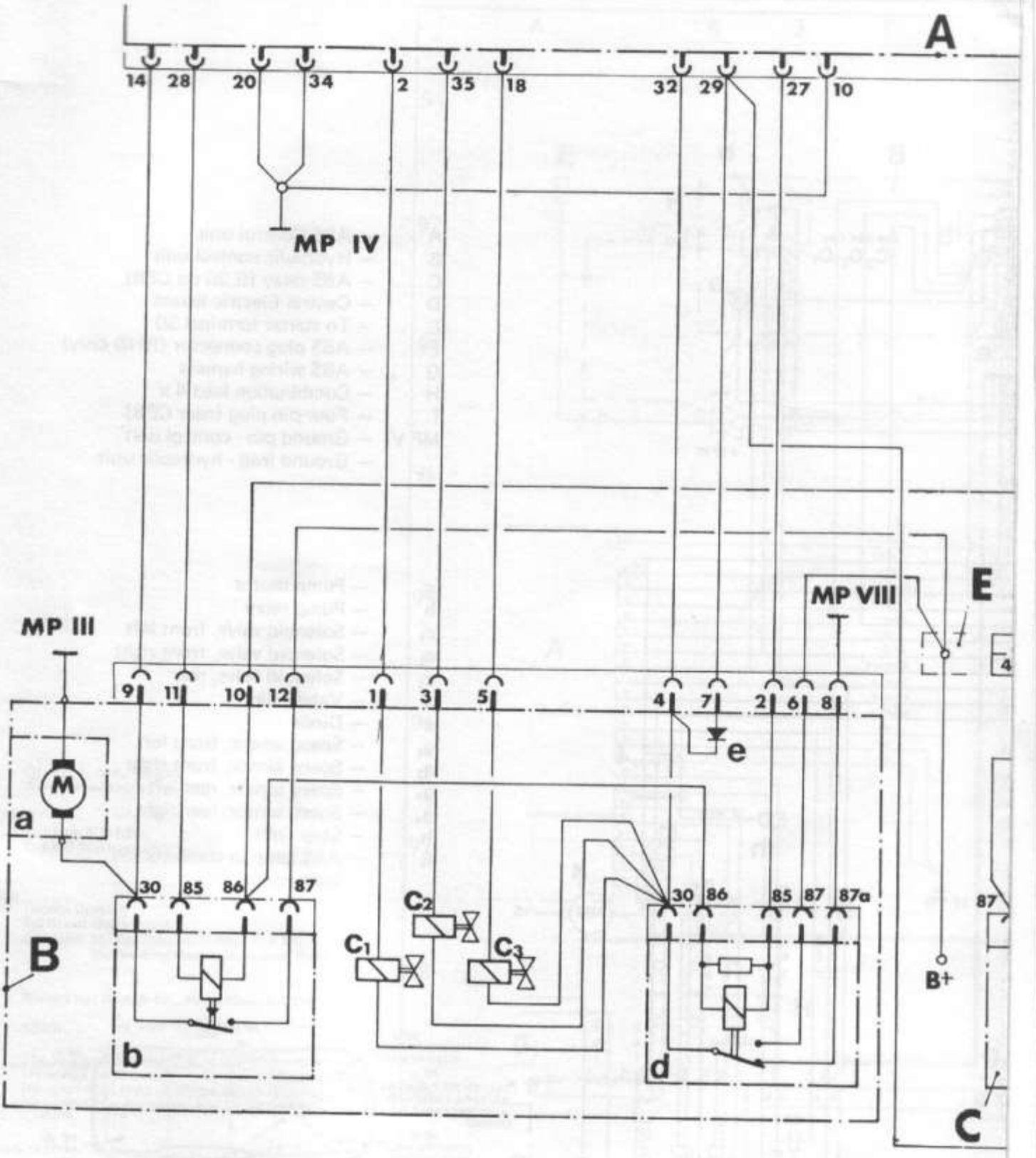
d — Valve relay
d_1 — Plug connection, black
d_2 — Plug connection, yellow
e — Diode

g_1 — Speed sensor, front left
g_2 — Speed sensor, front right
g_3 — Speed sensor, rear left
g_4 — Speed sensor, rear right

WIRING DIAGRAM ABS Model Year '84



A – ABS Control unit
B – ABS hydraulic control unit
C – Power supply relay XI
D – Central information board
E – Screw connection (30)
F – Combination instrument
G – Speed sensor
Y – Plug Y on CEB
S – Starter
⊠ – Ground on steering bracket
△ – Ground on wheel housing
a – Pump motor
b – Pump relay
c_1 – Solenoid valve, front left
c_2 – Solenoid valve, front right
c_3 – Solenoid valve, rear
d – Valve relay
d_1 – Plug connection
d_2 – Plug connection
e – Diode



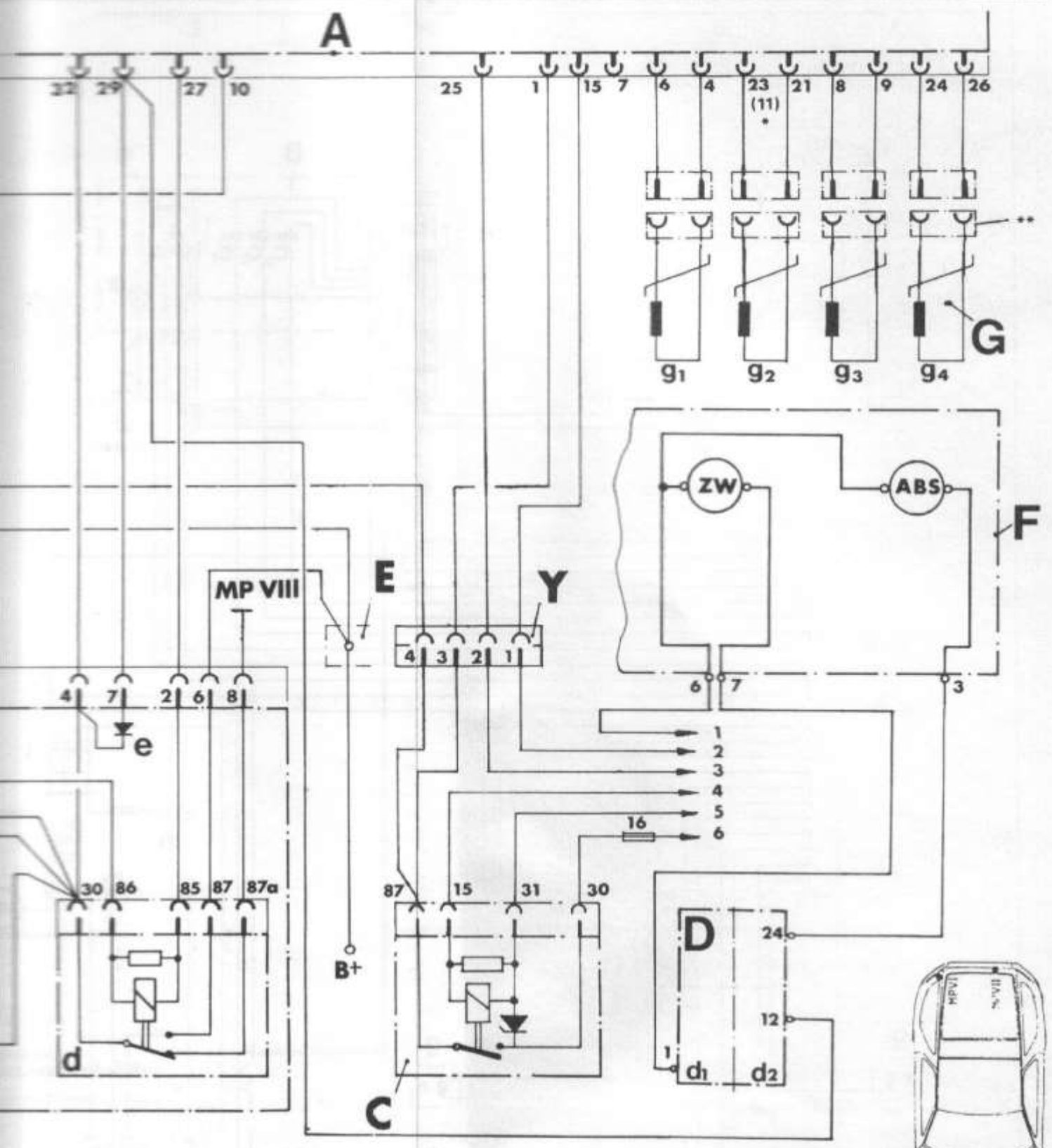
A – ABS Control unit
B – Hydraulic control unit
C – ABS relay XVII
D – Central information board
E – Cable connector

F – Combination instrument
G – Speed sensor
Y – Four-pin plug (near CEB)

1 – Terminal 15
2 – D +/61
3 – Stop light switch
4 – Terminal 15
5 – MP V
6 – B +

a – Pump motor
b – Pump relay
c_1 – Solenoid valve, front left
c_2 – Solenoid valve, front right
c_3 – Solenoid valve, rear
d – Valve relay

d_1 – Plug co
d_2 – Plug co
e – Diode
g_1 – Speed s
g_2 – Speed s
g_3 – Speed s
g_4 – Speed s

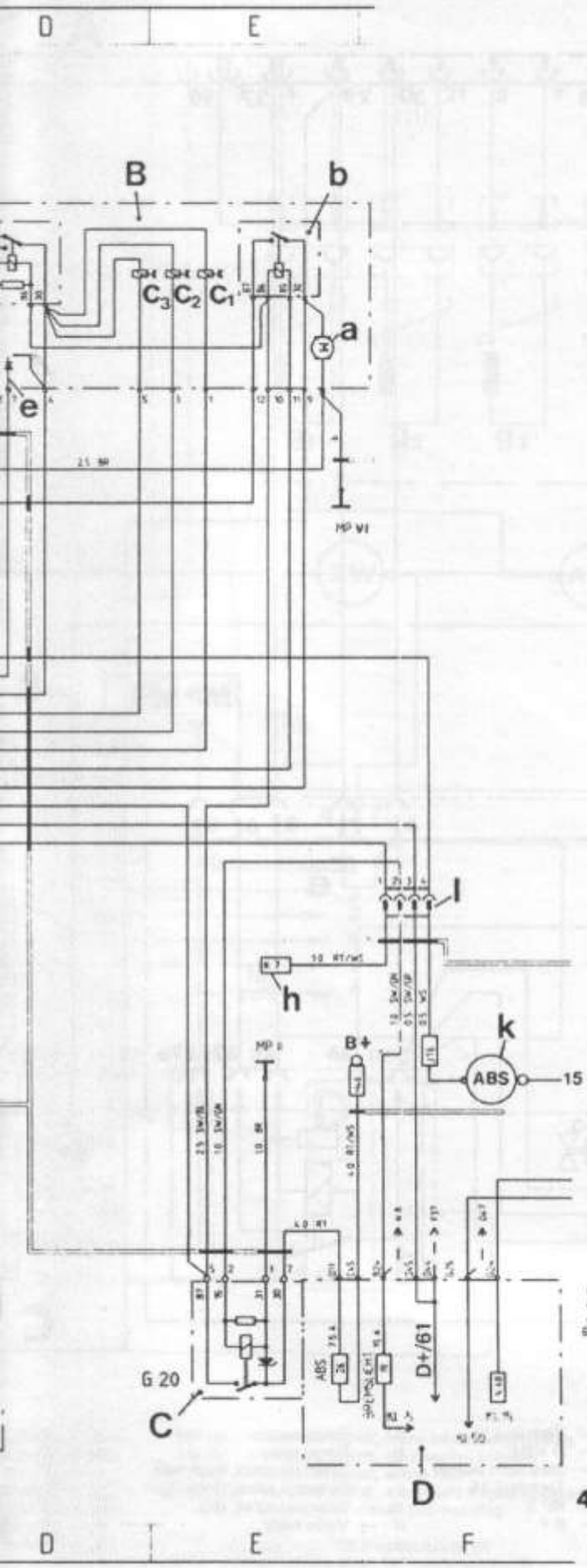


a — Pump motor
b — Pump relay
c_1 — Solenoid valve, front left
c_2 — Solenoid valve, front right
c_3 — Solenoid valve, rear
d — Valve relay

d_1 — Plug connection, black
d_2 — Plug connection, yellow
e — Diode
g_1 — Speed sensor, front left
g_2 — Speed sensor, front right
g_3 — Speed sensor, rear left
g_4 — Speed sensor, rear right

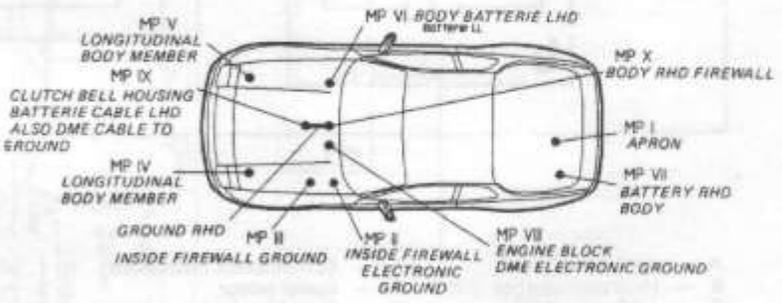
MP III — Ground point, front left wheel housing
MP IV — Ground point, via steering column
MP V — Ground point, above CE8
MP VIII — Ground point, upper left engine compartment, near clutch bell-housing

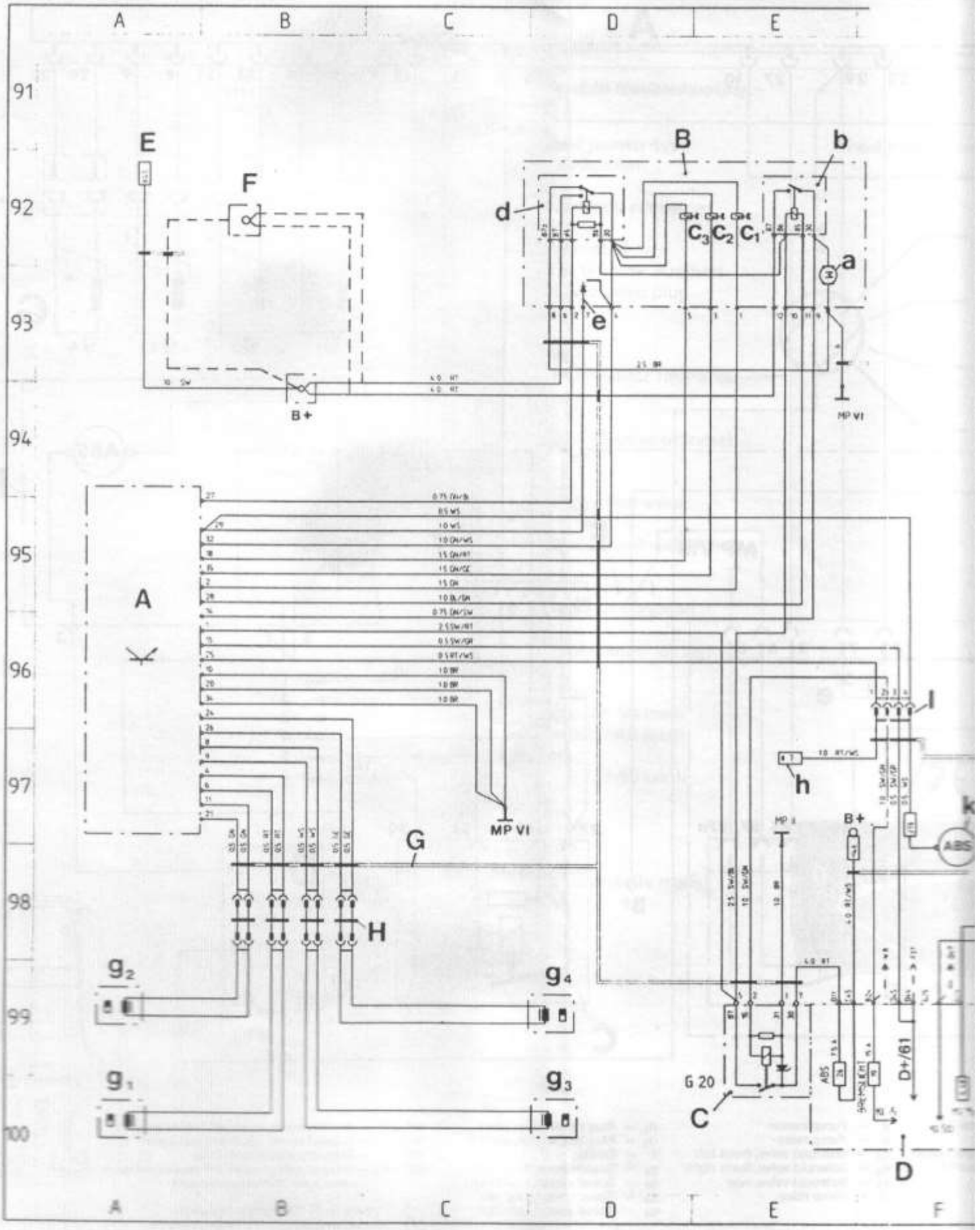
*) Values in (), '86 models onwards
**) Combination lead, '87 model onwards



A	– ABS Control unit
B	– Hydraulic control unit
C	– ABS relay (G 20 on CEB)
D	– Central Electric Board
E	– To starter terminal 30
F	– ABS plug connector (RHD only)
G	– ABS wiring harness
H	– Combination lead 4 x
I	– Four-pin plug (near CEB)
MP VI	– Ground pin - control unit
	– Ground lead - hydraulic unit

a	– Pump motor
b	– Pump relay
c_1	– Solenoid valve, front left
c_2	– Solenoid valve, front right
c_3	– Solenoid valve, rear
d	– Valve relay
e	– Diode
g_1	– Speed sensor, front left
g_2	– Speed sensor, front right
g_3	– Speed sensor, rear left
g_4	– Speed sensor, rear right
h	– Stop light
k	– ABS lamp in combination instrument




A
B
C
D
E
91
92
93
94
95
96
97
98
99
100
E
F
B
b
d
C3
C2
C1
a
e
B+
MP VI
A
MP VI
G
H
I
h
B+
ABS
G 20
C
D
D+/61
g2
g4
g1
g3