

A. General

Acceleration skid control (ASR) is an automatic system for improving the capacity for starting off and accelerating as well as driving stability.

ASR is a logical extension of the anti-lock braking system (ABS).

Whilst with ABS the wheels are prevented from locking when braking, thus maintaining steerability and driving stability as the vehicle decelerates, ASR prevents the driving wheels skidding when starting off and accelerating. It thus provides optimum driving stability together with increased traction capacity.

For ASR the basic ABS components are supplemented by an additional hydraulic unit, a pressure supply unit, a pressure accumulator, a fourth wheel speed sensor, enhanced electronics and electronic accelerator pedal with control unit, nominal value sensor and actuator.

Cruise control (Tempomat) is also contained in the electronic accelerator control unit.

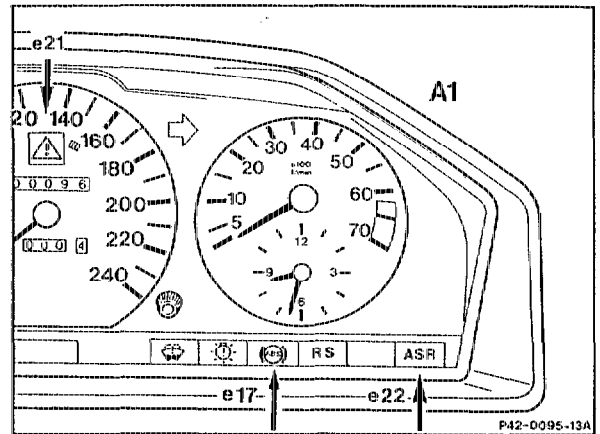
Advantages

- Improves starting off and acceleration capacity due to increased traction; particularly advantageous on road surfaces with different levels of adhesion and on corners.
- Increases active safety in the dynamics of vehicle movement, since only a wheel which is not skidding can provide optimum propulsion without any loss of lateral control.
- Automatically adapts the engine torque to the ability of the wheels to transmit this to the road when the driver applies too much throttle.
- A function display provides information on the ASR control operation and provides a signal to the driver that he is driving the vehicle close to its limits.

B. Driving with ASR II

Displays for ASR with various symbols are located in the instrument cluster.

- A1e17 ABS warning lamp
- A1e21 ASR function indicator lamp
- A1e22 ASR warning lamp



Switching on the ignition

When the ignition is switched on (ignition/starter switch "position 2") the function indicator lamp and warning lamps in the instrument cluster (bulb check) come on and go out when the engine is running.

Driving mode

In driving mode the function indicator lamp comes on as soon as ASR is operating. The function indicator lamp comes on approximately 1 s after the ASR control mode is terminated. The function display does not come on if ASR control mode is in operation for a very brief period.

Control mode

The function indicator lamp provides information on the ASR control mode and provides a signal to the driver that he is driving the vehicle close to its limits.

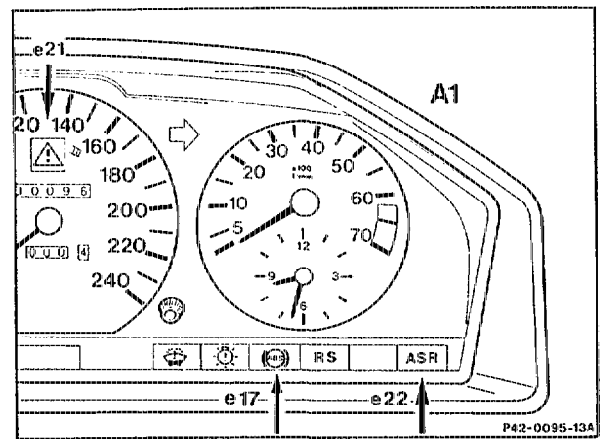
He can thus better adapt his driving style to suit prevailing road conditions.

Indication

If the ASR warning lamp comes on when the engine is running, there is a fault in the ASR or in the electronic accelerator pedal. If ASR is inoperative, the ABS continues to operate. If there is a fault in the electronic accelerator pedal it is possible to continue driving with reduced engine performance (accelerator goes into emergency running mode). The driver notices this due to changes in the force required to operate the accelerator pedal (after a short travel, accelerator is difficult to operate).

If the ASR and ABS warning lamps come on when the engine is running, there is a fault in the ABS, which always causes the ASR to be switched off as well.

In the event of a fault in the ASR which also affects the ABS, both systems are once again switched off.



- A1e17 ABS warning lamp
- A1e21 ASR function indicator lamp
- A1e22 ASR warning lamp

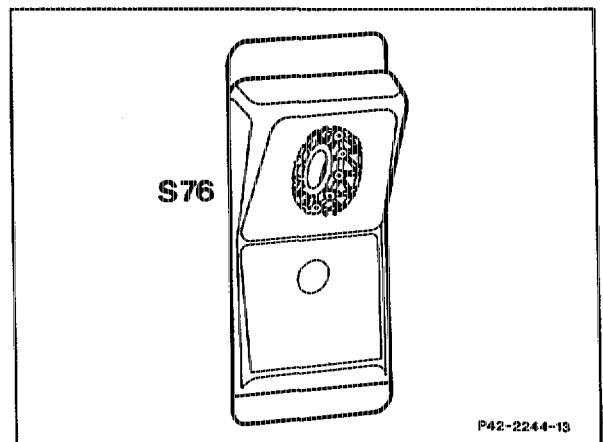
ASR snow chain switch (S76)

(Snow chain switch)

In deep snow and when snow chains are fitted, the sensitive, stability-oriented control of ASR can have a disadvantageous effect when starting off.

Therefore a special control logic has been programmed in for the starting off range in such situations, which can be selected by the driver via the snow chain switch.

The indicator lamp in the switch comes on when the snow chain switch is operated. After 50 ms continuous ASR control mode a higher drive slip is permitted at the wheels so that the vehicle can bite its way out in the above-mentioned situations.



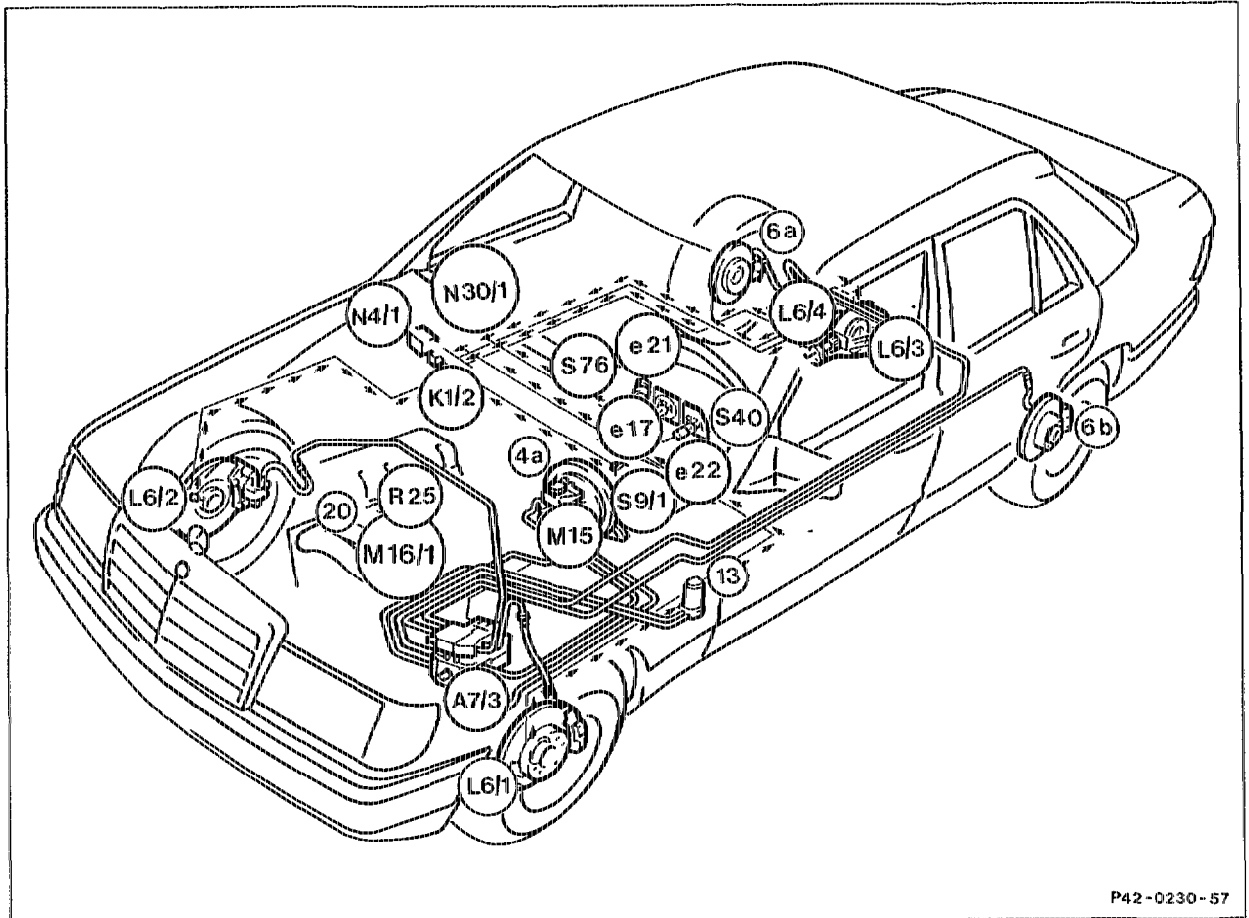
Since this higher slip would have a negative effect on driving stability particularly at higher speeds, it is limited to the speed range < 40 km/h. The higher drive slip remains stored in memory up to 60 km/h and is automatically brought back into operation when the vehicle speed falls below 40 km/h. If 60 km/h is exceeded the memory is erased and the indicator lamp in the switch goes out.



C. Overall function of ASR II

Location of components

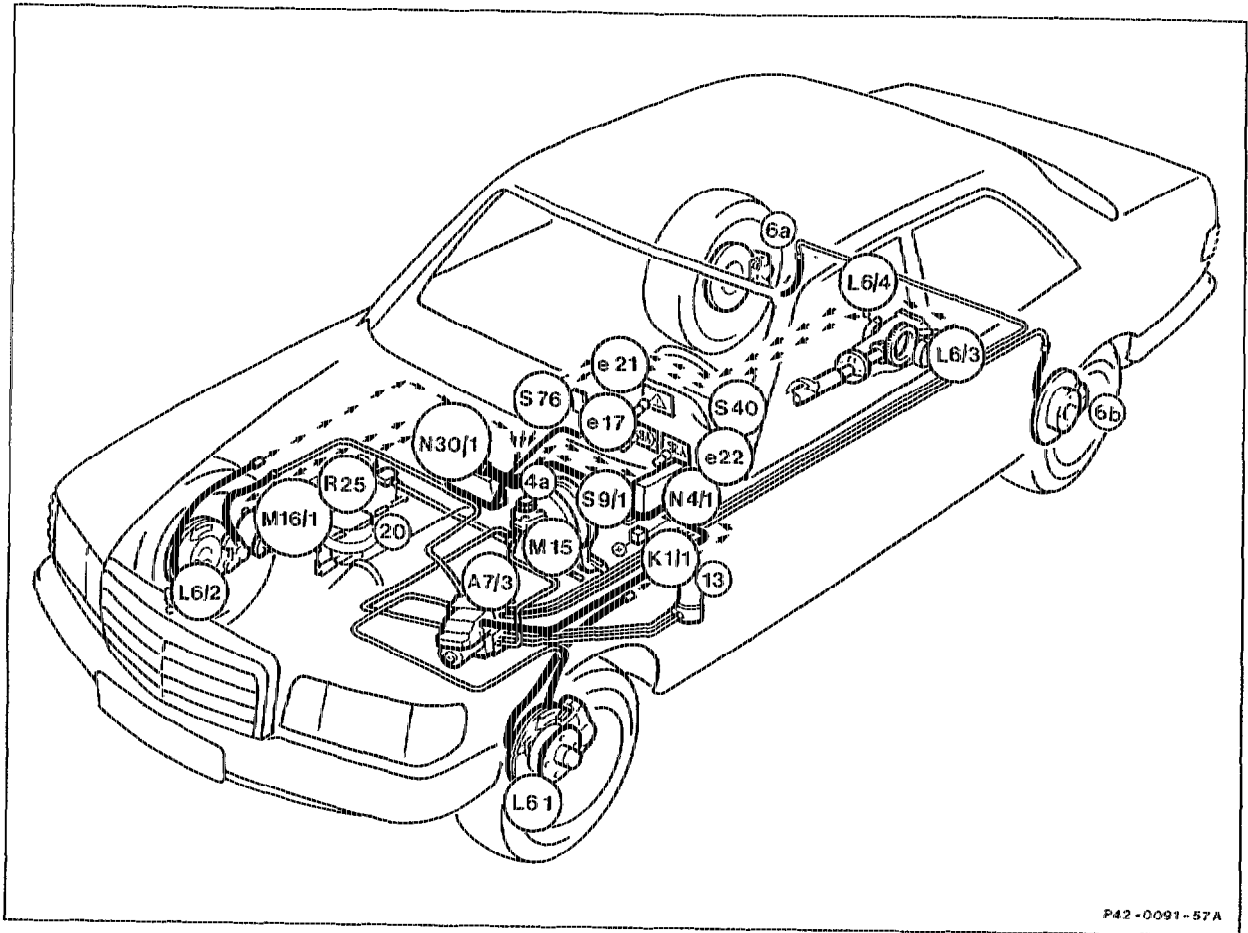
Model 124



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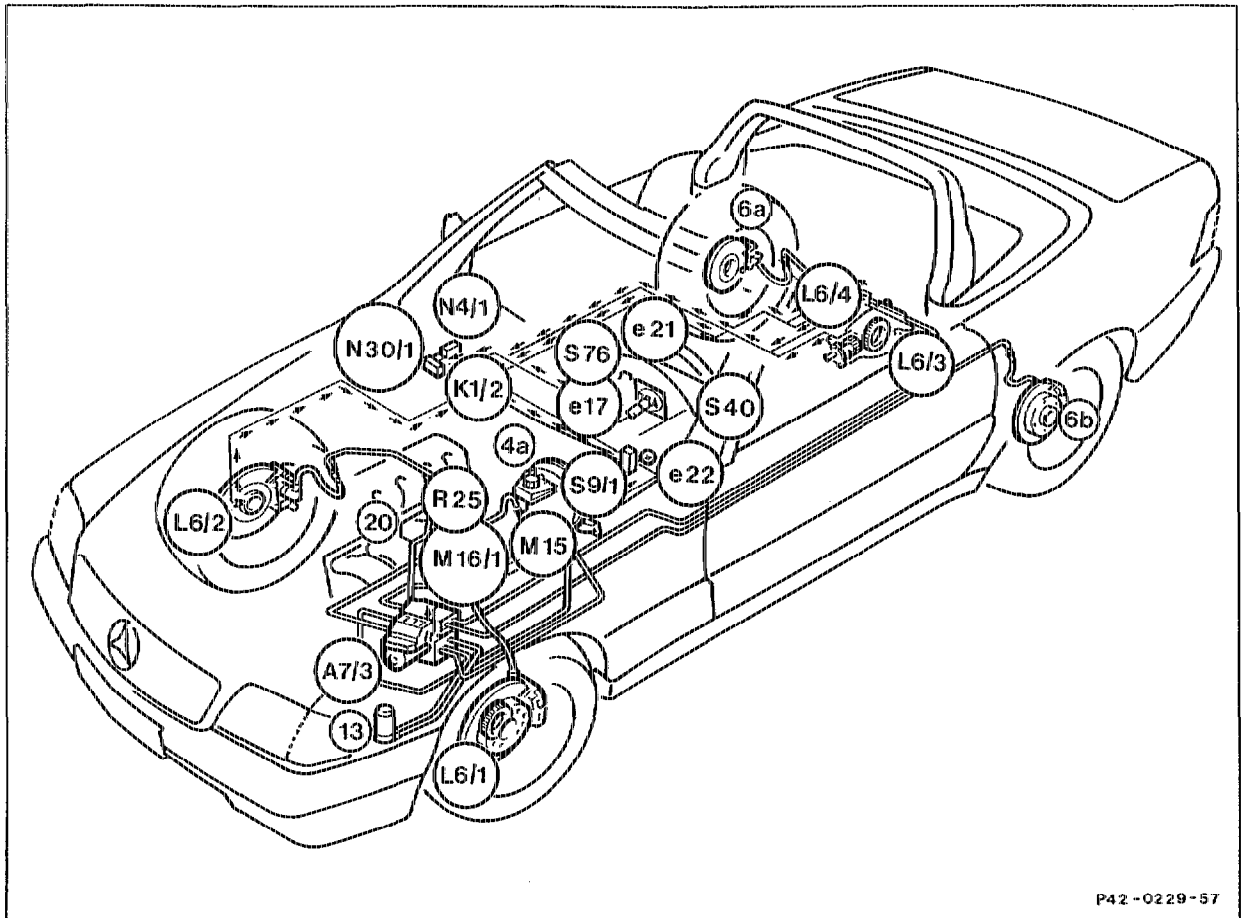
	Electrics/electronics	S9/1	Stop lamp switch
A1e17	ABS warning lamp	S40	Tempomat/cruise control switch
A1e21	ASR function indicator lamp	S76	Snow chain switch (ASR)
A1e22	ASR warning lamp		
K1/2	Overvoltage protection relay		Hydraulics
L6/1	Left front axle speed sensor	A7/3	ASR hydraulic unit
L6/2	Right front axle speed sensor	M15	ASR pressurizing pump
L6/3	Left rear axle speed sensor	4a	Brake fluid reservoir
L6/4	Right rear axle speed sensor	13	Pressure accumulator
M16/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) actuator	6a/6b	Rear brake caliper with wear indicator
N4/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) control unit		
N30/1	ASR control unit		Mechanical
R25	Electronic accelerator pedal (EFP) position sensor	20	Lost motion rod (redundancy rod)

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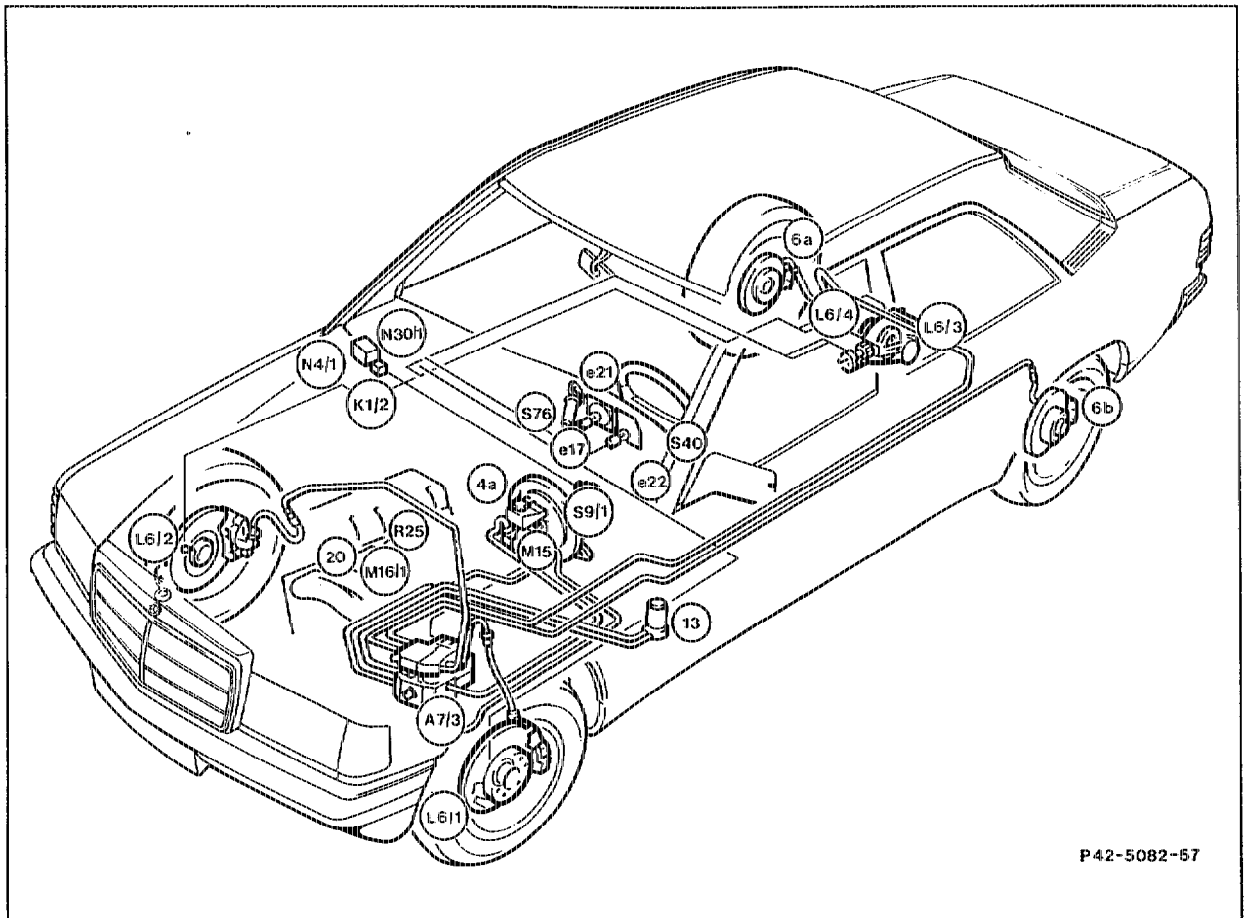
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	Electrics/electronics		
A1e17	ABS warning lamp	S9/1	Stop lamp switch
A1e21	ASR function indicator lamp	S40	Tempomat/cruise control switch
A1e22	ASR warning lamp	S76	Snow chain switch (ASR)
K1/2	Overvoltage protection relay		
L6/1	Left front axle speed sensor	A7/3	Hydraulics
L6/2	Right front axle speed sensor	M15	ASR hydraulic unit
L6/3	Left rear axle speed sensor	4a	ASR pressurizing pump
L6/4	Right rear axle speed sensor	13	Brake fluid reservoir
M16/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) actuator	6a/6b	Pressure accumulator
N4/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) control unit		Rear brake caliper with wear indicator
N30/1	ASR control unit		
R25	Electronic accelerator pedal (EFP) position sensor	20	Mechanical
			Lost motion rod (redundancy rod)



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|------------------------------|--|-------|---|
| Electrics/electronics | | S9/1 | Stop lamp switch |
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| K1/2 | Overvoltage protection relay | | |
| L6/1 | Left front axle speed sensor | A7/3 | ASR hydraulic unit |
| L6/2 | Right front axle speed sensor | M15 | ASR pressurizing pump |
| L6/3 | Left rear axle speed sensor | 4a | Brake fluid reservoir |
| L6/4 | Right rear axle speed sensor | 13 | Pressure accumulator |
| M16/1 | Electronic accelerator pedal (EFP)/Tempomat
cruise control (TPM) actuator | 6a/6b | Rear brake caliper with wear indicator |
| N4/1 | Electronic accelerator pedal (EFP)/Tempomat
cruise control (TPM) control unit | | |
| N30/1 | ASR control unit | | |
| R25 | Electronic accelerator pedal (EFP) position
sensor | | |
| | | 20 | Mechanical
Lost motion rod (redundancy rod) |

Model 201



P42-5082-57

	Electrics/electronics	S9/1	Stop lamp switch
A1e17	ABS warning lamp	S40	Tempomat/cruise control switch
A1e21	ASR function indicator lamp	S76	Snow chain switch (ASR)
A1e22	ASR warning lamp		
K1/2	Overvoltage protection relay		
L6/1	Left front axle speed sensor	A7/3	Hydraulics
L6/2	Right front axle speed sensor	M15	ASR hydraulic unit
L6/3	Left rear axle speed sensor	4a	Brake fluid reservoir
L6/4	Right rear axle speed sensor	13	Pressure accumulator
M16/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) actuator	6a/6b	Rear brake caliper with wear indicator
N4/1	Electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) control unit		
N30/1	ASR control unit		
R25	Electronic accelerator pedal (EFP) position sensor	20	Mechanical
			Lost motion rod (redundancy rod)

Overall function ASR II

The speeds of all wheels are recorded and processed in the ASR control unit (N30/1). If the ASR control unit (N30/1) recognizes from the wheel speed signals that one or both driving wheels are tending to skid, the ASR control mode starts with the braking moment control circuit and the drive moment control circuit.

The following processes are initiated:

- **Brake moment control circuit**

The skidding drive wheel is braked via the relevant wheel brake until it has achieved the most favorable acceleration skid range. In this way the other wheel can be driven to best effect (differential lock effect).

To brake the skidding wheel, part of the brake fluid under high pressure is led from the pressure accumulator into the brake caliper via the ASR hydraulic unit (pressure build-up).

A solenoid valve in the ASR hydraulic unit (A7/3) modulates the pressure characteristics in the brake caliper during brake moment control, in the pressure build-up phase, pressure holding stage, and pressure reduction stage.

For pressure reduction, the volume of brake fluid is returned from the brake caliper into the pressure accumulator via the return pump/charge pump (A7/3m1). This control sequence is performed individually for each wheel brake of the drive wheels.

- **Drive moment control circuit**

In order to reduce drive moment which is too high (with wheels skidding) for optimum traction, there is an exchange of signals via the connection between the ASR control unit (N30/1) and the electronic accelerator control unit (N4/1).

The throttle valve position is reduced by the actuator relative to the accelerator pedal position set by the driver.

A check is constantly made in the ASR control unit as to whether the control functions can be cancelled, e.g. as a result of a sudden improvement in road surface adhesion, so that the drive moment applied by the driver via the accelerator pedal can come back into operation as soon as possible.

A distinction has to be made between three control ranges in ASR control mode:

- A. Control mode with one skidding drive wheel and at vehicle speeds < 40 km/h.
Here the slip threshold of the drive moment control is higher than that of the brake moment control. In the event of control, the brake moment control is thus activated first. If the drive wheel nevertheless skids faster, the drive moment control is also activated. Thus priority is given to maximum traction.

B. Control mode when both drive wheels skid or at a vehicle speed > 40 km/h.

In this case, the slip threshold of the brake moment control is above that for the drive moment control.

Initially the throttle valve position is reduced in the event of a control. If the drive wheels nevertheless skid faster, the brake moment control is also activated. Thus priority is given to maximum driving stability.

C. Control mode when cornering, at vehicle speeds between approx. 20 km/h and 120 km/h.

In this case, depending on the lateral acceleration, the drive moment control comes into operation even sooner than for control mode "B".

An ASR function indicator lamp (A1e21) provides information concerning the ASR control mode and signals to the driver that he is driving the vehicle close to its limits.

The function of ABS is not impaired by ASR since the ASR control mode is interrupted when braking.

Brake moment control circuit

The brake moment control circuit builds on the electric/electronic and hydraulic components of the service brake with ABS.

Electrics/electronics

In addition to the ABS functions, all ASR functions are contained in a common ASR control unit (N30/1). Compared to the conventional ABS control unit, further input signals and 2 ASR microcomputers for ASR functions and additional output signals are provided.

Hydraulics

Building on the conventional ABS hydraulic unit a compact ASR hydraulic unit (A7/3) was developed for the ASR II.

Apart from the components familiar from the ABS, it contains a change-over valve for changing from braking mode to ASR control mode, pressure limiting valves as hydraulic safety equipment and the right rear axle solenoid valve (A7/3y4) for the right rear wheel brake.

The brake pressure necessary for ASR control mode comes from the pressure accumulator which is filled by the ASR pressurizing pump (M15) together with the return pump/charge pump (A7/3m1).

The speed signals of the wheel speed sensors (L6/1, L6/2, L6/3, L6/4) are continuously processed to the following parameters in the ABS/ASR control unit (N30/1).

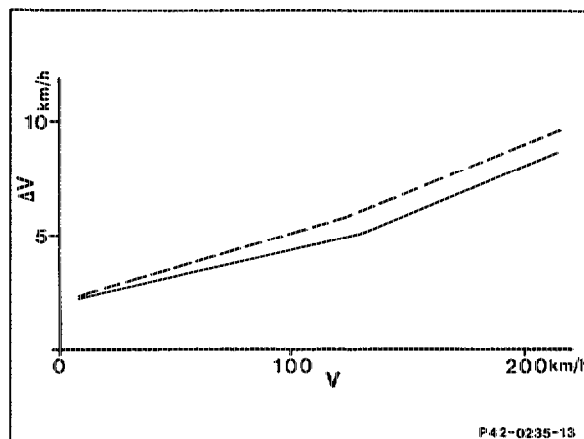
- Acceleration skid
- Acceleration
- Vehicle speed (front wheel)
- Curve recognition

If the values determined exceed specified nominal values, output signals from the ASR control unit (N30/1) effect control of the 3 pressure phases (pressure build-up, pressure holding, pressure reduction) in the ASR hydraulic unit (A7/3) (brake intervention).

Depending on the vehicle speed, the brake moment control starts as soon as the differential speed between the front and the rear wheel (Δv) exceeds the slip threshold of the brake moment control.

Thus the braking of the relevant rear wheel is controlled by pressure build-up, pressure holding and pressure reduction in the appropriate rear wheel brake.

If the differential speed (Δv) falls below the slip threshold again, the system switches to pressure reduction for a predetermined time interval.



Slip thresholds

v = speed

Δv = speed differential between front and rear wheels

----- brake moment control

————— drive moment control

Drive moment control circuit

The drive moment control circuit builds on the electric/electronic components of the ASR and is supplemented by the electronic accelerator pedal (EFP).

The electronic accelerator pedal comprises the following electrical/electronic and mechanical components:

- Electronic accelerator pedal nominal value sensor (R25)
- Electronic accelerator pedal actuator (M16/1)
- Electronic accelerator pedal control unit (N4/1)
- Control linkage and accelerator pedal
- Lost motion rod (redundancy rod)

The wheel speed signals from the wheel speed sensors (L6/1, L6/2, L6/3, L6/4) are constantly processed in the ASR control unit (N30/1) to the following parameters:

- Drive skid
- Acceleration
- Vehicle speed (front wheel)
- Curve recognition

If the values determined exceed specified nominal values, the ASR control unit (N30/1) causes the electronic accelerator pedal control unit (N4/1) to close the throttle valve.

Thus the electronic accelerator pedal (EFP)/Tempomat cruise control (TPM) actuator (M16/1) and thus the throttle valve are closed irrespective of the adjustment movements of the accelerator pedal.

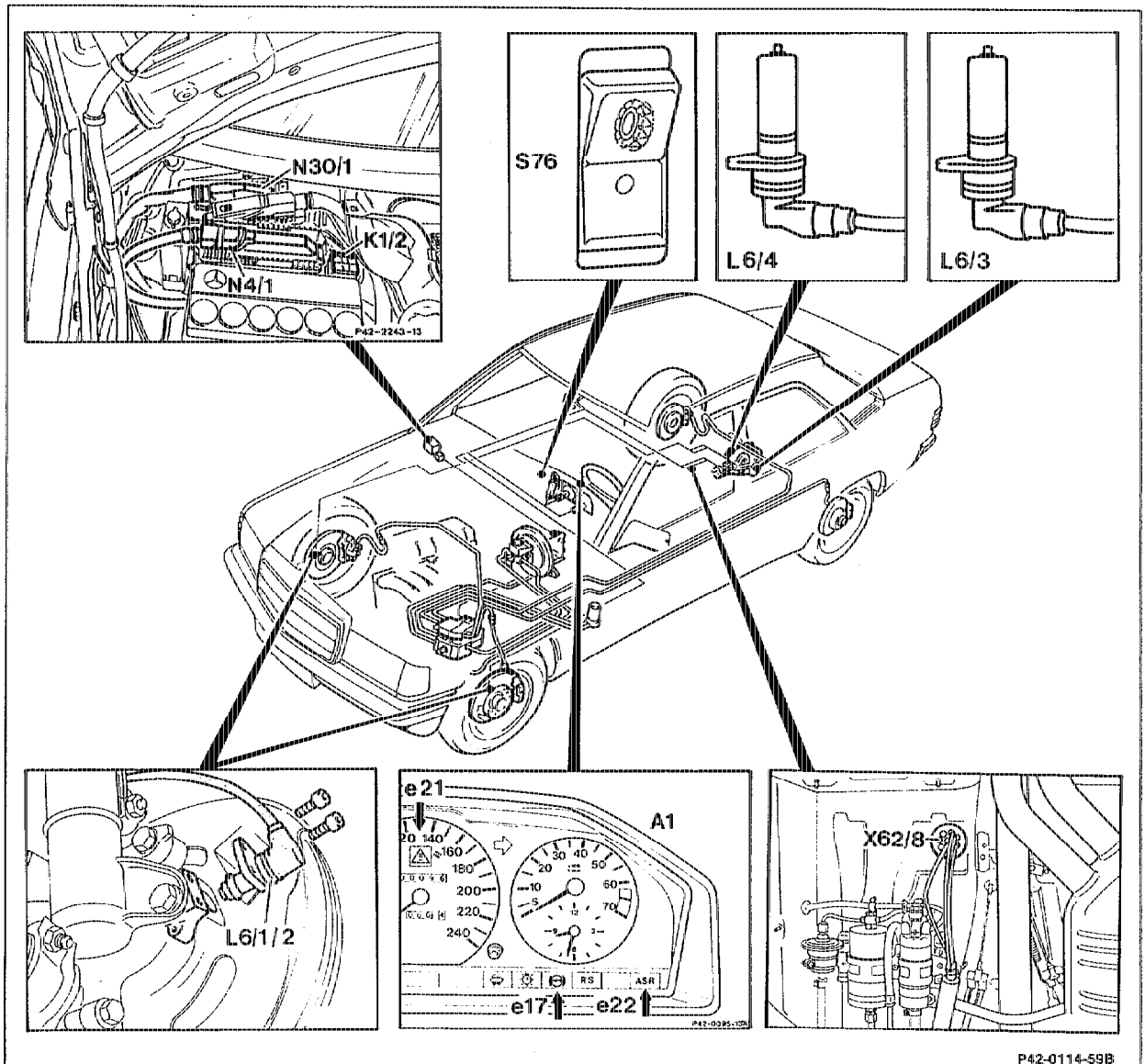
Depending on the vehicle speed, the drive moment control starts as soon as the differential speed (Δv) exceeds the slip threshold of the drive moment control.

The drive moment is controlled by closing, holding and opening the throttle valve.

If the differential speed (Δv) falls below the slip threshold again, the throttle valve is opened in accordance with what the driver dictates.

D. Location of electrics/electronics components

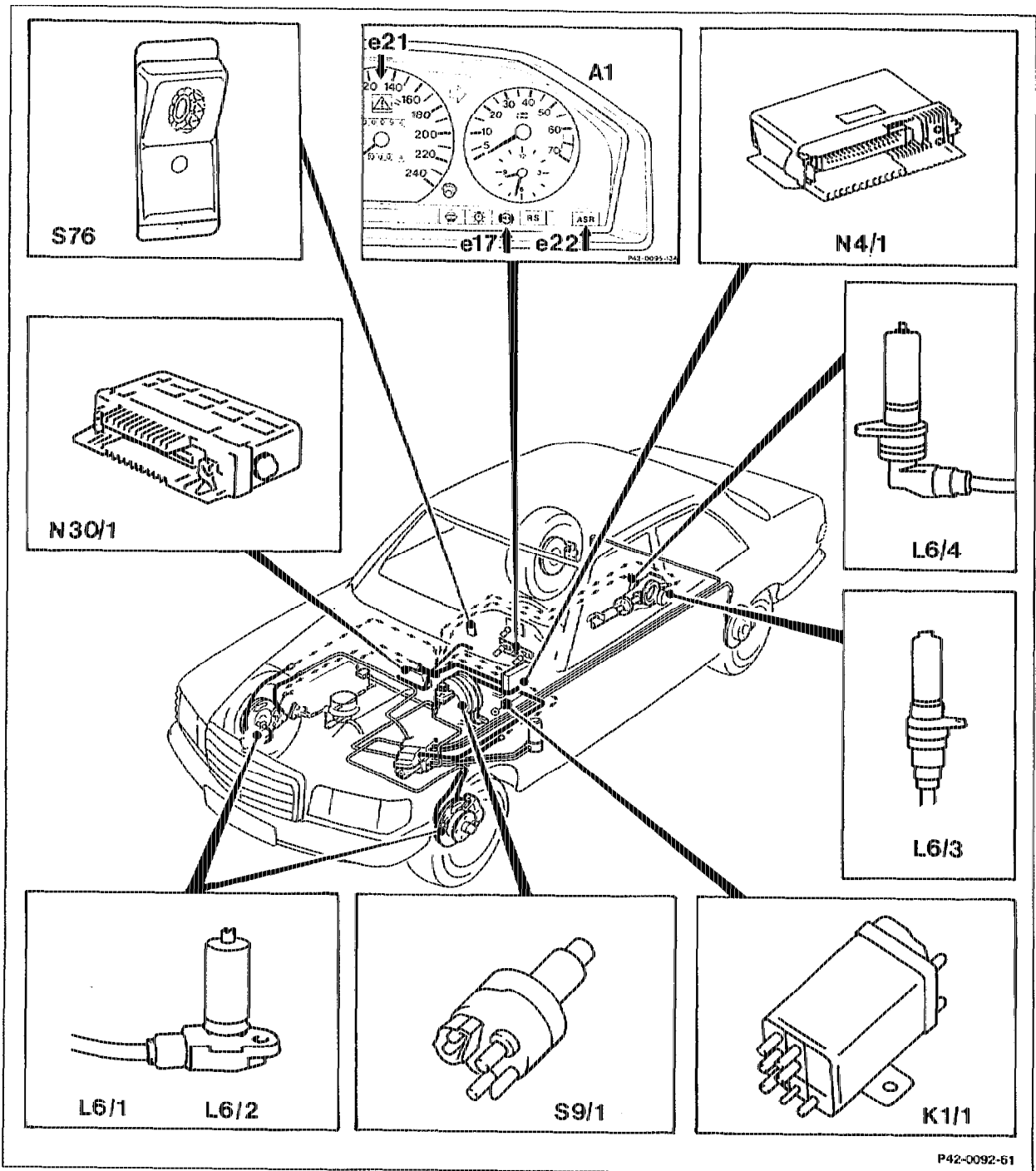
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A1e17 ABS warning lamp
 A1e21 ASR function indicator lamp
 A1e22 ASR warning lamp
 K1/2 Overvoltage protection relay
 L6/1 Left front axle speed sensor
 L6/2 Right front axle speed sensor

L6/3 Left rear axle speed sensor
 L6/4 Right rear axle speed sensor
 N4/1 Electronic accelerator pedal control unit
 N30/1 ASR control unit
 S76 Snow chain switch (ASR)
 X62/8 Plug connection, rear axle distributor

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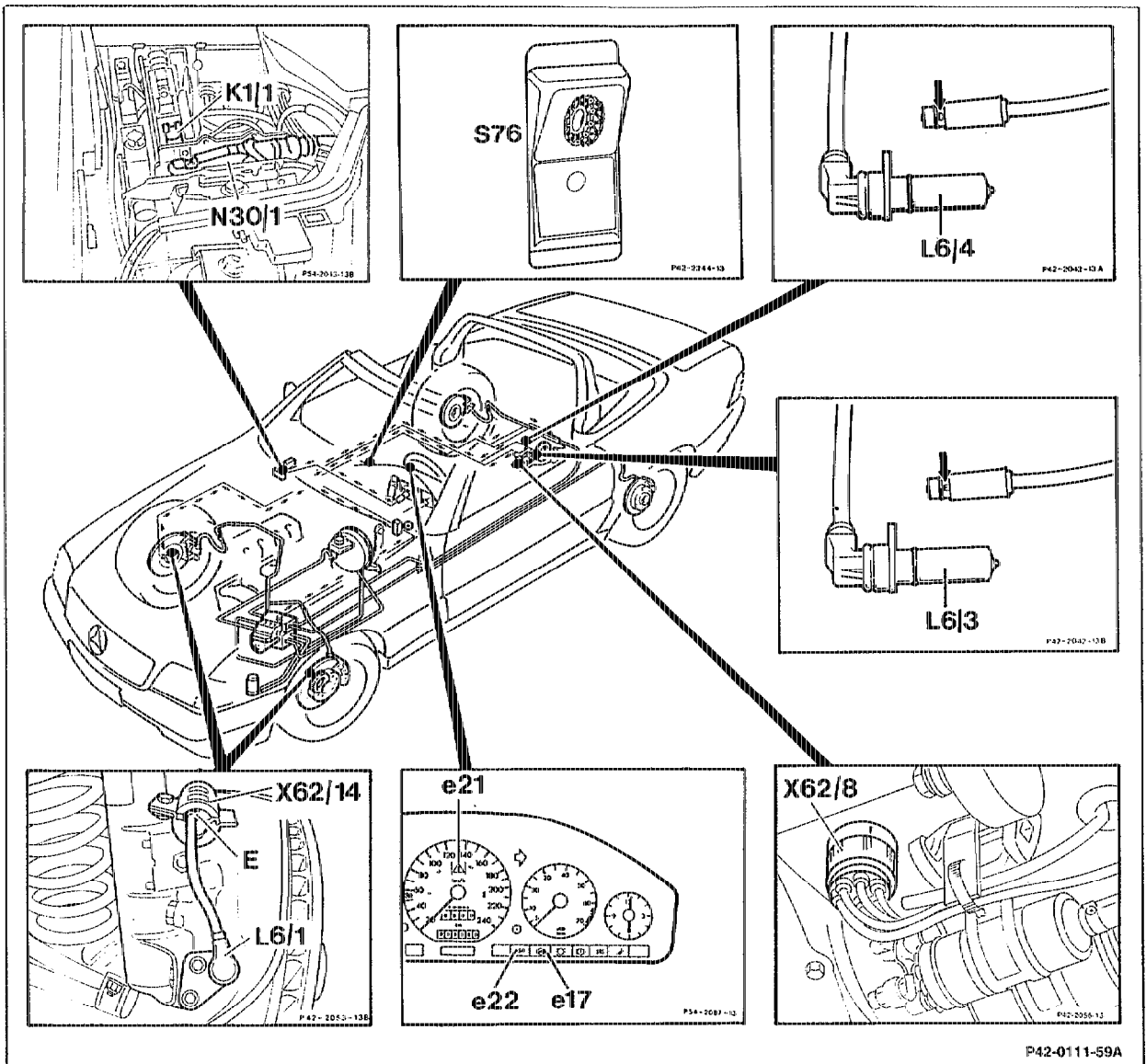


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- A1e17 ABS warning lamp
- A1e21 ASR function indicator lamp
- A1e22 ASR warning lamp
- K1/1 Overvoltage protection relay
- L6/1 Left front axle speed sensor
- L6/2 Right front axle speed sensor

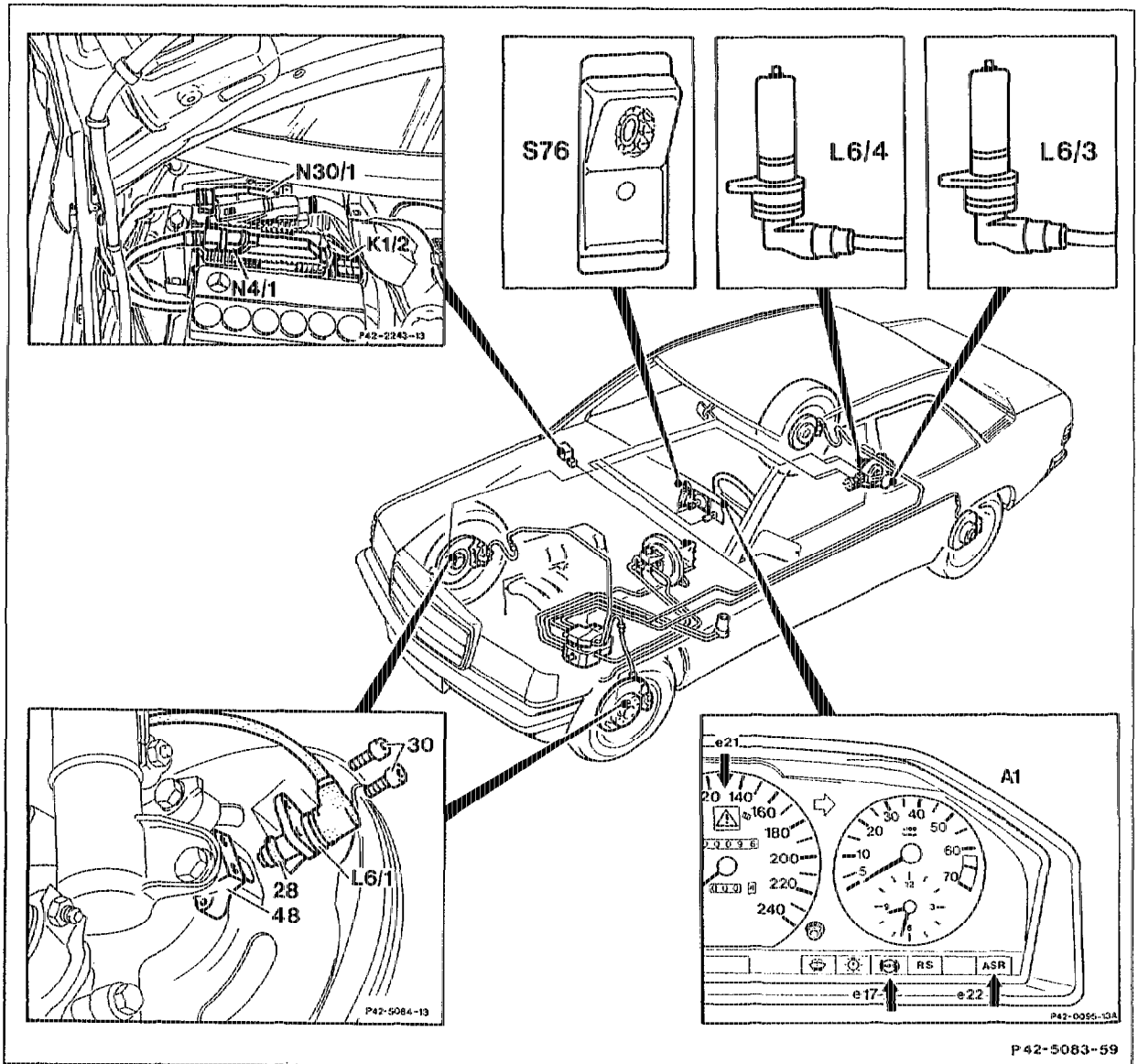
- L6/3 Left rear axle speed sensor
- L6/4 Right rear axle speed sensor
- N4/1 Electronic accelerator pedal control unit
- N30/1 ASR control unit
- S76 Snow chain switch (ASR)

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|-------|-------------------------------|--------|--|
| A1e17 | ABS warning lamp | N30/1 | ASR control unit |
| A1e21 | ASR function indicator lamp | S76 | Snow chain switch (ASR) |
| A1e22 | ASR warning lamp | X62/8 | Plug connection, rear axle distributor |
| K1/1 | Overvoltage protection relay | X62/14 | Plug connection, left front axle distributor (steering knuckle) |
| L6/1 | Left front axle speed sensor | X62/15 | Plug connection, right front axle distributor (steering knuckle) |
| L6/2 | Right front axle speed sensor | | |
| L6/3 | Left rear axle speed sensor | | |
| L6/4 | Right rear axle speed sensor | | |

Model 201



- | | | | |
|-------|-------------------------------|-------|---|
| A1e17 | ABS warning lamp | L6/3 | Left rear axle speed sensor |
| A1e21 | ASR function indicator lamp | L6/4 | Right rear axle speed sensor |
| A1e22 | ASR warning lamp | N4/1 | Electronic accelerator pedal control unit |
| K1/2 | Overvoltage protection relay | N30/1 | ASR control unit |
| L6/1 | Left front axle speed sensor | S76 | Snow chain switch (ASR) |
| L6/2 | Right front axle speed sensor | X62/8 | Plug connection, rear axle distributor |

E. Functions of electrics/electronics

The corresponding functions in the ASR hydraulic units (A7/3) (brake moment control circuit) and the functions of the electronic accelerator pedal (drive moment control circuit) are controlled by the electric/electronic components.

Voltage is supplied to the ASR electronic control unit (N30/1) mainly via the overvoltage protection relay (K1/2).

The ASR control unit (N30/1) receives input signals from the following components:

- 4 wheel speed sensors
- Stop lamp switch
- Electronic accelerator pedal control unit (throttle valve actual value)
- Snow chain switch
- Pressure switch

The input signals are processed in the ASR control unit into output signals for the following components

- Solenoid valves in the hydraulic unit
- Relay (solenoid valves, return pump/charge pump)
- Pressurizing pump
- Electronic accelerator pedal control unit (throttle valve nominal value)
- ASR function indicator lamp
- Display lamp in snow chain switch
- ABS warning lamp
- ASR warning lamp

The ASR control unit (N30/1) decides which of the three following operating modes have to be engaged based on the input signals:

- Normal mode
- ABS control mode
- ASR control mode

Normal operation

In this case no speed differences exist (which require a control mode). All solenoid valves in the ASR hydraulic unit (A7/3) are in the basic position, thus de-energised. The system is ready for braking.

If a pressurizing signal from the pressure switch (A7/1s1) in the ASR hydraulic unit (A7/3) exists at the ASR control unit (N30/1), the ASR pressurizing pump (M15) and the return pump/charge pump (A7/3m1) is controlled. The pressurizing process of the pressure accumulator continues until the pressure switch (A7/3s1) gives the signal that the pressure accumulator is full.

The throttle valve actual value is continuously checked in the ASR control unit (N30/1) in order to check the function of the electronic accelerator pedal.

ABS control mode

From the available speed signals, the ASR control unit (N30/1), recognizes that the criteria for a ABS control exist.

The left or right front axle solenoid valves (A7/3y1 or A7/3y2) and left or right rear axle solenoid valves (A7/3y3 or A7/3y4) in the ASR hydraulic unit (A7/3) are controlled by the ABS circuits in the ASR control unit (N30/1) via the corresponding output stages. The left or right front axle solenoid valves (A7/3y1 or A7/3y2) in the ABS/ASR hydraulic control unit (A7/3) are controlled separately as in the conventional ABS. The left or right rear axle solenoid valves (A7/3y3 or A7/3y4) are controlled jointly for the ABS control process.

ASR control mode

The wheel speed signals are continuously processed in the ASR microcomputers in the ASR control unit (N30/1).

As soon as a drivewheel tends to skid, the ASR control unit (N30/1) controls the switchover solenoid valve (A7/3y5), the left and/or right rear axle solenoid valves (A7/3y3 and/or A7/3y4) in the ASR hydraulic unit (A7/3).

The left or right rear axle solenoid valve (A7/3y3 or A7/3y4) are controlled separately. In the pressure reduction switch position (refer to "hydraulics function") the return pump/charge pump (A7/3m1) is controlled.

During the ASR control mode the ASR function indicator lamp (A1e21) lights up.

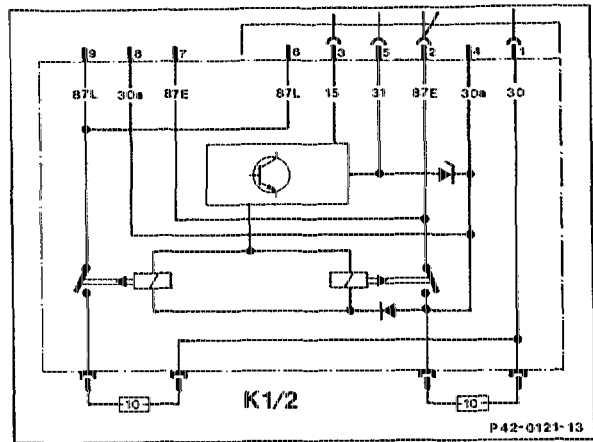
If an excessive drive moment is established in the ASR microcomputers in the ASR control unit (N30/1), the throttle valve nominal value output signal to the electronic accelerator pedal control unit (N4/1) changes.

In this way the electronic accelerator pedal actuator (M16/1) is controlled with a particular signal from the electronic accelerator pedal control unit (N4/1) whereby the throttle valve is adjusted against the accelerator pedal movement. The pressure accumulator is not charged during ASR control mode.

The ASR control mode is interrupted by operating the brake pedal. Faults which influence ASR and ABS function are recognized in the ABS/ASR control unit (N30/1) and displayed by the ASR and ABS warning lamps (A1e22, A1e17). In the event of faults, which are related to ABS, both systems are always switched off.

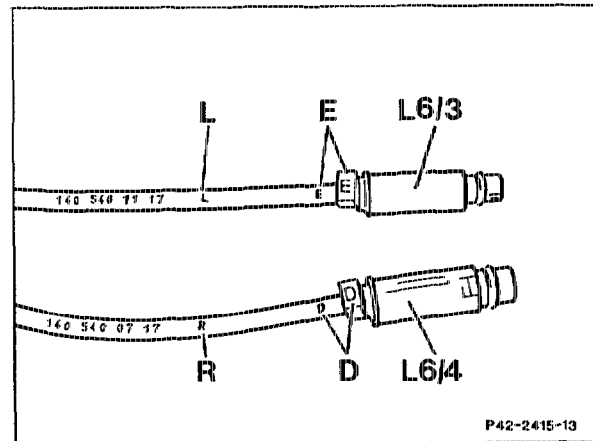
Overvoltage protection relay (K1/1 or K1/2)

Voltage is supplied for the ASR electronic control unit via the overvoltage protection relay. Overload is prevented by the 10-A fuse.



Note

In addition to the designations on the plug listed below, all cables and plugs are designated with "L" and "E" (left) or "R" and "D" (right).

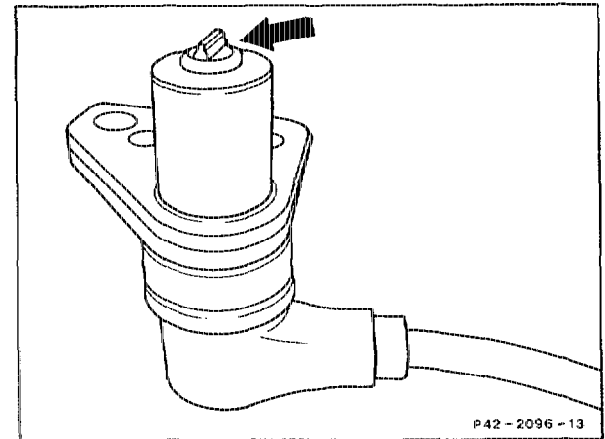


Wheel speed sensors

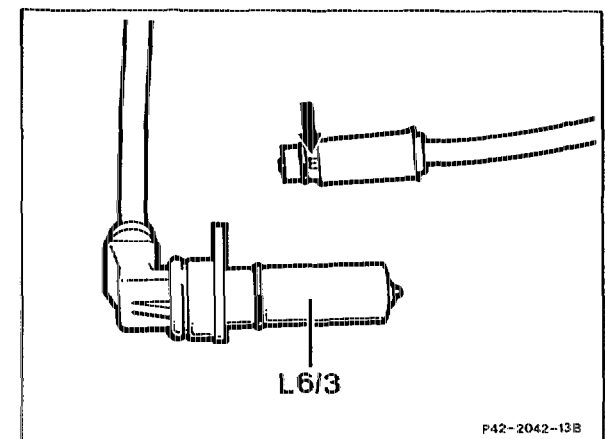
Vehicles with ASR are equipped with 4 wheel speed sensors.

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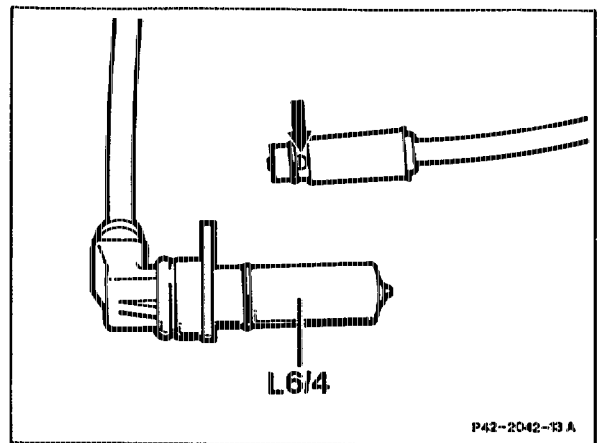
The 2 wheel speed sensors on the front axle (L6/1, L6/2) can be recognized by the single-edged tip (arrow) and by the long cable with coaxial plug (as on vehicles with ABS).



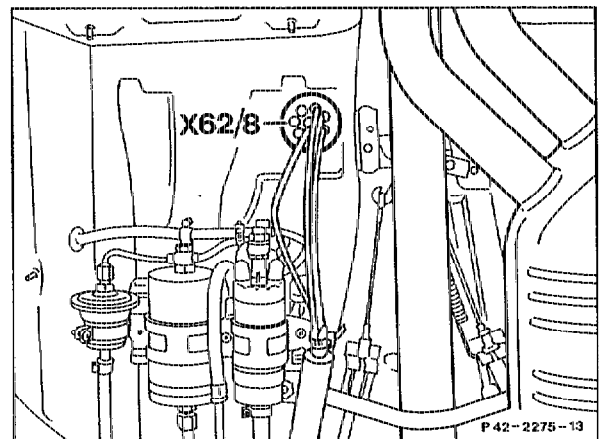
The left rear axle speed sensor (L6/3) is identified with "E" on the plug (arrow).



Right rear axle speed sensor (L6/4) is identified with "D" on the plug (arrow).

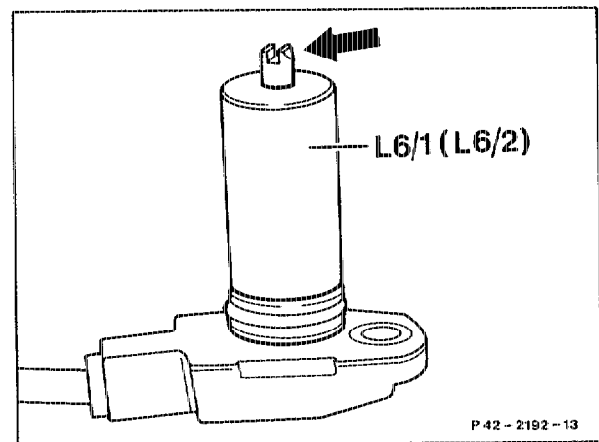


The plugs "D" and "E" of the wheel speed sensors are plugged into the plug connection, rear axle distributor (X62/8).

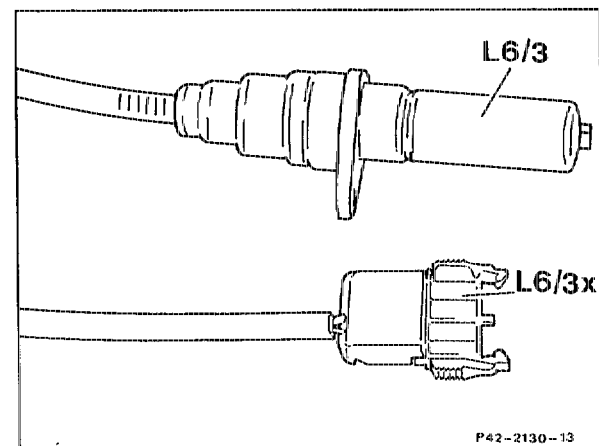


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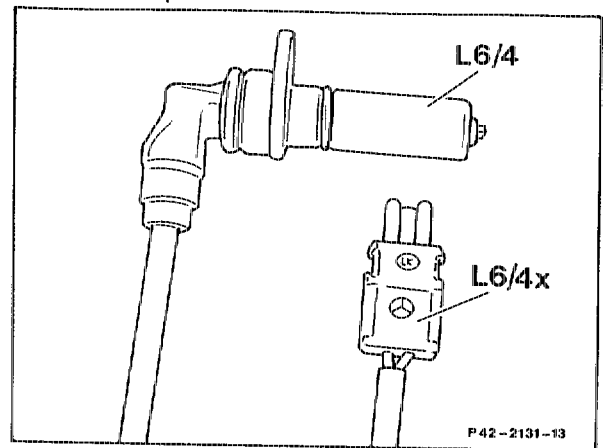
The 2 wheel speed sensors on the front axle (L6/1, L6/2) can be recognized by the double-edged tip (arrow) and by the long cable with coaxial plug (as on vehicles with ABS).



The left rear axle speed sensor (L6/3) is a straight design. The cable has a connector (L6/3x) as plug connection.

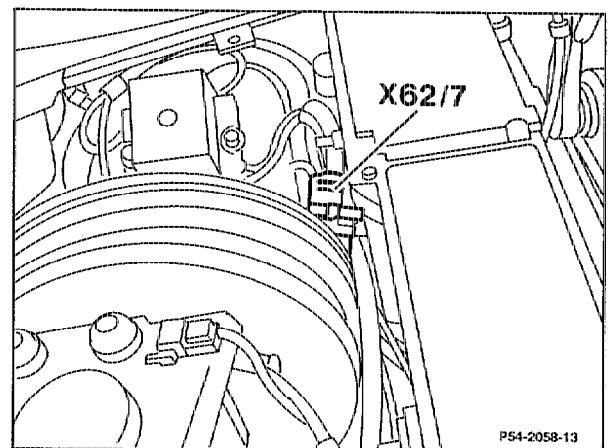


The right rear axle speed sensor (L6/4) is an angled design. The cable has a plug (L6/4x) as plug connection.

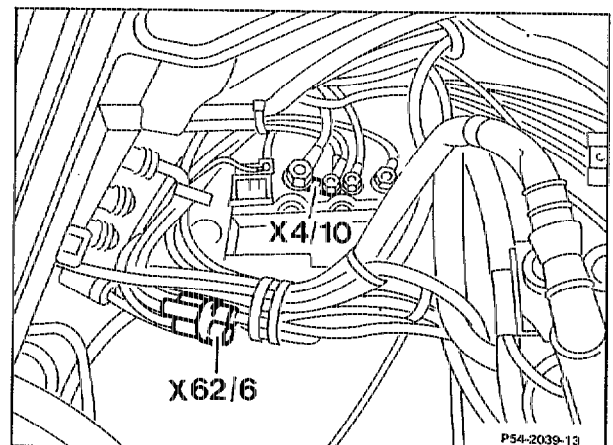


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The wheel speed sensors on the left or right of the front axle (L6/1 or L6/2) and left or right of the rear axle (L6/3 or L6/4) are connected to the ABS cable harness via the left (X62/7) and right (X62/6) plug connection, front axle distributor.

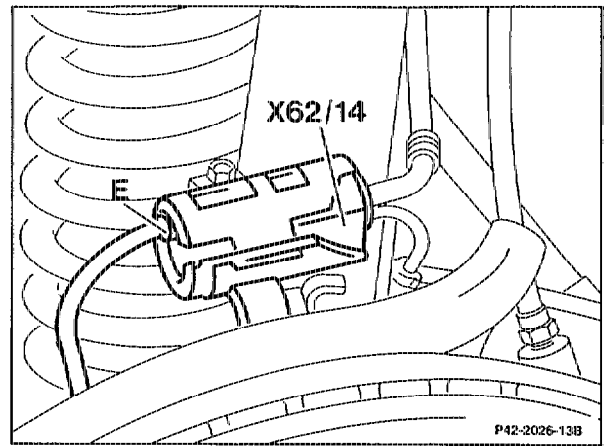


Location of the plug connection, left front axle distributor (X62/7) in left of the front axle component compartment.

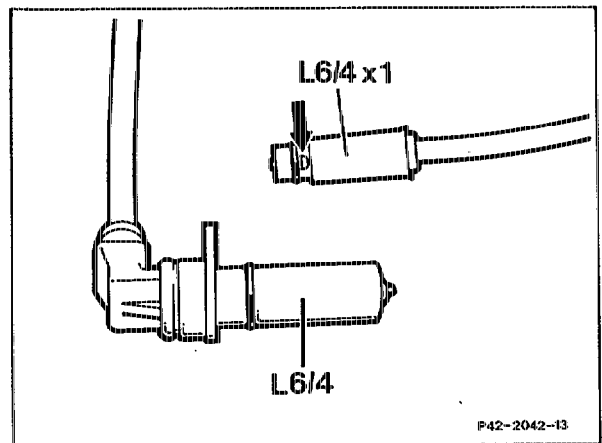


Location of plug connection, right front axle distributor (X62/6) in right of the front axle component compartment.

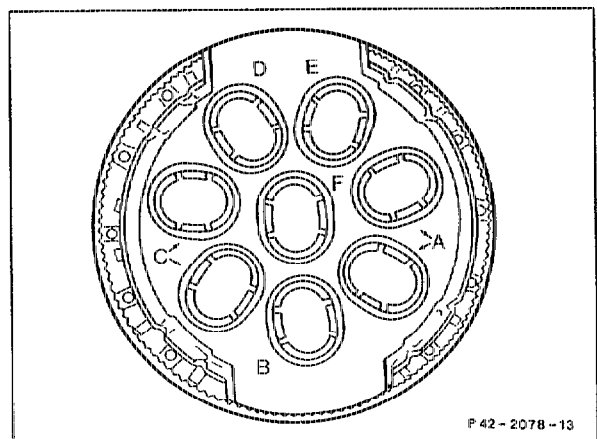
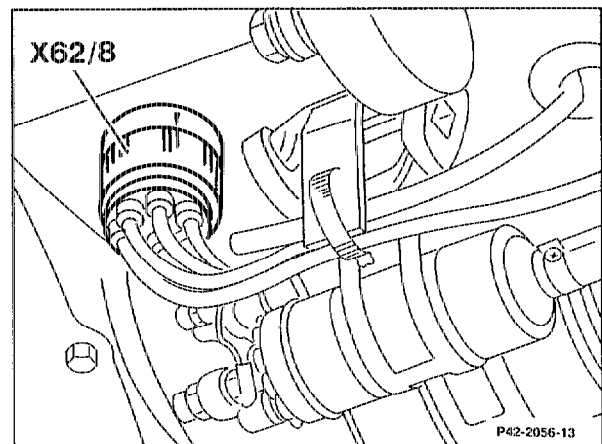
Location of the plug connection, left front axle distributor (X62/14) on steering knuckle.



The right rear speed sensor (L6/4) is an angled design. The plug (L6/4x1) is identified with the letter "D" (arrow).



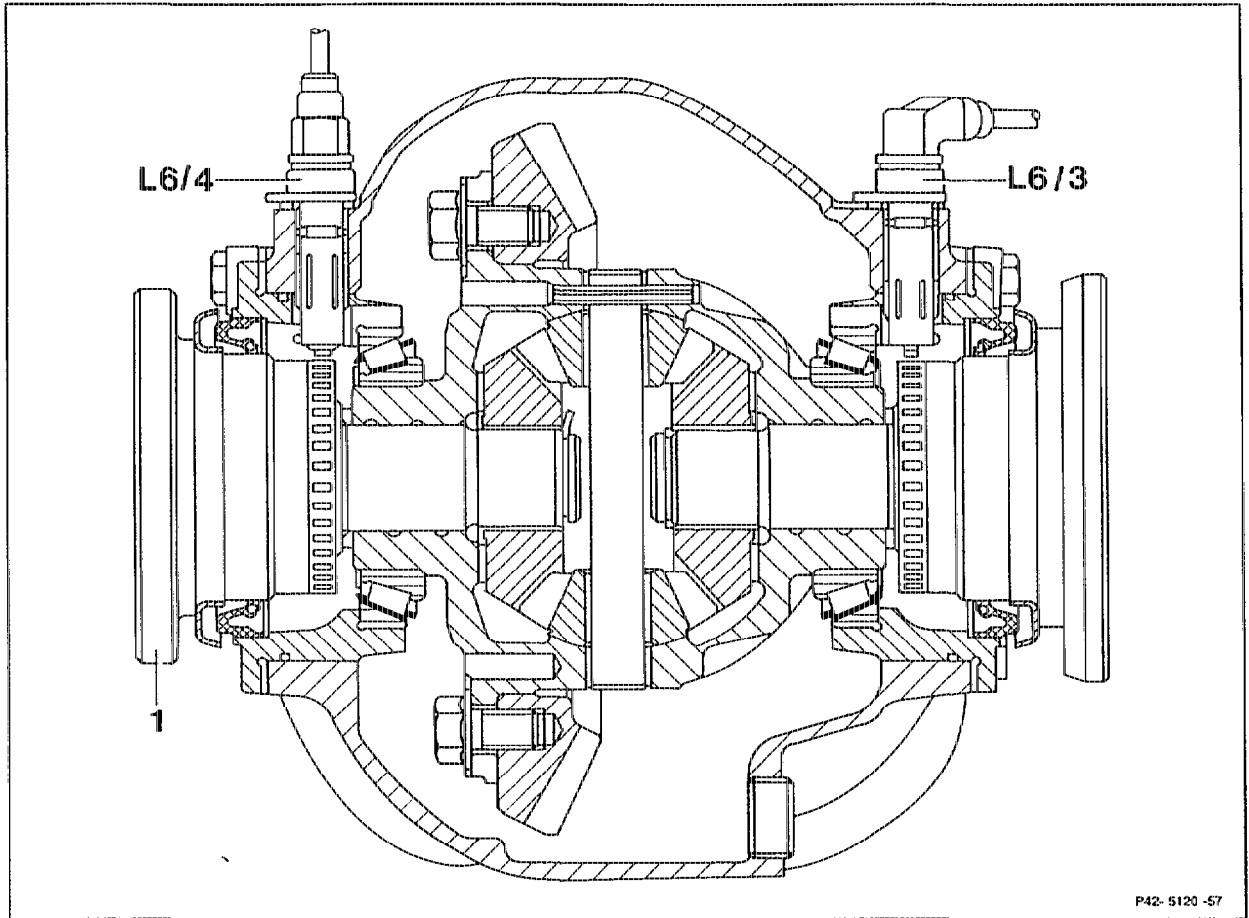
The plugs (D, E) of the left or right rear axle speed sensors (L6/3 or L6/4) are plugged into the plug connection, rear axle distributor (X62/8) into the openings marked "D" and "E".



D = for plug L6/3
E = for plug L6/4

Models 124, 126, 129, 201

The speeds of the rear wheels are measured separately at the serrations on the rear axle shaft flange.



Model 126

L6/3 Left rear axle speed sensor

L6/4 Right rear axle speed sensor

1 Rear axle shaft flange with serrations

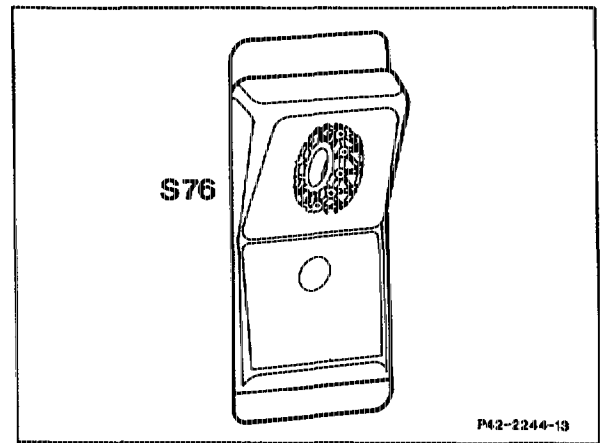
ASR snow chain switch (S76)

Snow chain switch

This switch should be operated when driving in deep snow with snow chains fitted.

After the switch has been operated, an indicator lamp in the switch comes on which confirms that a higher slip threshold is preselected in the ABS/ASR control unit.

Operation: Press at the top -- "ON"
Press at the bottom -- "OFF"

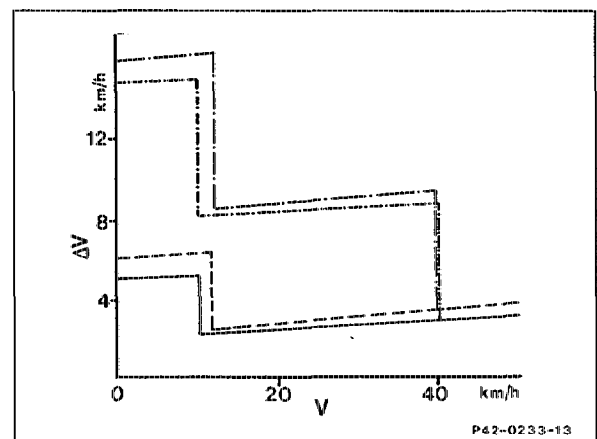


The slip thresholds in the lower speed range < 40 km/h are increased in stages after 50 ms control mode.

At vehicle speeds between 40 and 60 km/h the higher slip threshold is kept stored. If the speed exceeds 60 km/h the slip threshold changeover is erased again.

By increasing the slip thresholds, a higher differential speed between the front and rear wheels is possible. In this way, the vehicle can bite its way out of snow.

Thus maximum propulsion is achieved in deep snow when snow chains are fitted. For reasons of driving stability, this control is only allowed in the speed range up to 40 km/h.



Slip thresholds

(When both drive wheels skid)

- Brake moment control
- Drive moment control
- · - · - Brake moment control
Snow chain switch operated
- Drive moment control
Snow chain switch operated

V = Vehicle speed

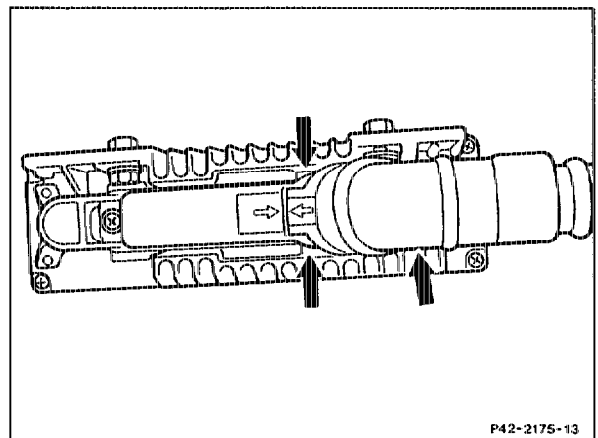
ΔV = Differential speed between front and rear wheel

ASR control unit (N30/1)

There are 4 versions of the ASR control unit (N30/1). The different characteristics for the electronic accelerator pedal are taken into account:

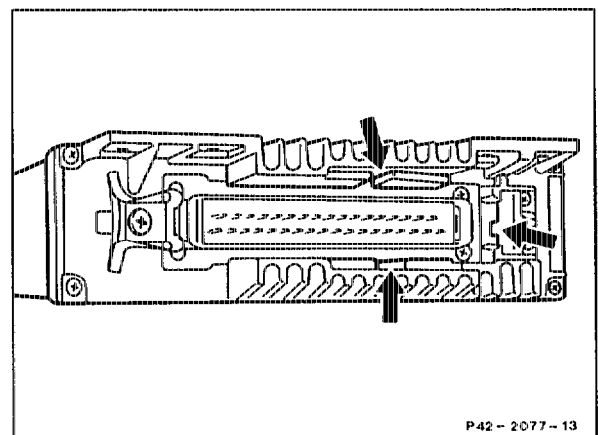
1. for vehicles model 124 with 103 and 104 engine without speed signal output
2. for vehicles model 129 with 103 and 104 engine with speed signal output
3. for vehicles model 126 with 116/117 engine without speed signal output
4. for vehicles model 129 with 119 engine with speed signal output

In order to avoid confusing ASR control units for the different engine variants, 2 lugs are cast on the side of the control unit connector. A recess at the respective different position is applied at the front claw.



2 grooves (arrows) are cast on the side of the ASR control unit at the guide for the connector. On the right of the locking device is a web at various positions (arrows).

The control unit comprises various circuit boards which are equipped with electronic components. Connection to the cable harness is via the 35-pin plug connection.



Apart from the ABS functions, the ASR control unit also contains all the ASR functions. It is divided up into functions as follows:

- Signal processing
- Input amplifier
- Logic sections
- Safety circuits
- Output stages

Signal processing

The input signals from the four wheel speed sensors are transformed into digital signals in the signal processing sections and transmitted to the ABS circuits and ASR microcomputer and processed.

Input amplifier

There is one input amplifier for each of the input signals from

- Stop lamp switch
- Throttle valve actual value
- Snow chain switch (S76)
- Pressure switch (A7/3s1)

Here the incoming digital signals are filtered and converted into a value which can be evaluated in the logic section and safety circuit.

Logic section

All input signals are processed in the logic sections of the ABS circuits and ASR microcomputer.

Wheel speed signals:

The processed wheel speed signals are continuously compared with each other and then with the specified slip thresholds (differential speeds between rear and front wheels, depending on the vehicle speed). The following values are determined by this comparative process:

- Drive slip
- Acceleration
- Front wheel driving speed
- Curve recognition

If the values determined exceed the specified slip thresholds then ASR control mode is initiated.

Adjustment of the throttle valve is controlled by the throttle valve nominal value output signal.

Stop lamp switch signal:

When the brake is operated, a signal is transmitted to the logic section. The solenoid valves are switched into the original position by the logic section via the respective output stages. In other words, ASR control mode is terminated immediately.

Throttle valve actual value signal:

In ASR control mode, the logic section controls the throttle valve closure of the electronic accelerator pedal via the throttle valve actual value according to the specified throttle valve nominal value.

Snow chain switch signal:

If there is a signal from the snow chain switch to the logic sections, an increased slip threshold is used in the logic and a signal issued to the indicator lamp via the corresponding output stage.

Pressure switch signal:

The pressurizing signal from the pressure switch causes the activation of the pressurizing pump and return pump/charge pump via the corresponding output stage.

Safety circuit

It is the task of the safety circuits to recognize faulty signals within the electronic control units and faults in the relays in the hydraulic unit as well as in the wheel speed sensors.

The ABS and ASR system is then switched off in the event of a fault.

The safety circuit also continuously monitors battery voltage. If the battery voltage is $< 10\text{ V}$, the system is switched off, until the voltage has again attained its nominal value. The following faults are recognized:

- Control unit defective
- Solenoid valve defective
- Wheel speed sensor defective or loose contact
- Relay defective
- Return pump/charge pump defective
- Accumulator leaking
- Pressure switch defective

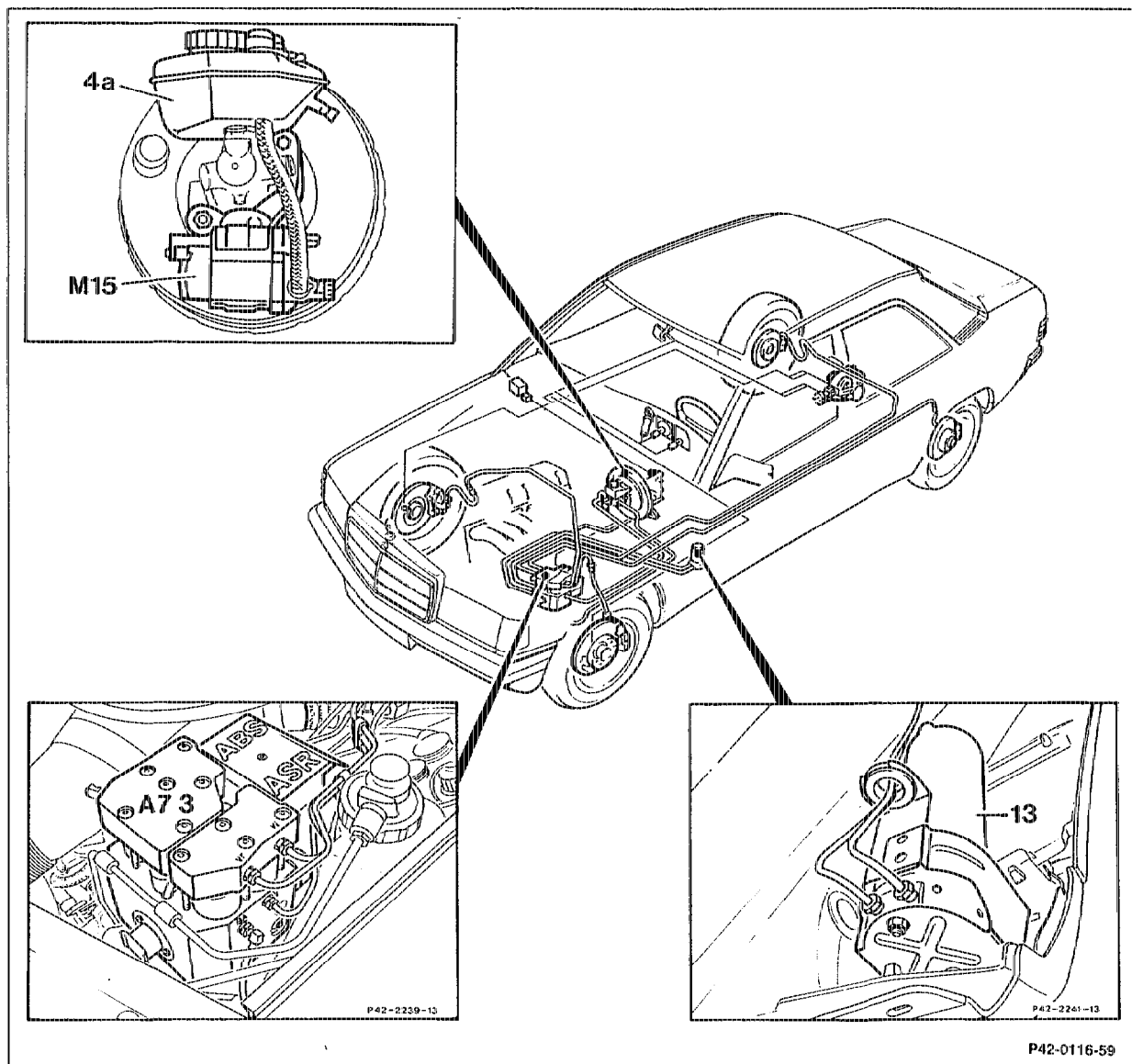
Faults detected are displayed by the warning lamps coming on. When the ignition is switched off, all faults which have occurred briefly are erased again.

Output stages

The output signals from the ABS circuits and ASR microcomputers to the solenoid valves, relays, warning lamps etc. are amplified by appropriate output stages.

F. Location of hydraulic components

Models 124/201

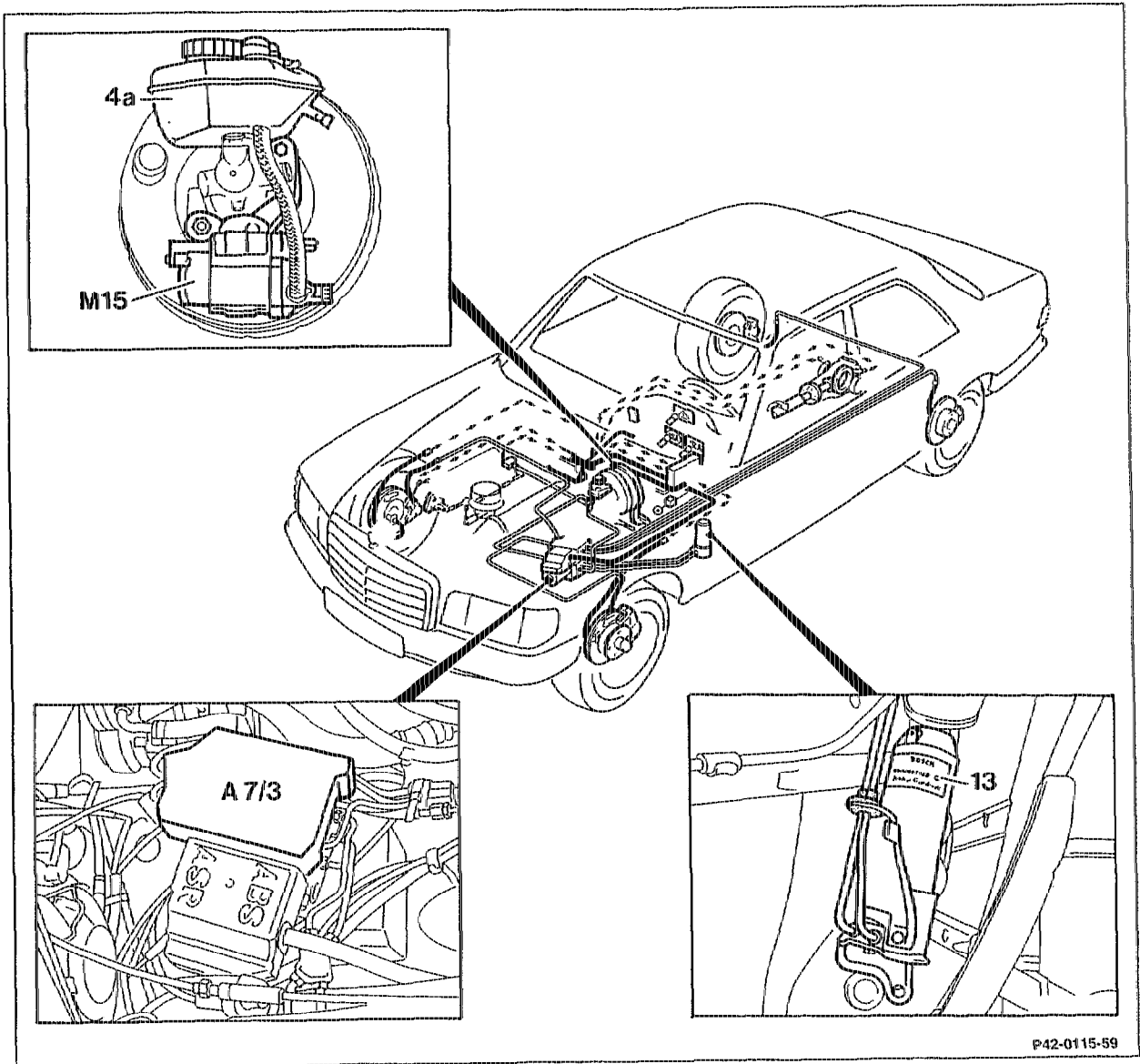


Shown on model 124

A7/3 ASR hydraulic unit
M15 Pressurizing pump

4a Brake fluid reservoir
13 Pressure accumulator

Model 126

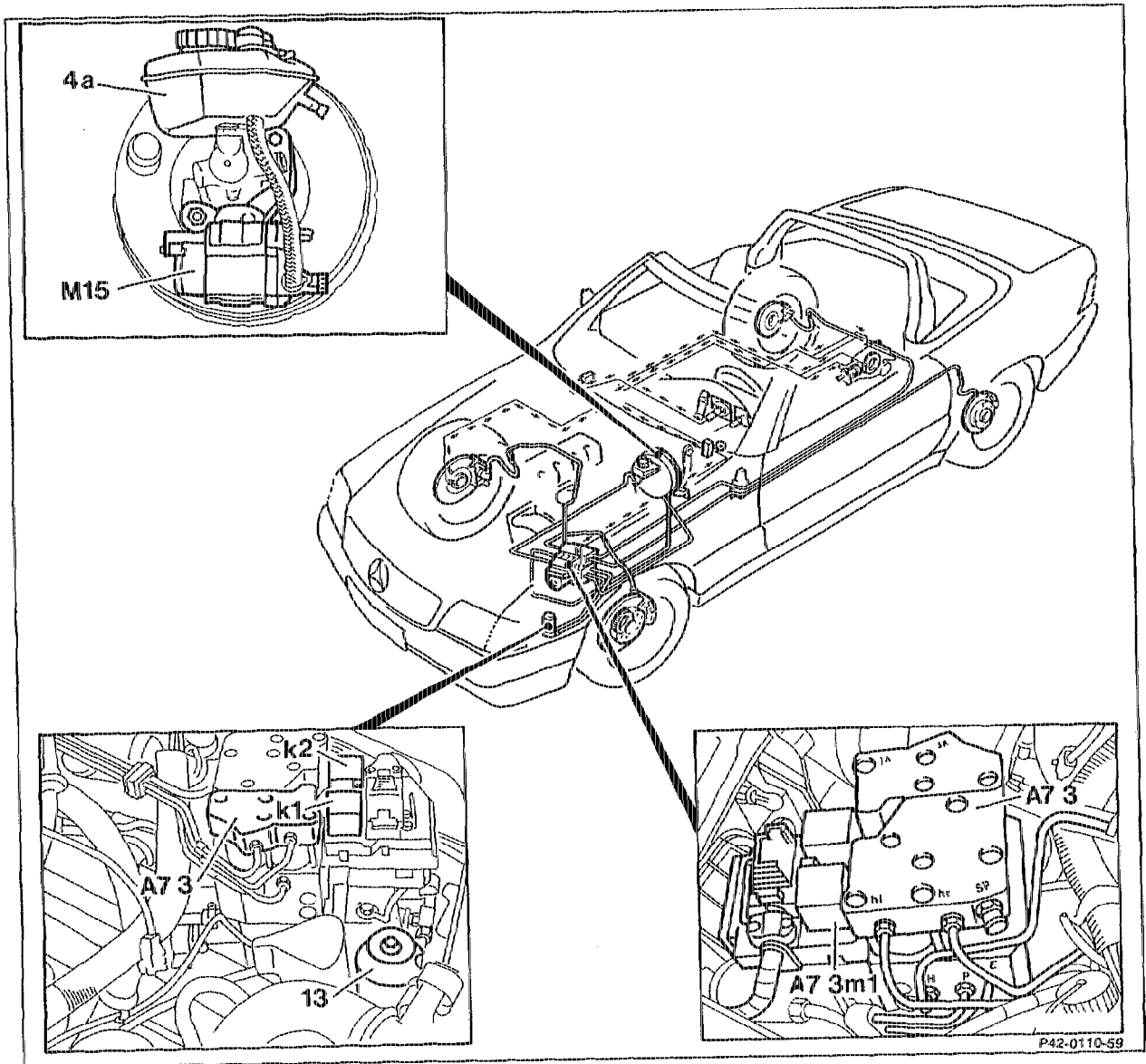


P42-0115-59

A7/3 ASR hydraulic unit
M15 Pressurizing pump

4a Brake fluid reservoir
13 Pressure accumulator

Model 129



A7/3 ASR hydraulic unit
M15 Pressurizing pump

4a Brake fluid reservoir
13 Pressure accumulator

Hydraulics function

The function of the hydraulics is divided up basically into 3 modes of operation, which are effective in the ASR hydraulic unit (A7/3).

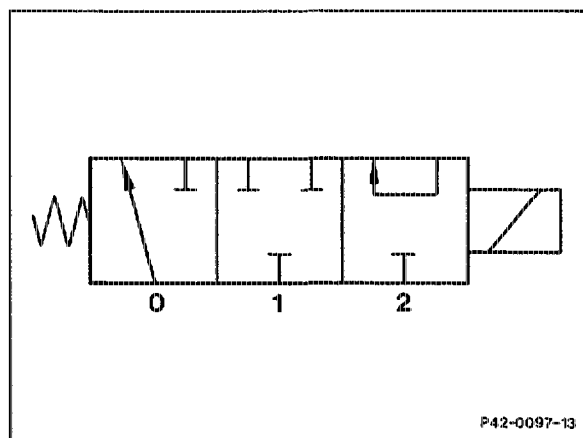
- Normal mode
- ABS control mode
- ASR control mode

Normal mode

All solenoid valves are in the original position (position 0).

The tandem master cylinder (4) is connected directly to the front axle brake calipers via the connection "V", the left front (A7/3y1) and right front (A7/3y2) solenoid valves. The brake line to the rear axle brake circuit is connected at connection "HZ".

The rear axle brake calipers are controlled via the switchover solenoid valve (A7/3y5) and both the left rear axle (A7/3y3) and right rear axle (A7/3y4) solenoid valves.



Solenoid valve positions 0, 1, 2

Accumulator charging

If the pressure accumulator (13) is empty or at a pressure < approx. 160 bar, the pressure switch (A7/3s1) transmits the signal for accumulator charging to the ASR control unit (N30/1).

The ASR pressurizing pump (M15) is controlled and conveys brake fluid at a pilot pressure of approx. 10 bar to the return pump/charge pump (A7/3m1) in the ASR hydraulic unit (A7/3) via the connection "BA".

The return pump/charge pump (A7/3m1) is controlled at the same time with the ASR pressurizing pump (M15). Together the pumps supply the pressure for accumulator charging.

At a pressure of approx. 180 bar, the pressure switch (A7/3s1) transmits the signal to terminate accumulator charging to the ABS/ASR control unit (N30/1). The time for accumulator charging is approx. 30-50 seconds.

ABS control mode

The following changes have been made relative to the ABS without ASR:

The brake pressure for the rear axle circuit is led from the tandem master cylinder via the switchover solenoid valve (A7/3y5) to the two left or right rear axle solenoid valves (A7/3y3 or A7/3y4).

During ABS control mode (pressure build-up, pressure holding, pressure reduction) the left or right rear axle solenoid valves (A7/3y3 or A7/3y4) are controlled synchronously together for the rear axle circuit.

ASR control mode

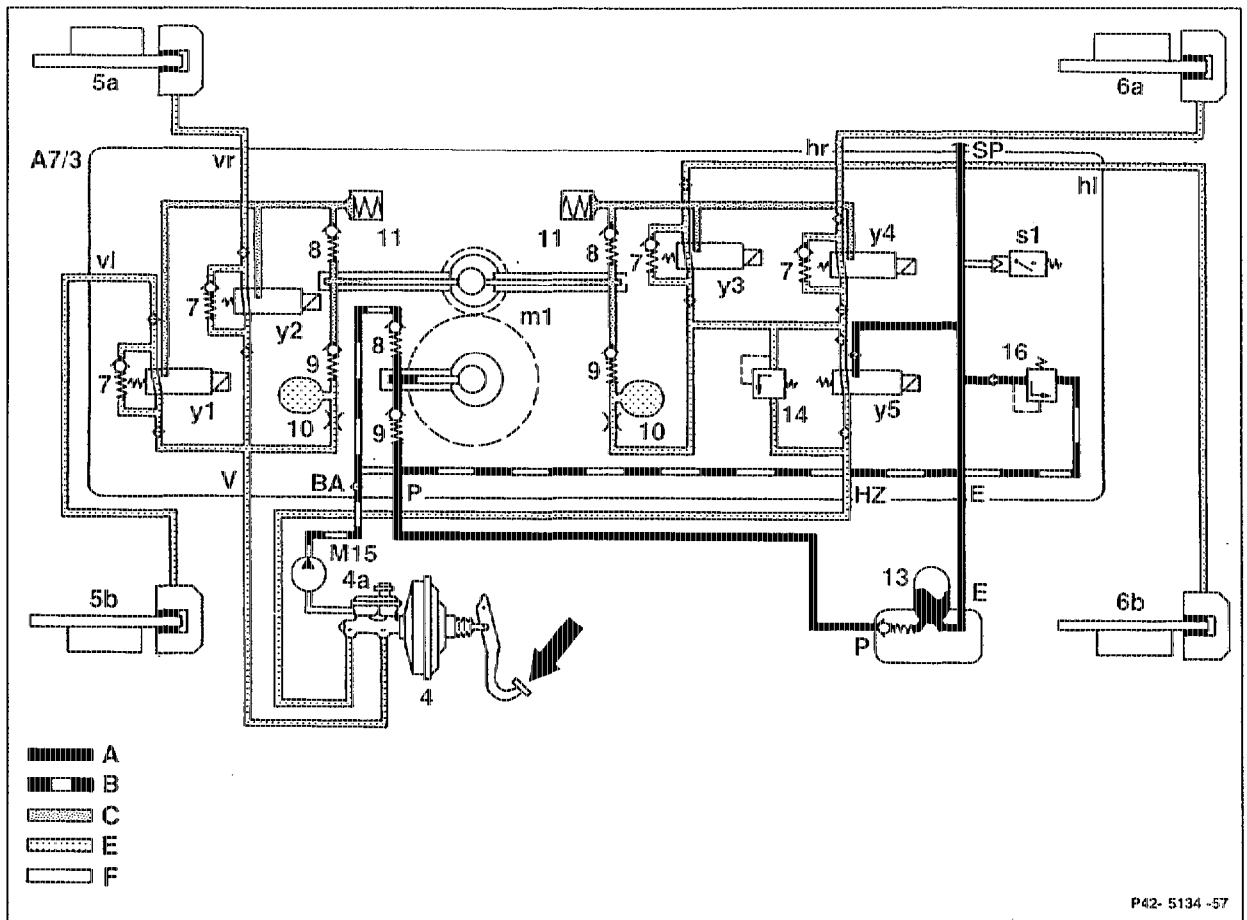
The control mode requires a full pressure accumulator. The pressure switch (A7/3s1) continuously monitors the accumulator pressure.

The brake pressure for acceleration skid control is provided solely from the pressure accumulator. If the ASR control unit (N30/1) recognizes that a wheel is tending to skid, the switchover solenoid valve (A7/3y5) is switched to position "2" (and remains in this position until the end of the control process). Thus the full accumulator pressure is applied to the left or right rear axle solenoid valves (A7/3y3 or A7/3y4).

Depending how much and which wheel now skids, the three pressure phases: Pressure build-up - position "0", pressure holding - "1", and pressure reduction - position "2" are switched at the left or right rear axle solenoid valves (A7/3y3 or A7/3y4).

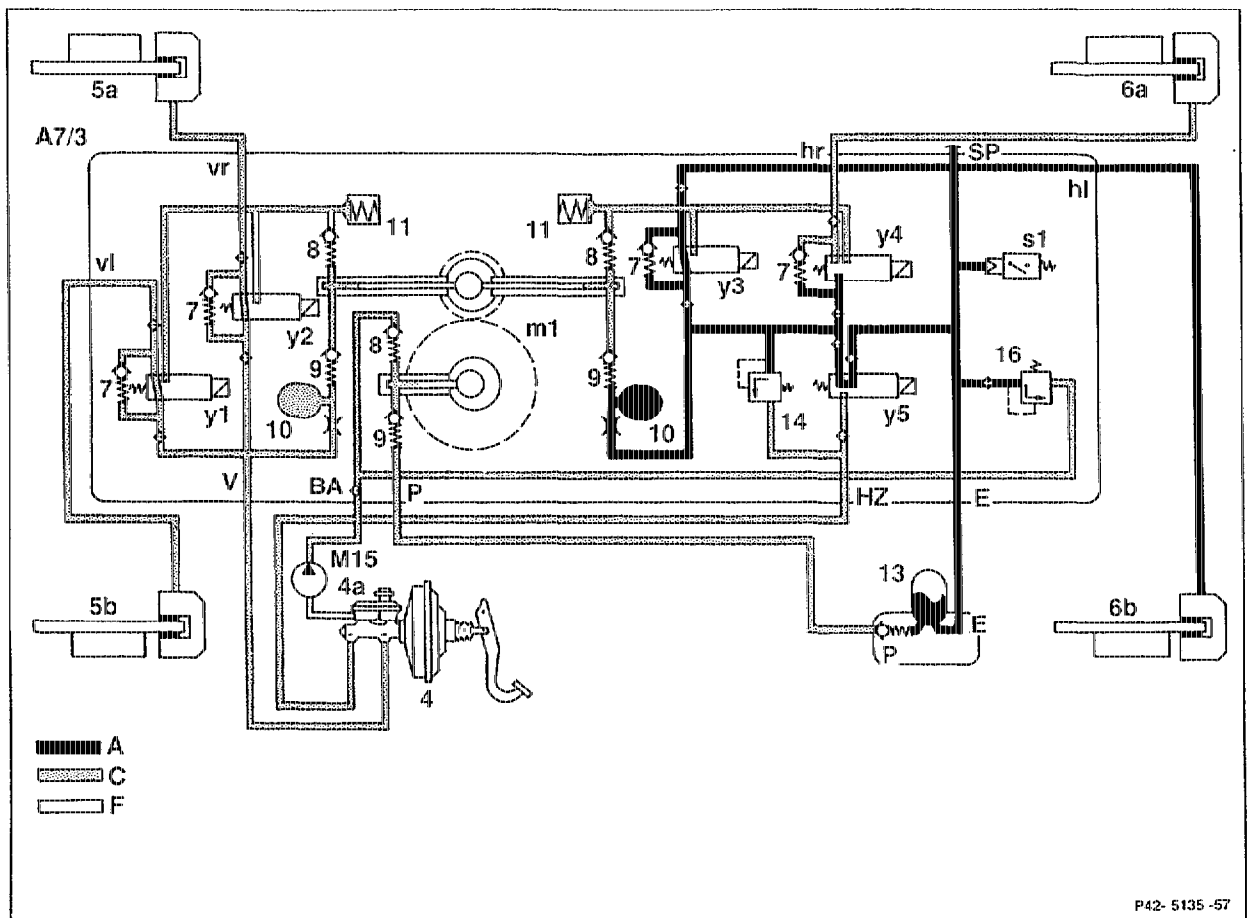
The 3 pressure phases during a control process are explained in the example of a left rear wheel (refer to hydraulic diagram).

Normal operation mode
(with accumulator charging)



A	Accumulator pressure	10	Silencer
B	Pilot pressure	11	Low pressure accumulator
C	Depressurized	13	Pressure accumulator
E	Brake pressure	14	Pressure limiting valve
F	Suction line	16	Pressure limiting valve
SP	Bleed screw	A7/3	ASR hydraulic unit
4	Brake booster with tandem master cylinder	A7/3y1	Left front axle solenoid valve
4a	Brake fluid reservoir	A7/3y2	Right front axle solenoid valve
5a	Right front wheel brake	A7/3y3	Left rear axle solenoid valve
5b	Left front wheel brake	A7/3y4	Right rear axle solenoid valve
6a	Right rear wheel brake	A7/3y5	Switchover solenoid valve
6b	Left rear wheel brake	A7/3m1	Return pump/charge pump
7	Check valve	A7/3s1	Pressure switch
8	Pump input valve	M15	Pressurizing pump
9	Pump output valve		

Pressure build-up

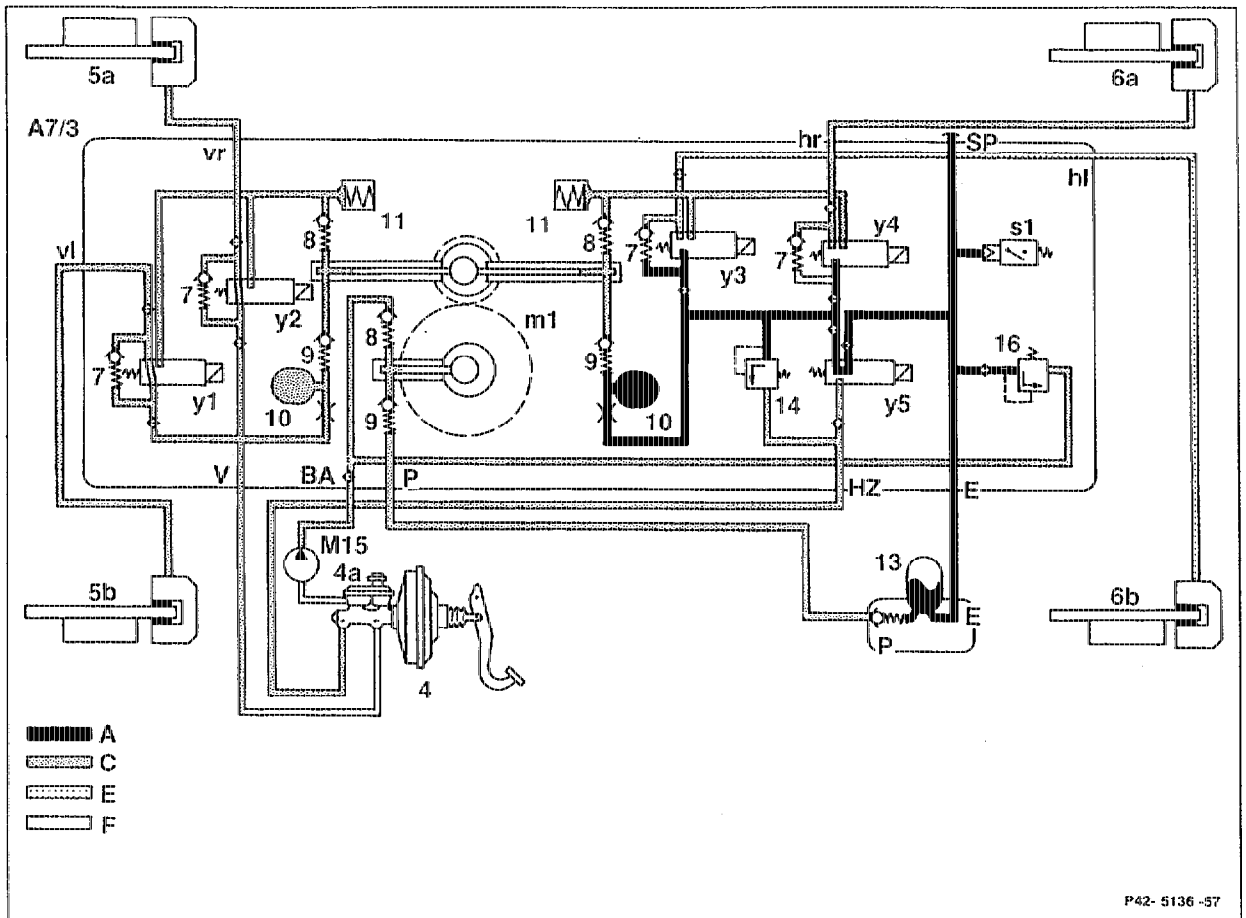


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A	Accumulator pressure	11	Low pressure accumulator
C	Depressurized	13	Pressure accumulator
F	Suction line	14	Pressure limiting valve
SP	Bleed screw	16	Pressure limiting valve
4	Brake booster with tandem master cylinder	A7/3	ASR hydraulic unit
4a	Brake fluid reservoir	A7/3y1	Left front axle solenoid valve
5a	Right front wheel brake	A7/3y2	Right front axle solenoid valve
5b	Left front wheel brake	A7/3y3	Left rear axle solenoid valve
6a	Right rear wheel brake	A7/3y4	Right rear axle solenoid valve
6b	Left rear wheel brake	A7/3y5	Switchover solenoid valve
7	Check valve	A7/3m1	Return pump/charge pump
8	Pump input valve	A7/3s1	Pressure switch
9	Pump output valve	M15	Pressurizing pump
10	Silencer		

The left rear axle solenoid valve (A7/3y3) is in position "0". Now the brake fluid which is at accumulator pressure directly reaches the left rear brake caliper (6b).

Pressure holding

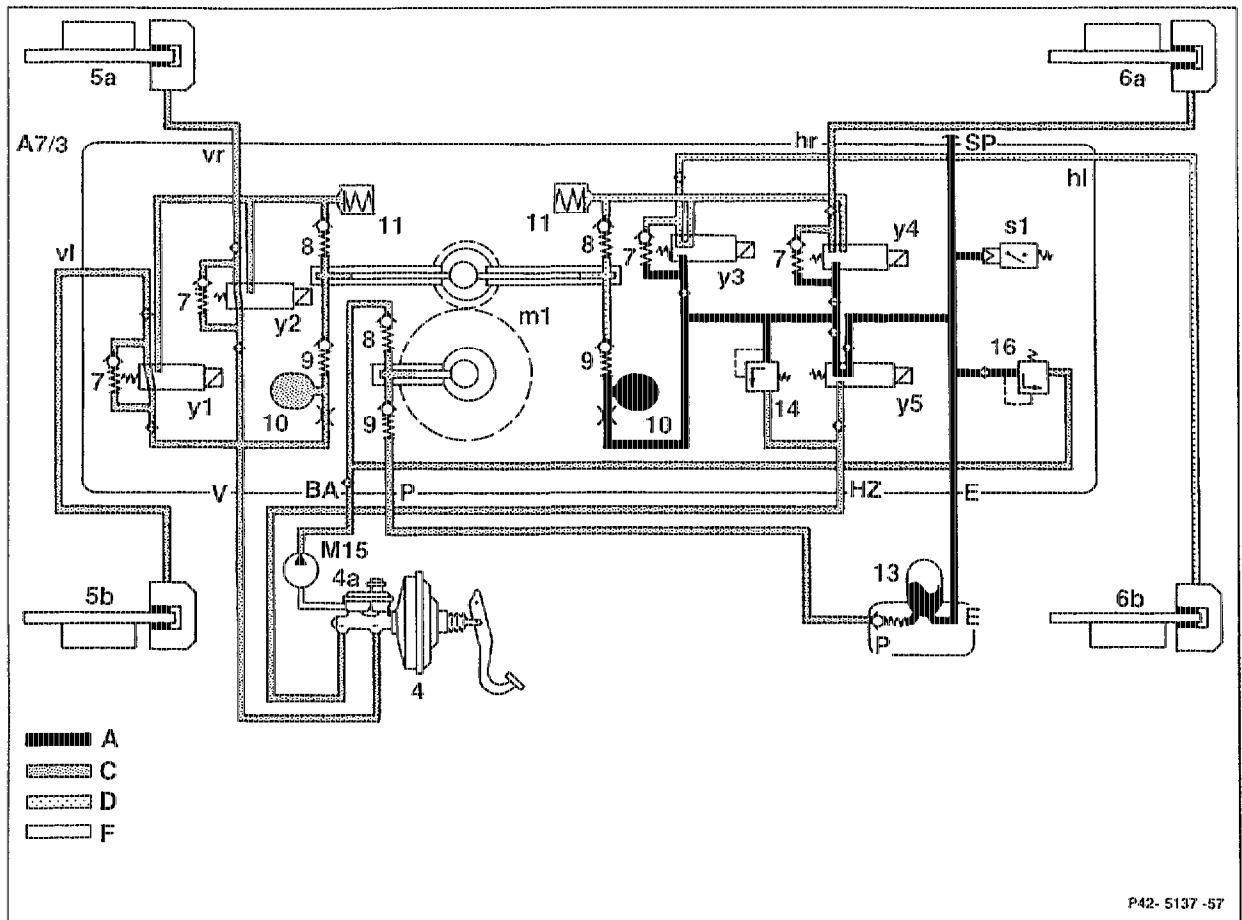


A	Accumulator pressure	10	Silencer
C	Depressurized	11	Low pressure accumulator
E	Brake pressure	13	Pressure accumulator
F	Suction line	14	Pressure limiting valve
SP	Bleed screw	16	Pressure limiting valve
4	Brake booster with tandem master cylinder	A7/3	ASR hydraulic unit
4a	Brake fluid reservoir	A7/3y1	Left front axle solenoid valve
5a	Right front wheel brake	A7/3y2	Right front axle solenoid valve
5b	Left front wheel brake	A7/3y3	Left rear axle solenoid valve
6a	Right rear wheel brake	A7/3y4	Right rear axle solenoid valve
6b	Left rear wheel brake	A7/3y5	Switchover solenoid valve
7	Check valve	A7/3m1	Return pump/charge pump
8	Pump input valve	A7/3s1	Pressure switch
9	Pump output valve	M15	Pressurizing pump

The left rear axle solenoid valve (A7/3y3) is switched into position "1". All connections at the solenoid valve are blocked.

The brake pressure in the left rear brake caliper (6b) remains constant.

Pressure reduction



P42- 5137 -57

A	Accumulator pressure	10	Silencer
C	Depressurized	11	Low pressure accumulator
D	Reduced pressure	13	Pressure accumulator
F	Suction line	14	Pressure limiting valve
SP	Bleed screw	16	Pressure limiting valve
4	Brake booster with tandem master cylinder	A7/3	ASR hydraulic unit
4a	Brake fluid reservoir	A7/3y1	Left front axle solenoid valve
5a	Right front wheel brake	A7/3y2	Right front axle solenoid valve
5b	Left front wheel brake	A7/3y3	Left rear axle solenoid valve
6a	Right rear wheel brake	A7/3y4	Right rear axle solenoid valve
6b	Left rear wheel brake	A7/3y5	Switchover solenoid valve
7	Check valve	A7/3m1	Return pump/charge pump
8	Pump input valve	A7/3s1	Pressure switch
9	Pump output valve	M15	Pressurizing pump

The left rear axle solenoid valve (A7/3y3) is switched into position "2". The pressure connection is blocked. The brake caliper (6b) is connected to the return pump (m1) via the left rear axle solenoid valve (A7/3y3). The brake fluid flows out of the brake caliper via the low pressure accumulator (11), the pump inlet valve

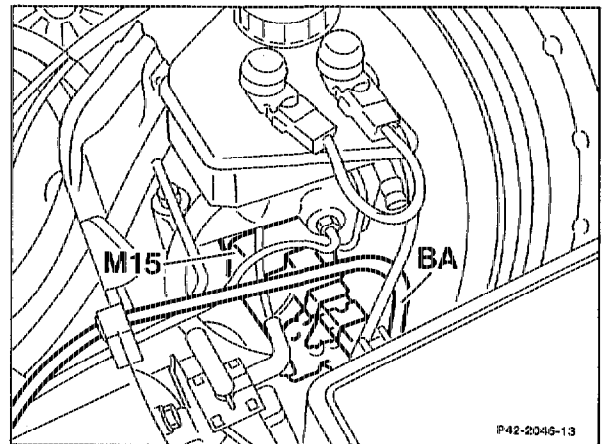
(8) and the silencer (10) back into the pressure circuit upstream of the solenoid valves (A7/3y3, A7/3y3) and back into the pressure accumulator (13) via the switchover valve (A7/3y5). In this way the control mode can be repeated in an unrestricted manner without exhausting the accumulator volume.

G. Function of hydraulic components

Pressurizing pump (M15)

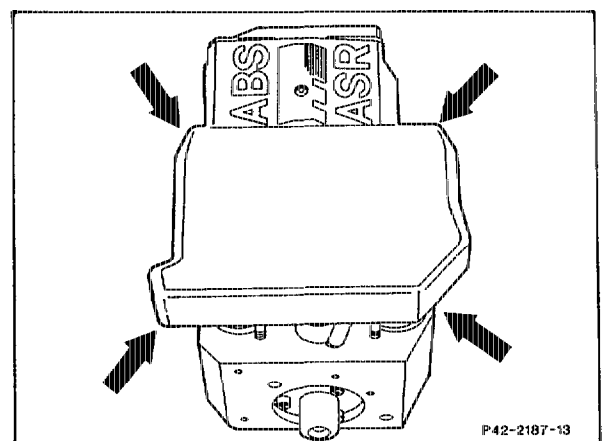
The pressurizing pump is located on the brake booster under the tandem master cylinder. It is designed as a gear driven pump. The pressurizing pump can produce a maximum pressure of 8-12 bar.

It is connected to the ASR hydraulic unit via the line (BA). It is controlled directly from the ASR control unit (N30/1).



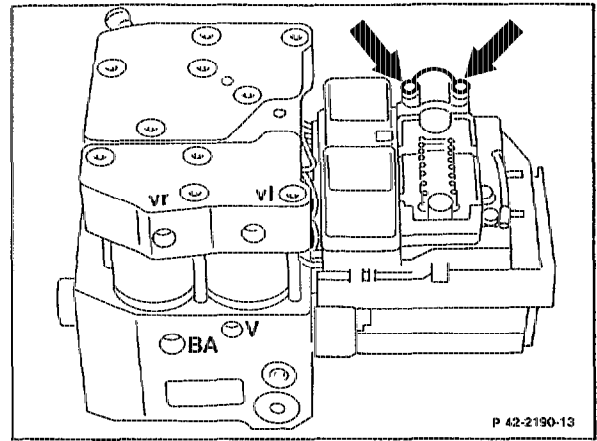
ASR hydraulic unit (A7/3)

The ASR hydraulic unit is located in the front left of the units compartment on all models. It is designed as a compact hydraulic unit, i.e. the components for the hydraulic functions of ABS and ASR are combined into one housing. The ASR hydraulic unit has two plastic covers. The smooth cover is clipped in at 4 points (arrows). The cover with lettering is fixed with a screw.

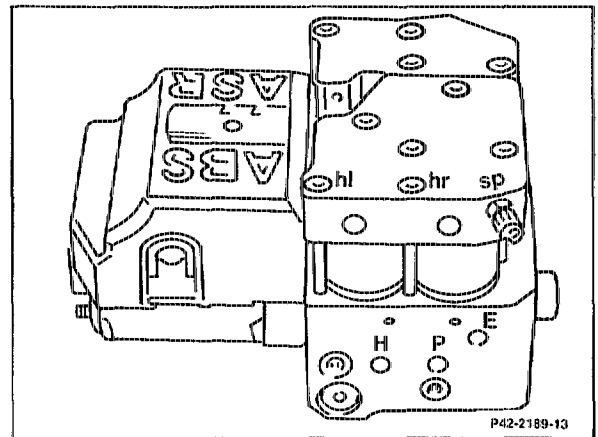


In detail the meaning of the connection markings is as follows:

- vl Left front wheel brake
- vr Right front wheel brake
- V Front axle tandem master cylinder
- BA Reservoir connection (pressurizing pump)



- hl Left rear wheel brake
- hr Right rear wheel brake
- SP Bleed screw
- P Pump
- E Pressure accumulator inlet
- H Rear axle tandem master brake cylinder



Return pump/charge pump (A7/3m1)

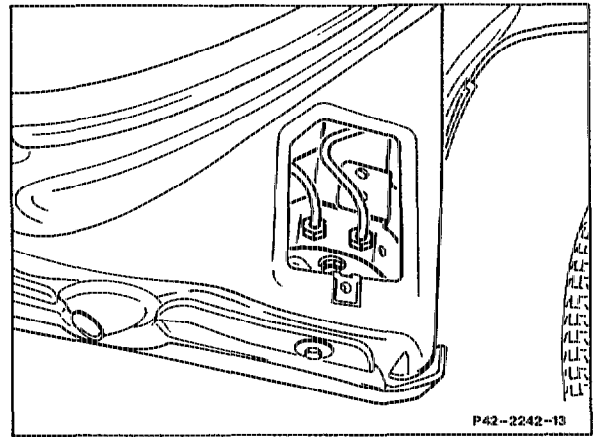
The return pump/charge pump (A7/3m1) are integrated in the ASR hydraulic unit (A7/3). The return pump/charge pump (A7/3m1) are driven together by the motor of the return pump (known from ABS). Thus the return pump has a direct drive and the charge pump is driven via an intermediate drive gear.

The delivery of the integrated return pump is less than that of the separate charge pump for ASR (1st version). Therefore the time for accumulator charging increases from approx. 10 seconds to approx. 30 seconds.

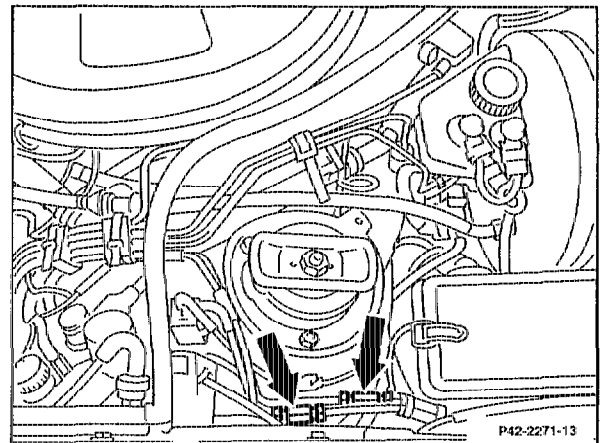
Pressure accumulator

Models 124 and 201

The pressure accumulator is located behind the window on the plastic cover beneath the left front fender.

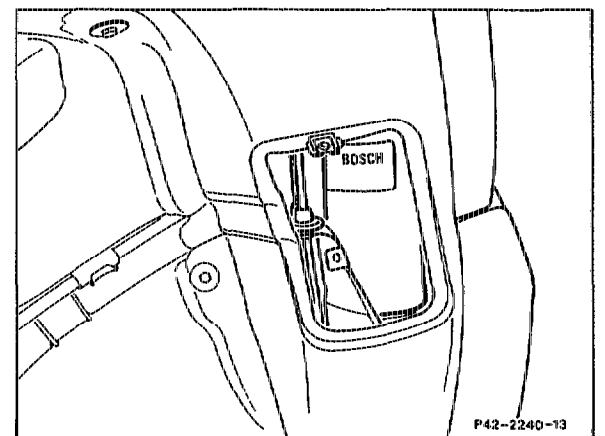


The hydraulic lines from the ASR hydraulic unit to the pressure accumulator are separated to improve assembly by means of a connector piece (arrows) next to the damper strut fixing.

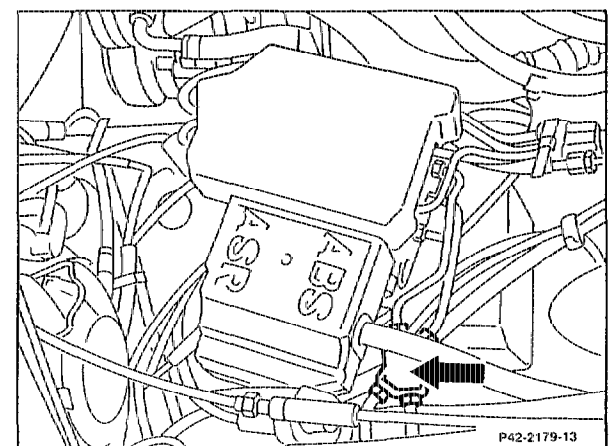


Model 126

The pressure accumulator is located behind the window on the plastic cover beneath the left front wing.

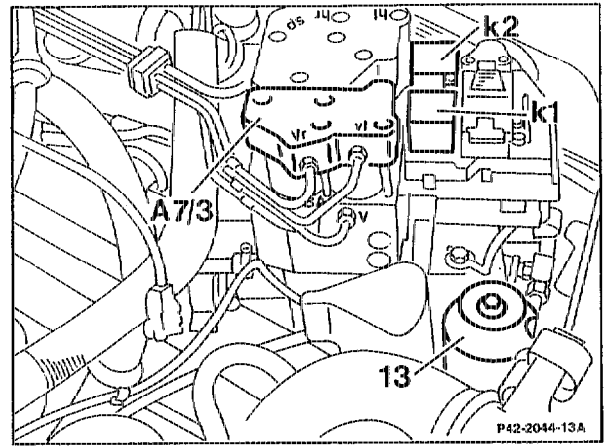


The hydraulic lines from the ASR hydraulic unit to the pressure accumulator are separated to improve assembly by means of a connector piece (arrow) next to the ASR hydraulic unit.

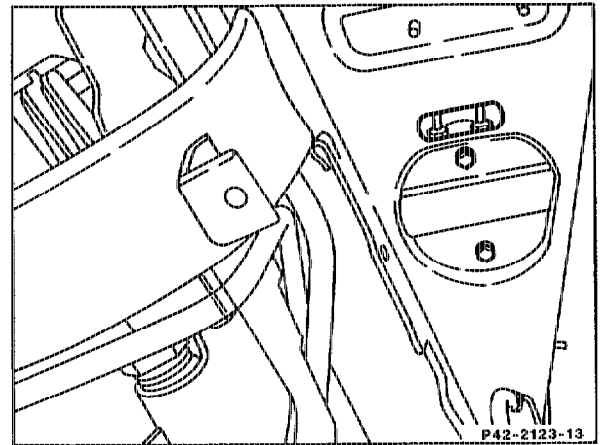


Model 129

The pressure accumulator (13) is located behind the left headlamp next to the ASR hydraulic unit (A7/3).



A check for leakage at the connections on the pressure accumulator can be performed from the underside of the vehicle through the recess in the wheelhouse panel.



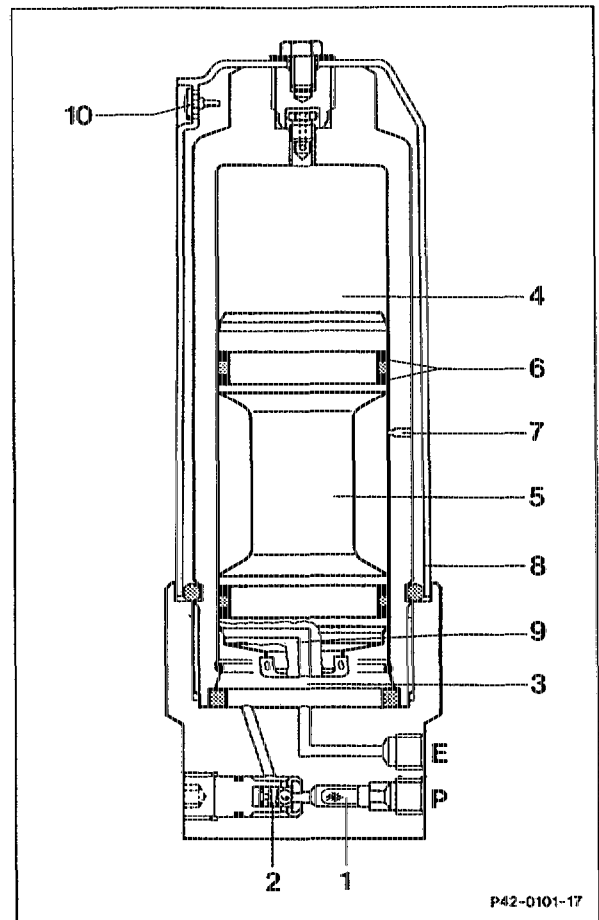
All models

The pressure accumulator is designed as a piston-type reservoir on all models.

The volume of brake fluid stored is approximately 42 cm³ at a pressure of 180 bar. The initial pressure of the gas fill is approx. 100 bar.

The charge pump delivers the brake fluid to the storage chamber through the filter and via the check valve. The brake fluid stored is applied directly to connection "E" of the ASR hydraulic unit via one line.

The purpose of the bore (7) is to convey any leakage at all (either gas from the gas chamber or brake fluid from the storage chamber) outwards into the collection chamber beneath the plastic cover. This prevents mixing of gas and brake fluid.



P42-0101-17

Pressure accumulator

- 1 Filter
- 2 Check valve
- 3 Storage chamber
- 4 Gas chamber
- 5 Double seal piston
- 6 O-ring
- 7 Bore
- 8 Plastic cover
- 9 Depressurizing bore
- 10 Overflow

- P Inlet line from charge pump
- E Outlet line to ASR hydraulic unit



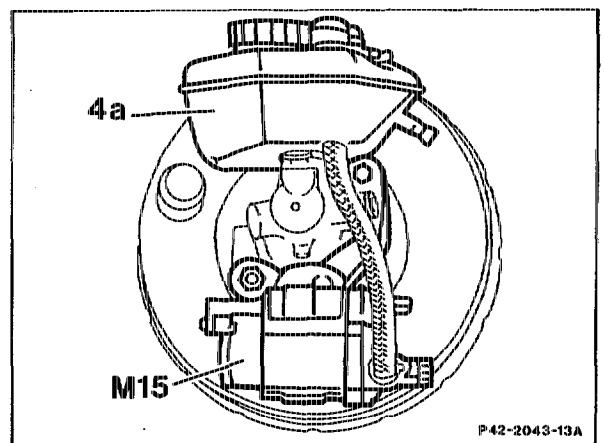
When bleeding the hydraulic system, the double-seal piston must seat positively on the base of the storage chamber. Thus the brake fluid forces any residual air directly to the outlet line "E" via the de-pressurizing bore (9) and from there to the bleed screw "SP" (refer to bleeding the ASR hydraulics). The bleed screw "SP" must be unscrewed at least one turn for bleeding.

Brake fluid reservoir (4a)

As previously, the brake fluid reservoir (4a) is located above the tandem master cylinder. The volume has been increased to 350 cm³ for vehicles with ASR (300 cm³ without ASR).

The brake fluid reservoir has an additional line connection, to which the pressurizing pump (M15) is connected.

2 brake fluid level check switches are located on the brake fluid reservoir.



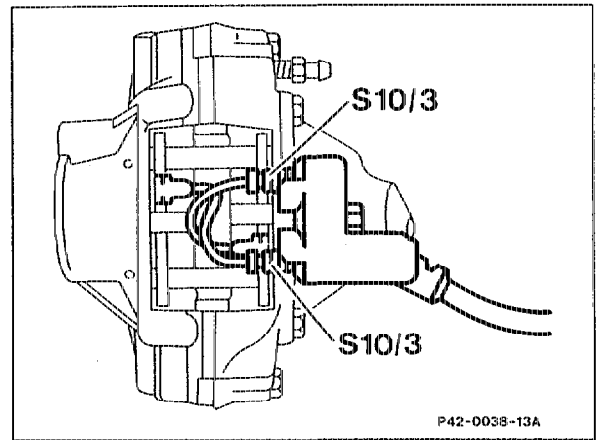
Rear wheel brake

On vehicles with ASR the rear wheel brakes have a wear indicator as on the front brakes.

The fixed brake caliper is made from spherulitic cast iron. A fixing eye is cast in for the plug connection of the wear indicator (S10/3).

The linings differ, however, by recesses in the lining back plate, which are used to attach the wear sensor.

The lining quality and the dimensions of the linings are the same as on vehicles without ASR.



Note on model 124

On the T saloon, an uprated rear wheel brake as well as a separate matched brake lining is fitted.

Note

The contact sensor lines must be routed as shown in the figure. Only contact sensors in the transparent (temperature-resistant design) may be installed.