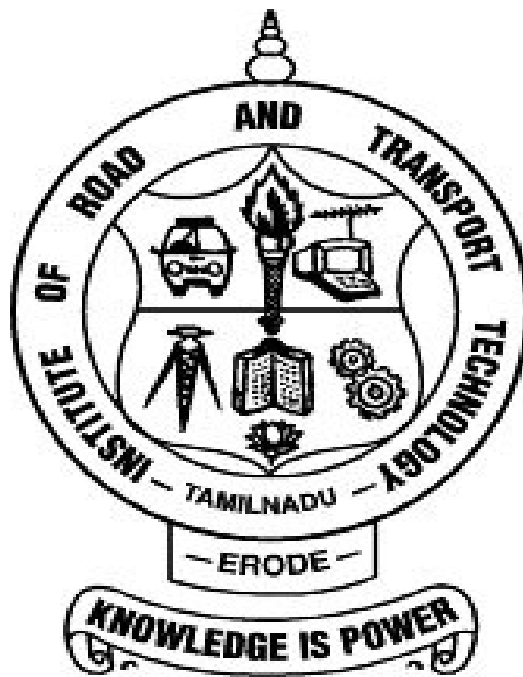


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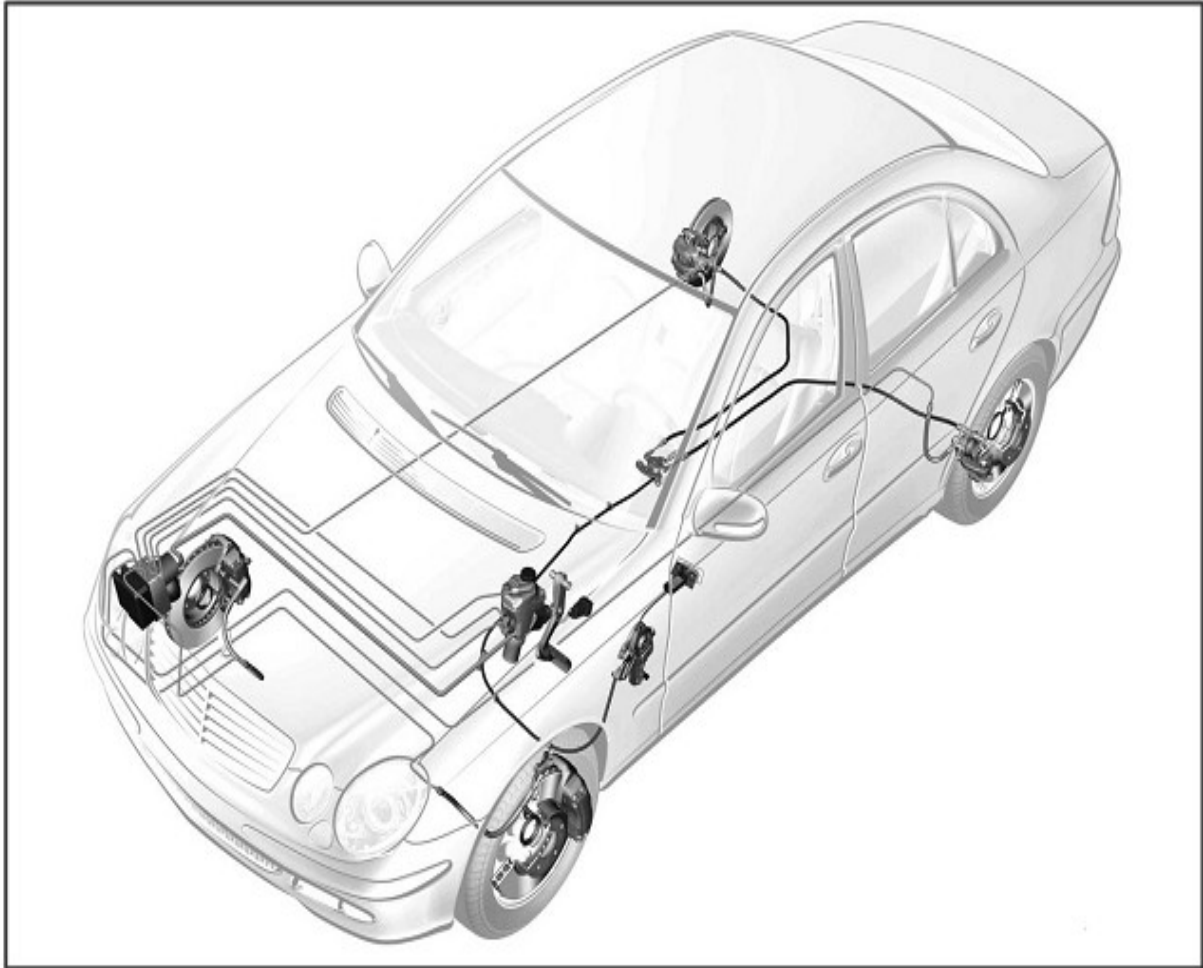
Presented by

D.kannan

B.E(Mechanical engg)

Final year

Sensotronic Brake Control (SBC)



R230 and W211: Starting MY2003

1

What is SBC

Sensotronic Brake Control (SBC) is the name given to an innovative electronically controlled brake system which will fit to future passenger car models.

With Sensotronic Brake Control electric signals are used to pass the driver's braking commands onto a microcomputer which processes various sensor signals simultaneously and, depending on the particular driving situation, calculates the optimum brake pressure for each wheel.

BRAKE PEDAL

In the Sensotronic Brake Control, a large number of mechanical components are simply replaced by electronics.

Sensors gauge the pressure inside the master brake cylinder as well as the speed with which the brake pedal is operated, and pass these data to the SBC computer in the form of electric impulses.

CONTROL UNIT

The central control unit under the bonnet is the centerpiece of the electro-hydraulic brake.

The microcomputer, software, sensors, valves and electric pump work together and allow totally novel, highly dynamic brake management.

In addition to the data relating to the brake pedal actuation, the SBC computer also receives the sensor signals from the other electronic assistance systems. For example, ESP which makes available the data from its steering angle and turning rate.

PRESSURE SENSOR

1. High precision and reliability are most desired functions in modern sensor design.
2. The conversion of pressure in the specific case, into an electrically measurable value is performed through piezo-resistive elements implanted on the surface of the silicon chip.
3. Two different sensitivities: a higher one in a low-pressure range (0 to 30 bar), and a lower one at higher pressures (up to 250 bar).

The sensor design

Defining a concept for a new sensor is no trivial job. Putting this into a realizable design is even more complex and requires a good deal of experience in sensor manufacturing and simulation techniques. The transducer chip design has been conceived in collaboration between EADS (European Aerospace Defense and Space company) with the contribution of the Technical University of Berlin.

ELECTRONIC DESIGN

Electronic should be maintained to a low level of complexity.

A low level of integration has been chosen to enable more design flexibility

FEATURES OF SENSOTRONIC BRAKE CONTROL

1. Emergency braking

SBC recognizes the driver's rapid movement from the accelerator onto the brake pedal as a clue to an imminent emergency stop and responds automatically: with the aid of the high-pressure reservoir, the system increases the pressure inside the brake lines and instantly presses the pads onto the brake discs so that they can get a tight grip the moment the driver steps onto the brake pedal

2. Driving stability

when there is a risk of swerving, the system interacts with the Electronic Stability Program (ESP®) which keeps the vehicle safely on course through precise braking impulses at all wheels.

SBC offers the benefits of greater dynamics and precision: thanks to the even faster and more accurate braking impulses from the SBC.

3. Comfort

SBC serve to increase brake comfort particularly during sharp deceleration

The usual vibration of the brake pedal does not occur which is not only a comfort feature but also offers measurable safety benefits.

SBC add-on functions

The Soft-Stop function of the SBC software ensures particularly gentle and smooth stopping during heavy traffic jams

On a wet road surface the system meters out short brake impulses at regular intervals to ensure that the water film on the brake discs dries off and that SBC can always operate with optimum effectiveness.

On hills or steep drives the Sensotronic Brake Control Drive-Away Assist prevents the car from rolling backwards or forwards – stepping onto the brake pedal quickly but sharply is all it takes to activate the brake

The future

The advent of electronics in brake technology opens up new and promising opportunities in the disciplines of safety and comfort. By means of SBC we have also moved a considerable way closer to the realization of long-term objective, namely to be able to automatically

guide the cars of the future along the roads with the aid of video cameras, proximity radar and advanced telematics. For such autonomous vehicle guidance, the experts need a computer-controlled brake system which automatically acts on the instructions of an electronic autopilot and stops the car safely.

SBC Incorporates these Functions:

- ABS (Anti lock Brakes 1984)
- + ASR (Automatic Slip Regulation 1991)
- + ETS (Electronic Traction System 1995)
- + ESP (Electronic Stability Program 1996)
- + BAS (Brake Assist System 1998)

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Advantages of SBC

- Improves metering of required brake pressure
 - each wheel can be precisely controlled
- Improved BAS function
 - monitors release of accelerator pedal and application of brake
 - maximum pressure available immediately
 - pre-filling of system (overcoming play)
 - when the BAS function is anticipated, slight pressure is applied

Advantages of SBC

- Electronic Brake Proportioning: EBP
 - allows brake proportioning front to back and side to side
- No pedal vibration during ABS operation
 - eliminates “distraction” to the driver during critical moments
 - indicator light in instrument cluster signals traction loss
- Improved driving dynamics: ABS, ASR, and ESP
 - faster response to brake request inputs

Advantages of SBC

- Pressure reduction at standstill
 - reduces stress on components
- Dry braking function
 - wiper input via CAN
 - ~every 7 to 14 minutes
 - brake actuation changes time interval



Driving with SBC - Wake-Up

SBC is functional as soon as it is “wakened” by:

- opening a door (via CAN)
 - operating the central locking system (via CAN)
 - depressing the brake pedal
 - turning key to position 1
 - operating parking brake
- The Wake-Up may be followed by a Pre-Drive self Check performed by SBC

Driving with SBC – Pre-Drive Check (PDC)

When SBC performs a PDC after a "wake-up", the following are checked:

Warning! Pressure is applied to brake calipers (~60 bar)

- reservoir pressure (if low, it will be corrected by running the high pressure charge pump in the hydraulic unit)
- pressure sensors
- control valves
- leak tests
- operational checks

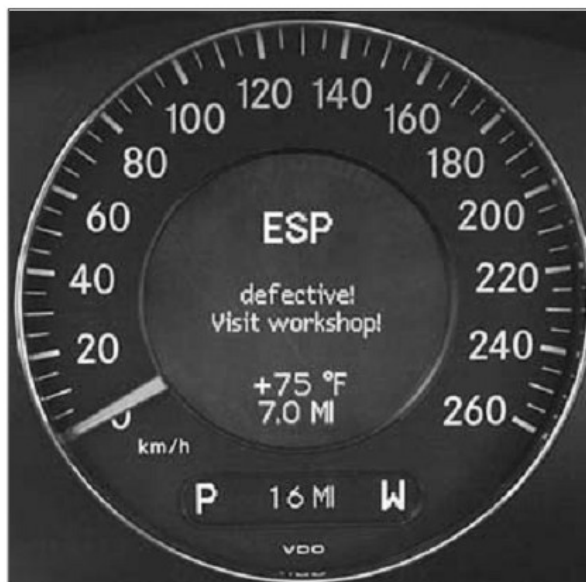
Note: self-tests are constantly conducted during driving (~ once every 16 brake applications)

Driving with SBC – Delayed Off Function

Time that SBC remains operational after use:

- with vehicle stationary and was locked = 20 seconds
- with vehicle stationary and ignition in “0”,
brake pedal not operated = 2 minutes
- with vehicle stationary, ignition in “0”,
brake pedal operated in delayed off phase and
released again = 4 minutes

Warning Display



Complete ESP control module failure -
Instrument cluster will scroll through failure displays

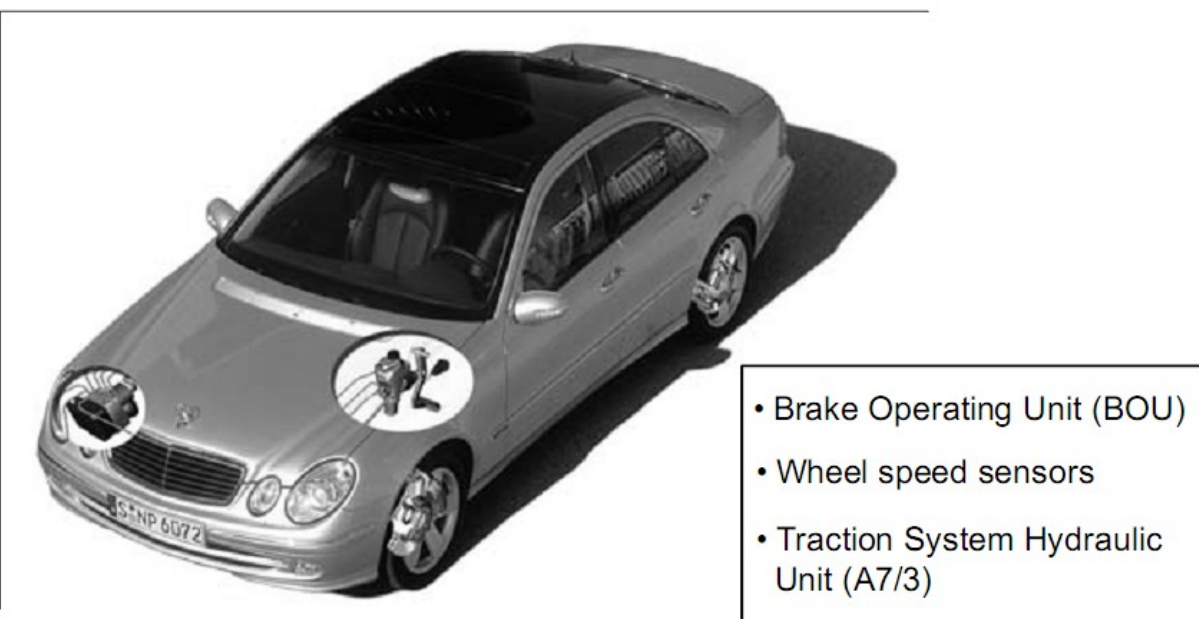
Warning Display

SBC control module failure

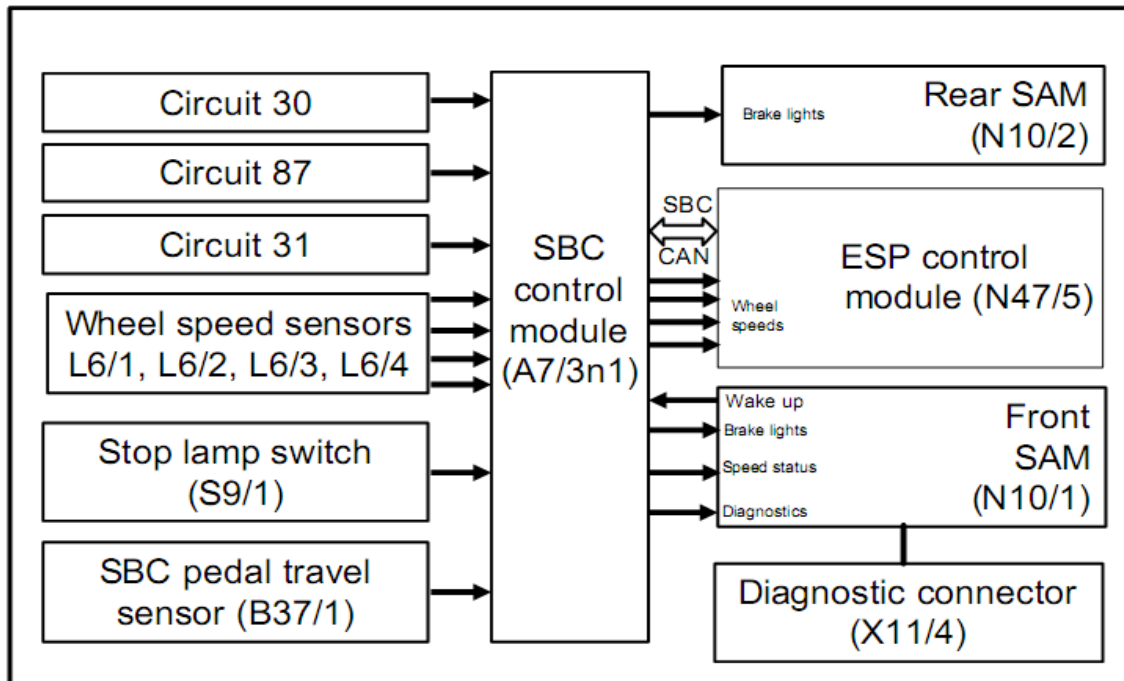


Certain faults will trigger audible signal

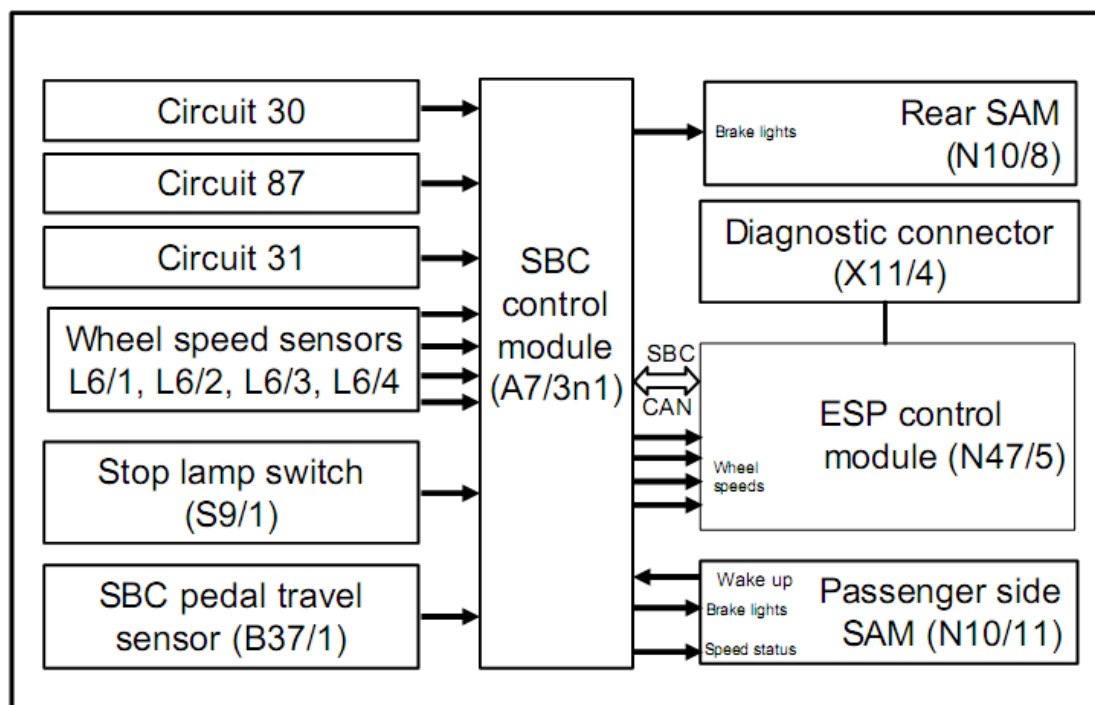
SBC Components



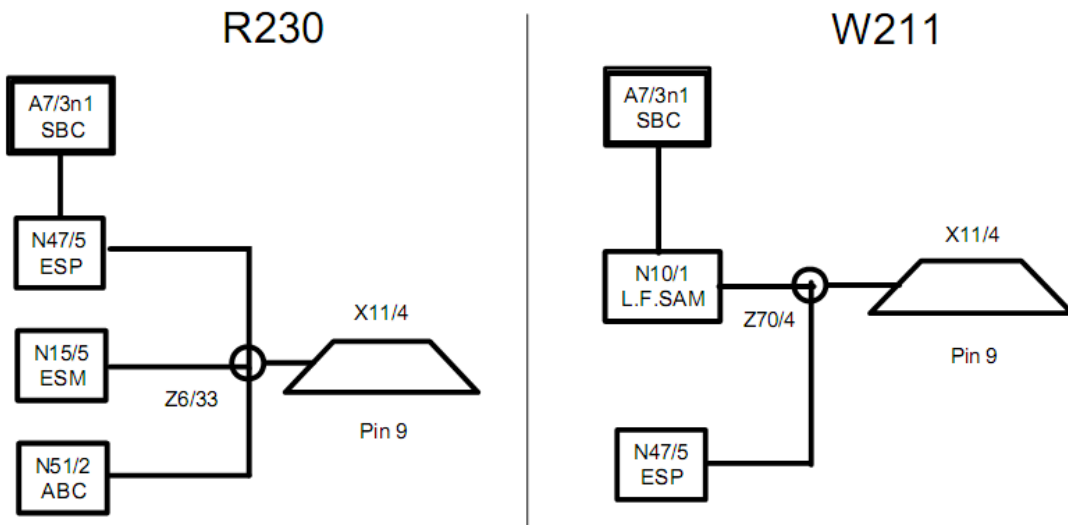
W211 System Overview



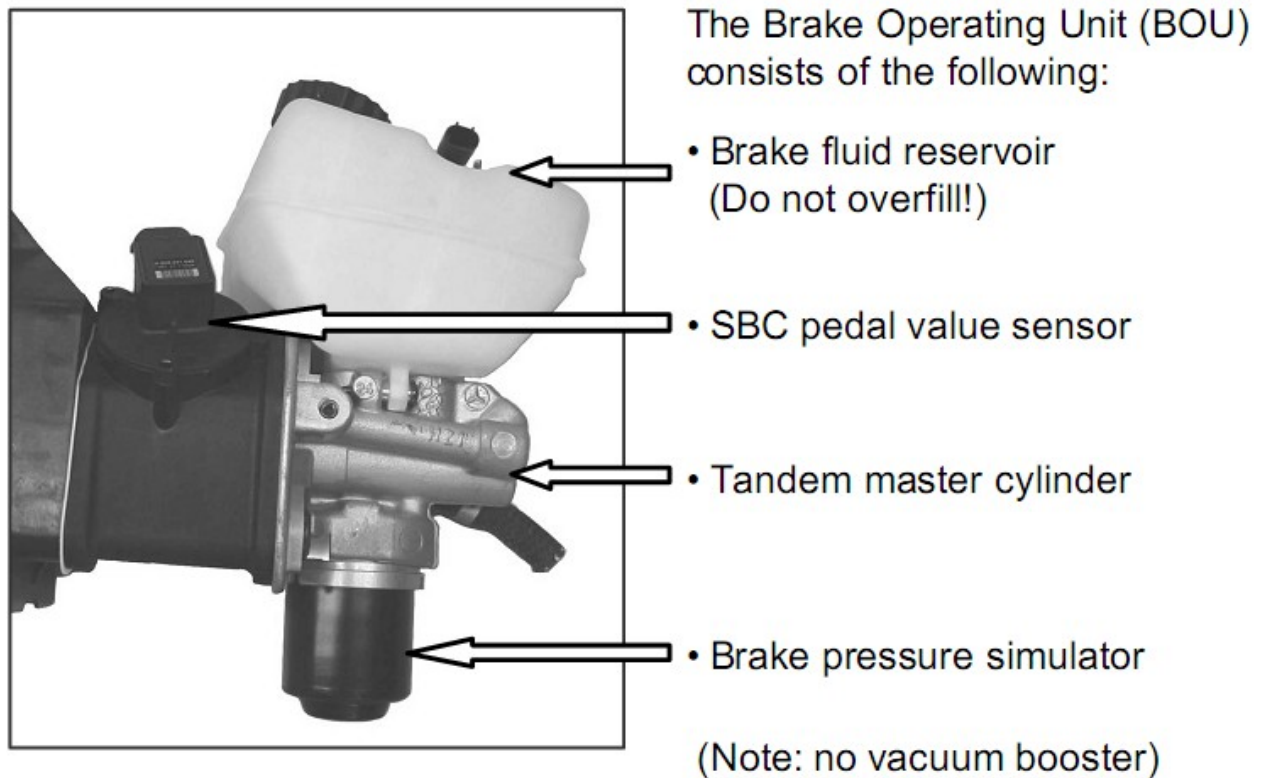
R230 System Overview



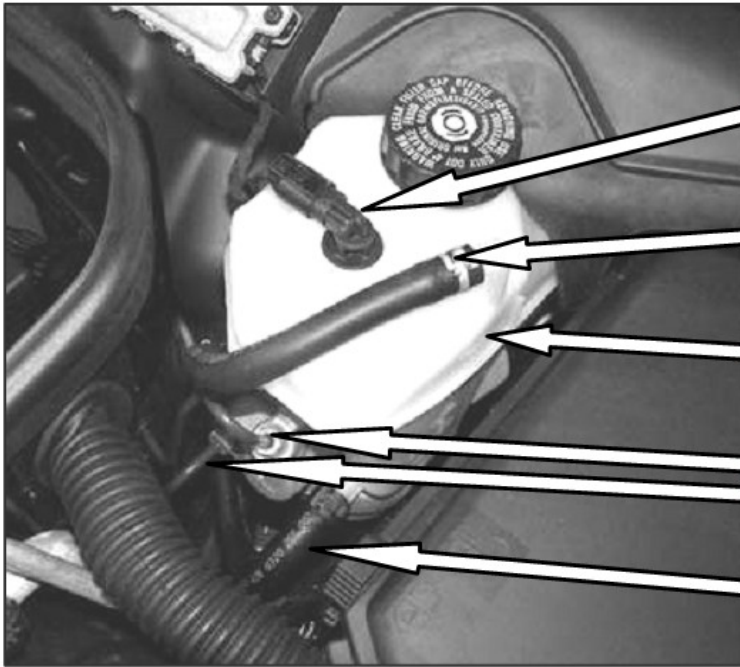
X11/4 Diagnosis Connection



Brake Operating Unit

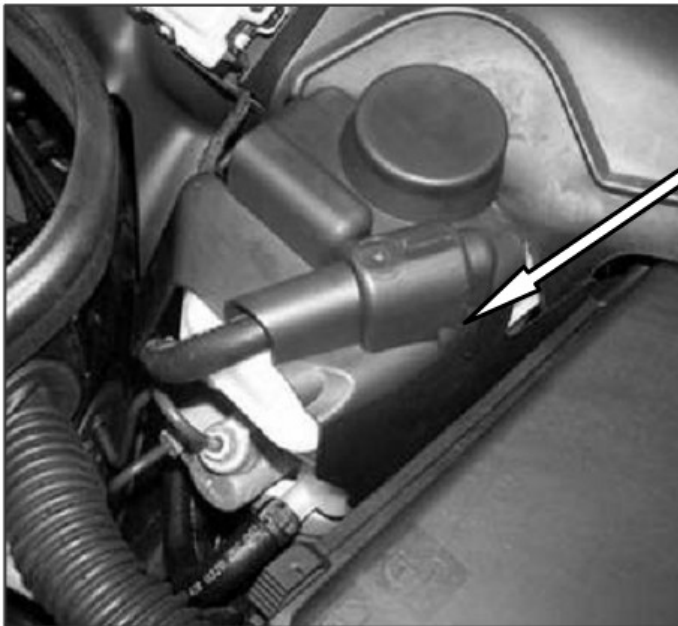


Master Cylinder



- Fluid level sensor
- Fluid return line
- Do not overfill
- Hydraulic lines to SBC
- Supply hose to SBC

Fluid Reservoir Cover



- Ultraviolet protection
(211 only)

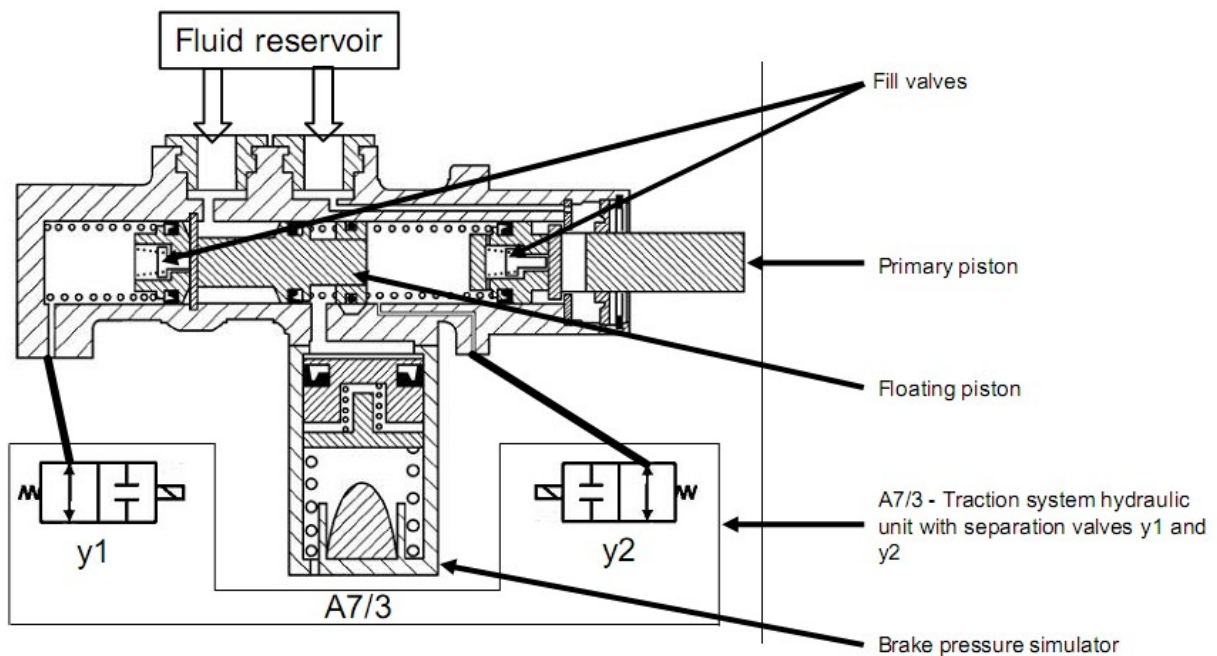
Pedal Value Sensor - (B37/1)



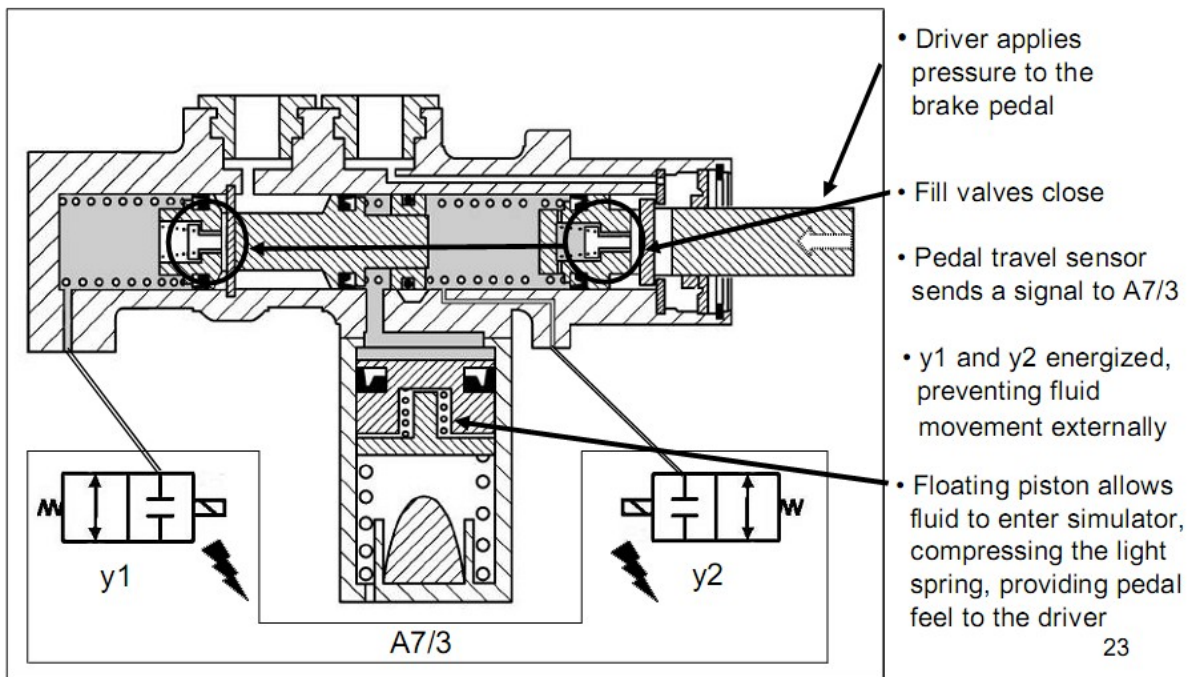
- Contains two hall effect sensors
- Converts pedal travel value to an electrical signal
- Provides input to SBC control module A7/3



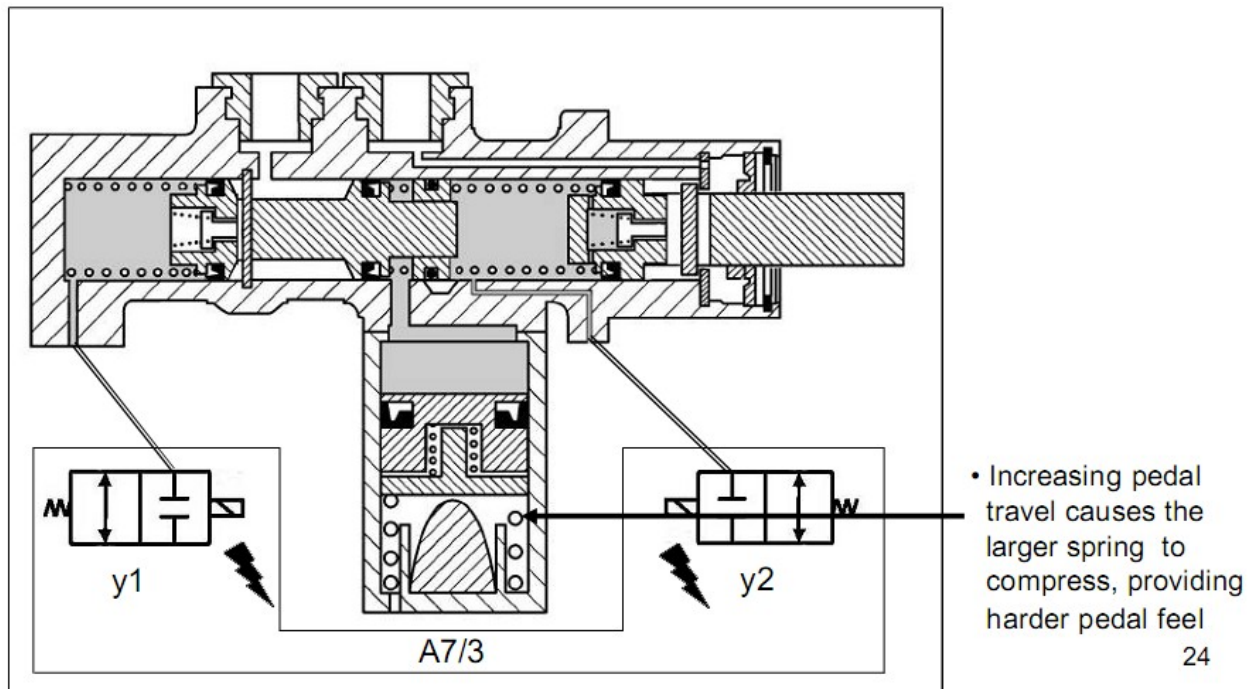
BOU Tandem Master Cylinder



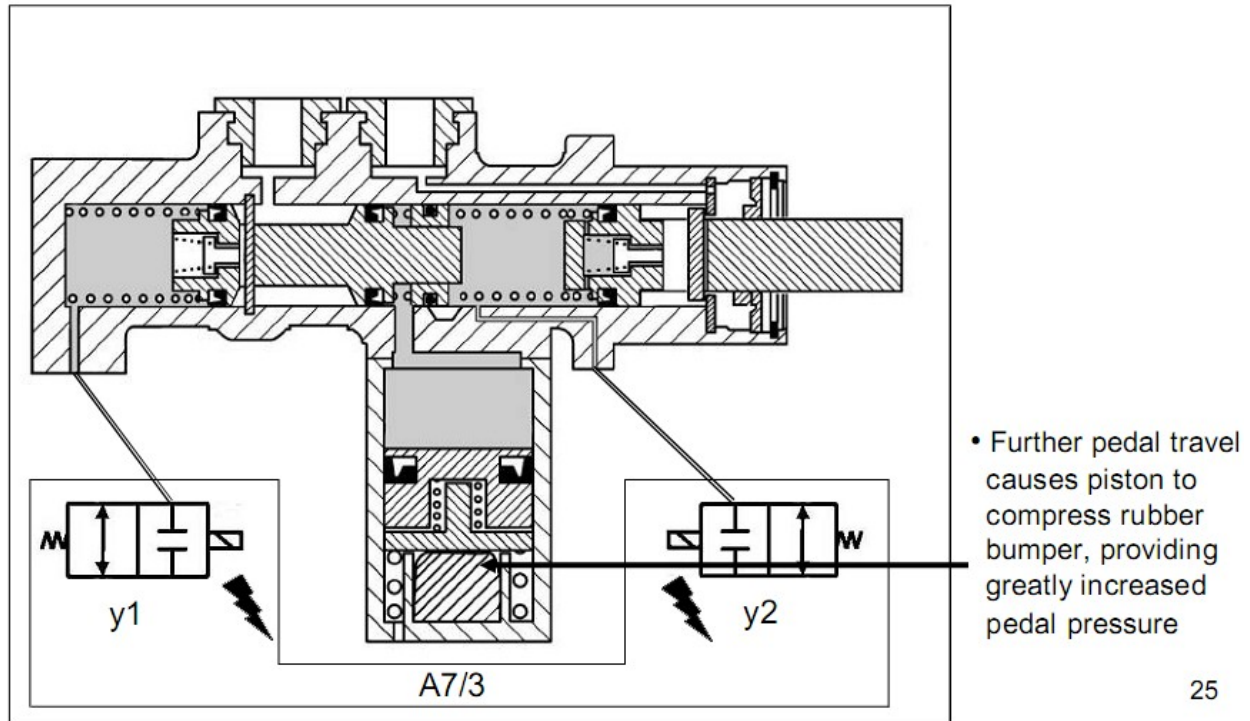
Normal Braking - Light Pressure



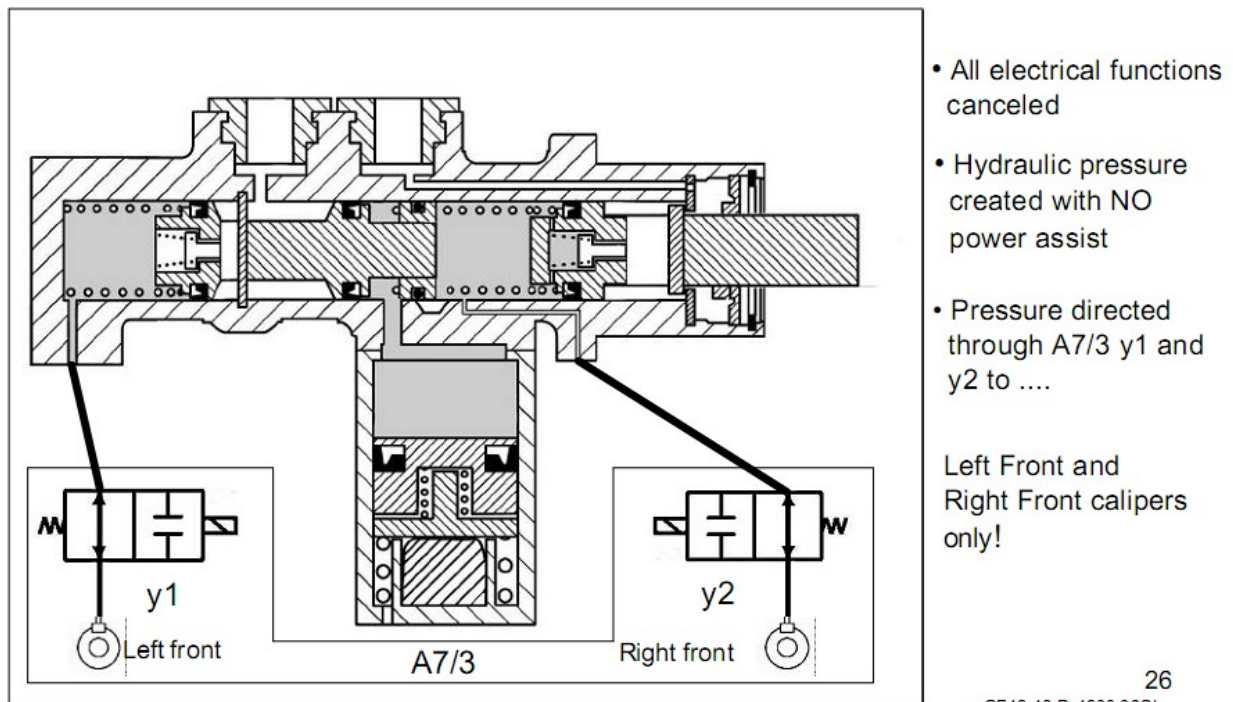
Normal Braking - Increased Pressure



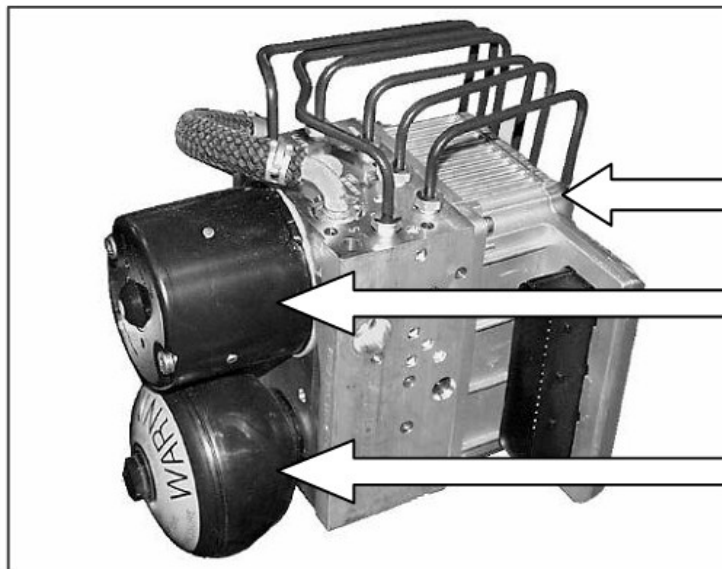
Normal Braking - Strongest Feedback



Emergency Operation



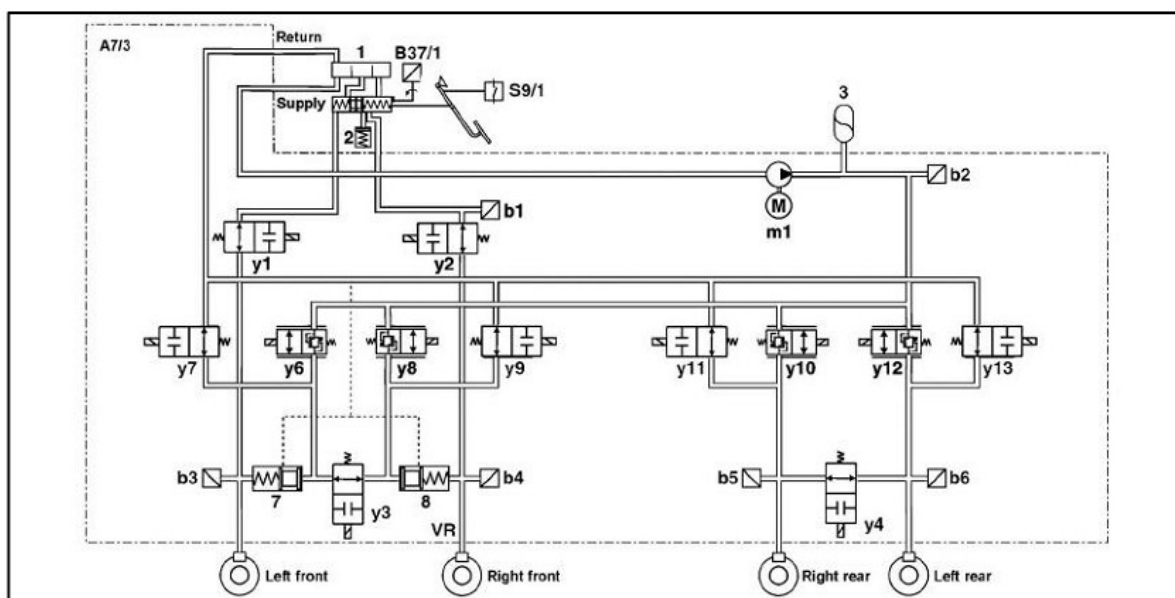
Traction System Hydraulic Unit (A7/3)



Consists of:

- SBC control module (A7/3n1)
- High pressure charge pump (A7/3m1)
- Pressure reservoir

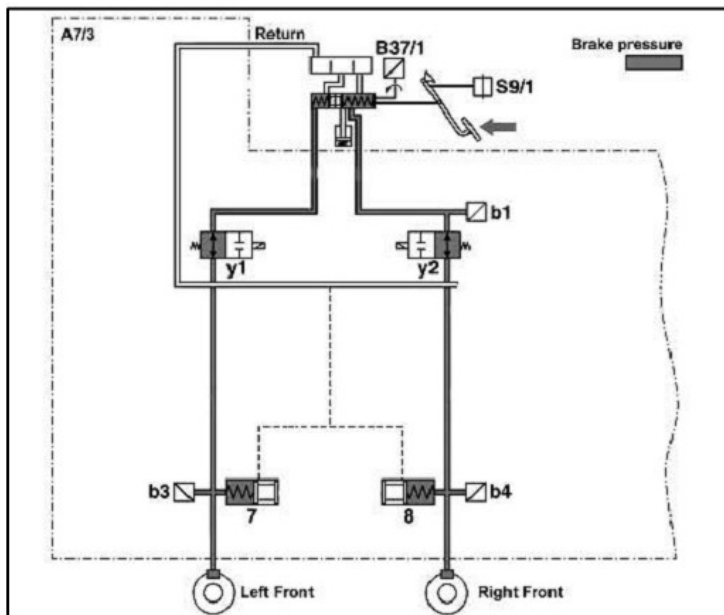
Traction System Hydraulic Unit A7/3



Legend

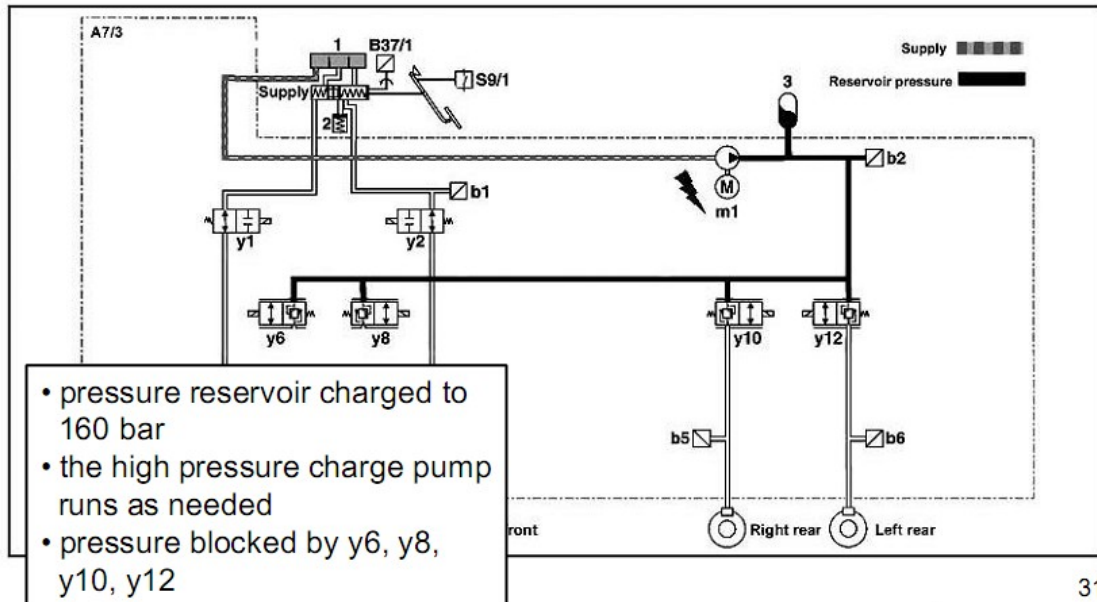
1	Brake Operating Unit	A7/3y1	Left front separation valve
2	Brake pressure simulator	A7/3y2	Right front separation valve
3	Pressure reservoir	A7/3y3	Front axle balance valve
7	Left front media separator (dividing piston)	A7/3y4	Rear axle balance valve
8	Right front media separators (dividing piston)	A7/3y6	Left front intake control valve
		A7/3y7	Left front outlet control valve
A7/3	Traction system hydraulic unit	A7/3y8	Right front intake control valve
A7/3b1	Front axle pre-pressure sensor	A7/3y9	Right front outlet control valve
A7/3b2	Reservoir pressure sensor	A7/3y10	Left rear intake control valve
A7/3b3	Left front pressure sensor	A7/3y11	Left rear outlet control valve
A7/3b4	Right front pressure sensor	A7/3y12	Right rear intake control valve
A7/3b5	Left rear pressure sensor	A7/3y13	Right rear outlet control valve
A7/3b6	Right rear pressure sensor	B37/1	SBC pedal value sensor
A7/3m1	High-pressure charge pump	S9/1	Stop lamp switch (4-pin)

Emergency Operation Circuit



- Pressure applied directly to front calipers
- y1 and y2 not energized
- b1, b3, and b4 pressure sensors may provide information to SBC control module
- Media separator/Dividing piston 7 and 8 isolate emergency circuit from normal circuit

Brake Pressure Supply

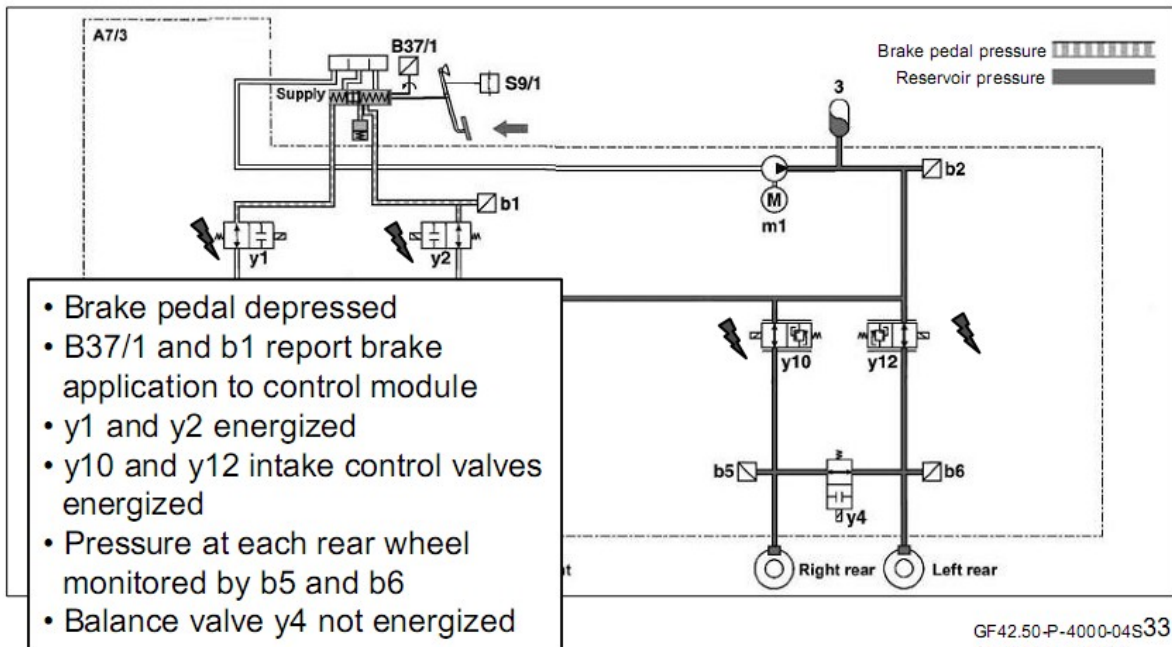


Three Pressure Stages

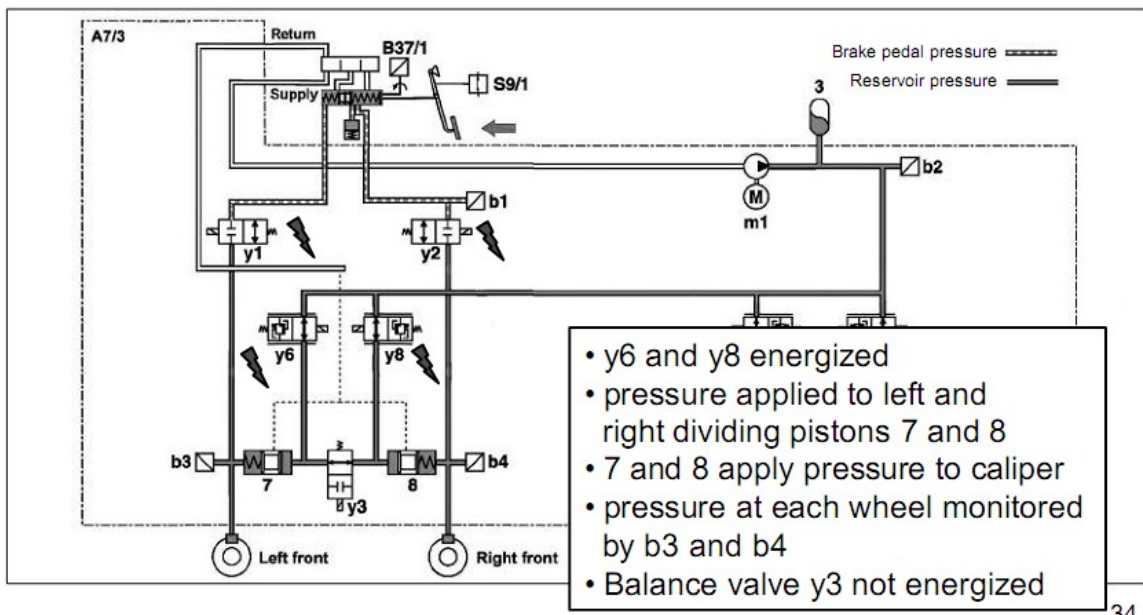
Same pressure stages as used with ABS functions:

- Pressure apply
- Pressure hold
- Pressure release

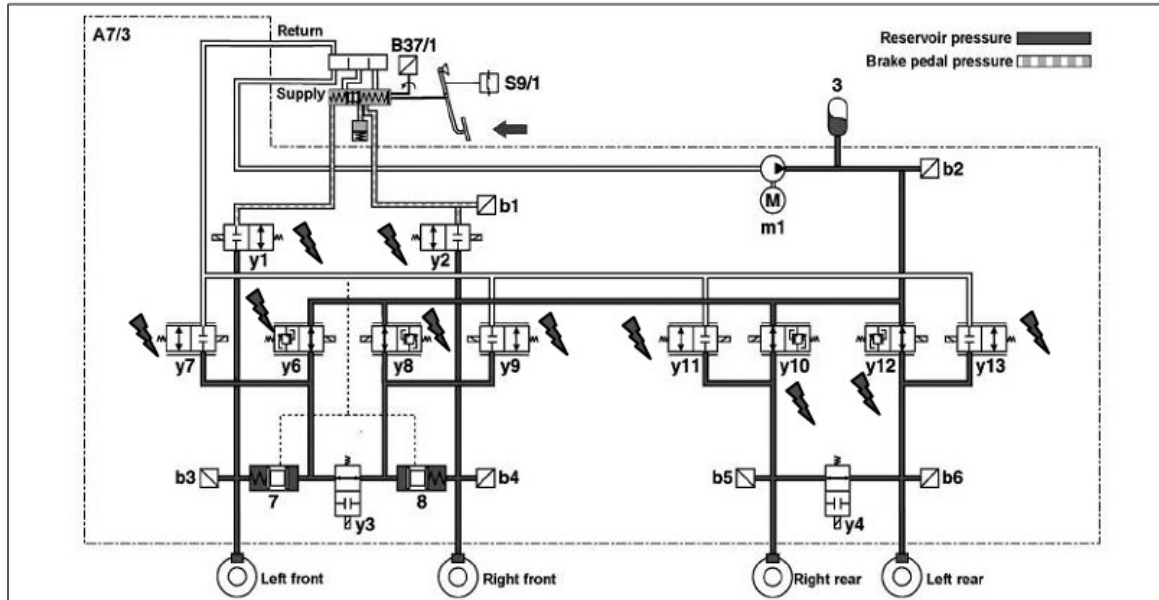
Pressure Apply - Rear Wheels



Pressure Apply - Front Wheels



Pressure Apply - All Wheels

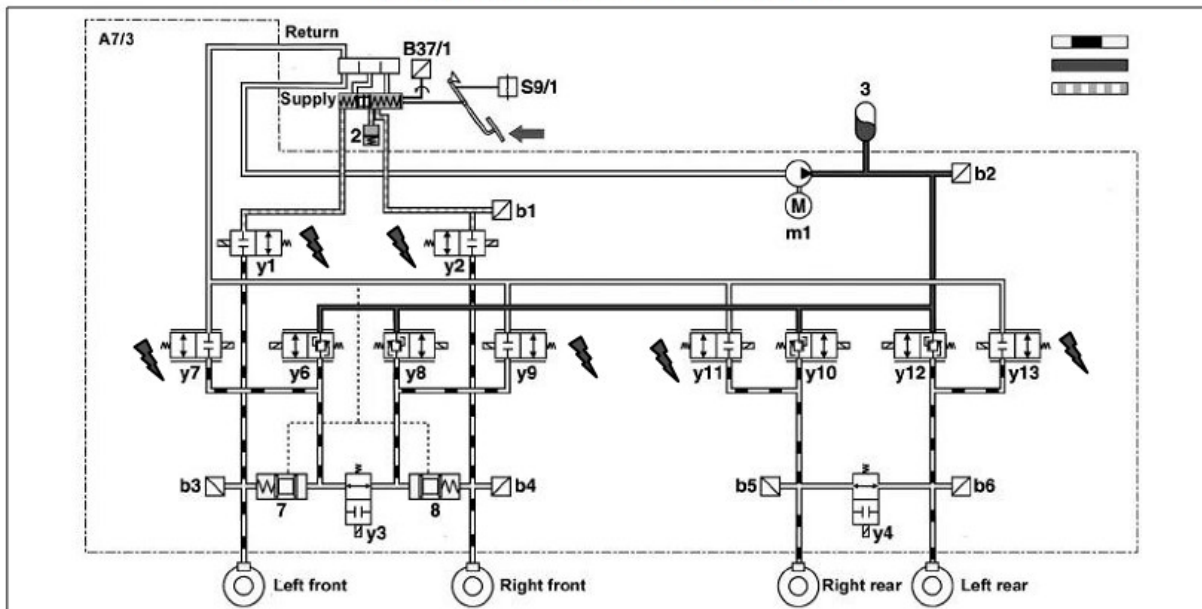


- Outlet control valves y7, y9, y11, y13 energized

35

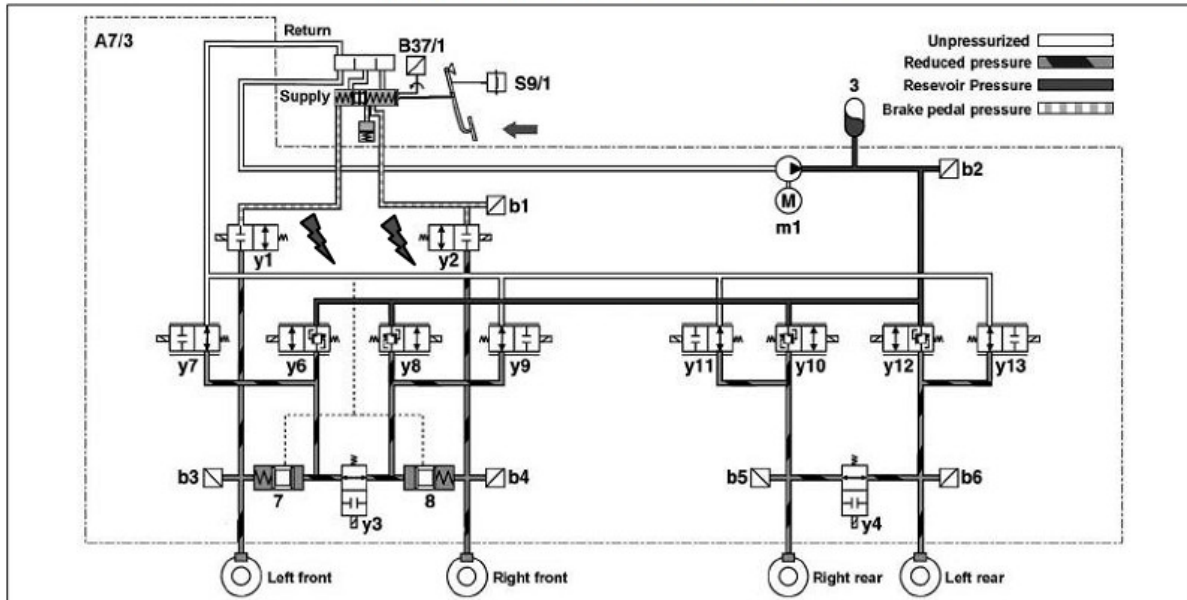
Pressure Hold - All Wheels

- y6, y8, y10, y12 de-energized



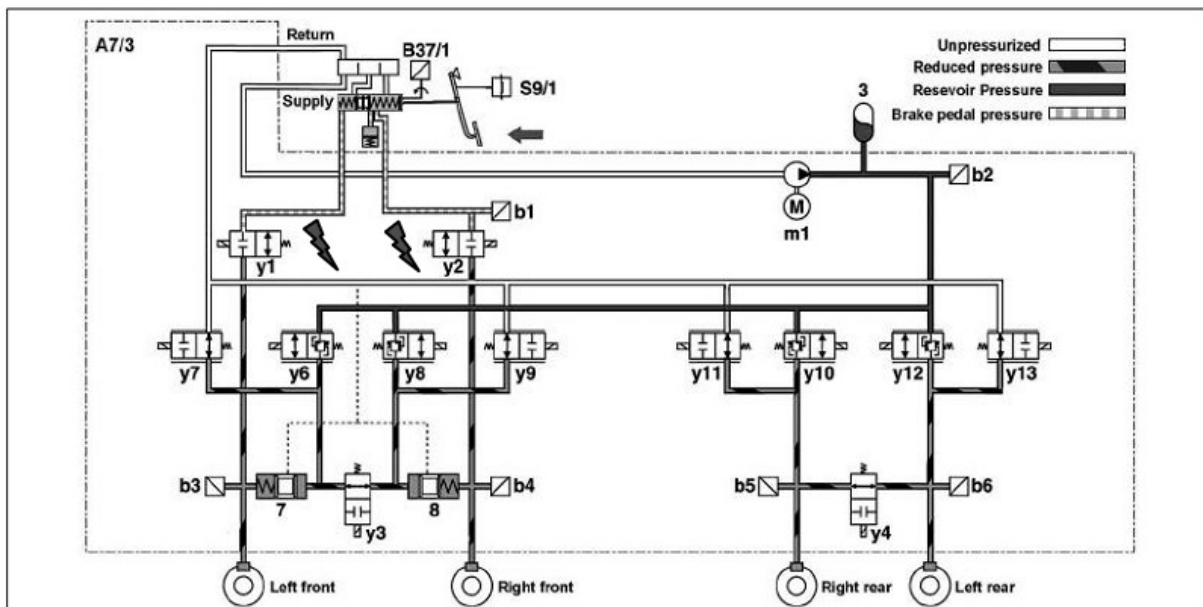
Pressure Reduction - All Wheels

- y7, y9, y11, y13 de-energized

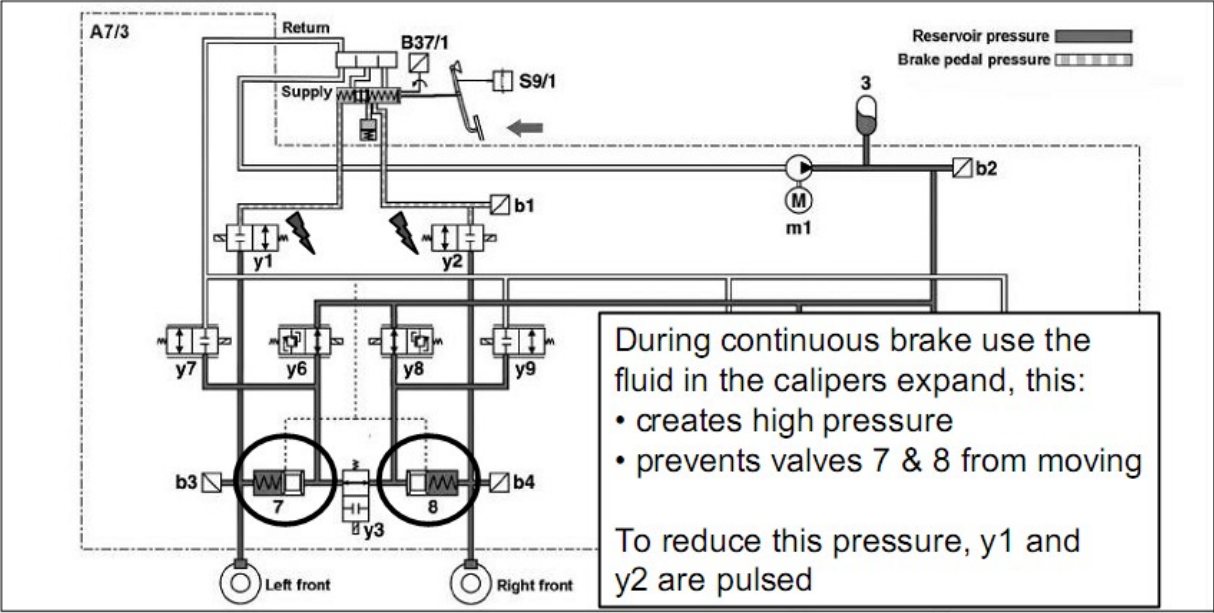


Pressure Reduction - All Wheels

- y7, y9, y11, y13 de-energized



Temperature Compensation



Deactivation

SBC must be deactivated with SDS before any work is performed on the system. This will prevent the pre-drive check from being automatically performed which could cause injury.

Deactivating the system will:

- empty the pressure reservoir
(a lower pressure with no volume may be retained)
- prevent the charge pump from operating
- Note: the warning buzzer is deactivated when accessing SBC with the SDS.

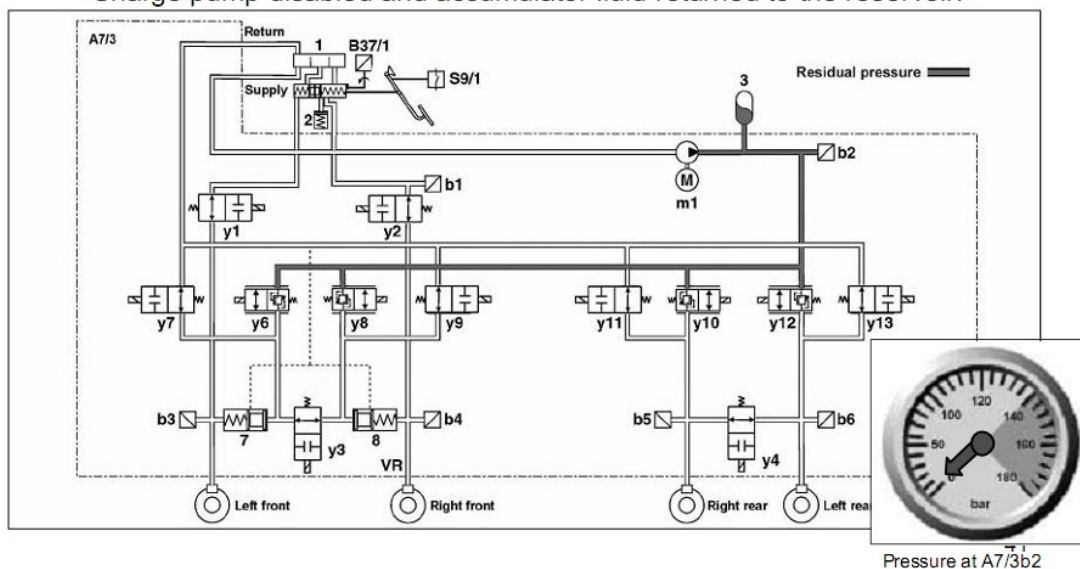
Deactivation

SBC must be deactivated *PRIOR* to:

- working on the hydraulic system
- removing or installing brake pads
- replacing rotors
- replacing the pressure reservoir
- replacing the BOU
- replacing the SBC hydraulic unit (A7/3)

Deactivation

Charge pump disabled and accumulator fluid returned to the reservoir!



System Activation

Activation must be performed anytime the system has been deactivated, *BEFORE* the engine is started!

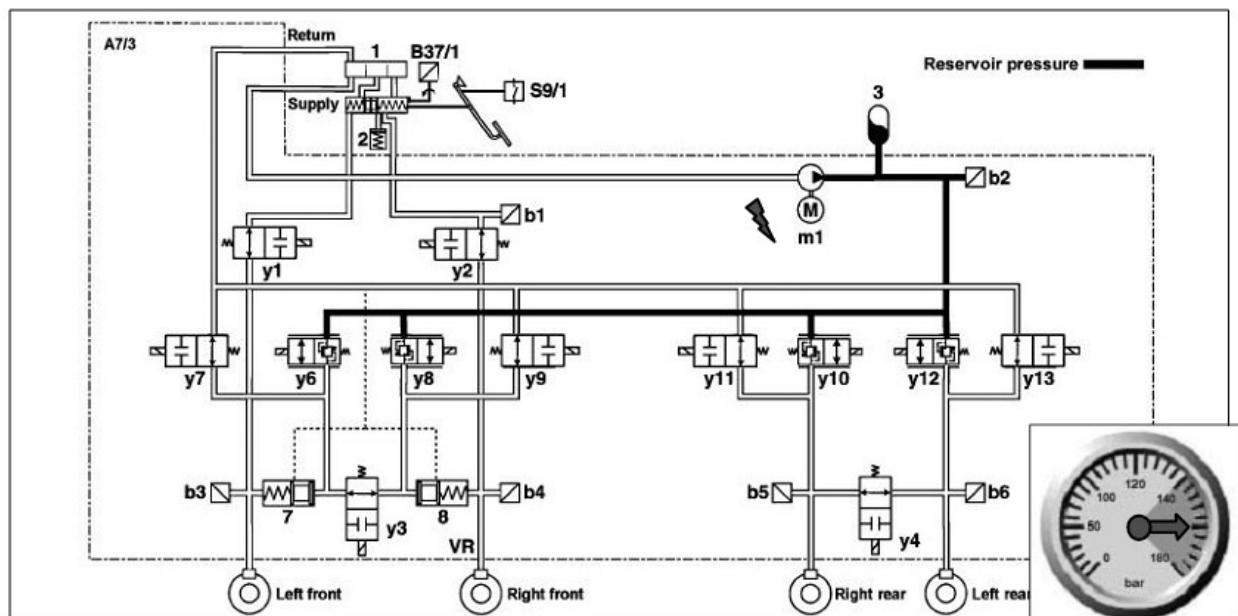
Failure to activate will prevent proper operation and create fault codes!

Activating SBC with SDS will:

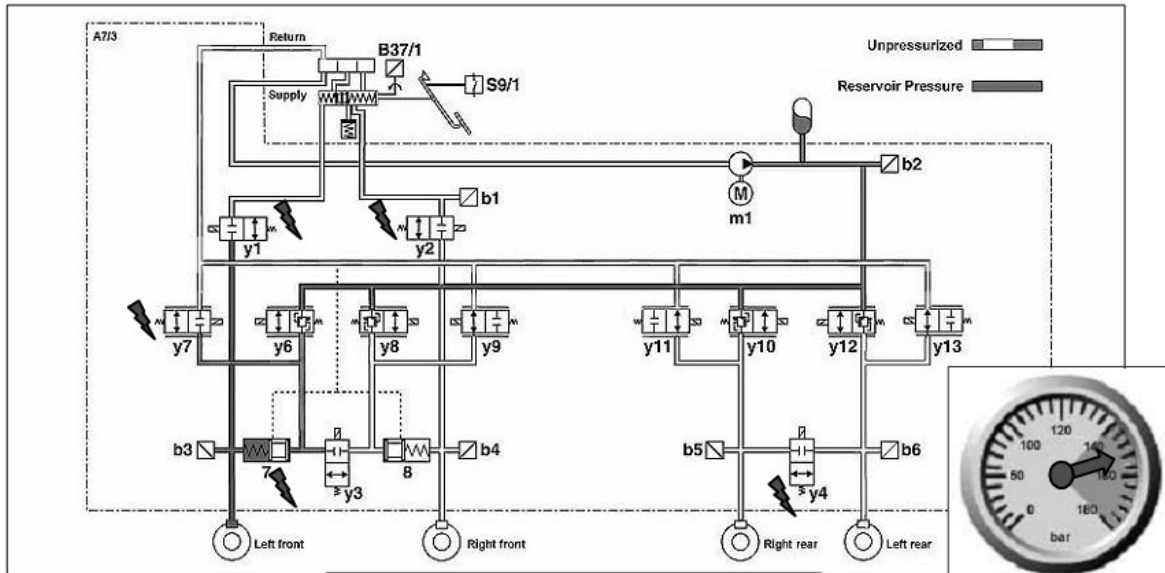
- charge the accumulator
- perform a Predrive Check
- move the pads towards the rotors with ~60 bar pressure
- erase the fault memory

(Note: may have to activate several times to position the brake pads)

System Activation



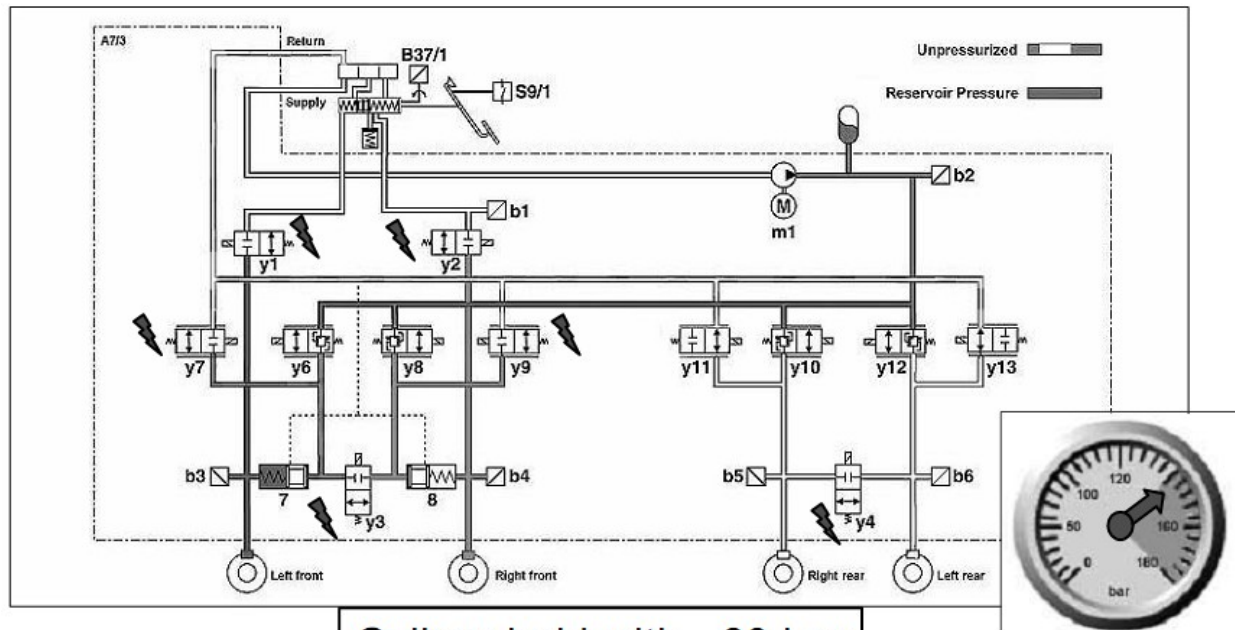
Activation - Left Front



Caliper held with ~60 bar

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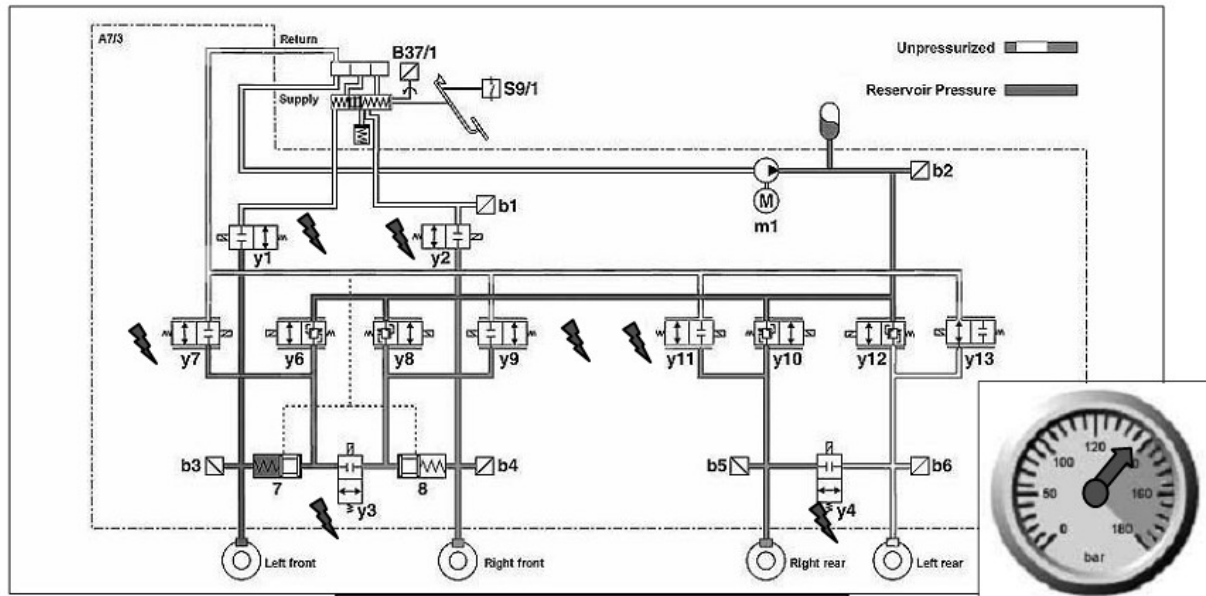
Activation - Right Front



Caliper held with ~60 bar

45

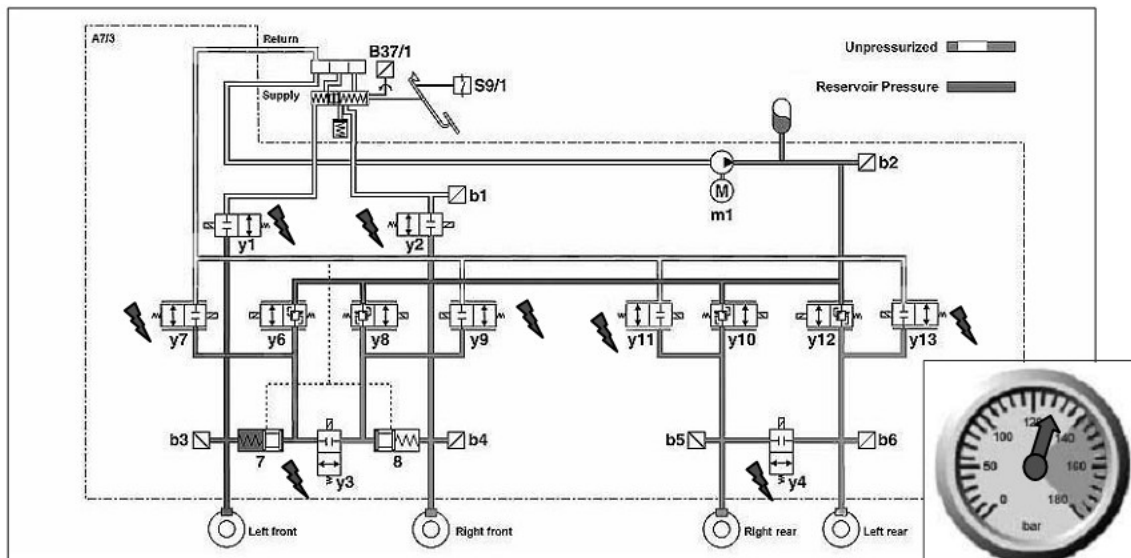
Activation - Right Rear



Caliper held with ~60 bar

46

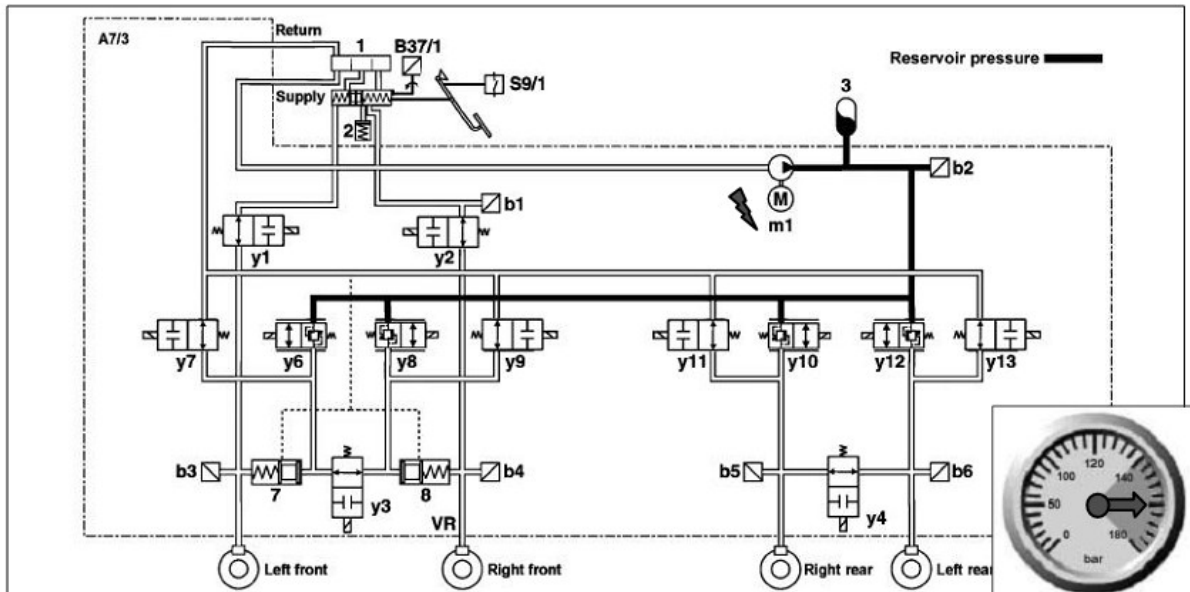
Activation - Left Rear



Caliper held with ~60 bar

47

Activation - Recharge

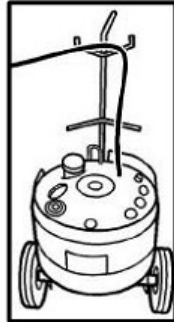
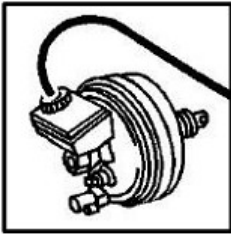


Bleeding the Brake System

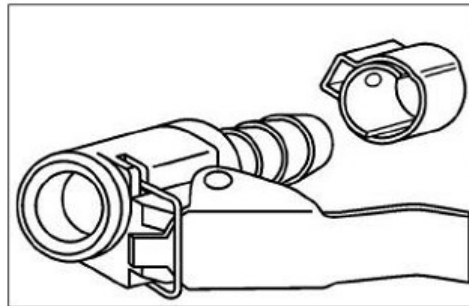
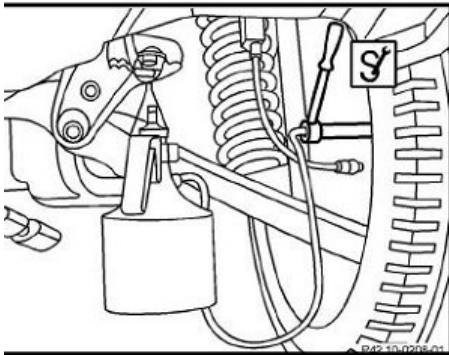
Proper system bleeding is critical!
Follow directions in SDS

- Bleeding must be performed using the SDS
- Pressure at bleeder valves will exceed 100 bar (Hold the bleeder hose securely)
- Bleeding may require ~1.5 hours
- Bleeding may use ~ 1.5 liters of brake fluid

Equipment Required



- Pressure bleeder
- Adapters
- Fluid receptacle
- SDS - follow instructions carefully

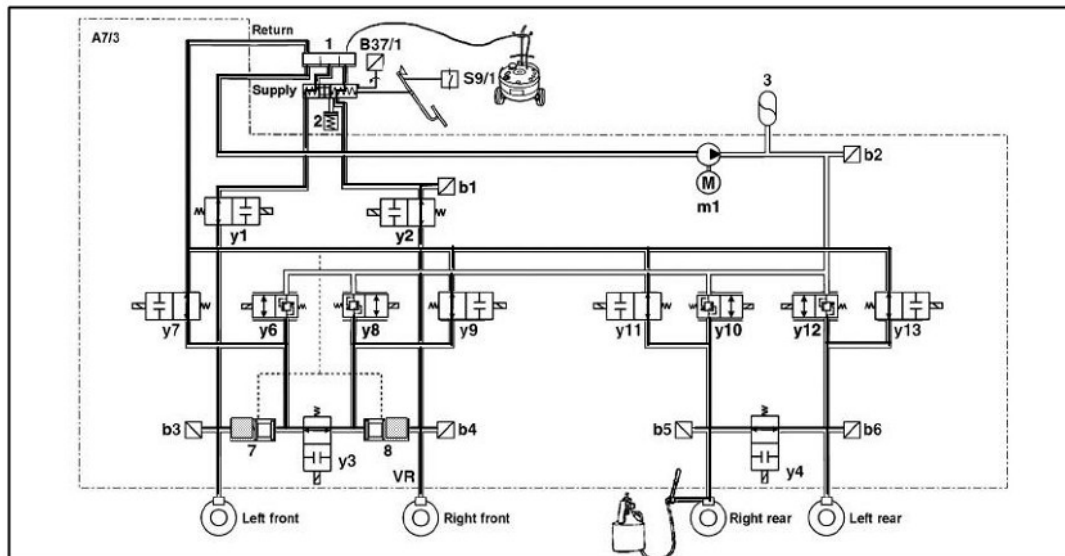


211 589 01 91 00

CAUTION:
Extremely high pressure at bleeder!

Bleeding the Brake System

Connect equipment and follow steps in SDS



Acronym List

(Used in This Handout.)

ABS - Anti-lock Brake System
ASR - Anti Slip Regulation
BAS - Brake Assist System
BOU - Brake Operating Unit
CAN - Controller Area Network
EBP - Electronic Brake Proportioning
EBR - Electronic Brake Regulation
E-Gas - Electronic Accelerator
ESP - Electronic Stability Program
ETS - Electronic Traction System
PDC - Predrive Check
SAM - Signal Acquisition Module
SBC - Sensotronic Brake Control