Sensotronic Brake Control (SBC)

R230 and W211: Starting MY2003
Objectives

At the end of this presentation, you should be able to:

1. Explain the function of and purpose for SBC
2. Describe the customer interface with SBC
3. List the hydraulic and electronic components used for SBC
4. Describe how the “normal” feel of the brake pedal is maintained
5. Explain emergency operation of the SBC braking system
6. Describe “temperature compensation”
7. Explain “Deactivation” and describe when it is necessary to do it
8. “Activate” the SBC system
9. Locate tools and the proper procedure for bleeding brakes
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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)
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

- Brake Operating Unit (BOU)
- Wheel speed sensors
- Traction System Hydraulic Unit (A7/3)
W211 System Overview

- Circuit 30
- Circuit 87
- Circuit 31
- Wheel speed sensors L6/1, L6/2, L6/3, L6/4
- Stop lamp switch (S9/1)
- SBC pedal travel sensor (B37/1)

SBC control module (A7/3n1)

- Brake lights
- Rear SAM (N10/2)

ESP control module (N47/5)

- Wheel speeds
- Front SAM (N10/1)

Diagnostic connector (X11/4)

- Wake up
- Brake lights
- Speed status
- Diagnostics
R230 System Overview

- Circuit 30
- Circuit 87
- Circuit 31
- Wheel speed sensors L6/1, L6/2, L6/3, L6/4
- Stop lamp switch (S9/1)
- SBC pedal travel sensor (B37/1)
- SBC control module (A7/3n1)
- Brake lights
- Rear SAM (N10/8)
- Diagnostic connector (X11/4)
- ESP control module (N47/5)
- Passenger side SAM (N10/11)
X11/4 Diagnosis Connection

R230

- A7/3n1 SBC
- N47/5 ESP
- N15/5 ESM
- N51/2 ABC
- X11/4
- Pin 9
- Z6/33

W211

- A7/3n1 SBC
- N10/1 L.F.SAM
- X11/4
- Pin 9
- Z70/4
- N47/5 ESP
Brake Operating Unit - (BOU)
Brake Operating Unit

The Brake Operating Unit (BOU) consists of the following:

- Brake fluid reservoir
  (Do not overfill!)

- SBC pedal value sensor

- Tandem master cylinder

- Brake pressure simulator

(Note: no vacuum booster)
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

Fluid reservoir

Fill valves

Primary piston

Floating piston

A7/3 - Traction system hydraulic unit with separation valves y1 and y2

Brake pressure simulator
Normal Braking - Light Pressure

- Driver applies pressure to the brake pedal
- Fill valves close
- Pedal travel sensor sends a signal to A7/3
- y1 and y2 energized, preventing fluid movement externally
- Floating piston allows fluid to enter simulator, compressing the light spring, providing pedal feel to the driver
Normal Braking - Increased Pressure

- Increasing pedal travel causes the larger spring to compress, providing harder pedal feel.
Normal Braking - Strongest Feedback

- Further pedal travel causes piston to compress rubber bumper, providing greatly increased pedal pressure.
Emergency Operation

- All electrical functions canceled
- Hydraulic pressure created with NO power assist
- Pressure directed through A7/3 y1 and y2 to ....

Left Front and Right Front calipers only!
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

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<td>Brake Operating Unit</td>
<td>A7/3y1</td>
<td>Left front separation valve</td>
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<td>2</td>
<td>Brake pressure simulator</td>
<td>A7/3y2</td>
<td>Right front separation valve</td>
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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

- pressure reservoir charged to 160 bar
- the high pressure charge pump runs as needed
- pressure blocked by y6, y8, y10, y12
Three Pressure Stages

Same pressure stages as used with ABS functions:

- Pressure apply
- Pressure hold
- Pressure release
Pressure Apply - Rear Wheels

- Brake pedal depressed
- B37/1 and b1 report brake application to control module
- y1 and y2 energized
- y10 and y12 intake control valves energized
- Pressure at each rear wheel monitored by b5 and b6
- Balance valve y4 not energized
Pressure Apply - Front Wheels

- y6 and y8 energized
- pressure applied to left and right dividing pistons 7 and 8
- 7 and 8 apply pressure to caliper
- pressure at each wheel monitored by b3 and b4
- Balance valve y3 not energized
Pressure Apply - All Wheels

- Outlet control valves y7, y9, y11, y13 energized
Pressure Hold - All Wheels

- y6, y8, y10, y12 de-energized
Pressure Reduction - All Wheels

• y7, y9, y11, y13 de-energized
Temperature Compensation

During continuous brake use the fluid in the calipers expand, this:
- creates high pressure
- prevents valves 7 & 8 from moving

To reduce this pressure, y1 and y2 are pulsed
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!

Pressure at A7/3b2
System Activation

Activation must be performed anytime the system has been deactivated, \textit{BEFORE} the engine is started!

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

Activating SBC with SDS will:
\begin{itemize}
  \item charge the accumulator
  \item perform a Predrive Check
  \item move the pads towards the rotors with \~60 bar pressure
  \item erase the fault memory
\end{itemize}

(Note: may have to activate several times to position the brake pads)
System Activation
Activation - Left Front

Caliper held with ~60 bar
Activation - Right Front

Caliper held with ~60 bar
Activation - Right Rear

Caliper held with ~60 bar
Activation - Left Rear

Caliper held with ~60 bar
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

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
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