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Dynamic Stability Control 8+

Initial Print Date: 09/05 Revision Date:

Dynamic Stability Control 8+ (DSC8+)

Model: E60, E61, E63, E64

Production: from 9/2005

OBJECTIVES

After completion of this module you will be able to:

- Understand the improvements made to the DSC8+ system

Introduction

Successor of DSC8

The Bosch traction control and stability system DSC8+ will be phased-in on the E6x model series as from 09/2005. E6x all-wheel drive model series are equipped with DXC8+.

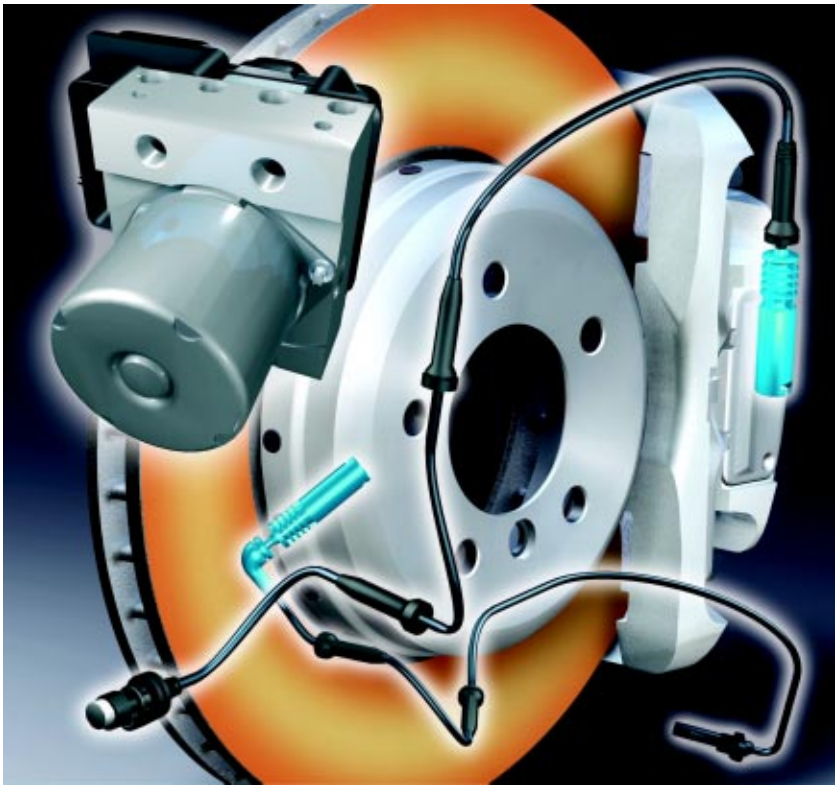
The main differences between the DSC8 and the DSC8+ are in the software of the DSC control unit and the further-optimized components within the DSC module.

Further comfort and safety functions have been achieved with the introduction of the DSC8+

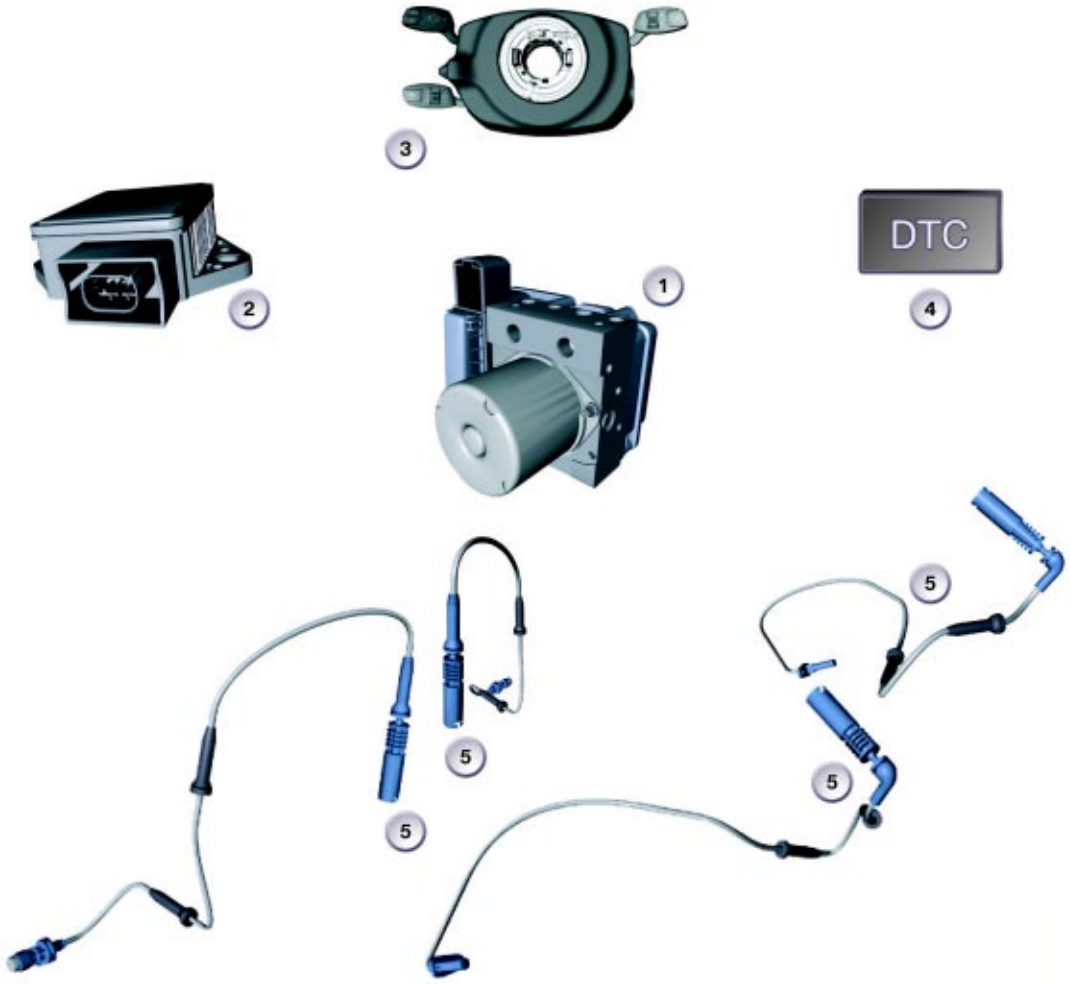
Overview of expanded functions:

- Dry Braking
- Brake Standby
- Automatic Soft-Stop Function
- Fading Assistance
- Start Assistant

For the first time, activation of the fading-brake support function is indicated by a yellow indicator in the instrument cluster.

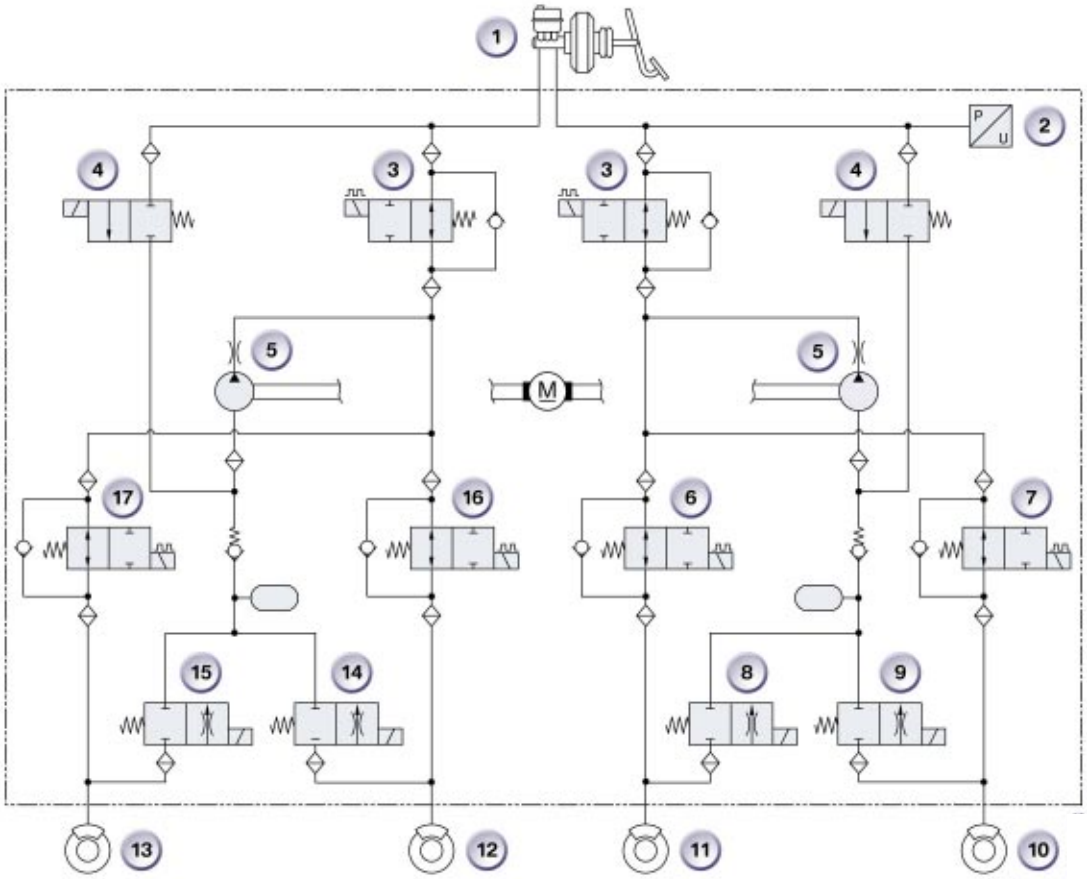


System Overview



Index	Explanation
1	DSC8+ Control Module
2	DSC Sensor Cluster (3.22 or 3.8)
3	Steering Column Switch Cluster
4	Wheel Speed Sensors
5	DTC Button

DSC8+ Hydraulic System Circuit Diagram



Index	Explanation	Index	Explanation
1	Tandem Brake Master Cylinder	10	Wheel Brake, front left
2	Pressure Sensor	11	Wheel Brake, front right
3	Changeover Valves	12	Wheel Brake, rear right
4	High Pressure Shift Valve	13	Wheel Brake, rear left
5	Return Pump	14	Outlet Valve, rear right
6	Inlet Valve, front right	15	Outlet Valve, rear left
7	Inlet Valve, front left	16	Inlet Valve, rear right
8	Outlet Valve, front right	17	Inlet Valve, rear left
9	Outlet Valve, front left		

System Components

Bosch DSC8+ Module

The DSC8+ module essentially consists of two components:

- Add-on control unit
- Valve block with integrated pressure sensor.

On exceeding a speed of approximately 4 mph (6 km/h), an electronic self-test is started, involving brief activation of the pump motor and all solenoid valves.

If the brake is operated at a driving speed of 4 mph (6 km/h) the self-test will be performed at approximately 9 mph (15 km/h).

The check of the wheel speed signals is already started at approximately 1.5 mph (2.75 km/h).

The analog-controlled valves provide even more exact control particularly in the low pressure range.

Advantages:

- Reduced control noise
- Improved control quality and control convenience
- Improved brake intervention through active/dynamic cruise control ACC/DCC.

Sensor System

DSC Sensor

The DSC sensor MM 3.8 registers following parameters:

- 1x Transverse acceleration
- 1x Yaw rate
- 1x Longitudinal acceleration (uphill gradient, downhill incline)

The DSC sensor MM 3.22 is used on vehicles with active steering.

This sensor redundantly measures the most important variables for the active steering.

- 2x Transverse acceleration
- 2x Yaw rate
- 1x Longitudinal acceleration (uphill gradient, downhill incline)

Initially, the plausibility of each measured value is checked in the sensor before this value is sent on the CAN.

Yaw Rate

The sensor element for the yaw rate consists of a surface mounted micro-mechanical measuring element and a digital sensor evaluation circuit. The sensor is based on the CVG principle (Coriolis Vibratory Gyroscope).

An electrostatic diaphragm drive generates the opposite phase oscillation of the seismic masses. One rotation about the x-axis of the vehicle, i.e. one rotation rate, generates a Coriolis force on the acceleration sensors that is measured capacitively. Synchronous demodulation of the Coriolis acceleration, utilizing the velocity of the seismic masses, generates a signal that is proportional to the rotation rate.

Acceleration/Gradient

The sensor element for acceleration also consists of a surface-mounted micromechanical element and a digital sensor evaluation circuit and is used for measuring the transverse and longitudinal acceleration of the vehicle. Likewise, its operating principle is based on capacitive measurement.

Wheel Speed Sensors

Active wheel speed sensors with an integrated evaluator circuit are used in connection with the DSC8+.

The active wheel speed sensors require a supply voltage for their operation and output a square-wave signal that is dependent on the wheel speed.

The output signal is transmitted as a data protocol using the pulse width modulation method (PWM). The PWM signal is used to determine the speed while the pulse width contains additional information on the direction of rotation, standstill detection, location detection and air gap (clearance) reserve to sensor ring.

Detection of the direction of rotation is made possible by the internal signal offset of 3 correspondingly arranged Hall elements in the sensor IC.

When the wheel is stationary, the wheel speed sensor outputs a pulse every 0.75 seconds. It is therefore possible to check the operational readiness of the sensor even when the vehicle is stationary.

Detection of the installation location indicates whether the change in the magnetic field strength is sufficient to ensure reliable operation.

Index	Explanation
1	Sensor Ring
2	Sensor IC with Hall Sensors
3	Sensor Housing

Wheel Speed Sensor

Functions

Operating Modes

The DSC 8+ offers the customer 3 different operating modes:

- DSC ON
- DSC OFF
- DTC

The various functions in the individual operating modes are illustrated in the following:

Function	DSC ON	DTC	DSC OFF
			
ABS	X	X	X
ASC Engine intervention	X	X[1]	
ASC Brake intervention	X	X	X
MSR	X		
EBV	X	X	X
DBC	X	X	X
CBC	X	X	X
Dry braking	X	X	X
Start assistant	X	X	X
Brake standby	X	X	X
Soft-stop	X	X	X
Fading assistance	X	X	X
Trailer stabilization logic	X	X	
Yaw moment control	X	X[2]	X[3]

1 = Thresholds increased
2 = Control thresholds increased
3 = Only active when brake light switch closed

Dry Braking

In wet conditions, a film of water is formed on the brake discs, resulting in delayed response of the brakes.

In connection with previous systems it was therefore recommended to operate the brake from time to time in wet conditions to wipe off the water film.

This dry braking function is dependent on the activity of the windscreen wiper.

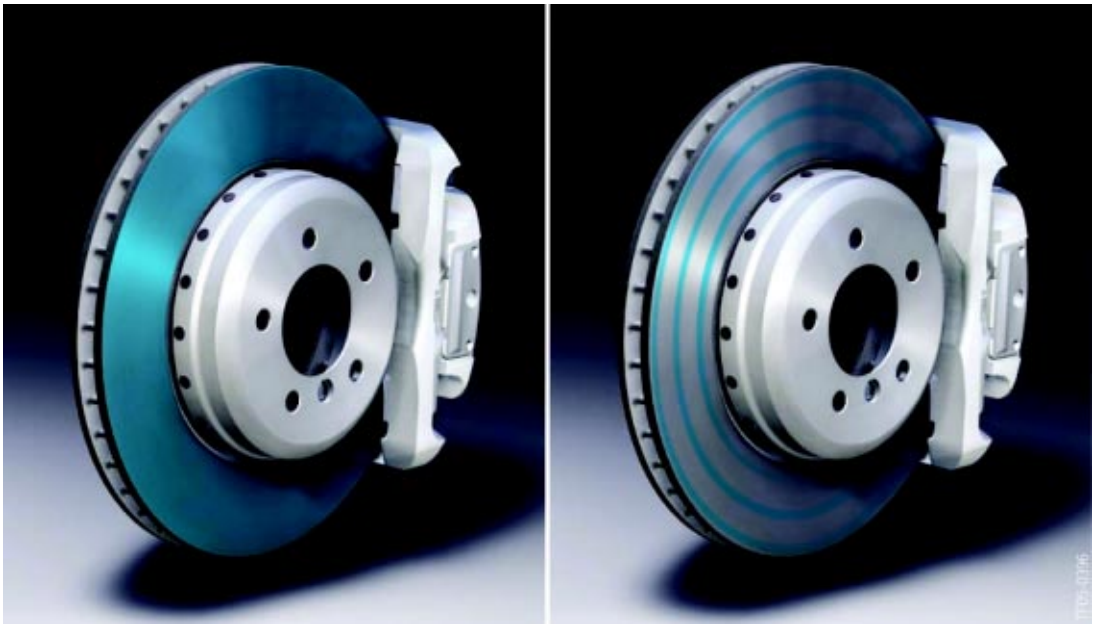
When the windscreen wiper is operating in continuous wipe mode, the wheel brakes are lightly applied against the brake disc cyclically every 90 seconds in order to wipe off the water film.

Dry braking takes place under following conditions:

- Speed > 70 km/h
- In continuous wipe mode

This applies only if the driver does not apply the brake himself during this period of time.

A delay of operating noises are not perceivable for the driver.



Left Brake Disc with Water Film before Dry Braking Right Brake Disc After Dry Braking

Brake Standby

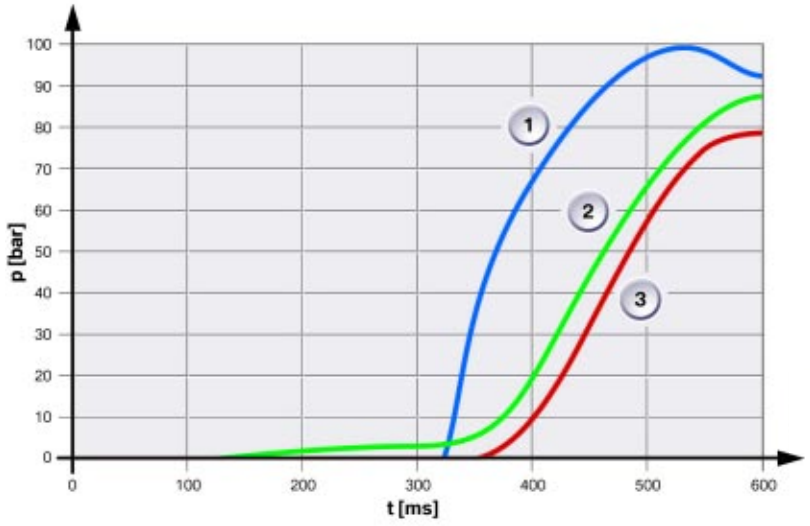
The brake pads are applied against the brake disc when the accelerator pedal is released quickly thus reducing the emergency braking stopping distance (by approx. 30 cm/100 km/h). The DSC module builds up a low braking pressure (approx. 2.5 bar) within a short space of time (approx. 0.5 s) in order to eliminate the clearance between the brake pad and brake disc by applying the brake pads.

The brake standby function is activated under following conditions:

- Speed > 70 km/h
- Minimum time between brake application 8 s
- The brake standby function is not activated in response to performance-oriented driving.

The signal indicating quick release of the accelerator pedal is made available by the DME/DDE control unit via the PT-CAN.

The sensitive driver may perceive a slightly harder brake pedal. A delay of operating noises are not perceivable for the driver.



Brake Pressure Curves

Index	Explanation
p	Brake Pressure in bar
t	Time in milliseconds
1	Brake Pressure at Tandem Master Brake Cylinder
2	Brake Pressure Curve with Brake Standby at Wheel
3	Brake Pressure Curve without Brake Standby at Wheel

Soft Stop

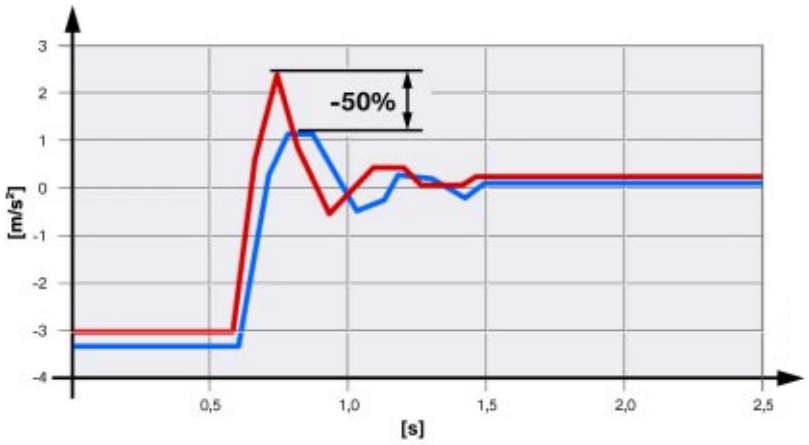
When braking to a standstill, a so-called stopping jerks occurs where the occupants perceive increased deceleration as a result of the transition from sliding friction to adhesion friction on the brake disc.

When braking lightly (< 25 bar) at constant pressure to standstill, the soft-stop function automatically reduces the braking pressure on the rear axle just before reaching standstill.

Consequently, the deceleration peak perceived by the occupants is reduced by approx. 50% and extended over time.

The function is inactive at medium to high deceleration or during ABS control in order not to extend the braking distance.

The speed and standstill status are detected via the wheel speed sensors.



Deceleration with and without Soft Stop

Index	Explanation
m/s2	Deceleration
s	Time in seconds
Red	Deceleration without soft stop
Blue	Deceleration with soft stop
-50%	Reduction of occupant deceleration

Fading Compensation

High temperatures (> 550 °C) can occur at the brake discs when driving downhill for longer periods of time or as the result of multiple braking operations (> 80 bar). These high temperatures result in a change in the coefficient of friction of the brake pads, causing the braking effect to diminish (fading).

The brake disc temperature is calculated based on a temperature model contained in the DSC8+ software. The braking pressure applied by the driver is measured by the pressure sensor and compared with the current vehicle deceleration (setpoint/target value).

If the braking effect diminishes, the driver is assisted by the fading compensation with additional pressure build-up of the DSC module.

A warning lamp in the instrument cluster informs the driver of the overheated brake.

The DSC control unit enters information in the fault code memory in response to activation of the facing compensation function.

Function triggered at temperatures above 500 °C

- HFC (Hydraulic Fading Control) is active for longer than 500 ms and the brake disc temperature is above 500 °C.

Function triggered at temperatures above 700 °C (multiple braking)

- HFC is active and the brake disc temperature is above 700 °C. The warning light in the instrument cluster is activated if the fading compensation function is triggered at brake disc temperatures above 700 °C. A check control message is additionally output on vehicles equipped with a display.

Start Assistant

This function provides assistance when driving off on uphill gradients by temporarily maintaining brake pressure in the wheel brakes.

Based on the gradient, the DSC calculates the holding pressure required in the wheel brakes in order to hold the vehicle.

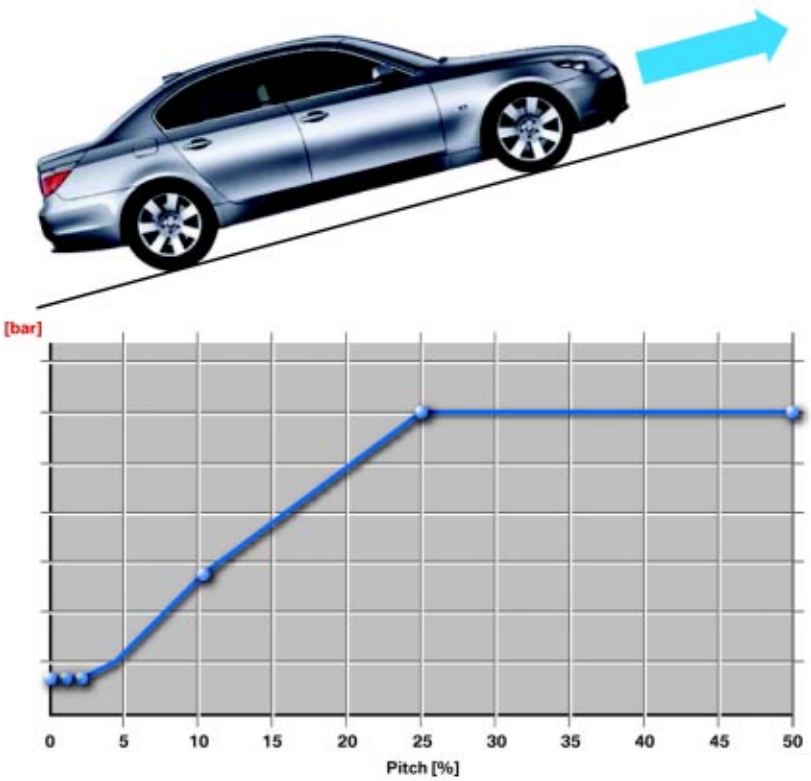
When the brake pedal is released, the pressure at the wheel brakes is immediately reduced to the holding pressure calculated by the DSC. After a further 0.7 seconds, the DSC reduces the pressure in the wheel brakes in stages to 0 bar and the vehicle starts off slowly providing the accelerator pedal is not pressed.

Reducing the pressure at the wheel brakes decreases the breakaway noise of the brakes.

This function is not active when the parking brake is applied.

The angle of inclination is measured by the longitudinal acceleration sensor in the DSC sensor and made available in the form of a telegram on the CAN.

This function is also effective on a downhill incline with reverse gear engaged.



Brake Pressure at the Wheels

Electric Steering Column Lock (ELV)

The ELV safety concept includes the monitoring of the vehicle status. The CAS will not permit the steering column to be locked if the speed signal from the DSC is not plausible or there is no signal. The CAS deactivates terminal 15 when none of the wheel speed sensors send a valid signal while the vehicle is stationary.

The DSC8+ informs the CAS of the vehicle status with regard to:

- Standstill
- Vehicle moving
- Validity of speed signal

The information is transmitted redundantly via the CAN and hard wiring between the control units. As from terminal position "R", the CAS supplies system voltage on the DFA CAS line to the DSC.

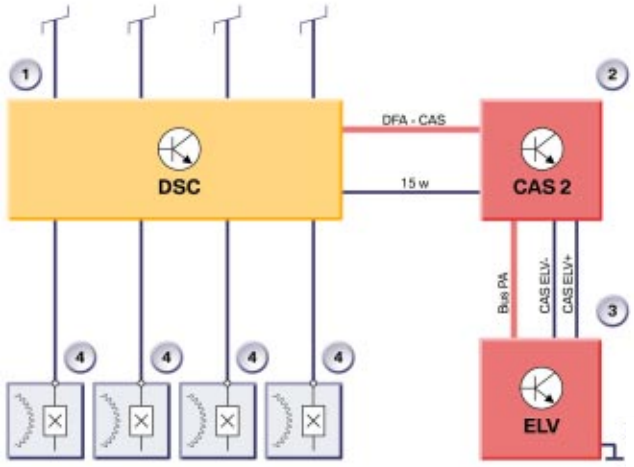
When the DSC is operational, the voltage applied by the CAS is connected to ground in various frequencies.

- 10 Hz vehicle stationary < 5 km/h
- 50 Hz driving speed > 5 km/h

This function is a part of the safety concept of the electric steering column lock.

The CAS does not permit locking of the ELV if it does not receive a valid speed signal.

The DSC must detect at least 3 wheel speed sensors as valid for the control unit to apply a frequency on the DFA CAS line.



System Schematic ELV

Index	Explanation	Index	Explanation
1	DSC8+ Dynamic stability control	3	ELV Electric steering lock
2	CAS2 Comfort access system	4	Wheel speed sensors

Service Information

Some jobs on the DSC sensor system require adjustments in the DSC module as well as the LWS and DSC sensors to ensure correct operation.

IMPORTANT!!!

All DSC systems without a pre-charge pump require the low-viscosity DOT4 brake fluid. Observe regulations governing fluids and lubricants.