DSC III

The ABS/ASC control unit takes into consideration the longitudinal slip in order to ensure stable driving characteristics when braking and accelerating.

The DSC system also takes into account the effects of transverse dynamics, i.e. vehicle instabilities which may occur while cornering, and initiates stabilizing actions.

DSC variants

DSC III is available as an optional extra on the E46 with 2.8 l engine.

System overview DSC III

The DSC III in the E46 consists of the following components:

- Hydraulic unit with control unit (combined as with ASC)

- 4 wheel speed sensors with corresponding pulse wheels

- Prebooster pump

- Tandem master brake cylinder

- Steering wheel angle sensor (LWS)

- Yaw rate sensor

- Transverse acceleration sensor

- 2 Brake pressure sensors

- Brake light switch (BLS)

- Brake fluid level switch

- DSC button

- Instrument cluster with ABS/DSC/ABL indicator lamps

- DME with ignition coil and injection valves

- Adaptive transmission control (AGS), optional

- CAN-bus

- Wiring harness

Technical features

In the same way as with the ASC Mk20 EI, the control unit and hydraulics of the DSC III are combined in one unit. Both components can be replaced individually in the case of repair.

Control unit

The electronic control unit corresponds to the AASC Mk20EI with regard to its basic design and functions.

In addition to the ABS/ASC control functions, it undertakes the corresponding DSC functions. In order to implement DSC control, the control unit additionally evaluates the following sensor signals:

- Yaw velocity through yaw rate sensor

- Transverse acceleration through transverse acceleration sensor

- Steering wheel angle through steering wheel angle sensor

The two brake pressure sensors and the brake fluid level switch supply further signals which are used during a control procedure.

The control unit communicates via the CAN bus with the DME with regard to engine intervention, the AGS, steering wheel angle sensor and the instrument cluster.

The DSC and ABL indicator lamps are also activated via the CAN bus.

DSC III hydraulic unit

Brake intervention can take place on the front or rear axle during a DSC control phase. For this reason, two additional solenoid valves have been integrated in the hydraulic unit:

The hydraulic units consists of an aluminium block which accepts 12 solenoid valves and the ABS return pump.

- 4 inlet solenoid valves

- 4 outlet solenoid valves

- 2 block valves with integrated pressure relief valve

- 2 changeover solenoid valves

The inlet solenoid valves and block solenoid valves are open when no power is applied.

The outlet solenoid valves and changeover solenoid valves are closed when no power is applied.

This logic ensures that the brakes remain fully operable even in the event of a control unit defect.

The changeover and block solenoid valves located in the front axle brake circuit enable brake intervention on the front axle during DSC control.

During ABS-controlled braking, the pump feeds the brake fluid back into the master brake cylinder while during ASC/DSC control with brake intervention it builds up the necessary brake pressure and conveys the fluid volume back into the master bake cylinder.

Brake light switch (BLS)

The brake light switch (active) is necessary in order to detect operation of the brakes during ASC control and to consequently terminate ASC control. During DSC control, together with the pressure sensors it serves to detect superimposed braking initiated by the driver.

In ABS mode, the signal from the brake light switch is used as an input variable thus increasing control comfort.

Wheel speed sensors with pulse wheel

The system operates with 4 active wheel speed sensors.

Speed signal outputs: The rear left and right speed signals are registered by the corresponding speed sensors, processed in the control unit and output again as a square-wave signal.

The rear left speed signal is used as the driving speed signal in the instrument cluster.

The rear right wheel speed signal serves as the input signal for other control units, e.g. AGS.

Brake fluid level switch

The brake fluid level switch monitors the brake fluid in the reservoir. If the level is OK. the switch is closed (ground).

If the brake fluid level drops below a certain value, the prebooster pump is switched off in DSC mode.

DSC button

The ASC/DSC functions can be deactivated or activated with the DSC button.

If the vehicle is turned off (engine off) with the DSC system deactivated, the DSC system is reactivated when terminal 15 is reactivated.

Steering wheel angle sensor (LWS 5)

The steering wheel angle sensor is fitted at the bottom end of the steering spindle.

The sensor features a 6-pin plug connector with following pin assignments:

- Pin 1: Terminal 30

- Pin 2: Ignition voltage with afterrunning (terminal 87)

- Pin 3: CAN-high

- Pin 4: CAN-low

- Pin 5: Ground

- Pin 6: Diagnostic link

Measuring principle: The sensor is designed as a potentiometer with two wipers offset by 90 degrees. The potentiometer signal is evaluated and converted into digital form (CAN).

The sensor signals provide a steering wheel angle variable which covers the entire range of steering wheel rotation. The signal is repeated after every 360 degrees. Voltage jumps are then evaluated thus determining the steering wheel turns.

The total angle is therefore derived from the sensor signal, the stored steering wheel angle offset and the number of steering wheel turns.

The steering wheel angle sensor is allocated to a particular type of vehicle. This ensures that incorrect signals are not obtained from a sensor not belonging to the vehicle, e.g. after replacement.

For this reason, a steering wheel angle offset must always be carried out after replacing a sensor otherwise the ASC/DSC function will remain deactivated. In order to reduce the risk of undetected replacement, the steering wheel angle sensor requests the vehicle identification number from the instrument cluster via the CAN bus.

The information on the stored steering wheel turns is lost in the event of voltage dips at terminal 30, e.g. disconnection of vehicle battery or removal of the steering wheel angle sensor. To ensure that the customer is not forced to reinitialise the steering wheel angle sensor, the current steering wheel turn value is determined by way of static evaluation of the front wheel speed.

Steering wheel angle sensor (LWS) matching

At the end of the assembly line or in the workshop, zero offset is carried out by means of diagnosis (front wheels in straight ahead position) after replacing the sensor (or working on the steering column/steering).

During this offset procedure, the mid-position of the steering wheel is permanently stored in the EEPROM as the start value. The offset serves as the basis for trouble-free operation of the steering wheel angle sensor.

In addition to the offset, the DSC III logic continuously determines the steering zero position while driving.

The LWS information serves the purpose of determining the cornering speed and the steering characteristics of the driver. The steering wheel angle sensor also supplies signals to other systems via the CAN bus.

Transverse acceleration sensor

The transverse acceleration sensor is installed in the left-hand A-pillar. The 3-pin plug connection to the DSC wiring harness has following pin assignments:

- Pin 1: Sensor signal

- Pin 2: Ground

- Pin 3: Sensor supply voltage (5 Volt)

Measuring range and offset values: Analog voltage from 0.5 to 4.5 Volt. The offset value is 1.8 Volt (vehicle stationary).

Measuring principle: This sensor is designed as a capacitive sensor.

Function in DSC III system: The measured transverse acceleration is used as a variable for determining the set yaw rate. This yaw rate corresponds to cornering which is still stable under the given driving conditions on reaching the cornering limit speed.

Pressure sensors

The two pressure sensors are located in the master brake cylinder. The 3-pin plug connector has the following terminals: Ground, signal voltage, supply voltage (5 Volt).

Measuring range and offset: The sensors supply an analog voltage which corresponds to a measuring range from 0 to 250 bar. The zero point offset takes place via diagnosis. In addition, the zero point is continuously corrected by DSC.

Measuring principle: Capacitive sensors

Function in DSC III system:

The information is used to detect and implement braking requirements when the brake is applied during a control procedure.

Rotation rate sensor

The rotation rate signal (yaw velocity) corresponds to the rotational velocity about the perpendicular axis of the vehicle.

The rotation rate sensor is mounted under the driver's seat. The 3-pin plug connector has the following terminals: Ground, signal voltage, supply voltage 5 Volt.

Measuring principle: Quartz crystal tuning fork system

Function in DSC III system:

The measured rotational velocity (yaw rate) is compared with driver requirements (steering wheel angle, driving speed and transverse acceleration information). The DSC corrects the vehicle rotational velocity as required by specific brake intervention at the front or rear axle as well as by influencing the engine torque.

These interventions achieve stable vehicle handling within physical limits under all driving conditions (braking, propulsion, rolling).

Instrument cluster with ABS/DSC/ABL lamps

The following indicator lamps are provided for DSC in the instrument cluster for the purpose of monitoring the various DSC III functions:

- ABS lamp (ABS fault lamp)

- DSC lamp (DSC fault lamp)

- ABL lamp (general brake warning lamp)

Activation and function indication of the lamps are identical to the ASC. The difference is in the DSC lamp instead of the ASC lamp (same symbol). The DSC lamp undertakes the indicator function for DSC and ASC.

DME

The DME control unit implements the ASC and DSC requirements to reduce/increase the engine torque.

Adaptive transmission control (AGS)

During control, the AGS receives information from the DSC control unit in order to avoid constant upshifts and downshifts by selecting another shift characteristic.

CAN-bus

The DSC is connected via the CAN bus to DME, AGS, the instrument cluster and the steering wheel angle sensor (LWS). The DSC communicates with the other control units via this data bus.

Prebooster pump

Brake intervention is started with a brake inlet pressure during DSC control with brake intervention. The brake inlet pressure is built up with a prebooster pump. During controlled braking, the pump is activated by the DSC control unit.

The prebooster pump draws in brake fluid from the reservoir and feeds it into the push rod circuit of the master brake cylinder. As a result, a maximum pressure of 10 bar is built up in the master brake cylinder and up to the ABS return pump.

This pressure is the prebooster pressure necessary in order to build up the required brake pressure under all conditions.

DSC III control function

The DSC control unit carries out a self-test when terminal 15 is activated. The entire periphery is then checked. This test is concluded up to max. 30 km/h.

The ASC control function basically takes place in the standard manner. If brake intervention is implemented during DSC control, the procedure is basically similar to that of ASC. However, with the DSC system, brake intervention can take place both at the wheels of the rear or front axle. Only one wheel of the corresponding axle is always braked.

The engine torque can be varied with the following interventions:

- Reduction of air mass drawn in

- Ignition timing retarded

- Cylinder blank-out

Brake intervention by DSC III

Example of brake intervention with DSC system while cornering:

Driving in a right-hand bend: The vehicle turns into the bend when oversteered. A load moment is produced to oppose the yaw moment by specifically building up an adapted brake force at the left front wheel. As a result, the vehicle drives under stable conditions.

In order to build up optimum brake pressure at the wheel brake cylinder, the control takes place in the phases pressure build-up, pressure retension, pressure reduction.

Whether a wheel on the front or rear axle is to be braked depends on whether the vehicle is understeered or oversteered.

Excessive understeering is avoided by braking the rear wheel on the inside of the curve. In this example, this would be the right-hand rear wheel.

Depending on the vehicle status, the wheel of the other axle on the same side may also be braked slightly.

Description of DSC III control

The DSC III control unit monitors the vehicle stability on the basis of sensor signals. If the vehicle reaches its dynamic driving limits, the control unit decides whether ABS control, ASC control or DSC control with or without brake intervention at the front and/or rear axle is to take place.

Stabilizing intervention is implemented if the control unit determines vehicle instability from the variables steering wheel angle, wheel speed, transverse acceleration and yaw rate.

DSC control intervention may be in the form of:

- Engine intervention or

- Engine intervention with brake intervention or

- Brake intervention

During DSC control, intervention in the engine management only takes place if the vehicle is understeered. In this situation, the 4 inlet solenoid valves and 2 block solenoid valves are opened when no power is applied. The 4 outlet solenoid valves and 2 changeover solenoid valves are closed when no power is applied. Normal braking is therefore possible.

Pressure build-up by way of example of driving in a right-hand bend and front left wheel:

As already mentioned, during DSC control, the pressure is always built up with the assistance of the prebooster pump. The only exception is when braking is superimposed by the driver.

The following components are activated electrically during front left pressure build-up:

- Prebooster pump

- Front right inlet valve, rear right inlet valve (rear left inlet valve closed)

- Block solenoid valve of front axle brake circuit closed

- Changeover solenoid valve of front axle brake circuit open

- ABS return pump

In addition to the system components activated during pressure build-up, the front left inlet solenoid valve must be additionally closed during the pressure retension phase. The changeover valve is closed.

Pressure build-up:

The front left outlet solenoid valve is activated during this phase. The thus enclosed brake fluid can escape into the low pressure accumulator and is then conveyed by the return pump. During renewed pressure build-up this volume of brake fluid can therefore be fed into one of the wheel brake cylinders or otherwise into the master brake cylinder.