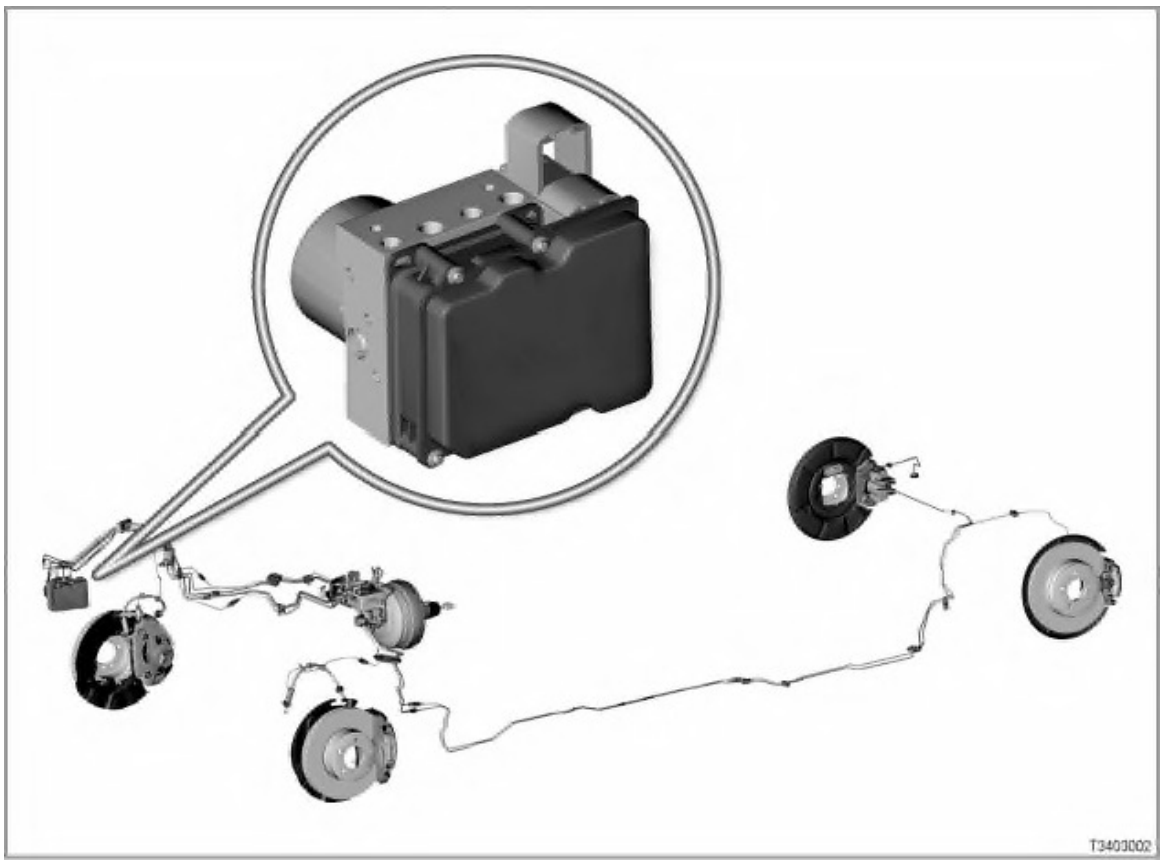
Dynamic Stability Control DSC 8

E60, E61, E63, E64



Introduction

The BMW 5 Series and the BMW 6 Series are equipped with Dynamic Stability Control DSC 8 as standard. DSC 8 is a further development of DSC 5.7 familiar from the E65.

The DSC unit (comprising a DSC control unit and hydraulic unit) performs even better. System supplier of DSC 8 is Bosch.
[System overview ...]

The principal new features of DSC 8 are:

- Very compact DSC unit, approximately 25 % smaller and some 30 % lighter
- No electric pre-pressurising pump
- DSC unit connected to the chassis CAN (F-CAN) in addition to connection to the powertrain CAN (PT-CAN)

DSC is a control system that maintains dynamic stability within the laws of physics when the car is being driven close to its limits of performance and handling.
It also improves traction.

The parameters DSC needs as input in order to discharge its control functions are as follows:

- Yaw rate (measure of movement of the car about its vertical axis)
- Lateral acceleration
- Wheel speeds (measure of the car's road speed)
- Steering angle
- Brake pressure

The measured values available are used to calculate how the car is moving at any given instant. This actual condition is compared to the nominal values calculated in the DSC control unit.

If the actual status deviates from the nominal values the DSC system goes active and intervenes in the braking system or the engine management system, as applicable.

The advantages:

The intervention of DSC in the engine control and brakes provides outstanding driving stability and traction in all driving situations. DSC combats negative, dynamic driving forces. This means DSC brings about maximum active safety within the physical limits. DSC thus enhances driving comfort by allowing more relaxed driving.

Brief description of components

Dynamic Stability Control (DSC) comprises the following components:

- **DSC unit**

  The DSC unit can be broken down into the components of DSC control unit and hydraulic unit.

  The DSC control unit regulates the pressure in the brake system via the hydraulic unit (comprises valve block and pump motor).
  [more ...]

- **4 wheel speed sensors**

  Each of the wheel speed sensors registers the speed of an individual wheel. In addition, the wheel speed sensors recognise the direction of rotation (forwards or backwards)
  . [more ...]

- **DSC sensor**

  The DSC sensor measures the rotation of the vehicle around the vertical axis (yaw rate) and the lateral acceleration of the vehicle. A car fitted with Active Steering has two DSC sensors (redundancy). The DSC sensors are connected to the DSC and AS control units via the chassis CAN.
  [more ...]

- **Steering-angle sensor**

  The steering-angle sensor detects the movements of the steering wheel. The steering-angle sensor is part of the steering column switch cluster (SZL).

  On vehicles with Active Steering, the cumulative steering angle is measured by the cumulative steering angle sensor (= steering angle at steering gear output).
  [more ...]

- **Internal brake pressure sensor**

  The DSC unit incorporates a brake-pressure sensor. This brake pressure sensor registers the braking pressure applied by the brake pedal and the brake booster.

- **2 additional brake pressure sensors (only in combination with Active Cruise Control, ACC)**

  Two more brake pressure sensors are integrated, one in the front brake circuit and one in the rear brake circuit. A car fitted with Active Cruise Control (ACC) is slowed by DSC when necessary. The braking pressure applied in this way at the front and rear wheels is often very low. It is controlled by means of the brake pressure sensors (objective: to equalise the brake load at the front and rear axles on long downhill stretches).

- **2 brake pad wear sensors**

  The brake pad wear sensors (front left and rear right) monitor the thickness of the brake pads. The Condition Based Service indicator (CBS) in the instrument cluster lights up if brake pad wear progresses to the point at which it becomes critical.

- **Brake light switch**

  The brake light switch tells DSC when the brake pedal has been pressed.

- **Brake fluid level switch**

  If the brake fluid level is too low, this will be detected and the DSC control unit will be informed.
  An insufficient brake fluid level will be indicated on the instrument cluster by the general brake system warning light (signal via CAN bus).

- **DSC button**

  The DSC button is in the centre console switch cluster (SZM) The DSC button has three switching states:

- DSC ready for use
- DTC ready for use
- DSC completely switched off

The DSC control unit also communicates with the following control units:

- **Digital motor electronics or digital diesel electronics**

  The DME / DDE controls engine adaptation (for example, reduction in engine output to prevent spin at the driven wheels). The DME / DDE also receives the converted wheel speed signal from the rear right wheel. This signal is used to check the plausibility of engine misfires (DME).

- **Car Access System or multi-audio system controller/Car Communication Computer**

  The CAS control unit and M-ASK/CCC receive the converted wheel speed signal from the rear left wheel.

  Both these control units use this signal to ascertain whether the car is moving or at a standstill.

- **Safety and gateway module**

  The SGM is the gateway between:

  - PT-CAN
  - K-CAN
  - byteflight
  - Diagnostic wire

- **Active Cruise Control**

  DSC receives requests from the Active Cruise Control (ACC) via the PT-CAN. In response, DSC reduces speed by applying the brakes at all four wheels.

- **Light module**

  As required by law, the brake lights are activated in the event of automatic braking when the Electronically Controlled Deceleration function (ECD) is triggered by the ACC. This function requires a signal sent via the K-CAN to the light module (LM).

- **Instrument cluster**

  The DSC control unit actuates the indicator and warning lights for DSC in the instrument cluster.

- **Electronic gearbox control (vehicles with automatic transmission)**

  The transmission control (EGS) receives the wheel-speed signals via the PT-CAN.

  The gearbox controller responds by adapting the gearshift characteristics for cornering and ascents. In addition, the gearshift characteristics are adapted to winter conditions (high wheel slip).

  Moreover, gearshifts are suppressed during DSC control.

- **Central Information Display and Controller**

  The detailed texts for the Check Control messages are shown in the Central Information Display (CID).

  CID and controller are also used to initialise the tyre defect indicator (RPA).

- **Telephone control unit with GPS antenna**

  If the car is **not fitted with a navigation system**, the telephone control unit receives the converted wheel speed signals from the front left and right wheels.

  The telephone control unit uses these signals to pinpoint the car's position as precisely as possible.

System functions

The dynamic stability control system (DSC) controls longitudinal and transverse dynamics by means of engine and brake system intervention.

Dynamic Stability Control (DSC) incorporates the following functions.

- Anti-lock brake system (ABS)
- Electronic brake force distribution (EBV)
- Cornering brake control (CBC)

- Automatic stability control (ASC)
- Dynamic traction control (DTC)
- Electronic brake force distribution (MSR)
- Dynamic brake control (DBC)
- Electronically controlled deceleration (ECD only in conjunction with ACC)
- Trailer stabilising control (only in conjunction with trailer module for E60 and E61)

Note: Yaw-rate control by the Active Steering (AS)

Active Steering also influences the vehicle's yaw characteristics. Consequently, the software in DSC is modified accordingly in cars fitted with Active Steering (for example, 2 DSC sensors).

Dynamic Stability Control

Dynamic Stability Control (DSC) detects the current status of the vehicle by evaluating the sensor signals. This status is compared with the nominal values derived from a computational model. In this way, the system recognises incipient instabilities.

The vehicle is stabilised as soon as a deviation exceeds the control threshold stored in the DSC control unit. Stabilisation (within the limits imposed by the laws of physics) is achieved by reducing engine power and by braking individual wheels.

DSC interventions override the ABS and ASC functions.

The DSC function can be deactivated by means of the DSC button.

Anti-lock braking system

The anti-lock braking system (ABS) stops the wheels locking during braking.

Advantage: Shorter stopping distances, the car retains its directional stability and remains steerable.

Brake pressure is regulated at all wheels to ensure that each wheel runs in the best possible slip range. When this happens, slip is controlled so that the maximum possible braking and lateral stability forces can be transmitted.

ABS alone is available for braking if a sensor for DSC fails or if a bus fault occurs (PT-CAN or chassis CAN). ABS is the surviving safety function in circumstances in which DSC control is no longer possible.

Electronic brake force distribution

Electronic brake force distribution (EBV) is a component of the ABS. EBV regulates the brake force distribution between the front and rear axles, depending on vehicle load.

Advantage: Regardless of the load state of the vehicle, the best possible braking distance is achieved while driving stability is maintained.

If ABS fails, the EBV function is sustained for as long as possible.

The signals from at least two wheel speed sensors are needed for the EBV function.

Cornering brake control

Cornering Brake Control (CBC) is an extension of ABS. CBC increases driving stability when the brakes are applied as the car corners ("cornering logic").

Advantage: Optimum driving stability if brakes are partially applied when cornering.

The shift in wheel loads as the car corners (the onset of this phenomenon requires no more than light application of the brakes) can result in a reduction in handling stability. If required, CBC generates a stabilising load moment when the brakes are applied lightly outside the ABS intervention range.

Automatic stability control

Automatic stability control (ASC) prevents the wheels spinning during acceleration by intervention in brake and engine operations.

Advantage: More traction and better driving stability.

If, for example, one of the wheels of the drive axle is on a high-grip surface and the other is on a slippery surface, the wheel tending to spin is braked. If necessary, the engine's power output is also reduced.

Dynamic traction control

Dynamic traction control (DTC) offers better traction as a trade-off against a reduction in stability in some circumstances. Consequently, its use should be reserved for exceptional conditions (driving in deep snow, for example).

The DTC function approximates to that of DSC with a slightly modified control strategy. DTC can be activated by deactivating DSC (DSC button). DTC intervenes in the braking actions to imitate the function of a conventional differential lock.

Advantage: Higher traction is available with DTC.

Vehicle stabilisation intervention (e.g. reduced power output) is made slightly later than with DSC.

This enhances traction with a slight loss of driving stability. Occasionally, a compromise is needed between driving stability and traction.

This is especially true when accelerating and driving uphill on loose surfaces or in deep snow (= friction values demanding increased slip).

DTC allows DSC to provide a high degree of driving stability while retaining sufficient traction.

Engine drag torque control

The engine drag torque control (MSR) counteracts the tendency of the wheels to lock on smooth surfaces. The engine's drag torque generated by downshifts or abrupt load changes can lock the driven wheels (especially on surfaces with a low coefficient of friction).

The wheel speed sensors tell MSR as soon as the wheels are about to lock. MSR then briefly reduces the engine's drag torque by opening the throttle slightly.

Advantage: The drive wheels retain their lateral stability in overrun mode.

Dynamic brake control

Dynamic brake control (DBC) assists the driver in emergency braking situations by automatically increasing the brake pressure.
Advantage: Shortest possible stopping distances in emergency-braking situations, because the ABS control threshold is reached at all four wheels.
In emergency-braking situations, drivers often fail to apply sufficient force to the brake pedal. ABS regulation is then not activated.

In the following situations, the return pump increases the brake pressure until ABS regulation is activated:

- When the brake pedal is rapidly depressed with insufficient pedal pressure
- When the brake pedal is depressed slowly and the demand for deceleration is subsequently high, after one wheel reaches the ABS control threshold.

  Which wheel locks first depends on load and coefficient of friction of the road surface.

  Example of a typical situation:

  The traffic slows, making light braking necessary at first, but then demands as short a stopping distance as possible.

Electronically controlled deceleration

The electronically controlled deceleration (ECD) reacts to a demand from the Active Cruise Control (ACC).

When ACC requires deceleration, DSC responds by applying the disc brakes on all four wheels (maximum rate of deceleration 2.5 m/s^2).

When the car is on a decent with the speed preset by the driver, ECD automatically applies the brakes in order to keep the car's speed constant at the preset value.

When the brakes are applied automatically in this way, the brake lights are activated in accordance with the requirements of road-safety legislation. The light module does not activate the brake lights unless the vehicle's rate of deceleration is greater than $1 m/s^2$. This prevents the brake lights from flickering on and off.

Trailer stabilising control (only in conjunction with trailer module for E60 and E61)

Trailer stabilising control detects when a trailer is rocking about its vertical axis. The system functions at a speed of about 65 km/h when the trailer socket is in use.

With the aid of the DSC sensors, Dynamic Stability Control (DSC) monitors the vehicle's yaw behaviour. If the trailer's rocking motion exceeds the limit, the engine output is reduced. In addition, DSC brakes all four wheels automatically.

If DSC is deactivated or faulty, then the trailer stabilising control does not work either.

Tyre defect indicator

The Run Flat Indicator (RPA) is not a function of the Dynamic Stability Control system.
RPA is integrated into the DSC control unit as the four wheel speed signals are required for this function.

By comparing the speed signals for all four wheels, the system detects differences in rolling circumference at the individual wheels. This enables the system to recognise a sudden loss of pressure in the tyres.

Operation

The DSC button is in the centre console switch cluster (SZM)

The DSC button has 2 functions that can be set by pressing the button for different lengths of time.

Press button	Function	Remarks
short < 3 seconds	DTC function activated.	DTC indicator light on. DSC indicator and warning light on.
long > 3 seconds	DSC is completely deactivated	DSC indicator and warning light on. This mode is intended for service work (e.g. brake dynamometer).

Note: Reactivating DSC

Briefly pressing the button again reactivates the DSC function. The DSC indicator and warning light goes out (unless the system has developed a fault).
If the DSC button remains pressed for longer than 10 seconds (e.g. by a handbag on the centre console), DSC will detect an operating error. The DSC function remains active and cannot be deactivated until the ignition has been switched off and on again.

Switch-on conditions

DSC is in ready mode after each engine start.

Notes for service staff

Service staff should note the following points:

- General information: [more ...]
- Diagnostics: ---
- Encoding/programming: [more ...]
- Car & Key Memory: ---

Subject to change.