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F01 Longitudinal Dynamics Systems

Initial Print Date: 01/09 Revision Date:

Subject **Page**

Longitudinal Dynamics Systems

Model: F01/F02

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Understand the systems related to Longitudinal Dynamics
- Locate and Identify components of the DSC and EMF systems
- Understand the new DSC functions on the F01/F02
- Understand the changes to the EMF system pertaining to the F01/F02

Introduction

Refinements in Detail

The longitudinal dynamics systems described in this document comprise the following:

- Dynamic stability control (DSC) and
- Electromechanical parking brake (EMF)

Both DSC and EMF are standard equipment on all F01/F02 models. Thus BMW has consistently continued the standards set by the E65/E66 and the E70/E71. Both systems are based on the technology used on the E70/ E71.

However, many specific details have had to be changed. Those changes were essential to ensure that DSC and EMF could be seamlessly integrated in the new dynamic handling system complex on the F01/F02.

As far as the Dynamic Stability Control was concerned, co-ordination with the central dynamic handling controller on the Integrated Chassis Management (ICM) master control unit had to be taken into consideration. And the new "dynamic handling control" function also affects the way the DSC operates. The thresholds and the nature of the DSC interventions have to be adapted to suit the setting selected.

Thus the DSC doesn't simply contain a setting that suits a luxury-class vehicle such as the F01/F02. Instead, several different settings have been developed which correspond to the characteristics of the various dynamic handling control settings.

In addition to adaptation to handling characteristics, there are numerous other changes to the Dynamic Stability Control on the F01/F02 which relate to location, display features, fault diagnosis and repair.

Starting from the basis of the system on the E70/E71, the electromechanical parking brake has been adapted to the requirements of the F01/F02. That includes such things as location and attachment to the vehicle. In addition, design enhancements have been introduced to make the EMF actuator quieter in operation.

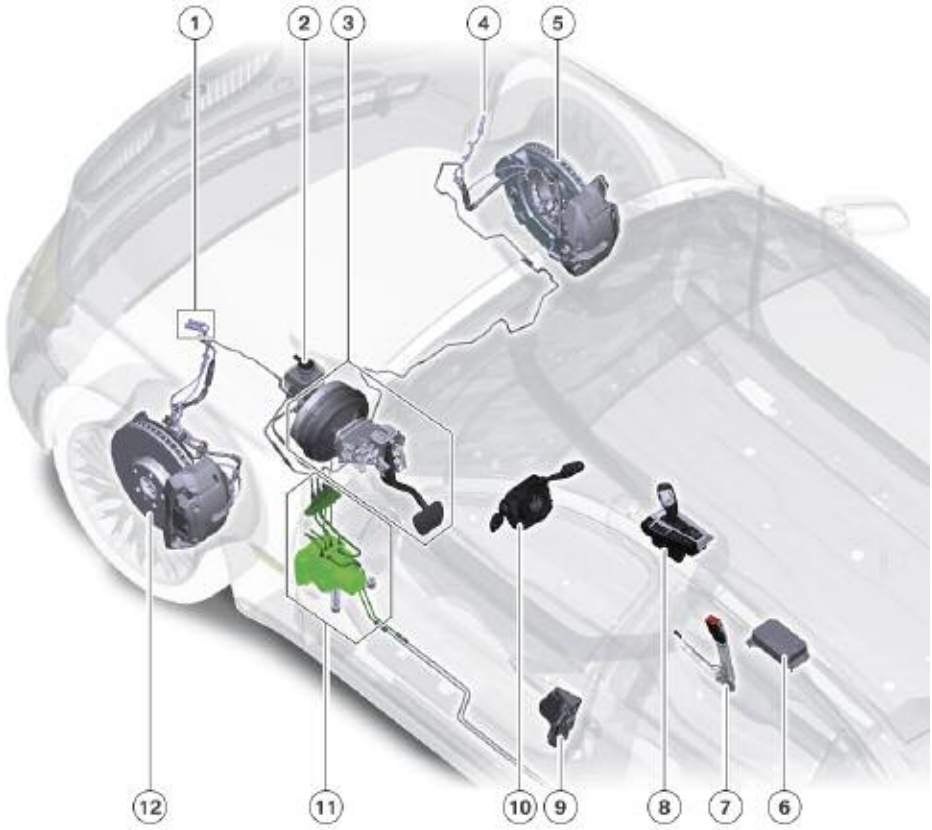
This reference document sets out in detail all the changes to the Dynamic Stability Control and electromechanical parking brake that are specific to the F01/F02.

However, features of the two systems that are familiar from the E70/ E71 are not repeated in this document. Those details can be found in the respective training manuals.

System Overview

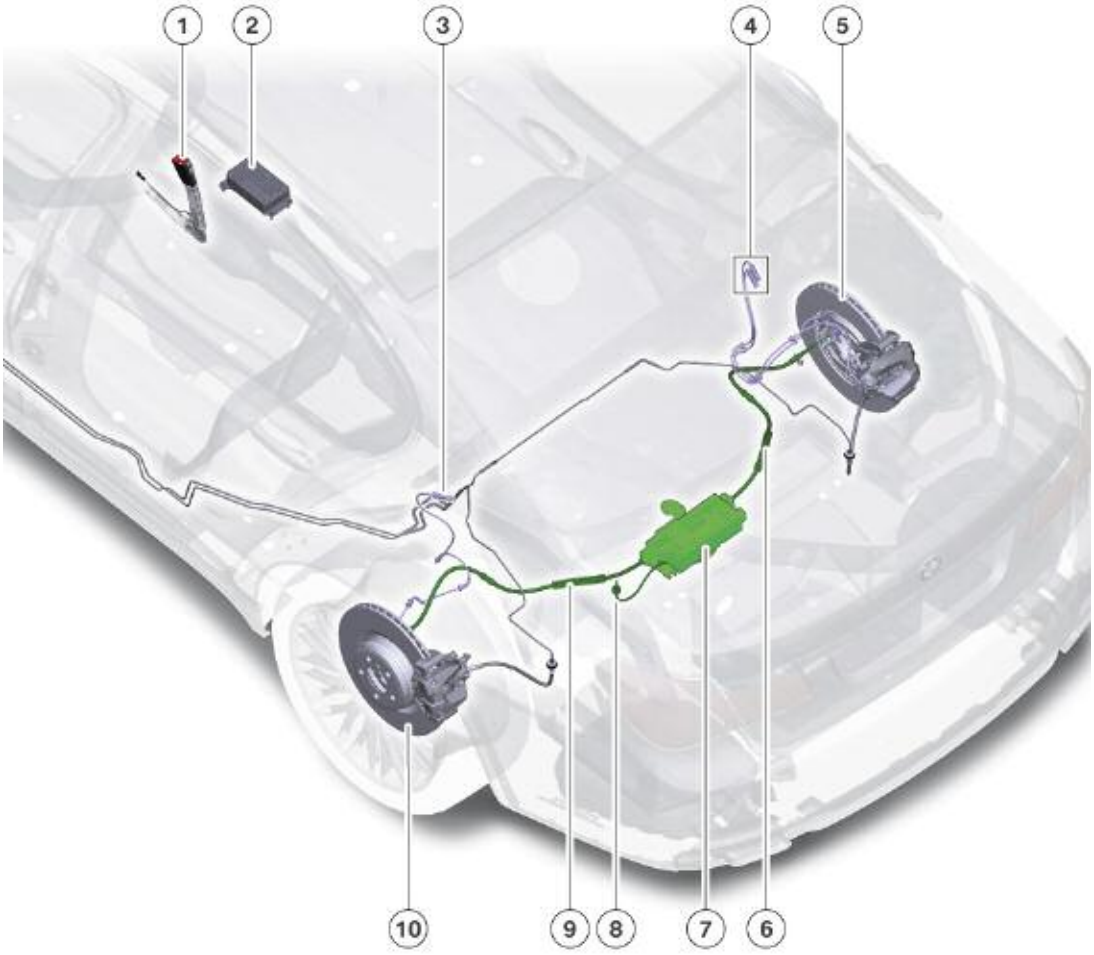
Components on the Vehicle

Components of Dynamic Stability Control and electromechanical parking brake on F01/F02 (front half of vehicle)



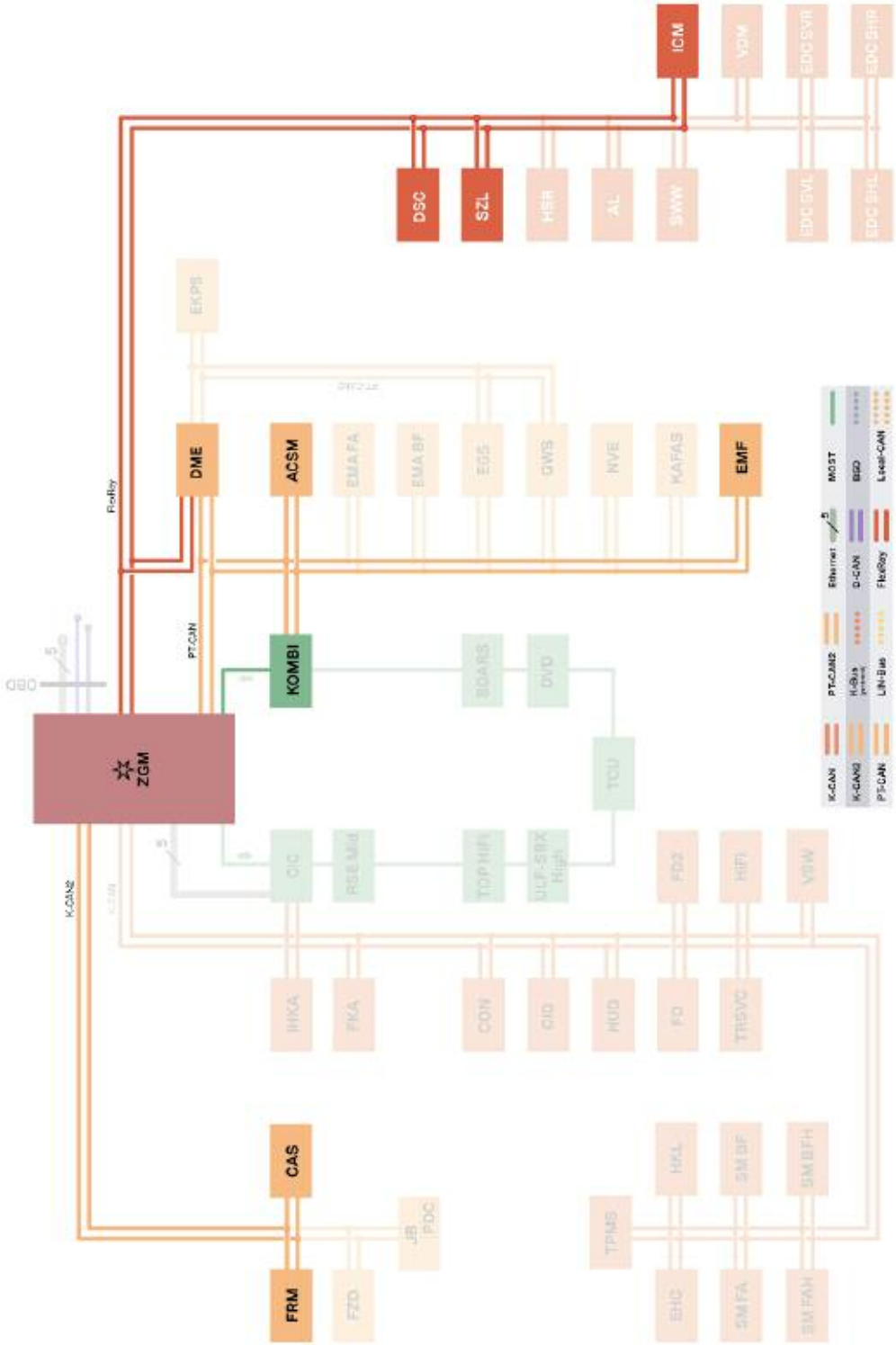
Index	Explanation
1	Connection for front left wheel-speed sensor and brake-pad wear sensor
2	Brake fluid reservoir with brake fluid level switch
3	Brake pedal cluster (brake pedal, brake servo unit, tandem master cylinder)
4	Connection for front right wheel-speed sensor
5	Wheel brake, front right
6	Integrated Chassis Management control unit
7	Seat belt buckle contact, driver's seat
8	Center console control panel (DTC button, handling setting switch, parking brake button, automatic hold button)
9	Door switch, driver's door
10	Steering column switch cluster with steering-angle sensor
11	DSC control unit and hydraulic modulator
12	Wheel brake, front left

Components of Dynamic Stability Control and electromechanical parking brake on F01/F02 (rear half of vehicle)



Index	Explanation
1	Seat belt buckle contact, driver's seat
2	Integrated Chassis Management control unit
3	Connection for rear left wheel-speed sensor
4	Connection for rear right wheel-speed sensor and brake-pad wear sensor
5	Wheel brake, rear right
6	Right EMF brake cable
7	Electromechanical parking brake control unit and actuator unit
8	Emergency release EMF
9	Left EMF brake cable
10	Wheel brake, rear left

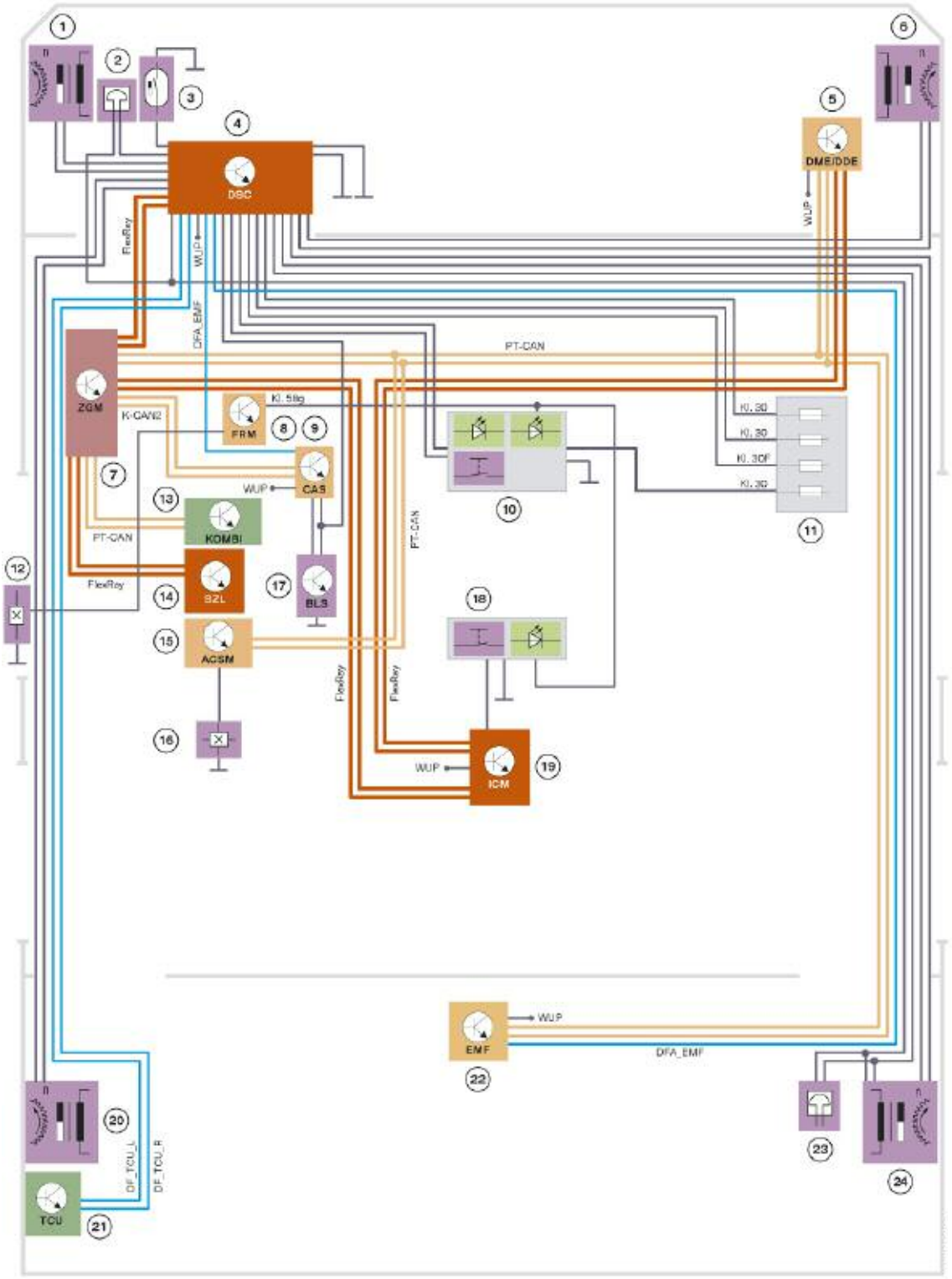
Bus System Overview for DSC and EMF



Index	Explanation
ACSM	Advanced Crash Safety Module
CAS	Car Access System
DME	Digital Motor Electronics
DSC	Dynamic Stability Control
EMF	Electromechanical Parking Brake
FRM	Footwell Module
ICM	Integrated Chassis Management
KOMBI	Instrument Cluster
SZL	Steering column switch cluster with steering-angle sensor
ZGM	Central Gateway Module

System Circuit Diagrams

Dynamic Stability Control



Index	Explanation
1	Wheel-speed sensor, front left
2	Brake pad wear sensor, front left
3	Brake fluid level switch
4	Dynamic stability control (DSC)
5	Digital Motor Electronics/Digital Diesel Electronics
6	Wheel-speed sensor, front right
7	Central Gateway Module
8	Footwell module
9	Car Access System
10	Auto-H button with function indicator and illumination
11	Fuses for DSC electronics, valves, pump motor and Auto-H button (front fuse board, junction box electronics)
12	Door switch, driver's door
13	Instrument cluster
14	Steering column switch cluster with steering-angle sensor
15	Crash Safety Module
16	Seat belt buckle contact, driver's seat
17	Brake light switch
18	DTC button with illumination
19	Integrated Chassis Management
20	Wheel speed sensor, rear left
21	Telematics Control Unit
22	Electromechanical parking brake
23	Brake pad wear sensor, rear right
24	Wheel-speed sensor, rear right

Functions

DSC Functions

Overview

The Dynamic Stability Control on the F01/F02 (DSC F0x) essentially incorporates the same functions as on the E70/E71 (DSC E7x).

As the DSC F0x is based on the same highly advanced technology as the DSC E7x, all DSC functions on the F01/F02 achieve outstanding performance in terms of:

- dynamic response (brake pressure can be generated extremely quickly).
- control precision (brake pressure can be adjusted extremely precisely and without significant fluctuation).
- noise emission (operation of the valves and the hydraulic pump is quieter than the previous generations).
- tactile response (unpleasant feedback from the brake pedal has been substantially reduced, e.g. pedal vibration during brake modulation).

Differences between the DSC functions on the E70/E71 and F01/F02 arise from the different drivetrain configurations (4-wheel drive/rear-wheel drive). Therefore, the DSC F0x does not include the “Hill Descent Control (HDC)” function specific to 4-wheel drive vehicles.

Instead of the 4-wheel-drive version of the automatic differential brake (ADB-X), the DSC F0x uses the version for vehicles with rear-wheel drive (ADB).

A new subfunction of the ADB is that traction-control brake modulation is available even when the DSC is switched off. This subfunction is called “Electronic Differential Lock Control” and is described in one of the subsections below.

Function	DSC ON	Traction	DSC OFF
Anti-lock braking system (ABS)	●	●	●
Electronic brake force distribution (EBV)	●	●	●
Cornering Brake Control (CBC)	●	●	●
Engine drag torque control (MSR)	●	●	●
Automatic Stability Control (ASC)	●	X	
Automatic Differential Brake (ADB)	●	X	X
Dynamic handling control (FDR) ⊕	●	X	
Brake modulation for increased agility	●	●	
Dry braking	●	●	●
Start assist	●	●	●
Brake readiness	●	●	●
Fading assistance	●	●	●
Dynamic Brake Control (DBC)	●	●	●
Automatic Hold combined with electromechanical parking brake (EMF) ⊕	●	●	●
Run Flat Indicator (RPA)	●	●	●
Condition Based Service (CBS)	●	●	●

Symbols:

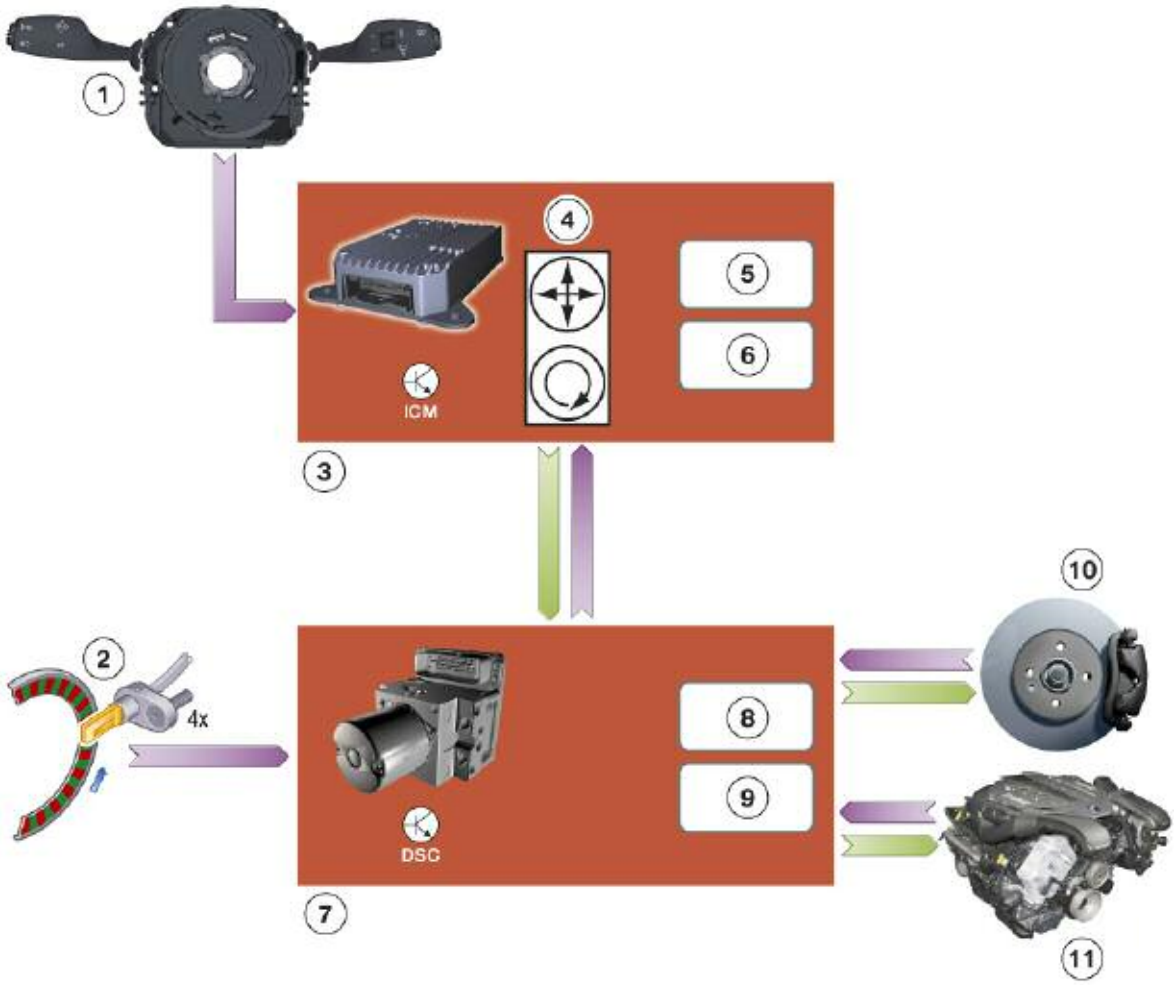
● = Function active

X = Function has adapted control thresholds

⊕ = Can be switched on/off by driver

DSC and Integrated Chassis Management

Input/output diagram: interaction of ICM and DSC



Index	Explanation	Index	Explanation
1	Steering column switch cluster with steering-angle sensor	7	Dynamic Stability Control
2	Wheel speed sensors	8	"Dynamic handling control" function on DSC
3	Integrated Chassis Management	9	"Actuator control" function on DSC
4	Integral DSC sensor (linear acceleration, lateral acceleration and yaw rate)	10	Brake
5	"Dynamic handling control" function on ICM	11	Drivetrain
6	"Actuator co-ordination" function on ICM		

On previous vehicles, the DSC control unit contained the central dynamic handling control functions. A dynamic handling control complex remains part of the DSC F0x. However, it is controlled by the central dynamic handling controller on the ICM (as are the other dynamic handling systems).

The ICM calculates the current handling status and the vehicle response desired by the driver. To do so, it makes use not only of the signals from the DSC sensor integrated in the ICM but also of those from external sensors such as the steering angle sensor and the wheel-speed sensors. If a difference between the response desired by the driver and the reaction of the vehicle is detected, the central dynamic handling controller on the ICM calculates a required compensatory yaw force.

The purpose of that yaw force is to bring about a yawing motion on the part of the vehicle that is superimposed over the existing movement of the vehicle. In that way, the vehicle handling can be corrected retrospectively, so to speak, when it threatens to become unstable. The highly advanced DSC technology and the central dynamic handling controller on the ICM even make is possible to optimize handling characteristics in advance. One example of that is brake modulation for the purposes of improved agility, which is described in one of the subsections further on.

Subordinate to the central dynamic handling controller on the ICM is an “actuator coordination” function. It decides whether and to what degree the DSC dynamic handling system is to contribute to producing the required yaw force.

The required force is signalled to the DSC’s dynamic handling controller, which puts it into action by operating the actuators represented by the brakes and drivetrain.

Simple implementation of the settings specified by the ICM is, however, not the only task of the DSC’s dynamic handling controller on the F01/F02. It also continues to independently perform the following original DSC functions:

- Anti-lock braking system (ABS)
- Cornering Brake Control (CBC)
- Automatic Stability Control (ASC)
- Engine drag torque control (MSR)
- Automatic Differential Brake (ADB)

The numerous additional functions over and above pure handling dynamics control are also carried out largely independently by the DSC and without intervention by the ICM.

- Functions which help to reduce stopping distance: they include brake drying, brake standby, brake fade prevention and dynamic brake control. The efficiency of the brake standby and dynamic brake control functions is further improved in combination with the “ACC Stop & Go” optional extra.
- Convenience functions which make driving easier, e.g. Automatic Hold, which is performed by the DSC and EMF in combination.
- The stresses on and wear of brake components are monitored with the aid of computation models. Based on information such as brake pressure and brake temperature and the signals from the brake-pad wear sensors, a remaining service life expressed as a mileage is calculated. The owner can view that information as a subfunction of Condition Based Service and use it as an aid to planning servicing appointments.

DSC Displays and Controls

New DSC symbols

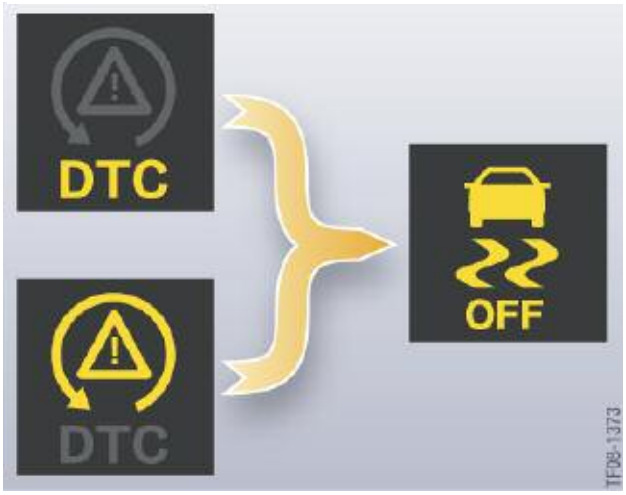
There is a new set of symbols for Dynamic Stability Control displays and controls. Starting on the F01/F02, this new DSC symbol set replaces the symbols previously used.

Previously there were two different symbols displayed on the instrument cluster for the statuses “DTC mode” and “DTC off”.

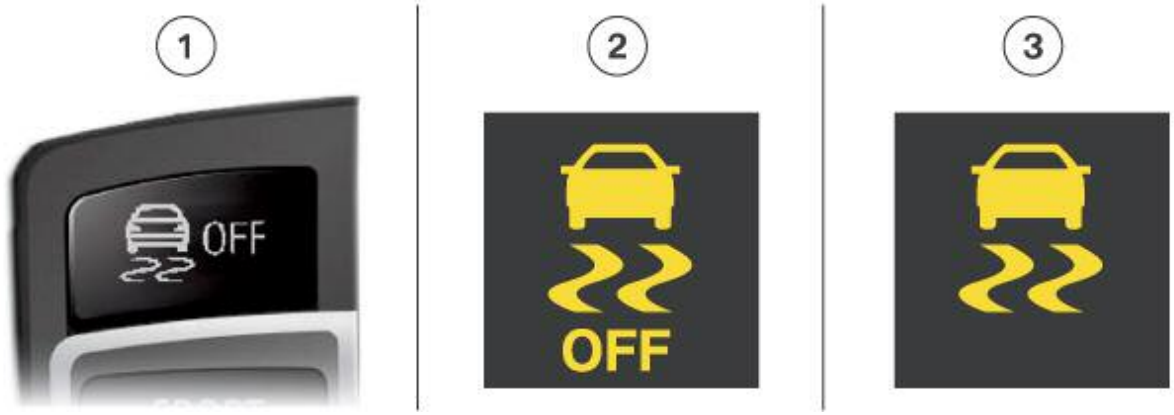
As of launch of the F01/F02, there is now only one symbol for both statuses. However, the drive can distinguish between the two statuses by means of additional information in text form.

The new DSC symbol set relates not only to the display but also the labeling of the DTC button.

DSC indicator and warning lamp on the instrument cluster:



DSC symbols



Index	Explanation
1	DTC button
2	DSC indicator and warning lamp on the instrument cluster: – DSC switched off or – DSC in DTC mode
3	DSC indicator and warning lamp on the instrument cluster: – DSC control sequence active (flashing) – DSC failure (permanently lit)

The new symbols will gradually be introduced on all new vehicles as they are phased in. The reason for the change of symbols are the new legal requirements which oblige all car manufacturers to use standardized display symbols. That will enable motorists to immediately recognize the controls and displays of a DSC system as such regardless of the brand of car they are driving.

The regulations also require that even merely limited DSC function must result in display of the word “off”. That is the case in “DTC mode”, in which the stabilizing interventions take place at a later stage.

DSC modes

As familiar from previous vehicles, the Dynamic Stability Control on F01/F02 incorporates the following function modes:

- DSC on
- DTC (Dynamic Traction Control)
- DSC off

In the “DSC on” mode, all DSC functions are fully active. The stabilizing interventions in brake and engine function take place at an early stage. That makes it easier for less expert drivers to regain control of a vehicle that is becoming unstable.

In “DTC mode” the stabilizing interventions take place at a slightly later stage.
The Automatic Stability Control and Automatic Differential Brake functions allow a greater degree of wheelspin. That improves traction when pulling away on loose surfaces such as uncompacted snow. The dynamic handling control function does not come into action until a larger sideslip angle is reached than in “DSC on” mode.

In “DSC off” mode, the stabilizing interventions by:

- the dynamic handling controller,
- the Automatic Stability Control and

are switched off.

Especially safety-critical DSC functions such as ABS remain fully active in all DSC modes, however.

The mode “DSC off” is aimed at the undiluted driving experience, the direct connection between the driver, vehicle and the road.

Integration in dynamic handling control

A new feature of the DSC modes on the F01/ F02 is that they are integrated in the dynamic handling control function. Dynamic handling control is activated by means of the handling setting switch and the DTC button.

Dynamic handling control enables the driver to choose one of six possible vehicle handing modes. The dynamic handling controller then controls all drivetrain and dynamic handling systems simultaneously and in co-ordination with one another. The result is totally harmonious handling in all modes.

DTC button and handling setting switch

The vehicle handling modes are called:

- Comfort
- Normal
- Sport
- Sport+
- Traction
- DSC off

When the vehicle is first started, the dynamic handling controller is always in “Normal” mode.

The table below shows what mode the Dynamic Stability Control is in for each of the vehicle handling modes.

The other dynamic handling systems and drivetrain control systems are switched in and out as appropriate to the vehicle handling mode selected.

Index	Explanation
1	DTC button
2	Handling setting switch

Vehicle handling mode	DSC mode
Comfort	DSC on
Normal	DSC on
Sport	DSC on
Sport +	DTC
Traction	DTC
DSC OFF	DSC off

DSC Functions in Detail

ADB Active Even When DSC is Off

The DSC function ADB has been around for a long while on a wide variety of BMW vehicles and especially in the form of the ADB-X version on the xDrive models.

If one of the wheels of a driven axle is spinning, it cannot transmit any driving force (torque) to the road. And because the differential distributes the torque equally between the two wheels, the other wheel on the axle can not transmit any driving force either.

ADB brakes the spinning wheel so that the driving torque and braking force are in equilibrium on that wheel. Then, by virtue of the differential, an equal amount of driving torque is applied to the wheel that is not spinning. And because that wheel is offered grip by the road surface, a driving force can be transmitted that results in forward motion of the vehicle.

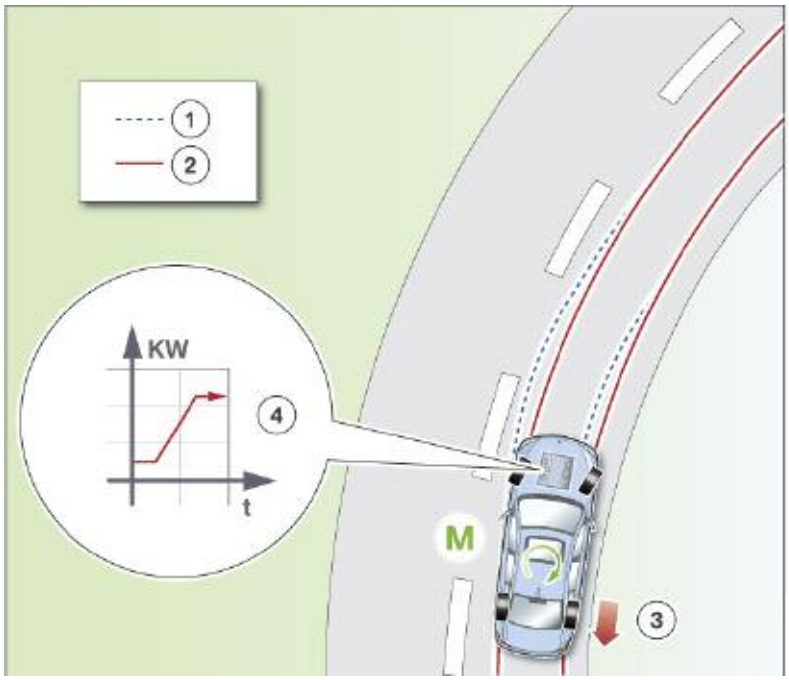
Thus ADB increases traction on slippery surfaces and has a similar effect to a differential lock.

- On the **xDrive** models, ADB-X remains active even when the DSC is switch off in order to achieve improved traction, especially when driving off road.
- On vehicles with **rear-wheel drive**, that individual braking of the driving wheels was previously only active when the DSC was active or in “DTC” mode.
- On the new F01/F02 (and the top 1 Series and 3 Series models) that ADB subfunction remains active even when the DSC is switched off.

That function is called **“Electronic Differential Lock Control”** and uses the DSC to emulate the effect of a differential lock on the driving wheels. In contrast with previous arrangements, such brake modulation for the purposes of increasing drive transmission takes places even if the driver has switched off the DSC.

Brake Modulation for Increasing Agility

The highly advanced hardware of the DSC F0x enables brake modulation to be carried out without unpleasant feedback for the driver. On the F01/F02, that capability is utilized to influence the vehicle's self-steering characteristics is a specifically targeted way.



Index	Explanation
1	Course of an understeering vehicle
2	Course of a vehicle with neutral handling
3	Individual modulation of brakes to prevent understeer
4	Increased engine torque to compensate for braking force
M	Yaw force acting on the vehicle as a result of individual modulation of brakes

If the vehicle begins to understeer, e.g. when cornering quickly, the central dynamic handling controller on the ICM detects the very first indications that it is starting to happen. A required setting is transmitted to the DSC requiring it to apply the brake on the rear wheel on the inside of the bend. The DSC sensitively applies the required setting and without generating a level of noise perceptible by the driver. The uneven braking effect thus produced, creates a yaw force acting around the vehicle's center of gravity. As a result, the vehicle turns towards the inside of the bend, doesn't understeer and corners with absolutely neutral handling.

This type of brake modulation increases road safety because it prevents the vehicle drifting towards the outside of the bend. The disadvantage, however, is that the vehicle is slowed slightly by the application of the brake and thus a degree of momentum is lost.

Therefore, in typical BMW fashion, the solution is taken a step further. Whenever handling stability considerations allow, the engine torque is increased simultaneously with brake application. The higher engine torque is transmitted to the road by the wheel on the outside of the bend that is not being braked. The control strategy ensures that the increase exactly matches the retardation by the brake application.

While that DSC function is active, there is no display of any kind on the instrument cluster.

In that way, highly advanced components (DSC) and intelligent control strategies are combined to produce an overall effect that substantially improves agility without impairing the handling stability of the vehicle.

Automatic Hold
This function has been around since the E65, on which it was called “Auto-P”. The Automatic Hold function was also used on the E70/E71.

Although the Automatic Hold function is computed on the DSC control unit, it can not be put into effect without an electromechanical parking brake (EMF). The EMF is always required whenever the DSC hydraulic modulator is unable to permanently hold the vehicle stationary. In particular, that is the case when the engine is switched off.

When the Automatic Hold function is active, the driver first of all brakes the vehicle to a standstill. It is then held stationary by the DSC hydraulic modulator. That is achieved by maintaining the final brake pressure applied by the driver. If the vehicle starts to roll on an incline, the DSC hydraulic modulator actively generates brake pressure.

Pressing the accelerator causes the brake pressure to be released and the vehicle starts to move again. Automatic holding and releasing of the brakes in that way makes driving in easier in conditions such as urban traffic and stopping at traffic lights or stop-and-go driving in traffic tailbacks.

After the engine is started, the function can be activated until the next time the engine is switched off. To do so, the driver’s door must be closed and the driver’s seatbelt fastened. The function can, of course, also be manually deactivated before the engine is switched.

The footwell module reads the signal from the door switch. The ACSM control unit analyses the signal from the seat belt buckle contact. The two signals are transmitted to the DSC control unit via the bus systems. One signal that is not analysed for the Automatic Hold function on the F01/F02 is the driver’s seat occupancy signal.

Conversely, the Automatic Hold function is automatically deactivated if the driver’s door is opened and the driver’s seatbelt unfastened. To prevent the vehicle rolling away in that situation, the EMF parking mode is activated. As long as the engine is running, the parking mode is effected by means of the DSC hydraulic modulator. If the driver switches the engine off, the function is taken over by the EMF actuator unit.

Note: Before the vehicle is driven into a car wash, the Automatic Hold function has to be deactivated as otherwise the brakes are applied when the vehicle is stationary and it can not be rolled.

The Automatic Hold function is activated and deactivated by means of the button marked "AUTO H" on the center console. Activation of the function is acknowledged by the function indicator lamp (green LED in the button). Whenever the green LED is lit, the Automatic Hold function is active. The status of the Automatic Hold function is also indicated on the instrument cluster.

The various function statuses and how they are indicated are summarized below.

Status of Automatic Hold function	Function indicator lamps in buttons	Display on instrument cluster
Switched off		
Switched on and on standby (e.g. when vehicle is moving)		
Switched on and active (vehicle is being held stationary)		
Deactivated by driver getting out of vehicle or switching engine off		

When Automatic Hold is holding the vehicle stationary, two additional internal DSC sub-functions are activated: roll-away monitoring and slide detection.

The roll-away monitoring function is described in the section “EMF functions”.

The slide detection function is designed to intervene if the vehicle starts to slide after stopping, i.e. if all four stationary wheels start to slip. That can happen on a steep slope when the road is slippery, for instance. If the driver were holding the vehicle stationary and became aware of such a situation, he/she would release the brake. In that way the vehicle can at least be steered as it rolls down the slope.

The slide detection function is based on exactly the same principle. When the vehicle is being held stationary by Automatic Hold, the slide detection function monitors the signals from the wheel-speed sensors. The DSC releases the pressure on one of the brakes in alternation while keeping the others under pressure. If the wheel-speed sensor registers a movement from the wheel on which the brake is released, then obviously the entire vehicle must be moving. That means that the other wheels, on which the brakes are applied, must be sliding while locked. Under those circumstances, the condition “sliding” would be detected.

The response to detection of sliding is progressive release of brake pressure so that the vehicle becomes steerable. The driver is made aware of the critical situation by a Check Control message and an audible warning signal.

Interface for Adaptive Braking Assistance

The function “Adaptive Braking Assistance” implemented as a co-ordinated strategy by the DSC and Adaptive Cruise Control with Stop & Go function is also available on the F01/F02. It is a function that was previously introduced on the E60/E61 LCI.

The interface relates to two functions on the Dynamic Stability Control:

- brake standby and
- dynamic braking control.

“Brake standby” can be activated by a request signal transmitted by the ICM control unit. That happens when a potential collision situation has been detected with the aid of the radar sensors. And, of course, “brake standby” is also activated if the internal DSC criteria familiar from previous models are met (minimum speed, rapid release of accelerator pedal).

The threshold for triggering dynamic braking control can be influenced by ACC Stop & Go. If a potential collision situation is detected, the ICM control unit sends out a signal requesting lowering of the activation threshold. To be precise, the activation threshold is the rate of increase of brake pressure applied by the driver that has to be exceeded in order to dynamic braking control (braking assistance). That makes it easier for the driver to trigger dynamic braking control. This function is the only means by which a driver braking hesitantly can activate dynamic braking control.

NOTES PAGE

System Components

DSC Components

DSC Unit

The DSC unit on the F01/F02 essentially uses the same technology as on the E70/E71.

Versions

The DSC unit comprises the DSC control unit and the hydraulic modulator. The two are attached to one another in such a way as to form a waterproof unit.

The repair kits available are either

- the complete DSC unit with pre-filled hydraulic modulator or
- the DSC control unit on its own.

There is a seal integrated in the casing of the DSC control unit at precisely the point where it joins the hydraulic modulator. That is the reason why the DSC control unit can be replaced separately (seal is replaced at the same time). The hydraulic modulator, by contrast, can not be replaced separately because the seal would be damaged when the two parts were separated. The required degree of waterproofing would then no longer be provided.

There are two versions of the DSC unit which differ by virtue of the number of pressure sensors fitted.

Optional extra ACC / ACC Stop & Go	Number of pressure sensors	Brake pressures measured
No	1	Pressure applied by driver
Yes	3	Pressure applied by driver Pressure in front-wheel brake circuit Pressure in rear-wheel brake circuit

The DSC unit with only one pressure sensor uses a computation model to determine the pressures in the front and rear brake circuits. The degree of accuracy obtained is sufficient for the functions of the dynamic handling systems and the cruise control with braking function. The optional extras ACC and ACC Stop & Go require a higher degree of accuracy for determining the brake pressure generated and modulated by the Dynamic Stability Control. Therefore, the two additional brake sensors are fitted in the front and rear brake circuits.

Hydraulic modulator

With its highly advanced pump design, the hydraulic modulator also offers an enhanced degree of control accuracy. There are 2 groups of 3 pump elements with a diameter of 6.5mm and intake-optimized units. This pump design produces, firstly, substantially improved pressure generation dynamics. And secondly, the pressure increments during pressure generation are smaller. Together with the improved design of the valves, the overall effect is less pedal feedback during brake modulation.

For the driver this is noticeable in as far as the pedal pulsation can now only be felt very slightly during ABS braking. There is a pressure sensor for detecting the pressure applied by the driver in the hydraulic modulator.

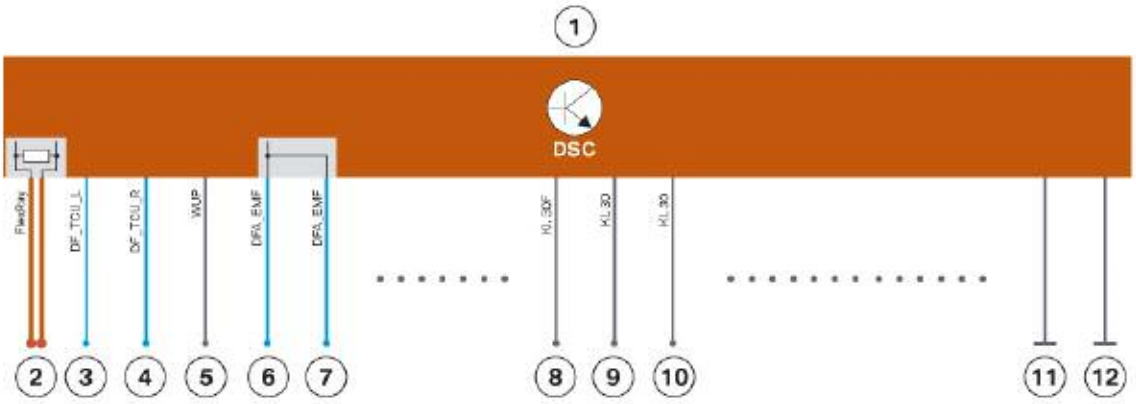
DSC control unit

Like the hydraulic modulator, the DSC control unit on the F01/F02 is also based on the one used on the E70/E71.

Specifically, the following special features and differences should be noted:

- FlexRay connection
- Wiring of the new DTC button
- Wheel-speed signals for electromechanical parking brake, Car Access System and Telematic Control Unit

Overview of important connections on DSC control unit



Index	Explanation
1	DSC control unit
2	FlexRay input with terminal resistor
3	DF_TCU_L, front left wheel-speed signal for Telematic Control Unit (TCU)
4	DF_TCU_R, front right wheel-speed signal for TCU
5	WUP, wake-up line
6	DFA_EMF, wheel-speed signal for Car Access System (CAS)
7	DFA_EMF, wheel-speed signal for electromechanical parking brake (EMF)
8	Power supply for DSC module (Terminal 30F)
9	Power supply for valves (Terminal 30)
10	Power supply for pump motor (Terminal 30)
11	Ground for DSC module
12	Ground for valves and pump motor

The DSC control unit on the F01/F02 is connected to the FlexRay and not, as on previous vehicles, to the PT-CAN and F-CAN.

The FlexRay is brought to the DSC control unit (from the ZGM) and ends there. The DSC control unit is thus the terminal node of the FlexRay. Accordingly, it contains a terminal resistor for the FlexRay.

On previous vehicles, the DTC button was electrically analysed by the IHKA control unit, for instance (E70/E71). On those vehicles, the button operation signal is transmitted via bus systems to the DSC control unit.

The new DTC button on the F01/F02 is connected to the ICM control unit instead. The DTC button and the associated function is part of the “dynamic handling control” function on the F01/F02. As that, in turn, is computed on the ICM control unit, the DTC button has been connected to the ICM control unit. The ICM control unit then signals the appropriate vehicle handling mode via the FlexRay. The DSC control unit analyses the signalled mode and adapts its function accordingly.

For the EMF and CAS control units, the information about vehicle standstill is of particular importance. For those two systems, the DSC control unit provides the DFA_EMF signal. It is a calculated signal computed from the speeds of the two rear wheels. It is transmitted as a pulse-width modulated signal on a dedicated line to the EMF and CAS control units.

If there is a Telematic Control Unit (TCU) fitted on the vehicle but no navigation system, the TCU control unit has to take on the task of determining vehicle location. That is necessary for the manual and automatic emergency call functions. The signals from the GPS aerial are insufficient for that purpose as it has to be possible to determine the vehicle’s location even if the GPS signals are temporarily unavailable. In that case, the TCU control unit uses the speed signals from the two front wheels to calculate the road speed and changes of direction when cornering. The wheel-speed signals are provided by the DSC control unit and transmitted to the TCU control unit by a directly wired connection (DF_TCU_L and DF_TCU_R).

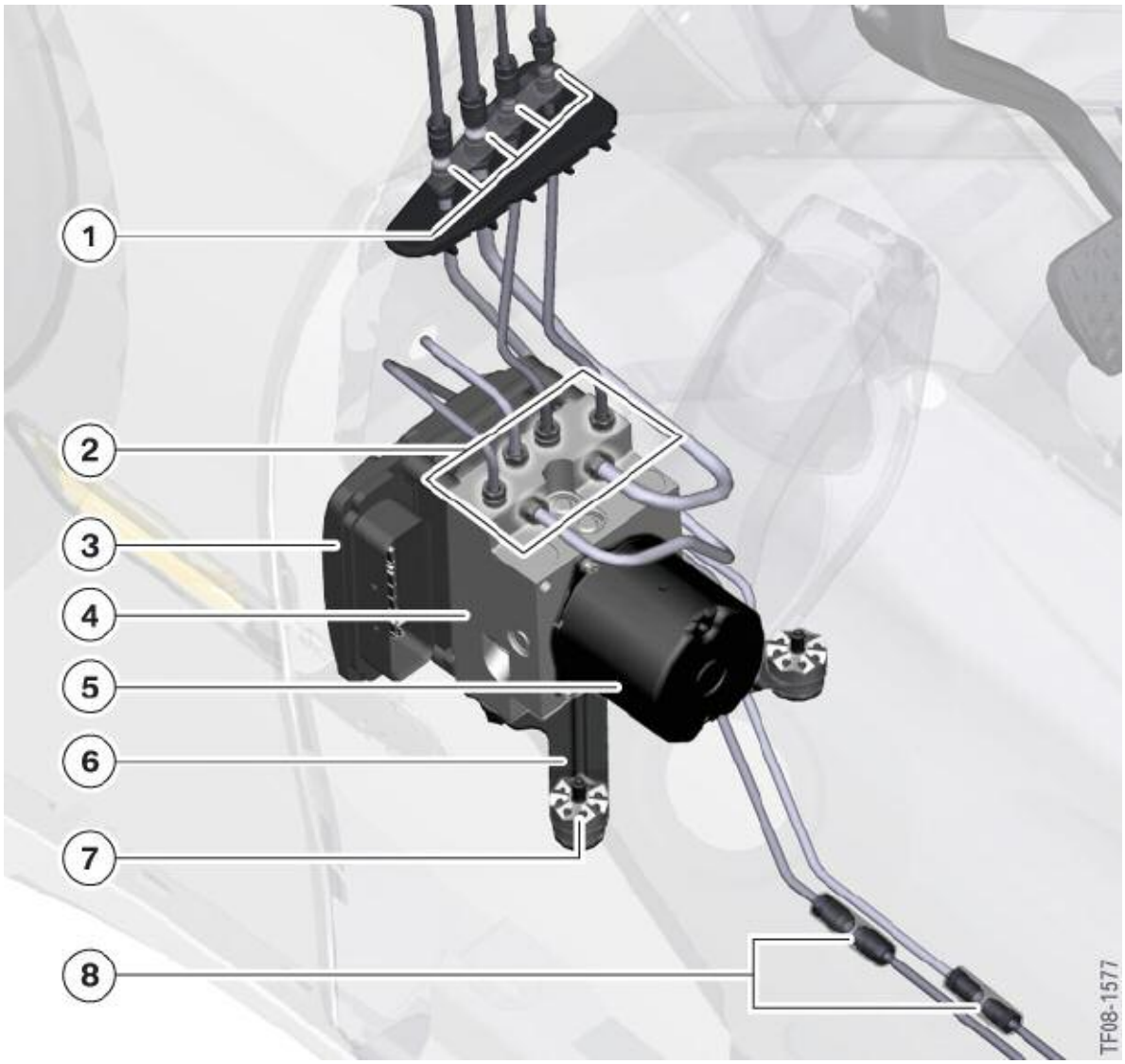
The power supply for the DSC unit is split into three: control unit, valves and pump motor are supplied by separate leads. That prevents interference from the load circuits (inductive loads) being transferred to the electronic circuitry.

The DSC control unit is also connected to the wake-up line. The wake-up line is used to wake up the DSC control unit.

Location and repair

The DSC unit is located in the vehicle underbody, set back somewhat from the wheel arch. That location applies to both left and right-hand-drive vehicles.

Location of DSC unit on F01/F02



Index	Explanation	Index	Explanation
1	Quick-release hydraulic pipe unions, 4 off	5	DSC pump motor
2	Screw-fit hydraulic pipe unions, 6 off	6	DSC unit mounting bracket
3	DSC control unit	7	Bolt fixing with vibration damper for DSC unit
4	DSC valve manifold	8	Screw-fit hydraulic pipe unions, 2 off

Six short lengths of hydraulic pipe are connected to the DSC unit by screw-fit unions.

Four of those hydraulic pipes run upwards from the hydraulic modulator and terminate at a block with quick-release unions. They are connected by those quick-release unions to the pipes running off to other parts of the vehicle. Specifically, that is the two pipes to the left and right front brakes and the two pipes to the tandem master cylinder.

The two remaining hydraulic pipes run to the rear. They are connected by quick-fit unions to the pipes running off to other parts of the vehicle. In this case, they lead to the left and right rear brakes.

If the DSC unit has to be replaced, first of all the vehicle underbody trim has to be removed in the appropriate places. When the DSC unit is removed, the six short lengths of hydraulic pipe referred to above are removed with it. Therefore, before removal, the four quick-release unions (4) and the two screw-fit unions (8) have to be disconnected. The short lengths of hydraulic pipe subsequently have to be removed and fitted to the new DSC unit.

Only after the DSC unit has been removed can the DSC control unit be separated from the hydraulic modulator, if necessary, and new one fitted.

The braking system must always be bled whenever the DSC unit has been removed and refitted/replaced.

The precise procedures for the individual repair operations in connection with the DSC unit are described in the Repair Instructions.

Sensors for DSC

Wheel speed sensors

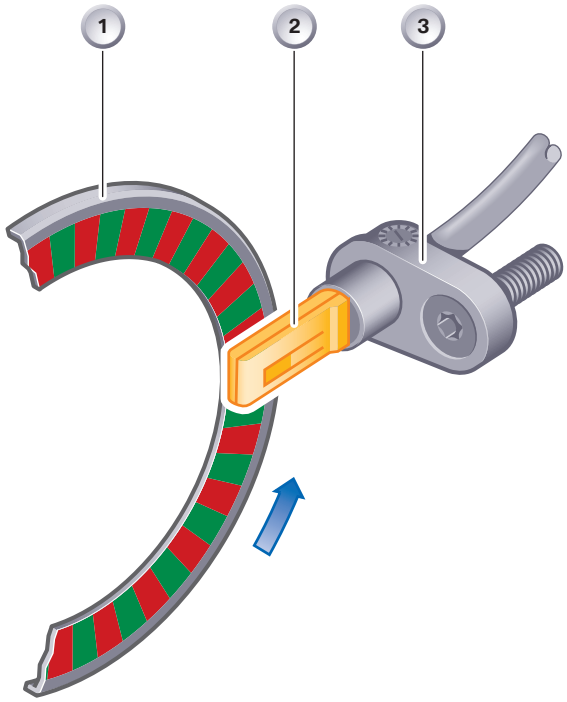
The same type of wheel-speed sensor is used on the F01/F02 as on the E70/E71 (DF11i made by Robert Bosch GmbH).

They are four active wheel-speed sensors, all four of which are connected by dedicated two-core leads directly to the DSC control unit. The wheel-speed data is transmitted to the DSC control unit as a pulse-width-modulated signal.

The active wheel speed sensors enable detection of direction of rotation and clearance gap.

Detection of direction of rotation is required for the hill-start assistance and Automatic Hold functions, among others. The clearance-gap sensing function allows sensor positioning faults to be detected. If there is too much play in the wheel bearings, the wheel-speed signal can also become unreliable. That situation is also detectable by the clearance-gap sensing capability of the wheel-speed sensors.

It can therefore be guaranteed that the DSC control unit only operates on the basis of correctly detected wheel-speed signals.

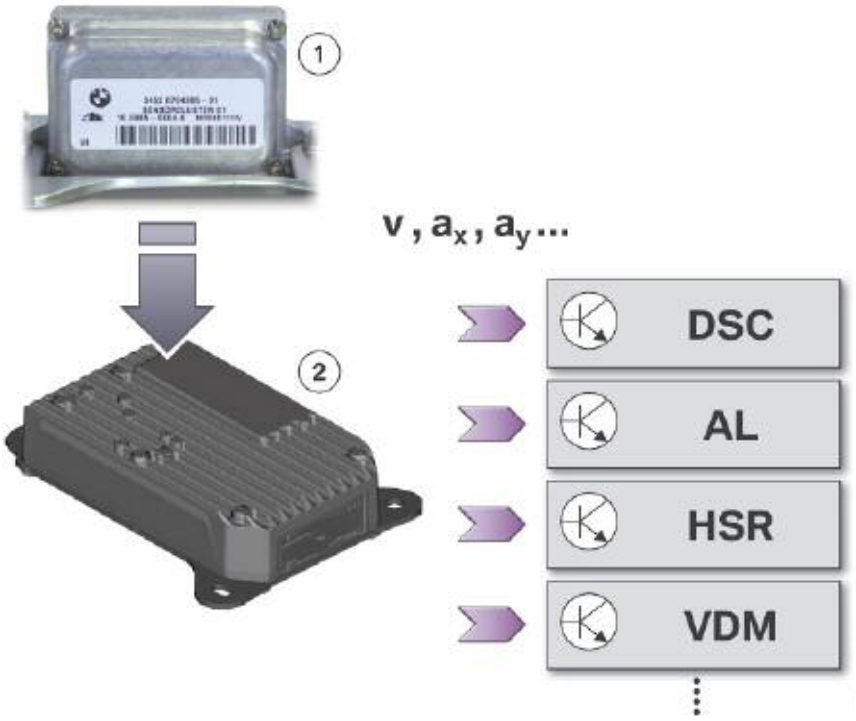


Index	Explanation	Index	Explanation
1	Sensor ring/ferromagnetic wheel bearing seal carrier	3	Sensor housing
2	IC sensor with Hall sensor		

The DSC control unit broadcasts the wheel-DSC sensor in ICM speed sensor signals via the FlexRay network and directly wired links to the other systems on the vehicle.

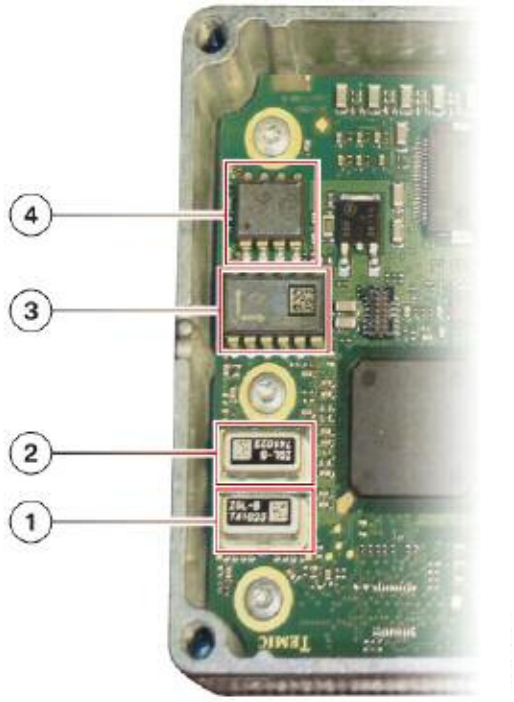
The DSC sensor, which was previously a separate component, has been integrated in the ICM control unit on the F01/F02.

Dynamic handling signals provided by ICM control unit



Index	Explanation	Index	Explanation
1	DSC sensor integrated in ICM control unit	DSC	Dynamic Stability Control
2	ICM control unit	AL	Active steering
v	Road speed	HSR	Rear suspension slip angle control
ax	Linear acceleration	VDM	Vertical Dynamics Management
ay	Transverse acceleration		

DSC sensor integrated in ICM control unit



Index	Explanation
1	Yaw rate sensor
2	Second, back-up yaw rate sensor
3	Linear and lateral acceleration sensor
4	Second, back-up lateral acceleration sensor

With the aid of the signals from those integrated sensors and the wheel-speed signals provided by the DSC control unit, the ICM control unit calculates the following variables that are of significance for the vehicle's dynamic handling status:

- Road speed
- Linear acceleration and pitch
- Lateral acceleration and roll
- Yaw rate

Steering-angle sensor in SZL

With the aid of the steering-angle sensor, the SZL is able to provide the following signals via the FlexRay bus system:

- Steering angle
- Steering rate

Those variables are used as input signals by the dynamic handling systems to determine the driver's intention when cornering. On the F01/F02 it is important to note that the steering-angle sensor signals are first analysed by the ICM control unit and then provided to control units of the other dynamic handling systems as the "effective steering-angle signal".

Detection of the steering angle and the steering rate is performed by an optical proximity sensor, the optical steering angle sensor.

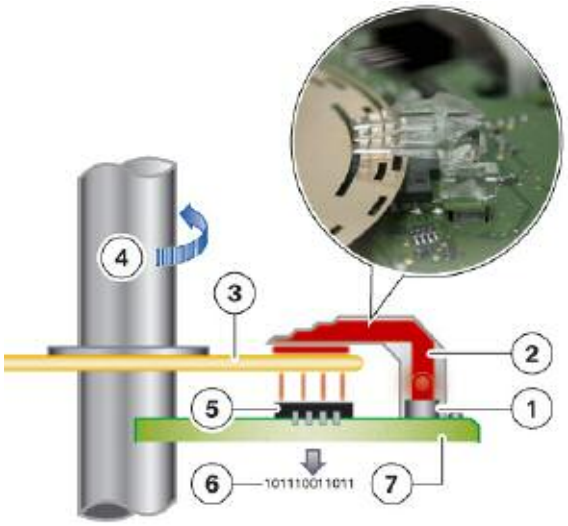
Information such as the absolute steering angle or the steering wheel rotation is calculated. The optical steering-angle sensor detects steering angles from -640° to +640°.

If the SZL suffers a power loss, e.g. if the battery terminals are disconnected, the steering wheel rotation data is lost. The SZL is then initially unable to determine the absolute steering angle and can only identify the relative steering angle.

This temporary fault status can be remedied by turning the steering wheel from lock to lock. Alternatively, the SZL can detect the straight-ahead position from the wheel-speed signals from the front wheels when driving in a straight line.

In either case, the absolute steering angle is then known again.

Schematic diagram of optical steering-angle sensor on F01/F02



Index	Explanation
1	Light-emitting diode
2	Fiber optics unit
3	Code disc
4	Steering column
5	Photo-transistors
6	Output: Conversion to electrical signals
7	PCB

Note: If at least one of the following conditions exists, the steering column switch cluster has to perform steering-angle sensor calibration:

- **Wheel alignment carried out**
- **SZL replaced or re-programmed**
- **Diagnosis system test procedure specifies calibration.**

Note: When calibrating the steering angle sensor, the instructions given by the diagnosis system must be followed precisely.

The vehicle must be standing on a level surface during calibration. The steering wheel must be aligned visually in the straight-ahead position.

Service Information

Important Points for Servicing and Repairs

Dynamic Stability Control (DSC)

General details

Note: The modes "Dynamic Traction Control" (DTC) and "DSC off" are still used on the F01/ F02. However, on the F01/F02, the DSC modes are integrated in the "dynamic handling control" function, which rather than controlling individual systems, controls the system complex of all drivetrain and dynamic handling systems.

Note: There is a new set of symbols for DSC displays and controls on the F01/F02.

DSC symbols

Automatic hold function

The Automatic Hold function is activated/ deactivated by means of a button on the center console control panel. The Automatic Hold status is indicated by the function indicator lamp on the button and an indicator lamp on the instrument cluster.

For Automatic Hold to be activated, the driver's seatbelt must be fastened and the driver's door closed.

Note: Before the vehicle is driven into a car wash, the Automatic Hold function has to be deactivated as otherwise the brakes are applied when the vehicle is stationary and it can not be rolled.

DSC unit

There are two versions of the DSC unit which have either one or three pressure sensor(s) (vehicles without/with “Active Cruise Control” optional extra)

Note: The repair kits available are either

- **the complete DSC unit with pre-filled hydraulic modulator or**
- **the DSC control unit on its own.**

The hydraulic modulator can not be replaced separately.

Note: The DSC unit is located in the vehicle underbody, set back somewhat from the wheel arch.

Note: If the DSC unit has to be replaced, first of all the vehicle underbody trim has to be removed.

When the DSC unit is removed, the six short lengths of hydraulic pipe are removed with it. Therefore, before removal, the four quick-release unions at the top and the two screw-fit unions at the bottom have to be disconnected from the hydraulic pipes.

The short lengths of hydraulic pipe subsequently have to be removed and fitted to the new DSC unit.

Signals and sensors

Note: The wheel speed sensors are connected to the DSC control unit. The DSC control unit processes the wheel-speed sensor signals and broadcasts them via the FlexRay network to other systems, in particular the Integrated Chassis Management.

Note: The DSC control unit does not only provide the wheel-speed signals in the form of bus signals. They are transmitted to the EMF, CAS and TCU control units by direct wired links.

Note: The DSC sensor, which was a separate component on previous vehicles, has been integrated in the ICM control unit. The ICM control unit processes the important sensor signals for the Dynamic Stability Control and supplies them in the form of bus signals. Those signals are:

- **Yaw rate**
- **Transverse acceleration**
- **Linear acceleration**
- **Steering angle**
- **Vehicle speed.**

Note: The DSC sensor in the ICM control unit has to be calibrated if

- **the ICM control unit has been replaced or**
- **the testing sequence on the diagnosis system demands it on the basis of a fault memory entry.**

Calibration must be performed with the vehicle on a surface that is level both lengthways and side to side. Terminal 15 must also be switched on.

Note: If at least one of the following conditions exists, the steering column switch cluster has to perform steering-angle sensor calibration:

- **Wheel alignment carried out**
- **SZL replaced or re-programmed**
- **Diagnosis system test procedure specifies calibration.**

Note: When calibrating the steering angle sensor, the instructions given by the diagnosis system must be followed precisely.

The vehicle must be standing on a level surface during calibration. The steering wheel must be aligned visually in the straight-ahead position.

Overview of EMF Functions

Normal Operation

Parking brake application

The driver can activate the EMF parking brake function by pulling on the parking brake button. Thus the way in which the parking brake button is operated emulates the action of a handbrake lever.

The signal from the parking brake button is read by the EMF control unit and transmitted to the DSC control unit as a bus signal. The DSC control unit then decides whether to use the DSC hydraulic modulator or the EMF actuator unit to implement the parking brake function. If the engine is running, the vehicle is held stationary by using the DSC hydraulic modulator; otherwise the EMF actuator unit is used.

The parking brake function is possible at any logical terminal status, i.e. at:

- Terminal 0
- Terminal R
- Terminal 15 (and Terminal 50)

Parking brake application at Terminal 0 is specifically made possible by the fact that the EMF control unit is supplied by Terminal 30 and the parking brake button is connected directly to the EMF control unit. If the driver operates the parking brake button at Terminal 0, the EMF control unit is woken up. The EMF control unit in turn wakes up the other control units on the vehicle. Only then can the EMF control unit receive the important signals relating to vehicle standstill. In addition, the changed status of the parking brake can be displayed after the system has been woken up.

The status “parking brake on” is indicated by a red LED on the parking brake button and an indicator lamp on the instrument cluster.

The driver does not have to operate any other controls to apply the parking brake. Once the parking brake is on, pulling the parking brake button again has no effect.

Indication of "parking brake on"

Index	Explanation
1	Function indicator lamp on parking brake button
2	Indicator lamp on instrument cluster

Roll-away monitoring

The roll-away monitoring function is computed on the DSC control unit. It is active while the vehicle is being held stationary by:

- the DSC hydraulic modulator or
- the EMF actuator unit.

The condition for activation of roll-away monitoring is thus that either the EMF parking brake function or the Automatic Hold function is active.

Roll-away monitoring observes the signals from the wheel-speed sensors. If any of the wheel-speed sensors signals movement of the wheel, that indicates that the vehicle is rolling. Since, however, the vehicle is supposed to be stationary by virtue of the brake pressure applied by the hydraulic system or the EMF actuator, the roll-away monitoring function has to intervene. The hydraulic brake pressure is increased by control signals to the DSC hydraulic modulator or EMF electric motor in order to increase the braking force. In that way the rolling is counteracted.

Release

In similar fashion to the operation of a handbrake lever, the EMF is released by pushing the parking brake button in.

But in order that the parking brake function is actually cancelled, Terminal 15 must also be on and one of the following conditions must be met:

- Brake pedal depressed or
- Automatic transmission parking lock engaged.

That prevents the vehicle rolling away if another occupant of the vehicle apart from the driver presses in the parking brake button (child safety feature).

Once the parking brake is released, the function indicator lamp on the parking brake button and the indicator lamp on the instrument cluster go out.

Indication of "parking brake released"

Index	Explanation	Index	Explanation
1	Function indicator lamp on parking brake button	2	Indicator lamp on instrument cluster

Dynamic braking

The law requires that vehicles have two means of applying the brakes. On the F01/F02, the second means (the brake pedal being the first) is the parking brake button on the center console.

If the parking brake button is pulled out while the vehicle is in motion, a defined degree of braking is applied by the DSC system. That function is intended for emergency situations in which the driver is unable to apply the brakes by pressing the brake pedal. Other occupants of the vehicle can also bring the vehicle to a standstill in that way if, for example, the driver suddenly loses consciousness.

Dynamic braking hydraulically applies brake pressure at all four brakes. The stabilization functions of Dynamic Stability Control remain fully functional and the brake lights are switched on. That represents a major advantage over a manual parking brake.

Braking takes place only while the parking brake button is pulled out. The degree of deceleration set by the DSC is increased progressively from initially 3 m/s2 to 5 m/s2.

During dynamic braking, the parking brake indicator light on the instrument cluster comes on. In addition, a Check Control message and an audible warning signal are issued to make the driver aware of the critical situation.

If the driver uses the brake pedal and the parking brake button at the same time to slow down, the DSC control unit prioritizes. The greater braking requirement is put into effect.

If dynamic braking is continued to the point of standstill, the vehicle continues to be held stationary after the parking brake button is released. The indicator lamp on the instrument cluster remains on. The driver can then release the parking brake (as described above).

Emergency release

A mechanical emergency release facility is provided in order to be able to release the parking brake in the event of the electromechanical actuator unit failing or insufficient power supply.

Note: Caution: secure vehicle to prevent it rolling before operating the emergency release!

Note: After a power supply failure, it may still not be possible to move the vehicle even after releasing the brake with the emergency release facility. The automatic transmission parking lock may still be engaged.

In that case, the parking brake must first be released with the emergency release facility. Then the automatic transmission parking lock must be released using the emergency release facility. To do so, the appropriate tool must remain engaged in the parking lock emergency release.

The parking brake emergency release status is indicated on the instrument cluster. The parking brake indicator lamp shows yellow.

Indication of "parking brake emergency release/fault"

The driver is shown the same indication (together with a check control message) if the parking brake has a fault.

When the parking brake is to be used again after an emergency release, that can not be done mechanically but only electrically. It requires pushing in the parking brake button once as if to release the parking brake. The familiar conditions for releasing the parking brake must also be met.

Service Function

Installation Mode

EMF installation mode is required for the purposes of replacing the EMF actuator unit or the brake cables. The EMF can be set to installation mode with the aid of the BMW diagnosis system. This mode is comprized of two subfunctions:

- Setting the EMF actuator unit to the installation position
- Preventing the EMF parking brake function.

To set the unit to the installation position, the brake cables are extended to the maximum length. That is the essential requirement for being able to remove and refit the cables.

While work is being carried out on the actuator unit, the brake cables or the duo-servo parking brake, the EMF must not be inadvertently or deliberately applied. Doing so would risk causing injury. Installation mode prevents the EMF parking brake function.
That means that pulling out the parking brake button as if to apply the parking brake has no effect.

Installation mode is indicated on the instrument cluster by the parking brake indicator lamp flashing yellow.

Indication of parking-brake installation mode

Installation mode can be cancelled in two ways:

- By the performing the service function “Reset installation mode” using the BMW diagnosis system
- By driving the vehicle; when doing so, a minimum speed must be exceeded.

Once installation mode has been successfully cancelled, the parking-brake indicator lamp on the instrument panel goes out.

Running-in the Brakes

The function for running-in the parking brakes only has to be carried out if

- the linings of the duo-servo parking brakes have been replaced or
- the rear brake discs have been replaced.

In either case, a material/surface pairing then initially exists which does not yet have the optimum frictional properties. That means that the required braking forces could not be achieved.

The brake running-in function removes play between the two surfaces forming the frictional pairing, i.e. the brake linings and the inside of the brake disc recess. It also wears-in the surfaces. Both operations are essential to achieving the required frictional coefficient between the two surfaces.

The brake running-in function is prepared with the aid of the BMW diagnosis system. It is started by pulling out the parking brake button once. The parking brake indicator lamp flashes red throughout the entire sequence.

While running-in the parking brakes, the EMF applies a defined force to the duo-servo parking brakes. That force is substantially lower than the brake force required to hold the vehicle stationary. The rear wheels are then rotated either on a brake dynamometer or by driving the vehicle on the road.

Note: The precise procedure for running-in the parking brakes is described in the Repair Instructions under the heading “Adjusting the parking brake”. The instructions given there must be followed exactly.

EMF Components

This section deals only with the special features of the actuator unit and the controls for the electromechanical parking brake. On the F01/F02, as on numerous other BMW models, the braking force for the parking brake is produced by the familiar duo-servo parking brakes on the two rear wheels.

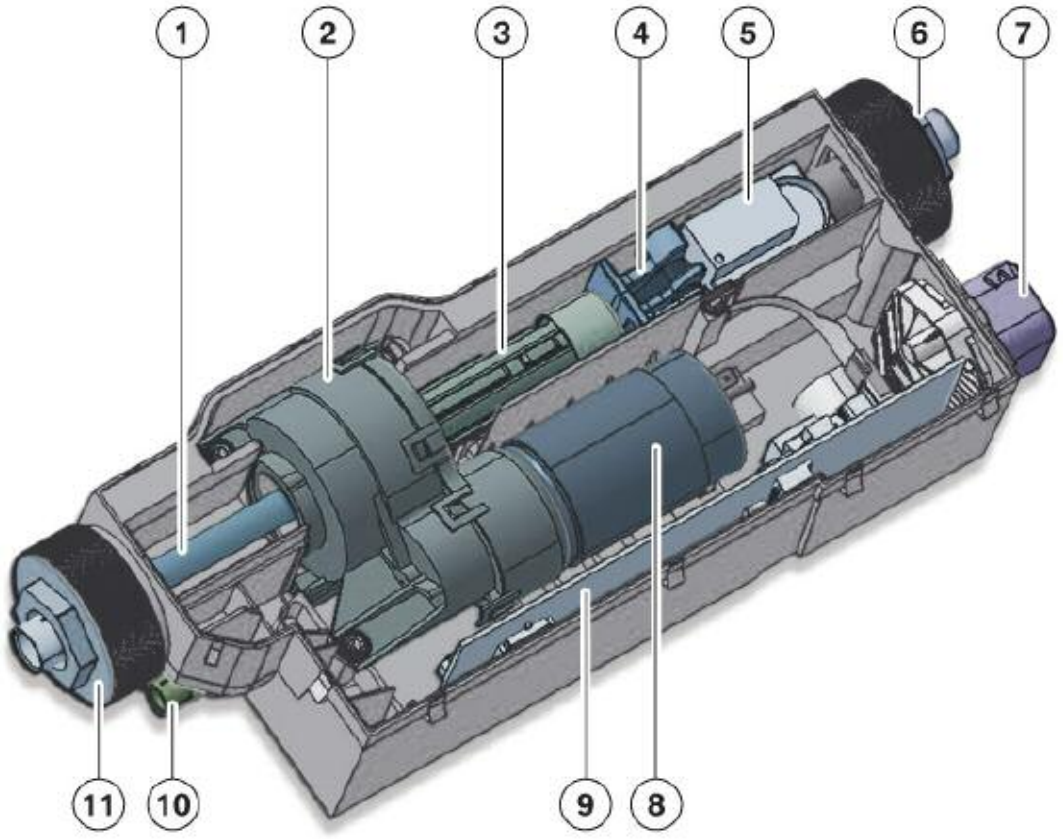
EMF Actuator Unit

The complete EMF actuator unit and especially the electric motor and gearing have been optimized for use on the F01/F02. That is noticeable in particular by quieter operation during actuation.

The EMF actuator unit is made up of the following main components:

- EMF control unit
- Electric motor
- Gearbox
- Force sensor

Those components are housed in a plastic casing that can not be opened. In the event of a fault, the EMF actuator unit can only be replaced as a complete unit.



Index	Explanation	Index	Explanation
1	Spindle	7	Connector
2	Gearbox	8	Electric motor
3	Splined shaft	9	Control unit circuit board
4	Emergency release mechanism	10	Entry/exit for emergency release cable
5	Force sensor	11	Sleeve nut for left brake cable
6	Sleeve nut for right brake cable		

EMF control unit

As on the E70, the EMF control unit on the F01/F02 is integrated in the actuator unit casing and is also identical in design to the one on the E70. It is the actuation controller for the EMF functions. It therefore controls the electric motor and reads the signals from the force sensor.

The most important control signal from outside is that from the parking brake button. The parking brake button is directly wired to the EMF control unit.

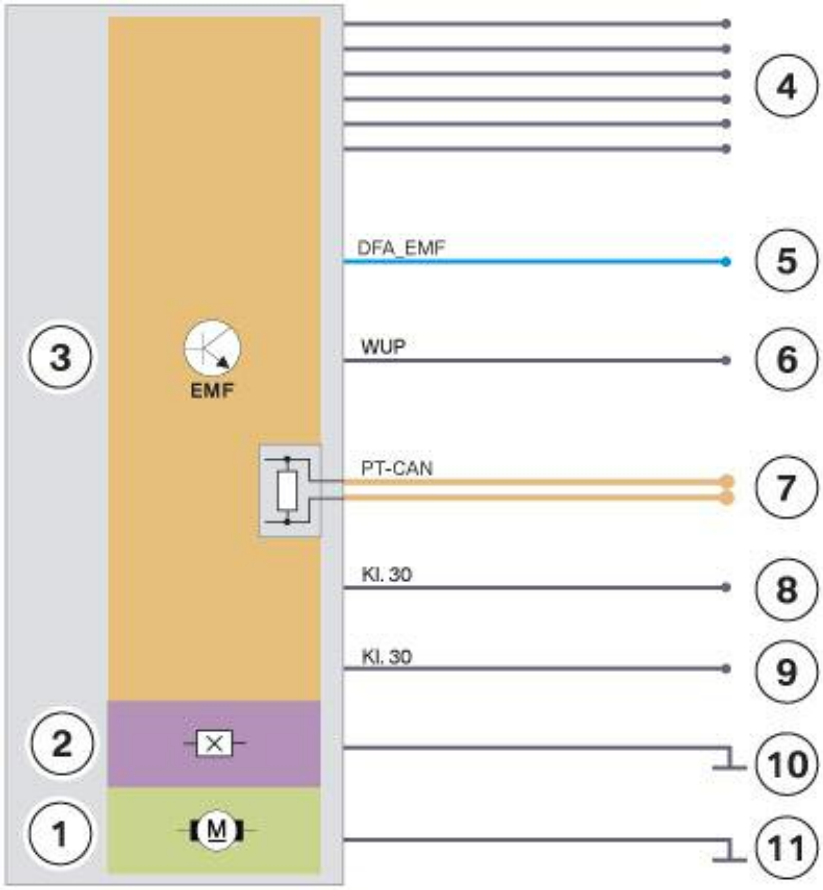
The EMF control unit is connected to the PTCAN. Integrated in the EMF control unit is one of the two terminal resistors for the PT-CAN. The EMF control unit communicates via the PT-CAN with its most important partner, the DSC control unit. As the DSC control unit is only connected to the FlexRay, the central gateway module is required to transfer the signals between the PT-CAN and the FlexRay.

A special place among the input signals is occupied by the information relating to vehicle standstill. The EMF actuator unit must not be activated while the vehicle is moving but rather only when it is stationary. Otherwise, the vehicle handling would become unstable due to the rear wheels locking up. The EMF control unit detects vehicle standstill on the basis of the following three input signals:

- Road speed (provided by Integrated Chassis Management via bus systems)
- Rear axle speed (provided by engine management via PT-CAN)
- Wheel-speed signal “DFA_EMF” (calculated by Dynamic Stability Control and transmitted via direct wired link to EMF control unit).

Only when those three signals definitively indicate vehicle standstill does the EMF control unit allow operation of the actuator unit.

Overview of important connections on EMF actuator unit



Index	Explanation
1	Electric motor
2	Force sensor
3	EMF control unit
4	Signal leads for parking brake button and function indicator lamp
5	DFA_EMF, wheel-speed signal from DSC
6	WUP, wake-up line
7	PT-CAN input with terminal resistor
8	Power supply for EMF control unit (Terminal 30)
9	Power supply for electric motor (Terminal 30)
10	Earth for EMF control unit
11	Earth for electric motor

Force sensor

Technically speaking, the force sensor is a travel sensor that operates according to the Hall effect. Between the two brake cables there is a spring with a defined strength. That strength is stored on the EMF control unit. Therefore, it can determine the force acting on the cables from the change in the length of the spring.

The force acting on the brake cables is an important input variable for the control algorithm on the EMF control unit. When the parking brake is applied, the EMF control unit has to ensure that a specific required force is applied to the brake cables. The EMF control unit calculates that required force on the brake cables directly from the legally required holding force on the wheels. The latter has to be great enough to safely keep the vehicle stationary on an uphill or downhill gradient of up to 20 %.

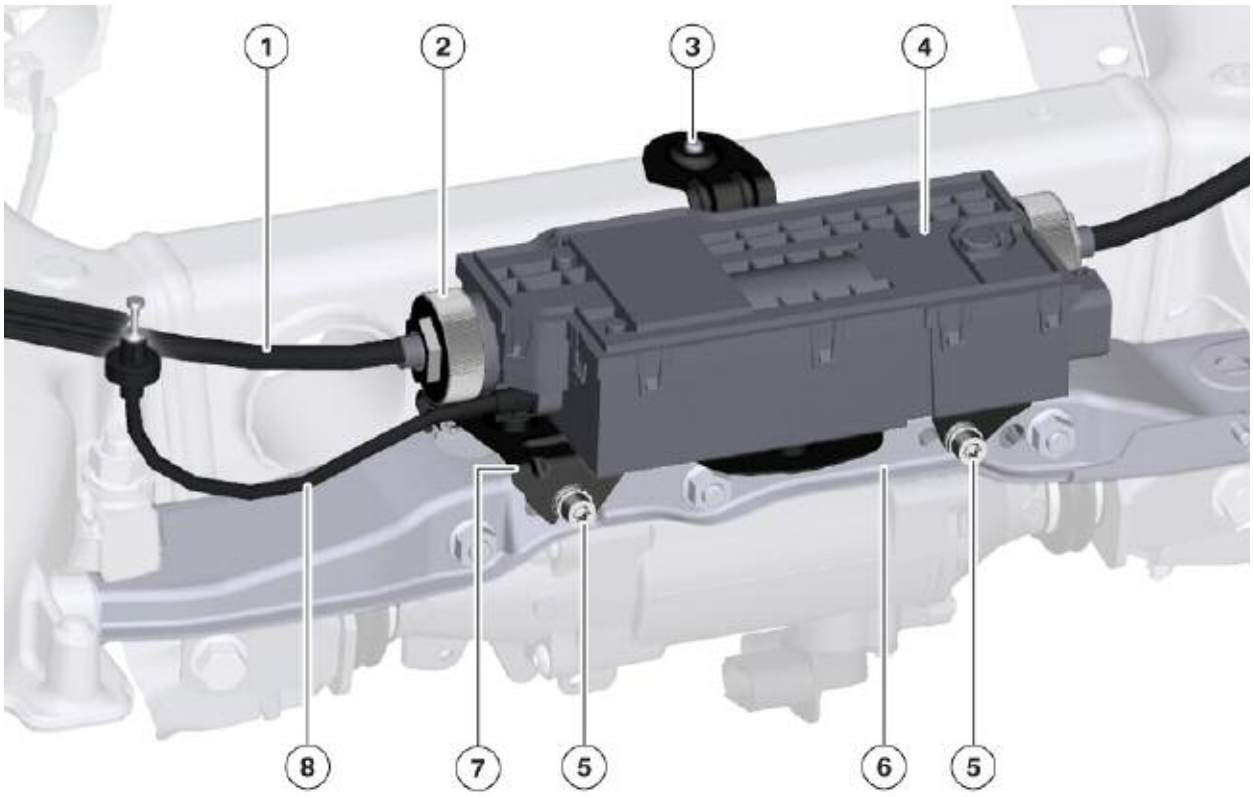
Over the life of the cables, a slight degree of stretching can occur. However, that does not corrupt the force-sensor signal. The spring does not, of course, start to compress until a force is acting on the cables. If, due to stretching, the cables are initially loose when in the released position, then no force is acting on the spring. Only when a force is applied to the cables, and, therefore, to the spring by operation of the electric motor does the spring compress. Then the force sensor sends the appropriate signal to the EMF control unit.

Bracket

To attach the EMF actuator unit to the vehicle's structural components, a multi-angled bracket is used. That design allows the EMF actuator unit itself to remain virtually identical in dimensions (to the one on the E70/ E71). Adaptation to the geometry of the surrounding components on the different vehicles is achieved by the specific design of the mounting bracket.

The bracket for the EMF actuator unit locates at the top on a boss on the rear suspension subframe. Fixing of the bracket at the bottom differs according to whether the vehicle is fitted with Integrated Active Steering or not. Vehicles with Integrated Active Steering have an actuator for the rear-wheel steering on the rear suspension. The bracket for the EMF actuator then rests on the rear-wheel steering actuator bracket. The two brackets are joined by two bolts.

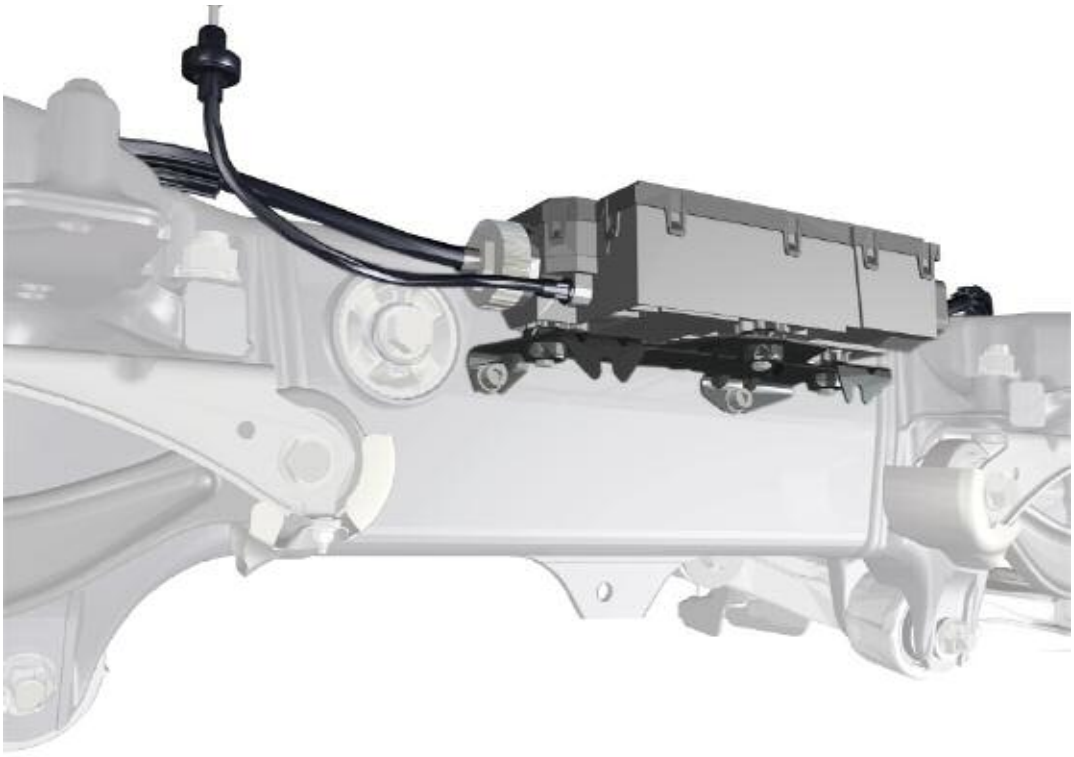
EMF actuator unit bracket and HSR actuator



Index	Explanation	Index	Explanation
1	Left brake cable	5	Bolt joining EMF actuator and HSR actuator brackets
2	Sleeve nut for left brake cable	6	HSR actuator bracket
3	Boss on rear suspension subframe	7	EMF actuator unit bracket
4	EMF actuator unit	8	Emergency release cable

On vehicles without Integrated Active Steering, the bracket for the EMF actuator unit is attached to the rear suspension subframe by the same two bolts.

EMF actuator unit bracket without HSR actuator



Index	Explanation	Index	Explanation
1	Bowden cable, emergency release	6	Bolt fixing EMF actuator to rear suspension subframe
2	Left brake cable	7	EMF actuator unit bracket
3	Sleeve nut for left brake cable	8	Rear suspension subframe
4	EMF actuating unit	9	Track rod
5	Bolt fixing EMF actuator to mounting bracket		

The bracket and the EMF actuator unit itself are also attached to one another by bolts. If replacement is necessary, both the bracket and the EMF actuator unit itself can be ordered as separate parts.

Controls

Parking Brake Button

The parking brake button supplies the EMF control unit with the button operation signal. The signal is duplicated on the parking brake button and transmitted to the EMF control unit via double direct wired connections. It not only enables the EMF control unit to distinguish between the resting position and the two directions of operation (release/apply). Faults can also be detected (e.g. broken circuit, short circuit). If such a fault is detected, the function of the parking brake can still be maintained in most cases.

Parking brake button with function indicator lamp

In contrast with the button on the E70/E71, the parking brake button on the F01/F02 has a function indicator lamp. It is an LED that tells the driver when the parking brake is on. The EMF control unit directly controls that LED.

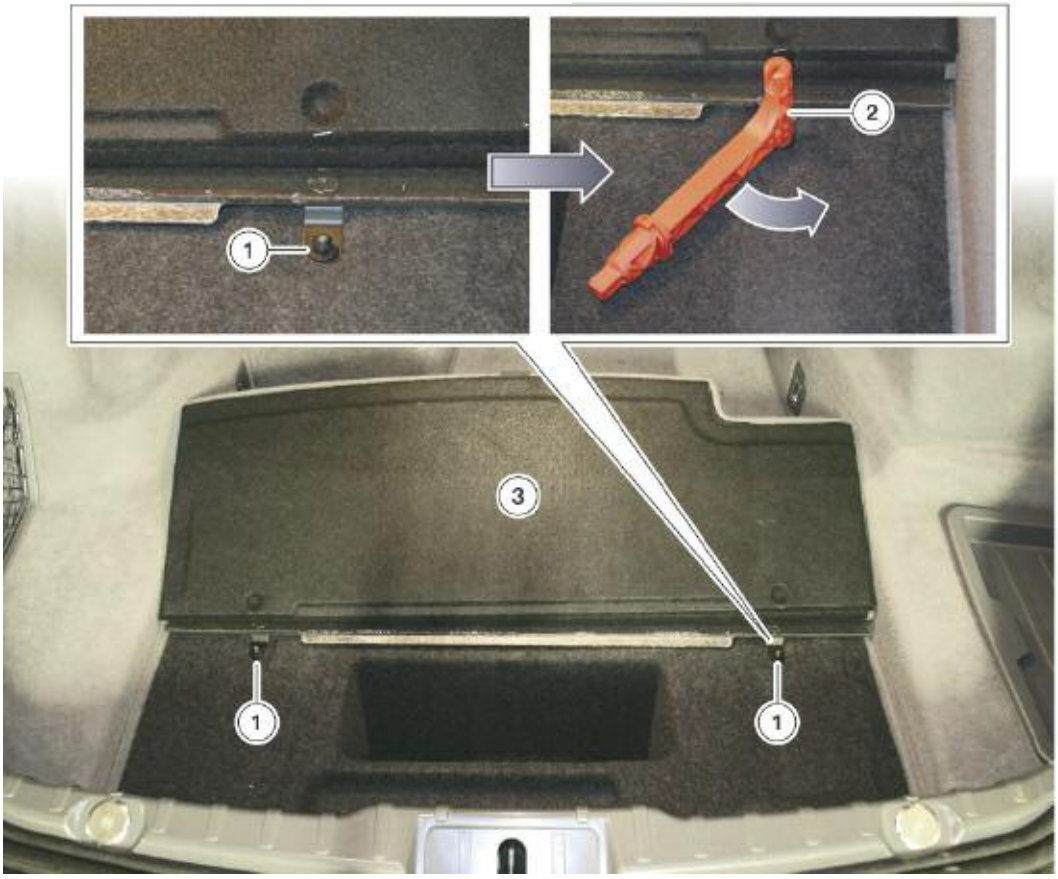
It is important to note that the button directly behind it for the Automatic Hold function is not wired to the EMF control unit but to the DSC control unit.

Emergency release

The cable for emergency release of the parking brake is accessible via the trunk.

However, the cable is located underneath the trunk floor trim, which on the F01/F02 can not be simply taken out.

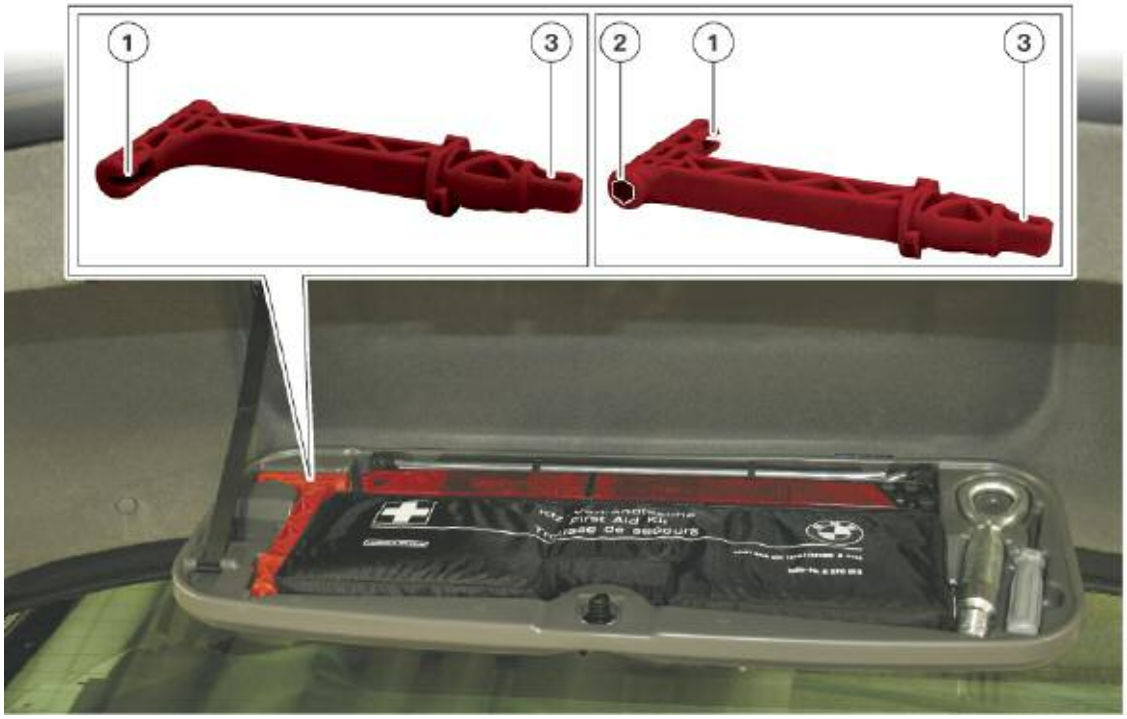
Removing trunk floor trim on F01/F02



Index	Explanation
1	Plastic nut (size 10mm)
2	Emergency release tool
3	Trunk floor trim

Under a flap there are two plastic nuts which fix be removed. The emergency release tool (red the trunk floor trim in place. Those nuts must T-shaped handle) incorporates a plastic first be undone before the trunk floor trim can socket for unscrewing the nuts.

Emergency release tool on F01/F02

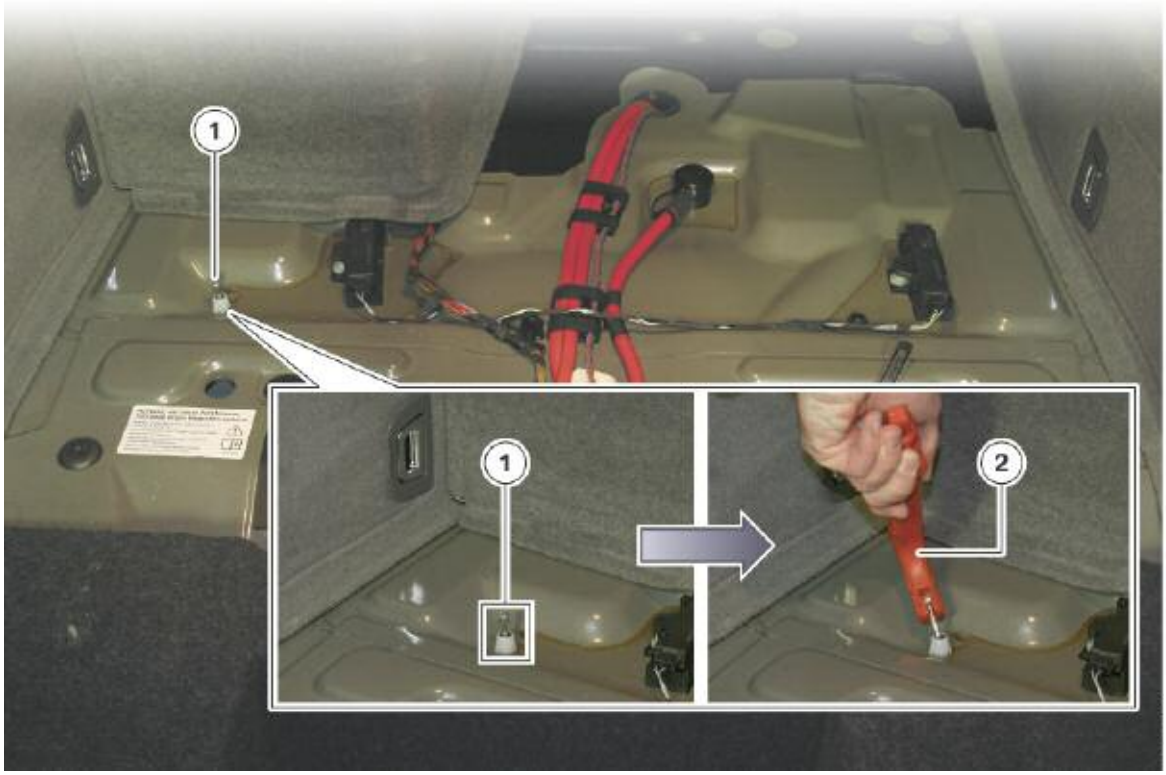


Index	Explanation
1	Slot for accepting the EMF emergency release cable
2	Socket (size 10mm) for unscrewing the plastic nuts on the trunk floor trim
3	Square key for releasing the automatic transmission parking lock

Once the trunk floor trim has been removed, the emergency release cable is directly accessible. The handle of the release tool is hooked onto the end of the emergency release cable by means of the slot provided.

Pulling the cable up operates the emergency release mechanism in the EMF actuator unit. There is a noticeable jolt when it releases. The cables to the two duo-servo parking brakes are then released from the force acting on them. The parking brake is thus released.

Emergency release of electromechanical parking brake on F01/F02



Index	Explanation
1	Bowden cable, emergency release (EMF)
2	Emergency release tool

Electromechanical Parking Brake (EMF)

General details

The electromechanical parking brake (EMF) is applied/released by means of the parking brake button on the center console control panel. The parking brake status is indicated by the function indicator lamp on the button and an indicator lamp on the instrument cluster.

Indication of "parking brake on"

The EMF can be applied in all logical terminal statuses (Terminal 0, Terminal R, Terminal 15, Terminal 50). The conditions for release of the EMF are: Terminal 15 active and brake pedal depressed or automatic transmission parking lock engaged.

Emergency release

The EMF can be released in an emergency by means of a cable. That cable is accessible through the trunk and is under the trunk floor trim. To effect emergency release of the EMF, the red T-shaped handle from the vehicle toolkit is required.

Note: Caution: Secure vehicle to prevent it rolling before operating the emergency release!

Note: After a power supply failure, it may still not be possible to move the vehicle even after releasing the brake with the emergency release facility. The automatic transmission parking lock may still be engaged.

In that case, the parking brake must first be released with the emergency release facility. Then the automatic transmission parking lock must be released using the emergency release facility. The appropriate tool must remain engaged in the parking lock emergency release for that purpose.

Note: When the parking brake is to be used again after an emergency release, it can only be done by pushing in the parking brake button. The familiar conditions for releasing the parking brake must also be met.

Installation mode

Note: Installation mode sets the EMF actuator unit to the installation position (brake cables extended to maximum). It also prevents the EMF being accidentally applied, e.g. when carrying out repairs.

Note: Installation mode can be cancelled either by means of a service function or by driving the car.

Running-in the brakes

While running-in the parking brakes, the EMF applies a defined force to the duo-servo parking brakes.

Note: The function for running-in the parking brakes only has t be carried out if:

- **the linings of the duo-servo parking brakes have been replaced or**
- **the rear brake discs have been replaced.**

Note: The precise procedure for running-in the parking brakes is described in the Repair Instructions under the heading "Adjusting the parking brake". The instructions given there must be followed exactly.

EMF actuating unit

The EMF actuator unit is made up of the following main components:

- EMF control unit
- Electric motor
- Gearbox
- Force sensor.

Note: In the event of a fault, the EMF actuator unit can only be replaced as a complete unit.

Note: The following are available as separate parts:

- **the EMF actuator unit itself**
- **the bracket for the EMF actuator unit and**
- **the cables.**

Note: The EMF control unit detects vehicle standstill on the basis of the following signals:

- **Road speed (from ICM)**
- **Rear axle speed (from DME)**
- **Wheel-speed signal "DFA_EMF" (from DSC).**

Only when those three signals definitively indicate vehicle standstill does the EMF control unit allow operation of the actuator unit.

Note: The EMF control unit is connected to the PT-CAN. Integrated in the EMF control unit is a terminal resistor for the PT-CAN.

Note: The EMF control unit is connected to the wake-up line.

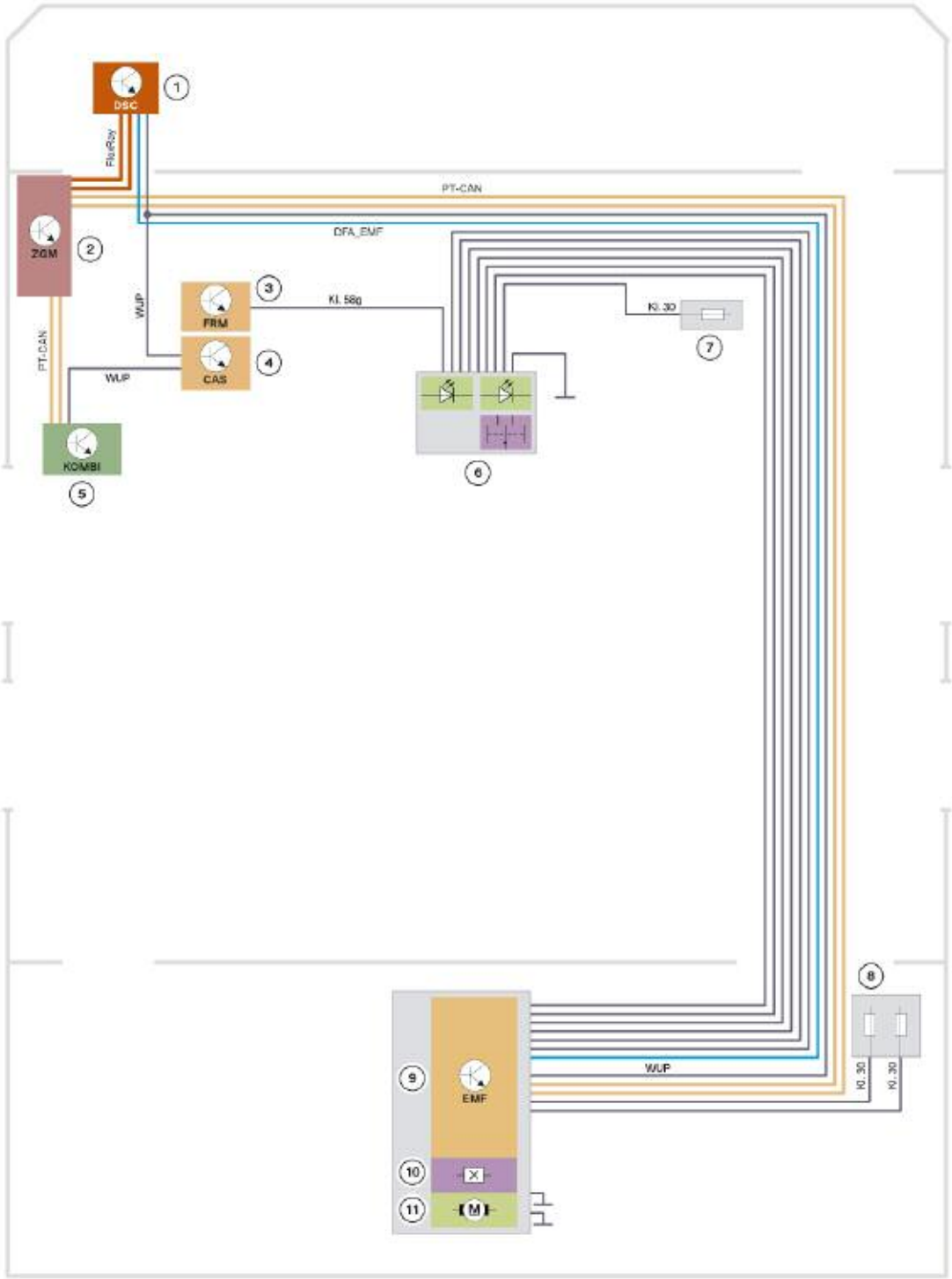
If the driver operates the parking brake button at Terminal 0, the EMF control unit is woken up. The EMF control unit in turn wakes up the other control units on the vehicle via the wake-up line.

Note: On vehicles with the Integrated Active Steering optional extra, the bracket for the EMF actuator unit is bolted to the bracket for the HSR actuator.

On vehicles without Integrated Active Steering, the bracket for the EMF actuator unit is bolted to the rear suspension subframe.

System Circuit Diagram

Electromechanical Parking Brake



Index	Explanation
1	Dynamic Stability Control
2	Central Gateway Module
3	Footwell module
4	Car Access System
5	Instrument cluster
6	Parking brake button with function indicator and illumination
7	Fuse for parking brake button (front fuse board, junction box electronics)
8	Fuses for EMF electronics and electric motor (rear fuse board in trunk)
9	EMF control unit
10	EMF force sensor
11	EMF electric motor