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EMF Parking Brake

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EMF Parking Brake

Model: E89, E65, E66, and F0x vehicles

Production: Start of production

OBJECTIVES

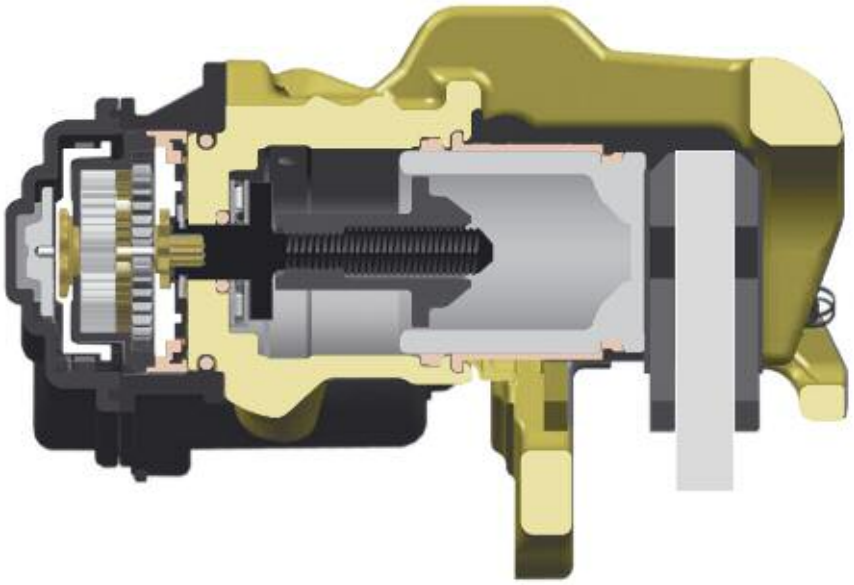
After completion of this module you will be able to:

- Identify and understand the function and features of the different types of parking brakes BMW has to offer.
- Diagnose and service the Electromechanical Parking Brake Systems.
- Place the Electromechanical Parking Brake in the service mode.

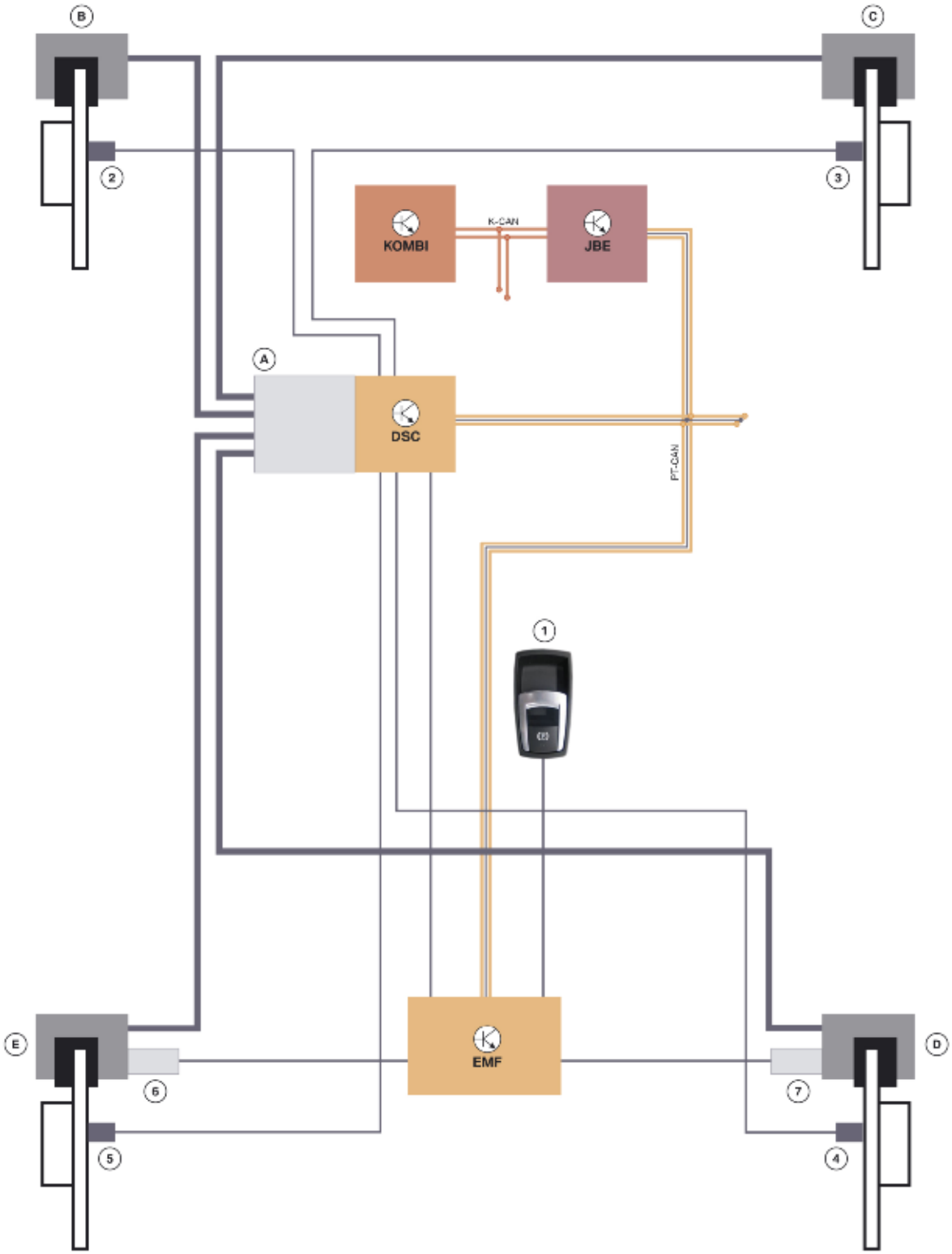
E89, F10, F12 and F25 Parking Brake

For the first time at BMW, the E89 / F10 / F12 and F25 are equipped with an electromechanical parking brake (EMF) integrated in the brake calliper. The use of the EMF offers the following advantages:

- Operation by means of a button ergonomically positioned in the center console.
- Reliable application and release of the electromechanical parking brake (EMF) under all conditions.
- Dynamic emergency braking function also at low friction ensured by the control systems (ABS).
- No parking brake lever means additional storage space in the area of the center console.

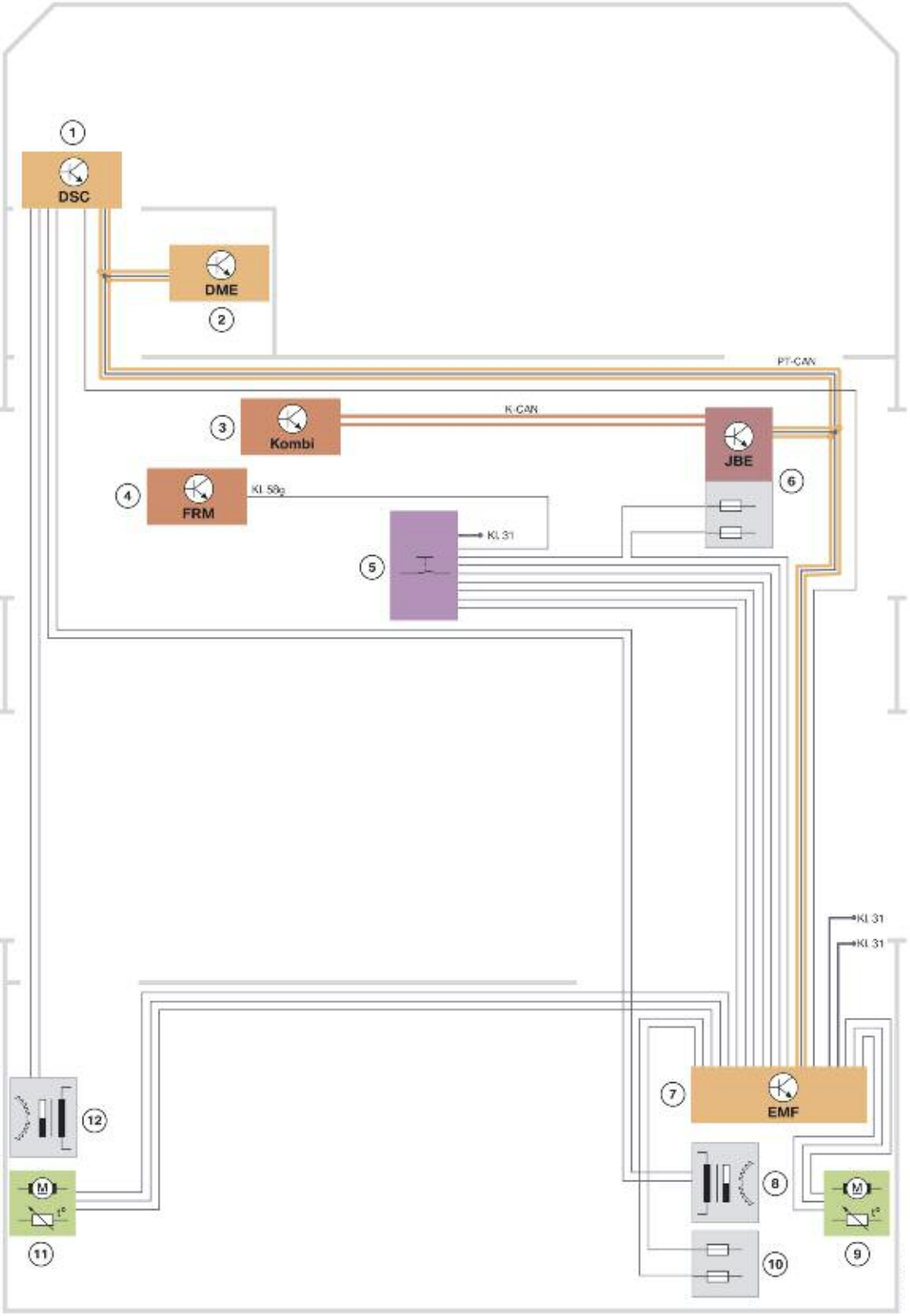


System Overview - E89 Electromechanical Parking Brake (EMF)



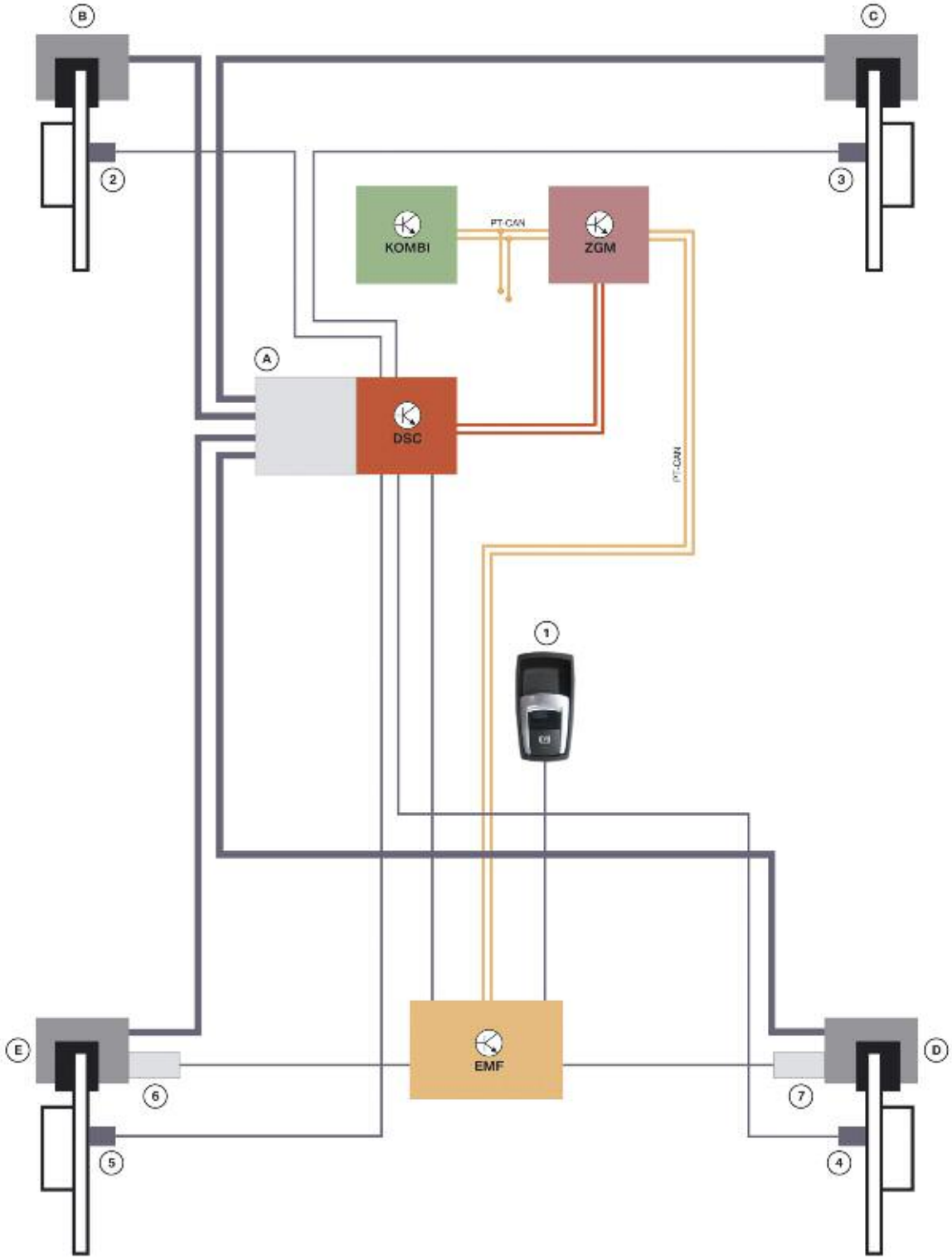
Index	Explanation
A	DSC unit
B	Brake calliper, front left
C	Brake calliper, front right
D	Brake calliper, rear right
E	Brake calliper, rear left
1	EMF button
2	Wheel speed sensor, front left (not used for EMF)
3	Wheel speed sensor, front right (not used for EMF)
4	Wheel speed sensor, rear right
5	Wheel speed sensor, rear left
6	EMF actuator, rear left
7	EMF actuator, rear right
EMF	Electromechanical parking brake (EMF)
DSC	Dynamic stability control
JBE	Junction box electronics
KOMBI	Instrument cluster
PT-CAN	Powertrain-Controller Area Network

System Circuit Diagram - E89 Electromechanical Parking Brake (EMF)



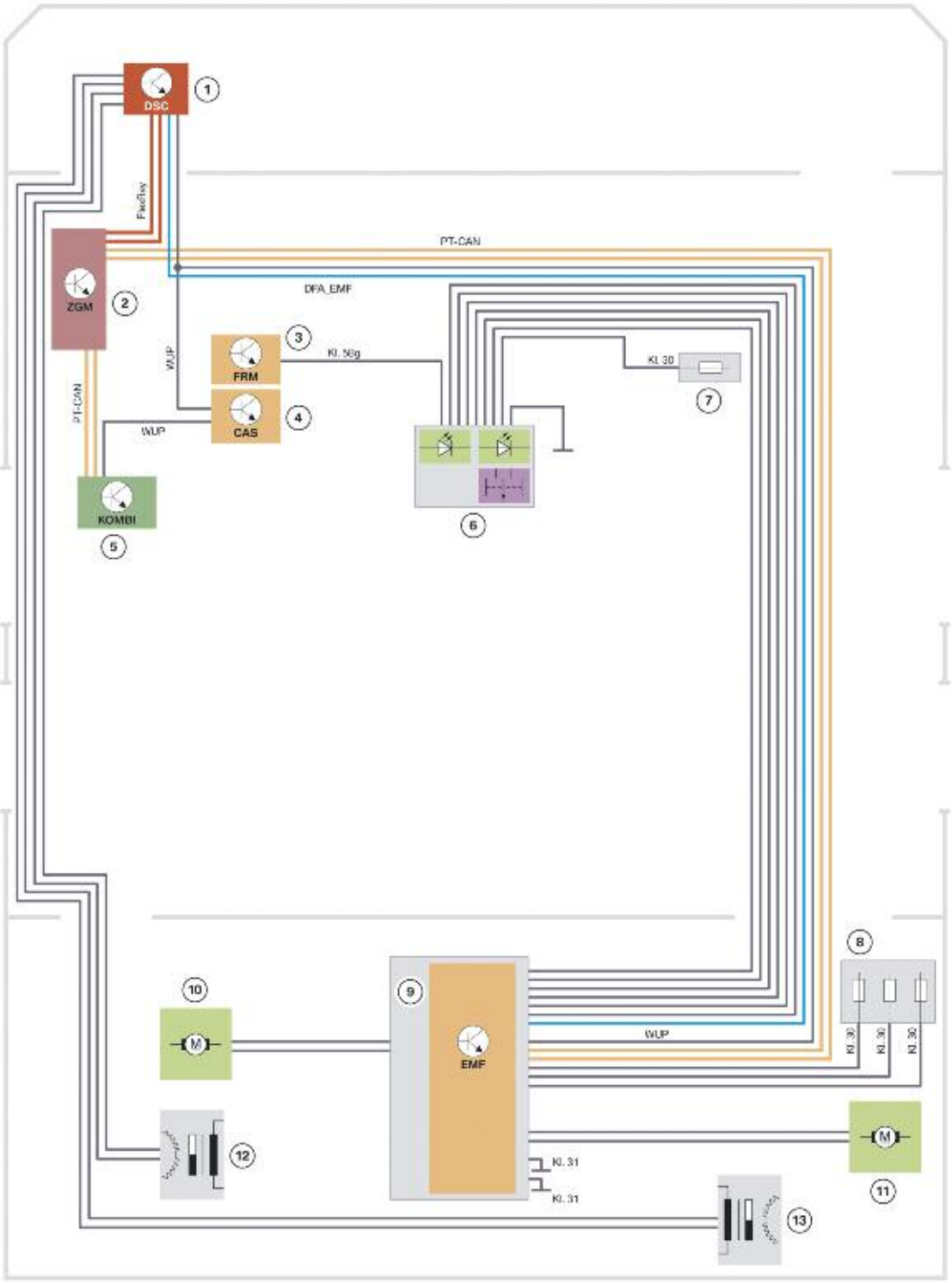
Index	Explanation
1	DSC (Dynamic stability control)
2	DME (Digital motor electronics)
3	KOMBI (Instrument cluster)
4	FRM (Footwell module)
5	EMF button
6	JBE (Junction box electronics)
7	Electromechanical parking brake (EMF)
8	Wheel speed sensor, rear right
9	EMF actuator, rear right
10	Fuses
11	EMF actuator, rear left
12	Wheel speed sensor, rear left

System Overview - F10 Electromechanical Parking Brake (EMF)



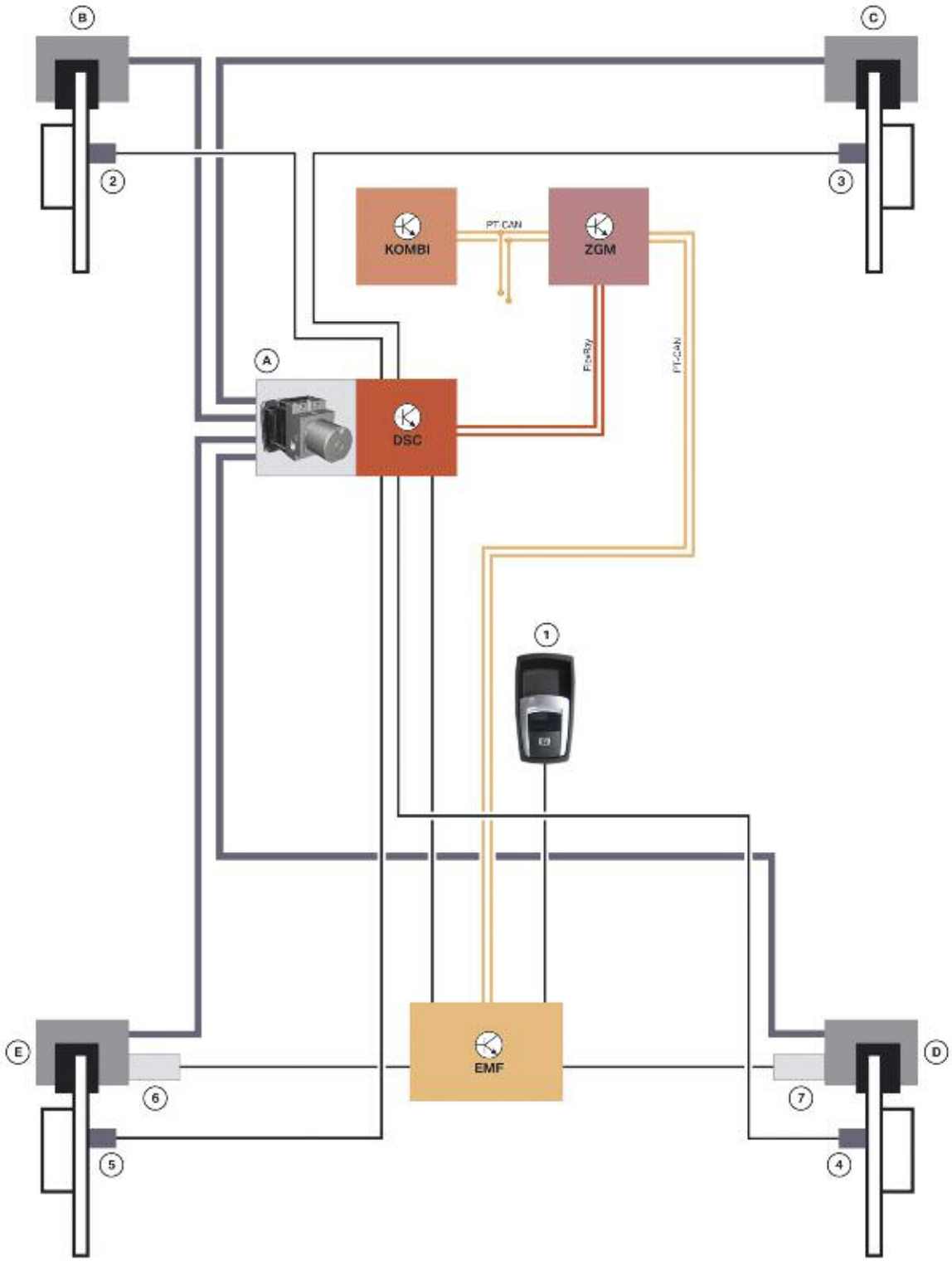
Index	Explanation
A	DSC unit
B	Brake calliper, front left
C	Brake calliper, front right
D	Brake calliper, rear right
E	Brake calliper, rear left
1	EMF button
2	Wheel speed sensor, front left (not used for EMF)
3	Wheel speed sensor, front right (not used for EMF)
4	Wheel speed sensor, rear right
5	Wheel speed sensor, rear left
6	EMF actuator, rear left
7	EMF actuator, rear right
EMF	Electromechanical parking brake (EMF)
DSC	Dynamic stability control
ZGM	Central Gateway Module
KOMBI	Instrument cluster
PT-CAN	Powertrain-Controller Area Network

System Circuit Diagram – F10 Electromechanical Parking Brake (EMF)



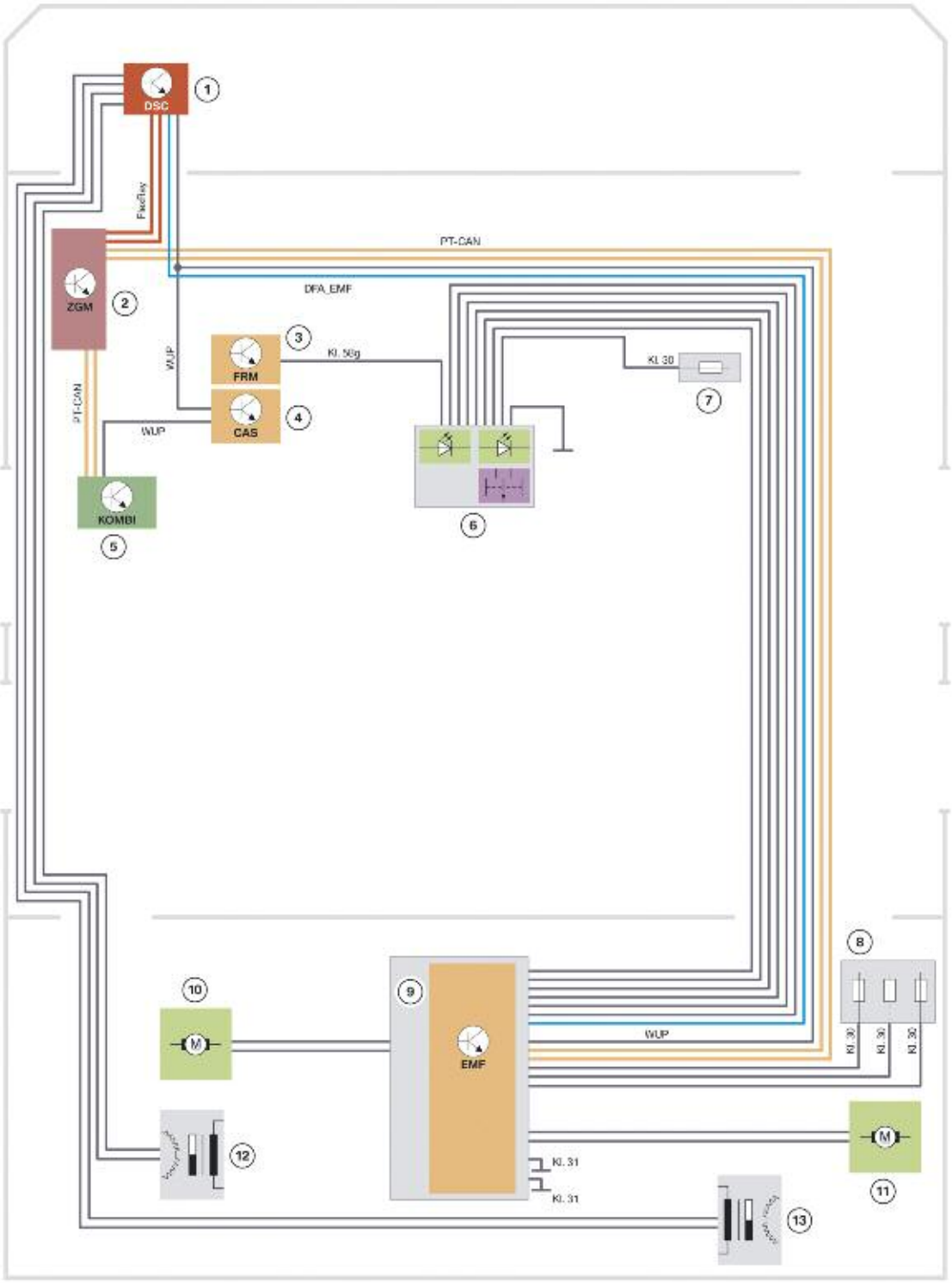
Index	Explanation
1	DSC (Dynamic Stability Control)
2	ZGM (Central Gateway Module)
3	FRM (Footwell module)
4	CAS (Car Access System)
5	KOMBI (Instrument cluster)
6	EMF Button
7	Front power distribution box
8	Rear power distribution box Wheel speed sensor, rear right
9	Electromechanical parking brake (EMF) Control unit
10	EMF actuator, rear left
11	EMF actuator, rear right
12	Wheel speed sensor, rear left
13	Wheel speed sensor, rear right
PT-CAN	Powertrain Controller Area Network
DFA-EMF	Redundant hard wired speed signal from DSC to EMF

System Overview - F12 Electromechanical Parking Brake (EMF)



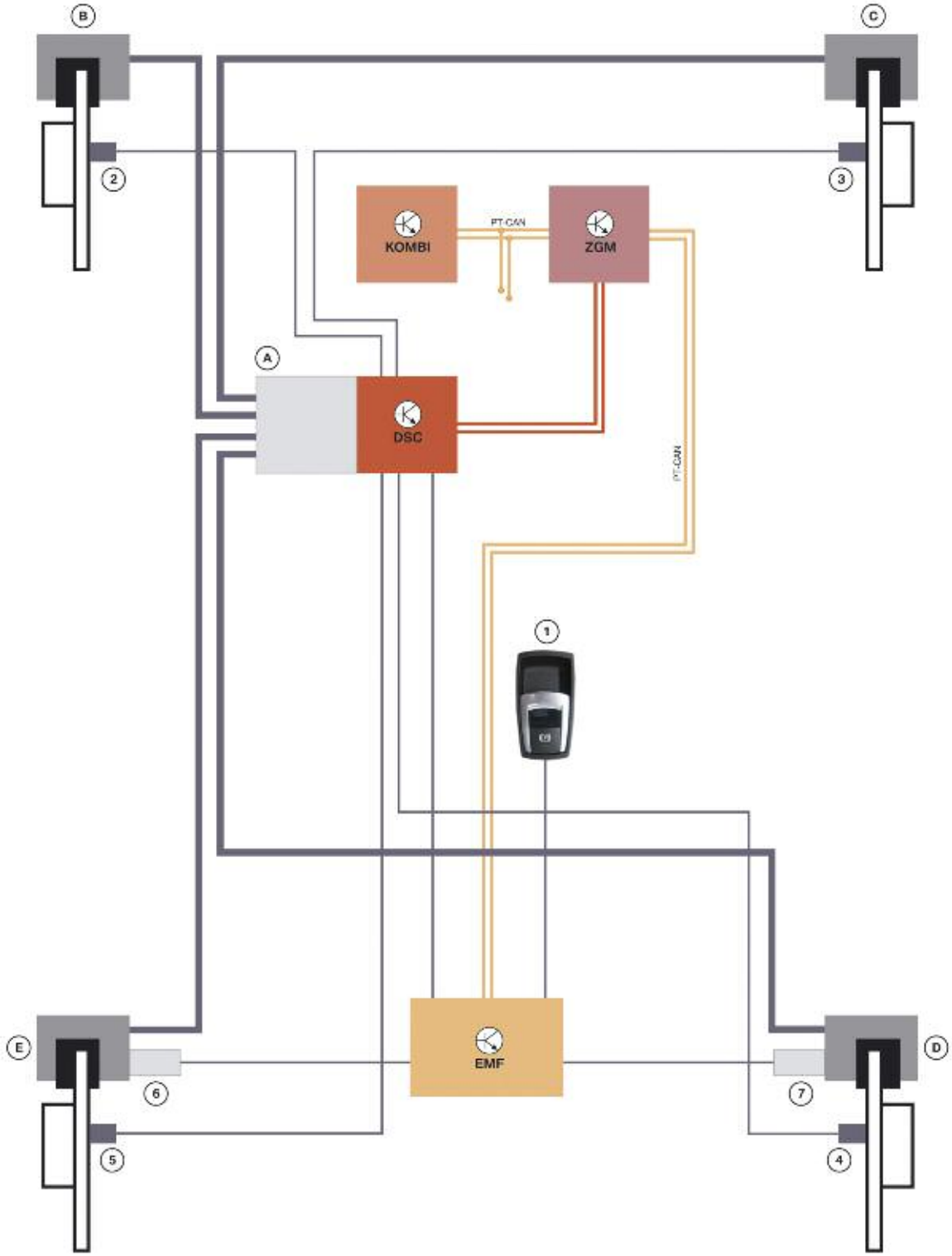
Index	Explanation
A	DSC unit
B	Brake calliper, front left
C	Brake calliper, front right
D	Brake calliper, rear right
E	Brake calliper, rear left
1	EMF button
2	Wheel speed sensor, front left (not used for EMF)
3	Wheel speed sensor, front right (not used for EMF)
4	Wheel speed sensor, rear right
5	Wheel speed sensor, rear left
6	EMF actuator, rear left
7	EMF actuator, rear right
EMF	Electromechanical parking brake (EMF)
DSC	Dynamic stability control
ZGM	Central Gateway Module
KOMBI	Instrument cluster
PT-CAN	Powertrain-Controller Area Network

System Circuit Diagram - F12 Electromechanical Parking Brake (EMF)



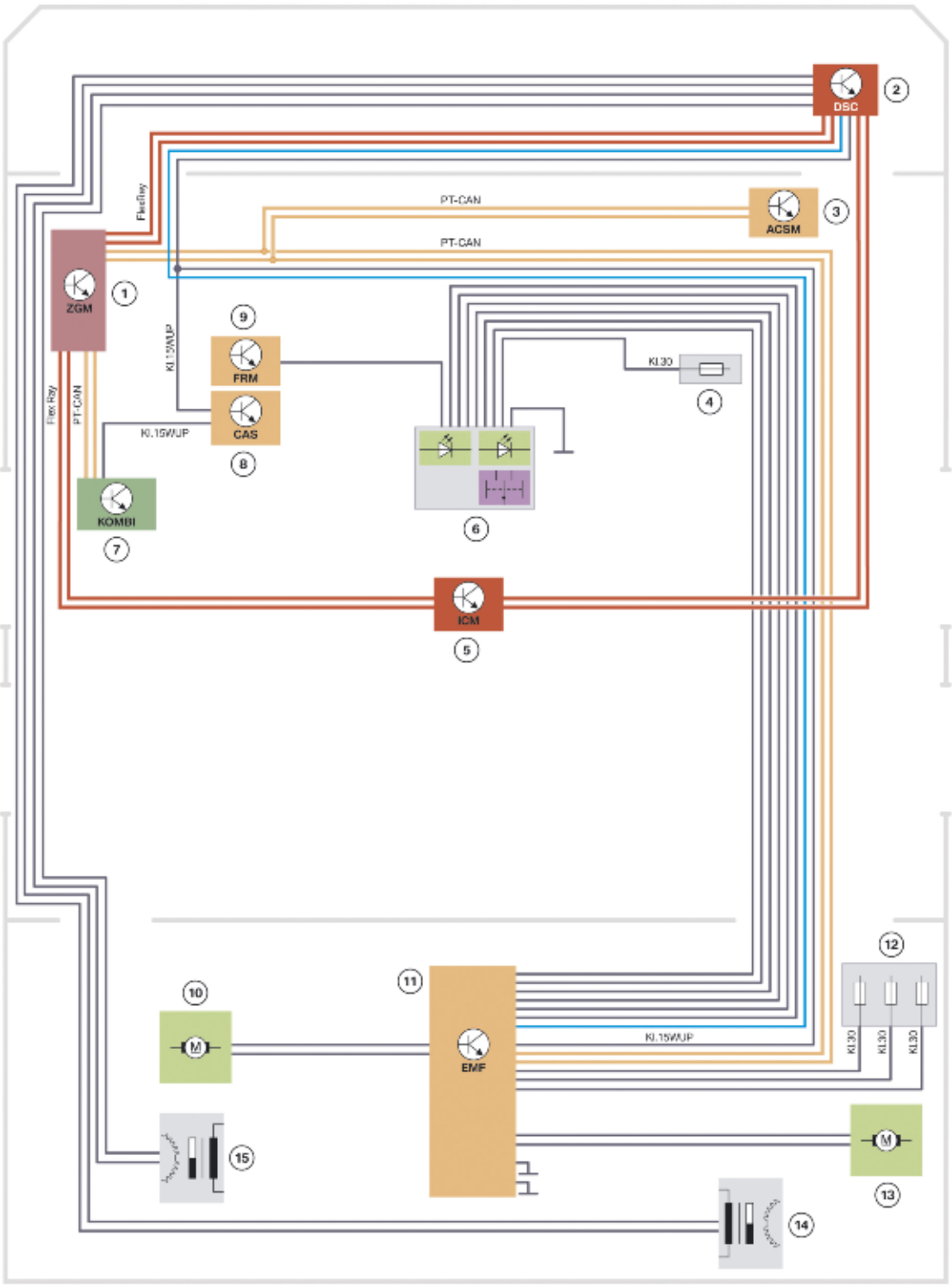
Index	Explanation
1	DSC (Dynamic Stability Control)
2	ZGM (Central Gateway Module)
3	FRM (Footwell module)
4	CAS (Car Access System)
5	KOMBI (Instrument cluster)
6	EMF Button
7	Front power distribution box
8	Rear power distribution box Wheel speed sensor, rear right
9	Electromechanical parking brake (EMF) Control unit
10	EMF actuator, rear left
11	EMF actuator, rear right
12	Wheel speed sensor, rear left
13	Wheel speed sensor, rear right

System Overview - F25 Electromechanical Parking Brake (EMF)



Index	Explanation
A	DSC unit
B	Brake calliper, front left
C	Brake calliper, front right
D	Brake calliper, rear right
E	Brake calliper, rear left
1	EMF button
2	Wheel speed sensor, front left (not used for EMF)
3	Wheel speed sensor, front right (not used for EMF)
4	Wheel speed sensor, rear right
5	Wheel speed sensor, rear left
6	EMF actuator, rear left
7	EMF actuator, rear right
EMF	Electromechanical parking brake (EMF)
DSC	Dynamic stability control
ZGM	Central Gateway Module
KOMBI	Instrument cluster
PT-CAN	Powertrain-Controller Area Network

System Circuit Diagram - F25 Electromechanical Parking Brake (EMF)

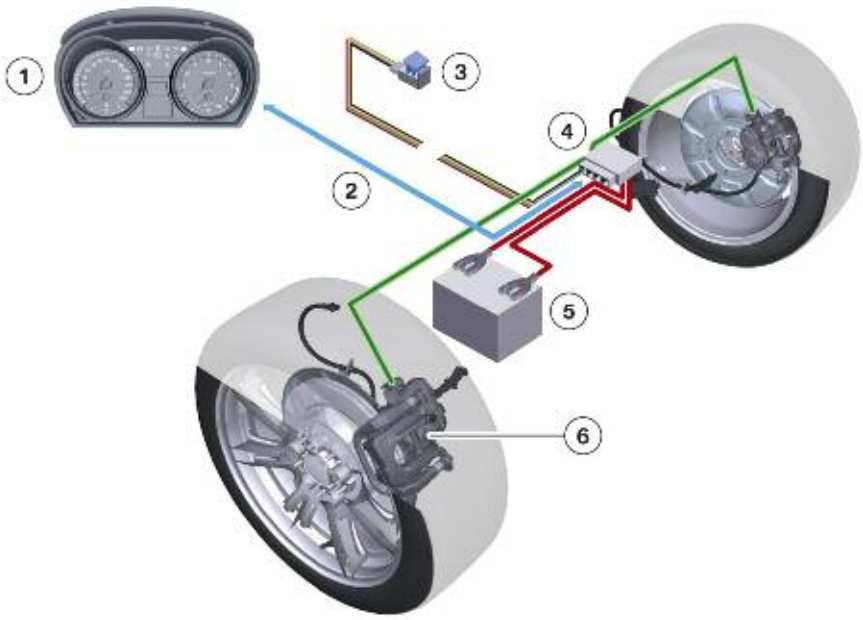


Index	Explanation
1	ZGM (Central Gateway Module)
2	DSC (Dynamic Stability Control)
3	Advanced Crash Safety Module
4	Front power distribution box
5	Integrated Chassis Management (ICM)
6	EMF Button
7	KOMBI (Instrument cluster)
8	CAS (Car Access System)
9	FRM (Footwell module)
10	EMF actuator, rear left
11	Electromechanical parking brake (EMF) Control unit
12	Rear power distribution box
13	EMF actuator, rear right
14	Wheel speed sensor, rear right
15	Wheel speed sensor, rear left

Principles of Operation

The EMF control unit receives the driver's choice to apply the parking brake from the EMF button on the center console. The vehicle status is determined via the link to the electrical system and the bus systems and the control unit decides whether all conditions for applying the brake are met. If this is the case, the two EMF actuators on the rear brake callipers are actuated.

EMF System Overview



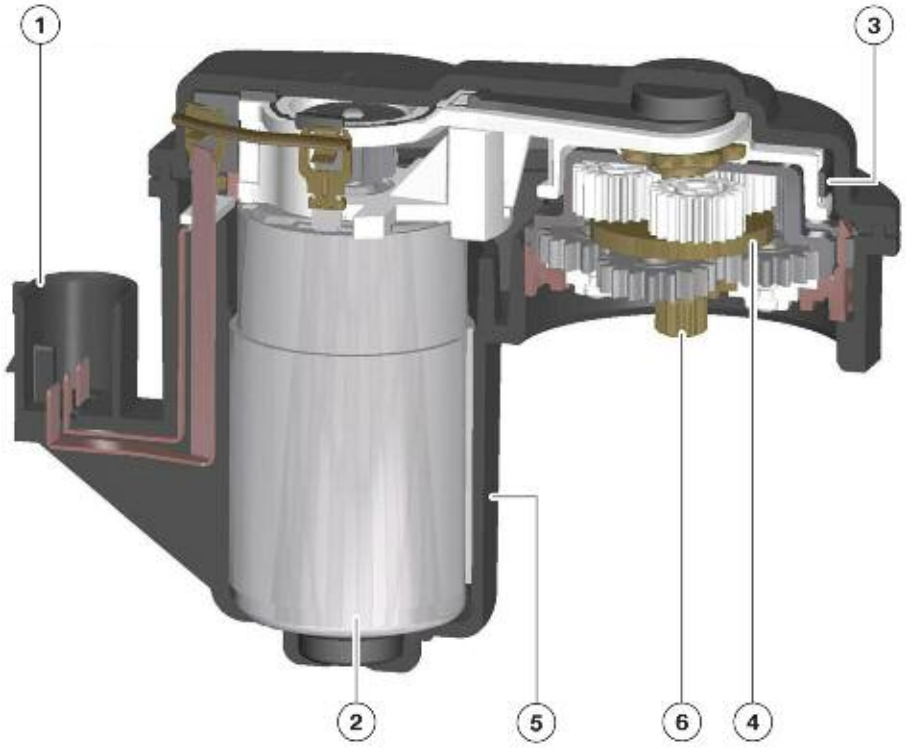
Index	Explanation
1	Instrument cluster
2	Information flow
3	EMF button
4	EMF control unit
5	Battery
6	EMF actuator

Due to the self-locking characteristics of the spindle, the tension is retained even when no power is applied, thus firmly holding the vehicle. On reaching the required force, the applied brake status is indicated by a red indicator lamp in the instrument cluster and an additional red LED in the EMF button.

Function of the EMF Actuator

The EMF actuator is mounted on the brake calliper and pushes directly on the back of the “normally” hydraulically operated brake piston.

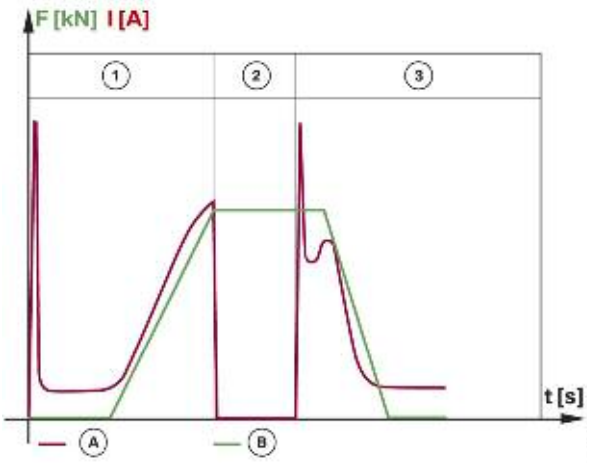
Design of EMF actuator



Index	Explanation
1	Plug connection
2	Electric motor
3	Drive belt
4	Planetary gear
5	Housing
6	Connection to spindle

The force is transmitted via electric motor (2) and drive belt (3) to a two-stage planetary gear train (4). Spindle (4) shown in the following graphic is driven by spindle connection (6). Spindle (4) in the spindle nut with anti-twist lock (2) in brake piston (3) provides the self-locking effect. The force is transmitted via the spindle and spindle nut with anti-twist lock to brake piston (3). As in hydraulically operated systems, the brake piston acts on the brake pads that are forced against the brake disc. Due to the self-locking effect of the spindle in the spindle nut with anti-twist lock, the tension is retained and the vehicle is held firmly even when no power is applied.

E89 EMF voltage and force curve

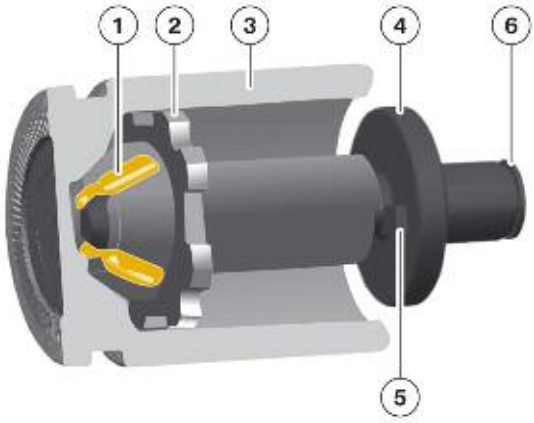


Index	Explanation
A	Force curve
B	Voltage curve
1	Applying EMF
2	EMF applied
3	Releasing EMF

Brake Piston

The brake fluid can flow via grooves (1), past the spindle nut, to ensure the brake system is completely bled. The screw-in travel is limited by spindle stop (5). This therefore prevents tightening and blocking when in open state.

Spindle and spindle nut in brake piston



Index	Explanation
1	Groove
2	Spindle nut with anti-twist lock
3	Brake piston
4	Spindle
5	Spindle stop
6	Connection to planetary gear

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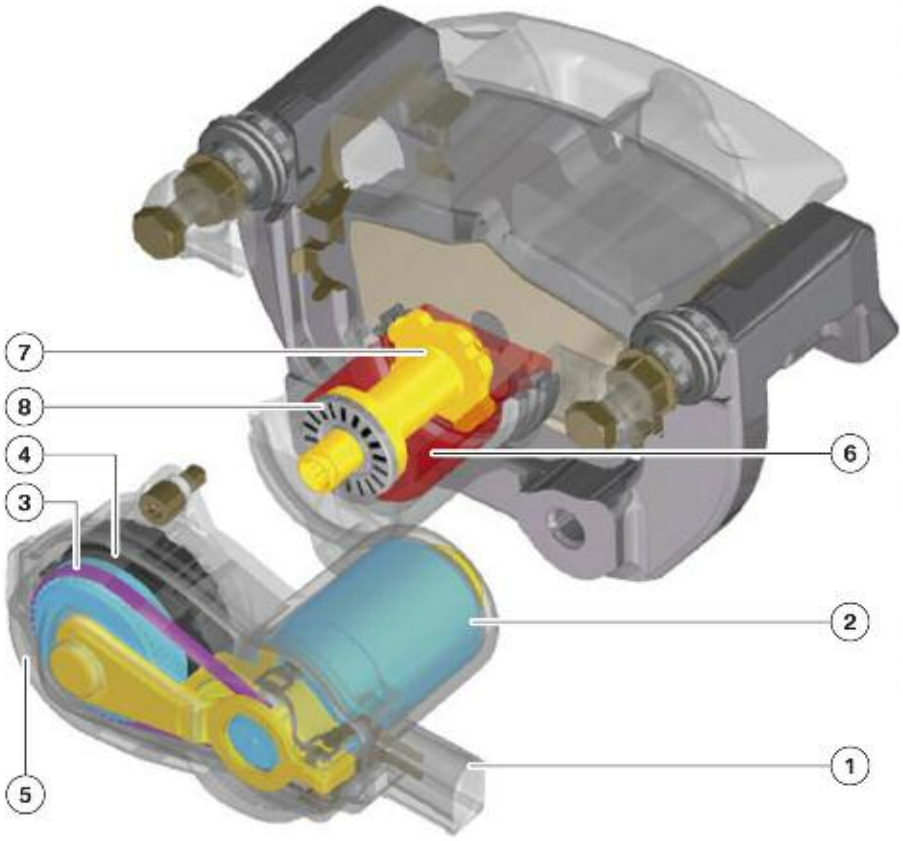
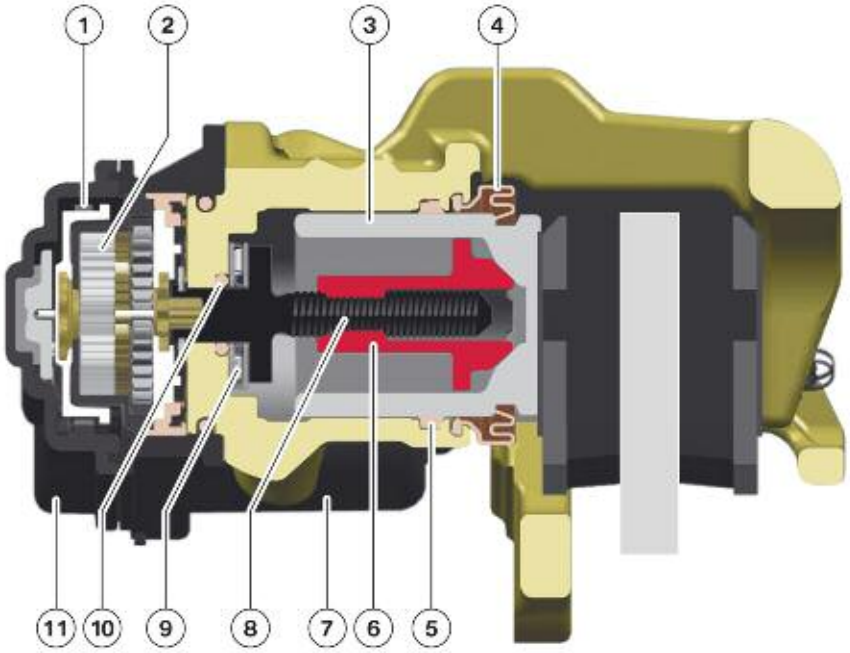
Overview of EMF actuator with brake calliper



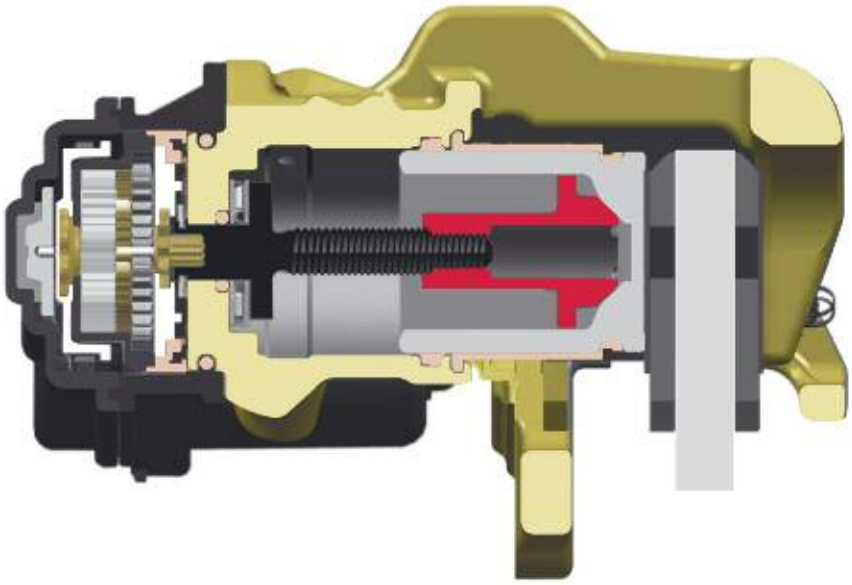
Index	Explanation
1	Plug connection
2	Electric motor
3	Drive belt
4	Planetary gear
5	Housing
6	Brake piston
7	Spindle with spindle nut
8	Roller bearing

Parking brake applied with new brake pads

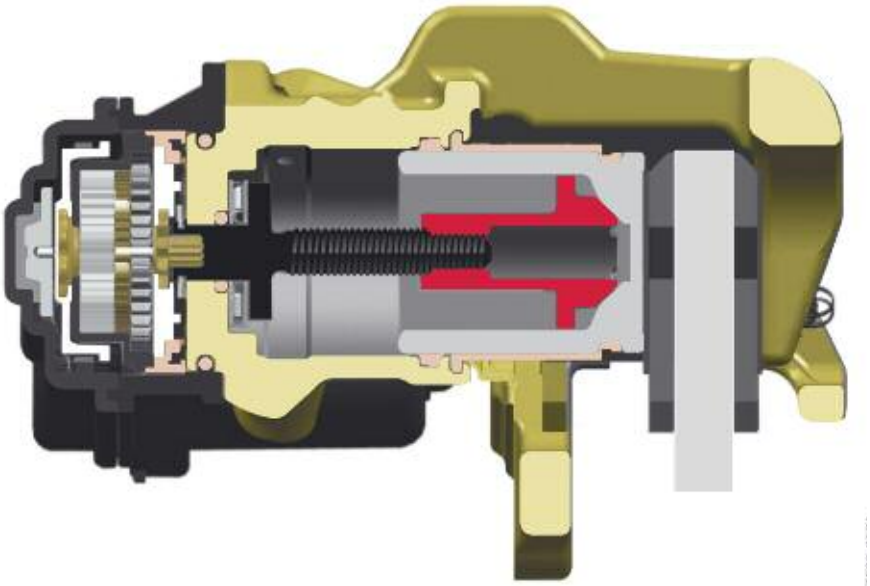


Index	Explanation
1	Drive belt
2	Planetary gear
3	Brake piston
4	Dust sleeve
5	Seal
6	Spindle nut
7	Electric motor
8	Spindle
9	Roller bearing
10	Seal
11	Housing

E89 Parking brake applied with worn brake pads



Parking brake released with new brake pads



Applying the Parking Brake

The driver can apply the parking brake by pulling the EMF button. The operating direction is the same as that of the mechanical handbrake lever.

The signal from the EMF button is read by the EMF control unit. The EMF control unit individually activates the EMF actuators at the wheel brake.

The parking brake can be applied in any logical terminal status. Applying the parking brake at terminal 0 is made possible by connecting terminal 30 to the EMF control unit. The EMF control unit is woken up when the driver operates the EMF button at terminal 0. In turn, the EMF control unit wakes the other control units in the vehicle. Only then does the EMF control unit receive the important information on the stationary status of the vehicle. In addition, the change status of the parking brake can be indicated after waking the control unit.

The parking brake applied status is indicated by a red LED in the EMF button and by the EMF indicator lamp in the instrument cluster. If the parking brake is already applied, pulling the EMF button again will have no effect.

Indicator lamp, parking brake applied

Rolling Monitor with Parking Brake Applied

This monitoring function is designed to prevent the vehicle from rolling with the parking brake applied. The rolling monitor is always activated when the status of the parking brake changes from released to applied and ends after a defined period of time after this status change.

The function ends:

- when a fault occurs that prevents mechanical retensioning.
- when the vehicle assumes sleep mode, the control unit is switched off or reset.

The DSC uses the wheel speed signal as the input variable for rolling detection. The tension at the EMF actuators is immediately increased as soon as this signal indicates that the vehicle is starting to roll during rolling monitoring. During the retensioning phase, the tensioning force is increased until the vehicle no longer rolls or a maximum tensioning force is reached.

Temperature Monitoring

The task of the temperature monitoring function is to compensate for the loss of force that occurs when the hot brake disc cools down. Temperature monitoring is activated when the temperature exceeds a defined value as the status of the parking brake changes from released to applied.

The DSC control unit calculates the brake disc temperature at the individual wheels and sends the corresponding value to the EMF control unit. During the status change, the higher temperature of the two brake discs is taken for the temperature monitoring function. A characteristic map contains the corresponding temperature ranges with the associated retensioning times.

The corresponding retensioning times in the characteristic map are activated depending on the temperature during the status change. The tension is increased once when the first retensioning time is reached. The tension is then increased again after the second retensioning time has elapsed and increased yet again after the third. The characteristic map may also contain the value 0 for one or several retensioning times. In these cases, the corresponding increase in tension does not take place. The function ends under following conditions:

- Occurrence of a fault that prevents retensioning
- The control unit is switched off or reset
- The last retensioning step has already been executed

Releasing the Parking Brake

The EMF button is pushed down to release the parking brake. For the parking brake to actually release, terminal 15 must additionally be on and at least one of the following conditions must apply:

- Brake pedal pressed or
- Parking lock of automatic gearbox engaged or clutch pedal pressed (only vehicle with manual gearbox).

This prevents the vehicle from inadvertently rolling if, for example, the EMF button is pressed by another occupant instead of the driver. The LED in the EMF button and the EMF indicator in the instrument cluster go out when the parking brake is released.

Activation of the EMF actuator causes the spindle to rotate. The rotation of the spindle causes the spindle nut to move a short defined distance from the brake piston.

Dynamic Emergency Braking

Two operating units for the brake are required by law. Besides the brake pedal, the second operating unit is the EMF button in the center console. Pulling the EMF button while driving triggers dynamic emergency braking with a defined sequence via the DSC system. This function is intended for emergencies when the driver can no longer slow down the vehicle using the brake pedal. Other occupants can also stop the vehicle in this way should, for example, the driver suddenly become unconscious.

During dynamic emergency braking, hydraulic braking pressure is built up at all four wheel brakes. The DSC functions are fully active and the brake lights come on. This is an important advantage compared to a manual parking brake.

Dynamic emergency braking takes place only for as long as the driver is pulling the EMF button. The deceleration initiated by the DSC is increased in ramps. The EMF indicator lamp in the instrument cluster is activated during dynamic emergency braking. In addition, a check control message is given together with an acoustic signal in order to warn the driver of this adverse situation.

The DSC control unit prioritizes if the driver attempts to slow down the vehicle by simultaneously pressing the brake pedal and pulling the EMF button. The higher deceleration request is implemented. If dynamic emergency braking is continued until the vehicle comes to a stop, the parking brake will remain applied even after the EMF button is released. The EMF indicator lamp in the instrument cluster remains active. The driver can then release the parking brake (see Releasing the Parking Brake).

Parking Brake Fault

The EMF indicator lamp in the instrument cluster lights yellow to indicate a fault in the parking brake. A check control message is also output.

Indicator lamp, parking brake fault

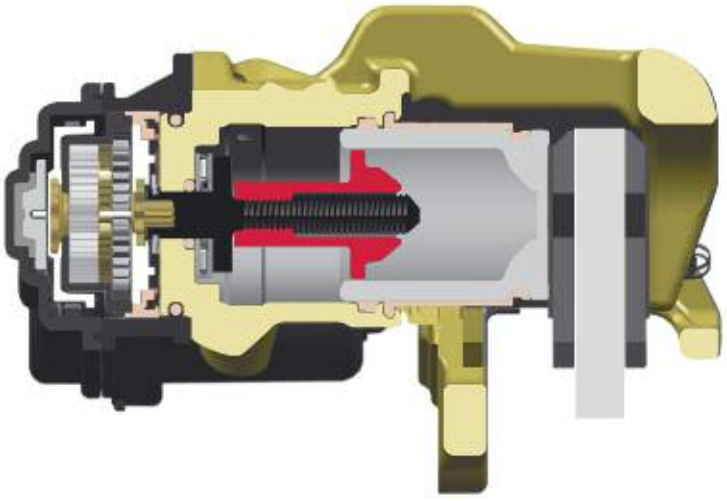
Emergency Release

No parking brake emergency release function is provided for the customer. The parking brake can be released using the BMW diagnosis system or the EMF actuators are removed and the spindle is turned back manually.

Changing Brake Pads

To change the brake pads, the EMF actuator must be in the fully opened position so that the brake piston can be pushed back. The BMW diagnosis system can be used to actuate the EMF actuators and assume the fully opened position. This position is necessary to change the brake pads. Installation mode is set automatically on reaching the installation position.

Parking brake with spindle nut in installation position for changing brake pads



For safety reasons, the parking brake cannot be activated for as long as the EMF control unit is in installation mode. If the EMF button is pulled, the EMF indicator lamp in the instrument cluster will flash yellow.

Installation mode can be cancelled in two ways:

- By carrying out the service function Reset Installation Mode with the aid of ISTA.
- By driving the vehicle and exceeding a programmed minimum speed.

After being changed, the brake pads must be bedded-in. This is necessary to ensure the brake pad and brake disc pairing assumes the specified friction parameters. Only then will the required braking force be reached.

The exact procedure for bedding-in the service brakes is described in the Repair Instructions. The instructions must be followed exactly.

Brake Test Rig Recognition

The EMF control unit recognizes the brake test rig based on a plausibility check (wheel speed comparison) and assumes brake test rig mode. The following target positions are assumed in succession by pulling the EMF button several times:

- Brake pads applied
- Force 1 for brake test rig
- Force 2 for brake test rig
- Target force

The EMF indicator lamp flashes slowly when brake test rig mode is activated and the EMF actuators are released.

The EMF indicator lamp begins to flash fast when brake test rig mode is activated and EMF actuators are partially applied.

The EMF indicator lamp lights permanently when brake test rig mode is activated and EMF actuators are fully applied.

The parking brake can be released on the brake test rig without pressing the brake pedal or clutch pedal.

Brake test rig mode is automatically cancelled on exiting the brake test rig. The mode is also deactivated by pressing the EMF button or if a fault occurs.

Description	Check control message	Central information display	General brake indicator lamp	Parking brake indicator lamp	Check control symbol
For safety reasons, the parking brake can only be released with the service brake pedal depressed	Additionally press foot brake Manual gearbox: Additionally press foot brake or clutch	-	-	-	
The driver must immediately be made aware of a fault in the EMF button	-	-	-		-
Parking brake applied mechanically	-	-	-		-
Redundant EMF button fault, workshop visit required as soon as possible	Parking brake fault!	Parking brake fault. Have checked by BMW Service dealer	-		
Mechanical application of parking brake no longer possible, dynamic emergency braking (emergency brake function) still available	Parking brake fault!	Parking brake fault. Not operative when vehicle stationary. Emergency braking function still possible. Have checked by nearest BMW Service dealer.	-		

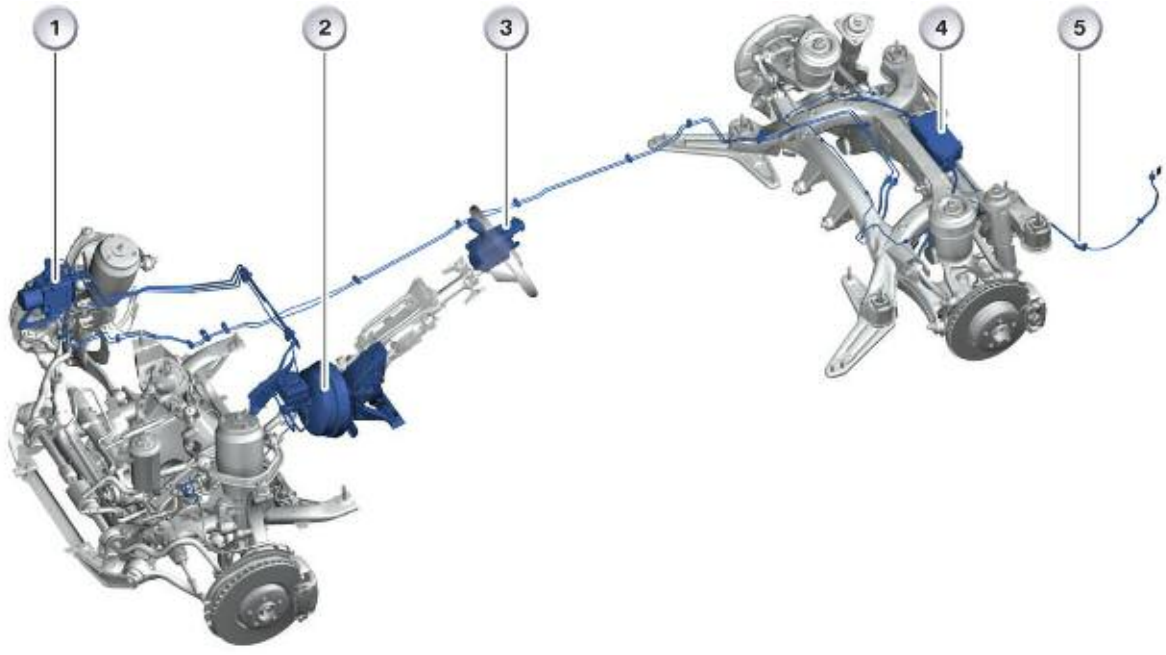
Description	Check control message	Central information display	General brake indicator lamp	Parking brake indicator lamp	Check control symbol
Dynamic emergency braking (emergency brake function) no longer possible, mechanical brake application still possible	Parking brake fault!	Parking brake fault. No emergency braking function. Parking brake can be applied with vehicle stationary. Have checked by your BMW Service dealer.	-		
Parking brake completely failed, mechanical parking brake cannot be applied, no emergency braking function	Parking brake failed!	Parking brake failed. Secure vehicle to prevent it rolling away. Have checked by nearest BMW Service dealer.			
Warning when driving off - parking brake or dynamic emergency braking applied	Release parking brake	-	-		
Installation mode (only with EMF button operated)	-	-	-		-

E70, E71, F01, F02, F04, and F07 Parking Brake

Parking Brake Functions

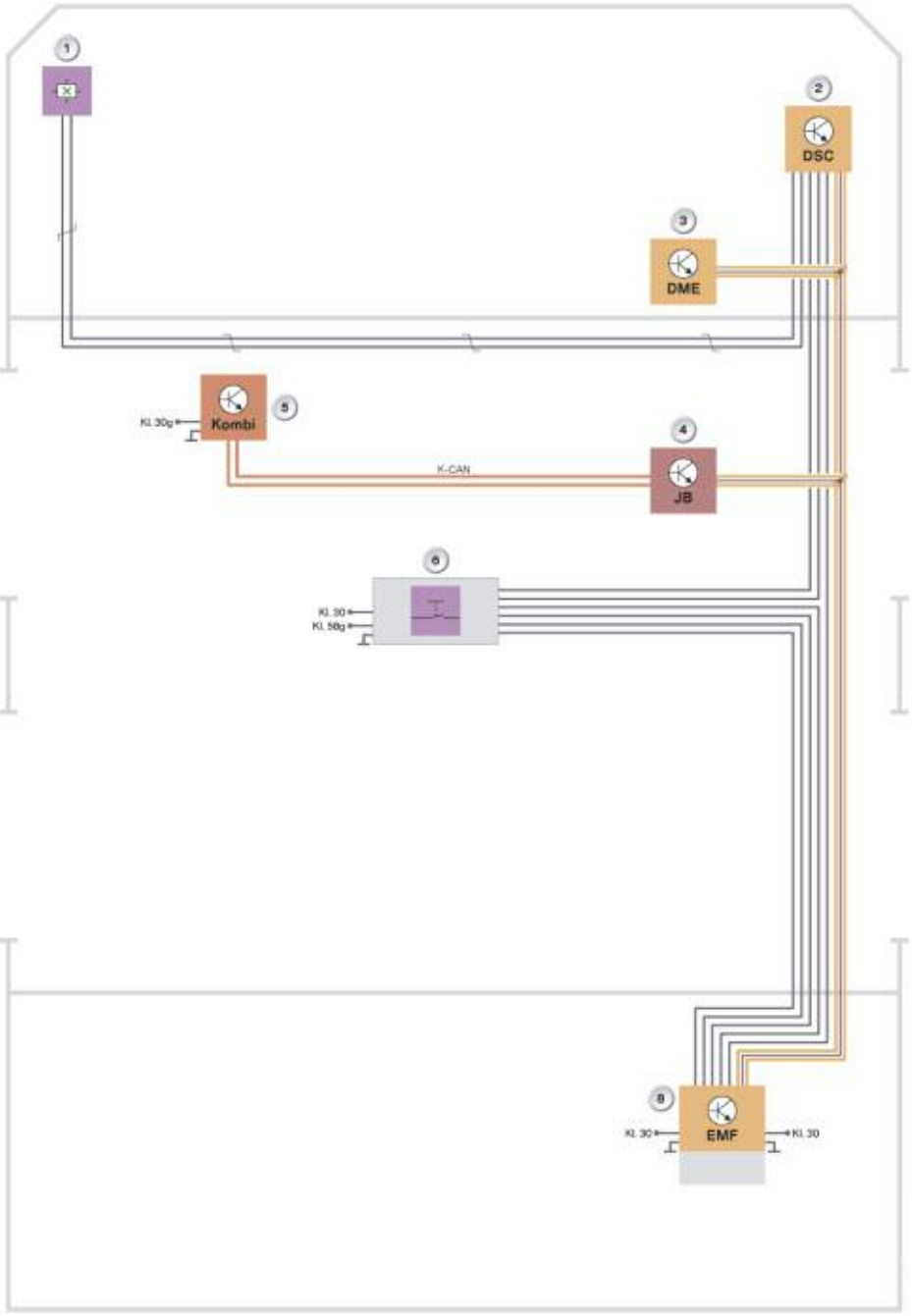
The parking brake (EMF) has two different functions, depending on the operating status of the vehicle.

- Parking brake mode
  - When the engine is running or the vehicle is rolling, the parking brake acts on the service brake with the aid of the DSC hydraulics. This means the brake units on the front and rear axle are active.
  - If the engine is not running and the vehicle is stationary, the electromechanical actuator and its cable assembly ensure the parking brake acts on the duo-servo drum brake on the rear axle. In this case, the vehicle is braked as defined in the control unit.
- Dynamic braking
  - Defined retardation is triggered via the DSC system if the parking brake button is pulled up while driving. The retardation or deceleration is monitored by the DSC control functions and takes place for as long as the parking brake button is pulled.



Index	Explanation	Index	Explanation
1	DCS unit	4	EMF actuator
2	Brake master/booster	5	Bowden cable, emergency release
3	EMF switch		

System Circuit Diagram - E70 Electromechanical Parking Brake (EMF)



Legend for EMF Schematic Circuit Diagram

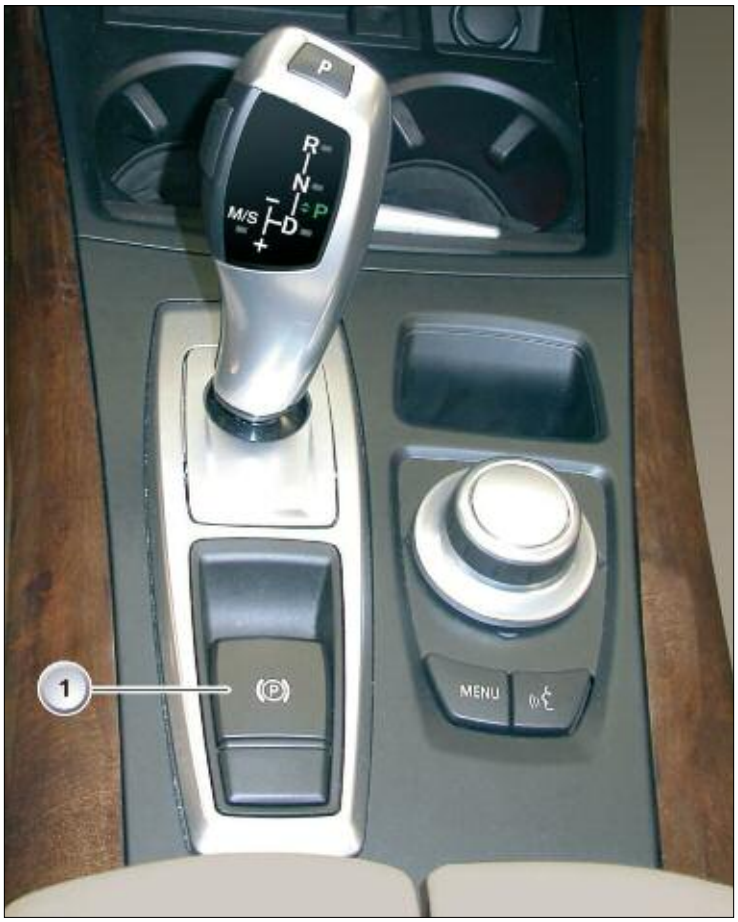
Index	Explanation	Index	Explanation
1	Wheel-speed sensor, front left	5	Instrument cluster
2	Dynamic stability control	6	Gear selector lever
3	Digital motor electronics	7	EMF actuating unit
4	Junction-box ECU		

EMF Button

The EMF button or the parking brake is located in the center console next to the gear selector lever.

The EMF button is based on the function logic of a hand brake.

- Pull EMF button (1) up: Parking brake is activated.
- Press EMF button (1) down: Parking brake is deactivated.



Index	Explanation
1	E70 EMF button

The indicator lamp in the instrument cluster shows the driver when the EMF is activated.

E70 Emergency Release Location

Index	Explanation
1	Bowden cable, emergency release EMF
2	Handle for emergency release

The tool kit is located in the luggage compartment which includes a red handle for the emergency release (2) of the EMF and the parking lock of the automatic gearbox. The EMF emergency release cable (1) is located on the rear left behind the side trim panel.

The location of the emergency release will vary between vehicles, please refer to the proper owners manual for cable locations.

Using the EMF Emergency Release

Index	Explanation
1	Handle for emergency release
2	Bowden cable, emergency release EMF

The opening in the handle for the emergency release (1) is attached to the EMF emergency release cable as illustrated and the parking brake is released in the electromechanical actuating unit by pulling the handle upwards.

CAUTION!!! Secure vehicle to prevent it rolling before operating the emergency release!

The release procedure is performed manually with the emergency release cable assembly and the emergency release handle from the vehicle tool kit. The emergency release procedure releases the duo-servo drum brake by way of mechanical intervention in the actuator of the electromechanical control unit.

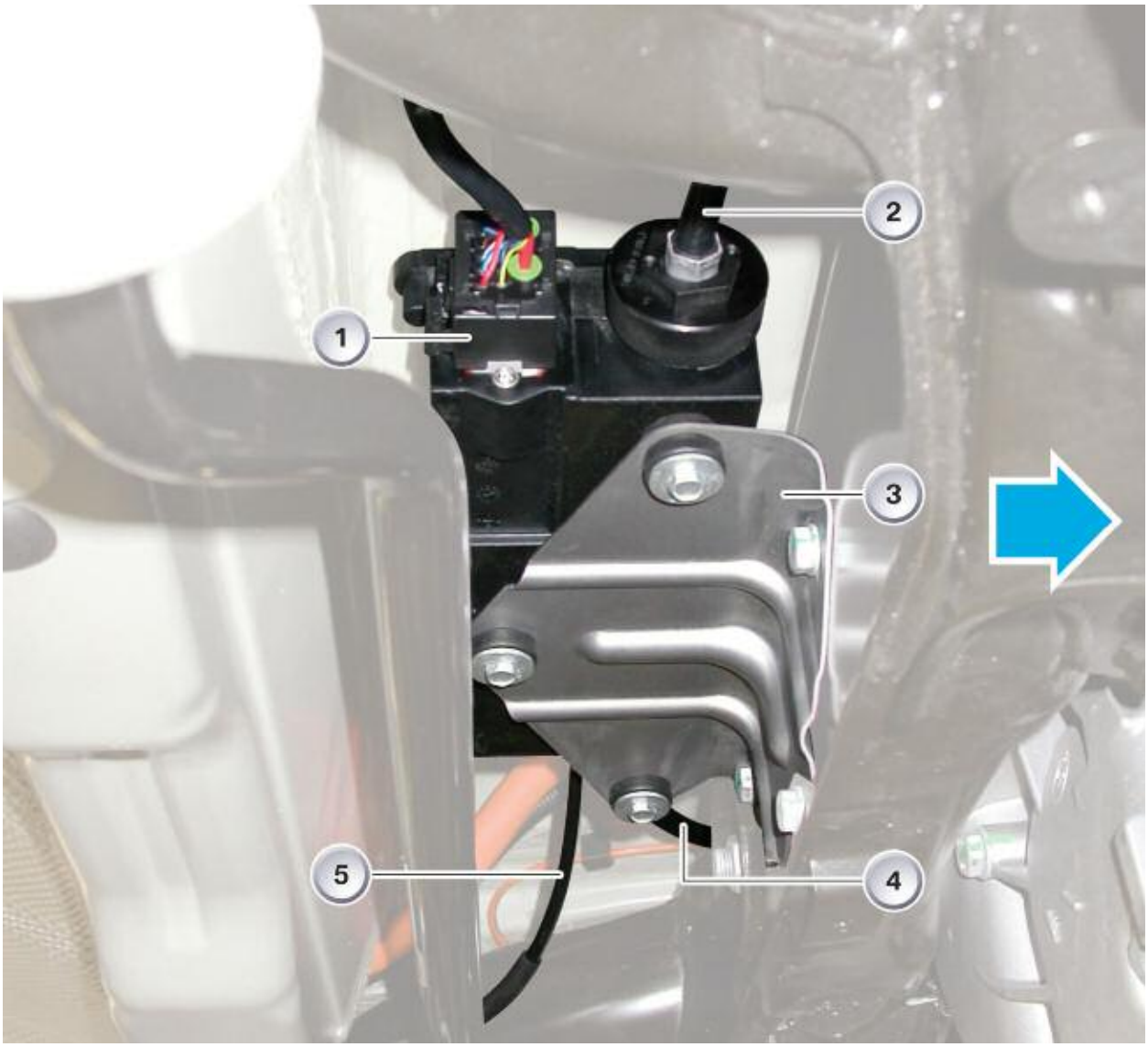
After a power failure, it may still not be possible to move the vehicle even after releasing the brake with the emergency release facility. The parking lock of the automatic gearbox may still be engaged (see current repair manual for placing the automatic gearbox in the neutral position).

Once released, using the emergency release facility, the parking brake cannot be reactivated manually. The function can be restored only by way of electrical activation.

Restoring Operation After Emergency Release

After turning on the ignition, push down the EMF operating button and pull up again to activate the parking brake.

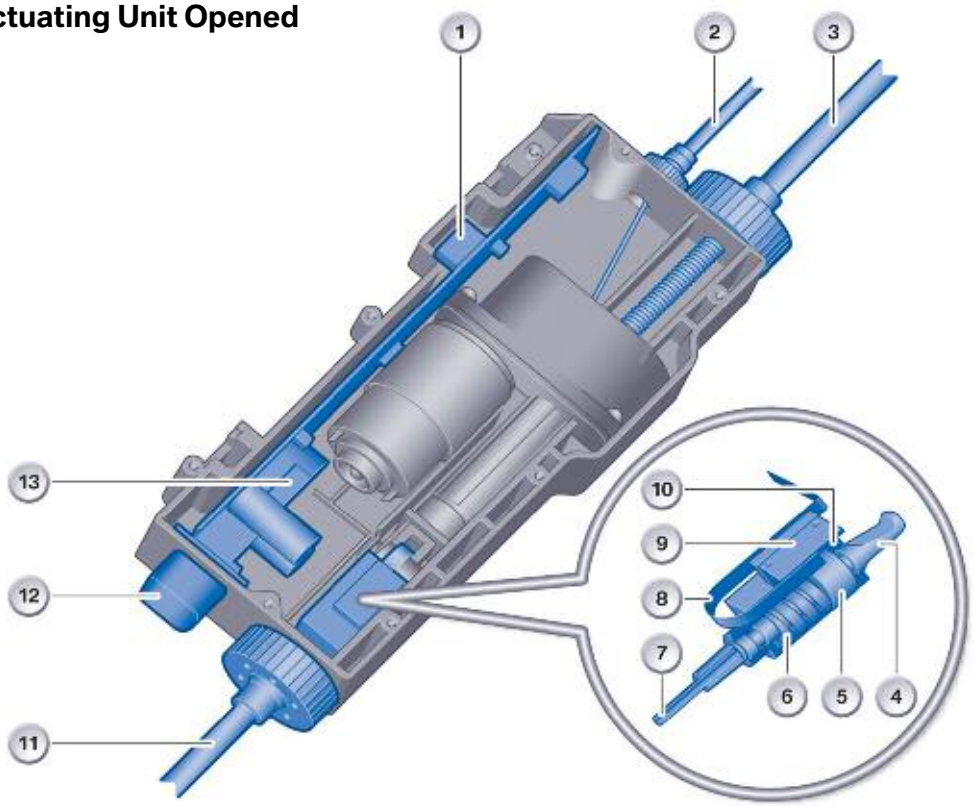
Electromechanical Actuating Unit



Index	Explanation	Index	Explanation
1	Electrical connection	4	Bowden cable, rear left wheel
2	Bowden cable, rear right wheel	5	Bowden cable, emergency release
3	Component carrier		

On the E70, the EMF actuating unit is located on the component carrier (3) on the rear axle.

EMF Actuating Unit Opened



Index	Explanation	Index	Explanation
1	EMF control unit (control electronics)	8	Flexible band
2	Bowden cable, emergency release	9	Force sensor pc-board
3	Bowden cable, rear left wheel	10	Force sensor magnet
4	Lock pin	11	Bowden cable, rear right wheel
5	Actuating piston	12	Electrical connection
6	Spring	13	EMF control unit (control electronics)
7	Emergency release cable		

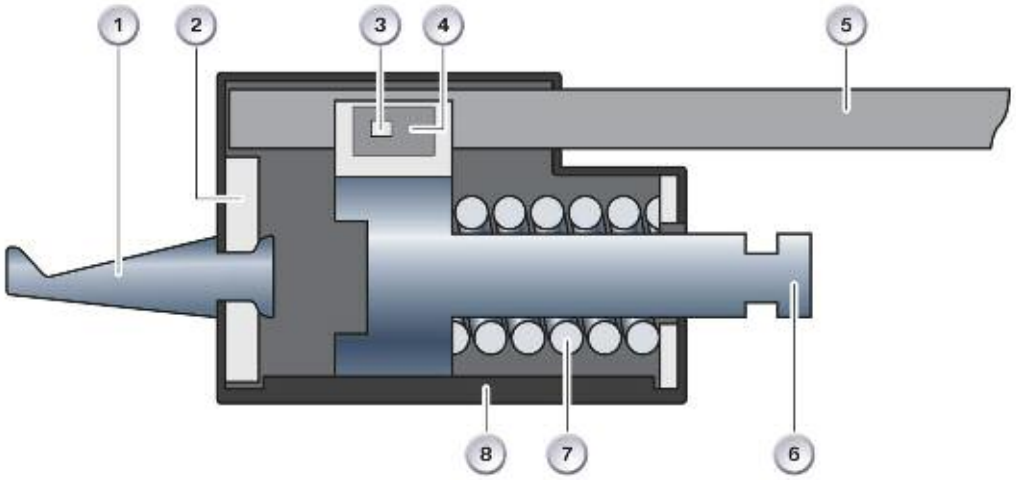
The EMF actuating unit is sealed watertight and the housing cannot be opened.

The EMF actuating unit contains the following main components:

- EMF control unit
- Electric motor
- Spindle gear mechanism
- Force sensor

The force sensor in the EMF actuating unit is a very important component for operation of the parking brake. With its signals, the force sensor makes it possible for the EMF control unit to determine the actuating force. The actuating force is essential for securing the required braking pressure.

Force Sensor



Index	Explanation	Index	Explanation
1	Hook	5	Force sensor pc-board
2	Retaining plate	6	Piston
3	Hall-IC	7	Spring
4	Magnet	8	Lower section of housing

The housing of the force sensor consists of two halves. The lower section of the housing (8) is made from pressure diecast aluminum so that it can take up the exerted forces.

The upper section of the housing is made of plastic, to which the force sensor pc-board (5) with the Hall-IC (3) is secured.

The magnet (4) is fixed to the piston (6). The force sensor is located between the left and right bowden cable assembly. During actuation, the piston (6) moves with the magnet against the spring (7).

The travel range of spring compression is measured in accordance with the familiar Hall principle. Since the spring data are defined, the EMF control unit can calculate the applied force from the travel range and the spring data. The force sensor is calibrated at the end of the assembly line.

Service Functions

After replacing the brake shoes of the duo servo drum brake as part of repair or maintenance procedures, the new brake shoes must be bedded-in to ensure adequate holding effect of the new brake shoes. The software of the EMF control unit features a "bedding-in" service mode that must be activated in this case with the BMW diagnostic system.

Indicator/warning lamps in the instrument cluster signal the operating status as well as system fault situations. In the event of faulty signals, the system causing the problem enters corresponding fault codes in the control unit and the system is partially or totally shut down corresponding to the situation. The driver receives additional information on any restricted functions in the control display.

It is only possible to coast or push the vehicle with the transmission in position N. Neutral usually remains selected for a maximum of 30 minutes. If the vehicle is stationary for longer, the automatic transmission parking lock will automatically be engaged.

Example Scenarios

Basic function of the parking brake controlled by the actuating unit Scenario: "Ignition ON", the engine is not yet running and the foot brake is pressed.

With the vehicle stationary, the parking brake is released or applied by pulling or pressing the EMF button. The indicator lamp in the instrument cluster either goes out or lights up red.

The parking brake can be released only with the foot brake pressed when the engine is running or turned off.

The dynamic braking function is triggered if the EMF operating button is pulled while the vehicle is rolling.

Transition from EMF Actuating Unit to DSC

The system switches over from mechanical to hydraulic mode when the engine is started. If the EMF actuating unit was applied at the time, the DSC hydraulics will assume control of the braking force. The EMF actuating unit is not released until the hydraulics are holding the vehicle secure. The indicator lamp remains lit red throughout this process, and the driver is unaware of the transition (the lamp does not even flash).

Transition from DSC to EMF Actuating Unit

The transition to the EMF actuating unit always takes place on exiting the hydraulic function at "ignition OFF". If the parking brake was applied, the hydraulics are not released until the EMF actuating unit is applied. The indicator lamp remains red throughout this transition.

Function of the Parking Brake Controlled by the DSC Hydraulics

Scenario: “Engine running”

The parking brake is applied or released completely by hydraulic means when the EMF operating button is pulled or pressed.

Dynamic braking (hydraulic) is triggered with the vehicle rolling and the button operated at a speed over 2 mph. The basic functions mainly correspond to the functional scope of a conventional mechanical parking brake.

The system switches between "brake applied" and "brake released" with pressure build-up and pressure reduction every time the EMF button is pulled or pressed.

The parking brake must be released by pressing the EMF button before starting off. Pulling away against the applied brake pressure results in an increase in pressure and a warning to the driver.

Scenario: “At rest”

With the key remote control removed, the parking brake enters rest status when the key remote control is removed. If the parking brake is applied, the time-delayed red indicator lamp signals this status to the driver.

If the EMF actuating unit is released in rest mode, the EMF actuating unit is applied when the EMF button is pulled with the vehicle stationary. If the vehicle is in motion, pressing the button will initiate dynamic braking.

Always take the key remote control with you when leaving the vehicle otherwise children could release the parking brake.

Dynamic Braking

Two braking units for brake operation are required by law (previously: foot brake and hand brake). In the E70, the second operating point besides the foot brake is the EMF button on the gear selector lever.

The vehicle is braked by the drum brakes at the rear axle if the EMF button is pressed and held at speeds below 2 mph and with the engine switched off.

The vehicle is braked at a rate of 3 m/s^2 for 0.8 seconds if the EMF button is pressed when the vehicle is in motion. Braking power is then ramped up to 5 m/s^2 for the next 2 seconds. This braking action is retained for as long as the EMF button is pulled.

For stability reasons (over-braking - rear axle) the dynamic braking function is also triggered in the rest state in response to the vehicle rolling (engine turned off, ignition OFF) by means of active pressure build-up by the DSC hydraulics together with the DSC function. The brake pressure required is made available as rapidly as possible.

The braking action is always monitored by the DSC control function. This ensures vehicle stability while braking. Since all four wheels are braked hydraulically, there is considerably greater deceleration with a minimum of operating effort (EMF button) by comparison with conventional parking brakes. The controlled brakes are therefore able to contribute to improving vehicle safety.

For traffic safety reasons, operation of dynamic braking is indicated to the road users behind by the brake lights coming on.

To avoid accidental operation and misuse, the driver is notified of dynamic braking operation by a display message and gong.

This function is intended only for use in an emergency and must never be used as a substitute for normal operation of the service brake.

The more effective braking solution is used if the parking brake deceleration request is overlapped by the brake pedal being depressed. The DSC control unit decides which deceleration request is to be carried out.

Exiting Dynamic Emergency Braking

The vehicle will remain hydraulically braked even after the EMF button has been released if the vehicle is braked to a halt by dynamic braking. There is a transition to the normal DSC hydraulics function. The hydraulic brake is only released when the EMF button is pressed once more.

If the EMF button is pressed while the vehicle is still in motion, the system level prevailing before the emergency dynamic braking was activated is resumed. If the parking brake is released and the vehicle is coasting, it is possible to activate emergency dynamic braking in any situation (terminal 30, 15, R) by pressing the EMF button.

Error Messages

All fault statuses are detected by the monitoring system and displayed to the driver. The main aim is to avoid safety-critical conditions for vehicle occupants, the vehicle and its surroundings.

A fault can be assigned different priorities depending on the driving situation (vehicle stationary/in motion, starting/stopping) and the system availability. In addition to the indicator lamp, supplementary instructions may be shown in the control display.

To avoid additional damage, faults in the parking brake mechanism, particularly a broken cable in the operating cable assembly and excess load are detected by the force sensor and indicated accordingly. See shutdown strategy table.

Error messages can no longer be output actively in the event of the EMF control unit failing. In this case, the instrument cluster assumes the control of the correct error message on recognizing the absence of the regular EMF telegram via the PT-CAN (alive signal).

Shut-down Strategy			
Fault	Availability		Back-up System
	Parking brake (mechanical) mph = 0	**Dynamic braking (hydraulic) mph > 0**	
CAN signal	**OK**	**OK**	
DSC hydraulics	**OK**	**NA**	Service brake + hand brake
Actuating mechanism	**NA**	**OK**	Park position automatic gearbox
EMF control unit	**NA**	**NA**	Park position automatic gearbox and service brake and auxiliary brake if necessary

General Parking Brake Fault Concept

Fault Distribution Between DSC and EMF Control Unit

Only DSC faults that actually affect operation of the parking brake result in shut-down of the hydraulic function. These are mainly faults that result in shut-down of the ABS functionality. They trigger the transition to manual emergency mode. Dynamic braking is no longer possible unless only CAN faults occur affecting this functionality.

- Shut-down level “electromechanical mode”
  (only EMF actuating unit) initiated by following DSC faults
  - DSC control unit fault
  - Electrical fault (e.g. wiring harness)
  - Sensor fault (brake light switch/wheel speed)
  - actuator fault/hydraulic unit
  - Bus communication fault
- Shut-down level “electrohydraulic mode”
  (failure of EMF actuating unit)
  - Force sensor fault
  - Actuator fault of EMF actuating unit
  - Error in actuation electronics
  - Fault in actuating mechanism
  - Electrical fault
- Shut-down level “total shut-down”
  - EMF control unit or controller fault
  - EMF button fault
  - Electrical fault, power supply

All fault codes are stored in the control unit in which the monitoring routine was performed. The EMF control unit is informed of the fault status of the DSC control unit and vice versa.

Fault Regeneration

When a fault is detected, the system remains in a safe mode until the end of the “ignition ON” cycle, once reached, a shut-down level is not cancelled during the cycle.

A shut-down status can only be cancelled when a corresponding check beforehand guarantees that the component previously detected as faulty is functioning correctly. For this reason, such component tests are also performed in shut-down mode. The fault information is retained in the fault code memory. The shut-down status is then cancelled when a new "ignition ON" cycle is started.

If correct operation of the component cannot be determined after a fault, the parking brake will remain in the secure, shut-down state until the next workshop visit where the fault code can be deleted by the diagnostic unit after a repair.

Monitoring and Fault Detection

- Monitoring of electrical faults:

  Breaks (open circuits) and short-circuits with respect to ground and U-batt of all cables leading to the control unit as well as short-circuits in the actuator or its cables are detected and dealt with accordingly. If possible, this also applies to short-circuits of neighboring connector pins.

  External breaks or short-circuits do not result in irreparable damage to the control unit.

- Monitoring input signals:

  All input variables of the parking brake are monitored. In the event of a fault occurring, the complete system is shut down with a corresponding error message and fault code entry.

- Monitoring EMF button:

  The EMF button has a redundant layout for diagnosis. The signal levels of this component are permanently monitored. In the event of a plausibility error, the complete system is shut down with a corresponding fault code entry.

  The DSC control unit also checks the plausibility of the signals from the EMF button. Signal level errors result in a corresponding fault code entry with partial shut-down. Dynamic braking is now no longer possible.

- Monitoring vehicle speed signals:

  The parking brake system is totally shut down only when all 3 speed inputs have failed or are not available

  – The direct digital wheel speed signal, also known as the discrete speed signal, is permanently checked in terms of plausible signal edge change.

  – A mutual plausibility check of the reference speed made available from the DSC via the PT-CAN and the discrete speed signal is constantly performed.

  – The reference speed is the mean wheel speed from the DSC which is compared with the transmission output speed sent by the EGS.

NOTES PAGE

E65, E66 Parking Brake

Purpose of The System

The Electromechanical Parking Brake (EMF) was used for the first time in the E65. The EMF is used to secure a stationary vehicle, preventing it from rolling away by firmly locking the parking brake. The EMF is an automatic comfort oriented system that replaces the previous handbrake or foot operated parking brake. The driver can apply and release the parking brake by pressing a push button.

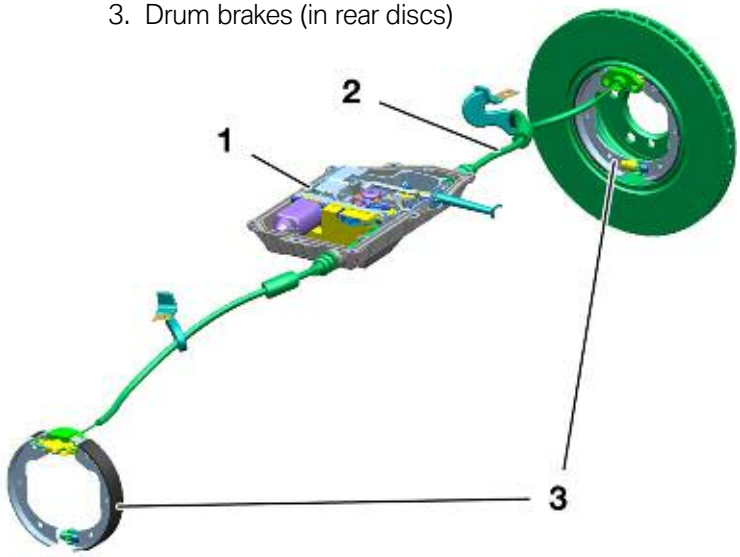
The system is designed for the characteristic requirements of the E65:

- Consideration for safety
- Optimum functionality
- Maximum system usage
- Best comfort and convenience

The Parking Brake push button is located in the instrument panel to the left of the headlight switch. The push button is an integral component of the Light Module.

The EMF mechanically locks the parking brake when the vehicle is stationary and provides an independent brake system as required by law (in addition to the service brakes).

1. EMF actuator
2. Bowden cable
3. Drum brakes (in rear discs)



EMF System

The EMF system offers additional comfort and safety functions.

Basic Function
There are two different parking brake functions depending on the operating status of the vehicle.

Locking (Brake Applied):

- With the engine running or the vehicle rolling, the parking brake function acts on the front and rear axle by the DSC hydraulically applying the service brakes.

- When the engine is not running and the vehicle is stationary, the electromechanical parking brake is applied.

Dynamic Braking:

- Braking required to decelerate a moving vehicle is identified by the DSC system when the parking brake push button is pressed while driving. The braking procedure is regulated by the DSC hydraulically applying the service brakes and takes place for as long as the push button is pressed.

Automatic Hold
This comfort function is selected using the controller or with the free programmable button on the multifunction steering wheel. After braking to a standstill, the vehicle is held by the DSC hydraulically applying the service brakes. The brakes are released by pressing the accelerator pedal. The hold and release function prevents “creeping” in stop and go traffic and “roll back” before pulling away on an incline (Hill Hold).

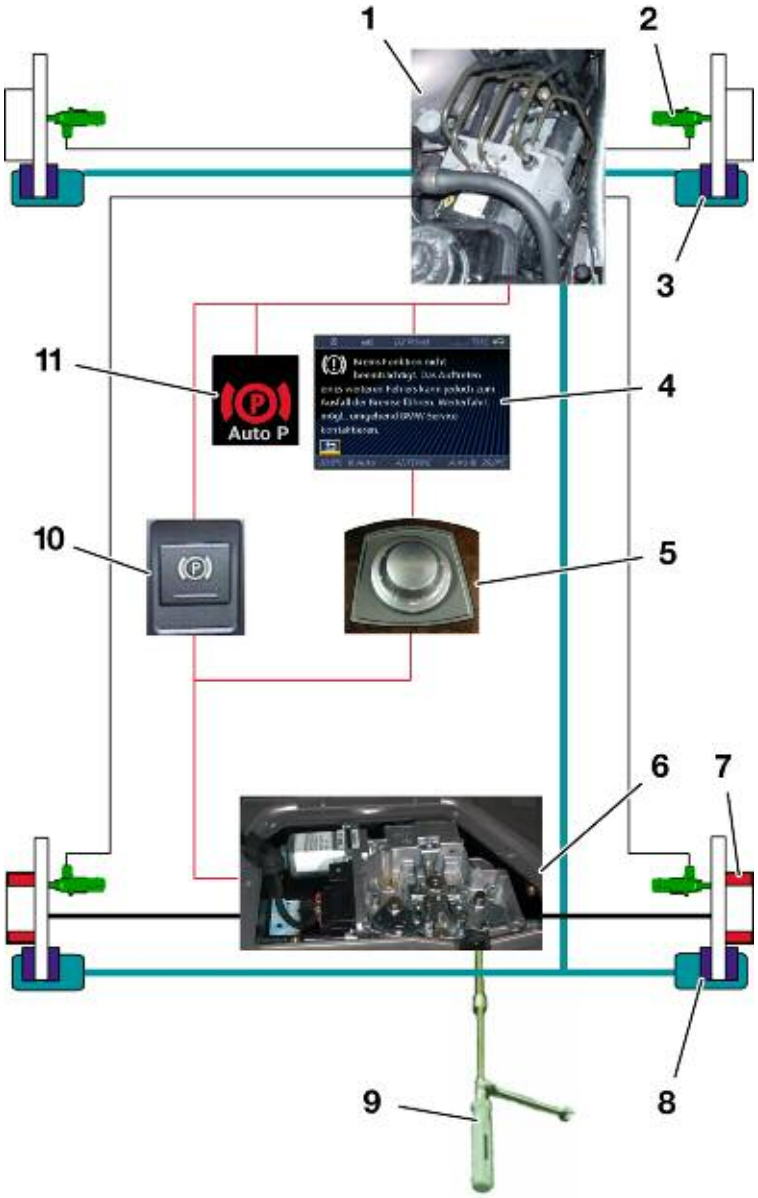
Brake Pedal “Feel”
The response of the brake pedal may change slightly (accompanied by an activation sound) because the parking brake function is activated using the brake system’s hydraulic circuits this is normal.

Emergency Release
A mechanical emergency release is provided to release the parking brake in the event of an actuating unit failure or a dead battery. It is possible to release the mechanical actuating parking brake unit using the emergency release tool and an open end wrench found in the vehicle tool kit.

Special Function
During vehicle operation, brake lining “seating” is conducted at defined intervals to ensure and maintain the effectiveness of the parking brake. The brake lining seating is performed to remove corrosion from the parking brake shoes and brake drums. The procedure automatically takes place approximately every 1,000 km or once a month and is transparent to the driver.

System Components

EMF Parking Brake

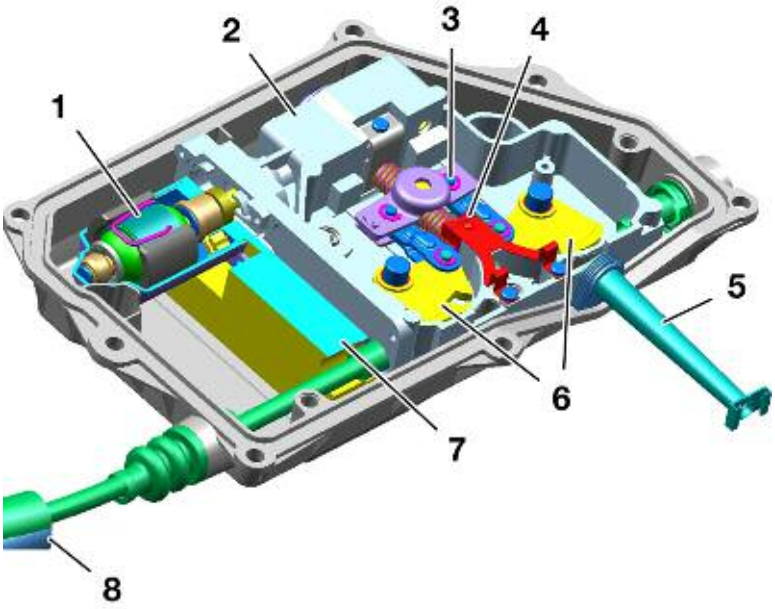


Index	Explanation	Index	Explanation
1	DSC module	7	Parking brake
2	Wheel speed sensors	8	Service brake rear axle
3	Service brake front axle	9	Mechanical emergency release tools
4	Control display	10	Parking brake push button
5	Controller	11	Display in instrument cluster
6	EMF actuating unit		

Electromechanical Actuating Unit (EMF)

The EMF receives the parking brake request and activates an electric actuator (motor) to tension the parking brake cables. The EMF actuating unit is located under the luggage compartment floor in front of the spare wheel recess.

Index	Explanation
1	Actuator motor with 2 Hall sensors
2	Gear mechanism
3	Balance arm
4	End stop
5	Tube for emergency operation
6	Cable module
7	Control module
8	Bowden cable (one of two)



Electromechanical Actuating Unit

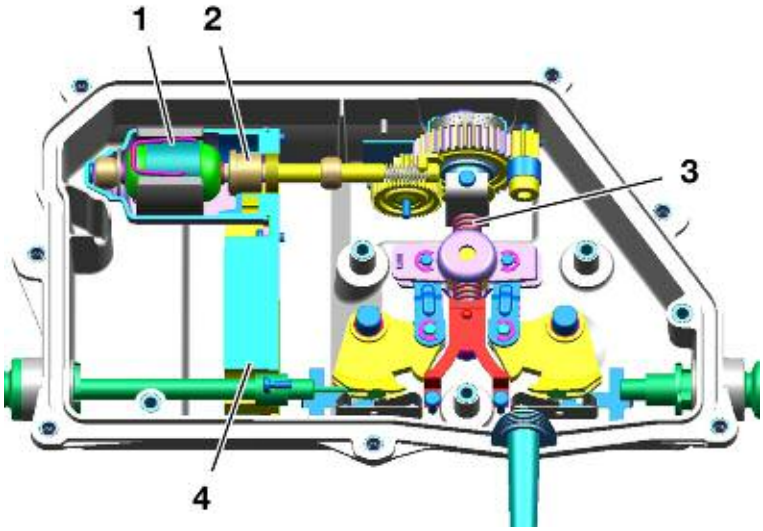
End Stop

The end stop is the “zero point” for the initial position which is required for the parking brake cable installation (release - no tension).

The balance arm rests against the end stop the first time the brake is released when the ignition is on (KL15).

Hall sensors are mounted on the motor to detect the speed and position. The control module detects the end stop by the increase in actuator motor current and the decrease in the motor speed (Hall sensors).

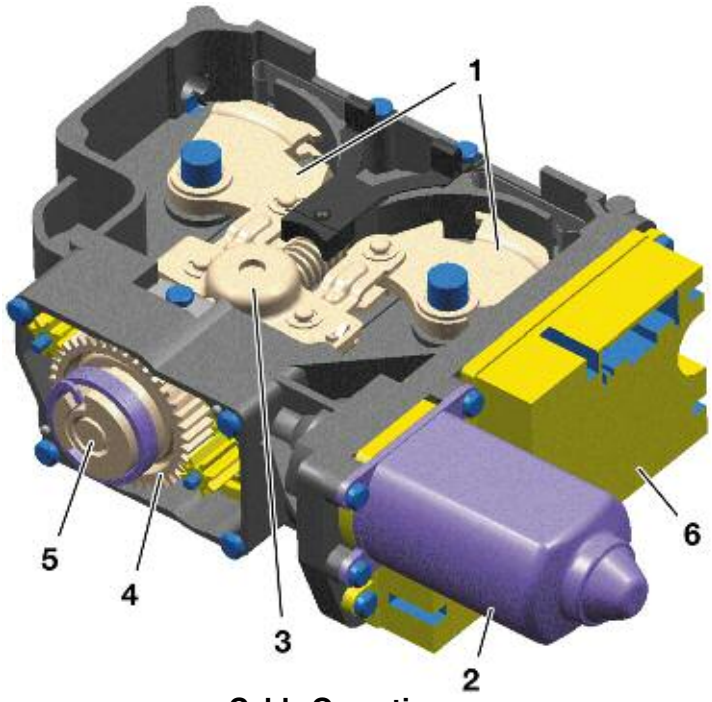
Index	Explanation
1	Electric motor
2	Hall sensors
3	Spindle (worm)
4	Control module



EMF Actuation

When activated, the spindle is turned by the motor using a gear drive mechanism to apply the parking brakes. The balance arm is pulled by the spindle (worm) and will compensate for the slight difference in side to side cable length. The balance arm is linked by connecting levers to pull the cable pulleys inwards towards the direction of the spindle rotation. The cables are attached to the cable pulleys which are pulled “in” to apply the parking brakes. Once the hold position is reached, the spindle worm gear ensures cable tension and will not release with out spindle rotation.

Index	Explanation
1	Cable pulley
2	Actuator motor
3	Balance arm
4	Gear drive mechanism
5	Spindle
6	Control module

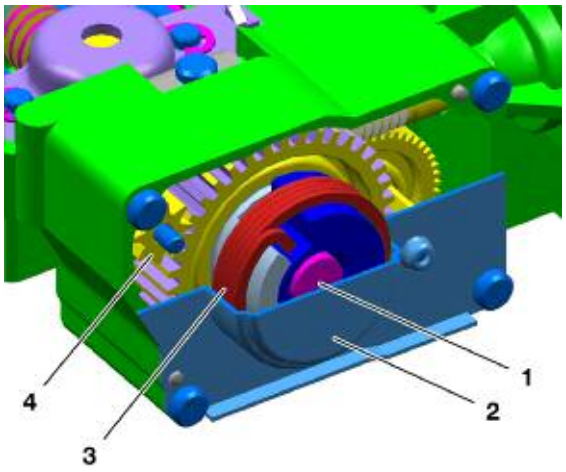


Cable Operation

Gear Drive Mechanism with Coil Spring

This is designed as a three stage (reduction) gear mechanism consisting of a worm, spur gear and spindle. The holding force for the parking brake is assisted by a coil spring mounted on the end of the spindle.

Index	Explanation
1	Spindle
2	Coil spring cover
3	Coil spring
4	Emergency release drive gear



Gear Drive Mechanism

When the brake is released, the spindle is turned by the motor and gear drive mechanism in the opposite direction. The balance arm, connecting levers and cable pulleys are pushed outwards by the spindle (worm). The cables are also pushed “out” to release the parking brakes. To assist in the release, return springs are installed in the parking brake assemblies inside the brake discs.

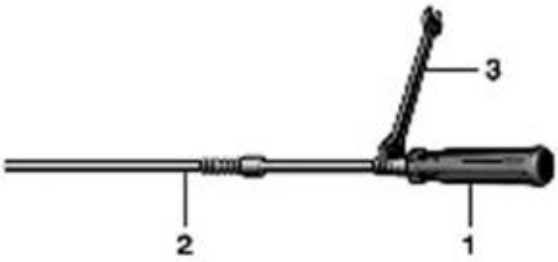
With the manual emergency release, the spindle can be turned through the gear drive mechanism with the tools found in the vehicle tool kit to release the parking brake.

Workshop Hints

Emergency Release

The parking brake is manually released directly through the gear drive mechanism. The tools in the vehicle tool kit to release the parking brake are:

Index	Explanation
1	Screwdriver handle
2	Emergency-release tool (spring loaded)
3	10 mm open-end wrench



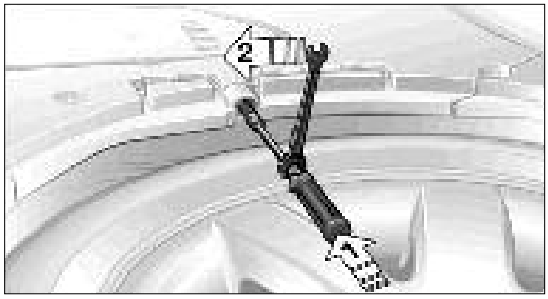
Emergency Release

CAUTION!!!

Make sure the transmission is in the Park position before releasing the parking brake!

To release the brake, the extension rod is inserted through a guide tube located in the luggage compartment floor in front of the spare wheel recess (1). Maintain pressure on the tool.

Using the open end wrench and the screwdriver handle, turn the release tool in a counterclockwise direction (2). The cable tension release will be felt during this procedure.



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After a power failure/interruption, it is possible that the vehicle can not be moved after releasing the parking brake using the emergency release. The parking lock of the automatic transmission can still be engaged. The parking brake may only be used again if it is released manually after a power interruption. If this is not performed, the parking brake may fail to operate correctly!

Resuming Operation after Emergency Release
When the voltage supply has been restored after the emergency release, the parking brake push button must be pressed 3 times at intervals of approx. 5 seconds to initialize the system.

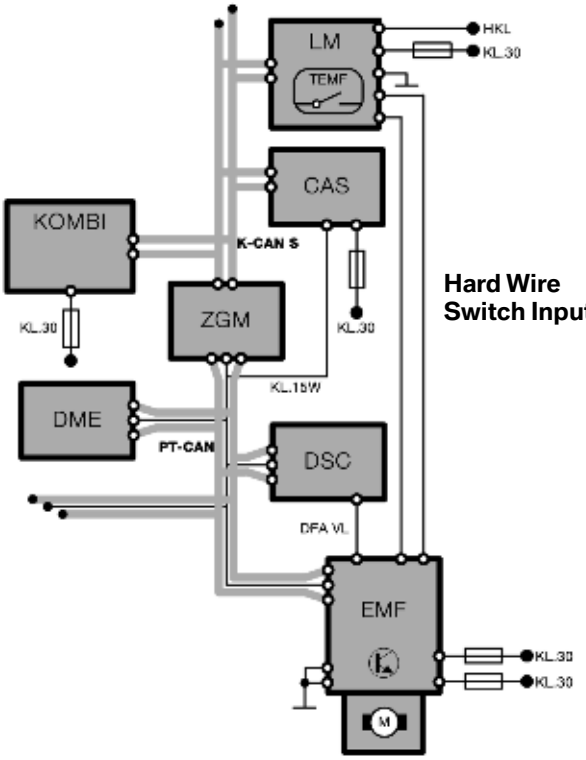
- 1st press - The control module attempts to release the brake. Since the brake has been released mechanically by the emergency release, the motor cannot run back and blocks.The control module recognizes a disengaged setting.
- 2nd press - The motor will move forward applying the parking brake. The control module detects an engaged setting. The “P” indicator light illuminates in red.
- 3rd press - The motor will run backward releasing the parking brake and the “P” indicator light goes out. The parking brake is ready for operation.

Control Module

The parking brake control module (integral in the EMF) is linked to other control modules for communication by the PT-CAN and K-CAN Busses. Diagnostic communication is provided through the ZGM over the PT-CAN Bus.

When the parking brake push button is pressed with the engine running, a fixed brake pressure is built up by the DSC hydraulic unit and applied to the service brakes.

The force applied at the spindle is calculated in the parking brake control module. The control module first determines the current flow of the actuating motor accounting for the temperature of the motor coil (affecting resistance). Hall sensors are mounted on the motor to detect the speed and position. The actuating force
is calculated by evaluating the speed reduction of the motor (speed is
a function of torque).



Index	Explanation
LM	Light Module
DSC	Dynamic Stability Control
TEMF	Parking brake push button
CAS	Car Access System
ZGM	Central Gateway Module
DFA VL	Speed signal (separate hard wire backup), left front wheel

Principle of Operation

Parking Brake Control

Two separate controls are provided to operate the parking brake functions.

Push Button
Located in the instrument panel to the left of the steering wheel and is used for the basic function. This will apply and release the parking brake when the vehicle is stationary and provide "Dynamic Braking" when the vehicle is driven depending on the vehicle speed.

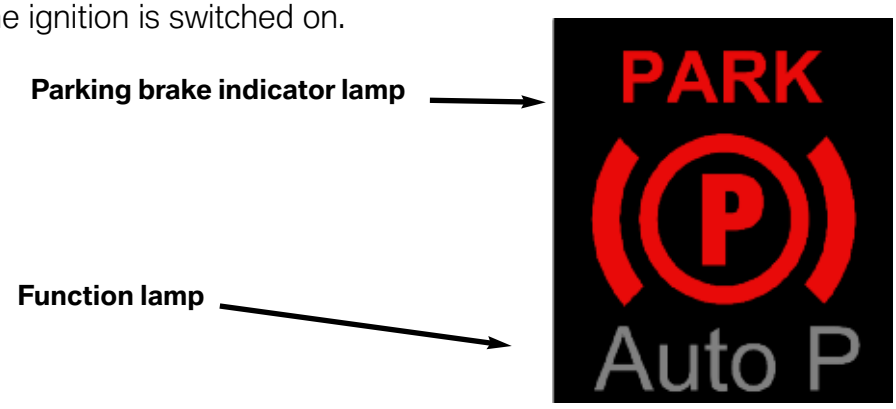
When the vehicle is stationary, it functions as an ON/OFF (momentary) push button. Only in the Dynamic Braking mode, the brake is applied for as long as the button is pressed.

The action field in the menu of the control display provides a second control. The menu screen is activated and controlled by the driver to activate or deactivate the "Automatic Hold" parking brake function.

This function can also be activated and deactivated with the free programmable button on the multifunction steering wheel set in the Control Display.

Indicator Lights

The driver is informed of the parking brake system status by an indicator light in the instrument cluster. When a fault is present, an additional message in the Control Display will provide more information. The parking brake control module communicates via the PT-CAN and K-CAN Busses. The light is activated as part of the pre-drive check when the ignition is switched on.



Indication

In the basic function, application of the parking brake is indicated by a red LED in the brake symbol and by the letter P on the inside. The letters "PARK" are illuminated in the indicator light for as long as the parking brake is applied.

The P symbol indicates that the requested status of "release" or "apply" is reached. When the parking brake is operated while driving (Dynamic Braking), an acoustic warning signal is additionally activated (multiple gong).

Automatic Hold Indication

Standby of the automatic hold function is indicated by the green lettering "AUTO-P" integrated in the light. The parking brake signal is additionally indicated when the automatic hold function is active and the vehicle is stopped. The parking brake symbol lights up in green because the hold function is activated by the DSC with all 4 wheel (service) brakes.

After the brake has been released when starting off (automatically), the green parking brake symbol goes out and only the green standby indication "AUTO-P" remains active. The transition from hydraulic to mechanical mode takes place automatically when the engine is switched off. The light changes from green to red indicating the parking brake is applied and the DSC (service brakes) are released.

Additional Indication

The driver is alerted of parking brake malfunctions by a yellow indicator light in the instrument cluster. In addition, the same symbol is illuminated in the variable indicator warning field and briefly explained by a text note.

In addition to the parking brake status, the variable indicator light is also made available to other control modules. It is only used by the parking brake control module for specific faults.

When the variable indicator light appears, the fault is explained in the Check Control display accompanied by additional information in the Control Display (Condition Based Service).

Indicators in Cluster

Index	Explanation
1	Parking brake indicator light
2	Check Control display
3	Variable indicator warning field

Instrument Cluster

System Function	Indicator Lamps
Parking Brake Released	
Parking Brake Applied	
Dynamic Braking + Acousstic Signal (gong)	
Automatic Hold Standby	
Automatic Hold Active	
System Error	

Parking Brake Functions

Basic Parking Brake Function with the EMF

Situation: “Ignition ON” and the engine is not running
When the vehicle is stationary, the parking brake is released or applied by pressing the push button. The light in the instrument cluster is either not lit or is red. The lettering "PARK" is illuminated while the brake is released or applied. Pressing the button while the vehicle is rolling triggers the dynamic braking function.

Changing from the EMF to DSC
When the EMF is applied and the engine is started, the system changes over to the service brakes using the DSC. The EMF is not released until the service brakes are applied. The light is permanently red and the transfer is not indicated to the driver (transparent).

Changing from DSC to EMF
When automatic hold is activated or the ignition is switched “OFF” (even if automatic hold was not activated), the service brakes are released after the changeover to the EMF takes place. If automatic hold was activated, the indicator light changes from green to red. If the service brakes are applied, they will be released after the changeover to EMF. The indicator light will remain red during this changeover.

Parking Brake Function with DSC (Service Brakes)

Situation: “Engine running”
When the push button is pressed, the service brakes are released or applied by the DSC and the indicator light is either off or red. When the vehicle is moving and the push button is pressed, Dynamic Braking is applied.

The parking brake push button acts as a switch at speeds below 2 mph, pressing the push button once will trigger an immediate function change. The brakes are released before starting off by pressing the push button. When attempting to start off without releasing the parking brake, the DSC will further increase the service brake pressure and a warning (gong) will alert the driver. When the parking brake is set and the driver exits the vehicle (CAN signal - driver's seat occupancy) with the engine running, the EMF parking brake will be applied in addition to the DSC service brakes.

Ignition Key Removed (Rest Status)
When the parking brake is applied, the P-light remains on for a certain period indicating “brake hold” to the driver. **The parking brake can be released at any time by pressing the push button until the ignition key is removed (car wash function).** The rest status is assumed when the ignition key is removed. The parking brake can not be released when the ignition key removed (child safety). The ignition key must be inserted and the ignition switched on to release the parking brake.

Automatic Hold Function

The Automatic Hold function is activated by selecting “Auto P” in the Control Display (or MFL free programmable button) **only when the engine is running and the hood is closed** (or the hood contact switch is in the service position). It then remains operational until the next time the engine is switched off. When selected, the vehicle is automatically held by the service brakes each time it comes to a stop. This also applies when the Automatic Hold function is requested and the vehicle is stationary.

When the vehicle is stationary, the brake pressure that the driver applies from the brake pedal is "locked in". When the vehicle comes to a stop without operating the brake pedal (roll to a stop), hydraulic pressure is built up by the DSC pump. Increased pressure will be automatically supplied if the vehicle begins to roll (detected by the wheel speed sensors).

When the automatic transmission is engaged in a drive gear, the brakes will be automatically released by pressing on the accelerator pedal. The next time the vehicle stops it will be automatically held by the service brakes. The standby status of the automatic mode is indicated by the green lettering "Auto-P". When the vehicle is stationary, the parking brake symbol is additionally illuminated in green.

The Automatic Hold function is deactivated by selecting “OFF” in the Control Display (or MFL free programmable button). This will not change the current parking brake status. This means when the vehicle is stationary, it remains held hydraulically after selecting "Auto-P OFF". The parking brake indicator light will change from green to red and the "Auto-P" indicator will go out.

The Automatic Hold function is always aborted when the push button is pressed and must be reactivated by selecting “ON” in the Control Display (or MFL button). When the engine is switched “OFF” in the Automatic Hold function, the EMF will apply the parking brake.

The parking brake can be released at any time by pressing the push button until the ignition key is removed (car wash function). The parking brake will apply after the ignition key has been removed.

Automatic Hold Safety Control

Release of the Automatic Hold function by pressing the accelerator pedal is based on two safety functions.

Situation: “Hood open”

Automatic release of the service brakes when the accelerator pedal is pressed is inhibited when the hood is open (CAN signal - hood contact switch) while the engine is running.

In this situation, the parking brake can only be released by pressing the push button (Automatic Hold deactivation). When the hood is closed, the Automatic Hold must be selected again by the driver. This situation also applies when the luggage compartment (trunk) lid is open and Reverse is engaged.

Situation: “The driver exits the vehicle”

When the driver exits the vehicle (CAN signal - driver's seat occupancy) with the engine running, the automatic release of the service brakes by pressing the accelerator pedal is inhibited. The EMF parking brake will also be applied and the transmission will automatically shift to the P-position.

When the driver re-enters the vehicle (CAN signal - driver's seat occupancy), the brake pedal must be pressed and a transmission drive gear must be engaged to drive off. The brake light switch signal requests the EMF to release the parking brake. The Automatic Hold function must be selected again by the driver.

Dynamic Braking

Two separate controls are required by law for brake operation, the brake pedal and hand-brake lever were previously used. In the E65, the footbrake and the push button in the dashboard fulfills the requirements.

When the vehicle is moving and the engine is “OFF”, the EMF parking brake is applied when pressure is maintained on the push button at speeds below 2 mph. During this situation, the parking brake is applied for 0.8 seconds. For the next 2 seconds there is an increase in the braking power and the rate of deceleration is maintained as long as the push button is pressed.

The Dynamic Braking function is active while the vehicle is rolling at speeds above 2 mph (when the ignition is in position KL_R or KL_15) when pressure is maintained on the push button. This maintains vehicle stability by preventing over braking of the rear axle using DSC hydraulic pressure build-up application to the service brakes. The required brake pressure is made available as fast as possible by the DSC.

Since braking takes place hydraulically on all four wheels, higher deceleration rates are possible with minimum operating force as compared to the EMF parking brakes. This controlled braking contributes to increased vehicle safety.

For safety reasons, traffic is warned when Dynamic Braking is active by the brake lights.

To avoid incorrect operation, the "Release Parking Brake" display and gong draw the driver's attention to Dynamic Brake operation.

This function should only be used in exceptional circumstances.

When Dynamic Braking is activated until the vehicle comes to a stop, the vehicle will remain held by the service brakes and the red P-indicator light remains on. If the brake pedal is pressed during this operation, the DSC interprets this as a higher priority and will override the parking brake function.

Exiting the dynamic emergency braking function
After emergency braking the vehicle to a stop, the vehicle will remain held by the service brakes even after releasing the parking brake push button. The service brakes will not be released until the push button is pressed again.

Safety Concept

Fault Messages

The EMF and DSC control modules monitor the system for faults and alert the driver. A fault has different priorities depending on driving situations: vehicle stationary/moving and starting off/deceleration. To avoid damage, faults in the EMF actuating mechanism like cable breakage and stretch (actuating range exceeded) are detected by the Hall sensors in the motor.

If the EMF control module is defective, fault messages will not be available. The instrument cluster recognizes the absence of the normally active parking brake message (alive - enable) over the PT-CAN Bus and will display a fault message. The safety concept is based on a staged shut down strategy. In addition to the yellow warning light, information is available in the Control Display.

Fault	Availability	Availability	Availability	Back-up system
	Parking brake (mechanically) mph = 0	Parking brake (hydraulic) mph > 0	Automatic hold	
Can signal error	OK	OK	Not available	Service brake and auxiliary brake
DSC hydraulics fault	OK	Not available	Not available	Service brake and auxiliary brake
Actuating mechanism fault	Not available	OK	Not available	Park position automatic gearbox
Fault in parking brake control unit	Not available	Not available	Not available	Park position automatic gearbox and if applicable service brake + auxiliary brake

General Parking Brake Fault Concept

Fault Division Between DSC and EMF Control Module

DSC faults that only affect the parking brake will result in a shut down of the hydraulic function (Dynamic Braking not possible). These are typically faults that result in a shut down of the ABS functions and Manual Emergency Mode will be assumed by the EMF. If the fault is only a CAN Bus fault, Dynamic Braking will be possible.

Shut Down Stage of "Manual Emergency Mode"

This will only apply when the EMF actuating unit is not in operation and is implemented for one of the following DSC faults:

- DSC control module defect
- Electrical defect (example: wiring harness)
- Sensor fault (brake pressure sensor, wheel speed sensors)
- EMF actuator fault, DSC hydraulic unit
- CAN communication fault

Shut Down Stage "Only Dynamic Braking Available"

This stage will provide Dynamic Braking by the DSC hydraulic service brakes in the event of an EMF actuating failure.

- Fault in the actuating motor Hall sensors
- Actuating motor fault
- Fault in control electronics
- Fault in actuating mechanism (mechanical)
- Electrical faults

Shut Down Stage "Total Shut Down"

- Parking brake control module failure
- Push button fault
- Electrical faults including voltage supply

All fault codes are stored in the EMF control module and is also informed of the DSC control module fault status.

Fault Regeneration

If a fault is detected, the system remains in the current stage until the ignition is switched “OFF”. A shut down situation will not be deactivated until the faulty component is operating correctly. If the fault is not present during the next restart, the shut down stage is cancelled to resume normal operation. Component tests are carried out continually, even during the shut down situation.

The fault information remains stored in the fault code memory. If correct function of the component cannot be determined after a fault has occurred, the parking brake will remain in the safe, shut down state until the next workshop visit with the exception of: CAN timeout error, overvoltage and temperature protection. After properly repaired, the fault can be deleted with the Diagnostic tools.

Regeneration of CAN Faults

CAN timeout faults can be regenerated. The shut down stage is cancelled if the signal is received correctly for a certain period of time.

Monitoring and Fault Detection

Electrical faults monitoring: The wiring to the EMF control module, including the actuator motor, is monitored for breaks or shorts to B+ and ground.

Hydraulic interface monitoring: The DCS checks the plausibility of the deceleration request by the parking brake during Dynamic Braking and the hydraulic Hold Function. If the request and feedback do not agree within a defined time (5 seconds), the corresponding shut down stage is assumed and a fault code will be stored.

Input signals monitoring: In the event of a faulty input signal, the entire system is shut down with a Check Control error message and a stored fault code.

Parking brake push button monitoring: The push button signals are continually monitored (hardwired to the EMF control module). In the event of a push button plausibility fault, the entire parking brake system is shut down and the "Parking Brake Push Button Defective" fault code is stored. The DSC control module also checks the plausibility of the parking brake push button signals that are transmitted via the CAN Bus (from the EMF control module). If faulty, the "Parking Brake Push Button Signals via CAN Implausible" fault code is stored and partial shut down is carried out (Dynamic Braking is not possible).

Speed signals monitoring: Total shut down of the parking brake system will occur with the loss of all 3 speed inputs.

- The direct digital wheel speed signal (separate hard wire backup, front left) is continually checked for the plausibility of the signal edge change.
- The plausibility of the reference speed signal from the DSC over the PT-CAN Bus and the direct digital wheel speed signal is continually and mutually checked.
- The reference speed signal from the DSC is compared with the automatic transmission output speed.

Fault codes:

- Direct wheel speed signal implausible or faulted.
- DSC speeds implausible or no message.
- EGS automatic transmission output speed implausible or no message.

Hall sensors monitoring: The plausibility of the actuating motor Hall sensors is continually checked. When there are deviations that are out of tolerance, partial shut down (only Dynamic Braking available) is implemented and the "Parking Brake Actuating Unit Defective, Plausibility of Hall Sensors" fault code will be set.

In addition, the plausibility of the position is checked during the actuating motor operation. When the Hall sensor signal is not received, the parking brake system is shut down and a fault code will be set.

EMF actuating unit monitoring: After the ignition is switched on and a fault is present, it will be detected before a required parking brake function is active.

EMF Self Diagnostics
The self diagnostic functions are divided into several modes. These modes are executed in priority for diagnosis. When the vehicle is stationary and self diagnosis is being executed, the parking brake function is fully operational. Fewer diagnostic modes are allowed while the vehicle is moving. A self diagnostic mode that will restrict or completely deactivate the parking brake function is executed only when the vehicle is stationary.

Certain faults in CAN communication will cause the EMF to malfunction and the Automatic Hold will not function. The "manual level" is operational and the parking brake will still be applied and released by the EMF or DSC when the push button is pressed with the vehicle stationary. Dynamic Braking also remains available. The loss of the Automatic Hold function is indicated only with the variable parking brake indicator lamp.

Workshop Hints

Please familiarize yourself with the statements below regarding new procedures when making repairs to the Electromechanical Parking Brake. Consult the Repair Information in TIS for additional information on the following procedures:

The parking brake shoes are adjusted the same way as current BMW models by turning the adjuster with a screwdriver, through the wheel bolt hole of the wheel hub.

Parking Brake Cable Removal

To remove the parking brake cable assemblies, the EMF top cover must be removed and the end stop plate must be raised with a screwdriver. Using the brake release tool (found in the vehicle tool kit), release the parking brake completely so that the balance arm is turned back to the stop. This will allow the pulleys to rotate far enough so that the cable crimp can be disengaged from the recess in the pulley.

Parking Brake Initialization

The parking brake must be initialized through the ISID after replacing the brake shoes. The brake cable “free play” is learned by the EMF control module from the Hall sensors in the actuating motor.

Parking Brake Lining Seating

When the parking brake shoes are replaced, the new brake linings must be seated (bedded down) to achieve adequate holding power. A "Special Bedding Down Routine" is integrated in the parking brake software and can be accessed with the Diagnostic equipment.

The parking brake indicator light in the instrument cluster will flash red (at a low frequency) to signal the standby status of the brake bedding down program. After activating the program, the ignition must not be switched off and the bedding down procedure must be carried out within 30 minutes.

If more than 30 minutes have lapsed, the parking brake button is pushed, or the ignition is turned off before the procedure is carried out, the brake bedding down program will be terminated. The system will resume the normal parking brake function.

The brake linings are seated by the EMF applying a reduced holding force. The braking force at the spindle during this procedure is 20% of the maximum actuating force.

The procedure is activated when the vehicle is stationary (for example: stopped at a traffic light). The brake shoes “scrub” when the vehicle starts off. The EMF releases the parking brakes when a speed of 15 km/h is reached or 30 seconds after the start of the seating procedure.

For safety reasons, the seating procedure is immediately terminated when any DSC function is required. The seating procedure is also terminated when the push button is pressed or the ignition is turned off.

Travel Monitoring

Normal parking brake lining wear increases the actuating travel over the service life. Based on the reference point (stop in the EMF unit), the Hall sensors in the actuating motor allows the EMF control module to measure the travel range.

When the defined travel limit is exceeded, information is provided to the driver and a fault is stored in the EMF control module. This can also be checked using the Diagnostic equipment.

Brake Testing on a Roller Dynamometer

The E65 parking brake operation can be tested on a brake roller dynamometer. The parking brake test can be conducted with the engine running by pressing the parking brake push button. With the engine turned off, the parking brake test can activated by pressing the parking brake push button. The actuating unit will quickly apply and lock the parking brake.

Assembly Mode

Replacement EMF's are shipped in "assembly mode" to suppress activation until the brake cables and EMF are completely assembled and installed in the vehicle. This prevents unintentional operation of the EMF by the parking brake push button and can also be activated (for safety reasons) on an existing EMF in the vehicle when work is being performed.

Before initial operation, the assembly mode must be deactivated by using the Diagnostic equipment When installing the EMF, make sure that the seal to the body and the seals for the parking brake cables are correctly installed.

Coding Data

The coding data for the parking brake system is stored in the EMF control module (EEPROM) and the DSC control module (EEPROM). The coding data is entered through the ISID when a control module is replaced.

Check Control and Control Display Fault Descriptions

Description	Check Control Message	Central Information Display	Parking Brake Indicator Light	Check Control Symbol
Parking Brake Engaged	-----	-----		-----
Installation Mode	-----	-----		-----
Brake test stand detected - Actuator released	-----	-----		
Brake test stand detected - Actuator in inter-mediate position	-----	-----		
Retensioning due to rollaway monitoring - Vehicle with manual transmission	Parking brake overloaded!	Parking brake. Parking brake overloaded. To park, secure the vehicle against rolling away.	-----	
Retensioning due to rollaway monitoring - Vehicle with automatic transmission	Parking brake overloaded!	Parking brake. To park, ensure that selector lever position P is engaged.	-----	
Disengaging the parking brake	Disengaging the parking brake	-----		

Description	Check Control Message	Central Information Display	Praking Brake Indicator Light	Check Control Symbol
Additionally press foot brake	Additionally press foot brake	-----	-----	
Additionally engage selector lever position P	Additionally engage transmission P!	Parking brake. To release the parking brake, also engage selector lever position P!	-----	
Additionally press foot brake or clutch	Additionally press foot brake or clutch	-----	-----	
Parking brake button sensor fault	-----	-----		-----
Redundancy loss, speed	Parking brake fault!	Parking brake. Parking brake malfunctioning. Please ask your nearest BMW Service Center to check this.		
Redundancy loss, parking brake button	Parking brake malfunctioning!	Parking brake. Parking brake malfunctioning. Please ask your nearest BMW Service Center to check this.		
Electromechanical mode - Vehicle with manual transmission	Parking brake malfunctioning!	Parking brake. No Emergency braking function. When vehicle is at a standstill, parking brake can be engaged and released via button. Ask you nearest BMW Sercice Center to check this.		

Description	Check Control Message	Central Information Display	Praking Brake Indicator Light	Check Control Symbol
Electromechanical mode - Vehicle with manual transmission	Parking brake malfunctioning!	No Emergency braking function. When vehicle is at a standstill, parking brake can be engaged and released via button. Ask you nearest BMW Sercice Center to check this.		
Immobilization - Vehicle with namual transmission	Parking brake defective!	Parking brake. Parking brake defective. To park, secure the vehicle against rolling away. Ask your nearest BMW Service Center to check this.		
Immobilization - Vehicle with namual transmission	Parking brake defective!!	Parking brake. Parking brake defective. To park, secure engage selector lever position P. Ask your nearest BMW Service Center to check this.		

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