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# M6 Complete Vehicle

**Model: F12/F13 M6**

**Production: From Start of Production**

# OBJECTIVES

After completion of this module you will be able to:

- Describe the changes to the body when compared to the standard F12/F13
- Identify the features of the F1x M6
- Identify the transmission that is available for the F1x M6
- Describe the changes to the interior
- Identify the changes to the suspension and brakes when compared to the standard F1x M6

# Introduction



European versions shown



The F12 M6 convertible will enter the market in July 2012 and the F13 M6 Coupe in August 2012. These high-performance sport cars developed by BMW M GmbH conveys a confidence that is unique in the upper class premium segment.

A rear diffuser provides an additional power boost on the rear axle. BMW M's latest TwinPower V-8 engine rated at 560 horsepower and 500 pound-feet of torque. With the M-DCT 0-60 mph acceleration takes the F12 around 4.3 seconds and the F13 around 4.1 seconds, the top speed comes in at 155 mph.

The new M6 also includes some emission reduction features:

- Automatic engine start/stop function
- Gasoline direct fuel injection with Valvetronic
- Fuel pump with demand-driven control
- Volumetric-flow-controlled oil pump
- Volumetric-flow-controlled VARIOSERV® power steering pump
- M Double-Clutch Transmission w/Drivelogic
- Brake energy recovery

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## Standard Equipment

Includes:

- M TwinPower Turbo and M engine dynamic button.
- M Double-clutch Transmission with launch comfort.
- M gear selector switch with Drivelogic button and drive dynamic button area.
- M instrument panel.
- M Drive menu.
- M Dynamic Mode MDM button.
- M Dynamic Damper Control button.
- M Servotronic button.
- M design seat with seat heating for driver and front passenger with extended features, front head restraint, center console with armrest, armrests at doors in leather.
- M logo on the front head rest.
- M interior trim finishers aluminum trace.
- M leather steering wheel with two M multifunction key.
- M side gill, M sills, M footrest.
- M6 Aerodynamic package: front and rear bumper, widened front fenders with side gills, M exterior mirrors and rocker panels.
- M6 lettering on trunk.
- M quad chrome-plated exhaust pipes.
- M light alloy wheels Double-spoke style 344M, 19".
- Carbon Fiber roof (F13 only).

**Note: This training material discusses the F12/F13 M6 vehicles but it is important to point out that the F12/F13 M6 is largely based on the F10 M5 and thus shares the same Powertrain, Chassis Suspension, Braking and Electrical system.**

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## Equipment Packages

### **Driver Assistance Package (ZDA)**

- Lane Departure Warning
- Active Blind Spot Detection
- Side & Top View Camera
- Speed Limit Info

### **Executive Package (ZEC)**

- Heated Steering Wheel
- Soft-close automatic doors
- Power rear sunshade
- Active front seats
- Heated rear seats
- Full LED headlights
- Head-up Display
- Satellite radio with 1 year subscription
- BMW Apps

## F12/F13 M6 Overview

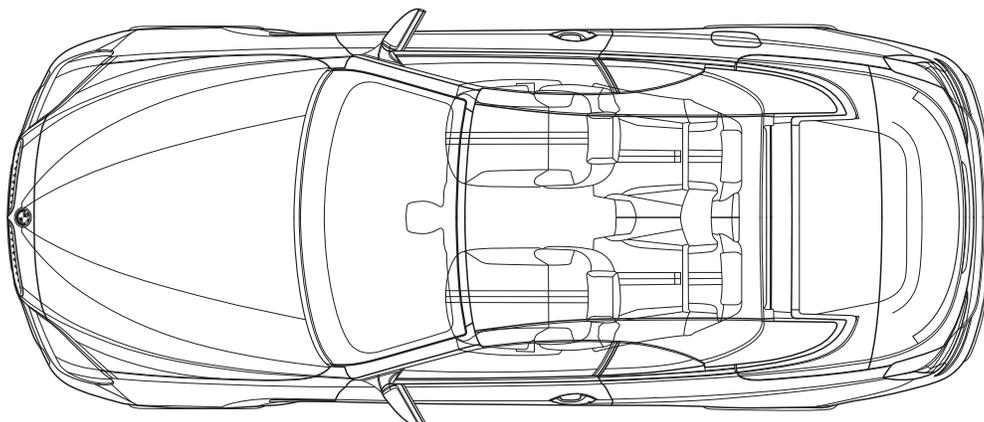
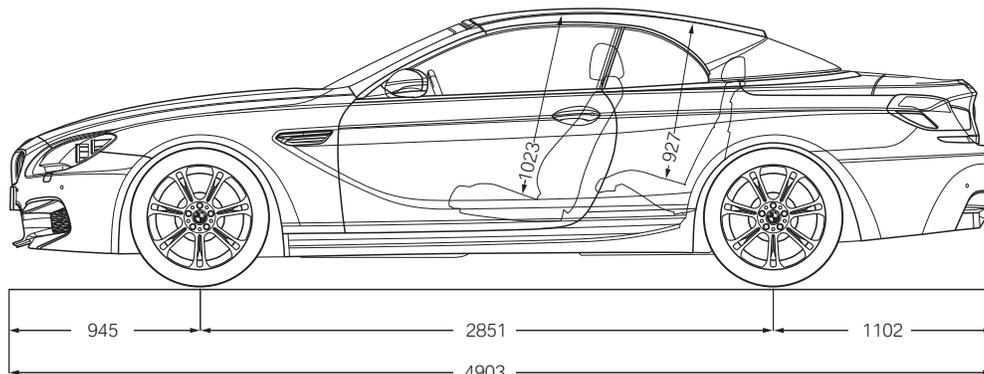
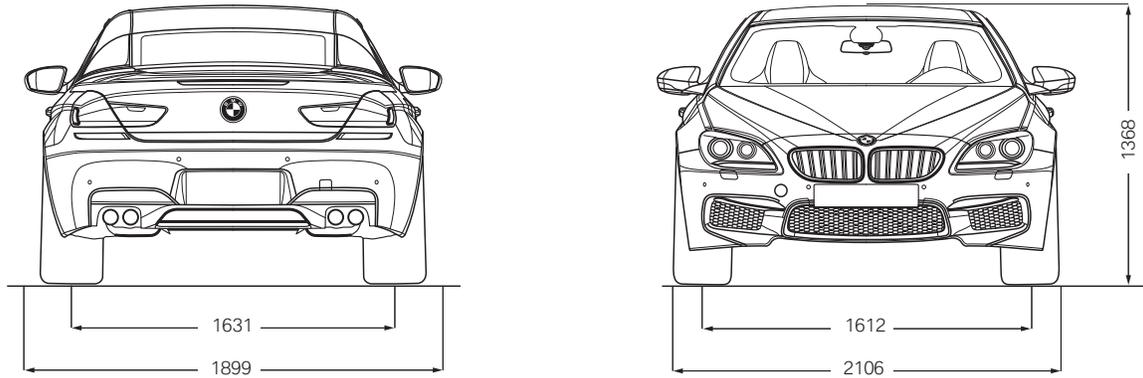


- **Design and aerodynamics:** M specific features in the front, side and rear area. Aerodynamic design at front, side, rear and underbody.
- **Engine/Transmission:** Efficient, with even more powerful and even more spontaneous linear power development. Choice of 3 engine dynamics control programs. M Double-Clutch Transmission with Drivelogic. Electronically controlled M rear-axle differential lock.
- **Engine sound:** Impressive engine sound in the lower and upper speed and performance range, as well as an Active Sound Design System, which in connection to the actual engine noise makes the engine sound in the passenger compartment even more desirable.
- **Steering:** Direct and precise variable M Hydro rack-and-pinion steering with Servotronic. Featuring 3 selectable stages. M6 specific steering wheel including paddle shift and now with two freely programmable M mode buttons.
- **Chassis and suspension/Dynamic design:** Adaptive M running gear, 3 driving dynamics programs from comfort to sport plus. Offering an optimal driving experience that includes adjustments of steering, suspension and damping depending on the selected program. Dynamic Stability Control DSC with M Dynamic Mode MDM in place of Dynamic Traction Control DTC.
- **Seating comfort:** M multifunction seat standard / M Active front seat (optional).
- **Ergonomic interior equipment:** M instrument panel, M Drive menu, M Head-Up Display, M seat, M specific decorative trim, M footrest and rocker panel trim.

# Body

## Dimensions

### F12 M6 Convertible



## Technical Data M Comparison

Designation	Unit	F12/F13 M6	F12 650i	E64 M6
Engine series		S63B44T0	N63B44O0	S85B50O0
Engine control		MEVD17.2.8	MSD 85	MS S65
Transmission type designation		GS7D36BG	GA8HP70Z	SMG III (Getrag 247)
Length	[mm]	4,903	4,896	4,871
Width with out mirrors	[mm]	1,899	1,894	1,855
Height	[mm]	F12 1,368 F13 1,374	1,365	1,377
No. of seats		4	4	4
Maximum speed	mph	155*	155*	155*
Acceleration 0-60 mph	[s]	F12 4.3 F13 4.1	4.7	4.5
Acceleration 0-124 mph	[s]	13.1	—	—
1,000 m, stationary start	[s]	22.1	—	22.9
Nominal engine power at engine speed	[kW/BHP] [rpm]	412/560 6,000-7,000	300/400 5,500-6,400	373/500 7,750
Power-to-weight ratio (DIN)	[kg/kW] [kg/HP]	4.5 3.5	5.9 4.3	5.2 3.8
Torque [Nm/ lbs-ft] at speed [rpm]		680/500 1,500-5,750	600/450 1,750-4,500	520/383 6,100
Curb weight - US	[kg/lbs]	F12 2,045/4,508 F13 1,930/4,255	2,050/4,520	1,930/4246
Rear axle load proportion empty (DIN)	[%]	49.0	49.2	49.8
Load capacity	[kg/ lbs]	540/1,188	600/1,320	520/1,144
Permissible total weight	[kg/lbs]	2,410/5,313	2,461/5,425	2,300/5,060
Fuel consumption	[l/100 km]	10.3	—	14.7
Approx. fuel tank capacity	[l]	80	70	70
CO2 emissions	[g/km]	239	—	352
Exhaust emission standards US		LEV II	LEV II	ULEV II

\*Electronically regulated.

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## **Body Shell**

### **Front Axle Area**

There is a welded fixture in the lower end wall wheel arch area for the screw connection of the front axle support.

### **Rear Axle Area**

The crossbeam tunnel has a special geometry for mounting the M trailing links and for mounting the M exhaust system. An M trailing link is installed as a reinforcement measure on the right and left and for mounting the M rear axle stiffening plate.

### **Engine Compartment**

There is a M specific holder installed in the engine compartment for the intake silencer cylinder 1-4 at the spring-strut support (in direction of travel on right).

### **Luggage Compartment**

A holder for the control unit of the regulated rear-axle differential lock (GHAS) is installed in the luggage compartment floor in front of the battery.

### **Underbody**

There is a stiffening plate and trailing links at the front and rear for reinforcement. The front stiffening plate has an opening for the oil drain plug and the oil filter. The one-piece engine compartment shielding has ducts integrated at the side for brake cooling. A new underbody panelling improves the airflow of the rear axle final drive. New covers in the tank area improve the underbody airflow.

# Exterior

## Front View



The bumper has been designed specifically for the M6. The lower area of the bumper reduces lift at the front axle. The PDC sensors are painted in the vehicle color. No fog lights are installed due to the large air inlets.

A striking element is the newly designed M radiator grill with its black, paired grill bars, which bear the model inscription "M6" (optional with integrated fixture for BMW Night Vision).

The optional adaptive LED headlights are introduced in the upper area by a positioning light also fed by LED. Their bright white, 3D LED light rings are flattened in the upper and lower areas. Both the dipping and the high-beam headlights are generated from two light rings.

The LED units serve as light sources, which are positioned on a horizontal bridge in their center and guide the light into the reflectors at the front. The turn indicators in the shape of horizontal LED units are integrated below the light rings in the headlight assemblies.

**Night vision camera**



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## Air Ducts

The air intake duct and the intake silencer, as well as their positioning, are new. The sound insulation of the engine compartment lid is also new. Its geometry is adapted to the space requirement of the intake silencer.

### M6 air intake duct



There is a new air duct both for the center radiator package and for the side M-specific low-temperature radiator. The lower engine compartment shielding is one-piece for stiffness reasons (instead of 3-piece). It includes the exhaust air duct of the engine oil cooler and improves aerodynamics. The lower bumper support is plastic (saves on weight) and is secured to the M6-specific deformation elements. The shaped element in the upper bumper support is adapted to the shape of the M6 bumper panel.

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## Side View



### Soft Top

The soft top system remains unchanged from the F12 and is described in detail in the training material for the F12.



### Carbon Fiber Roof

The carbon fiber roof is standard on the F13. It is a double contoured design which improves aerodynamics. The carbon fiber roof is approximately 10 lbs lighter than a conventional steel roof found on the F13 650. This lowers the vehicles center of gravity. This has a particularly positive effect on the vehicle dynamics.

### Exterior Mirror and Sill

As standard (100% optional equipment) the exterior mirrors are heated and are electrochromic shaded, have memory and foldable functions and the passenger mirror an automatic parking function. The mirror cap at the bottom is designed as standard in high-gloss black including the shaft cover. The exterior mirrors have been adapted in terms of optical, aerodynamic and aeroacoustic features.

The side sill (rocker panel) is also aerodynamically designed.

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## Front Fender

The familiar M gills with the integrated side directional lights are mounted on the front fenders.

The coolant expansion tank is located on the left side behind the gill and the windshield washing tank on the right.

The optional side view camera is integrated in the fenders of the wheel arch similar to the F12/F13 production vehicle.

The front fenders are now wider due to the tire size for the M6. Each fender is widened by approx. 20 mm from the standard F12/F13. The rear quarter panels remain the same as the standard F12/F13.

## Rear Bumper

The rear bumper is aerodynamically designed. The PDC sensors are painted in the vehicle color. The four tail pipes are typical M6 in design.

The rear diffuser in the rear bumper between the tail pipes and the rear spoiler on the trunk lid reduce the rear axle lift. The trunk also incorporates the rear view camera as standard and the power tailgate is optional. The F13 will come standard with a rear trunk mounted spoiler.



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## **Wheel/Rim Design**

Cast 19" M6 BMW light-alloy wheels in a double-spoke rim styling with mixed tires of size 265/40 R 19 at the front and 295/35 R 19 at the rear are fitted as standard.

Forged 20" M6 wheel rim in a double-spoke rim styling with mixed tires of size 265/35 R20 at the front and 295/30 R 20 at the rear are also available as optional equipment.

## **Underbody**

There is a stiffening plate and trailing links at the front and rear for reinforcement. The front stiffening plate has an opening for the oil drain plug and the oil filter. The one-piece engine compartment shielding has ducts integrated at the side for brake cooling. A new underbody panelling improves the airflow of the rear axle final drive. New covers in the tank area improve the underbody airflow.

## **Thermal Protection**

New features and heat insulation:

- The left heat insulation of the center underbody panelling is new.
- The heat insulation of the fuel tank is new.
- The heat insulation of the tunnel is new.
- A special heat insulation of the luggage compartment prevents the luggage compartment heating up too much by the exhaust air flow of the rear axle final drive.

# Interior

## Cockpit

For the full leather upholstery (optional equipment) , similar to the F10 M5, is covered with black Walk Nappa leather at the top and leather Merino in the upholstery color at the bottom.

### M cockpit



## Steering Wheel

Introducing the newly styled M6 leather multifunction steering wheel with M gear selector shift paddles with M switching logic, (left for down-shift, right for up-shift). A smaller impact absorber with a smaller airbag (which satisfies all crash requirements) has been installed. The double spoke design of the leather wrapped wheel is an excellent new element along with the traditional M badging and M color stitching.

The two M mode buttons located in the left spoke of the multifunction steering wheel are new. The E64 M6 used only one button for M mode.



Index	Explanation
1	M button 1
2	M button 2

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## Seats

### **M Multifunction Seat**

The M multifunction seat is standard on the M6. The seats are fully electric sports seats with integrated side airbags and seat belt buckle tensioners. The crash active head restraints are also standard.

Equipment of the M multifunction seat (driver and front passenger):

- Leather merino.
- Seat heating.
- Electric adjustment of seat base, angle and backrest angle and head restraint height.
- Manual head restraint depth and seat depth adjustment.
- Memory function for the driver's seat and passenger.
- M specific design with shoulder pads in the seat backrests for improved side support.
- Pneumatic upper and lower adjustment of lumbar support.
- Electric backrest upper section adjustment.
- Electric gap-free seat depth adjustment.
- Electric backrest width adjustment.
- Embossed M logo in the head restraints and two additional seams in the front view.
- Pneumatic upper and lower adjustment of lumbar support.

### **M Active Front Seat**

- M Active front seats for driver / front passenger is available as an option included in the Executive Package (ZEC).

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## Doors

The door trim panels are adapted to the specific M model. In the basic version the armrests and upper part of the door pull are covered in leather merino.

The complete door trim panel in leather merino is optional .

M specific decorative strips.

## Interior Design

The interior trim finishers are located in the dashboard and in the door trim panels.

- The door sills with M6 lettering.
- M footrest with stainless steel support and M emblem.
- M-specific function button unit is integrated in the center console cover (proximity of the M gear selector switch).

# Body Electronics

The F12/F13 M6 vehicle electronics is based on the standard F12/F13 vehicle.

## Bus Overview

The following changes apply in comparison to the standard F12/F13.

### PT-CAN

The S63B44T0 engine uses two DME's with version MEVD17.2.8. In place of the electronic transmission control EGS, the M Double-Clutch Transmission w/Drivelogic (M DCT) is used along with the gear selector switch M GWS with Drivelogic button. The electronic fuel pump control EKPS is connected to the PT-CAN.

### FlexRay

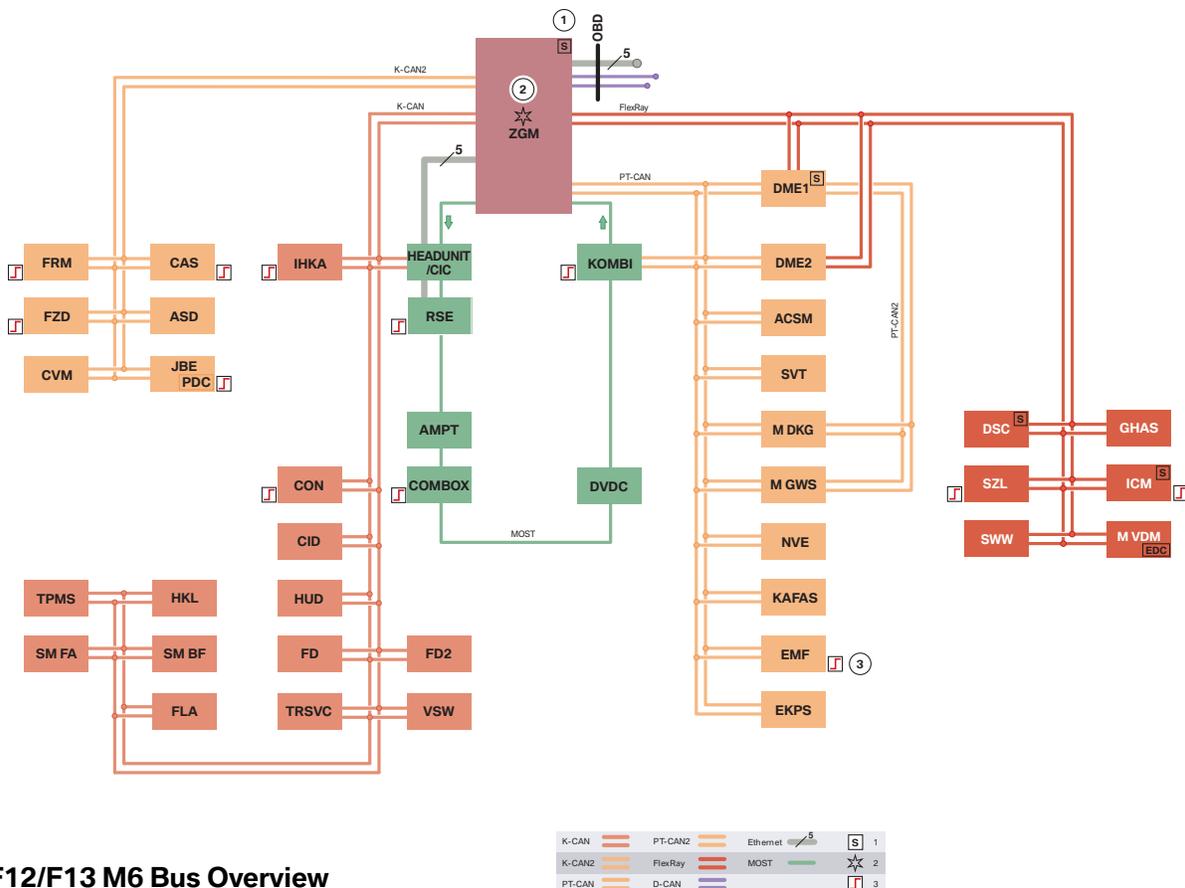
The regulated rear-axle differential lock (GHAS) and the M VDM are new.

### K-Can 2

Active Sound Design (ASD) is new.

### MOST

Same as current standard F12/F13.



## F12/F13 M6 Bus Overview

## F12/F13 M6 Bus Overview Legend

Index	Explanation	Index	Explanation
1	Start-up nodes control units for starting and synchronizing the FlexRay bus system	Headunit	Headunit (new general term for CIC)
2	Star coupler of the FlexRay bus system	HKL	Automatic trunk lid
3	Control units with wake-up authorization	HUD	Head Up Display
ACSM	Advanced Crash Safety Module	ICM	Integrated Chassis Management
AMPT	Amplifier Top	IHKA	Integrated automatic heating/air conditioning
ASD	Active Sound Design	JBE	Junction box electronics
CAS	Car Access System	KAFAS	Camera-based driver support systems
CID	Central Information Display	KOMBI	Instrument panel (M-specific)
COMBOX	Combox	M DCT	M Double-Clutch Transmission w/ Drivelogic
CON	Controller	M GWS	M gear selector switch
CVM	Convertible Top Module (F12 only)	M VDM	Vertical Dynamics Management
DME	Digital Motor Electronics 1&2	NVE	Night vision
DSC	Dynamic Stability Control	PDC	Park Distance Control (integrated in JB)
DVDC	DVD Compact changer	RSE	Rear Seat Entertainment system
EDC	Electronic Damper Control (M5/M6 version integrated in the M VDM)	SMBF	Front passenger seat module
EKPS	Electronic fuel pump control	SMFA	Driver's seat module
EMF	Electromechanical parking brake	SVT	Servotronic
FD	Rear monitor	SWW	Lane change warning
FD 2	Rear monitor 2	SZL	Steering column switch cluster
FLA	High-beam assistant	TPMS	Tire pressure monitoring system
FRM	Footwell module	TRSVC	Top Rear Side View Camera
FZD	Roof function center	VSW	Video switch
GHAS	Regulated differential lock	ZGM	Central Gateway Module

# Instrument Cluster

The M6 instrument panel uses black panel technology as introduced in other BMW models. The red needles and gauge markings are always visible even with the ignition off including the yellow/red warning fields in the tachometer.

The following M-specific changes have been made in comparison to the F12 650i.

Round gauges:

- Vehicle Speed up to 200 mph and engine speed up to 8000 rpm.
- Typical M red needles, with white dial gauge numbering, M logo in tachometer.

## M instrument panel



M-specific displays:

- MDM M Dynamic Mode symbol in place of the DTC.
- M1/M2 = M Drive1 / M Drive2.
- Digital vehicle speed read out under speedometer.
- Display of current gear .
- Display of Drivelogic (bar symbol and button).
- Display of Driving Dynamics: engine,damper control and steering.

In the instrument panel the current configuration of driving dynamics such as engine, damper control and steering are shown in the lower part of the tachometer. This function can be activated and displayed using the CID settings in the display configuration menu. The M Drive settings for DSC, engine dynamics, transmission, EDC and steering are also displayed in the instrument panel.

## M Drive menu Cluster



# System Information

The M Drive menu can be found in the settings menu. There are now two individually adjustable M Drive configurations, M Drive1 and M Drive2.

## M Drive menu CID



The settings can be selected by pressing the corresponding button on the multifunction steering wheel. The two M buttons on the steering wheel allow the driver to select between two different M Drive modes that can be saved and activated.

The activation of a M Drive configuration is displayed by a M1 or M2 symbol in the instrument panel below the tachometer.

## Steering wheel M buttons



Index	Explanation
1	M Drive Button 1
2	M Drive Button 2

**M Drive buttons**



**M1 and M2 Cluster Display**



While driving in one of the M configuration modes and the ignition is switched off the M button must be reselected when the ignition is switched back on in order to reactivate the M mode. The M1 or M2 symbol in the instrument panel goes out when deactivated

At the factory a setting of **Sport / Comfort** configuration is preset using the M1 button and a **Sport / Sport Plus** configuration preset using the M2 button. This setting can be changed by the customer in the M Drive menu and can also be reset again to the factory setting. Both M buttons can be individually configured and the settings are assigned to the corresponding remote control key.

**M Drive menu DSC confirmation**



If the DSC selection of "MDM" or "DSC OFF" is selected, a second actuation of the corresponding M button is required to activate the M configuration as a confirmation for M mode for safety reasons.

---

## M Drive Button Selections

The following functions and configurations can be selected, set and adjusted;

### Dynamic Stability Control (DSC)

- On
- MDM
- Off

### Engine Dynamic Response

- Sport Plus
- Sport
- Efficient

### Chassis Setting

- Sport Plus
- Sport
- Comfort

### Steering Assist

- Sport Plus
- Sport
- Comfort

### Head-Up Display

- M view
- Unchanged

### Drivelogic

- Drivelogic program "S" switch position 1-3 bars
- Drivelogic program "D" switch position 1-3 bars

## Configuration Quick-Save

A modified M setting or a new M setting using the drive dynamic buttons can be assigned to one of the two M buttons on the steering wheel M1 or M2. The corresponding M button on the steering wheel must be pressed and held for two seconds. The current configuration is set and overwrites any previously saved settings. This allows quick saving without accessing the M Drive menu.

## Active Configuration

While driving, the individual driving stability controls can be set by the driver using the assigned buttons. Then one of the two M buttons on the steering wheel can be pressed and held for 2 seconds to save the current configuration.

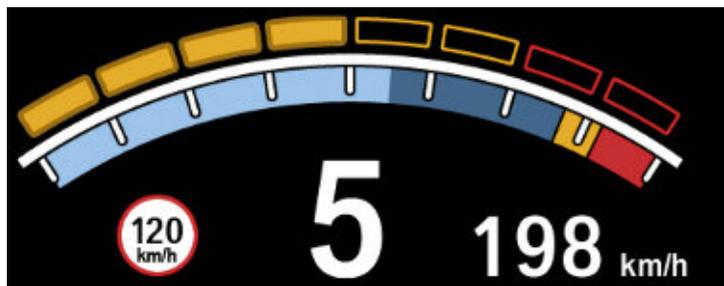
## M Head-Up Display

The optional full-color Head-Up Display can be changed to M display by accessing the M Drive menu using the M button on the steering wheel or by making a selection in the Head-Up configuration menu.

The following information can be displayed:

- Shift point indicator via shift lights
- Speed via tachometer range
- Current gear
- Vehicle speed
- Speed limit info (included in the Driver Assistance Package, ZDA)

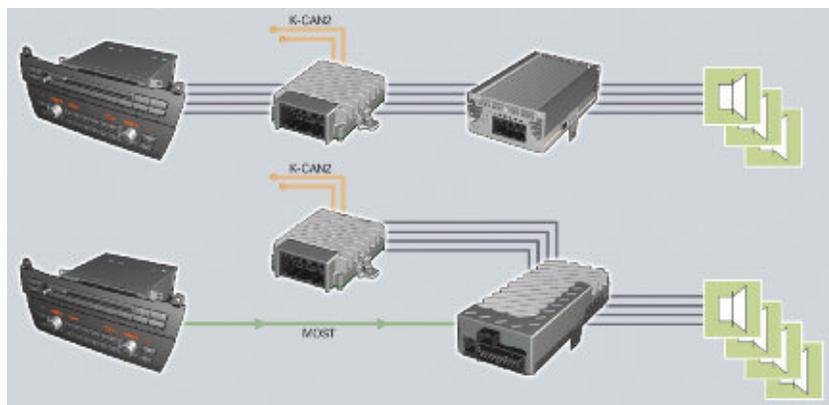
### M Head-Up Display



## Active Sound Design

The Active Sound Design (ASD) is installed in the M6 and is described in a separate Training Manual. The “ST1204 Active Sound Design” training material is available on ICP and TIS.

### Active sound design



# Drivetrain

## Engine S63B44T0

The S63B44T0 (TOP) engine (also referred to as the S63 TU) is installed in the F12/F13 M6 and is described in a separate training manual. ST1202 S63 TU Engine training material is available on TIS and ICP.

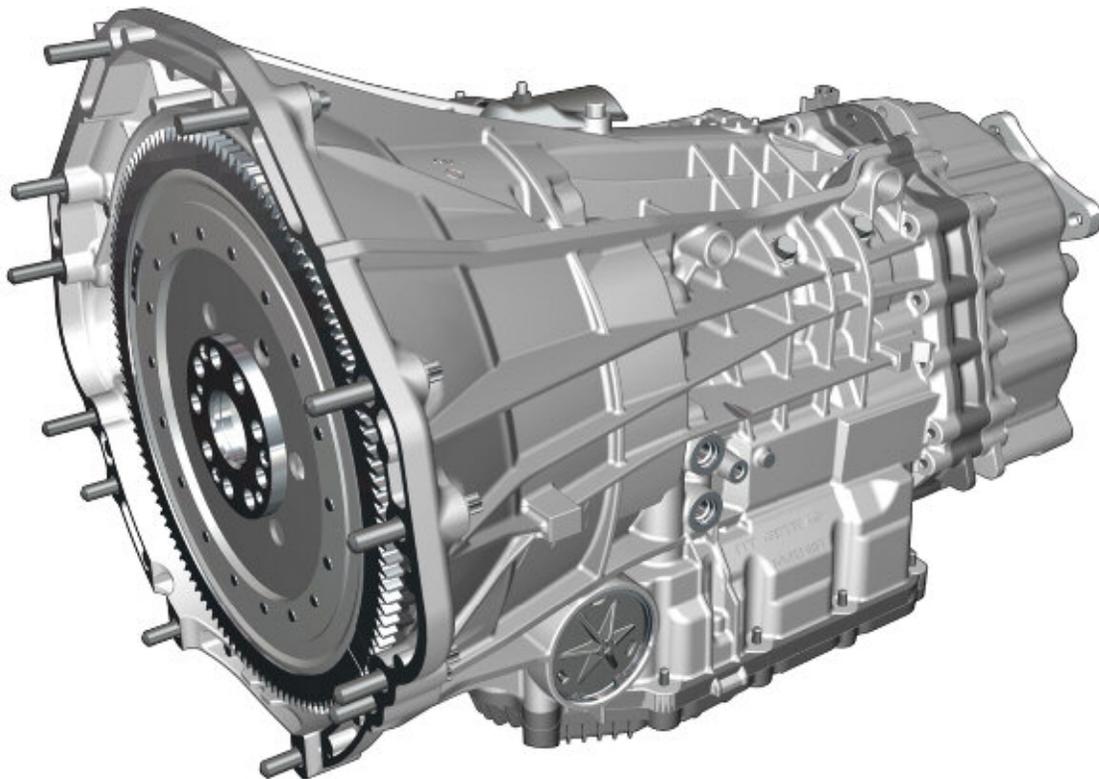
## GS7D36BG Double-Clutch Transmission

The GS7D36BG M Double-Clutch Transmission w/Drivelogic is standard in the F12/13 M6. The customer will benefit from the increased efficiency of the gear shifts along with reduced fuel consumption in comparison to the previous model. In comparison to the GS7S47BG (SMG 3) in the E64 M6, there is no delay between gearshifts. The drive is retained continuously.

This is due to the M Double-Clutch Transmission w/Drivelogic that was first introduced in the E9x M3 with the S65B40 engine.

This reference manual only describes the differences of the GS7D36BG to the GS7D36SG.

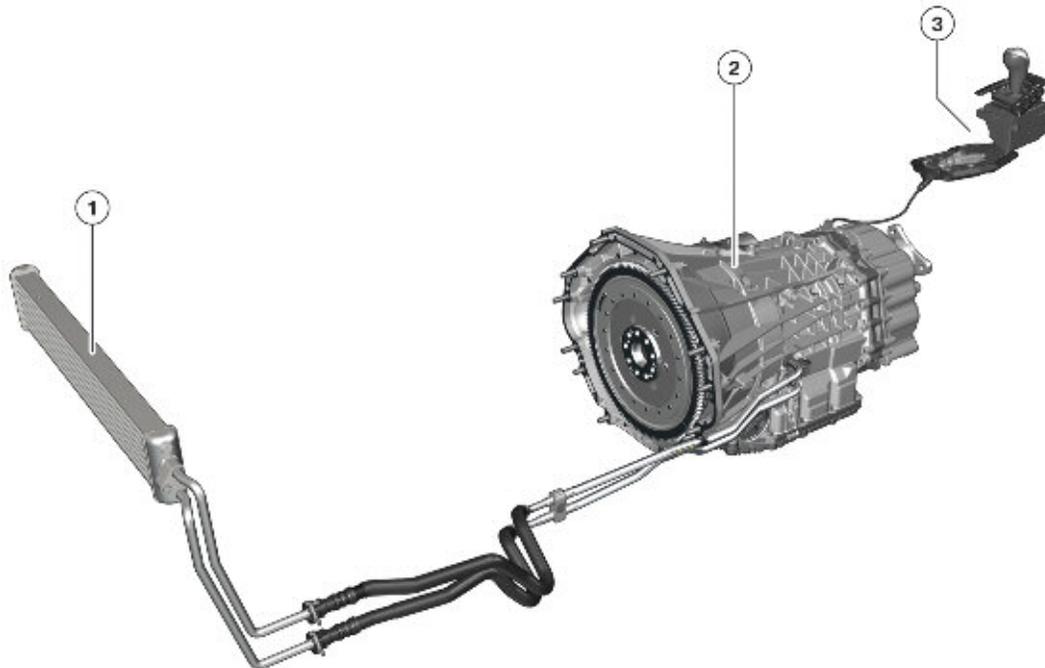
### F12/F13 M6 external view of the M DCT



Transmission changes compared to the M3 GS7D36SG:

- Adaptation of torque and power through a special processing procedure of the gear surfaces.
- Due to the lower speed range of the S63B44T0 engine, 5th gear is now a direct gear and 7th gear is the indirect gear. There is also a change to the 7th position in the designation of the transmission. M3 designation GS7D36"**S**"G (sport) F1x M5/M6 designation GS7D36"**B**"G (Gasoline).
- All gear sets and the control of the sliding clutches 5/7, have been redesigned.
- The hydraulic emergency operation is discontinued. In the event of a power failure the transmission remains in Neutral.
- The parking lock automatically engages after approx. 15 minutes after the engine has shut off with the gear selector position "N" and ignition "ON" Car wash mode.
- The transmission oil cooling system is different to that of the M3 with M DCT Drivelogic. The coolant/oil heat exchanger and the 95° C (203° F) thermostat are not used. The air/oil heat exchanger circuit provides the cooling on its own. The oil capacity is approx. 9.5 liters (10 quarts) including the radiator.

**F12/F13 M6, M DCT Drivelogic with external oil circuit**



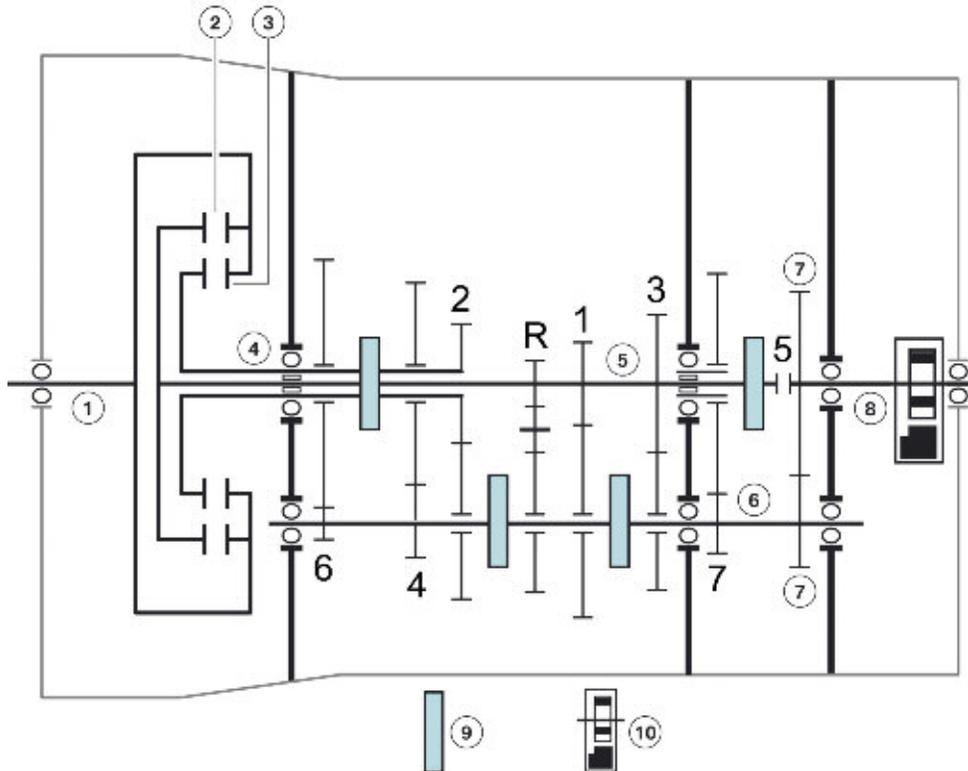
Index	Explanation
1	Air/Transmission oil cooler
2	M Double-Clutch Transmission w/Drivelogic
3	M gear selector switch

## Design

The gear sets have been modified to the respective gear ratio.

The transmission housing and the shaft bearing are unchanged for the GS7D36BG. The engine connection to the transmission has been modified to the S63.

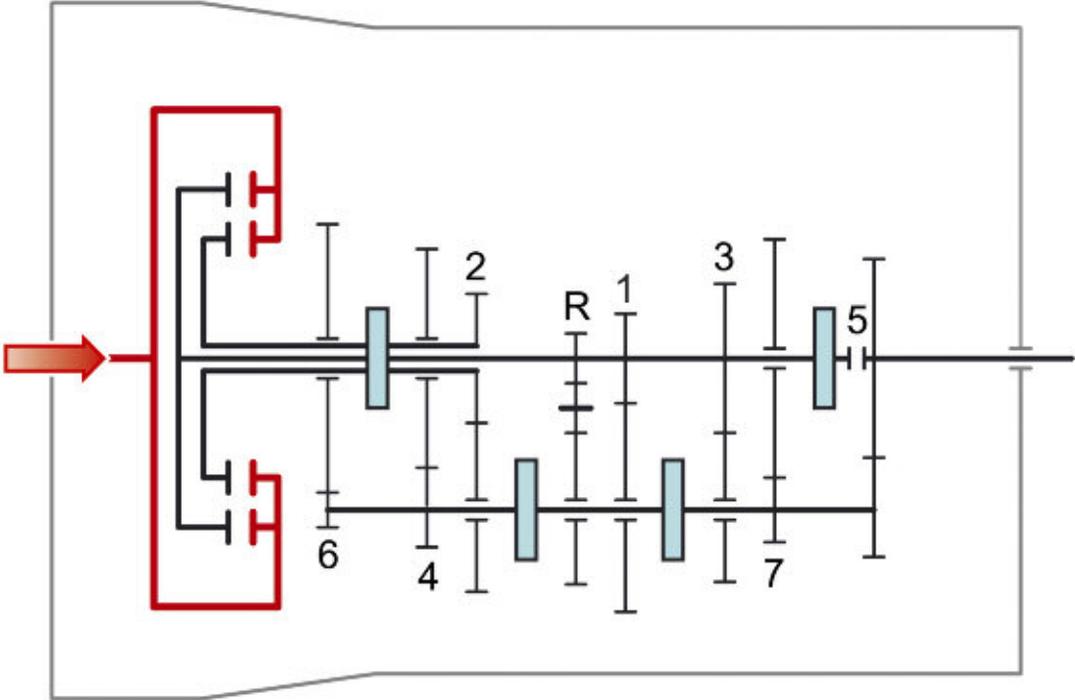
### F12/F13 M6 M DCT design



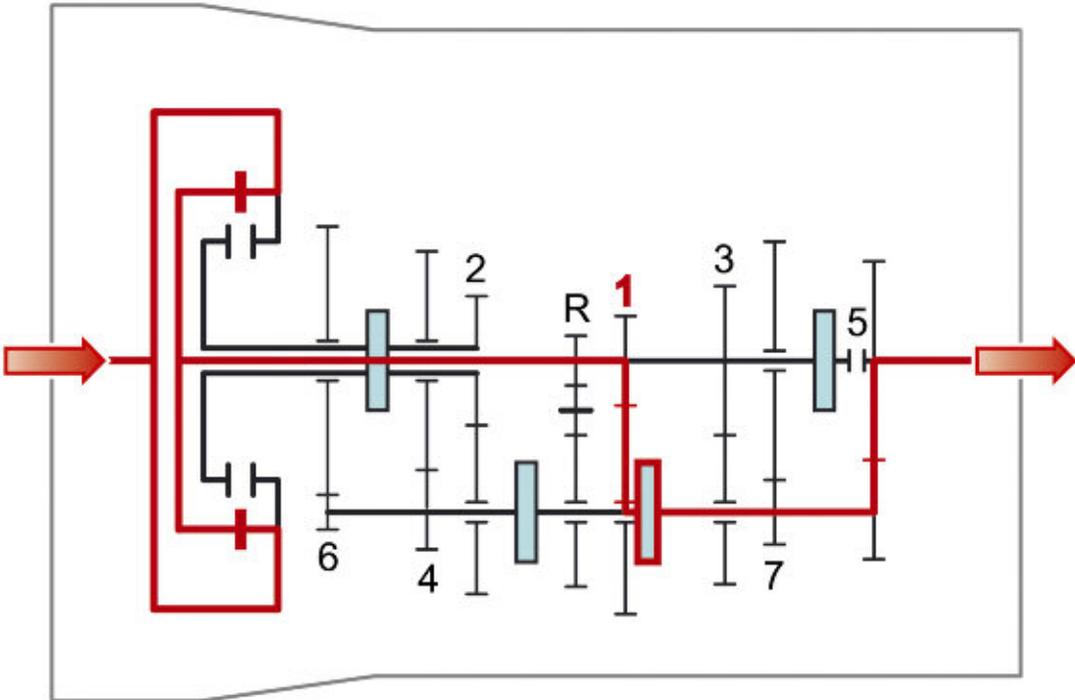
Index	Explanation
1	Central input shaft with clutch input
2	Clutch 1
3	Clutch 2
4	Inner input shaft 2
5	Inner input shaft 1
6	Balancing shaft
7	Constant gears
8	Output shaft
9	Sliding Clutches
10	Parking lock

# Power Flow

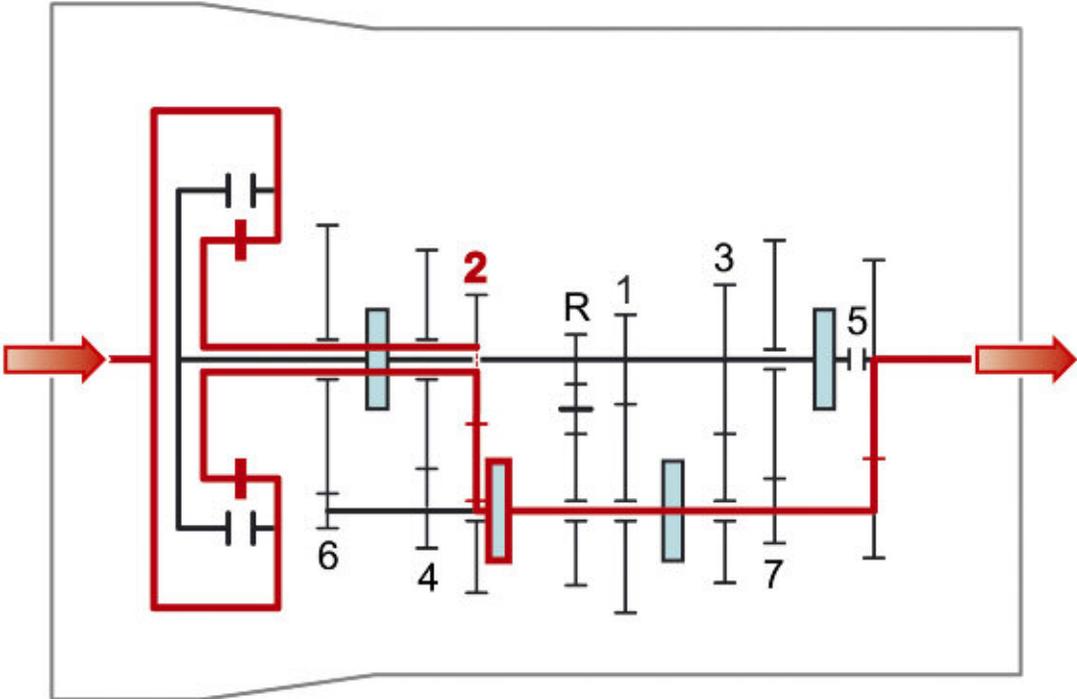
“Neutral” clutches open



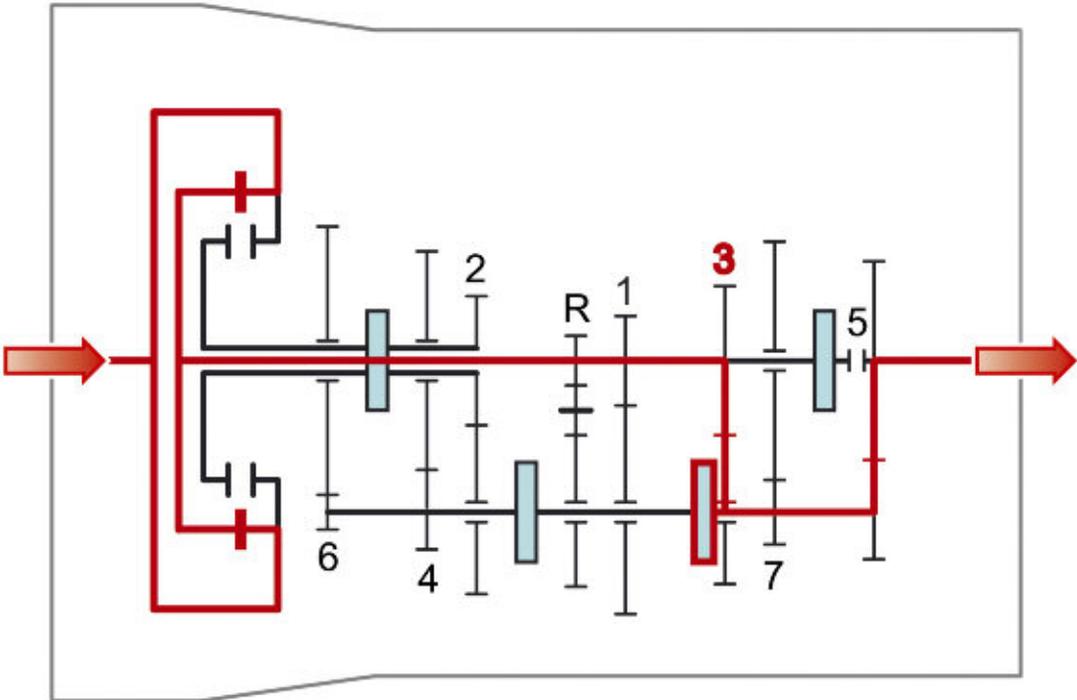
1st gear



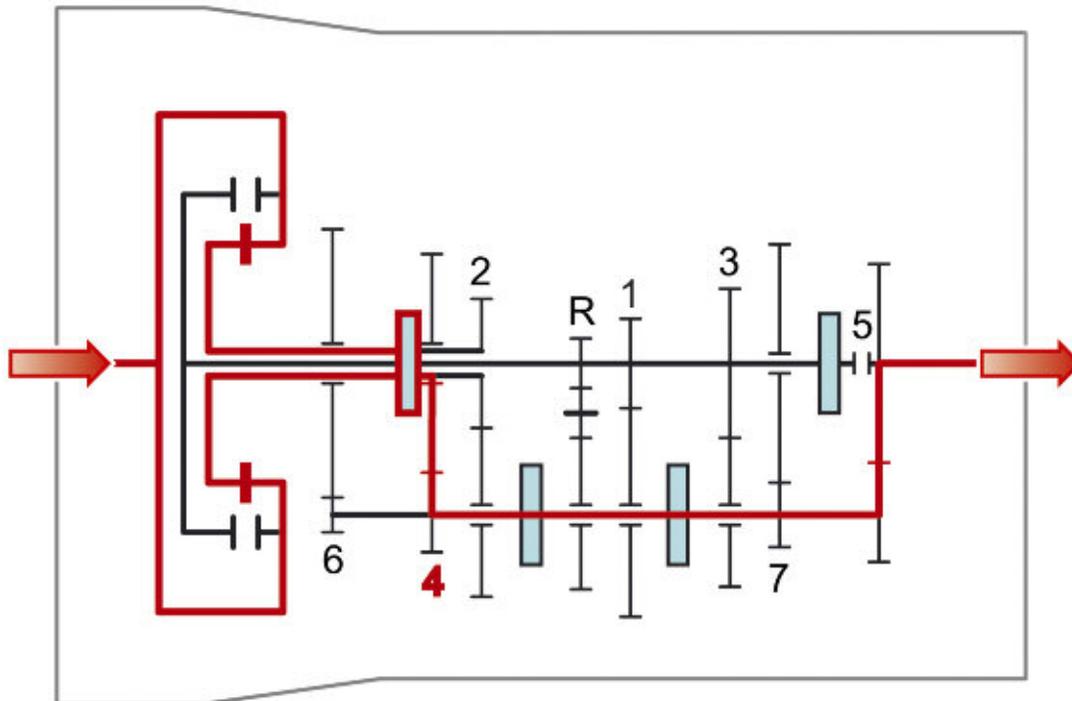
2nd gear



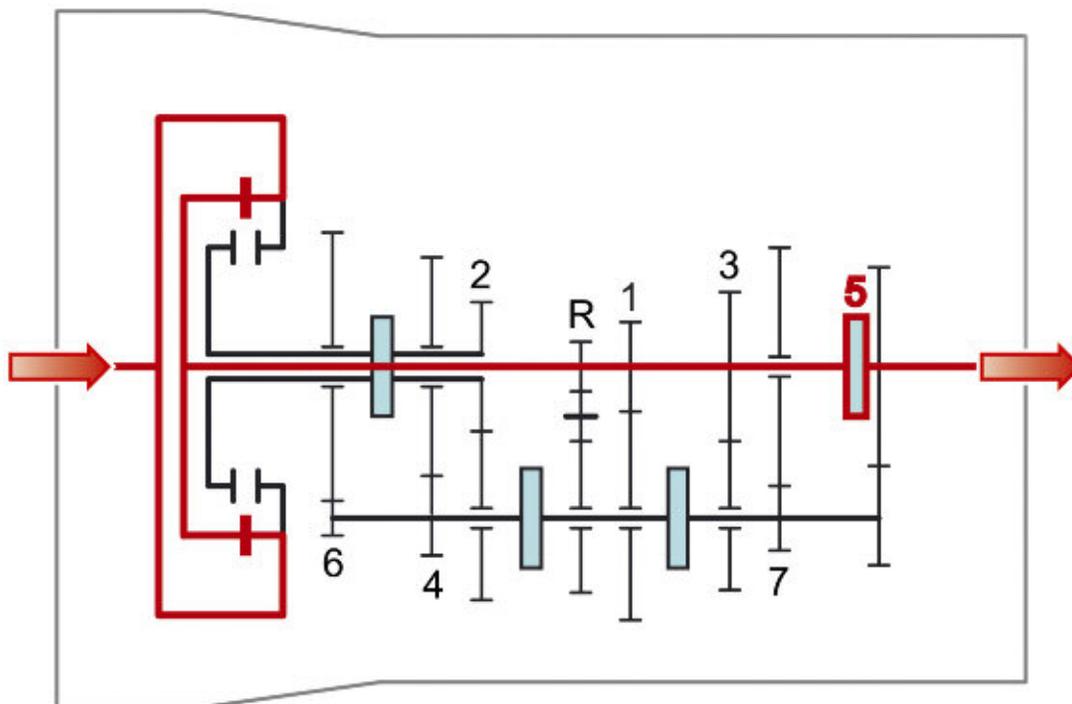
3rd gear



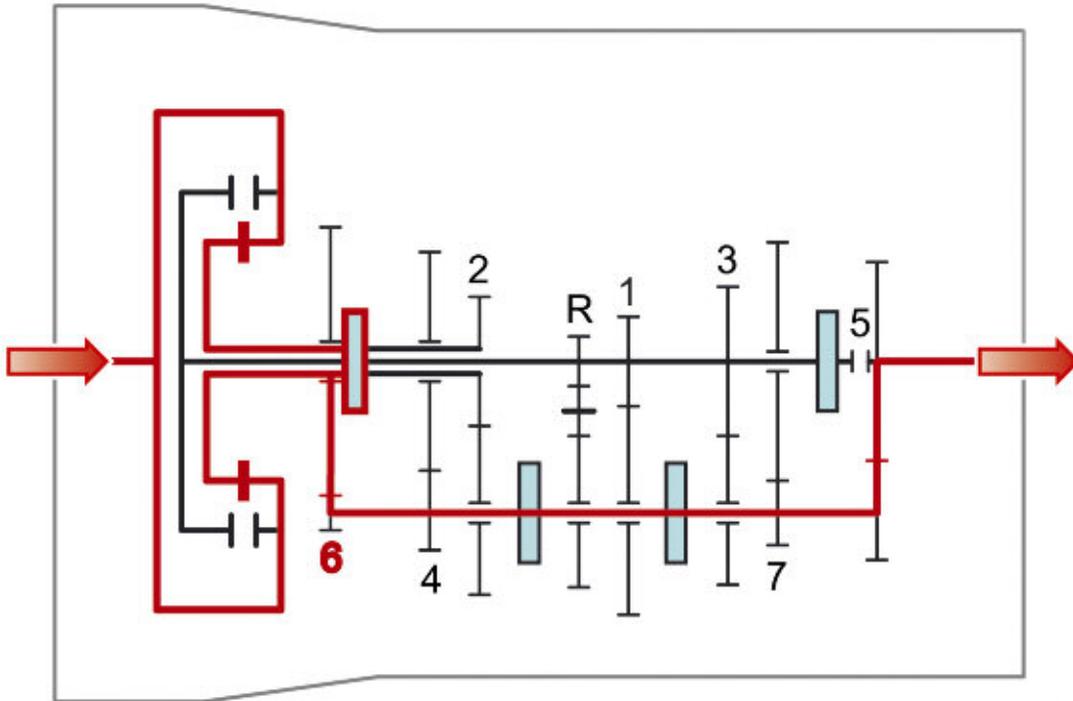
**4th gear**



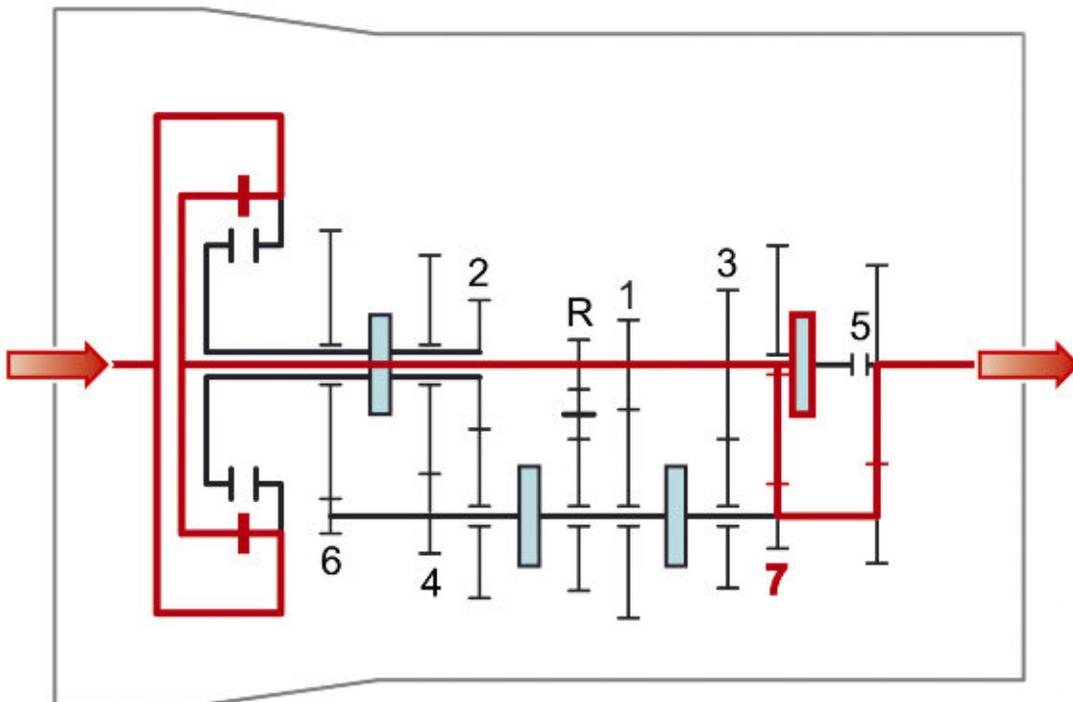
**5th gear direct drive**



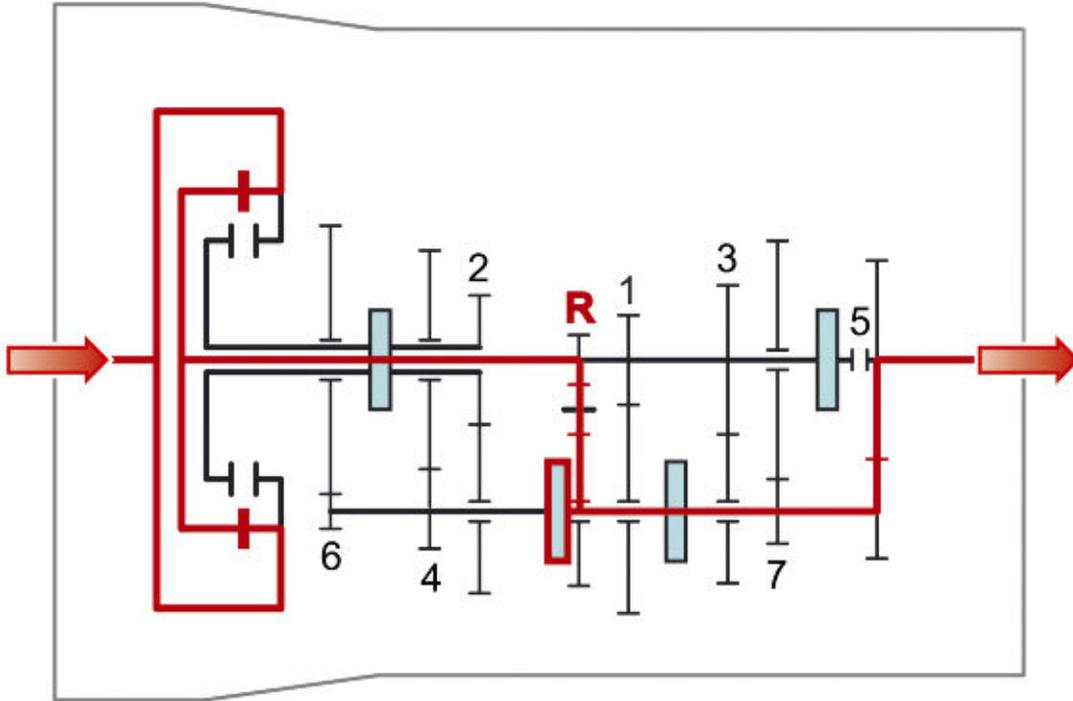
6th gear under drive



7th gear under drive



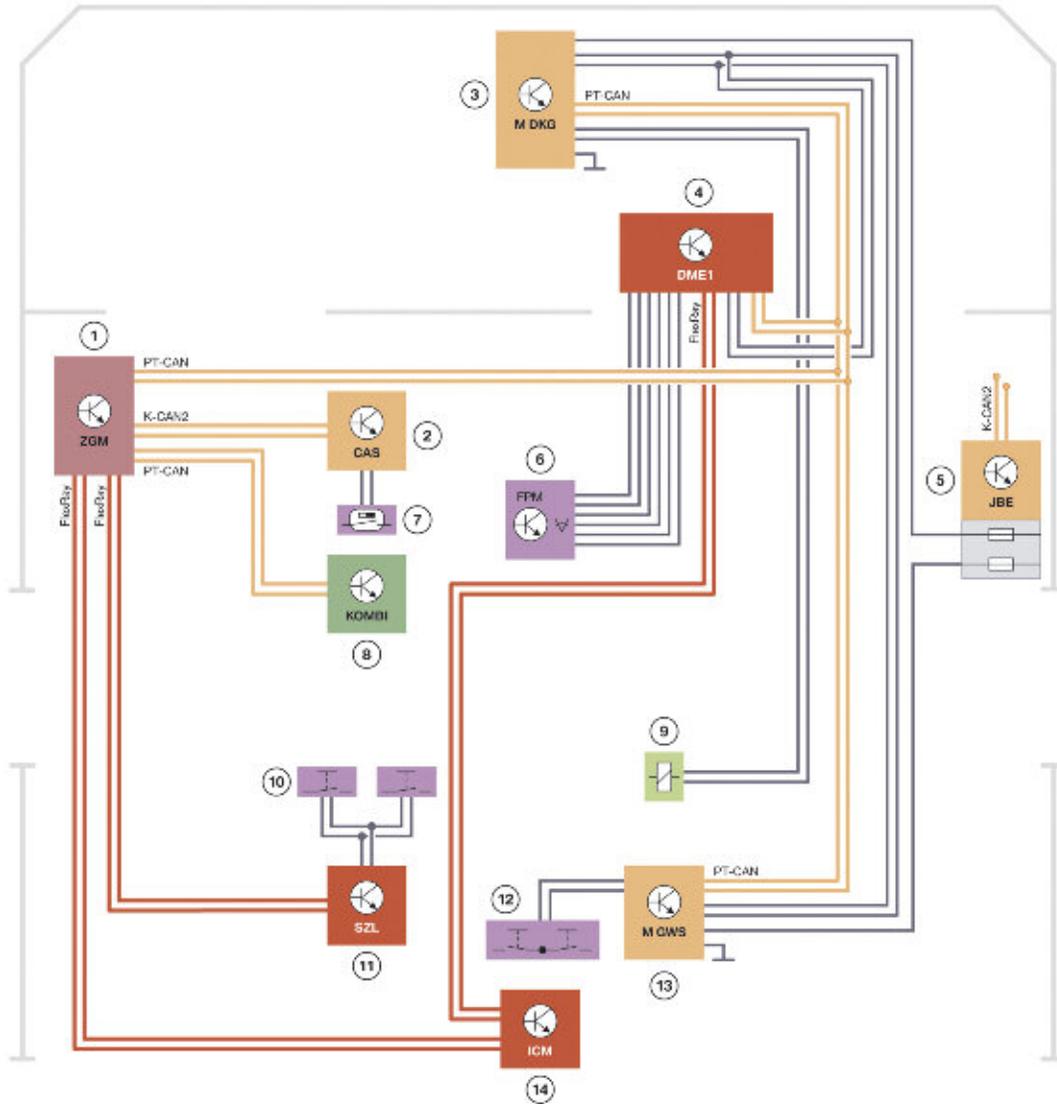
## Reverse gear



## Technical Data

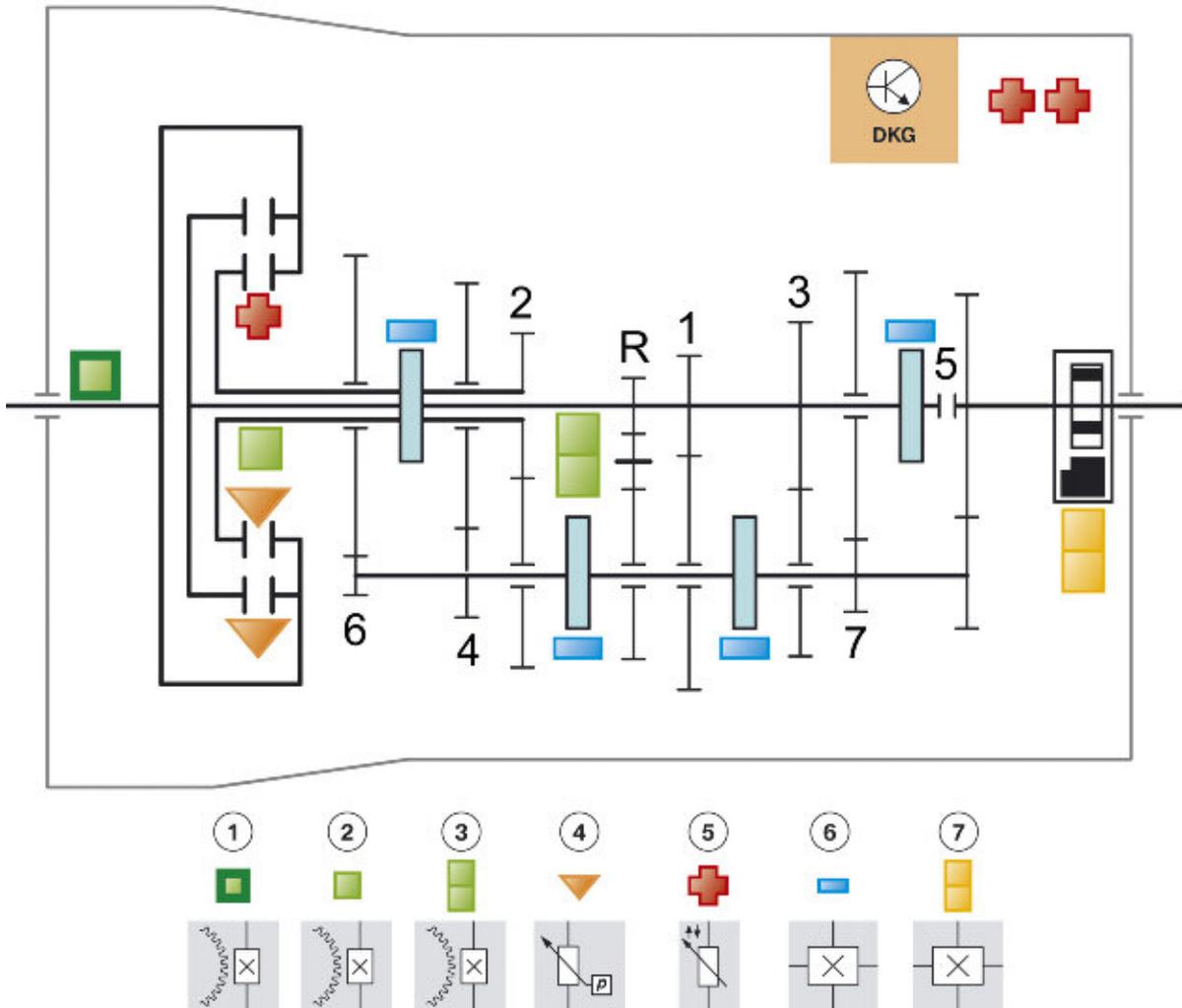
	<b>F12 M6</b>	<b>E9x M3</b>
Maximum speed rpm	7,500	9,000
Design torque Nm/lbs-ft	700/516	520/383
Dry weight without dual-mass flywheel kg/lbs	85/187	85/187
	<b>Ratio [:1]</b>	<b>Ratio [:1]</b>
Constant	1.630	1.630
<b>Gear position</b>		
1st gear	4.806	4.780
2nd gear	2.593	3.056
3rd gear	1.701	2.153
4th gear	1.277	1.678
5th gear	1.000	1.390
6th gear	0.844	1.203
7th gear	0.671	1.000
Reverse gear	4.172	4.454
Rear axle	3.154	3.154

# M DCT System Overview



Index	Explanation	Index	Explanation
1	Central gateway module	8	Instrument cluster
2	Car Access System	9	Shiftlock actuator
3	M Double-Clutch Transmission Control Unit	10	M steering wheel shift paddle
4	Digital Motor Electronics 1	11	Steering column switch cluster
5	Junction box electronics	12	Drivelogic button
6	Accelerator pedal module	13	M gear selector switch
7	Brake light switch	14	Integrated Chassis Management

## M DCT Electronics and Sensors



Index	Explanation	Index	Explanation
1	Input speed hall-effect sensor	5	Temperature NTC sensors
2	Gear speed hall-effect sensor of the inner input shaft 2	6	Shift travel hall-effect sensors
3	Gear speed hall-effect sensor with detector for direction of rotation of the inner input shaft 1	7	Parking lock hall-effect sensor (redundant)
4	Clutch oil pressure (Piezo) sensors		

## M Gear Selector Switch

Functional design and the operation of the M gear selector switch is identical to the E9x M3 with M DCT Drivelogic.

There are now three Drivelogic driving programs in Drive mode three Drivelogic driving programs in sequential mode.

The location and symbols of the driving dynamic buttons in the center console are listed below.

### M DCT Drivelogic gear selector / drive dynamic buttons (M5 shifter shown)



Index	Explanation
1	DSC button (including the M Dynamic Mode)
2	Engine dynamic button
3	EDC switch
4	Servotronic button
5	DCT Drivelogic button

---

## Drivelogic

After changing between sequential mode and Drive mode the last selected driving program is active.

After each engine start, driving program 1 in the Drive mode is always active.

### ■ Drive mode

Three driving programs are available for selection:

1. Efficient driving
2. Relaxed driving
3. Sporty driving

### ■ Sequential mode

Three driving programs are available for selection:

1. Comfortable gear shifts
2. Sporty, quick gear shifts
3. Maximum shifting speed and the prerequisite for activation of launch control

For using the highest, i.e. the third driving program, DSC must not be deactivated.

## Launch Control

The launch control allows optimal acceleration when starting-off on a dry surface.



**During the first 5,000 km/3,000 miles the launch control should not be used. The 2,000 km/1200 mile pre-delivery check must be performed and reset/confirmed with ISTA (do not reset via the instrument panel service function as the launch control is not released).**

---

## Preconditions

In order for the launch control to be activated the following pre conditions must be met:

1. The vehicle must be stationary, the engine running and be at operating temperature (approx 10 km/ 6 mile warm-up drive).
2. The dynamic stability control is deactivated.
3. The sequential mode and the third Drivelogic driving program are selected.
4. The brake pedal is pressed gently using the left foot.
5. The M gear selector switch is pressed forwards in the direction of travel and held there for steps 6-8.
6. In the M instrument panel a flag symbol must appear (if not, check steps 1-5).
7. The accelerator pedal is fully pressed and remains pressed. An engine speed of approx. 3,500 rpm is set, which can be increased an additional 500 rpm's by using the cruise control speed button.
8. The left foot is then removed off the brake.

## Activation

Launch control can be activated by releasing the gear selector switch that was pressed to the front. The vehicle is then accelerated.

### ■ Effect

- The launch control starts up automatically using the shortest possible shifting times, up to 5th gear as long as the driver keeps the accelerator pedal fully depressed up to a maximum time limit of 22 seconds.
- The start flag icon in the instrument panel remains active during launch control.

## Automatic Deactivation

- The driver leaves vehicle or the accelerator pedal full load range during acceleration or the acceleration phase reaches a duration of 22 seconds.
- If one of the preconditions are not met launch control is not possible.
- If the transmission oil temperature is too high (e.g. repeated launch control or start-up similar to a race), activation is blocked until the oil temperature is in a acceptable range.
- For each deactivation the start flag goes out and the automatic start-up is cancelled.

## Transmission Control Unit (DCT)

The DCT control unit is installed in the transmission and is connected to the PT-CAN.

## Emergency Release of Parking Lock



In the event of a power interruption the transmission parking lock must be manually unlocked in order to move the vehicle. It can only be unlocked if the vehicle is on level ground, it is not recommended to unlock the transmission if the incline/longitudinal gradient is  $> 10^\circ$ . After parking the vehicle the parking lock must be locked again.

### Unlocking

1. Open cup holder cover at front.
2. Remove cup holder insert.
3. Insert a screwdriver in the center hole , push the parking lock lever from left to right shown by the arrow below)) to the end position.
4. The parking lock is unlocked.

### F1x M-DCT emergency unlocking of the parking lock (F10 M5 shown)



Locked Position



Unlocked Position

### Locking

To engage the parking lock, move the parking lock lever from left to right as far as the end position. The parking lock is now locked.

**Note: This training material discusses the F12/F13 M6 vehicles but it is important to point out that the F12/F13 M6 is largely based on the F10 M5 and thus shares the same Powertrain, Chassis Suspension, Braking and Electrical system.**

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## **Gearbox Oil**

For work on the oil circuit of the double-clutch transmission this must be done with extreme cleanliness.

This involves:

- Cleaning of the outer oil circuit connections before dismantling the components or opening the oil circuit
- Immediate closing of openings and lines after dismantling and using clean original plugs. Do not use any unsealed components or spare parts of the oil circuit without checking for cleanliness.
- The work bay at which a DCT is opened must be completely clean and protected against dirt and contamination. For example use clean lint-free rags.

### **Long-Term Oil Filling**

The Gearbox oil change is currently not required at the 2,000 km / 1200 mile service or at every third engine oil change.

### **Repair/Part Replacement**

Depending on the type of repair the data status of the DCT must be read beforehand and read again after replacing components (e.g. mechatronics replacement).

If the twin-clutch assembly is replaced, the gear selector position "Neutral" must be selected before shutting down the engine.

---

## Rear Axle Final Drive

### Electrically Activated M lock

This new electro-mechanically controlled rear-axle differential lock was developed especially for the F12 M6.

The new M rear axle final drive is a HAG 220 (ring gear Ø 220 mm) with the new M rear axle lock is used. The system designation is a regulated rear-axle differential lock, the control unit designation GHAS (Regulated Rear Axle Differential lock) is connected to the Flex Ray Bus.

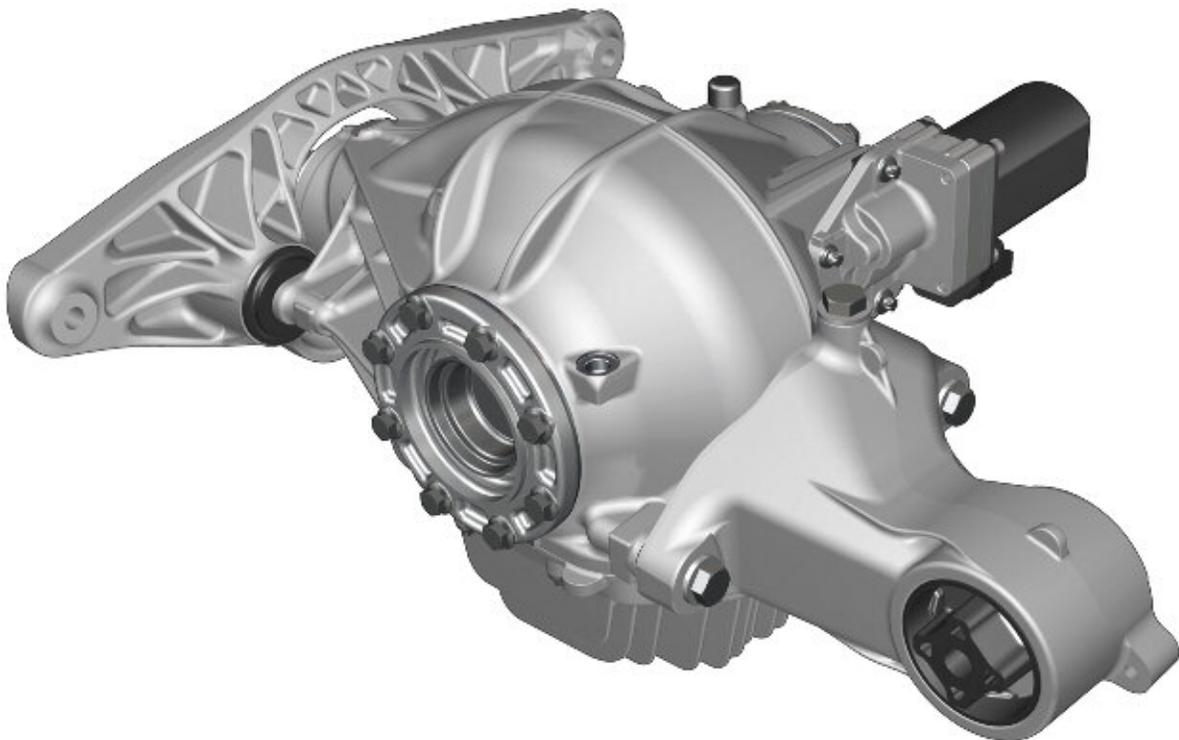
This replaces the variable M differential lock used in the E60 M5 designated HAG 215 (ring gear Ø 215 mm).

The gear ratio of the HAG 220 is 3.154:1 (HAG 215: 3.615:1).

The new M rear axle final drive can be identified by the aluminum oil sump installed on the differential and the external electric drive motor.

At 49.7 kg / 109 lbs the HAG 220 is about 2.8 kg / 6 lbs heavier than the HAG 215 of the E60/E61 M5 or E63/E64 M6.

### Rear axle final drive, external view



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## Operation

The lock is a demand-driven rear-axle differential lock that is active in the following situations:

- Pulling away.
- Differential speed at the rear axle for straight-ahead driving under load due to different coefficients of friction left/right.
- Dynamic cornering.
- Heavy oversteering.
- Stabilization in coasting/decelerating.

Traction, handling and driving stability are optimized by adjusting a defined differential speed or a differential torque at the rear axle.

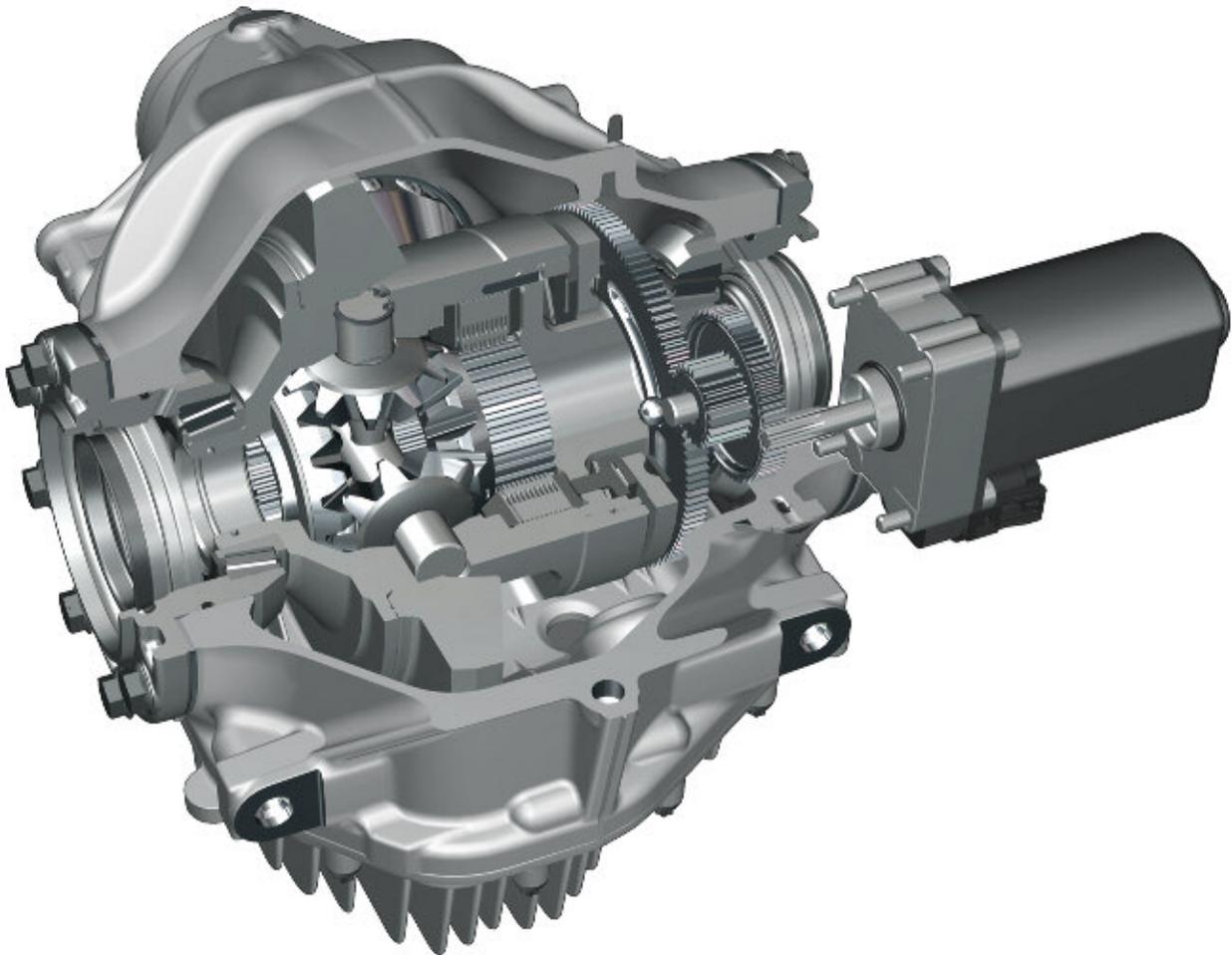
The controlled M rear-axle differential lock works with a position-controlled electric motor and a ball ramp. The GHAS control unit is installed in front of the battery in the trunk.

---

## Design/Function

The locking torque is generated by a multidisc clutch. The necessary axial pressure is applied by a direct current motor by means of gearing and a ball ramp mechanism to the multidisc clutch. The clutch pack acts between the differential housing (steel outer discs) and the output hub (molybdenum-coated steel inner discs).

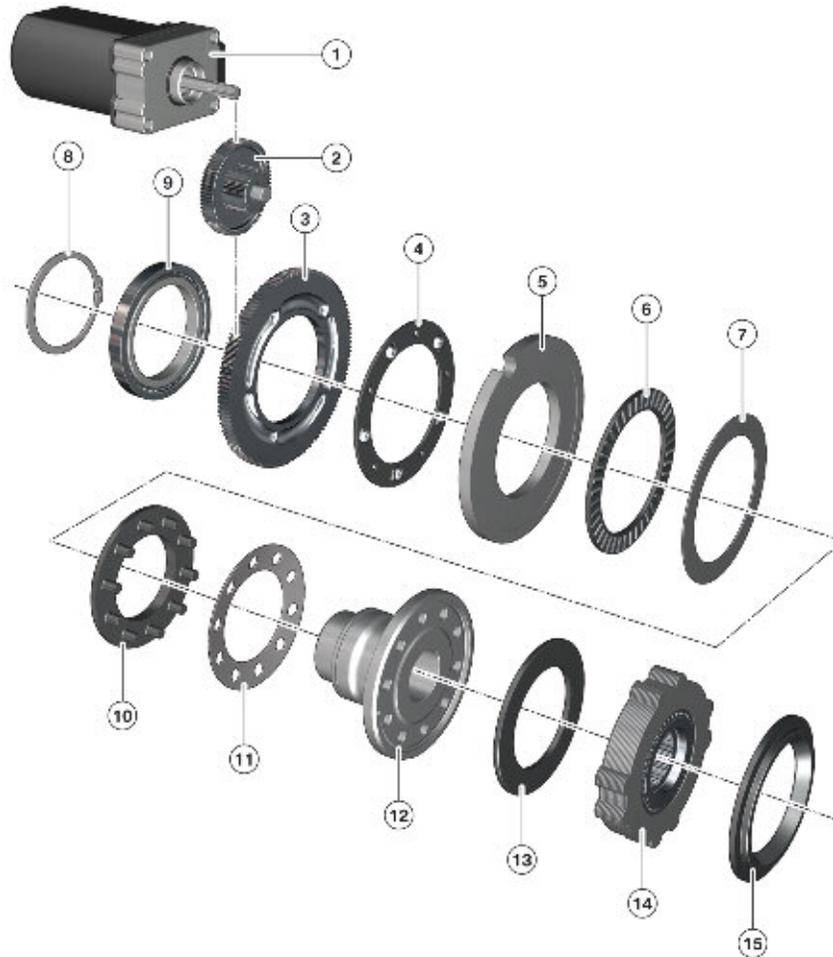
### Rear axle final drive, cross-section



### System Components

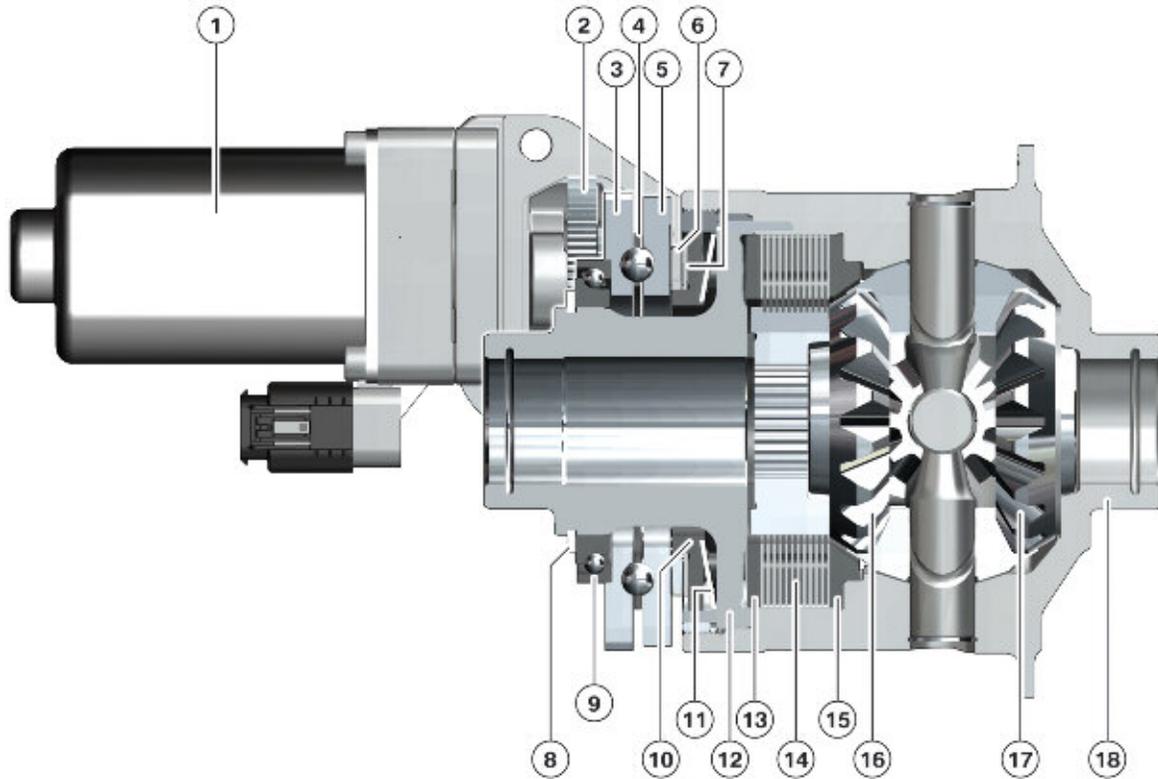
- Wiring harness
- Regulated differential lock, control unit (GHAS)
- Electric motor and gearing
- Lock

### Components of inner gear lock (exploded diagram)



Index	Explanation	Index	Explanation
1	Electric motor	9	Ball bearing between inner output hub and differential housing
2	Intermediate gear	10	Disc spring thrust ring
3	Ball ramp with cut gears for adjusting discs and first ball ramp half	11	Disc spring
4	Balls/Rounded washer	12	Inner output hub (connected with inner discs)
5	Fixed pressure disc with the second ball ramp half	13	Pressure plate
6	Axial needle bearing	14	Multidisc clutch
7	Axial bearing thrust washer	15	Counter pressure plate
8	Snap ring (ball bearing mount)		

## Differential lock (motor sectional view)



Index	Explanation	Index	Explanation
1	Electric motor	10	Disc spring thrust ring
2	Intermediate gear	11	Disc spring
3	Ball ramp with cut gears for adjusting discs and first ball ramp half	12	Inner output hub (connected with inner discs)
4	Balls/Rounded washer	13	Pressure plate
5	Fixed pressure disc with the second ball ramp half	14	Multidisc clutch
6	Axial needle bearing	15	Counter pressure plate
7	Axial bearing thrust washer	16	First bevel gear
8	Snap ring (ball bearing mount)	17	Second bevel gear
9	Ball bearing between inner output hub and differential housing	18	Differential housing (connected with outer discs)

---

## Function

The electric motor (1) is screwed on at the housing and the pressure disc is fixed to the second ball ramp half (5) in the housing. The movable components of the ball ramp (2, 3 and 4) generate the necessary axial displacement of the pressure disc (5). These components are not subject to the differential gear rotation and are disconnected from the rotating components by the axial needle bearing (6).

The components with the Index 6 to 18 are part of the differential gear and rotate proportional to the rear axle wheel speeds.

The lock acts between the inner output hub (12) and the differential housing (18) and counteracts a difference in speed between the output bevel gears (16 and 17). The disc spring (11) opens the lock if the engine is not supplied with power.

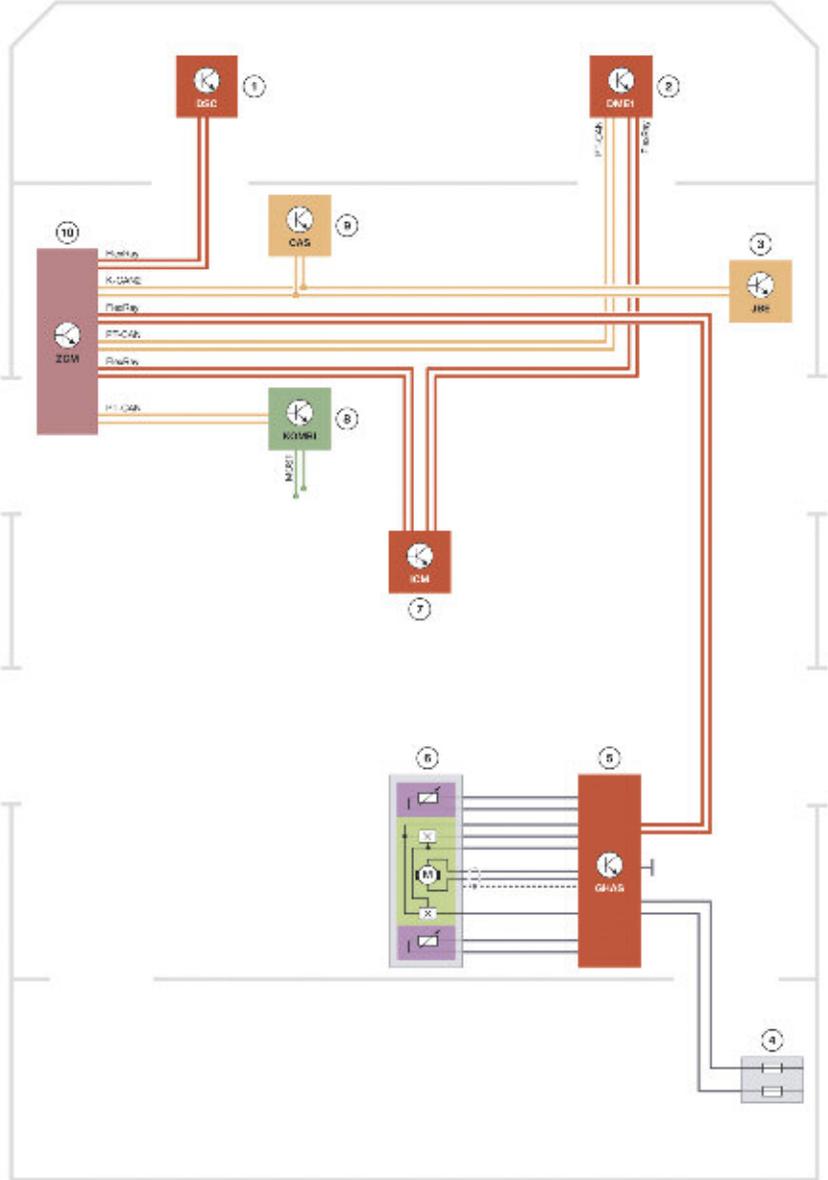
## System Information

The GHAS control unit monitors the drive dynamic parameters from other control units on the FlexRay data bus and determines the locking torque to be applied. The DSC control unit can make and overriding requests with regard to the differential lock for stabilizing the vehicle when the DSC system is activated or deactivated.

The position-regulated direct current motor is activated directly by the power electronics of the GHAS control unit with a pulse-width modulated signal. The frequency is 12.8 kHz and the maximum current is 30 A.

Two hall-effect sensors are used to determine the position and the direction of rotation of the electric motor.

# System Wiring Diagram



Index	Explanation	Index	Explanation
1	Dynamic Stability Control (DSC)	6	Components of the regulated rear-axle differential lock
2	Digital Motor Electronics 1 (DME 1)	7	Integrated Chassis Management (ICM)
3	Junction box electronics (JBE)	8	Instrument panel (KOMBI)
4	Fuses	9	Car Access System (CAS)
5	Control unit regulated rear-axle differential lock (GHAS)	10	Central Gateway Module (ZGM)

## Interfaces

The GHAS control unit works with the following control units and obtains the following information:

Control unit	Bus system	Information
CAS	K-CAN2	Terminal status Vehicle identification number (for encoding)
DME 1	PT-CAN/FlexRay	Accelerator pedal angle, Wheel drive torque, "Engine running" signal
DSC	FlexRay	Wheel speed, Target transverse torque distribution, Stabilization status, Braking value
ICM	FlexRay	Tolerance adjustment of wheel (adjustment of different wheel circumferences), Lateral acceleration, Yaw speed, Vehicle speed, Roadway longitudinal inclination, Steering angle
JBE	K-CAN2	Vehicle condition (power management and fault memory e.g. for voltage drop by engine start)
KOMBI	PT-CAN	Date/Time, Ambient temperature, Mileage reading
ZGM	Gateway for all data bus systems	Forwarding of information to GHAS

## Electric Motor Position Identification

Two hall-effect sensors are installed inside the motor for determining the position of the electric motor.

For determining the characteristic curve of the locking torque over the motor position, a recalibration is regularly carried out to compensate for clutch wear.

To calculate the clutch locking torque for a certain position of the servomotor a reference run is performed every 1,000 km / 620 miles, at the same time it uses this reference run to determine clutch wear. A reference run of the motor is performed by activating the motor with a defined amount of current. The locking torque of approx. 1,500 Nm is applied to the clutches.

---

## Temperature Monitoring

Three temperature sensors are used. They monitor the temperature of the control unit (driver final stage), electric motor and the differential oil temperature.

The following temperature thresholds are listed below:

Control unit 105 °C / 221°F.

Electric motor 160 °C / 320°F.

Differential oil temperature 190 °C / 374°F.

The current oil specification is "BMW final drive oil synthetic MSP/A" (Castrol SAF-XJ) and is the same oil in the previous M vehicles with variable M differential lock.

The capacity of the rear differential is 1.2 liters (1.26 quarts).

### **CAUTION!!!**

**If the GHAS locking function is switched off due to a fault, a locked differential is automatically reopened as the locking function is not self-locking.**

The driver is warned/informed and the following is applied:

- Decreased traction for the dynamic driving style and lower coefficients of friction, in particular for different coefficients of friction left/right.
- Lack of the vehicle stability in dynamic driving situations.

## Service Information

In the case of a replacement of the GHAS control unit must be coded (activation of a vehicle-related characteristic curve) and then an initial calibration is required along with deleting the fault memory.

If the complete M rear axle final drive has been replaced a calibration must be performed and then the fault memory deleted.

The fault memory has to be deleted for the replacement of an electric motor, or the oil temperature sensor.

The final drive oil needs to be replaced at 2,000 km / 1200 miles (pre-delivery check) and at every third engine oil change.

## Output shafts

The special feature of the output shafts is the gearing on two sides. They are no longer flange-mounted at the rear axle final drive, but inserted in the rear axle final drive and in the wheel hub. The procedure for installation and removal has changed.

Please refer to the Repair Manual in ISTA for the removal and installation procedures.

# Chassis and Suspension

The chassis and suspension is based on the technology of the standard F12/13, almost all M-specific components are new or have been modified.

## Complete chassis and suspension

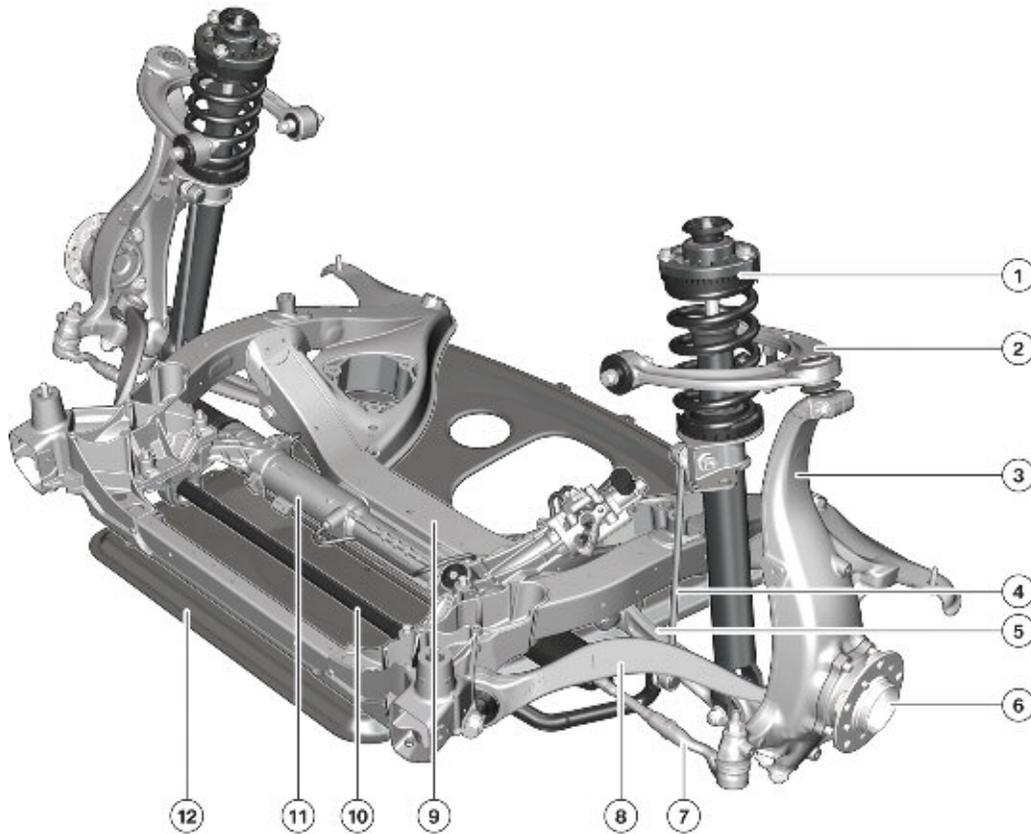


Designation	F12/F13 M6	F12 650	E64 M6
Wheelbase Turning circle	2,851mm 12.1mm	2,855mm 11.7mm	2,780mm 12.5mm
Front track width	1,631mm	1,594mm	1,567mm
Rear track width	1,612mm	1,651mm	1,584mm
Front axle	M double wishbone axle	Double wishbone axle	M Double-pivot spring strut axle
Steering	Hydraulic M rack steering with Servotronic	Electromechanical steering	Hydraulic M rack steering with Servotronic
Average overall ratio	13.05	17.1	12.4
Steering wheel turns, lock to lock	2.6	3.0	2.4
Rear axle	M Integral IV (based on E60 M5)	Integral V	M Integral IV
Axle ratio	3.154	2.813	3.615

## Front Axle

The front axle is based on the double wishbone front axle of the standard F1x vehicles. All components and the bushings are M-specific and are new. The M front axle support carrier is typical M and has been enhanced with a stiffening plate.

### Double wishbone front axle

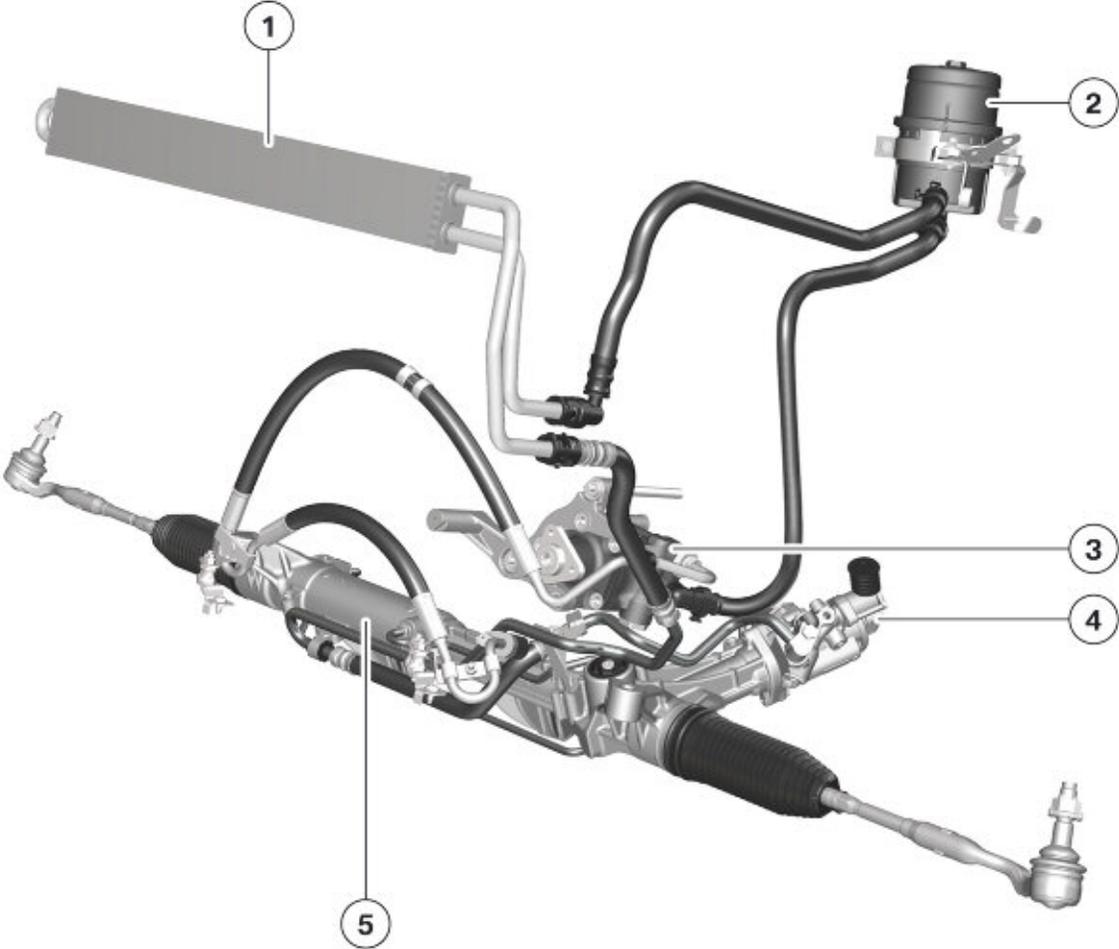


Index	Explanation	Index	Explanation
1	M spring strut with support bearing	7	M track rod
2	M wishbone, top	8	M trailing link with hydro mount
3	M swivel bearing	9	M front axle support
4	M anti-roll bar link	10	M anti-roll bar (Ø24.5 mm)
5	M wishbone, lower	11	M steering box
6	M wheel hub	12	M stiffening plate

# Steering

M rack and pinion power steering gear with variable ratio, standard with Servotronic.  
 The average overall ratio is 13.05:1 for 2.6 steering wheel turns lock-to-lock compared to 17.1:1 and 3.0 with the F1x.

## Power steering components



Index	Explanation
1	Air/power steering oil cooler
2	Hydraulic fluid reservoir
3	VARIOSERV® power steering pump
4	Servotronic control valve
5	M steering rack

---

## VARIOSERV® Power Steering Pump

A vane-type power steering pump is used for the first time at BMW in the F1x M5/M6. The pump efficiency has increased without an electrical control valve. It works with a mechanical/hydraulic control of the volumetric flow via an integrated control valve.

### Power steering pump (VARIOSERV®)



The development of this pump was to lower CO<sub>2</sub> and fuel consumption values. Further improvement potential in the reduction of the steering oil temperature and in protecting the pump against possible overloading.

The manufacturer is ZF Lenksysteme.

### Design

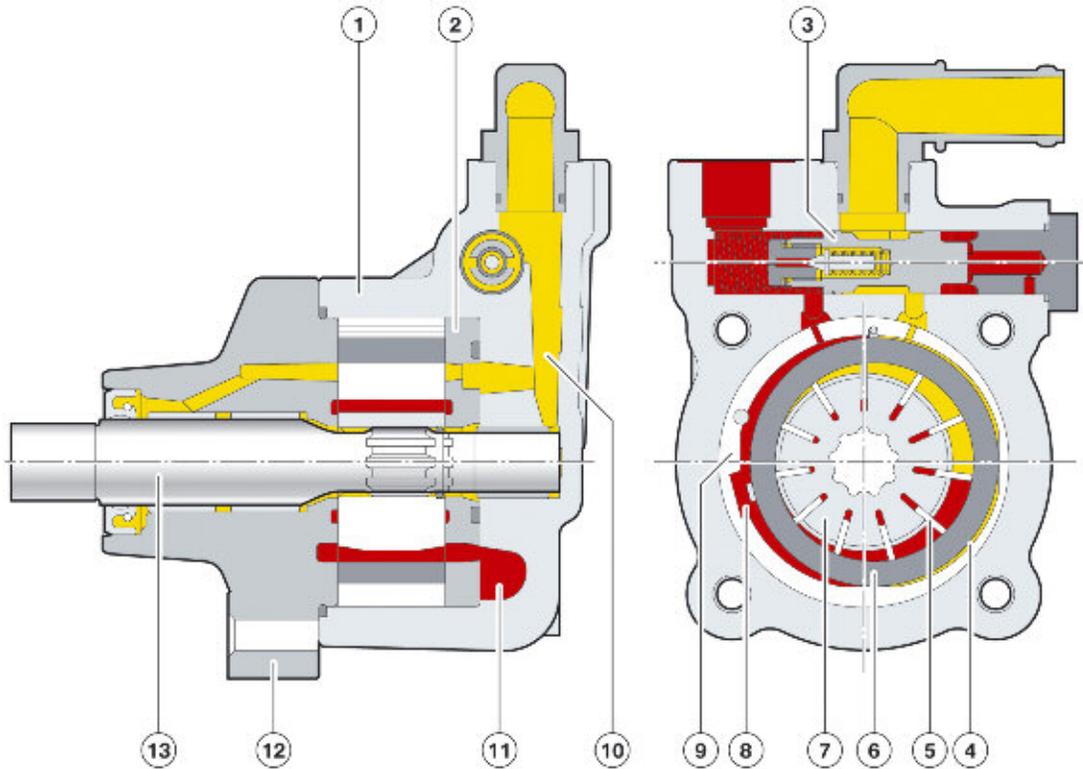
In comparison to the normal vane-type pump, the cam ring (6) of the VARIOSERV® pump is adjustable and can generate adjustable flow volume by the varying its position. The cam ring is adjusted depending on the speed using the differential pressure between the left (8) and right chamber (4). A control valve (3) installed traverse to the shaft (13) with integrated pressure control that determines the function.

### Function

After achieving the pump speed at engine idle speed the pump conveys a constant volumetric flow. An increasing change in speed leads to the fact that the internally rising pump pressure opens the control valve, exposes the cam ring and reduces the eccentricity for the rotor (7). The smaller pump spaces only create a reduced volumetric flow. This limited pumping ability prevents an overproduction of oil pressure and leads to a significantly reduced energy consumption at higher pump speeds through the reduced power consumption. There is also the option of reducing the cooling measures in the steering system.

In the event of decreasing engine speed, the pressure gap between the left and right chamber enlarges the area between the rotor and the cam ring. As a result the oil volume rises again.

## Cross sectional view of power steering pump



Index	Explanation
1	Housing
2	Front plate
3	Control valve with integrated pressure control
4	Right chamber
5	Feed vane
6	Rotor
7	Inner rotor
8	Left chamber
9	Outer ring
10	Suction chamber VARIOSERV®
11	Pressure chamber
12	Cover
13	Shaft

---

## Servotronic

This is the first M Servotronic which has three selectable stages and its own button in the drive dynamic button area in the center console. The stages can be switched between "Comfort", "Sport" and "Sport plus". This can be done by using the button on the center console or the configuration menu in the CID. The corresponding characteristic curve is activated. In the "Sport" position the power steering support is noticeably harder. The program selection can also be preconfigured in the M Drive menu and selected via the M button (M1 or M2) on the steering wheel.

The servotronic control unit SVT is installed in the luggage compartment (installation location for space reasons). It receives the control valve signals from the DME and functions as a power output stage.

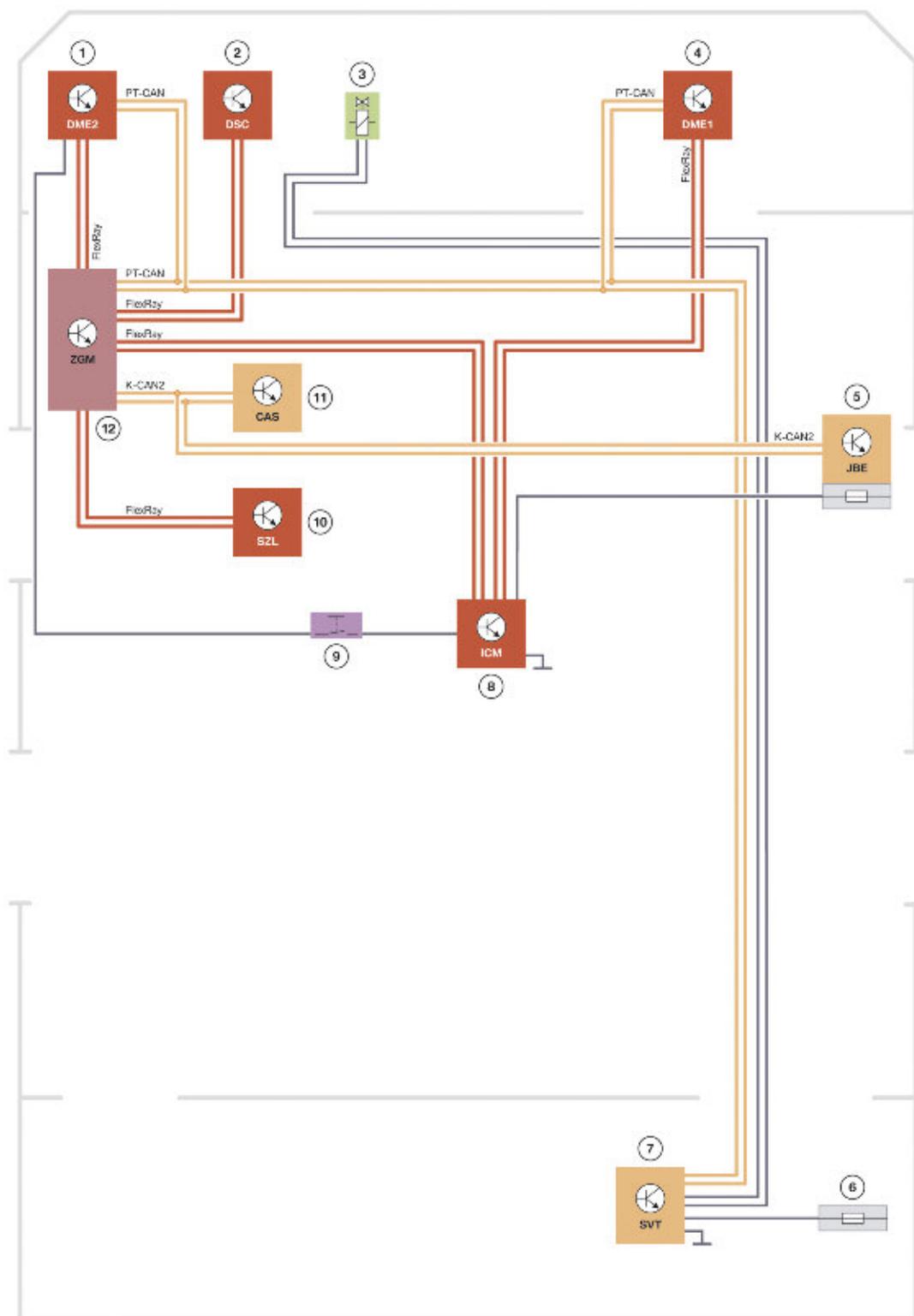
While the DME1 is the primary DME, a ground signal is sent from the Servotronic button to the DME2. The communication between DME and SVT is sent via the PT-CAN. The Servotronic button receives the ground signal from the Integrated Chassis Management control unit ICM.

All drive dynamic buttons except the engine dynamic button are sent to the ICM.

### Legend Servotronic

Index	Explanation
1	Digital Motor Electronics 2
2	Dynamic Stability Control
3	Servotronic control valve
4	Digital Motor Electronics 1
5	Junction box electronics
6	Fuse
7	Servotronic control unit
8	Integrated Chassis Management
9	Servotronic button
10	Steering column switch cluster
11	Car Access System
12	Central Gateway Module

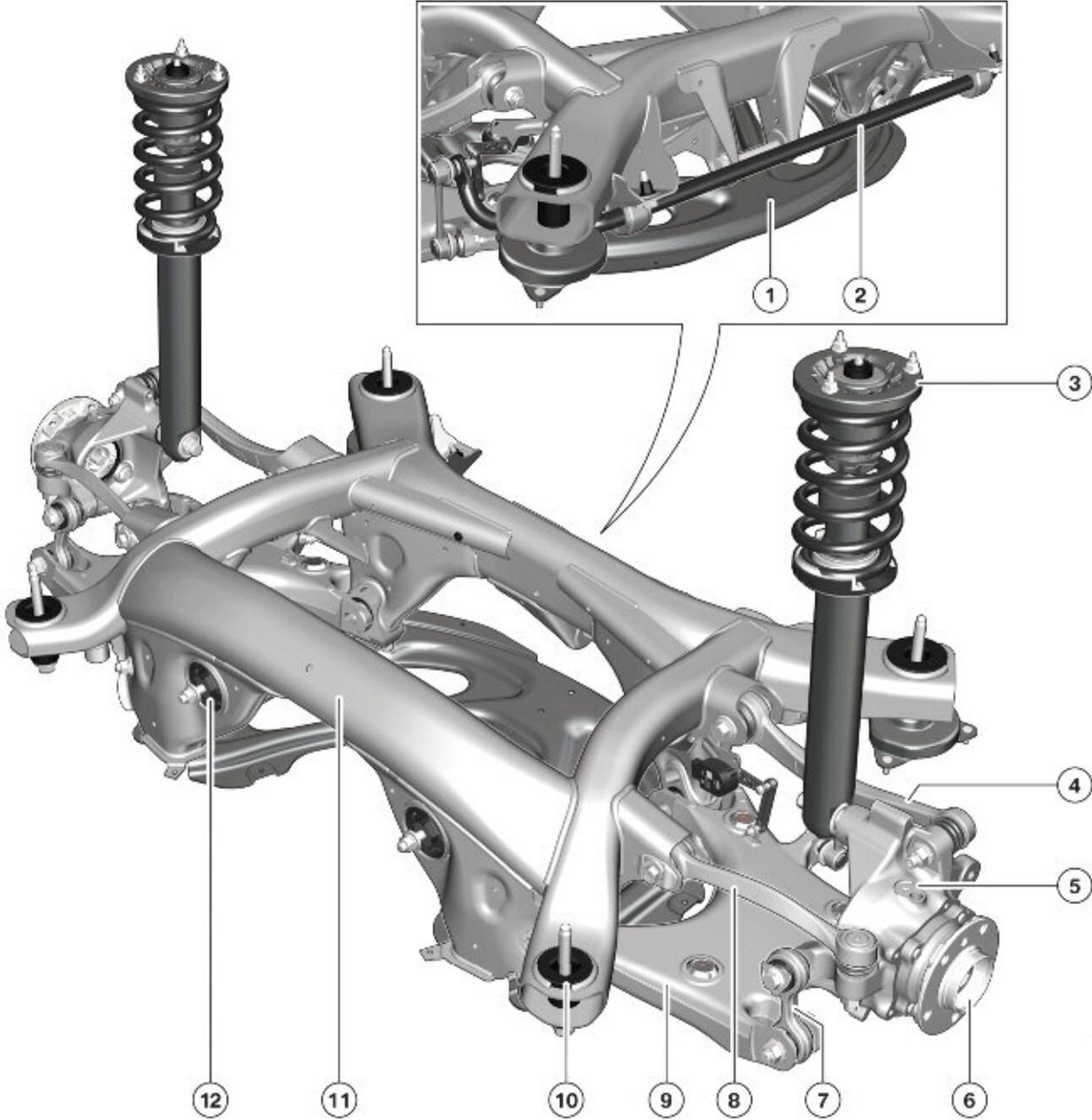
## Wiring diagram for Servotronic



# Rear Axle

The M rear axle is based on the integral link IV rear axle of the E6x Mx. All components and bushings are new to the F1x M5/M6 or have been adapted. The M rear axle support is bolted directly to the body and reinforced for the first time with a stiffening plate.

## M Integral IV rear axle

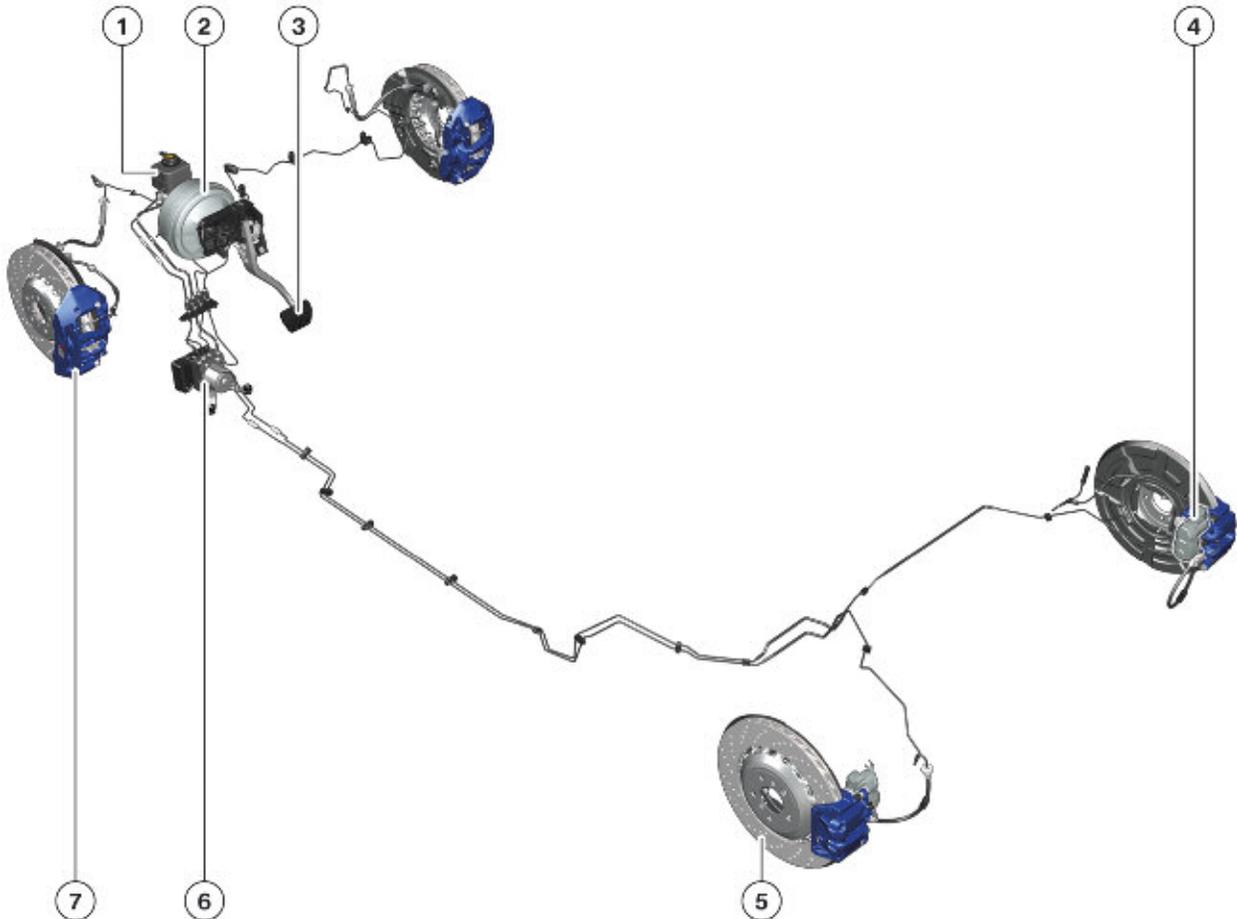


### Legend M Integral IV rear axle

Index	Explanation
1	M stiffening plate
2	M anti-roll bar(Ø 21.5 mm)
3	M spring strut
4	M wishbone
5	M wheel carrier
6	M wheel hub
7	M integral link
8	M control arm
9	M Trapezoidal-link suspension (swinging arm)
10	Attachment point rear-axle bearing (screwed-in without rubber mount)
11	M rear axle support
12	Attachment point for rear axle final drive

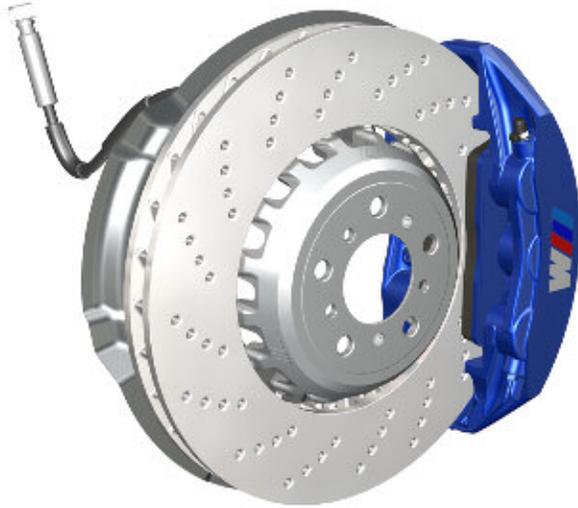
# Brakes

## Brake system overview



Index	Explanation
1	Brake fluid expansion tank
2	Brake servo (left-hand drive)
3	Brake pedal
4	Rear single piston floating caliper with actuator for the electromechanical parking brake EMF
5	Rear brake disc
6	Dynamic Stability Control (DSC)
7	Front six-piston fixed caliper

## Front brake



The front brakes are specific to the F12/F13 M6. It uses a large ventilated M Compound brake discs combined with a six-piston fixed calipers. In comparison to the F12/F13 650i, the diameter of the front brake disc @ 15.7 inches is 1.02 inches larger.

All brake calipers on the F12/F13 M6 are painted blue.

The rear ventilated M Compound brake disc @ 15.5 inches is 2 inches larger in diameter than the F12/F13 650i disc. The rear brake caliper, including the electromechanical parking brake EMF, was taken from the F12/F13 650i. The single-piston floating caliper is also painted blue.

The characteristic maps of DSC and EMF are specific to M.

## Brake Pad Wear Sensors

The M6 only has one brake pad wear sensor on the left front brake pad and one on the right rear pad.

## Comparison chart

Designation	F12/F13 M Compound	F12 650i	E64 M6
Front brake	6-piston fixed caliper	Single-piston floating caliper	Double-piston floating caliper
Brake disc front	400mm x 36mm	374mm x 36mm	374mm x 36mm
Rear brake	Single-piston floating caliper	Single-piston floating caliper	Single-piston floating caliper
Brake disc rear	396mm x 24mm	345mm x 24mm	370mm x 24mm
Parking brake	Electro-mechanical	Electro-mechanical	Conventional

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## Driving Stability Control Systems

The M-specific setting of the driving dynamics (longitudinal, transverse and vertical) was tested at the Nürburgring Nordschleife (Northern Loop), along with other locations.

### Vertical Dynamics Management

The EDC function is integrated in the M Vertical Dynamics Management control unit M VDM which controls the adjustable dampers.

The suspension can be controlled by the driving dynamics selector button in the center console. The program selection can also be preconfigured in the M Drive menu and selected by pressing the corresponding M button (M1 or M2) at the steering wheel.

### Electronic damper control

There are no EDC satellites installed at the shock absorbers, only M specific control valves are installed. The shock absorbers have been developed with the supplier ZF Sachs and the system is adapted to the F1x M5/M6 vehicles.

The EDC works with infinitely variable valves in the dampers. The hydraulic oil flow is regulated by the electromagnetic control valves. This makes it possible to provide the damping force required at all times.

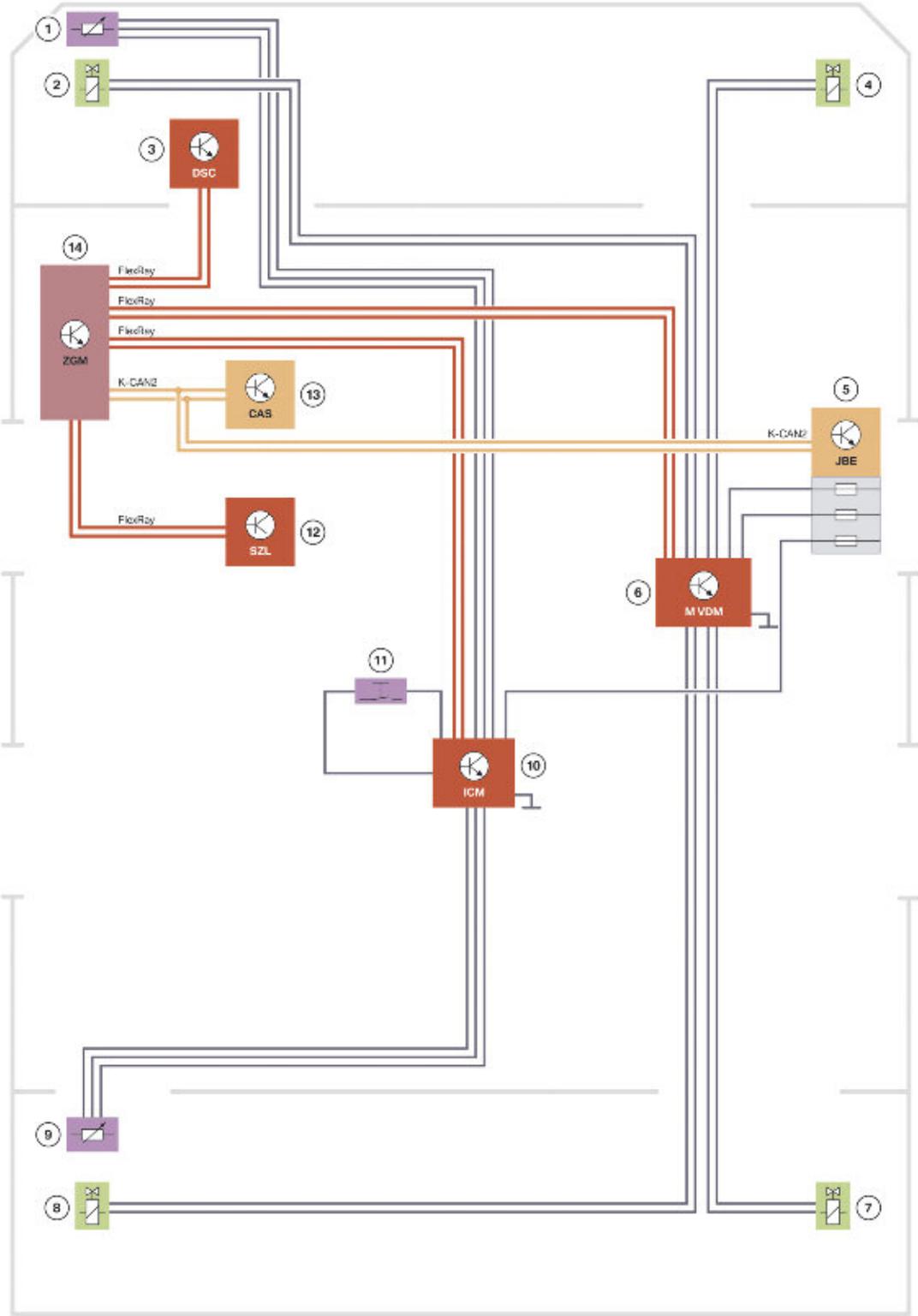
Control variables such as the front wheel speeds, steering angle, body movements and damper piston speed have been modified to corresponding control variables.

In addition, the vertical acceleration between the suspension and body is monitored by the ride height sensors of the headlights. There is one ride height sensor installed at the front left and one at the rear left. They are potentiometer's and their signals are hard wired to the Integrated Chassis Management control unit. The ICM sends these signals over the FlexRay data bus to the M Vertical Dynamics Management (EDC) control unit M VDM.

### Legend M VDM

Index	Explanation	Index	Explanation
1	Ride height sensor front	8	Control valve, rear left
2	Control valve, front left	9	Ride height sensor rear
3	Dynamic Stability Control	10	Integrated Chassis Management
4	Control valve, front right	11	M Vertical Dynamics Management (EDC) switch
5	Junction Box Electronics	12	Steering column switch cluster
6	M Vertical Dynamics Management control unit	13	CAS
7	Control valve, rear right	14	Central Gateway Module

**System wiring diagram M VDM**



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## **EDC Button Selection**

The EDC button receives a ground signal from the ICM and forwards it back to the ICM when activated. The ICM forwards this information over the FlexRay data bus to the M VDM.

The selection options for damper control are "Comfort", "Sport" and "Sport+". All three programs have dynamic control in the F1x M5/M6 vehicles.

### **Program description**

- "Comfort" emphasizes a comfortable design in order to meet the comfort requirements of M5/M6 customers. The dampers are set to a comfortable setting.
- "Sport" supports a dynamic and sporty driving style with a increased damper hardness.
- "Sport+" supports a dynamic control in which the damper hardness is raised further in comparison to "Sport".

## **Transverse Dynamics Management**

The Integrated Chassis Management ICM is the main control unit for the transverse dynamics system. The ICM control unit controls the interaction between the Servotronic, DSC and the regulated rear-axle differential lock GHAS.

## **Longitudinal Dynamics Management**

The longitudinal dynamics management is controlled by the Dynamic Stability Control (DSC).

## **M Dynamic Mode and DSC OFF Mode**

In the M Dynamic Mode MDM, the control threshold of the brake interventions is delayed and the engine power is reduced by DSC considerably later. This allows for a more sport oriented drivability.

Using the driving dynamics button "DSC" or the configuration in the M Drive menu in the CID, the driver can switch between DSC ON, MDM and DSC OFF. The button receives its ground from the ICM and forwards a ground signal when actuated back to the ICM. The ICM forwards this information via the FlexRay data bus to the DSC.

**Note: This training material discusses the F12/F13 M6 vehicles but it is important to point out that the F12/F13 M6 is largely based on the F10 M5 and thus shares the same Powertrain, Chassis Suspension, Braking and Electrical system.**

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