Reference Manual

4TH GENERATION M3 COMPLETE VEHICLE

Technical Training

Table of Contents

4th Generation M3 Introduction

Initial Print Date: 1/08 Revision Date:

4th Generation M3 Introduction

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify key changes to the M3
- Obtain general information on the new M3

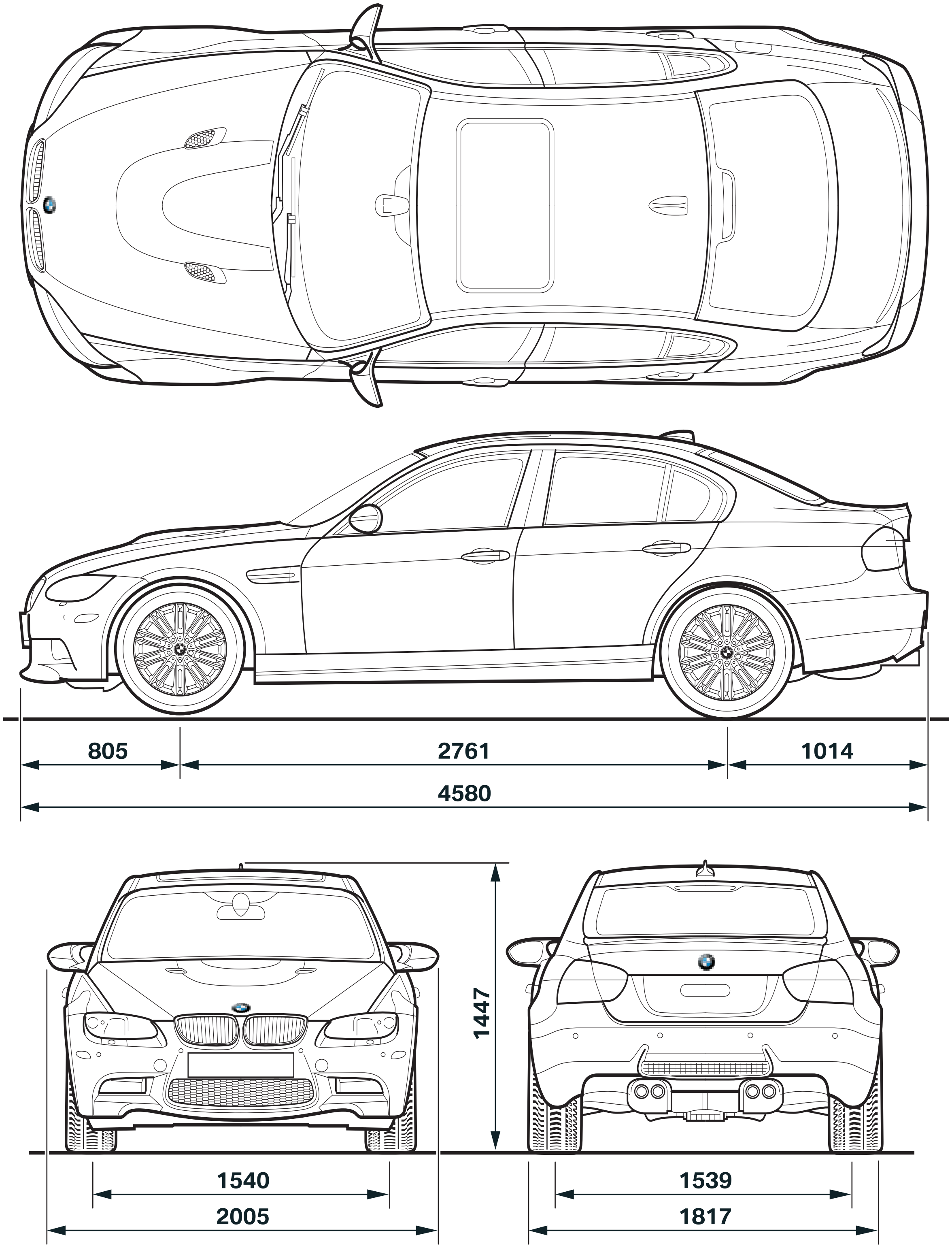
The new BMW M3

A new addition to the 'M' family has just arrived. The new BMW M3. A simple letter and number combination which has become synonymous with an extremely powerful and dynamic performance car.

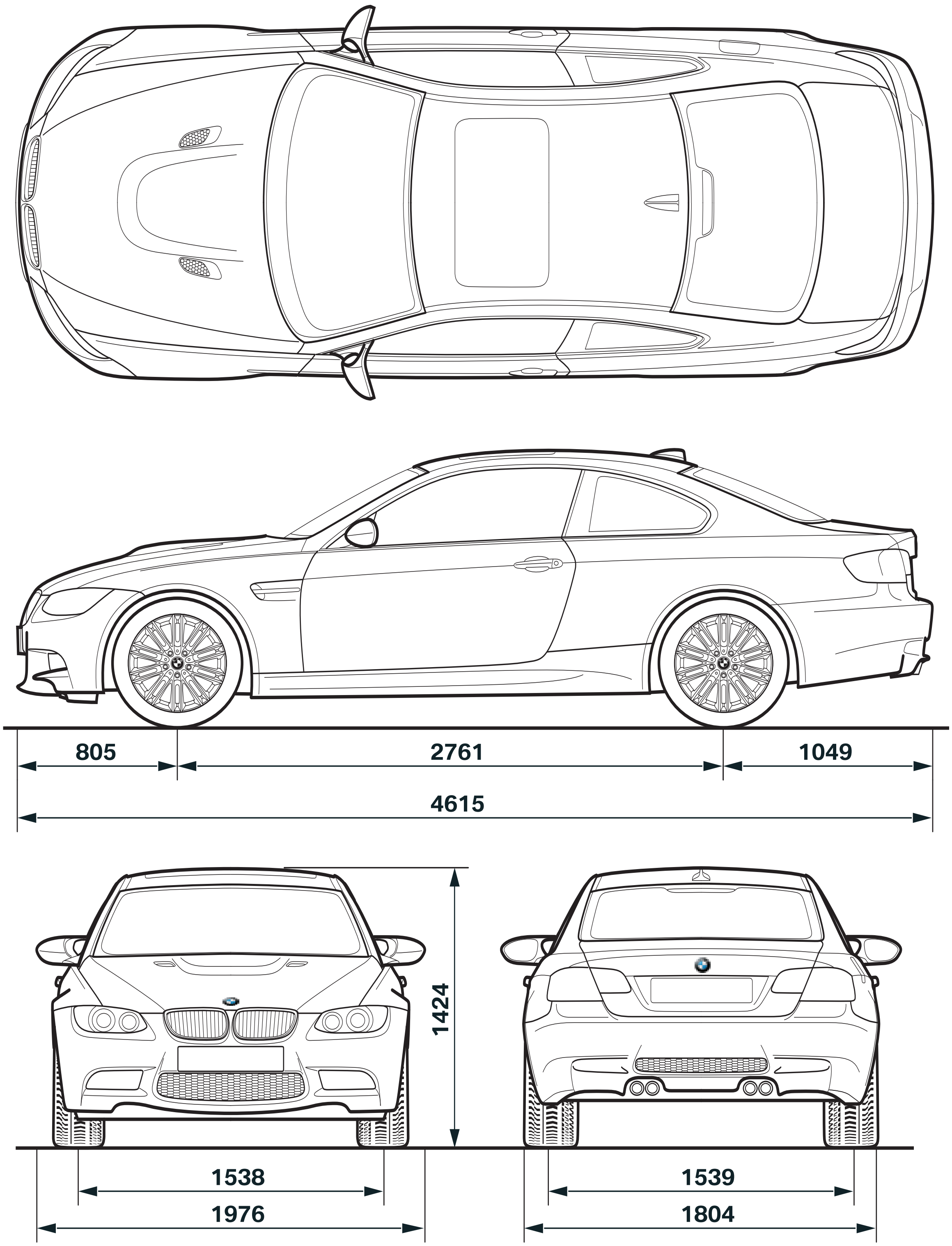
The M3 is now in its fourth generation with a history of success in the world of motor sport, winning races across the globe since its beginning back in 1985. Not only has the race version of the M3 gained a successful motor sports heritage, its on road credentials live up to the expectations and demands of today's M3 drivers. The E92 M3 will be launched in the spring of 2008.

This precisely balanced sports car will set new benchmarks in driving dynamics for sport coupes. As with its predecessor the focus has been on optimizing the power to weight ratio whilst maintaining the high engine speed concept. This combination ensures that both power and driving agility are exceptional, placing the M3 in an even higher level of sport car competition.

E90 M3 Dimensions and Vehicle Data



E92 M3 Dimensions and Vehicle Data



M3 Heritage

E30 M3

1988 - 1991

From 1988, the first M3 generation turned the world of racing upside down. One year prior, the M3 had been launched as a thoroughbred sports car for the road.

Powered by a four-cylinder four-valve engine, the original M3 showed its sporting ambitions in its exterior design: flared wheel arches and a large rear spoiler gave it lots of road presence.

Engine Configuration:	4 cylinders, in-line
Capacity:	2.3 liters
0-62:	6.8 sec
Top Speed:	145 mph
Performance:	192 hp @ 6,750 rpm
Torque:	230 Nm (169 lb-ft) @ 4,750 rpm

E36 M3

1995, 1996-2000

Family affair: the second-generation M3 was offered as a complete model series.

First came the Coupé, two years later the Convertible and Sedan. And the engine received a nice boost, too: the four-valve six-cylinder unit delivered 240 hp.

	1995	1996-2000
Engine Configuration:	6 cylinders, in-line	6 cylinders, in-line
Capacity:	3.0 liters	3.2 liters
0-60:	6.1 sec.	5.9 sec.
Top Speed:	128 mph	128 mph
Performance:	240 hp 6,000 rpm	245 hp @ 6,000 rpm
Torque:	305 Nm @ 4,200 rpm 225 lb-ft @ 4,200 rpm	319 Nm @ 3800 rpm 236 lb-ft @ 3800 rpm

E46 M3

2001 - 2006

The third generation of the M3 enters the stage: with the M3 Coupé and the high-revving naturally aspirated engine delivering 333 hp at up to 8,000 rpm, BMW once more introduced a true sports car, which, like its predecessor, was crowned “best handling car”. From 2001, BMW added the convertible version.

Engine Configuration:	6 cylinders, in-line
Capacity:	3.2 liters
0-60:	4.8 sec.
Top Speed:	155 mph
Performance:	333 hp @ 7,900 rpm
Torque:	355 Nm (262 lb-ft) @ 4,900 rpm

E92 M3

2007

BMW M3 Reloaded. With a new naturally aspirated V8 engine, suspension and drivetrain, a convincing design and best-in-class performance, the latest generation of the BMW M3 is once again making headlines. A true sports car with fantastic everyday usability. The successor takes over the lead: the new BMW M3.

Engine Configuration:	8 cylinders, V configuration
Capacity:	4.0 liters
0-60:	4.7 sec. (coupé) - 4.8 sec. (sedan)
Top Speed:	155 mph
Performance:	414 hp @ 8,300 rpm
Max Torque:	400 Nm (295 lb-ft) @ 3,900 rpm

M3 Concept

Body

In addition to the sporty and dynamic appearance in both the external design and the interior, the main features were weight optimization and a reinforced bodyshell for improved dynamic handling. A further outstanding feature of the E92 M3 is also once again the sophisticated aerodynamics typical of the M series.

M- Specific Equipment

Exterior: Front zone with generous air inlets, "Powerdome" engine hood with air inlet, carbon roof, side gills, outside mirrors, sill, wheel rim design, extended wheel arches, and the boot with spoiler and four exhaust tailpipes all combine to provide the initial impression.

Interior: Sill trim strips, seats, steering wheel, instrument cluster, switches in the center console and the gear lever design all increase the anticipation.

Engine

Under the engine hood, the 8-cylinder power pack is the high-speed S65B40.

With individual throttle butterflies, a generous intake air and exhaust manifold, and many more refined M-specific features such as the MSS60 engine control, the S65B40 is once again an outstanding highlight of the M series.

Drive

Double-disc clutch, 6-gear manual transmission and the fully variable M limited-slip differential ensure the forward momentum.

Chassis and Suspension

Front and rear axles with new suspension geometry and M-specific suspension settings with 18" tires.

Specific objectives of the development were weight optimization, and in particular, control of the longitudinal and lateral acceleration/power that is generated when enjoying the pleasure of driving the M3.

The M3 brake with compound brake discs, new high-performance brake pads and standard M series ABS/DSC guarantee optimum braking efficiency and active safety.

Electrical System

The electrical equipment and bus structure of the M3 are based on the E92.

The optional MDrive menu can be used to preset/configure the standard Servotronic and the M engine dynamics control (enhanced with "Sport Plus"), the optional electronic damper control EDC-K (in the E9x series only available in the M3) and the DSC M dynamic mode.

In the E9x series, the BMW Individual High End audio system is offered for the first time in the M3.

Engine and Technical Data

V8 with High Engine Speed Concept

It will be the first time that a V8 engine has been fitted in a series production M3. The main concept behind this high-revving, high performance engine with a sporty sound is the extremely light, rigid and robust construction which is capable of reaching extreme engine speeds of up to 8,400 rpm. The engine achieves an impressive 400 hp (roughly 100 hp per liter).

The S65B40 is derived from its big brother, the S85B50. The main changes can be seen in the engine oil system, VANOS valve gear system and air intake system. Special consideration has also been given to engine weight optimization.

The engine with all its assemblies is built in the special engine production area of the Munich BMW plant.

One standard engine is used throughout the world and adapted to suit specific market requirements.

A New Dimension

The M engineers consider the high engine speed concept to be the most intelligent strategy of obtaining the maximum thrust from a vehicle.

For example, in a modern formula 1 engine, the crankshaft works at up to 19,000 rpm (resulting in piston speeds of over 25 meters per second).

The actual thrust at the driven wheels is the decisive factor for car acceleration. This thrust is achieved by the engine speed, the torque and the short gear ratio.

This concept has been adopted for vehicles in the 'M' range from motor sport. The fully variable M limited-slip differential means that the thrust is optimally distributed to the live axle.

Furthermore, the S65B40 also includes the established M-specific features such as double VANOS, individual throttle butterflies and high-performance engine electronics (MSS60 control unit).

S65B40 View of the Intake Manifold

S65B40 View of the Intake Flutes

Technical workarounds by increasing the cylinder capacity or boosting become excessive, thus avoiding the increased engine weight and consumption often associated with these methods.

The high engine speed concept helps to achieve dynamically agile handling and the maximum in sports driving performance characteristics.

A maximum torque of 400 Newton meters at 3,900 rpm is reached. Approx. 85 percent (340 Nm) can be utilized beyond the enormous engine speed range of 6,500 rpm.

The S65B40 attains 8,400 rpm, and therefore a value that was previously only reserved for racing car engines or exotic custom vehicles.

Note: For safety reasons, due to the engine dynamics when the vehicle is stationary (i.e. without a road-speed signal), it is already down-controlled at 7,000 rpm to prevent the engine speed from increasing into an impermissible range.

Overview of Special Features

Body:

- M3 Front and rear apron
- Carbon fiber roof in carbon optic,
  if no optional sliding/tilt sunroof (body color)
- Gills in front side panels
- M3 outside mirrors
- Aluminum hood with "Power Dome" and air inlet
- M dome braces, thrust panel and underbody V-brace
- Weight-optimized bumper brackets, front and rear
- Optimized heat isolation package
- Optimized noise isolation package
- Optimized underbody paneling, front and rear

Interior:

- M3 steering wheel
- M gear lever
- M driver foot supports
- M3 seats
- Lighter floor trim (carpet)
- Lightweight design through-loading in rear

Electrics-:

- M3 Instrument cluster
- M-specific switches for gear lever in the center console
- Buttons for the tire pressure system between center air conditioning outlets
- Intelligent alternator control (IGR)
- AGM battery

Engine:

- New high-engine-speed concept V8 engine
  S65B40 with MSS60 engine control system
- M3 Air intake guide
- M Individual throttle butterflies
- M Ion-flow combustion monitoring
- M VANOS
- M3 Exhaust system

Drive:

- Dual-disc clutch used in an M3 for the first time
- M 6-gear manual transmission
- Fully variable M differential with locking action

Chassis:

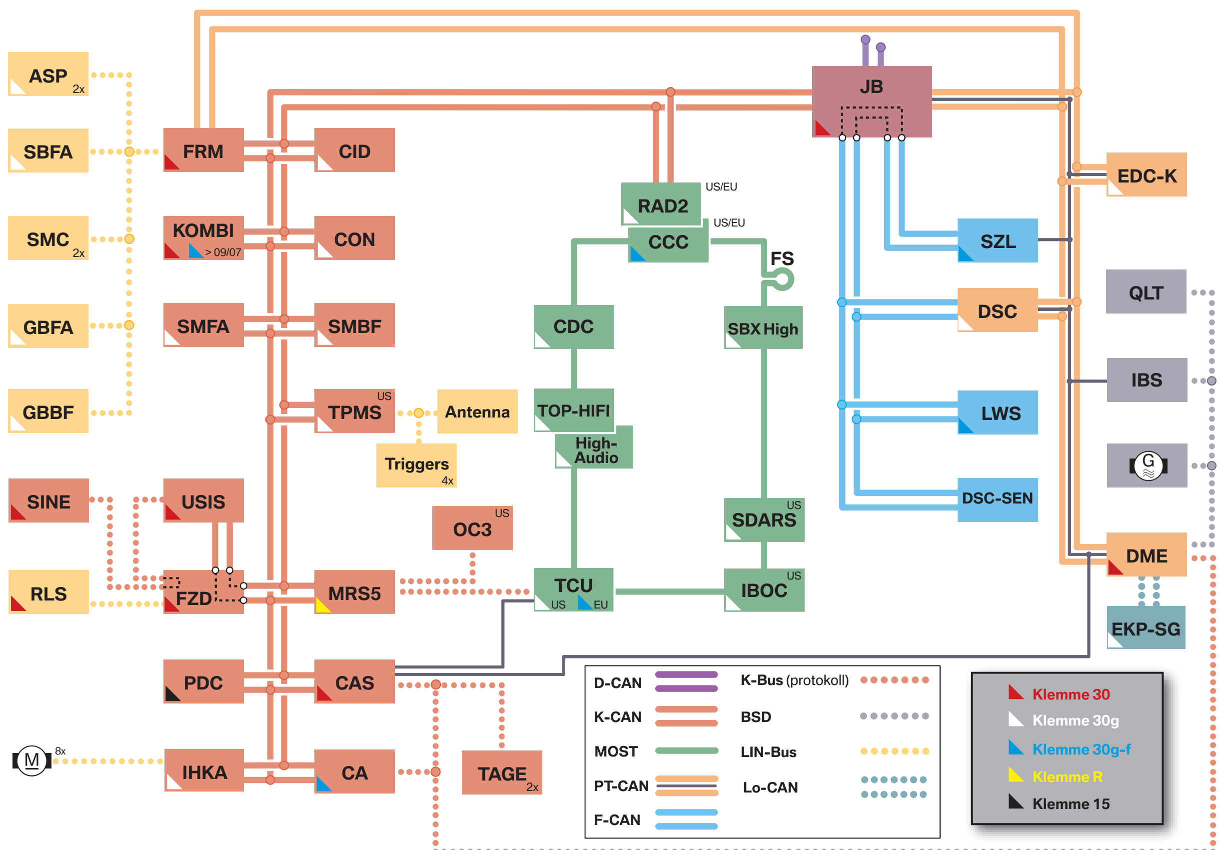
- M3 Rims, tires
- M3 Compound brake system
- Adapted front axle carrier, M front axle components
- Servotronic hydraulic steering, M steering gear ratio
- Adapted rear axle carrier,
  M rear axle components
  M-specific options:
- MDrive menu
- EDC-K
- 19" M3 rims, tires (optional)
- Seat back width adjustment (passive)
- Enhanced leather interior
- High speed down-control option 7ME "M Driver’s Package"
  (280 km/h)

System Overview

Vehicle Electrical System

The vehicle electrical system is based on the E92 series production vehicle system and has been adapted for the M3.

Vehicle Electrical System and Terminal Status Overview



Index	Explanation	Index	Explanation
ASP	Outside mirrors	IHKR	Integrated heating/air conditioning system
CA	Comfort Access	JB	Junction box
CAS	Car Access System	KOMBI	Instrument cluster
CCC	Car Communication Computer	LWS	Steering angle sensor
CDC	(Compact) CD changer	M-ASK	Multi-audio system controller
CID	Central information display	MRS5	Multiple restraint system, 5th generation
CON	Controller	OC3	Seat occupancy detector mat (US)
DAB	Digital Audio Broadcast	PDC	Park distance control
DME	Digital motor electronics	QLT	Quality, level, temperature oil sensor
DSC	Dynamic Stability Control	RAD	Radio1 or Radio2
DSC-SEN	DSC sensor	RLS	Rain light sensor
SINE	Emergency current siren/tilt	SBFA	Switch block, driver's door
EDC-K	Continuous Electronic Damping Control	SBX	Interface box (ULF functionality)
EKP	Electric fuel pump control unit	SBX High	Interface box High (Bluetooth telephony, voice input and USB/audio interface)
FLA	High beam assistant	SDARS	Satellite tuner (US only)
FRM	Footwell module	SMBF	Passenger's seat module
FS	MOST direct access	SMC	Stepper motor controller
FZD	Roof function center	SMFA	Driver's seat module
GBBF	Seat belt extender controller, front passenger	SZL	Steering column switch cluster
GBFA	Seat belt extender controller, driver	TAGE	Outside door handle electronics
High - Audio	BMW Individual High End Audio system	TCU	Telematics Control Unit
IBOC	In Band On Channel (Digital Radio)	TOP-HiFi	Top-HiFi amplifier
IBS	Intelligent battery sensor	USIS	Ultrasonic passenger-compartment sensor
IHKA	Integrated automatic heating/air conditioning system	VM	Video module (only for US)

The MDrive

The MDrive menu known from the M5/M6 is also available in the M3 if equipped with the navigation system.

Starting from the iDrive main menu, the MDrive menu can be called up by pressing on the iDrive controller and selecting M settings.

The overall setting is called up/activated by pressing on the M button on the steering wheel. Pressing the M button again or restarting the vehicle deactivates the settings. The settings can, of course, be retrieved again using the M button.

The following is a list of menu items with selection options that are currently available in the MDrive menu:

- M Engine Dynamics Control (Power)
  – "Unchanged"
  – "Normal"
  – "Sport"
  – "Sport Plus"
- DSC
  – "Unchanged"
  – "OFF"
  – "ON"
  – "M Dynamic mode"
- Servotronic
  – "Normal"
  – "Sport"
- EDC-K (only if fitted)
  – "Unchanged"
  – "Comfort"
  – "Normal"
  – "Sport"

By selecting "Unchanged", when the M button is pressed (i.e. the settings in the MDrive menu are called up), the current settings of this system are retained.

Example:

The driver has deactivated the Dynamic Stability Control function using the DSC button.

- MDrive setting: M Engine dynamics control "Sport Plus"; DSC "Unchanged"; Servotronic "Sport".

The driver presses the M button on the steering wheel to call up the M settings.

- Only the "Sport Plus" and Servotronic "Sport" settings for M engine dynamics control are activated. DSC remains deactivated.

Menu Item Details

M Engine Dynamics Control (Power)
Apart from "Unchanged", three engine control programs are available; "Normal", "Sport" and "Sport Plus".

The options determine how spontaneously the engine responds to actuation of the accelerator pedal. The maximum engine power is not changed.

Using the power button in the center console, the driver can only choose between "Normal" and "Sport".

"Sport Plus" is only available in the MDrive menu.

DSC
Apart from the "Unchanged" setting, in the DSC submenu, the options "OFF" "ON" and "M Dynamic mode" can be selected.

If "M Dynamic Mode" is selected, the Dynamic Stability Control (DSC) permits higher slip values at the wheels. The system does not activate the stabilizing function until very close to the handling limit range, when it influences engine output and/or actively engages the brakes.

In "OFF" mode, an experienced sports car driver can also completely deactivate the DSC function.

Using the DSC button in the center console, the driver can switch between "OFF" and "ON" or if "M Dynamic Mode" is active, between "M Dynamic Mode" and "OFF".

"M Dynamic Mode" is only available in the MDrive menu.

EDC-K

If option 223 continuous Electronic Damper Control is fitted together with MDrive, in addition to "Unchanged", three EDC programs can be selected in the MDrive menu: "Comfort", "Normal" and "Sport".

The driver can use the EDC button in the center console to switch sequentially between the three programs.

Servotronic

The settings that can be selected for the Servotronic steering function are "Normal" and "Sport". Depending on the selection, the appropriate characteristic curve for power assisted steering is active.

This selection option is only available in the MDrive menu. Without MDrive, the customer has no option, and a fixed programmed speed dependent characteristic curve is used.

"Key-Dependent Settings" Menu

Under "M settings", the "Key-dependent settings" menu is also available as well as the MDrive menu.

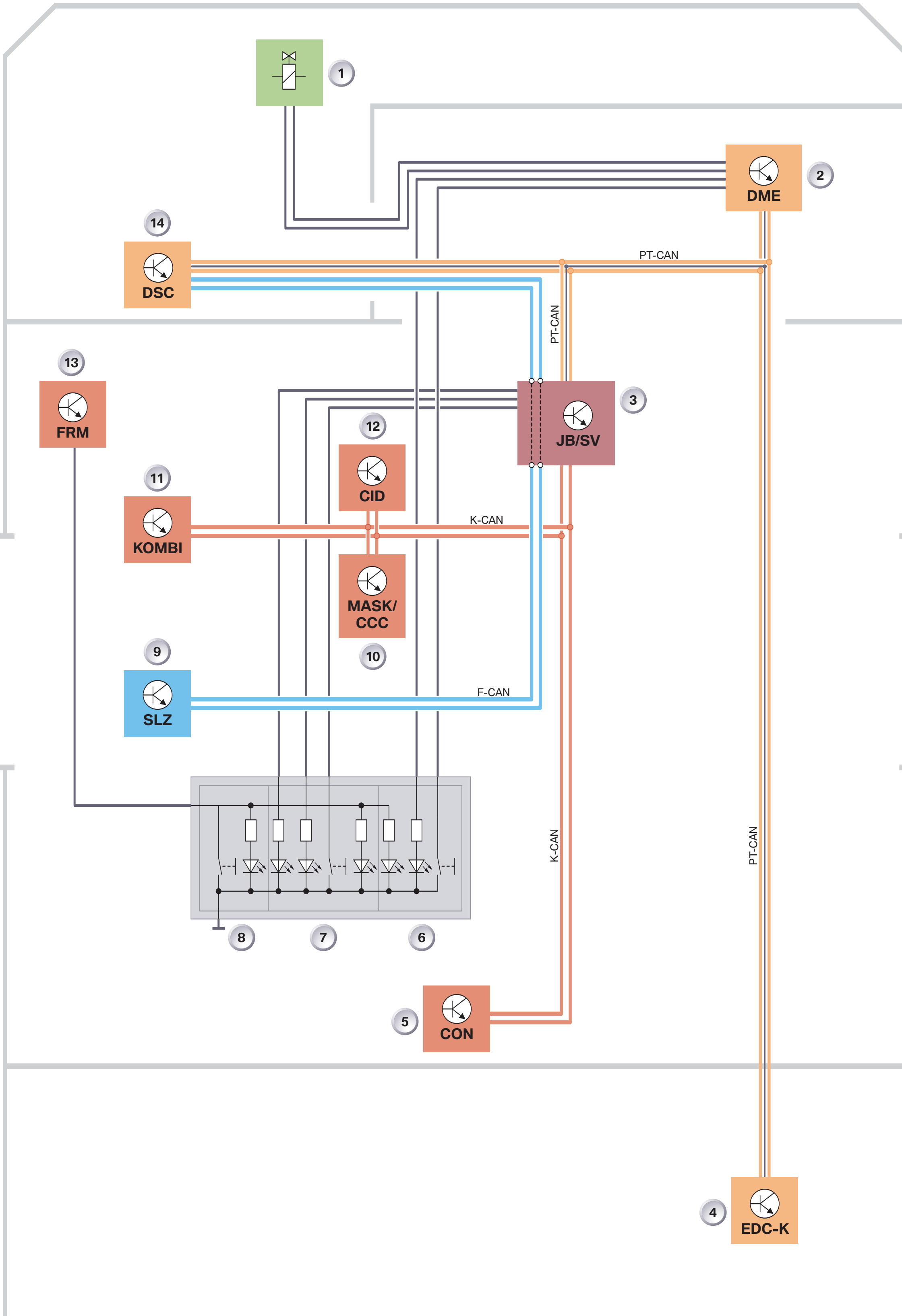
This allows key-specific settings for certain MDrive menu items.

M engine dynamics control and EDC settings are currently possible, which are assigned to the specific key used during the configuration (configuration => ZV closing action => memorizing).

Under the M engine dynamics control menu item, "Normal" or "Sport" can be selected.

In the EDC menu item, the options "Comfort", "Normal" or "Sport" can be selected.

M Drive Bus Diagram



Index	Explanation
1	Servotronic valve
2	DME MSS60
3	Junction Box distribution box
4	Electronic Damping Control controller
5	iDrive controller
6	POWER button
7	EDC button
8	DSC button
9	Steering column switch cluster
10	Multi audio system controller/Car Communication Computer
11	Central Information Display
12	Instrument cluster
13	Footwell module
14	Dynamic Stability Control

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4th Generation M3 Body

Initial Print Date: 1/08 Revision Date:

4th Generation M3 Body

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the changes made to the M3 when compared with the series E92

Bodyshell

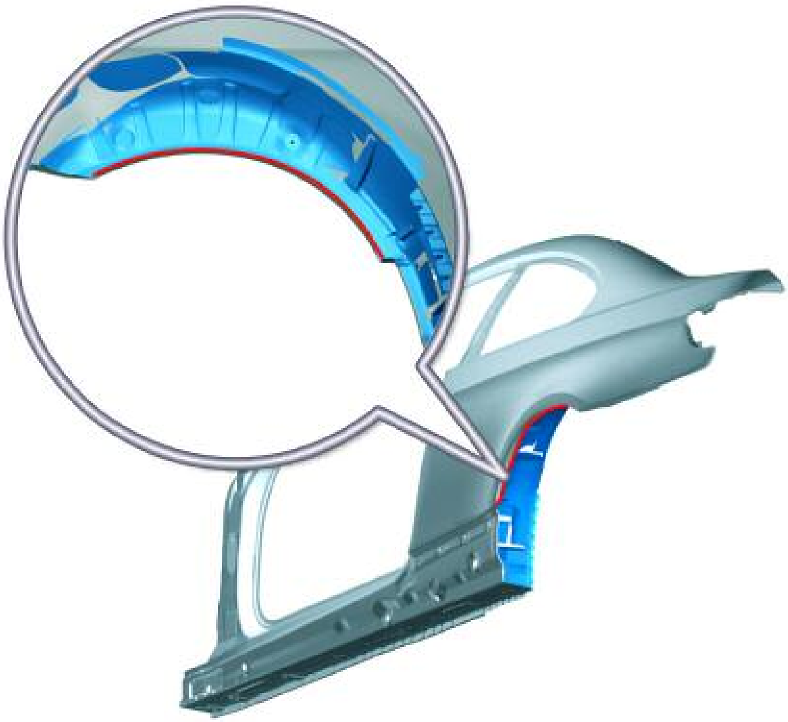
Due to changes to the wheel arch and the carbon roof, the bodyshell components shown in blue have a different part number to the series model E92.

E92 M3 bodyshell components, view from above

E92 M3 bodyshell components, view from below

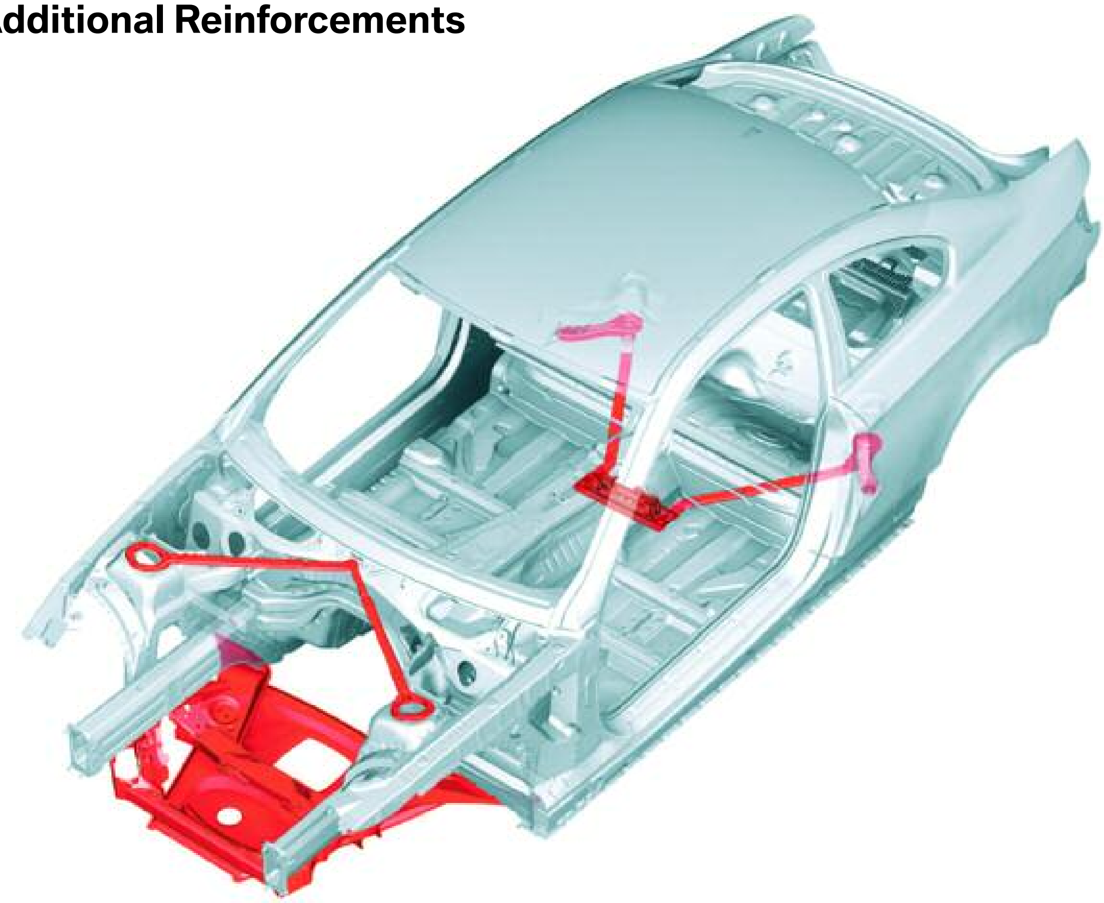
New body side panels which are 20mm wider each side over the flared rear wheel arches are typical of the ’M’ design.

To ensure the necessary M3 wheel clearance at the rear wheel arch, the side frame wheel arch has been extended by approximately 20 mm, and the 180° joining lip edge inside the wheel arch has been rolled upwards to further increase the wheel clearance in the wheel housing.



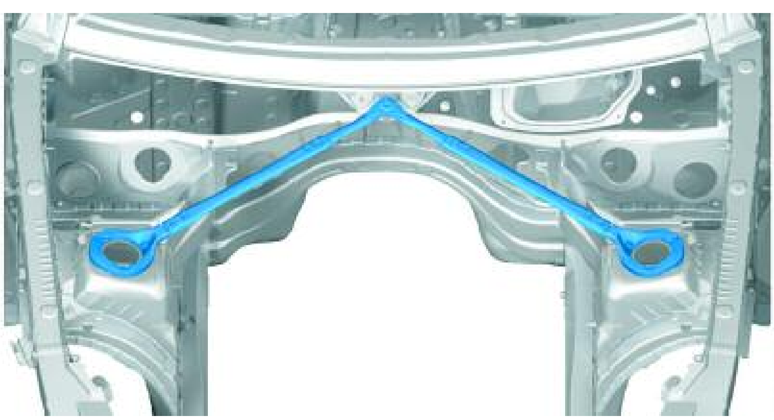
E92 M3 Rear wheel arc

Additional Reinforcements



E92 M3 Overview of additional bolted-on reinforcements

The E92 M3 is equipped with a v-shaped reinforcement brace in the engine compartment, known as the dome strut, which consists of five separate components. It is secured to the suspension strut dome and screwed centrally to the middle of the bulkhead.



E92 M3 Dome strut

The E92 M3, just like the E46 M3, is equipped with a reinforcement plate, known as the thrust panel, made from aluminum alloy.

The thrust panel primarily increases the torsional strength while also acting as a lower motor cover and oil pan protection. The thrust panel is fitted to the axle carrier with six bolts from below, and has two openings for changing the oil.

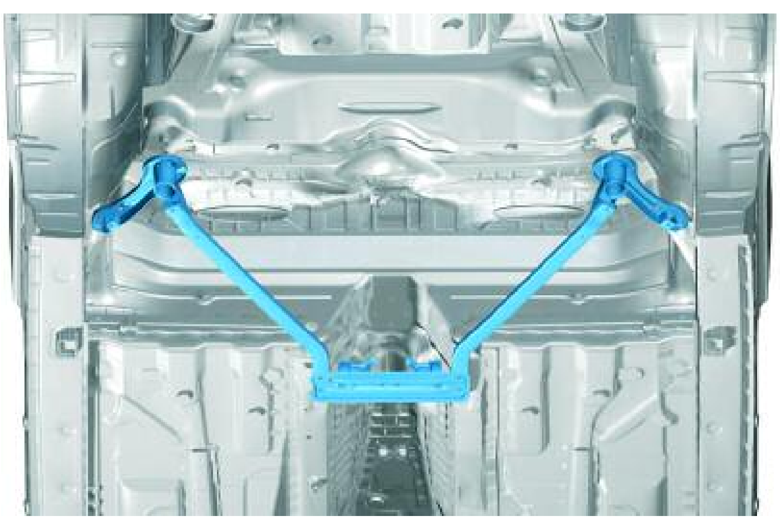
E92 M3 thrust panel

The V-shaped braces used in the rear underbody area of the series production E92 have been strengthened and adapted.

M3 - Permanently welded to the tension strut and screwed to the body with the transmission tunnel bridge

Series E92 - they are screwed to the tension strut and welded to the bridge

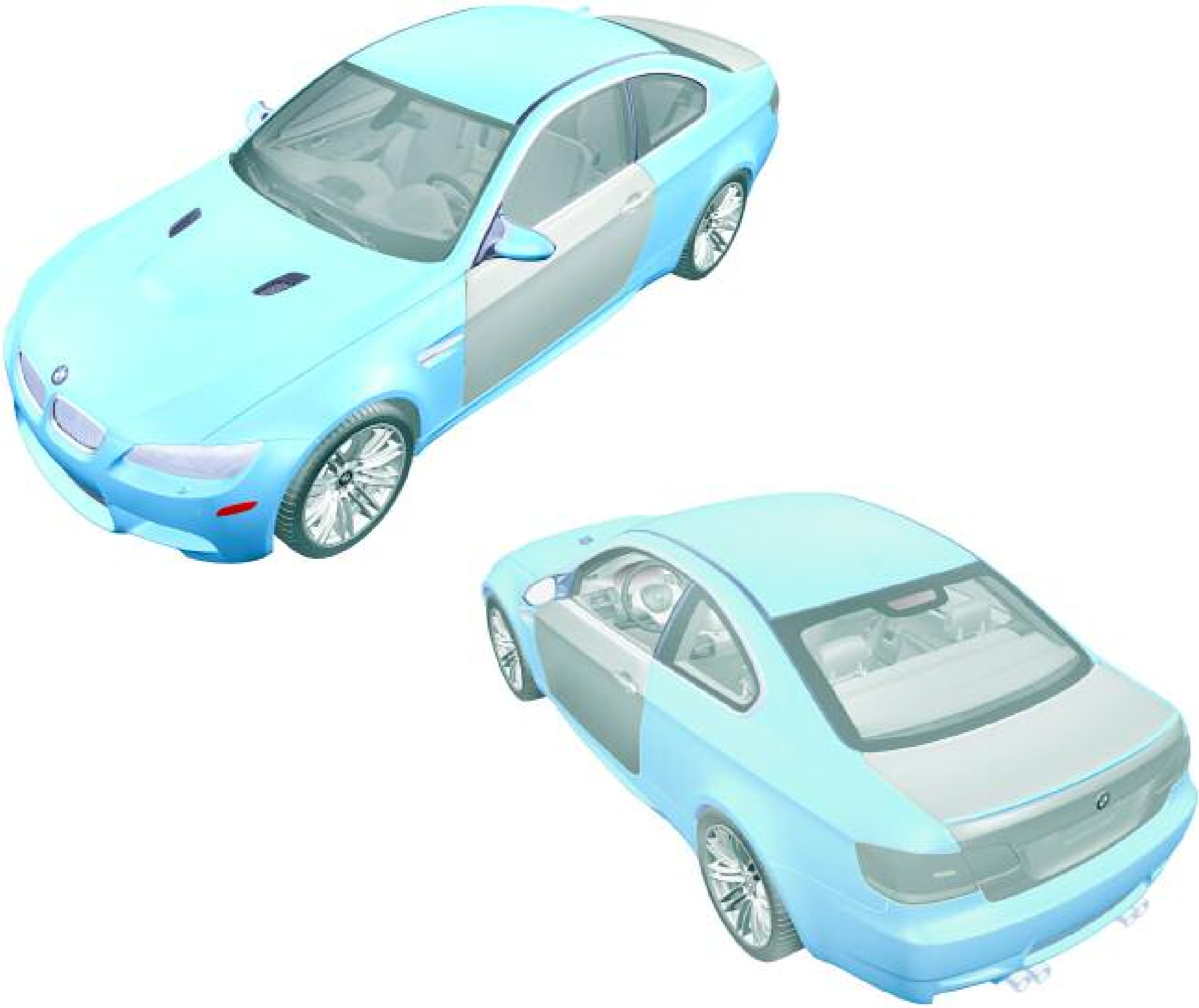
The bridge has been strengthened and adapted. In the M3, it is also used to mount the exhaust line.



E92 M3 Rear axle braces and transmission tunnel bridge

Exterior Body

View of M3-specific external body components



The doors and the tailgate are taken from the series-model E92. All other external body components are new (shown in blue).

Hood

New "Powerdome" aluminum hood lid with air apertures. The aperture on the left when viewed in the direction of travel is used for incoming engine air, and the right-hand aperture offers optical symmetry.

Power Dome aluminum hood lid

Fenders

An advanced plastic material is used for the front side panels, which are wider than those used on the series E92. The side panels include the model-specific "M side gills" with integrated side indicators and M3 emblem.

Front fender (side panel)

Roof

The roof on the E92 M3 is manufactured from carbon fiber. This has reduced the overall vehicle mass on the upper level of the car by approximately 5 kg, therefore considerably lowering the center of gravity.

A roof rack system can be assembled on the E92 M3 with carbon fiber roof. The roof has specific inserts for roof luggage rack brackets.

The repair procedures and options are similar to or the same as the M6.

If the sunroof option is selected, a steel roof similar to the series model E92 is fitted.

E92 M3 Carbon roof

Side Sills

The side sills are more highly accentuated, in accordance with the M design criteria.

Side sill trim

Exterior Rear View Mirrors

The ’M’ designed exterior door mirrors have an optimized air flow design. The mirror surface area is larger to comply with future legislation. The mirror base mounting has been adapted to suit the new mirror unit.

The functions of the outside mirrors are the same as the series production E92. Driver and passenger mirrors are electrically heated and adjusted.

The cover cap of the exterior mirror housing is painted in the body color.

Tailgate

The tailgate is taken from the series production E92. The rear spoiler (Gurney) is attached as a standard feature on the E92 M3.

Tailgate and spoiler (Gurney)

Wheel Well Covers

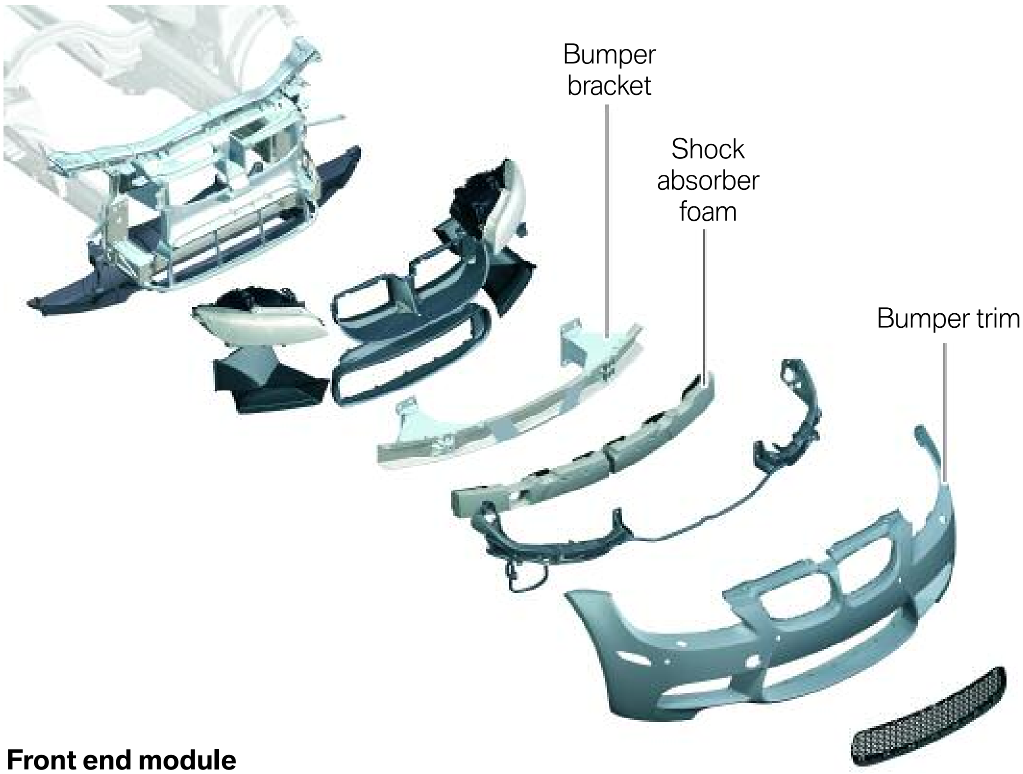
The new M3 is fitted with larger wheel housing covers that accommodate the larger wheels and flared wheel arches. The front wheel housing cover has been adapted specifically to meet the M3 requirements.

Front wheel housing cover

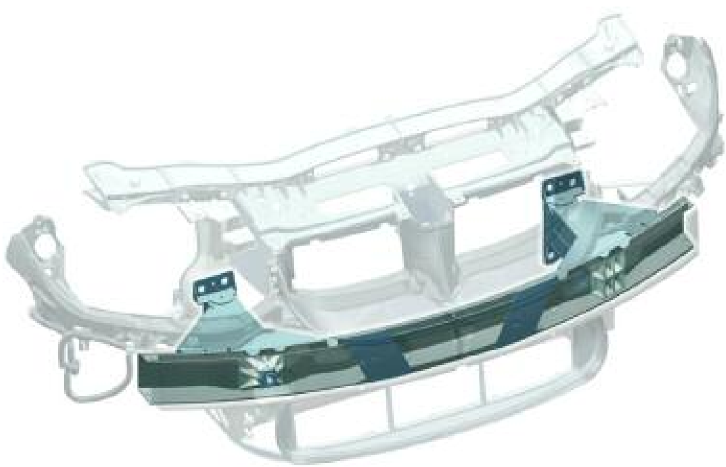
Rear wheel housing cover

Front End Module

The front end module has a new single piece M-specific thermoplastic bumper trim and is fitted to a reinforced lightweight plastic bracket.



Front end module



Plastic bumper brackets

Front bumper trim

The bumper trim is color coded to the car.

The front M3 bumper has apertures for the kidney grill, engine air inlet, PDC ultrasonic sensors (optional), the headlight-cleaning system and the mounting for the towing eye.

Front bi-xenon headlamp units are identical to the series E92. The M3 front bumper overhang is longer than that of the series E92.

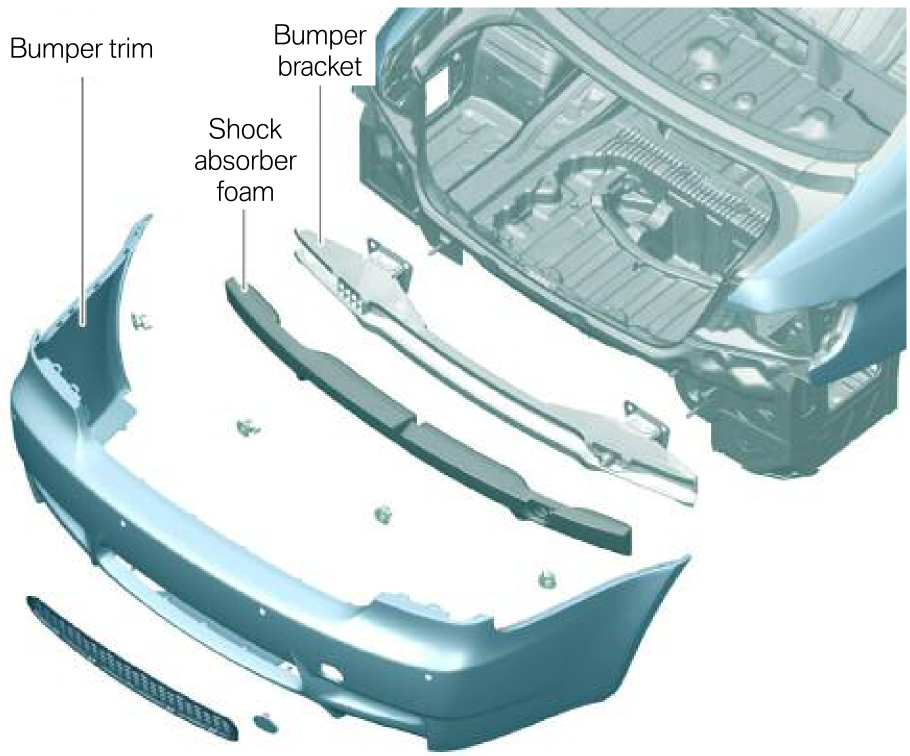
Headlight Cleaning System (SWR)

The container for the M3 headlight cleaning system is new. The design has been changed from the series E92 in order to provide the necessary space for installing the M3 side gills with integrated indicators in the M style. The filler neck and the line for the headlight cleaning system are new, together with the fixed washer nozzles on the bumper trim.

The wiring harness for the headlight cleaning system has been adapted accordingly.

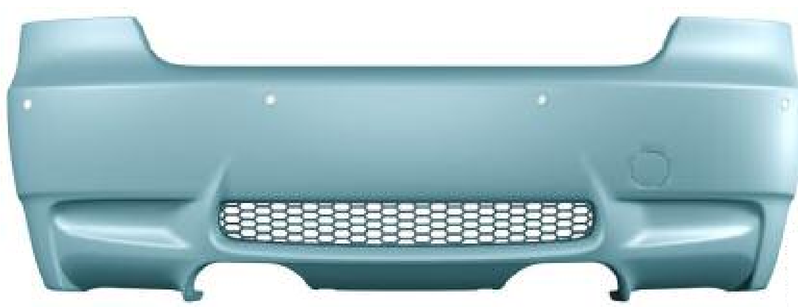
Headlight cleaning system

Rear End Module



The rear end module also features a new, single-piece bumper trim in the M style made from a special thermoplast material. The bracket is also made from reinforced lightweight plastic.

The module has apertures for the bumper grid, PDC ultrasonic sensors (optional) and the mounting for the towing hook.

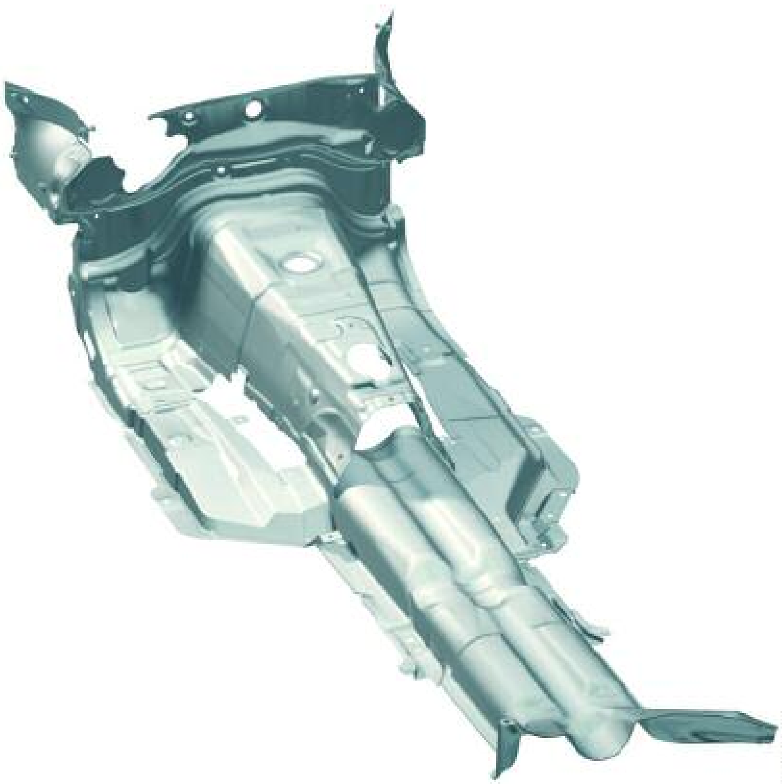


Rear bumper trim

Sound/Thermal Insulating

New sound insulation and thermal insulation covers have been installed.

The sound-insulating mats are attached in the vehicle interior to the bulkhead and transmission tunnel, and the thermal insulation is mounted in the underbody area of the exhaust system and the engine.



Sound insulating mat and thermal insulation

Other Underbody Paneling

The underbody panels have been optimized to ensure the best possible vehicle aerodynamics and the maximum possible cooling capacity for the driveline components.

Underbody Paneling

Interior Body

Luggage Compartment

The M3 floor insert in the luggage compartment has been modified to accommodate the M Mobility System.

M Mobility System

Seats

The front head restraints feature the M logo, as in the E6x M5.

The front seat backrests have been revised. The seat upholstery is the same as that used on the E92 series-model sport seat.

The frame with rear seat bench with throughloading capability has enabled further weight savings. This is achieved through the use of lighter materials, which are processed using a special method for seat construction in a sandwich design (1).

Sectional view of the frame of a rear seat back (1)

Rear seat bench

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S65B40 Engine

Initial Print Date: 1/08 Revision Date:

S65B40 Engine

Model: E90 M3, E92 M3

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the components of the S65B40 engine
- Identify the difference between the S85B50 and S65B40 engines
- Explain the oil supply system of the engine

Crankcase and Crankshaft Drive

Engine Block with Bedplate Construction

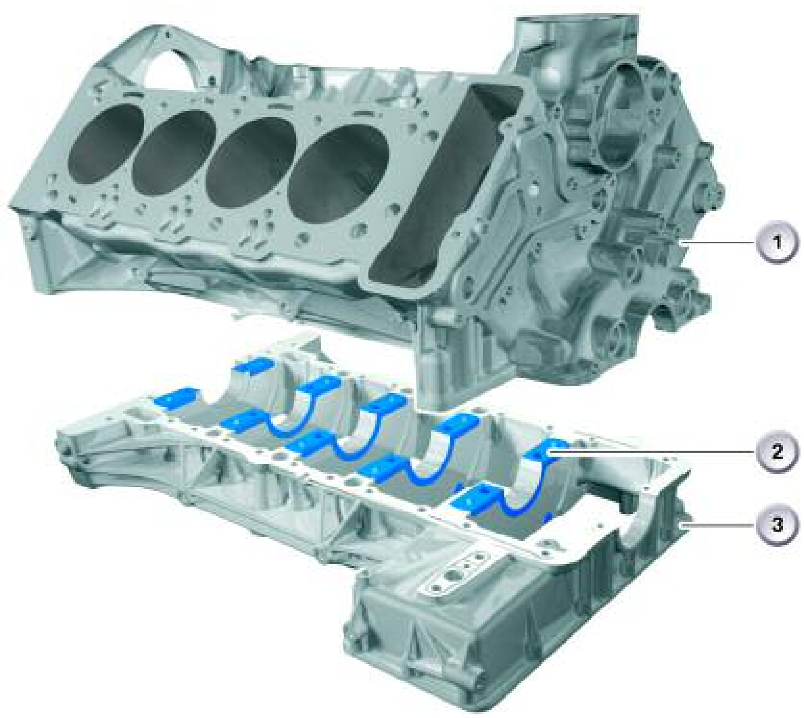
The construction and materials are identical to the S85; the upper low-pressure die-cast crankcase is made from an aluminum-silicon alloy.

The cylinder bores are formed using exposed hard silicon crystals, rendering the use of cylinder liners redundant.

The lower crankcase (bedplate) is also constructed using die-cast aluminum. Due to the extreme forces, grey cast iron inlays are used to reinforce the bedplate construction.

These also limit crankshaft bearing clearances over a greater temperature range and thus have a positive effect on the oil flow rate.

S65B40 Engine block with bedplate construction



Index	Explanation
1	Engine block (upper section)
2	Grey cast iron inlays
3	Bedplate construction (lower section)

Crankshaft

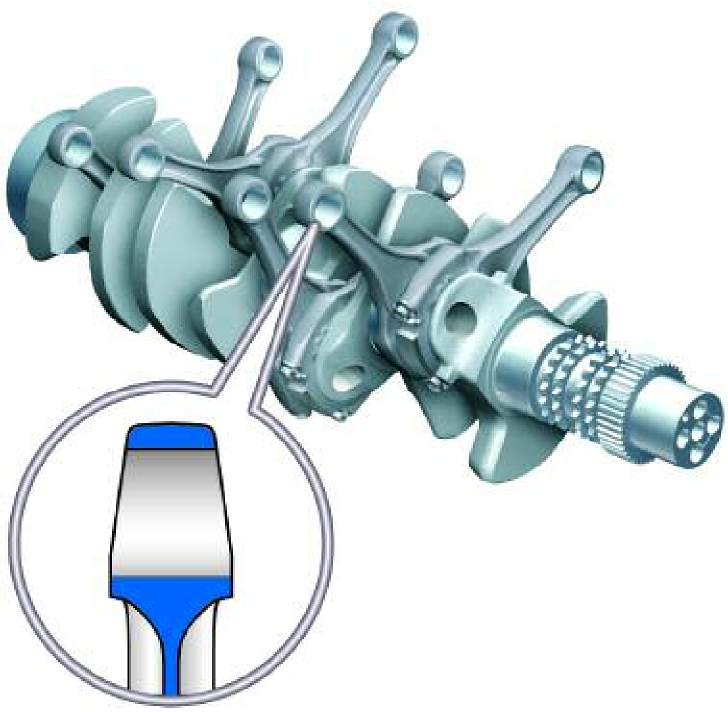
The five-bearing crankshaft is forged from a single piece, including the two double-chain wheels for driving the valve gear. The gear wheel for the oil pump drive is flange mounted.

The cylinder spacing is 98 mm. The crankshaft possesses a high level of bend resistance and high torsional strength at a relatively low weight. The crank pin offset is 90°. The diameter of the main bearing journal is 60 mm. The crankshaft end float is controlled by a thrust bearing located at the fifth main bearing.

For design reasons, the firing order 1-5-4-8-7-2-6-3 was chosen for the S65, instead of the firing order 1-5-4-8-6-3-7-2 more commonly employed in BMW V8 engines.

Connecting Rods

The weight-optimized, high tensile steel connecting rods split by fracture separation and the pistons are the same as those used in the S85 engine. For weight reduction, the upper section of the connecting rod has a trapezoidal shaped cross-section.

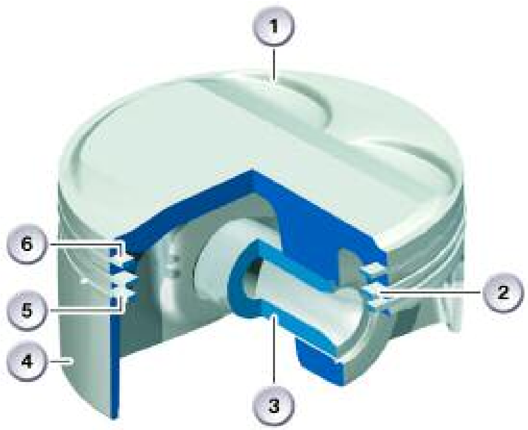


S65B40 crankshaft with magnification of the upper section of the connecting rod

Note: The large connecting rod eye is asymmetrically ground to reduce the length of the engine. This means that the installation is direction-specific. For the workshop, bearing shells are available in a repair stage (for more information, see the service documentation).
The identification marking of the bearing shells is engraved on the crankcase and on the first crank web.

Pistons

A piston is manufactured from a cast aluminum alloy and weighs approximately 480 grams including gudgeon pin and piston rings. The piston design is the same as the S85 piston (piston shaft with galvanized iron coating [Ferrostan] and a running-in layer containing tin. The installation position is direction-specific.



Index	Explanation
1	Pistons
2	Taper-faced ring
3	Gudgeon pin
4	Piston skirt
5	Oil scraper ring (VF system)
6	Compression ring (plain compression ring with spherical contact face)

Oil Supply

Two oil pumps are installed in the S65 engine; the oil return pump, which is driven via a gearwheel by a crankshaft, and the volume flow-controlled main oil pump, driven via chain drive by the oil return pump.

In the S85, the VANOS high pressure pump is installed instead of the S65 oil return pump, and the S85 oil return pump is contained in a housing together with the main oil pump (tandem pump).

Since there is no space to install a tandem pump in the S65, the oil return pump has been moved from the main oil pump housing and installed instead of the VANOS high-pressure pump. This allows the pump drive principle (crankshaft => gearwheel => pump => chain => pump) to be maintained. As in the S85, the volume flow-controlled main oil pump is a hinged-valve oil pump with a feed capacity adjusted to suit the VANOS low-pressure system.

The duocentric design of the oil return pump ensures that oil is always available at the inlet pipe of the main oil pump in the rear area of the oil pan, even when braking sharply from high speeds.

The electrical oil return pumps installed in the S85 for scavenging the cylinder heads are no longer required, which results in a further weight saving.

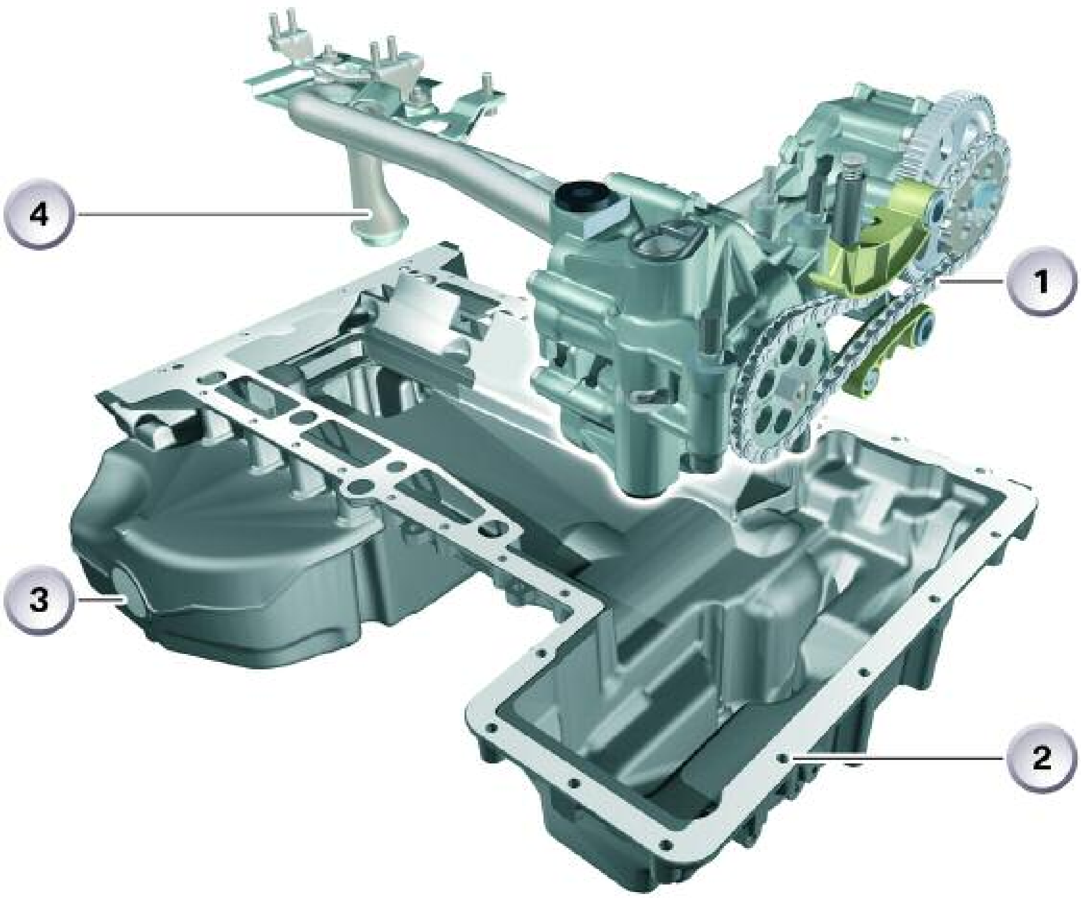
This is made possible by the lower number of cylinders, modification of the oil return routes, and the large capacity of the oil pan.

The oil pan has a capacity of 8.3 liters (S85 9.3 liters).

The oil supply is also guaranteed at extreme longitudinal and lateral accelerations of up to 1.4 times the normal gravitational acceleration.

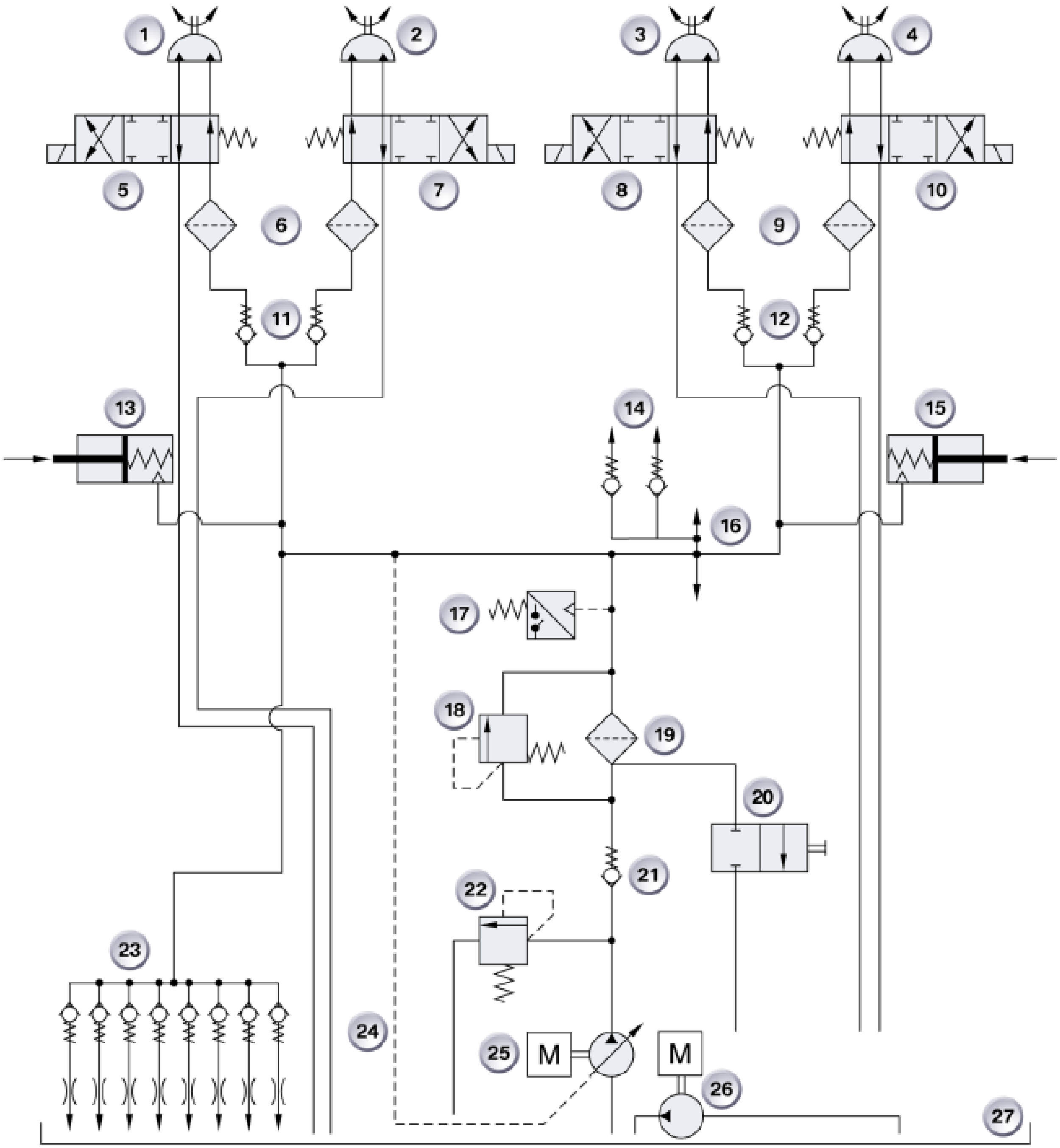
The oil filter housing is installed on the engine.

S65B40 Oil Pumps



Index	Explanation
1	Oil intake area of the oil return pump
2	Front, smaller section of the oil pan
3	Main oil pan
4	Oil intake area of the main oil pump

Oil Supply Hydraulic Circuit Diagram



Legend for Oil Supply Circuit Diagram

Index	Explanation
1	Cylinder bank 1 VANOS exhaust hydraulic motor
2	Cylinder bank 1 VANOS inlet hydraulic motor
3	Cylinder bank 2 VANOS inlet hydraulic motor
4	Cylinder bank 2 VANOS exhaust hydraulic motor
5	Cylinder bank 1 VANOS exhaust multi-way adjustment valve
6	Cylinder bank 1 VANOS sieve filter (max. 300 μm) before multi-way adjustment valve
7	Cylinder bank 1 VANOS inlet multi-way adjustment valve
8	Cylinder bank 2 VANOS inlet multi-way adjustment valve
9	Cylinder bank 2 VANOS sieve filter (max. 300 μm) before multi-way adjustment valve
10	Cylinder bank 2 VANOS exhaust multi-way adjustment valve
11	Cylinder bank 1 VANOS non-return valve
12	Cylinder bank 2 VANOS non-return valve
13	Cylinder bank 1 chain tensioner
14	Cylinder bank 1 and 2 non-return valve from chain lubrication
15	Cylinder bank 2 chain tensioner
16	Main oil channel (lubrication points engine block and cylinder head)
17	Oil pressure switch
18	Oil filter bypass valve
19	Oil filter
20	Oil filter outlet aperture
21	Non-return valve
22	Pressure limiting valve
23	Piston cooling nozzles
24	Oil pressure regulation line
25	Volume flow-controlled hinged valve main oil pump
26	Oil return pump
27	Sump

Valvetrain

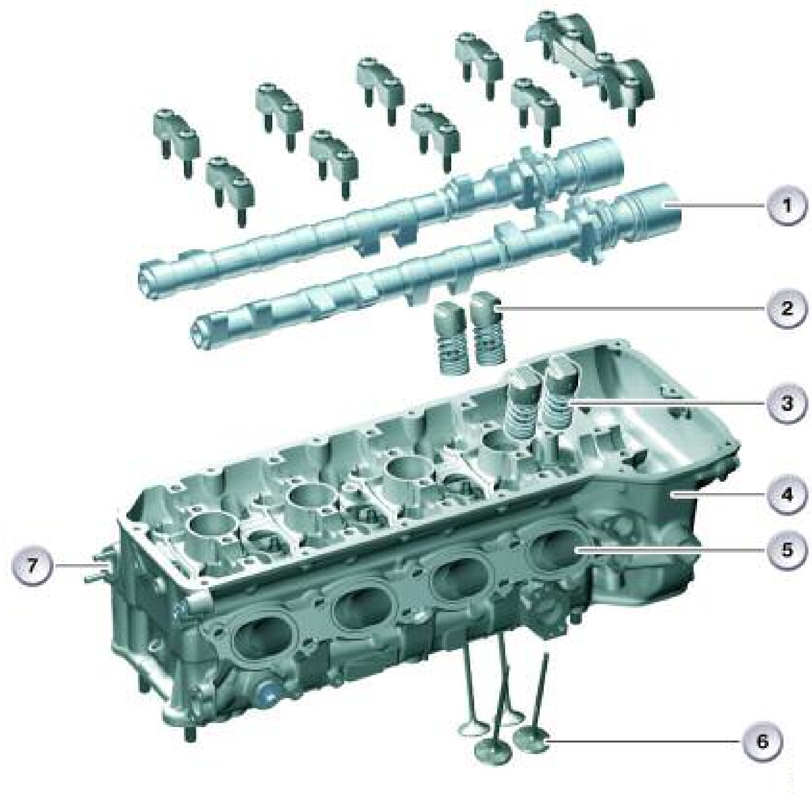
Cylinder Head

The cylinder head is constructed from a single piece of aluminum alloy. To reduce the number of sealing faces, the secondary air channel has been integrated back into the cylinder head.

The design of the cylinder head is based on the S85. Changes have been made in the front engine compartment to the VANOS and the timing chain.

The inlet and exhaust tracts have been further airflow-optimized. The integrated idle air channel has been discontinued and replaced by an idle air bar for each cylinder bank.

As in the S85, the camshafts are manufactured as a hollow-cast, one-piece construction with integrated sensor gears.



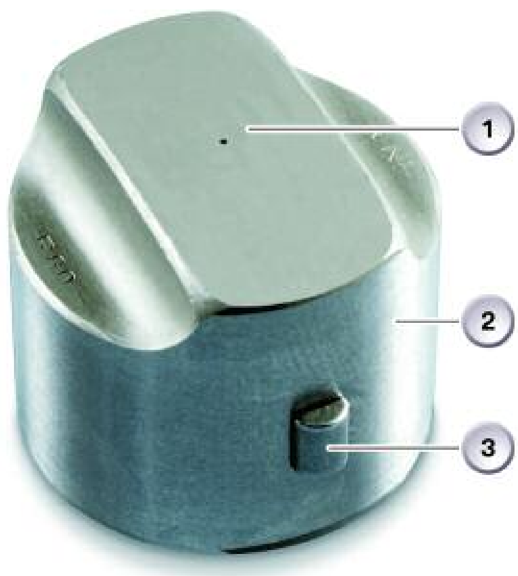
S65B40 Cylinder Head

Index	Explanation	Index	Explanation
1	Camshaft	5	Intake passage
2	Bucket tappet with hydraulic valve clearance adjustment	6	Valve
3	Beehive-shaped valve springs	7	Connection flange of the integrated secondary air channel
4	Cylinder head		

Hydraulic Bucket Tappet

The weight-optimized valves with a 5 mm shaft diameter and the spherical bucket tappets with hydraulic valve clearance adjustment are also used.

These bucket tappets with a cylindrical camshaft contact surface and rotational lock allow a high level of convexity. This results in effective valve lift characteristics with the smallest possible tappet diameter and hence tappet mass (ideal for high engine speeds).

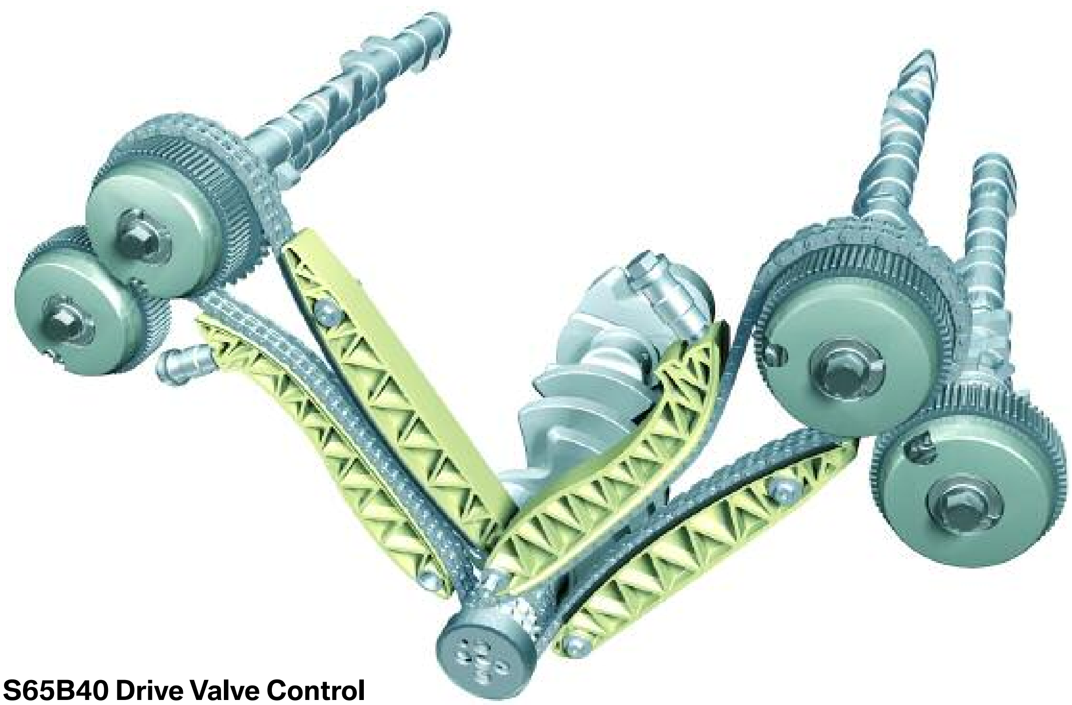


Index	Explanation
1	Spherical contact surface
2	Box tappet
3	Guide lug

Camshaft Drive

As in the S85, the inlet camshafts are driven by chain drive and the exhaust camshafts are driven by a gearwheel drive. This means that the inlet and exhaust camshafts always have an opposite direction of rotation. In contrast to the S85, which works with two single-roller chains between the crankshaft and the inlet crankshafts, in the S65, two double-roller chains are installed. This is because of the higher chain drive load in the V8 S65.

The VANOS adjustment units are an integral component of the valve control and are mounted on the relevant camshaft by a central bolt.



S65B40 Drive Valve Control

Technical Data	E92 M3	E46 M3	E6x M5/M6
Engine identifier	S65B40	S54B32	S85B50
Camshaft drive	2x double-roller chain	Double-roller chain	2x single-roller chain

Note: The central bolts of the inlet and exhaust side have a CCW thread, please refer to the repair instructions.

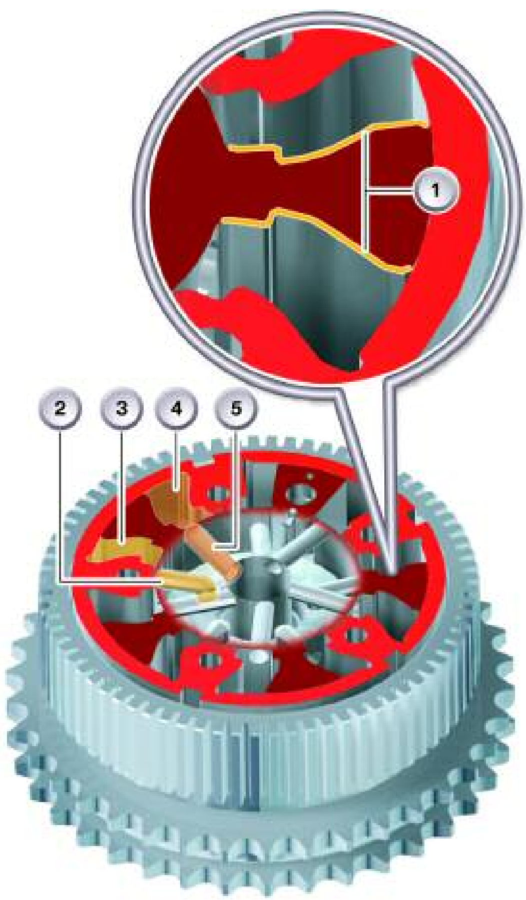
VANOS

The compact double VANOS system fitted to the S65 engine operates at normal oil pressure, unlike the S85 engine (which uses high oil pressure). The low-pressure system means that the high-pressure pump and additional pressure lines and reservoir are unnecessary. This results in a space saving as well as a weight reduction of approximately 8.4 kg.

This has been made possible by the considerably stronger switching moments at the camshaft compared to the 10-cylinder and 6-cylinder engine, particularly in the lower engine speed range. The low-pressure system uses these switching moments to adjust the overall gear ratio.

The oil is directed to the sealed oil chambers (3 and 4) of the VANOS adjustment unit.

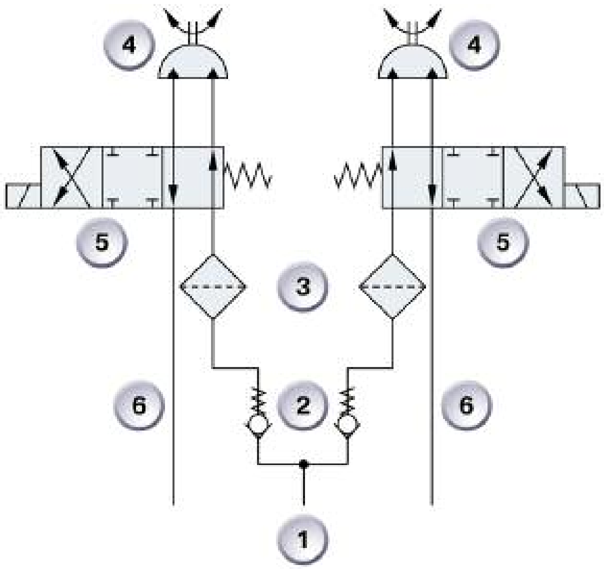
When the chambers are pressurized with oil pressure, one chamber allows the camshaft to advance whilst the other chamber allows the camshaft to retard.



Index	Explanation
1	Optimized hydraulic rotor pressure surfaces
2	Optimized inlet channel oil chamber 1
3	Oil chamber 1
4	Oil chamber 2
5	Optimized inlet channel oil chamber 2

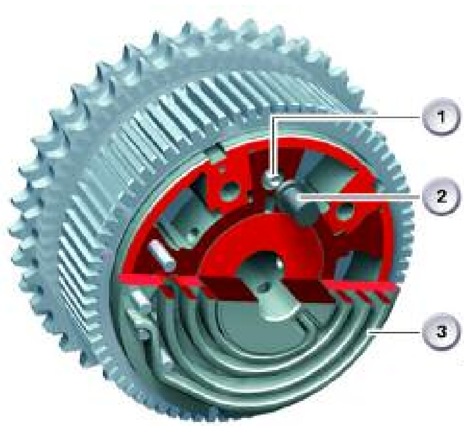
S65B40 VANOS hydraulic motor

S65B40 VANOS Hydraulic schematic of a cylinder bank



Index	Explanation
1	Oil supply from the main oil gallery
2	Non-return valves
3	Sieve filter upstream from control valves
4	Hydraulic motor at the inlet and exhaust camshaft
5	Multi-way adjustment valves inlet and exhaust side
6	Oil return flange to the oil sump

The VANOS oil pressure is supplied by the engine's main oil pump. The VANOS oil flow is controlled by one multi-way valve for each camshaft. These VANOS multi-way valves are controlled by the MSS60 and are directly installed in the cylinder head.



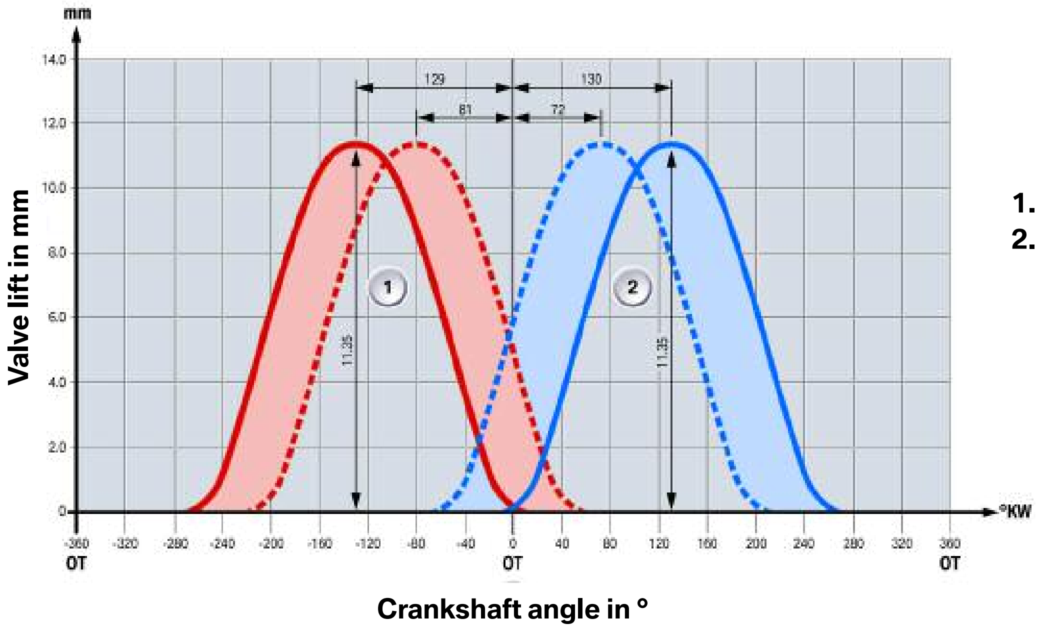
Index	Explanation
1	Locking pin spring
2	Locking pin
3	Spiral-wound spring

As with the S85, the VANOS adjustment unit of the inlet camshaft drives the VANOS adjustment unit of the exhaust camshaft by means of a constantly meshed gear.

At zero pressure, a locking pin (2) also holds the VANOS unit in the normal position or engine start position.

The spiral-wound spring (3) is also used for coordinating the adjustment time between the advance and retard adjustment. In contrast to AG petrol engines, the spiral wound spring for the inlet and exhaust sides is mounted in the opposite working direction, since the camshafts in the S65 rotate in the opposite direction.

The principle of action of the hydraulic motor in this M VANOS is based on the VANOS in current BMW petrol engines and is optimized for the S65 in terms of oil supply and drainage diameters, and in the rotor surface area.



1. Exhaust cam
2. Inlet cam

The setting angle of the inlet camshaft is 58° in relation to the crankshaft. The exhaust camshaft has a setting angle of 48°. As in the S85 engine, this VANOS also reaches an adjustment rate of 360° camshaft per second.

Note: The service instructions should be followed exactly.
The VANOS adjustment unit must not be disassembled.

Technical Data	E92 M3	E46 M3	E6x M5/M6
Engine identifier	S65B40	S54B32	S85B50
Variable camshaft control (VANOS)	2x double (engine oil pressure) oscillating rotor VANOS	Double high-pressure VANOS	2x double high-pressure VANOS
Adjustment range E/A [°KW]	72-130/81-129	70-130/83-128	79-145/91-128
Kingpin inclination E/A [°KW]	58/48	60/45	66/37
Response time E/A [°KW]	256/256	260/260	268/260

Belt Drive

The main belt drive drives the coolant pump and the generator, while the auxiliary belt drive drives the air conditioning compressor and the power-assisted steering pump.

The generator and the coolant pump are in the same position as in the S85.
The coolant pump is identical to the S85, but has a larger belt pulley.

S65B40 Belt Drive

Air Supply

Air Intake Guide/Oil Separator/Secondary Air System

Index	Explanation
1	Engine hood air inlet
2	Air inlet behind the ornamental grills of the BMW kidney
3	Air inlet in the bumper
4	Air filter element

The combustion air enters the engine via three flow-optimized air guides. An air inlet is located on the left side of the engine hood when viewed in the direction of travel. To maintain an optical balance in the appearance of the engine hood, another intake grill is located on the right-hand side, but this is blinded and does not perform any function.

The second air inlet guide is located behind the kidney grills of the BMW kidney.

The third air inlet guide is on the left below the front bumper.

The S65 has a large, single-piece air collector for the intake air to both cylinder banks.

A cylindrical air filter element (4) with an enlarged surface area is used.

The filtered air flows into the intake manifold, from where it flows through eight integrated individual inlet pipes and into the individual throttle valve assemblies.

To optimize air resistance, no air-mass sensor is installed in the intake area.

The air flow is determined using a model based calculation from the aperture of the throttle valve assemblies and the idle speed actuator, the VANOS adjustment position, the engine speed, the air temperature and the atmospheric pressure.

For safety reasons, an additional pressure sensor is mounted in the idle speed system (see idle speed control).

Oil Separators

The oil separators are bolted onto the cylinder head covers. The connection between the oil separator and the intake manifold is not screwed but plugged. This reduces the risk of incorrect assembly.

As is typical for the M series, no crankcase pressure control is mounted/integrated.

Oil separator connection point to the intake manifold

Secondary Air System

The secondary air pump is mounted on the rear side of the engine in the "V" of the cylinder banks. The secondary air is guided into the relevant exhaust channel via a check valve and an air channel integrated in the cylinder head.

An upstream secondary air pump hot-film air mass sensor measures the secondary air flow. The structure and function are the same as the system in the E60M5.

Individual Throttle Butterfly System

Single throttle valve system

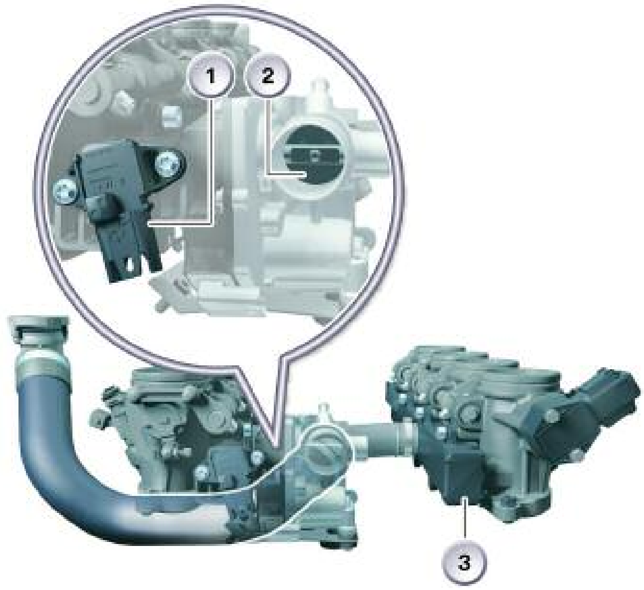
Index	Explanation
1	Double throttle valve sensor cylinder bank 1 and 2
2	Individual throttle valve assemblies
3	Electrical throttle-valve actuator

The design principle of the S65 individual throttle valve air intake system is the same as the S85 and consists of eight individual throttle valve assemblies and two electrical throttle valve actuators. One electric throttle valve positioner activates four individual throttle butterflies of one cylinder bank, which are mechanically coupled. The throttle valve position for each cylinder bank is recorded using a double throttle valve sensor on the shared throttle body shaft. A signal is sent directly to the throttle valve actuator responsible for this cylinder bank. The throttle valve actuator can therefore independently adjust the throttle valve position specified by the MSS60.

The second signal is sent to the MSS60 for checking purposes.

For communication with the MSS60, the two electrical throttle valve actuators use a shared DK-CAN bus (DK-CAN).

Idle Control System



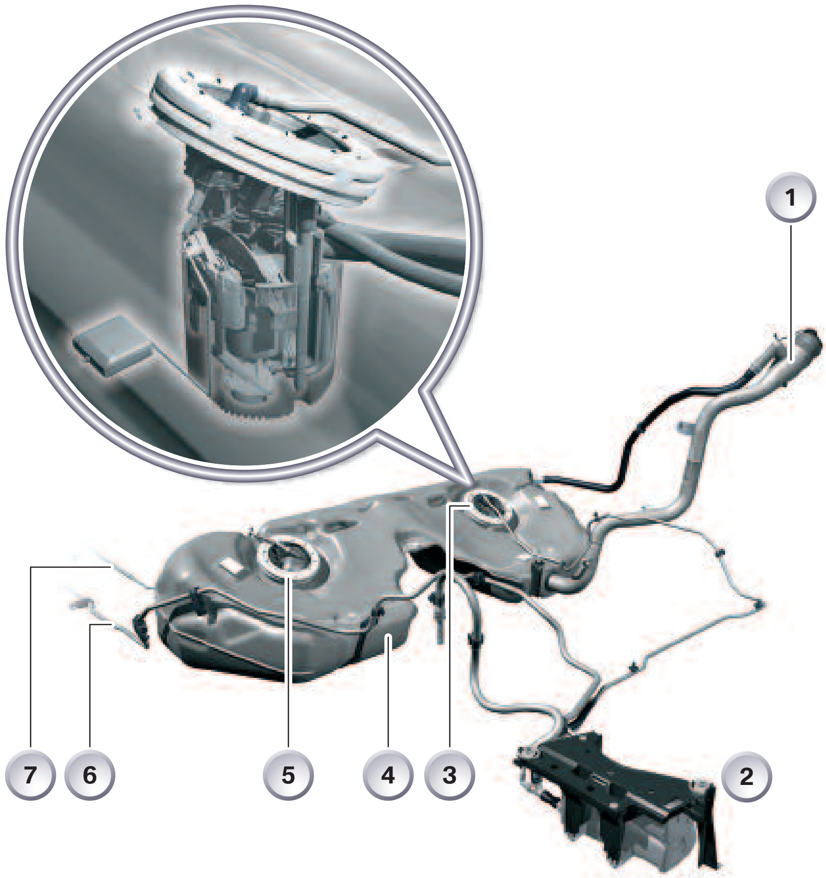
Index	Explanation
1	Pressure sensor on idle air bar, cylinders 5-8
2	Throttle valve
3	Idle air bar, cylinders 1-4

One common idle speed actuator for both cylinder banks controls the air supply at idle speed and at low engine loads. The idle speed actuator is located in the V formed by the two cylinder banks, and controls the idle air supply using a throttle valve. The air enters the shared bar for each cylinder bank via the relevant air ducts, and from there is guided into each throttle body below the throttle valve.

The idle speed actuator receives control instructions from the MSS60 via its own local CAN bus (LoCAN).

To ensure emergency operation in the event of the failure of one or both throttle valve sensors (even without the hot film air-mass sensor), an additional pressure sensor is integrated on the idle air bar (as in the S54B32HP (M3 CSL)). This allows evaluation of the pressure conditions behind the throttle valves. This pressure is also used for the plausibility check of filling and load in normal operation.

Fuel Supply



Index	Explanation	Index	Explanation
1	Tank filling supports	5	Left fuel supply unit
2	Tank leakage diagnosis unit	6	Tank vent valve
3	Right fuel supply unit	7	Engine fuel supply line
4	Fuel tank		

The fuel tank is based on the series E92 tank, although the shape has been changed to accommodate the exhaust system. Both in tank units are new. The fuel pump is installed in the right-hand unit, and the pressure regulator is installed in the left-hand unit in front of the fuel filter.

The ventilation lines have been adapted, while all other lines have been taken from the E92 335i. The US release is fitted with a tank leakage diagnosis unit.

The electrical controls are described in the MSS60 engine control system.

Cooling System

The mechanical coolant pump was taken from the S85.

The water pump belt pulley has been adapted due to the reduced water flow rate in the S65 compared with the S85. It has a larger diameter, which has allowed a reduction in pump speed.

A one-piece crossflow radiator is used to cool both banks, unlike the S85 engine which has a two-piece radiator, one part for each bank.

The following components have been adjusted for the M3: The expansion tank for the coolant, the crossflow radiator, the radiator hoses, the thermostat and the electric fan.

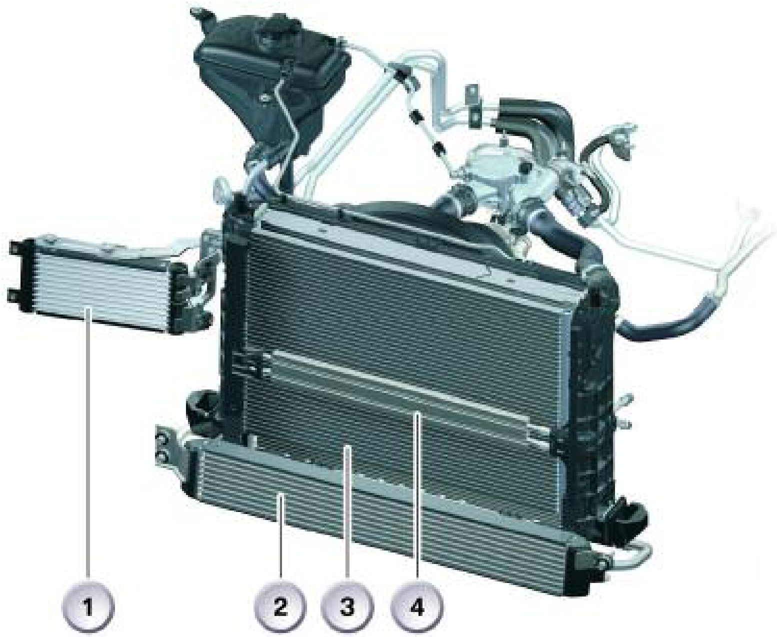
The gear oil and steering oil coolers are also installed in the series-model E92.

The control of the electric fan is described in the MSS60 engine control system.

Oil cooler

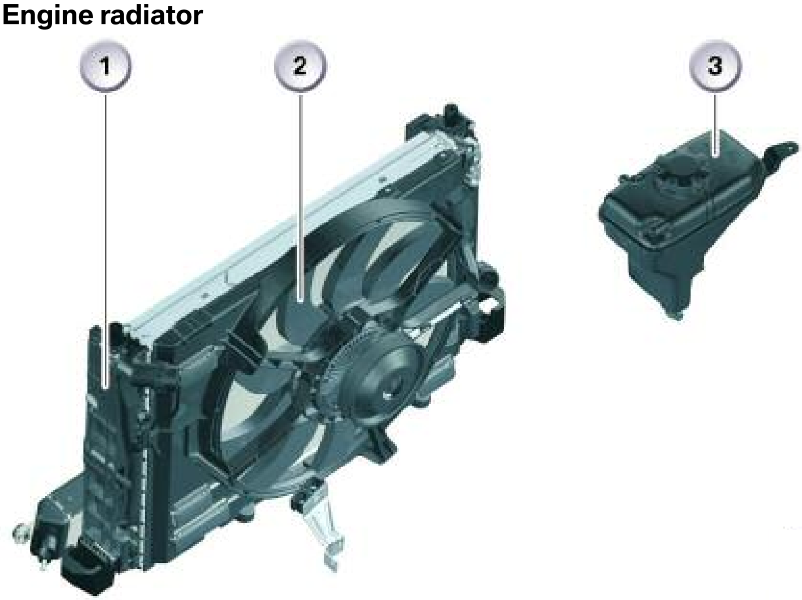
Index	Explanation
1	Gearbox oil cooler
2	Engine oil cooler

Complete cooler package



Index	Explanation	Index	Explanation
0	Gearbox oil cooler	3	Engine coolant cooler
1	Engine oil cooler	4	Steering oil cooler

Engine radiator



Index	Explanation	Index	Explanation
1	Engine cooler package	3	Expansion tank
2	Cooler fan		

Exhaust System

The exhaust pipes of the M vehicles are manufactured using the innovative internal high pressure forming technology (IHU). The "IHU" technology was used for the first time in the world in 1992 in the BMW M3, since when it has undergone continual refinement.

Using the IHU technology, the seamless stainless steel exhaust pipes are formed under a pressure of up to 800 bar. This results in extremely thin wall thicknesses of between 0.65 and 1.0 millimeters, which means both the weight of the exhaust system and the response characteristics of the catalytic converters can be optimized. At the same time, the IHU technology enables unprecedented styling and even more efficient geometric tolerances.

The largest possible pipe cross-sections are used, thus minimizing flow resistance. The complete exhaust system is manufactured in stainless steel and has a dual flow.

The 4-in-1 exhaust manifold in each cylinder bank, as used in motor sport, has a length and cross-section designed to enable optimal use of dynamics in the exhaust flow and to avoid unnecessary exhaust backpressure.

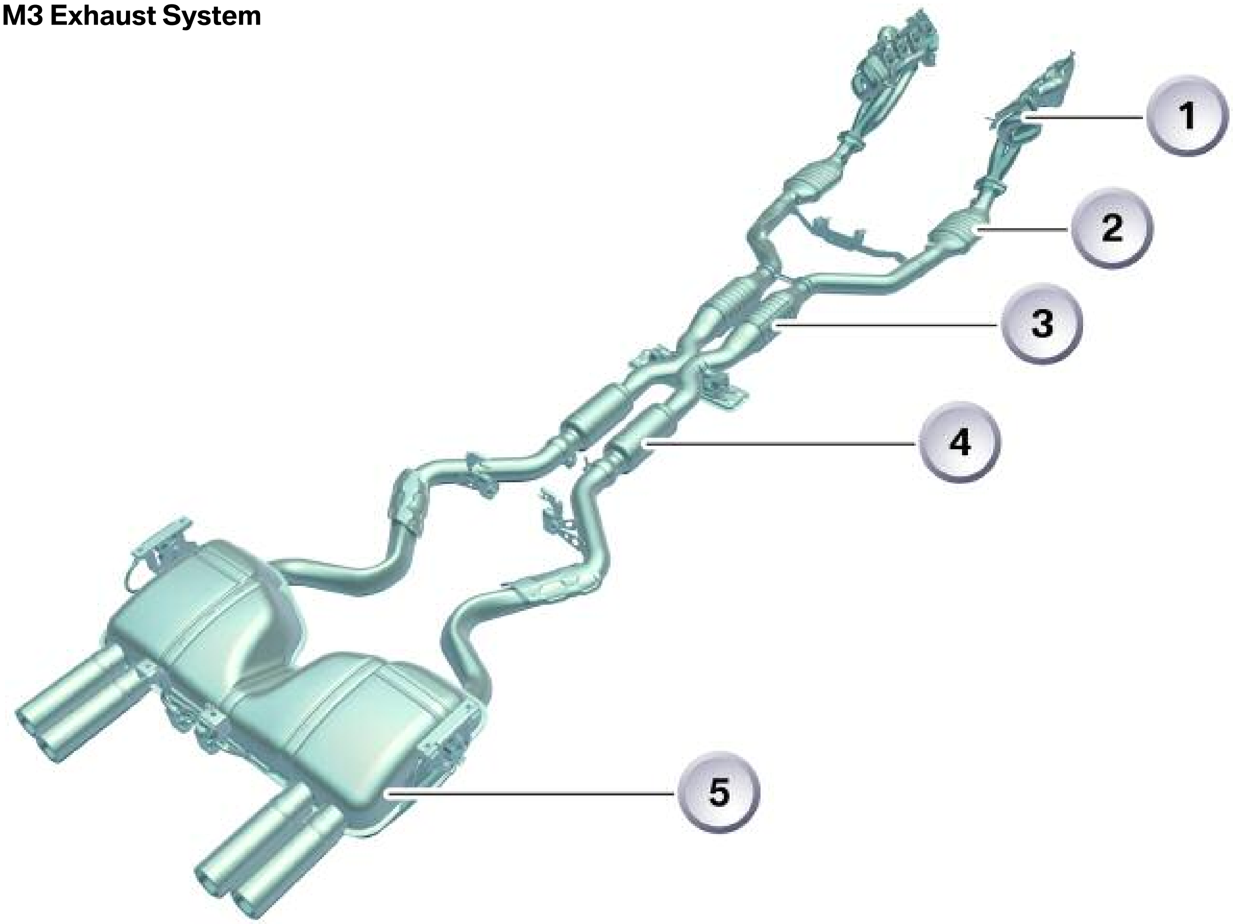
The exhaust system has one quick responding metal catalytic converter close to the engine per exhaust line, (approx. 20 cm behind the exhaust manifold), followed by the metal main catalytic converter. The front silencer and the final muffler shared by both exhaust lines with a volume of 35 liters are constructed in an absorption design.

The lambda oxygen sensors are located before and after both engine-side catalytic converters. The exhaust temperature sensor installed in previous M models is no longer required and is replaced by an internal calculation model in the control device.

The S65 fulfills the requirements of the LEV 2 classification.

Note: At maximum operating temperatures, the entire exhaust system can expand in length by 35 mm.

M3 Exhaust System



Index	Explanation
1	Manifold
2	Catalytic converter close to the engine
3	Main catalytic converter
4	Front exhaust silencer
5	Final muffler

Table of Contents

MSS60 Engine Management System

Initial Print Date: 1/08 Revision Date:

MSS60 Engine Management System

Model: E90 M3, E92 M3

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the digital motor electronics control module version
- Identify the improvements made to the ionic current monitoring system
- Identify and explain the purpose of the components used in the fuel system
- Identify and explain the purpose of the components used in the cooling system

MSS60 Engine Control System

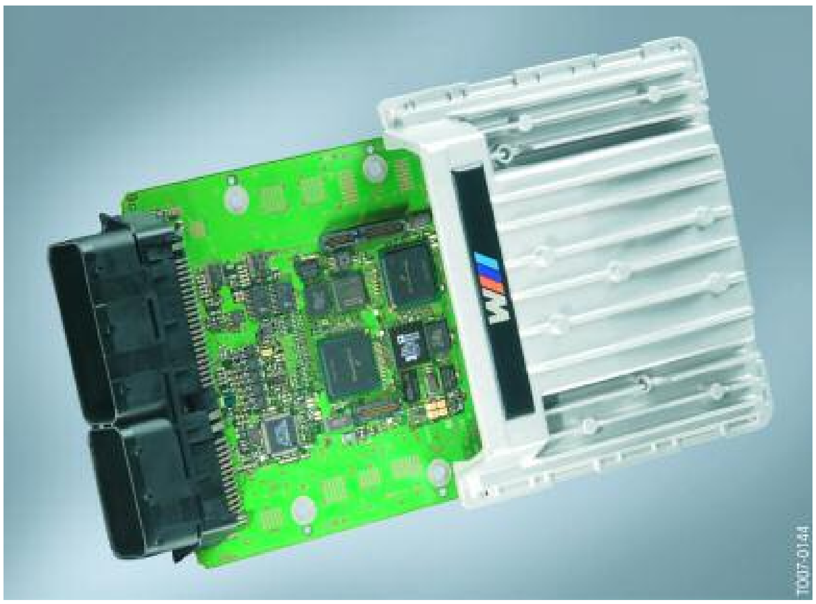
The S65 features a revised engine control system, the MSS60, which is based on the MSS65 in the S85 engine.

This engine control system is designed for engine speeds of up to 9,000 rpm.

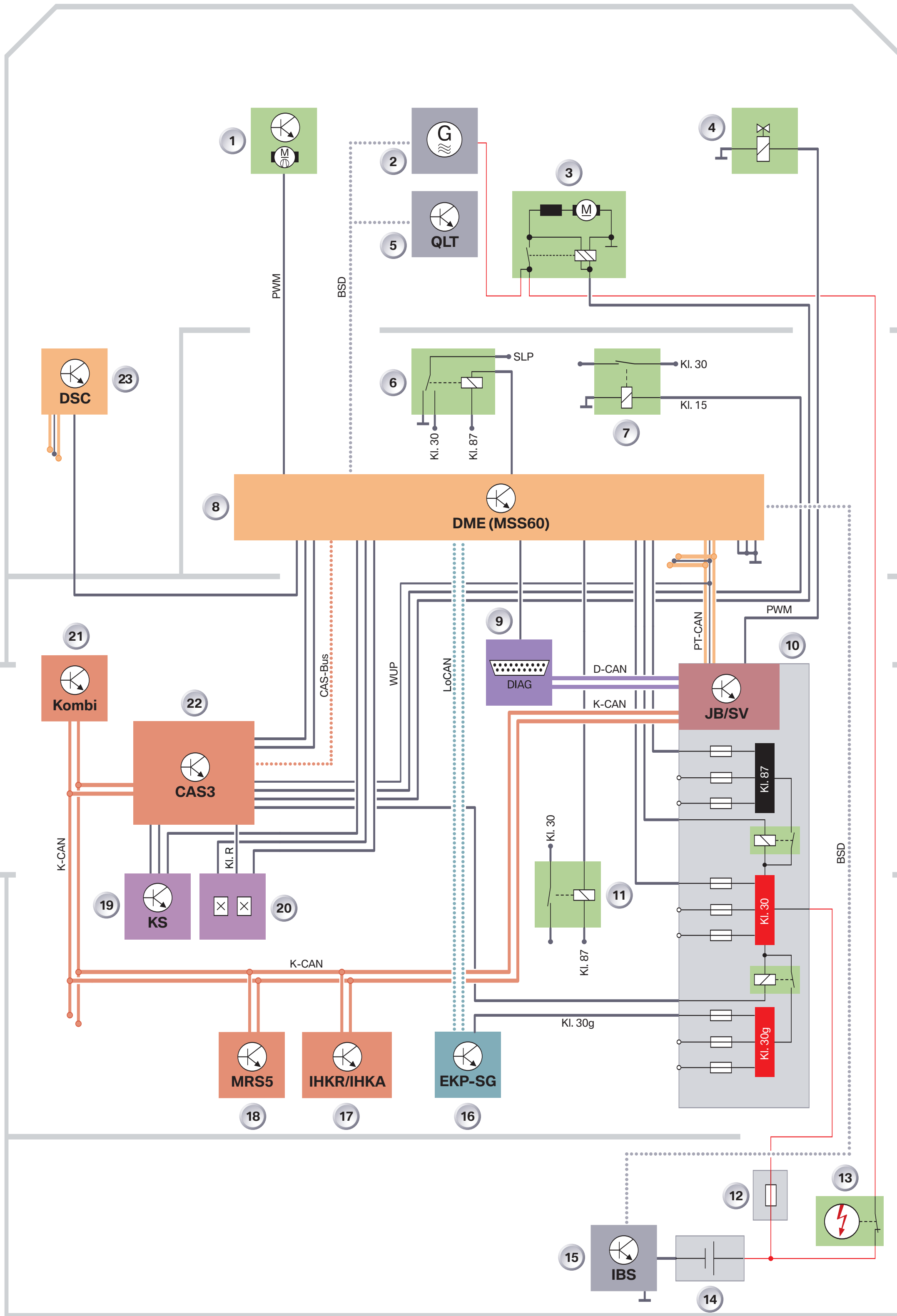
These engine control units belong to the latest generation and are characterized by an extremely high data processing capability, processing millions of calculations per second.

The main functions are described in the product information for the E60 M5.

The following is a description of the areas of the system that differ from the MSS65.



On-Board Connection



Index for On-Board Connection

Index	Explanation
1	Electrical cooling fan
2	Alternator
3	Starter
4	Control valve in the air conditioning compressor
5	Oil condition sensor
6	Secondary air pump relay
7	Injection nozzle supply relay
8	Engine control unit MSS60
9	OBD2 diagnosis connector (TD output from MSS60 and D-CAN to JB)
10	Junction box (JB) and distribution box (SV)
11	Evacuating pump relay for brake servo action
12	High-current circuit breaker (250 A)
13	Safety battery terminal (SBK)
14	AGM battery.
15	Intelligent battery sensor (IBS)
16	Electric fuel pump control unit
17	IHKR/IHKA control unit
18	Multiple restraint system (MRS5)
19	Clutch module (KS)
20	Brake light switching module
21	Instrument cluster
22	Car Access System (CAS3)
23	Dynamic Stability Control (DSC)

Ion Current Combustion Monitoring

The ion current combustion monitoring is also used in the MSS60 for knock identification and misfiring identification. In principle, the method of action is identical to the S85 and its MSS65.

The S85 has two ion current monitoring devices, each of which covers a whole cylinder bank. In the S65, the electronic ion current system is integrated into each ignition coil and the ion current monitoring devices are not required.

During ignition, the measurement current is stored in a capacitor integrated in the ignition coil, and after ignition, is available at the spark plug electrode. In the S65, the ion current measurement and evaluation is also performed exclusively by the MSS60.

The functional range of the ion current electronics has been further refined. There is no longer a need for two measurement control lines, and the ignition current and the ion current measurement signal have been combined into a single transmission route (separate in the S85).

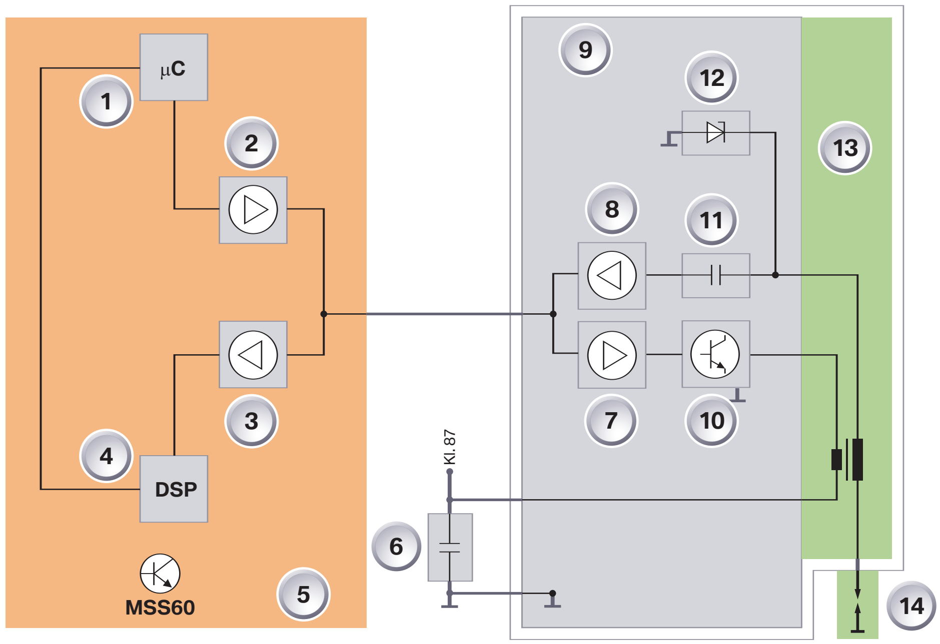
For the purposes of smoothing the voltage and electromagnetic compatibility, an "ignition suppression capacitor" is installed in the wiring harness of each cylinder bank (in the S85 this is in the ion current control device). This is electrically connected using terminal 87 and the vehicle earth.

The same spark plugs are used as in the S85 (basic value approx. 60,000 km).

Note: If the ignition suppression capacitor is defective, this can lead to faults in the communications and/or audio electronics when the engine is running.

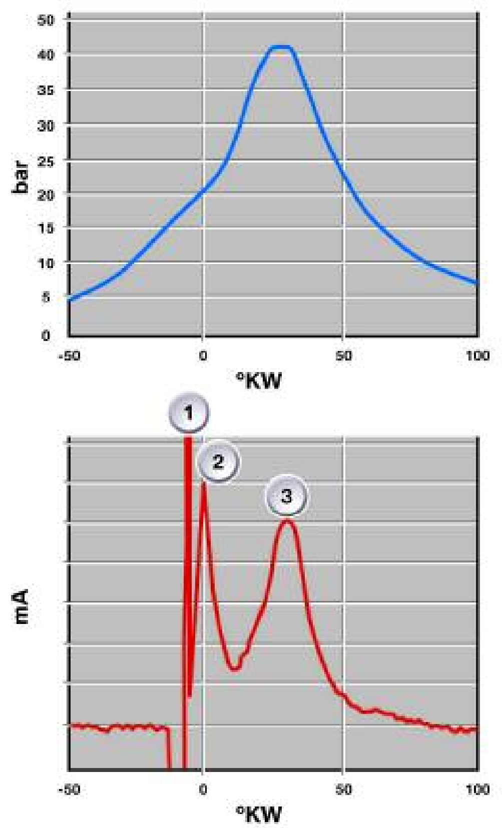
For design reasons, the firing order 1-5-4-8-7-2-6-3 is used in the S65, instead of the firing order 1-5-4-8-6-3-7-2 more commonly employed in BMW V8 engines until now.

Simplified Basic Layout of Ion Current Monitoring



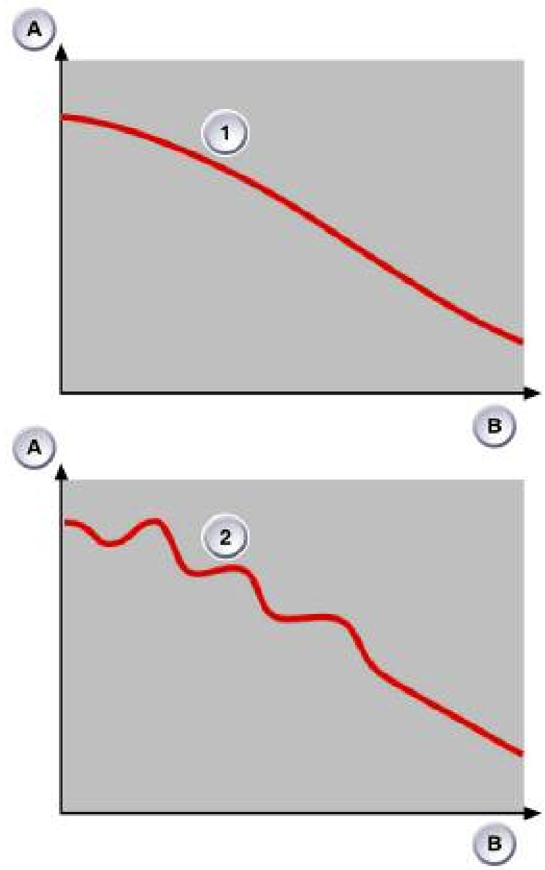
Index	Explanation	Index	Explanation
1	Microcontroller ignition	8	Output amplifier of the ion current measurement signal
2	Output amplifier of the ignition signal	9	Ignition coil with integrated ion current electronics
3	Ion current input amplifier	10	Ignition output stage
4	Digital signal processor for ion current measurement signal	11	Capacitor for storing measured flow
5	MSS60 Engine control system	12	Zener diode for limiting the measured voltage
6	Ignition suppression capacitor (one per cylinder bank for 4 cylinders)	13	Primary and secondary coil
7	Input amplifier for ignition signal	14	Spark plugs

The following diagrams show the ion current curve (bottom) in relation to the development of combustion pressure (top). This curve is used for the evaluation of combustion quality and the identification of misfiring.



Combustion curve (top) and ionic current (bottom)

Index	Explanation
1	Ionic current maximum by induction of ignition coil
2	Ionic current maximum due to ignition (flame front directly in area of spark plugs)
3	The ionic current progression is a function of the pressure curve



MSS60 Representation of normal combustion and combustion knock

Index	Explanation
A	Ionic current (mA)
B	Section of measuring window
1	Normal combustion (no knocking)
2	Combustion knock

Depending on the engine load, the level of the ionic current generated at the spark plug lies in the range 50-500 µA and is only measured by the electronic system in the mA range.

Combustion knock is identified in the ionic current measurement signal in the form of oscillations within a defined measuring window. The measuring window is after position 3 of the above diagram.

NOTES PAGE

Fuel Supply System

A separate control unit is used for the electric fuel pump (EKP-SG). The EKP control signals from the MSS60 are produced via a dedicated CAN bus (LoCAN) (M5: PWM signal). The EKP control unit is made ready for operation by the MSS60 via the input terminal 87. The load current is controlled via a relay at the terminal 30g by CAS3.

In the event of a crash that reaches the relevant threshold value, the MRS5 requests an interrupt to the fuel supply via the K-CAN connection to CAS3.

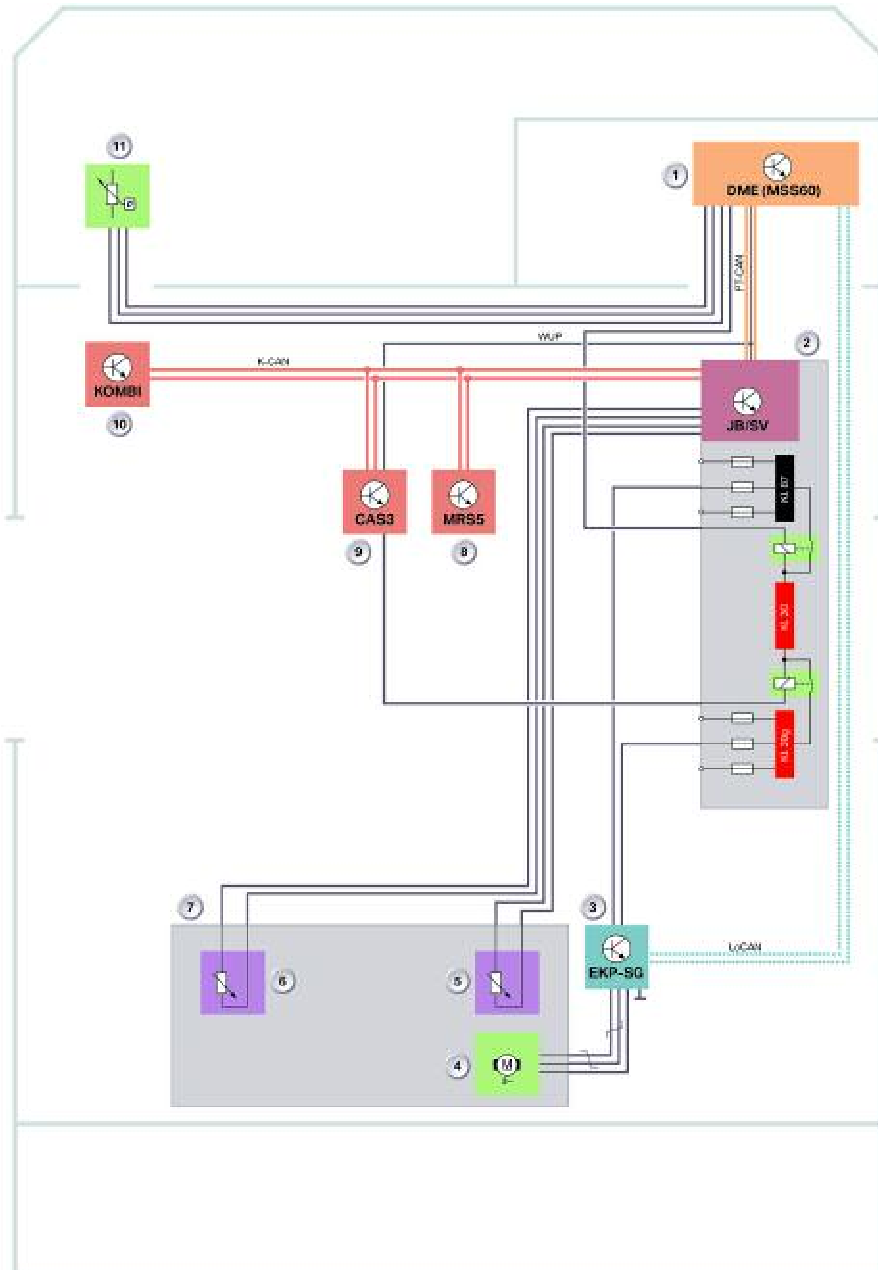
There is now only one fuel pump (the M5 has two). This has a three-phase motor, which ensures sufficient torque across the whole pump speed range. The pump speed is used to provide the required fuel pressure of 3-6 bar, depending on the engine operating state.

A fuel pressure sensor sends its signal to the MSS60. The fuel pressure sensor is located behind the inner fenderwell.

If the pressure sensor fails or there is a fault in the CAN bus and in the engine emergency program, the fuel pump is operated at full speed. In this process, the pressure is limited to 6 bar by the mechanical pressure sensor.

The signals from both tank fill level sensors are sent to the junction box and are forwarded to the instrument cluster via the K-CAN, where they are evaluated and displayed.

MSS60 Fuel Supply System Circuit Diagram



Index	Explanation	Index	Explanation
1	Engine control unit MSS60	7	Fuel tank
2	Junction box	8	Multiple restraint system 5th generation (MRS5)
3	Electric fuel pump control unit	9	Car Access System 3rd generation (CAS3)
4	Fuel pump with three-phase motor	10	Instrument cluster
5	Tank fill level sensor, right	11	Fuel pressure sensor
6	Tank fill level sensor, left		

Cooling System

In the E92 M3, an electric fan is installed (as in the E70), which initially reaches a maximum output of 850 Watts. The fan is activated by the MSS60 via a pulse width-modulated signal (PWM signal) with a frequency of 100-300 Hz for fan operation, wake-up function, and interface diagnosis function.

A frequency of 10 Hz is used for overrun requests.

The signal voltage is approximately the same as the on-board supply voltage. The following cycle ratio specifications (in %) refer to the "low" proportion of the signal period.

The cooling fan power supply is produced using a 100 A high-current circuit breaker in the luggage compartment distributor and a high-voltage relay near the front passenger footwell. The relay is control by terminal 30g (CAS).

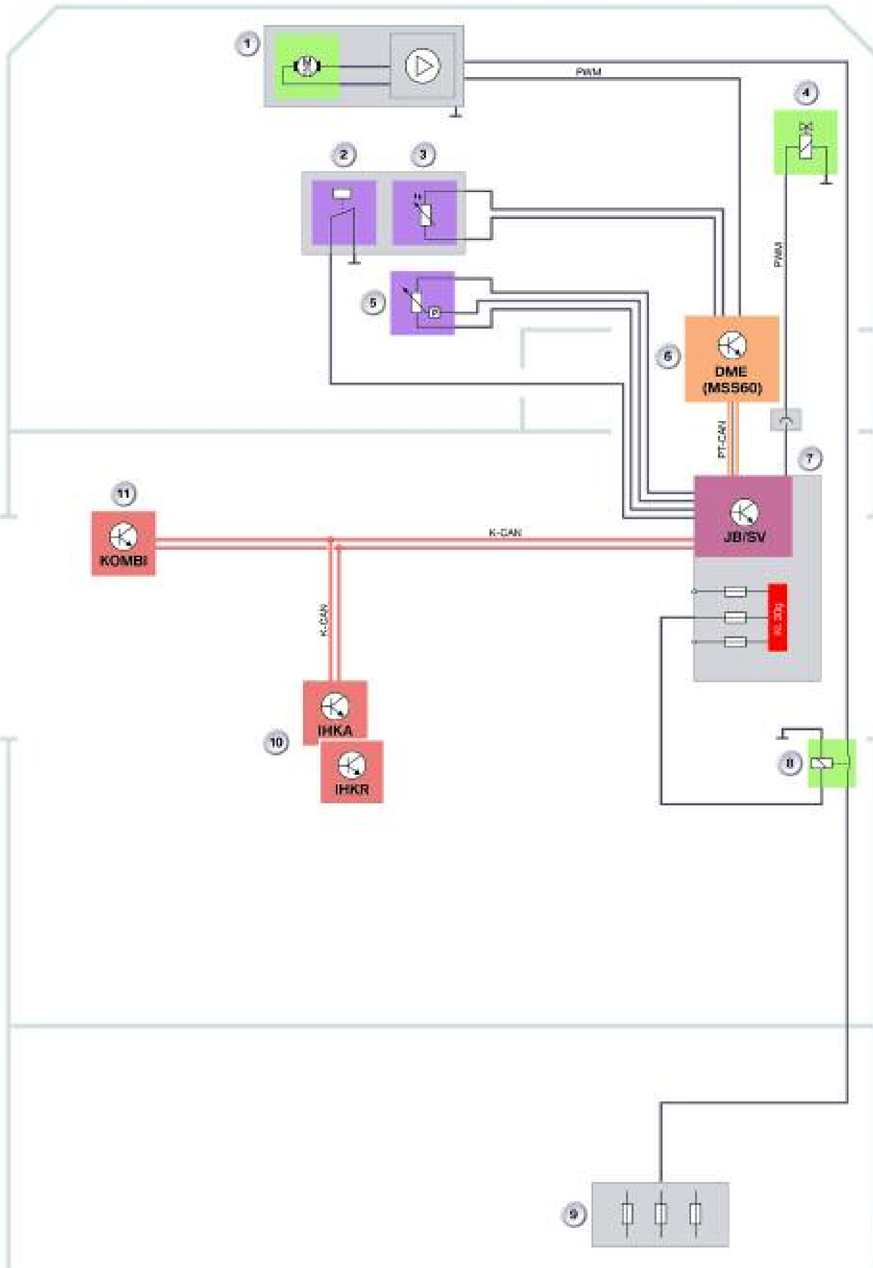
The performance of the cooling fan depends on the coolant temperature, the IHKA request, the intake air temperature, the calculated exhaust gas temperature downstream from the catalytic converter, and the request by the generator (overheating protection).

The control valve in the air conditioning compressor and the coolant pressure sensor are electrically connected to the junction box (JB). The IHKA/IHKR can use the K-CAN connection to evaluate the pressure and send the appropriate control requests for the control valve in the air conditioning compressor to the JB. A resulting load torque for the torque correction and an electric fan speed request are also sent to the MSS60 via the K-CAN.

The junction box only activates the control valve in the air conditioning compressor following release by the MSS60. The MSS60 adapts the idle speed control accordingly and activates the electric fan.

The switching state of the coolant level switch is also transmitted to the junction box and evaluated by the instrument cluster via the K-CAN connection. If there is insufficient coolant, a corresponding warning is sent to the driver.

Cooling System Circuit Diagram



Index	Explanation	Index	Explanation
1	Electric fan (850 W)	7	Junction box
2	Coolant level switch	8	Electric fan relay
3	Coolant temperature sensor	9	High-current circuit breakers
4	Control valve in the air conditioning	10	IHKA
5	Coolant pressure sensor	11	Instrument cluster
6	MSS60 Engine control system		

Function/control of the Electric Fan

Fan Operation

The adjusted fan speed increases in a linear fashion as the cycle ratio increases. The rated speed (n_{Nom}) in the M3 is the same as the maximum number of revolutions (2,400 rpm).

The engine speed of the M3 is controlled in a linear relationship with the cycle ratio (10-91%), starting with 800 rpm (1/3 of n_{Nom}) up to 2,400 rpm.

Note: In the E6x M5/M6 (600 W fan), an additional unregulated increase in engine speed to at least 2,700 rpm (n_{max}) is produced, from a 92% to 95% cycle ratio.

"Wake-up" Function

If they are in sleep mode, the fan electronics can be "woken" by a PWM signal (100-300 Hz) with a cycle ratio of 5-9%. In the E92 M3, in normal operation, the waking is triggered by activation of the terminal 30g with "Ignition ON".

Interface Diagnosis Function

An interface diagnosis is triggered by the MSS60 and used to check the interface. The MSS60 sends a PWM signal (100-300 Hz) for approx. 1 second with a cycle ratio of 96-99%.

If the interface is intact, the fan electronics for confirming the PWM signal cable are set to "low" for 2.5-3 seconds (M5 fan 1-1.5 s).

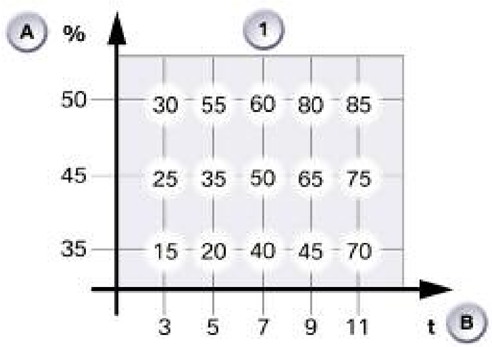
Overrun Request

If an overrun of the fan is required after "Ignition OFF", approximately 7 seconds after "Ignition off", the MSS60 emits a PWM signal with a frequency of 10 Hz for at least 3 seconds. At the issued cycle ratio, the electrical fan system detects at which speed and for what duration the overrun should occur.

The cycle ratio is between 15 and 85% in 5% increments.

It contains the information displayed in the following graphic:

- Engine speeds of 35, 45 or 50% of the rated speed.
- Run-on time of 3-11 minutes in increments of 2 minutes.



Index	Explanation
A	Percentage of rated speed
B	Overrun in minutes
1	Cycle ratio in percent

Fan Self-diagnosis and Fault Signal

The electronic fan system performs an internal diagnosis procedure. If a fault is detected, fan operation is continued as far as possible, if necessary at reduced power.

The following faults lead to a diagnosis message:

- Engine is blocked
- A fault has occurred in the electronic fan system, which means that fan operation is permanently restricted or impossible.

In response to the fault message, the electronic fan system changes the PWM signal to "low" for at least 5, to a maximum of 7 seconds.

Note: A fault message is issued with a delay of approx. one minute, since the electronic fan system first executes a triple internal test cycle.

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4th Generation M3 Drivetrain

Initial Print Date: 1/08 Revision Date:

4th Generation M3 Drivetrain

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the components used in the drivetrain of the M3

Introduction

Via the self-adjusting SAC double-disc clutch, the power flow from the S65B40 engine is forwarded to the 6-gear manual gearbox (GS6-53BZ). This gearbox is based on the 6-speed transmission used in the E60 M5. In contrast to this gearbox, however, the M3 features electrically controlled transmission oil cooling.

A further highlight of the M range is located behind the M3 drive shaft.

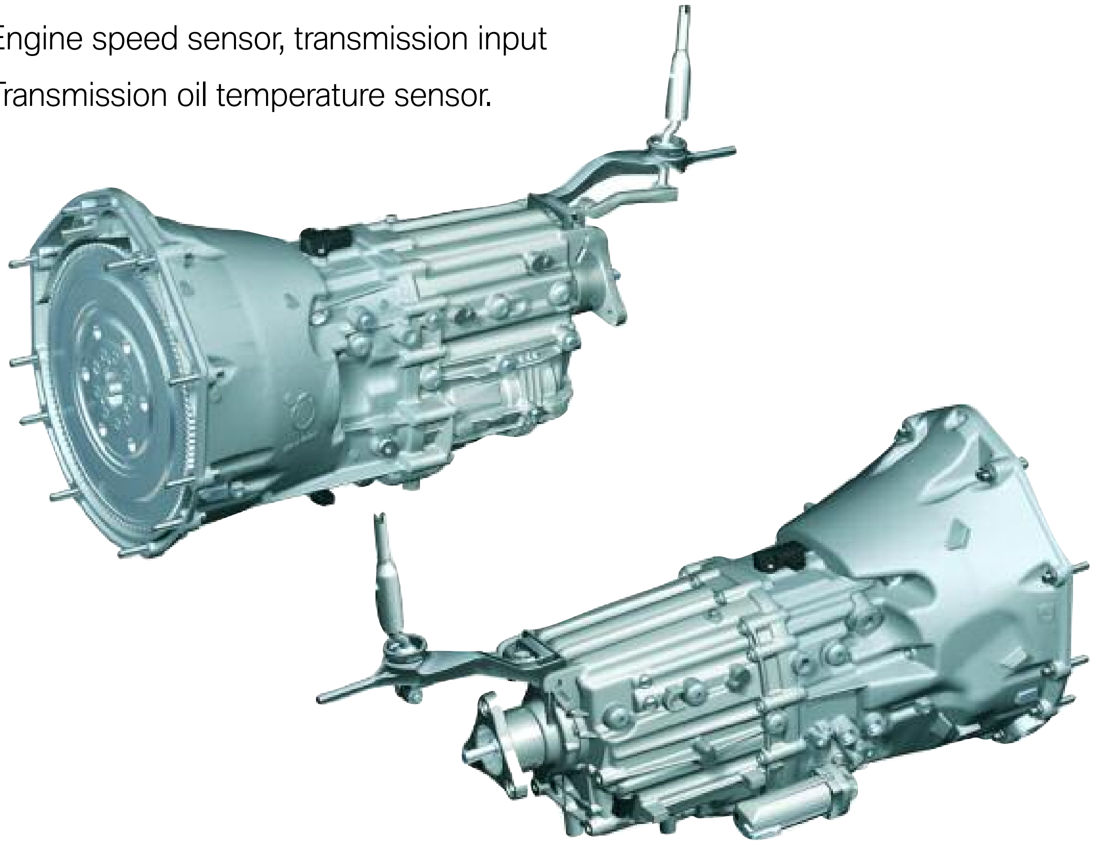
This is the fully-variable limited slip differential transmission, which was first used in the E46 M3, and has now been adapted to the demands of the E92 M3.

Appropriately adjusted output shafts ensure the distribution of power flow to the rear wheels.

GS6-53BZ Manual Transmission

The following sensors are fitted on manual gearbox housings:

- Zero gear sensor (selector gate)
- Engine speed sensor, transmission input
- Transmission oil temperature sensor.

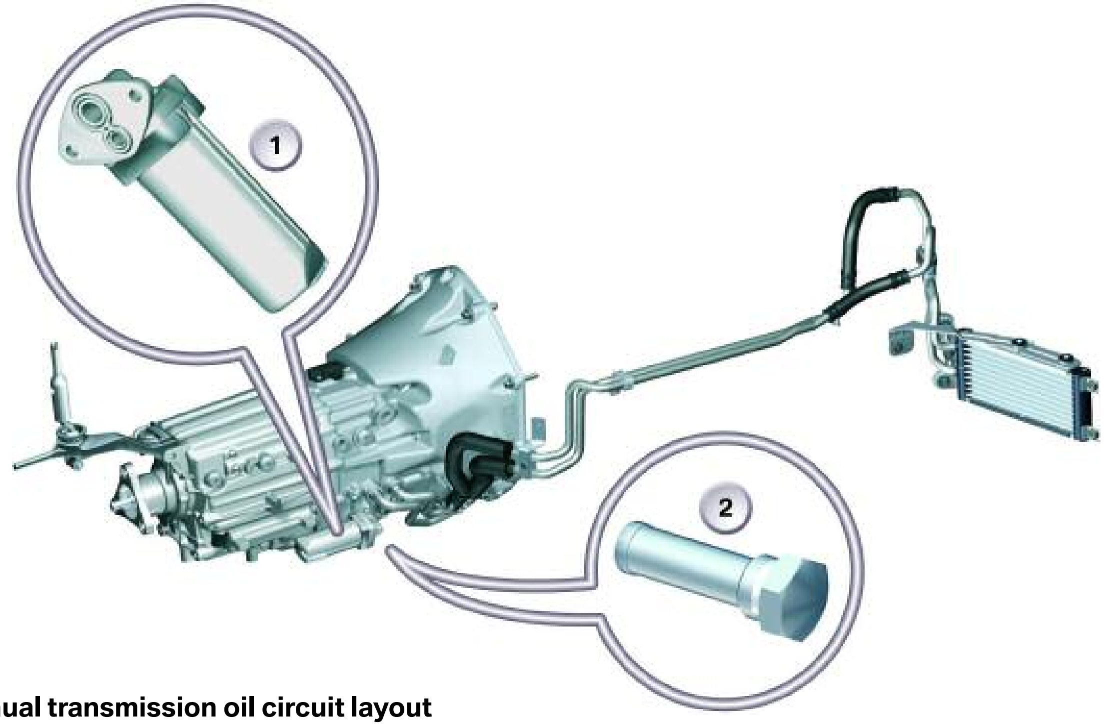


The signals of these sensors are monitored and evaluated by the MSS60.

When reverse gear is engaged, the reversing light switch mounted on the gearbox issues an earth signal to the footwell module (FRM) to activate the reversing lights.

The transmission oil pump is controlled by the MSS60 depending on the transmission oil temperature.

Model	E92 M3	Gear Ratio (1/2/3/4/5/6)	Gear Ratio (reverse)
E92 M3	GS6-53BZ	4.055/2.396/1.582/1.192/1/0,872	3.678
E46 M3 Coupé	S6S420G	4.227/2.528/1.669/1.226/1/0.828/	3.746
E92 335i	GS6-53BZ	4.055/2.396/1.582/1.192/1/0.872/	3.678



Manual transmission oil circuit layout

Index	Explanation
1	Gearbox oil pump
2	Screw oil filter

The activation threshold for the pump is approximately 130°C and the deactivation threshold is approximately 110°C.

Should the transmission oil temperature rise above approx. 145°C due to a fault, the temperature value is gradually reduced in accordance with the engine speed in increments of 150-500 rpm, to a minimum of 5,000 rpm. 5,000 rpm is also the value in the event of a failure of the ATF temperature sensor.

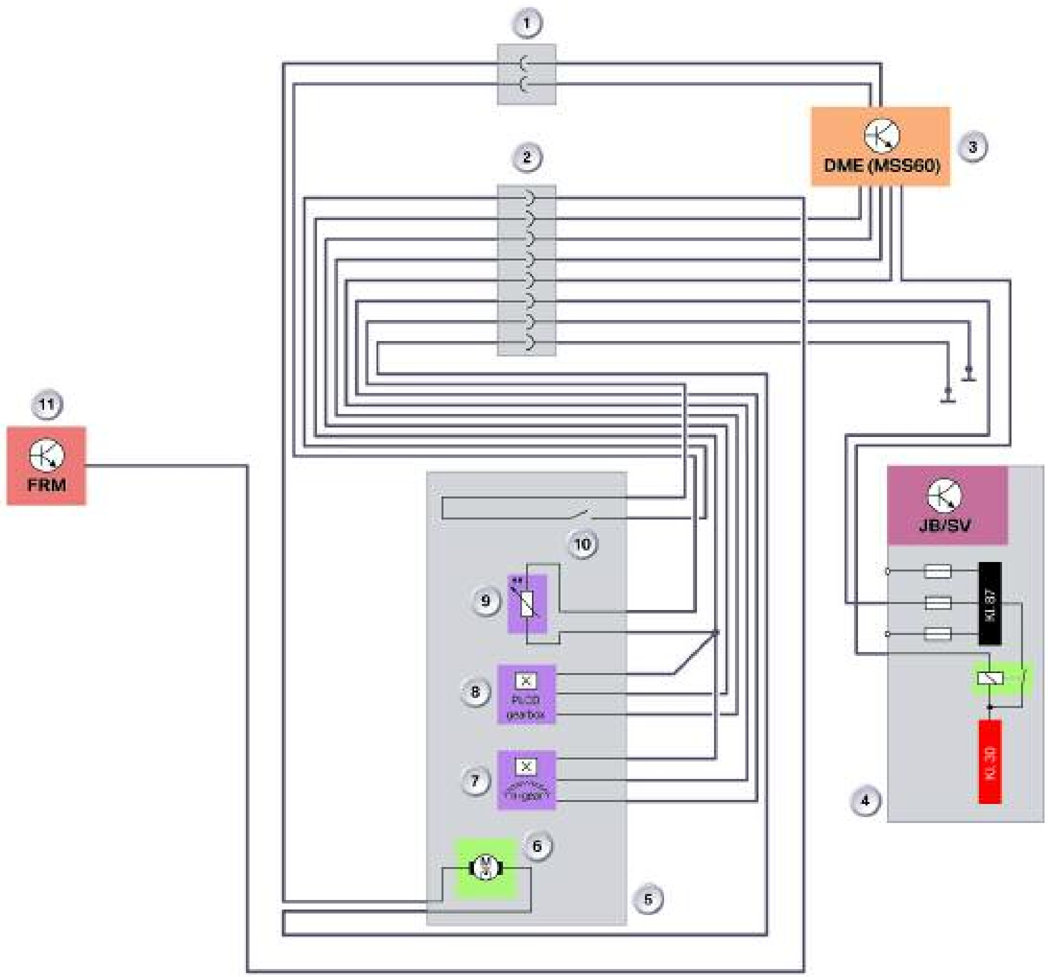
An electrical gear-oil pump is used to pump gear oil from the gearbox to the gearbox oil cooler. A screw oil filter is located below the oil pump.

The transmission housing has been adapted for the oil cooler connection. The oil pump is mounted on the manual transmission housing.

The gear oil is replaced and the screw oil filter is checked or cleaned during the running-in inspection, and later according to service specifications (estimated after every third engine oil change).

Note: For fault symptoms with engine speed limitation, the gear oil temperature should also be considered as a possible cause.

Manual transmission system circuit diagram



Index	Explanation	Index	Explanation
1	Plug-in connection for engine wiring harness	7	Engine speed sensor, transmission input
2	Plug-in connection for vehicle wiring harness	8	Zero gear sensor (selector gate)
3	MSS60 Engine control system	9	Transmission oil temperature sensor
4	Junction box/distribution box	10	Reversing light switch
5	Transmission housing	11	Footwell module
6	Electrical transmission oil pump		

Clutch

It is the first time that a double drive plate clutch has been used on an M3.

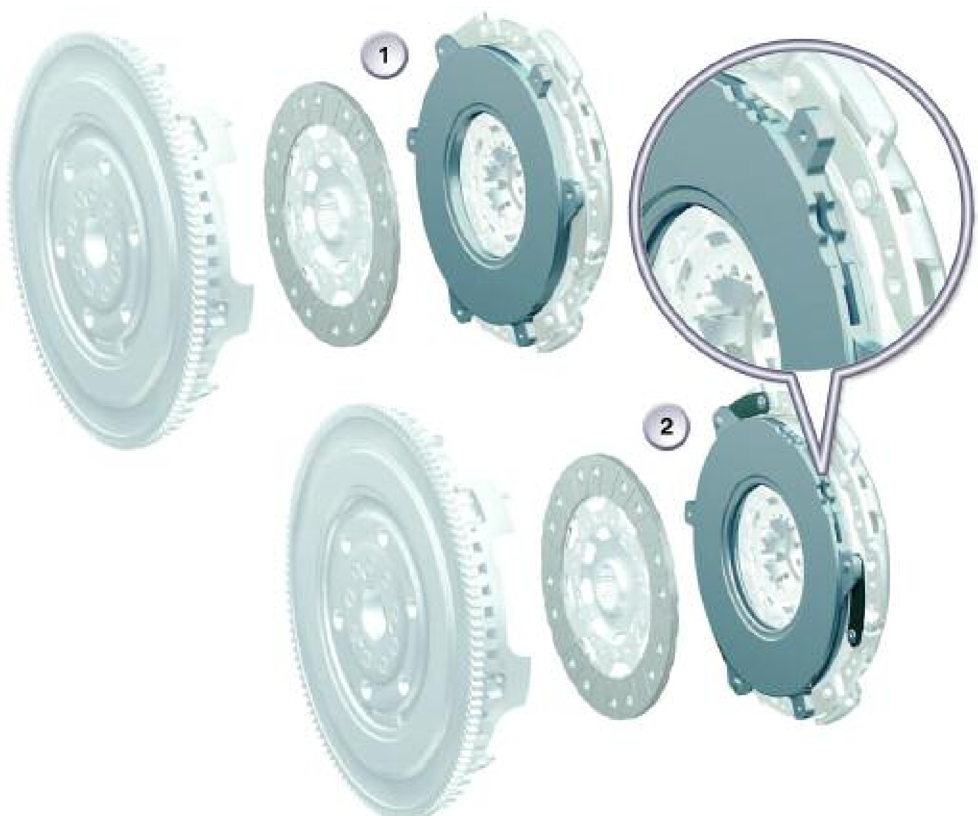
The clutch and the dual-mass flywheel are based on the E60 M5 and E63/E64 M6 (manual gearbox), but their combined weight has been reduced by 4 kg.

The contact plate and the transfer plate form a single unit with the integrated clutch driving plate.

The following changes have been made:

- The weight of the clutch and the dual-mass flywheel has been reduced.
- The transfer plate is hollow cast and shaped, similar to an internally ventilated brake rotor/disc. This increases heat dissipation and hence the permissible thermal load of the clutch.

Comparison of the S65B40 double-disc clutch and the S85B50 manual clutch



Index	Explanation	Index	Explanation
1	E6x M5/M6 SAC Clutch	2	E92 M3 Clutch

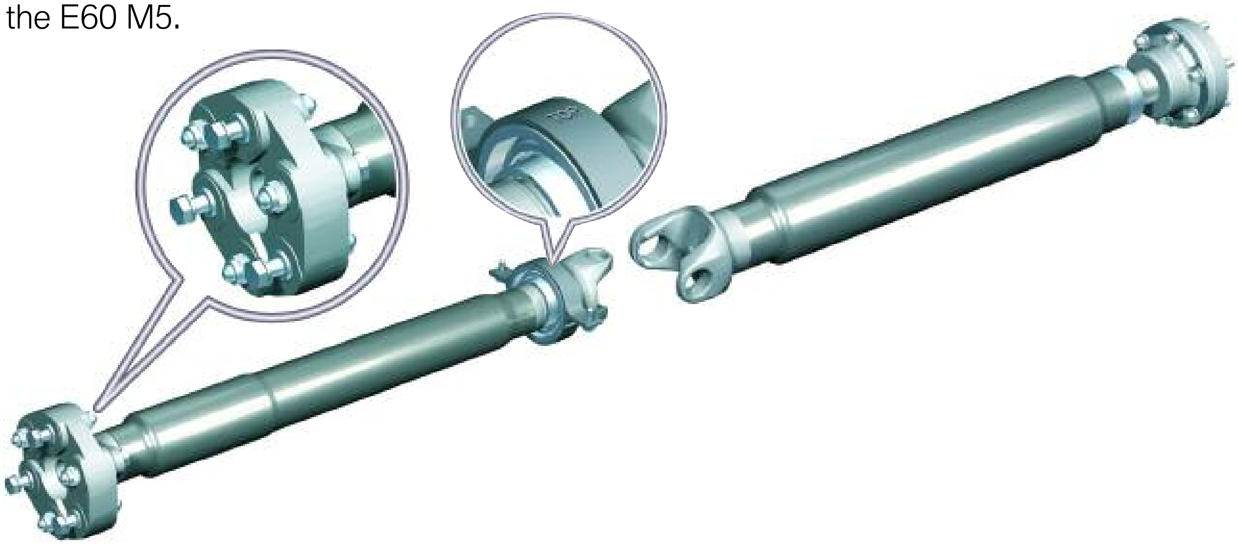
Note: The clutch and the dual-mass flywheel are permanently connected and are balanced as a single unit. They can only be replaced in a set.

Propeller Shaft and Output Shafts

The flexible clutch of the front propeller shaft is taken from the E6x M5/M6.

The front drive shaft is hollow and has a graduated cross section.

The rear propeller shaft is also a tubular construction and has an equal cross section along its entire length. The thickness of the tubing and the geometry of the front and rear propeller shaft have been adapted to handle the increased driving power. Both propeller shafts are fitted with the same constant velocity joints that are used on the E60 M5.



E92 M3 Axle drive components (Front propeller shaft with flexible clutch & rear)

Note: The center bearing can be mounted in two directions. It is important that the bearing is mounted with the word "TOP" facing the body.

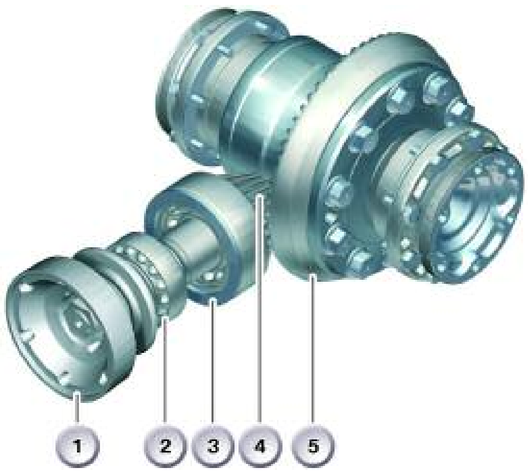
Both output shafts are hollow and have a graduated cross section. The external axle shaft joint is new. The internal axle shaft joint is based on the joint used in the E60 M5. The left and right output shafts are different in length.

Axle drive with output shafts

Final Drive

In principle, the final drive is assembled in the same way as in the E6x M5/M6. It is, however, a separate new development.

The bevel gear shaft bearing is a friction optimized, double-row, angular-contact ball bearing. The gear ratio between the bevel gear and the crown gear has been adapted to the engine speed and gearbox ratio of the M3.



Index	Explanation
1	Propeller flange
2	Front double-row angular contact ball bearing
3	Rear double-row angular contact ball bearing
4	Bevel gear
5	Crown gear

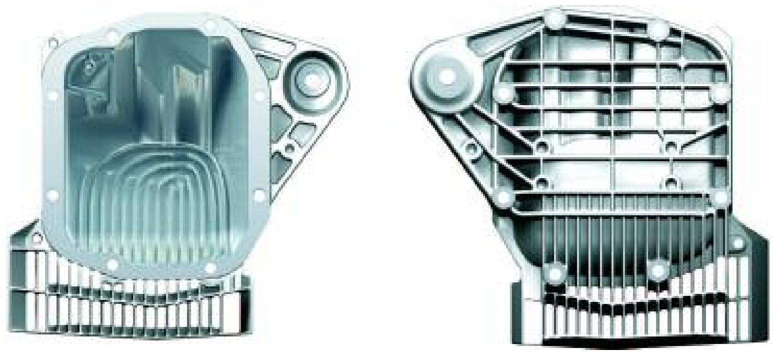
The final drive ratio is 3.85:1.

The 215 gear set (crown wheel diameter 215 mm) has been temperature and noise optimized. A friction-reduced gearing is used.

The housing of the final drive has been adapted to accommodate the double-row angular-contact ball bearing. The flanges for the propeller and drive shafts are the same as those used on the E6x M5 and M6.

Final gear housing

Note: Due to their function, the shafts of the right and left stub axles in the final drive have different lengths. In an idle state, this results in a noticeably different vertical clearance of both flanges, which is a feature of the design. This does not affect the function and is not a cause for complaint. This uneven clearance applies for all models with fully variable M slip differential and may affect either the right or the left flange, depending on the version and model.



Final drive end cover

The transmission housing end cover has been modified to ensure optimum gear oil cooling and bevel gear lubrication. The end cover has more ribs, which improves heat exchange.

The internal styling of the end cover is adapted according to the size of the differential and the final drive ratio.

This M final drive also has three bearings, with two front bearing and one rear bearing.

Fully Variable M Differential with Locking Action

This unique limited slip differential design is based on the E46 M3 and the E6x M5/M6 limited slip differential, where it is described in detail.

The function of the limited slip differential has been adapted to ensure that the M3 develops the best traction at different engine speeds and in every road situation.

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4th Generation M3 Chassis Dynamics

Initial Print Date: 1/08 Revision Date:

4th Generation M3 Chassis Dynamics

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the changes made to the suspensions of the M3 when compared to the series production E92.
- Explain the components used in the steering system of the M3.
- Identify the version of DSC used.
- Identify the braking system upgrades made to the M3 when compared to the series production E92.

Chassis and Suspension

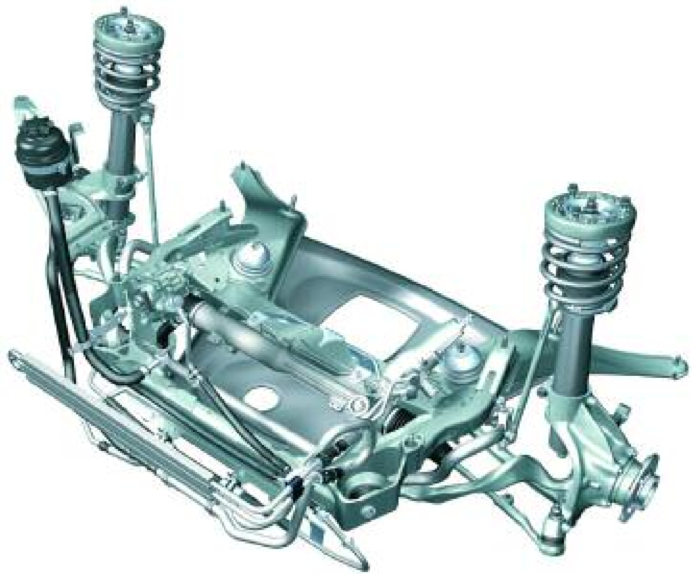
The chassis of the E92 M3 is based on the chassis of the series model E92. All modifications are described in this section.

E92 M3 Chassis

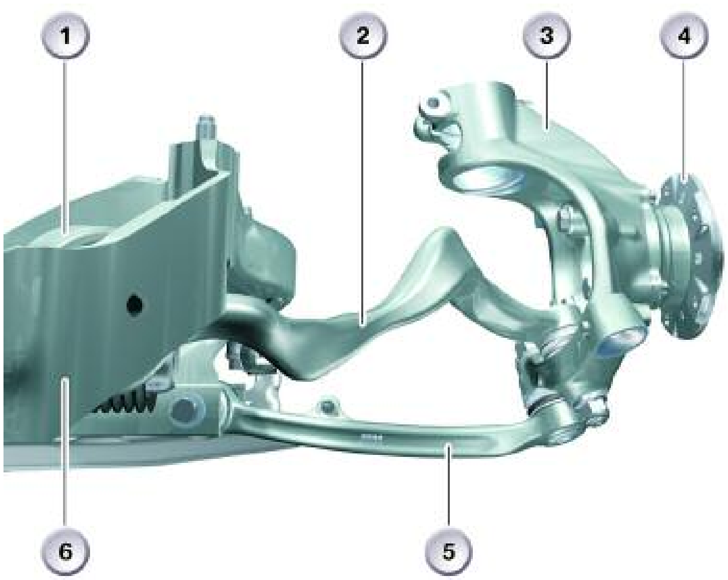
Designation	E92 M3	Series E92 335i
Tire type/Wheel rim type/Rim offset [mm]	245-40 ZR 18/8.5Jx18/ IS29	225-45 WR 17 RSC/8Jx17/ IS34
Tire radius [mm]	305	295
Wheelbase [mm]	2761	2760
Track width [mm]	1538	1500
Total toe	16’	14’
Toe differential angle	2° 14’	1° 40’
Camber	-1°	-18’
Kingpin inclination	15° 2’	14° 7’
Kingpin offset [mm]	8.4	5.1
Trail [mm]	29.4	20.3
Trail angle	7° 8’	7° 5’

Front End

Components of the double-jointed spring strut front axle



Complete front axle



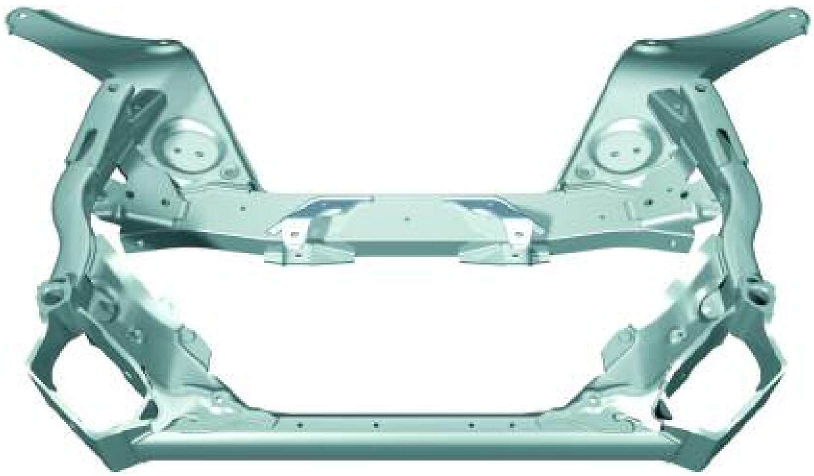
Wheel suspension components

Index	Explanation	Index	Explanation
1	Rubber mount for tension strut	4	Wheel hub
2	Tension strut	5	Wishbone
3	Swivel bearing	6	Front axle carrier

Front Axle Carrier

The front axle carrier is an aluminum alloy construction. In order to ensure optimum strength and torsional rigidity, a high-pressure forming technique has been used to manufacture certain sections.

Aluminum has been chosen for its lightweight and strength properties. The components of the front axle are joined together by an aluminum welding process.



Front axle carrier

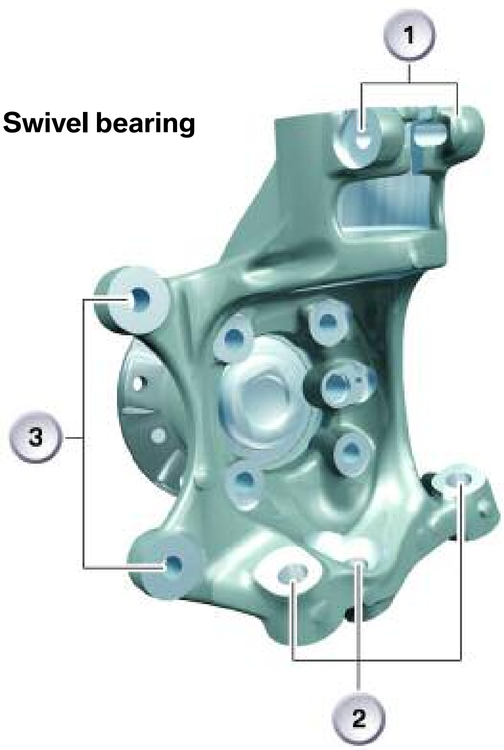
Swivel Bearing

The ’M’ swivel bearing is completely new. The bearing is made from an aluminum cast alloy, which reduces the weight by 500 grams.

The following changes have been made to the front wheel carrier:

- Adjusted dimensions for the larger 'M' wheel.
- As described below, the method by which the spring strut is clamped into the swivel bearing has been changed.
- The geometric fixing points for the wishbone, tension strut and steering track rod have been selected to ensure optimum sports vehicle kinematics.
- Modified mounting position for the larger brake caliper.

Swivel bearing

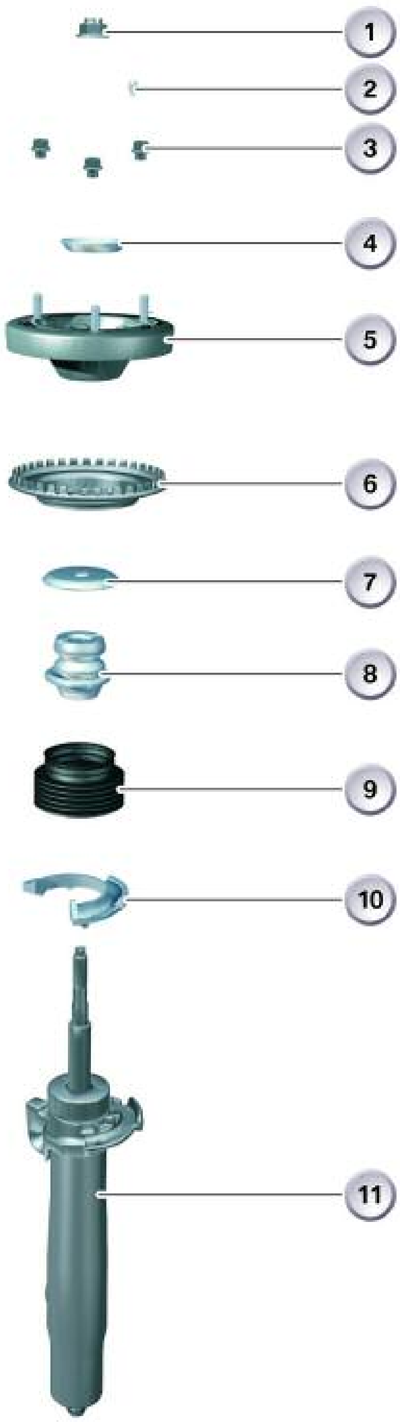


Index	Explanation
1	Clamp connection of the spring strut support
2	Attachment points for the tension strut, wishbone and steering track rod
3	Brake caliper mounting

Spring Strut

The front steel suspension spring has a 95 mm compression and 100 mm rebound travel.

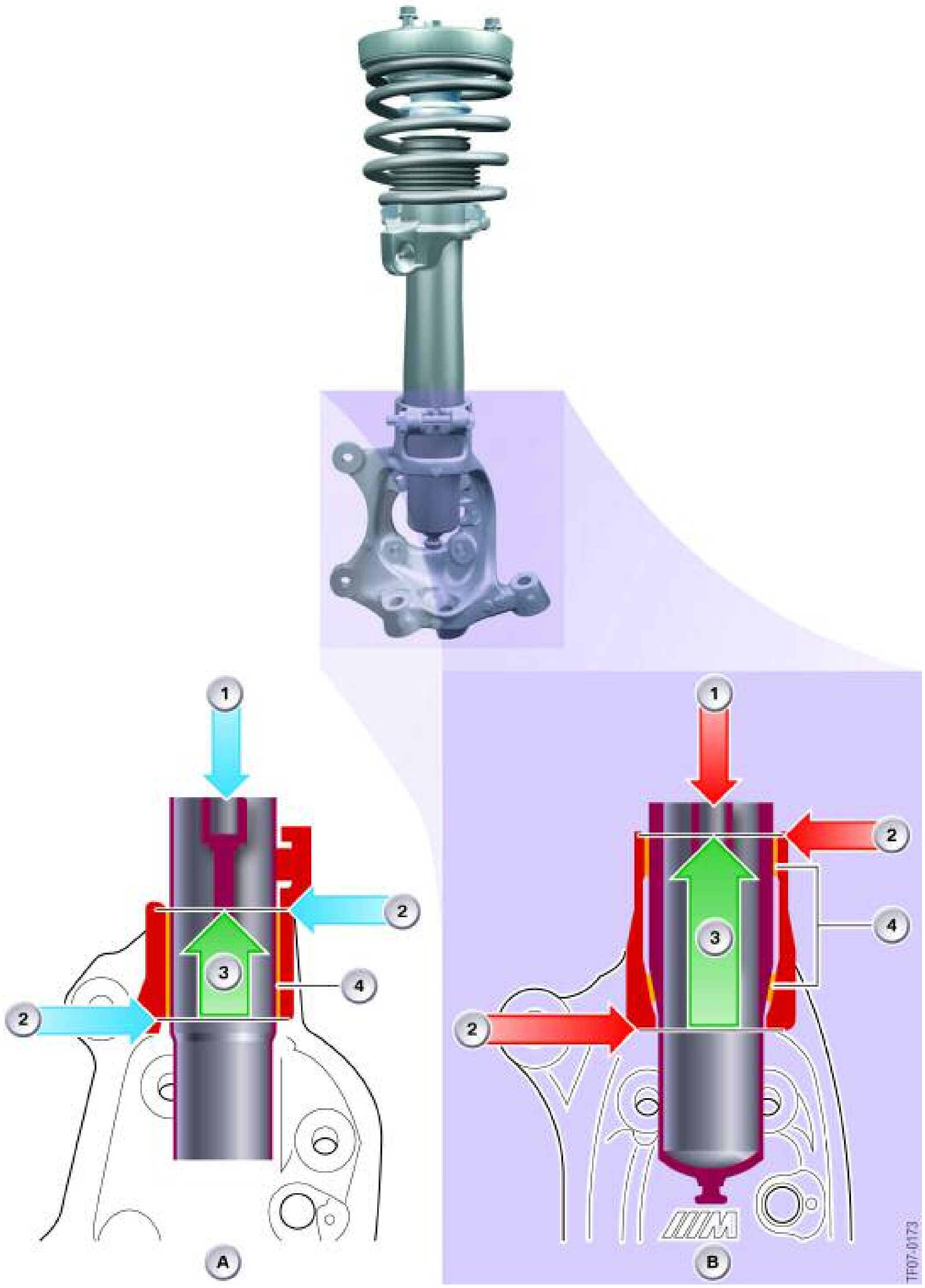
A new spring concept supports lateral chassis stability. Depending on the vehicle weight (equipment), modified spring types are used.



Index	Explanation
1	Retaining nut, shock absorber to support bearing
2	Dowel pin, support bearing to body
3	Mounting fixture, support bearing to body
4	Joint seat
5	Support bearing
6	Upper spring seat
7	Support disc
8	Additional damper/spring
9	Gaiter
10	Lower spring seat
11	Spring strut

M3 Front spring strut

Connection to the Wheel Carrier



Spring strut connection to the wheel carrier compared to the E92 series model

Legend for graphic on previous page

Index	Explanation
A	Spring strut support in the E92 series model
1	Vertical force (Z-axis)
2	Upper and lower limit for supporting lateral and longitudinal force (X and Y axis)
3	Clamp height 52 mm parallel fit
4	Parallel contact face

Index	Explanation
A	Spring strut support in the E93 M3
1	Vertical force (Z-axis)
2	Upper and lower limit for supporting lateral and longitudinal force (X and Y axis)
3	Clamp height 76 mm with parallel upper and conical lower fit
4	Upper cylindrical and lower conical contact face

As shown in the diagram, the clamp height has been increased on the Z-axis from 52 mm on the series E92 (left) to 76 mm on the E92 M3 (right).

The front spring strut now has an additional support. The wheel carrier has also been modified to compensate for the increased drive and dynamic forces.

The lower contact face of the spring strut in the E92 M3 has a cone, which is positioned firmly in the wheel carrier. In the series E92, however, the front spring strut has a parallel construction and is only held in place by the clamping force.

This design change and the increased clamp height accommodate the increased reaction forces of the spring strut and increase the overall stability of the wheel suspension.

During assembly, the M3 spring strut is pulled into the lower cone using a new special tool.

Note: Follow the new installation and removal process according to the service repair manual.

Tension Strut

The tension strut is similar to that used in the series E92, but features an 'M'-specific harder rubber mount.

Wishbone

The M control arm is completely new and is connected to the axle carrier and wheel carrier by two ball joints. It is manufactured out of forged aluminum alloy.

Wheel Bearing Unit

The M3 wheel bearing unit is identical to the E60 M5 wheel bearing unit. It has three dowel pins for the brake disc.

Front Anti-roll Bar

The weight-optimized front anti-roll bar was adapted for the M3 and has a special rubber bearing material for more direct response. The hinged brackets are made out of an aluminum alloy (series E92 steel).

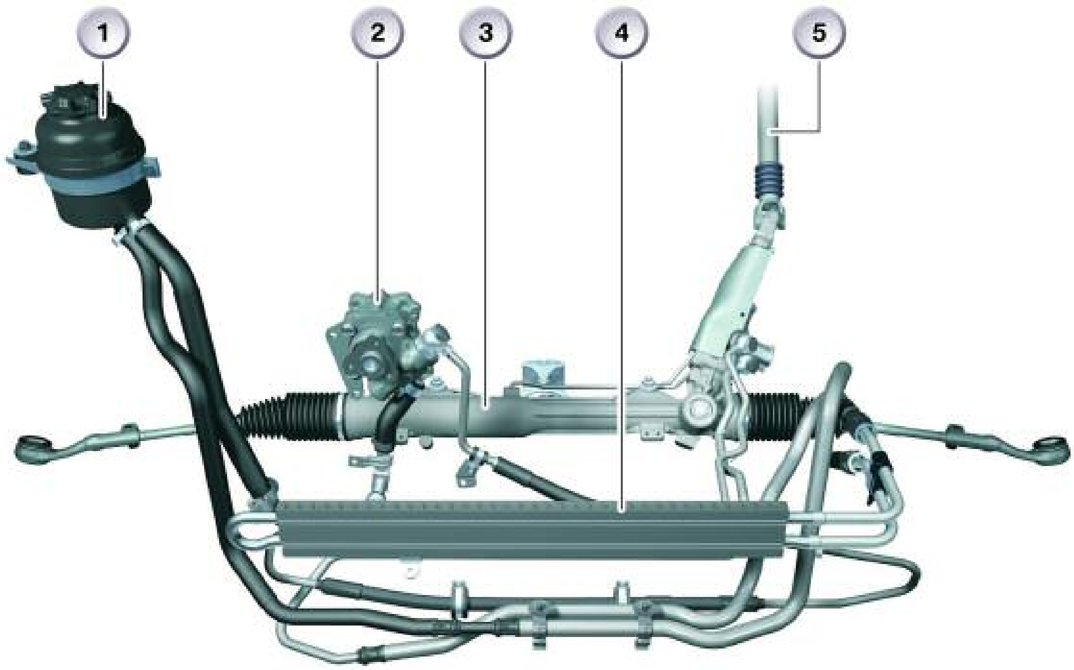
Steering

The design of the rack-and-pinion steering system is the same as the series E92. The average variable overall ratio is 12.5 and hence sports-oriented (16 in the series E92).

In the M3, the steering force support is controlled by the MSS60 via the Servotronic valve. A speed dependent characteristic curve is stored in the MSS60 for this purpose. With the MDrive menu option, a second and even more sports oriented characteristic curve can be activated (see the chapter on MDrive).

The steering oil is guided through a steering oil cooler before it returns to the oil reservoir.

The E92 M3 is not available with active steering.



Index	Explanation
1	Steering oil header tank
2	Steering oil hydraulic pump
3	Steering transmission housing
4	Steering oil cooler
5	Steering wheel spindle

Rear Axle

Rear Axle Carrier

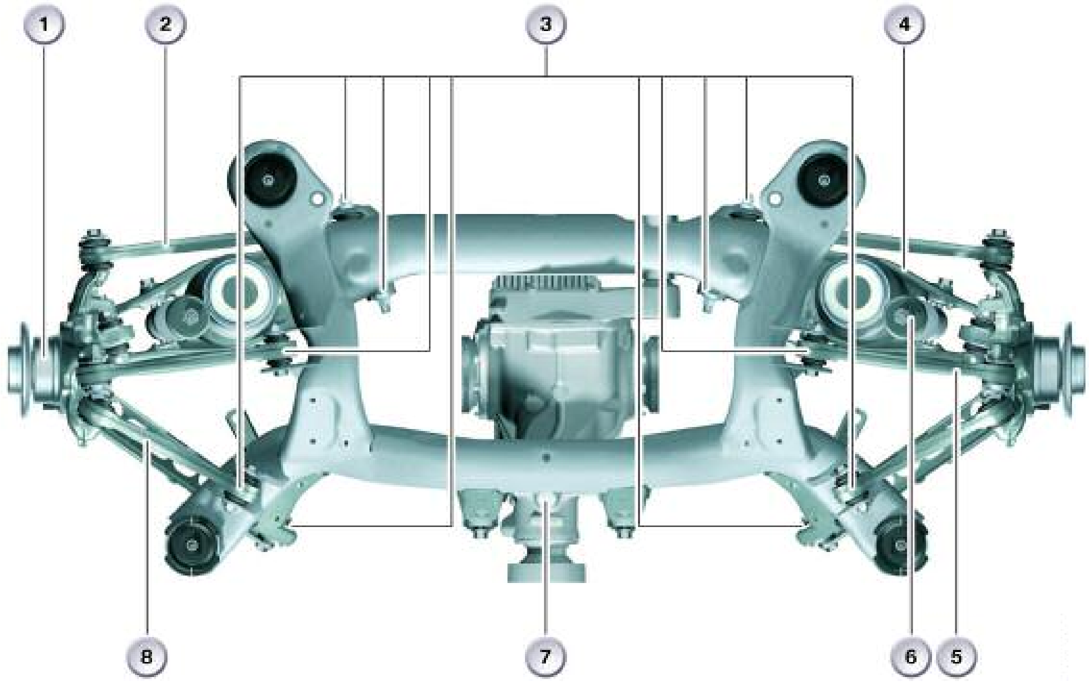
The rear axle carrier is constructed from steel sections which are welded together. All mounting points for the rear axle and suspension components are formed or attached to the axle carrier making it an integral component.

Nearly all components of the rear chassis have been revised, the aim is to achieve optimum sports vehicle kinematics, chassis stability and a more precise and direct response, with a simultaneous reduction in weight.

This has been achieved by the careful selection of materials for the axle components and bearings, and through a modification of the axle geometry.

Designation	E92 M3	Series E92 335i
Tire type/Wheel rim type/Rim offset [mm]	265-40 ZR 18/9.5Jx18 / IS23	225-45 WR 17 RSC/8Jx17/ IS34
Tire radius [mm]	311	295
Wheelbase [mm]	2761	2760
Track width [mm]	1539	1513
Total toe	10’	18’
Driving axis angle	0°	0°
Camber	-1° 45’	-1° 30’

Construction of Rear Axle



Complete rear axle

Index	Explanation	Index	Explanation
1	Wheel carrier	5	Wishbone
2	Toe struts	6	Shock absorber
3	Connections from control arm to rear axle carrier	7	Rear axle carrier
4	Camber struts	8	Traction strut with semi-trailing arm below it

Wheel Carrier

The attachment points for toe, camber, wishbone, longitudinal and traction struts have been positioned specifically for the 'M' model.

Its overall dimensions allow for the larger M wheel to be fitted. The ’M’ wheel carrier is fitted with a modified rubber mount connecting to the semi-trailing arm and a ball joint for the camber strut.

Toe Struts

The new ’M’ toe strut is forged from Aluminum. It is one-piece and has two integrated ball joints.

Camber Struts

The 'M' camber strut is a new lightweight component forged from Aluminum. Its design reduces the unsprung mass of the vehicle.

Wishbone

The new 'M' wishbone is forged from aluminum and has a modified integrated ball joint and a rubber mount.

Control Strut

The semi-trailing arm is the only rear suspension strut that is taken from the series E92. It is connected further inwards on the rear axle carrier, only the rubber mount is new.

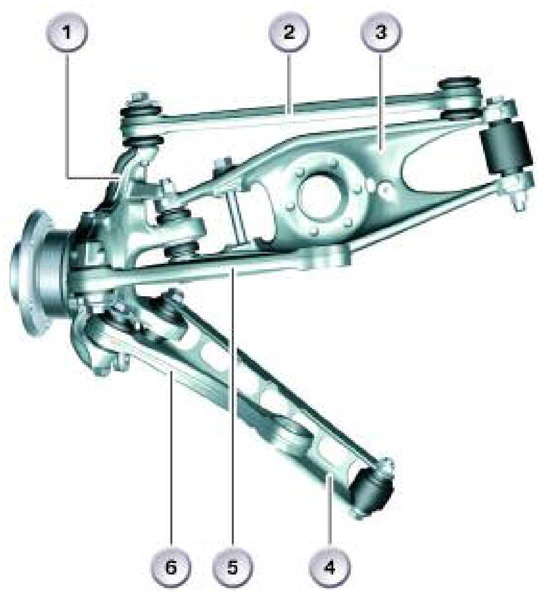
Traction Strut

The geometry of the forged aluminum 'M' traction strut has been revised. It now has a new integrated rubber mount for the wheel carrier. The ball joint for the rear axle carrier has been taken from the series E92.

Rear Shock Absorbers

New 'M' specific rear aluminum dampers are fitted to the M3. Electronic damper control - continuous (EDC-K), is available as an option.

The integrated lower damper rubber mount has a support sleeve that improves the rigidity and stability between the damper and the camber strut.



Overview of rear axle struts

Index	Explanation
1	Wheel carrier
2	Toe strut
3	Camber strut
4	Control strut
5	Wishbone
6	Traction strut

Electronic Damper Control - Continuous (EDC-K)

EDC-K is available for the first time in the E92 M3. EDC-K is an option and is based on the EDC-K in the E65.

Both dampers of one axis are always activated in parallel. The valve is installed internally in the damper in the damper oil system.

The driver can choose between three settings, the controlled programs "Comfort" and "Normal", or the uncontrolled fixed setting "Sport".

The program is selected using the EDC-K button on the center console or preset via the MDrive menu and activated using the M button on the steering wheel (for more information, see the MDrive chapter).

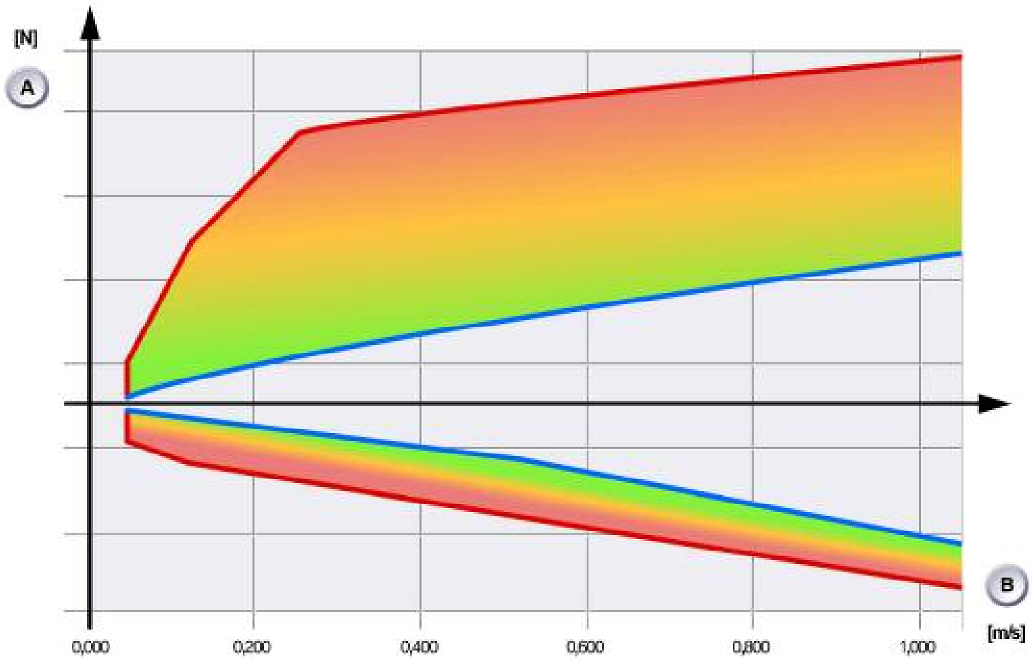
The input signals come from two vertical acceleration sensors in the front wheel arches and a third sensor in the rear right-hand wheel arch.

The steering column switch cluster sends the steering angle to the F-CAN. This is transmitted together with the wheel speeds from the DSC to the PT-CAN and evaluated in the EDC-K control unit.

The longitudinal, lateral and vertical accelerations calculated as a result are used as a basis for regulation.

The EDC-K button signal enters the junction box and is transmitted to the EDC-K on the PT-CAN.

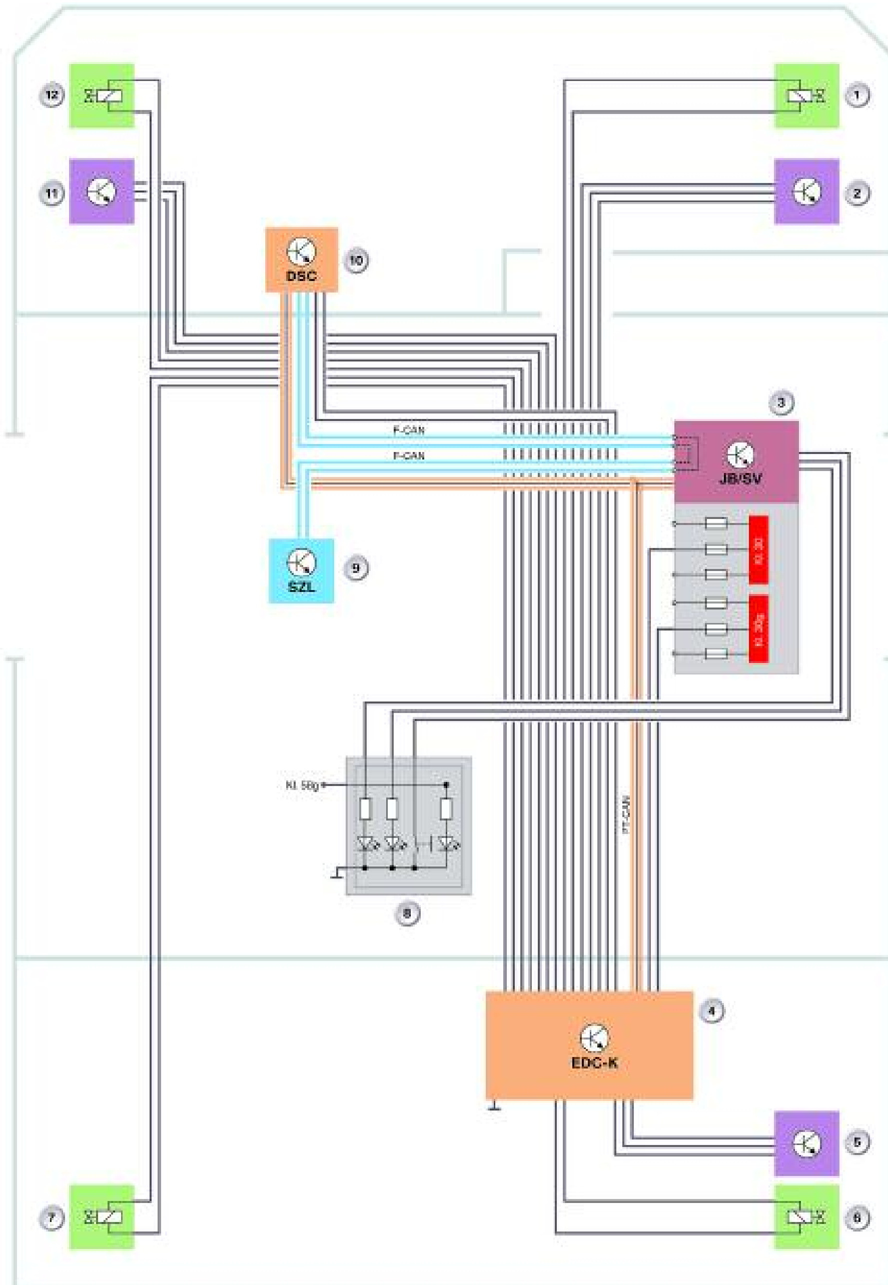
Damping behavior characteristic map



Index	Explanation
A	Damping force rebound phase (above) and compression phase (below)
B	Damper piston speed

The compression phase, and in particular the rebound phase, of the shock absorbers can be adjusted by the EDC-K depending on the input signals in a smooth transition from relatively comfortable to a harder sports setting.

EDC-K System Circuit Diagram



Index	Explanation	Index	Explanation
1	EDC valve, front right	7	EDC valve, rear left
2	Vertical acceleration sensor, front right	8	EDC button on center console
3	Junction box/distribution box	9	Steering column switch cluster
4	EDC-K control unit	10	DSC control unit
5	Vertical acceleration sensor, rear left	11	Vertical acceleration sensor, front left
6	EDC valve, rear right	12	EDC valve, front left

Wheels, Tires and Brakes

Wheels and Tires

In the standard version, the cast 18" 'M' double spoke wheel (style 260) is available for the E92 M3, with the forged and polished 19" 'M' double-spoke wheel (style 220) available as an option. These are weight-optimized M3 light alloy wheels.

The tires are also specifically selected for the M3. The Michelin Pilot Sport (PS2*) is currently fitted.

Wheel/tire Specification

Standard wheel:

Front - Wheel: 8.5 J x 18; IS 29; EH2+
Tires: 245-40 ZR 18

Rear - Wheel: 9.5 J x 18; IS 23; EH2+
Tires: 265-40 ZR 18

Optional:

Front - Wheel: 8.5 J x 19; IS 29; EH2
Tires: 245-35 ZR 19 XL

Rear - Wheel: 9.5 J x 19; IS 23; EH2
Tires: 265-35 ZR 19 XL

Brakes

For the E92 M3, the M Compound brake system with perforated brake discs and three 'M'-typical brake pad wear sensors is used, with a specifically adapted operating principle and dimensions.. The diameter of the brake discs has increased compared to the E46 M3 by 35 mm at the front, and by 22 mm at the rear.

Brake System Specification

Front brake:	Diameter 360 mm, thickness 30 mm, direction-specific ventilation, single-piston floating caliper (lightweight metal alloy), brake pad wear sensor right and left.
Rear brake:	Diameter 350 mm, thickness 24 mm, direction-specific ventilation, internal handbrake with 185 mm diameter (similar to E60 M5), single-piston floating caliper (cast metal alloy), brake pad wear sensor on right.

Dynamic Stability Control (DSC) MK60E5

The E92 M3 is equipped with the MK60E5 DSC system made by Continental Teves, which has been specifically adapted to its driving dynamics. The "civilian" version is installed in several models including the 6-cylinder series E92 and an M-specific version is installed in the E6x M5 and M6.

The fundamental difference in both versions is the replacement of Dynamic Traction Control (DTC) with M Dynamic Mode (MDM). MDM has been adapted to suit sports car dynamism for experienced sports drivers. The permitted float angle and longitudinal slip in good environmental conditions (road, weather, etc.) are also equally high.

Furthermore, the driving-performance control (FLR), soft stop and Fading Brake Support (FBS) functions are not required in the 'M' version.

The braking readiness, "apply the footbrake and the handbrake until the discs and drums are dry" and the gradient assistant functions have been adapted appropriately.

Table of Contents

4th Generation M3 Service Information

Initial Print Date: 1/08 Revision Date:

4th Generation M3 Service Information

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Understand some specific procedures that must be taken into consideration when servicing the M3.

Introduction

M3 Concept

A maximum torque of 400 Newton meters at 3,900 rpm is reached. Approx. 85 percent (340 Nm) can be utilized beyond the enormous engine speed range of 6,500 rpm.

The S65B40 attains 8,400 rpm, and therefore a value that was previously only reserved for racing car engines or exotic custom vehicles.

For safety reasons, due to the engine dynamics when the vehicle is stationary (i.e. without a road-speed signal), it is already down-controlled at 7,000 rpm to prevent the engine speed from increasing into an impermissible range.

S65B40O0 Engine

Crankshaft

The identification marking of the bearing shells is engraved on the crankcase and on the first crank web.

Connecting Rods

The large connecting rod eye is asymmetrically ground to reduce the length of the engine. This means that the installation is direction-specific.

For the workshop, bearing shells are available in a repair stage (for more information, see the service documentation).

Camshaft Drive

The VANOS adjustment units are an integral component of the valve control and are mounted on the relevant camshaft by a central bolt.

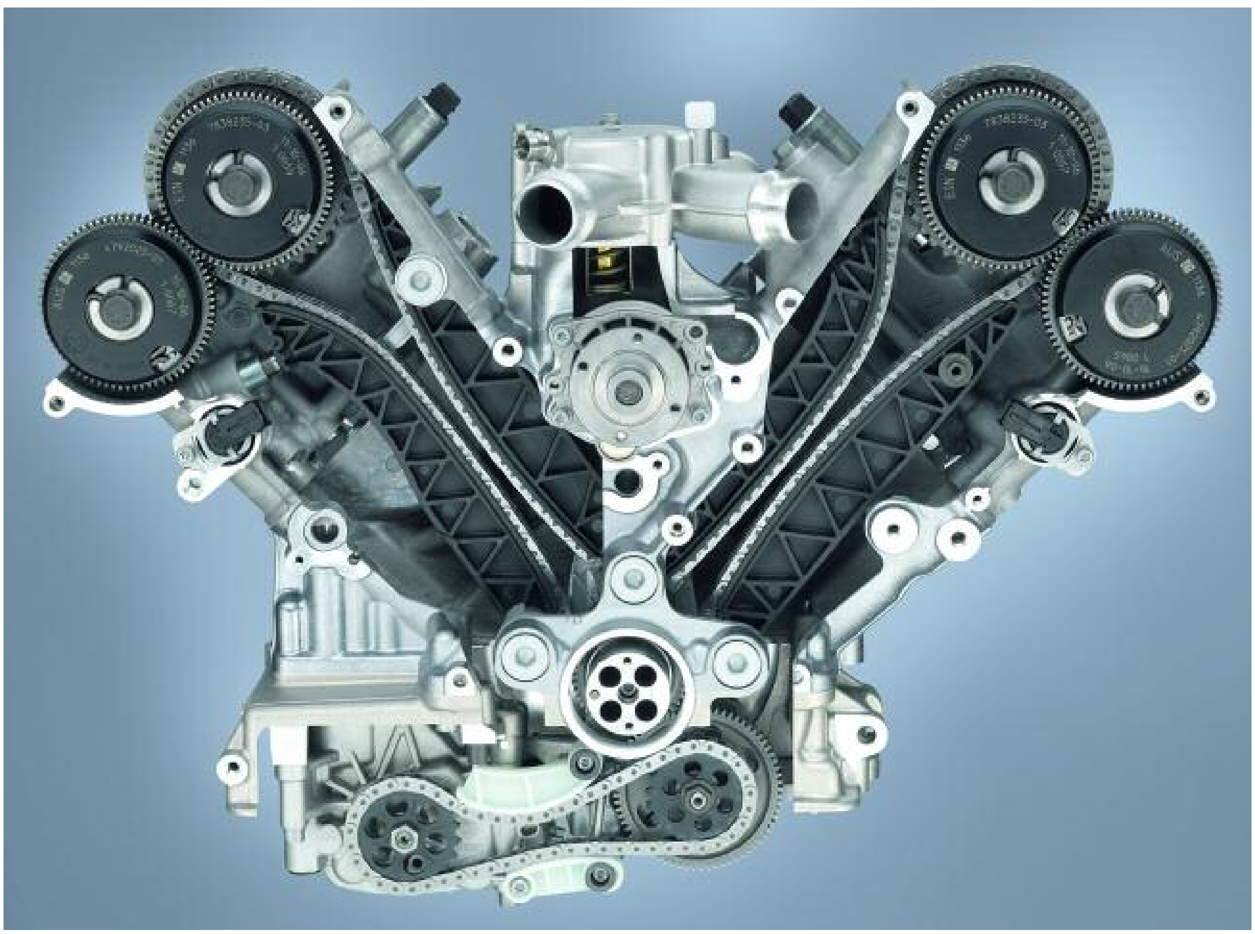
The central bolts of the inlet and exhaust side have a CCW thread, please refer to the repair instructions.

VANOS

The compact double VANOS system fitted to the S65 engine operates at normal oil pressure, unlike the S85 engine (which uses high oil pressure). The low-pressure system means that the high-pressure pump and additional pressure lines and reservoir are unnecessary.

The setting angle of the inlet camshaft is 58° in relation to the crankshaft. The exhaust camshaft has a setting angle of 48°. As in the S85 engine, this VANOS also reaches an adjustment rate of 360° camshaft per second.

The service instructions should be followed exactly. The VANOS adjustment unit must not be disassembled.



MSS60 Engine Control System

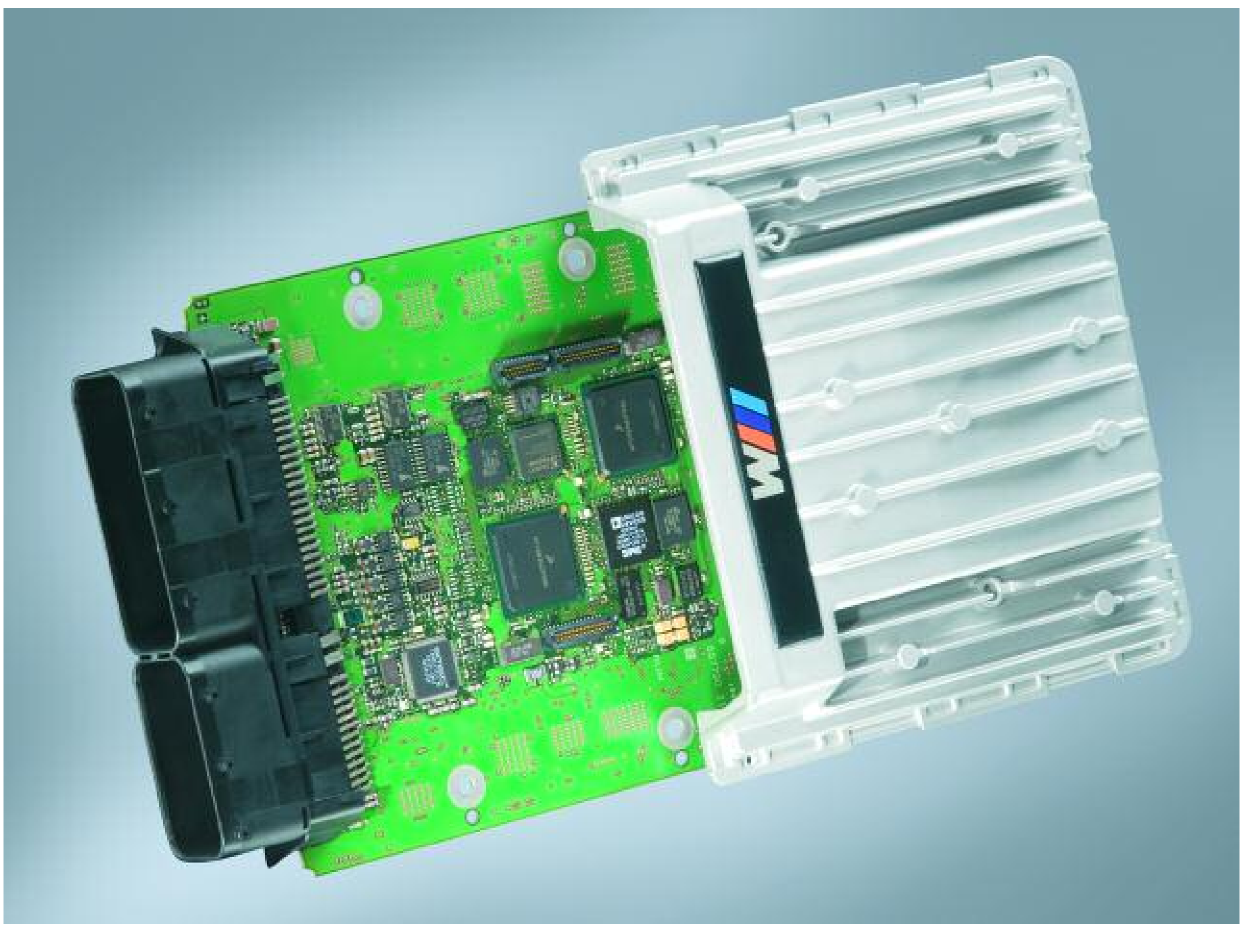
Ion Current Combustion Monitoring

In the S65, the ion current electronic system is integrated into each ignition coil and the ion current control devices are not required.

For the purposes of smoothing the voltage and electromagnetic compatibility, an "ignition suppression capacitor" is installed in the wiring harness of each cylinder bank (in the S85 this is in the ion current control device). This is electrically connected using terminal 87 and the vehicle earth.

If the ignition suppression capacitor is defective, this can lead to faults in the communications and/or audio electronics when the engine is running.

For design reasons, the firing order 1-5-4-8-7-2-6-3 is used in the S65, instead of the firing order 1-5-4-8-6-3-7-2 more commonly employed in BMW V8 engines.



Cooling System

Fan Operation

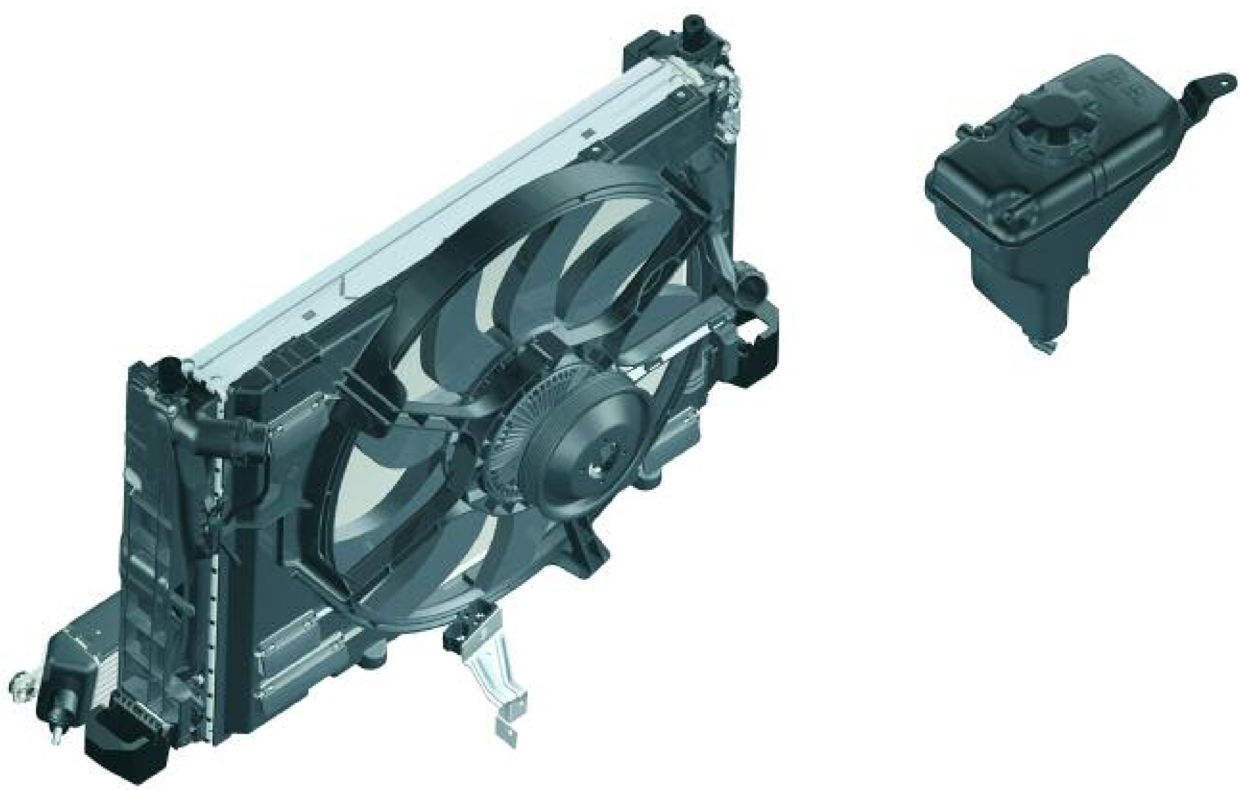
The adjusted fan speed increases in a linear fashion as the cycle ratio increases. The rated speed (nNom) in the M3 is the same as the maximum number of revolutions (2,400 rpm).

The engine speed of the M3 is controlled in a linear relationship with the cycle ratio (10-91%), starting with 800 rpm (1/3 of nNom) up to 2,400 rpm.

In the E6x M5/M6 (600 W fan), from a 92% to 95% cycle ratio, an additional unregulated increase in engine speed to at least 2,700 rpm (nmax) is realized.

Fan Self-diagnosis and Fault Signal

A fault message is issued with a delay of approximately one minute, since the electronic fan system first executes a triple internal test cycle.



Drivetrain

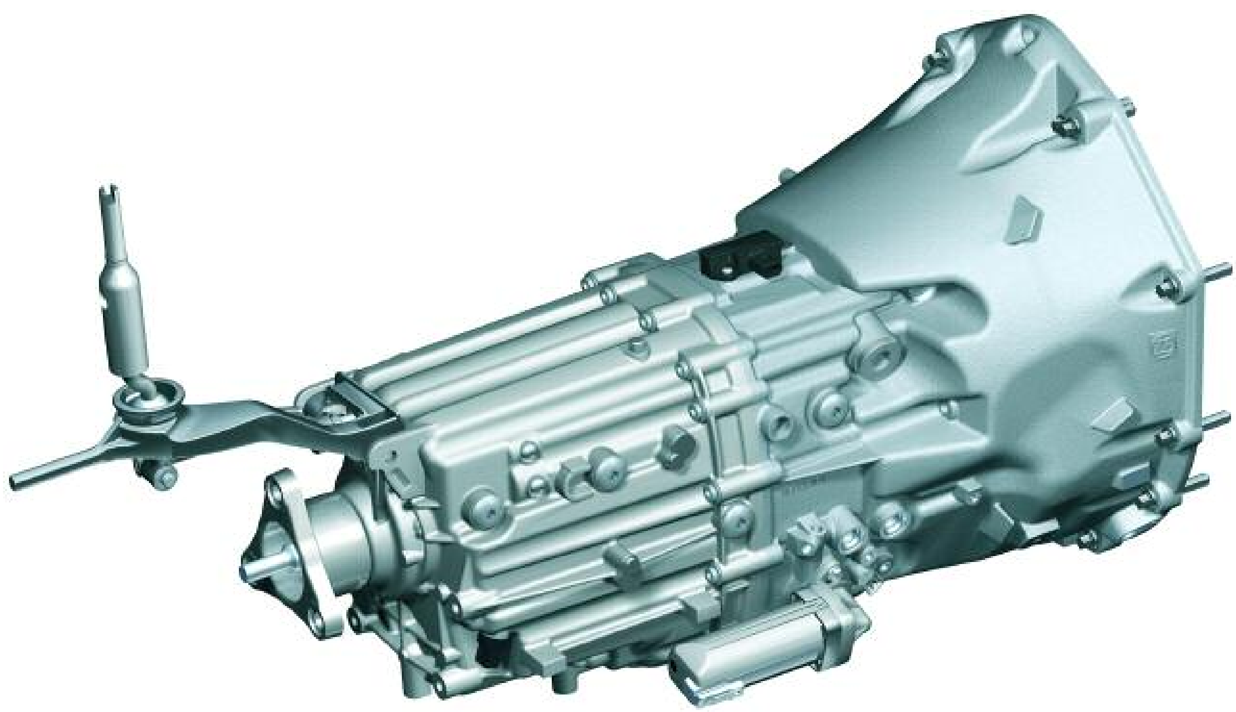
Manual Transmission GS6-53BZ

The gear oil is replaced and the screw oil filter is checked or cleaned during the running-in inspection, and later according to service specifications (estimated after every third engine oil change).

For fault symptoms with engine speed limitation, the gear oil temperature should also be considered as a possible cause.

Clutch

The clutch and the dual-mass flywheel are permanently connected and are balanced as a single unit. They can only be replaced in a set.



Propeller Shaft

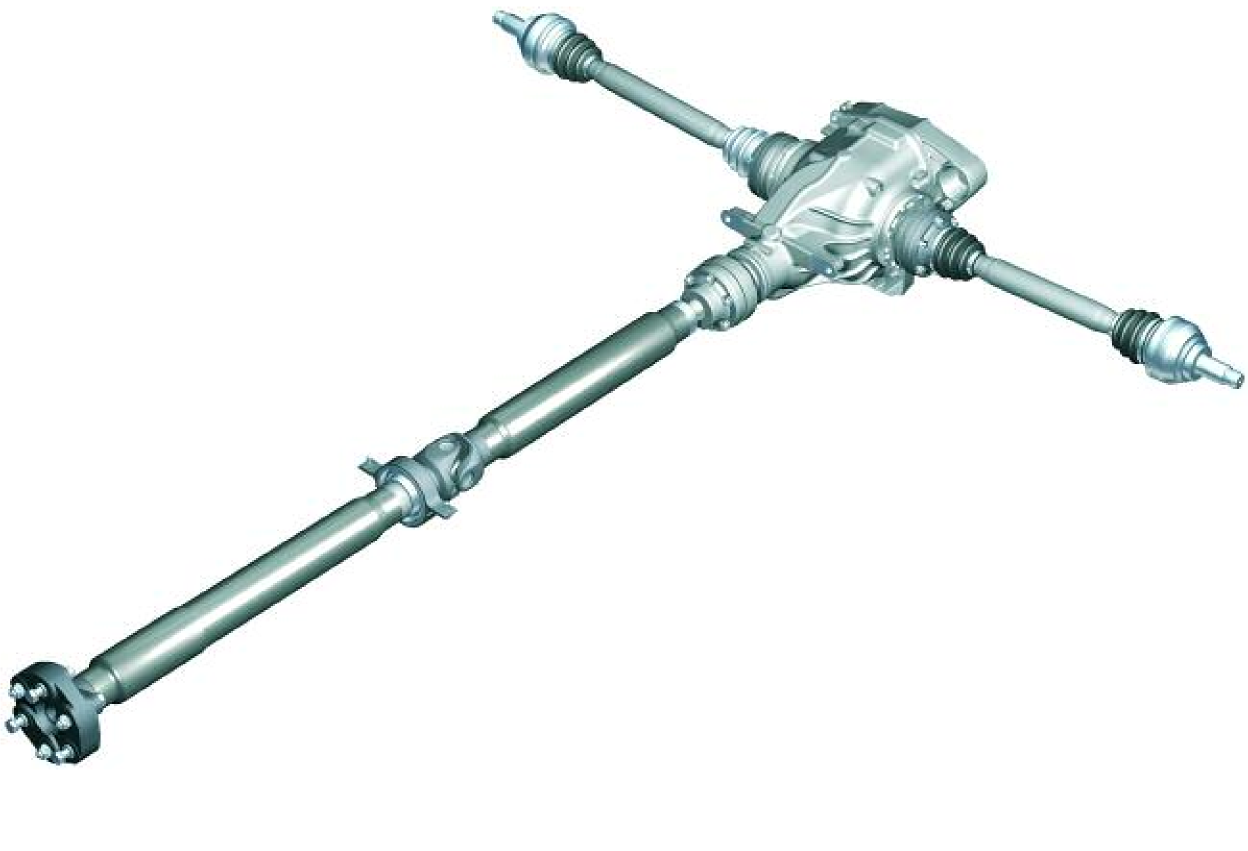
The center bearing can be mounted in two directions. It is important that the bearing is mounted with the word "TOP" facing the body.

Final Drive

Due to their function, the shafts of the right and left stub axles in the final drive have different lengths. In an idle state, this results in a noticeable different vertical clearance of both flanges, which is a feature of the design.

This does not affect the function and is not a cause for complaint.

This uneven clearance applies for all models with fully variable M slip differential and may affect either the right or the left flange, depending on the version and model.



Swivel Bearing

Spring strut connection to the wheel carrier:

During assembly, the M3 spring strut is pulled into the lower cone using a new special tool.

Follow the new installation and removal process according to the service repair manual.