Technical training.
Product information.

G12 Powertrain

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BMW Group University
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BMW Service

General information

Symbols used

The following symbol is used in this document to facilitate better comprehension or to draw attention to very important information:

⚠

Contains important safety information and information that needs to be observed strictly in order to guarantee the smooth operation of the system.

Information status and national-market versions

BMW Group vehicles meet the requirements of the highest safety and quality standards. Changes in requirements for environmental protection, customer benefits and design render necessary continuous development of systems and components. Consequently, there may be discrepancies between the contents of this document and the vehicles available in the training course.

This document basically relates to the European version of left hand drive vehicles. Some operating elements or components are arranged differently in right-hand drive vehicles than shown in the graphics in this document. Further differences may arise as the result of the equipment specification in specific markets or countries.

Additional sources of information

Further information on the individual topics can be found in the following:

- Owner's Handbook
- Integrated Service Technical Application.

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The information contained in this document forms an integral part of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the latest relevant information systems of the BMW Group for any changes/additions to the technical data.

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1. Introduction

This training reference manual contains information about the different engine and transmission variants of the new BMW 7 Series. The training reference manual also covers the special features relating to fuel preparation and the drive train.

The content of this training reference manual builds on the knowledge from the reference information for the different engines. This document does not deal with the fundamental technical functions of the engines.

1.1. Development code

The new BMW 7 Series G12 will be launched on the market from October 2015. Apart from the different body versions, there are no technical distinguishing features in the drive area.

1.2. History

The following table provides an overview of the different BMW 7 Series models of the past years.

Not all models were available for the US.

1.2.1. Powertrain variants E23

BMW 7 Series E23

Production period 1977 - 1979

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
728	M30B28	R6	2788	125 (170) at 5800 rpm	238 at 4000 rpm
730	M30B30	R6	2985	135 (184) at 5800 rpm	260 at 3500 rpm
733i	M30B32	R6	3205	145 (197) at 5500 rpm	280 at 4300 rpm

Production period 1979 - 1986

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
725i	M30B25	R6	2494	110 (150) at 5500 rpm	215 at 4000 rpm
728i	M30B28	R6	2788	135 (184) at 5800 rpm	240 at 4200 rpm
732i	M30B32	R6	3210	145 (197) at 5500 rpm	285 at 4300 rpm
735i	M30B34	R6	3430	160 (218) at 5200 rpm	310 at 4000 rpm
745i*	M30B32	R6	3210	185 (252) at 5200 rpm	380 at 2600 rpm
745i*	M30B34	R6	3430	185 (252) at 4900 rpm	380 at 2200 rpm

*Turbocharged engine.

1.2.2. Powertrain variants E32

BMW 7 Series E32

G12 Powertrain
1. Introduction

Production period 1986 - 1994

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
735i	M30B35	R6	3430	155 (211) at 5700 rpm	305 at 4000 rpm
740i/iL	M60B40	V8	3982	210 (286) at 5800 rpm	400 at 4500 rpm
750i/iL	M70B50	V12	4988	220 (300) at 5200 rpm	450 at 4100 rpm

1.2.3. Powertrain variants E38

BMW 7 Series E38

Production period 1994 - 2001

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
740i/iL	M60B40	V8	3982	210 (286) at 5800 rpm	400 at 4500 rpm
740i/iL	M62B44	V8	4398	210 (286) at 5400 rpm	420 at 3900 rpm
740i/iL	M62B44	V8	4398	210 (286) at 5400 rpm	440 at 3600 rpm
750i/iL	M73B54	V12	5379	240 (326) at 5000 rpm	490 at 3900 rpm
740d	M67D40	V8	3901	180 (245) at 4000 rpm	560 from 1750 rpm

1.2.4. Drive variants E65/E66

BMW 7 Series E65

Production period 2001 - 2008

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
745i/iL	N62B44	V8	4398	245 (333) at 6100 rpm	450 at 3600 rpm
750i/iL	N62B48O1	V8	4799	270 (367) at 6300 rpm	490 at 3400 rpm
760i/iL	N73B60	V12	5972	327 (445) at 6000 rpm	600 at 3950 rpm

1.2.5. Drive variants F01/F02

BMW 7 Series F01

G12 Powertrain
1. Introduction

Production period since 2008

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm
740i/Li	N54B30O0	R6	2979	240 (326) at 5800 rpm	450 from 1500 rpm
740i/Li (xDrive)	N55B30O0	R6	2979	235 (320) at 5800 rpm	450 from 1300 rpm
750i/Li (xDrive)	N63B44O0	V8	4395	300 (407) from 5500 rpm	600 from 1750 rpm
750i/Li (xDrive)	N63B44O1	V8	4395	330 (450) from 5500 rpm	650 from 2000 rpm
760i/Li	N74B60U0	V12	5972	400 (544) from 5250 rpm	750 from 1500 rpm
740d (xDrive)	N57D30T0	R6	2993	225 (306) at 4400 rpm	600 from 1500 rpm

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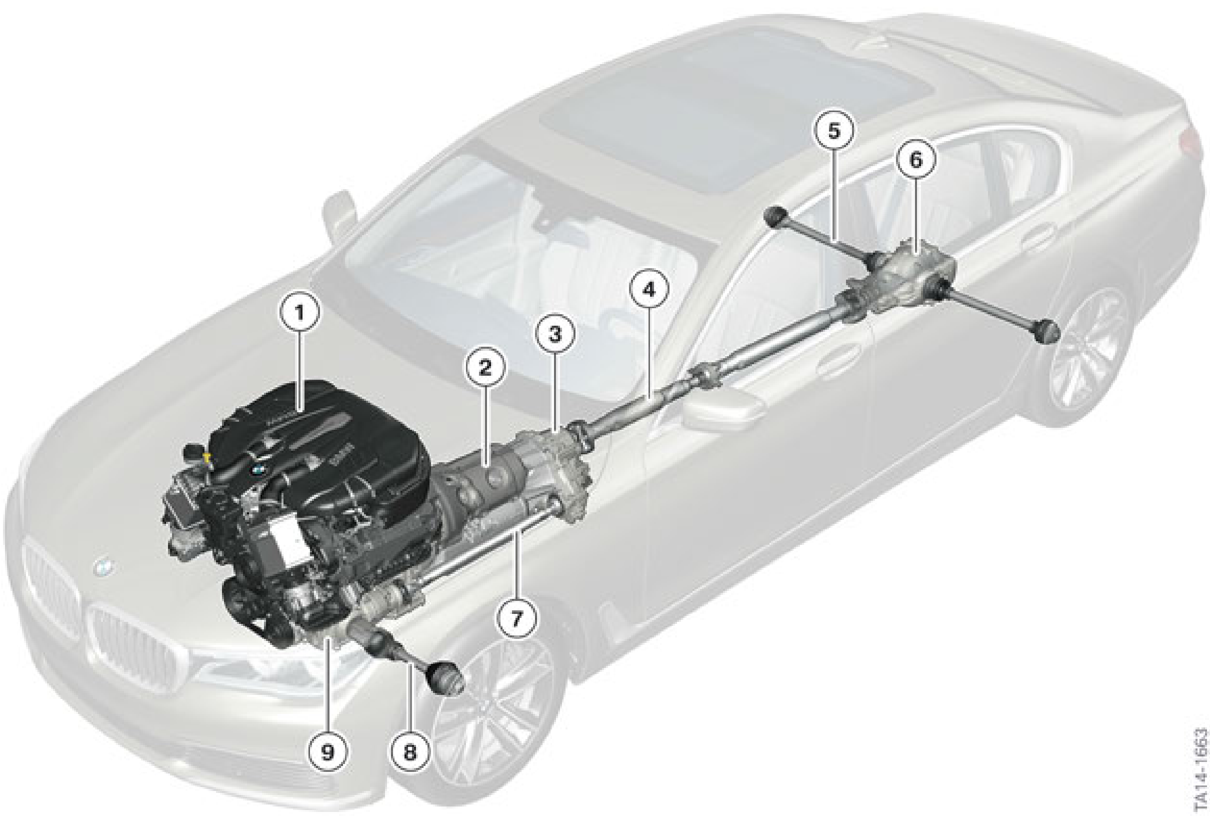
2. Drive Variants

Like the predecessor, the G12 is also optionally available with all-wheel drive. For the market introduction, it is possible to choose between 6 and 8-cylinder engines. Further engines will follow at a later date.

The 6-cylinder engine is a newly developed gasoline engine of the modular family (B-engines) which have their series introduction in the F30 LCI and G12.

The 8-cylinder gasoline engine N63TU2 has also been revamped for the second time and also has its series introduction in the G12.

All engines comply with the exhaust emission standard ULEV II. Lower exhaust emission standards.



Overview of drive in G12

Index	Explanation
1	Engine
2	Automatic transmission
3	Transfer box VTG (only for xDrive)
4	Drive shaft
5	Output shaft, rear

G12 Powertrain
2. Drive Variants

Index	Explanation
6	Rear axle differential
7	Drive shaft (only for xDrive)
8	Front output shaft (only for xDrive)
9	Front axle differential (only for xDrive)

2.1. Models

The following model variants are available for the market introduction of the G12.

G12	Drive	Transmission
740i	6-cylinder gasoline engine	8HPTU automatic transmission
750i	8-cylinder gasoline engine	8HPTU automatic transmission
750i xDrive	8-cylinder gasoline engine	8HPTU automatic transmission

G12 Powertrain
2. Drive Variants

2.2. Engine designation

The following table provides an overview of the composition of the different engine codes.

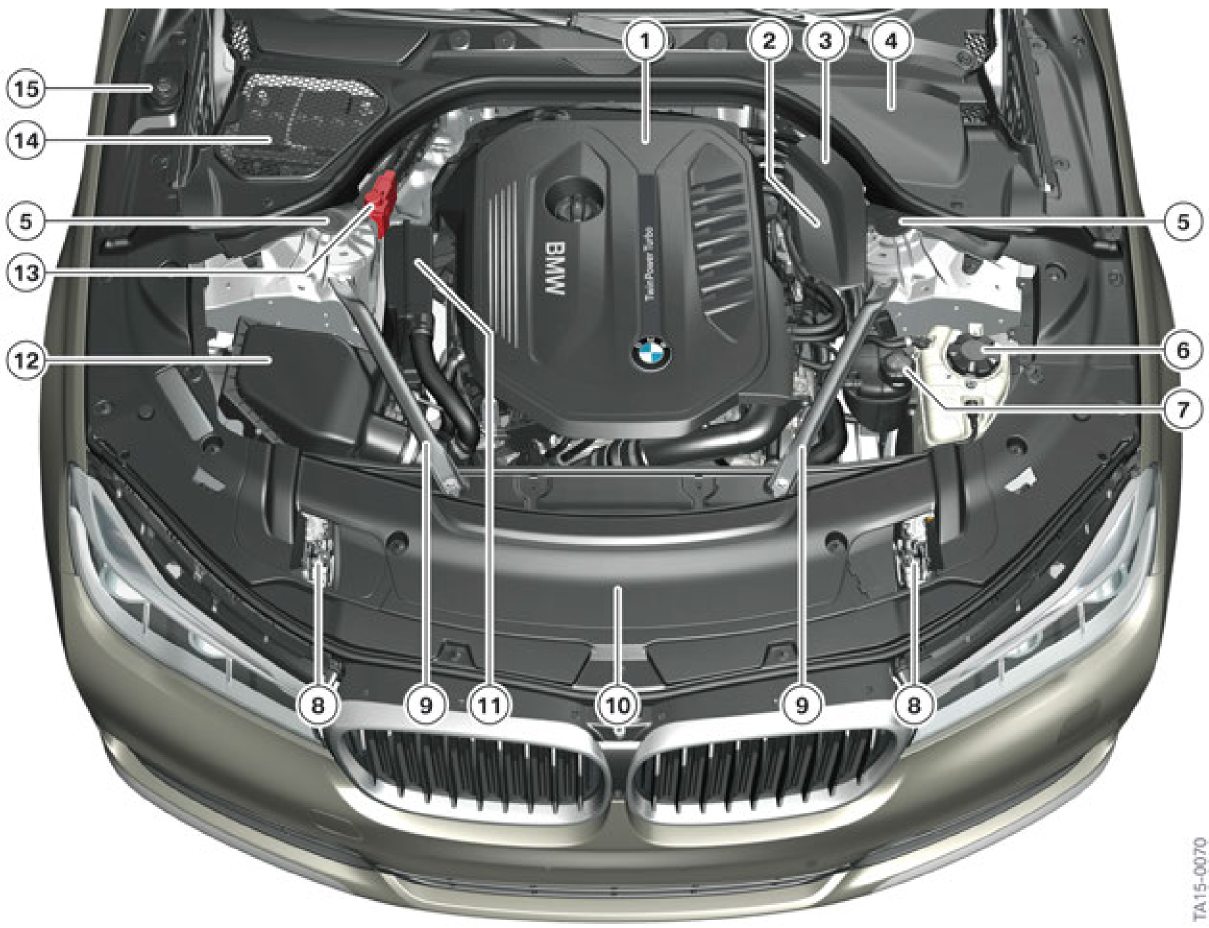
Position	Meaning	Index	Explanation
1	Engine developer	M, N, B P S W	BMW Group BMW M Sport BMW M GmbH Bought-in engines
2	Engine type	3 4 5 6 7	3-cylinder in-line engine (e.g. B38) 4-cylinder in-line engine (e.g. B48) 6-cylinder in-line engine (e.g. B58) V8 engine (e.g. N63) V12 engine (e.g. N74)
3	Change to the basic engine concept	0 1 – 9	Basic engine Changes, e.g. combustion process
4	Working method or fuel type and possibly installation position	A B C D H K	gasoline, transverse mounted gasoline, longitudinally mounted Diesel, transverse mounted Diesel, longitudinally mounted Hydrogen gasoline, horizontal mounting
5 + 6	Displacement in 1/10 liter	12 15 20 30 40 44 60	1,2 l 1.5 L 2.0 L 3,0 L 4,0 L 4,4 L 6,0 L
7	Performance class	K U M O T S	Lowest Lower Middle Upper Top Super
8	Revision relevant to approval	0 1 – 9	New development Redesign

G12 Powertrain
3. Gasoline Engines

The B58 and N63TU2 engines are installed in the new G12. The following table provides information on the different variants.

Models	Engine code	Design	Displacement in cm³	Power in kW (HP)	Torque in Nm (lb-ft)
740i	B58B30M0	R6	2998	240 (320) from 5500 rpm	450 (330) from 1380 rpm
750i (xDrive)	N63B44O2	V8	4395	330 (445) from 5500 rpm	650 (480) from 1380 rpm

3.1. BMW 740i



Overview of engine compartment of B58 engine in the G12

Index	Explanation
1	Engine design cover
2	Integrated supply module
3	Digital Motor Electronics (DME)
4	Cowl panel cover

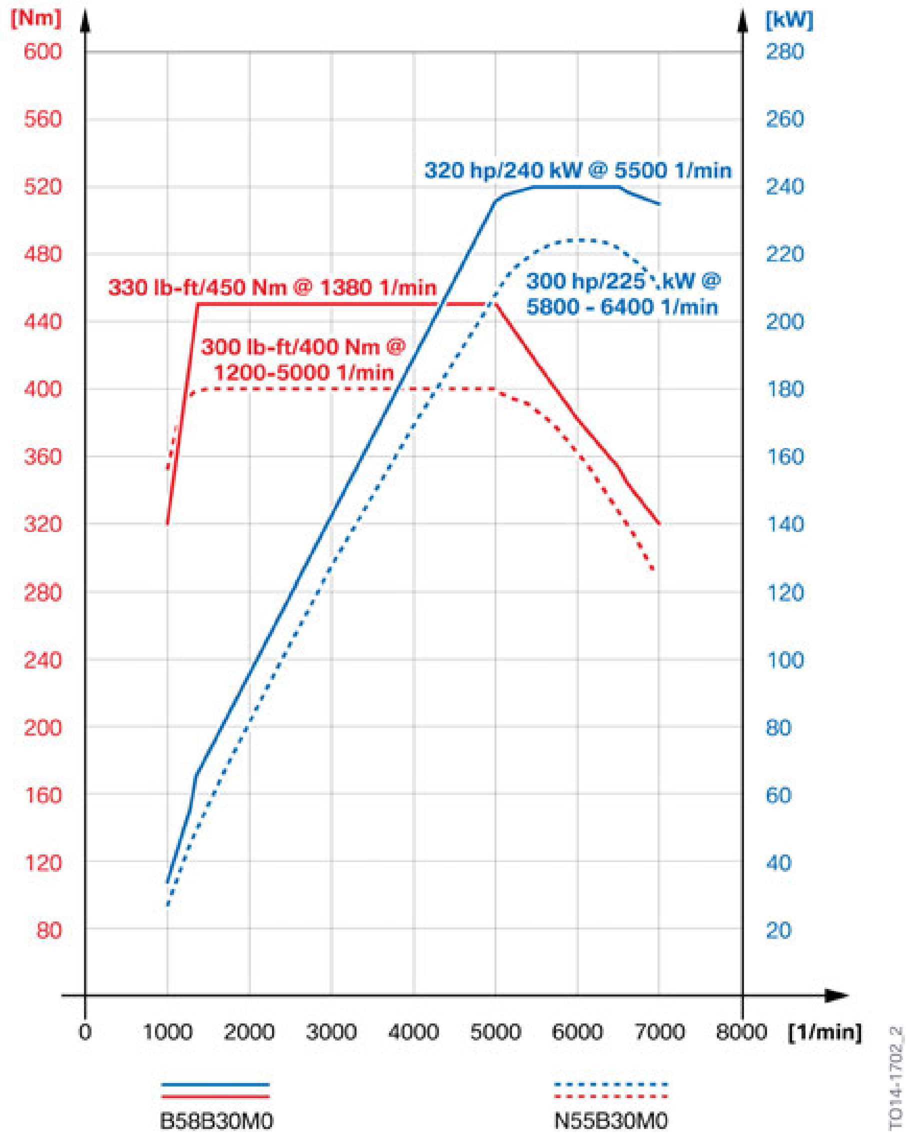
Index	Explanation
5	Front axle support bearing
6	Expansion tank for the high-temperature coolant circuit
7	Expansion tank for the low-temperature coolant circuit
8	Two-lock system
9	Front strut braces
10	Cover for cooling package
11	Resonator
12	Intake silencer
13	Jump start terminal point
14	12 V battery (vehicle electrical system support)
15	Filler neck for washer fluid reservoir

3.1.1. Technical data

Technical data	Unit/standard	B58B30M0
Operating mode		TVDI*
Firing order		1-5-3-6-2-4
Bore	mm	82
Stroke	mm	94,6
Compression ratio	[ε]	11:1
Permitted fuel	RON	91-100
Digital Motor Electronics		DME 8.6
Emission standards	ULEV II	6

*TVDI:

1 T = Turbo
2 V = Valvetronic
3 D = Direct
4 I = Injection.



Full-load diagram for B58B30M0

3.1.2. Highlights of the B58 engine

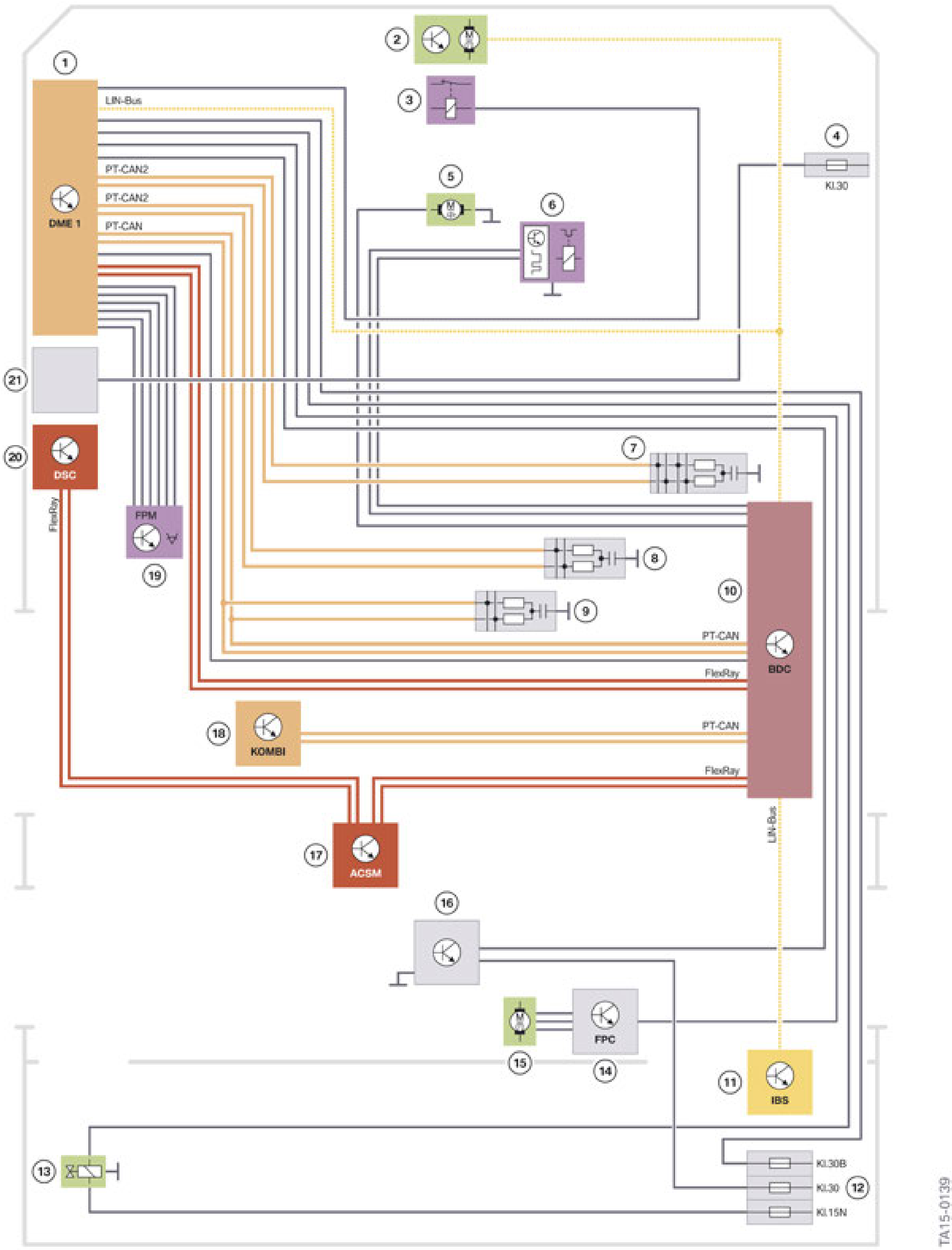
TA15-0553

B58 engine

1 Valvetronic 4th generation
2 Heat management module
3 Intake air system with integrated charge air cooler
4 Twin-scroll turbocharger with electrical wastegate valve controller
5 New Digital Motor Electronics (DME) 8.6

Further information on the B58B30M0 engine is provided in the Technical Training Manual “ST1505 B58 Engine”.

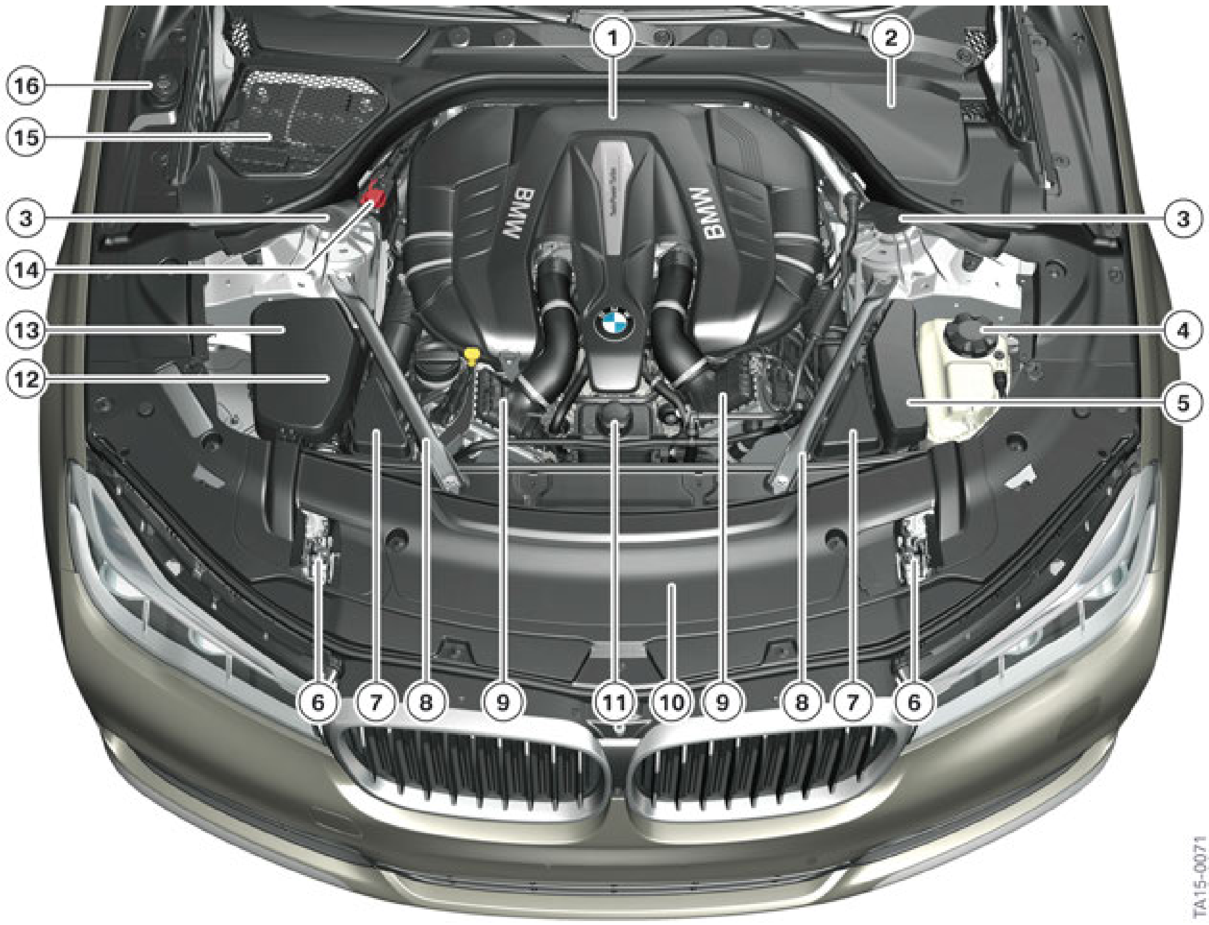
3.1.3. System wiring diagram



System wiring diagram of B58 engine in the G12

Index	Explanation
1	Digital Motor Electronics (DME)
2	Electric fan
3	Relay for electric fan
4	Power distribution box, engine compartment
5	Pinion starter
6	Air conditioning compressor
7	CAN terminator 6
8	CAN terminator 5
9	CAN terminator 4
10	Body Domain Controller (BDC)
11	Intelligent Battery Sensor (IBS)
12	Rear right power distribution box
13	Electrical exhaust flap
14	Fuel pump control (FPC)
15	Tank leak diagnosis (Natural Vacuum Leak Detection NVLD)
16	Crash Safety Module (ACSM)
17	Instrument panel (KOMBI)
18	Integrated supply module, accelerator pedal module (FPM)
19	Dynamic Stability Control (DSC)
20	Integrated supply module
21	Rear power distribution box

3.2. BMW 750i



Overview of engine compartment of N63TU2 engine in the G12

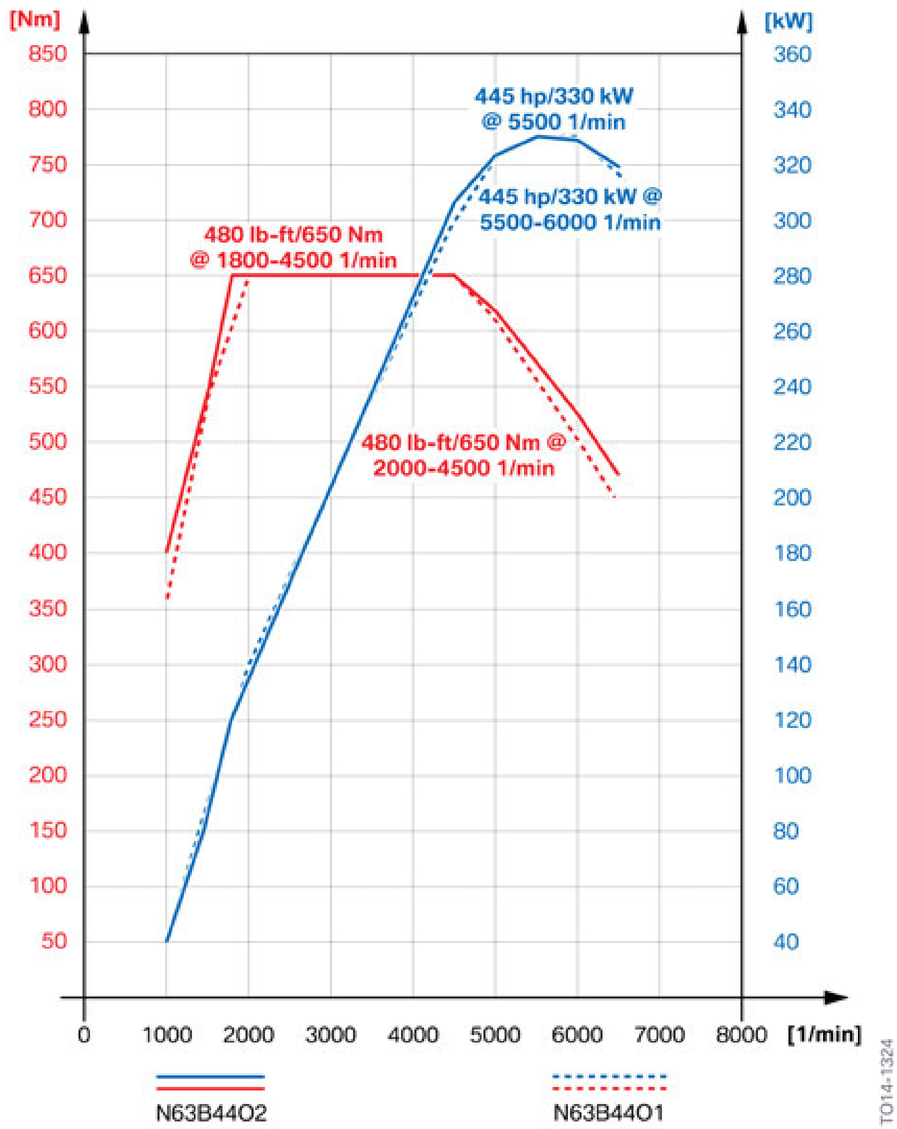
Index	Explanation
1	Engine design cover
2	Cowl panel cover
3	Front axle support bearing
4	Expansion tank for the high-temperature coolant circuit
5	Digital Motor Electronics (DME) I
6	Two-lock system
7	Resonator
8	Front strut braces
9	Indirect charge air cooler
10	Cover for cooling package
11	Expansion tank for the low-temperature coolant circuit
12	Integrated supply module

Index	Explanation
13	Digital Motor Electronics (DME) II
14	Jump start terminal point
15	12 V battery (vehicle electrical system support)
16	Filler neck for washer fluid reservoir

3.2.1. Technical data

*TVDI:

1 T = Turbo
2 V = Valvetronic
3 D = Direct
4 I = Injection.



Full load diagram N63B44O2 engine

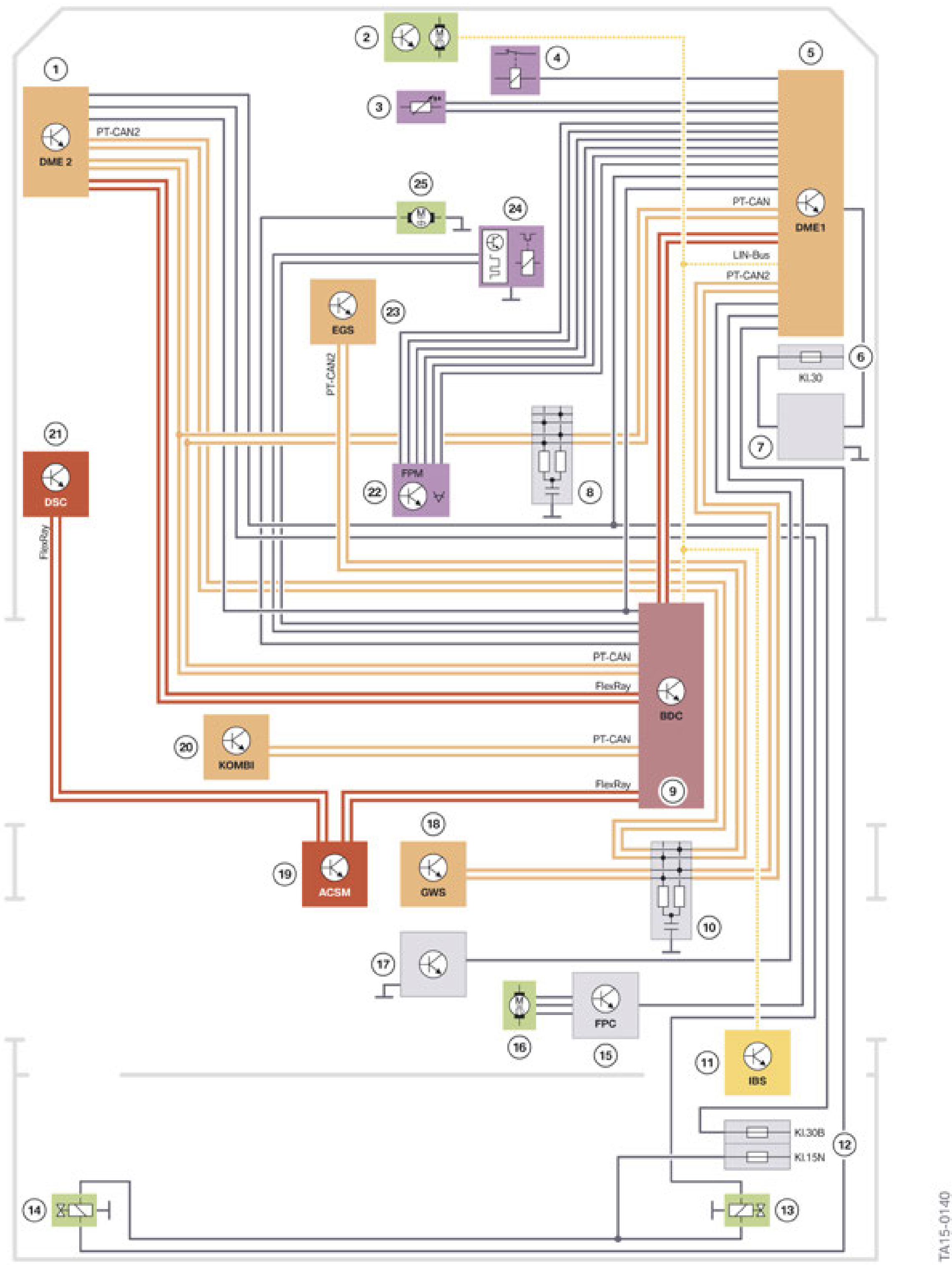
3.2.2. Highlights of the N63TU2 engine

N63TU2 engine

1 Map-controlled oil pump
2 Twin-scroll turbocharger with electrical wastegate valve controller
3 Engine temperature management Split-Cooling-Combined cooling system (SCC)
4 Engine oil /coolant heat exchanger integrated in the V-space
5 New coolant-cooled Digital Motor Electronics (DME) 8.8

Further information on the N63B44O2 engine is provided in the Technical Training Manual “ST1511 N63TU2 Engine”.

3.2.3. System wiring diagram

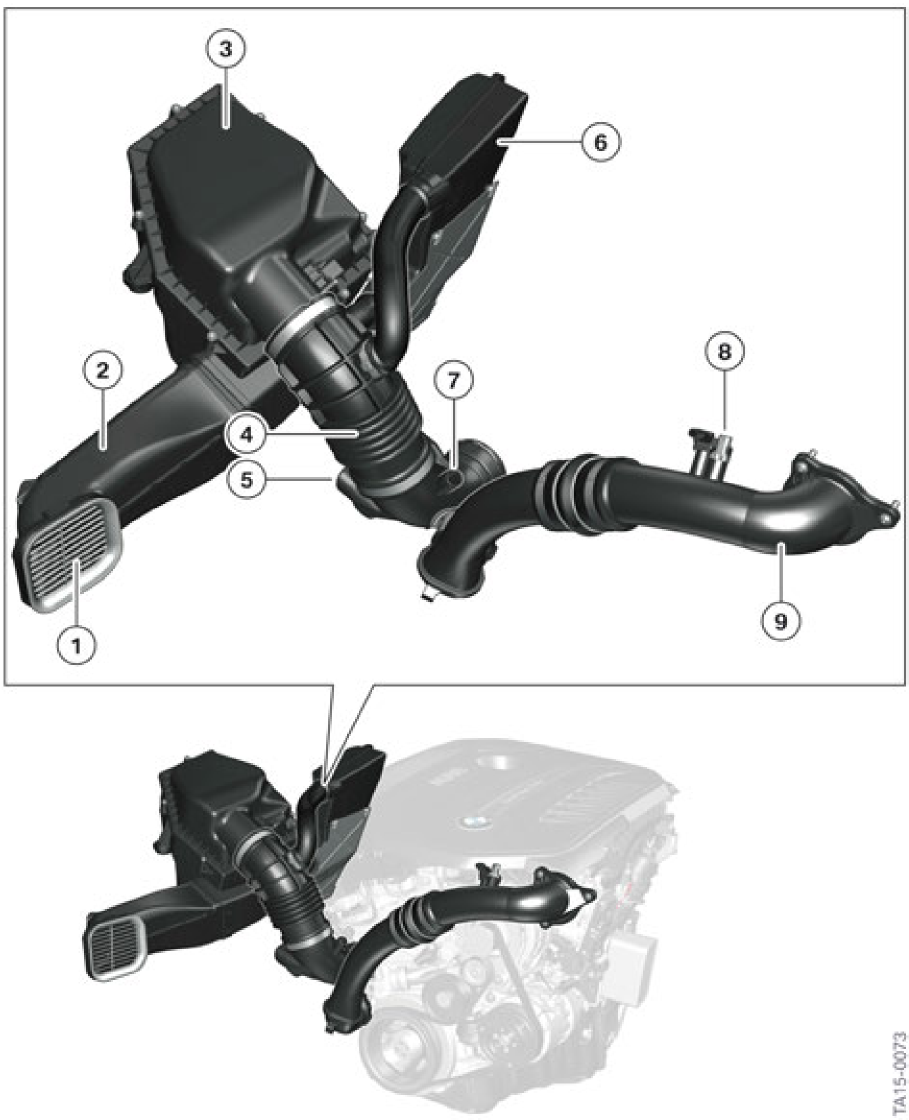


System wiring diagram of N63TU2 engine in the G12

Index	Explanation
1	Digital Motor Electronics (DME) II
2	Electric fan
3	Temperature sensor
4	Relay for electric fan
5	Digital Motor Electronics (DME) I
6	Power distribution box, engine compartment
7	Integrated supply module
8	CAN terminator 4
9	Body Domain Controller (BDC)
10	CAN terminator 5
11	Intelligent Battery Sensor (IBS)
12	Rear right power distribution box
13	Electrical exhaust flap, right
14	Electrical exhaust flap, left
15	Fuel pump control (FPC)
16	Electric fuel pump
17	Tank leak diagnosis (Natural Vacuum Leak Detection NVLD)
18	Gear selector switch (GWS)
19	Crash Safety Module (ASCM)
20	Instrument panel (KOMBI)
21	Dynamic Stability Control (DSC)
22	Accelerator pedal module
23	Electronic transmission control (EGS)
24	Air conditioning compressor
25	Pinion starter

3.3. Air intake and exhaust emission systems

3.3.1. Air intake duct in B58 engine



Air intake duct of B58 engine in the G12

Index	Explanation
1	Unfiltered air intake with grille
2	Two-branch air intake duct
3	Intake silencer
4	Clean air pipe
5	Broadband silencer

Index	Explanation
6	Resonator
7	Connection for blow-by gas line
8	Combined charging pressure and temperature sensor
9	Charge air hose downstream of charge air cooler

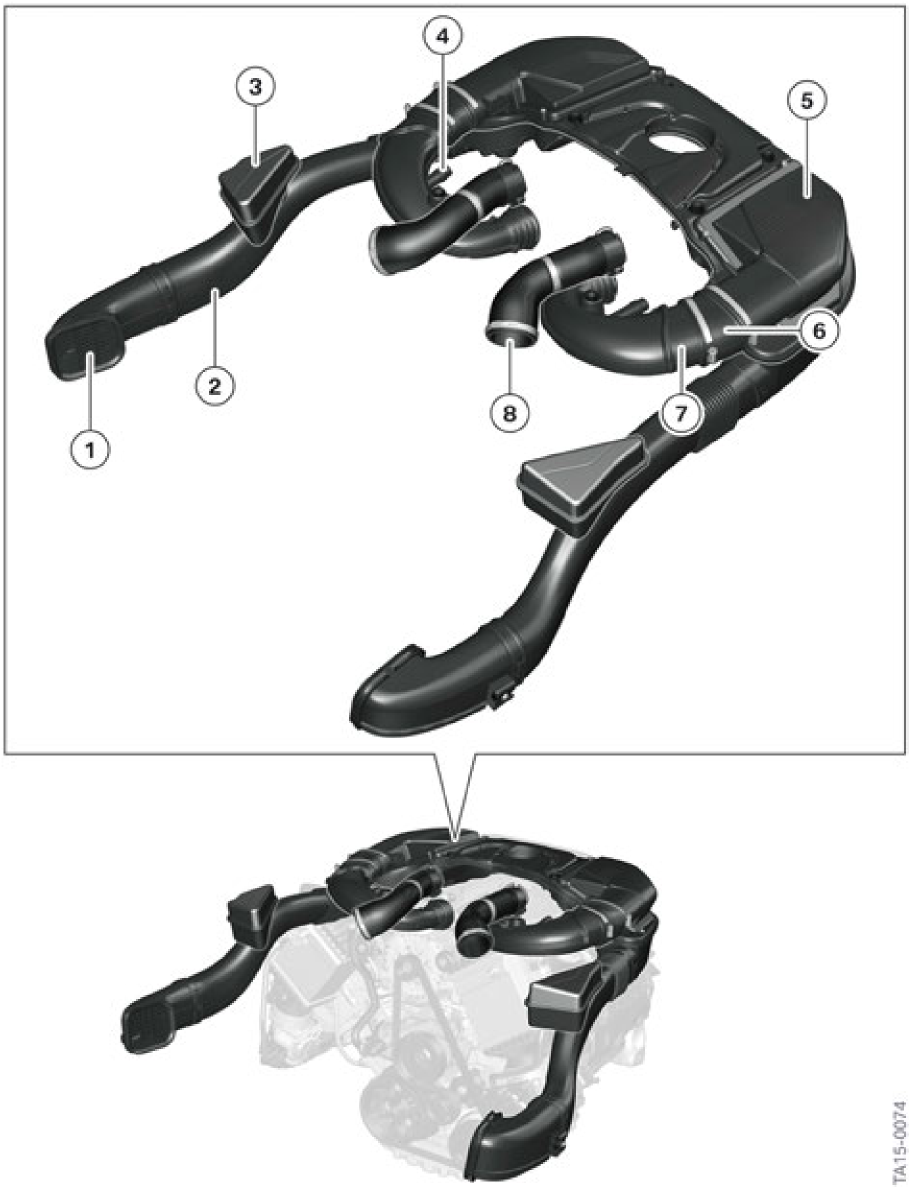
Resonator

The pulsating air flow of the rotating engine is damped in the air intake duct by using resonators. The B58 engine of the G12 has a total of 2 resonators.

Broadband silencer

If a blow-off valve is no longer used on turbo engines, a transient high-frequency noise occurs when the engine load is reduced. This is caused by the turbocharger pressure on the intake side. Broadband silencers are matched to this to a frequency of approximately 3 kHz to eliminate it.

3.3.2. Air intake duct in N63TU2 engine



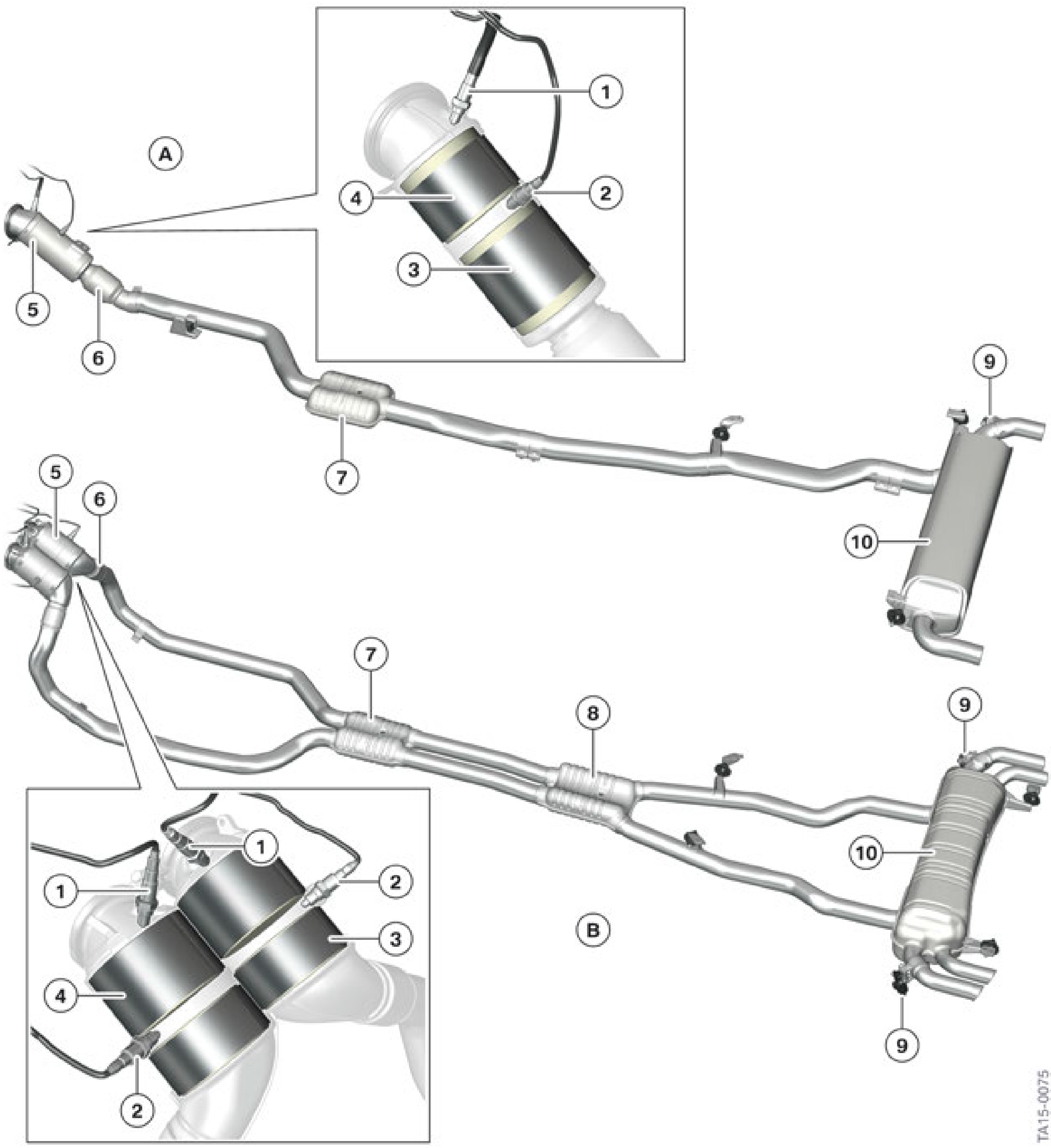
Air intake duct of N63TU2 engine in the G12

Index	Explanation
1	Unfiltered air intake with grille
2	Unfiltered air pipe
3	Resonator
4	Connection for blow-by gas line

Index	Explanation
5	Intake silencer (left and right)
6	Clean air gaiter
7	Clean air pipe
8	Charge air hose downstream of charge air cooler

The 8-cylinder gasoline engine has a two-branch intake system. This ensures that the necessary air volume is made available to the engine in every load range.

3.3.3. Exhaust emission system



Exhaust emission system of gasoline engine in the G12

Index	Explanation
A	B58 engine (single-branch)
B	N63TU2 engine (two-branch)
1	Control sensor (broadband oxygen sensor LSU ADV)
2	Monitoring sensor (voltage jump oxygen sensor LSF xFour)
3	Monolith 1
4	Monolith 2
5	3-way catalytic converter
6	End coupling element
7	Front silencer
8	Center silencer
9	Electrically activated exhaust flap
10	Rear silencer

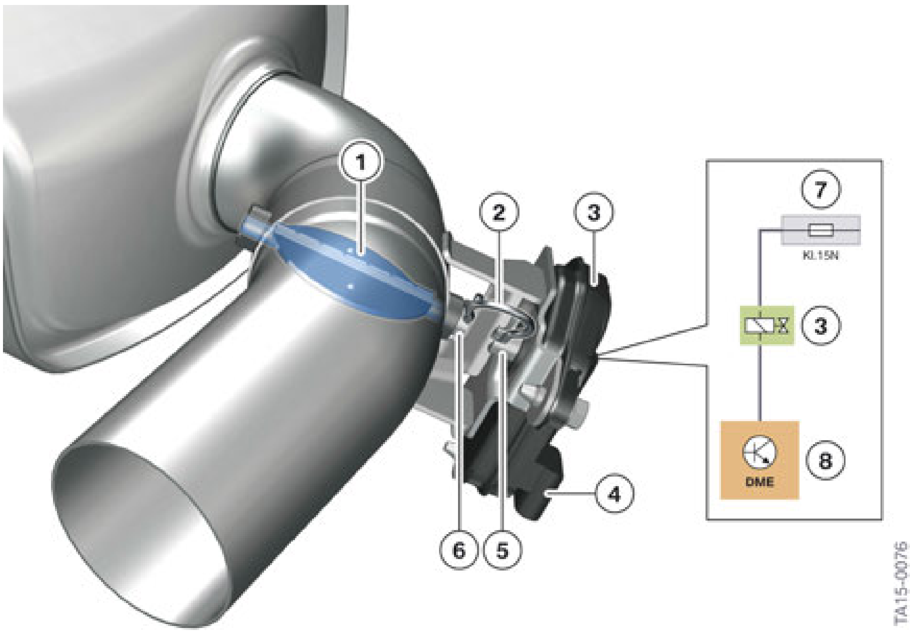
Special features of the exhaust emission system:

- Optimum design of the exhaust system with respect to the conflict of goals between exhaust gas counterpressure and acoustics.
- Design of the silencers corresponds to the high comfort standards of the G12.
- Electrical exhaust flap(s) for acoustics with high load feedback and powerful sound upon acceleration.
- Consistent lightweight construction through bracket design, resulting in reduced number of attachment points.

Technical data of the exhaust emission system

Exhaust emission system	B58 engine	N63TU2 engine
3-way catalytic converter	2-monolith system	2-monolith system
Cell density of monolith 1*	600	600
Cell density of monolith 2	400	400
Volume of front silencer	5 L	5 L
Volume of middle silencer	—	5 L
Volume of rear silencer	35 L	38 L
Number of electrically activated exhaust flaps	1	2
Number of exhaust tailpipes	2	4
Tailpipe trims	Integrated in the body	Integrated in the body

Electrically activated exhaust flap



Electrically activated exhaust flap on B58 engine in the G12

Index	Explanation
1	Exhaust flap
2	Spring
3	Electrical exhaust flap actuator
4	Electrical connection (4-pin)
5	Drive pin
6	Output pin
7	Fuse, rear right power distribution box
8	Digital Motor Electronics (DME)

The exhaust flap is integrated in the rear silencer. The exhaust flap is driven via an electric motor with integrated transmission and electronics. The actuator of the electrically adjustable exhaust flap has the following electrical connections:

- Voltage supply (+)
- Ground (-)
- Actuating wire (PWM signal line)

At low engine speed and low load, the exhaust flap allows the noise level to be significantly reduced by closing the exhaust flap. At high engine speed and high load, the exhaust gas counterpressure can be reduced by opening the exhaust flap.

The exhaust flap is activated by the Digital Motor Electronics (DME) by means of a pulse-width-modulated signal. The input variables are:

- Engine speed
- Load
- Driving speed

The exhaust flap cannot travel to an intermediate position and is either completely open or closed. The flap is moved to the respective mechanical end stops by means of pulse-width modulated signals (PWM signals). The preferred position is the open position in the event of detected faults or loss of activation or after the engine is switched off.

Electrical exhaust flap	B58	N63TU2
Installation location	right	right and left
Pulse-width modulated signal open	10 % duty cycle	10 % duty cycle
Pulse-width modulated signal closed	90 % duty cycle	90 % duty cycle

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The actuator of the electrical exhaust flap can be replaced separately. The actuator can be moved to an installation position using the BMW diagnosis system ISTA.

The exact position of the exhaust flap is stored in a characteristic map in the Digital Motor Electronics. The following table provides only an approximate overview of the different conditions of the exhaust flap.

Engine operating points	Exhaust flap open	Exhaust flap closed
Idling		X
Low load		X
Coasting (overrun) mode		X
Constant-speed driving with partial load		X
Acceleration with high load	X	
Full load	X	

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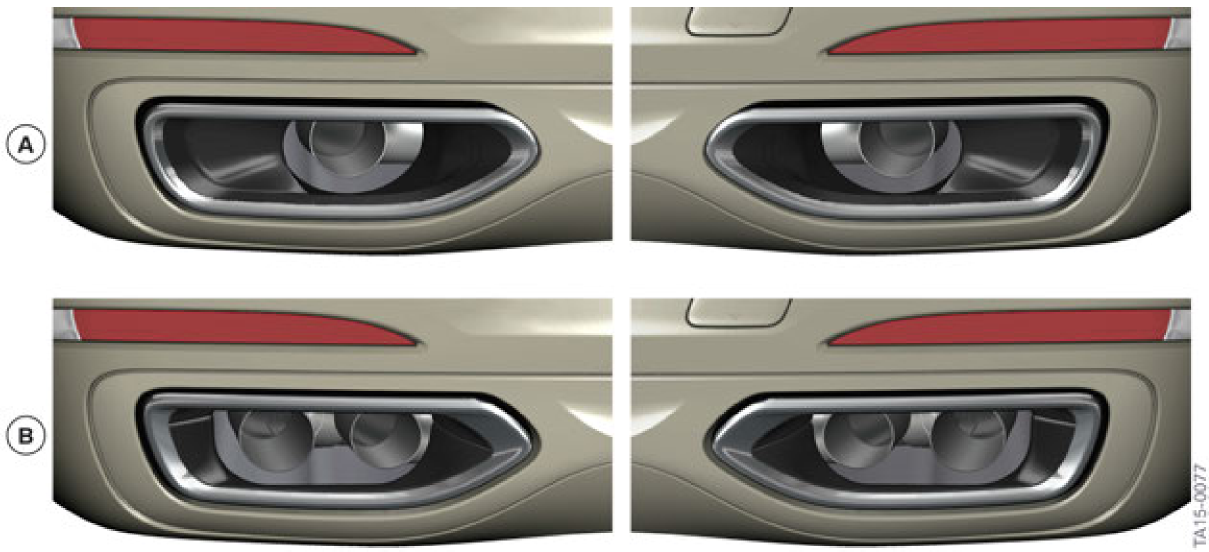
Please note that the right flap on the B58 engine and the outer exhaust flaps on the N63TU2 engine are closed at idle. For this reason, no emission measurement can be performed at these tailpipes.

Tailpipe versions



Tailpipe versions for gasoline engine in the G12

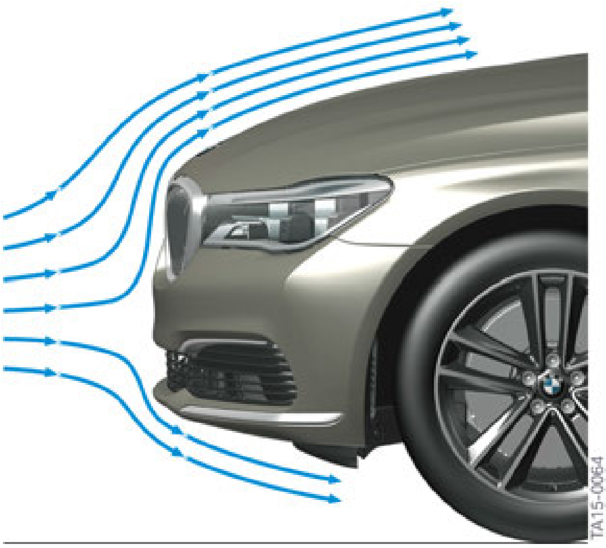
Index	Explanation
A	6-cylinder gasoline engine
B	8-cylinder gasoline engine

The tailpipe trims are not part of the exhaust system on the G12, but are integrated in the rear bumper.

4. Cooling

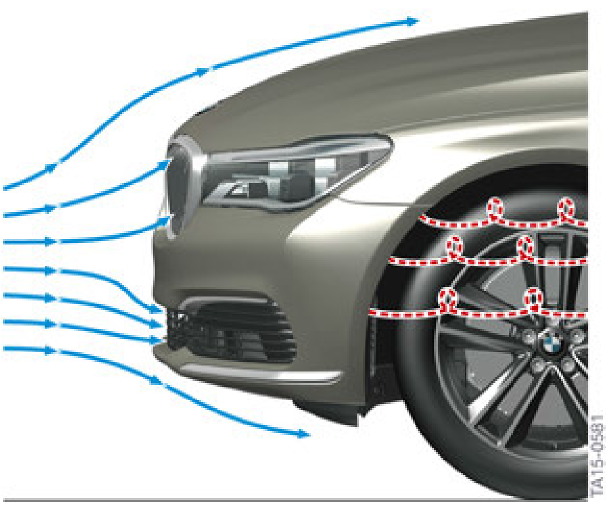
4.1. Active air-flap control

The cooling surfaces at the front of the vehicle can be closed by means of two separate air flaps. This reduces the drag coefficient and thus saves fuel. A further advantage is faster heating up of the engine after a cold start. It is possible to reduce the carbon dioxide emissions by a maximum of 0.8 g/km.



Ambient air flow with closed air flaps on G12

The current cooling air requirement for engine cooling, brake cooling and air conditioning is determined by the Digital Motor Electronics (DME). The adjustable flaps are then moved to the proper position. The air flaps are opened as required. The flaps can be adjusted to different positions. The flaps of the BMW radiator grill are opened only when there is a high cooling requirement. The flaps can also be closed at high driving speeds.



Ambient air flow with open air flaps on G12

4. Cooling

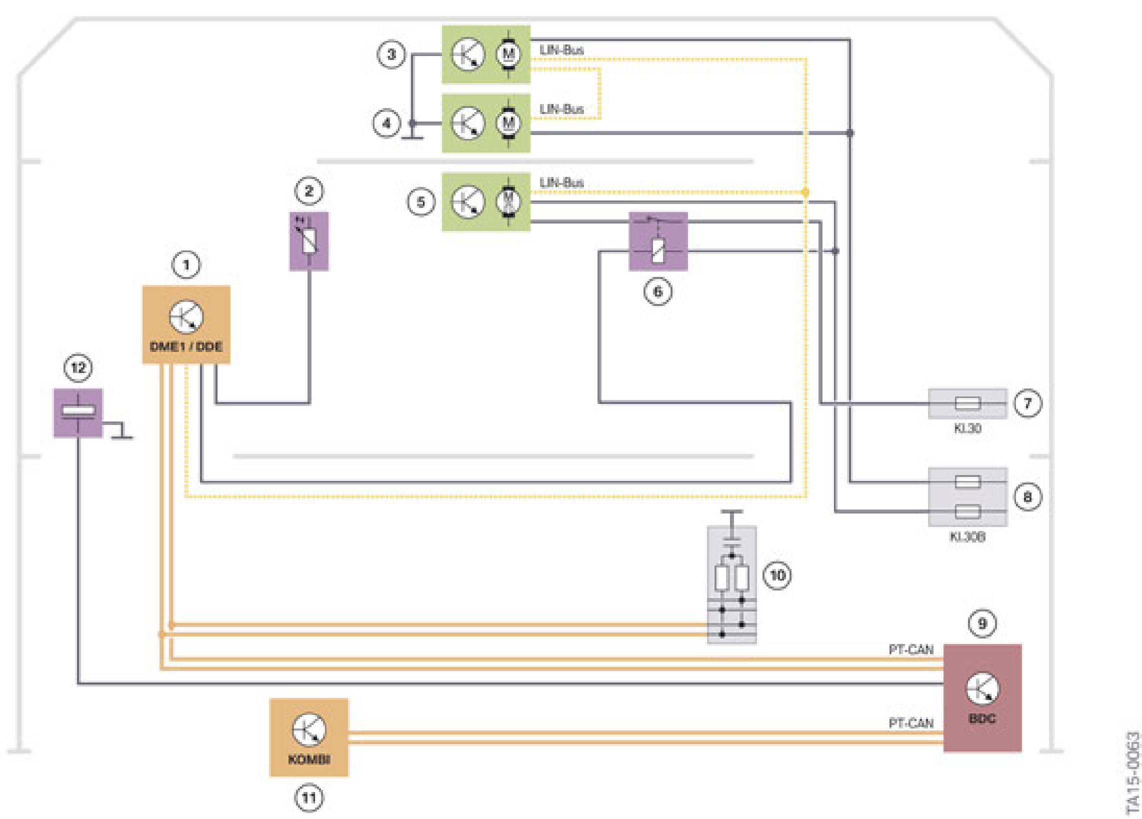
Cooling requirement	Active air-flap control	Positions
Low	Closed at top Closed at bottom	
Low	Closed at top Partially open at bottom (15°– 30°C / 59°– 86°F)	
medium	Closed at top Open at bottom	
maximum	Open at top Open at bottom	

The active air-flap control in the G12 allows a large number of settings to be carried out to control the cool air intake according to demand. Both the upper and lower air flaps are actively opened or closed by a separate electric motor.

The active air-flap control has a more sensitive sensor system, which detects and evaluates more temperature thresholds. Among other things, the following information is used for evaluation:

- Coolant temperature
- Air conditioning condenser temperature
- Transmission oil temperature
- Catalytic converter temperature
- Charge air temperature
- Brake temperature
- Driving speed

4.2. System wiring diagram



System wiring diagram of active air-flap control in the G12

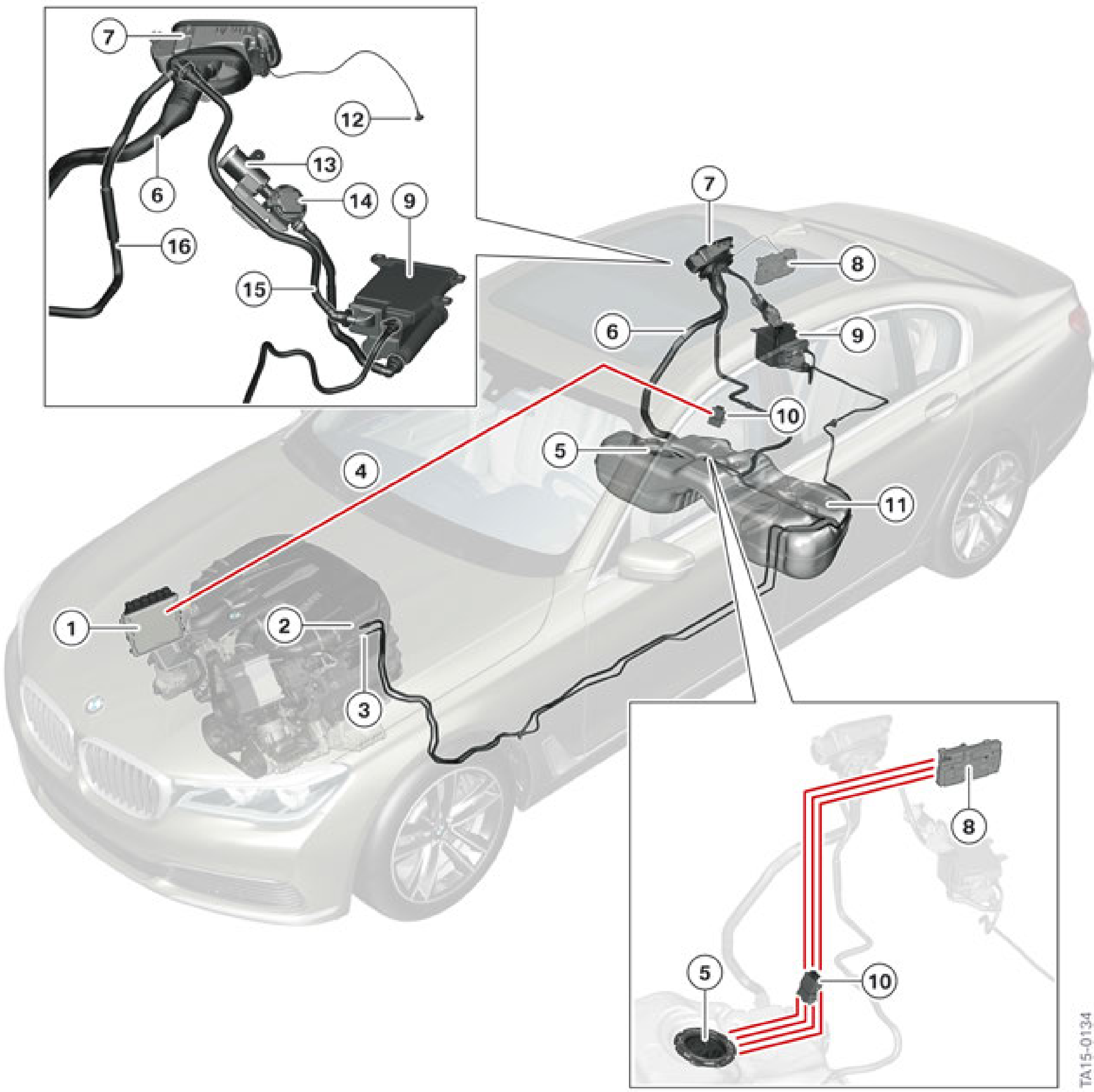
Index	Explanation
1	Engine control unit (DME)
2	Coolant temperature sensor
3	Active air-flap control, top
4	Active air-flap control, bottom

4. Cooling

Index	Explanation
5	Electric fan
6	Relay for electric fan
7	Power distribution box, engine compartment
8	Power distribution box, front right
9	Body Domain Controller (BDC)
10	CAN terminator 4
11	KOMBI
12	Coolant level sensor

G12 Powertrain
5. Fuel Supply

5.1. gasoline engine

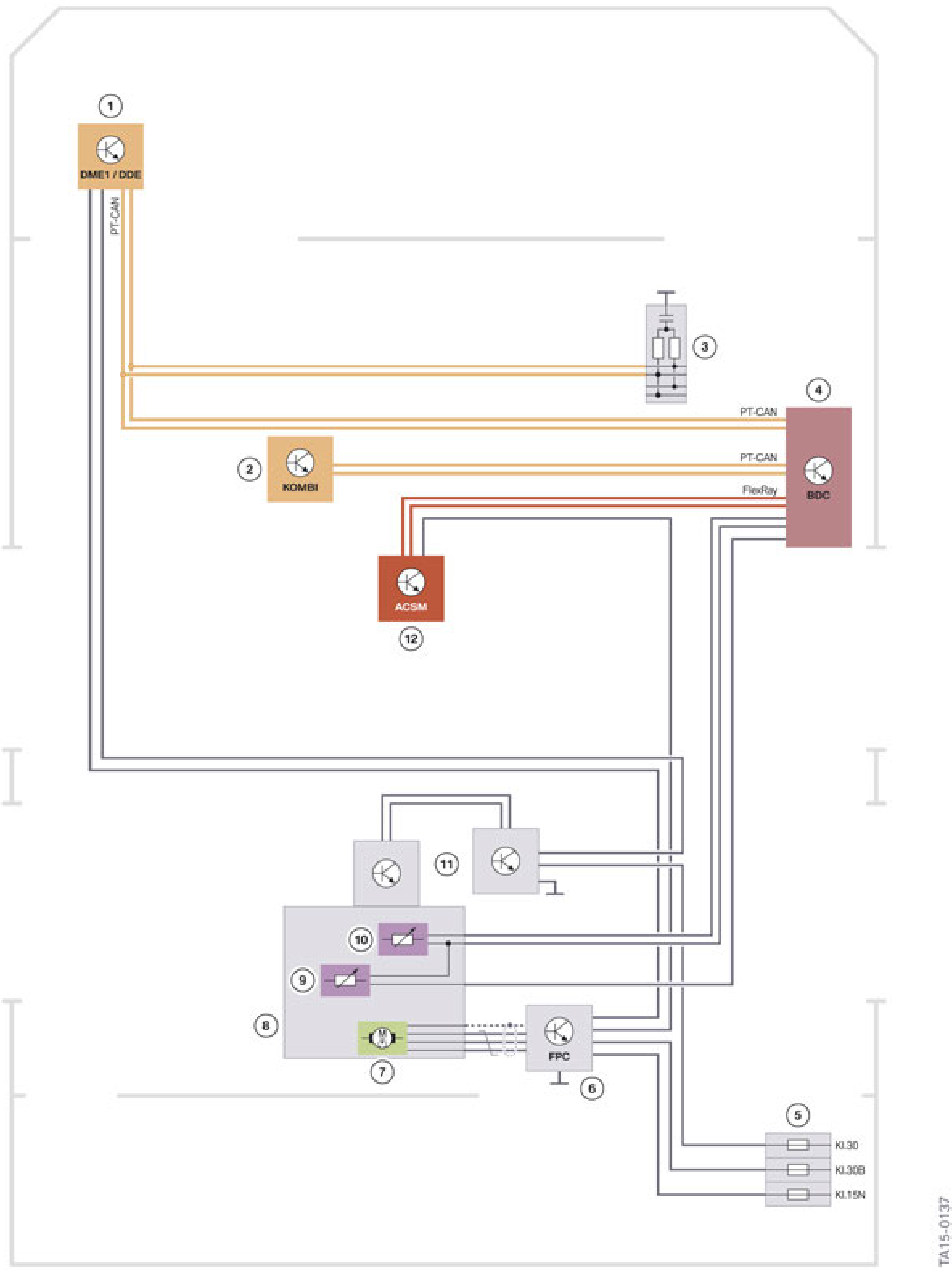


System overview of fuel supply for gasoline engine in the G12

Index	Explanation
1	Digital Motor Electronics (DME)
2	Purge air line, carbon canister
3	Fuel feed from fuel tank
4	Data line to fuel pump control module
5	Delivery unit
6	Fuel filler neck

Index	Explanation
7	Fuel filler flap
8	Rear right power distribution box
9	Carbon canister
10	Fuel pump control (FPC)
11	Fuel tank (78 l)
12	Emergency release
13	Fresh air filter
14	Natural Vacuum Leak Detection (NVLD)
15	Ventilation line, carbon canister
16	Tank ventilation line

5.2. System wiring diagram



System wiring diagram for fuel supply in G12

Index	Explanation
1	Engine control unit (DME)
2	Instrument panel (KOMBI)
3	CAN terminator 4
4	Body Domain Controller (BDC)
5	Rear right power distribution box
6	Fuel pump control (FPC)
7	Electric fuel pump
8	Delivery unit
9	Fuel level sensor, left
10	Fuel level sensor, right
11	Natural Vacuum Leak Detection (NVLD)

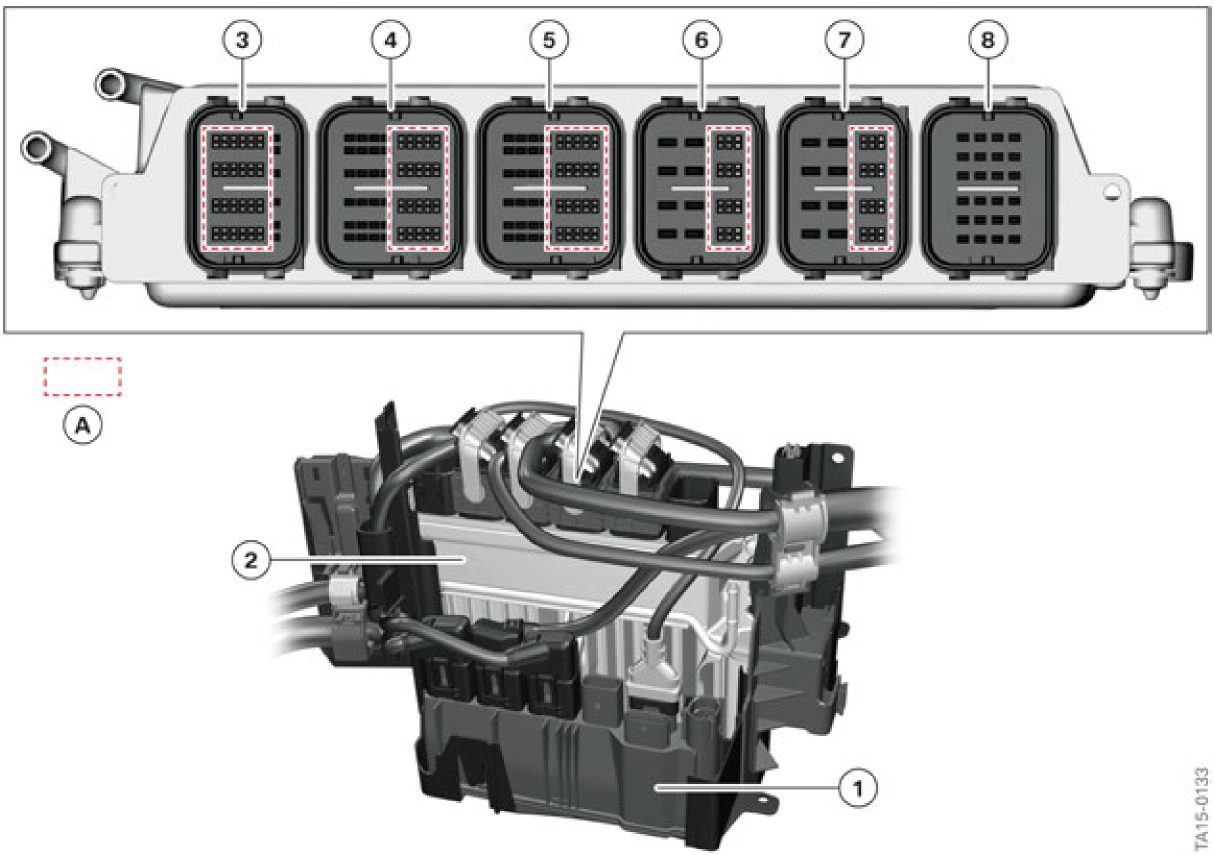
G12 Powertrain

6. Engine Electrical System

6.1. Engine control unit

A new 8th generation engine control unit from Bosch is used in the G12.

6.1.1. Nano MQS plug connections



8th generation engine control unit with nano MQS plug connections in the G12

Index	Explanation
A	Nano MQS plug connections (Micro Quadlok system)
1	Integrated supply module
2	8th generation engine control unit
3	Vehicle module (module 100)
4	Sensor module 1 (module 200)
5	Sensor module 2 (module 300)
6	Valvetronic or preheating control (module 400)
7	Supply module (module 500)
8	Ignition and injection module (module 600)

5 of the 6 connector module of the engine control unit are equipped with a nano MQS plug connection (Micro Quadlok system) (see 3).

The nano MQS plug connection offers the following advantages:

- Low space requirement
- Minimum mass
- High vibration resistance

With a minimum wire cross-section of 0.13 mm^2 – 0.35 mm^2, the compact nano MQS plug connection offers a significant weight advantage combined with exceptionally good vibration resistance. As a result of the reduced installation dimensions, it was possible to reduce the space requirement on the PC board. The nano MQS plug connection can be operated with currents of up to a max. 3 A.

⚠

Measurements on the wiring harness must be performed exclusively using the measuring procedures approved by BMW. Use of the incorrect tools, such as measuring probes, can damage the plug-in contacts.

System overview with nano MQS plug connections

The following systems are also equipped with the new nano MQS plug connection.

- Roof function center
- Reversing camera
- Rear Seat Entertainment system
- Telematic Communication Box (TCB)
- Head unit
- Digital Motor Electronics DME
- Camera-based assistance systems
- Interior light
- Storage shelf speakers

6. Engine Electrical System

6.1.2. Control unit code for Digital Motor Electronics DME

The control unit code (DME 8.x.yH) can be interpreted as follows.

Abbreviation	Meaning
DME	Digital Motor Electronics
8	Control unit generation (modular platform for gasoline and diesel engines)
X	Number of cylinders as hexadecimal figure
y	Vehicle electrical system architecture
H	Hybrid version

Number of cylinders as hexadecimal figure:

- 3 = 3-cylinder engine
- 4 = 4-cylinder engine
- 6 = 6-cylinder engine
- 8 = 8-cylinder engine
- C = 12-cylinder engine

Vehicle electrical system architecture:

- 0 = Vehicle electrical system version 1 (large series)
- 1 = Vehicle electrical system version 2 (small series)

Examples for gasoline engines

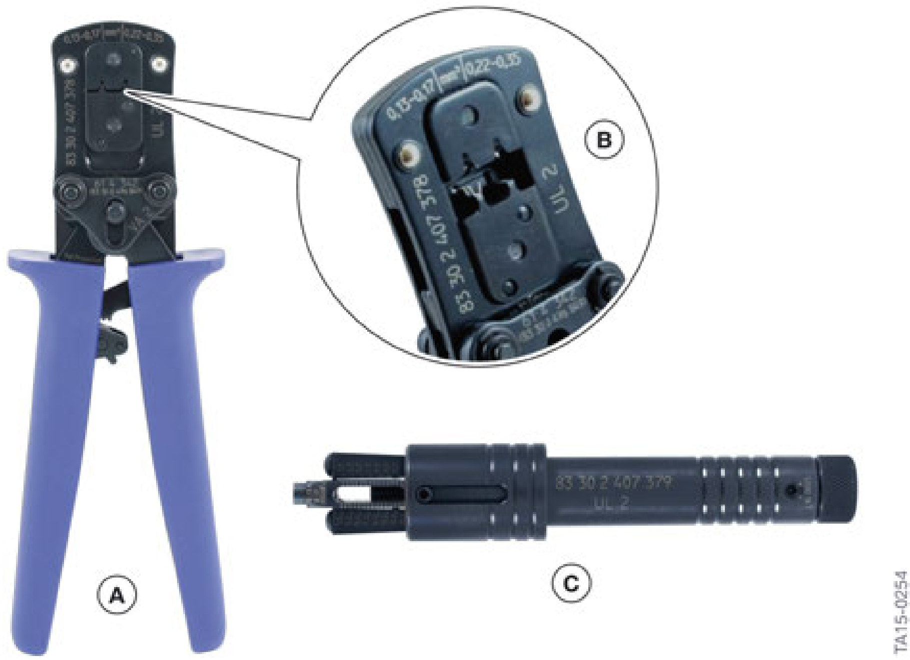
- DME 8.4.0H = B48 PHEV* (vehicle electrical system version 1)
- DME 8.6.1 = B58
- DME 8.8.0 = N63TU2
- DME 8.C.0 = N74TU

*PHEV = Plug-in Hybrid Electric Vehicle.

G12 Powertrain
6. Engine Electrical System

6.1.3. Special tools

Tools for nano MQS plug connections



Tools for nano MQS plug connections

Index	Explanation
A	Crimping pliers
B	Crimping pliers head
C	Insulation stripping tool

The tools show above are available to BMW Service for repair of the nano MQS connectors. The crimping pliers can be separated from the crimping pliers head and used with various other attachments.

The length of the wire strand can be preadjusted by means of a depth gauge on the insulation stripping tool.

Various test cables are available for the test cable case for electrical measurements on the nano MQS plug connections.

Tool	Order number
Crimping pliers	0 494 159 or 0 496 849
Crimping pliers head	83 30 2 407 378
Insulation stripping tool for nano MQS connectors	83 30 2 407 379
Test cable set for nano MQS connectors	83 30 2 361 523

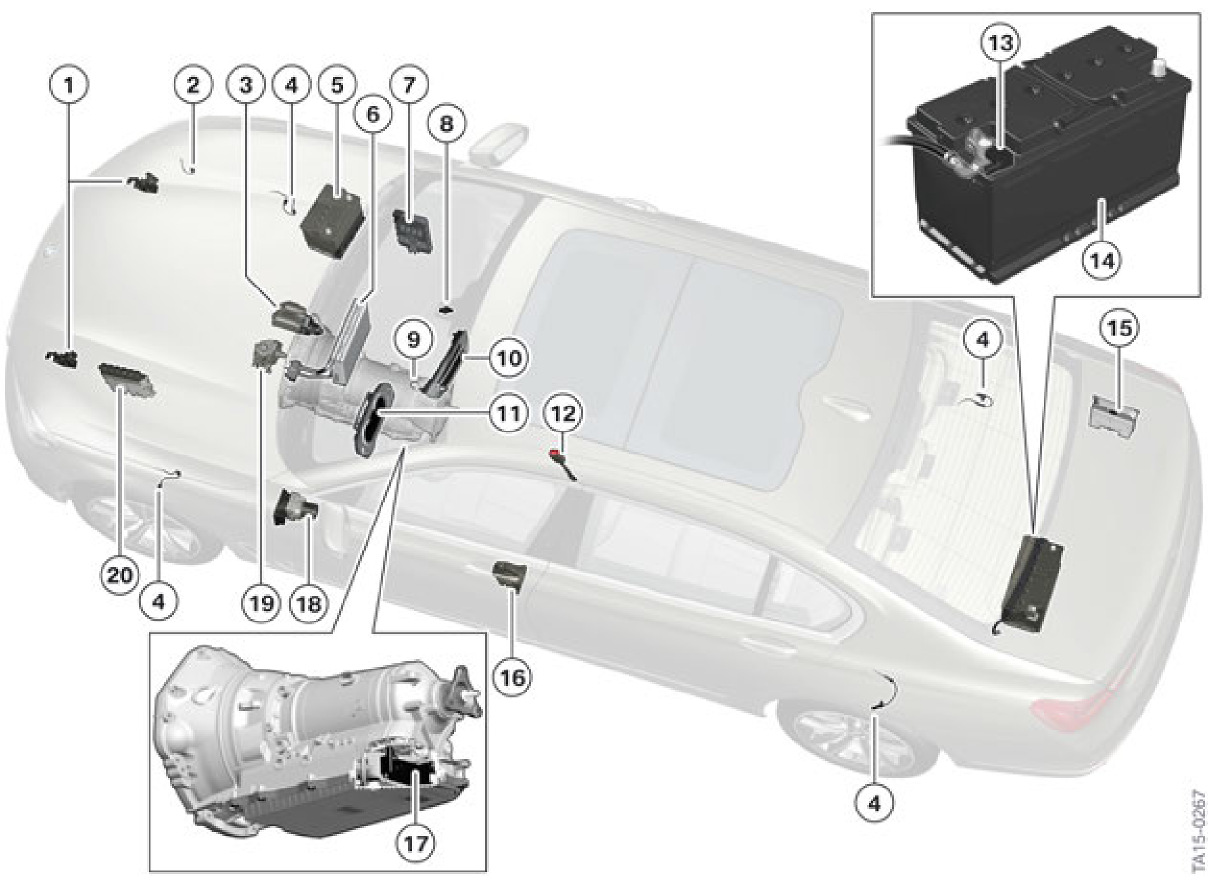
Adapter cable DME

The following new special tools are available to Service for electrical measurements on the various control unit connectors of the Digital Motor Electronics DME .

Tool	Order number
V adapter cable (24-pin)	83 30 2 352 995
V adapter cable (64-pin)	83 30 2 352 993
V adapter cable (54-pin)	83 30 2 352 992
V adapter cable (32-pin)	83 30 2 352 991
Test box set	83 30 2 352 990

6.2. Automatic engine start/stop function

The MSA 2.3 is used for the model launch of the G12.



MSA 2.3 system components

Index	Explanation
1	Engine compartment lid contact switch
2	Outside temperature sensor
3	Starter
4	Wheel speed sensor
5	AGM battery 60 Ah (For EARS)
6	Evaporator
7	Body Domain Controller (BDC)
8	Condensation sensor
9	START-STOP button
10	Integrated automatic heating / air conditioning
11	Instrument cluster (KOMBI)
12	Seat belt buckle switch
13	Intelligent Battery Sensor (IBS)
14	AGM battery 105 Ah
15	Power Control Unit (PCU) (DC/DC converter)
16	Door contact
17	Hydraulic impulse storage
18	Dynamic Stability Control (DSC)
19	High pressure pump
20	Digital Motor Electronics (DME)

The operating logic is known from the current BMW models. Only the changes that will be introduced with the MSA 2.3 will be described in this section.

The comfort and availability of MSA 2.3 have been further increased compared with MSA 2.2. The following measures help enhance the comfort:

- The automatic engine start-stop function is initiated at < 3 km/h / < 1.8 mph. This increases the availability of the automatic engine start-stop function and makes it easier for customers to understand its operation.
- The automatic engine start-stop function stop is also initiated when the vehicle is at a standstill on uphill and downhill gradients.
- Starting times and starter turning over are reduced.
- Initiation of automatic engine start-stop function stop at driver request.
- Prevention of automatic engine start-stop function stop by targeted "underbraking".
- Reflex start up to higher engine speed is possible in the event of a sudden change in mind.
- Improved stopping and starting comfort.
- Manoeuvrability during automatic engine start-stop function coasting.
- Manoeuvrability during reflex start.
- Steering when at standstill during engine shutdown (straighten steering wheel).

6.2.1. Automatic mode

The automatic engine start-stop function is ready for operation following every engine start.

The automatic engine start-stop function is activated as from a certain driving speed:

- > 5 km/h / > 3 mph

6.2.2. Driving

As long as the vehicle is in motion the driver will not be aware of the automatic engine start-stop function.

Index	Explanation
1	Vehicle moving.
2	Selector lever in drive position "D", driver operates accelerator pedal.
3	Engine running, the engine speed display and fuel consumption display correspond to the driving situation.

The goal of the automatic engine start-stop function is to switch off the engine when the vehicle speed falls below 3 km/h / 1.8 mph on the flat or when the vehicle is at a standstill on uphill and downhill gradients.

6.2.3. Stopping

The stopping process with subsequent engine stop from the driver's point of view is as follows:

Index	Explanation
1	Vehicle is decelerated at a red traffic light, for example.
2	Selector lever remains in the "D" drive position, driver presses the brake pedal to decelerate the vehicle and the vehicle speed drops to < 3 km/h / 1.8 mph or = 0 km/h / 0 mph on uphill or downhill gradients.
3	Engine is switched off, engine speed display shows “Ready”. The vehicle is held by the DSC hydraulics on uphill or downhill gradients.

In the situation depicted above the driver holds the vehicle at a standstill by operating the brake pedal.

Alternatively, the driver can move the selector lever from the "D" to the "P" position and release the brake pedal. The engine remains switched off.

6.2.4. Pullaway

The driver indicates his intention to drive off by releasing the brake pedal then operating the accelerator pedal.

Index	Explanation
1	Driver wishes to continue the journey (green light).
2	The selector lever remains in the "D" drive position, driver releases the brake pedal and then operates the accelerator pedal.
3	The engine is started, the engine speed display changes from “Ready” to idle speed. The vehicle drives off upon subsequent operation of the accelerator pedal. The DSC hydraulics is additionally released on uphill and downhill gradients.

If the driver held the car at a standstill up to this point by operating the brake pedal, the engine starts as soon as the driver releases the brake pedal.

If the driver put the selector lever into position "P" after the engine was switched off automatically, the engine starts automatically if the selector lever is now moved to position "D".

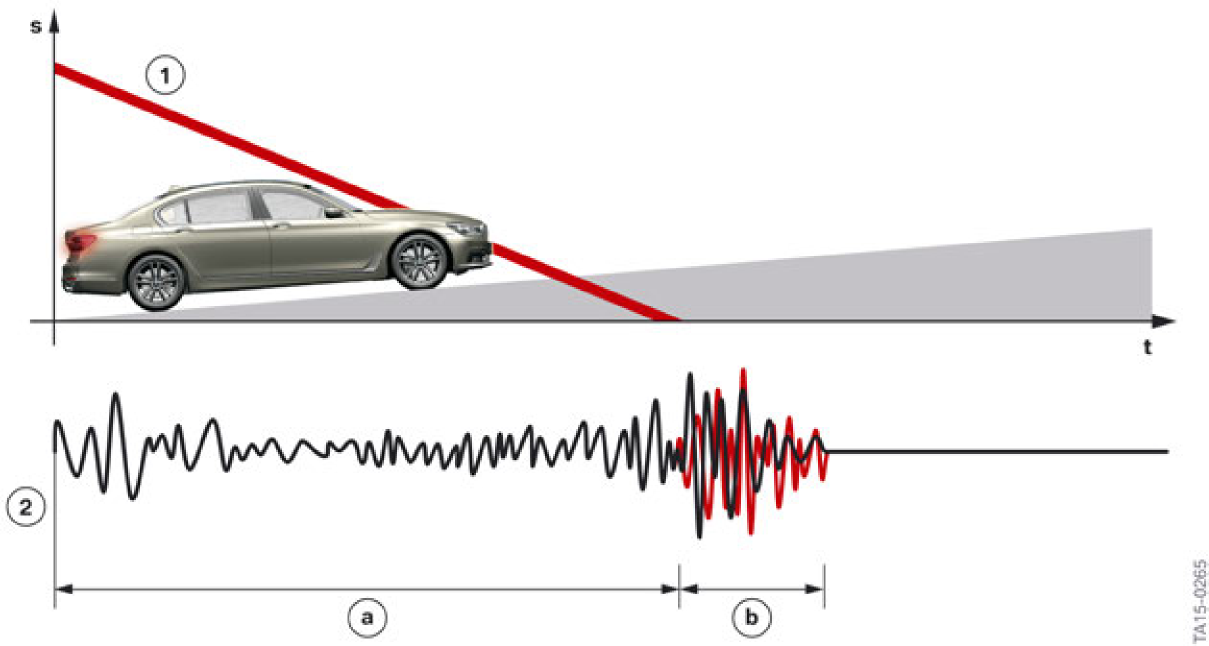
In this case, the automatic engine start is activated by the DSC control unit that monitors the brake pressure, and not automatically via a signal from the brake light switch.

Automatic Hold

If the driver has activated the "Automatic Hold" function, he can also release the brake pedal once the vehicle has come to a standstill. The automatic engine start-stop function also switches the engine off in this case. The vehicle is held at a standstill by the DSC hydraulics. The engine only starts when the driver operates the accelerator pedal.

6.2.5. Automatic engine start-stop function stop on uphill gradients

In contrast to the MSA 2.2, which immediately stopped the engine only up to an uphill or downhill gradient (up to approx. 3.5 %), with the MSA 2.3 the engine is also stopped on uphill or downhill gradients at vehicle standstill. .



MSA 2.3 stopping deceleration on uphill gradient

Index	Explanation
1	Vehicle speed
2	Vehicle excitation
a	Roadway excitation
b	Stopping jerk of the vehicle

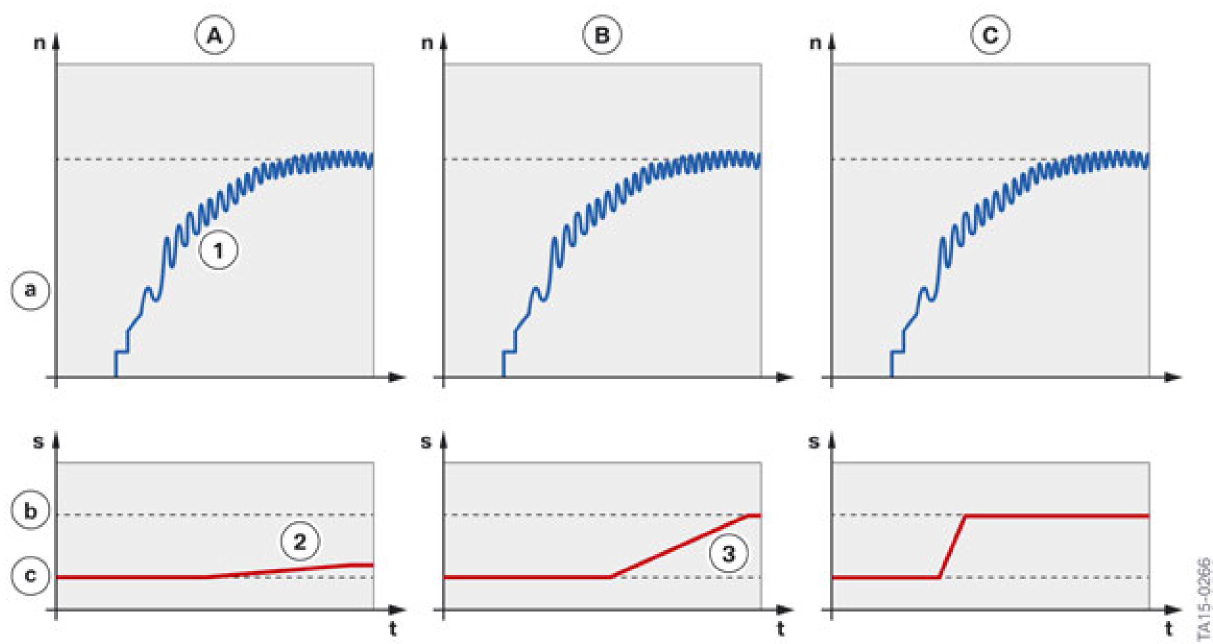
This is made possible by communication of the MSA via the engine control DME, electronic transmission control (EGS) and Dynamic Stability Control (DSC). If an engine stop is initiated via MSA 2.3, the vehicle is simultaneously also held on uphill gradients via the DSC hydraulics (drive-off assistant). The vehicle does not roll back on uphill gradients even if the driver changes his mind with a so-called reflex start.

6.2.6. Comfort concept

It was possible to further improve the stopping and starting comfort by intelligent interaction of the engine control DME, electronic transmission control (EGS) and the brake DSC.

- By inclusion of the Valvetronic for the gasoline engine, the Valvetronic is adjusted almost completely to zero lift while the engine is being switched off. After the engine has stopped, the Valvetronic is adjusted to idle position again in order to be prepared for a possible engine start.
- The vehicle can also be held securely on uphill and downhill gradients for an automatic engine stop and start by targeted use of the DSC hydraulics (drive-off assistant) in combination with the MSA 2.3.
- The MSA 2.3 permits comfortable engine stopping and starting due to the fact that the transmission in the G12 can now be disconnected via the release at standstill function for the torque converter and thus for the automatic transmission. Without this release at standstill, any disturbing torque fluctuations that occur as a result of the automatic engine stop or start will be felt in the drive train.

6.2.7. Start strategy



MSA 2.3 start strategy

Index	Explanation
A	System start via release at standstill (without starting request)
B	Convenient start (start request without accelerator pedal)
C	Dynamic start (start request with accelerator pedal)
1	Engine speed
2	Release at standstill active

Index	Explanation
3	Position of multidisc clutch
a	Idle speed
b	Multidisc clutch closed
c	Multidisc clutch open

With the MSA 2.3, the automatic engine start of the G12 with automatic transmission was further optimized by use of the release at standstill function.

It is now possible to start the engine with even more comfort and without any influence on the drive train at the system start by using the release at standstill function.

System start via release at standstill	Convenient start	Dynamic start
The automatic engine start is effected by a system switch-on request (e.g. by the heating and air conditioning system), the brake pedal remains pressed.	The automatic engine start is effected by releasing the brake, the accelerator pedal is not pressed.	The automatic engine start is effected by releasing the brake, the accelerator pedal is pressed for drive off.
The engine speed is slowly increased until it reaches the idle speed.	The engine speed is slowly increased until it reaches the idle speed.	The engine speed is increased quickly.
The engine remains disconnected from the automatic transmission and thus from the drive train via the release at standstill function.	The multidisc clutch in the automatic transmission closes slowly.	The multidisc clutch in the automatic transmission closes quickly.
This means that there is no influence on the drive train, thereby preventing a longitudinal jerk by the drive train which can be felt by the driver.	Smooth and comfortable drive-off is made possible.	Quick drive off is therefore made possible.

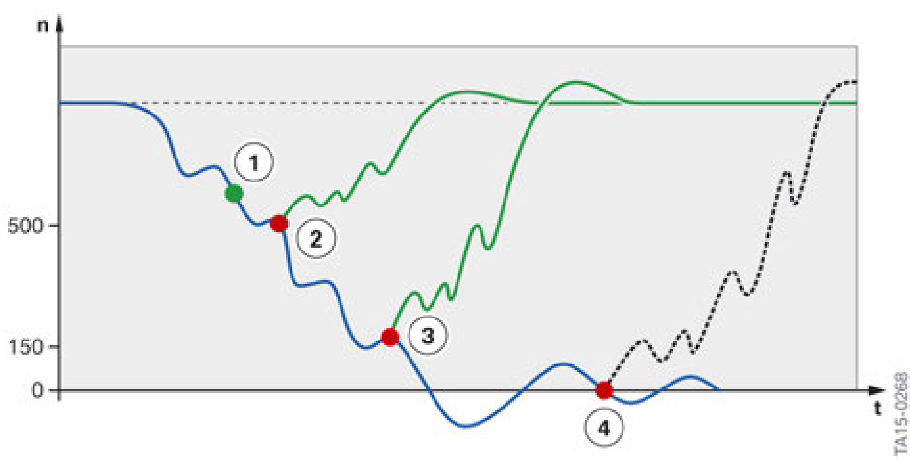
For an engine start with fewer vibrations, with the system start and convenient starting the engine speed is initially increased quickly and then slower until it reaches the idle speed. The ignition timing is adjusted to the "late" direction for this.

6.2.8. Reflex start in the event of a change in mind

The so-called reflex start is a significant challenge for the automatic engine start-stop function. This is the situation where the engine has not yet completely stopped after an automatic engine start-stop function stop, but an automatic start is already requested again. It was not possible with conventional starter motors to engage in a rotating ring gear during this reflex start. With the MSA 2.2, a new starter motor technology was used for the first time which enabled comfortable engagement up to an engine speed of 150 rpm.

With the introduction of the MSA 2.3, it has now been possible to increase this to > 500 rpm. Since the possibilities with a conventional starter motor are exhausted here, this reflex start is done by the engine control DME. This function is referred to as a “flying start”:

- Engine speed > 500 rpm
  The "flying start" function can be applied up to an engine speed of > 500 rpm. For this purpose, combustion is resumed again during the engine stopping process in the event of an automatic engine start-stop function stop and an initiated reflex start. This is achieved on the gasoline engine by targeted ignition in the relevant cylinders.
- Engine speed < 500 rpm
  If the speed drops to below 500 rpm, the "flying start" function for a reflex start is no longer possible. In this case, it is necessary to wait until the engine speed has fallen below 150 rpm. The engine can be started again by means of the starter motor when the engine speed has dropped below 150 rpm.



MSA 2.3 reflex start

Index	Explanation
1	Driver request “START”
2	“Flying start” 500 rpm (MSA 2.3)
3	Engagement with starter motor KSopt150 150 rpm (MSA 2.2)
4	Engagement with starter motor KSopt0 0 rpm (MSA 2.1)

The abbreviation KSopt stands for optimized conventional starter motor.
KSopt150: Reinforced starter motor that can engage up to 150 rpm.
KSopt0: Reinforced starter motor that can engage only at engine standstill.

6.2.9. Automatic engine stop at driver request

Under certain conditions, it is possible that the driver would like to initiate an automatic engine start-stop function stop, e.g. with active switch-off inhibitor.

Index	Explanation
1	Vehicle is decelerated to a standstill at a red traffic light, for example. The engine continues running.
2	After the vehicle has come to a standstill, the brake pedal is briefly pressed forcefully and then is immediately held with the usual pedal force or "P" is selected briefly.
3	Engine is switched off, engine speed display shows “Ready”.

6.2.10. Manoeuvrability for automatic engine start-stop function coasting or stop

With MSA 2.3, steering is possible during automatic engine start-stop function coasting below V < 3 km/h / 1.8 mph or when the vehicle is stopped V = 0 km/h. In addition, a second 60 Ah AGM auxiliary battery may be used, depending on the optional equipment (SA), which supports the vehicle electrical system at engine standstill, e.g. in the automatic engine start-stop function stop phases, and thus also supports steering via the EPS when coasting below V > 3 km/h / 1.8 mph or in the event of an engine standstill V = 0 km/h.

Further information on the voltage supply for the 12 volt systems is provided in the Technical Training Manual “G12 General Vehicle Electronics”.

6.2.11. Switch-off inhibitors

Under certain conditions it is necessary to suppress the automatic engine start-stop function. The following parameters change with the MSA 2.3 compared with the MSA 2.2:

- The vehicle is rolling on uphill or downhill gradients (driving speed > 1 km/h / .6 mph).
- The ambient temperature is above 35 °C / 95°F with the air conditioning switched on (30 °C / 86°F for MSA 2.2).

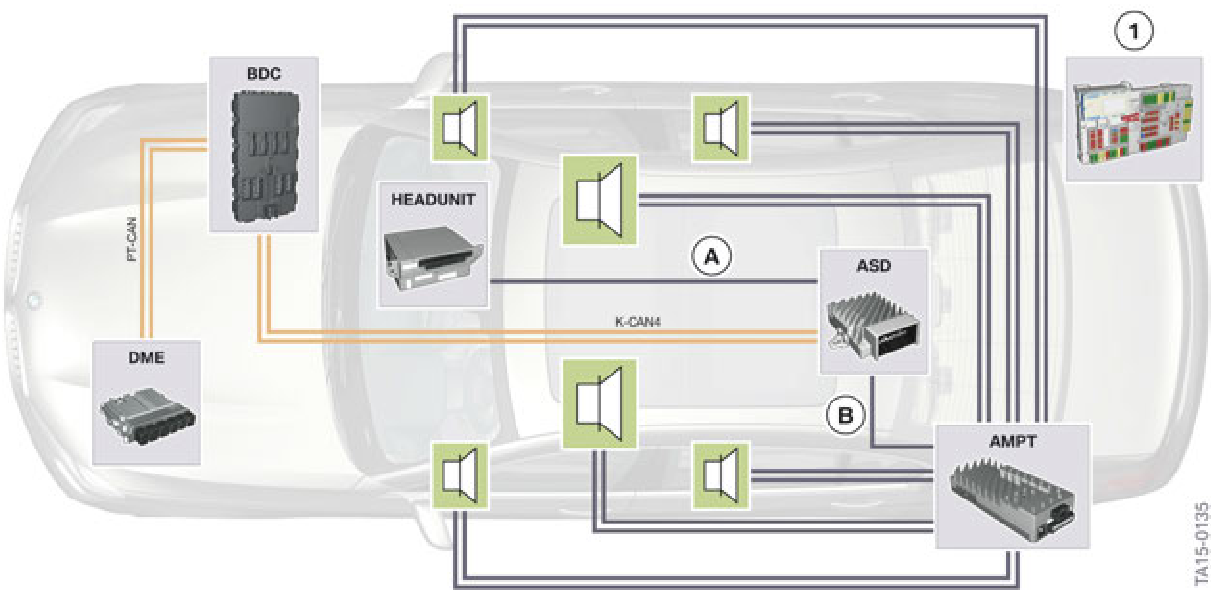
6.2.12. Switch-on prompts

Conversely, it may also be necessary to start the engine. The following parameters change with the MSA 2.3 compared with the MSA 2.2:

- The ambient temperature is above 35° C / 86°F with air conditioning switched on.
- the vehicle rolls (vehicle speed > 3 km/h / > 1.8 mph).

6.3. Active Sound Design (ASD)

With Active Sound Design ASD, the sound of the respective engine is **not** changed but is emphasized depending on the selected driving mode.



Active Sound Design ASD in the G12

Index	Explanation
A	Audio signal of the headunit
B	Audio signal of the Active Sound Design (ASD) control unit (processed audio signal for perfect engine sound)
1	Rear right power distribution box
AMP	Amplifier
ASD	Active Sound Design control unit
BDC	Body Domain Controller
DME	Digital Motor Electronics
Head unit	Control unit for entertainment and infotainment functions
K-CAN4	Body CAN4
PT-CAN	Powertrain CAN

6. Engine Electrical System

The engine control unit controls the Active Sound Design (ASD) of the vehicle using characteristic data such as engine speed, load and driving speed. The ASD transports the optimum sound into the vehicle interior.

The Active Sound Design (ASD) can be temporarily deactivated during a test drive (noise analysis drive) by means of the BMW diagnosis system ISTA. However, permanent deactivation of the ASD is not possible. If the ASD is deactivated via the ISTA function "ASD muting ON", the ASD will remain switched off only until the next terminal change.

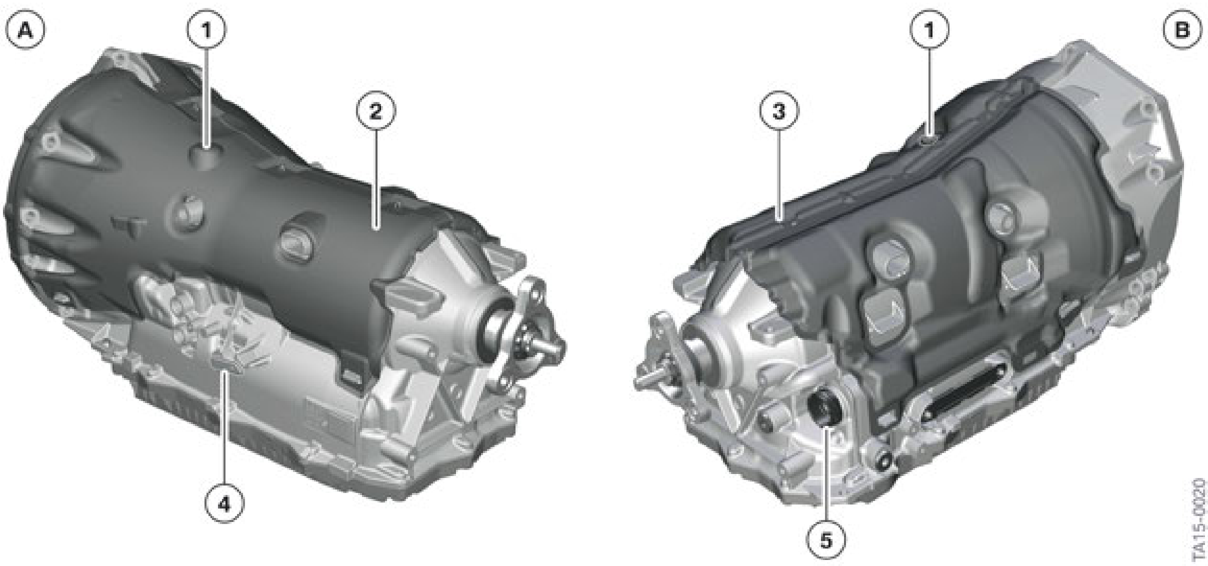
⚠

A deactivated ASD is activated again after every terminal change.

G12 Powertrain

7. Automatic Transmission

The G12 vehicle is equipped with the revamped 8HPTU automatic transmission, which is already known from the F23 (2 Series convertible) and F85/F86 (X5 M, X6 M).



8HPTU automatic transmission with acoustic encapsulation in the G12

Index	Explanation
A	8HPTU for 6-cylinder engines
B	8HPTU for 8-cylinder engines
1	Transmission breather
2	Acoustic encapsulation (three-part)
3	Acoustic encapsulation (two-part)
4	Mechanism for emergency release
5	Electrical connection (mechatronics to vehicle electrical system)

7.1. Transmission variants

Different transmission variants are used depending on the engine installed.

Engine	GA8HP50Z	GA8HP75Z
6-cylinder gasoline engine (B58)	X	
8-cylinder engine gasoline engine (N63TU2)		X

7. Automatic Transmission

7.2. Highlights

The following further developments made it possible to increase the comfort, dynamics and efficiency of the revamped 8-speed automatic gearbox:

- Improved driving comfort through hot-end decoupling of the rotational imbalance of the engine by means of a centrifugal pendulum.
- Improved shifting comfort through slightly increased gear steps (2 modified planetary gear sets).
- Increased efficiency through optimum gear spread and gear stepping.
- Reduction of vehicle-specific insulation measures due to acoustic encapsulation on the transmission.
- Functional enhancements in the area of ConnectedShift.
- Enhanced customer experience due to new operating possibilities with the driving experience switch or shift paddles.

7.3. Description

The following table provides an overview of the composition of the different transmission codes.

Position	Meaning	Index	Explanation
1	Description	G	Transmission
2	Type of transmission	A	Automatic transmission
3	Number of gears	6 8	6 forward gears 8 forward gears
4	Type of transmission	HP	Hydraulic planetary gear train
5 + 6	Transferable torque	19 26 32 45 (General Motors Powertrain) 45 (Zahnradfabrik Friedrichshafen) 50 70 90 95	300Nm 600 Nm 720Nm 350Nm 450 Nm 500Nm 700 Nm 900Nm 950Nm
7	Manufacturer	G J R Z H	Getrag Jatco General Motors Powertrain Zahnradfabrik Friedrichshafen In-house part

7.4. Technical data

The 8HPTU modular transmissions 8HP50 and 8HP75 replace the established 8-speed automatic transmissions 8HP45 and 8HP70, which had their series introduction in the F07 in 2009.

The following table shows a comparison of the two transmission generations.

Technical data	Unit	8HP50 (new)	8HP45 (old)	8HP75 (new)	8HP70 (old)
Maximum input power, gasoline	kW	260	240	350	380
Maximum input torque, gasoline	Nm	500	450	700	700

The following table shows the different transmission ratios in the different drive positions of the respective automatic transmissions.

Drive position	8HP50 (new)	8H75/95 (new)	8HP45 (old)	8HP70/90 (old)
1st gear	5.000	5.000	4.714	4.714
2nd gear	3.200	3.200	3.143	3.143
3rd gear	2.143	2.143	2.106	2.106
4th gear	1.720	1.720	1.667	1.667
5th gear	1.314	1.313	1.285	1.285
6th gear	1.000	1.000	1.000	1.000
7th gear	0.822	0.823	0.839	0.839
8th gear	0.640	0.640	0.667	0.667
Reverse gear	3.456	3.478	3.295	3.317
P	—	—	—	—
N	—	—	—	—
Spread	7.81	7.81	7.07	7.07

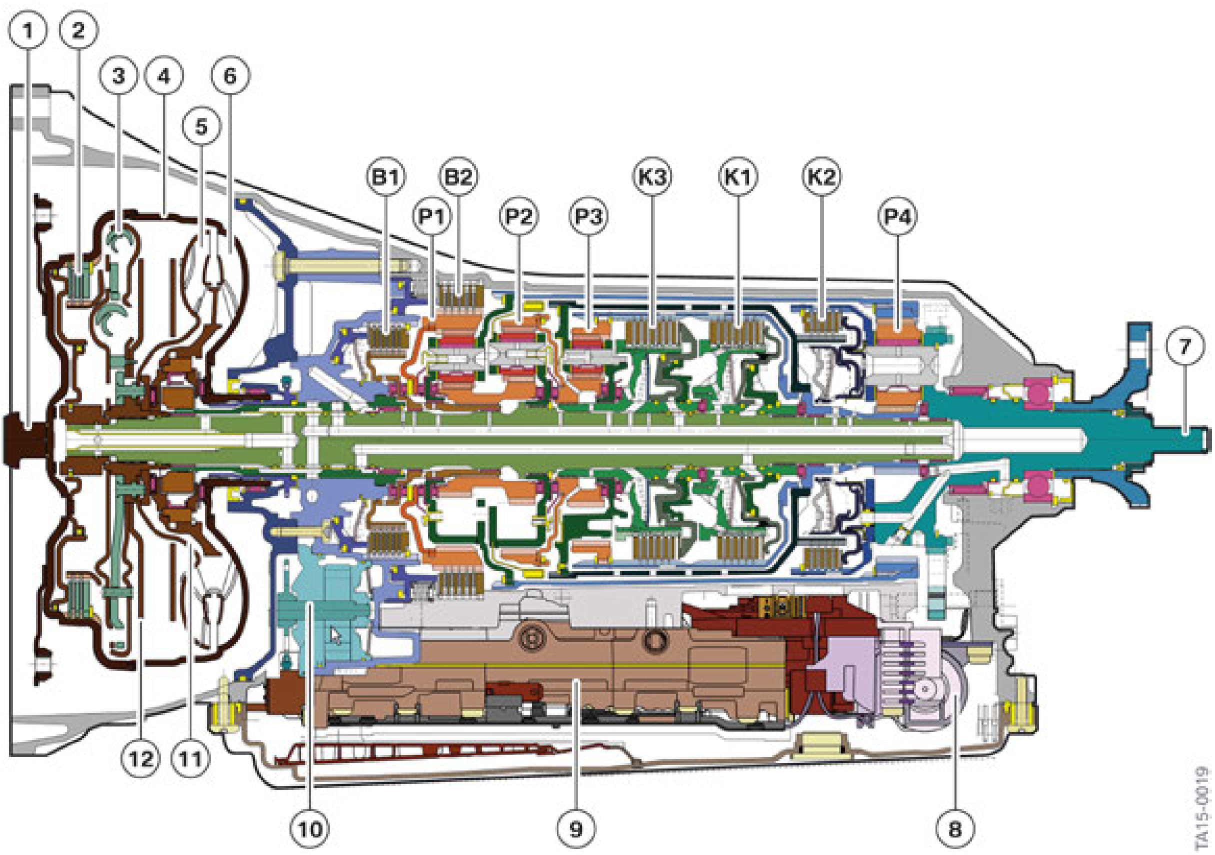
The spread is defined by the ratio between the lowest and highest gears. The spread can be calculated as follows:

- Ratio of 1st gear : ratio of 8th gear = spread.

Example calculation of spread for the 8HP50 (new) transmission:

- 5.000 : 0.640 = 7.81.

7.5. Shift matrix



Overview of automatic transmission 8HPTU in the G12

Index	Explanation
1	Guide pin
2	Converter lockup clutch
3	Spring/Damper system
4	Torque converter
5	Turbine wheel
6	Impeller
7	Transmission output shaft
8	Hydraulic impulse storage
9	Mechatronics
10	Vane-type compressor
11	Stator
12	Centrifugal pendulum
B1	Brake1

7. Automatic Transmission

Index	Explanation
B2	Brake2
K1	Clutch 1
K2	Clutch 2
K3	Clutch 3
P1	Planetary gear set 1
P2	Planetary gear set 2
P3	Planetary gear set 3
P4	Planetary gear set 4

The following table shows the shift matrix of the different gears of the 8-speed automatic transmission.

Drive position	Brakes		Clutch		
	B1	B2	K1	K2	K3
1st gear	X	X	X	—	—
2nd gear	X	X	—	—	X
3rd gear	—	X	X	—	X
4th gear	—	X	—	X	X
5th gear	—	X	X	X	—
6th gear	—	—	X	X	X
7th gear	X	—	X	X	—
8th gear	X	—	—	X	X
Reverse gear	X	X	—	X	—
P	X	—	—	—	—
N	X	—	—	—	—
Spread	—	—	—	—	—

7.6. Torque converter with centrifugal pendulum

In order to reduce fuel consumption and carbon dioxide emissions, high-charged engines are used, the number of cylinders is reduced and the drivable speeds are lowered.

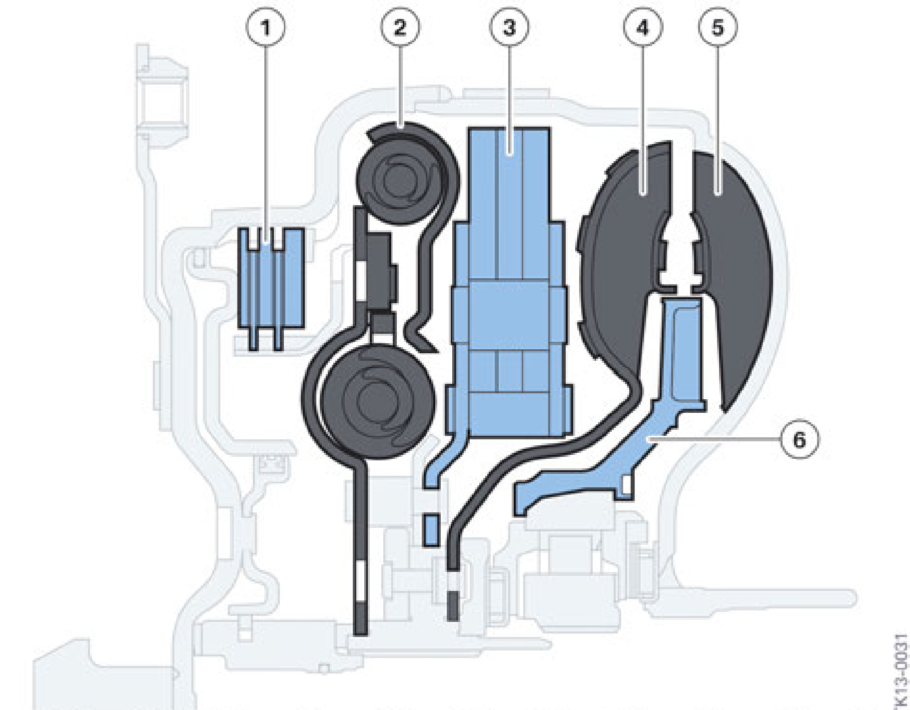
However, with these measures the rotational imbalance at the crankshaft is increased which is caused by the acceleration during the power cycle and deceleration during the compression cycle. This irregular rotation is the reason for torsional vibrations in the drive train.

The occurring torsional vibrations near the source, i.e. in the torque converter, are therefore minimized.

7. Automatic Transmission

When the converter lockup clutch is open there is a difference in speed or a slip in the torque converter between pump and turbine wheel. The torsional vibrations of the engine can be compensated by this slip and the hydrodynamic power transmission. However, the slip has a negative effect on the efficiency.

When the converter lockup clutch is closed there is a positive connection between the impeller and the turbine wheel. A slip is avoided, however there is no longer any vibration-reducing effect. This is why a spring/damper system is installed which reduces the torsional vibrations of the engine.

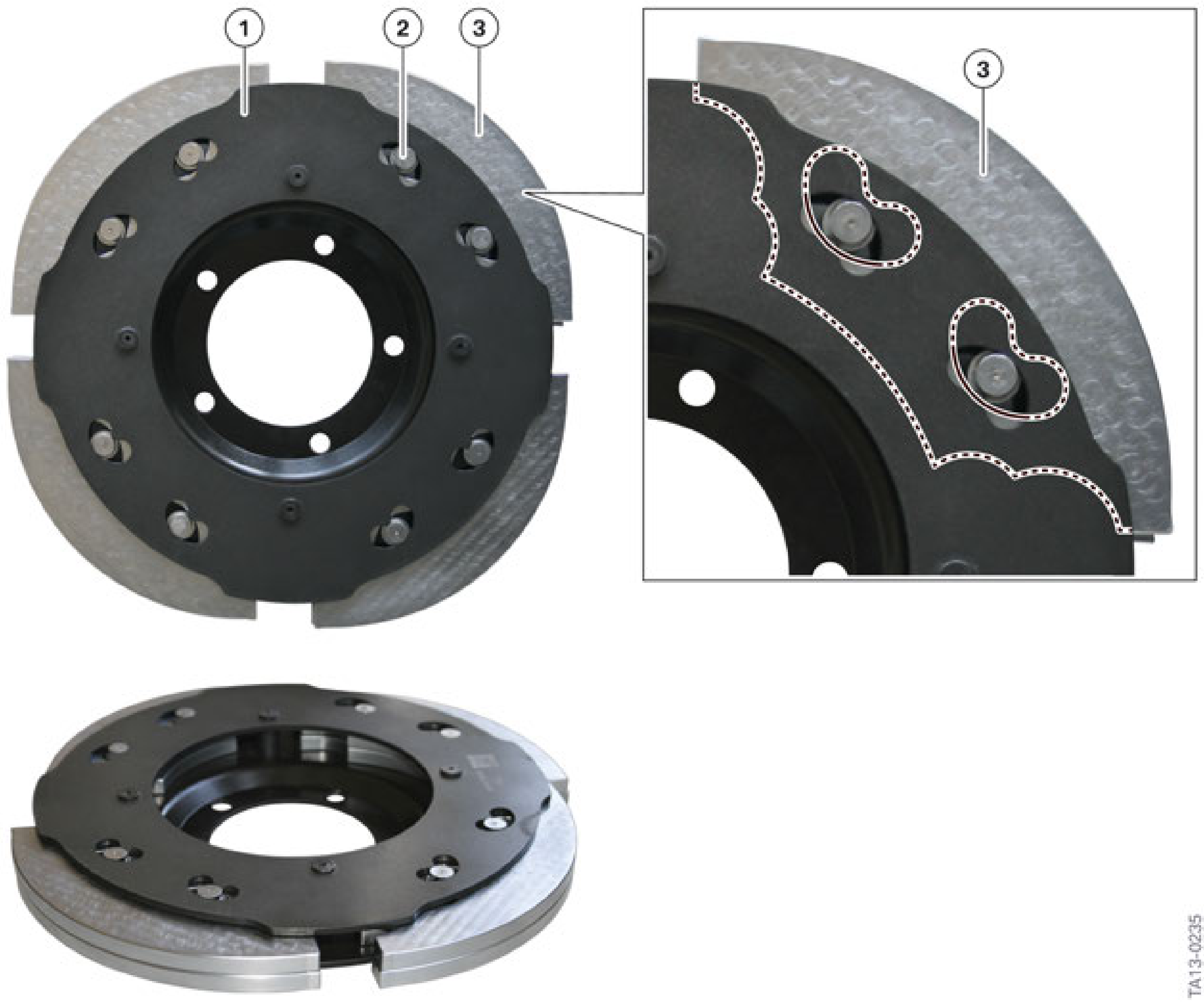


Torque converter with centrifugal pendulum

Index	Explanation
1	Converter lockup clutch
2	Spring/Damper system
3	Centrifugal pendulum
4	Turbine wheel
5	Impeller
6	Stator

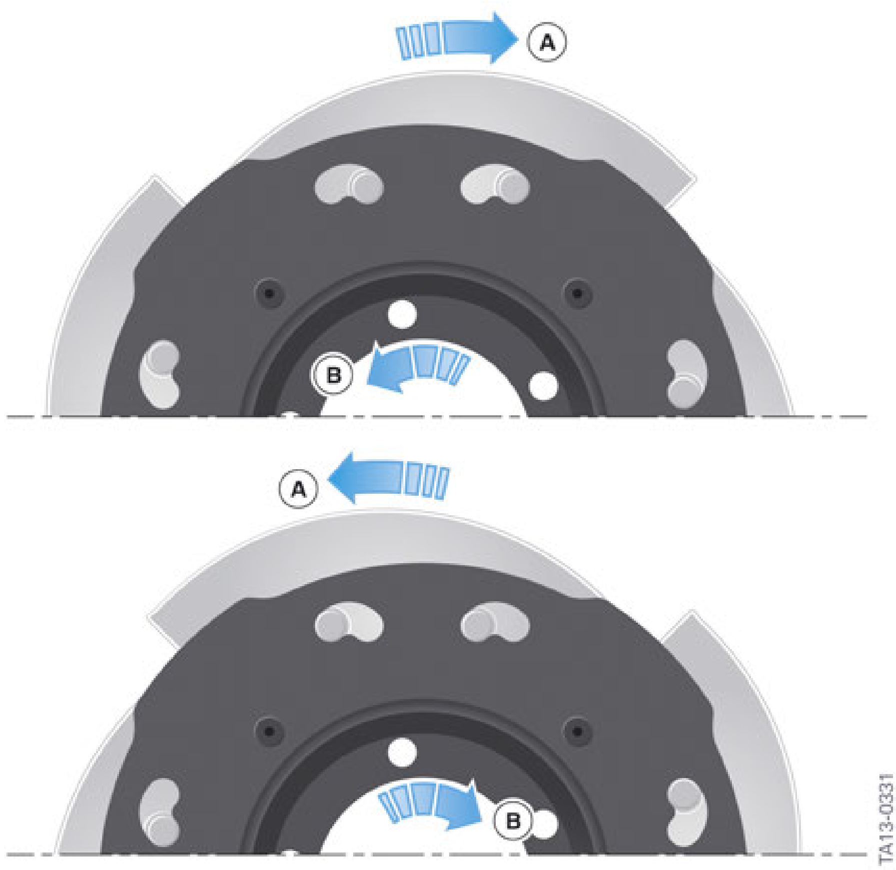
7. Automatic Transmission

The centrifugal pendulum is secured between the turbine wheel and spring/damper system.



Centrifugal pendulum

Index	Explanation
1	Sheet metal
2	Roller
3	Mass



Function of centrifugal pendulum

Index	Explanation
A	Oscillating mass
B	Torsional vibrations of the engine

The centrifugal pendulum consists of 2 guide plates which are attached to each other and which allow damping masses to move between them on defined paths. Arch-shaped curved tracks are integrated in the sheet metal and in the masses, which serve as running tracks. The damping masses are connected with the guide plates by two rollers in each case and can move along the curved paths.

The centrifugal pendulum consists of several oscillating masses (dynamic vibration absorbers). They vibrate contrary to the torsional vibrations and compensate for these. At low engine speeds, i.e. precisely when the annoying vibrations occur most, the deflection of the dynamic vibration absorbers is particularly big.

The following advantages result from deleting the torsional vibrations:

- The converter lockup clutch can remain closed over a larger engine speed range.
- The slip in the converter lockup clutch can be reduced and thus also the slip percentage in the torque converter. The efficiency is therefore improved.
- Lower engine speeds can be driven.

These measures lead to a reduction of the fuel consumption and improved acoustics in the passenger compartment.

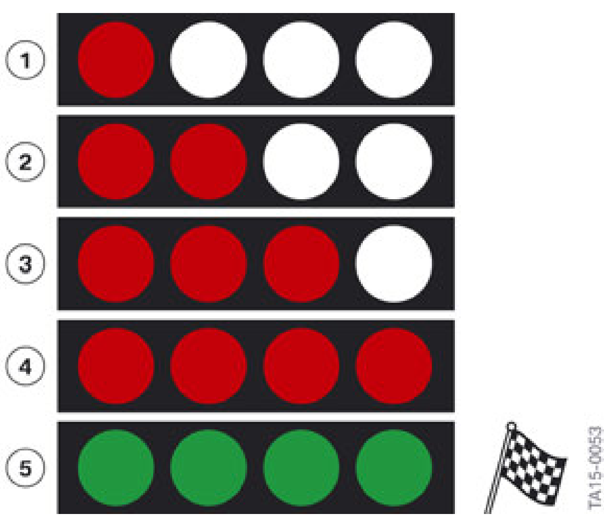
7.7. Sport automatic transmission

In the standard equipment Steptronic Sport transmission (2TB), the customer additionally receives 2 shift paddles on the steering wheel and additional functions such as the Launch Control.

7.7.1. Launch Control

As an additional customer function, vehicles with the optional equipment Steptronic Sport transmission (2TB) are equipped with a Launch Control. This function allows customers to reproduce the manufacturer's specifications for 0 - 100 km/h / 0 - 62 mph acceleration (racing start) in good ambient conditions when the transmission is at operating temperature.

The following illustration shows the 5 steps for activation of Launch Control.



Activation of Launch Control in the G12

Index	Explanation
1	Activate Dynamic Traction Control (DTC) (press DTC button briefly)
2	Move selector lever to "S" position (Sport)
3	Depress the brake very firmly and hold
4	Press accelerator pedal to kick-down
5	Release brake and hold accelerator pedal in kick-down position

The additional acceleration is achieved by shifting to the next-higher gear without reducing the engine torque.

7.7.2. Functional enhancements of the shift paddles

Shift paddles on the automatic Sport transmission of the G12

Index	Explanation
+	Upshift
–	Downshift

The driver can change to manual shift mode by means of the shift paddles. The driver can manually shift to the next higher or lower gears by actuating the +/- shift paddles.

Activation of manual shift mode in "D" position (Drive)

If one of the two shift paddles (+ or –) is pressed in "D" position, the electronic transmission control (EGS) switches to a time-limited manual shift mode. Depending on the route profile, this mode is cancelled automatically either earlier or later (normal value approximately 20 s) if one of the two shift paddles is not actuated in this time. The driving profile is detected by means of the steering wheel movements as well as the dynamic acceleration forces acting on the vehicle.

It is possible to cancel manual mode prematurely by a long pull on the + shift paddle.

7. Automatic Transmission

Activation of manual shift mode in "S" position (Sport)

If one of the two shift paddles (+/-) is actuated, the electronic transmission control (EGS) permanently switches to manual shift mode.

It is possible to cancel manual mode again by a long pull on the + shift paddle.

Activation of coasting

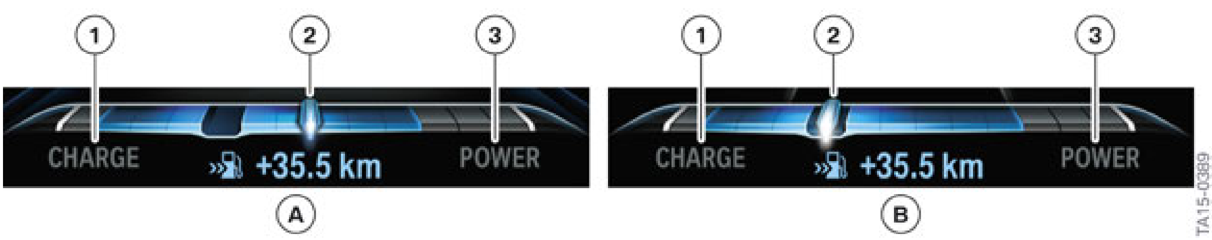
The driver can manually activate coasting mode by means of the following configuration:

- Gear selector switch in D position (Drive)
- Driving experience switch in ECO PRO mode
- Accelerator pedal not actuated
- Coasting mode activated in ECO PRO configuration menu (CID)
- Multiple operation of + shift paddle until no logical higher gear selection is possible

The vehicle now switches to coasting mode. The engine is disengaged from the transmission in coasting mode. The engine continues running at idle speed.

Coasting mode is cancelled again by actuating the – shift paddle or the accelerator pedal.

The respective mode is displayed to the driver by means of the BMW EfficientDynamics display in the instrument cluster.



BMW EfficientDynamics display in the G12

Index	Explanation
A	Coasting mode deactivated
B	Coasting mode activated
1	Energy recovery display (system battery charging)
2	BMW EfficientDynamics marker
3	Acceleration display

7.8. ConnectedShift

ConnectedShift uses the following systems for a predictive shift strategy:

- Use of the navigation data
- Use of the radar sensors

Use of the navigation data is already known from the 5 Series LCI. Use of the navigation data is mentioned in this document to better understand the system.

7.8.1. Use of the navigation data

ConnectedShift uses navigation data for a forward-thinking shift strategy of the automatic transmission. If, for example, a sharp bend is detected, the automatic transmission shifts down early and the gear is retained in the bend.

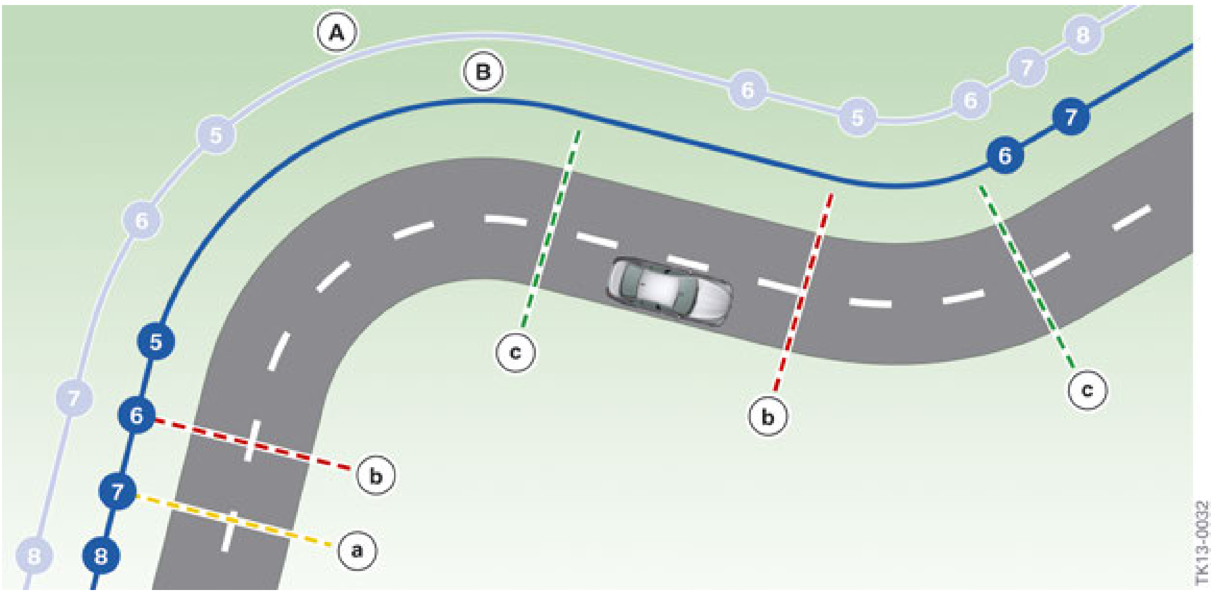
The route guidance of the navigation system does not need to be activated for the function. However, the identification of a turn-off request, for example by the active route guidance or operating the turn indicator, helps to control the system more accurately. Up-to-date navigation map data also influences the control accuracy.

Advantages

ConnectedShift offers various advantages depending on the route:

Traffic guidance	Advantages
Bend/Subsequent bend	• Higher engine braking effect before the bend • Tensile force reserve for accelerating from the bend • Optimized shift characteristics in the bend
Intersections	Upon recognized turn-off request by active route guidance or operation of the turn indicator: • Higher engine braking effect before intersections • Optimized shift characteristics in the intersections
Traffic circle	• Higher engine braking effect before the traffic circle • Tensile force reserve before entry • Optimized shift characteristics in the traffic circle and in the exit

Shift example for a vehicle with and without ConnectedShift



ConnectedShift shift example

Index	Explanation
A	Shift points without ConnectedShift
B	Shift points with ConnectedShift
a	Taking the foot off the gas (coasting (overrun) mode)
b	Slight brake control
c	Accelerator pedal is operated

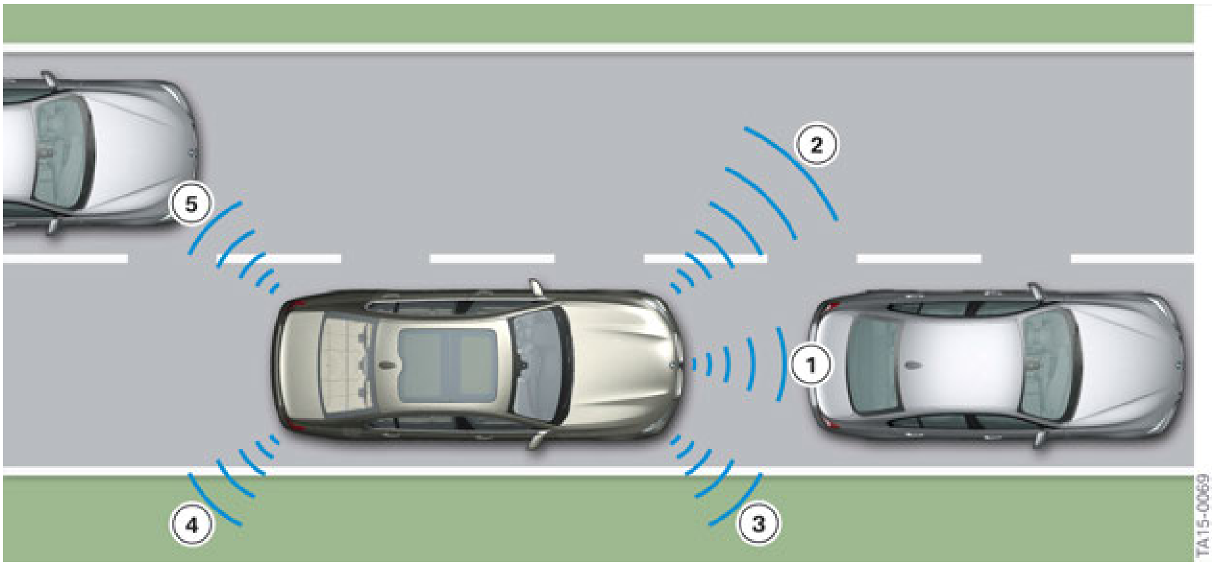
ConnectedShift can select downshifts before curves and avoid up and down shifts between consecutive curves. A higher engine braking effect before a curve is achieved, as well as a reduction of the shift frequency in curves and optimal exiting from the curves.

7.8.2. Use of radar

The radar-based ConnectedShift is new and available for the first time in a BMW vehicle.

A prerequisite for use of this function is equipment with front and rear radar systems. The following table provides information on the vehicle equipment in which a radar system is used.

equipment version	Front radar, center	Front radar, side	Rear radar
Standard version	—	—	—
Driving Assistant (5AS)	—	—	2
Active Driving Assistant Plus includes ACC Stop and Go (5AT)	1	2	2



Radar-based ConnectedShift in the G12

Index	Explanation
1	Front radar, center
2	Front radar, side left
3	Front radar, side right
4	Rear radar, side right
5	Rear radar, side left

If a vehicle detects rapid approach to an obstacle via the front radar, the electronic transmission control (EGS) automatically shifts down to a lower gear.

The lower gear offers the driver the following advantages:

- The higher engine braking torque reduces the driving speed if the driver is not trying to overtake.
- If an overtaking manoeuvre is about to take place, the driver has a higher tractive power reserve of the engine available.

In addition to the front radar, the system also uses the side radar, e.g. in order to make it easier to feed into flowing traffic thanks to an optimum gear selection.

7.8.3. Characteristics and availability

In SPORT and COMFORT modes the characteristics of ConnectedShift are adapted to the respective driving program, in ECO PRO mode ConnectedShift is not available. ConnectedShift is also not available during control operation of cruise control.

A prerequisite is that the navigation map data and the required additional information for the country are available. This is dependent on the navigation map provider and is not available worldwide for all countries.

A prerequisite for radar-based ConnectedShift is the optional equipment Active Driving Assistant Plus (5AT).

7.9. New functions

7.9.1. Transmission behavior when driving off

When the vehicle is at standstill with the brake pedal pressed and the selected drive position, a defined converter slip of the automatic transmission is **not** set as previously. Instead, the clutch remains completely open for selection of a gear (release at standstill). When the brake is released after vehicle standstill, the vehicle does **not** crawl (rolling away possible). Crawling can be activated on request by pressing the accelerator pedal. The crawl function is cancelled again only when the vehicle is once more at standstill.

7.9.2. Stepped Sport shift mode

A new feature in the G12 is an additional sport shift map which offers the driver a further configuration option between "D" (Drive) and "S" (Sport) drive positions.

7. Automatic Transmission

Activation of the additional Sport shift map D + FES Sport in the G12

Index	Explanation
1	Personalization menu on the Central Information Display (CID)
2	Configuration of automatic transmission in Sport mode
3	Gear selector switch in D (Drive)
4	Driving experience switch in Sport mode

With previous automatic transmissions, it was possible to change to Sport mode for a sporty driving style only by means of the gear selector switch.

In the G12, there is an additional stepped Sport shift mode, which can be activated as follows:

- Gear selector switch in D position (Drive)
- Driving experience switch in Sport

In stepped Sport shift mode, upshifts take place later and downshifts earlier than in D (Drive) mode. However, the shift points are not at the same level as for pure Sport mode (gear selector switch in S).

The stepped Sport shift mode can be activated or deactivated by means of the personalization menu on the Central Information Display (CID).

This additional configuration option allows the driver to adapt the vehicle to his gearshift wishes more exactly.

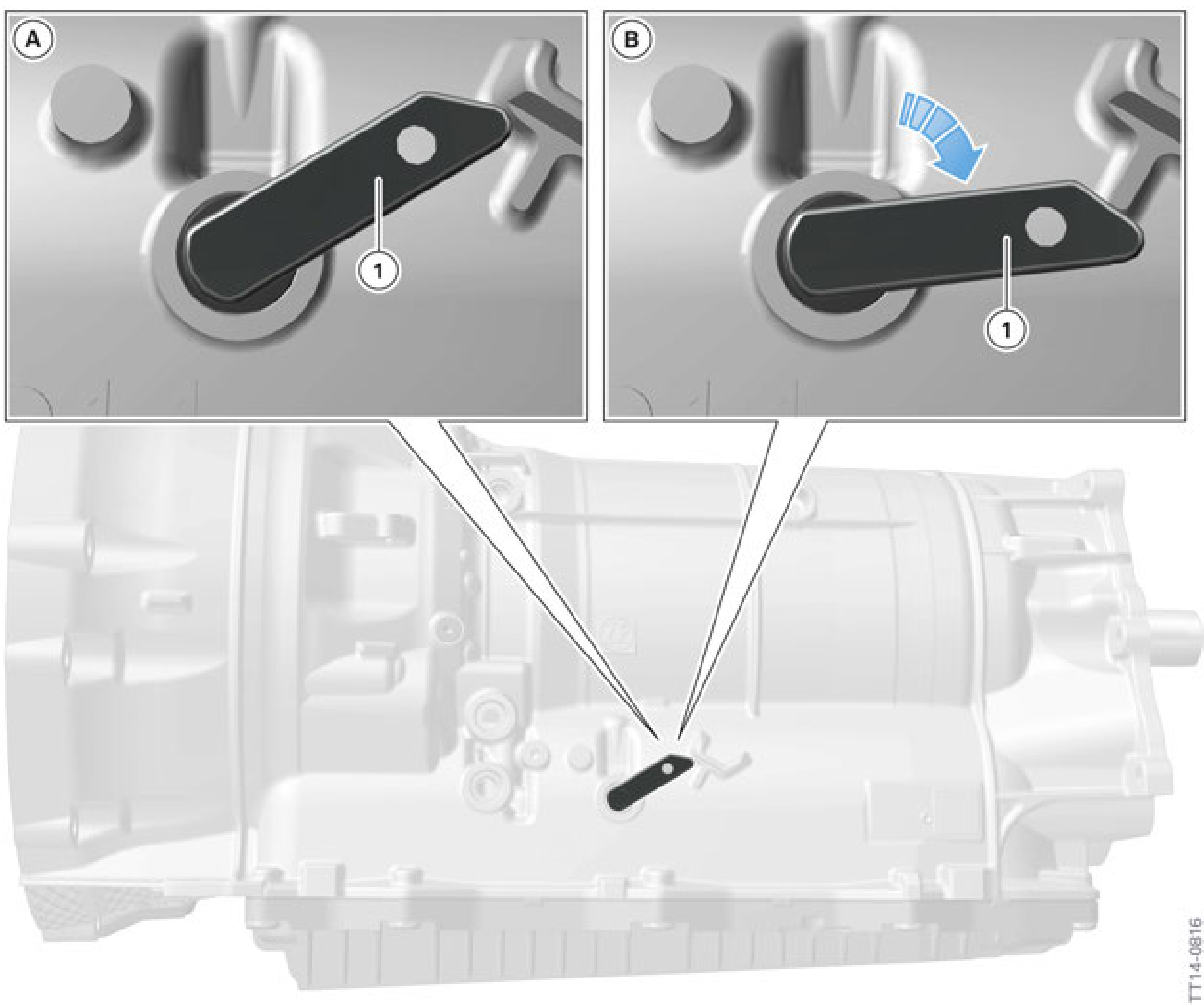
7.10. Transmission emergency release

Transmission emergency release:

1 Mechanical transmission emergency release.
2 Electronic transmission emergency release.

7.10.1. Mechanical transmission emergency release

The mechanical transmission emergency release has also been modified. For this purpose the parking lock lever must be secured using a new special tool (order number 83 30 2 355 850) in the position pictured below.



F23 mechanical transmission emergency releaseGA8HP50Z

Index	Explanation
A	Transmission parking lock engaged
B	Transmission parking lock released
1	Parking lock lever

⚠

The mechanical transmission emergency release may only be operated by trained Service personnel. The vehicle must be secured to prevent it from rolling away during emergency release.

7.10.2. Electronic transmission emergency release

Operation of the electronic transmission emergency release was simplified in the G12. The required conditions and procedure are explained in more detail below.

Electronic transmission emergency release is possible only when the engine does not start but the starter motor turns.

The electronic transmission emergency release is active for 30 minutes. Wheel speed signals due to movement of the vehicle do not have any influence on the predefined period, but they prevent the parking lock from being engaged as long as they are transmitted. If a vehicle is moved shortly before expiry of the 30 minutes, for example, the parking lock will be engaged only when the vehicle comes to a standstill again. The time specified is also dependent on the battery capacity. Time-independent activation of the parking lock takes place if the battery voltage falls below defined voltage thresholds.

⚠

The vehicle must be secured to prevent it from rolling away before performing electronic transmission emergency release!

Electronic transmission emergency release in the G12

Index	Explanation
1	Press brake pedal and hold down during the procedure.
2	Press start/stop button and hold down during the procedure.
3	Press release button at electronic gear selector switch.
4	Press and hold down release button, move the gear selector switch to N position and hold in this position for approx. 5 seconds.
5	As soon as N (neutral) has been engaged in the transmission, a Check Control message will appear in the instrument cluster.
6	The brake pedal, start/stop button, gear selector switch and release button can be released.

The following conditions can prevent or impede electrical transmission emergency release:

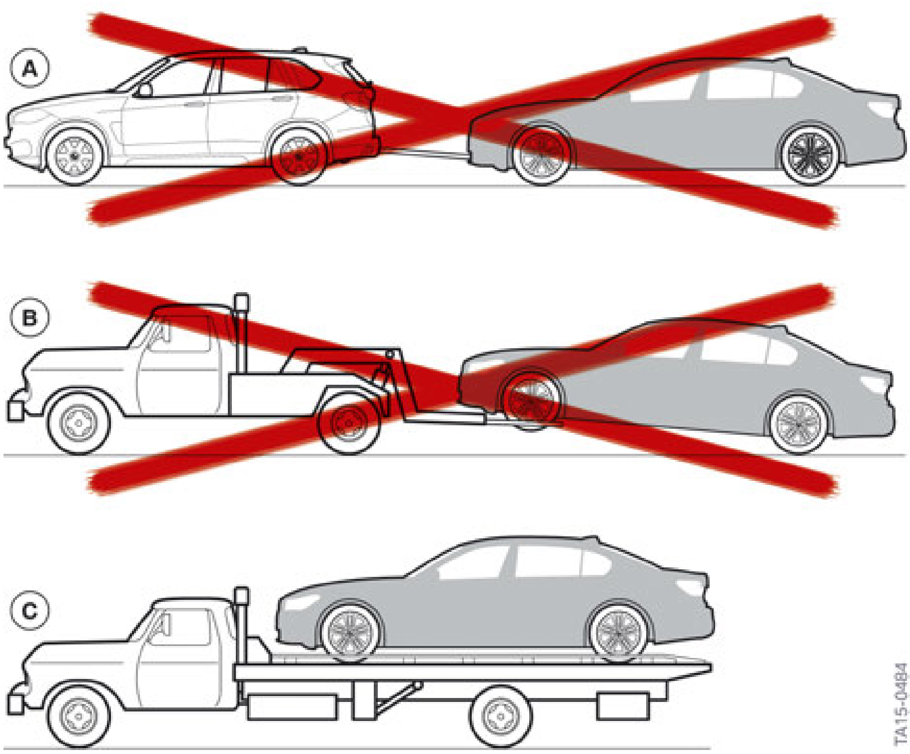
- If the vehicle is on an incline (tensioning in the drive train).
- At very high or low transmission oil temperatures (modified viscosity).

⚠

The vehicle is only capable of manoeuvring and **cannot** be towed after successful electronic transmission emergency release.

Detailed information on the electronic transmission emergency release is provided in the corresponding repair instructions and in the Owner's Handbook.

7.11. Towing



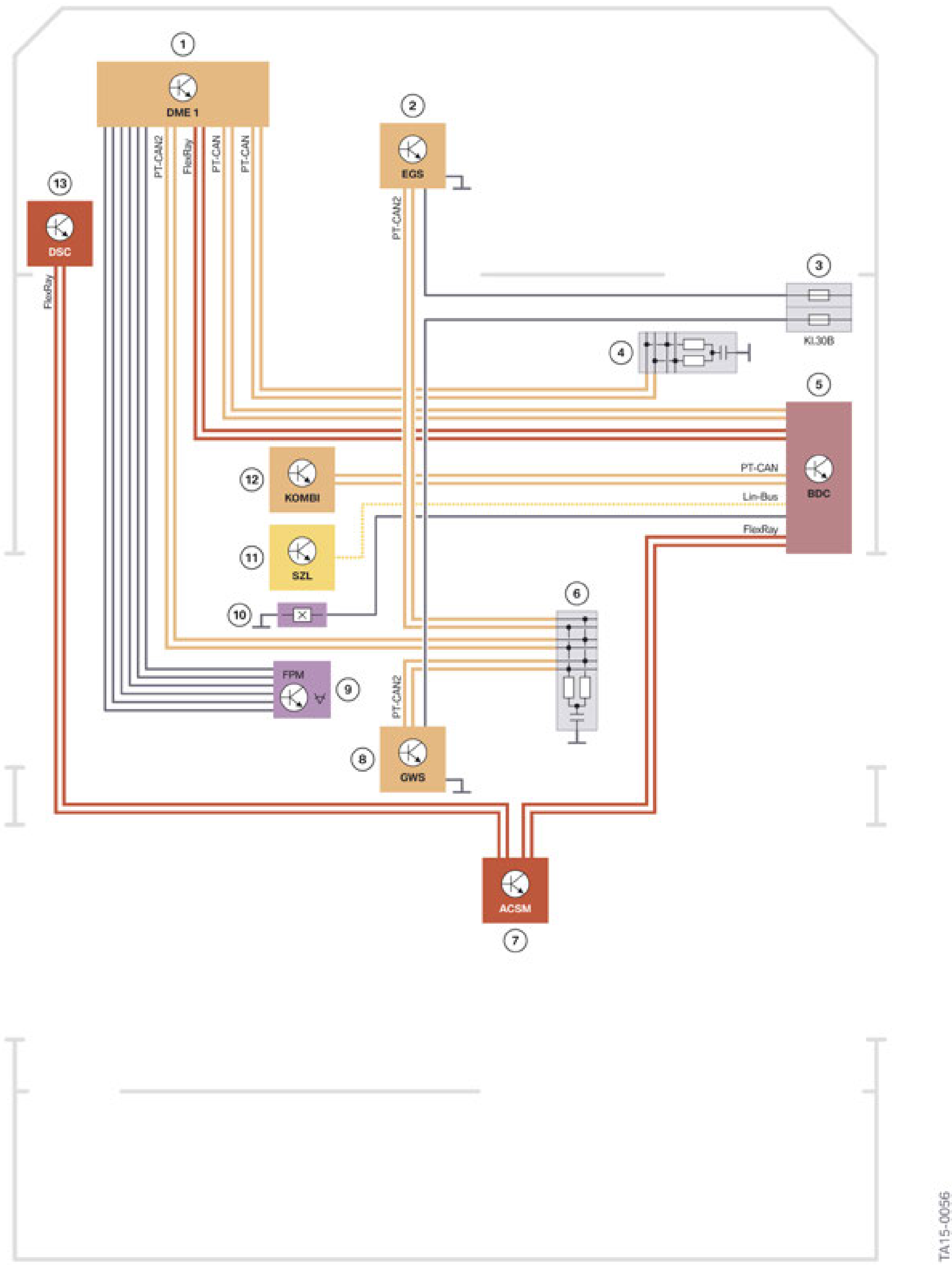
Towing the G12

Index	Explanation
A	Towing on both vehicle axles
B	Towing on the rear vehicle axle
C	Recovery on a transport deck

7. Automatic Transmission

Towing of the automatic transmission on the driven vehicle axle is **not** permitted. Limited time and speed-dependent towing would not technically damage the automatic transmission, but permanent release of the parking lock cannot be guaranteed due to the changed mechanical and electronic transmission emergency release. Sudden engagement of the parking lock during a towing operation on the driven vehicle axle can lead to damage to the vehicle and to serious accidents.

7.12. System wiring diagram



System wiring diagram of electronic transmission control EGS in the G12

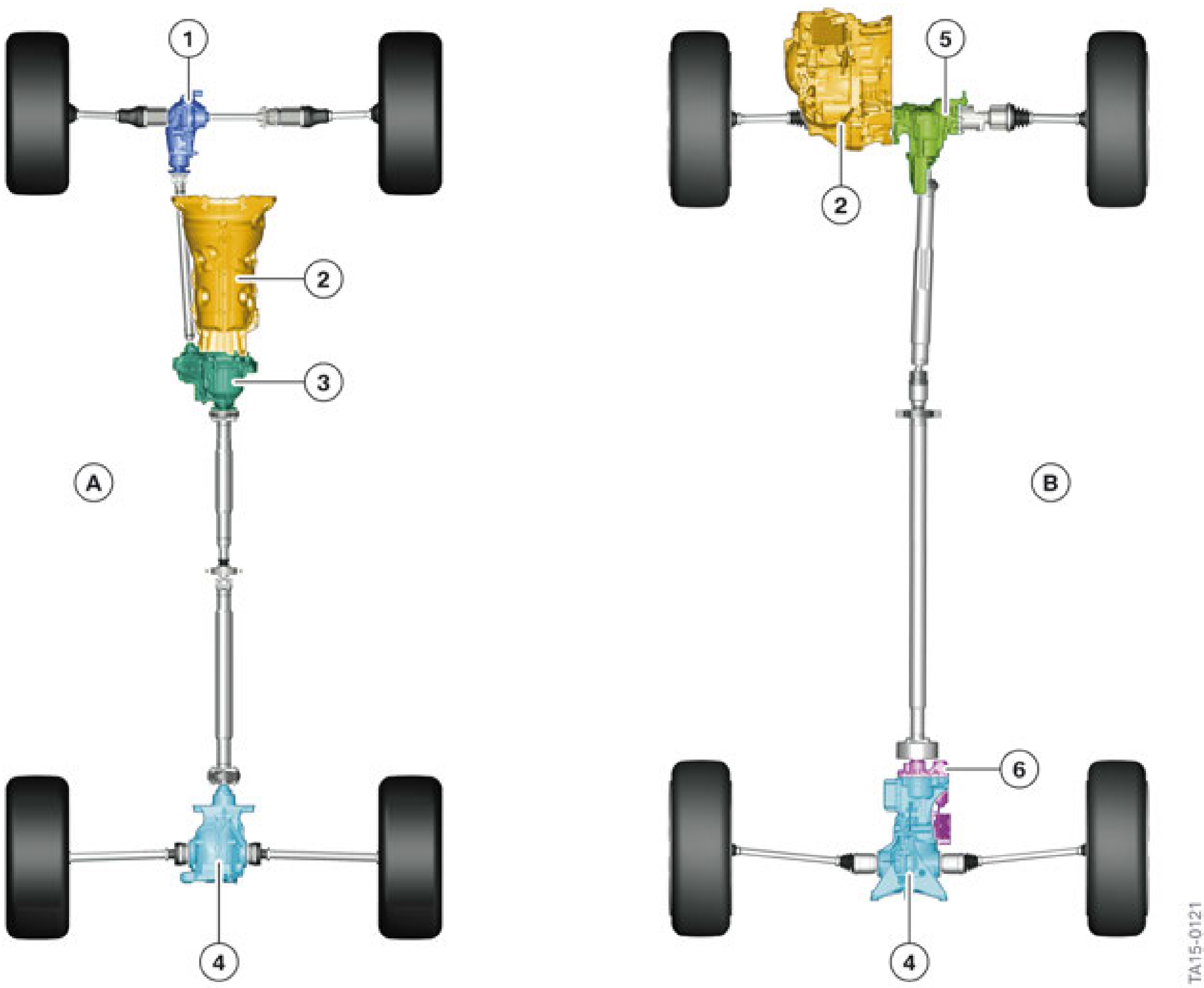
7. Automatic Transmission

Index	Explanation
1	Engine control unit (DME)
2	Electronic transmission control (EGS)
3	Power distribution box, front right
4	CAN terminator 4
5	Body Domain Controller (BDC)
6	CAN terminator 5
7	Advanced Crash Safety Module (ACSM)
8	Gear selector switch (GWS)
9	Accelerator pedal module
10	Brake light switch
11	Steering column switch cluster
12	Instrument panel (KOMBI)
13	Dynamic Stability Control (DSC)

8. Four-Wheel Drive

8.1. Overview of all-wheel drive systems

The all-wheel drive variants used at BMW differ with respect to the different drive platforms. Although the all-wheel drive system of the front-wheel drive-based vehicles such as the X1 F48 differs from that of the rear-wheel drive-based vehicles, both all-wheel drive systems are referred to as xDrive at BMW.



Overview of all-wheel drive systems in the different series

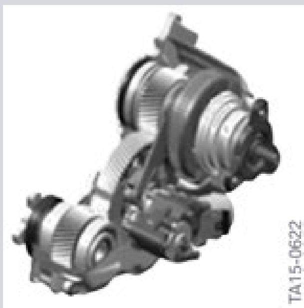
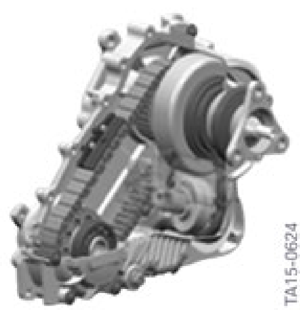
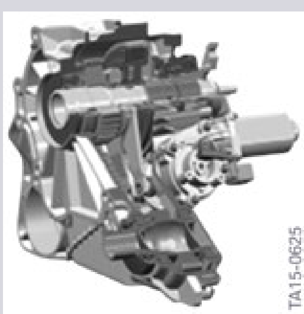
Index	Explanation
A	Rear-wheel drive-based xDrive
B	Front-wheel drive-based xDrive
1	Front axle differential
2	Manual gearbox or automatic transmission
3	Transfer box
4	Rear axle final drive
5	Bevel gears
6	Longitudinal torque distribution (integrated in the rear axle differential)

G12 Powertrain

8. Four-Wheel Drive

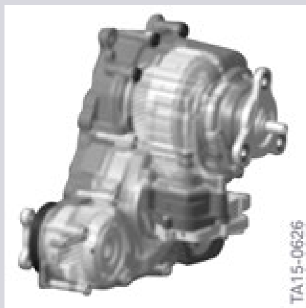
A rear-wheel drive-based xDrive is used in the G12.

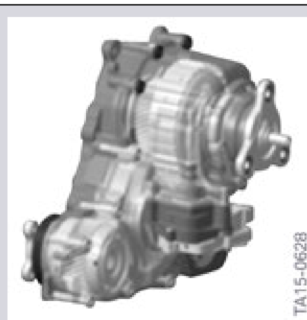
The following table provides an overview of the different transfer boxes used at BMW.

User	VTG 2006 – 2009	Technical data
E6x E9x		ATC300 – Power transmission by spur gear set – Use in saloons and X1 – Weight with oil 25.2 kg – Multidisc clutch up to 1400 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A
E83		ATC400 – Power transmission by chain – Use in X vehicles apart from X1 – Weight with oil 24.2 kg – Multidisc clutch up to 1400 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A
E70		ATC700 – Power transmission by chain – Use in X vehicles apart from X1 – Weight with oil 24.5 kg – Multidisc clutch up to 1600 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A

G12 Powertrain

8. Four-Wheel Drive

Use	VTG 2009 – 2011	Technical data
E84		ATC350 – Power transmission by spur gear set without oil pump – Use in saloons and X1 – Weight with oil 23.9 kg – Multidisc clutch up to 1400 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A
F25		ATC450 – Power transmission by chain without oil pump – Use in X vehicles apart from X1 – Weight with oil 21.2 kg – Multidisc clutch up to 1400 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A

Use	VTG Light since 2011	Technical data
E84		ATC350L – Power transmission by spur gear set – Use in saloons and X1 – Weight with oil 22.6 kg – Multidisc clutch up to 1100 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A
F25		ATC450L – Power transmission by chain – Use in X vehicles apart from X1 – Weight with oil 19.5 kg – Multidisc clutch up to 1100 Nm – Torque buildup 0 ~ 1000 Nm in < 125 ms – Torque reduction 1000 ~ 50 Nm in < 100 ms – Starting current 30 A/holding current 5 – 6 A

G12 Powertrain
8. Four-Wheel Drive

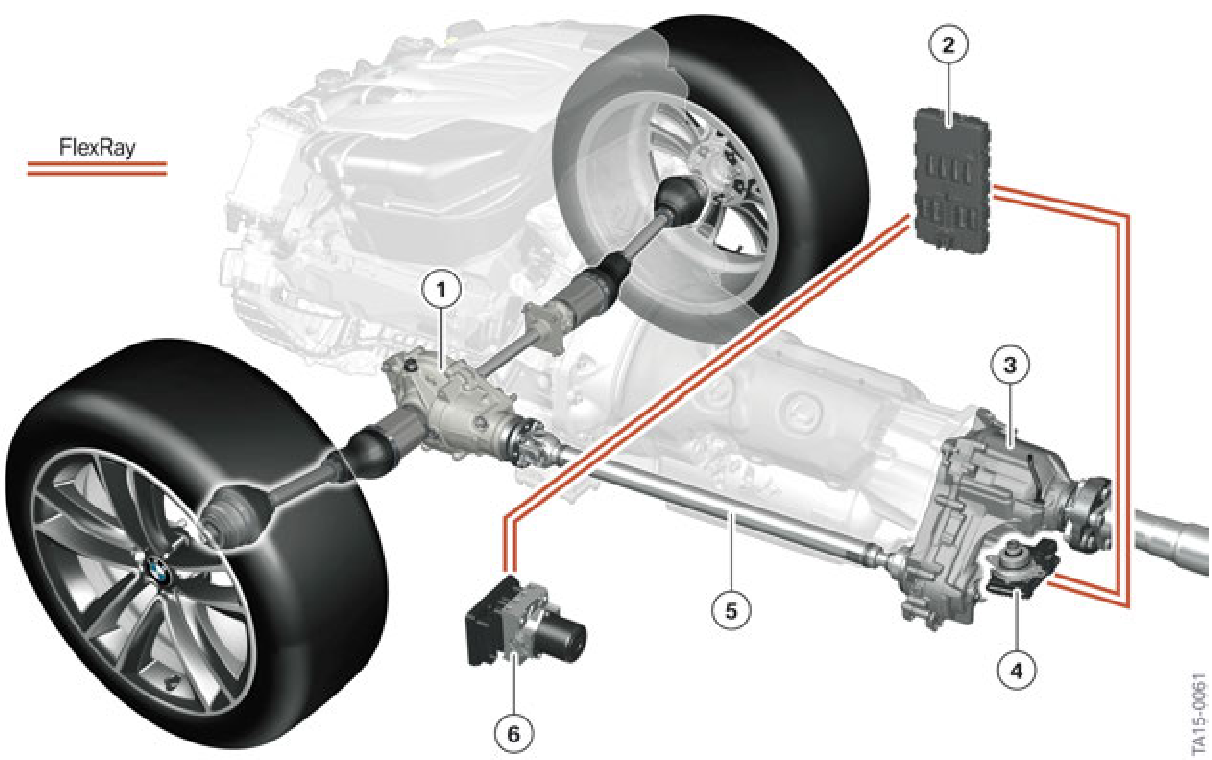
Use	VTG from 2015	Technical data
G12		ATC13–1 – Power transmission by chain – Use of standard transfer box (all models) – Multidisc clutch up to 1300 Nm

8.2. New features in xDrive

The optional all-wheel drive of the G12 does not differ visually from the rear-wheel drive-based xDrive systems currently used.

However, the xDrive of the G12 offers the following new features:

- The maximum transferable torque to 1300 Nm.
- Reduction in the thermal load by over-opening of the all-wheel drive multidisc clutches.
- Reduced fuel consumption by intelligent all-wheel drive control and demand-based oil level control in the transfer box (Efficiency Mode).



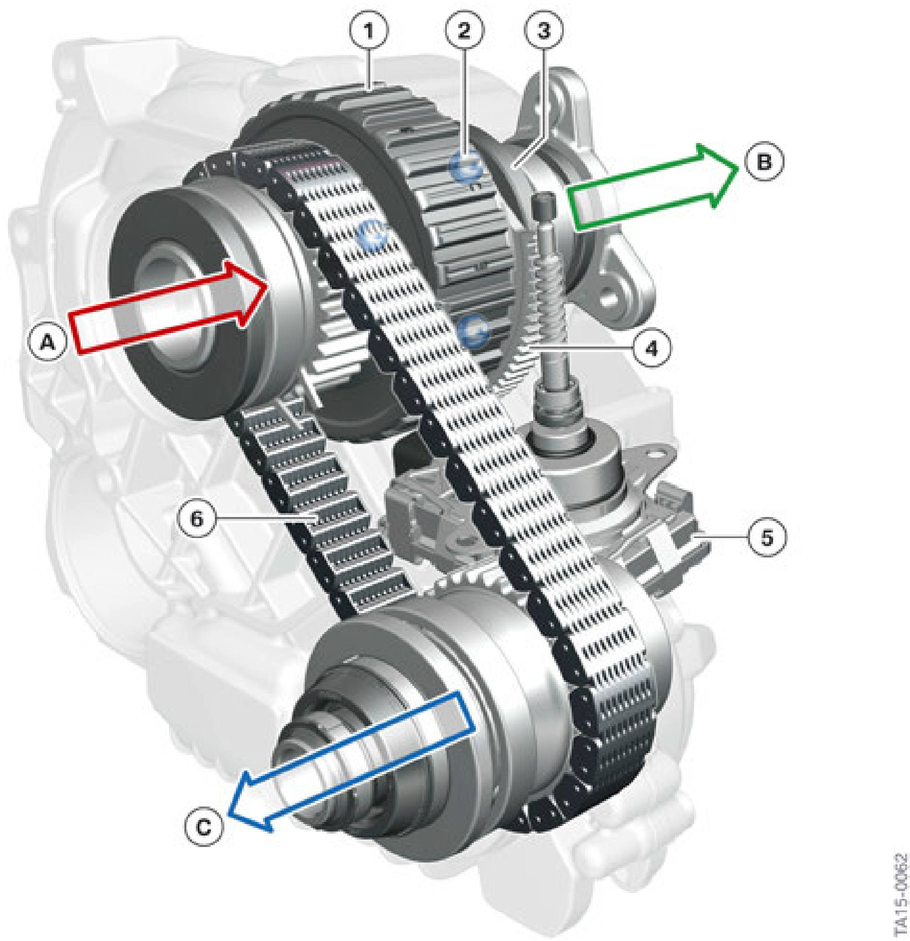
System overview of xDrive in the G12

8. Four-Wheel Drive

Index	Explanation
1	Front axle differential
2	Body Domain Controller (BDC)
3	Transfer box
4	VTG control unit
5	Front drive shaft
6	Dynamic Stability Control (DSC)
FlexRay	FlexRay bus

The torque generated by the engine is stepped up in the automatic transmission and is supplied via the transmission output shaft to the transfer box. The downstream transfer box in the drive train has the task of variably distributing the torque to the front and rear axles depending on the driving situation. Since a rigid connection of the rear axle with the front axle is not possible due to possible differences in the wheel speeds, there is a multidisc clutch inside the transfer case. The multidisc clutch performs the task of variable torque distribution between the two drive axles.

8.3. Functional description of xDrive



Transfer box in the G12

Index	Explanation
A	Drive from automatic transmission
B	Output to rear axle
C	Output to front axle
1	Multi-plate clutch
2	Balls (3 pieces)
3	Ball ramp
4	Toothed adjusting ring
5	VTG control unit
6	Chain

8. Four-Wheel Drive

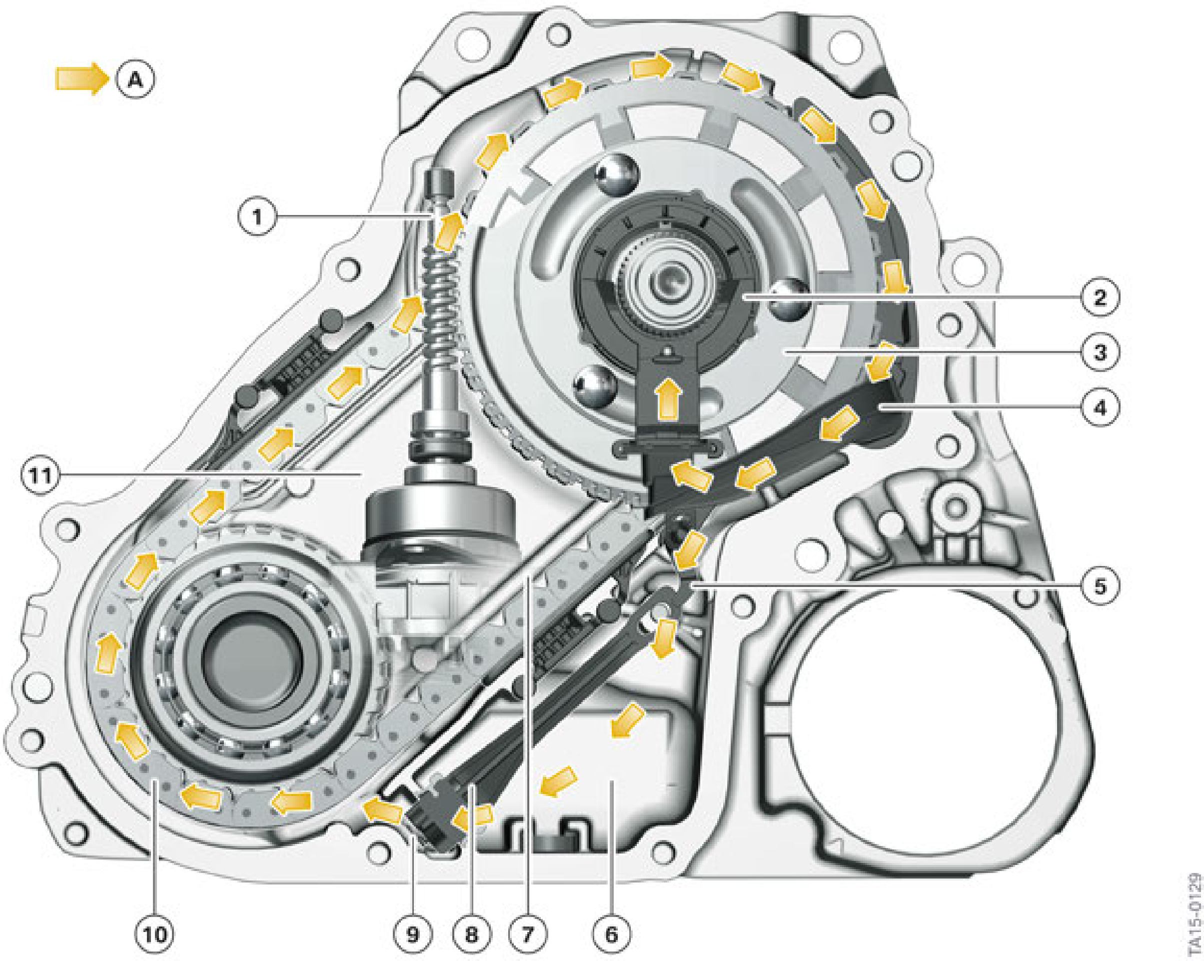
The multidisc clutch in the all-wheel drive transfer box allows the torque to be distributed to both axles within certain limits. Seen statistically, the torque distribution between the front and rear axles on the current BMW all-wheel drive vehicles is 40:60. In the G12, the torque distribution to the two drive axles was split equally in the direction of 50:50. In terms of dynamics, however, other important parameters such as different wheel slip values play a part. It is no longer possible to speak of a 50:50 torque distribution with different wheel slip values at the two drive axles. In this case, the drive torques are distributed variably in the range between theoretically 0:100 and 100:0 corresponding to the driving situation.

The entire torque is transmitted to the rear axle when the multidisc clutch is open. The multidisc clutch must be closed in order to transfer torque to the front axle.

The clutch torque to be transmitted is calculated in the Dynamic Stability Control (DSC) and is forwarded to the transfer box control unit via a FlexRay bus. The transfer box control unit calculates the angle to be set at the toothed adjusting ring from the requested clutch torque. The adjusting torque required for control is generated by an electric motor.

The contact pressure of the multidisc clutch is increased depending on the requested torque distributions. As a result, the stepped-up engine torque is seamlessly distributed between the two drive axles corresponding to the driving situation.

8.4. Efficiency Mode



Efficiency mechanism of the xDrive in the G12

Index	Explanation
A	Oil circuit
1	Worm shaft
2	Oil stop (oil shutoff to the multidisc clutch)
3	Toothed adjusting ring
4	Oil line with reservoir
5	Switching shaft (actuation of oil reservoir)
6	Oil chamber 2
7	Overflow

Index	Explanation
8	Oil reservoir (barrier between the oil chambers)
9	Spring
10	Chain
11	Oil chamber 1

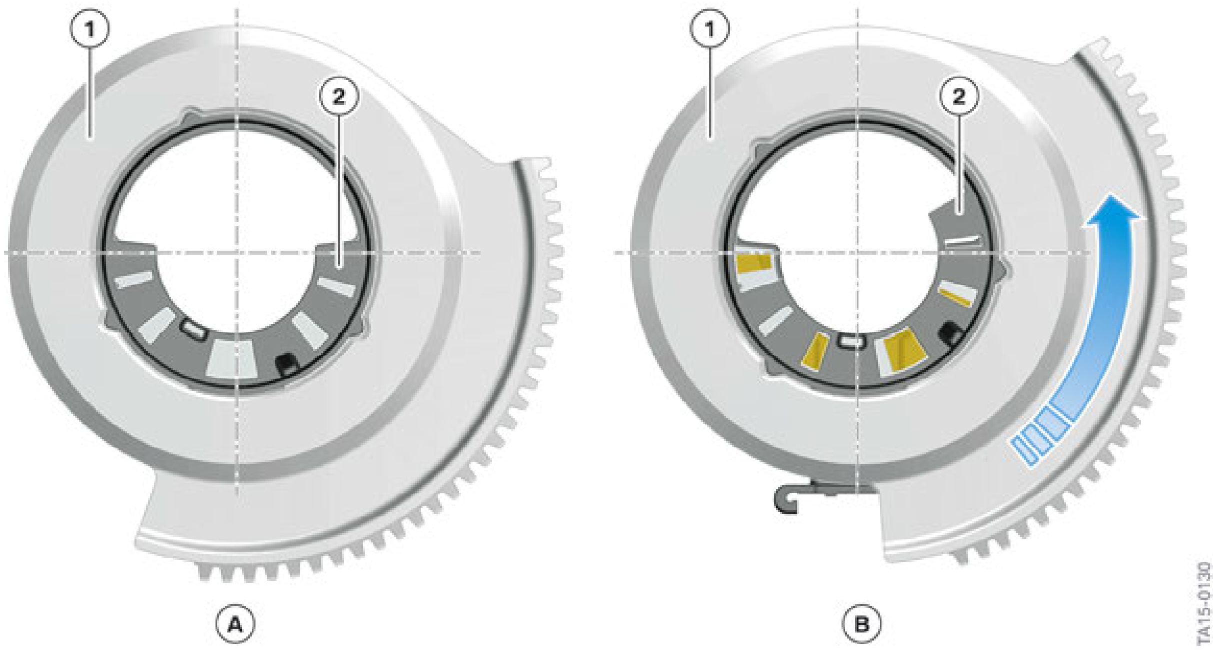
“Efficiency Mode” is a new development in the area of drag torque reduction and is designed to increase efficiency. The multidisc clutches of the transfer box are opened depending on the driving situation by intelligent control of the all-wheel drive system. This permits reduction of the lubrication in the transfer box. A distinction is made between the following functions:

- Oil stop
- Oil reservoir

Both of these functions are described in more detail below. Both functions have the task of minimizing losses in the transfer box. They are always activated in parallel, but act in different areas of the unit.

Efficiency Mode is always used when there is **no** all-wheel drive request from the DSC control unit and the multidisc clutch is therefore open.

8.4.1. Oil stop



Oil stop function of the xDrive in the G12

Index	Explanation
A	Oil stop active (closed)
B	Oil stop inactive (open)
1	Toothed adjusting ring
2	Oil flow closure system

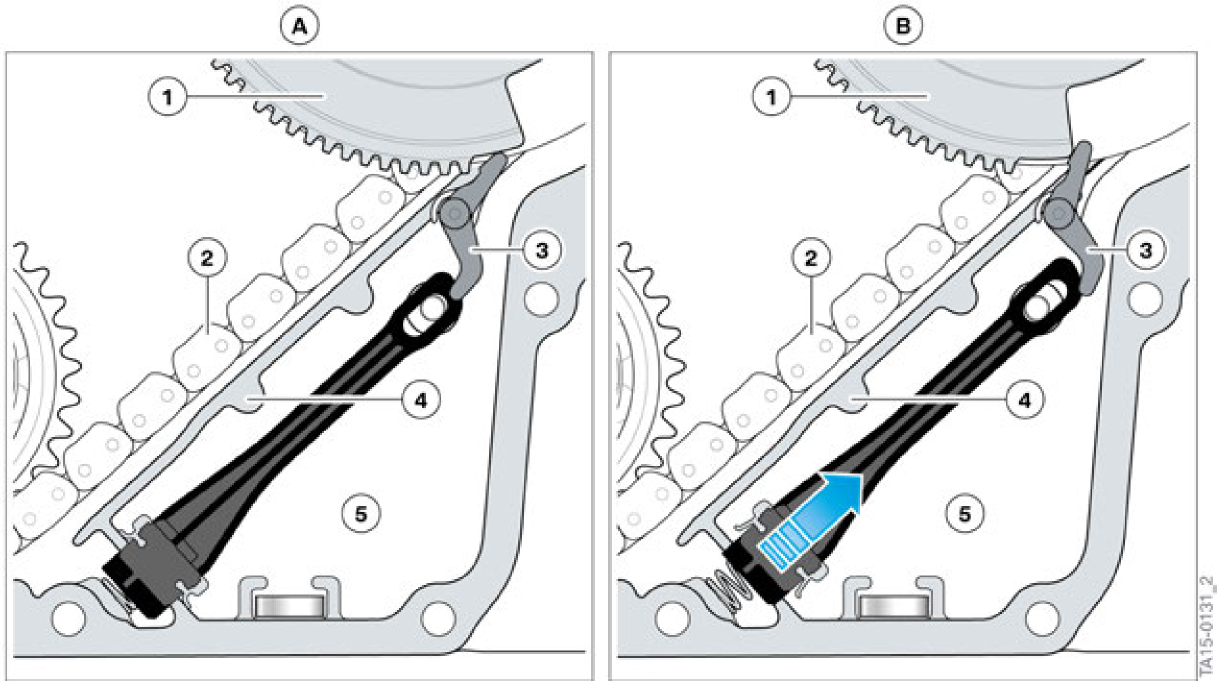
The oil stop function of the xDrive transfer box offers the following advantages:

- Reduction in the engine drag torques when the multidisc clutch is open.
- Fast availability of lubrication oil for the multidisc clutch thanks to small oil reservoir directly in front of the disc set.

The oil supply to the clutch pack is blocked when the multidisc clutch is open. The oil is stored in the line and in the oil reservoir. The toothed adjusting ring is rotated by means of the worm shaft in order to activate and deactivate the oil stop. The oil flow to the multidisc clutch is interrupted by rotation of the adjusting ring. In the event of a torque request to the transfer box (multidisc clutch is closed), the oil supply is opened again due to rotation of the adjusting ring and the multidisc clutch is lubricated and cooled.

The lower oil fill level means that churning losses, which are caused by immersion of the rotated multidisc clutch, are eliminated. This reduces fuel consumption as well as wear on the multidisc clutch.

8.4.2. Oil reservoir



Oil reservoir function of the xDrive in the G12

Index	Explanation
A	Oil reservoir closed
B	Oil reservoir open
1	Toothed adjusting ring
2	Chain
3	Switching shaft (actuation of oil reservoir)
4	Oil reservoir (barrier between the oil chambers)
5	Oil chamber 2

The oil reservoir is closed when no torque request is made to the transfer box (multidisc clutch is open). The oil reservoir has the task of storing the oil in a defined space (oil chamber 2). The oil reservoir function is done by a lever system which is supported in the housing and which closes a defined opening by means of an elastomer seal.

A switching shaft, which is moved by the toothed adjusting ring, actuates the oil reservoir and keeps it in the designated position. The oil chambers are closed off with respect to each other, reducing churning losses to a minimum. A defined quantity of oil always remains in circulation in order to guarantee lubrication of bearings and sealing rings. This is ensured by an overflow between the 1st and 2nd oil chambers.

8. Four-Wheel Drive

8.5. Operating strategy

The all-wheel drive (xDrive) was designed as an intelligent system in the G12. Intelligent control of the xDrive supports efficient and thus fuel-saving operation of the vehicle. However, the all-wheel drive is not switched off or deactivated, for example, but is adapted corresponding to the current driving situation. A large number of different sensors supply information about the current traction requirement. The drive torque is distributed to the different drive wheels as required corresponding to the traction and driving dynamics.

Operating strategy of the xDrive in the G12

Index	Explanation
A	Wet conditions
B	Snow
C	Asphalt
D	Off-road
E	xDrive

In many driving situations the all-wheel drive multidisc clutch is open and only the rear wheels are driven. Only in certain driving situations is some of the drive torque also transmitted to the front wheels. The distribution of the drive torque takes place proactively. Calculation of the required distribution takes place in the control unit for Dynamic Stability Control (DSC).

The DSC takes into account the following criteria for calculation of the torque distribution:

- Vehicle speed
- Lateral and longitudinal acceleration
- Yaw rate
- Brake control (ABS)
- Steering angle
- Wheel speeds
- Vehicle longitudinal inclination
- Pedal sensor position
- Driving program (SPORT, COMFORT, ECO PRO)
- DSC status (DSC activated/deactivated, DTC activated/deactivated)

Depending on the driving situation, some of the drive torque is transmitted to the front wheels. The exact ratio of the torque distribution is dependent on the activation of the multidisc clutch, as well as the slip of the wheels. Some of the influencing factors are listed below.

The all-wheel drive clutch torque is increased in the following driving situations if there are no other criteria present that prevent this:

- Road speed < 20 kph / <12 mph
- Driving program SPORT activated
- Dynamic Stability Control (DSC) deactivated
- Dynamic Traction Control (DTC) activated
- Oversteering vehicle
- Increased difference in speed between front and rear wheels
- Large vehicle longitudinal inclination (e.g. on inclines)
- High accelerator pedal input, e.g. kick-down position
- Load reversal conditions such as transition to coasting overrun (driver takes his foot off the accelerator pedal)

The all-wheel drive clutch torque is reduced in the following driving situations if there are no other criteria present that prevent this:

- Driving speeds > 180 km/h / >111 mph
- Understeering vehicle
- With increasing steering angle (to avoid distortions in the drive train)
- Strong braking (ABS braking)

To assess the road condition and to ensure effective, proactive longitudinal torque distribution, the coefficients of friction between the tires and roadway are determined by the DSC control unit. The wheel slip as well as the longitudinal and lateral acceleration are evaluated for this purpose, for example.

If wheel speed information received by the Dynamic Stability Control (DSC) suggests different tire rolling circumferences of the wheels (e.g. in the case of tires with significant differences in the amount of wear), the all-wheel drive multidisc clutch is closed to a lesser extent than in the normal case. This prevents excessive distortion in the drive train, which would lead to high power losses of the xDrive.

8.5.1. Determination of the wheel slip

Wheel slip occurs on the wheels of the different axles both as a result of acceleration and deceleration. The wheel slip is determined using the sensor signals from all wheel speed sensors as well as an arithmetic model in the DSC control unit.

The wheel slip can be defined as follows:

- Wheel slip is the deviation of the wheel circumferential velocity from the driving speed.

If a wheel is accelerated or braked to such an extent that the maximum static friction force is exceeded, the slip then increases until the wheels spin or locks.

Two types of slip occur in practice.

- Traction slip
- Brake slip

Traction slip can be reduced by the following measures.

- DSC intervention by reduction of the engine torque.
- Increase in the clutch torque to be transmitted by the xDrive (torque distribution to both drive axles).

Brake slip can be reduced by the following measures.

- ABS control operation (Antilock Brake System).

In order to permit individual wheel control of the brake forces at a wheel during strong braking (ABS or DSC control operation) and avoid any influence on the other drive axle, the all-wheel drive clutch torque is decreased as required or completely reduced if necessary.

Calculation example for traction slip

- Wheel circumferential velocity = 16.67 m/s (corresponds to approx. 60 km/h / 37 mph)
- Driving speed = 13.89 m/s (corresponds to 50 km/h / 31 mph)

Since the wheel circumferential velocity is higher than the driving speed for the specified values, the slip here is so-called traction slip.

$$S_A = \frac{V_{Wheel} - V_{Vehicle}}{V_{Vehicle}}$$

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Formula for traction slip

Index	Explanation
SA	Traction slip
V Wheel	Wheel circumferential velocity
V Vehicle	Vehicle speed

SA = (16.67 m/s – 13.89 m/s) : 13.89 m/s = 0.2

SA in % = 0.2 · 100 % = 20 %

The traction slip is 20 %.

Calculation example for brake slip

- Wheel circumferential velocity = 11.12 m/s (corresponds to approx. 40 km/h / 25 mph)
- Driving speed = 13.89 m/s (corresponds to approx. 50 km/h / 31 mph)

Since the wheel circumferential velocity is lower than the driving speed for the specified values, the slip here is so-called brake slip.

$$S_B = \frac{V_{Wheel} - V_{Vehicle}}{V_{Vehicle}}$$

TA15-0558

Formula for brake slip

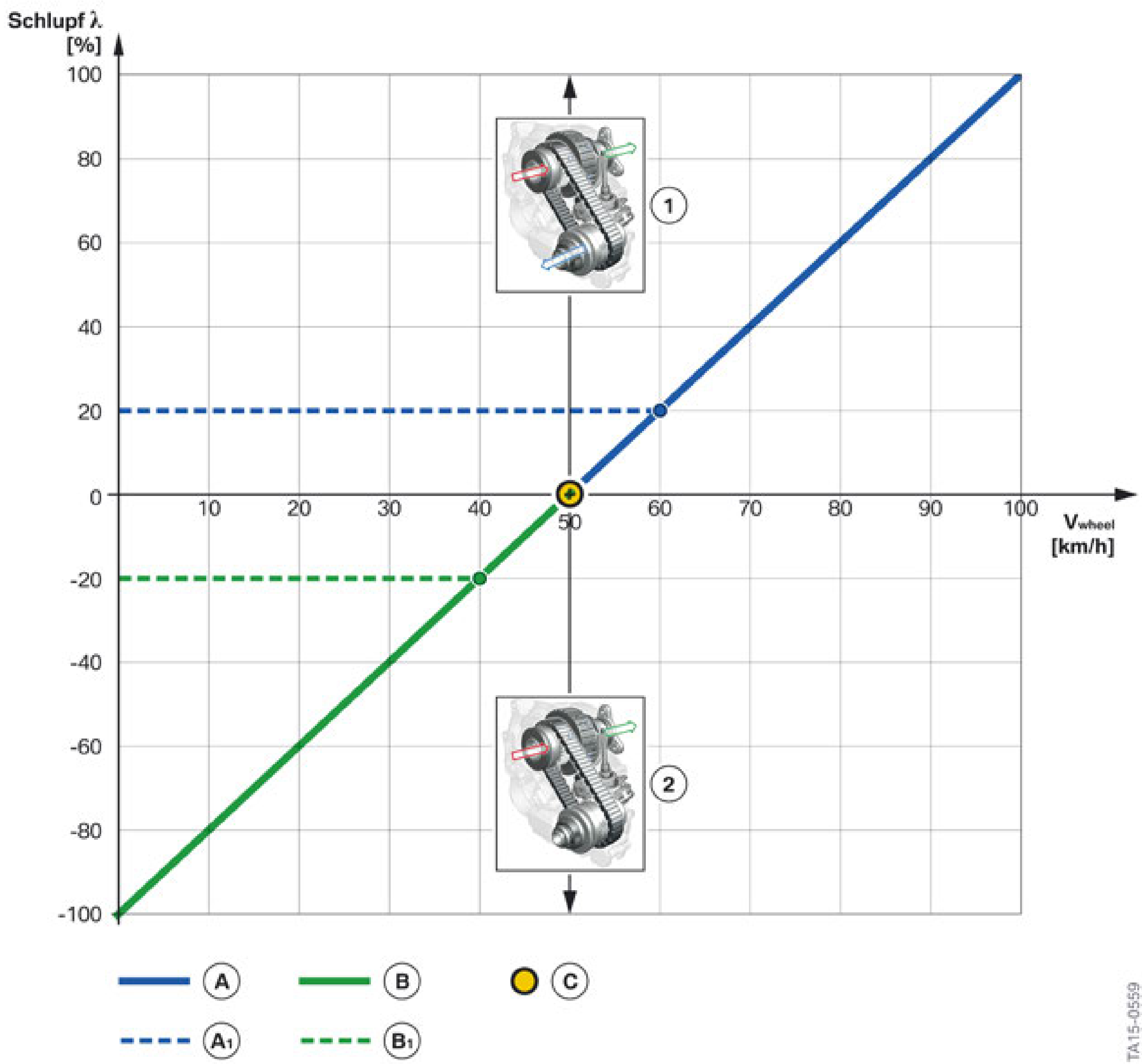
Index	Explanation
SB	Brake slip
V Wheel	Wheel circumferential velocity
V Vehicle	Vehicle speed

SB = (11.12 m/s – 13.89 m/s) : 13.89 m/s = – 0.2

SB in % = – 0.2 · 100 % = – 20 %

The brake slip is 20 %.

xDrive operating strategy for different wheel slip values



Wheel slip diagram with xDrive control

Index	Explanation
A	Wheel circumferential velocity (drive slip)
A1	20 % drive slip
B	Wheel circumferential velocity (brake slip)
B1	20 % brake slip
C	Driving speed (constant)

Index	Explanation
1	Multidisc clutch in the transfer box closed
2	Multidisc clutch in the transfer box open
Slip λ [%]	Wheel slip in [%]
V wheel in [km/h]	Wheel circumferential velocity in kilometers per hour

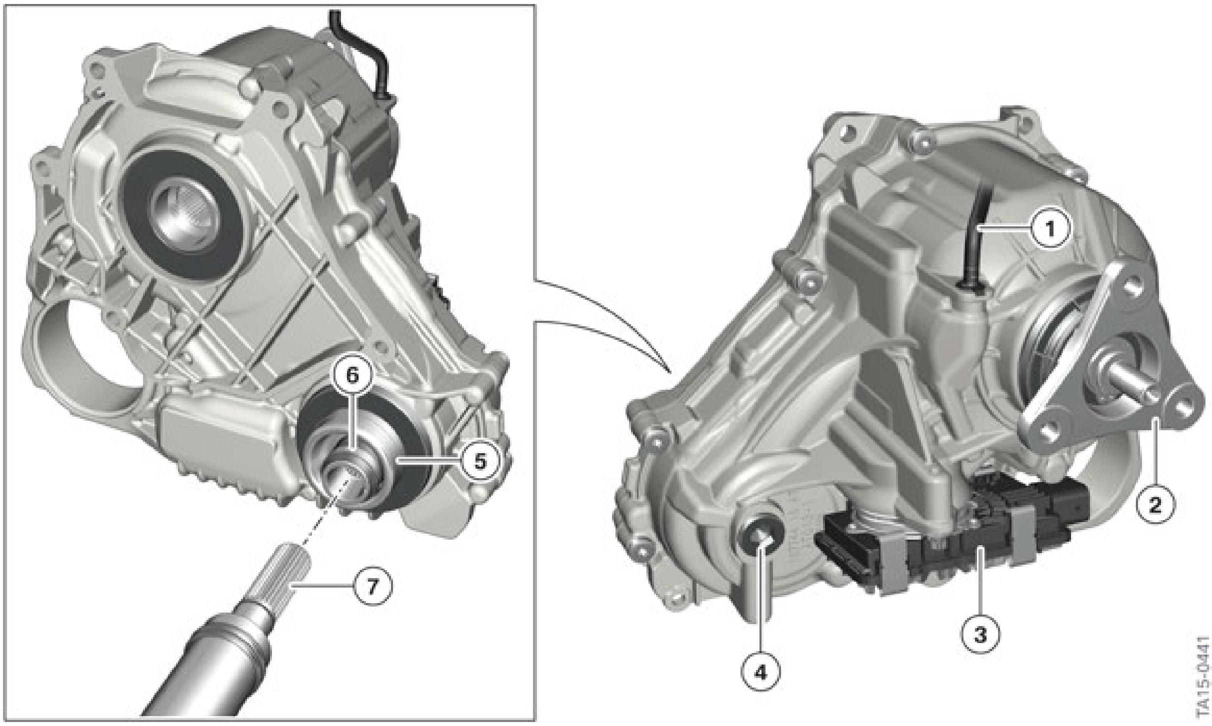
8.6. Notes for Service

- The vehicle must **not** be driven when the front drive shaft has been removed.
- When carrying out work on a brake test stand, it is not necessary to take into account any all-wheel drive-specific points.
(roller mode for testing the brake system is detected automatically.)
- The vehicle must **not** be towed if only one axle is raised.
- The oil filling of the transfer box is designed for the entire unit service life. However, a fault code entry with an oil change recommendation for the transfer box oil is stored when a mileage of 150,000 km / 100,000 miles is exceeded. When refilling the transfer box oil, it is necessary to move the oil reservoir to the open position using the BMW diagnosis system ISTA.
- Various test plans are available in the BMW diagnosis system ISTA for Service.

⚠

The tire tread depth, tire rolling circumference as well as the tire manufacturer should be the same on the front and rear axles if possible, in order to ensure proper functioning of the xDrive. It is also recommended to use only tires that have been approved or recommended by BMW.

8. Four-Wheel Drive



Transfer box of the G12

Index	Explanation
1	Transmission breather
2	Output, rear drive shaft
3	VTG control unit
4	Fluid filler plug
5	Dust boot
6	Output with joint to the front propeller shaft
7	Front drive shaft

The joint of the front drive shaft is located on the output inside the transfer box. This is beneficial for the small package dimensions of the transfer box. The component sharing concept with other vehicle series can also be ensured in this way.

The front drive shaft is inserted in the output with joint by means of a plug connection. A dust boot protects the connection against dirt.

Since the output with joint is no longer fixed when the front drive shaft is removed, the vehicle must no longer be driven in this condition. The lacking guide would lead to an uncontrolled movement of the output when the vehicle is accelerated, thus causing damage to the transfer box.

⚠

The vehicle must **not** be driven when the front drive shaft has been removed.

8.6.1. Oil change for transfer box

The oil filling of the transfer box is designed for the entire unit service life. This corresponds to a mileage of approximately 150,000 km / 100,000 miles. A fault code entry with an oil change recommendation for the transfer box is stored when this mileage is exceeded.

The transfer box does not have an oil drain plug. The oil filling to be renewed must be removed using an extractor unit.

The new transfer box oil can be filled using an oil filler plug.

In order to ensure that the entire oil filling has been exchanged, the oil reservoir must remain open for the duration of extraction and filling.

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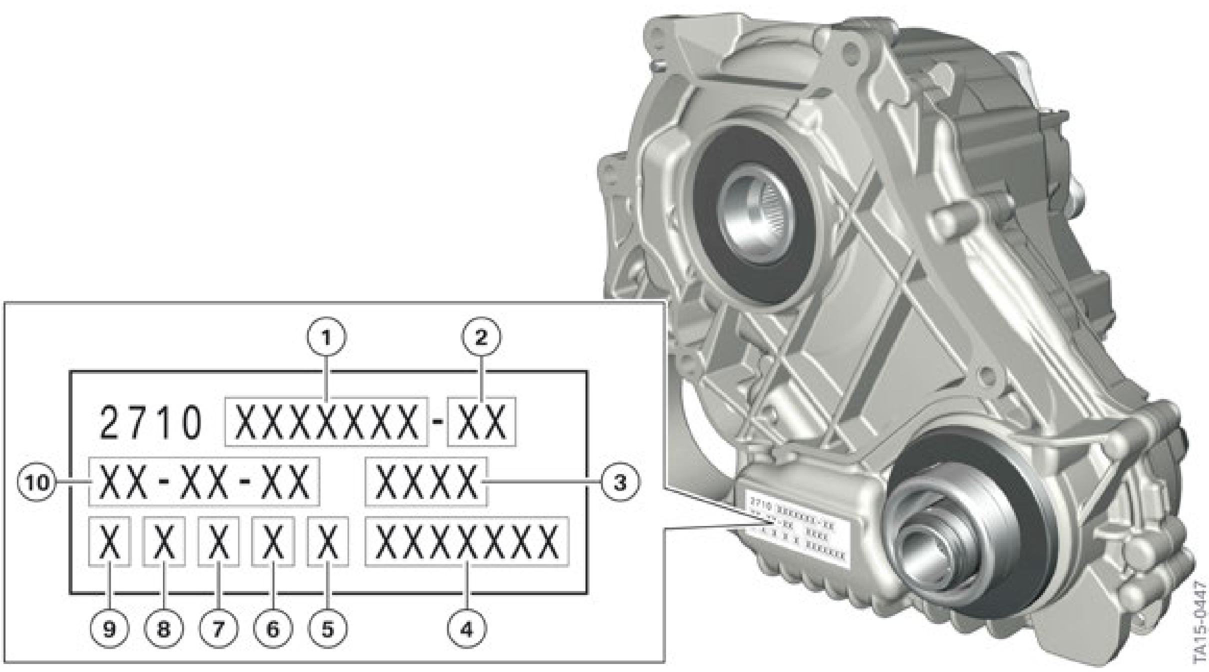
The Service employee can move the oil reservoir to the open position by means of the "Service function > Transfer box VTG > Oil change" in the BMW diagnosis system ISTA.

8.6.2. Classification of the transfer box



Classification of the transfer box in the G12

Index	Explanation
1	BMW part number
2	Revision index
3	Transfer box classification
4	Serial number

8. Four-Wheel Drive

Index	Explanation
5	Housing type
6	Assembly line
7	Works (A = Austria, M = Mexico)
8	Output flange diameter (96 mm, 105 mm)
9	Versions
10	Production date

Due to the permitted component tolerances of the different components of the transfer box, the stroke of the ball ramp for closing the multidisc clutch in the transfer box differs in each case. However, these tolerances can be compensated by adapted control of the electric motor for closing the multidisc clutch. For this purpose, the tolerance class must be entered in the control unit for the transfer box.

The respective tolerance is determined during production and entered on a type plate on the transfer box (see graphic above).

The tolerance can be determined as follows in Service:

- Reading off the tolerance class on the type plate on the transfer box.
- Reading out the tolerance class via the BMW diagnosis system ISTA.

The four-digit classification code can be entered in the control unit for the transfer box VTG by means of a service function in BMW diagnosis system ISTA. This must be within a stored classification range in order to be accepted by the VTG control unit.

The following table shows the complete classification range of the transfer box in the G12.

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
21	3013	3024	3035	3046	3057	3068	3079	3080	3091	3100	3111	3122	3133	3144	3155	3166	3177	3188	3199	3208	3219
22	3220	3231	3242	3253	3264	3275	3286	3297	3306	3317	3328	3339	3340	3351	3362	3373	3384	3395	3404	3415	3446
23	3437	3448	3459	3460	3471	3482	3493	3502	3513	3524	3535	3546	3557	3568	3579	3580	3591	3600	3611	3622	3633
24	3644	3655	3666	3677	3688	3699	3708	3719	3720	3731	3742	3753	3764	3775	3786	3797	3806	3817	3828	3839	3840
25	3851	3862	3873	3884	3895	3904	3915	3926	3937	3948	3959	3960	3971	3982	3993	4006	4017	4028	4039	4040	4051
26	4062	4073	4084	4095	4104	4115	4126	4137	4148	4159	4160	4171	4182	4193	4202	4213	4224	4235	4246	4257	4268
27	4279	4280	4291	4300	4311	4322	4333	4344	4355	4366	4377	4388	4399	4408	4419	4420	4431	4442	4453	4464	4475
28	4486	4497	4506	4517	4528	4539	4540	4551	4562	4573	4584	4595	4604	4615	4626	4637	4648	4659	4660	4671	4682
29	4693	4702	4713	4724	4735	4746	4757	4768	4779	4780	4791	4800	4811	4822	4833	4844	4855	4866	4877	4888	4899
30	4908	4919	4920	4931	4942	4953	4964	4975	4986	4997	5000	5011	5022	5033	5044	5055	5066	5077	5088	5099	5108
31	5119	5120	5131	5142	5153	5164	5175	5186	5197	5206	5217	5228	5239	5240	5251	5262	5273	5284	5295	5304	5315
32	5326	5337	5348	5359	5360	5371	5382	5393	5402	5413	5424	5435	5446	5457	5468	5479	5480	5491	5500	5511	5522
33	5533	5544	5555	5566	5577	5588	5599	5608	5619	5620	5631	5642	5653	5664	5675	5686	5697	5706	5717	5728	5739
34	5740	5751	5762	5773	5784	5795	5804	5815	5826	5837	5848	5859	5860	5871	5882	5893	5902	5913	5924	5935	5946
35	5957	5968	5979	5980	5991	6004	6015	6026	6037	6048	6059	6060	6071	6082	6093	6102	6113	6124	6135	6146	6157
36	6168	6179	6180	6191	6200	6211	6222	6233	6244	6255	6266	6277	6288	6299	6308	6319	6320	6331	6342	6353	6364
37	6375	6386	6397	6406	6417	6428	6439	6440	6451	6462	6473	6484	6495	6504	6515	6526	6537	6548	6559	6560	6571
38	6582	6593	6602	6613	6624	6635	6646	6657	6668	6679	6680	6691	6700	6711	6722	6733	6744	6755	6766	6777	6788
39	6799	6808	6819	6820	6831	6842	6853	6875	6875	6886	6897	6906	6917	6928	6939	6940	6951	6962	6973	6984	6995
40	7008	7019	7020	7031	7042	7053	7064	7075	7086	7097	7106	7117	7128	7139	7140	7151	7162	7173	7184	7195	7204
41	7215	7226	7237	7248	7259	7260	7271	7282	7293	7302	7313	7324	7335	7346	7357	7368	7379	7380	7391	7400	7411

A

B

TA15-0448

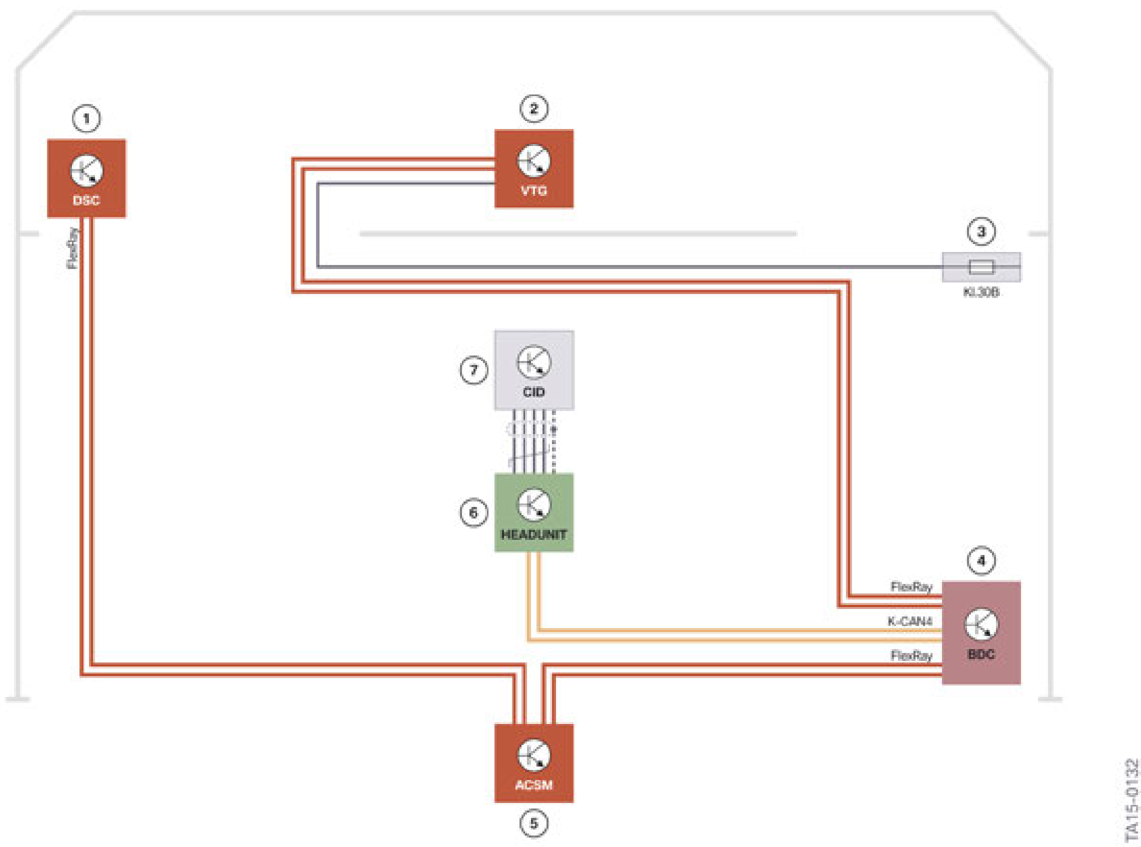
Classification table for transfer box in the G12

Index	Explanation
A	Offset classes in [°]
B	Pitch classes in [%]

The tolerance class must be entered in the VTG control unit after the following service work:

- VTG control unit was renewed.
- Transfer box was renewed.

8.7. System wiring diagram



System wiring diagram for xDrive in the G12

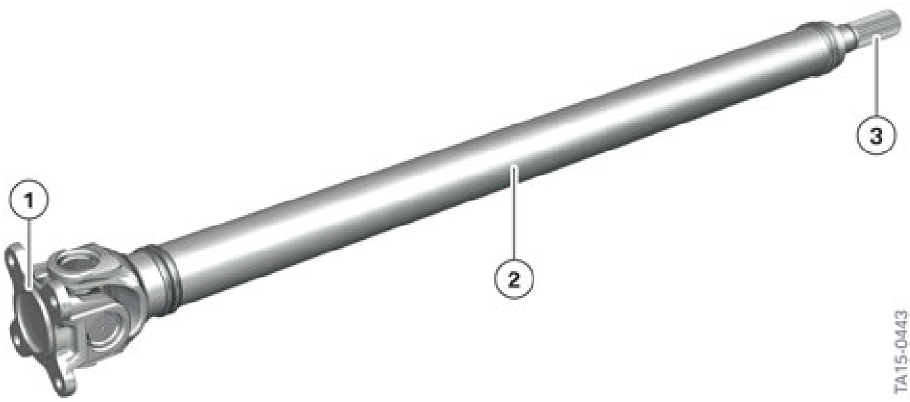
Index	Explanation
1	Dynamic Stability Control (DSC)
2	VTG control unit
3	Power distribution box, front right
4	Body Domain Controller (BDC)
5	Advanced Crash Safety Module (ACSM)

Index	Explanation
6	Head Unit
7	Central Information Display (CID)
FlexRay	FlexRay bus
K-CAN4	Body CAN4

9. Drive Shafts and Differential

9.1. Four-wheel drive

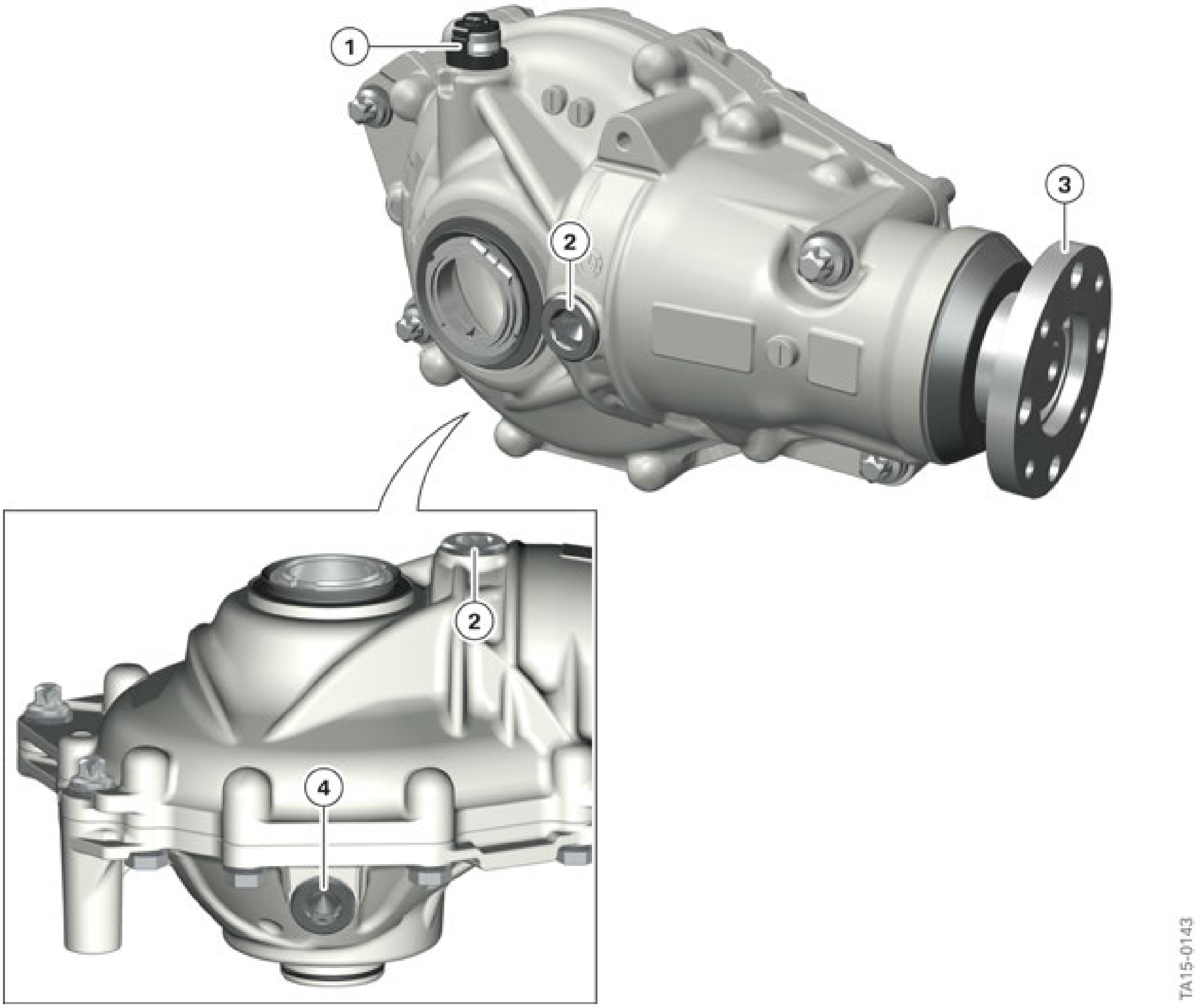
9.1.1. xDrive drive shaft



Drive shaft of the all-wheel drive in the G12

Index	Explanation
1	Universal joint (on the front axle differential)
2	Tubular shaft of drive shaft
3	Plug connection at transfer box

9.1.2. xDrive front axle differential



Front axle differential of the xDrive drive in the G12

Index	Explanation
1	Differential breather
2	Differential oil filler screw
3	Differential drive flange
4	Differential oil drain plug

A new Differential oil is used in order to increase the efficiency of the drive train.

For the initial filling at the plant, the front axle differential is filled with the following oil:

- Fuchs Titan EG3846.

However, when the oil is topped up by BMW Service, the following oil is used as before:

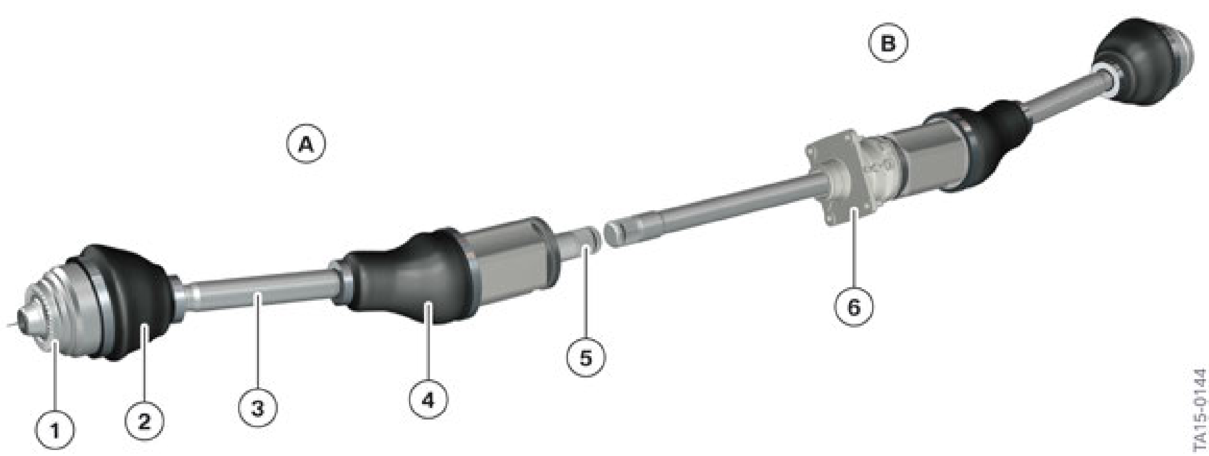
- Castrol SAF-XO.

Both oils are compatible with each other and can be topped off. The oil of the front axle differential is not subject to a service interval and can be used for the entire vehicle lifecycle.

Technical data

Technical data	Front axle differential 170AL	Front axle differential 175AL
In-line engine	X	—
V-engine	—	X
Oil volume	0.6 L	0.6 L
Oil grade at plant	Fuchs Titan EG3846	Fuchs Titan EG3846
Oil grade in BMW Service	Castrol SAF-XO	Castrol SAF-XO
Maximum input torque	1300Nm	1300Nm
Possible ratios	2.56/2.81/3.08/3.23	2.81
Weight including oil filling	13.5 kg / 33.7 lbs	14.5 kg / 32.0 lbs

9.1.3. Front output shafts of xDrive



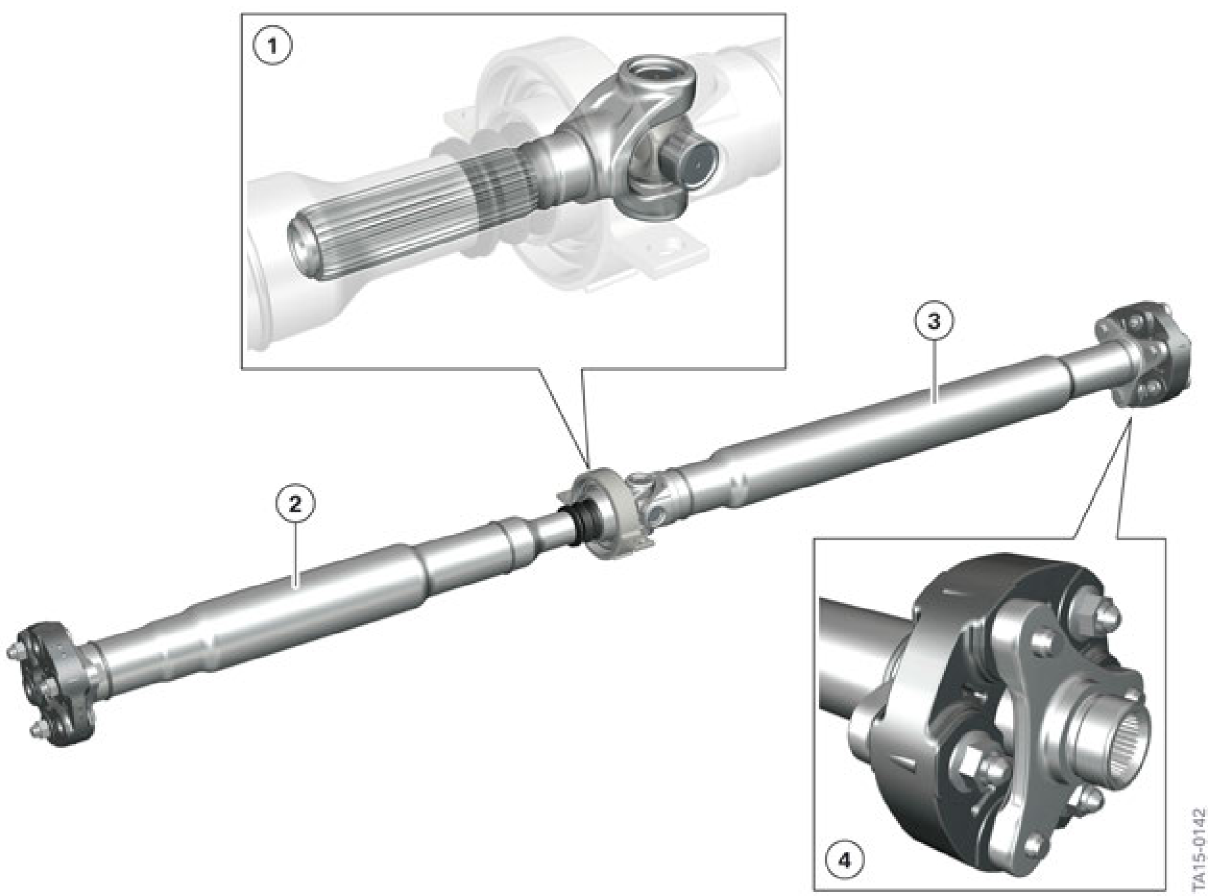
Drive shafts of the front axle in the G12

Index	Explanation
A	Output shaft, front left
B	Output shaft, front right
1	Spur gearing
2	Gaiter sleeve, wheel end

Index	Explanation
3	Output shaft
4	Gaiter sleeve, transmission end
5	Plug connection on front axle differential
6	Bearing support

9.2. Rear-wheel drive

9.2.1. Drive shafts



Drive shaft in the G12

Index	Explanation
1	Drive shaft center bearing with sliding unit
2	Front partial shaft (tubular shaft including crash feature)
3	Rear partial shaft (tubular shaft)
4	Plugged-in three-hole flange (on rear axle differential)

Different steel drive shafts are used depending on the engine and transmission variant.

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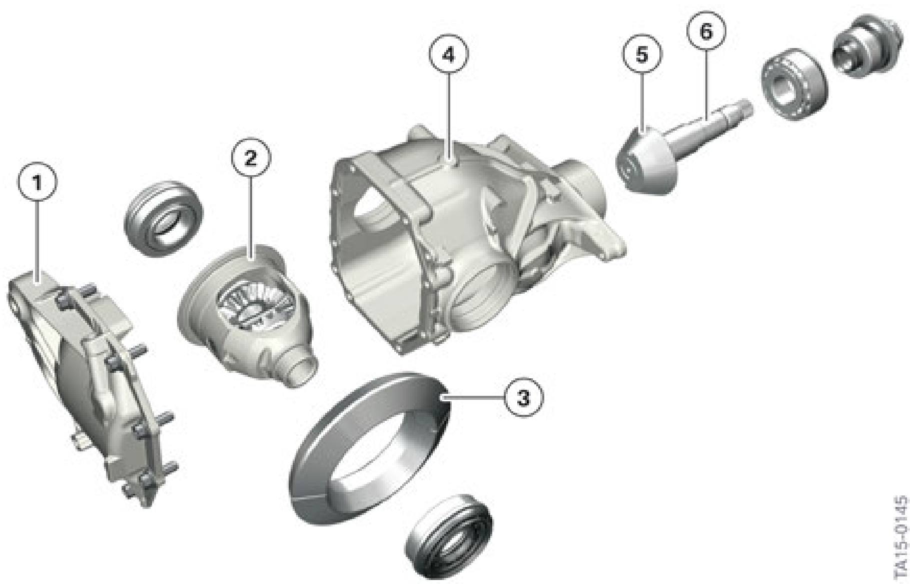
The maximum permissible deflection angle of the drive shaft must not be exceeded when working on the drive shaft center bearing. The instructions in the current repair instructions must be observed in all cases.

9.2.2. Rear axle final drive



Rear axle differential in the G12

Index	Explanation
1	Housing cover
2	Differential
3	Ring wheel
4	Housing
5	Pinion
6	Transmission input shaft

A new differential oil is used in order to increase the efficiency of the drive train.

For the initial filling at the plant, the rear axle differential is filled with the following oil:

- Castrol BOT-448.

However, when the oil is topped up by BMW Service, the following oil is used as before:

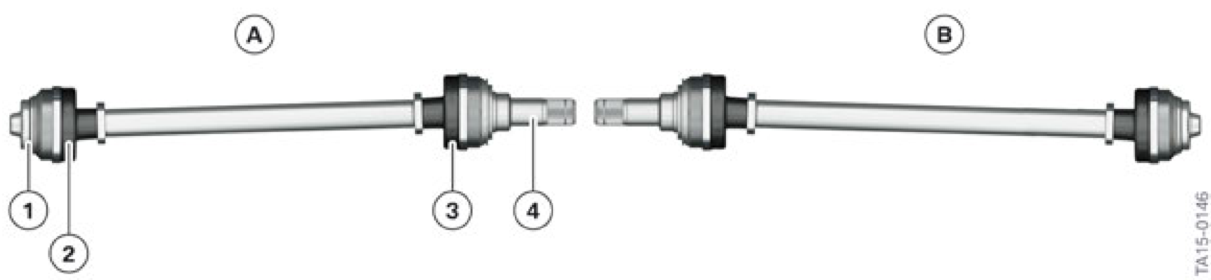
- Castrol SAF-XO.

Both oils are compatible with each other and can be topped off. The oil of the rear axle differential is not subject to a service interval and can therefore be used for the entire vehicle lifecycle.

Technical data

Technical data	Rear axle differential 205AL	Rear axle differential 225AL
In-line engine	X	—
V-engine	—	X
Oil volume	approx. 0.75 – 0.9 l	approx. 0.9 – 1.4 l
Oil grade at plant	Castrol BOT-448	Castrol BOT-448
Oil grade in BMW Service	Castrol SAF-XO	Castrol SAF-XO
Possible ratios	3.08/3.23	2.56/2.81/3.08

9.2.3. Rear output shafts



Drive shafts of the rear axle in the G12

Index	Explanation
A	Output shaft, left
B	Output shaft, right
1	Spur gearing
2	Gaiter sleeve, wheel end
3	Gaiter sleeve, transmission end
4	Plug connection on differential

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