

Technical training.
Product information.

F01/F02 LCI Powertrain and Chassis



BMW Service

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General notes

Symbols used

The following symbol/schematic diagram 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 deviations may arise as a 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 element of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the current respective information systems of the BMW Group for any changes/additions to the technical data.

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F01/F02 LCI Powertrain and Chassis

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1. Powertrain

1.1. Powertrain variants



F01/F02 LCI Powertrain

1.1.1. Models

The following models are available for the market introduction of the F01/F02 LCI:

F01	F02
BMW 740i	BMW 740Li
—	BMW 740LiH
—	BMW 740Li xDrive
BMW 750i	BMW 750Li
BMW 750i xDrive	BMW 750Li xDrive
BMW 760i	BMW 760Li

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1. Powertrain

Gasoline engines

BMW	740i 740Li 740LiH 740Li xDrive	750i 750i xDrive 750Li 750Li xDrive	760Li
Engine	N55B30O0	N63B44O1	N74B60U0
Automatic transmission	GA8HP45Z (*)	GA8HP70Z	GA8HP90Z

(*) The 740LiH ActiveHybrid uses the GA8P70HZ

1.1.2. Further information

The descriptions of the engines and the eight-speed automatic transmission can be found in the following training manuals:

- ST916 N55 engine training manual
- ST1209 N63TU engine training manual
- ST915 N74 engine training manual
- GA8HP automatic transmission (described in the ST116 F25 Complete Vehicle and in the "Powertrain" section).

Information regarding the engines can also be found in the following online web courses and training videos on ICP:

- VO916 N55 engine VOD
- VO915 N74 engine VOD
- OL1209 N63TU engine WBT

1.2. Engines

1.2.1. N55 engine

The N55 engine is the successor to the N54. Technical updates and modifications make it possible to use only one exhaust turbocharger instead of two. The technical data has remained virtually the same - with reduced costs and improved quality.

Highlights:

- TwinScroll exhaust turbocharger
- Air-gap-insulated exhaust manifold six in two; engine-proximate catalytic converter
- Direct fuel injection with central injector location, solenoid valve injectors
- 3rd generation Valvetronic

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1. Powertrain

- Upstream Digital Engine Electronics (MEVD17.2 Bosch), integrated in air intake system, FlexRay-compatible
- Lightweight crankshaft
- Map-controlled oil pump
- Uniform single-belt drive across all model series
- Initial introduction in the F07, then cross-series introduction.

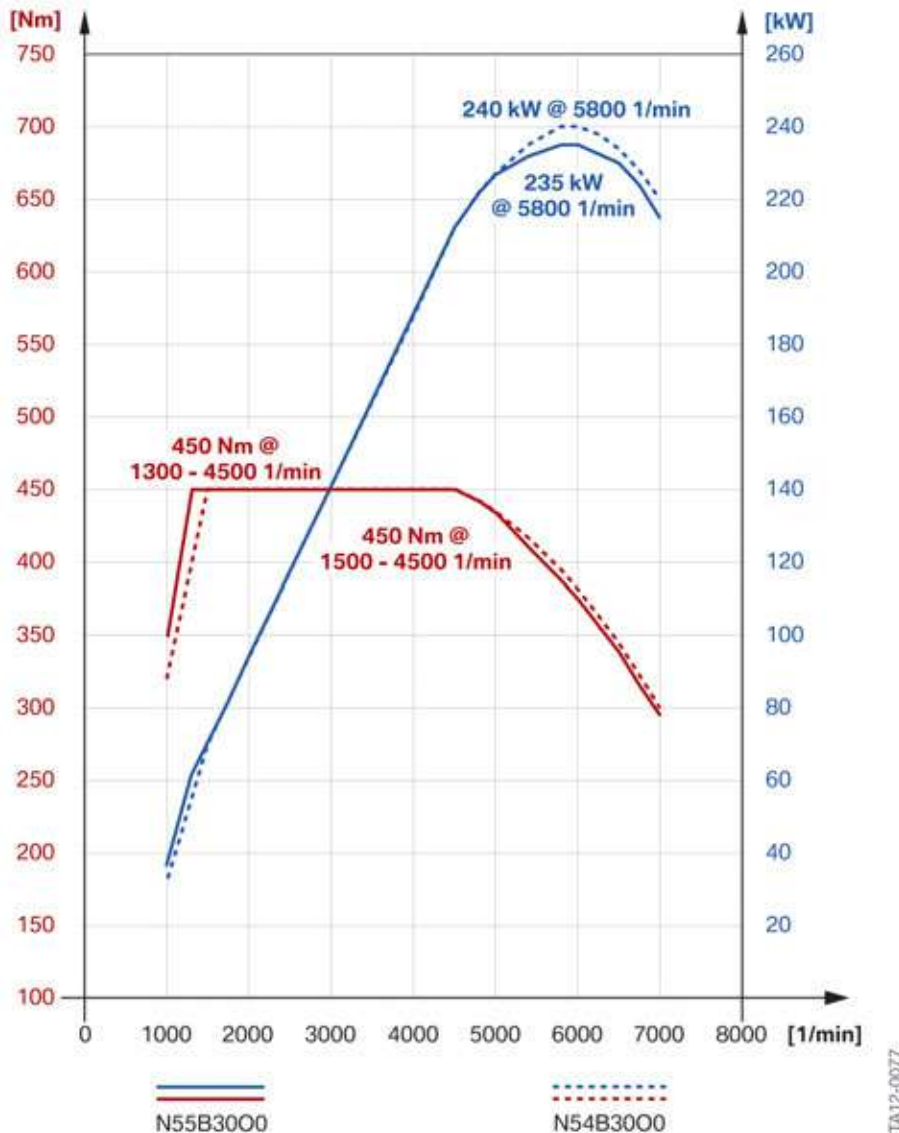
Technical data

		N54B3000 F01, 740i F02, 740Li	N55B3000 F01 LCI, 740i F02 LCI, 740Li F02 LCI, 740LiH F02 LCI, 740Li xDrive
Design		R6	R6
Valves per cylinder		4	4
Engine control		MSD 87	MEVD17.2.6
Displacement	[cm ³]	2979	2979
Stroke/Bore hole	[mm]	89.6/84.0	89.6/84.0
Power output at engine speed	[kW (HP)] [rpm]	240 (326) 5800	235 (315) 5800
Torque at engine speed	[Nm (lb-ft)] [rpm]	450 (332) 1500 – 4500	450 (332) 1300 – 4500
Compression ratio	[ε]	10.2 : 1	10.2 : 1
Fuel grade		RON 95 – 98	RON 91 – 98
Exhaust emission standards		EURO 5 (ULEV II)	EURO 5 (ULEV II)
Fuel consumption complying with EU	[l/100 km]	9.9 (F01) 10.0 (F02)	7.9 (F01 LCI) 7.9 (F02 LCI) 8.3 (F02 LCI xDrive)
Acceleration 0 – 60 mph	[s]	5.9 (F01) 6.0 (F02)	5.6 (F01 LCI) 5.6 (F02 LCI) 5.6 (F02 LCI xDrive)

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1. Powertrain

Full load diagram



Full load diagram F01/F02 LCI with N55B3000 engine compared with F01/F02 with N54B3000 engine.

1.2.2. N63TU engine

The N63TU engine is the successor to the N63 engine. The fundamental further development of the N63 engine to the N63TU engine is the latest fuel-mixture generation technology Turbo-Valvetronic Direct Injection TVDI. The new engine boasts better performance data at reduced fuel consumption and CO₂ emissions.

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Highlights:

- New control unit concept with one control unit per cylinder head
- Integration of the engine control units in the low-temperature circuit
- New cylinder head cover with adapted crankcase ventilation
- Adaptation of the cylinder head and crankshaft drive to the new Turbo-Valvetronic direct injection TVDI
- Use of a temperature-dependent coolant pump for achieving the operating temperature of the engine quicker (not for USA and South Korea).

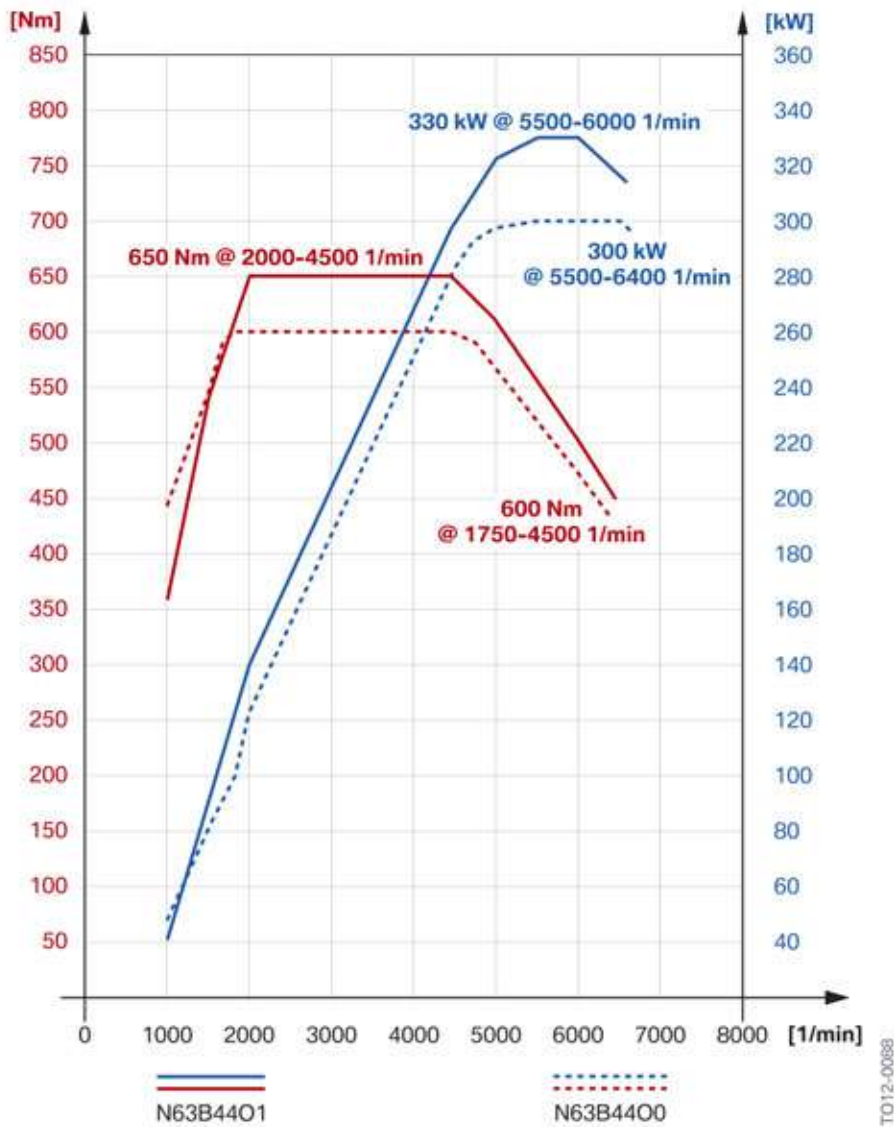
Technical data

		N63B44O0 F01, 750i F01, 750i xDrive F02, 750Li F02, 750Li xDrive	N63B44O1 F01 LCI, 750i F01 LCI, 750i xDrive F02 LCI, 750Li F02 LCI, 750Li xDrive
Design		V8	V8
Valves per cylinder		4	4
Engine control		MSD85.0	MEVD17.2.8
Displacement	[cm ³]	4395	4395
Stroke/Bore hole	[mm]	88.3/89.0	88.3/89.0
Power output	[kW (HP)]	300 (400)	330 (445)
at engine speed	[rpm]	5500 - 6400	5500
Torque	[Nm (lb-ft)]	600 (450)	650 (480)
at engine speed	[rpm]	1750 – 4500	2000 – 4500
Compression ratio	[ε]	10.0 : 1	10.0 : 1
Fuel grade		RON 91 – 98	RON 91 – 98
Exhaust emission standards		EURO 5 (ULEV II)	EURO 5 (ULEV II)
Fuel consumption complying with EU	[l/100 km]	11.4 (F01) 11.9 (F01 xDrive) 11.4 (F02) 11.9 (F02 xDrive)	8.6 (F01 LCI) 9.3 (F01 LCI xDrive) 8.6 (F02 LCI) 9.4 (F02 LCI xDrive)
Acceleration 0 – 60 mph	[s]	5.1 (F01) 5.0 (F01 xDrive) 5.2 (F02) 5.1 (F02 xDrive)	4.7 (F01 LCI) 4.6 (F01 LCI xDrive) 4.8 (F02 LCI) 4.6 (F02 LCI xDrive)

F01/F02 LCI Powertrain and Chassis

1. Powertrain

Full load diagram



Full load diagram F01/F02 LCI with N63B44O1 engine compared with F01/F02 with N63B44O0 engine.



For more information regarding the N63TU engine refer to the ST1209 N63TU training material and the OL1209 N63TU engine online web course available on TIS and ICP.

1.2.3. N74 engine

The N74 engine is the successor to the N73 engine, but shares many technological features with the N63 engine.

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1. Powertrain

Highlights:

- High-precision injection
- Bi-turbocharging with indirect charge air cooling
- Exhaust turbocharger mounted on the outside of the engine.

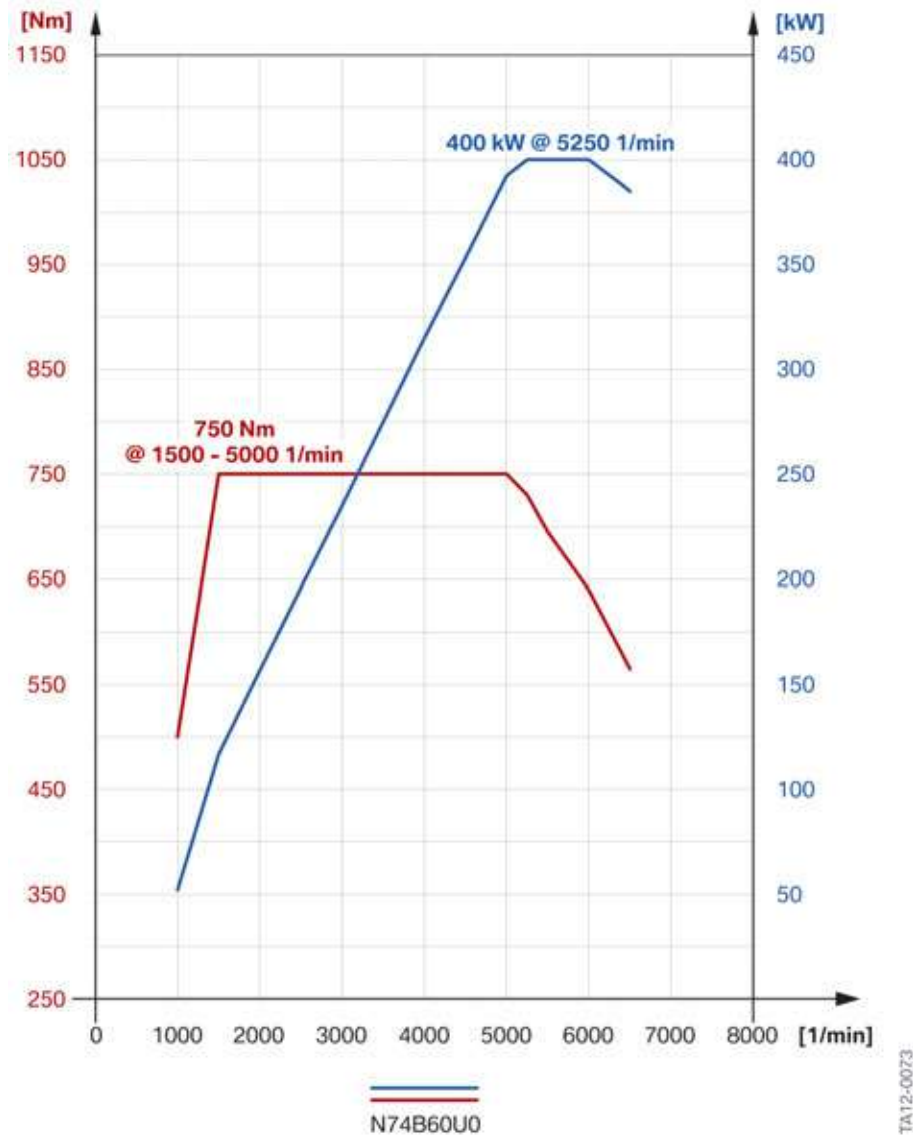
Technical data

		N74B60U0 F01, 760i F02, 760Li	N74B60U0 F01 LCI, 760i F02 LCI, 760Li
Design		V12	V12
Valves per cylinder		4	4
Engine control		MSD87-12	MSD87
Displacement	[cm ³]	5972	5972
Stroke/Bore hole	[mm]	80.0/89.0	80.0/89.0
Power output at engine speed	[kW (HP)] [rpm]	400 (536) 5250	400 (536) 5250
Torque at engine speed	[Nm (lb-ft)] [rpm]	750 (553) 1500 – 5000	750 (553) 1500 – 5000
Compression ratio	[ε]	10.0 : 1	10.0 : 1
Fuel grade		RON 91 – 98	RON 91 – 98
Exhaust emission standards		EURO 5 (ULEV II)	EURO 6
Fuel consumption complying with EU	[l/100 km]	12.9 (F01) 13.0 (F02)	12.8 (F01 LCI) 12.9 (F02 LCI)
Acceleration 0 – 60 mph	[s]	4.5 (F01) 4.5 (F02)	4.5 (F01 LCI) 4.5 (F02 LCI)

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1. Powertrain

Full load diagram



Full load diagram F01/F02 LCI with N74B60U0 engine.

1.3. Automatic engine start-stop function

As from the market introduction (in July 2012) all F01/F02 LCI vehicles (except for the 760i/iL models) are equipped as standard with the automatic engine start-stop (MSA) function.

Compared with other BMW vehicles, already equipped with the automatic engine start-stop function, the comfort of the function has been improved in the F01/F02 LCI.

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1. Powertrain

The following measures have been implemented:

- Improved shutdown comfort is achieved by relieving the alternator and A/C compressor load on the drive train during automatic engine stopping
- Starting acoustics during automatic engine starting are improved by early starter motor demeshing in vehicles with gasoline engines and automatic transmissions
- The availability and repeatability of the automatic engine start-stop function is improved by:
 - the discontinuation of the outside temperature threshold of 3 °C / 37.4 °F (switch-off inhibitor)
 - the reduction of the reactivation speed to 5 km/h (3 mph) in vehicles with automatic and manual transmissions (switch-off inhibitor)
 - the discontinuation of time restrictions of automatic engine stops for some selected switch-off inhibitors
 - the enhanced automatic engine start by the MSA function with gear engaged for three seconds if the engine was shut down beforehand on account of insufficient engine revs (only in vehicles with manual gearboxes).

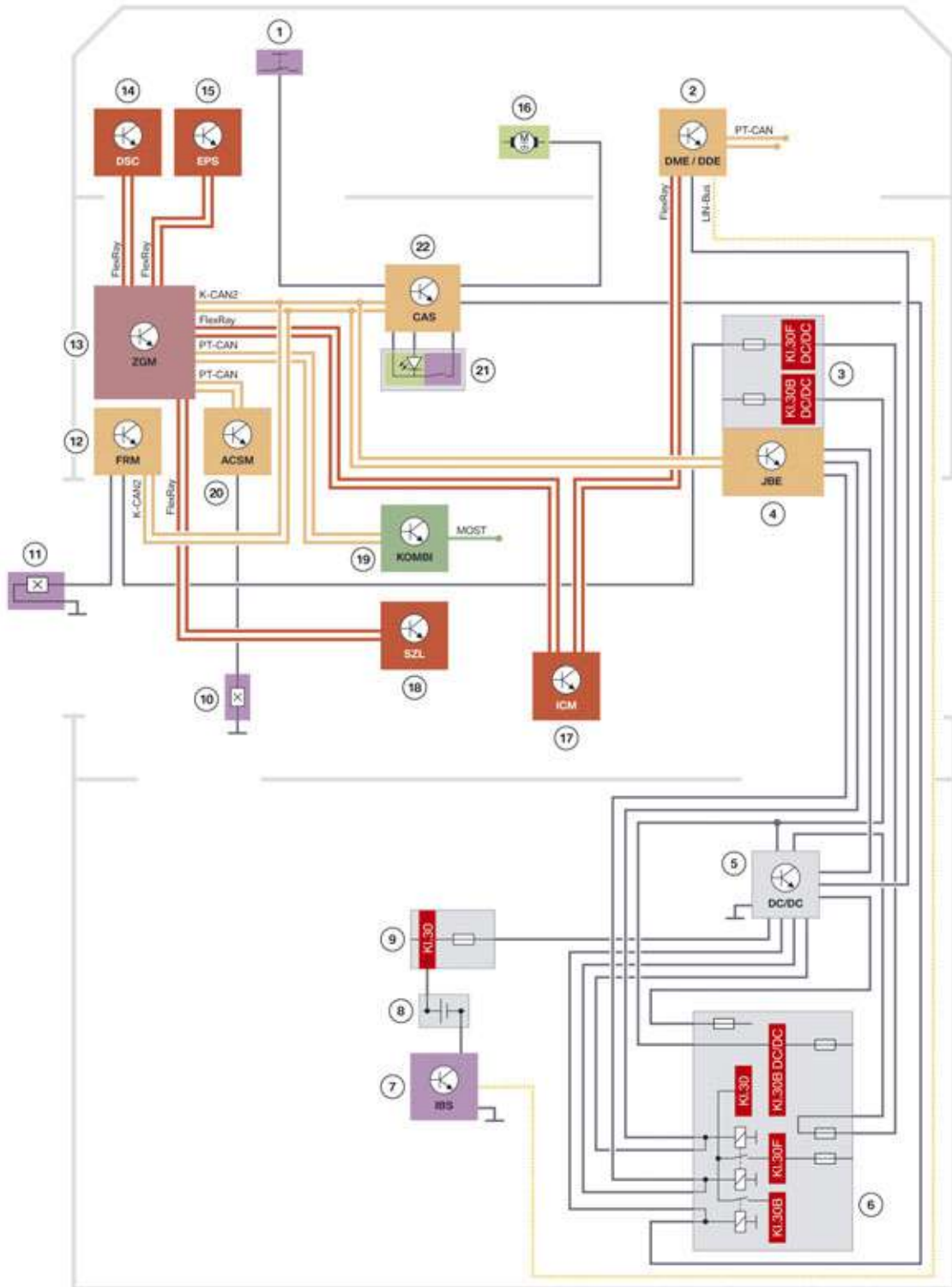


The Automatic Engine Start-Stop (MSA) function is not available in the BMW 760 i/iL models.

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1.3.1. System wiring diagram



F01/F02 LCI wiring diagram, automatic engine start-stop function II

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1. Powertrain

Index	Explanation
1	Engine compartment lid contact switch
2	Digital Engine Electronics (DME)
3	Junction box for the power distribution box
4	Junction box electronics
5	DC/DC converter
6	Power distribution box, luggage compartment
7	Intelligent battery sensor (IBS)
8	Battery
9	Battery power distribution box
10	Seat belt buckle contact, driver
11	Door contact, driver
12	Footwell module (FRM)
13	Central gateway module (ZGM)
14	Dynamic Stability Control (DSC)
15	Electronic Power Steering (EPS)
16	Starter motor
17	Integrated Chassis Management (ICM)
18	Steering column switch cluster (SZL)
19	Instrument cluster (KOMBI)
20	Crash Safety Module (ACSM)
21	START-STOP button
22	Car Access System (CAS)
KI.30	Terminal 30
KI.30B	Terminal 30 basic operation
KI.30F	Terminal 30, fault-dependent

The higher frequency of starting operations in vehicles with the automatic engine start-stop function can lead to voltage dips in the vehicle electrical system. A DC/DC converter is installed to protect specific voltage-sensitive components.

1.3.2. Operation

After each engine start the automatic engine start-stop function is active, regardless of whether the automatic engine start-stop function was deactivated via the engine start-stop button when the engine was last switched off.

The automatic engine start-stop function is activated in vehicles with manual and automatic transmissions at road speeds of > 5 km/h (3 mph). In other words, the engine is only switched off if the vehicle speed prior to vehicle standstill was > 5 km/h (3 mph).

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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 driving situation is indicated by the rev counter and fuel consumption display

The purpose of the automatic engine start-stop function is to switch the engine off if the vehicle is at a standstill.

Stopping

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



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Index	Explanation
1	Car slows to a stop, e.g. at a red light
2	Selector lever remains in the "D" drive position, driver depresses the brake pedal to decelerate and hold the vehicle at a standstill
3	The engine is switched off after roughly 1 second, "0" appears in the rev counter

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.

Drive-off

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 then operates the accelerator pedal
3	Engine is started, rev counter and fuel consumption display revert back to normal to reflect the driving situation

If the driver held the car at a standstill up to this point by depressing 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.

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1. Powertrain

Establishing start-up readiness

If the driver wants to start the engine but not yet move off, he can establish start-up readiness:

- Press the brake pedal briefly and with more force
- Release the brake pedal slightly.

The engine starts automatically.

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.

Preventing automatic engine shutdown

In order to be able to drive off quickly, e.g. at a crossing, automatic engine shutdown can be prevented through active intervention within one second of the vehicle coming to a standstill.



Index	Explanation
1	Car slows to a stop, e.g. at a red light
2	Immediately after the vehicle comes to a standstill (within one second) the brake pedal is pressed briefly with more force then immediately held with the usual brake pedal force
3	The engine continues running

1.3.3. Switch-off inhibitor, switch-on requests, deactivators

Switch-off inhibitors

Under certain conditions it is necessary to suppress the automatic engine start-stop function:

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- the vehicle is coasting/rolling (vehicles with manual gearboxes only)
- the brake vacuum pressure is too low (vehicles with manual gearboxes only)
- the brake pedal is not pressed firmly enough which means the vehicle is detected as not being held sufficiently
- the vehicle stops on uphill/downhill gradients > 12%
- the steer angle is > 6°
- the steering wheel movement is not yet complete (as otherwise sufficient support would not be provided by the power steering as a consequence)
- the vehicle was not driven at a speed of > 5 km/h* following the previous engine shutdown
- the engine is not running at idle speed (accelerator pedal is being pressed)
- the vehicle is reversing
- the operating temperature of the engine is too low
- the carbon canister is being flushed (gasoline engines only)
- the diesel particulate filter is being regenerated
- the fuel grade is insufficient
- the transmission adaptation is active (vehicles with automatic transmissions only)
- the hydraulic impulse storage is not yet charged (vehicles with automatic transmissions only)
- stop-and-go traffic
- the state of charge is too low
- the ambient temperature is above +30 °C / 86 °F (with heating and air conditioning system switched on)
- the condensation sensor of the IHKA detects fogging of the windshield
- the heating and air conditioning system is switched on but the passenger compartment has not yet heated up or cooled down to the required temperature
- ABS braking has been applied.

Switch-on prompts

Conversely, it may be also be necessary to start the engine:

- the vehicle is not sufficiently held by the released brake pedal (vehicles with automatic transmissions only)
- the steering wheel is moved
- the engine is not running at idle speed (accelerator pedal is being pressed)
- the driver previously shifted from position "D" to "P" so he could take his foot off the brake pedal (vehicles with automatic transmissions only)
- the transmission changes from "D" to "N" or "R" (vehicles with automatic transmissions only)
- the brake vacuum pressure is too low (vehicles with manual gearboxes only)
- the state of charge is too low

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- the ambient temperature is above +30 °C / 86 °F (with heating and air conditioning system switched on)
- the condensation sensor of the IHKA detects fogging of the windscreen
- the evaporator temperature is too low to ensure sufficient climate control
- Special case: the driver's seat belt is still fastened and the driver's door is opened (e.g. when using a dummy seat belt buckle in regions where wearing a seatbelt is not mandatory).

Deactivator

If a deactivation condition exists, the automatic engine start-stop function is deactivated.

The following scenarios arise, depending on when the deactivation condition for the automatic engine start-stop function occurred:

- the engine continues running and is no longer stopped automatically
- the engine was stopped automatically and starts once again automatically
- the engine was stopped automatically and no longer starts automatically (the Check Control message "MSA off" appears - the start/stop button must be operated in order to start the engine).

The following deactivators may occur:

- the driver's absence has been detected
- the engine did not start when the ignition was switched on
- the engine compartment lid is unlocked
- a fault related to the automatic engine start-stop function has been detected at the engine, transmission or components involved in the automatic engine start-stop function
- the bus communication is faulty
- the automatic engine start-stop function has been deactivated via the automatic engine start-stop function button
- the automatic engine start-stop function was deactivated via the diagnosis system
- the vehicle is in transport mode
- the engine was switched off on account of insufficient engine revs (in vehicles with manual gearboxes an automatic engine start is possible with the gear engaged for three seconds).

The individual statuses can be read out using the diagnosis system.

An easy-to-follow example of a deactivation with subsequent switch-on request:

- the automatic engine start-stop function is deactivated via the automatic engine start-stop function button in the automatic engine shutdown phase
- as a consequence, the engine starts automatically
- after this, no further automatic engine shutdowns occur, the automatic engine start-stop function remains deactivated.

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1.3.4. Detection of driver's absence

The automatic engine start-stop function is deactivated when the driver is absent to prevent an automatic engine start.

The driver's absence is detected via the seat belt buckle switch and via the door contact.

The automatic engine start-stop function is always reactivated if:

- the driver's seat belt is fastened and the vehicle is travelling at a speed of > 5 km/h (3 mph)
- the driver's door is closed and the vehicle is travelling at a speed of > 5 km/h*.

The prerequisites for deactivation of the automatic engine start-stop function vary, depending on which switching mode the seat belt buckle switch and door contact are in when the automatic engine start-stop function is activated:

Status during activation of automatic engine start-stop function	Prerequisites for deactivation of automatic engine start-stop function
• The driver's seat belt is fastened. • The driver's door is closed.	The driver unfastens the seat belt buckle and opens the driver's door.
• The driver's seat belt is not fastened. • The driver's door is closed.	The driver opens the driver's door.
• The driver's seat belt is fastened. • The driver's door is opened.	The driver unfastens the seat belt buckle.

After the automatic engine start-stop function has been deactivated by the detection of the driver's absence, it is reactivated if:

- the seat belt buckle is fastened and/or the driver's door is closed and the engine is started
- the seat belt buckle is fastened and/or the driver's door is closed and the vehicle is travelling at a speed of > 5 km/h* (3 mph).

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1.3.5. Deactivation via automatic engine start-stop function button



F01/F02 LCI automatic engine start-stop function button

Index	Explanation
1	Button for deactivation/activation of automatic engine start-stop function

The automatic engine start-stop function can be deactivated manually via the automatic engine start-stop function button. The LED in the automatic engine start-stop function button lights up when the automatic engine start-stop function is deactivated. The automatic engine start-stop function is reactivated each time the engine is restarted.

1.3.6. Notes for Service

Protection against automatic engine start



Always observe the safety precautions when carrying out repair work on vehicles equipped with the automatic engine start-stop function!

The engine is prevented from starting automatically when repair work is being carried out in the engine compartment. The automatic engine start-stop function is deactivated as soon as the hood is opened. The automatic engine start-stop function can be deactivated temporarily via the diagnosis system.



When the contact of the hood contact switch is pulled out it engages in the service position. The automatic engine start-stop function subsequently remains active even though the hood is open!

The engine can be restarted via the start/stop button.

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The automatic engine start-stop function is reactivated if:

- the hood is closed and the engine is started
- the hood is closed and the vehicle is travelling at a speed of > 5 km/h*.

Automatic engine start-stop function checklist for acceptance by the customer

In the event of customer complaints, check these against the "Automatic engine start-stop function checklist".

Process any fault entries using the diagnosis system. If no fault entries exist, check the condition of the automatic engine start-stop function with the automatic engine start-stop function system check.

The automatic engine start-stop function system check service function shows an overview of the most recent automatic engine start-stop function status and provides further assistance with troubleshooting.

Customer complaint	Yes	No
Often no engine shutdown: An automatic engine shutdown was expected but the engine repeatedly does not stop.		
Check the general automatic engine shutdown criteria in dialogue with the customer:	☐	☐
Driver's seat belt fastened?	☐	☐
Vehicle at standstill?	☐	☐
Automatic transmission in position "D", brake pedal depressed?	☐	☐
Engine at operating temperature?	☐	☐
Vehicle not driven backwards before stopping?	☐	☐
Automatic engine start-stop function activated (automatic engine start-stop function button not operated - LED does not light up)?	☐	☐
State of battery charge OK (no long immobilization periods or excessive short-distance driving)?	☐	☐
Quality level of battery OK (no external charging procedure, no other devices connected to the battery)?	☐	☐

If all criteria have been answered with **Yes**:

- Implement automatic engine start-stop function system check service function.

If at least one criterion has been answered with **No**:

- Automatic engine start-stop function is in working order.

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Customer complaint	Yes	No
Sporadically no engine shutdown: An automatic engine shutdown was expected but the engine sometimes does not stop.		
Check whether the automatic function has prevented the engine from being shut-down for safety or comfort reasons. Explain the automatic functions to the customer:	☐	☐
Heating and air conditioning system switched on and passenger compartment in cooling-down period (e.g. when setting off or following engine shutdown)	☐	☐
Windscreen starts to fog up with automatic air conditioning	☐	☐
Steering wheel movements when vehicle is at a standstill	☐	☐
Stop-and-go traffic (at least three stops made in short succession at a speed of < 25 km/h / 15.5 mph)	☐	☐

If all criteria have been answered with **No**:

- Implement automatic engine start-stop function system check service function.

If at least one criterion has been answered with **Yes**:

- Automatic engine start-stop function is in working order.

Customer complaint	Yes	No
Sudden engine start of its own: No automatic engine start was expected yet the engine started anyway.		
Check whether the engine has been automatically started by the automatic function for safety or comfort reasons. Explain the automatic functions to the customer:	☐	☐
Passenger compartment heating up with heating and air conditioning system switched on	☐	☐
Windshield starts to fog up with automatic air conditioning	☐	☐
Steering wheel movements when vehicle is at a standstill	☐	☐
The vehicle has started moving (speed < 5 km/h / 3 mph)	☐	☐
Low brake vacuum due to repeated operation of brake pedal	☐	☐
State of battery charge too low due to extended engine stop phases	☐	☐

If all criteria have been answered with **No**:

- Implement automatic engine start-stop function system check service function.

If at least one criterion has been answered with **Yes**:

- Automatic engine start-stop function is in working order.

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Customer complaint	Yes	No
No engine start: The brake pedal was released yet no automatic engine start follows.		
Driver's door opened and seat belt buckle unfastened during the engine stop phase?	☐	☐
Or engine compartment lid open?	☐	☐

If both criteria have been answered with **No**:

- Implement automatic engine start-stop function system check service function.

If at least one criterion has been answered with **Yes**:

- Automatic engine start-stop function is in working order.

Automatic deactivation of terminal 15

Terminal 15 is switched off automatically via the door contact when the driver's door is opened and closed with the engine switched off.

Terminal 15 can be switched permanently back on by subsequently pressing the start/stop button.

Power management and battery replacement

The automatic engine start-stop function and power management are strongly intertwined.

The data on battery type and state of charge could get lost after the following:

- programming of the engine control
- replacement of the intelligent battery sensor
- disconnection of the battery
- changing of the battery.

This data will only be available again once a standby current measurement has been carried out internally in the vehicle and after it has gone to sleep and has been locked. This measurement takes around 6 hours during which the vehicle must not be woken up. The automatic engine start-stop function will remain inactive until the data is transferred.

In order for the vehicle to register the battery data after the battery has been replaced, the internal standby current must be measured.

If the battery is replaced, an AGM battery must be reinstalled (initialized) to ensure the automatic engine start-stop function remains in proper working order.

F01/F02 LCI Powertrain and Chassis

1. Powertrain

1.4. Automatic transmission

1.4.1. Designation

A unique designation is used for the transmission in the technical documentation so it can be clearly identified. In frequent cases, however, only a short designation is used. This short form is used so the transmission can be assigned to a transmission family. The GA8HP transmission family, consisting of the GA8HP45Z, the GA8HP70Z and the GA8HP90Z transmissions for example, are often mentioned.

Position	Meaning	Index	Explanation
1	Designation	G	Transmission
2	Type of transmission	A	Automatic transmission
3	Number of gears	6 8	Six forward gears Eight forward gears
4	Type of transmission	HP L R	Hydraulic planetary gear train Designation of General Motors Powertrain Designation of General Motors Powertrain
5 + 6	Transmittable torque	19 26 32 45 (ZF) 45 (GMPT) 70 90 390	300 Nm gasoline engine 600 Nm gasoline engine 720 Nm gasoline engine 450 Nm gasoline engine, 500 Nm diesel engine 350 Nm gasoline engine 700 Nm gasoline engine and diesel engine 900 Nm gasoline engine 390 Nm, 4th gear 410 Nm, gasoline engine
7	Manufacturer	G J R Z H	Getrag Jatco GMPT ZF In-house part

1.4.2. Variants

Model	Engine	Transmission	Torque converter
BMW 740i	N55B30O0	GA8HP45Z	NW235TTD
BMW 740Li	N55B30O0	GA8HP45Z	NW235TTD
BMW 740LiH	N55B30O0	GA8P70HZ	—
BMW 740Li xDrive	N55B30O0	GA8HP45Z	NW235TTD
BMW 750i	N63B44O1	GA8HP70Z	NW250TTD
BMW 750i xDrive	N63B44O1	GA8HP70Z	NW250TTD
BMW 750Li	N63B44O1	GA8HP70Z	NW250TTD
BMW 750Li xDrive	N63B44O1	GA8HP70Z	NW250TTD
BMW 760Li	N74B60U0	GA8HP90Z	NW270TTD

F01/F02 LCI Powertrain and Chassis

1. Powertrain

1.4.3. GA8HP transmission

The new automatic transmissions GA8HP45Z, GA8HP70Z and GA8HP90Z are used in the F01/F02 LCI.



GA8HP automatic transmission

Highlights

- Significantly enhanced spontaneity of the gear shifts
- Greater driving and shifting comfort as a result of smaller gear jumps
- Higher control precision of the converter lockup clutch at low engine loads
- High power transmission of the converter lockup clutch
- Reduced fuel consumption (-5 to -6%).

The GA8HP45Z and GA8HP70Z are newly developed transmissions that will supersede the existing GA6HP19Z TU 6-speed automatic transmission or GA6HP26Z TU. The overall gear ratio has been enlarged from 6.04 to 7.07; the gear jumps have become smaller, thus also reducing the differences in speed when shifting gear. The weight of the transmission has been reduced significantly using, among other things, a plastic oil pan.

The electronic transmission control (EGS) control unit is integrated in the control unit network of the electronic immobilizer (EWS). This provides better protection against theft.

It is operated via the gear selector switch or using the shift paddles (optional equipment 2TB, automatic sports transmission, via the steering column switch cluster (SZL)).

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F01/F02 LCI Powertrain and Chassis

1. Powertrain

Mechanical torsional vibration dampers of the second generation are deployed in the torque converter:

- Turbine torsional vibration damper TTD
- Two-damper torque converter ZDW (typically used with diesel engines).

The function and design of the converter is described in the "E70 automatic transmission" training material available on TIS and ICP.

The vibration isolation reduces the proportion of slip on the converter lockup clutch and enables a larger operating range with the converter lockup clutch closed. This reduces the fuel consumption by 5% to 6% in the consumption cycle (KV01) compared to the TU six-speed automatic transmissions used until now.

Technical data

		GA8HP45Z	GA8HP70Z	GA8HP90Z
Maximum transmittable power (with gasoline engines)	[kW]	250	380	550
Maximum transmittable power (with diesel engines)	[kW]	180	240	330
Maximum transmittable torque (with gasoline engines)	[Nm]	450	700	900
Maximum transmittable torque (with diesel engines)	[Nm]	500	700	1000
Transmission ratio 1st gear		4.714	4.714	4.714
Transmission ratio 2nd gear		3.143	3.143	3.143
Transmission ratio 3rd gear		2.106	2.106	2.106
Transmission ratio 4th gear		1.667	1.667	1.667
Transmission ratio 5th gear		1.285	1.285	1.285
Transmission ratio 6th gear		1.000	1.000	1.000
Transmission ratio 7th gear		0.839	0.839	0.839
Transmission ratio 8th gear		0.667	0.667	0.667
Transmission ratio reverse gear		3.295	3.317	3.317

1.4.4. Hydraulic pressure accumulator

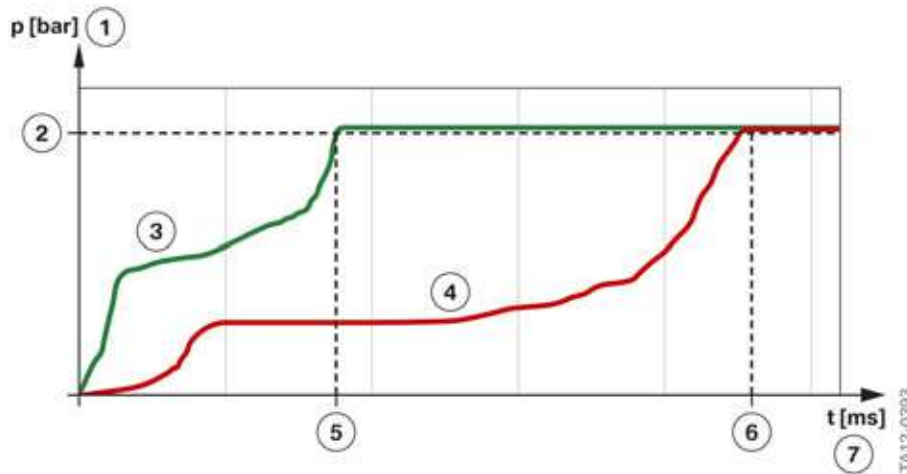
When the automatic start/stop function is activated the engine may shut off once the vehicle is at a standstill, the engine restarts automatically as the driver releases the brake to drive off.

In these engine stop phases the transmission oil pump is not driven, thus the fluid pressure supply ceases, the gearshift elements open, and there is no longer a transfer of power in the transmission. Maximum transmission oil pressure is required in order for the drive off process to take place dynamically without a noticeable delay when the automatic start/stop function is activated. However, the mechanically driven transmission oil pump cannot build up pressure quickly enough while the engine is starting.

F01/F02 LCI Powertrain and Chassis

1. Powertrain

A hydraulic pressure accumulator is therefore used in the F01/F02 LCI automatic transmission for this purpose. With the volume of transmission fluid stored in the hydraulic pressure accumulator, the shift elements can be filled as soon as the engine is started, even before the transmission oil pump has built up the necessary pressure to drive off.



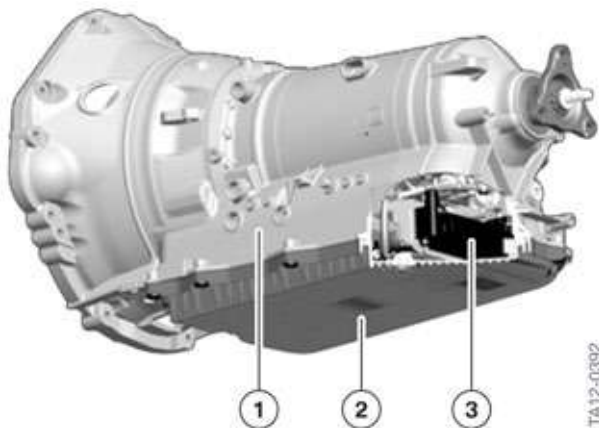
Variation in gearbox oil pressure over time at engine start

Index	Explanation
1	Transmission oil pressure
2	Nominal value of the transmission oil pressure which is required to hydraulically actuate the shift elements
3	Characteristic of the transmission oil pressure with hydraulic pressure accumulator
4	Characteristic of the transmission oil pressure without hydraulic pressure accumulator
5	Point at which the automatic transmission with hydraulic pressure accumulator is ready to drive off
6	Point at which the automatic transmission without hydraulic pressure accumulator is ready to drive off
7	Time

Installation location

F01/F02 LCI Powertrain and Chassis

1. Powertrain



Installation location of hydraulic pressure accumulator

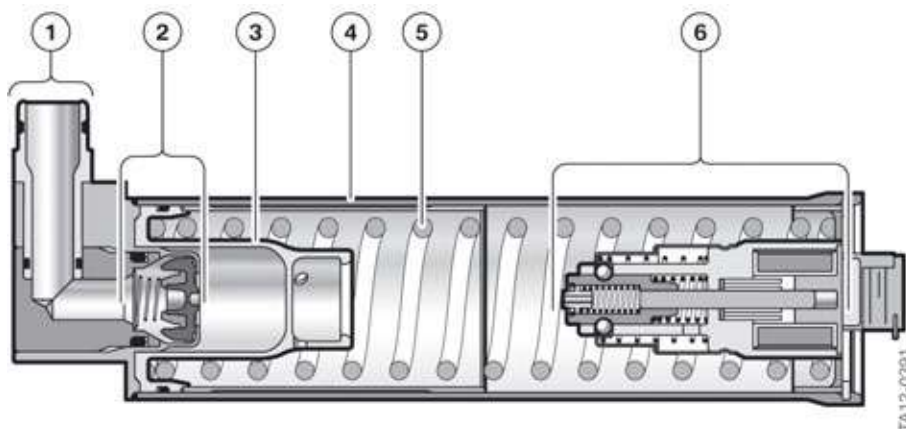
Index	Explanation
1	Transmission housing
2	Transmission oil sump
3	Hydraulic pressure accumulator

The hydraulic pressure accumulator is integrated in the automatic transmission. It is located in the transmission oil sump, in the direction of travel behind the mechatronics module.



The hydraulic pressure accumulator can be replaced as a separate component.

Design



Design of hydraulic pressure accumulator

F01/F02 LCI Powertrain and Chassis

1. Powertrain

Index	Explanation
1	Connection to hydraulic system of automatic transmission
2	Throttle and non-return valve
3	Hydraulic piston
4	Hydraulic cylinder
5	Coil spring
6	Electromechanical latch mechanism

The hydraulic pressure accumulator consists of a hydraulic cylinder. This cylinder contains a piston that moves against the force of a spring. The piston can be electromechanically locked in the tensioned end position. The electromechanical latch mechanism incorporates locking balls, a tension spring, a release spring, and a solenoid.

The solenoid is activated and deactivated by the EGS. A corresponding wiring harness to the hydraulic pressure accumulator is laid inside the transmission housing.

The cylinder of the hydraulic pressure accumulator is connected to the transmission's hydraulic system directly (without any valves between them). The hydraulic pressure accumulator in fact contains an element which functions as a throttle and non-return valve. The throttle limits the volumetric flow of the fluid while the hydraulic pressure accumulator is being filled. In general, this filling operation corresponds to the charging operation of the accumulator which is why the expressions "charging" or "discharging" are used in this description.

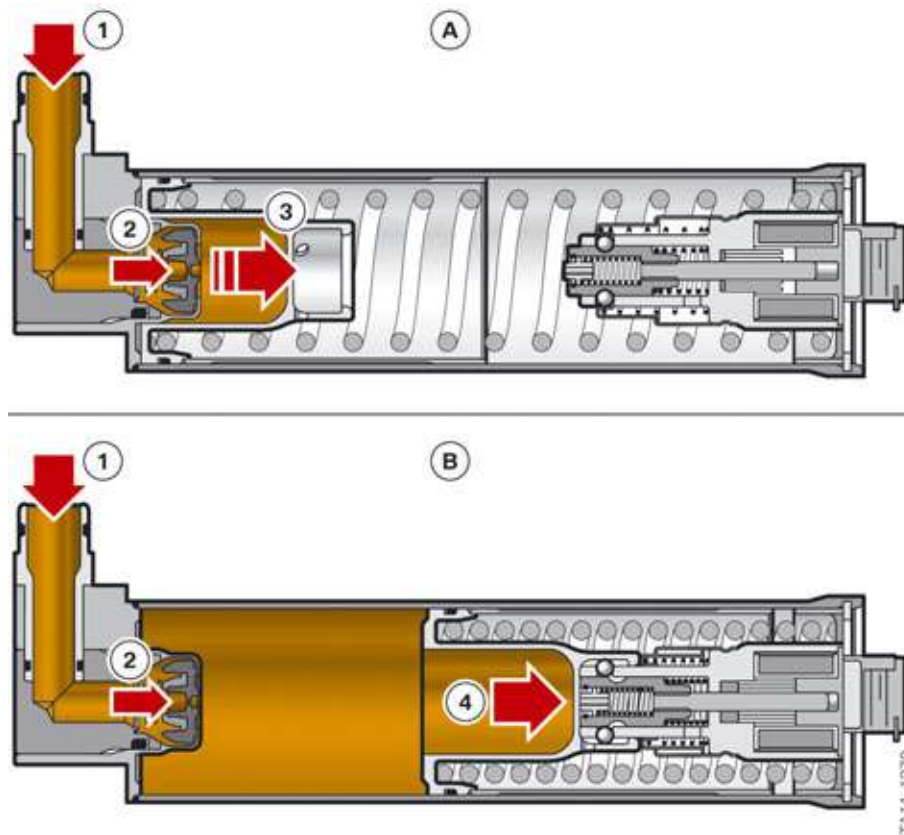
The non-return valve ensures that the transmission fluid flows into the hydraulic pressure accumulator via the throttle during charging. The transmission fluid does not flow through the throttle during the discharging process, the non-return valve now opens instead to allow an unrestricted flow of transmission fluid back into the hydraulic system. The purpose of the non-return valve is therefore not to maintain the pressure in the charged state. In the charged state, the transmission fluid in the hydraulic pressure accumulator is depressurized and the energy is stored in the tensioned spring.

Charging

The hydraulic pressure accumulator is therefore always charged when the engine is running and the transmission oil pump is working. During charging transmission fluid flows through the throttle into the hydraulic cylinder. In the process only a small volume is drawn from the hydraulic system so that the pressure level does not drop unintentionally. The transmission fluid pushes on the piston which acts against the spring force increasing the tension on the spring.

F01/F02 LCI Powertrain and Chassis

1. Powertrain



Charging of the hydraulic pressure accumulator

Index	Explanation
A	Discharged state - charging procedure starts
B	Charged state - charging procedure ends
1	Transmission fluid flows from the hydraulic system of the automatic transmission into the hydraulic pressure accumulator
2	Volumetric flow of the transmission fluid is limited by the throttle
3	The transmission fluid exerts force on the piston which moves and tensions the coil spring
4	Transmission fluid exerts a force on the piston so that it is held in the "charged" end position

At the end of the charging process the piston travels past the latch mechanism (locking balls) until it reaches the end/stop. The transmission fluid pressure holds the piston against the spring force in the end position.

The latch mechanism does not engage yet. The hydraulic pressure accumulator is fully charged in this end position.

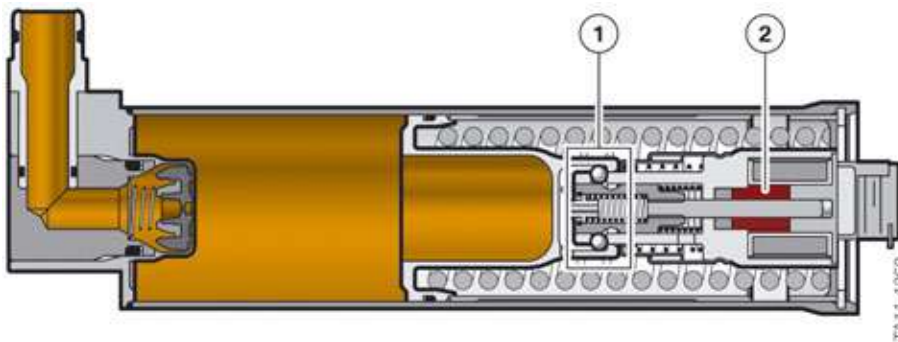
F01/F02 LCI Powertrain and Chassis

1. Powertrain

Locking

When the engine is switched off (while the hydraulic pressure accumulator is charged) the transmission oil pressure drops causing the spring to be released slightly. This allows the piston to slide into the locked position where locking balls hold the piston mechanically in place.

The now energized solenoid holds the inner slide in place so that the locking balls cannot enter the channels designated for releasing the lock. The electric power used for this is low ($< 10\text{ W}$) and is only required while the engine is off. Therefore the additional energy consumption of the hydraulic pressure accumulator viewed over an entire driving cycle is very low.



Charged and locked state of the hydraulic pressure accumulator

Index	Explanation
1	Mechanical latch mechanism
2	Solenoid activated

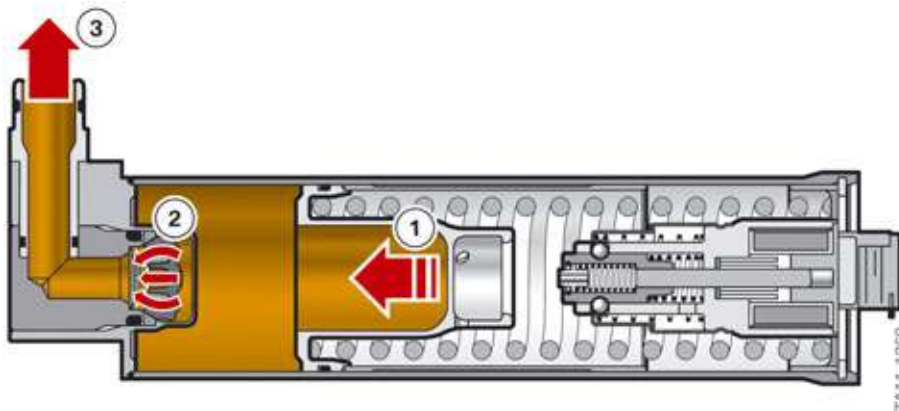
Discharging

When the engine is started, as the driver wants to drive off, the gearshift elements in the automatic transmission for driving off must be engaged. The hydraulic pressure accumulator supplies the transmission fluid pressure required for this during the discharging process.

As the solenoid is deactivated for discharging the inner slide (driven by a small spring) moves in the direction of the locking balls. This allows the balls to enter the channels designated for releasing the lock which in turn releases the piston. The spring (compressed during the charging process) exerts force on the piston which pressurizes the transmission fluid in the cylinder.

F01/F02 LCI Powertrain and Chassis

1. Powertrain



Discharging of the hydraulic pressure accumulator

Index	Explanation
1	The large spring pushes on the piston, which in turn, forces the transmission fluid out of the hydraulic cylinder
2	Transmission fluid can now flow through the throttle and the opened non-return valve
3	Transmission fluid flows from the hydraulic pressure accumulator back into the hydraulic system of the automatic transmission

The piston moves (in the graphic to the left) and thereby pushes the transmission fluid back into the transmission hydraulic system. The transmission fluid exits the cylinder through the now opened non-return valve and throttle.

The oil volume forced back into the hydraulic system of the transmission is sufficient to engage the gearshift elements needed for the driving off process. This system is designed to provide the initial fluid pressure needed for the transmission to go into "Gear" at the exact moment just before the engine is started. As soon as the engine is started, the transmission fluid pressure is then again generated by the transmission oil pump and the entire process is restarted.

1.4.5. Transmission emergency release

The F01/F02 LCI features the new control concept for operation of the mechanical transmission emergency release. The transmission emergency release is no longer operated from the passenger compartment.

Mechanical transmission emergency release

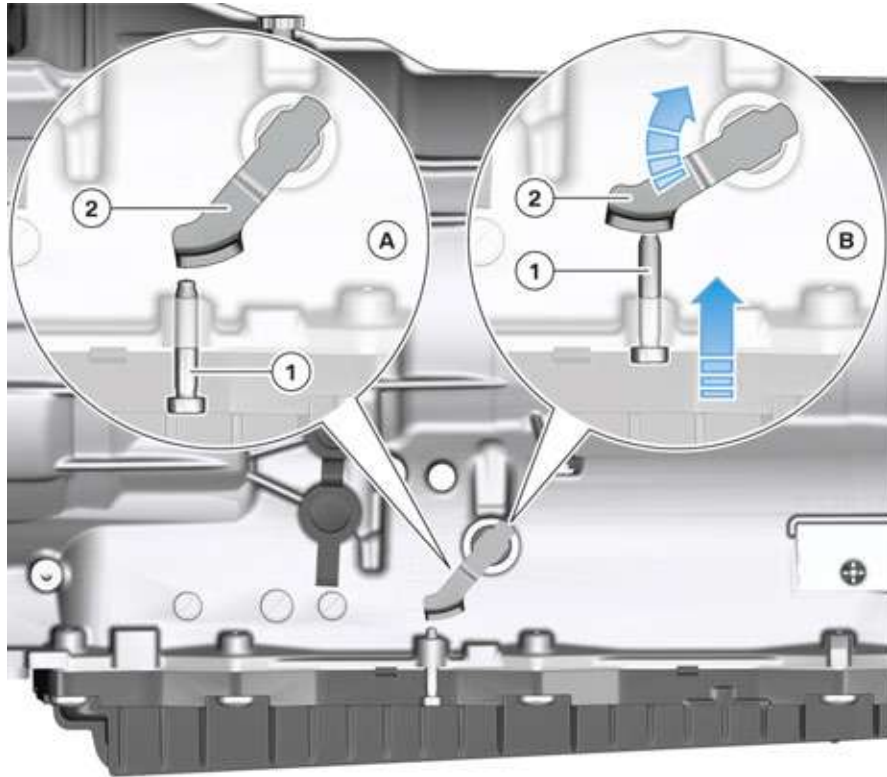


The mechanical transmission emergency release may only be operated by specially trained Service Technician.

To actuate mechanical transmission emergency release, it is necessary to raise the vehicle and remove the underbody panelling.

F01/F02 LCI Powertrain and Chassis

1. Powertrain



F01/F02 LCI mechanical transmission emergency release GA8HP

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

In the event of a fault, the engaged automatic transmission parking lock can be disabled via a mechanical emergency release function by turning an adjusting screw in the vehicle underbody.

For detailed information on the mechanical transmission emergency release, refer to the corresponding repair instructions.

Electronic transmission emergency release



Only specially trained service technicians are permitted to actuate electronic transmission emergency release.

The vehicle must not be towed while electronic transmission emergency release is actuated; it may only be maneuvered. In case of misuse an entry is made in the fault memory.

F01/F02 LCI Powertrain and Chassis

1. Powertrain



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

Electronic transmission emergency release is active for a maximum of 15 minutes. This time is extended by an extra 15 minutes as soon as a wheel speed signal is recorded. After this time period the parking lock is engaged without a Check Control message being displayed. The time specified is dependent on the battery capacity.

Electronic transmission emergency release procedure:

- Secure the vehicle before operating the electronic transmission emergency release function to prevent it from rolling away
- Depress and hold the brake pedal throughout the entire process
- Press the start/stop button - the starter motor cranks the engine for a specific time



Electronic transmission emergency release GA8HP

Index	Explanation
1	Release button
2	Gear selector switch

F01/F02 LCI Powertrain and Chassis

1. Powertrain

- Press release button (1) and hold pressed
- Move gear selector switch (2) forwards by one step and hold for two seconds – strictly observing the specified time
- Release the gear selector switch (2) and move forwards again briefly by one step
The transmission position "N" is displayed in the instrument cluster - the transmission is unlocked electronically.



If the start/stop button is pressed again, the parking lock is reactivated without a Check Control message being displayed.

For detailed information on the electronic transmission emergency release, refer to the corresponding repair instructions.

1.5. Front axle differential

The already familiar front axle differentials VAG 170AL and VAG 175AL are used in those models with xDrive.

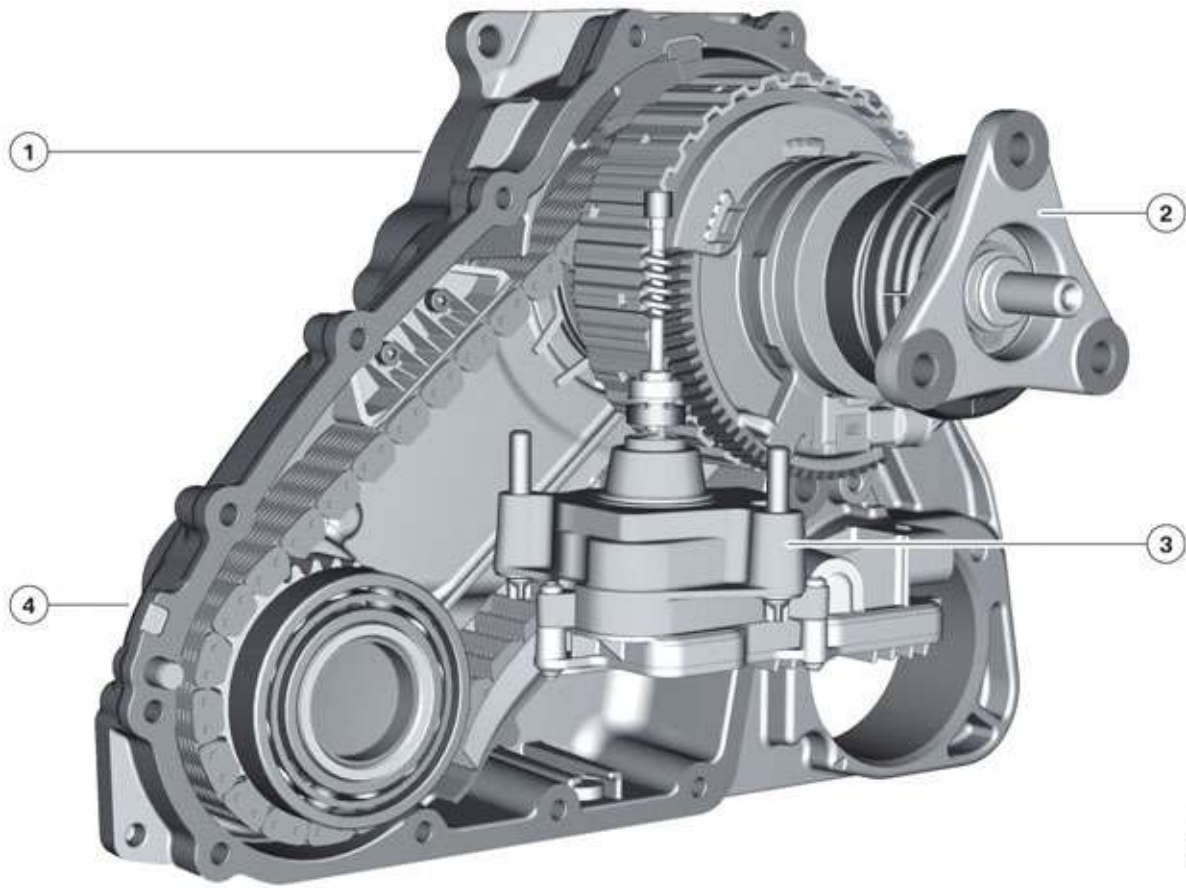
Model	Front axle differential	Gear ratio [i]	Weight (incl. oil) [kg]
BMW 740Li xDrive	VAG 170AL	3.077	14.2
BMW 750i xDrive BMW 750Li xDrive	VAG 175AL	2.813	14.7

F01/F02 LCI Powertrain and Chassis

1. Powertrain

1.6. Transfer box

The ATC 35L transfer box is a further development of the ATC 350.



Mechanical design of ATC 35L transfer box

Index	Explanation
1	Connection to the transmission
2	Connection to the rear axle
3	Control unit, transfer box VTG (for activating the multi-disc clutch)
4	Connection to the front axle

Highlights:

- 1.4 kg weight reduction
- Optimized efficiency
- Cost reduction.

F01/F02 LCI Powertrain and Chassis

1. Powertrain

It has been possible to achieve improved efficiency through:

- Integration of the printed circuit board and the servomotor in the transfer box VTG control unit
- Omission of the mechanical oil pump
- Lubrication and cooling of the components by the toothed chain oil delivery function
- Reduction in the actuator mechanism components
- Minimization of the mechanical tolerances.

1.7. Rear axle differential

The already established rear axle differentials HAG 205AL, HAG 225AL and HAG 235L-K are used in the F01/F02 LCI.

Model	Rear axle differential	Gear ratio [i]	Weight (incl. oil) [kg]
BMW 740i BMW 740Li BMW 740LiH	HAG 205AL	3.077	23.6
BMW 740Li xDrive	HAG 205AL	3.077	23.6
BMW 750i BMW 750Li	HAG 225AL	2.813	29.7
BMW 750i xDrive BMW 750Li xDrive	HAG 225AL	2.813	29.7
BMW 760Li	HAG 235L-K	2.813	38.2

F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension

Various adaptations have been made in the F01/F02 LCI in order to enhance ride comfort:

- Optimized suspension tuning for all models
- Improved rubber mounts on the rear axle support
- Air suspension comes as standard in the F01/F02 LCI. (A new damper is also fitted)
- Stiffer and lighter steel bases for the front seats
- Improved 18"/19" tires.

2.1. Steering

The F01/F02 LCI is now fitted (depending on the model) with Electronic Power Steering (electromechanical power steering) (EPS). It is important to note that vehicles with xDrive are fitted with hydraulic steering.

Vehicles with the Integral Active Steering (option 2VH) optional equipment and 760i/760Li models are fitted with the 24 V EPS system, as installed in the F10.

The following tables provide an overview of all the steering variants.

F01 LCI	Standard equipment	Integral Active Steering (option 2VH)
BMW 740i	EPS	EPS (24 V) with active steering
BMW 750i	EPS	EPS (24 V) with active steering
BMW 750i xDrive	Hydraulic power steering	—
BMW 760i	EPS (24 V) with active steering	
F02 LCI	Standard equipment	Integral Active Steering (option 2VH)
BMW 740Li	EPS	EPS (24 V) with active steering
BMW 740LiH	EPS	—
BMW 740Li xDrive	Hydraulic power steering	—
BMW 750Li	EPS	EPS (24 V) with active steering
BMW 750Li xDrive	Hydraulic power steering	—
BMW 760Li	EPS (24 V) with active steering	

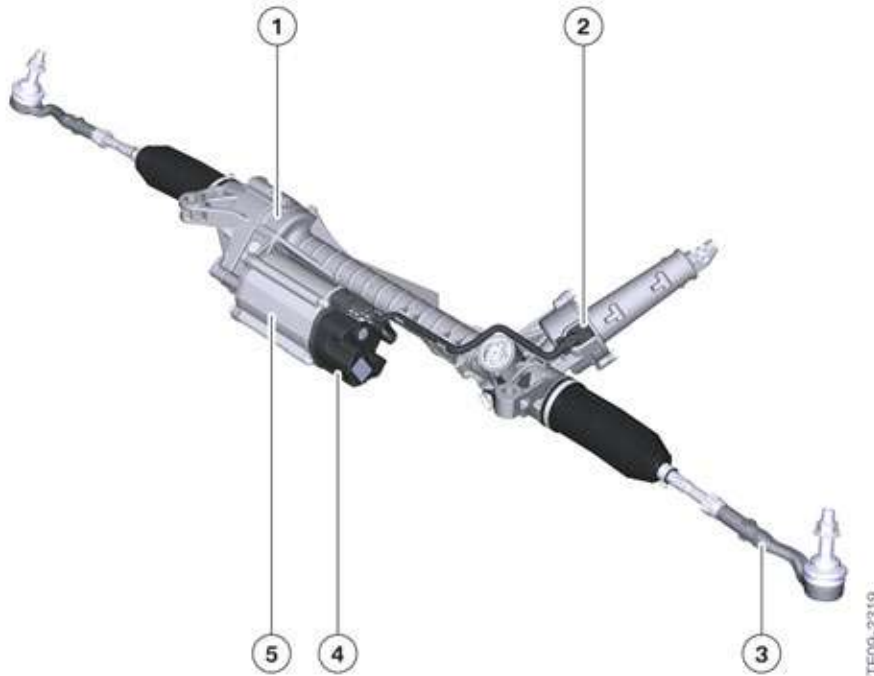
Note: The BMW 760Li is equipped as standard with Integral Active Steering (option 2VH).

Note: Vehicles with xDrive are fitted with hydraulic steering.

F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension

2.1.1. Electromechanical power steering (EPS)



F01/F02 LCI Electronic Power Steering (EPS)

Index	Explanation
1	Reduction gear
2	Steering-torque sensor
3	Track rod
4	EPS control unit
5	Electric motor with motor position sensor

Electronic Power Steering (EPS) reduces fuel consumption by roughly 0.3 l per 100 km (60 miles) when compared to conventional hydraulic power steering. This helps reduce CO₂ emissions.

As there is no oil in an EPS, it is environmentally cleaner than conventional hydraulic power steering.

For reasons inherent in the system, EPS is always equipped with the Servotronic function. Two different settings ("Normal" and "Sporty") can be accessed via the drive dynamic control switch.

The EPS is less sensitive to external disturbance variables such as judder and steering wheel vibration. It also features active roll damping which enhances the driving safety of the F01/F02 LCI.

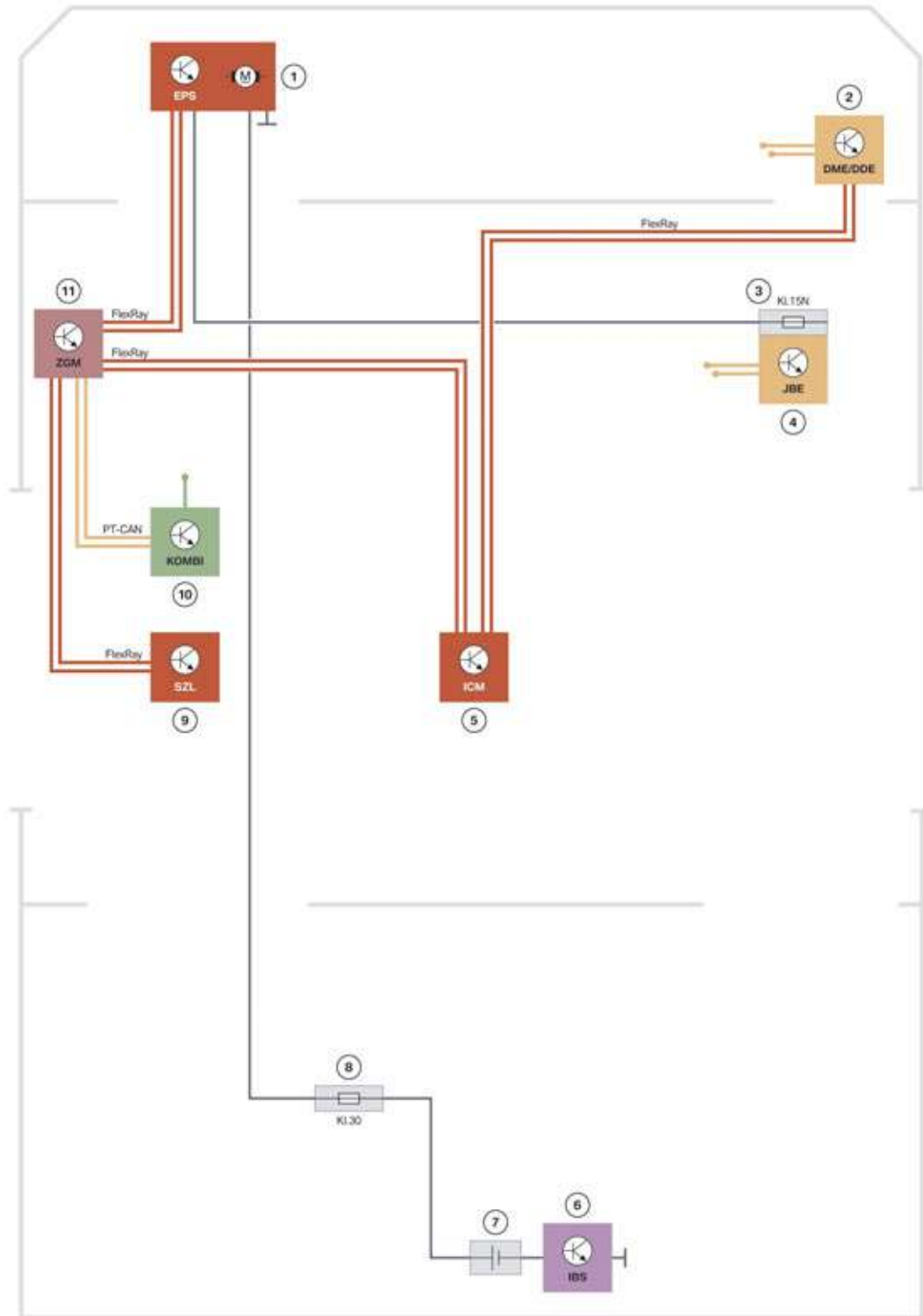
The return characteristics of the EPS are fully configurable. That means that optimum drivability can be guaranteed. EPS allows the implementation of the parking assistant feature.

The operating principle and design of the EPS are identical with those of the F10 and are described in the "Chassis Dynamics" section of the ST1202 F10 Complete Vehicle training material available on TIS and ICP.

F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension

For more information on the parking assistant, refer to the "F10 Driver Assistance systems".



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F01/F02 LCI system wiring diagram, basic steering

F01/F02 LCI Powertrain and Chassis

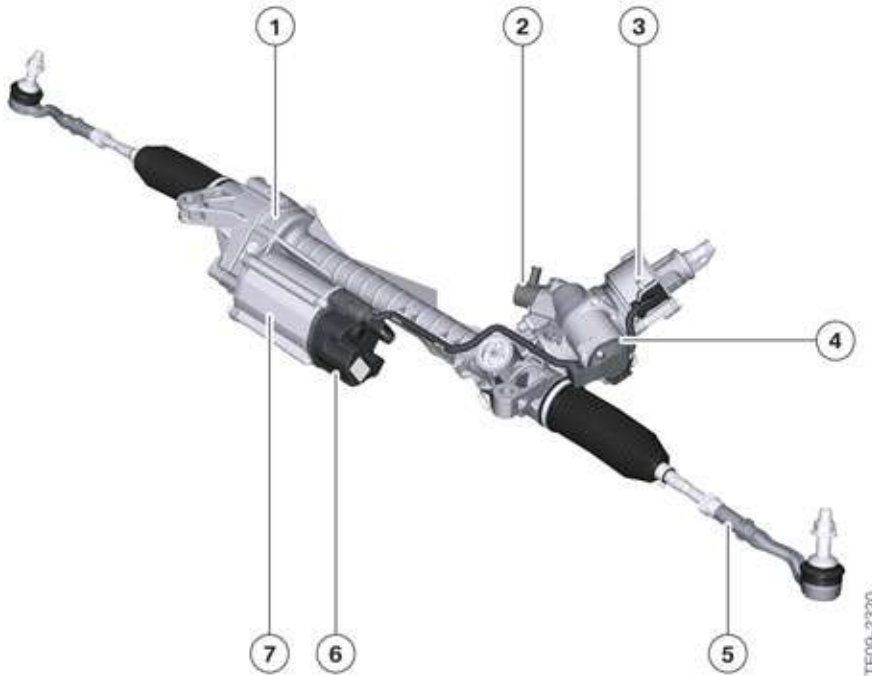
2. Chassis and Suspension

Index	Explanation
1	Electronic Power Steering (EPS)
2	Digital Engine Electronics (DME)
3	Junction box for the power distribution box
4	Junction box electronics (JBE)
5	Integrated Chassis Management (ICM)
6	Intelligent battery sensor (IBS)
7	Battery
8	Battery power distribution box
9	Steering column switch cluster (SZL)
10	Instrument cluster (KOMBI)
11	Central gateway module (ZGM)
Kl.15N	Ignition (after-run)
Kl.30	Terminal 30

F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension

2.1.2. Active steering



F01/F02 LCI Electronic Power Steering (EPS) with active steering

Index	Explanation
1	Reduction gear
2	Active Steering lock
3	Steering-torque sensor
4	Active Steering servomotor with motor angular position sensor
5	Track rod
6	EPS control unit
7	Electric motor with motor position sensor

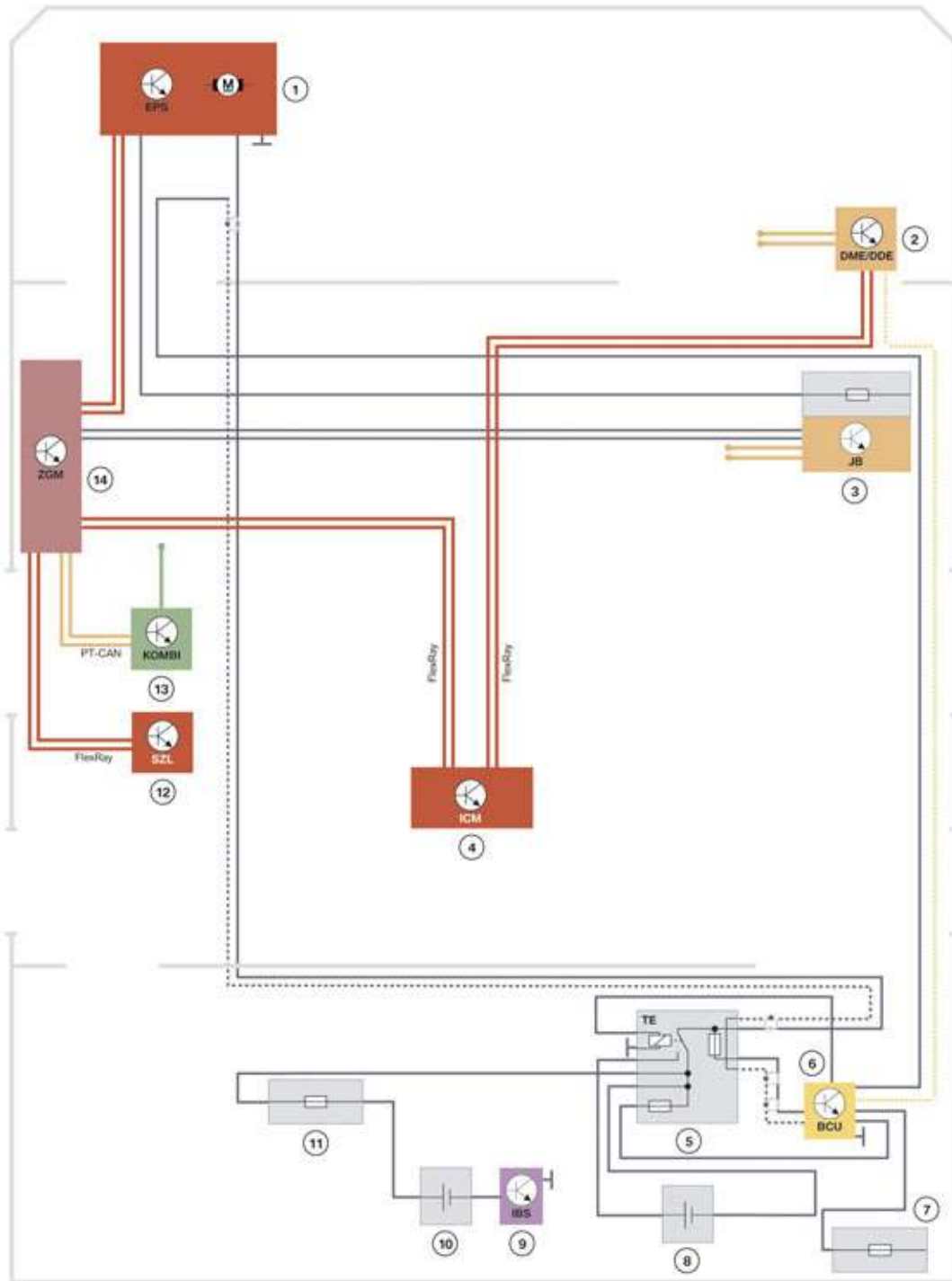
Depending on the version, EPS or hydraulic steering is used for active steering.

EPS is supplied by a vehicle electrical system nominal voltage of 12 V. The electromechanical active steering requires a 24 V power supply because of the higher steering power requirements. The 24 V vehicle electrical system is implemented by a DC/DC converter in conjunction with a second small 12 V battery.

The components of Integral Active Steering "active steering (AL)" and "rear axle slip angle control (HSR)" cannot be ordered separately and are only available with the Integral Active Steering package (option 2VH).

F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension



F01/F02 LCI system wiring diagram, EPS (24 V) with active steering

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F01/F02 LCI Powertrain and Chassis

2. Chassis and Suspension

Index	Explanation
1	EPS
2	Digital Engine Electronics (DME)
3	Junction box electronics with front power distribution box
4	Integrated Chassis Management (ICM)
5	Separator
6	Charging controller for auxiliary battery (Battery Charge Unit BCU)
7	Rear right power distribution box
8	Auxiliary battery
9	Intelligent battery sensor (IBS)
10	Battery
11	Battery power distribution box
12	Steering column switch cluster (SZL)
13	Instrument cluster (KOMBI)
14	Central gateway module (ZGM)



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