Reference Manual

G05 PHEV COMPLETE VEHICLE

Technical Training

Technical training.
Product information.

G05 PHEV Complete Vehicle.

Edited for the U.S. market by:
BMW Group University
Technical Training
ST2005 6/1/2020

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.

Originally Published: May 2019

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.

The information contained in the training course materials is solely intended for participants in this training course conducted by BMW Group Technical Training Centers, or BMW Group Contract Training Facilities.

This training manual or any attached publication is not intended to be a complete and all inclusive source for repair and maintenance data. It is only part of a training information system designed to assure that uniform procedures and information are presented to all participants.

For changes/additions to the technical data, repair procedures, please refer to the current information issued by BMW of North America, LLC, Technical Service Department.

This information is available by accessing TIS at www.bmwcenternet.com.

Additional sources of information

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

- Owner's Manual
- Integrated Service Technical Application
- Aftersales Information Research (AIR)

G05 PHEV Complete Vehicle.

Contents.

G05 PHEV Complete Vehicle.

Contents.

G05 PHEV Complete Vehicle.

Contents.

G05 PHEV Complete Vehicle.

1. Introduction.

1.1. Further information

With the new BMW X5 xDrive45e, BMW enhances The Ultimate Driving Machine with a further innovative model variant. With its plug-in hybrid drive, the latest BMW X5 variant combines driving dynamics and efficiency. It is capable of local electric driving with zero emissions without having to miss out on the characteristic versatility of a sports activity vehicle.

This Reference Manual only covers the alterations to the new BMW X5 xDrive45e in comparison with its predecessor, the BMW X5 xDrive40e iPerformance. Here, knowledge of the predecessor model (F15 PHEV) and the high-voltage technology of Hybrid Generation 3.0 is a requirement.

More information can be found in the listed documents:

More information
• F15 PHEV High-voltage Components Reference Manual • F15 PHEV High-voltage Battery Unit Reference Manual • SP44 High-voltage Battery Reference Manual

Only Service employees who satisfy all the prerequisites are permitted to work on the designated high-voltage components: suitable qualifications, compliance with the safety rules, procedure following the exact repair instructions.

Work on live high-voltage components is expressly prohibited. Prior to every operation which involves a high-voltage component, it is essential to disconnect the high-voltage system from the voltage supply and to secure it against unauthorized return to service.

1 Charging plug is not connected to the vehicle.

2 Enter the PARK vehicle condition (e.g. by holding down the volume control button).

3 Wait until the vehicle enters "Sleep" mode (identifiable by the fact that the inscription in the START/STOP button is not illuminated).

4 Open high-voltage safety disconnect.

5 Secure the high-voltage system against restarting with a lock.

6 Activate PAD mode (e.g. by operating the start/stop button three times within 0.8 s).

7 Wait until the Check Control message "High-voltage system switched-off" is displayed in the instrument cluster.

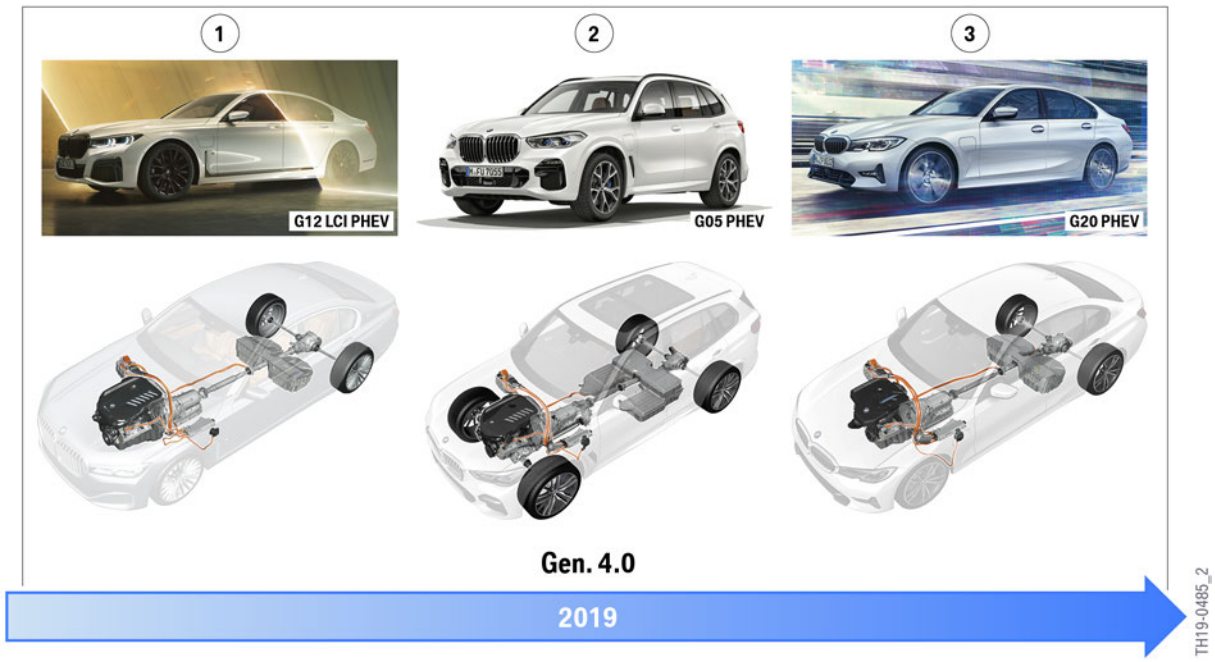
8 Enter PARK vehicle condition.

G05 PHEV Complete Vehicle.

1. Introduction.

1.2. Positioning

The BMW X5 xDrive45e, whose development code is G05, is based on the G05. It is the third vehicle of the new **Hybrid Generation 4.0** and, together with the BMW 745e (G12 LCI PHEV) and the BMW 330e (G20 PHEV), lays the foundations for a series of plug-in hybrid electric vehicles which above all have greater ranges than their predecessors.



Hybrid generation 4.0 vehicles

Index	Explanation
1	BMW 745e (G12 LCI PHEV)
2	BMW X5 xDrive45e (G05 PHEV)
3	BMW 330e (G20 PHEV)

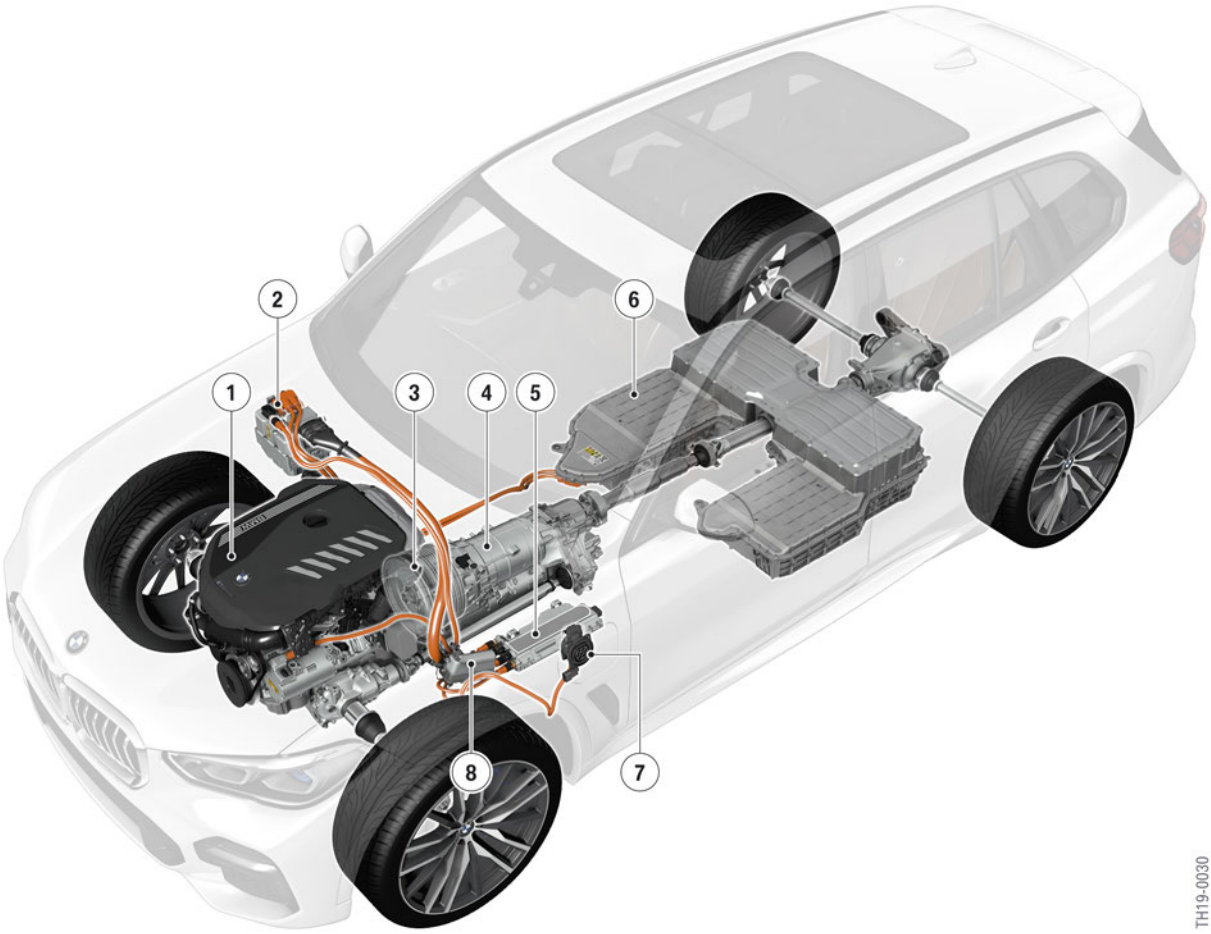
The model designation "iPerformance" and the associated exterior identifying features are no longer used for vehicles of hybrid generation 4.0.

Technically, hybrid generation 4.0 is mostly based on the drive technology used in the BMW iPerformance models (hybrid generation 3.0). The G05 PHEV is a full hybrid vehicle with lithium ion high-voltage battery which can be charged via an AC domestic socket outlet.

The abbreviation PHEV in the development code stands for **P**lug-in **H**ybrid **E**lectric **V**ehicle.

G05 PHEV Complete Vehicle.

1. Introduction.



G05 PHEV hybrid drive

Index	Explanation
1	Combustion engine B58B30M1
2	Electrical machine electronics (EME)
3	Electrical machine
4	Automatic transmission GA8P75HZ
5	Convenience charging electronics (KLE)
6	High-voltage battery unit
7	Charging socket
8	Electrical heating (EH)

The higher model designation in comparison with the predecessor model is already an indication of this. The drive system of the BMW G05 PHEV consists of a **6-cylinder gasoline engine** with TwinPower Turbo technology, the established 8-speed automatic transmission and the familiar electrical machine. The main advantage of the drive system deployed in the G05 PHEV is naturally the enhanced drive power compared to the predecessor model (290 kW (394 hp)).

G05 PHEV Complete Vehicle.

1. Introduction.

The electric drive of the G05 PHEV enables all-electric driving and thus emission-free driving at speeds up to 87 mph. The larger, **more powerful high-voltage battery unit** with 12 cell modules makes an electric range of approx. 54 miles (WLTP) or 60 miles (NEDC) possible.

The driving and drive system modes have been merged and simplified. With the Driving Experience Control in the G05 PHEV, the driving modes ADAPTIVE, SPORT, **HYBRID** and **ELECTRIC** can be selected. Each of the last two driving modes can be individualized with regard to efficiency or dynamics. The drive system modes are no longer used in the familiar form.

The enhanced anticipatory hybrid drive and new **adaptive recuperation** increase the intelligence of the parallel hybrid drive.

1.3. Identifying features

1.3.1. Exterior

The exterior identifying features have been significantly reduced in comparison with the BMW iPerformance models of hybrid generation 3.0.

G05 PHEV exterior identifying features

Index	Explanation
1	Model designation "xDrive45e" on the tailgate, right
2	Acoustic cover with "eDrive" inscription
3	Charging socket cover

G05 PHEV Complete Vehicle.

1. Introduction.

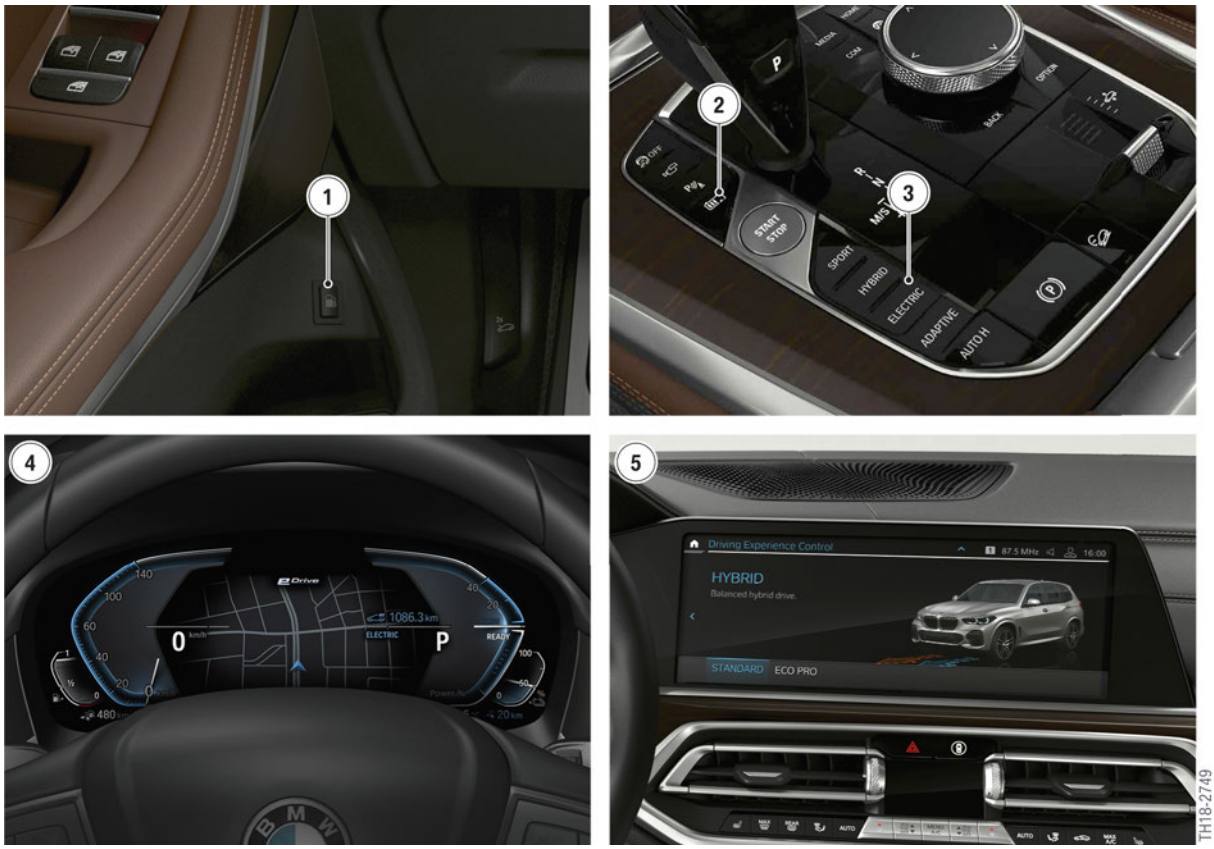
The acoustic cover of the combustion engine is significantly more unobtrusive with a smaller "eDrive" inscription. The following exterior identifying features are **no longer** used:

- "eDrive" inscription on both C-pillars
- Hub cap with blue identification
- "i" inscription on both front side panels
- Blue marking of the air flaps

The optional equipment BMW iPerformance Design Elements Deletion - (SA 3DE) is not available for the G05 PHEV. The idea behind this is to ensure that, in the event of an accident, rescue services can identify the vehicle as a high-voltage vehicle by way of the “e” in the model designation.

1.3.2. Interior

The most conspicuous new feature of the interior equipment is the Driving Experience Control with the new driving modes. The familiar eDrive button is no longer present. A separate Battery Control button is used instead.



G05 PHEV interior identifying features

G05 PHEV Complete Vehicle.
1. Introduction.

Index	Explanation
1	Refuelling button
2	Battery Control button
3	Driving Experience Control with the SPORT, HYBRID, ELECTRIC and ADAPTIVE driving modes
4	Hybrid-specific displays in the instrument cluster
5	eDrive menus in the central information display (CID)

The installation location of the refuelling button has been changed. It is no longer featured on the A-pillar trim panel in the driver's footwell, but is now easier to reach in the driver's door at the bottom.

1.4. Technical data

Combustion engine and transmission	**Unit**	**BMW X5 xDrive40i G05**	**BMW X5 xDrive40e F15 PHEV**	**BMW X5 xDrive45e G05 PHEV**
Combustion engine		B58B30M1	N20B20M0	B58B30M1
Design		R6	R4	R6
Number of valves per cylinder		4	4	4
Displacement	[cm^3]	2998	1997	2998
Transmission		GA8X51CZ	GA8P75HZ	GA8P75HZ
Drive		All-wheel	All-wheel	All-wheel
Maximum power, combustion engine	[kW (HP)] [rpm]	250 (340) 5500 – 6500	180 (241) 5000 – 6500	210 (286 hp) 5000 – 6000
Maximum torque of combustion engine	[Nm] [rpm]	450 1500 – 5200	350 1350 – 4800	450 1500 – 3500
Complete system power	[kW (HP)]		230 (313)	290 (394)
Storable energy, high-voltage battery unit	[kWh]		9.2	24
Electrical machine **peak** power	[kW (HP)]		83 (111)	83 (111)
Maximum torque, electrical machine	[Nm]		250	265

G05 PHEV Complete Vehicle.

1. Introduction.

Vehicle performances	Unit	BMW X5 xDrive40i G05	BMW X5 xDrive40e F15 PHEV	BMW X5 xDrive45e G05 PHEV
Acceleration 0 – 60 mph	[s]	5.5	6.5	5.3
Electric range	[miles]		19 (NEDC)	60 (NEDC) 54 (WLTP)
Maximum speed	[mph]	150	130	146

Consumption and emissions	Unit	BMW X5 xDrive40i G05	BMW X5 xDrive40e F15 PHEV	BMW X5 xDrive45e G05 PHEV
Average fuel consumption*	[l/100 km]	–	3.3	2.0 – 2.4
Average CO_2 emissions*	[g/km]	–	77	45 – 55

Dimensions and weights	Unit	BMW X5 xDrive40i G05	BMW X5 xDrive40e F15 PHEV	BMW X5 xDrive45e G05 PHEV
US vehicle curb weight	[lbs]	4872	5081	5672
Payload US	[lbs]	1929	1653	937
Fuel tank capacity	[gallons]	22	22.5	18
Luggage compartment volume	[liters]	550 – 1770	500 – 1720	500 – 1720
Max. trailer load, braked	[lbs]	7716	5952	5952

– Values were unavailable by the editorial deadline.

* Values may increase, depending on the equipment

1.5. Equipment

The range of optional equipment on offer for the G05 and the G05 PHEV also differs. Below is a list of the key optional equipment that is **not** offered in the G05 PHEV:

- Adaptive M sports suspension (OE 2VF)
- M Dynamics Professional (OE 2VW)
- Adaptive Comfort 2 + xOffroad (OE 3E3)
- M Sport exhaust system (OE 1MA)
- Third-row seating (OE 4UB)
- Remote Engine Start (OE 1CR).

G05 PHEV Complete Vehicle.
1. Introduction.

The following equipment is part of the standard equipment:

- Two-axle ride level control (“Adaptive Comfort”, SA 2VR)
- BMW Live Cockpit Professional (SA 6U3)

Just as in the G12 LCI PHEV the optional equipment Steptronic Sport transmission with shift paddles (OE 2TB) is available for the G05 PHEV.

1.6. Overview of changes

The following table provides an overview of the changes to the G05 PHEV in comparison with the F15 PHEV.

Component / system	**F15 PHEV BMW X5 xDrive40e**	**G05 PHEV BMW X5 xDrive45e**
Combustion engine	N20B20M0 (245 HP, 245 Nm)	B58B30M1 (286 HP, 450 Nm)
Starting system	Toothed belt starter motor with tensioning pulley and belt pulley with freewheel	Pinion starter motor on flywheel
Fuel supply	Pressurized fuel tank (stainless steel) on the underbody, 22.5 gallons, refuelling button on lower A-pillar trim panel, driver's side	Pressurized fuel tank (stainless steel) in sheet steel housing in the luggage compartment, 18 gallons, refuelling button in lower driver's door area
Vacuum supply	Mechanical and electrical vacuum pumps	Mechanical vacuum pump
Transmission	8-speed automatic transmission with dual-mass flywheel, additional torsional vibration damper, separating clutch and additional electrical transmission oil pump	Adaptations to the 6-cylinder engine: damping characteristics of dual-mass flywheel and additional torsional vibration damper; higher number of discs in the separation clutch K0; 4 instead of 3 planetary gears in gear set 2
Electrical machine	GC1P25A (111 HP, 250 Nm) Permanently excited synchronous machine with internal rotor and separation clutch in the automatic transmission, stator cooling by coolant, rotor cooling by transmission oil	GC1P25M (111 HP, 265 Nm) Software adaptations, permanently excited synchronous machine with internal rotor and separation clutch in the automatic transmission, oil cooling
Electrical machine electronics (EME)	EME on underbody, on right in front of the rear axle	EME in rear engine compartment on the passenger's side

G05 PHEV Complete Vehicle.

1. Introduction.

Component / system	F15 PHEV BMW X5 xDrive40e	G05 PHEV BMW X5 xDrive45e
Brake system	Hybrid brake system with modified DSC unit, electrical vacuum pump, vacuum sensor and brake pedal angle sensor	DSCi brake system
Terminal control	Vehicle electrical system 2020, Service Pack 2013	Vehicle electrical system 2020, Service Pack 2018, parking, residing, driving vehicle conditions and PAD mode
Vehicle Sound Generator (VSG)	Separate control unit with integrated loudspeakers on the K-CAN3	Function takeover by Receiver Audio Module (RAM) with connected loudspeaker
Refrigerant circuit	Electric A/C compressor with air conditioning condenser and 2 combined expansion and shutoff valves (evaporator, vehicle interior, and heat exchanger, high-voltage battery unit)	Electric A/C compressor and coolant-cooled air conditioning condenser and 1 combined expansion and shutoff valve (evaporator, vehicle interior) as well as 1 shutoff valve and 2 expansion valves (high-voltage battery unit)
Driving and drive system modes	3 driving modes selectable via Driving Experience Control (ECO PRO, COMFORT, SPORT) 3 driving modes selectable via eDrive button (AUTO eDrive, MAX eDrive, SAVE BATTERY), all combinable	4 driving modes selectable via Driving Experience Control (ELECTRIC, HYBRID, SPORT, ADAPTIVE), partly individualized, BATTERY CONTROL

G05 PHEV Complete Vehicle.

1. Introduction.

Component / system	F15 PHEV BMW X5 xDrive40e	G05 PHEV BMW X5 xDrive45e
Anticipatory hybrid drive	Suspension of the electrical energy for electric driving in the destination zone, in slow-driving zones and road segments with traffic jam or roadworks	Suspension of the electrical energy for electric driving in the destination zone, in towns and urban environments as well as road segments with traffic jam or roadworks (in virtually all driving modes)
Adaptive recuperation	Predefined coasting recuperation when the driver takes their foot off the accelerator pedal, in ECO PRO immediate introduction of coasting when the driver takes their foot off the accelerator pedal	Intelligent adaptation of coasting and coasting recuperation to the respective traffic situation and the stretch of road
High-voltage battery unit	Installation location luggage compartment Generation 3.0 cell capacity 26 Ah 6 cell modules 6 cell supervision circuits with equal rights in a linear bus structure	Installation location underbody Generation 4.0 cell capacity 68 Ah 12 cell modules 1 primary and 11 serially interconnected secondary cell supervision circuits (daisy chain)

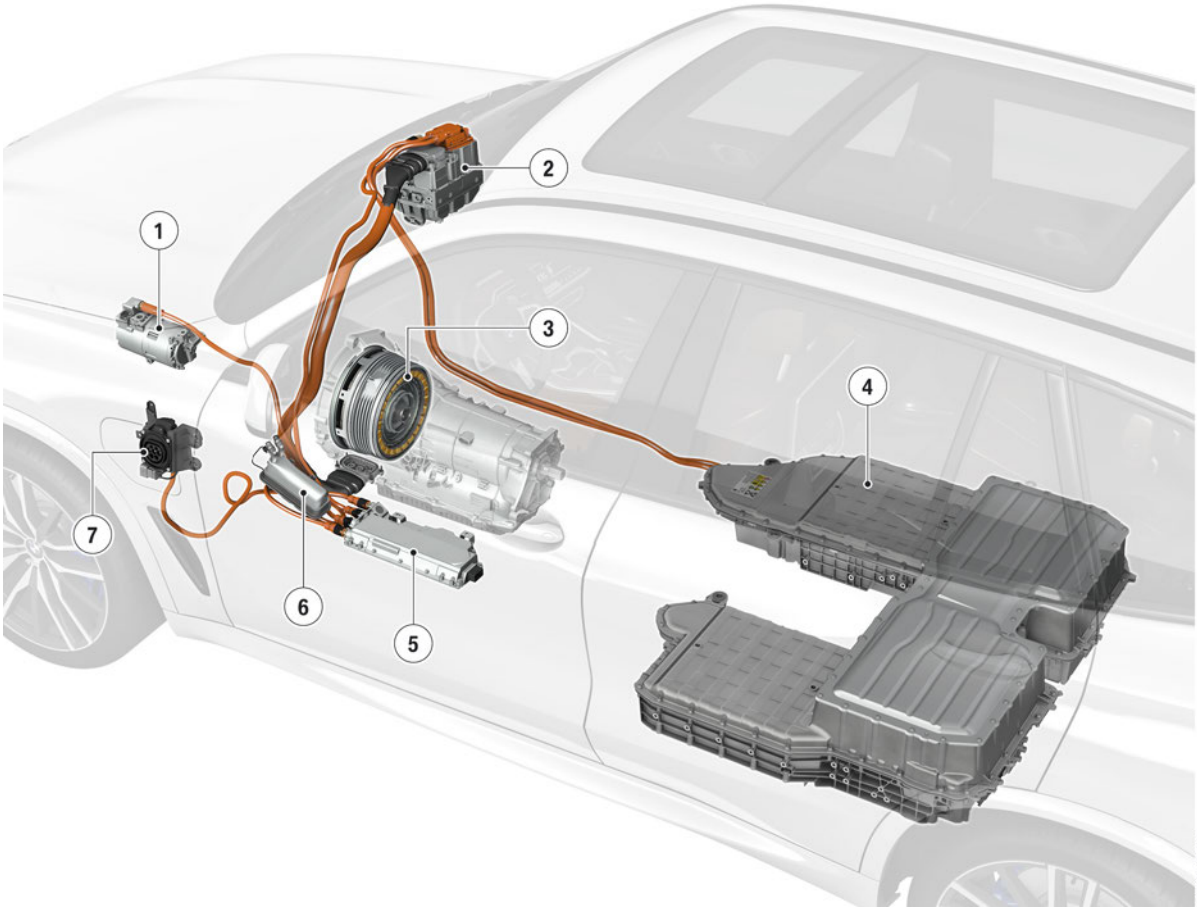
Detailed information on the high-voltage battery unit can be found in the reference manual ST2006 “SP44 High-voltage Battery ”.

G05 PHEV Complete Vehicle.

1. Introduction.

1.7. Hybrid generation 4.0

The G05 PHEV belongs to Hybrid Generation 4.0.



G05 PHEV high-voltage system

Index	Explanation
1	Electric A/C compressor (EKK)
2	Electrical machine electronics (EME)
3	Electrical machine
4	High-voltage battery unit
5	Convenience charging electronics (KLE)
6	Electrical heating (EH)
7	Charging socket

G05 PHEV Complete Vehicle.
1. Introduction.

The most extensive **changes / new features** in the high-voltage system compared to hybrid generation 3.0 are:

- Installation of 6-cylinder engine
- Increase in the cell capacity in the high-voltage battery unit
- Variant reduction of the driving and drive system modes.

Many high-voltage components and hybrid-specific adaptations have been adopted for the G05 PHEV **unchanged** from Hybrid Generation 3.0. Only the most important components that are used in unchanged form are listed here:

- Electrical machine
- Automatic transmission GA8P75HZ
- Electrical machine electronics (EME)
- Convenience charging electronics (KLE)
- Electric A/C compressor (EKK)
- Electrical heating (EH)
- Fuel supply with pressurized fuel tank
- High-temperature and low-temperature coolant circuits
- 12 V power supply with vehicle battery and auxiliary battery in the luggage compartment (supplementary start system)
- Auxiliary battery with separate intelligent battery sensor (IBS2) and separate safety battery terminal (SBK2)
- High-voltage service disconnect in the luggage compartment on the right and rescue disconnect in the engine compartment on the right.

1.7.1. Training

Performing work on high-voltage components

Qualification to work on the high-voltage system of the G05 PHEV can only be acquired through the respective **Web-based Training**. Face-to-face training is not offered for the G05 PHEV. Certification is provided through the WBT if the service employee fulfils the following **prerequisites**:

- Valid "High-voltage Components" certification for another vehicle of hybrid generation **3.0** with **longitudinally installed** combustion engine

  AND
- Valid vehicle-specific certification “... PHEV” for another vehicle of Hybrid Generation **4.0** with **longitudinally installed** combustion engine.

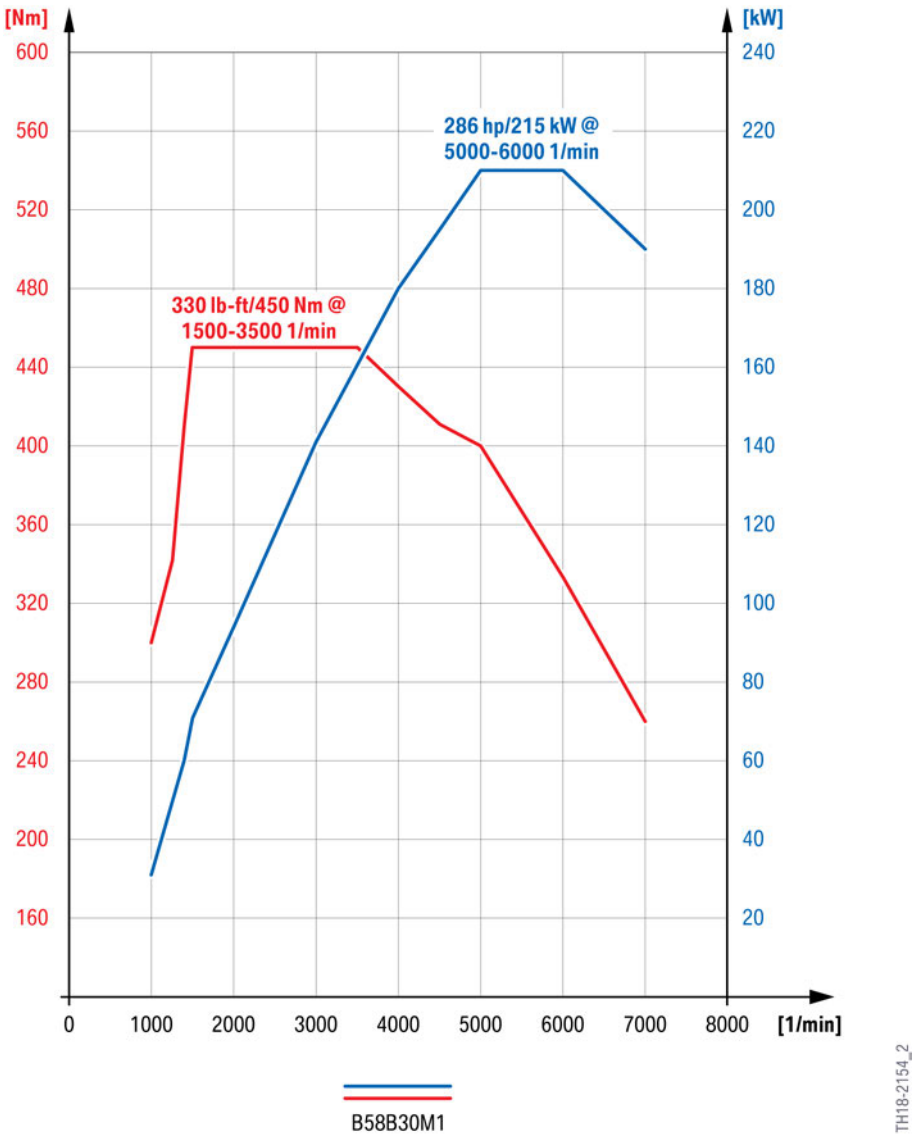
G05 PHEV Complete Vehicle.
2. Powertrain.

2.1. Powertrain variants

Model	Combustion engine	sDrive	xDrive
X5 xDrive45e	B58B30M1	–	●

2.2. Modified B58TU engine

The B58B30M1 is a constituent part of the hybrid drive in the G05 PHEV. The 3.0-liter engine generates an output of 215 kW (286 hp) and a maximum torque of 450 Nm (330 lb-ft).



Torque and power output diagram for B58B30M1 in the G05 PHEV

G05 PHEV Complete Vehicle.
2. Powertrain.

The most extensive changes compared to the conventional B58TU engine are:

- Simplified belt drive
- Vibration damper with rigid belt pulley
- Mechanical vacuum pump (despite DSCi brake system)
- Improved air intake system with resonator
- Starter motor adapted to the more frequent starting operations
- Wiring harness adapted to the engine peripherals.

G05 PHEV B58B30M1 engine

Some of the changes are discussed in more detail in the next subchapters.

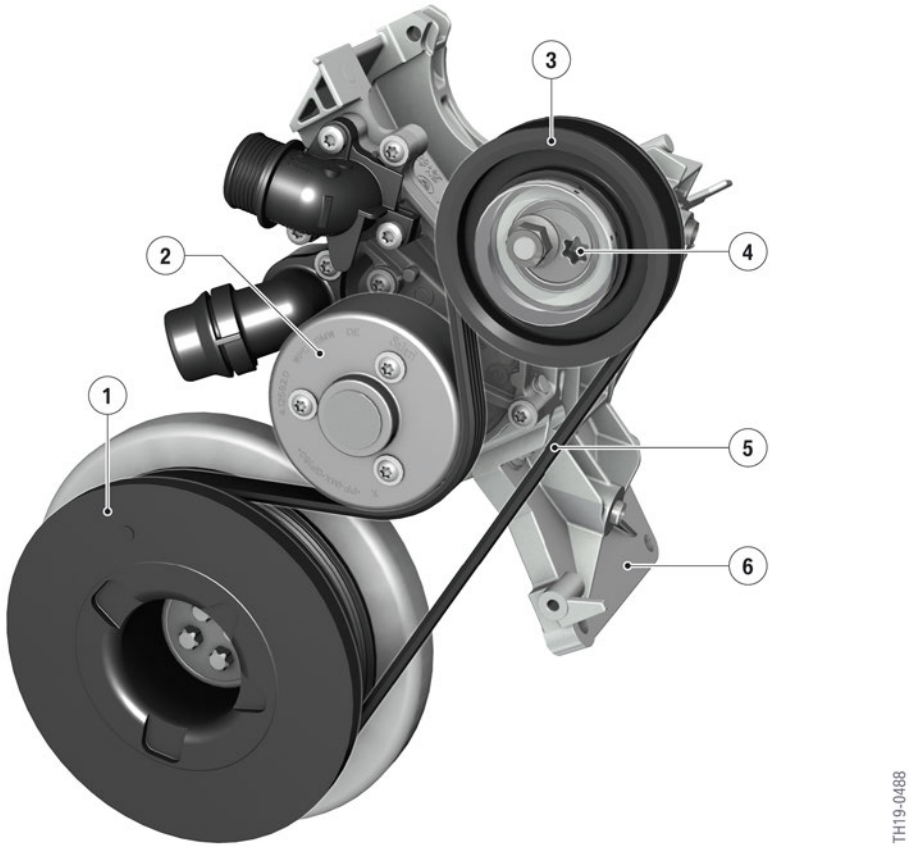
2.2.1. Belt drive

For deployment in the G05 PHEV, the belt drive has been modified compared to the B58TU engine in a conventional vehicle. The elimination of the alternator and mechanical air conditioning compressor enabled a reduction in the width of the belt from 6 ribs to 4 ribs.

The vibration damper has also been adapted to the modified belt drive. A viscous vibration damper with rigid belt pulley is deployed.

G05 PHEV Complete Vehicle.

2. Powertrain.



G05 PHEV belt drive B58B30M1

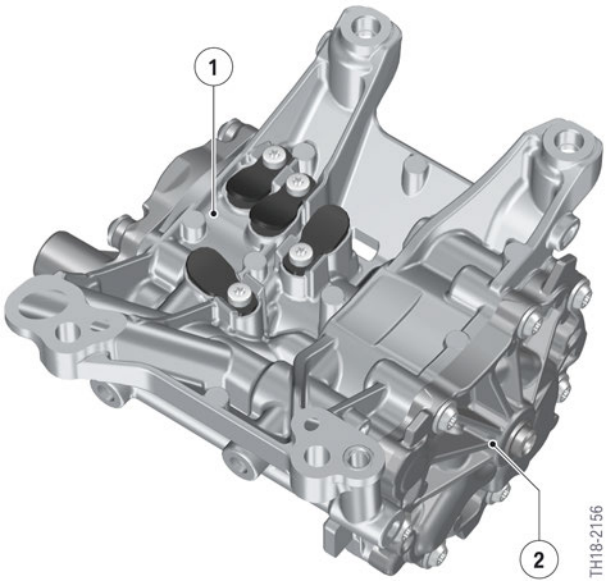
Index	Explanation
1	Viscous vibration damper with rigid belt pulley
2	Coolant pump belt pulley
3	Tensioning pulley
4	Eccentric tensioning device
5	Elastic belt
6	Component carrier

The belt is tensioned via an eccentric tensioning pulley mounted on the component carrier.
The dust-protected tensioning device is located under a cover on the tensioning pulley.

A belt that is not tensioned in line with accepted technical principles can lead to loss of function of the driven component or to damage. The notes and instructions in the current repair instructions therefore apply.

2.2.2. Vacuum supply

The installation of the DSCi brake system means that the electrical vacuum pump is not required in the G05 PHEV. The controlled damping mounts, however, will continue to be fitted.



G05 PHEV oil vacuum pump in the B58TU engine

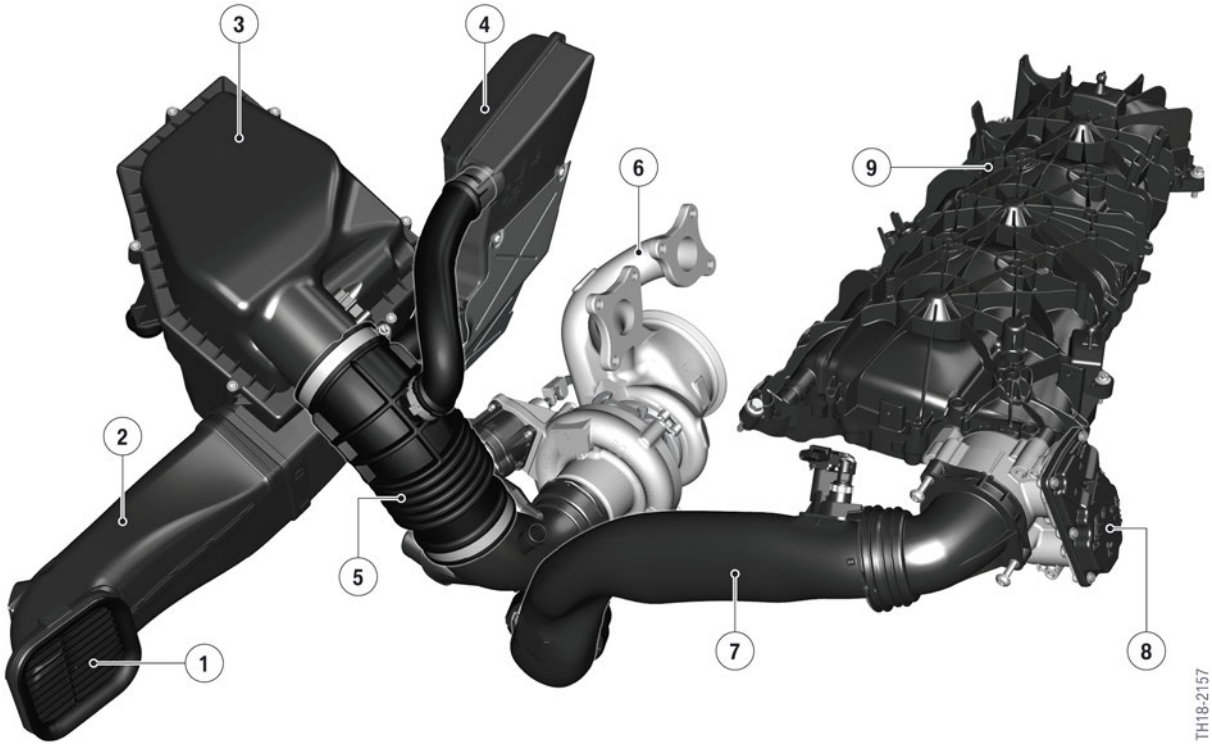
Index	Explanation
1	Integrated mechanical vacuum pump
2	Tandem oil pump

The B58TU engine in the G05 PHEV therefore has the mechanical vacuum pump integrated in the oil pump. This already generates sufficient vacuum during both the initial and supplementary start of the combustion engine to switch the engine mounts to "soft".

2.2.3. Air intake system

The air intake duct of the B58TU engine has been revised with regard to flow control, efficiency and reduction of the installation space.

G05 PHEV Complete Vehicle.
2. Powertrain.



G05 PHEV air intake system B58TU engine

Index	Explanation
1	Unfiltered air intake with grille
2	Unfiltered-air duct
3	Intake silencer
4	Resonator
5	Clean air pipe
6	Exhaust turbocharger for cylinder-head integrated exhaust manifold, ZIAK
7	Charge air hose
8	Throttle valve
9	Intake system with integrated indirect charge air cooler

The resonator on the clean air pipe has been reduced in size and provides an improvement in acoustics. It is fitted with a heat protection plate.

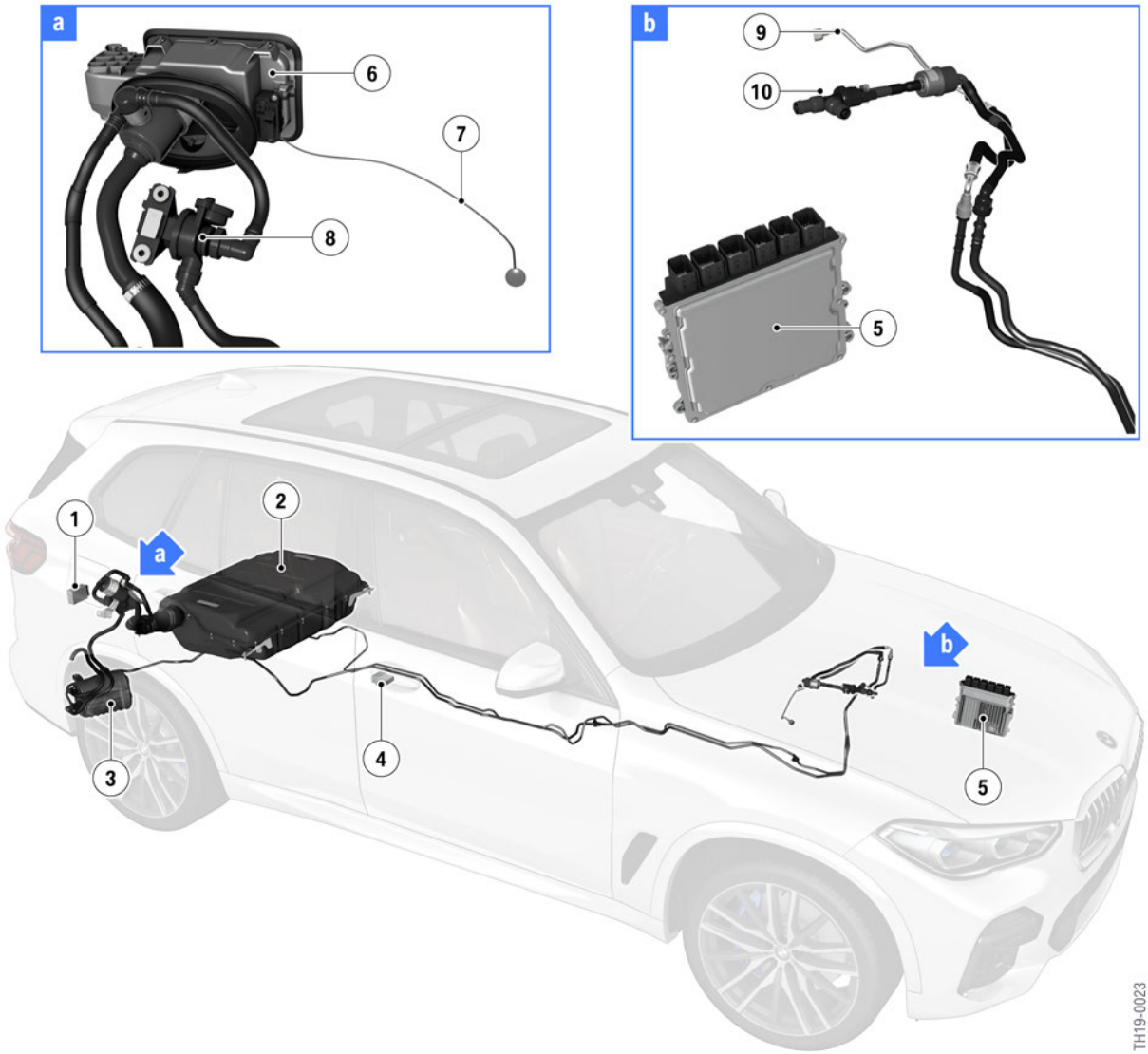
2.3. Fuel supply

The G05 PHEV too has a stainless steel pressurized fuel tank. Unlike in the predecessor, the pressurized fuel tank is not secured to the underbody, but is instead located underneath the luggage compartment (like G12 PHEV and G30 PHEV).

G05 PHEV Complete Vehicle.

2. Powertrain.

2.3.1. Components and their installation locations



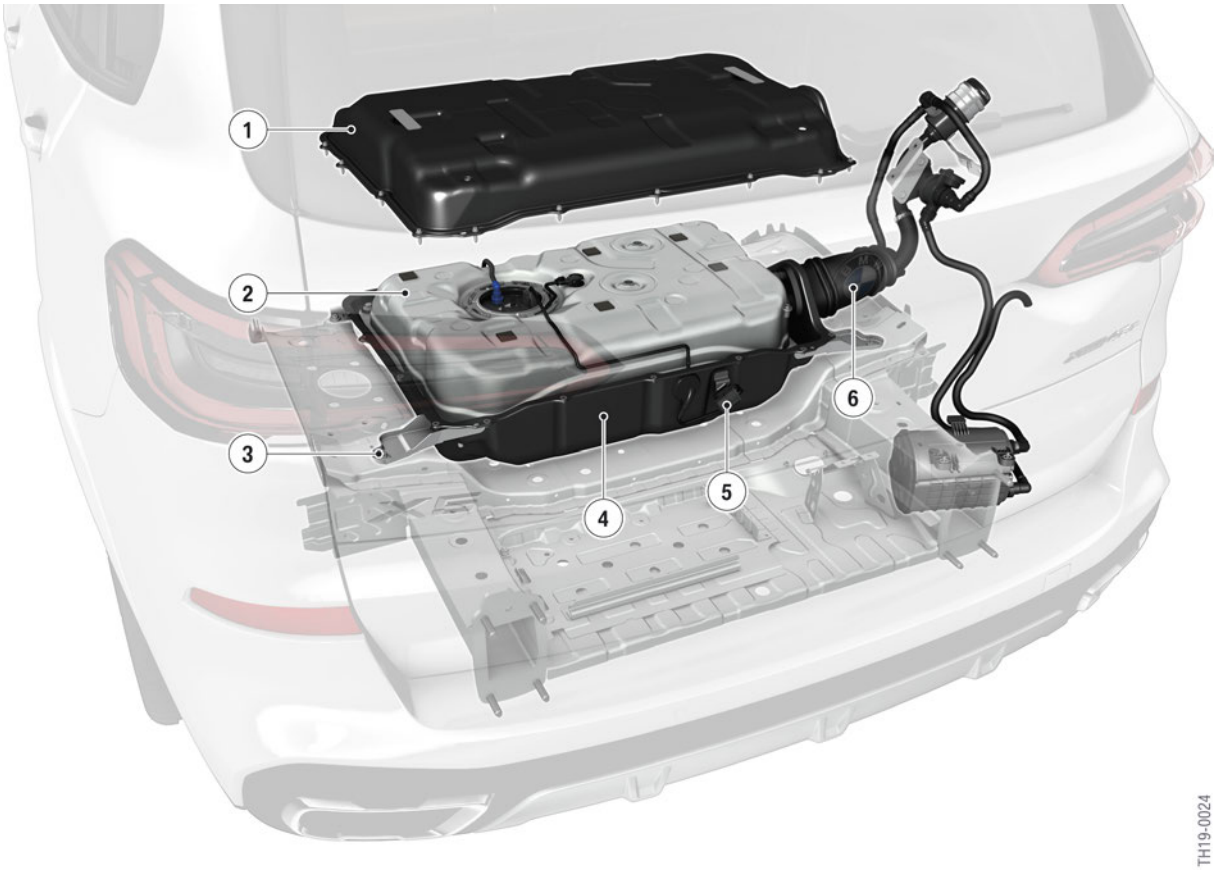
G05 PHEV components of the fuel supply in European version

Index	Explanation
1	Hybrid pressure refuelling electronic control unit (TFE)
2	Pressurized fuel tank (in sheet steel housing)
3	Carbon canister
4	Fuel pump control electronics
5	Digital Motor Electronics (DME)
6	Fuel filler flap with cover

Index	Explanation
7	Cable for emergency release of the fuel filler flap
8	Fuel tank isolation valve
9	Fuel line to high-pressure fuel pump
10	Tank vent valve

Pressurized fuel tank

The G05 PHEV has the high-voltage battery unit under the rear seat in the area of the original fuel tank packaging space. This has lowered the center of gravity, and the luggage compartment can be used more efficiently (flat loading platform, through-loading system). The pressurized fuel tank with a fuel tank capacity of 18 gallons was integrated below the luggage compartment.



G05 PHEV pressurized fuel tank

G05 PHEV Complete Vehicle.
2. Powertrain.

Index	Explanation
1	Upper housing section (made of sheet steel)
2	Pressurized fuel tank made from stainless steel
3	Mounting
4	Lower housing section (made of sheet steel)
5	Electrical connection of inner components
6	Grommet around the filler pipe

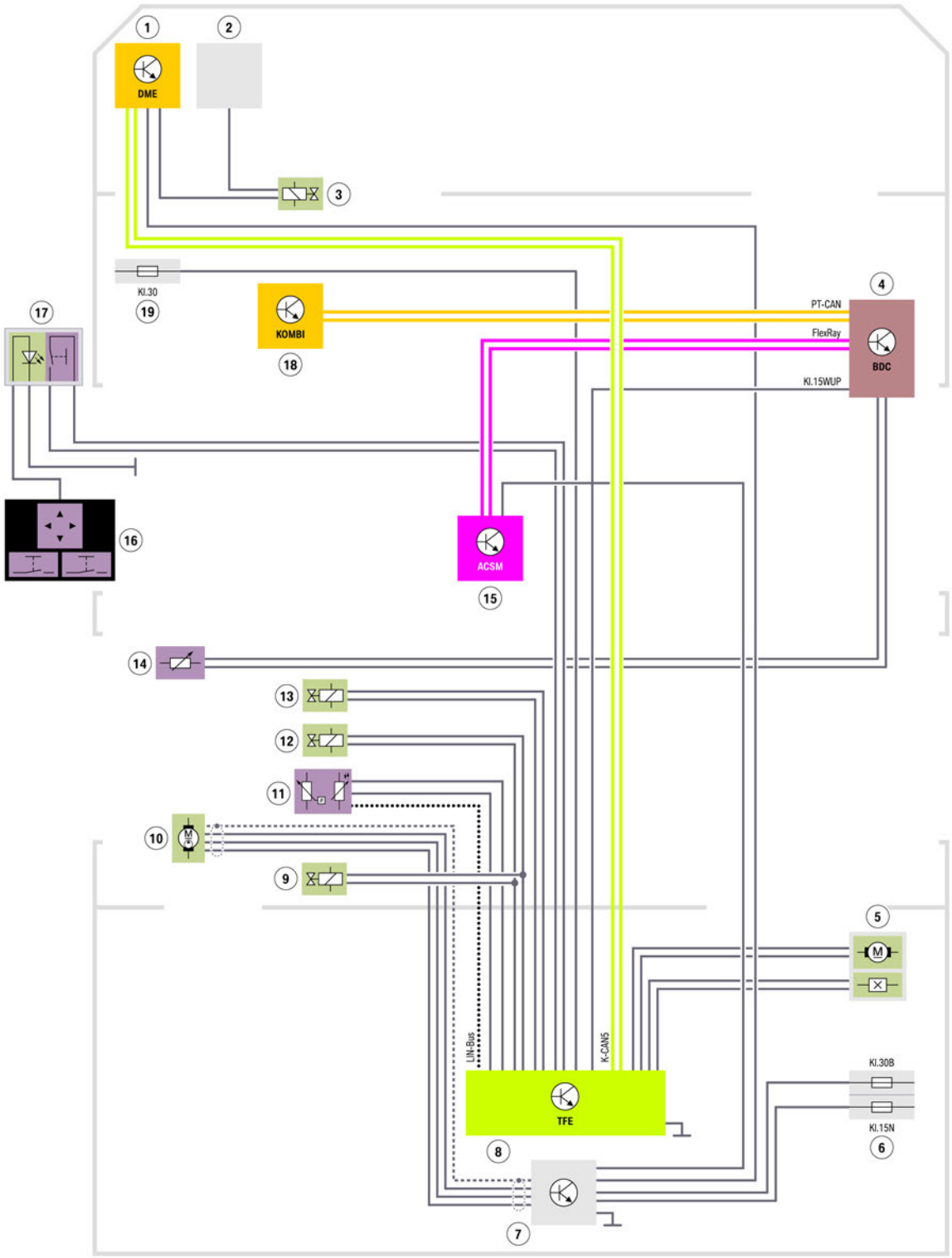
Unlike in the G12 PHEV or G30 PHEV, the pressurized fuel tank is not located in an aluminum housing, but instead in a sheet steel housing. The consequently lighter housing is secured to the body and in part bonded to it.

The pressure temperature sensor in the pressurized fuel tank has been optimized and detects, aside from pressure and temperature, sloshing by the fuel. This arrangement eliminates the risk of incorrect measurements caused by sloshing while driving.

G05 PHEV Complete Vehicle.

2. Powertrain.

2.3.2. System wiring diagram



G05 PHEV, system wiring diagram for fuel supply

Index	Explanation
1	Digital Motor Electronics (DME)
2	Integrated power supply module (PDM)
3	Shutoff valve purge air line (only for US version)
4	Body Domain Controller (BDC)
5	Fuel filler flap lock
6	Fuses in the rear power distribution box
7	Fuel pump control electronics
8	Hybrid pressure refuelling electronic control unit (TFE)
9	Fuel tank isolation valve (only for US version)
10	Electric fuel pump
11	Pressure/Temperature sensor
12	Not for US
13	Fuel tank shutoff valve (only for US version)
14	Lever sensor for fuel level
15	Advanced Crash Safety Module (ACSM)
16	Power window switch block, driver's door
17	Refuelling button
18	Instrument cluster (KOMBI)
19	Fuse in power distribution box, front left

2.3.3. Refuelling

The process for refuelling and the system-side processes are the same as in Hybrid Generation 3.0 vehicles. The only thing that has changed compared with the predecessor is the installation location of the refuelling button. It is no longer situated on the lower A-pillar trim panel in the driver's footwell, but is now easier to reach in the driver's door at the bottom.

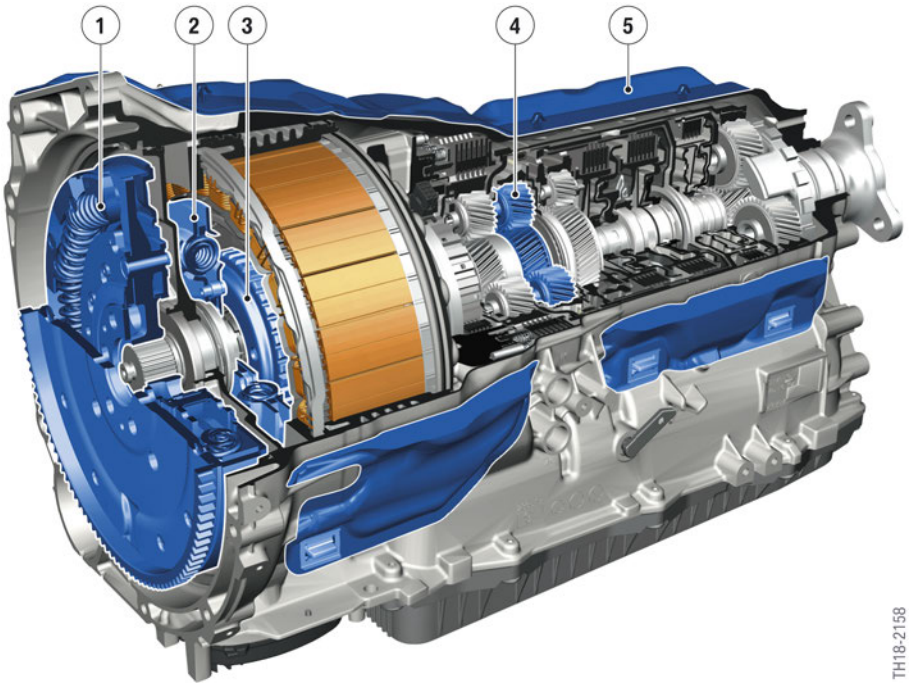
The button is no longer illuminated via the Body Domain Controller (BDC), but instead via the switch block in the driver's door.

G05 PHEV Complete Vehicle.

2. Powertrain.

2.4. Automatic transmission

In order to adapt the GA8P75HZ transmission to the 6-cylinder engine, the following changes have been made.



Overview of changes GA8P75HZ

Index	Explanation
1	New configuration of the damping characteristics of the dual-mass flywheel
2	New configuration of the damping characteristics of the additional torsional vibration damper
3	Increase in the number of discs in the separating clutch K0
4	Increase in number of planetary gears from 3 to 4 in gear set 2
5	Adaptive changes to the SynTAK trim panel

The exact procedure for electronic emergency gearbox release had not yet been defined when this product information was created. Please check the Owner's Manual for the vehicle for the necessary steps.

G05 PHEV Complete Vehicle.

3. Electrical Machine.

3.1. Overview of changes

The electrical machine is a component that has been adopted from vehicles of hybrid generation 3.0. However, the permanently energized synchronous machine is activated with higher currents by the Electrical Machine Electronics (EME), increasing the maximum torque from 250 Nm to **265 Nm**.

The torque increase meant that a new type approval test was carried out and the last letter in the designation of the electrical machine was changed as follows: GC1P25M.

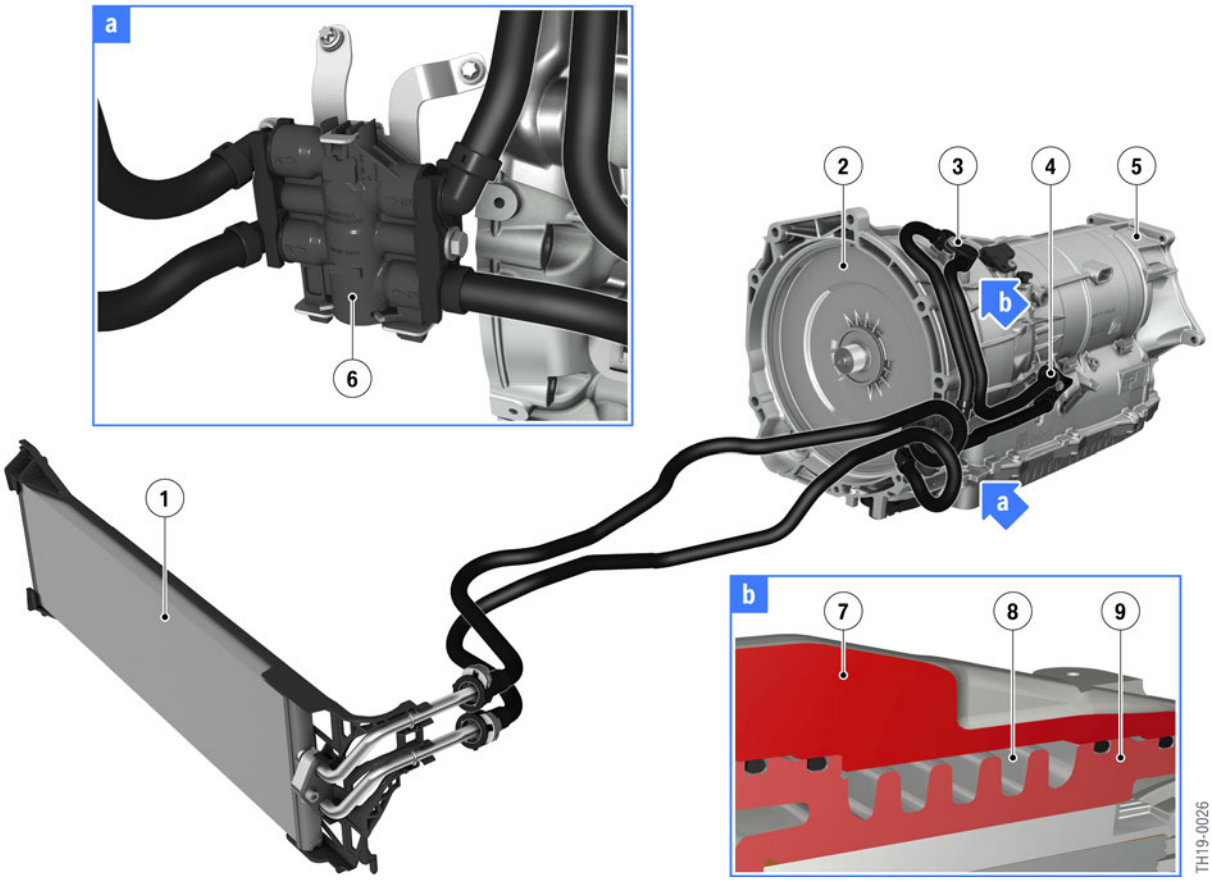
The electrical machine is a high-voltage component!

Only Service employees who satisfy all the prerequisites are permitted to work on the designated high-voltage components: suitable qualifications, compliance with the safety rules, procedure following the exact repair instructions.

G05 PHEV Complete Vehicle.
3. Electrical Machine.

Oil cooling

As in current hybrid vehicles the electrical machine is cooled by the transmission oil.



G05 PHEV oil cooling GA8P75HZ

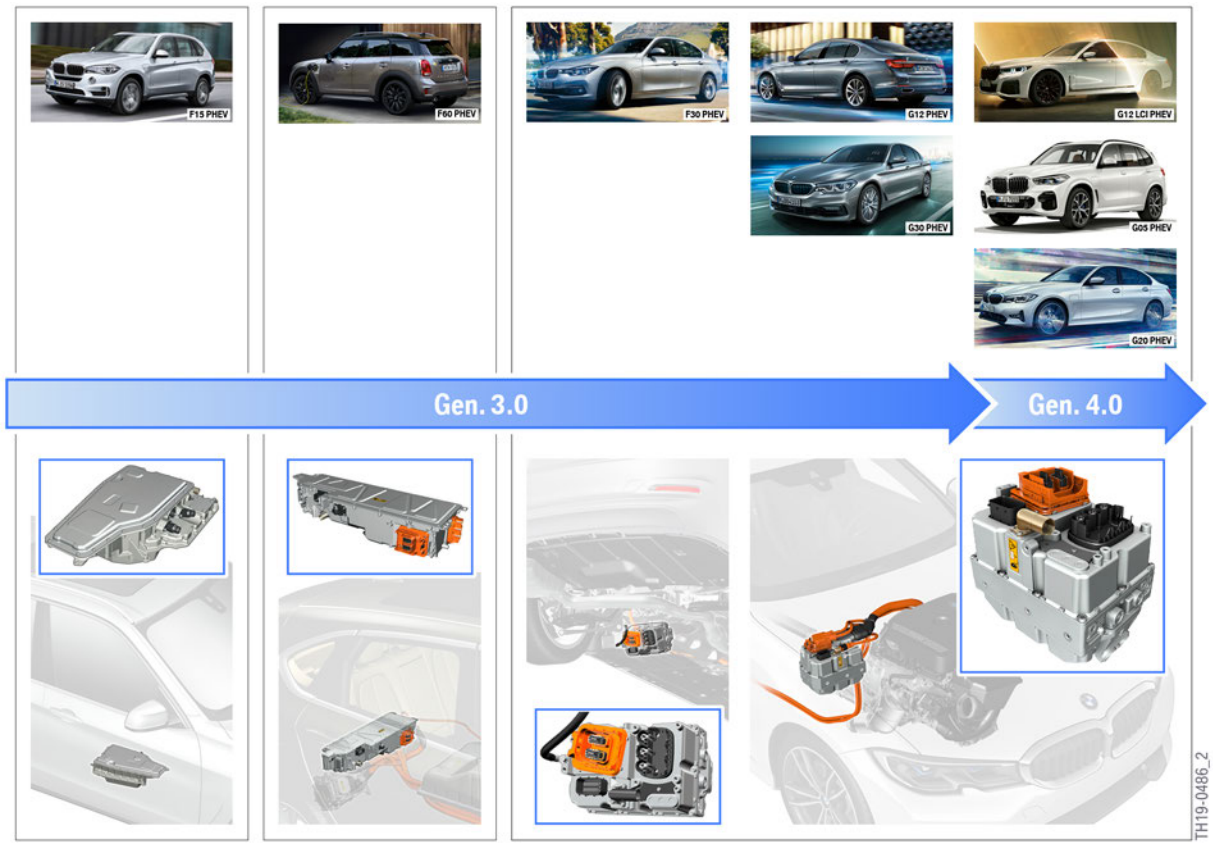
Index	Explanation
1	Transmission oil cooler
2	Electrical machine
3	Connection of transmission oil lines (for cooling the electrical machine)
4	Connection of transmission oil lines (for cooling the automatic transmission)
5	Automatic transmission
6	Transmission oil thermostat
7	Automatic transmission housing
8	Transmission oil duct electrical machine
9	Stator support

G05 PHEV Complete Vehicle.

4. Electrical Machine Electronics.

4.1. Overview

The G05 PHEV is equipped with electrical machine electronics (EME) that differs from its predecessor. The EME familiar from the current Hybrid Generation 3.0 and 4.0 vehicles is used.



G05 PHEV installation overview, electrical machine electronics (EME)

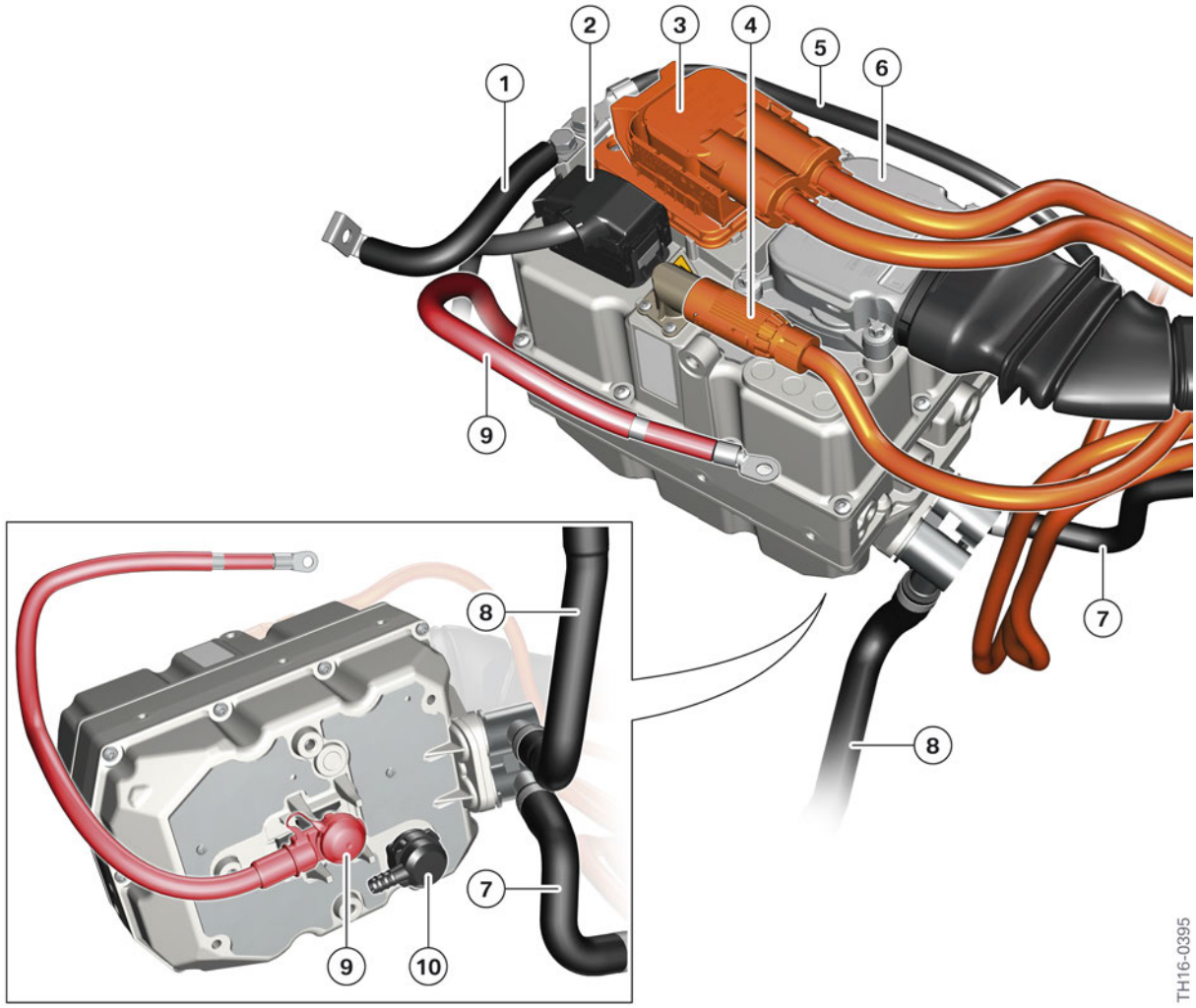
The EME is located in the rear engine compartment on the passenger's side.

The electrical machine electronics is a high-voltage component!

Only Service employees who satisfy all the prerequisites are permitted to work on the designated high-voltage components: suitable qualifications, compliance with the safety rules, procedure following the exact repair instructions.

G05 PHEV Complete Vehicle.
4. Electrical Machine Electronics.

4.2. Connections



G05 PHEV connections, electrical machine electronics (EME)

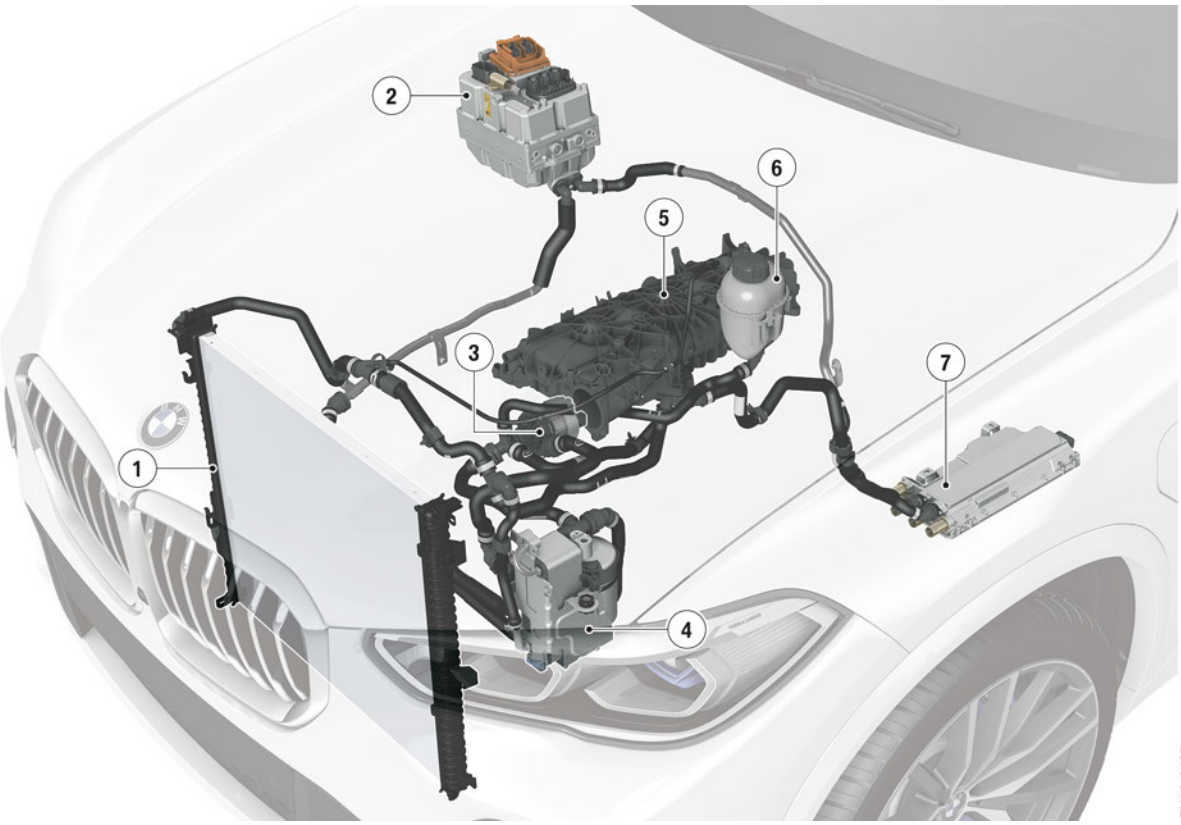
Index	Explanation
1	Connection for potential compensation line
2	Low-voltage connector
3	High-voltage connection (DC) to the high-voltage battery unit
4	High-voltage connection to convenience charging electronics
5	Battery earth lead
6	High-voltage connection (AC) to the electrical machine
7	Coolant return line
8	Coolant feed line
9	Output, DC/DC converter +12 V
10	Ventilation

G05 PHEV Complete Vehicle.
4. Electrical Machine Electronics.

A detailed description of the EME can be found in the “G12 PHEV High-voltage Components” reference manual.

4.3. Cooling

Both the electrical machine electronics (EME) and the convenience charging electronics (KLE) are cooled by the low-temperature coolant circuit. In contrast to the F15 PHEV, the integrated, indirect charge air cooler and the coolant-cooled air conditioning condenser have been incorporated in the coolant circuit.



G05 PHEV low-temperature coolant circuit – installation locations

Index	Explanation
1	Radiator (coolant-to-air heat exchanger)
2	Electrical machine electronics (EME)
3	Electric coolant pump (130 W)
4	Coolant-based air conditioning condenser (coolant-refrigerant-heat exchanger)
5	Integrated indirect charge air cooler (air-coolant heat exchanger)
6	Coolant expansion tank
7	Convenience charging electronics (KLE)

An electric coolant pump (130 W) is used.

G05 PHEV Complete Vehicle.
4. Electrical Machine Electronics.

When components have been replaced on the **low-temperature coolant circuit** or the cooling system has been opened, an automated coolant bleeding routine must be carried out. Otherwise there is a risk of damage to the components to be cooled.

The actuators in the cooling system are activated during the automated coolant bleeding routine. The automated coolant bleeding routine is completed after around 10 minutes.

The following prerequisites must be fulfilled to be able to carry out an automated coolant bleeding routine on the **low-temperature coolant circuit**:

- Detach charging cable from the high-voltage connection
- Open hood
- Check and if necessary correct coolant level in the expansion tank
- Connect 12 V battery charger to the jump start terminal point and switch on
- Activate PAD mode
- Set temperature of the integrated automatic heating/air conditioning system to “High”
- Switch on the lowest blower speed.

Proceed as follows to start the automated coolant bleeding routine:

- Press the accelerator pedal all the way down for at least 10 seconds
  (do not press the brake pedal while doing so)
- Release accelerator pedal

The starting and ending of the automated coolant bleeding routine is displayed in the instrument cluster.

After completing the service function, check and if necessary correct the coolant level in the expansion tank and disconnect the 12 V battery charger.

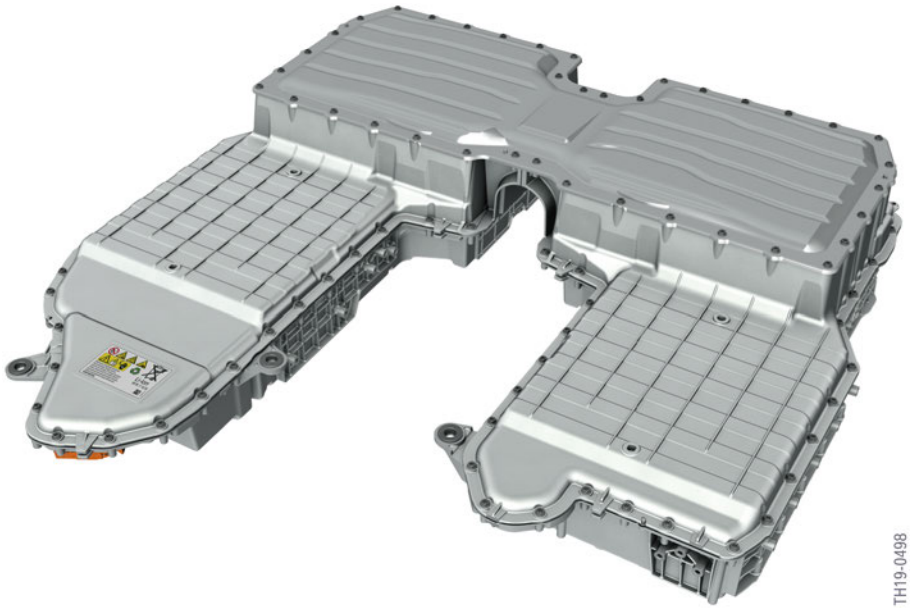
G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

5.1. Overview

The G05 PHEV likewise is fitted with a Generation 4.0 high-voltage battery unit (development code SP44). As with all high-voltage battery units of this generation, the cell capacity of the cell modules has also been increased from 26 Ah to 34 Ah. Having half the cells in the cell module connected in parallel delivers a cell capacity of **68 Ah**.

With its **12 cell modules** the SP44 has a storable amount of energy of 24 kWh and is thus the most powerful high-voltage battery unit to be used in a BMW plug-in hybrid electric vehicle to date.



G05 PHEV high-voltage battery SP44

The high-voltage battery unit is a high-voltage component!

Only Service employees who satisfy all the prerequisites are permitted to work on the designated high-voltage components: suitable qualifications, compliance with the safety rules, procedure following the exact repair instructions.

This product information deals with mounting the SP44 high-voltage battery and its particularities during installation and removal. Detailed information on the high-voltage battery unit and its repair can be found in the ST2006 “SP44 High-voltage Battery” reference manual.

G05 PHEV Complete Vehicle.
5. High-voltage Battery Unit.

5.2. Technical data

Technical data	SP44
Voltage	354.2 V (nominal voltage) Min. 269 V – Max. 403 V (voltage range)
Battery cells	Lithium-ion
Number of battery cells	192
Electrical connection of battery cells	Serial and parallel
Number of cell modules	12
Cells per cell module	16
Electrical connection inside the cell module	In each case 2 cells in parallel, 8 of which in series
Cell voltage	3.69 V
Capacitance	34 Ah 68 Ah (by parallel electrical connection)
Storable amount of energy	24 kWh
Usable energy	17 kWh*
Max. power (discharge)	83 kW (short-term)
Maximum power (AC charging)	3.7 kW
Weight	500 lbs (with retaining bracket)
Dimensions	1255 mm x 1246 mm x 276 mm
Cooling system	Refrigerant R1234yf 2 expansion valves

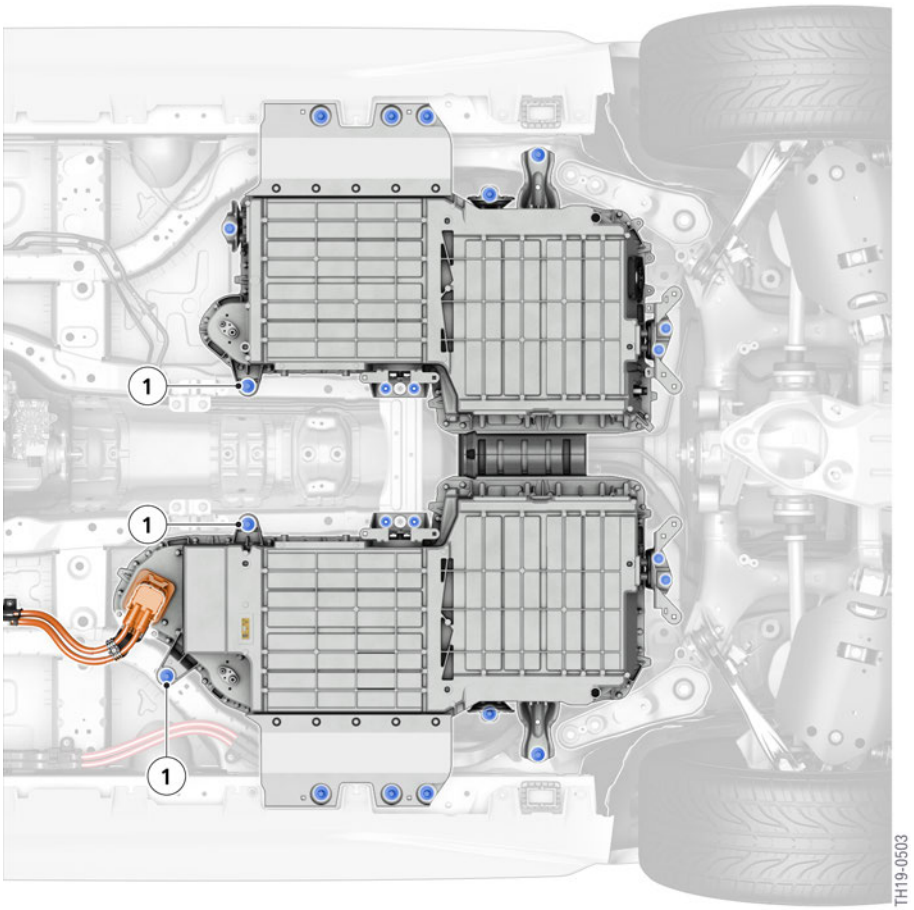
* The usable energy may vary, depending on the market and state of aging of the high-voltage battery unit.

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

5.3. Mounting

The high-voltage battery unit is mounted centrally on the underbody in front of the rear axle. It is attached to the vehicle body with 11 brackets, 18 screws and 4 nuts.



G05 PHEV mounting high-voltage battery unit

Index	Explanation
1	Mounting bolt and equipotential bonding screw

All mounting bolts are accessible from the vehicle underbody. However, to release the screw connections, several pieces of underbody panelling, the exhaust system, the propeller shaft and the rear axle compression struts must be removed first.

Equipotential bonding is effected by 3 mounting bolts on the front of the housing. The bolts are designed as paint tapping bolts.

The established procedure for installation, in particular the tightening process for the mounting bolts that ensure equipotential bonding (four-eyes principle, documentation etc.), is unchanged and can be found in the current repair instructions.

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

The low-resistance connection between the housing of the high-voltage battery unit and the body ground is an essential requirement for perfect operation of the automatic insulation monitoring function. For that reason it is essential pay attention to application of the correct tightening torque on all equipotential bonding screws.

It is also important to ensure that neither the housing of the high-voltage battery unit, nor the body are painted, corroded or contaminated around the corresponding bore holes. It is also important to ensure the threads concerned are clean. Before fixing the equipotential bonding screws it may be necessary to expose the bare metal.

If the connection between the high-voltage battery unit and the body ground is not sufficiently conductive, a fault could remain undetected and thus pose a potential risk of personal injury.

When mounting the equipotential bonding screw, the exact procedure must be observed:

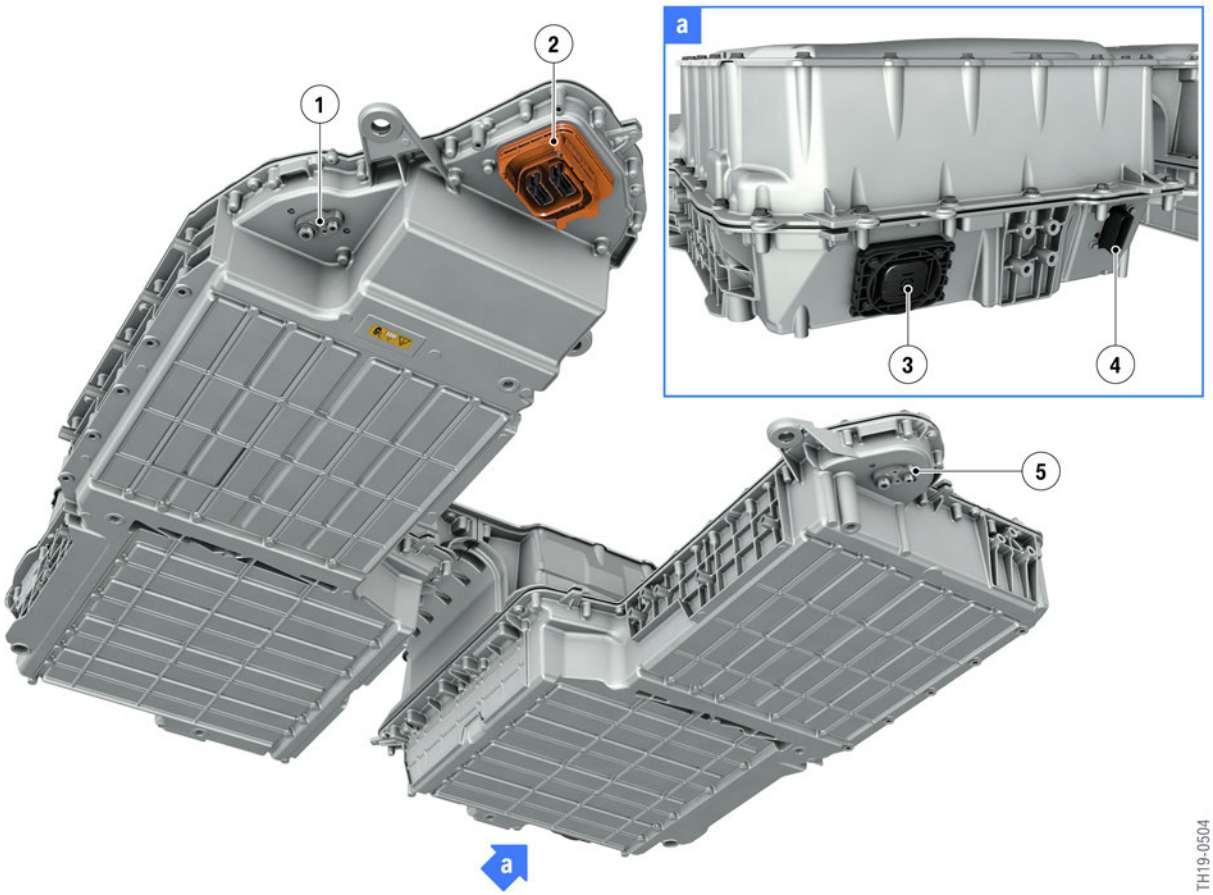
- Clean contact surfaces and screw hole threads and have them checked by a second person
- Tighten assembly screws to specified torque
- Have torque checked by second person
- Both persons must record this in the vehicle records for the correctness of the version. There is a **"form for equipotential bonding screw connections"** for the purpose in ISTA.

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

5.4. Connections

The connections of the high-voltage battery unit are adapted to its geometry and installation location. The high-voltage connection is located on the front underside of the right battery half. The signal connector connection and the venting unit are located on the back of the left battery half.



SP44 connections

Index	Explanation
1	Connection, expansion valve, right
2	High-voltage connection
3	Venting unit
4	Connection for signal connector
5	Connection, expansion valve, left

Each battery half has a separate refrigerant connection on the front underside. An expansion valve is mounted on each of these refrigerant connections.

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

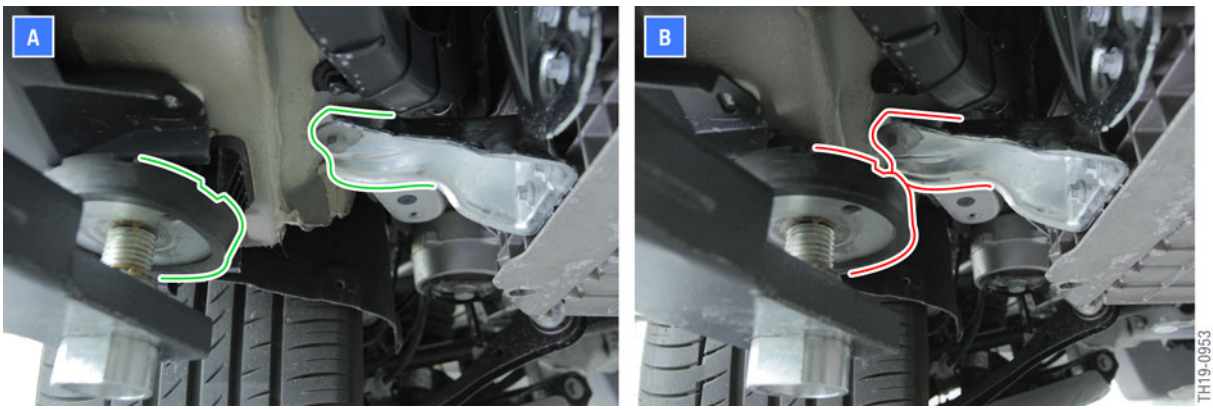
5.5. Installation and removal

Owing to the size of the high-voltage battery unit, special work steps and new special tools are required to remove and install it.

The following descriptions of removing and installing the high-voltage battery unit are only a general list of the content and the procedure. **In general, only the specifications and instructions in the current valid edition of the repair instructions apply.**

5.5.1. Lifting the vehicle

To facilitate the problem-free removal of the high-voltage battery unit, it is essential to correctly engage the vehicle lift securing points at the vehicle's rear jacking points.



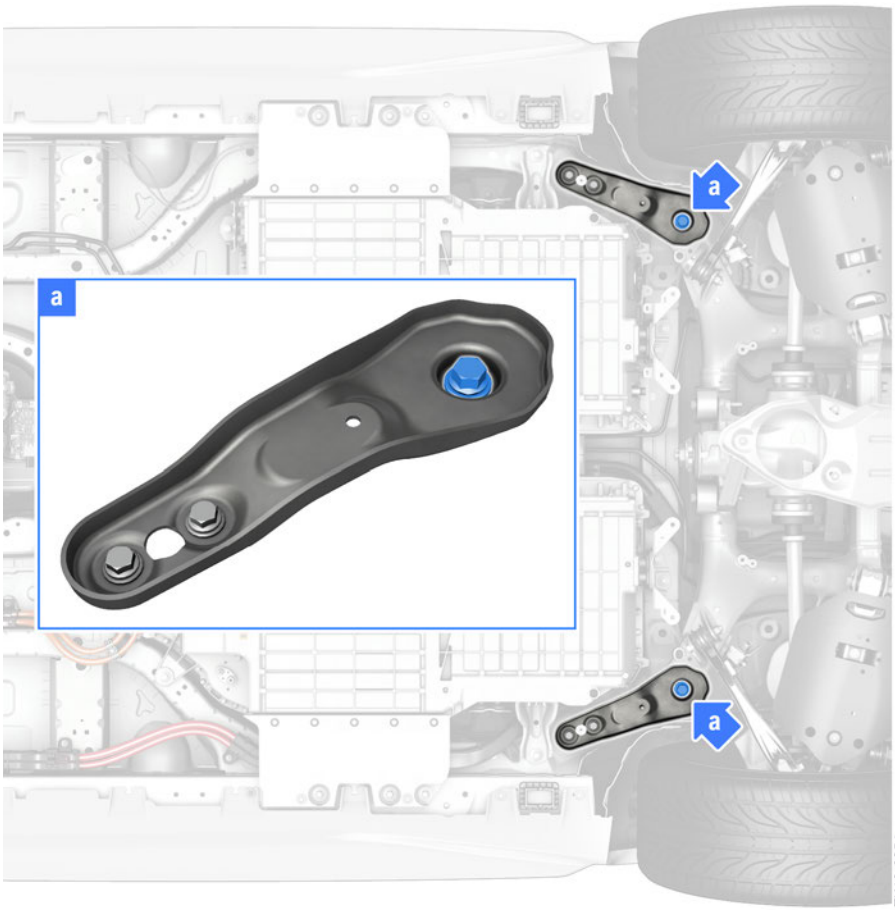
G05 PHEV correctly and incorrectly engaged vehicle lift securing points (rear)

Index	Explanation
A	Correctly engaged vehicle lift securing point
B	Incorrectly engaged vehicle lift securing point

If the vehicle left securing point is engaged too far inwards on the vehicle, it will block the side bracket of the high-voltage battery unit during removal.

5.5.2. Rear axle compression strut

The compression struts on the rear axle must be removed in order to remove the high-voltage battery unit.



G05 PHEV front mounting bolts of rear axle support

If both bolts on the rear axle support are removed when the compression struts are being installed or removed, the entire rear axle support will tilt downwards on one side. This may cause damage to the vehicle or injuries to the service employee.

If one compression strut is removed, the rear axle support must be immediately secured to the body again before the other compression strut is removed. The same also applies to their installation.

5.5.3. Special tools

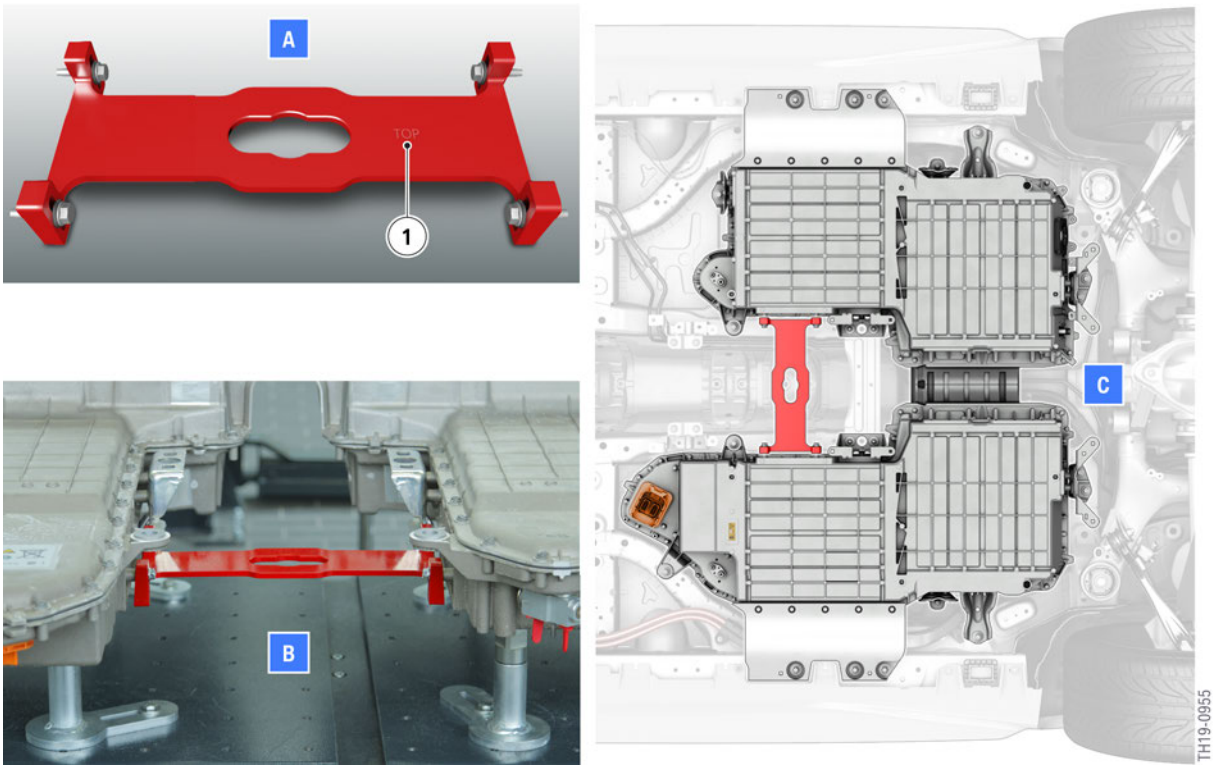
In addition to the service employees being suitably qualified, the necessary special tools and a suitable work bay for installation and removal must be available in the dealership. The most important items of work equipment are:

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

- 2-post vehicle lift
- Mounting bridge no. 2 467 913 for stabilizing the battery halves
- Mobile lifting table MHT 1200 with adapter for holding the high-voltage battery unit
- Mobile workshop crane and multifunctional lifter for potentially turning the high-voltage battery unit on the mobile lifting table.

A new special tool is used to ensure the stability of the battery halves.



G05 PHEV mounting bridge for removing the SP44 high-voltage battery

Index	Explanation
A	Mounting bridge no. 2 467 913
B	Mounted special tool on the removed high-voltage battery unit
C	Mounted special tool before removal of the high-voltage battery unit
1	Lettering of direction of installation “TOP”

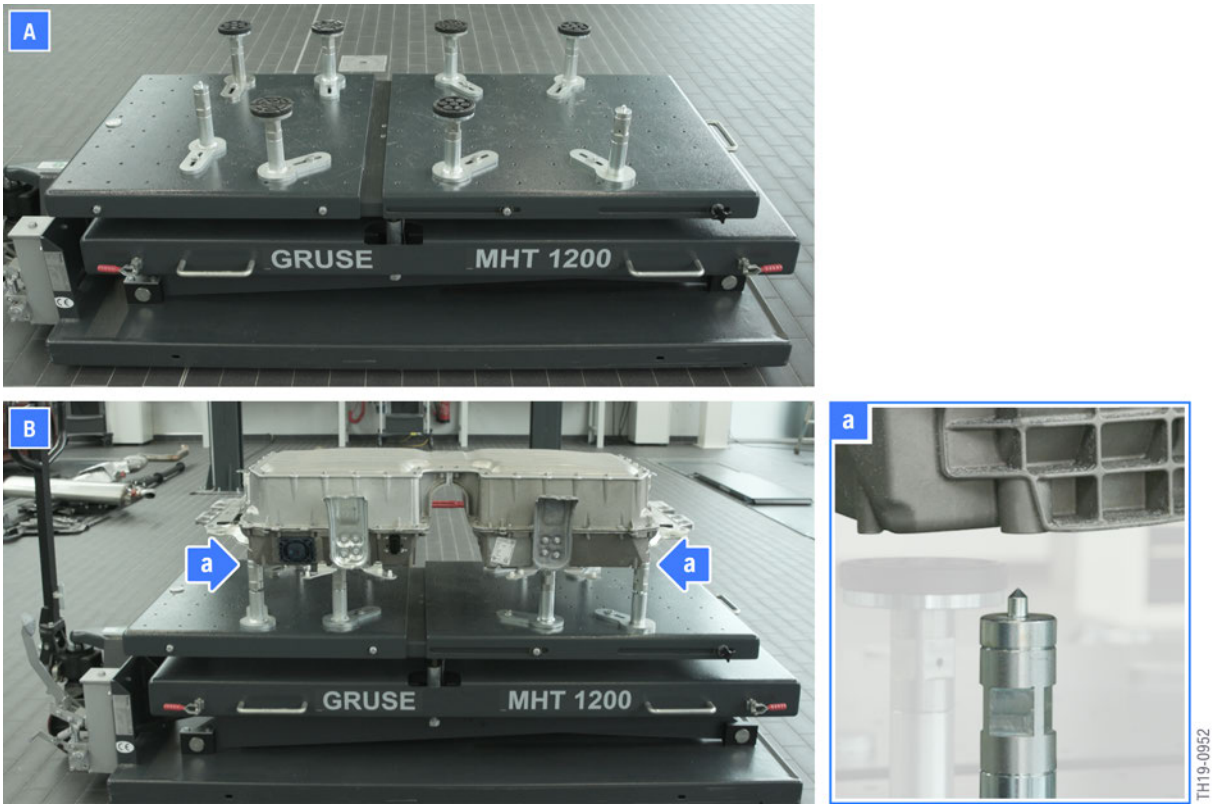
This **mounting bridge** must be mounted between the battery halves before the high-voltage battery unit is removed. The special tool may be removed again only when the high-voltage battery unit is secured in the vehicle.

Due to the trapezoidal outer side of the contact surfaces, it is essential to observe the direction of installation on the mounting bridge.

G05 PHEV Complete Vehicle.
5. High-voltage Battery Unit.

5.5.4. Positioning on the lifting table

To ensure safe repair, it is imperative to secure the high-voltage battery unit on the mobile lifting table against sideways slippage. This is done by means of bores in the lower housing sections and the corresponding attachments on the lifting table. In view of its size, the high-voltage battery unit must for this purpose be positioned “transversely” on the mobile lifting table.



SP44 high-voltage battery on mobile lifting table

Index	Explanation
A	Setup, mobile lifting table
B	Transversely positioned high-voltage battery unit

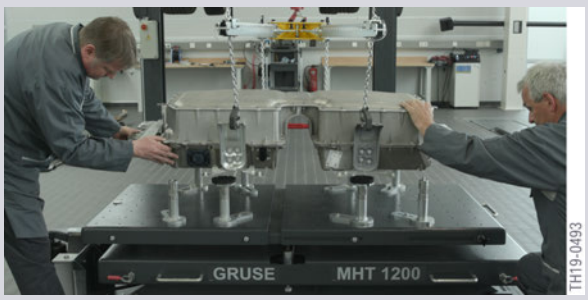
The precise coordinates for positioning the attachments on the mobile lifting table are listed in the repair instructions.

In order to position the high-voltage battery unit transversely on the mobile lifting table, it is necessary to position the mobile lifting table transversely to the vehicle's direction of travel. If the workbay and above all the vehicle lift do not allow access from the side with the mobile lifting table, the mobile lifting table must be positioned longitudinally to the vehicle's direction of travel and then the high-voltage battery unit turned through 90°.

G05 PHEV Complete Vehicle.

5. High-voltage Battery Unit.

Work sequence if the mobile lifting table cannot be positioned transversely to the direction of travel under the vehicle:

Work steps	Image
Equip lifting table for “longitudinal removal”	
Removal of the high-voltage battery unit	
Lift high-voltage battery unit with mobile workshop crane and multifunctional lifter	
Modify lifting table	
Set down high-voltage battery unit - turned through 90° - on the lifting table	

G05 PHEV Complete Vehicle.

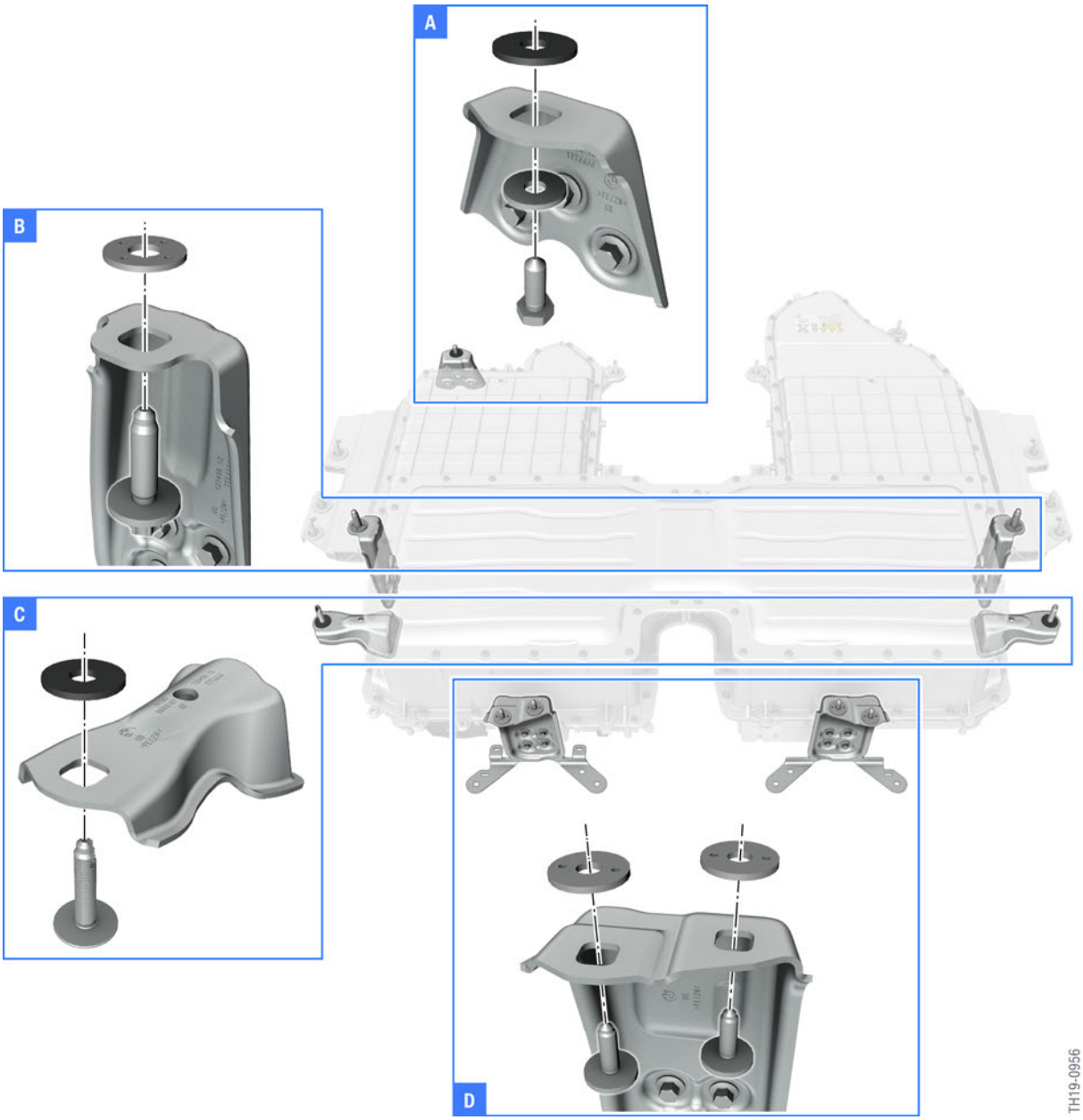
5. High-voltage Battery Unit.

A second service technician should be present to provide assistance in safely lifting and setting down the high-voltage battery unit. The exact procedure, the coordinates for equipping the lifting table and the configuration of the lifting equipment can be found in the repair instructions.

The high-voltage battery unit is installed in reverse order.

5.5.5. Washers

The associated washers must be placed on all the sheet metal brackets before the high-voltage battery unit is installed and the mounting bolts fitted. The washers differ, depending on the bracket and mounting bolt.



SP44 high-voltage battery, washers on sheet metal brackets

Index	Explanation
A	Bolt M10 x 25, no bores in the washer
B	Bolt M12 x 45, 4 bores in the washer
C	Paint tapping bolt M10 x 50, no bores in the washer
D	Bolt M8 x 25, 2 bores in the washer

Missing washers between vehicle body and bracket may cause distortions while driving and consequently damage to the high-voltage battery unit and the vehicle body.

5.6. Charging

5.6.1. AC charging

The high-voltage battery unit of the G05 PHEV can generally only be charged by alternating current (AC charging) at a maximum charging power of 3.7 kW.

Charging power	Charging level	Charging accessories	Charging time
1.1 kW, 1-phase	1	Standard charging cable	State of charge 0-80%: 12.4 h State of charge 0-100%: 15.5 h
*7.4 kW, 1-phase	2	Wallbox Charging station	State of charge 0-80%: 3.4 h State of charge 0-100%: 4.6 h

*Although the wallbox has a maximum of 7.4 kW, the vehicle can only accept a maximum of 3.7 kW.

The optional equipment “Inductive charging” is not available for the G05 PHEV.

5.6.2. Standard charging cable

The G05 PHEV is equipped with the standard charging cable of the 2nd generation for AC mains charging. The standard charging cable is stowed under the middle luggage compartment floor cover.

Standard charging cable generation 2

Index	Explanation
1	Main plug
2	In-Cable-Control-Box (ICCB)
3	Charging plug

The charging current intensity is limited to 10 A.

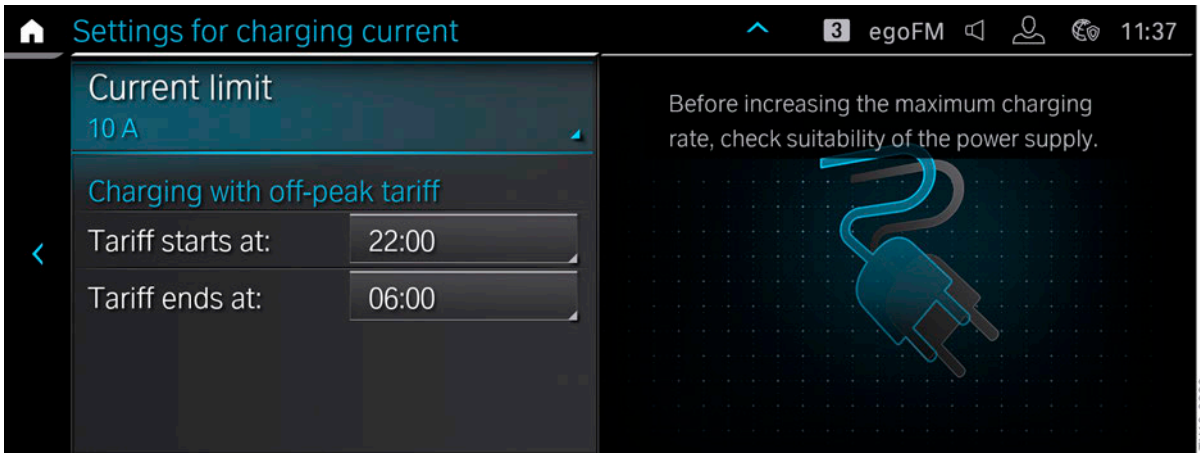
The standard charging cable of the 2nd generation has the following features:

- Power: 1.2 kW (10 A / 120 V)
- Protection against contact and water ingress (IP degree of protection): IP 67
- Temperature sensor system:
  1 temperature sensor in ICCB
  2 temperature sensors in the mains plug (phase and PEN conductor).

The temperature in the In-Cable Control Box (ICCB) and in the mains plug is monitored to protect the standard charging cable. If the temperature exceeds a defined value, the power consumption via the ICCB is reduced or temporarily switched off completely.

5.6.3. Adjusting the charge current level

The charge current level when charging with the standard charging cable at the power socket can also be set in the G05 PHEV. As in the G12 LCI PHEV, the charge current level can be adjusted precisely in amperes. The adjustable range is 6-16 A.



G05 PHEV, menu for setting the charge current level

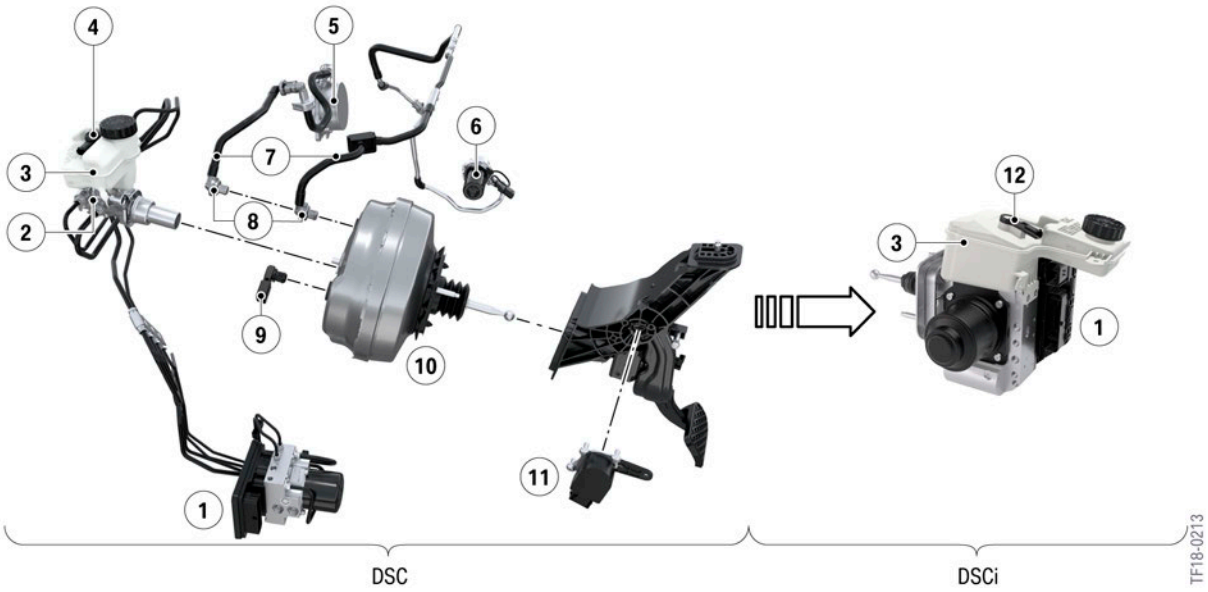
The maximum charge current must always be reset to the customer's settings following a workshop visit.

G05 PHEV Complete Vehicle.
6. Hybrid Brake System.

6.1. Overview

In the G05 PHEV as well, the deceleration is composed of a **hydraulic** braking proportion and a **regenerative** braking proportion.

In contrast to the predecessor model, the new **DSCi brake system** is deployed. A comparison of the previous system structure of the DSCi brake system reveals a clear reduction in the number of components required. The regenerative braking within the DSC brake system, which was previously implemented with high overhead, is easily possible with the DSCi brake system. This means it does not need any extra DSCi variant for a hybrid vehicle.



System overview of DSC and DSCi brake system (example)

Index	Explanation
DSC	Dynamic Stability Control
DSCi	Dynamic Stability Control integrated
1	DSC unit
2	Tandem brake master cylinder
3	Expansion tank
4	Brake fluid level switch
5	Mechanical vacuum pump
6	Electrical vacuum pump
7	Vacuum line
8	Non-return valve

Index	Explanation
9	Brake vacuum pressure sensor
10	Brake servo
11	Brake pedal travel sensor
12	Brake fluid level sensor

The following components which enabled the hybrid functions of the DSC brake system used until now are no longer present in the G05 PHEV:

- Electrical vacuum pump
- Specially modified DSC unit
- Brake vacuum pressure sensor
- Brake pedal angle sensor

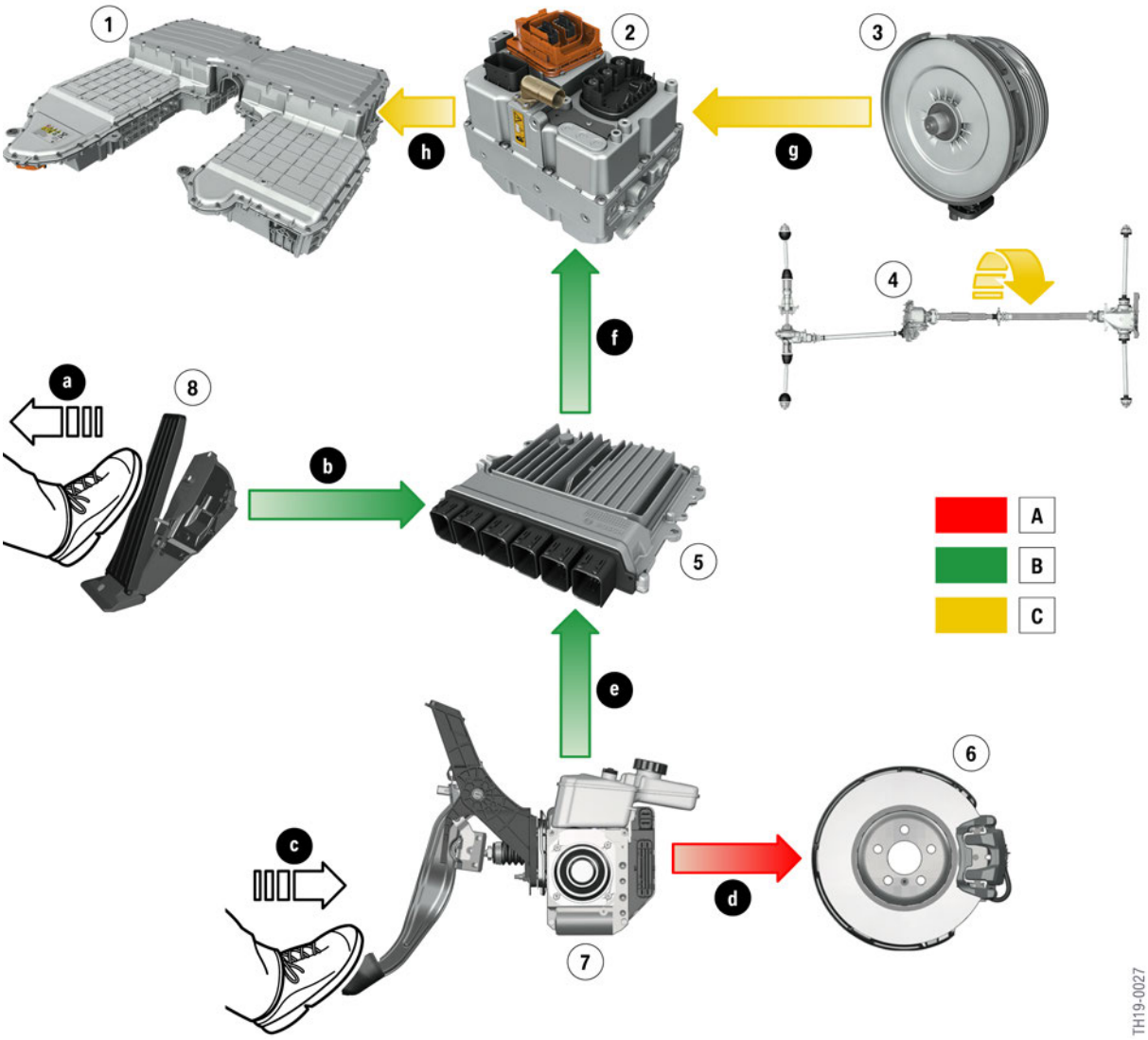
The mechanical vacuum pump is still present in the G05 PHEV to supply the controlled damping mount with vacuum (see subchapter “Vacuum supply”).

This chapter only provides you with an overview of the DSCi brake system. More detailed information and service notes can be found in the ST1852 "DSCi" reference manual.

G05 PHEV Complete Vehicle.

6. Hybrid Brake System.

6.2. System overview



G05 PHEV, system overview of hybrid brake system

Index	Explanation
A	Hydraulic braking
B	Signal path
C	Regenerative braking
1	High-voltage battery unit
2	Electrical machine electronics (EME)
3	Electrical machine
4	Drive train
5	Digital Motor Electronics (DME)

Index	Explanation
6	Wheel brakes
7	Brake pedal with DSCi unit
8	Accelerator pedal module
a	Releasing the accelerator pedal
b	Electrical signal "accelerator pedal angle" from the accelerator pedal module to the DME (coasting energy recovery)
c	Operation of the brake pedal
d	Hydraulic pressure from the DSC to the wheel brakes
e	Bus message "recuperation torque" from the DSCi to the DME
f	Bus message "recuperation torque" from the DME to the EME (coasting energy recovery and regenerative braking)
g	Electrical energy generated by the electrical machine (high AC voltage)
h	Rectified high voltage (DC) for storage in the high-voltage battery unit

6.3. Regenerative braking

The regenerative braking makes possible brake energy regeneration. Here the electrical machine works as a generator and thereby brakes all 4 drive wheels. Using the electrical energy generated here, the high-voltage battery unit is charged via the electrical machine electronics (EME).

Energy recovery occurs if necessary already when the accelerator pedal is not pressed (see subchapter “Adaptive recuperation”).

When the driver presses the brake pedal, the brake request is sensed via a brake pedal travel sensor integrated in the DSCi unit. 2 driver separator valves prevent the hydraulic pressure generated from being able to act in the direction of the wheel brake. Instead, the hydraulic pressure passes through the opened simulator valve to the brake pedal force simulator. An elastomer inside the brake pedal force simulator generates the customary counterforce.

The sensor signal of the brake pedal travel sensor is processed by the DSCi control unit and the "recuperation torque" is forwarded to the Electrical Machine Electronics (EME). In response, the EME activates the electrical machine as an alternator and the vehicle is decelerated by the energy recovery.

The maximum permissible brake force by brake energy recovery is subject to stability monitoring of slip, lateral accelerations and stability control processes. It is thus ensured that the vehicle constantly remains in a stable driving condition, also during brake energy regeneration.

The recuperation level is reduced or is not permitted in the following operating conditions:

1 On detection of adversely affected driving stability, the energy recovery level is reduced.

2 If emergency braking is detected, the deceleration request is implemented purely hydraulically in order to ensure fast implementation of the hydraulic interventions at the individual wheels as required.

3 If no energy recovery is available (for example fully charged high-voltage battery unit or temperature limits exceeded), the deceleration is implemented purely hydraulically.

4 At driving speeds below approx. 9 mph.

A maximum deceleration of 0.18 g is possible with regenerative braking. Essentially, the slip at the rear wheels determines the recuperation level. Higher recuperation may be achieved with an all-wheel drive vehicle since, with the multidisc clutch in the transfer box closed, the front wheels provide for increased driving stability especially on a wet road.

6.4. Hydraulic braking

If the brake request exceeds the deceleration possible as a result of energy recovery, the linear actuator is activated. The electro-hydraulic brake pressure generated in this way is routed through the opened linear actuator changeover valves in the direction of the wheel brakes. The vehicle decelerates in this situation both hydraulically and via the electrical machine.

G05 PHEV Complete Vehicle.

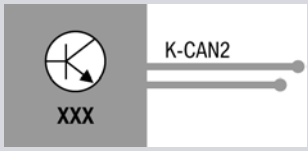
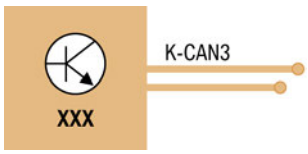
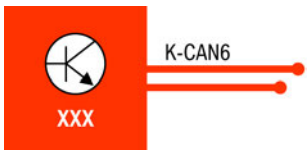
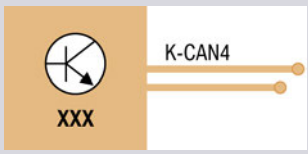
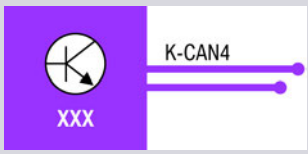
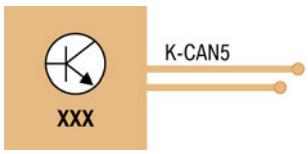
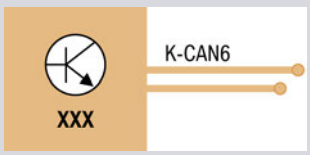
7. Low-voltage Vehicle Electrical System.

7.1. Bus overview

7.1.1. New schematic diagram

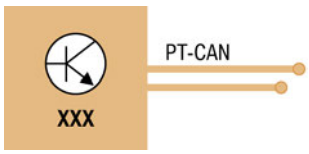
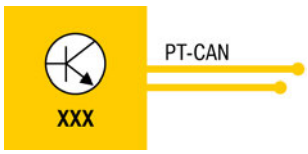
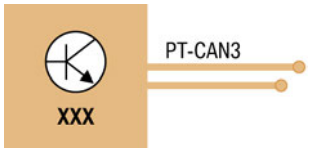
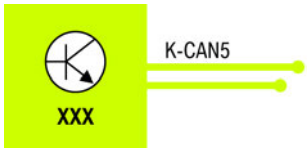
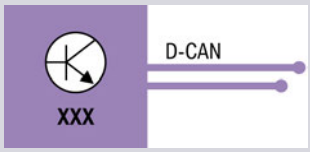
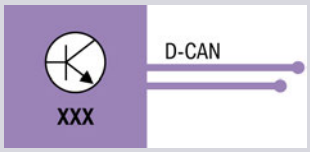
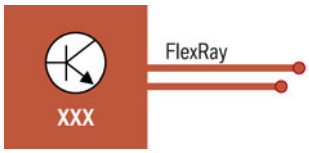
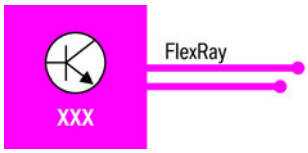
The representation of the individual bus systems and their designations have been adapted to the representation and the designation of the ISTA workshop information system.

The following table provides an overview of the previous and the current representation and designation:

Bus system previously	Bus system currently
K-CAN2 	K-CAN2 
K-CAN3 	K-CAN6 
K-CAN4 	K-CAN4 
K-CAN5 	Local-CAN 
K-CAN6 	K-CAN3 

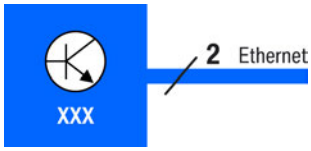
G05 PHEV Complete Vehicle.

7. Low-voltage Vehicle Electrical System.

Bus system previously	Bus system currently
PT-CAN	PT-CAN
	
PT-CAN2	PT-CAN2
	
PT-CAN3	K-CAN5
	
D-CAN	D-CAN
	
FlexRay	FlexRay
	

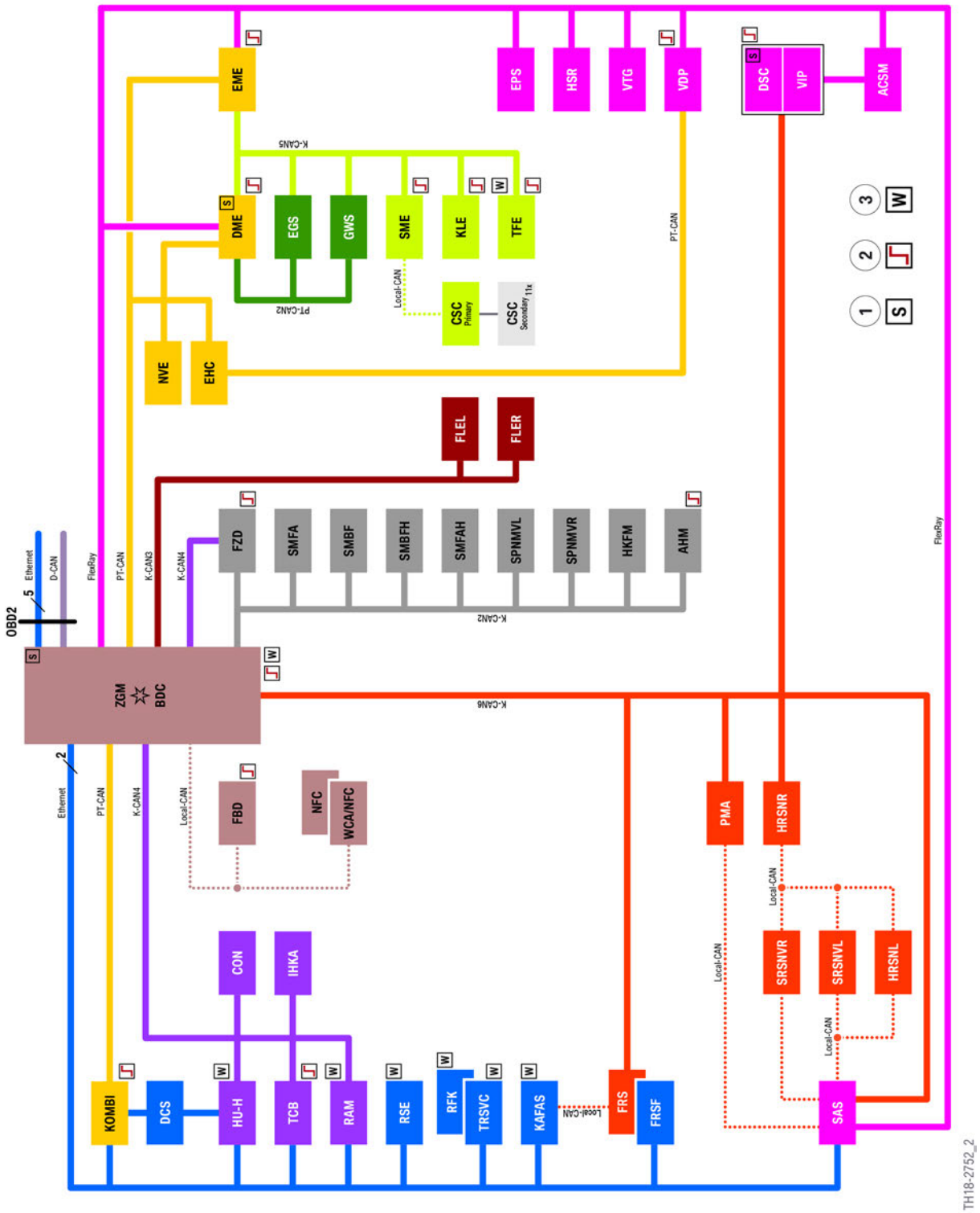
G05 PHEV Complete Vehicle.

7. Low-voltage Vehicle Electrical System.

Bus system previously	Bus system currently
MOST 	MOST 
Ethernet 	Ethernet 
LIN bus 	LIN bus 

G05 PHEV Complete Vehicle.

7. Low-voltage Vehicle Electrical System.



G05 PHEV, bus overview

G05 PHEV Complete Vehicle.
7. Low-voltage Vehicle Electrical System.

Index	Explanation
ACSM	Advanced Crash Safety Module
AHM	Trailer Hitch module
BDC	Body Domain Controller
CON	Controller
CSC primary	Primary cell supervision circuit
CSC secondary	Secondary cell supervision circuit
DCS	Driver Camera System
DME	Digital Motor Electronics
DSC	Dynamic Stability Control
EGS	Electronic transmission control
EHC	Electronic ride height control
EME	Electrical machine electronics
EPS	Electromechanical Power Steering
FDB	Remote control receiver
FLEL	Frontal Light Electronics Left
FLER	Frontal Light Electronics Right
FRS	Front radar sensor
FRSF	Front radar sensor long range
FZD	Roof function center
GWS	Gear selector switch
HU-H	Head Unit High
HKFM	Tailgate function module
HRSNL	Rear radar sensor short range left
HRSNR	Rear radar sensor short range right
HSR	Rear axle slip angle control
IHKA	Integrated automatic heating / air conditioning
KAFAS	Camera-based driver assistance systems
KLE	Convenience charging electronics
KOMBI	Instrument panel
NFC	Near Field Communication
NVE	Night Vision Electronics
PCU	Power Control Unit
PMA	Parking Maneuver Assistant
RAM	Receiver Audio Module
RFK	Rear view camera

Index	Explanation
RSE	Rear Seat Entertainment
SAS	Optional equipment system
SME	Battery management electronics
SMBF	Front passenger seat module
SMFA	Driver's seat module
SMBFH	Seat module, front passenger's side, rear
SMFAH	Seat module, driver's side, rear
SPNMVL	Seat pneumatics module front left
SPNMVR	Seat pneumatics module front right
SRSNVL	Side radar sensor short range front left
SRSNVR	Side radar sensor short range front right
TCB	Telematic Communication Box
TFE	Hybrid pressure refuelling electronic control unit
TRSVC	Top rear side view camera
VDP	Vertical Dynamic Platform
VIP	Virtual Integration Platform
VTG	Transfer box
WCA/NFC	Wireless charging station with control electronics for Near Field Communication
ZGM	Central gateway module
1	Start-up node control units for starting and synchronizing the FlexRay bus system
2	Control units authorized to perform wake-up function
3	Control units also connected at terminal 15WUP

The following hybrid-specific components are connected via LIN buses to the specified control units. These LIN bus components are diagnosed via the respective control unit.

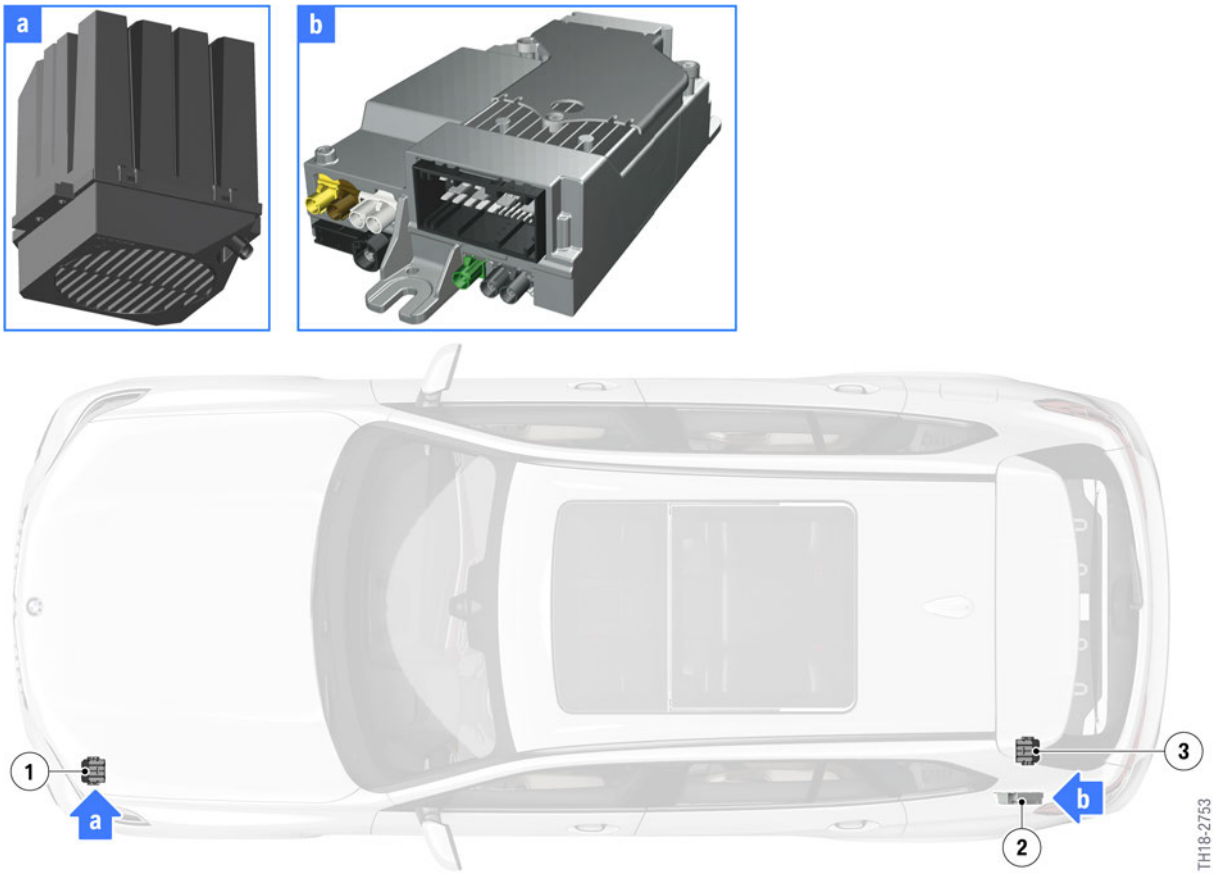
Components	Control unit
Electric A/C compressor (EKK)	Integrated automatic heating/air conditioning (IHKA)
Electrical heating (EH)	Integrated automatic heating/air conditioning (IHKA)
Charger unit for auxiliary battery (BCU)	Digital Motor Electronics (DME)
Intelligent battery sensor for IBS2 auxiliary battery	Electrical machine electronics (EME)

G05 PHEV Complete Vehicle.

7. Low-voltage Vehicle Electrical System.

7.2. Vehicle Sound Generator

A Vehicle Sound Generator (VSG) is also used in the G05 PHEV. In contrast to the predecessor, this is no longer a K-CAN3 control unit with integrated loudspeaker. The VSG control unit has been integrated into the Receiver Audio Module (RAM), which is therefore also responsible for actuation of the VSG loudspeaker.



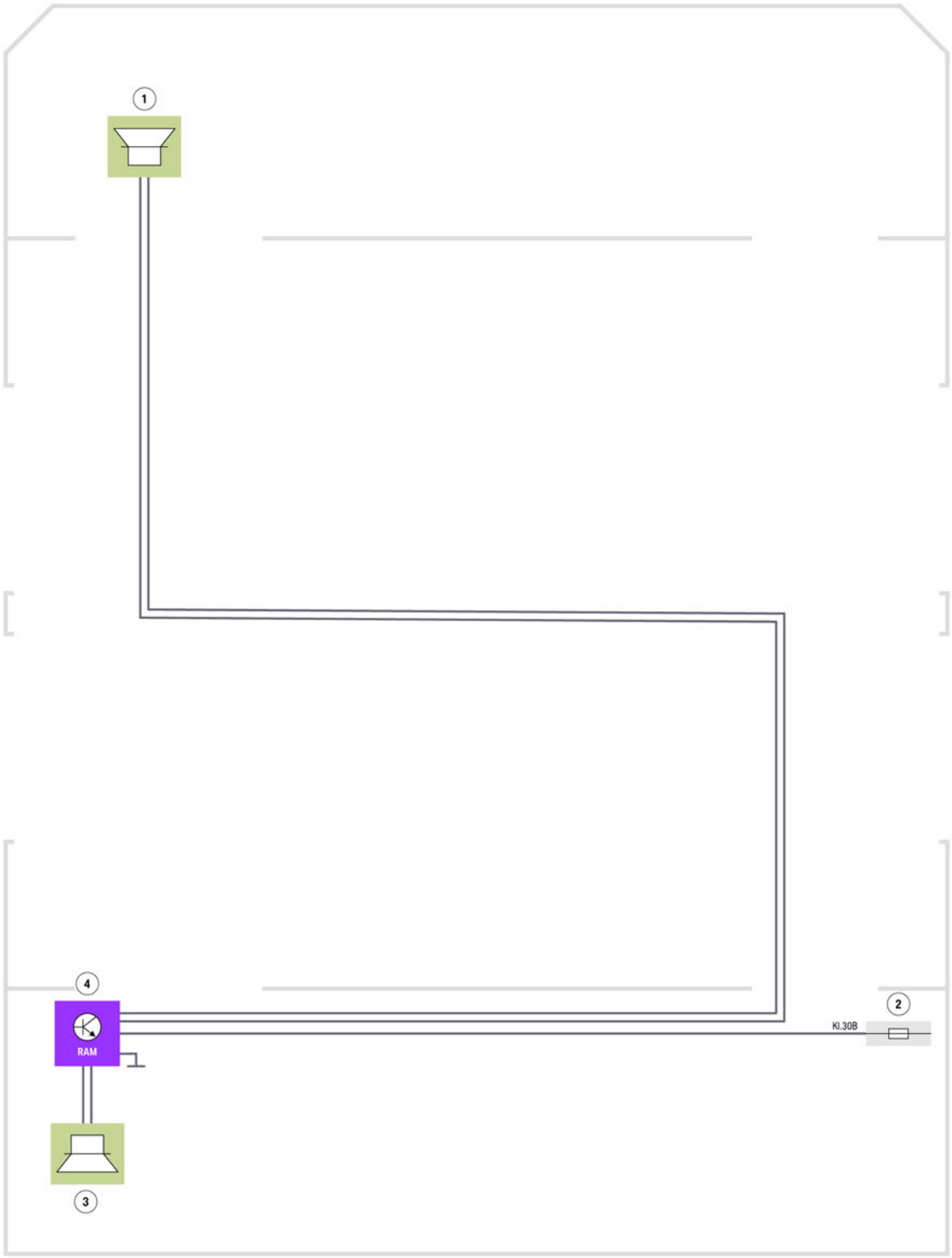
G05 PHEV system components Vehicle Sound Generator (VSG) (US version)

Index	Explanation
1	VSG front loudspeaker
2	Receiver Audio Module (RAM)
3	VSG rear loudspeaker (only US vehicles)

When stationary and when driving up to approx. 19 mph, the RAM generates artificial engine noise via the VSG loudspeaker which gradually becomes quieter as the speed increases. The engine noise is the same when driving forwards and reversing. For US versions, more stringent legal requirements mean that an additional VSG loudspeaker is used in the rear of the vehicle.

G05 PHEV Complete Vehicle.

7. Low-voltage Vehicle Electrical System.



G05 PHEV system wiring diagram Vehicle Sound Generator (US version)

G05 PHEV Complete Vehicle.
7. Low-voltage Vehicle Electrical System.

Index	Explanation
1	VSG front loudspeaker
2	Fuse for rear right power distribution box
3	VSG rear loudspeaker (only US vehicles)
4	Receiver Audio Module (RAM)

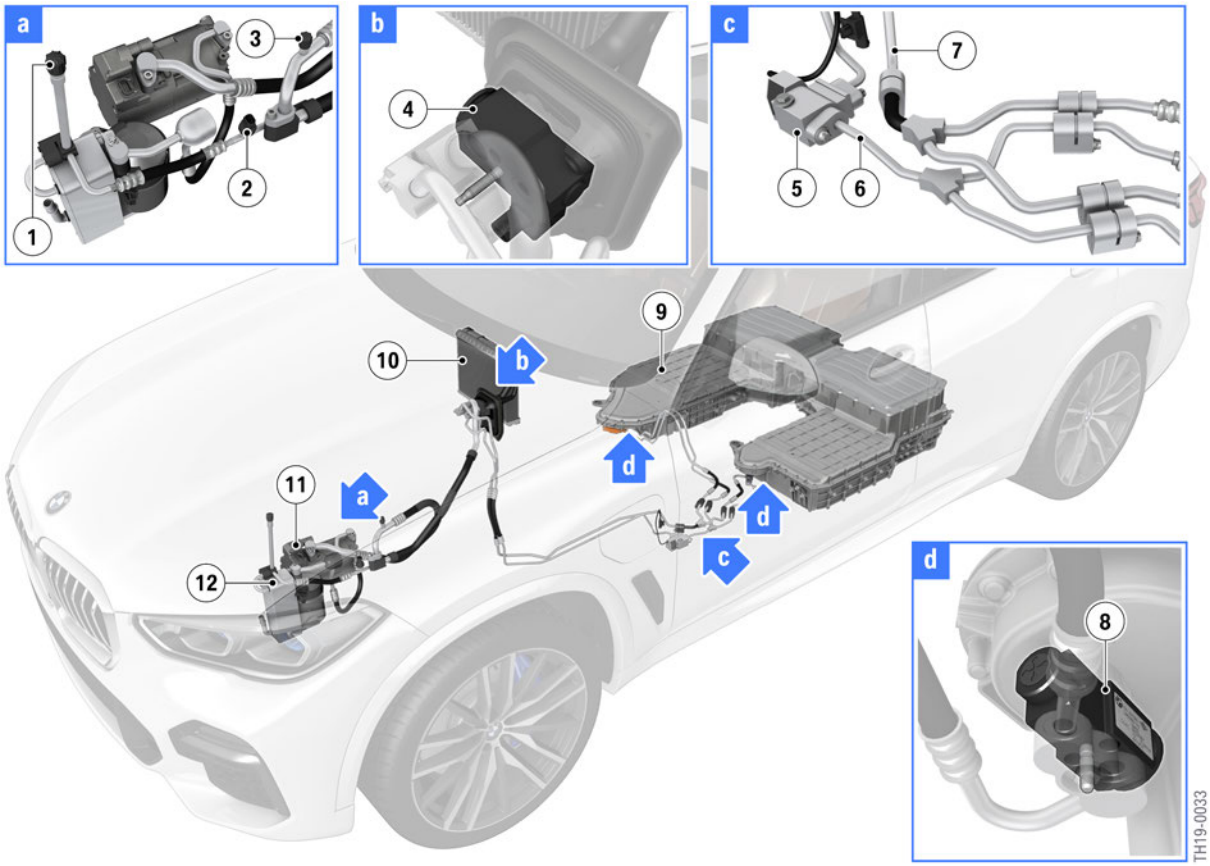
G05 PHEV Complete Vehicle.

8. Climate Control.

The G05 PHEV, like the BMW Hybrid Generation 3.0 iPerformance vehicles, deploys a refrigerant circuit to cool the vehicle interior and the high-voltage battery unit. The air conditioning condenser from the predecessor has been replaced by the established coolant-cooled air conditioning condenser.

8.1. System overview

The refrigerant circuit has been adapted to the geometry and the internal structure of the high-voltage battery unit. 1 shutoff valve and 2 expansion valves are used rather than a combined expansion and shutoff valve for this purpose.



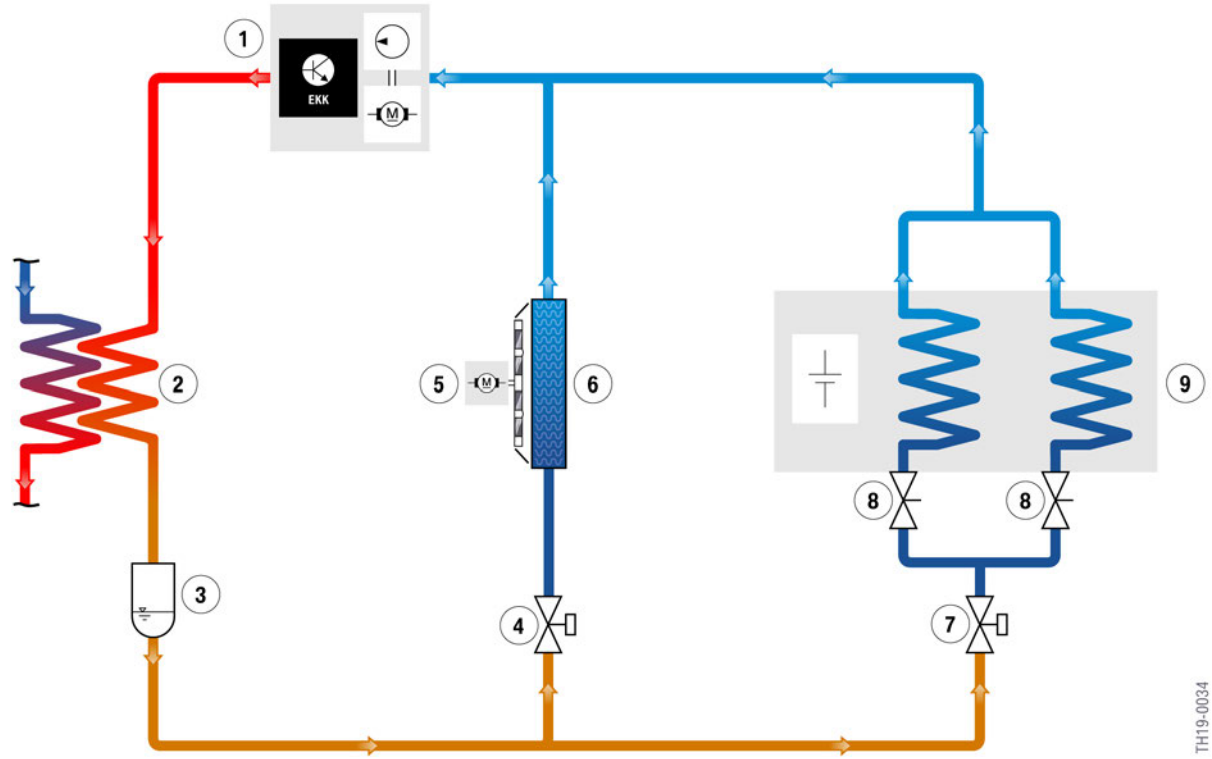
G05 PHEV, system overview of climate control

Index	Explanation
1	High-pressure connection (for drawing off, evacuating and filling)
2	Refrigerant pressure sensor
3	Low-pressure connection (for drawing off, evacuating and filling)
4	Combined expansion and shutoff valve (passenger compartment)
5	Shutoff valve
6	Pressure line to high-voltage battery unit

G05 PHEV Complete Vehicle.
8. Climate Control.

Index	Explanation
7	Suction line from high-voltage battery unit
8	Expansion valves on high-voltage battery unit
9	High-voltage battery unit
10	Evaporator (vehicle interior)
11	Electric refrigerant condenser (EKK)
12	Coolant-based air conditioning condenser (coolant-refrigerant-heat exchanger)

The shutoff valve is also activated by the battery management electronics (SME). It closes or opens both paths to the high-voltage battery unit on the pressure side (inlet). The expansion valves are located on either half of the high-voltage battery unit.



G05 PHEV schematic system overview, climate control

Index	Explanation
1	Electric refrigerant condenser (EKK)
2	Coolant-based air conditioning condenser (coolant-refrigerant-heat exchanger)
3	Dryer flask
4	Combined expansion and shutoff valve (passenger compartment)
5	Blower for passenger compartment

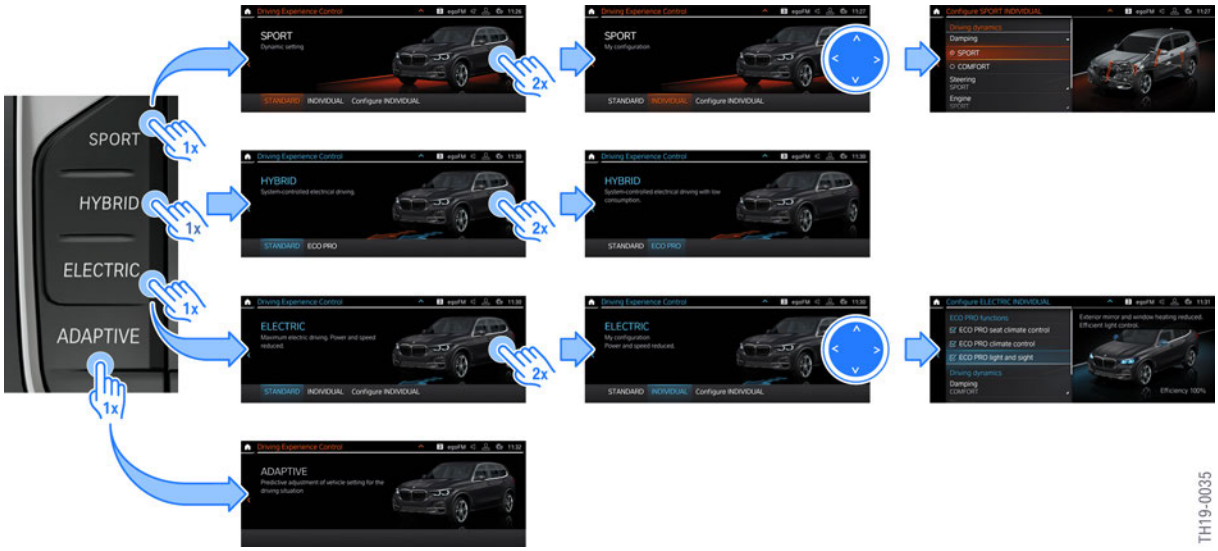
Index	Explanation
6	Evaporator (vehicle interior)
7	Shutoff valve
8	Expansion valve
9	Heat exchanger in the high-voltage battery unit

G05 PHEV Complete Vehicle.
9. Displays and Controls.

9.1. Driving modes

9.1.1. Overview

The driving and drive system modes have been merged in the G12 LCI PHEV and can be activated using the new Driving Experience Control. The separate eDrive button which can be used to shift through the drive system modes is no longer deployed. The place of the automatic engine START/ STOP function button is taken by the Battery Control button.



G05 PHEV, overview of driving modes

The HYBRID driving mode is divided into 2 specified variants and/or attributes. It is possible to shift through these variants by repeatedly pressing the corresponding button on the Driving Experience Control. Alongside the standard variant, the SPORT and ELECTRIC driving modes have an individual variant which the driver can also shift through by repeatedly pressing the Driving Experience Control. In addition, these two driving modes can be configured using the controller.

The familiar ECO PRO functions can be activated in the HYBRID ECO PRO and ELECTRIC INDIVIDUAL driving modes.

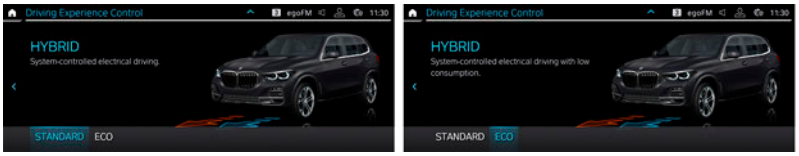
A shift of the gear selector switch to the manual position is possible in almost any driving mode. Here the combustion engine is turned on and the drive adopts a sporty style (shift characteristic, accelerator pedal, etc.). The chassis and suspension settings are not changed here.

It is only in the case of the ELECTRIC driving mode that manual shifting (also via the shift paddles on the steering wheel) leads to a switch into the HYBRID driving mode with its last selected variant.

9.1.2. HYBRID

In the HYBRID driving mode, the vehicle chooses the optimum drive combination depending on the state of charge of the high-voltage battery unit and accelerator pedal position. If the driver's power request exceeds the maximum available electrical power, the combustion engine is activated automatically and comfortably.

G05 PHEV Complete Vehicle.
9. Displays and Controls.



TH19-0036

G05 PHEV, HYBRID driving mode attributes

The HYBRID driving mode is available with 2 attributes:

- STANDARD
- ECO PRO

The HYBRID COMFORT attribute is not used in the G05 PHEV.

STANDARD

The attribute of the HYBRID STANDARD driving mode corresponds to the combination of COMFORT and Auto eDrive mode from the predecessor model. HYBRID STANDARD is always active after a new vehicle start.

Exception:

- The gear selector switch is in manual/Sport program position.
- The ELECTRIC INDIVIDUAL driving mode has been selected as the standard driving mode and is available.

The HYBRID STANDARD mode can in principle be divided into 2 parts: The charge depleting phase and the charge sustaining phase.

In the charge depleting phase the G05 PHEV can be driven electrically up to approx. 68 mph. The combustion engine is activated at speeds above 68 mph or for high power requirements. The combustion engine is switched off if the speed falls below 65 mph into the electric driving range.

In the charge sustaining phase, accelerations up to approx. 25 mph and constant-speed driving up to approx. 37 mph are possible as all-electric driving. During operation at low speeds, driving states in which the combustion engine is off alternate with driving states in which the combustion engine is running.

Outside this efficiency-optimized eDrive range, the combustion engine is automatically started in case of high load and speed demands.

In general, the following applies to the electric drive: If the vehicle is driven after a long immobilization period at very cold ambient temperatures, this may result in a power reduction of the electrical drive or it may not be available at all. A reason for this may be an excessively low cell temperature in the cell modules of the high-voltage battery unit.

ECO PRO

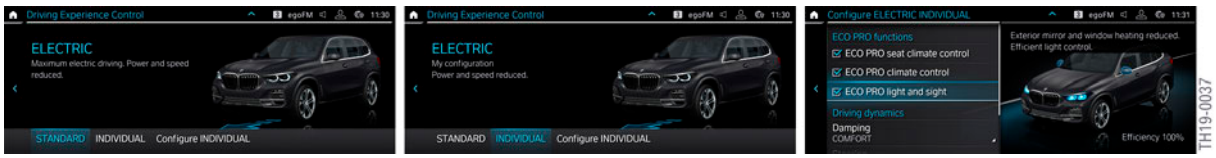
The HYBRID ECO PRO driving mode rigorously supports an anticipatory driving style that reduces consumption and its attribute corresponds to the combination of ECO PRO and Auto eDrive of the predecessor model. In this driving mode the G05 PHEV has its maximum overall range. Essentially the following measures help to increase the range:

- A modified accelerator pedal characteristic curve and shift program with automatic transmission helps the driver adopt a driving style that optimizes fuel consumption.
- No boost function available (except with kickdown).
- Adaptive recuperation or coasting (innovation, see chapter “Operating strategy”).
- Combustion engine is switched off up to 99 mph.
- Power reduction of the electrical comfort consumer units such as mirror, seat or rear window heating.
- Power reduction of heating / air-conditioning system.

Individualization in the same way as in the predecessor model is no longer possible in the HYBRID ECO PRO mode. The attribute corresponds to specified parameters.

9.1.3. ELECTRIC

The attribute of the ELECTRIC driving mode corresponds to the combination of COMFORT and MAX eDrive mode of the predecessor model. In contrast to the HYBRID driving mode, in ELECTRIC INDIVIDUAL the driver has the possibility to adjust settings with regard to efficiency and driving dynamics.



G05 PHEV, ELECTRIC driving mode attributes

The ELECTRIC driving mode is available with 2 attributes:

- STANDARD
- INDIVIDUAL

STANDARD

With a sufficient charge state of the high-voltage battery unit, all-electric driving of the vehicle with maximum output of the electric drive is possible for up to **54** (WLTP) miles. The maximum speed has been increased compared with the predecessor to 87 mph.

In the STANDARD variant, all ECO PRO settings are switched off and the damping and steering are set to "Comfort" (see ELECTRIC INDIVIDUAL).

The following events can mean that the ELECTRIC driving mode cannot be selected or is disabled:

- State of charge of the high-voltage battery unit too low
- Kickdown (switch to HYBRID STANDARD)
- Speed too high
- Gear selector switch in Manual / Sport program
  (change to HYBRID with the last selected variant)
- Shift paddles on the steering wheel actuated
  (change to HYBRID with the last selected variant)
- Cell temperature too high / low
- System fault.

All-electric drive up to a cell temperature of 27 °F is available in the Hybrid Generation 3.0 vehicles and in the G12 LCI PHEV. This temperature limit has been extended in the G05 PHEV to 21 °F.

For vehicles from Hybrid Generation 4.0 the maximum adjustable set speed of Dynamic Cruise Control (DCC) or Active Cruise Control with Stop&Go function (ACC Stop&Go) in the ELECTRIC driving mode has been increased to 87 mph. Previously only one set speed of max. 75 mph could be adjusted in the MAX eDrive driving mode for both cruise control variations.

INDIVIDUAL

In the G05 PHEV the driver has the possibility to individualize the ELECTRIC driving mode and make settings with regard to efficiency and sportiness. ELECTRIC INDIVIDUAL can be selected as the standard driving mode so that this driving mode is active at every engine start. Alongside all other settings, this is saved for the driver profile currently in use.

There is no longer a display of the ECO PRO potential.

9.1.4. SPORT

In the SPORT driving mode, a sporty engine and suspension setting provides an assured and dynamic driving experience.

G05 PHEV, SPORT driving mode attributes

The SPORT driving mode is available with 2 attributes:

- STANDARD
- INDIVIDUAL

STANDARD

In the SPORT STANDARD driving mode, the combustion engine is always running or running in addition while the vehicle is being driven as soon as the driving mode is activated.

Essentially the following measures contribute to increasing the output and dynamics:

- Alteration of the attributes of the accelerator pedal characteristic curve and the shift program in automatic transmissions for a sporty driving style.
- More sporty setting of the driving dynamics systems (damping and steering).
- Higher boost output available.
- Combustion engine is not switched off while the vehicle is being driven (only at a standstill).
- No coasting available.
- Greater increase in the load point of the combustion engine to ensure sufficiently high battery charge for provision of the boost function.

INDIVIDUAL

In exactly the same way as in ELECTRIC, the SPORT driving mode can be individualized. Here, setting options from the predecessor model are used.

9.1.5. ADAPTIVE

With the ADAPTIVE driving mode, the entire engine and vehicle settings automatically adapts to both the driving situation and the driving style.

9.1.6. Service note

The combustion engine can be started with the vehicle at a standstill, for example for an emission inspection. To achieve this, with activated driving readiness, the brake **and** accelerator must be pressed while drive position P or N is engaged. The driver's door must then be opened to prevent the combustion engine from stalling.

G05 PHEV Complete Vehicle.
9. Displays and Controls.

9.2. BATTERY CONTROL

BATTERY CONTROL mode is selected by means of the separate Battery Control button. The target charging value can be set to a state of charge of 30-100% (for Hybrid Generation 3.0 30-90%).

G05 PHEV BATTERY CONTROL

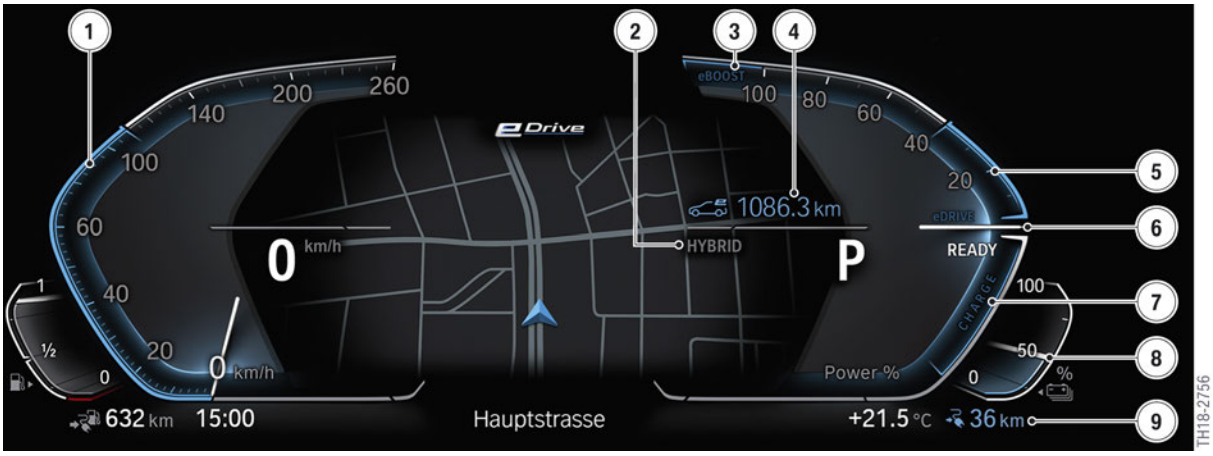
Index	Explanation
1	Battery Control button

9.3. Displays in the instrument cluster

9.3.1. Displays of operating conditions

The hybrid-specific operating states and the state of charge of the high-voltage battery unit are displayed in the instrument cluster and, if desired, in the central information display (CID).

The displays shown below may appear, depending on the driving situation and driving mode.



G05 PHEV, driving readiness instrument cluster

Index	Explanation
1	All-electric driving is possible within this speed range. In the ELECTRIC driving mode, the range up to 87 mph is highlighted.
2	Display of the driving mode
3	eBoost; the needle is in the eBoost range during powerful acceleration
4	All-electric driving distance travelled
5	eDrive range; all-electric driving is possible within this range
6	READY; driving readiness established
7	CHARGE; the needle shows the energy recovery as a function of the deceleration or brake pedal actuation intensity
8	State of charge of high-voltage battery unit with new battery symbol complying with standard
9	Remaining electric range

In the instrument cluster, the driver is provided with a visual acknowledgement about the level of requested power.

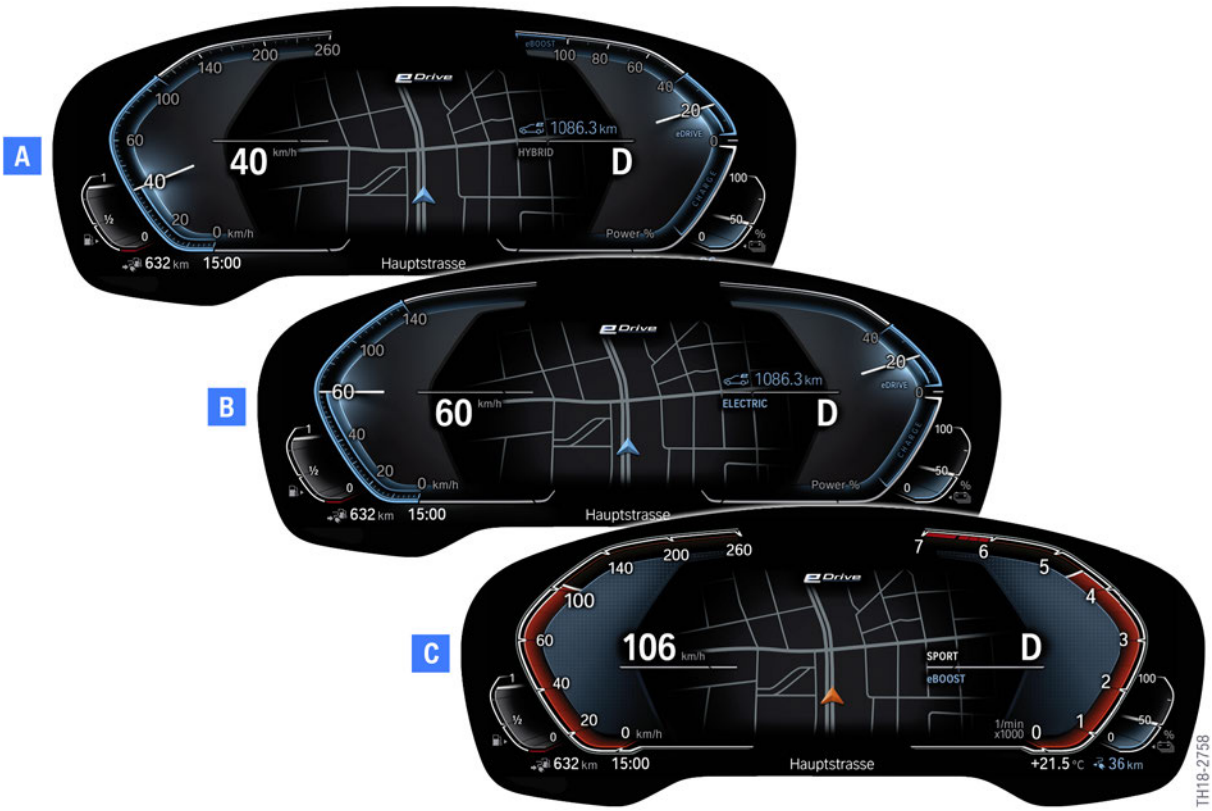
Depending on the activated driving mode, the following additional information is displayed in the form of widgets in the right-hand area of the instrument cluster (KOMBI).

Driving mode	Widget
HYBRID	• Current consumption (fuel) • Consumption display (fuel) • Average consumption (fuel) • Distance recorder for driving without combustion engine
ELECTRIC	• Current consumption (electrical energy) • Consumption display (electrical energy) • Average consumption (electrical energy) • Distance recorder for driving without combustion engine
SPORT	• Coolant temperature

G05 PHEV Complete Vehicle.
9. Displays and Controls.

9.3.2. Display of driving modes

The following graphic shows the instrument cluster (KOMBI) in the various driving modes:



G05 PHEV, driving modes in the instrument cluster

Index	Explanation
A	HYBRID
B	ELECTRIC
C	SPORT

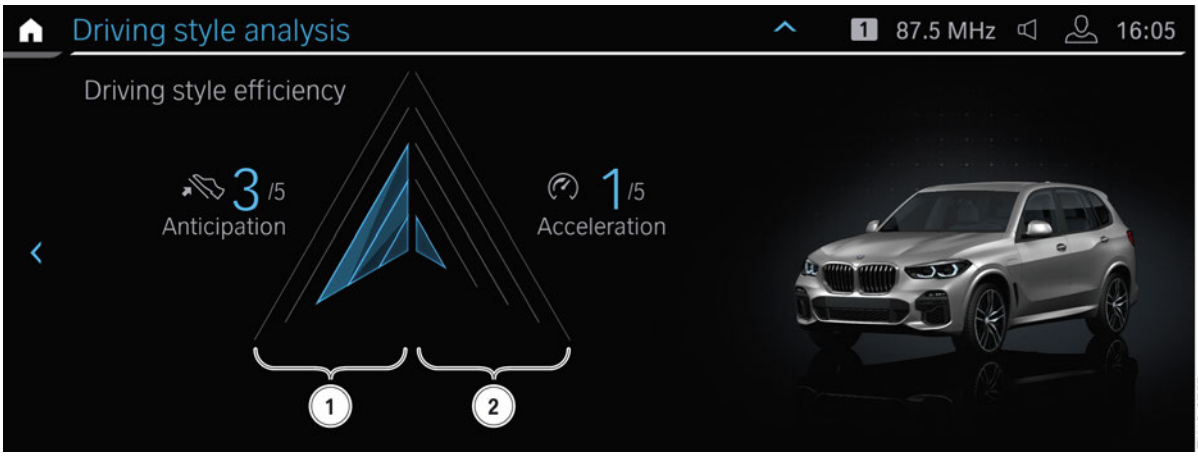
9.4. Displays in Central Information Display

The familiar hybrid-specific displays are used:

- Trip data (previously eDrive use)
- Energy and power flow display
- Anticipatory hybrid drive
- Driving style analysis.

G05 PHEV Complete Vehicle.
9. Displays and Controls.

The representation of the driving style analysis has been revised. In this way, it helps to develop a particularly efficient driving style and to save fuel and/or electrical energy. The function is only available in the HYBRID ECO PRO driving mode. The efficiency is visualized in the form of a triangle.



G05 PHEV, display of driving style analysis

Index	Explanation
1	Anticipation
2	Acceleration

The more efficient the driving style, the more bars are displayed in color and the higher the number of points displayed. In the case of an inefficient driving style, on the other hand, a reduced number of bars and a lower number are displayed.

G05 PHEV Complete Vehicle.
10. Operating Strategy.

10.1. Adaptive recuperation

10.1.1. Introduction

Adaptive recuperation is used in the G05 PHEV. Here, the application and extent of **coasting recuperation** (and the resulting vehicle deceleration) is adapted intelligently and depending on the situation to the traffic situation and the stretch of road. The function decides automatically whether the vehicle coasts or regenerates power (recuperates).

In this way, the driver is supported in anticipatory driving and energy recuperation is optimized. Furthermore, comfort is enhanced by the reduced number of brake pedal operations.

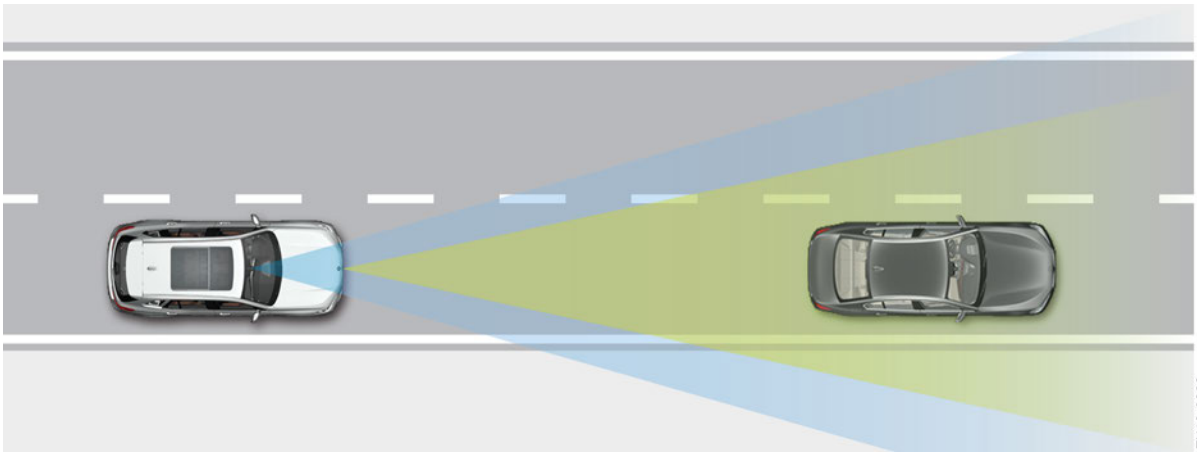
Adaptive recuperation is not a separate item of optional equipment. It is available as a function in the **HYBRID ECO PRO** driving mode.

10.1.2. Functional principle

The aim of adaptive recuperation is to use the vehicle's kinetic energy appropriately for the situation and thus more intelligently. The traffic situation in front of the vehicle and the stretch of road ahead are evaluated for this purpose. The following events are taken into consideration:

Traffic situation in front of the vehicle

Evaluation of the traffic situation in front of the vehicle is effected, depending on the equipment specification, via the respective variant of the KAFAS camera and the front radar sensor.



G05 PHEV, adaptive recuperation – evaluation of vehicle in front

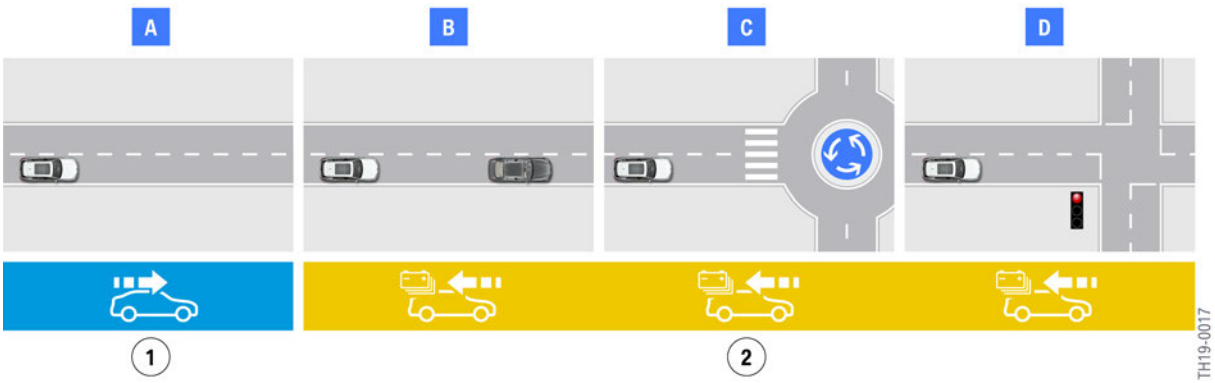
Stretch of road

The stretch of road is evaluated by means of the navigation system data.

Detected situations
• Top speed limitations • Town border signs • Bends • Traffic Circles • Highway exits • Turning-off priority roads • Red lights*

* For US vehicles: Only with the optional equipment Traffic Jam Assistant (OE 5AR).

If the system detects a traffic situation in which no braking operations are necessary, the vehicle coasts as soon as the driver takes his/her foot off the accelerator pedal. If the system detects a traffic situation in which braking operations are necessary, the vehicle is specifically decelerated to the prevailing or requested speed by recuperation.

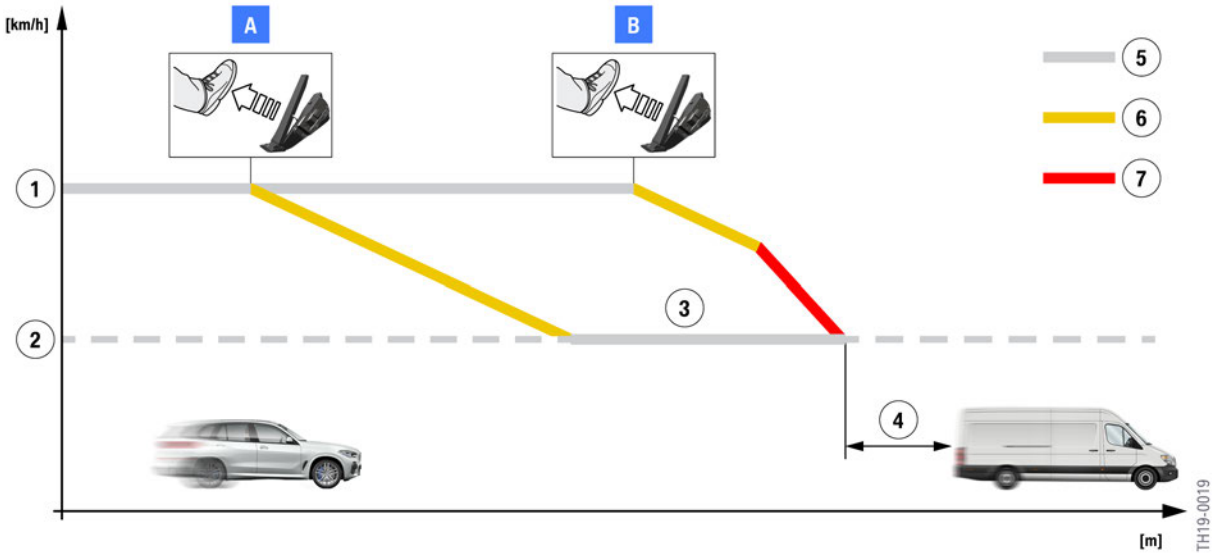


G05 PHEV, adaptive recuperation

Index	Explanation
A	Free driving
B	Detected vehicle in front
C	Deceleration
D	Traffic light situation
1	Coasting
2	Adaptation of coasting recuperation to the respective situation

Example without adaptive recuperation

Initial situation: The driver drives towards a vehicle in front which is travelling at a lower speed.



G05 PHEV, recuperation strategy without adaptive recuperation

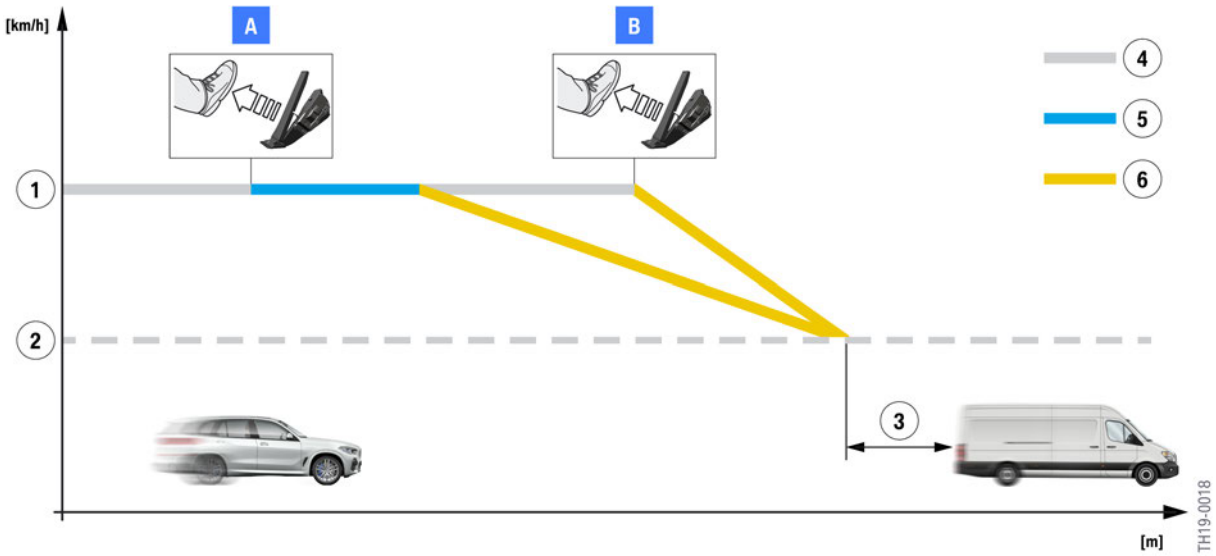
Index	Explanation
A	Case A
B	Case B
1	Speed of own vehicle
2	Speed of vehicle travelling in front
3	Renewed, avoidable traction (double energy conversion)
4	Included nominal distance
5	Traction
6	Predefined recuperation
7	Brake actuation by the driver

Case A: If the driver takes his/her foot off the accelerator pedal too early, the predefined recuperation ensues in accordance with the driving mode and the current speed. The driver's own vehicle would decelerate too heavily, making it necessary for the driver to accelerate. This is inefficient and uncomfortable.

Case B: If the driver takes his/her foot off the accelerator pedal late, the predefined recuperation would not be enough to slow the driver's own vehicle down to the speed of the vehicle in front. The driver must respond actively with a brake intervention. Depending on the deceleration, energy is recovered more heavily through regenerative braking and the kinetic energy is not completely lost. This is nevertheless uncomfortable for the driver.

Situation example with adaptive recuperation

Same initial situation: The driver drives towards a vehicle in front which is travelling at a lower speed.



G05 PHEV, recuperation strategy with adaptive recuperation

Index	Explanation
A	Case A
B	Case B
1	Speed of own vehicle
2	Speed of vehicle travelling in front
3	Included nominal distance
4	Traction
5	Coasting
6	Adaptive recuperation

Case A: If the driver takes his/her foot off the accelerator pedal too early, adaptive recuperation uses the still sufficient distance for coasting. Only as the distance decreases is the vehicle automatically decelerated by recuperation to the speed of the vehicle in front. The extent of energy recovery is adapted to suit the situation in the process. A speed-dependent nominal distance is included during the control operation.

Case B: If the driver takes his/her foot off the accelerator pedal late, adaptive recuperation prevents coasting and immediately starts with recuperation. Recuperation is increased compared with case A to achieve a sufficient deceleration.

Adaptive recuperation permanently evaluates the current driving situation. If the driving situation changes during the control operation, the changed situation is evaluated and the control operation resumed accordingly.

Example: The driver's own vehicle slows down to the speed of the vehicle in front, but the vehicle in front now changes lane. If the driver's own lane is free or a new vehicle in front is travelling faster than the driver's vehicle, the system switches to coasting. If the driver's own lane is occupied by a new, slower vehicle in front, the vehicle is in turn slowed to the slower vehicle's speed.

The same happens when traffic lights are just changing or traffic cuts into the driver's own lane.

On tight bends the radius is used to calculate a bend entry speed to which the vehicle can be specifically decelerated. In this way, for tighter bends a lower bend entry speed can be calculated and recuperation can be higher.

During recuperation to speed limits ahead the target speed is calculated with a tolerance value of approx. +6 mph. The situation may thus arise where the vehicle arrives 6 mph faster at the requested speed limit.

If the vehicle has not yet reached the prescribed speed at the requested point, recuperation continues until the vehicle attains the requested speed.

Pressing the brake or accelerator pedal deactivates adaptive recuperation.

Adaptive recuperation facilitates energy-optimized and comfortable deceleration by coasting recuperation. There is no automatic braking for obstacles by the function. The driver is responsible for adhering to the speed and the requested minimum distance.

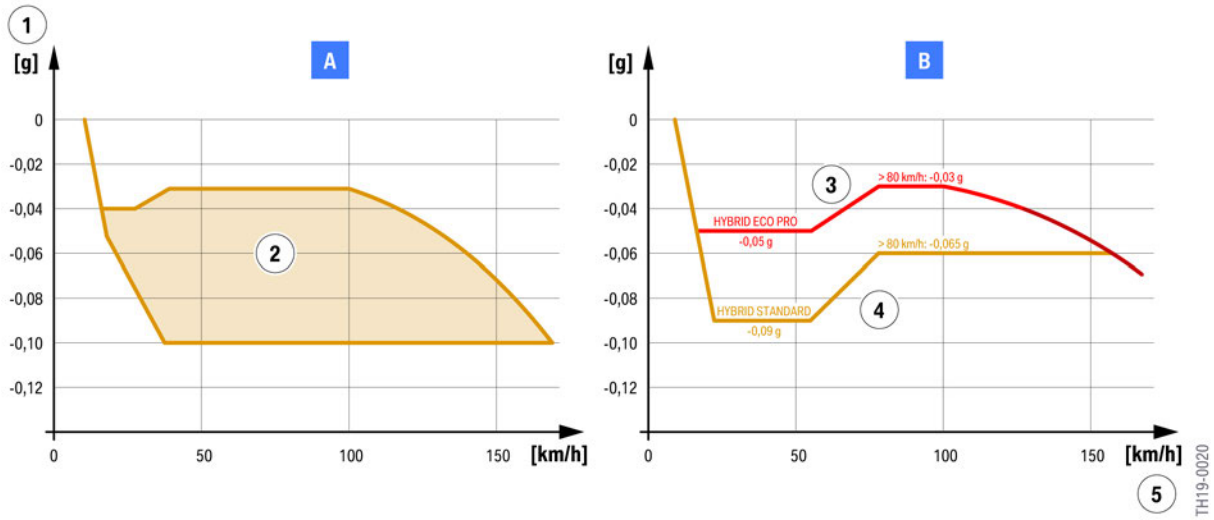
Route guidance

Adaptive recuperation uses the data and calculations of the route-ahead assistant. In this way, adaptive recuperation can be used by the navigation system when route guidance is both active and not being used. When the route guidance is not active, the most likely route is used for evaluation. However, the stretch of road can be calculated more accurately, and therefore more efficiently, when the route guidance is active.

G05 PHEV Complete Vehicle.
10. Operating Strategy.

Decelerations

The following diagram shows the extent of recuperation with and without adaptive recuperation depending on the speed. The brake lights are not activated automatically during recuperation.



G05 PHEV comparison of deceleration with and without adaptive recuperation

Index	Explanation
A	Vehicle with adaptive recuperation (example: G05 PHEV)
B	Vehicle without adaptive recuperation (example: G12 LCI PHEV)
1	Deceleration by recuperation
2	Control range of adaptive recuperation
3	Control of recuperation in HYBRID ECO PRO driving mode
4	Control of recuperation in HYBRID STANDARD driving mode
5	Vehicle speed

To illustrate this: -0.1 g corresponds to a speed reduction of approx. 2 mph (0.981 m/s^2) per second.

Deceleration to a standstill does not happen since in the low speed range the vehicle is driven via the automatic transmission (creeping).

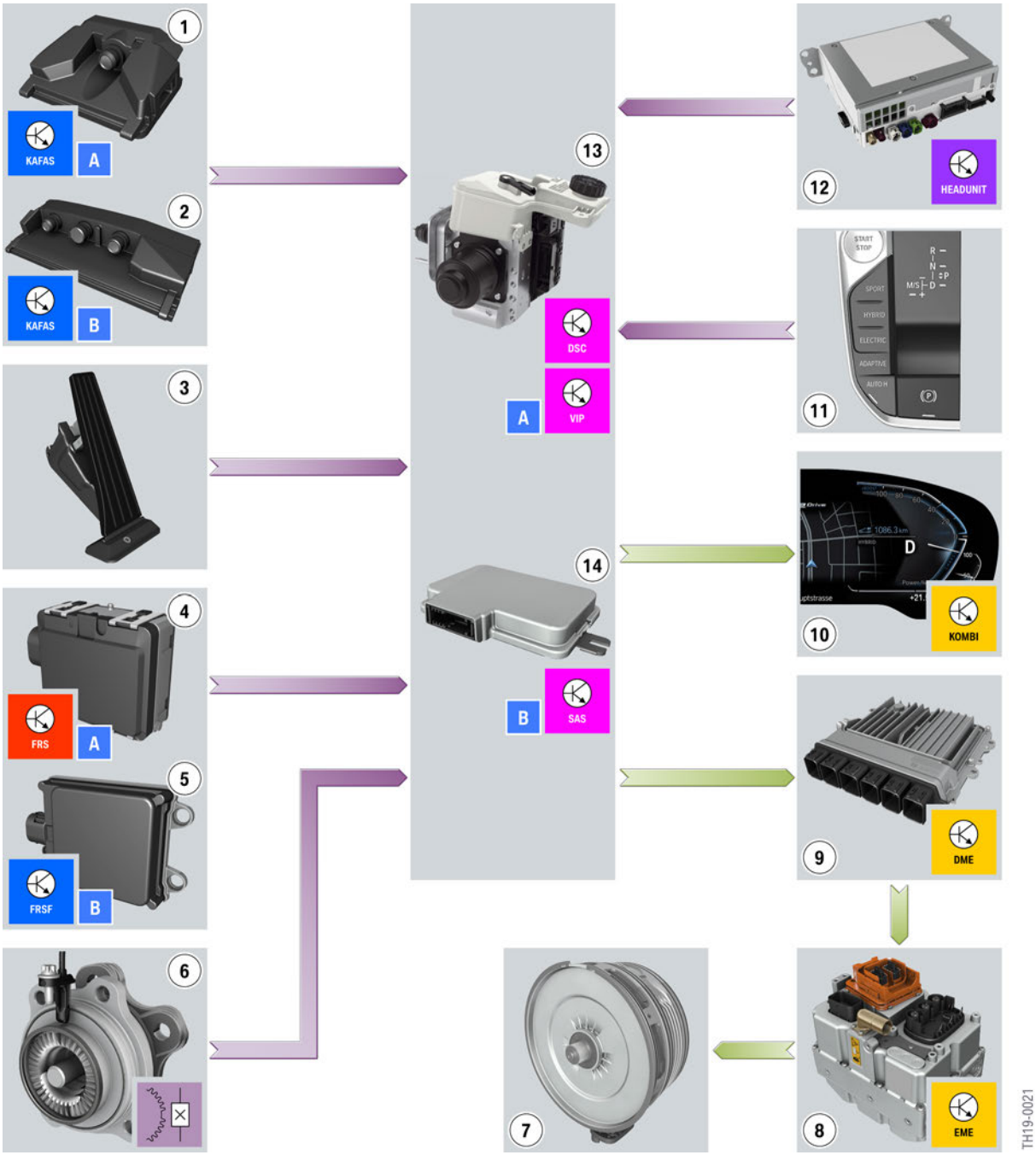
G05 PHEV Complete Vehicle.

10. Operating Strategy.

10.1.3. System components

The front radar sensor (FRS) or the front radar sensor long range (FRSF) is needed to reliably detect the vehicles in front.

Adaptive recuperation can be implemented on different control units. Depending on the equipment specification, the function is integrated in the optional equipment system SAS control unit (with Driving Assistant Professional, SA 5AU) or in the DSCi control unit (with Active Guard Plus, SA 5AQ).



G05 input/output, adaptive recuperation

Index	Explanation
A	Used in vehicles **without** the optional equipment Driving Assistant Professional (OE 5AU)
B	Used in vehicles **with** the optional equipment Driving Assistant Professional (OE 5AU)
1	KAFAS-Mid-Camera
2	KAFAS-High-Camera
3	Accelerator pedal
4	Front radar sensor (FRS)
5	Front radar sensor long range (FRSF)
6	Wheel speed sensors
7	Electrical machine
8	Electrical machine electronics (EME)
9	Digital Motor Electronics (DME)
10	Instrument cluster (KOMBI)
11	Driving Experience Control (FES)
12	Head Unit High 3
13	Dynamic Stability Control integrated (DSCi)
14	Optional equipment system (SAS)

Operation of the brake pedal is recorded and processed directly by the DSCi unit.

The Digital Motor Electronics (DME) assumes the central coordination between the setpoint torque specifications which are output by the different control units. The higher torque request is then forwarded to the EME for implementation. The DME also stores the driving modes in which the function is available and not available.

10.1.4. Displays and operation

The function does not have any separate display or operating elements. The function is only available in the HYBRID ECO PRO driving mode. The function cannot be deactivated.

Recuperation is displayed as usual in the instrument cluster below the drive-ready state indicator (CHARGE area). Adaptive recuperation is currently not depicted separately.

Adaptive recuperation is deactivated as soon as a cruise control or distance control function of an assistance system is active (DCC, ACC Stop&Go or Speed Limit Assist).

Nominal distance

The nominal distance included by the system to vehicles travelling in front is generously calculated and can be influenced by the driver. To this end the accelerator pedal must be held constant at the desired distance and approaching the same speed of the vehicle in front for approx. 1 second. The function stores the contemplated distance for the duration of the journey. The value is deleted when the system switches to the "Park" vehicle condition.

The nominal distance included by adaptive recuperation does not necessarily correspond to the minimum distance required by law. The driver is responsible for maintaining the required minimum distance.

Deactivation criteria

Adaptive recuperation is prevented under the following conditions:

- When the brake pedal is pressed
- When the accelerator pedal is pressed
- During coasting
- After the target speed is reached
- With active cruise or longitudinal control
- When the driving mode is changed
- In event of system faults in the components involved

10.1.5. US version

Adaptive recuperation is subject to the following changes in US vehicles:

- **Adaptive recuperation not adapted to the stretch of road**
  Currently adaptive recuperation is only performed when vehicles in front are detected. Implementation of an adaptation to the stretch of road is under review.
- **Availability in a number of driving modes**
  Unlike in European vehicles, adaptive recuperation is available in all driving modes in US vehicles. To be able to use adaptive recuperation in the SPORT driving mode as well, it is necessary to select SPORT INDIVIDUAL and set “COMFORT” at the engine setting.
- **Deactivation possible**
  Adaptive recuperation can be deactivated via iDrive.

10.2. Anticipatory hybrid drive

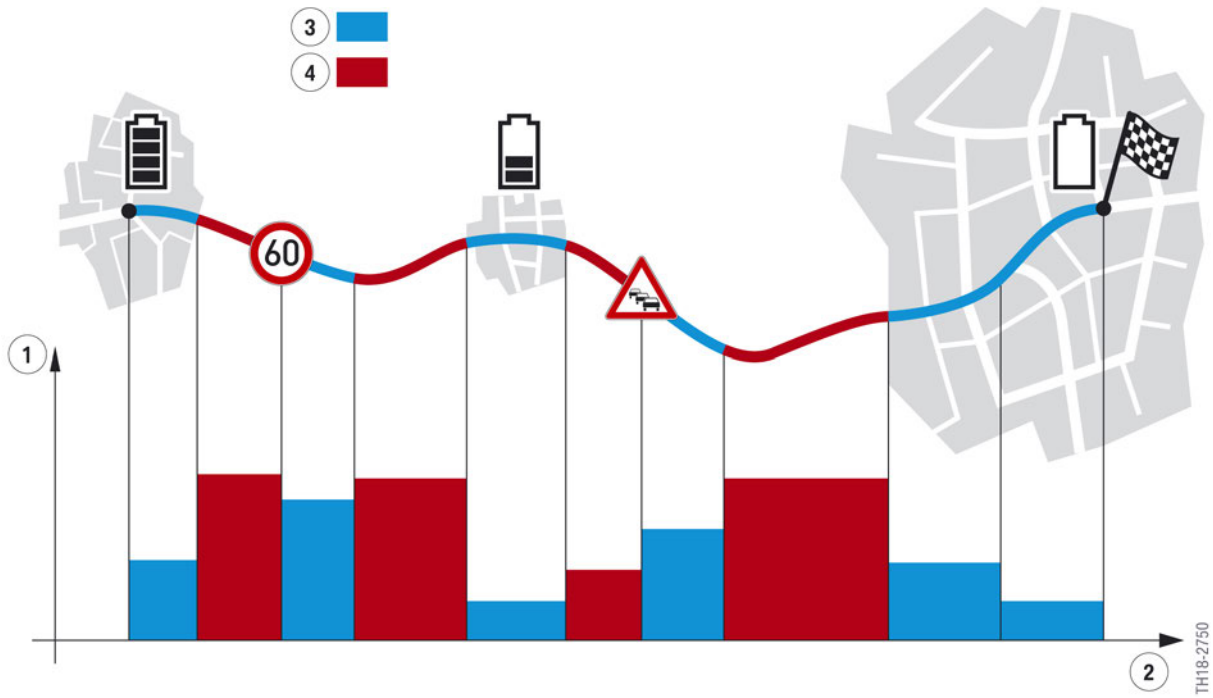
The anticipatory hybrid drive has been revised and enhanced with the G05 PHEV. The driver can find this function under "Anticipatory hybrid drive" in the vehicle literature and the vehicle's integrated operating instructions.

Here, with active route guidance by the navigation system the route is analyzed and the operating strategy adapted to the stretch of road. The navigation and traffic data of the individual distances permit a calculation of the power required to cover these distances.

G05 PHEV Complete Vehicle.

10. Operating Strategy.

Based on these power forecasts and the state of charge of the high-voltage battery unit, a decision is made on whether the combustion engine or the electric motor is used for this distance. The aim is to reserve the electrical energy for the destination zone, the urban environment and further stretches in which the vehicle is driven at a lower speed. If necessary, the high-voltage battery unit must be actively charged beforehand (load point increase) for this purpose.



G05 PHEV, anticipatory hybrid drive

Index	Explanation
1	Power forecast for the respective distance
2	Distance travelled
3	Use of the electric drive
4	Use of the combustion engine

Anticipatory use of the electrical energy can reduce consumption and also enhance the experience of electric driving for the driver. The combustion engine is stored where the driver expects and also senses it (at low speeds with a low noise level, e.g. in towns).

New features:

- Extension of the slow-driving zone
  The classification of a slow-driving zone necessary for the function has been extended to entire towns. In this way, the electrical energy is reserved for electric driving in urban environments. Previously, only individual stretches were taken into account with up to approx. 18 mph.

- More intelligent distribution of electrical energy
  Reserving the electrical energy for stretches in which the vehicle is driven more slowly (e.g. for speed limits, in traffic jams, in roadworks areas) is now possible in a number of driving modes. Previously, this was only possible in the ECO PRO driving mode.

The following requirements must be fulfilled for the function of the anticipatory hybrid drive:

- Route guidance activated in the navigation system
- HYBRID STANDARD, HYBRID ECO PRO or ADAPTIVE driving mode used.

The anticipatory hybrid drive is not available in the ELECTRIC driving mode and when BATTERY CONTROL is used. Anticipatory recuperation is only possible on downhill gradients in the SPORT driving mode or the manual sport gutter.

The following table once again provides a summary of the functionality depending on the respective driving mode.

Functionality	SPORT	ADAPTIVE	HYBRID STANDARD	HYBRID ECO PRO
Electric destination zone	–	●	●	●
Electric passage through urban area	–	●	●	●
Full recuperation on downhill gradient	●	●	●	●
Intelligent, traffic-related energy distribution	–	●	●	●

The anticipatory hybrid drive appears in the energy flow display of the CID. A relevant screen with note is displayed when a corresponding situation occurs or in the course of preparation for such a situation.

G05 PHEV anticipatory hybrid drive display, example: Preparation for electric driving in destination area