FUB-FUB-FB-630003-K13 LED headlight

VIN:	Vehicle: 5' / F10 / Sedan / M5 / S63 / EUR / right-hand drive / MANUAL / 2013 / 7
System version: 1.1.4	Data version: 3.39

LED headlight

The LED headlights are used for exterior lighting.
LEDs are construction components made from semiconductors. In the LED, the energy from the electrical current is converted into light energy. As the individual LEDs emit a smaller quantity of light than incandescent bulbs or xenon bulbs, several LEDs are usually bundled and interconnected in so-called LED modules.
The advantages of LEDs are:

- Long service life
- High efficiency
- Mechanical robustness
- Adaptation of light colour
- Option of dimming

Depending on the national-market version and vehicle equipment, the light for the following lighting functions will be generated with the LED headlight:

- Parking light
- Side marker light
- Side lights
- Daytime driving lights
- Driving light
- High-beam headlight and headlight flasher
- Turn indicator
- Hazard warning flashers
- Cornering light
- Adaptive Headlights
- Variable light distribution

Brief component description

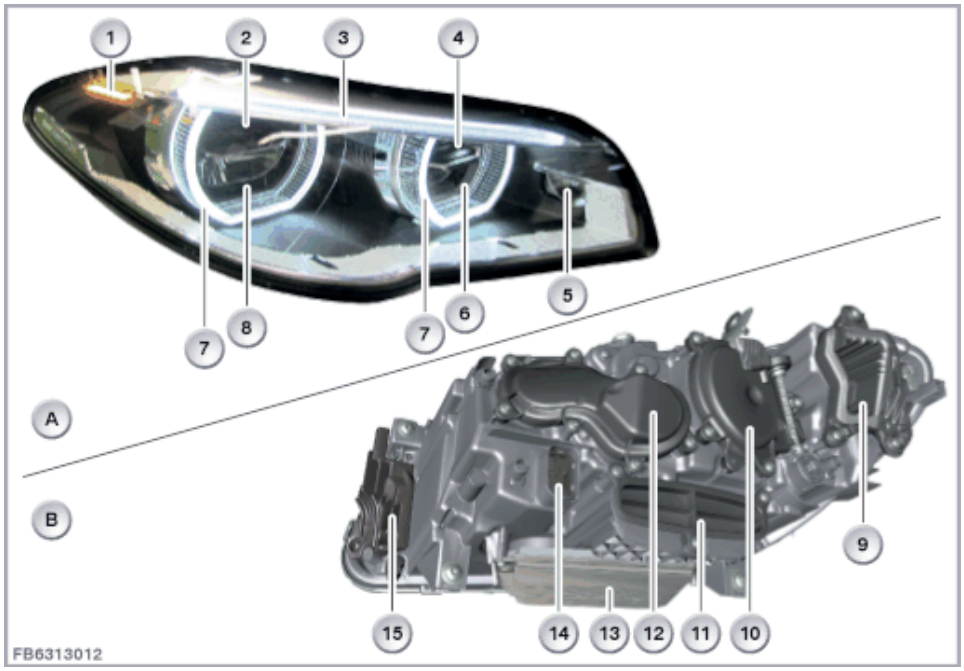
Components can vary depending on the vehicle-specifics and equipment-specifics. In this way, the Body Domain Controller (BDC) replaces the footwell module (FRM) and the junction box electronics (JBE) in F15 for example.
The following components for controlling the LED headlights are described:

- LED headlight
- LED main light module
- Headlight driver module
- Car Access System
- Junction Box Electronics
- Footwell module
- Central gateway module
- Integrated chassis management
- Crash safety module
- Controller
- Steering column switch cluster
- Rain-light-solar-condensation sensor
- Camera-based driver support systems

- High-beam assistant
- Operating facility for light
- Turn signal/high beam switch
- Hazard warning switch

LED headlight

The footwell module (FRM) or the Body Domain Controller (BDC) is the master control unit for the exterior lights. That means: All lighting functions are controlled by the footwell module (FRM) or the Body Domain Controller (BDC).
Depending on the selected lighting function, the corresponding components are either activated directly by the control unit (FRM or BDC) or at the request of the corresponding control unit (FRM or BDC) via the headlight driver module and the LED main light module.
Depending on the light function, multiple LEDs are usually bundled and switched together in so-called LED modules.
Both reflectors in the LED headlight can be pivoted horizontally. Only the outer reflector is vertically pivotable as well.
The following graphic shows the right LED headlight using the example of F10.



Item	Explanation	Item	Explanation
A	LED headlight, right - General view from front	B	LED headlight, right - General view from rear
1	Side-marker light	2	External reflector for the low-beam headlight
3	Positioning light and turn indicator	4	Internal reflector for the low-beam headlight
5	Cornering light	6	Internal reflector for the high-beam headlight (for broad range illumination)
7	Lighting ring for parking lights, side lights and daytime driving lights	8	Exterior reflector for the high-beam headlight (partial high-beam headlight, vertical light/dark boundary)
9	LED module for turn indicator and positioning light	10	Outer fan cover
11	Right headlight driver module (STMR)	12	Inner fan cover

13	LED main headlight module on the right (LHMR)	14	12-pin plug connection
15	Cornering light with heat sink		

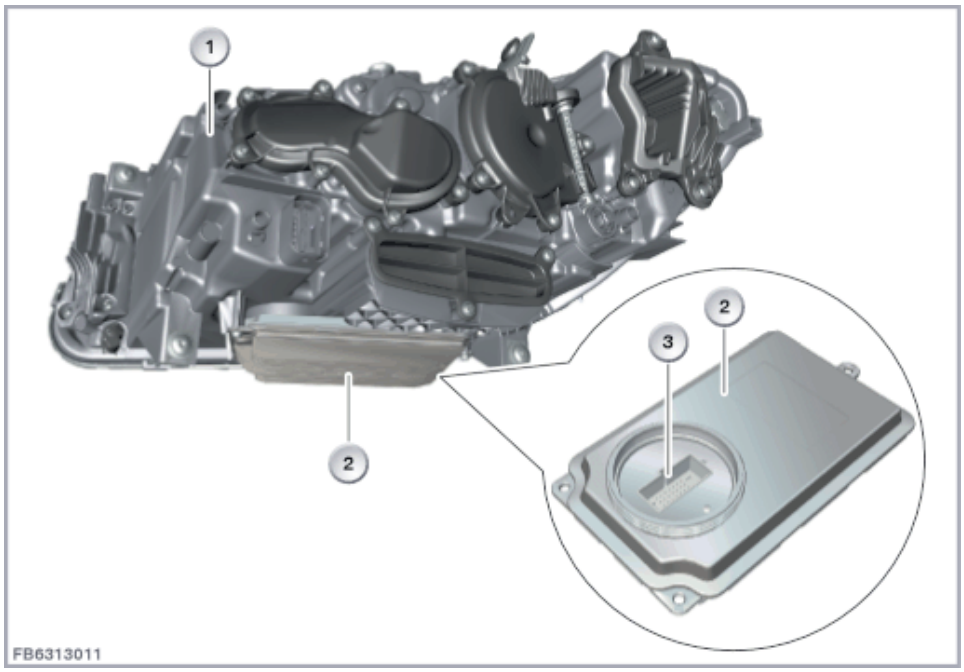
A headlight consists of 4 reflectors, two upper for the low-beam headlights and two lower for the high-beam headlights. Two reflectors on top of each other (one reflector each for the low-beam headlight and for the high-beam headlight) constitute one unit each.The interior and exterior units have different light distributions.
The external unit is swivelled in and out with the adaptive headlight stepper motor around the vertical axis. Both units are fitted in one frame (also known as: Swivel module), which is swivelled up and down by the stepper motor for the headlight beam throw adjustment.
The LED is activated by the interconnected modules, which assume the necessary constant voltage control for the LEDs. One main LED light module (LHM) and one headlight driver module are used. The headlight driver module also activates the stepper motors. The footwell module (FRM) or the Body Domain Controller (BDC) issues the request on the LIN bus.

LHML and LHMR: LED main light module on the left and LED main headlight module on the right

At the request of the footwell module (FRM) or the Body Domain Controller (BDC), the LED main light module activates the following lighting functions for example:

- Low-beam headlights
- Cornering light
- High-beam headlight
- Headlight flasher

The LED main light module also regulates the temperature control in the LED headlight. The values of several temperature sensors in the LED headlight, as well as the signals relating to driving speed and ambient temperature messages communicated via the bus serve as input signals.
The fans are controlled depending on requirements. After the lighting functions and terminal 15 are switched off an after-run of the fans until rest state of the LED main light module is possible to prevent the LED headlight from thawing.
In the event of a temperature sensor malfunction, the fans are switched on at full blast to protect the components in the LED headlight.
The following graphic shows the LED main headlight module on the right (LHMR) using the example F10.



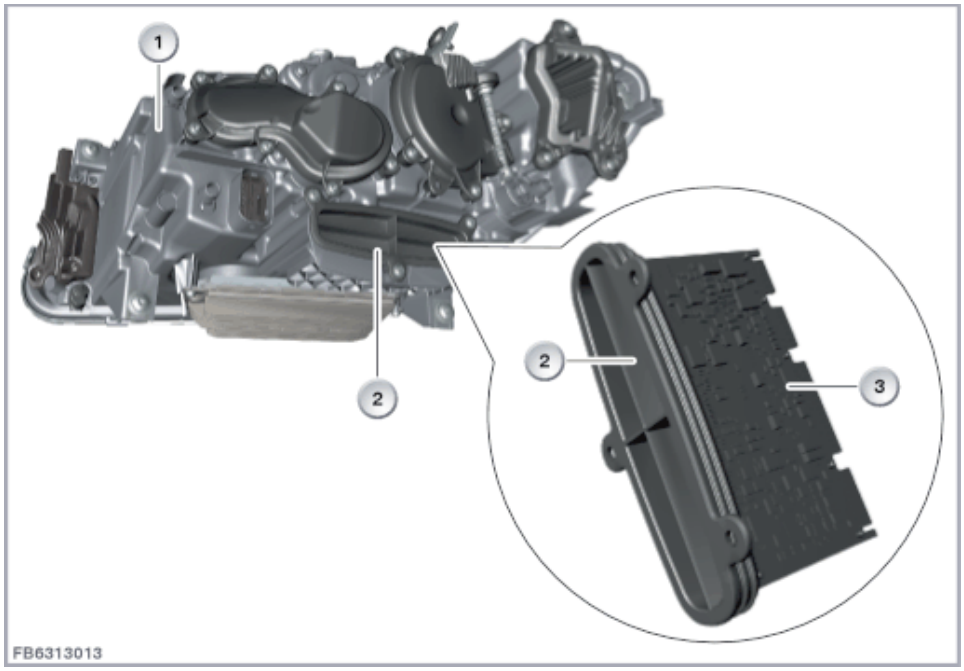
Item	Explanation	Item	Explanation
1	Right headlight, general view from rear	2	LED main headlight module on the right (LHMR)
3	32-pin plug connection		

STML and STMR: Left headlight driver module and right headlight driver module

The headlight driver module is fitted as a printed circuit board in the LED headlight. The headlight driver module analyses the signals transmitted by the footwell module (FRM) or the Body Domain Controller (BDC). In this process, the headlight driver module assumes control of the following lighting functions of the LED headlight:

- Side lights
- Daytime driving lights
- Side marker light
- Turn indicator
- Positioning light

Besides the lighting functions, the headlight driver module also controls the stepper motors for headlight beam throw adjustment and for the adaptive headlight. The footwell module (FRM) or the Body Domain Controller (BDC) issues the request as a message to the LIN bus.
The following graphic shows the right headlight driver module (STMR) using the example F10.



Item	Explanation	Item	Explanation
1	Right headlight, general view from rear	2	Right headlight driver module (STMR)
3	Printed circuit board		

CAS: Car Access System

The Car Access System (CAS) controls access into the vehicle (central locking system) and access to vehicle functions (e.g. key identification, electronic immobiliser, engine start release).
The CAS control unit is the master control unit. It is therefore the CAS control unit that issues the release.

JBE: Junction Box Electronics

The junction box electronics (JBE) module combines many functions that are made available to the other bus users.
The junction box electronics (JBE) module requests the status of the ambient brightness from the rain-light-solar-condensation sensor via the LIN bus. The junction box electronics (JBE) transmits status as a message to the data bus. The footwell module (FRM) assesses the status of the ambient brightness.

FRM: Footwell module

All functions of the exterior lights are controlled by the footwell module (FRM).

The footwell module receives many input signals that lead to the switching on of the LED headlight. The footwell module forms the interface to the instrument cluster (KOMBI). It enables communication between the bus system and thereby the message transmission to the respective other data bus.

ZGM: Central gateway module

The central gateway module (ZGM) links all of the data buses. The central gateway module's gateway function enables data exchanges amongst the various bus systems. Stored system functions can be called up using appropriate commands.

BDC Body Domain Controller

The Body Domain Controller (BDC) represents a new generation superseding existing control units and their functions. The body domain controller (BDC) is the central control unit in the vehicle electrical system. At the same time, the body domain controller (BDC) is the gateway for the other control units. The body domain controller (BDC) makes available functions from the previous control units footwell module (FRM), Car Access System (CAS), Junction Box Electronics (JBE) and central gateway module (ZGM). The central gateway module (ZGM) is an independent module in the Body Domain Controller (BDC).
The Body Domain Controller (BDC) as the master control unit is responsible for the exterior lights functions. The Body Domain Controller (BDC) decides which light functions are to be activated or deactivated. For many functions, information from sensors, contacts and switches is required. The Body Domain Controller (BDC) receives the signals from the components and transmits the corresponding information to the bus users.

ICM: Integrated chassis management

Data from ride height sensors at the front and rear axle is directly evaluated by the Integrated Chassis Management (ICM). The automatic headlight beam throw adjustment thus ensures that oncoming traffic is not dazzled. In addition to the sensors, which are there for driving dynamics control, the Integrated Chassis Management includes a longitudinal and a lateral acceleration sensor for impact detection. Two wires provide a direct connection between the Integrated Chassis Management and the Crash Safety Module (ACSM) for transmission of the sensor signals.
The footwell module (FRM) receives the signals from the Integrated Chassis Management (ICM) via the CAN bus. The signal is transferred from FlexRay to the CAN bus in the central gateway module (ZGM).
The Body Domain Controller (BDC) receives the signals from the Integrated Chassis Management (ICM) as a message via the LIN bus.

ACSM: Crash safety module

The Crash Safety Module (ACSM) is the control unit for the passive safety system. The Crash Safety Module (ACSM) evaluates the longitudinal acceleration and lateral acceleration of all the involved sensors.Comprehensive tests were used to define triggering thresholds for all possible types of accident. The Crash Safety Module (ACSM) transmits a message to other bus users when the restraint systems are triggered. Depending on the accident severity to be expected, each of the control units performs certain functions, such as switching on the hazard warning flasher using the footwell module (FRM) or the Body Domain Controller (BDC).

CON: Controller

The controller (CON) is connected to the central information display (CID) via the data bus. The central information display serves to display the vehicle functions that can be selected and configured.
The following functions of the LED headlights can e.g., depending on the options fitted, be set using the controller (CON) in the Central Information Display (CID):

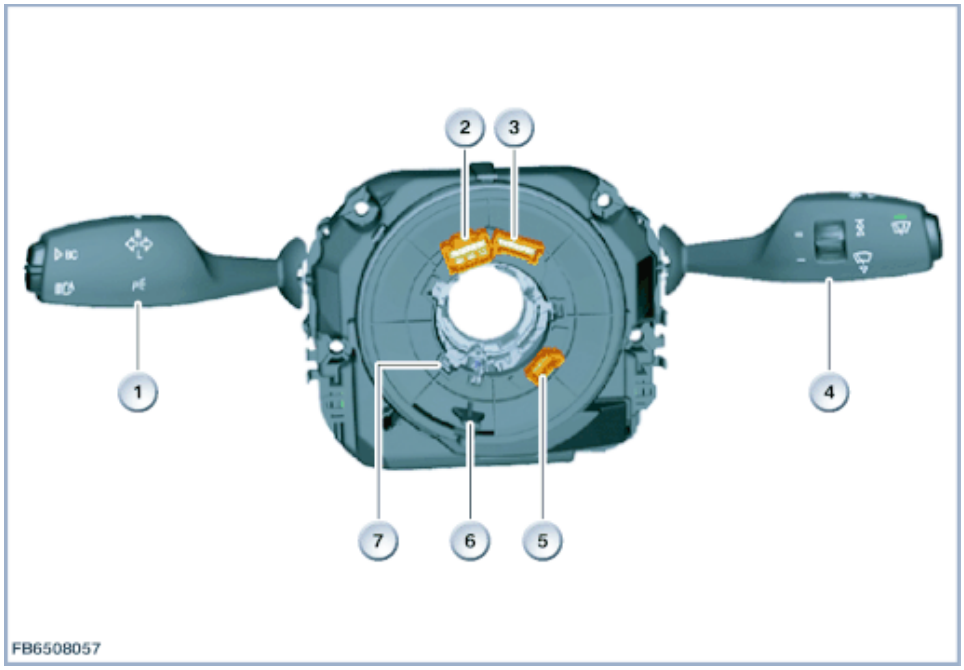
- Daytime driving lights
- Headlight courtesy delay feature
- Visual acknowledgement of central locking system
- Welcome lights
- One-touch flashing

SZL: Steering column switch cluster

Depending on the series, the steering column switch cluster is a control unit (e.g. F10) or is no longer a control unit (e.g. F15). The steering column switch cluster features one steering column switch each on the left and right sides. The right-hand steering column switch is designed for operating the functions of the wash/wipe system. The steering column switch on the left side of the steering column controls the high-beam headlight and turn indicators as well as operation of the on-board computer.
The signals are made available by the steering column switch cluster via the FlexRay or the LIN bus.

The steering column switch cluster transmits the following requests to the footwell module (FRM) or the Body Domain Controller (BDC) to control the LED headlight:

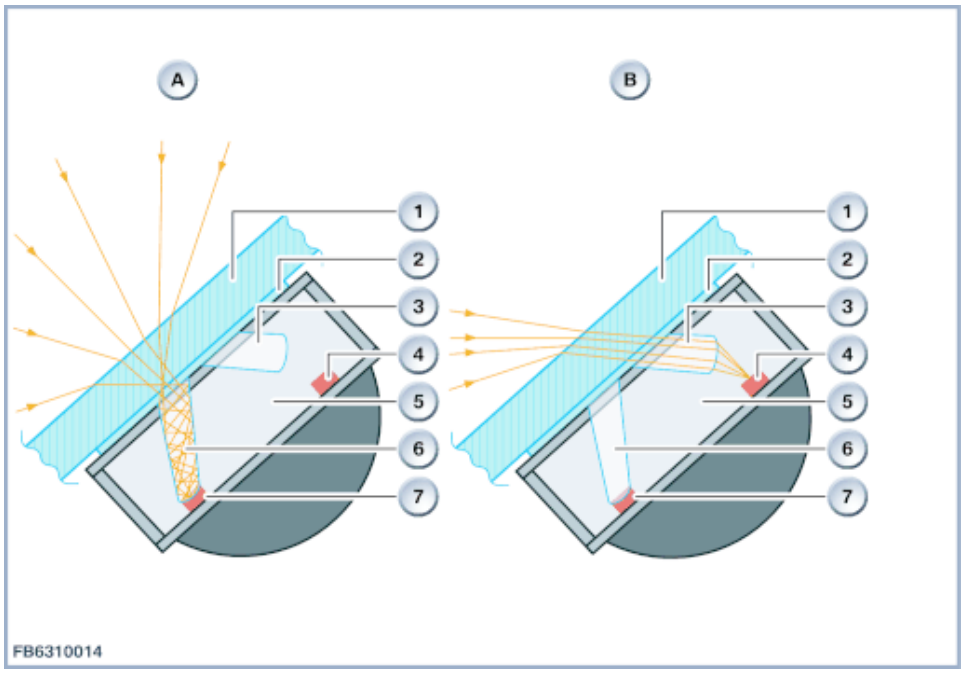
- Turn indicator light
- Parking light
- High-beam headlight
- High-beam assistant
- Headlight flasher



Item	Explanation	Item	Explanation
1	Turn signal/high beam switch	2	Plug connection to the ignition squibs of the airbag
3	Plug connection for horn switch, multifunction buttons and steering wheel module	4	Wash/wipe switch
5	Plug connection, vibration actuator (voltage supply)	6	Driver
7	Stop bolt, steering column switch cluster		

Rain-light-solar-condensation sensor

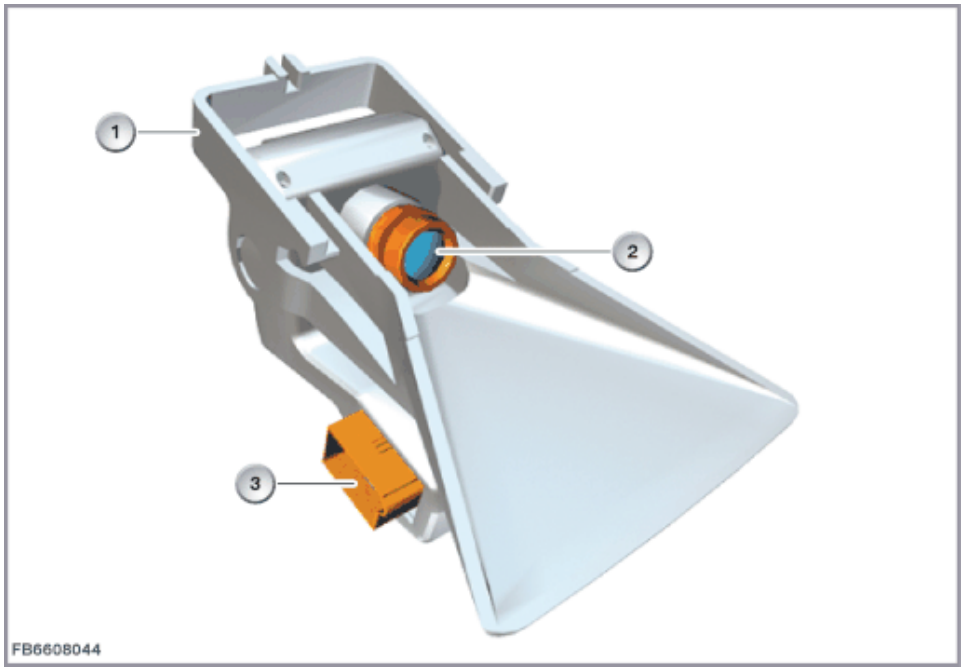
The light sensor detects the ambient brightness and the brightness of the frontal light. The signal is transmitted as a message on the LIN bus to the junction box electronics (JBE) or the Body Domain Controller (BDC).
The junction box electronics (JBE) adopt the signals into the corresponding CAN message and send this in cycles (signal values unchanged) or event-controlled (signal values changed). This provides the footwell module (FRM) with the request to switch the driving lights on or off when the automatic driving lights control is activated.
The 2 light sensors (forward light sensor and ambient light sensor) register ambient brightness and monitor the lighting ahead of the vehicle.



Item	Explanation	Item	Explanation
A	Ambient brightness	B	Forward lighting intensity
1	Windscreen	2	Bonding surface
3	Forward lighting sensor optics	4	Forward lighting sensor receiver diode
5	Rain-light-solar-condensation sensor	6	Ambient light sensor optics
7	Ambient light sensor receiver diode		

KAFAS: Camera-based driver support systems

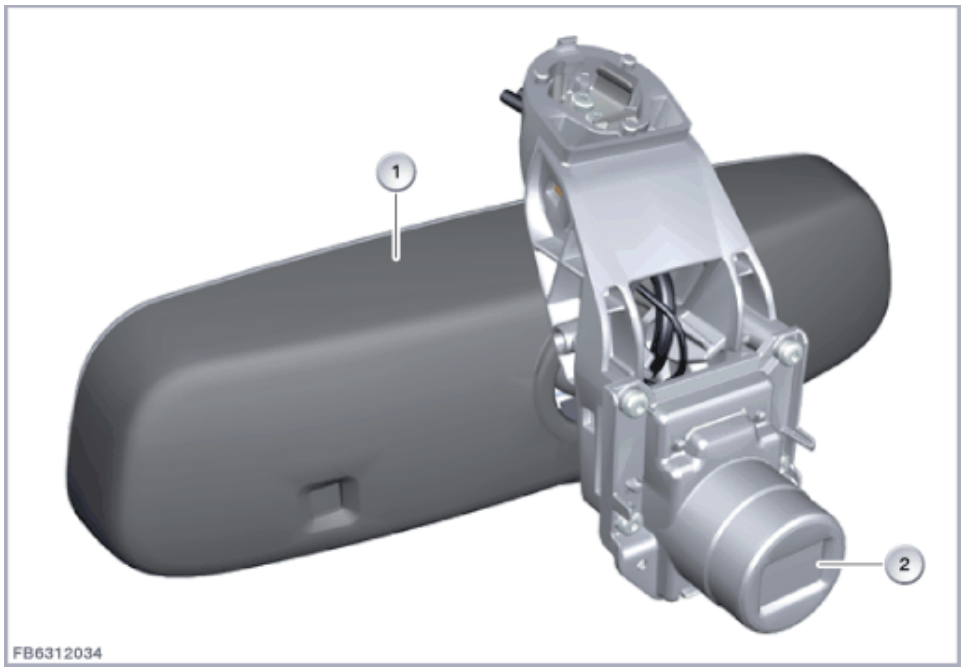
Depending on the options fitted, various camera-based systems are available. The light points, light colours and light intensities picked up by the video camera are evaluated by the KAFAS control unit. The evaluation by the KAFAS control unit results, among other things, in a recommendation to switch on or off the high-beam assistant. Technically, the system is implemented with a joint camera and a joint control unit, the KAFAS control unit.



Item	Explanation	Item	Explanation
1	Camera holder	2	Camera
3	10-pin plug connection		

FLA: High-beam assistant

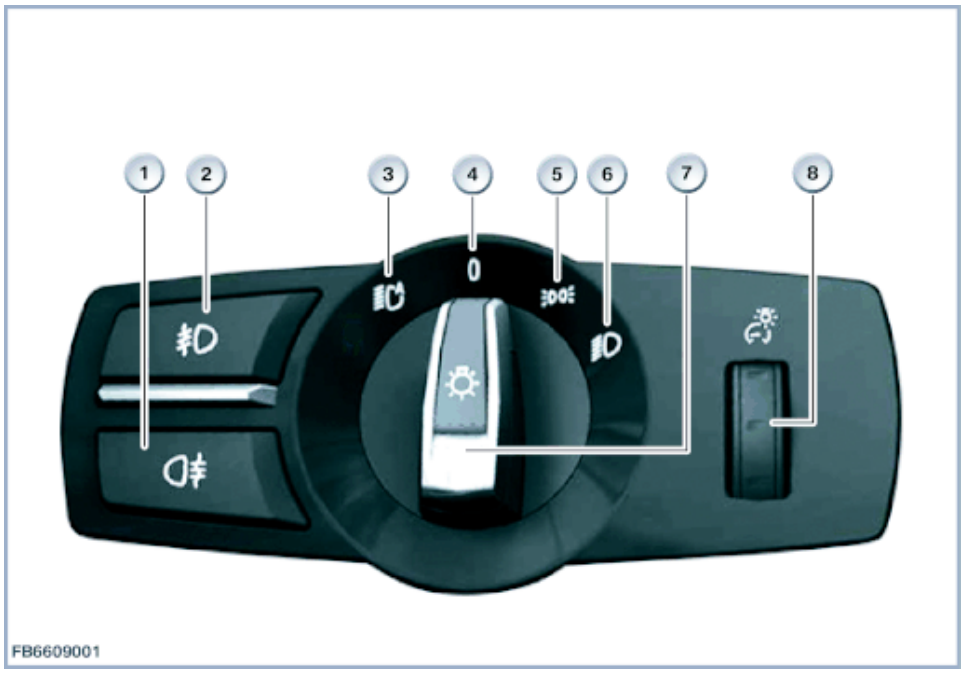
The function high-beam assistant can be activated only when the light switch is in position A. The switch position A stands for automatic driving light control.
The function high-beam assistant assists the driver in operating the high-beam headlights. The high-beam assistant (FLA) automatically switches the high-beam headlight on and off depending on the traffic situation. On the basis of other input values, the footwell module (FRM) or the Body Domain Controller (BDC) decides whether the high-beam headlight should be switched on or switched off.
The high-beam assistant (FLA) relies on an image sensor to recognise preceding and oncoming vehicles as well as built-up areas with continuous street lighting. The image sensor is a special camera for detecting light sources. The image sensor can detect other light sources within a range of about 1000 m. The light cone of the high-beam headlights has a range of about 400 m. This ensures that the image sensor detects oncoming vehicles before their drivers can be dazzled by the light cone of the high-beam headlights. When the image sensor detects an oncoming vehicle, the high-beam assistant (FLA) transmits a recommendation to the footwell module (FRM) or the Body Domain Controller (BDC) to switch off.
The High-Beam Assistant (FLA) is integrated in the inside mirror on a printed circuit board. The image sensor is installed in the mirror base.



Item	Explanation	Item	Explanation
1	Interior mirror	2	Image sensor

Operating facility for light

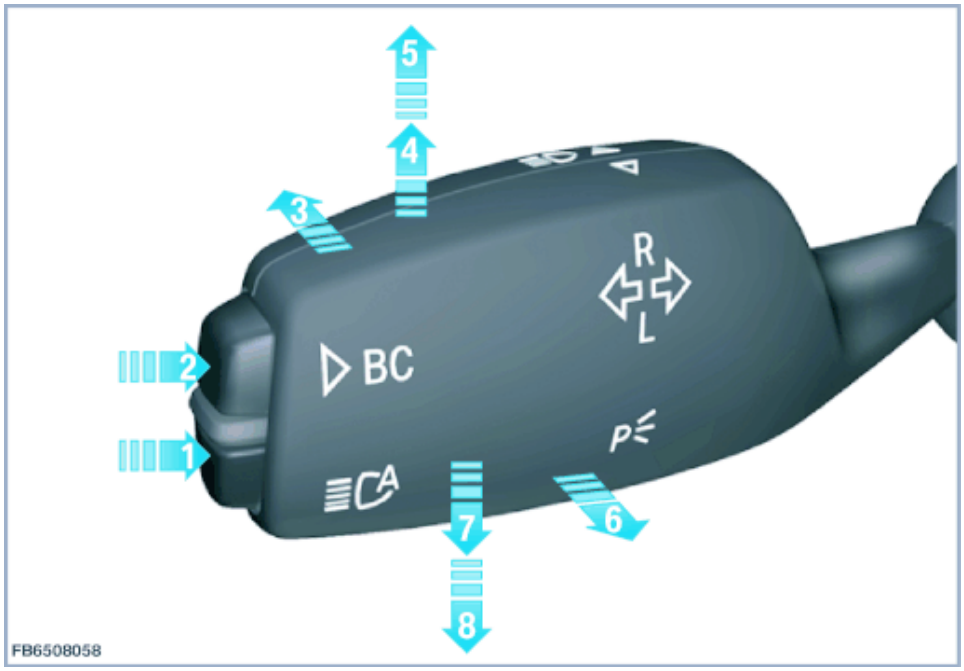
The LED headlights can be switched on and off using the operating facility for lights. The operating facility for lights includes both the light switch and additional components for other lighting functions.



Item	Explanation	Item	Explanation
1	Rear fog light switch (not US version)	2	Front fog light switch
3	Position A for automatic driving lights control (optional equipment)	4	Position 0 for daytime driving lights
5	Position 1 for side lights	6	Position 2 for driving lights
7	Light switch	8	Dimmer for instrument lighting

Turn signal/high beam switch

The turn indicator and the high-beam headlight are operated using the turn signal/high beam switch on the left steering column switch of the steering column switch cluster. The signal from the turn signal/high beam switch is transmitted both via FlexRay protocol and through a separate line to ensure functional redundancy. The central gateway module (ZGM) transmits the signal to the CAN bus. This is how the footwell module (FRM) receives the signals from the turn signal/high beam switch. The turn indicator lights continue to operate if the information fails to reach the footwell module (FRM) through the bus system. This redundant data-transmission is also employed for the one-touch flashing and headlight flasher functions.



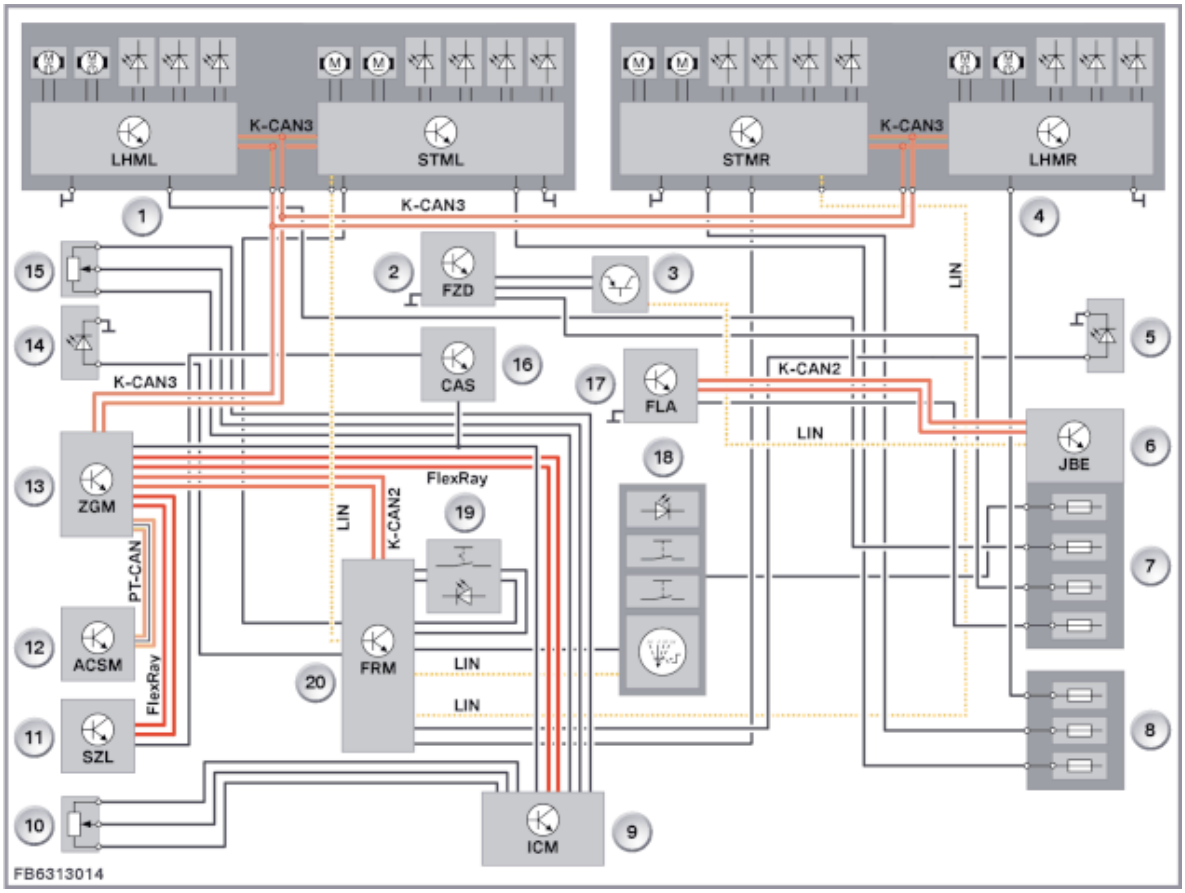
Item	Explanation	Item	Explanation
1	High beam assistant button	2	On-board computer button
3	High-beam headlight	4	One-touch flashing, right
5	Continuous flashing, right	6	Headlight flasher
7	One-touch flashing, left	8	Continuous flashing, left

Hazard warning switch

The hazard warning flashers are activated by pressing the hazard warning switch. All turn indicators are activated simultaneously and the hazard warning switch also flashes.
If the turn signal/high beam switch is pressed in the direction for left or right turns while the hazard warning flashers are operating, the turn indicator light assumes priority.
The system reverts to operation of the hazard warning flashers after Terminal 15 off or when the turn indicator light has returned to its original position. If the hazard warning switch is depressed while the turn indicator lights are operating, then the hazard warning flashers assume priority.
With Terminal 30 on the hazard warning flashers are implemented in their energy-saving mode. In this mode, the hazard warning flashers light up for a shorter period and remain off for a longer period than usual.
When the alarm signal of the alarm system is activated, the hazard warning switch is suppressed and does not flash.

System overview

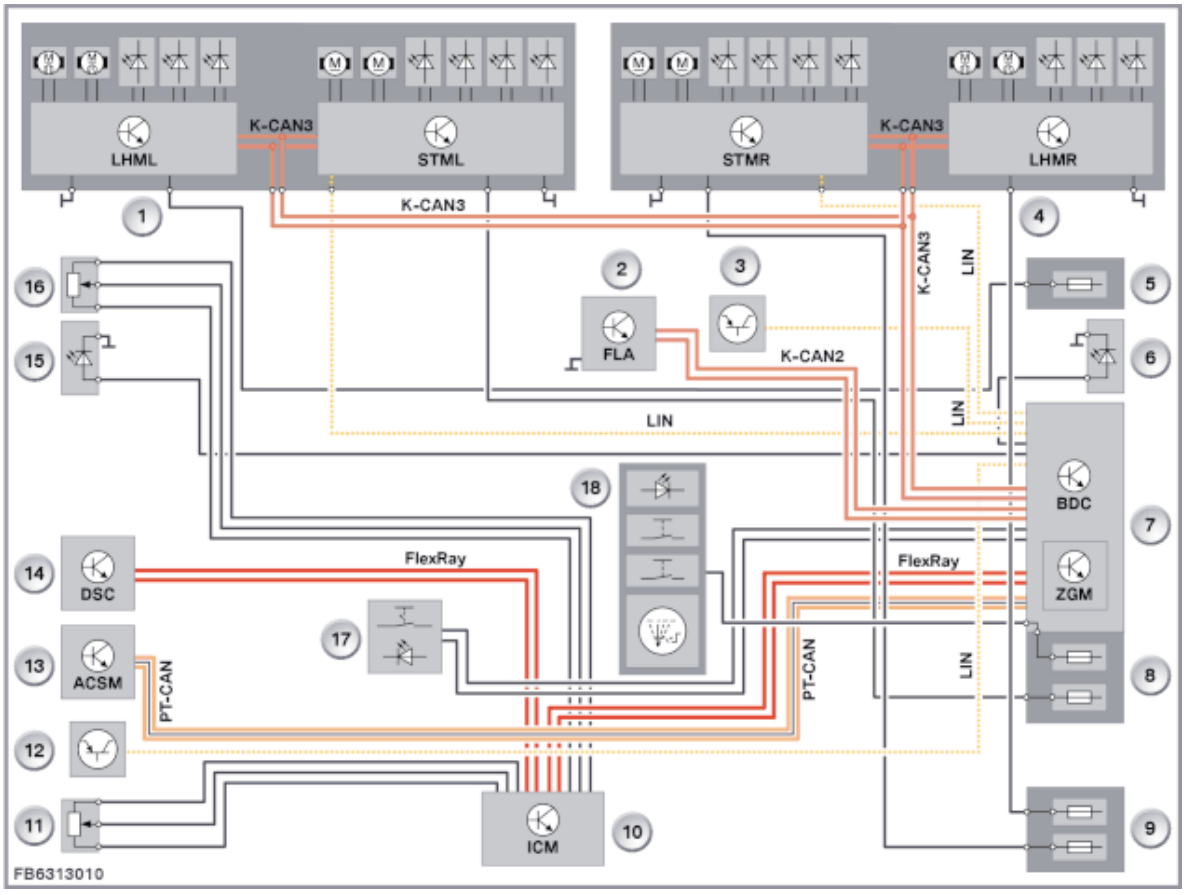
The following graphic shows the system network of the LED headlight using the example of F10.



Item	Explanation	Item	Explanation
1	Left LED headlight, with left-hand headlight driver module (STML) and LED main light module on the left (LHML)	2	Roof function centre (FZD)
3	Rain-light-solar-condensation sensor	4	Right LED headlight, with right headlight driver module (STMR) and

			LED main headlight module on the right (LHMR)
5	Side turn indicator, right	6	Junction Box Electronics (JBE)
7	Power distributor in junction box	8	Power distribution box, rear
9	Integrated chassis management (ICM)	10	Ride height sensor, rear
11	Steering column switch centre (SZL)	12	Crash Safety Module (ACSM)
13	Central gateway module (ZGM)	14	Side turn indicator, left
15	Ride height sensor, front	16	Car access system (CAS)
17	High beam assistant (FLA)	18	Operating facility for light
19	Hazard warning switch	20	Footwell module (FRM)

The following graphic shows the system network of the LED headlight using the example of F15.



Item	Explanation	Item	Explanation
1	Left LED headlight, with left-hand headlight driver module (STML) and LED main light module on the left (LHML)	2	High beam assistant (FLA)
3	Rain-light-solar-condensation sensor	4	Right LED headlight, with right headlight driver module (STMR) and LED main headlight module on the right (LHMR)
5	Front fuse and relay module	6	Side turn indicator, right
7		8	

	Body Domain Controller (BDC), central gateway module (ZGM) integrated as independent control unit		Fuses on the Body Domain Controller (BDC)
9	Power distribution box, rear	10	Integrated chassis management (ICM)
11	Ride height sensor, rear	12	Steering column switch cluster
13	Crash Safety Module (ACSM)	14	Dynamic stability control (DSC)
15	Side turn indicator, left	16	Ride height sensor, front
17	Hazard warning switch	18	Operating facility for light

System functions

The following lighting functions are described:

- Parking light
- Side lights/ positioning light and turn indicator
- Side marker lights (depending on national-market version)
- Daytime driving lights
- Low-beam headlights
- High-beam headlight
- Headlight courtesy delay feature
- Welcome lights
- Tourist light
- Automatic headlight beam throw adjustment
- Variable light distribution
- Cornering light
- High-beam assistant
- Automatic driving lights control
- Hazard warning flashers
- Visual feedback signal from central locking system
- Emergency light operation

Parking light

Depending on the national-market version, the following lights are activated when the parking light is switched on in the headlight on the selected side of the vehicle:

- Lighting rings of the side lights
- Positioning light

The steering column switch (turn signal/high beam lever) must be moved upwards or downwards for longer than 0.5 seconds at terminal 30. On request from the footwell module (FRM) or the Body Domain Controller (BDC), the corresponding headlight driver module switches on the parking light in the headlight on the selected side of the vehicle. For the parking light function, the 2 lighting rings and the positioning light in the LED headlight are supplied with a pulse-width-modulated voltage.

Side lights/ positioning light and turn indicator

Depending on the national-market version, the following lights are activated when the side lights are switched on in the LED headlight:

- Lighting rings of the side lights
- Positioning light
- Side marker light (depending on national-market version)
- Taillamp

The positioning lights (LED) are activated by the headlight driver module. The positioning light is also used as a turn indicator. Therefore, the fibre-optic conductor is designed in two colours.

The positioning light will only be switched off while flashing when the daytime driving lights are switched on. Otherwise, the positioning light will remain switched off while flashing.
As soon as the side lights have been switched on, an acoustic signal sounds when the driver's door is open. Additionally, the instrument panel displays a Check Control message. Leaving the side lights on can drain the vehicle's battery.
The front turn indicators can be switched on from terminal R. The turn indicators are operated by the turn signal/high beam switch on the steering column switch cluster (SZL). The signal from the turn signal/high beam switch is transmitted both via FlexRay protocol and through a separate line to ensure functional redundancy. This enhances the availability of the systems in the event of a fault. The turn indicator light remain operational even when the information fails to reach the footwell module (FRM) through the bus system. This redundant data-transmission is also employed for activating the one-touch flashing function. If a turn indicator is faulty, the remaining turn indicators flash twice as quickly. The malfunction is displayed to the driver as a Check Control message in the instrument cluster (KOMBI).
During one-touch flashing the turn indicators are activated once. The number of flashes can be set to once or three times in "Personal Profile". A visual and acoustic indication of turn indicator status is supplied by the instrument panel (KOMBI). The footwell module (FRM) uses the CAN bus to transmit the information to the instrument cluster (KOMBI), which activates the acoustic sensor and the indicator lights simultaneously with the turn indicators. The acoustic signal and visual display in the instrument cluster (KOMBI) are deactivated when the vehicle's central locking system is engaged while the hazard warning flasher function is activated.

Side marker light (depending on national-market version)

The side marker lights (LED) are activated by the headlight driver module. E.g., the side marker light will be illuminated in combination with the side lights.

Daytime driving lights

The daytime driving lights are realised by the positioning lights and the lighting rings in the LED headlight. However, the pulse width modulation is cancelled and the LEDs are supplied directly with full voltage from the vehicle voltage. This makes the daytime driving lights substantially brighter than the side lights.
The light switch must be turned to "Position 0" before the daytime driving lights can be activated. The daytime driving lights can also be activated by the automatic driving lights control when the rain-light-solar-condensation sensor indicates high-intensity ambient brightness. The light switch must be in its "Position A".
On national-market versions with this feature, the daytime driving lights are activated when terminal 15 is switched on. Via "Personal Profile" in the Central Information Display (CID), the daytime driving lights can be activated or deactivated using the controller (CON). The daytime driving lights are switched off at "Terminal 15 off".
Depending on the corresponding local regulations, in some of the national-market versions the daytime driving lights cannot be deactivated via the "Personal Profile".

Low-beam headlights

For the low-beam headlight function, both upper reflectors of the LED headlight are used. Upon request from the footwell module or the Body Domain Controller (BDC), the LED main light module activates the corresponding LED modules.
Switching the low-beam headlight on will reduce the brightness of the daytime driving lights.

High-beam headlight

For the high-beam headlight function, both lower reflectors in the LED headlights are used. Upon request from the footwell module (FRM) or the Body Domain Controller (BDC), the LED main light module activates the corresponding LED modules.

Headlight courtesy delay feature

If the headlight flasher is activated after the vehicle is parked with the lights off, the low-beam headlights light up. The switched-on period for the headlight courtesy delay feature can be adjusted via the iDrive to a maximum of 240 seconds.

Welcome lights

The welcome lights are activated when the vehicle is unlocked (light switch in the ”automatic driving lights control” or ”low-beam headlights” position). The footwell module (FRM) or the Body Domain Controller (BDC) switches on the side lights and the side marker light using the headlight driver module for around 20 seconds. The footwell module (FRM) or the Body Domain Controller (BDC) switches the welcome lights to dim once the shifting time has elapsed.

Tourist light

The tourist light is the dazzle-free low-beam headlight for countries in which one drives on the other side of the road, in comparison to the country of registration. The headlights are slightly rotated to the outside and downward.

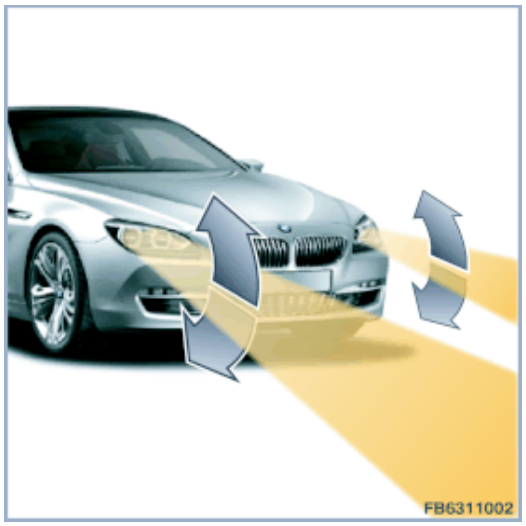
The tourist light function is activated via the central information display.

Automatic headlight beam throw adjustment

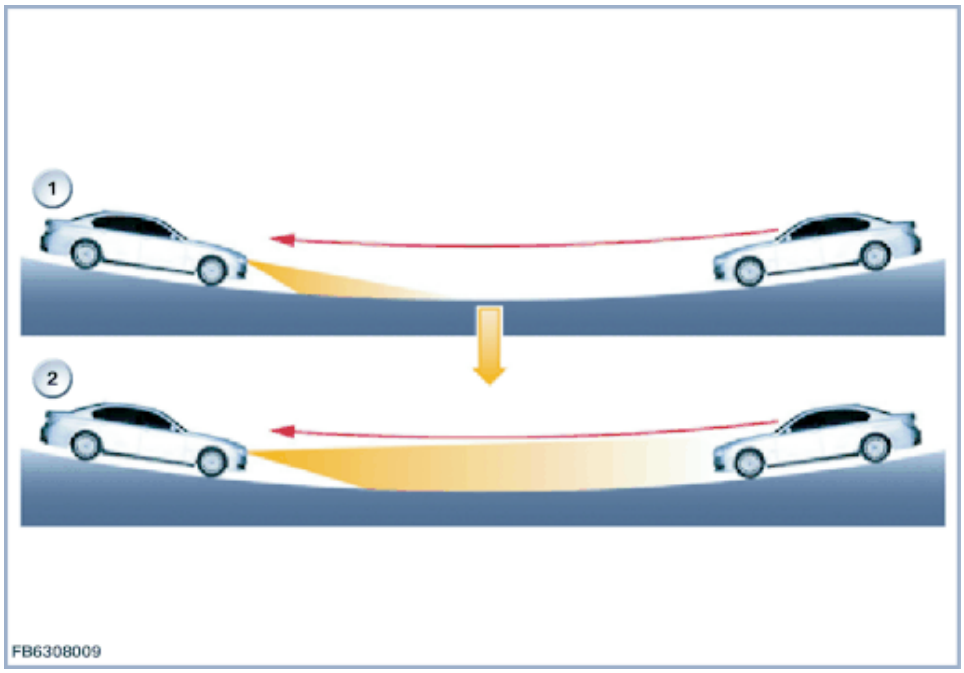
As standard, vehicles with LED headlights have automatic headlight beam throw adjustment to compensate different load statuses of the vehicle. The automatic headlight beam throw adjustment for the LED headlight includes the following functions:

- Dynamic headlight beam throw adjustment
  The dynamic headlight beam throw adjustment was developed for compensating pitching movements that occur as a result of braking and acceleration.
- Adaptive headlight beam throw adjustment
  The adaptive headlight beam throw adjustment uses vehicle information to identify driving over rises or dips. The headlights are turned appropriately. The automatic headlight beam throw adjustment thus ensures that oncoming traffic is not dazzled.

The automatic headlight beam throw adjustment is supported by 2 ride height sensors. one ride height sensor each located on the front axle and the rear axle of the vehicle. Data from ride height sensors are evaluated directly by the Integrated Chassis Management (ICM).
The footwell module (FRM) receives the signals from the Integrated Chassis Management (ICM) via the CAN bus. The Integrated Chassis Management issues the signal as a message on the FlexRay. The signal is transferred by the FlexRay on the CAN bus in the central gateway module (ZGM).
The Body Domain Controller (BDC) receives the signals from the Integrated Chassis Management (ICM) via the LIN bus.
The following graphic shows the light cone's primary motion patterns during operation of the automatic headlight beam throw adjustment.

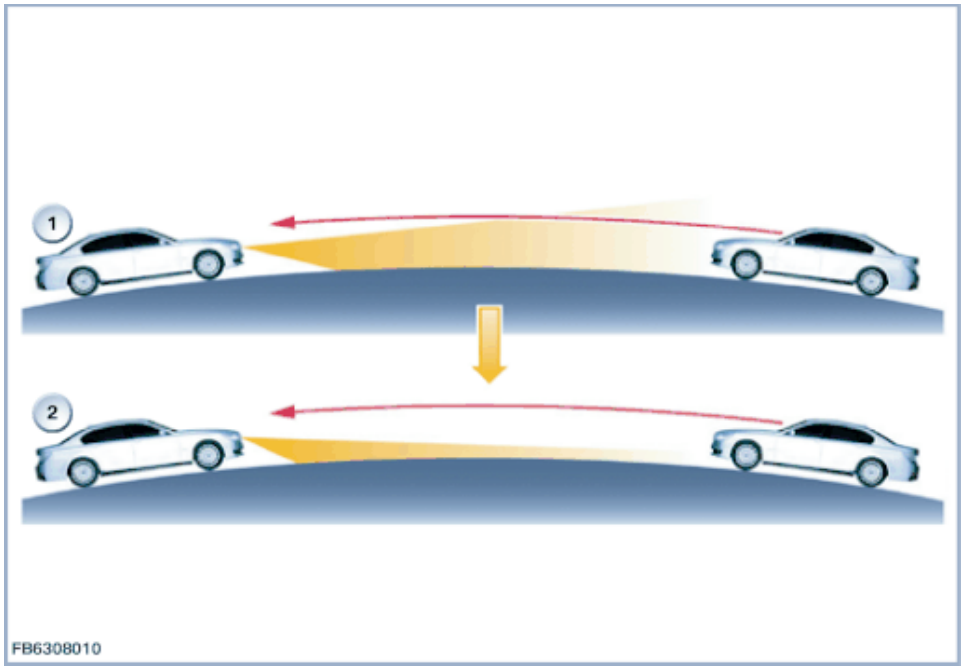


The adaptive headlight beam throw adjustment is employed when driving through dips and over crests. Depending on the request from the footwell module (FRM) or the Body Domain Controller (BDC), the headlight driver module controls the swivel module using the stepper motors and therefore controls the headlight beam throw of the headlight.
When the vehicle passes through a dip, the headlight beam throw is increased. The swivel module is moved up slightly. The roadway is illuminated a greater distance ahead.



Item	Explanation	Item	Explanation
1	Vehicle without adaptive headlight beam throw adjustment	2	Vehicle with adaptive headlight beam throw adjustment

When the vehicle passes over a crest, the headlight beam throw is reduced somewhat. The swivel module is moved down slightly. This reduces dazzling effect of an oncoming vehicle.



Item	Explanation	Item	Explanation
1	Vehicle without adaptive headlight beam throw adjustment	2	Vehicle with adaptive headlight beam throw adjustment

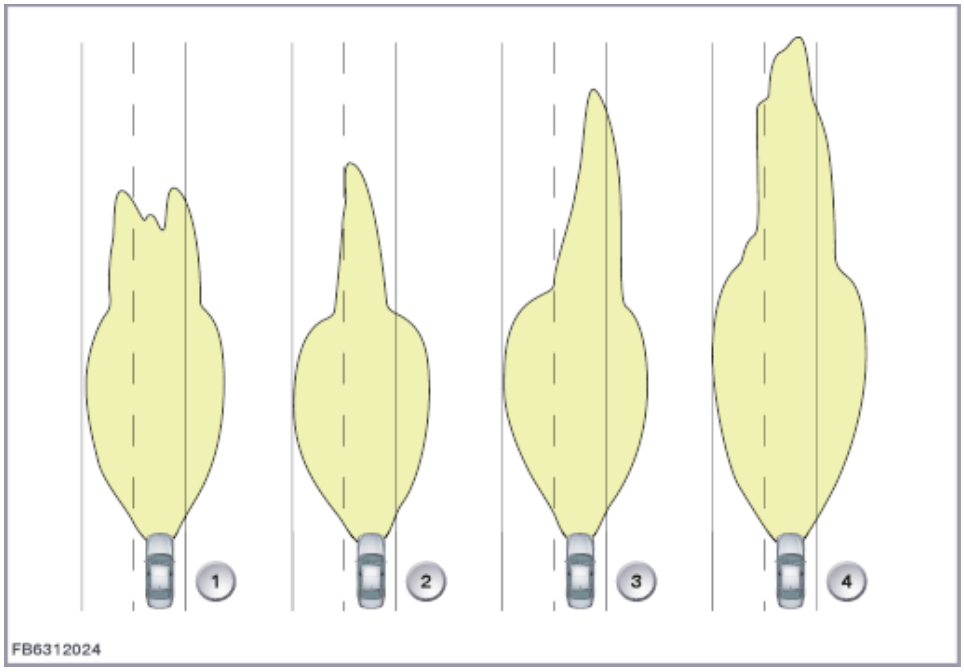
Variable light distribution (depending on the national-market version)

The variable light distribution enables a broader illumination of the roadway ahead of the vehicle. With the exception of the light distribution on a country road, the light distribution is determined by a brightness control of the LEDs and specific headlight adjustments (which means rotating the headlights to the side and in height).

Depending on the request from the footwell module (FRM) or the Body Domain Controller (BDC), the headlight driver module controls the swivel module using the stepper motors and therefore controls the light distribution. The transitions between the individual light distributions are smooth.
In conjunction with the ”Adaptive Headlight” optional equipment, the following variable light distribution are available:

- Engine start
  In switch position A (light switch in the switch position for automatic driving lights control) and terminal 15 ON, both headlights execute a reference run. That means: Both swivel modules are moved down slightly and then to the desired position (visible when the vehicle is parked in front of a wall: The light cone moves down and then back up. Briefly to the side and then back again). The desired position depends on the load status of the vehicle.
  When the engine is started, the headlight driver module initially controls the city light distribution.
- City light distribution
  The city light distribution enables a broader illumination of the left roadway at low speeds. The left headlight is moved approx. 7° outward and approx. 0.7° downward. The city light distribution is activated from engine start to a driving speed of approx. 50 km/h.
- Country road light distribution
  The country road light distribution is the same as the standard low-beam headlights. For example, at a driving speed above approx. 50 km/h, the city light distribution is changed to the country road light distribution. At a driving speed less than approx. 50 km/h, the footwell module (FRM) or the Body Domain Controller (BDC) switches the light distribution back to the city setting. The country road light distribution represents the basic setting for the headlights. The basic setting is assumed when there are faults in the complete light distribution system.
- Motorway light distribution
  The motorway light distribution increases the range of the driving light. The left headlight is moved approx. 3.5° to the left and approx. 0.25° downward. The right headlight is moved approx. 0.2° upward. If the car is driven at over 110 km/h for more than 30 seconds or if the speed exceeds 140 km/h, the footwell module (FRM) or the Body Domain Controller (BDC) switches the corresponding stages of the motorway light distribution depending on the driving speed. If the vehicle speed drops below 110 km/h, the headlights are gradually reset, depending on the driving speed. This takes places in stages (110 km/h - 100 km/h - 90 km/h - 80 km/h). The country road light distribution is activated again at 80 km/h and below.
- Fog light distribution
  The fog light distribution is activated when the fog lights are switched on. The fog light distribution can be combined with the city light distribution and the country road light distribution. Up to a driving speed of approximately 70 km/h, the left headlight is moved approximately 4.5° to the left and approximately 0.7° downward. Beginning at a driving speed over approximately 70 km/h the left headlight moves to the left approximately 3.5° and lowered. If the high beam headlights are switched on while the fog light distribution is active, the headlight moves to the basic setting, i.e. to the country road light distribution.

The following graphic shows an example of possible light distributions.



Item	Explanation	Item	Explanation
1	City light distribution	2	Tourist light light distribution

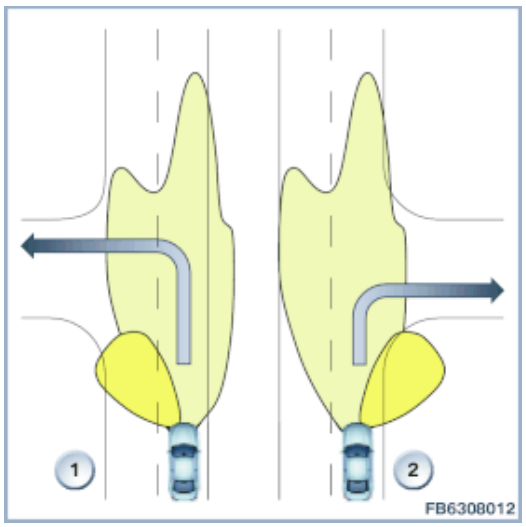
3	Country road light distribution (also the basic setting of the headlights)	4	Motorway light distribution

In the event of a system fault, the footwell module (FRM) or the Body Domain Controller (BDC) prompts a Check Control message. In addition, the footwell module (FRM) or the Body Domain Controller (BDC) switches the system off as follows:

- If the stepper motors are still functional, the headlights are returned to the straight-ahead position. The headlights are no longer moved towards bends in the road.
- If it is no longer possible for a headlight to be moved back to the straight-ahead position, the headlight is lowered (by the stepper motors for automatic headlight beam throw adjustment). This prevents dazzling of oncoming traffic.

Cornering light

A fixed additional reflector with an LED module is built into the headlight with a cornering light. The special styling of the reflector prevents dazzle to the front. Upon request from the footwell module (FRM) or the Body Domain Controller (BDC), the cornering light is activated by the LED main light module.
The cornering light is not switched on and switched off suddenly. The cornering light is switched on dimmed according to special time parameters. When making a turn or in tight bends (serpentines), the area beside the roadway is given additional illumination. Depending on the country concerned, the turning light is switched on when cornering.
The graphic below shows and example for the light distribution for the cornering light.



Item	Explanation	Item	Explanation
1	Turning left	2	Turning right

At driving speeds above 70 km/h, the footwell module (FRM) or the Body Domain Controller (BDC) no longer activates the cornering light.
When reversing, the footwell module (FRM) or the Body Domain Controller (BDC) switches on the cornering light up to speeds of 40 km/h:

- US version: both sides
- Other countries:
  - Turn indicator activated: side of the active turn indicator
  - Steering angle (turn indicator not activated): side on the outside of the curve only

When the turn indicator is switched on: If the vehicle is stationary, the turning lights will automatically be deactivated after approx. 4 seconds, e.g. when waiting at traffic lights. However, the turning lights can be activated again with the turn signal/high beam switch (up to 3 times) until the reflector has reached a certain temperature.
A temperature model in the footwell module (FRM) or the Body Domain Controller (BDC) protects the headlight from excessive thermal load. If a critical temperature is reached, the cornering light is switched off. After a cooling-down period, the cornering light can be switched on again.

High-beam assistant

The light switch of the operating facility for lights must be rotated to Position A to activate the high-beam assistant. When the driving light is switched on, the activated high-beam assistant transmits a recommendation to the footwell module (FRM) or the

Body Domain Controller (BDC) to switch on or switch off the high-beam headlight. The high-beam assistant takes into account lights on approaching and preceding traffic as well as sufficient ambient brightness. The high-beam assistant ensures that the high-beam headlights are activated whenever traffic situations allow.
The high-beam headlight can always be switched on and off through manual intervention.

Limits of the system

The high-beam assistant cannot serve as a substitute for the driver's own judgement regarding use of the high-beam headlights. Thus the headlights must be dipped manually whenever conditions render it necessary to do so. Operation of the high-beam assistant is restricted, or it may fail to operate entirely, under the following conditions:

- Unfavourable weather conditions such as fog or heavy precipitation
- Low visibility road user
- Sharp curves, steep rises and dips
- Crossing traffic or partially hidden traffic on dual carriageways
- Poorly lit towns and intense reflections from road signs
- Low driving speed
- Windscreen dirty in the area in front of the rain-light-solar-condensation sensor
- Windscreen dirty in the area in front of the camera

Automatic driving lights control

The following preconditions must be satisfied before the driving light can be activated automatically:

- Light switch in Position A
- Terminal 15 on
- Rain-light-solar-condensation sensor reports insufficient ambient brightness.

The rain-light-solar-condensation sensor is connected to the junction box electronics (JBE) or the Body Domain Controller (BDC) via the LIN bus.
The junction box electronics (JBE) transmit a signal to the footwell module (FRM) via the CAN bus.
The footwell module (FRM) or the Body Domain Controller (BCD) carries out any prompt received to switch the driving lights on or off.
Should no signal be received from the rain-light-solar-condensation sensor owing to a fault while the automatic driving lights control is activated, the footwell module (FRM) or the Body Domain Controller (BDC) switches on the driving light. Once the headlamps have been switched on by the automatic driving lights control, they can be switched off again with the light switch of the operating facility for lights or by the rain-light-solar-condensation sensor, provided the ambient brightness is adequate.
Even after Terminal 15 off the side lights can remain on because they were activated by the automatic driving lights control system. The side lights are switched off automatically when the driver's door is opened. When the occupants exit the vehicle from another door, the side lights are switched off when the vehicle's locks are engaged.
The footwell module (FRM) or the Body Domain Controller (BDC) will only switch on the driving lights when there is low ambient brightness. There may thus be a delayed activation of the driving lights when the vehicle enters a tunnel or a tree-shaded lane.

Hazard warning flashers

The hazard warning flashers are activated by pressing the hazard warning switch. All turn indicators are activated simultaneously while the hazard warning switch display within the instrument panel also flashes. With Terminal 30 on the hazard warning flashers are implemented in their energy-saving mode. In this mode, the hazard warning flashers light up for a shorter period and remain off for a longer period than usual. When the turn signal/high beam switch is used to activate the turn indicator light while the hazard warning flashers are operating, the turn indicator light assumes priority. The system reverts to operation of the hazard warning flashers after Terminal 15 off or when the turn indicator light has returned to its original position. If the hazard warning switch is depressed while the turn indicator light is operating, then the hazard warning flashers assume priority.

Hazard warning flashers when anti-theft alarm system triggers alarm

The footwell module (FRM) or the Body Domain Controller (BDC) receives the request for the hazard warning flashers in the event of an alarm activation via the CAN bus. The signal is generated by the ultrasonic interior movement detector. The hazard warning flashers continue for 6 minutes provided that the anti-theft alarm system is not switched off in the intervening period. When the anti-theft alarm system is signalling an active alarm the hazard warning switch is suppressed and does not flash with the alarm system. The ultrasonic interior movement detector is completely integrated within the roof function centre (FZD).

Hazard warning flashers during dangerous or emergency braking

In the event of hazard braking or emergency braking, the hazard warning flasher is automatically activated. This serves as supplementary warning source for following traffic. If the vehicle comes to a standstill, the hazard warning flasher remains switched on. The hazard warning flasher is switched off if the vehicle is accelerated again.

Visual feedback signal from central locking system

The factory setting for the central locking system's visual feedback signal is the flashing of the turn indicators upon activation. The Car Access System (CAS) makes this signal available via the CAN bus. The visual feedback signal can be deactivated in "Personal Profile". The anti-theft alarm system can also initiate visual feedback signals for the customer.

Emergency light operation

To avoid the exterior lights being switched off while driving, the driving lights activated in driving mode remain on. In the following situations, the exterior lights are switched off:

- Terminal 15 on fails
- Emergency shutdown of engine (press start/stop button 3 times)
- Accidental pressure on the start/stop button

If the driving speed falls to below 20 kilometres per hour, the driving lights are not switched off until after a delay of approximately 30 seconds.

Notes for Service department

Adjust LED headlights

If the driving lights are switched on by the automatic driving lights control, the urban traffic light distribution is activated. The LED headlights can only be correctly adjusted in the country road light distribution mode. In the urban traffic light distribution mode the left LED headlight is simultaneously lowered and swivelled slightly to the left. If the light is set to urban traffic light distribution, oncoming traffic may be dazzled by the automatic driving lights control while driving.
Therefore, always turn the light switch of the operating facility light to Position 2 for the headlight adjustment.

Component replacement

During the service life of the vehicle, various repairs may become necessary. In the course of repairs, components for various software versions and hardware numbers may be installed. New parts are then used together with components already installed in the vehicle. It is always essential to adapt the replacement components for operation in the vehicle.
When replacing individual components, proceed according to repair instructions.

Diagnosis

The footwell module (FRM) or the Body Domain Controller (BDC) allows the LED headlight to be diagnosed. The LED headlights are set to the "diagnostic mode" for carrying out various diagnosis orders.
Missing or implausible bus signals are stored as faults in the footwell module (FRM) or in the Body Domain Controller (BDC).

General notes

Monitoring of light source
Faulty LEDs are detected by the LED main light module or by the headlight driver module and transmitted to the footwell module (FRM) or the Body Domain Controller (BDC) as fault messages.
Hot monitoring at "lights on"
The hot monitoring is based on the current measurement of the individual outputs of the footwell module (FRM) or the Body Domain Controller (BDC). The power consumption readings assist in detection of short and open circuits. Failure of the LED headlights is indicated as a Check Control message in the instrument cluster (KOMBI).
Emergency operation
If a fault occurs in the footwell module (FRM) or in the Body Domain Controller (BDC) that could lead to a malfunction of the LED headlight, an emergency operation is activated by the LED main light module. In the event of a fault in the LED main light module, emergency operation is activated by the footwell module (FRM) or the Body Domain Controller (BDC). However, the driving lights remain switched on until the vehicle is stopped. The malfunction is displayed to the driver as a Check Control message in the instrument cluster (KOMBI).