

Interior mirror with digital compass



Introduction

A digital compass is offered as optional equipment (SA 4NA) in the inside mirror.

> up to 09/2006

A small liquid crystal display at the top right in the inside mirror displays in which direction of travel the vehicle is pointing: e.g. **SW** for South West.

> from 09/2006

The display is realised with transparent light technology. An liquid crystal display (window) is no longer needed. The display can be deactivated.

The compass offers an additional benefit especially in the USA. In large cities the streets are frequently arranged according to the points of the compass. The signposts are also specified with points of the compass. However, the compass also assists orientation in large European cities on the basis of the points of the compass. [\[System overview ...\]](#)

> E88, E93 from 09/2008

The digital compass must be calibrated once with the soft top or hardtop closed and once with the soft top or hardtop open. The position of the soft top or retractable hardtop has an effect on the magnetic field in the vehicle. A deflected magnetic field will lead to calibration errors.

Brief component description

The following components deliver signals for the digital compass:

- **Magnetic field sensor**

> up to 09/2006

The magnetic field sensor is installed in the mirror base. The magnetic field sensor measures the current alignment of the magnetic field. The signal is sent to the control electronics for the compass in the inside mirror.

> from 09/2006

The magnetic field sensor is on the PCB in the inside mirror.

[\[more ...\]](#)

- **Control electronics for the compass**

The inside mirror is electrically connected to the roof function centre (FZD).

The control electronics for the compass are integrated into the printed circuit board for the inside mirror. The signals from the magnetic field sensor are received by the control electronics. The liquid crystal display is activated directly by the control electronics.

The following components are controlled:

- **Display in inside mirror**

- > up to 09/2006**

- The liquid crystal display (window) is situated at top right in the inside mirror.

- The points of the compass are presented digitally on the liquid crystal display (LCD: Liquid Crystal Display). The display is divided into eight compass points.

- > from 09/2006**

- The point of the compass is displayed in transparent light technology in the inside mirror as well. The display is also at the top right in the inside mirror. The display is divided into eight compass points.

System functions

The following system functions for the digital compass are described:

- Display
- Brightness control of display
- Adjustment of magnetic field zones and calibration
- from 09/2006: Further adjustments
- up to 09/2006: Fault display

Display

The 8 points of the compass are digitally displayed by abbreviations.

- > from 09/2006**

The display is available in English and German (delivery status: English LHD)

N:	North
NE:	North East (German: NO)
E:	East (German: O)
SE:	South East (German: SO)
S:	South
SW:	South West
W:	West
NW:	North West

The changeover between displays is carried out as follows:

- The current vehicle position is the centre of a 360° circle.
- The eight points of the compass divide these 360 into sixteen 22.5 segments.
- The display changes over if the direction of travel changes by more than 22.5°.

Brightness control of display

2 photosensors in the electrochromic inside mirror record the ambient brightness (1 photosensor for the ambient brightness coming from the front, 1 photosensor for the ambient brightness coming from the rear).

The photosensors deliver the signals for the display brightness control.

The brightness of the display is adjusted by the inside mirror control electronics to suit the ambient brightness.

> E88, E93

A darkened inside mirror will become lighter while the soft top or the retractable hardtop is opening and closing.

The roof function centre (FZD) transmits the signal (roof open or closed) to the control electronics for the inside mirror. The signal is transmitted on the line that is also used for transmitting the signal for driving in reverse.

Adjustment of magnetic field zones and calibration

The worldwide magnetic field zones are permanently stored in the inside mirror. The magnetic field zones represent the deviations in relation to an ideal magnetic field for earth. The orientation "North" is precisely determined by the magnetic field zones.

The current magnetic field zone may be adjusted according to the geographic location. For example, Germany is located in magnetic field zone "8".

A vehicle has its own magnetic field. This makes it possible for the magnetic field sensor to measure an overlapping of the magnetic field with the Earth's magnetic field. This overlapping is "worked out" by calibrating the compass.

A changed magnetic field is normally calibrated "automatically".

The vehicle's magnetic field may change under the following special circumstances:

- Powerful vibration during an accident
- Very large external magnetic field - e.g. if a vehicle passes under a train when travelling through an underpass

However, a manual calibration may speed up the automatic calibration.

For procedure to be followed when setting the magnetic field zones as well as manual calibration: see notes for service staff.

From 09/2006: Further adjustments

Different time-based adjustment menus can be obtained by means of the control button:

- 0 to 3 seconds: Display ON/OFF
- 3 to 6 seconds: Adjustment of the magnetic field zones (0 -15)
- 6 to 9 seconds: Calibration (C)
- 9 to 12 seconds: Left-hand drive or right-hand drive (L or R)
- 12 to 15 seconds: English or German (E or O)

Release the control button when the correct menu is obtained. Select values in the menu by pressing briefly. After approx. 5 seconds the value is stored and the menu is automatically exited.

up to 09/2006: Fault display

The LC matrix for the liquid crystal display lights up completely if a system fault develops. A fault is displayed under the following conditions:

- If the vehicle is highly magnetised (2200-2500 milligauss), the measuring range of the magnetic field sensor will be exceeded.
- If a fault develops in the circuitry of the magnetic field sensor.

Note: Physical unit Gauss!

Gauss is the unit of measurement for magnetic flux density.

Switch-on conditions

At terminal 15 ON, the display is activated with a test run.

> up to 09/2006

The LC matrix lights up completely (approx. 3 seconds). The digital compass is then switched on. There is no switch to deactivate the liquid crystal display if terminal 15 is ON.

Notes for Service department

The following information is available for service staff:

- General information: [\[more ...\]](#)
- Diagnosis: ---
- Encoding/programming: ---

We can assume no liability for printing errors or inaccuracies in this document and reserve the right to introduce technical modifications at any time.

Interior mirror with digital compass



Introduction

A digital compass is offered as optional equipment (SA 4NA) in the inside mirror.

> up to 09/2006

A small liquid crystal display at the top right in the inside mirror displays in which direction of travel the vehicle is pointing: e.g. **SW** for South West.

> from 09/2006

The display is realised with transparent light technology. An liquid crystal display (window) is no longer needed. The display can be deactivated.

The compass offers an additional benefit especially in the USA. In large cities the streets are frequently arranged according to the points of the compass. The signposts are also specified with points of the compass. However, the compass also assists orientation in large European cities on the basis of the points of the compass. [\[System overview ...\]](#)

> E88, E93 from 09/2008

The digital compass must be calibrated once with the soft top or hardtop closed and once with the soft top or hardtop open. The position of the soft top or retractable hardtop has an effect on the magnetic field in the vehicle. A deflected magnetic field will lead to calibration errors.

Brief component description

The following components deliver signals for the digital compass:

- **Magnetic field sensor**

> up to 09/2006

The magnetic field sensor is installed in the mirror base. The magnetic field sensor measures the current alignment of the magnetic field. The signal is sent to the control electronics for the compass in the inside mirror.

> from 09/2006

The magnetic field sensor is on the PCB in the inside mirror.

[\[more ...\]](#)

- **Control electronics for the compass**

The inside mirror is electrically connected to the roof function centre (FZD).

The control electronics for the compass are integrated into the printed circuit board for the inside mirror. The signals from the magnetic field sensor are received by the control electronics. The liquid crystal display is activated directly by the control electronics.

The following components are controlled:

- **Display in inside mirror**

- > up to 09/2006**

- The liquid crystal display (window) is situated at top right in the inside mirror.

- The points of the compass are presented digitally on the liquid crystal display (LCD: Liquid Crystal Display). The display is divided into eight compass points.

- > from 09/2006**

- The point of the compass is displayed in transparent light technology in the inside mirror as well. The display is also at the top right in the inside mirror. The display is divided into eight compass points.

System functions

The following system functions for the digital compass are described:

- Display
- Brightness control of display
- Adjustment of magnetic field zones and calibration
- from 09/2006: Further adjustments
- up to 09/2006: Fault display

Display

The 8 points of the compass are digitally displayed by abbreviations.

- > from 09/2006**

The display is available in English and German (delivery status: English LHD)

N:	North
NE:	North East (German: NO)
E:	East (German: O)
SE:	South East (German: SO)
S:	South
SW:	South West
W:	West
NW:	North West

The changeover between displays is carried out as follows:

- The current vehicle position is the centre of a 360° circle.
- The eight points of the compass divide these 360 into sixteen 22.5 segments.
- The display changes over if the direction of travel changes by more than 22.5°.

Brightness control of display

2 photosensors in the electrochromic inside mirror record the ambient brightness (1 photosensor for the ambient brightness coming from the front, 1 photosensor for the ambient brightness coming from the rear).

The photosensors deliver the signals for the display brightness control.

The brightness of the display is adjusted by the inside mirror control electronics to suit the ambient brightness.

> E88, E93

A darkened inside mirror will become lighter while the soft top or the retractable hardtop is opening and closing.

The roof function centre (FZD) transmits the signal (roof open or closed) to the control electronics for the inside mirror. The signal is transmitted on the line that is also used for transmitting the signal for driving in reverse.

Adjustment of magnetic field zones and calibration

The worldwide magnetic field zones are permanently stored in the inside mirror. The magnetic field zones represent the deviations in relation to an ideal magnetic field for earth. The orientation "North" is precisely determined by the magnetic field zones.

The current magnetic field zone may be adjusted according to the geographic location. For example, Germany is located in magnetic field zone "8".

A vehicle has its own magnetic field. This makes it possible for the magnetic field sensor to measure an overlapping of the magnetic field with the Earth's magnetic field. This overlapping is "worked out" by calibrating the compass.

A changed magnetic field is normally calibrated "automatically".

The vehicle's magnetic field may change under the following special circumstances:

- Powerful vibration during an accident
- Very large external magnetic field - e.g. if a vehicle passes under a train when travelling through an underpass

However, a manual calibration may speed up the automatic calibration.

For procedure to be followed when setting the magnetic field zones as well as manual calibration: see notes for service staff.

From 09/2006: Further adjustments

Different time-based adjustment menus can be obtained by means of the control button:

- 0 to 3 seconds: Display ON/OFF
- 3 to 6 seconds: Adjustment of the magnetic field zones (0 -15)
- 6 to 9 seconds: Calibration (C)
- 9 to 12 seconds: Left-hand drive or right-hand drive (L or R)
- 12 to 15 seconds: English or German (E or O)

Release the control button when the correct menu is obtained. Select values in the menu by pressing briefly. After approx. 5 seconds the value is stored and the menu is automatically exited.

up to 09/2006: Fault display

The LC matrix for the liquid crystal display lights up completely if a system fault develops. A fault is displayed under the following conditions:

- If the vehicle is highly magnetised (2200-2500 milligauss), the measuring range of the magnetic field sensor will be exceeded.
- If a fault develops in the circuitry of the magnetic field sensor.

Note: Physical unit Gauss!

Gauss is the unit of measurement for magnetic flux density.

Switch-on conditions

At terminal 15 ON, the display is activated with a test run.

> up to 09/2006

The LC matrix lights up completely (approx. 3 seconds). The digital compass is then switched on. There is no switch to deactivate the liquid crystal display if terminal 15 is ON.

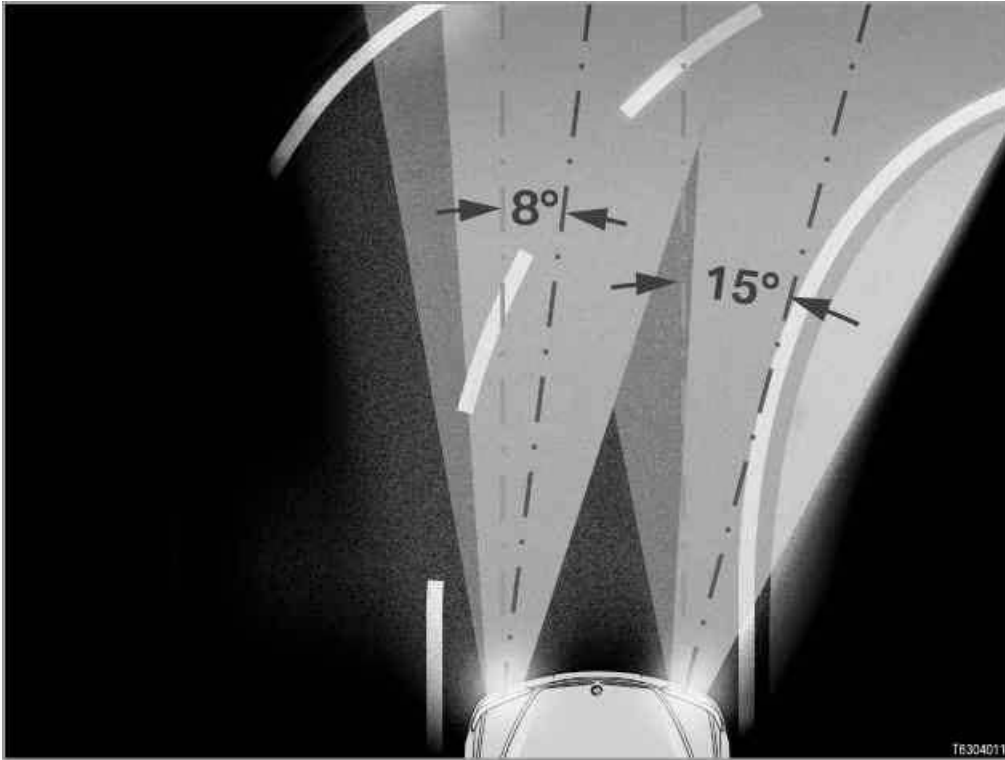
Notes for Service department

The following information is available for service staff:

- General information: [\[more ...\]](#)
- Diagnosis: ---
- Encoding/programming: ---

We can assume no liability for printing errors or inaccuracies in this document and reserve the right to introduce technical modifications at any time.

Adaptive Headlights



Note: Option 524 only in conjunction with optional equipment 522.

Optional equipment 524 "Adaptive headlights" is only available in conjunction with optional equipment 522 "Xenon light for dipped and main-beam headlights".

Note: EU approval for optional equipment 522 only in conjunction with optional equipment 502.

Optional equipment 522 "Xenon light for dipped and main-beam headlights" is only available together with optional equipment 502 "Headlight cleaning system" (in countries subject to EU approval).

Note: ALC => AHL

The development code for the adaptive headlights was "ALC". ALC stood for "Adaptive Light Control". The marketing and sales designation for optional equipment 524 in English-language markets is "adaptive headlights", abbreviated to "AHL". Diagnosis and technical vehicle documentation therefore use the abbreviation "AHL". However, "ALC" is still used on some control units and in the EPC (Electronic Parts Catalogue).

Introduction

The Adaptive Headlight system turns the bi-xenon headlights towards the inside of a bend when cornering. This improves illumination of the curve of the road. Visibility is therefore improved. When cornering, the occupant is not looking into a "black hole" - instead, the adaptive headlights allow the driver to see the curve of the road.

This BMW Service Technology bulletin (SBT) describes the adaptive headlights for the following model series:

- > E60, E61, E63, E64 up to 03/2005

[\[System overview ...\]](#)

The system overview applies accordingly for the E65 and E66 up to 03/2005.

- > E60, E61, E63, E64 from 03/2005 until 09/2005

[\[System overview ...\]](#)

The system overview applies accordingly for the E65 and E66 from 03/2005.

Note: AHL control unit discontinued from 03/2005.

From 03/2005, the AHL control unit software is integrated into the light module on the E60, E61, E63, E64, E65 and E66. The AHL control unit is no longer fitted.

> E60, E61, E63, E64 from 09/2005

[\[System overview ...\]](#)

The vehicle electrical system was changed from 09/2005. As a result of the changeover, several control units were discontinued and some control unit functions were integrated into new control units.

> E70, E71, E72

[\[System overview ...\]](#)

The cornering light function is new on the E70 from the series launch.

The cornering light gives the area next to the roadway additional illumination when you are turning or cornering (driving in tight bends). They are also active when you park the vehicle. Depending on the country concerned, the cornering light are switched on while cornering.

> E81, E82, E87, E88, E89, E90, E91, E92, E93

[\[System overview ...\]](#)

For the E81, E82, E88, E89, E92, E93 from series launch and for the E87 from 03/2007, the cornering light function is new.

Note: Cornering light in conjunction with optional extra 524

Cornering lights are a subfunction of optional equipment 524 "Adaptive headlights". Bi-xenon headlights are standard equipment on the E92, E93. Optional equipment 524 is standard on the US version.

Note: AHL components on E46, E53 and E83

There is a separate system description for the adaptive headlights on the E46, E53, E83 . [\[more in the vehicle engineering diagnosis \(FTD\) 63 03 03 047\]](#)

Note: AHL components on the E63, E64

- The E63, E64 has a zero-position sensor.
[\[more in the vehicle engineering diagnosis \(FTD\) 63 03 03 047\]](#)
- Otherwise, the E63 and E64 are the same as the other 5-Series models.

Note: AHL components on the E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93

The adaptive headlights largely correspond to the adaptive headlights of the E60, E61, E63, E64 and E65, E66:

- The E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93 has a zero-position sensor.
- The E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93 uses the FRM (footwell module) as a control unit for the exterior lights. The footwell module contains the functions of the light module, AHL control unit and the basic module (or body general module).

[\[more in the vehicle engineering diagnosis \(FTD\) 61 04 04 094\]](#)

Brief component description

The following components and control units provide signals for the adaptive headlight system:

- **CAS: Car Access System**

The Car Access System supplies signals for the terminal control (e.g. terminal 15 ON). The adaptive headlights control unit is activated when terminal 15 is switched ON.

- **Light switch**

The rotary switch for the side lights and low-beam headlights differs depending on the vehicle equipment level (adaptive headlights, automatic driving lights control, automatic or manual headlight beam throw adjustment). For the adaptive headlights function to operate, the light switch position must be set to "A" ("A" = "automatic driving lights control" and "adaptive headlights"). [\[more ...\]](#)

- **Turn signal/high beam switch**

The high-beam headlights are switched on and off by the turn signal/high beam switch (by pressing or pulling the switch). The adaptive headlights function operates with both low-beam headlight and high-beam headlights. [\[more ...\]](#)

- **SZL: Steering column switch cluster**

The SZL control unit forwards the signals from the turn signal/high beam switch to the adaptive headlights control unit.

> E60, E61, E63, E64, E65 and E66

[\[more ...\]](#)

> E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93

The steering column switch cluster forwards the signals from the turn signal/high beam switch to the footwell module (FRM). [\[more in the vehicle engineering diagnosis \(FTD\) 61 07 04 103\]](#)

- **, ride height sensors**

If the optional equipment "Adaptive headlights" is fitted, the adaptive headlights control unit evaluates the signals from the ride height sensors. Reason: the adaptive headlights control unit also controls the automatic headlight beam throw adjustment.

The automatic headlight beam throw adjustment feature adjusts the height of the headlights to compensate for variations in the vehicle inclination angle (e.g. when the vehicle is laden, and under braking and acceleration in dynamics driving situations).

[\[more ...\]](#)

- **Brake light switch**

If the optional equipment "Adaptive headlights" is fitted, the signals from the brake light switch are read by the adaptive headlights control unit. In addition, the brake light switch signal is also a signal for automatic headlight beam throw adjustment, see above: Ride height sensors.

- **Position sensor**

> E60, E61 > E65, E66

Hella headlights have a position sensor.

The position sensor in the swivel module for the bi-xenon headlights supplies a signal for the horizontal movement of the headlights.

[\[more ...\]](#)

- **Zero-position sensor**

> E63, E64

> E70, E71, E81, E82, E87, E88, E89, E90, E91, E92, E93

Automotive Lighting headlights, previously Bosch, have a zero-position sensor.

The zero-position sensor registers the horizontal movement of the headlight.

[\[more ...\]](#)

- **transmission control unit or reversing light switch**

When reverse gear is engaged, the headlights are moved to the straight-ahead position.

- On vehicles with automatic transmission, the EGS control unit provides the "Reverse gear engaged" signal. (EGS: electronic transmission control).
- On vehicles with manual gearboxes, the signal is supplied by the reversing light switch.

- **Rain/light sensor for automatic driving lights control**

The rain/light sensor measures the ambient brightness outside the vehicle.

- In twilight conditions, the rain/light sensor transmits the message "Twilight" so that the automatic headlight beam throw adjustment can activate low-beam headlights. The headlights are tilted up and down as required, but they are not yet moved towards the bend in the road.
- In darkness, the rain/light sensor transmits the message "Darkness". The adaptive headlights are then activated when the vehicle is cornering. The headlights are moved to the left or right:

[\[more ...\]](#)

- **Steering angle sensor and DSC sensor**

The steering angle sensor and DSC sensor (DSC = Dynamic Stability Control) supply signals for the adaptive headlights to the adaptive headlights control unit. These signals are evaluated as follows, depending on the driving speed:

- Driving speed up to **30 km/h**: The adaptive headlights function is controlled using the information from the

steering angle sensor (in the steering column switch cluster).

- Driving speed between **30 km/h and 50 km/h**: In the 30 to 50 km/h speed range, there is a **continuous transition** in signal evaluation: from the signal evaluation sent by the steering angle sensor to signal evaluation sent by the yaw sensor (in the DSC sensor).
- **In extreme dynamics driving situations**, e.g. if the vehicle starts to skid or fishtail, even at driving speeds of less than **50 km/h**, the signals from the yaw sensor are considered. If the vehicle starts to skid or fishtail, the headlights will move to the straight-ahead position. The headlights are not moved until the vehicle has stabilised.
- Driving speed over **50 km/h**: At speeds upwards of 50 km/h, the signals from the **yaw sensor** (in the DSC sensor) form the primary basis for control of the adaptive headlights function.

Reason: For a constant cornering radius, the required steering angle increases disproportionately with speed. In addition, the required steering angle also depends on the coefficient of friction of the roadway. Yaw rate is directly proportional to speed. For this reason, the yaw rate is always the most suitable measure for controlling the adaptive headlights at high speeds.

Even at high speeds, however, the steering angle sensor signal is used to detect (predict) the driver's choice **in advance**. This prediction is important: The yaw-rate signal is not supplied until the vehicle has **responded** to the steering wheel movement.

The steering angle sensor signal is disabled so that rapid, momentary steering wheel adjustments (so-called "surging") do not affect the adaptive headlights function.

A number of control units are involved in the adaptive headlights system (see above: CAS, EGS, SZL). Depending on the model series and model revision concerned, the adaptive headlights are actuated by the following control units:

- **AHL: Adaptive Headlights**

> E60, E61, E63, E64, E65, E66 until 03/2005

The AHL control unit actuates the adaptive headlights.

For safety reasons, the AHL control unit is also responsible for the automatic headlight beam throw adjustment.

Reason: Oncoming traffic may not be dazzled by the adaptive headlights. If a headlight sticks in an unfavourable position, the AHL control unit will attempt to move this headlight down (using the stepper motors in the automatic headlight beam throw adjustment).

The AHL control unit is connected to the powertrain CAN.

[\[more ...\]](#)

- **LM: Light module**

> E60, E61, E63, E64, E65, E66 from 03/2005

From 03/2005, the AHL control unit is integrated in the light module.

The light module (LM) controls and monitors all vehicle lights. Information is transmitted and received via the body controller area network data bus.

The light module actuates the indicator light for the adaptive headlights (on the light switch).

[\[more ...\]](#)

- **FRM: Footwell module**

> E70, E71, E72, E81, E82, E87, E88, E90, E91, E92, E93

The footwell module controls the exterior lights and the adaptive headlights.

The footwell module thus takes the place of the light module and the AHL control unit.

The footwell module controls the indicator light for the adaptive headlights (on the light switch).

[\[more ...\]](#)

The footwell module has its own system description.

[\[more in the vehicle engineering diagnosis \(FTD\) 61 04 04 094\]](#) "footwell module".

The following additional control units are involved in the adaptive headlights:

- **SMC: Stepper motor controllers**

The stepper motor controllers control the stepper motors in the headlights (for the automatic headlight beam throw adjustment and for the adaptive headlights). The stepper motor controllers are not capable of self-diagnosis. The stepper motor controllers are diagnosed and encoded via the control unit for

adaptive headlights.

[\[more ...\]](#)

- **SGM: Safety and gateway module**

> E60, E61, E63, E64 until 09/2005 and E65, E66

The safety and gateway module (SGM) is the interface between the two data buses body controller area network and powertrain CAN. Thus, all messages exchanged between the light module and the AHL control unit passes through the SGM. Information from the yaw sensor (in the DSC sensor) is also fed through the SGM to the AHL control unit.

- **BGM: Body gateway module**

> E60, E61, E63, E64 from 09/2005

The vehicle electrical system was changed from 09/2005. As a result of the changeover, several control units were discontinued and some control unit functions were integrated into new control units.

The new body gateway module (KGM) supersedes the safety and gateway module (SGM) previously fitted, the door modules and the micro-power module.

[more in the vehicle engineering diagnosis (FTD) 610205143] "Body gateway module"

- **Xenon control unit**

The xenon control unit actuates the bulb in the bi-xenon headlights.

The xenon control unit is not capable of self-diagnosis. The Xenon control unit is monitored by the light module (E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93: footwell module).

[\[more ...\]](#)

The following components are controlled:

- **Headlight**

Optional equipment 524 "Adaptive headlights" is only available in conjunction with optional equipment 522 "Xenon light for dipped and main-beam function". This means that bi-xenon headlights are employed.

[\[more ...\]](#)

- **Stepper motors for the adaptive headlights**

The stepper motors turn the swivel modules in the bi-xenon headlights. The stepper motors move the headlights vertically and horizontally (vertically = up and down for automatic headlight beam throw adjustment; horizontally = left and right for the adaptive headlights function).

The swivel modules execute the movement.

[\[more ...\]](#)

- **Indicator light on the light switch**

The indicator light (green light-emitting diode) next to the "A" (= "automatic driving lights control" and "adaptive headlights") has 2 display functions:

- The indicator light **lights up permanently** when the automatic driving lights control or adaptive headlights function is switched on (= light switch in position "A").
- The indicator light **flashes** if a fault develops in the adaptive headlight system.

> E60, E61, E63, E64, E65 and E66:

The indicator light is activated by the light module.

> E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93:

The indicator light is activated by the footwell module.

Note: From 09/2007, the fault display in the form of the indicator light on the light switch flashing is discontinued.

From 09/2007, the fault display in the form of the indicator light on the light switch flashing is discontinued due to legal stipulations.

From 09/2007 system fault will be indicated by a Check Control message in the instrument panel.

System functions

The adaptive headlights system moves headlights horizontal (i.e. from left to right) in order to illuminate the inside of a bend when cornering.

The following system functions of the adaptive headlights system are described below:

- System activation and reference run
- Activation of stepper motor controllers
- Speed-dependent evaluation of signals
- Adjustment of headlight horizontal aim
- Deactivation of adaptive headlights function under extreme driving conditions
- Deactivation of adaptive headlights function in response to system faults
- Setting headlights to parked position
- Automatic headlight beam throw adjustment
- Adaptive headlights for automatic driving lights control
- Cornering light
- Adaptive headlight beam throw adjustment
- Variable light distribution (depending on the national-market version)

Note: Different control units for adaptive headlights.

> E60, E61, E63, E64, E65, E66 up to 03/2005: The adaptive headlights are actuated by the AHL control unit.

> E60, E61, E63, E64, E65, E66 up to 03/2005: The adaptive headlights are actuated by the light module (LM).

> E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93: The adaptive headlights are controlled by the footwell module (FRM). The footwell module has its own system description. [\[more in the vehicle engineering diagnosis \(SBT\) 61 04 04 094\]](#)

For this reason, the following text refers to the general "control unit for adaptive headlights".

System activation and reference run

When terminal 15 is switched ON, the headlights always perform a reference run, even if the low-beam headlights are not switched on. The control unit for adaptive headlights transmits the "perform reference run" request to the stepper motor controllers (SMCs, control units for the headlight stepper motors). The stepper motor controllers control the stepper motors in the headlights. The reference run is performed. In the reference run, the headlights move as follows:

1. The headlights move to the right and left (= reference run for adaptive headlights).
2. The headlights move up and down (= reference run for automatic headlight beam throw adjustment).
3. At the end of the reference run, the headlights are in the straight-ahead position.

Following the reference run, the system is operational.

When reverse gear is engaged, the headlights are moved to the straight-ahead position.

Note: The reference run is only performed after terminal 15 has been switched OFF for at least 15 seconds.

> E66, E61, E63, E64, E65, E66 **until 09/2006**

> E87, E90, E91, E92, E93 **until 03/2007**

If terminal 15 is repeatedly switched on and off (e.g. for demonstration purposes), the reference run will not be executed every time terminal 15 is switched on. Terminal 15 must have been switched off for at least 15 seconds before it is switched on again. Only then is a reference run performed when terminal 15 is switched on.

Note: Reference run always after terminal 15 ON and low-beam headlights ON.

> E66, E61, E63, E64, E65, E66 **from 09/2006**

> E70, E81, E82, E88, E89, **from series launch**

> E87, E90, E91, E92, E93 **from 03/2007**

If terminal 15 is repeatedly switched on and off (e.g. for demonstration purposes), the reference run will not be executed every time terminal 15 and the low-beam headlights are switched ON.

Note: Reference run with enlarged movement range.

> not E65, E66

From 09/2007, starting with the E60, E61, E63, E64, a reference run with larger movement range will be introduced. The reference run with larger movement range will then gradually be introduced on other model series.

Activation of stepper motor controllers

The control unit for adaptive headlights transmits the stepper motor controllers (SMC) the setpoint values for the swivel modules (position of swivel modules and speed of movement).

The control unit for adaptive headlights calculates the setpoint values using the following signals:

- Driving speed
- Steering angle (at speeds up to 50 km/h, dependent on encoding)
- Yaw rate (50 km/h upwards, see "Steering angle sensor and DSC sensor" above)

Speed-dependent evaluation of signals

Depending on the driving speed, the adaptive headlights are controlled using the following signals: Signals from the steering angle sensor and signals from yaw sensor (in the DSC sensor).

The encoding (at the end of line) determines the priority assigned to sensor signals above which speed threshold.

Adjustment of headlight horizontal aim

The stepper motor controllers move the headlights to the right or left during cornering.

Horizontal movement range of headlights:

- Inwards, i.e. towards centre of vehicle: up to max. 8°
- Outwards: up to max. 15°

Example: Right-hand bend: The right-hand headlight turns by up to 15° (the right-hand headlight is the "inside" headlight on a right-hand bend).

Viewed from the vehicle, the right-hand headlight moves "outwards".

The left-hand headlight moves up to 8° (the left-hand headlight moves towards the centre of the vehicle, i.e. "inwards" as viewed from the vehicle).

The headlight on the outside of the bend has to reach its end position at the same time as the headlight on the inside of the bend so that the carriageway remains smoothly and evenly illuminated.

On a right-hand bend, the left-hand headlight is on the outside of the bend. The right-hand headlight is on the inside of the bend.

Deactivation of adaptive headlights function under extreme driving conditions

If the vehicle drifts, skids and loses sideways grip, the adaptive headlights function is deactivated as follows:

- The headlights are returned to the straight-ahead position. The headlights are no longer turned.
- The low-beam headlights remain on.

Deactivation of adaptive headlights function in response to system faults

Until 09/2007, a system fault will be indicated by the indicator light on the light switch flashing.

From 09/2007 system fault will be indicated by a Check Control message in the instrument panel.

Dazzling of oncoming traffic must be prevented in the event of a system fault.

For this reason, the adaptive headlights function is deactivated 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.
- Vehicles **up to 09/2007**: If the headlight cannot be lowered, the bi-xenon bulb in this headlight is disabled as follows:

When the vehicle is parked up, the control unit registers rest state for the adaptive headlights, as follows:
Vehicle standstill and terminal R OFF for several minutes.

The next time the vehicle is restarted, the bi-xenon light of the defective headlight is not switched on.

The front fog lights are switched on in order to ensure a minimum level of lighting.

The low-beam headlights are **not** switched off while the vehicle is in motion.

Note: From 09/2007, the low-beam headlights will not be switched off in the event of a system fault.

If a system fault develops in the adaptive headlights, the low-beam headlights for the affected headlight will **not** be switched off.

Setting headlights to parked position

When terminal R is switched off, the headlights move to the parked position. The parked position is important for the headlights' next reference run: From the parked position, the headlights are run through a reference run in the pre-drive check. During each reference run, the control unit for adaptive headlights relearns the straight-ahead position for the headlights.

When the headlights have reached the parked position, the stepper motor controllers SMCs inform the control unit for adaptive headlights ("confirmation").

The control unit for adaptive headlights deactivates the stepper motor controllers.

The after-running period lasts approx. 10 seconds.

Automatic headlight beam throw adjustment

If the optional equipment "Adaptive headlights" is fitted, the control unit for adaptive headlights also controls the automatic headlight beam throw adjustment.

The automatic headlight beam throw adjustment adapts the headlight range for different vehicle inclinations. Variations in the vehicle inclination angle are produced by vehicle loads and braking or acceleration in extreme driving situations. The automatic headlight beam throw adjustment moves the headlights up and down as required.

The control unit for adaptive headlights also controls the automatic headlight beam throw adjustment as follows:

1. The ride height sensors and the brake light switch supply the signals for the automatic headlight beam throw adjustment.
2. The control unit for adaptive headlights computes the vehicle inclination (longitudinally to the roadway) from the signals.
3. The stepper motors for the automatic headlight beam throw adjustment automatically and dynamically control the headlight beam throw.

The headlight range is adjusted so that the actual headlight beam throw conforms to the legally required headlight beam throw as follows:

- If vehicle rear is lower than front: The actual headlight beam throw will be longer than the legally stipulated headlight beam throw. The headlight beam throw is lowered to reduce the headlight beam throw to match the legal requirement.
- If the vehicle is horizontal: The actual headlight beam throw will be the same as the legally stipulated headlight beam throw .
- If vehicle front is lower than rear: The actual headlight beam throw will be shorter than the legally stipulated headlight beam throw. The headlight beam throw is raised to increase the headlight beam throw to match the legal requirement.

Adaptive headlights for automatic driving lights control

The automatic driving lights control feature (optional equipment in conjunction with the rain/light sensor) automatically switches the side lights and low-beam headlights on or off.

Switch-on conditions:

- The automatic driving lights control must be encoded (in the light module on the E60, E61, E63, E64, E65, E66, in the footwell module on the E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93).
- The light switch position must be "A" ("A" for automatic driving lights control and adaptive headlights).
- The rain/light sensor must be installed and operational.

The rain/light sensor detects the ambient brightness.

The rain/light sensor transmits the following requests to the light module (on the E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93: footwell module):

- Ambient brightness low: In twilight, darkness, in an underground garage or tunnel.
"Switch on low-beam headlights" request
- Ambient brightness sufficient.
"Switch off low-beam headlights" request

If only the side lights are to be switched on, the light switch must be set to side lights (switch position 1).

When the light switch position is set to "A", the control unit for adaptive headlights is also activated:

- When the automatic driving lights control function switches on the low-beam headlights (e.g. at dawn/dusk), the adaptive headlights function is notified at the same time.

The control unit for adaptive headlights thus assumes control of the automatic headlight beam throw adjustment.

- The signals from the rain/light sensor are also evaluated (E60, E61, E63, E64, E65, E66: by the light module; E81, E82, E87, E88, E90, E91, E92, E93: by the footwell module).

The headlights are not turned when the vehicle is cornering until total darkness sets in.

The message "low-beam headlights on" is given individually for each headlight.

If a headlight fails, the adaptive headlights are switched off. The front fog lights are switched on in order to ensure a minimum level of lighting.

Cornering light

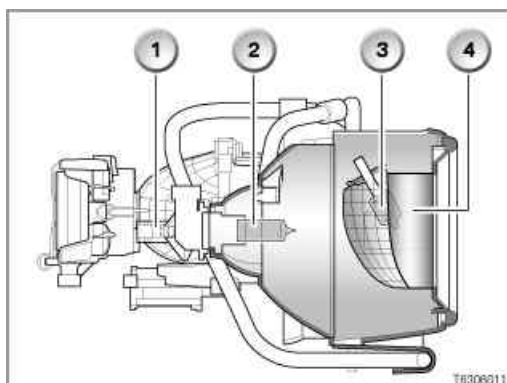
The cornering light is linked to the adaptive headlight (optional equipment 524).

The footwell module (FRM) uses the following signals to adjust the cornering light:

- Steering angle
- Yaw rate
- Status, reverse gear

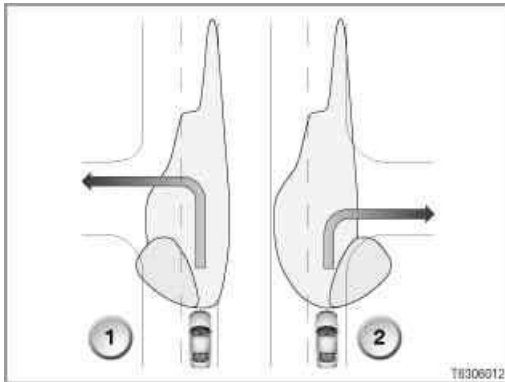
> E81, E82, E88, E89, E92, E93 with the series launch and E87 from 03/2007

Instead of the high-beam headlight (H7), the headlight with cornering light has a fixed additional reflector with an H3 bulb. The special styling of the headlight lens prevents dazzle to the front.



The graphic shows the main headlight with cornering light on the E81, E82, E87, E88, E89, E92, E93

- 1) Bi-xenon lamp
- 2) H8 bulb for side lights and daytime driving lights
- 3) H3 bulb for cornering lights
- 4) Reflector for cornering light



The graphic shows the headlight with cornering light on the E81, E82, E87, E88, E89, E90, E91, E92, E93

- 1) Turning left
- 2) Turning right

The following prerequisites must be satisfied for the cornering lights to be switched on:

- Terminal 15 ON
- Light switch in position "A" ("A" stands for automatic driving lights control)
- Rain/light sensor identifies twilight or darkness (threshold value exceeded)

At driving speeds greater than 70 kph, the cornering light is no longer switched on.

> European version: For legal reasons, the cornering lights on the European version can only be activated via the turn indicator at speeds up to 40 km/h.

When reversing, the footwell module (FRM) activates the cornering lights as follows in the speed range 0 km/h to 35 km/h:

- US version, both sides
- Other countries, only outer side of bend

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 protects the headlights against excessive thermal load.

The switching-off conditions for the cornering light depend on the country concerned.

Note: Temperature monitoring by temperature model!

A temperature model in the footwell module calculates the temperature of the reflector. The temperature at the reflector must not exceed a certain value. If a critical temperature is reached, the footwell module (FRM) will deactivate the cornering lights. After a cooling-down period, the cornering light can be switched on again.

> **E70; E71, E72 with series launch**

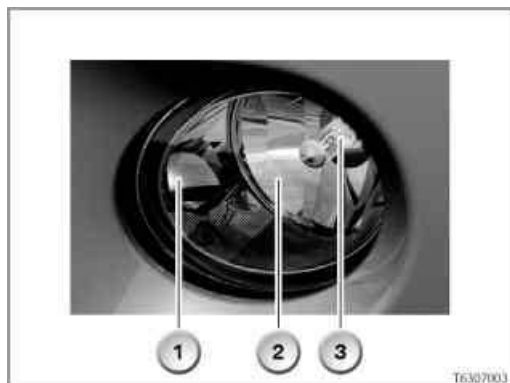
The cornering lights are implemented with the front fog lights. (Reason: The installation position of the headlights is too high for the cornering lights. This prevents legal specifications from being adhered to.)

Depending on activation, the right-hand and/or left-hand front fog light is switched on. The cornering lights are activated by the light module (LM).

The front fog lights have an additional reflector to improve illumination of the areas to the sides.

When turning, the front fog light on the inside of the turn is automatically activated. The additional reflector for the cornering light reflects the light beam towards the turning area.

The cornering light is not switched on suddenly but rather dimmed in accordance with special time parameters. Depending on the country concerned, the turning light is switched on when cornering.



The graphic shows the front fog light on the E70

- 1) Additional reflector for the cornering light
- 2) Reflector for the front fog lights
- 3) Bulb

The following prerequisites must be satisfied for the cornering lights to be **switched on**:

- Terminal 15 ON
- Light switch in position "A" ("A" stands for automatic driving lights control)
- Rain/light sensor identifies twilight or darkness (threshold value exceeded)

and

- Turn indicator ON (not one-touch flashing)
- Speed range (forwards travel):
 - European and Japanese version from 0 km/h to 35 km/h
 - US version from 0 km/h to 65 km/h
- Swivel angle (theoretical):
 - In stationary mode $\geq 77^\circ$
 - While driving $\geq 10^\circ$

or

- Speed range (reversing):
 - 0 km/h to 35 km/h
- Swivel angle (theoretical):
 - during stationary mode or driving $\geq 70^\circ$

If the vehicle is stationary, the cornering lights will automatically be deactivated after a certain time, e.g. when waiting at traffic lights. However, the cornering lights can be switched on again using the turn signal/high beam switch

The following prerequisites must be satisfied for the cornering lights to be **switched off**:

- Light switch not in position "A" ("A" stands for automatic driving lights control)
- Rain/light sensor does not identify twilight or darkness (fallen below lower threshold value)

or

- Turn indicator OFF
- Speed range (forwards travel):
 - European and Japanese versions ≥ 40 km/h
 - US version ≥ 70 km/h
- Swivel angle (theoretical):
 - In stationary mode 77°
 - During driving 10°

or

- Speed range (reversing): ≥ 40 km/h
- Swivel angle (theoretical): when in stationary mode and when driving below a certain value

or

- Vehicle skids and swings out.

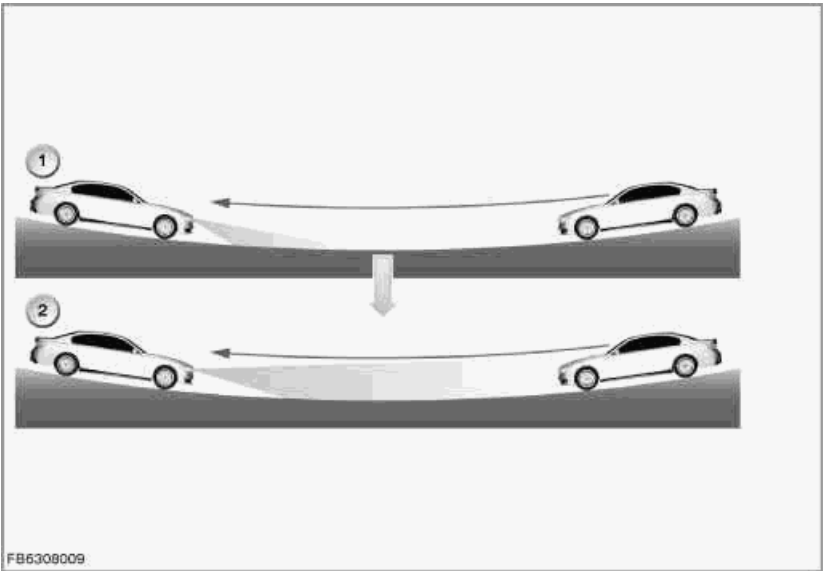
or

- Front fog lights are switched on with the front fog lights switch.

Adaptive headlight beam throw adjustment

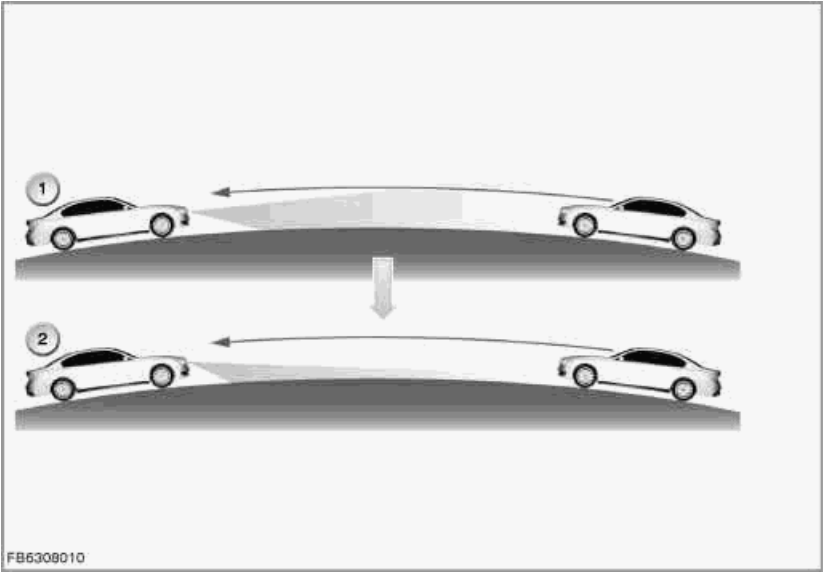
The adaptive headlight beam throw adjustment is employed when driving through dips and over crests. In accordance with a request from the control unit, the headlight driver module activates the swivel module via the stepper motors and in this way adjusts the headlight beam throw.

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.



<u>Index</u>	<u>Explanation</u>	<u>Index</u>	<u>Explanation</u>
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.



<u>Index</u>	<u>Explanation</u>	<u>Index</u>	<u>Explanation</u>
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. In accordance with a request from the control unit, the headlight driver module activates the swivel module via the stepper motors and in this way adjusts 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). 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 link headlight is moved approx. 12° to the left and approx. 0.7° downwards. The city light distribution is activated from engine start to a driving speed of approx. 50 km/h.

- **Country road light distribution**

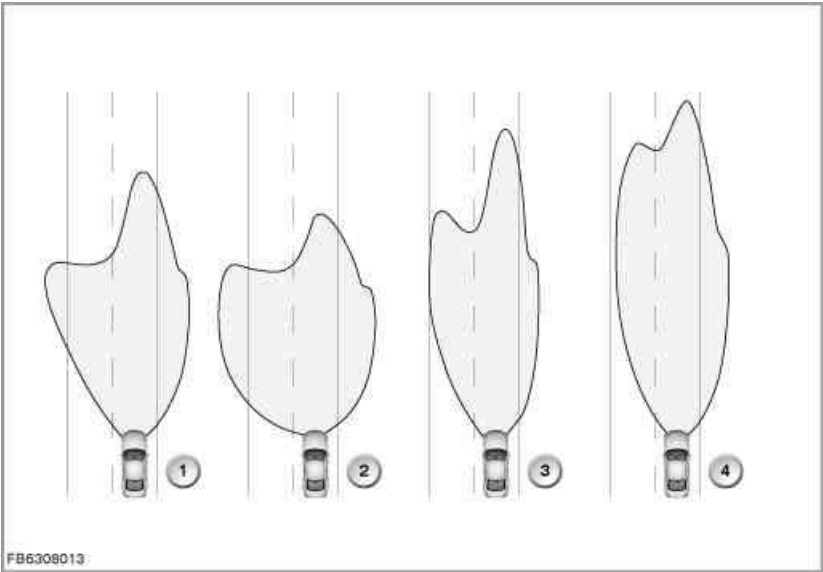
The country road light distribution is the same as the standard low-beam headlights. At a driving speed above approx. 50 km/h, the city light distribution is changed to the country road light distribution. Below a driving speed of approx. 50 km/h, the footwell module (FRM) changes the light distribution back to city. 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° downwards. The right headlight is moved approx. 0.2° upward. If the vehicle speed exceeds 110 km/h for longer than 30 seconds, or if 140 km/h is exceeded, the footwell module switches on the motorway light distribution. 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. The link headlight is moved approx. 8° to the left and approx. 0.7° downwards. 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.



Index	Explanation	Index	Explanation
1	City light distribution	2	Fog light distribution

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

Switch-on conditions

The control unit for adaptive headlights is "awake" from terminal 15 ON. The movement of the lights is subject to the following preconditions:

- Reverse gear must **not** be engaged.
- The system is trouble-free (indicator light **not** flashing and no Check Control message)
- The bulbs for the bi-xenon headlights are OK in both headlights.
- The vehicle must not be skidding or fishtailing.
- The rain/light sensor must identify darkness.
- Additional switch-on conditions: automatic driving lights control is active (light switch position "A", see above).

Notes for Service department

Warning! Exercise caution when working on bi-xenon headlights

Whenever checking or working on the headlights, always observe the safety regulations and accident prevention regulations. The headlight system has dangerously high voltage.

- General information: [\[more ...\]](#)
- Diagnosis: [\[more ...\]](#)
- Encoding/programming: [\[more ...\]](#)
- Car & Key Memory:

> E60, E61, E63, E64, E65, E66

The sensitivity of the driving light sensor can be set to one of 2 stages with the Car & Key Memory.

> E70, E71, E72, E81, E82, E87, E88, E89, E90, E91, E92, E93

All Car & Key Memory functions are programmed inside the vehicle itself.

(Please refer to the "Personal profile" section of the Owner's Handbook: Personal profile for a maximum of 3 infrared remote keys via the display in the instrument panel or via the Central Information Display.)

National-market version

The options "Daytime driving lights" and "Manual headlight beam throw adjustment" are available in certain countries. Vehicles with manual headlight beam throw adjustment do not have adaptive headlights. This is because vehicles with manual headlight beam throw adjustment have low-beam halogen headlights. Adaptive headlights (optional equipment 524) are only available in conjunction with optional equipment 522 "Xenon light for dipped and main-beam headlights".

Switching on adaptive headlights in conjunction with daytime driving lights function

The optional equipment "daytime driving lights" (Northern Europe and Canada) means that

Low-beam headlights and side lights (E70, E92, E93: daytime driving lights) are **always** switched on:

- Light switch in position "2"
- Terminal 15 ON

The automatic headlight beam throw adjustment is active (actuated by the control unit for adaptive headlights).

If terminal 15 is switched off, the low-beam headlights and the side lights are automatically switched off as well.

The light switch must also be set to position "A" with the optional equipment "Daytime driving lights". The control unit for adaptive headlights is then in standby.

System functions for optional equipment "Daytime driving lights" when the light switch is set to position "A":

- If the vehicle is encoded with the optional equipment "Daytime driving lights" (end of line), the light switch can remain in position "A" at all times.

When terminal R is switched on, the side lights, parking lights and number-plate lights are switched on.

As soon as terminal 15 is switched on, the low-beam headlights are also switched on.

- When the low-beam headlights are switched on, the control unit for adaptive headlights is activated (for automatic headlight beam throw adjustment).
- The indicator light on the light switch lights up and indicates the system's operational readiness.
- The adaptive headlights turn when the vehicle is stationary if the steering-wheel angle is turned (to the right only).
- The headlights are moved during cornering if the rain/light sensor identifies darkness.

The switch-on conditions for the adaptive headlights in conjunction with optional equipment "Daytime driving lights" are as follows:

- The vehicle must be encoded with the optional equipment "Daytime driving lights" (end of line)
- The light switch must be in position "A"
- Terminal 15 must be switched on and reverse gear must not be engaged
- Rain/light sensor must identify darkness

We can assume no liability for printing errors or inaccuracies in this document and reserve the right to introduce technical modifications at any time.