# Table of Contents

## BMW Night Vision




Initial Print Date: 03/06 Revision Date:

# BMW Night Vision

## Model: E60, E61, E63, E64, E65, E66

## Production: March 2006

# OBJECTIVES

After completion of this module you will be able to:

- Familiarize yourself with the technology used in the BMW Night Vision system
- Know which components are responsible for the system's operation
- Understand how to utilize the BMW Night Vision Feature
- Know the benefits to having this technology in the vehicle

# Introduction

The BMW Night Vision system provides the driver with a black-and-white image of the driving environment ahead of the vehicle in the central information display (CID).

BMW Night Vision is a 100% passive system without active infrared illumination. Objects situated ahead of the vehicle are shown in varying degrees of brightness depending on the temperature of these objects. This enables the driver to detect in good time heat-emitting objects such as people, animals, and other vehicles.

This thermal image is recorded with a Far Infrared camera (FIR) via a special imaging sensor which detects the infrared radiation in a specific wavelength range.

The BMW system is distinguished from infrared systems with active illumination by its resistance to dazzling, its long range, and its clearly structured image.

**Image taken from CID**

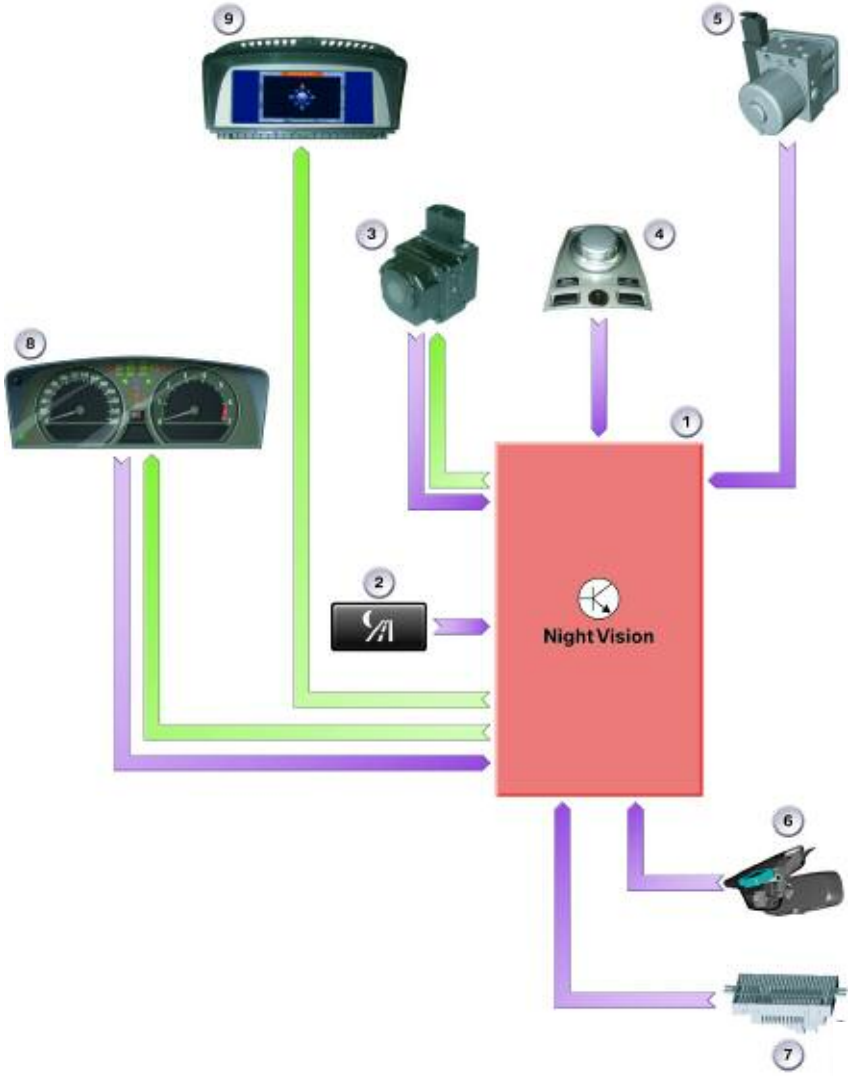
The system offers the following advantages:

- Improved vision in conditions of dusk and darkness
- No dazzling by the headlights of oncoming vehicles
- Highlighting of unilluminated, heat-emitting objects such as pedestrians, cyclists vehicles and deer, etc.
- Better overview of the driving situation thanks to the depiction of the route of the road beyond the headlight cone
- Enlarged depiction thanks to the zoom function of objects in the far distance at high speeds
- Illumination of bends/curves thanks to the bend/curve mode (pivoting of image detail)
- Illumination of dark courtyard and garage entrances

**Note: The driving speed must be adapted to the relevant visibility conditions in each case. BMW Night Vision is designed as a supporting system, which, with a modified driving style, affords the driver an early, better overview of the road conditions ahead of the vehicle.**

# System Overview

### IPO Diagram (E65/E66)




| Index | Explanation |
|---|---|
| 1 | Night Vision control unit |
| 2 | Button in light switch center |
| 3 | Night Vision camera |
| 4 | Controller |
| 5 | Dynamic Stability Control |
| 6 | Rain/light sensor |
| 7 | Light module |
| 8 | Instrument cluster |
| 9 | Control display |

## Connection of Control Units

### Control Unit and Camera

The Night Vision control unit and the Night Vision camera are connected via the following cables:

- LIN bus;
  Diagnosis, programming and camera control
- Sym. Video;
  Video signal from the camera
- CAN_POW;
  Power supply from control unit to camera, heating of camera lens
- Ground;
  Common earth/ground of camera and control unit for suppressing interference

The video signal between the camera and the control unit is transmitted via two cables as a symmetrical, Analog video differential signal.

In the control unit the differential signal is converted into a CVBS signal and, depending on the equipment specification, transmitted to the navigation system or the video module.

The camera is powered under the following conditions:

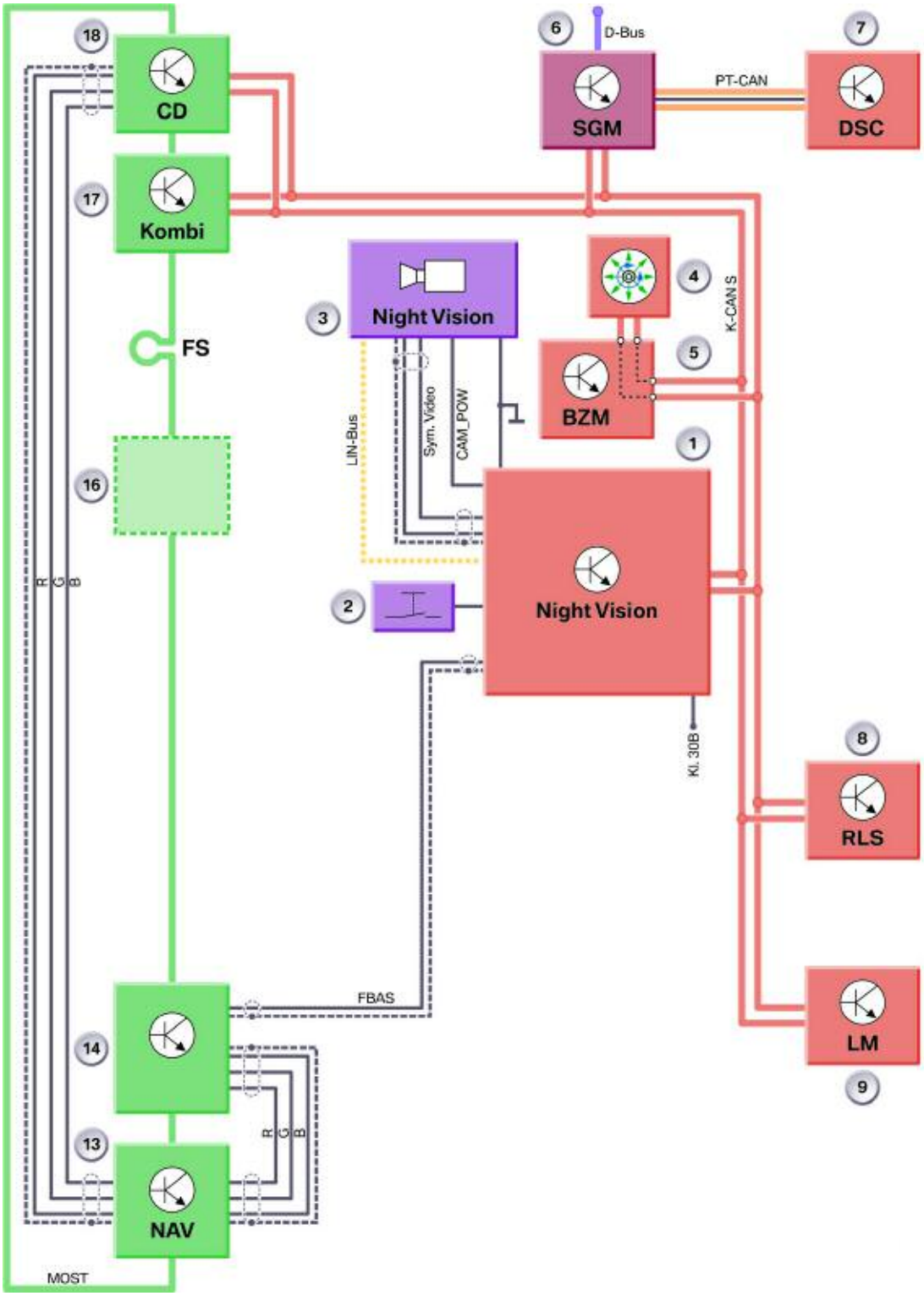
- Switching on of BMW Night Vision by the button in the light switch center
- Rain/light sensor detects dusk/half-light (driving lights are switched on)

The BMW Night Vision control unit is powered by the front distribution box via term. 30B.

### K-CAN

The K-CAN connection of the Night Vision control unit serves to transmit the diagnosis and programming data and to read out the information from the RLS (brightness), the LM (driving lights on) and DSC (yaw rate, speed and steering angle). The signals from DSC are placed on the K-CAN via the SGM. In addition, the control unit receives information on the terminal status via the K-CAN.

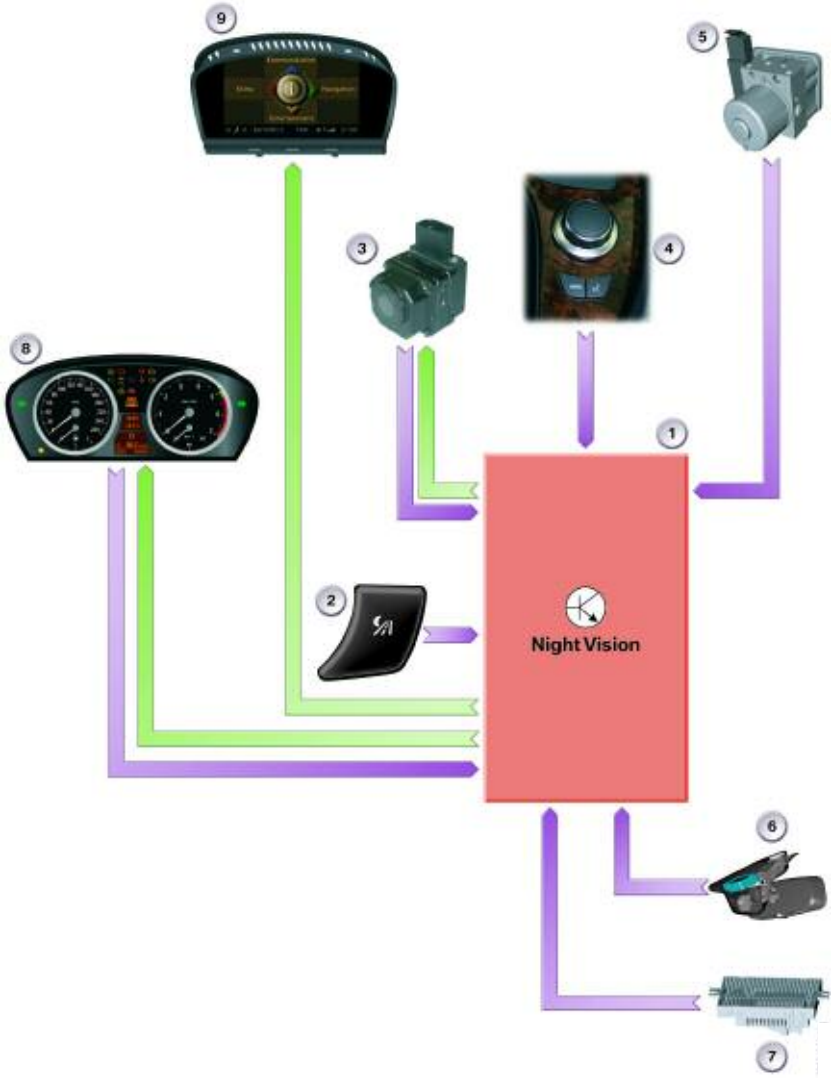
**System Circuit Diagram (Front Equipment - E65/E66)**



**Legend for System Circuit Diagram**

| Index | Explanation | Index | Explanation |
|---|---|---|---|
| 1 | Night Vision ECU | 18 | Control Display |
| 2 | Button in Light Switch Center | D-Bus | Diagnosis Bus |
| 3 | Night Vision Camera | PT-CAN | Powertrain CAN |
| 4 | Controller | K-CAN | Body CAN |
| 5 | Center Console Switch Cluster | MOST | Media Oriented System Transport |
| 6 | Safety Gateway Module | LIN-Bus | Local Interconnect Network Bus |
| 7 | Dynamic Stability Control | Kl. 30B | Continuous Positive |
| 8 | Rain/light Sensor | Sym. Video | Symmetrical, Analog Video Differential Signal |
| 9 | Light Module | CAN_POW | Power Supply, Night Vision Camera |
| 13 | Navigation System | RGB | Red-Green-Blue Video Signal Cable |
| 14 | Video Switch, Drive | FBAS | Composite Video Burst Synchronization Signal |
| 16 | MOST Components (optional) | FS | MOST Direct Access |
| 17 | Instrument Cluster | | |

## IPO Diagram (E60/E61/E63/E64)




| Index | Explanation |
|---|---|
| 1 | Night Vision Control Unit |
| 2 | Night Vision Button on Light Switch |
| 3 | Night Vision Camera |
| 4 | Controller |
| 5 | Dynamic Stability Control |
| 6 | Rain/Light Sensor |
| 7 | Light Module |
| 8 | Instrument Cluster |
| 9 | Central Information Display |

## Connection of Control Units

### Control Unit and Camera

The Night Vision control unit and the Night Vision camera are connected via the following cables:

- LIN bus;
  Diagnosis, programming and camera control
- Sym. Video;
  Video signal from the camera
- CAN_POW;
  Power supply from control unit to camera, heating of camera lens
- Ground;
  Common ground of camera and control unit for suppressing interference

The video signal between the camera and the control unit is transmitted via two cables as a symmetrical, Analog video differential signal.

In the control unit the differential signal is converted into a CVBS signal and, depending on the equipment specification, transmitted to the navigation system or the video module.

The camera is powered under the following conditions:

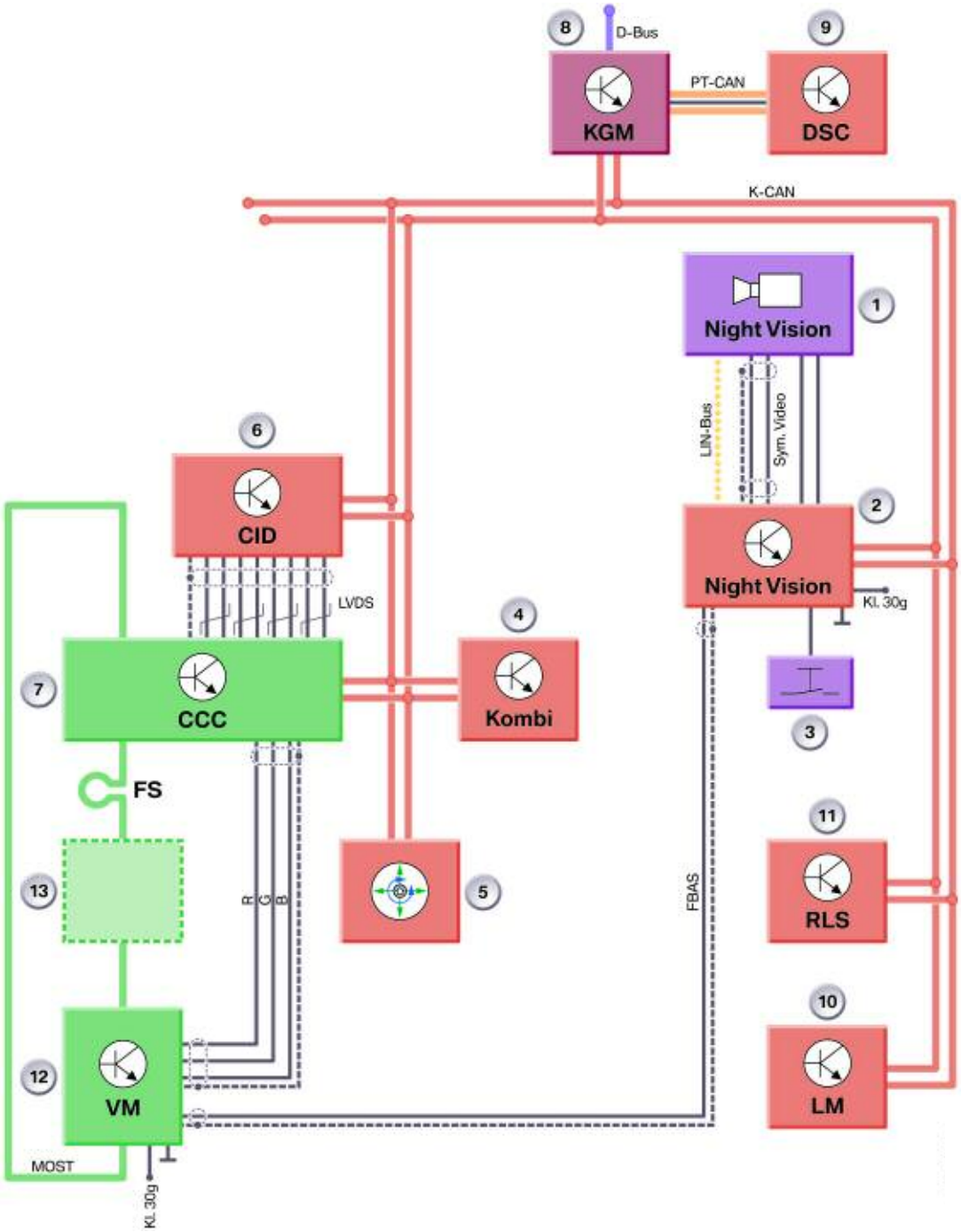
- Switching on of BMW Night Vision by the button in the light switch center
- Rain/light sensor detects dusk/half-light (driving lights are switched on)

The BMW Night Vision control unit is powered by the front distribution box via term. 30B.

### K-CAN

The K-CAN connection of the Night Vision control unit serves to transmit the diagnosis and programming data and to read out the information from the RLS (brightness), the LM (driving lights on) and DSC (yaw rate, speed and steering angle). The signals from DSC are placed on the K-CAN via the KGM. In addition, the control unit receives information on the terminal status via the K-CAN.

## System Circuit Diagram (E60/E61/E63/E64)



**Legend for System Circuit Diagram (E60/E61/E63/E64)**

| Index | Explanation | Index | Explanation |
|---|---|---|---|
| 1 | Night Vision Camera | 13 | MOST Components (optional) |
| 2 | Night Vision Control Unit | D-Bus | Diagnosis Bus |
| 3 | Button in Light Switch Center | PT-CAN | Powertrain CAN |
| 4 | Instrument Cluster | K-CAN | Body CAN |
| 5 | Controller | MOST | Media Oriented System Transport |
| 6 | Central Information Display | LIN-Bus | Local Interconnect Network Bus |
| 7 | Car Communication Computer | Sym. Video | Symmetrical, Analog Video Differential Signal |
| 8 | Body Gateway Module (KGM) | CAN_POW | Power Supply, Night Vision Camera |
| 9 | Dynamic Stability Control | RGB | Red-Green-Blue Video Signal Cable |
| 10 | Light Module | FBAS | Composite Video Burst Synchronization Signal |
| 11 | Rain/light Sensor | FS | MOST Direct Access |
| 12 | Video Switch, Drive | | |

# System Components

## Components

The BMW Night Vision system consists of the following components:

- Night Vision camera with camera bracket and camera washer jet
- Night Vision control unit
- Button in light switch center
- Sensor system


**Night Vision installation Locations**

| Index | Explanation |
|---|---|
| 1 | Night Vision Control Unit |
| 2 | Control Display |
| 3 | Controller |
| 4 | Instrument Cluster |
| 5 | Button in Light Switch Center |
| 6 | Night Vision Camera |

## Night Vision Camera

The thermal imaging camera consists of a heated optical element and a thermal imaging sensor. The thermal imaging sensor is made up of a multitude of sensor elements.

Each display pixel is assigned one such sensor element. The sensor elements generate an electrical signal as a function of the impinging intensity of heat radiation.

The higher the temperature, the brighter the corresponding pixel will be displayed. The heat radiation is converted into electrical signals on the basis of the principle of a change in resistance.

**Camera with Bracket (E65 shown)**

The image can be replaced up to 60 times per second. In order to ensure an image of consistent quality, it is necessary for the camera to be calibrated roughly every 120 seconds. This calibration can take up to approx. 0.5 seconds. For this reason, the image may be seen to freeze in the display.

The Night Vision camera is mounted with a bracket directly behind the left ventilation grille on the bumper mounting bracket.

The camera is equipped with a sensor which detects heat-emitting objects in the Far Infrared range (wavelengths from 8 μm to 15 μm).

The camera resolution is 320 x 240 pixels. The maximum angle of view is 36°. The calculations for the "Bend/curve mode" functions are made in the camera. The camera operates in an ambient-temperature range of - 104°F to 185°F (40°C to +85°C). The camera and imaging sensor are thermally insulated to provide protection against heat influences from the camera surroundings.

The washer jet is screwed to the camera bracket and is situated directly above the camera's front lens. It is directly connected to the headlight washer system and therefore operates in conjunction with the latter.

A heater element is incorporated on the inside of the camera-housing cover to prevent the optical element from misting over or freezing up. The heater is activated when the rain/light sensor detects precipitation or at temperatures below 32°F (0°C).

## Night Vision Control Unit

The control unit is accommodated in the front device holder behind the glovebox.

**12-pin Plug Connection**

The control unit increases the image data from the camera from 320 x 240 pixels to 640 x 480 pixels. Only one detail is shown in the control display. 640 x 240 pixels are displayed when the "Full screen" function is activated while 400 x 240 pixels are displayed for the splitscreen function. The diagnosis, programming and coding data are transmitted to the camera via the control unit.

The camera and the front-lens heater are powered via the control unit. In addition, the control unit converts the symmetrical image data from the camera into a CVBS signal and, depending on the equipment specification, makes this signal available to either the navigation system or the video module.

The Night Vision control unit is accommodated in the front device holder behind the glovebox.

The camera-housing cover features a 12-pin plug connection.

## Button in Light Switch Center

The button for switching BMW Night Vision on and off is integrated in the light switch center.

**Switch/Button on E65/66**

**Switch/Button on E60/E61/E63/E64**

# Principles of Operation

The BMW Night Vision camera is a thermal imaging camera, which converts thermal radiation into electronic signals and then into images visible to the human eye.

The thermal image is converted first by the sensor into electrical signals and then with the aid of image-processing software into a visible image in the control display.

The sensor elements alter the resistance in proportion to the temperature. The higher the temperature, the higher the electrical signal and the whiter the pixel will be shown.

Thanks to increased dynamic sensitivity, the sensor can generate a new image up to 60 times per second. This results in a softer and clearer image.

Heat radiation is absorbed and dissipated by virtually every solid or liquid body. Heat radiation, however, is not visible to the human eye because it belongs in the long-wave infrared range. From a physical standpoint, this represents electromagnetic waves with a wavelength of 8 μm to 15 μm. This long-wave infrared radiation is known as Far Infrared (FIR).

The advantage of utilizing radiation in the Far Infrared range is the greater range compared with Near Infrared systems with a wavelength of 0.7 μm to 1.4 μm. These systems require illumination with just this wavelength.

Essentially, FIR systems consist of an optical element, a thermal imaging camera, an control unit and a display.

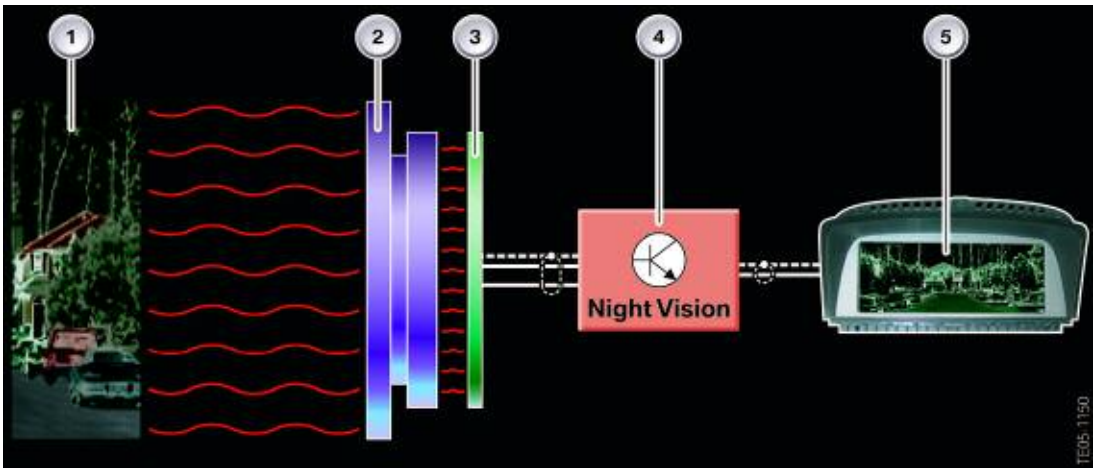



**Diagram Representing Principle of Operation**

| Index | Explanation | Index | Explanation |
|---|---|---|---|
| 1 | Environment ahead of vehicle | 4 | BMW Night Vision control unit |
| 2 | Optical element | 5 | Central Information Display |
| 3 | Thermal Imaging Sensor | | |

## Switch-On Conditions

BMW Night Vision is activated as soon as the button in the light switch center is pressed.

The following basic conditions can exist:

- The rain/light sensor detects sufficient ambient light and the driving lights are switched off; BMW Night Vision is ready for operation approx. 2 seconds after the button in the light switch center is pressed. A message is shown in the control display during this period of 2 seconds.
- The rain/light sensor detects insufficient ambient light and the driving lights are switched on; BMW Night Vision is ready for operation immediately after the button is pressed.
- In conditions of darkness (underground car park), the driving lights are switched off and the driving speed is less than 5 km/h; BMW Night Vision is ready for operation after the button in the light switch center is pressed.

**Switch/Button on E65/66**

**Switch/Button on E60/E61/E63/E64**

BMW Night Vision cannot be activated when:

- the driving lights are switched off,
- the rain/light sensor detects insufficient ambient light, and
- the driving speed is greater than 5 km/h

Once BMW Night Vision has been activated, a message appears in the control display to the effect that the system cannot be used at night without driving lights.

## Operation by iDrive

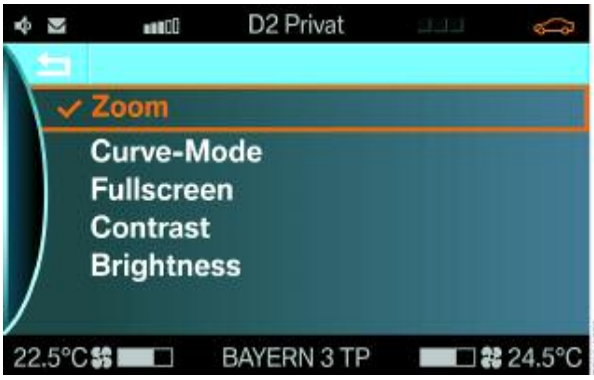
### Calling up Settings

The individual functions and settings can be selected and activated via the iDrive.

The following settings can be called up:

- Night Vision off (not E65)
- Zoom
- Curve mode
- Full screen
- Contrast
- Brightness

A tick/check symbol indicates when zoom, bend/curve mode or full screen is activated.




**E65/E66 Settings Menu**


**E60/E61/E63/E64 Settings Menu**

### Calling Up Menu

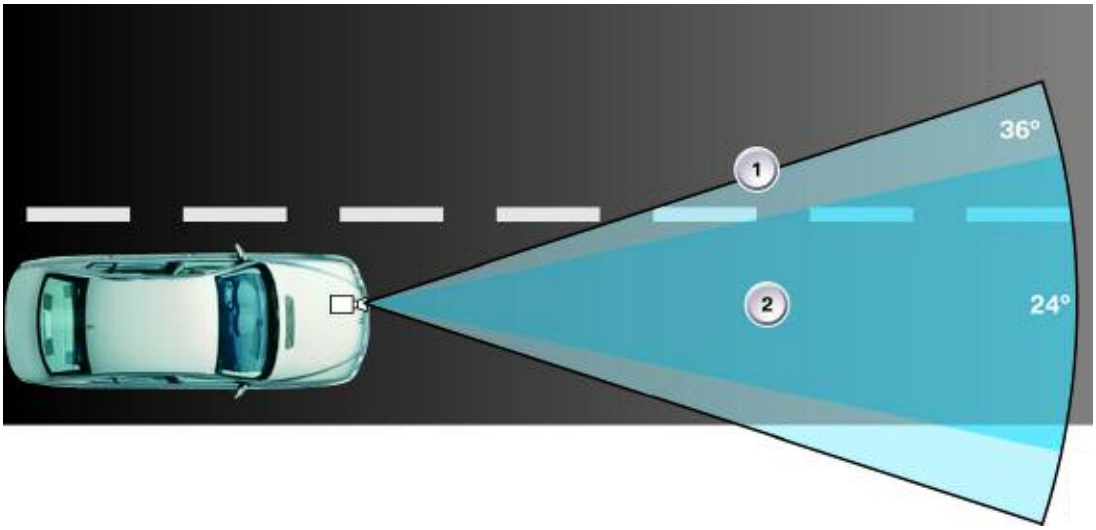
The BMW Night Vision menu can only be called up when the system is activated.

When the preconditions are in place, the menu can be called up for example from the Start menu as follows:

- Briefly press the controller. The "BMW Night Vision" menu appears in the control display
- Select the desired menu item, e.g. "Brightness", by turning the controller
- Press the controller to activate the function
- Set the desired value and confirm by pressing
- Select the menu item "Back" and quit the "BMW Night Vision" menu

## Zoom - Angle of View of Camera

When the "Zoom" function is activated, BMW Night Vision automatically switches to a 1.5 times enlargement of the display at speeds in excess of 44 mph (70 km/h). The camera's angle of view is reduced to 24° here. Zoom is deactivated automatically again when the speed drops below 37 mph (60 km/h). The camera's angle of view reverts to 36°. Zoom is calculated by the camera.




Angle of View of Camera

| Index | Explanation |
|---|---|
| 1 | Angle of view of 36° without zoom |
| 2 | Angle of view of 24° with zoom |

**Note: The "Zoom" function can only be selected when the "Full screen" function is deactivated.**

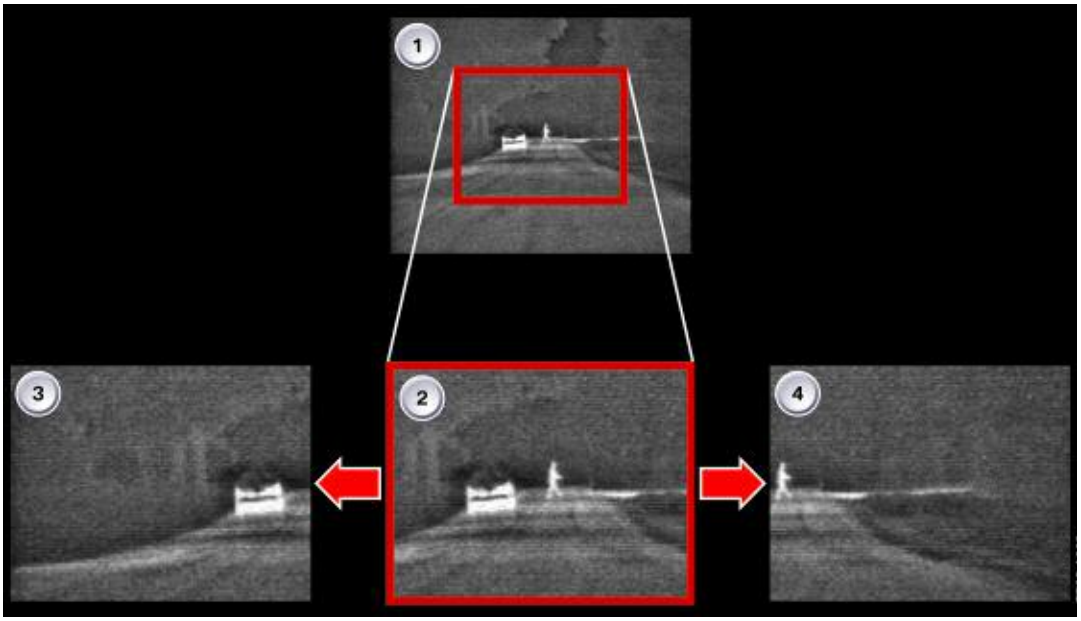
## Bend/Curve Mode

Depending on the driving situation, the image detail follows the cornering path of the vehicle along the same lines as the directional headlights.

The image detail is calculated in the camera.

Bend/curve mode is only available when the "Zoom" function is activated.

For better understanding, the following graphic shows a driving situation in which the "Bend/curve mode" function is activated.




| Index | Explanation |
|---|---|
| 1 | Driving situation without zoom |
| 2 | Driving situation with zoom, direction of travel |
| 3 | Cornering to the left, enlarged 1.5 x |
| 4 | Cornering to the right, enlarged 1.5 x |

## Full Screen

In the case of the "Full screen" function, the Assist window is removed and the thermal image is shown over the entire width of the control display. 640 x 240 pixels (for full screen) and 400 x 240 pixels (for split screen) are used to display the BMW Night Vision image.


**Full Screen in Control Display**

## Contrast and Brightness

Both values can be personalized and changed on a scale between -10 and 10.


**Adjusting Brightness**

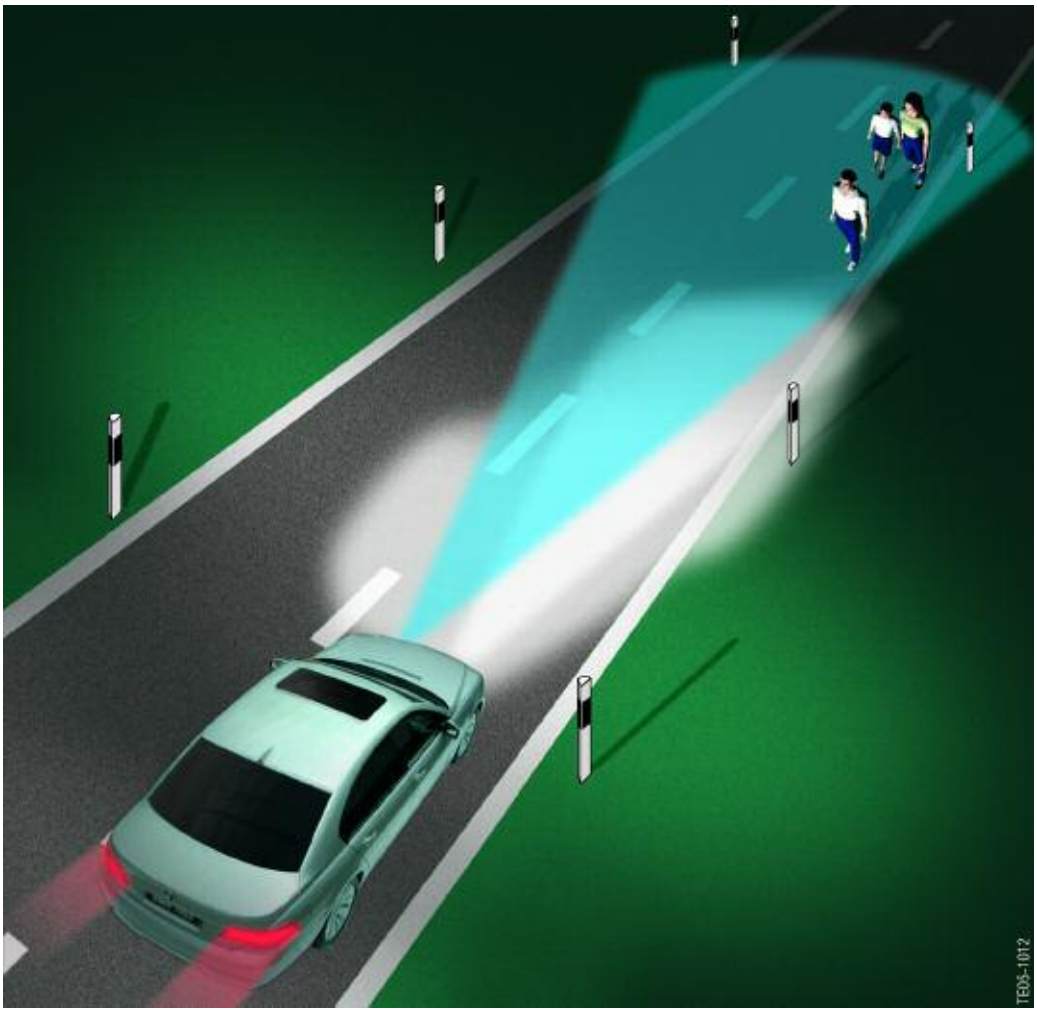
## Visibility

Normal driving-light illumination is approximately 328 ft (150 m).

The use of BMW Night Vision enables heat emitting objects to be detected up to a distance of approx. 984 ft (300 m).

This specified distance is dependent on weather factors.

For example, heavy fog or rain reduces visibility.




**Comparison of BMW Night Vision Visibility with Different Vehicle Headlights**

**The driving speed must be adapted to the relevant visibility conditions in each case. BMW Night Vision is designed as a supporting system, which, with a modified driving style, affords the driver an early, better overview of the road conditions ahead of the vehicle.**

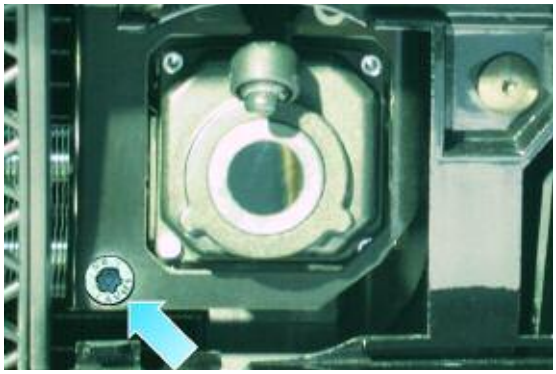
# Service Information

## Axial Camera Adjustment

The camera can be axially readjusted by means of an adjusting screw on the housing.

The following procedure must be performed:

- Detach the left ventilation grille from the front spoiler
- Position the headlight aiming device in front of the vehicle
- Engage a Torx screwdriver and move the camera to the desired position
- Reassemble all parts that have been removed in reverse order



**Camera Adjustment**

## Vertical Camera Adjustment

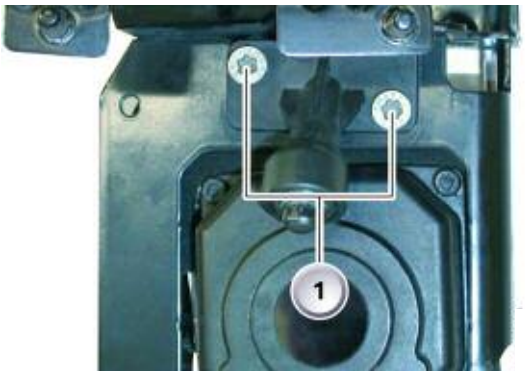
Vertical camera adjustment should be adjusted until the horizontal plane is centered on the CD/CID. This adjustment is only possible through a test plan in the BMW tester.

## Replacing Camera Washer Jet

A washer jet with a direct connection to the headlight washer system for cleaning the lens is mounted on the camera.

Follow the procedure below to replace the washer jet:

- Detach the left ventilation grille from the front spoiler
- Release the two Torx screws (1)
- Release the hose clamp on the connecting hose to the headlight washer system and detach the washer jet towards the front
- Reinstall all parts that have been removed in reverse order




**Washer Jet Mounting Position**

**Note: Please refer to the repair instructions for more detailed information on removing the camera and washer jet.**

## Displays in Event of a Fault

The following warnings are displayed if the camera is faulty:

- Check control icon in the instrument cluster
- A symbol/description is also shown in CD or CID
- Check control message in the cluster under the tachometer (E65/E66 only)


**Displays in Event of a Fault (E65/E66)**


**Displays in Event of a Fault (E60/E61/E63/E64)**

## Initialization

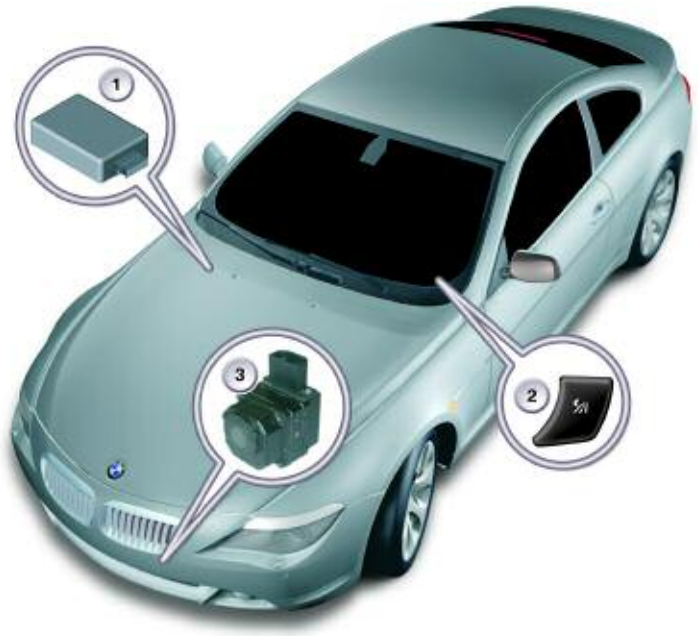
When replacing the camera, it is always necessary to initialize the software by entering a clearance code (FSC).

The camera is programmed by means of a control unit. The control unit receives the programming and coding data for the camera via the K-CAN. The control unit forwards these data to the camera via the LIN bus.

## Component Location

### E65/E66


### E60/E61/E63/E64




| Index | Explanation |
|---|---|
| 1 | Voltage regulator |
| 2 | Ignition output stage for belt force limiter |
| 3 | Igniter pellet for belt force limiter |