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E70 Rear-view Camera (RFK)

Initial Print Date: 10/06 Revision Date:

Rear-view Camera

Model: E70

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Describe the functions of the E70 Rear-view camera.
- Diagnose and Service components and functions of the E70 Rear-view camera.

Introduction

Rear-view Camera

The Rear-view camera system (RFK) serves to assist the driver when driving into/out of parking spaces and maneuvering.

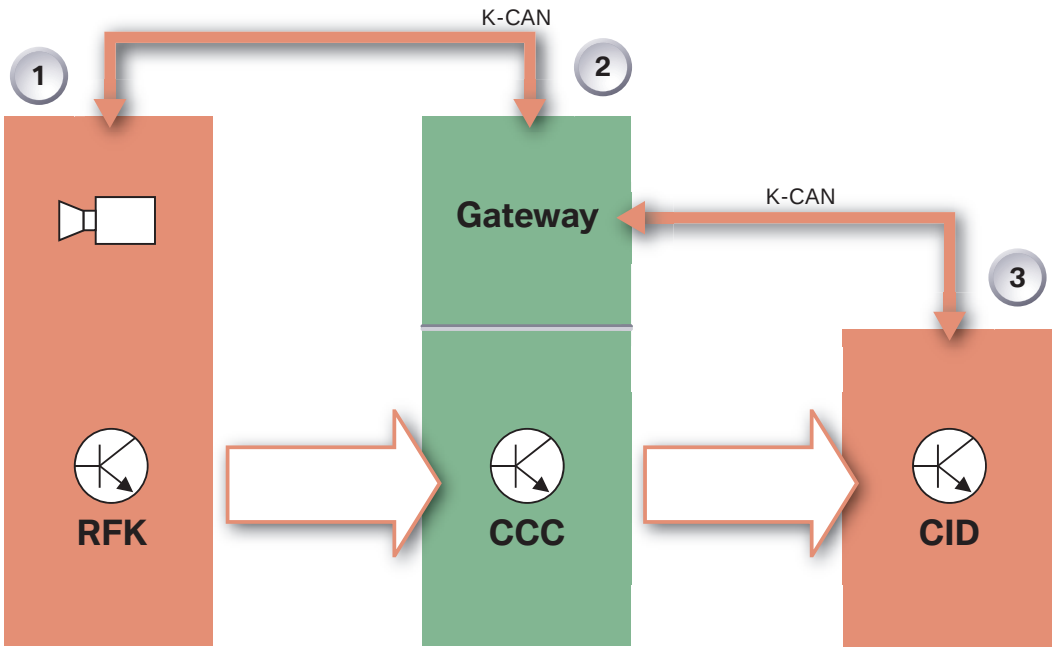
As well as showing a high-quality wide-angle image of the area behind the vehicle, the system contains a series of additional customer functions.

The system is located in the tailgate. The Rear-view camera is located offset to the right of vehicle center in the tailgate strip handle.

The Rear-view camera is activated automatically together with the park distance control by engaging reverse gear or manually by pressing the parking button. A wide angle color image of the area behind the vehicle is shown on the central screen. The electronic equalizer ensures natural perspectives in the image. Driver assistance graphics in the image show the calculated space requirement for parking into spaces and maneuvering referred to the current steering wheel position thus assisting the driver when parking into spaces. The shaded obstacle markings in the real camera image that are based on the ultrasonic sensor system help the driver (in addition to the PDC warning tone) to pay particular attention to obstacles and confined areas when parking into spaces and maneuvering. Selection menus on the central information display allow for interactive changes to the system settings. Automatic activation of the system can also be disabled in these menus. Following activation after opening the vehicle, the rear-view camera is not available before the navigation display is operational.

Range of Rear-view Camera

Input/Output



Index	Explanation
1	Rear-view camera system
2	Car communication computer
3	Central information display
K-CAN	Body CAN
MOST	Media Oriented System Transport

The rear-view camera is controlled by means of the K-CAN and MOST bus systems while the CCC acts as the gateway. The video signal is transmitted via a separate video link (CVBS, RGB) to the car communication computer. From there, the existing LVDS connection is used.

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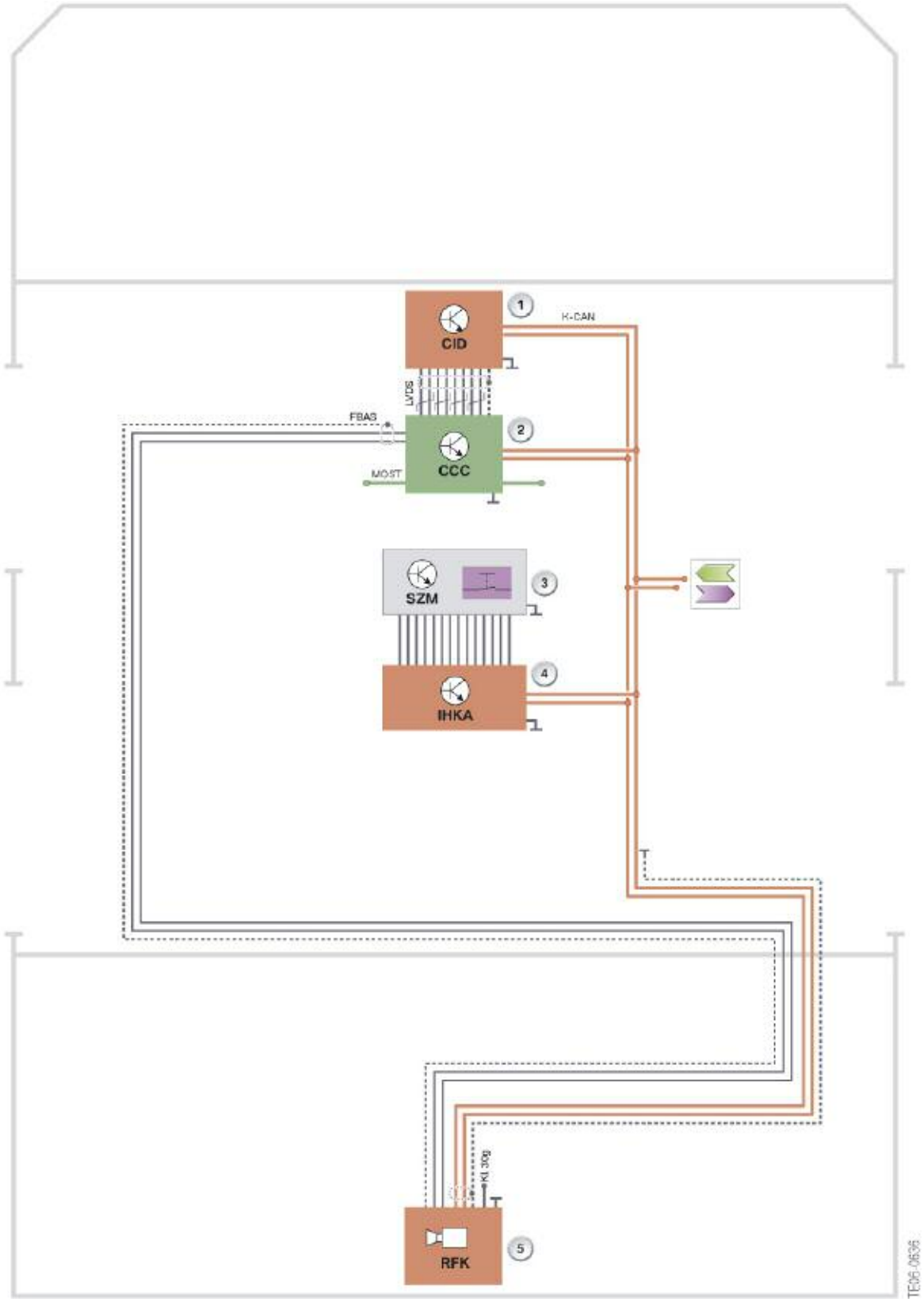
Rear-view Camera System Schematic



Legend for Rear-view Camera System Schematic

Index	Explanation
1	Central information display
2	Car communication computer
3	Center console switch cluster
4	Automatic climate control
5	Rear-view camera
6	Video module
K-CAN	Body CAN
LVDS	LVDS data line
FBAS	CVBS line
MOST	Media Oriented System Transport
KL 30g	Terminal 30g

K-CAN Signals at Rear-view Camera Control Unit

In/Out	Signal	Source	Function
In	PDC signals	PDC sensors PDC control unit	Information for superimposing distance graphics
In	PDC button	PDC button in center console Air conditioning control unit	Activation and deactivation of the Rear-view camera system
In	Road speed	Wheel speed sensors DSC control unit	Deactivation of Rear-view camera system from a speed of 20 km/h in forward driving Differentiation, forward driving/reversing
In	Configuration	Controller Head unit (Champ/CCC)	Configuration of displays and functions of Rear-view camera system
In	Steering wheel angle	Steering angle sensor Steering column switch cluster	Adaptation of lane help lines to the steer angle
In	Vehicle inclination	Ride-height sensor Footwell module/VDM	Adaptation of lane help lines to vehicle inclination
In	Outside temperature	Outside temperature sensor instrument cluster	Defrosting of rear-view camera lens
In	Distance travelled	Wheel-speed sensors DSC control unit	Rear-view camera system switches off display after a distance of 50 m in forward direction
In	Tailgate	Contact, tailgate CAS control unit	No lane help lines are superimposed when the tailgate is open
Out	CC messages	Head unit (Champ/CCC) > CID control unit	CC messages are forwarded to the existing head unit

Functions

Basic Functions of the Rear-view Camera System

The basic function of the rear-view camera system is to record optically a wide-angle view (about 120°) of the area behind the vehicle. The image is recorded via the lens in the rear-view camera system and then transmitted in electronically conditioned form to the car communication computer (CCC).

The video picture is transmitted via a video interface (CVBS, RGB). Communication for controlling the system in the entire vehicle and connection to the overall-bus system are effected via a K-CAN interface.

In addition, the rear-view camera system serves to show further assorted assistance information in the form of superimposed overlays (graphics and text) in the output signal (superimposed with the real camera picture).

Image Reproduction Functions

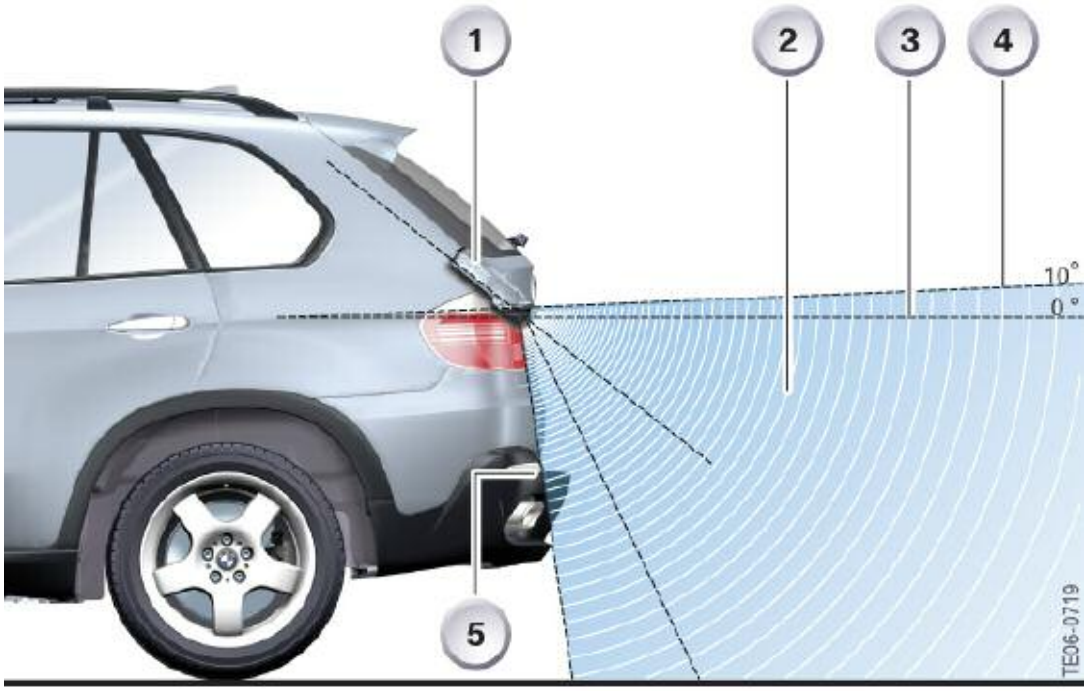
The rear-view camera system shows the view of the area behind the vehicle with a horizontal aperture angle of 120° on the central information display. The view can be shown on the navigation display in two modes:

Full image view 620x240 pixels

Main window view 400x240 pixels

Lens Coverage Alignment

The entire coverage area of the rear-view camera system ranges from the bumper at the bottom up to an angle of 10° from the horizontal at the top.



Index	Explanation
1	Rear-view camera system
2	Coverage range
3	Horizontal
4	Maximum possible upward coverage range (10° upward from the horizontal)
5	Rear bumper

Electronic Image Equalization

The rear-view camera features an electronic image equalizer. The equalizer serves the purpose of correcting the distortions in vertical and horizontal correction caused by the principle of the wide-angle lens. The equalization algorithm must be such that the secondary effects such as information loss in the form of blurred edges as well as distortion that occurs as part of the equalization process are minimized.

The aim is to achieve the most realistic representation of the view of the area behind the vehicle that can be unmistakably interpreted by the driver

View of Image Section

The Rear-view camera system always provides a view of a certain section of the overall image. This makes it possible to adapt to the external conditions of the vehicle. If the vehicle is parked on uneven ground so that it is not straight, the Rear-view camera system can adapt the video image corresponding to the incoming information.

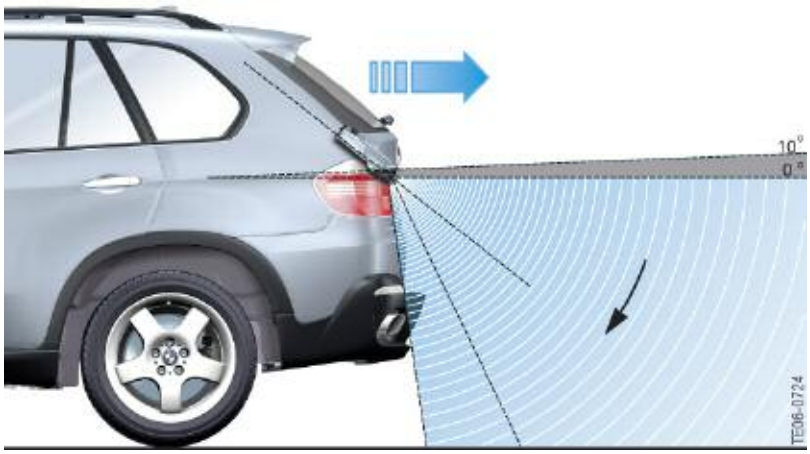
This function is required for realizing the functions described in the following:

- Virtual camera pan
- Image adaptation to vehicle inclination
- Software-based system calibration

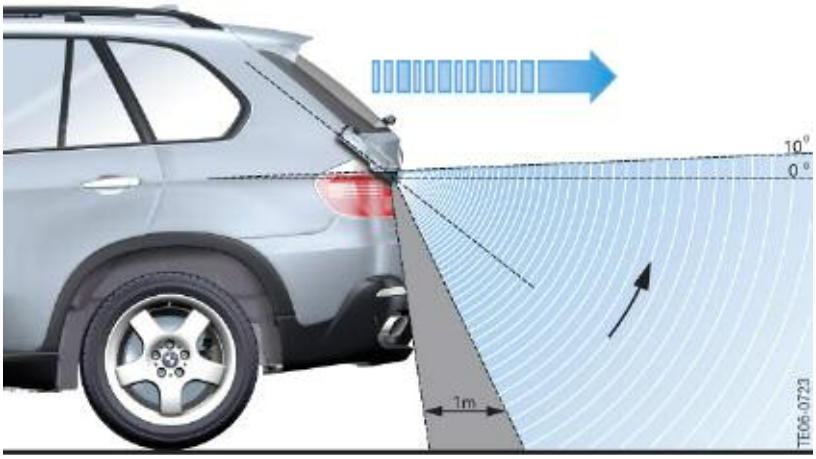
Virtual Camera Pan

Different areas are shown on the screen in vertical direction depending on the driving speed.

The bottom area of the image (from the bumper up to the horizontal) is shown when rear-view at slow speed (up to about 3mph)



Increasingly only the upper area of the image (from about 1m distance from the vehicle up to a minimum angle of 10° above the horizontal) is shown on the screen when rear-view at faster speed (more than 3 mph)



Camera Pan as a Function of Speed

The camera pans virtually without the camera moving mechanically. This function gives the driver a view of the area behind the vehicle adapted to the current speed. When driving at slow speed, the area very close to the rear of the vehicle is shown so that every detail can be recognized. At speeds above 3 mph, the upper section of the image is shown to provide an extended view.

Additional Functions of the Rear-view Camera System

Assistance Graphics in Camera Image

Assistance graphics are superimposed on the camera image to help the driver to park into spaces and maneuver.

The following assistance graphics can be superimposed:

- Lane help lines
- Turning circle lines
- Obstacle markings
- Zoom of towing hitch

Note: The brightness can be adjusted or the image completely switched off

Lane Help Lines

The lane help lines are used to show the predicted path of the vehicle and therefore the required maneuvering space depending on the current position of the steering wheel. The lane help lines are deactivated automatically when driving in forward direction.

Turning Circle Lines

The turning circle lines mark the minimum possible vehicle turning circle. These marks remain superimposed on the image also when driving in forward direction.

Only the relevant turning circle line is shown as soon as the driver turns the steering wheel. The opposite turning circle line is blanked out depending on the steering lock and is no longer shown at full lock.

Obstacle Markings

Obstacle markings shown in the real camera image are partly transparent overlays true to scale of the obstacle detected by the PDC. The obstacle distribution in the area behind the vehicle is shown as a 3D graphic. Its form, position and color depend on the distance to each of the four PDC sensors in the bumper. Through corresponding visualization with form and color, the way the obstacle markings are represented gives the driver a spatial perspective of the obstacle distribution about the area behind the vehicle. The view corresponds to the virtual PDC view.

Personal Profile

The settings last made by each user are stored in the Rear-view camera system and retrieved after corresponding identification. The following setting options can be stored in the rear-view camera depending on the vehicle key.

- Display format (full image, main window as well as permanently switch on/off camera image)
- Lane help lines (ON/OFF)
- Turning circle lines (ON/OFF)
- Obstacle markings (ON/OFF)
- Camera pan (ON/OFF)
- Image brightness (brightness value)

System Activation

System activation by driver The Rear-view camera system can be activated by the driver by pressing the parking aid button (PDC button) as from terminal 15. The system can no longer be activated at a speed higher than 12 mph

Automatic System Activation

Initially, the Rear-view camera system is ready to send data after engaging reverse gear (identification by CAN messages) and then sends an enquiry to the CCC. In response, the CCC gives the authorization to output the video signal. The rear-view camera video signal is output only after receiving this authorization.

A corresponding error message is sent in the form of a CC message in the event of the Rear-view camera system not being available.

System Deactivation

Automatic or Indirect System Activation.

The rear-view camera is deactivated automatically in response to the following conditions:

- After exceeding a certain preset speed Vmax - forward (about 12mph) as well as
- A preset distance (about 50m) when driving in forward direction.

Deactivation by Vehicle User

Deactivation by vehicle user (while image from the rear-view camera is shown on the CID) by:

- Operating iDrive (pop-up menu)
- Pressing the PDC button

The rear-view camera is activated again when reverse gear is engaged.

Permanent System Deactivation

The rear-view camera can be permanently deactivated in the 5th menu.

Rear-view Camera Design

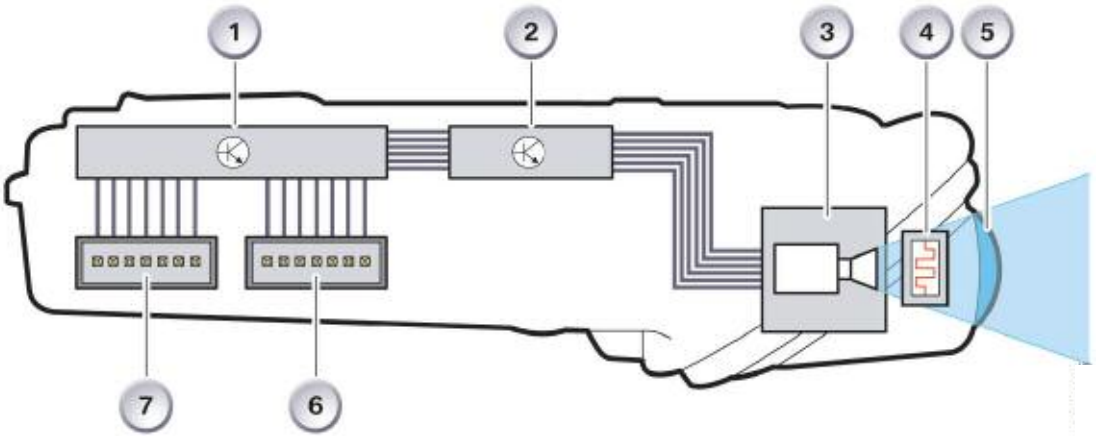
The rear-view camera is based on a CMOS sensor (Complementary Metal Oxide Semiconductor sensor) adapted for use in the vehicle with an integrated image processing unit for full-digital processing of the raw sensor data (up to 110 Mbits/s). The electronic circuitry is designed as a two-processor system. The image processing takes place in the electronic module. The following processing steps are executed:

- Histogram control - brightness and color adaptation to various exposure scenarios
- Image equalization - compensation of lens effects
- Superimposition of driver assistance line and camera pan
- Calibration functions

The tasks of bus communication, flash and boot routines and other standard applications are implemented in a separate microprocessor.

The lens with the 2.0 shutter is made up of 6 glass lenses.

It contains an automatically controlled heating element to de-ice the lens in winter. The heating element is largely controlled infinitely variable with a PWM control.



Index	Explanation
1	Processor for bus communication, flash and boot routines
2	Processor for all image conditioning functions
3	CMOS image sensor
4	Heater
5	Lens
6	Power supply and bus link connector
7	Signal output connector

Location or Rear-view Camera

The Rear-view camera system is installed on the right in the tailgate next to the tailgate lock. Tailgate seal A rubber seal seals off the housing of the rear-view camera from the tailgate.

Index	Explanation
1	Tailgate handle
2	Rear-view camera seal
3	Rear-view camera lens

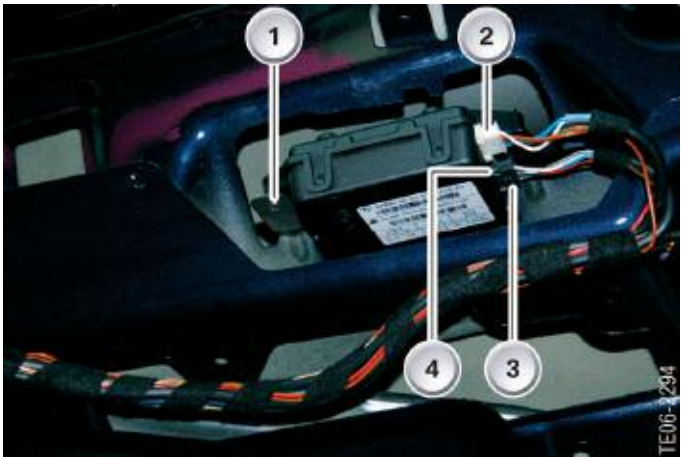
Mounting in the Tailgate

The rear-view camera is installed from the rear of the tailgate and secured to the housing by means of two screws.

Temperature-controlled Lens Thawing

In freezing conditions, the camera lens is heated and thawed automatically to keep it free of snow and ice.

Index	Explanation
1	Mounting screw
2	Connector, white (power supply and bus connection)
3	Mounting screw
4	Connector, black (video signal)



Service Information

Calibration of the Rear-view Camera

Note: In order to maintain the accuracy of the rear-view camera, a calibration procedure must followed as per the latest BMW Service information found in TIS or on the GT-1.