Technical training.
Product information.

F48 Driver Assistance Systems

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BMW Group University
Technical Training
ST1508 8/1/2015

BMW Service

General information

Symbols used

The following symbol is used in this document to facilitate better comprehension or to draw attention to very important information:

Contains important safety information and information that needs to be observed strictly in order to guarantee the smooth operation of the system.

Information status and national-market versions

BMW Group vehicles meet the requirements of the highest safety and quality standards. Changes in requirements for environmental protection, customer benefits and design render necessary continuous development of systems and components. Consequently, there may be discrepancies between the contents of this document and the vehicles available in the training course.

This document basically relates to the European version of left-hand drive vehicles. Some operating elements or components are arranged differently in right-hand drive vehicles than shown in the graphics in this document. Further differences may arise as a result of the equipment specification in specific markets or countries.

Additional sources of information

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

- Owner's Handbook
- Integrated Service Technical Application.

Contact: conceptinfo@bmw.de

The information contained in this document forms an integral part of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the latest relevant information systems of the BMW Group for any changes/additions to the technical data.

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F48 Driver Assistance Systems

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F48 Driver Assistance Systems

1. Introduction

The assistance systems facilitate driving of the vehicle by:

- providing the driver with information
- giving the driver suggestions or
- automatically intervening in the driving process.

This product information bulletin provides an overview of the assistance systems which are new or whose function has been modified:

- Collision warning with city braking function
- Pedestrian warning with city braking function
- Road sign recognition including no overtaking display
- Park Distance Control
- Parking Maneuver Assistant
- Rear view camera
- Cruise control

In the F48, a lot of the optional equipment known from other BMW models is still only available in conjunction with optional equipment packages Driving Assistant (SA 5AS) or Driving Assistant Plus (SA 5AT). The following table shows which systems are included in the different optional equipment packages:

System	Driving Assistant (SA 5AS)	Driving Assistant Plus (SA 5AT)	Standard equipment
High-beam assistant	X	X	
Lane departure warning	X	X	
Road sign recognition	X	X	
Collision warning with city braking function	X	X	X
Pedestrian warning with city braking function	X	X	
Active Cruise Control		X	

The optional equipment package Driving Assistant (SA 5AS) is an element of the optional equipment package Driving Assistant Plus (SA 5AT).

F48 Driver Assistance Systems

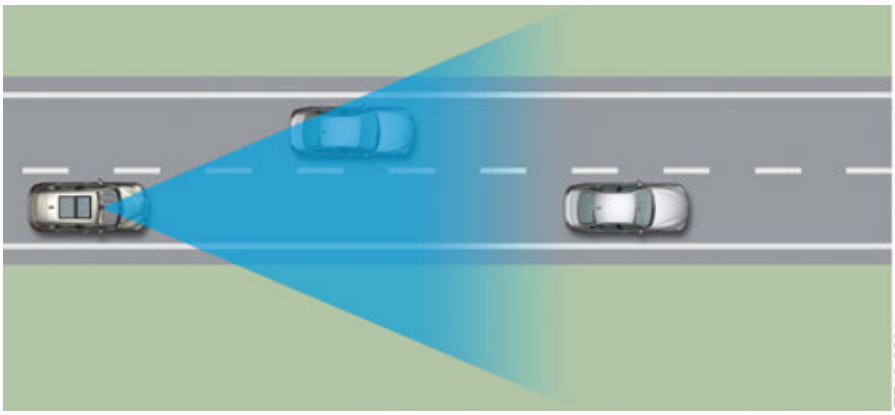
2. KAFAS

The recognition of road users driving ahead and the detection of pedestrians are among the most important functions to be satisfied by assistance systems. This function must be satisfied at both long distance and close range. The functions in the F48 have been implemented in optionally available combinations as camera-based systems using a shared camera and shared control unit.

The KAFAS camera and KAFAS control unit therefore constitute the central element of the following assistance systems:

- Collision warning with city braking function
- Pedestrian warning with city braking function
- Road sign recognition
- Lane departure warning
- Camera-based cruise control

2.1. Person recognition



F48 Detection range of KAFAS camera

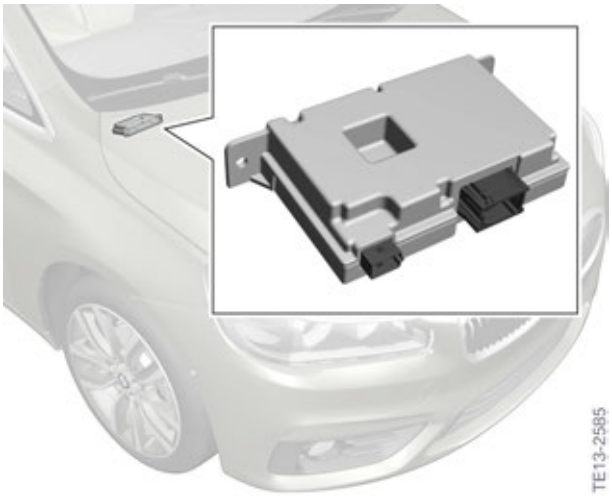
The person recognition in the F48 only takes place with the help of the camera-based driver support system. A radar sensor is not offered in the F48, unlike in other BMW models.

F48 Driver Assistance Systems

2. KAFAS

F48 KAFAS camera

Index	Explanation
1	KAFAS camera
2	Rain-light-solar-condensation sensor
3	Photosensor for electrochromic interior mirror



F48 KAFAS control unit

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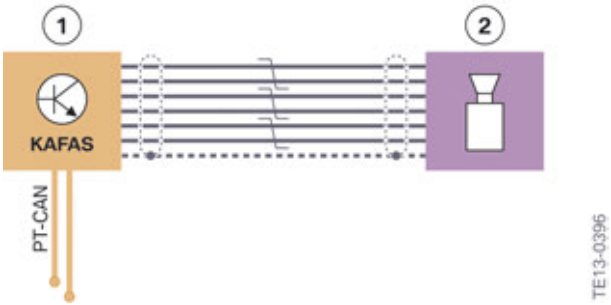
2. KAFAS



F48 Image transmission via LVDS data line

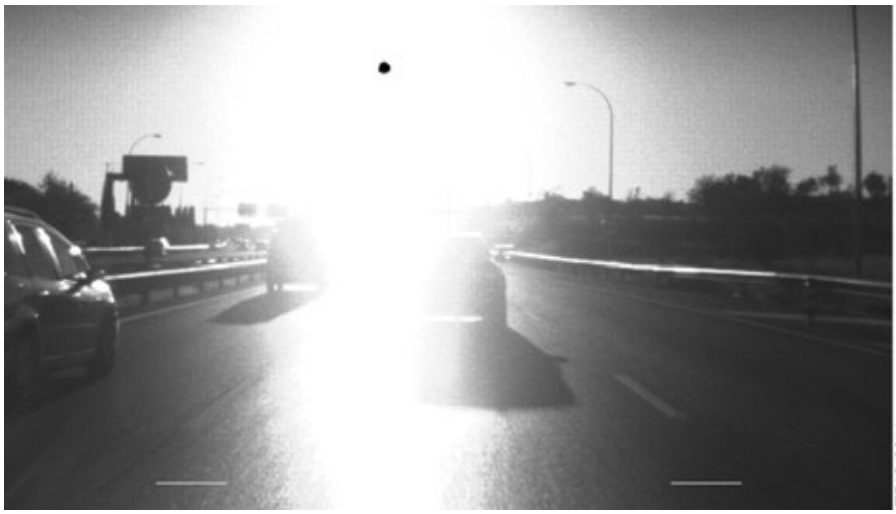
Index	Explanation
1	KAFAS control unit
2	KAFAS camera

The KAFAS camera captures the scene in front of the vehicle and detects entire rear views of moving and stationary vehicles in the field of view using machine vision. The KAFAS camera also ensures that driving lane information, vehicle positions and movements are determined at the same time.
With the aid of the image data from the KAFAS camera, objects can be clearly identified as vehicles and corresponding transverse movements as lane changes.

F48 Driver Assistance Systems

2. KAFAS

2.2. Functional limitations



Example of functional limitation by backlight

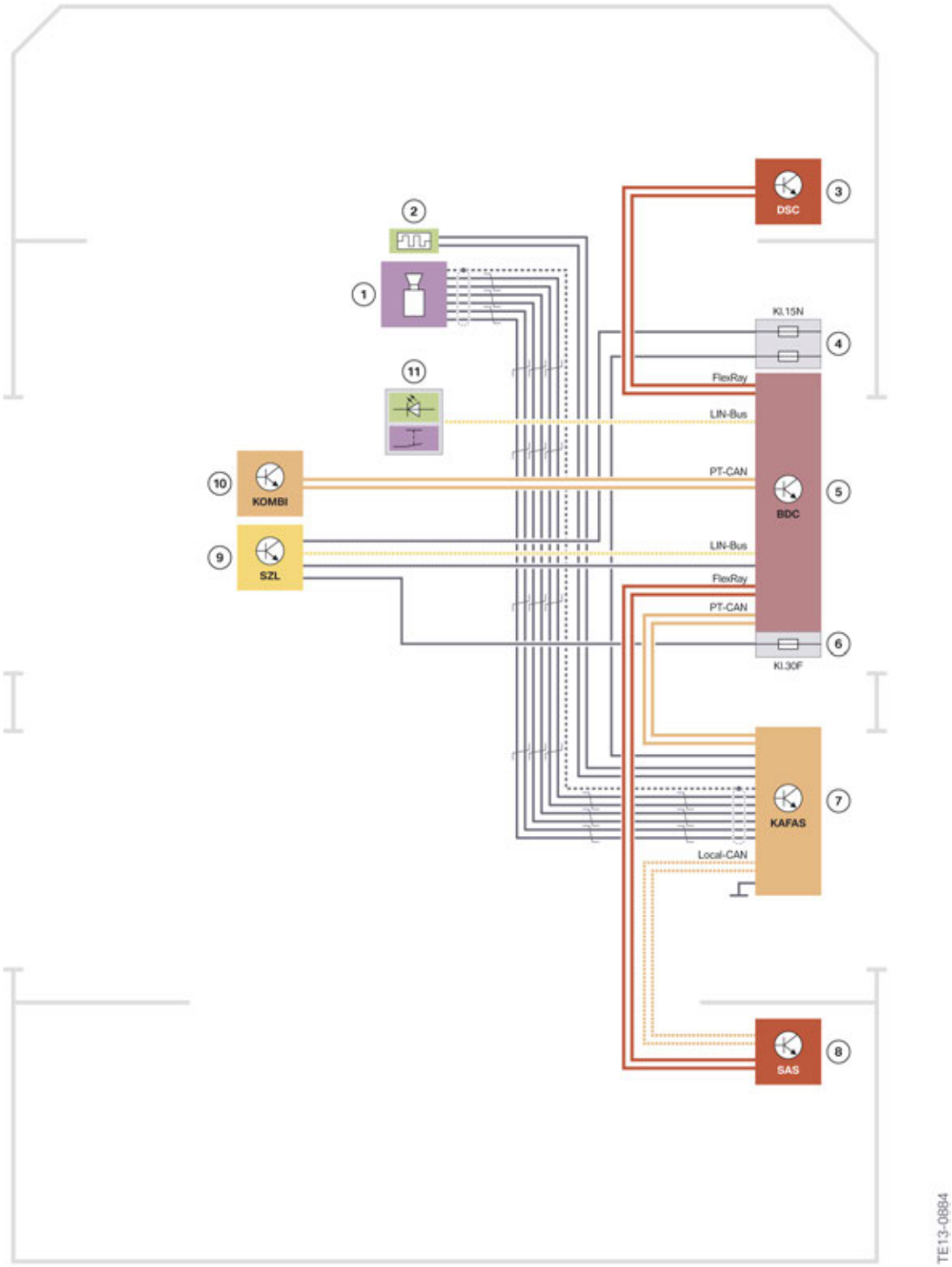
The function of the KAFAS camera and thus also the function of the corresponding assistance systems may be impaired in the following situations, for example:

- heavy fog, rain, rain spray or snow
- strong backlight
- if the field of view of the KAFAS camera or the windscreen is dirty or covered
- at sharp bends
- up to 10 seconds after the engine start via the START-STOP button
- during the calibration process for the KAFAS camera immediately after vehicle delivery or a camera change

F48 Driver Assistance Systems

2. KAFAS

2.3. System wiring diagram



F48 system wiring diagram for KAFAS

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2. KAFAS

Index	Explanation
1	KAFAS camera
2	Heating, KAFAS camera
3	Dynamic Stability Control (DSC)
4	Fuse in the power distribution box in the passenger compartment
5	Body Domain Controller (BDC)
6	Fuse in the Body Domain Controller
7	Camera-based driver support systems (KAFAS)
8	Optional equipment system (SAS)
9	Steering column switch cluster (SZL)
10	Instrument cluster (KOMBI)
11	Intelligent Safety button

F48 Driver Assistance Systems

3. Road Sign Recognition

With the road sign recognition function, current top speed limitations can be displayed in the instrument cluster and, if applicable, also in the Head-Up Display, in order to avoid possible excess speed.

The road sign recognition is an element of the optional equipment Driving Assistant (SA 5AS).

Depending on the equipment, the function of the road sign recognition may vary:

- Road sign recognition with navigation system
- Road sign recognition without navigation system

The responsibility for the vehicle and the speed driven lies solely with the driver.

3.1. Operation

The road sign recognition can be switched on and off using a controller. For this purpose, select the following:

1 Settings

2 Instrument cluster

3 Road sign recognition

If the road sign recognition is switched on, the information recorded is shown in the instrument cluster. If a speed limitation symbol with three horizontal lines is displayed in the instrument cluster instead of the max. permissible speed, then the road sign recognition is not available (e.g. in non-mapped areas such as underground car parks and car parks).

3.2. Function

In the F48, the road sign recognition can be ordered from BMW by the customer for the first time **without** the connection to a navigation system. This also makes it possible to offer the function in countries which had to waive this function due to missing navigation data.

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3. Road Sign Recognition

3.2.1. Road sign recognition with navigation system

The control unit for the road sign recognition function is the KAFAS control unit.

In addition, the detected top speed limitation is compared using data from the navigation system, in order to avoid incorrect displays and to display a top speed limitation on unmarked roads.

If data on the top speed limitations relating to the current road is stored in the navigation system, this is used by the KAFAS control unit and forms the basis of a possible display for the driver.

Traffic signs containing supplementary information, e.g. "In wet conditions", or symbols are also detected and synchronised with internal vehicle data, e.g. the rain sensor, and displayed depending on the situation. The system also takes the applicable time restrictions which have been identified, e.g. "between 10:00 pm and 6:00 am" into account. Here the current time of the on-board clock and the time from the navigation map are used.

At the same time, the video data from the centrally arranged KAFAS camera which points forward is also evaluated in the KAFAS control unit.

The image data is read by the KAFAS control unit and evaluated for traffic signs relating to speed limitations and withdrawal of speed limitations.

In the case of concealed and non-recognizable signs on the withdrawal of top speed limitations, the displays are cancelled according to the specified time and distance parameters.

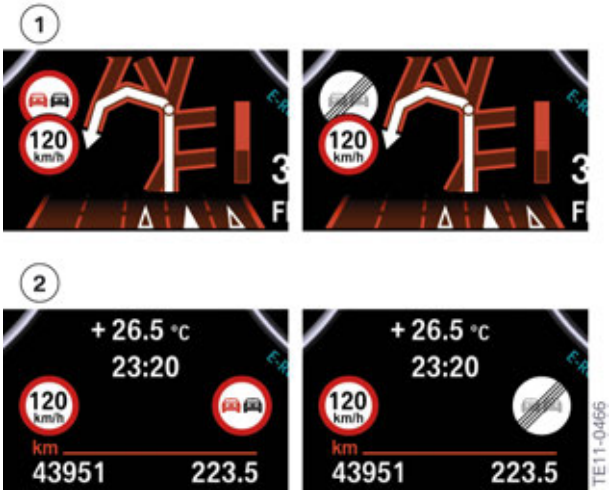
In addition to image data, other information from the vehicle electrical system is also used in the evaluation and calculation for the display:

- Time display (for temporal additional conditions)
- Status of wiper (for additional sign "In wet conditions")
- Turn indicator signal (special speed limit, e.g. on motorway exits)
- Status of outside temperature sensor in "Frost/Snow"

The basis of this diverse information leads to relatively high precision of this function in the evaluation.

F48 Driver Assistance Systems

3. Road Sign Recognition



F48 display of road sign recognition in the instrument cluster

Index	Explanation
1	Displays of road sign recognition during an active navigation display
2	Displays in standard view

Traffic signs for speed limits and for no overtaking, which do not correspond to the legal standard, in particular those without a circular frame, are not always recognized. The same also applies for traffic signs which are fully or partially covered by labels, dirt or vegetation.

Long distances to the road sign, high driving speeds and poor weather conditions, particularly at night, make it more difficult for the system to recognise road signs reliably.

The data from the navigation map must be up-to-date for the correct display of the current speed limit and no overtaking sign. If the current location for the navigation is not yet taken into consideration, for example when driving in development areas, on new roads or on roads with modified road layout, a recognized traffic sign for speed limits or for no overtaking can only be displayed for roughly the next 500 m.

F48 Driver Assistance Systems

3. Road Sign Recognition

3.3. Limits of the system

Traffic signs on parallel, forking or emerging roads

Parallel roads are not recognized with the KAFAS camera or using the navigation map. Signs on these roads can be recognized and displayed as speed limits or no overtaking for the current road. Speed limits and no passing signs for forking or emerging roads are generally also assumed and displayed for the current road.

Traffic signs at exits

Speed limits for exits off highway with or without an arrow as an additional character are generally evaluated correctly and suppressed in the display if driven past. This is only the case if the data on the navigation map is up-to-date.

In the case of sign gantries on the highway with different, lane-dependent speed limits, the speed limit which is closest to the lane of the vehicle is displayed. There is no adaptation of the display after a later lane change.

Information signs in the road sign surroundings

Information signs with speed limits or no overtaking, such as at border crossing points with information on the different legal speed limits for national roads and highway, may be incorrectly recognized as currently valid and displayed. The same applies to information signs with different color configurations, e.g. for minimum or recommended speeds.

Stickers on vehicles

Labels with a speed limit on vehicles ahead or overtaken, such as trucks, buses, trailers or construction machinery, etc., may be incorrectly recognized as a currently valid speed limit and displayed.

Town/city limits

If the sign for the entrance to a village/town is not clearly recognized (detection is only possible in Germany) and the data from the navigation map is not up-to-date, the speed limit at the entrances to and exits from villages/towns may be displayed incorrectly.

Legal changes

If legally prescribed maximum speeds change, then these are only available after a map data update. Up until the update the original, but no longer valid speed limits are displayed.

General no passing signs

No overtaking signs are only displayed if these are also signs posted. General no overtaking, which applies for example at level crossings or is marked by a white line on the roadway, is not displayed without an additional sign.

F48 Driver Assistance Systems

4. Camera-based Collision Warning

The collision warning warns the driver of a possible risk of collision and is recognized in the F48 using the KAFAS system. The camera-based collision warning includes the following functions:

- Collision warning with city braking function
- Pedestrian warning with city braking function

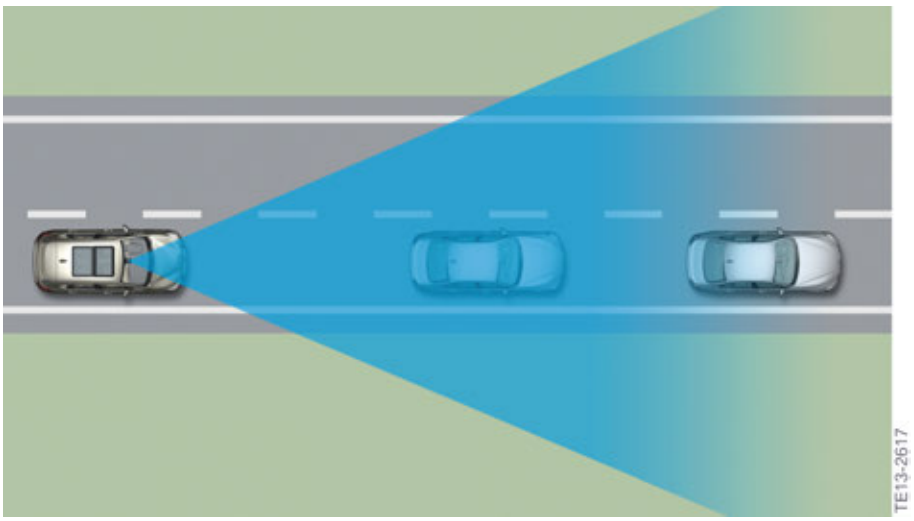
The collision warning with city braking function is already included in the standard equipment of the F48. The pedestrian warning with city braking function is an element of the optional equipment Driving Assistant (SA 5AS).

The system can warn the driver in situations where a collision is imminent. The **early warning**, a visual signal, is issued first to draw the driver's attention to the situation. If the situation becomes more critical, an **acute warning** in the form of a visual and acoustic signal is issued. The nature of the warning is such that the driver can still prevent a collision providing he acts quickly. If there is no reaction from the driver after an acute warning, the driver is supported with automatic braking of the vehicle (5-85 km/h).

4.1. Collision warning with city braking function

4.1.1. Functional principle

The corresponding warning stages "early warning" and "acute warning" are output in critical situations on the basis of the calculated positions, distances and relative speeds of other vehicles. For the early warning and acute warning, the brakes of the vehicle are prepared for emergency braking, depending on the actual speed, and the activation thresholds of the brake assistant are reduced.



F48 Detection range of collision warning by KAFAS camera

4.1.2. Early warning

The early warning works from a speed of approximately 15 km/h.

The early warning is issued, for example, if there is a danger of collision because the vehicle driving ahead is being driven at a much slower speed and/or if the distance to a vehicle ahead is extremely short.

The early warning is indicated by a vehicle symbol which lights up red in the instrument cluster.

The early warning can be configured using the controller ("early", "middle" or "late"). The "late" setting corresponds to a deactivated early warning, for this reason, only the acute warning is active for an immediate risk of collision due to a high differential speed.

The collision warning is dependent on the vehicle's own driving speed. The distance measured for the collision warning is significantly lower than the legally required minimum distance. It is therefore the responsibility of the driver to adhere to the legal minimum distance.

4.1.3. Acute warning

The acute warning works from a speed of approximately 15 km/h and is issued by the system as late as possible and only if there is an imminent danger of a collision when the vehicle is approaching the vehicle driving ahead at a relatively high differential speed or if there is an imminent danger of a collision with a pedestrian. The time of the acute warning is measured so that a collision can only be avoided by immediate emergency braking or by swerving. The acute warning can therefore not be introduced or controlled intentionally.

If the vehicle is, for example, approaching the vehicle driving ahead at very low speed, or is approaching a person, an acute warning is not issued even when the distance is very small.
This intentional driving situation only triggers the early warning. This way there are fewer meaningless and annoying acute warnings issued by the system.

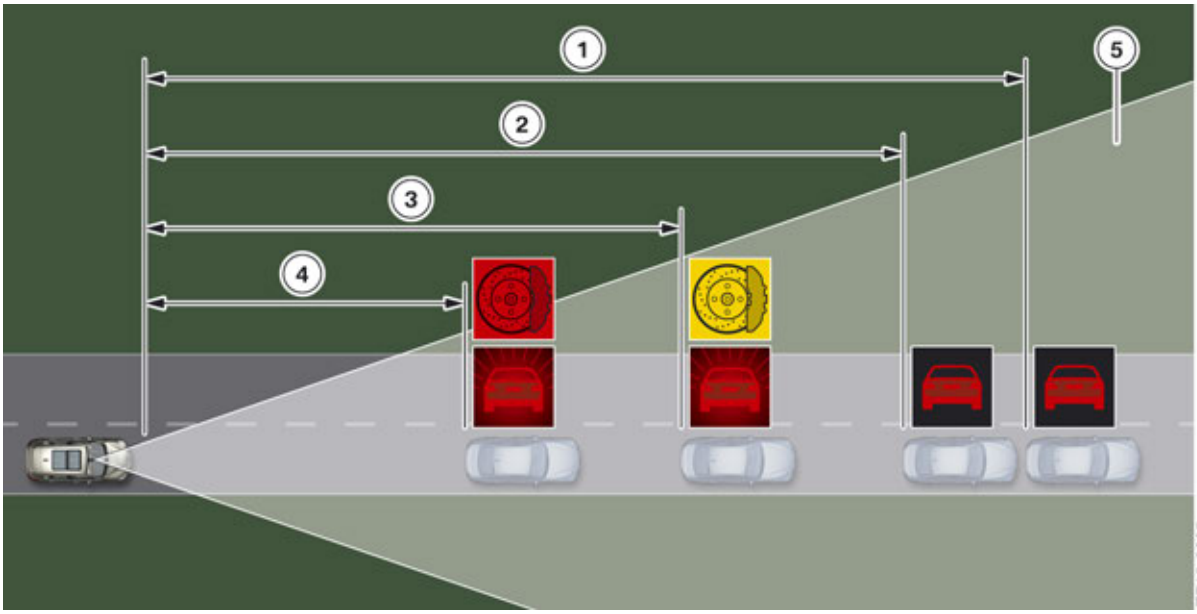
The acute warning cannot be deactivated. The time for the acute warning also cannot be adjusted.
If the acute warning is not to be issued, the "collision warning" front protective function must be deactivated.

The acute warning issues a prompt for intervention and is supported if there is a danger of collision by a two-stage intervention. Brake preconditioning is only effected after the driver warning.

The acute warning does not relieve the driver of his responsibility to adapt the speed and driving style to the traffic conditions and adhere to the prescribed safety distance.

F48 Driver Assistance Systems

4. Camera-based Collision Warning



F48 Time plan for the camera-based collision warning

Index	Explanation
1	Collision warning ("early")
2	Collision warning ("medium")
3	Acute warning (acoustic warning signal, brake system is prepared and brake assistant is adapted)
4	Braking at approximately 4 m/s² is introduced (city braking function only in the range between 5 and 85 km/h)
5	Detection range of KAFAS camera

4.1.4. Braking function

The collision warning with city braking function is active from 5-85 km/h. This way the severity of collisions should be reduced through automatic brake intervention up to 85 km/h. With the braking function an accident up to approximately 20 km/h differential speed can be prevented. In the case of a greater differential speed the accident severity can be reduced.

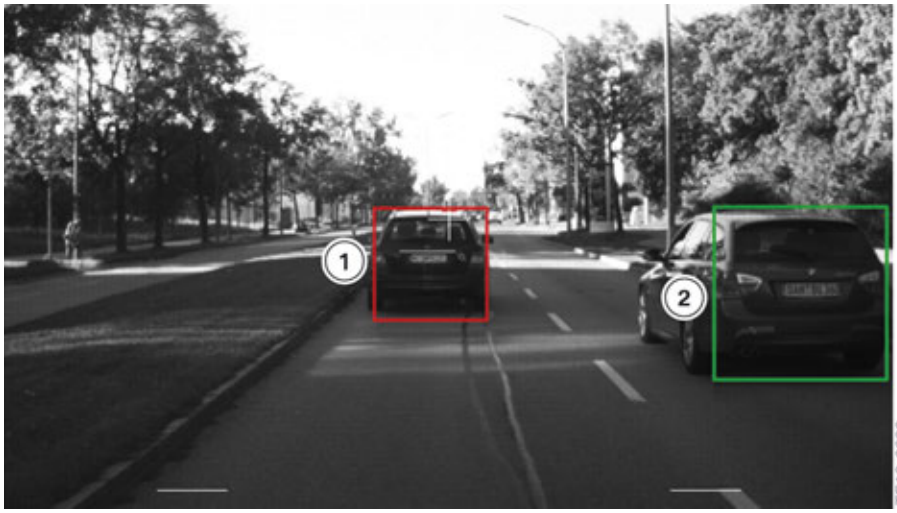
If there is still no response from the driver in this speed range (approximately 5 – 85 km/h) after an acute warning, the vehicle is decelerated at approximately 4 m/s².

The brake intervention is restricted to approximately 1.5 seconds. Additional dangers for the traffic behind are therefore avoided.

The brake intervention is only effected when the Dynamic Stability Control is switched on.

F48 Driver Assistance Systems

4. Camera-based Collision Warning



Example of vehicle identification by KAFAS camera

Index	Explanation
1	Vehicle in same lane
2	Vehicle in different lane

4.2. Pedestrian warning with city braking function

The system warns the driver of possible collisions with pedestrians in the 10 and 60 km/h range and can thus reduce the results of an accident or prevent accidents. In addition, braking is automatically introduced.

The pedestrian warning with city braking function is based on the collision warning with braking function. It detects critical situations in which pedestrians cross the path of the vehicle. In the warning stage (acute warning), a pedestrian symbol is displayed in the instrument cluster and an acoustic warning is also issued. The warning stage can be switched on or off using the Intelligent Safety button. The function is always available upon an engine start.

The KAFAS camera captures the scene in front of the vehicle and detects pedestrians in the field of view using machine vision. Based on the calculated positions, distances and the movement of the detected pedestrians, an acute warning is issued in critical situations and the vehicle is decelerated at approximately 4 m/s².

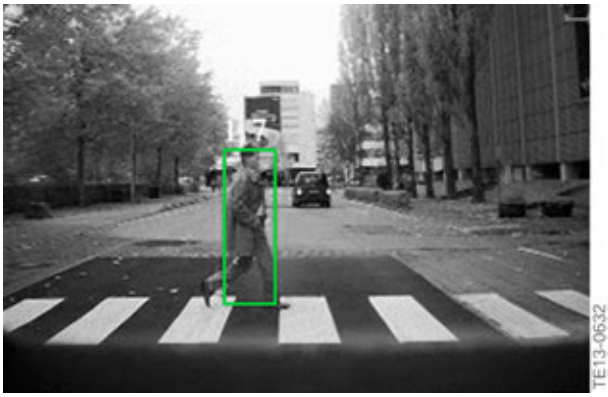
The brake intervention is restricted to approximately 1.5 seconds. Additional dangers for the traffic behind are therefore avoided.

An early warning is not available for the pedestrian warning with city braking function.

The brake intervention is only performed when the Dynamic Stability Control is switched on.

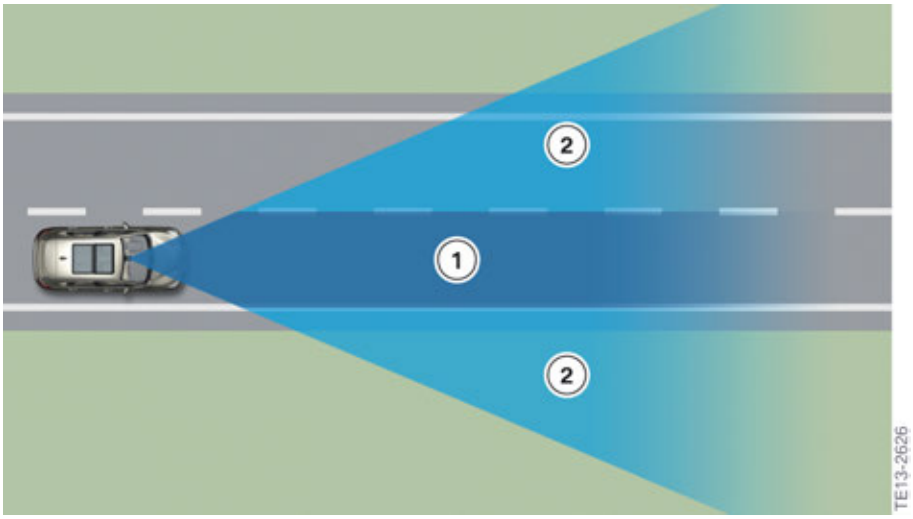
F48 Driver Assistance Systems

4. Camera-based Collision Warning



Example of person recognition by KAFAS camera

The warning zone for person recognition in front of the vehicle is subdivided into two areas. The central area (ahead of the vehicle) and the additional area (to the left and right in front of the vehicle).



F48 Warning zone, person recognition

Index	Explanation
1	Central area
2	Extended area

A collision is imminent if people are located in the central area. A warning is only issued for people located in the extended area if they are moving in the direction of the central area.

F48 Driver Assistance Systems

4. Camera-based Collision Warning

4.3. Warnings in the instrument cluster

The warning function is divided into two stages. If there is a danger of collision, a warning symbol is displayed in the instrument cluster.

System	Speed range	Early warning	Acute warning	Active brake intervention
Collision warning with city braking function	> 85 km/h	 Early warning from approximately 15 km/h		No. The brake system is prefilled and the activation thresholds of the brake assistant are reduced.
Collision warning with city braking function	5-85 km/h	—		4 m/s² for maximum 1.5 seconds
Pedestrian warning with city braking function	10-60 km/h	—		4 m/s² for maximum 1.5 seconds

The system sensitivity is reduced for intentional tailgating of a vehicle in order to avoid unfounded and therefore annoying warnings.

The collision warning with city braking function and the pedestrian warning with brake activation function via the KAFAS camera. For this reason, the same functional limitations apply for both systems, like for all KAFAS systems.

4.4. Operation

The collision warning and pedestrian warning functions are switched on automatically after each engine start via the start/stop button.

Switching on/off

The collision warning and pedestrian warning with city braking function, as well as the lane departure warning, are switched on and off via the Intelligent Safety button.

F48 Driver Assistance Systems

4. Camera-based Collision Warning

F48 Intelligent Safety button

Index	Explanation
1	Intelligent Safety button

Press button:

- A board on the Central Information Display (CID) is displayed on which the settings can be performed. The individual settings are stored for the ID transmitter currently used.

Press button briefly:

- Intelligent Safety systems are switched off individually depending on the Personal Profile.
- The LED in the Intelligent Safety button lights up orange or goes out, depending on the Personal Profile.

Press button again:

- All Intelligent Safety systems are switched on.
- The LED in the Intelligent Safety button lights up green.

Press and hold button:

- All Intelligent Safety systems are switched off.
- The LED in the Intelligent Safety button goes out.

Adjusting the warning time:

The driver can set the time for the warning in three stages when the collision warning is active. The "late" setting corresponds to the point of the acute warning.

F48 Driver Assistance Systems

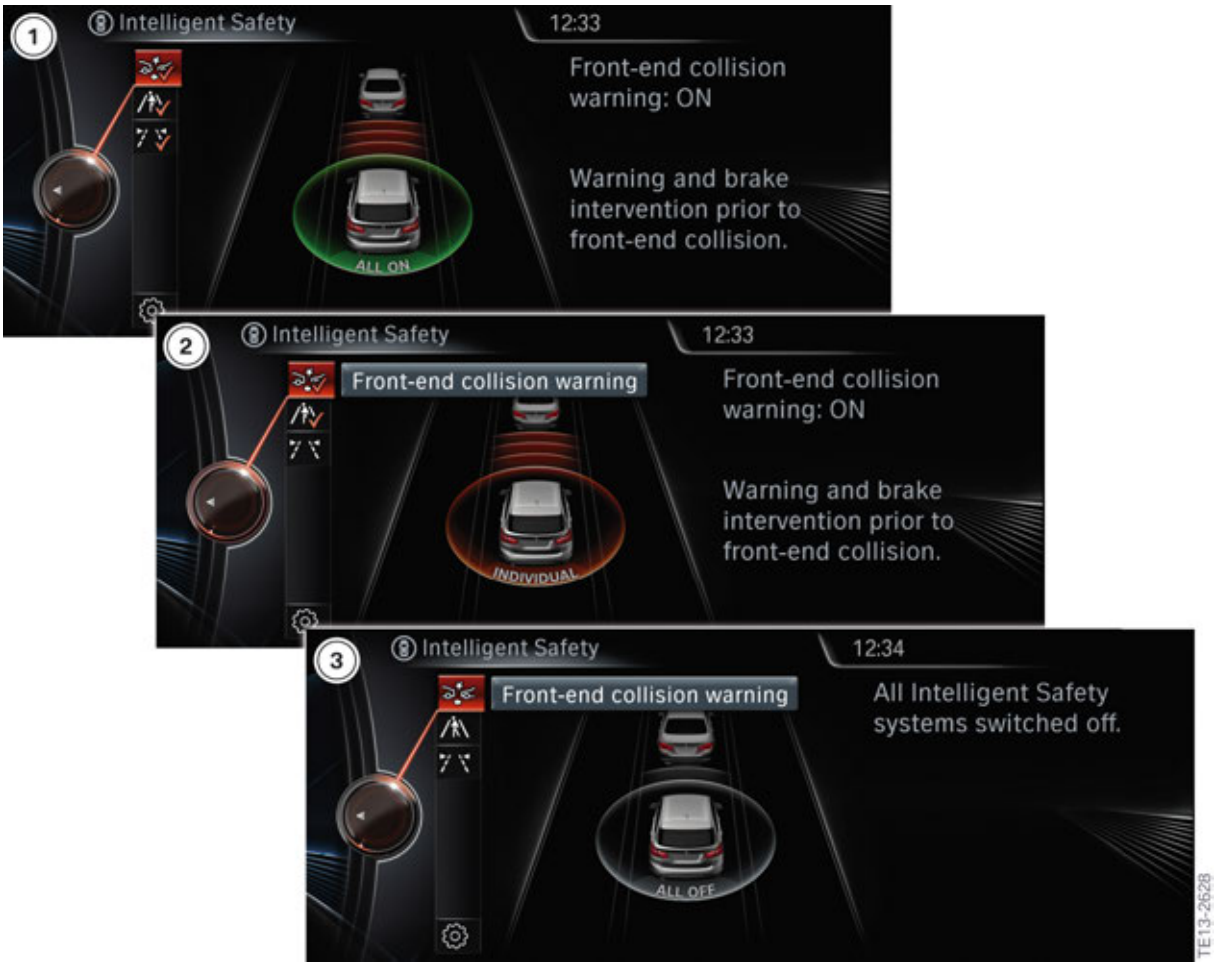
4. Camera-based Collision Warning

The setting is made via the controller:

- "Settings"
- "Collision warning"
- Set the required warning time using the controller at the Central Information Display (CID).

The setting for the time of the early warning is saved for the current driver profile or for the ID transmitter currently used.

4.5. Displays



F48 Intelligent Safety displays

Index	Explanation
1	All systems active
2	Systems are individually adjusted
3	All systems deactivated

F48 Driver Assistance Systems

4. Camera-based Collision Warning

4.6. Limits of the system

The collision warning has a limited capacity for detection. As a result, incorrect or delayed warnings may occur.

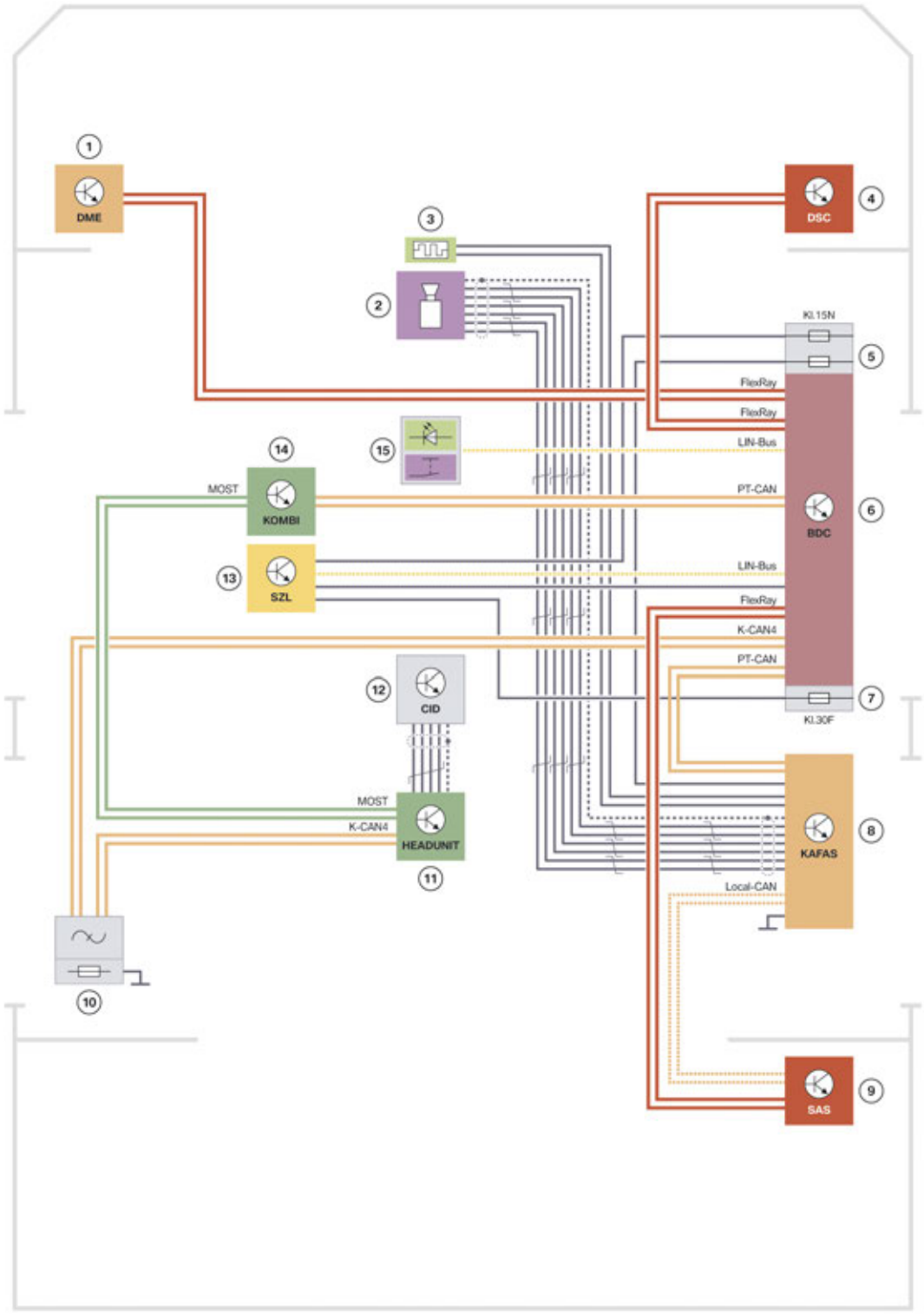
It is possible the following vehicles are not detected:

- a slower vehicle when driving off at high speed
- sudden swerving or heavy decelerating vehicles
- vehicles with an unusual rear view or with insufficiently visible rear lights
- partially covered vehicles
- bicycles ahead.

F48 Driver Assistance Systems

4. Camera-based Collision Warning

4.7. System wiring diagram



F48 system wiring diagram for camera-based collision warning

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4. Camera-based Collision Warning

Index	Explanation
1	Digital Motor Electronics (DME)
2	KAFAS camera
3	Heating, KAFAS camera
4	Dynamic Stability Control (DSC)
5	Fuses in the power distribution box in the passenger compartment
6	Body Domain Controller (BDC)
7	Fuse in the Body Domain Controller
8	Camera-based driver support systems (KAFAS)
9	Optional equipment system (SAS)
10	K-CAN terminator
11	Headunit
12	Central information display (CID)
13	Steering column switch cluster (SZL)
14	Instrument cluster (KOMBI)
15	Intelligent Safety button

F48 Driver Assistance Systems

5. Park Distance Control

The optional equipment Park Distance Control is available in two versions. In the following table you see where and how many ultrasonic sensors are installed with the respective optional equipment:

Optional equipment	sensors
Park Distance Control (SA 507)	4 sensors in the rear bumper
Park Distance Control (SA 508)	4 sensors in the rear bumper and 4 sensors in the front bumper

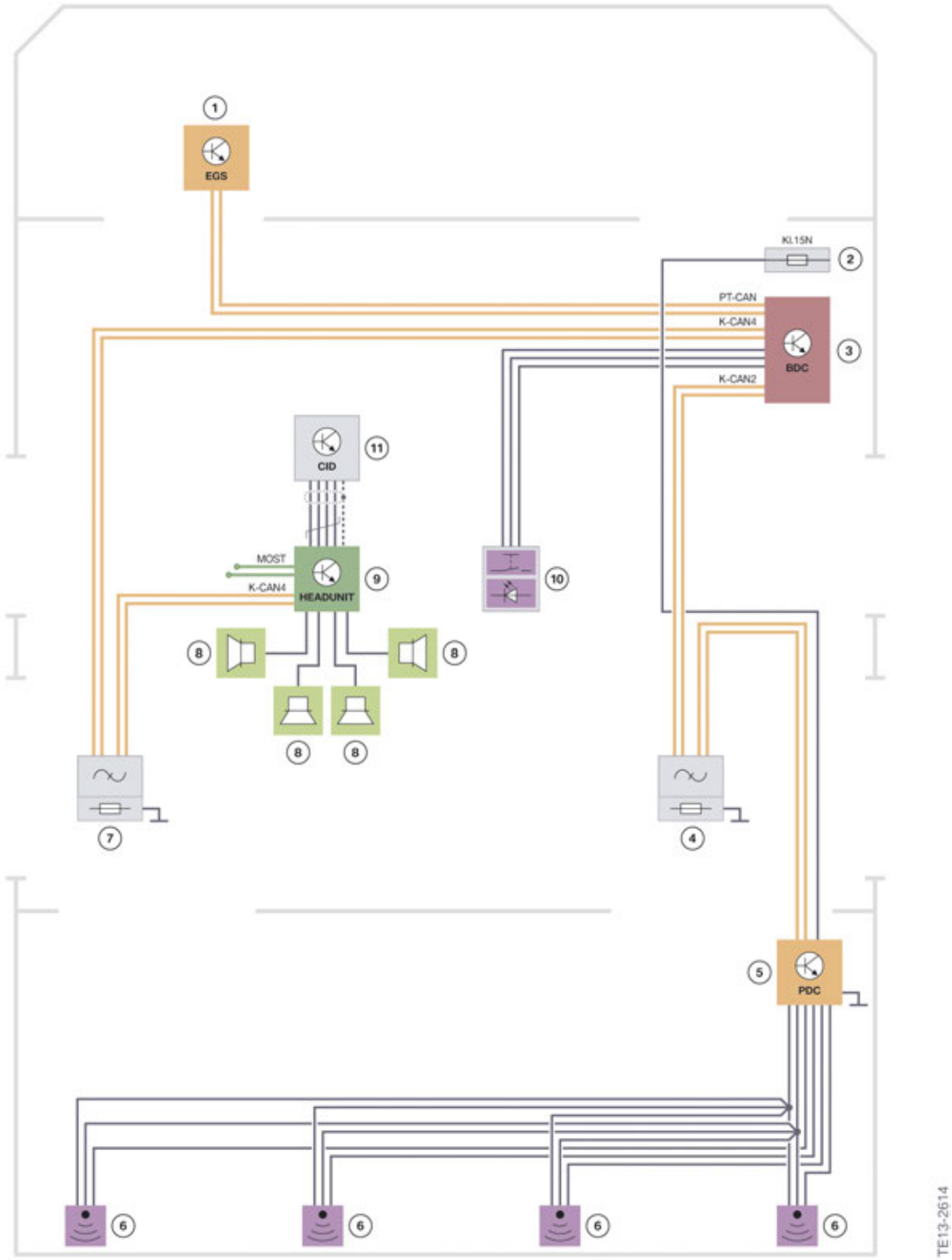
Vehicles not equipped with a Parking Maneuver Assistant have their own PDC control unit. The control unit is used instead of the PDC control unit in vehicles with the optional equipment Parking Maneuver Assistant. The PMA control unit then assumes the function of the PDC.

During the vehicle diagnosis the PDC control unit is always displayed as a PMA control unit.

F48 Driver Assistance Systems

5. Park Distance Control

5.1. System wiring diagram



F48 system wiring diagram for Park Distance Control

F48 Driver Assistance Systems

5. Park Distance Control

Index	Explanation
1	Electronic transmission control (EGS)
2	Fuse in the power distribution box in the passenger compartment
3	Body Domain Controller (BDC)
4	K-CAN terminator
5	Park Distance Control (PDC)
6	Ultrasonic sensors for Park Distance Control, rear
7	K-CAN terminator
8	Speaker
9	Headunit
10	Park Distance Control button
11	Central information display (CID)

5.2. Operation

PDC is automatically switched on in the following situations:

- If when the engine is running the selector lever position R is engaged.
- If with corresponding equipment obstacles are detected at the rear or front of the vehicles by the ultrasonic sensors and the speed is less than 4 km/h (Auto PDC must be active).

The volume of the PDC signal can be adjusted via the central information display.

F48 Park Distance Control volume balancing

F48 Driver Assistance Systems

5. Park Distance Control

5.2.1. Deactivation criteria

The deactivation criteria are dependent on which optional equipment the F48 has. The following table points out the deactivation criteria of the individual systems:

System	Distance travelled	Speed
Park Distance Control	approximately 50 m	approximately 15 km/h
Parking Maneuver Assistant	—	approximately 35 km/h
Rear view camera	approximately 10 m	approximately 15 km/h

To ensure the ultrasonic sensors remain fully operational, they must be kept clean and free of ice. When cleaning the sensors using a high pressure cleaner, avoid direct and sustained contact with a high-pressure water jet. Furthermore, when using high pressure cleaners, a distance of at least 30 cm from the sensors must be maintained.

5.3. Auto PDC

PDC is automatically activated with the Auto PDC function:

- if there is an object closer than 60 cm to the front of the vehicle when driving forwards.
- if there is an object closer than 1.5 m to the rear of the vehicle when reversing.
- if the speed driven does not exceed 4 km/h.

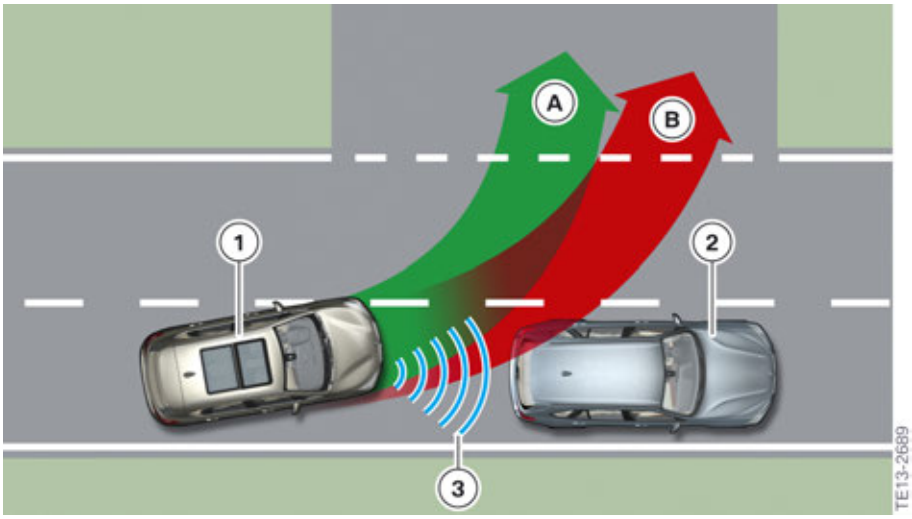
The automatic switching-on upon the identification of obstructions can be switched on and off in the "Settings" menu using a controller. The settings are stored for the ID transmitter currently used.

F48 Auto PDC

A sound is only output if the detected object (in front of or behind the vehicle) is directly in the lane (risk of collision). If the detected object is not directly in the lane, the acknowledgement is only done visually in the CID.

F48 Driver Assistance Systems

5. Park Distance Control



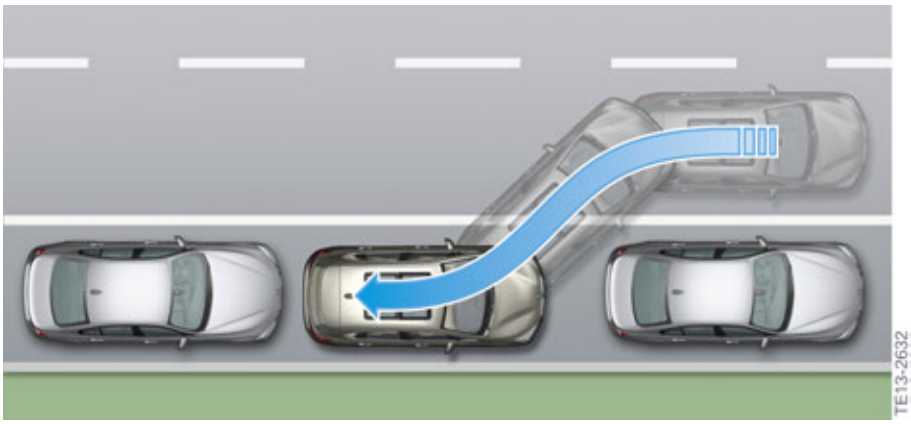
F48 Person recognition

Index	Explanation
A	Lane without object contact (visual acknowledgement in the CID)
B	Lane with object contact (visual and acoustic acknowledgement)
1	Turning vehicle
2	Detected object
3	Detection of obstacle by the PDC sensors

F48 Driver Assistance Systems

6. Parking Maneuver Assistant

6.1. Introduction



F48 Principle of Parking maneuver Assistant

The optional equipment Parking Assistance Package comprises the following elements:

- Park Distance Control, rear (4 sensors) (SA 507)
- Park Distance Control, front (4 sensors) (SA 508)
- Parking Maneuver Assistant with 2 additional sensors in the wheel arch panel

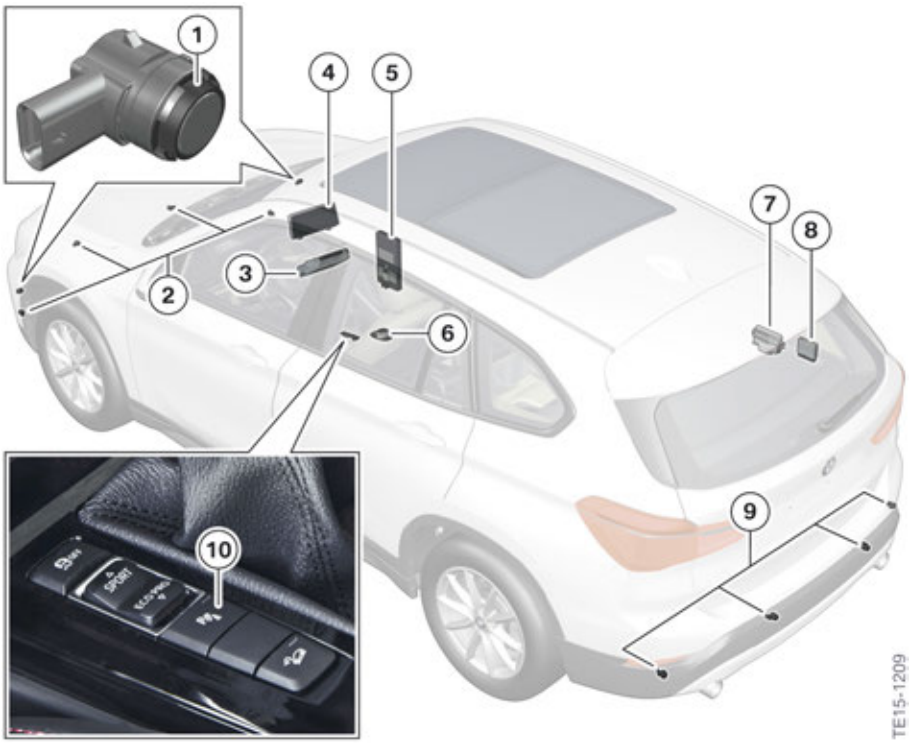
The Parking Maneuver Assistant only facilitates parking in gaps between cars parallel to the roadway.

F48 Driver Assistance Systems

6. Parking Maneuver Assistant

6.2. System components

Vehicles with the optional equipment Parking Assistant Package (SA 5DU) also obtain four additional ultrasonic sensors in the front bumper, as well as the rear ultrasonic sensors known from the PDC. For the detection of the parking space, the Parking Maneuver Assistant requires two additional ultrasonic sensors at the side, which can detect the parking space on the left or right of the vehicle when driving by. The ultrasonic sensors of the Parking Maneuver Assistant are installed in the wheel arch panels at the front left and right.



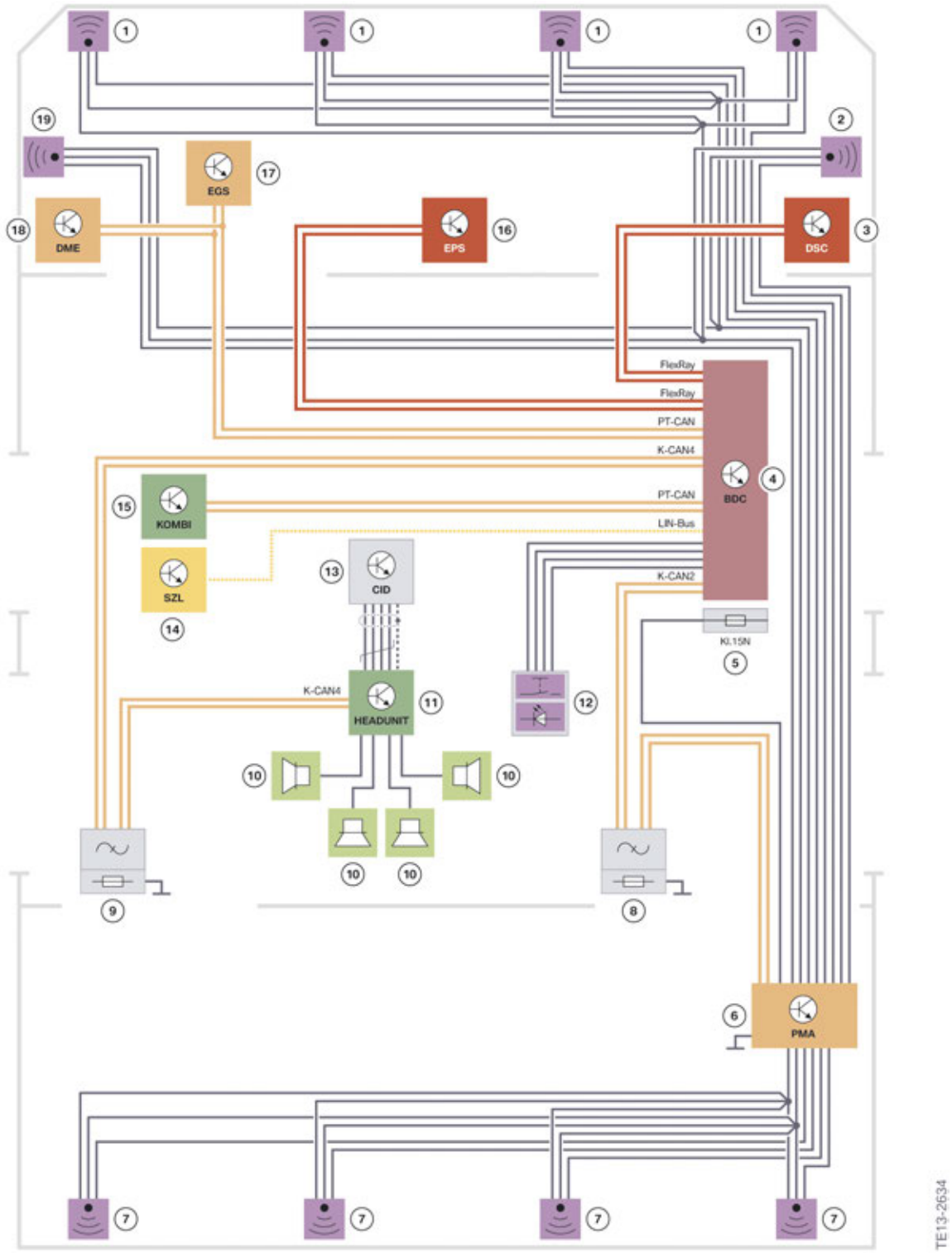
F48 System components of Parking maneuver Assistant

Index	Explanation
1	Ultrasonic sensors at the side (for Parking maneuver Assistant)
2	Ultrasonic sensors, front
3	Headunit
4	Central information display (CID)
5	Body Domain Controller (BDC)
6	Controller (CON)
7	Optional equipment system (SAS)
8	Parking maneuver Assistant (PMA)
9	Ultrasonic sensors, rear
10	Park Distance Control button

F48 Driver Assistance Systems

6. Parking Maneuver Assistant

6.3. System wiring diagram



F48 system wiring diagram for Parking maneuver Assistant

F48 Driver Assistance Systems

6. Parking Maneuver Assistant

Index	Explanation
1	Ultrasonic sensors, front
2	Ultrasonic sensor, right (for Parking Maneuver Assistant)
3	Dynamic Stability Control (DSC)
4	Body Domain Controller (BDC)
5	Fuse in the power distribution box in the passenger compartment
6	Parking Maneuver Assistant (PMA)
7	Ultrasonic sensors, rear
8	K-CAN terminator
9	K-CAN terminator
10	Speaker
11	Headunit
12	Park Distance Control button (Parking Maneuver Assistant)
13	Central information display (CID)
14	Steering column switch cluster (SZL)
15	Instrument cluster (KOMBI)
16	Electronic Power Steering (EPS)
17	Electronic transmission control (EGS)
18	Digital Motor Electronics (DME)
19	Ultrasonic sensor, left (for Parking maneuver Assistant)

F48 Driver Assistance Systems

6. Parking Maneuver Assistant

6.4. Control unit

F48 Parking maneuver Assistant control unit

The Parking Maneuver Assistant control unit evaluates the signals of the ultrasonic sensors and calculates the length of a parking space based on the distance information from the DSC. It also calculates the optimum path into a parking space and monitors the parking procedure.

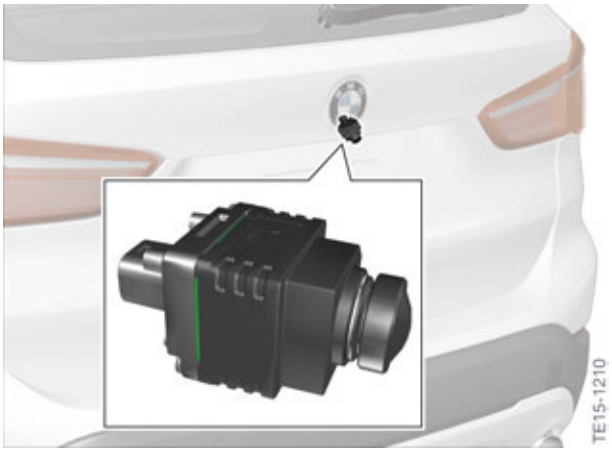
F48 Driver Assistance Systems

7. Rear View Camera

The main function of the rear view camera system is the optical detection of a wide-angled view of the rear area of the vehicle in order to offer the driver additional support during the parking process or maneuver. The image is forwarded from the rear view camera via a CVBS line to the headunit.

The image from the rear view camera is displayed with additional auxiliary lines in the CID.

7.1. System components



F48 Control unit for the rear view camera

The lens of the rear view camera is located in the handle strip of the tailgate.

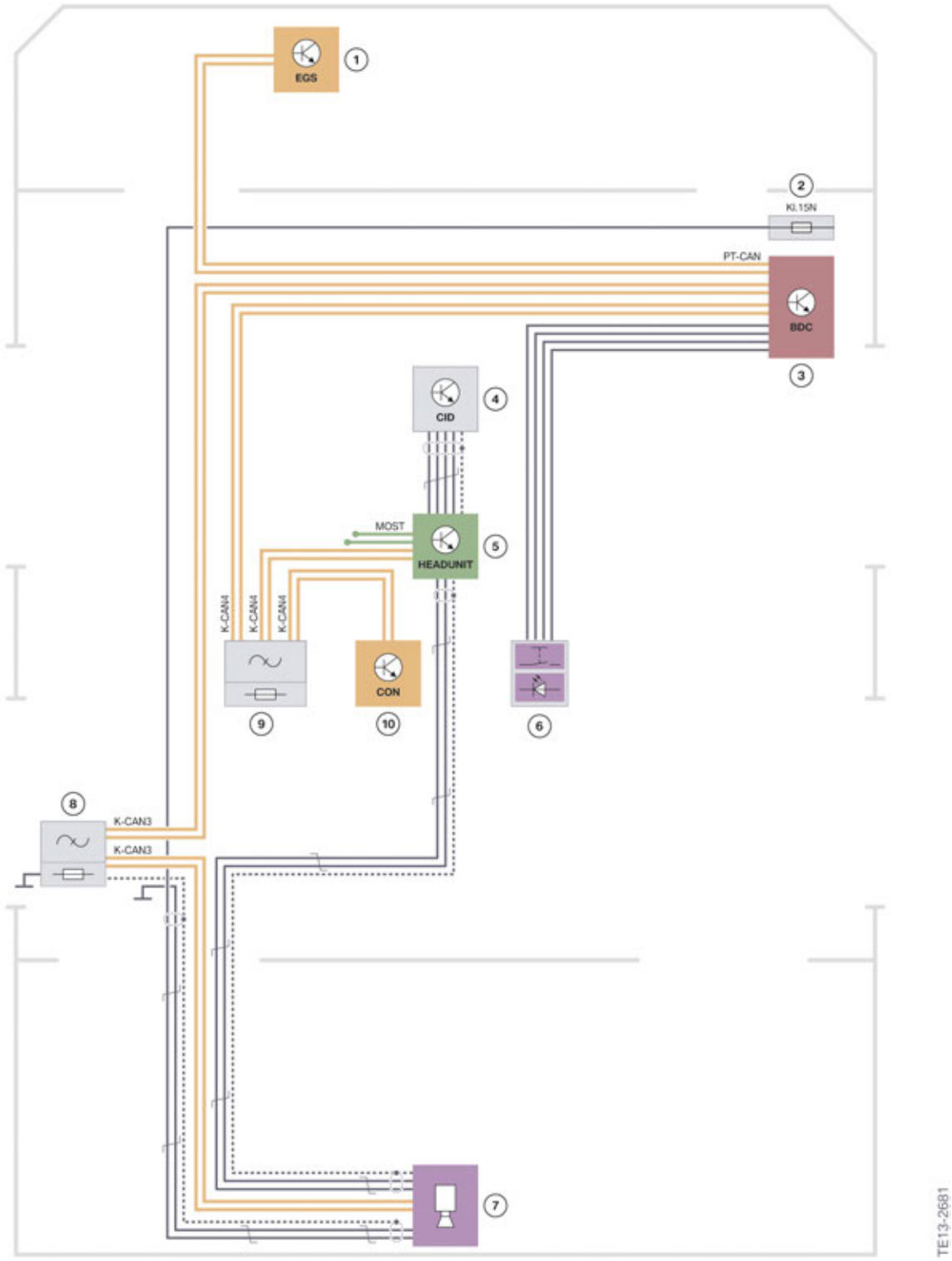
The top rear side view camera control unit is integrated in the housing of the rear view camera.

The new camera must be taught in after the rear view camera is replaced. The rear view camera of the F48 does not need to be calibrated after teaching-in, as it is self-calibrating. The calibration is effected during the journey by the TRSVC control unit by means of a steering angle sensor and known road markings. Calibration compensates for installation tolerances by shifting and rotating the image.
The maximum time required for a full calibration is five hours. A Check Control message is displayed in the CID if the rear view camera could not be successfully calibrated. Reasons for failed calibration may be incorrect installation, dirt contamination or a defect with the rear view camera. The rear view camera is also constantly readjusted after a full calibration in order to ensure an optimum image.

F48 Driver Assistance Systems

7. Rear View Camera

7.2. System wiring diagram



F48 System wiring diagram for rear view camera

F48 Driver Assistance Systems

7. Rear View Camera

Index	Explanation
1	Electronic transmission control (EGS) (for vehicles with automatic transmission)
2	Fuse in the power distribution box in the passenger compartment
3	Body Domain Controller (BDC)
4	Central information display (CID)
5	Headunit
6	Park Distance Control button
7	Rear view camera (RFK)
8	K-CAN terminator
9	K-CAN terminator
10	Controller (CON)

F48 Driver Assistance Systems

8. Cruise Control

8.1. Introduction

Two cruise controls are offered for the F48. The customer can choose between the optional equipment DCC cruise control with braking function and the optional equipment ACC active cruise control.

The DCC is an element of the optional equipment Driving Assistant Plus (SA 5AT), or can be ordered as separate optional equipment (SA 544).

The ACC Stop & Go function was extended with the traffic jam assistant function. The traffic jam assistant is described in more detail in chapter 9 "Traffic jam assistant".

The speed control systems support the driver with adapting his speed, distance and driving style to the traffic conditions but do not relieve him of this responsibility. The driver may need to actively intervene, e.g. by braking, steering or taking evasive action, as otherwise there is a risk of an accident.

8.2. Cruise control with braking function

The cruise control with braking function (SA 544) is used in the F48 as optional equipment.
The system is also referred to as "Dynamic Cruise Control". Dynamic Cruise Control supports the driver on roads with less traffic by keeping the speed constant irrespective of the rolling resistances (incline, vehicle load). In spite of the support, the driver remains responsible for control of the vehicle. It is possible to override the DCC function at any time by braking or accelerating the vehicle.

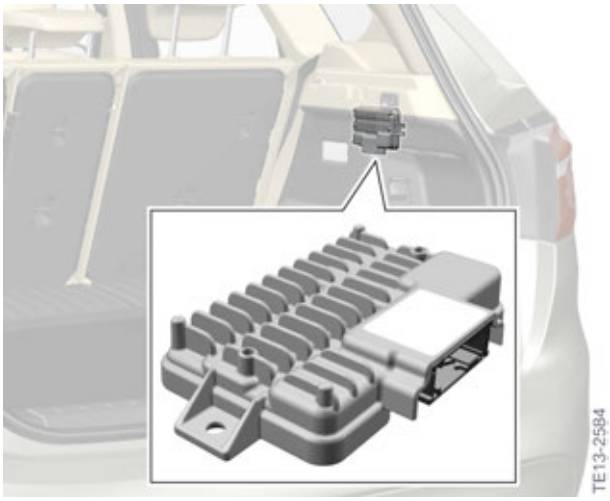
When ECO PRO mode is activated, the cruise control is also adjusted to a consumption-friendly driving style.

Depending on equipment, the calculation is effected in different control units:

- The calculations are performed by the DSC control unit.
- In vehicles that are equipped with an optional equipment system (SAS) due to other optional equipment packages, the calculations are performed in the SAS control unit.

F48 Driver Assistance Systems

8. Cruise Control

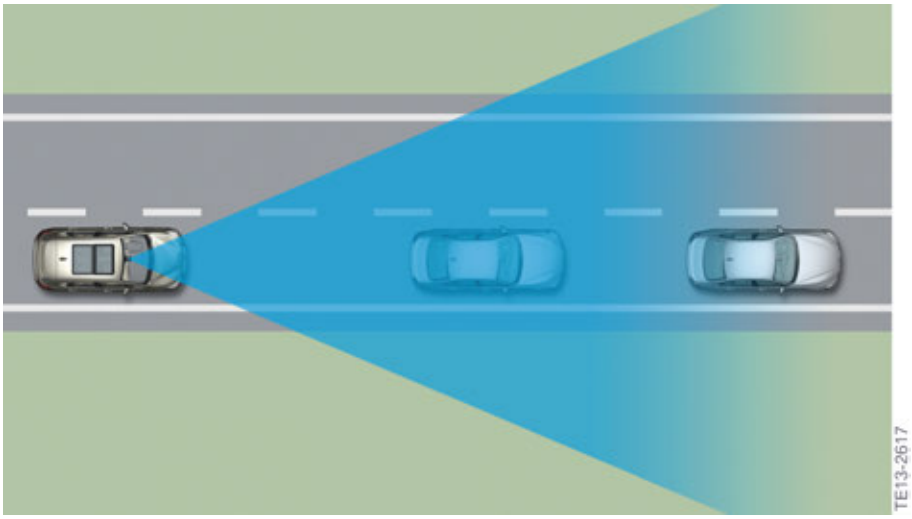


F48 Installation location of optional equipment system

8.3. Camera-based cruise control with Stop&Go function

The active cruise control (ACC) Stop&Go function is an element of the optional equipment Driving Assistant Plus (SA 5AT).

With the ACC Stop&Go function in the F48, there are **no** radar sensors installed for the detection of vehicles ahead. The detection is effected solely via the KAFAS system.



F48 Active Cruise Control detection by KAFAS camera

ACC Stop&Go adjusts a driver-specified desired speed and, if required by the traffic situation, also the preselected trailing distance automatically to the vehicle driving ahead. Passenger cars, trucks and motorbikes are detected as vehicles. The application range of ACC Stop&Go ranges from higher speeds down to a standstill. The distance and the speed are automatically adjusted in this range.

Depending on the stationary time, driving off from a standstill is performed automatically or in response to a prompt by the driver.

F48 Driver Assistance Systems

8. Cruise Control

ACC Stop&Go detects not only slowly stopping, but also stationary vehicles, and can react to these. The response to transverse movements has been improved and the system can now respond more quickly to vehicles swerving in and out and turning off.

The application range is extended by incorporating the KAFAS camera and the image data is evaluated by the KAFAS control unit. The KAFAS control unit detects vehicles clearly when their rear is identified by the video camera. In addition, the KAFAS control unit ensures that the driving lane information, vehicle positions and movements are determined.

As the ACC Stop&Go in the F48 is a pure camera system without radar sensors, the adjustment range for the set speed was restricted to 140 km/h.

The acceleration behavior of ACC Stop&Go is adapted for ECO PRO mode. In ECO PRO mode, ACC Stop&Go accelerates the vehicle in a fuel-efficient manner.

If the vehicle ahead drives off again after a standstill, the driver is informed thereof with a note. To drive off again, the driver must acknowledge this information. The acknowledgement is effected by operating the RES button or by briefly touching the accelerator pedal. Only if the duration of the standstill is very short (approximately 3 seconds), is the starting process effected automatically.

8.3.1. KAFAS camera

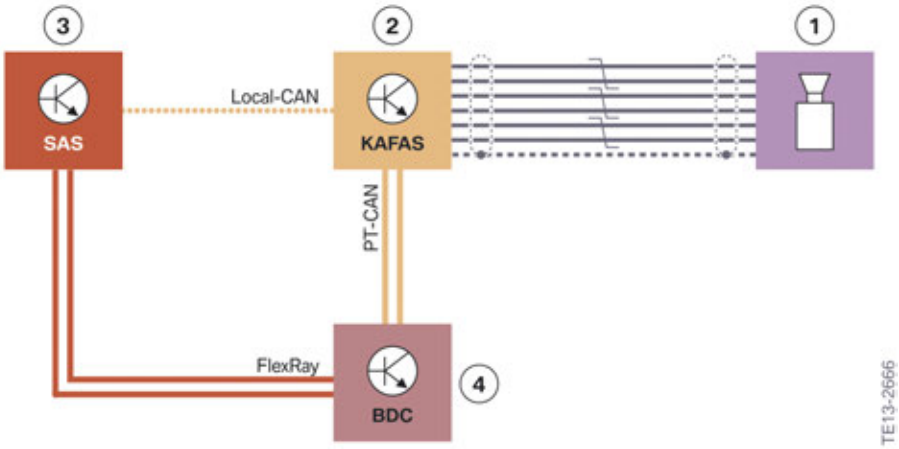
F48 KAFAS camera

Index	Explanation
1	KAFAS camera
2	Rain-light-solar-condensation sensor
3	Photosensor for electrochromic interior mirror

F48 Driver Assistance Systems

8. Cruise Control

Connection for KAFAS camera



F48 ACC Stop&Go detection, KAFAS camera

Index	Explanation
1	KAFAS camera
2	Camera-based driver support systems (KAFAS)
3	Optional equipment system (SAS)
4	Body Domain Controller (BDC)

The front camera can detect vehicles ahead at a distance of up to 90 m. Stationary vehicles and vehicles weaving in and out of traffic are also detected early.

As with the front camera it is an optical sensor, the quality of the person recognition and signal accuracy are dependent on the existing weather conditions.

8.3.2. Control function

Vehicles with ACC Stop&Go; element of optional equipment Driving Assistant Plus (SA 5AT):

- The calculations are performed in the optional equipment system (SAS).

Cruise control

In principle, the cruise control in the ACC Stop&Go system works in exactly the same way as the Dynamic Cruise Control (DCC) system.

Distance control (ranging)

The distance control is the core function of the ACC Stop&Go system. The driver can select a desired distance in four stages using a button on the multifunction steering wheel. The optional equipment system calculates the set point distance of the control from this preselection.

The set point distance during the journey is proportional to the driving speed. At a lower driving speed the proportional distance to the driving speed is no longer used for the ACC Stop&Go, but instead a fixed value in metres. The distance control uses the prepared object data with the highest diagnostic statistic as input variables.

Acceleration and deceleration

Depending on the situation, the ACC Stop&Go accelerates the vehicle by a maximum of approximately 2 m/s² and decelerates the vehicle by a maximum of approximately 4 m/s².

Cruise control on bends

The cruise control of the ACC Stop&Go on bends is based on the control characteristics of the Dynamic Cruise Control (DCC). If an object is lost on bends, the system waits to see whether the object reappears (transition curve). The vehicle only accelerates if it does not reappear or the KAFAS camera no longer detects an object. Depending on the actual lateral acceleration, the speed is reduced in a longitudinal direction during controlled cornering as necessary. When coming out of the bend the speed is adjusted until it once again reaches the desired level.

8.3.3. Display

The set speed is shown in the instrument cluster with digital speed reading. During active control this display is illuminated in green. If the active cruise control is in a "Deactivated" state this display is illuminated in orange. The resume speed is displayed.

Vehicles driving ahead to which a safe trailing distance is observed are displayed in orange in the round instrument as soon as they have been detected and are at a distance relevant for the control. If the system can no longer adjust a safe distance, for example due to very high differential speeds, then the driver is requested to assume the guidance of the vehicle entirely by a flashing red vehicle symbol and an acoustic signal. With active control the messages are also displayed in the optional equipment Head-Up Display HUD (SA 610).

8.3.4. Operation

ACC Stop&Go cannot only be activated by the driver during the journey, but also when the vehicle is at a standstill, if the system detected another vehicle before its own vehicle. To activate ACC Stop&Go at standstill, the driver must press the brake pedal and at the same time press the SET or RES button.

When the system is active the set speed can be adjusted in 1 or 10 km/h increments.

The driver has the option at any time to override the ACC system request and thus accelerate stronger by pressing the accelerator pedal. The system is not activated as a result. The overriding is shown in the instrument cluster by the suppression of the distance bar.

F48 Driver Assistance Systems
8. Cruise Control

The following conditions must also be satisfied for activation:

- Seat belt fastened and door closed
- Drive position D is engaged
- Engine running
- Parking brake not activated
- No system faults detected

The system does not decelerate for:

- pedestrians, cyclists or similar slow road users
- red lights
- cross traffic
- oncoming traffic
- unlit vehicles or vehicles with defective lighting at night

Detection

Many vehicles are not detected or are detected at a late stage. The reason for this may be:

- Vehicles swinging out
  A vehicle ahead is only detected when it is completely in its own lane.
- Cornering
  In narrow bends there may be situations where a vehicle ahead is no longer detected or detected at a significantly later stage due to the restricted detection range of the system.

Malfunction

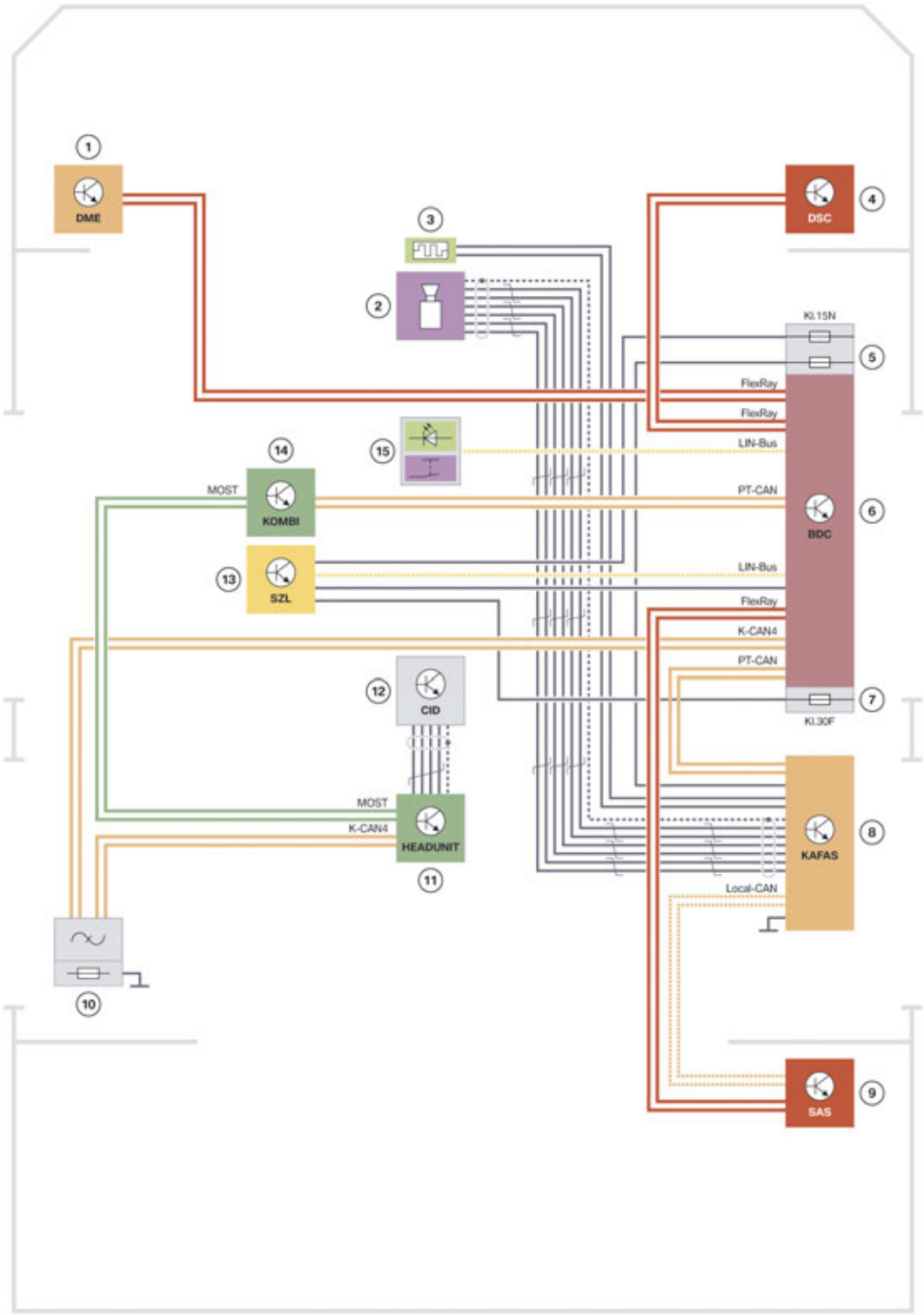
If the system has a malfunction, the driver is made aware of such with a Check Control message. The reasons for malfunctions may be:

- heavy fog, rain, rain spray or snow
- if the camera field of view or the windscreen is dirty or concealed
- strong back light
- up to 20 seconds after engine starting via the START-STOP button
- when calibrating the camera immediately after vehicle delivery

F48 Driver Assistance Systems

8. Cruise Control

8.3.5. System wiring diagram



F48 system wiring diagram for active cruise control (ACC) Stop&Go

F48 Driver Assistance Systems

8. Cruise Control

Index	Explanation
1	Digital Motor Electronics (DME)
2	KAFAS camera
3	Heating, KAFAS camera
4	Dynamic Stability Control (DSC)
5	Fuses in the power distribution box in the passenger compartment
6	Body Domain Controller (BDC)
7	Fuse in the Body Domain Controller
8	Camera-based driver support systems (KAFAS)
9	Optional equipment system (SAS)
10	K-CAN terminator
11	Headunit
12	Central information display (CID)
13	Steering column switch cluster (SZL)
14	Instrument cluster (KOMBI)
15	Intelligent Safety button

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