Workbook

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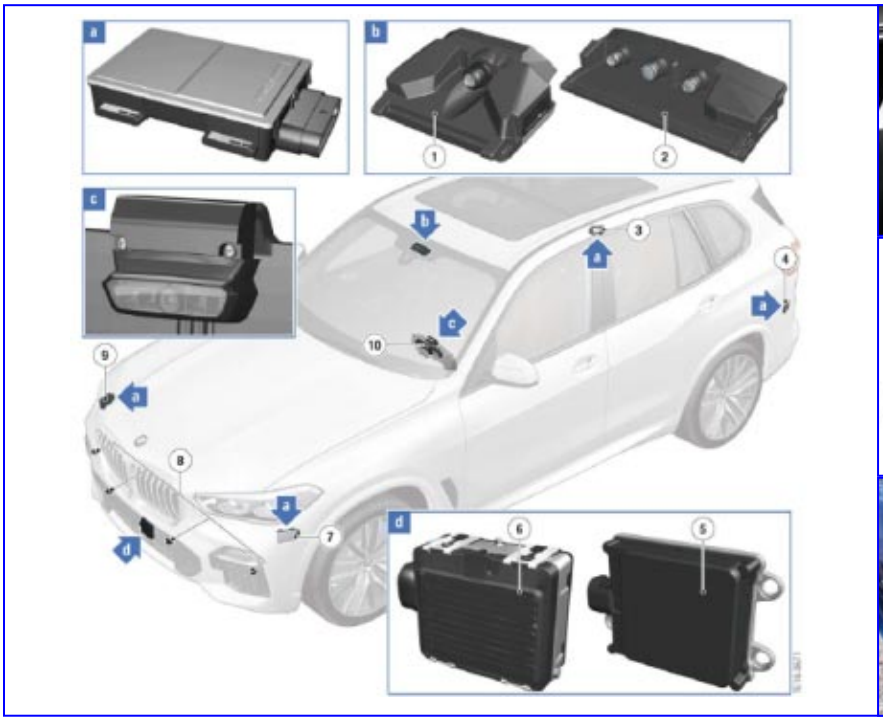
BMW
Body & Paint Training

Assistance Systems for Collision Repair



053

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This training manual is not intended to be a complete and all-inclusive source for repair and maintenance. It is only a part of a training information system designed to assure that uniform procedures and information are presented to all participants in the BMW Group University Body & Paint Training Center.

The technician must always refer and adhere to the following official BMW service publications available in Integrated Service Technical Application (ISTA) & Aftersales Information Research (AIR).

- Service Information
- Repair Manuals
- Technical Reference Information
- Specifications

The information contained in the training course materials is solely intended for participants in this training course conducted by BMW Body & Paint Training Group or one of its approved vendors.

For changes/additions to the technical data, please refer the current information issued via the Integrated Service Technical Application (ISTA), Aftersales Information Research (AIR), and Service Information Bulletins.

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INTRODUCTION

Each year, the number of Driver Assistance Systems found on BMW cars and SAVs increases. As these advanced systems become more commonplace, after-collision service takes on an even more important role in assuring the safe operation of the vehicle. When a damaged vehicle is serviced in a BMW collision center, the collision advisor now has the responsibility of identifying these systems, knowing where sensors are located, determining the appropriate measures if sensor and system componentry need to be disconnected, removed, or replaced. Advisors should know how to identify any malfunction indicator warning lamps and be able to access any check control messages related to system operation.

On-road collision incidents are frequently caused by operator error. The individual operating the vehicle is also the best preventer of these types of incidents. While current assistance systems are at a very high technical level, they cannot replace the intelligence and decision-making abilities of a person in certain situations.

Presently the driver still has the responsibility for controlling the operation of the vehicle even if certain systems allow them to take their hands off the steering wheel for a few seconds. Certain systems can provide the driver with relief on long journeys. This level of driver responsibility will also apply to the next levels of automation: the driver will still have responsibility for vehicle control.

BMW continues to be the **Ultimate Driving Machine**. In the future, the “Joy of Driving” will take on even more meaning. For instance, the BMW client will have the option to experience both the "The Ultimate Driving Machine" and "The Ultimate Automated Driving Machine", depending on their preference and the driving situation.

Today’s motorists spend many hours every year in congested urban areas without being able to make better use of their time. It is expected that this new way of driving will lead to significantly more comfort. Passengers, including the driver, can make better use of travel time while relaxing, working, reading, or enjoying the multimedia and information systems found in their BMW.

BMW uses the term “Personal Co-Pilot” to describe systems that can either automate or assist the vehicle driver. This term will become increasingly important as the assistance systems and active role they will play in vehicle operation continues to expand.

This program will provide collision advisors with helpful information about servicing these advanced systems during a collision repair.

NOTE: This Manual contains information for both the **US** and **Canadian** markets. Information specific to the Canadian user is identified by a red Maple Leaf icon: Data specific to the US is marked with a flag icon:

The Road to Autonomous Driving

Auto makers have adopted a classification system that describes the different levels of automation. The levels of automation range from simple to complex warning systems to fully autonomous driving where the capabilities and fitness to drive a vehicle is no longer required and the vehicle assumes complete control of itself.

Illustration 1: The Five Levels of Autonomous Driving

Level 1:
Assisted Driving

Support the driver when driving, ensuring enhanced safety and comfort. Systems, such as the Active Cruise Control with Stop & Go function,which independently controls the distance to the vehicle ahead, or the Front Collision Mitigation with Daytime Pedestrian Protection,which can ideally prevent collisions by an automatic braking process are found in **Level 1**.

Level 2:
Semi-automated Driving

Semi-automated assistance systems, like the Steering Assistant including Traffic Jam Assistant, facilitate driving. The systems brake and accelerate automatically. Compared to Level1, **Level 2** systems can take over vehicle guidance. With semi-automated driving, the driver is still responsible for vehicle control and cannot ignore traffic conditions.

Level 3:
Highly Automated Driving

The driver is further relieved and gains more freedom from driving tasks in **Level 3**. Under some conditions, the driver can look away from traffic conditions and have driving tasks be delegated completely to the vehicle. The vehicle can navigate independently for longer distances using highly automated systems. The driver must be able to resume control within a few seconds.

Level 4:
Fully Automated Driving

Level 4 is the precursor to fully autonomous driving. At this level, the vehicle is able to navigate most of a journey independently. The vehicle is so technically advanced that it can overcome highly complex urban traffic situations without intervention by the driver. In situations where the system's limitations are exceeded, the driver must still be fit to drive in order to assume control if necessary. At Level 4, the driver may even be able to sleep temporarily during a journey. If the driver ignores safety warnings, onboard systems have the authority to transfer the vehicle to a safe operating state and even stop the vehicle.

In Level 3 and 4 both the driver's fitness to drive and a valid driver's license are required. This is no longer important with **Level 5** fully autonomous operation. The vehicle assumes the driving task completely. The steering wheel and operating pedals become superfluous. From a technical point of view, the vehicle can also be moved without a driver. The presence of a driver is no longer absolutely necessary.

Level 5:
Autonomous Driving

As the complexity of the technical solutions is extremely high, fully autonomous vehicles will first be permitted on roads with relatively low speeds, in restricted areas of an urban environment, or on selected highway sections.

Future Mobility

Digitalization is constantly affecting more areas of everyday life. The trend towards automating routine processes will also have a profound effect on individual mobility concepts. Smart assistance systems, as well as digital operating concepts initiated by touch screen, gestures, or voice input, have long become an established reality. Looking forward to "**Future Mobility**", in addition to the advancing digitalization related to **ConnectedDrive**, the BMW Group is also increasing its focus on autonomous driving and the systems that will eventually support it.

Autonomous vehicles must be able to communicate with the environment, with pedestrians, with other vehicles sharing the same space on the road, and be able to respond quickly and independently to dangerous conditions or immediate perils.

Vehicle Networking

This is where both the networking of
vehicles as well as highly precise, real-time navigation maps will provide the essential traffic and mapping data needed for autonomous driving.

The BMW Group together with two competitors purchased the company **HERE**. In the future BMW Group vehicles will utilize the map version called "HERE HD Live Map", which is able to combine high-resolution map data with real-time information about other vehicles sharing the same space.

Real Time Traffic Information (RTTI) as well as the Hazard Preview represent an initial attribute of the exchange of real-time vehicle and traffic information. Car-to-X-Communication will form the basis for the data exchange required for fully automated driving.

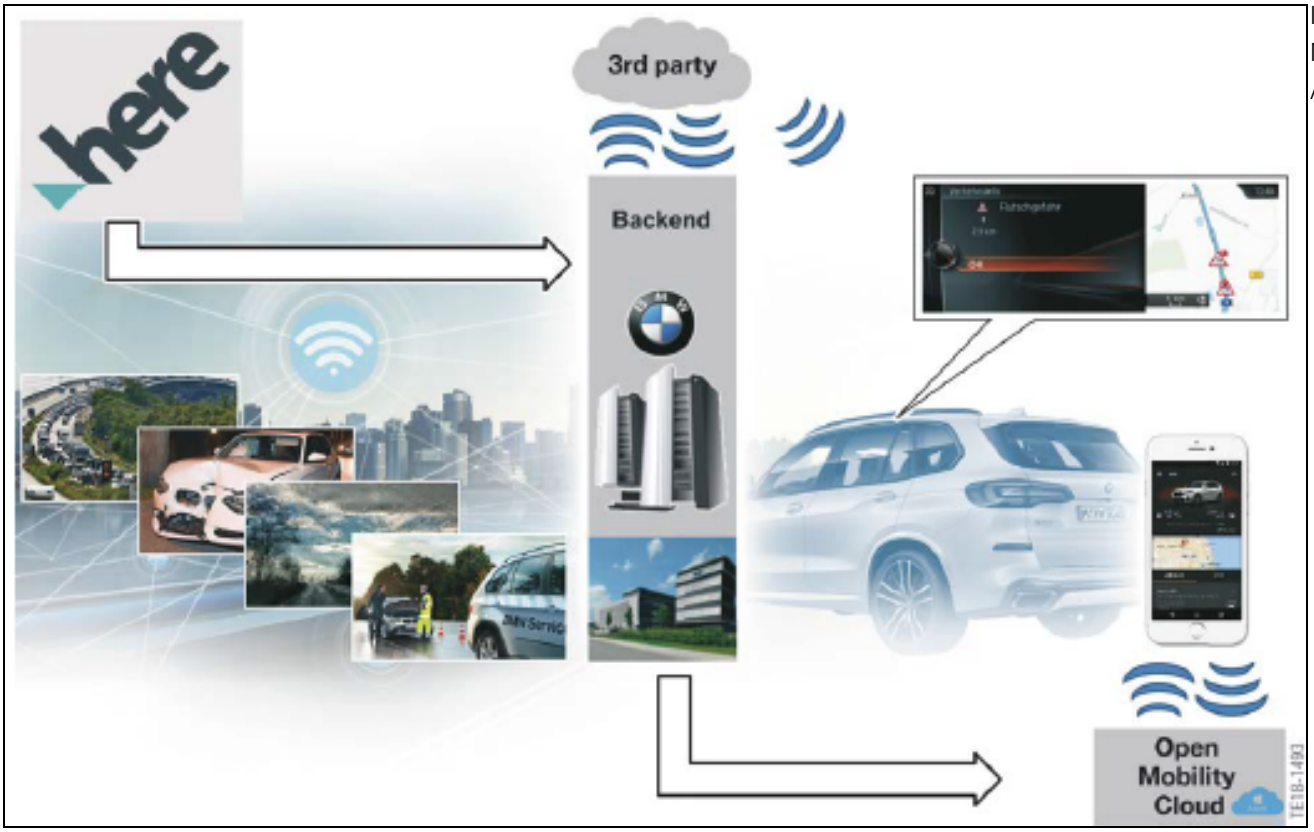

Illustration 2: Networking and an Accident Call

The development and rollout of the 5G standard, as well as the creation of an appropriate infrastructure for autonomous vehicles, will drastically influence the development stages and next steps towards autonomous driving.

There is also a need for autonomous vehicles to communicate with each other so that vehicles will be able to share their intentions with other road users. Besides the technology, social implications must also be realized in the way that the vehicle will communicate with pedestrians.

One approach may be that an autonomous vehicle could project a virtual pedestrian crossing on the road surface in order to indicate to a pedestrian that the vehicle will stop itself and yield the right-of-way to the pedestrian.

Artificial Intelligence

In the automotive area Artificial Intelligence (AI) is a key topic. For Level 3, 4, and 5 vehicles, the on-board processors must make immediate decisions based on inputs from the system's sensors and act appropriately. The human brain can process millions of signals and, based on the processing function in the brain and past experiences of the driver, take immediate action. A driver has little problem differentiating between a small animal, a shrub, and a child.

AI will play a very big and important role in the future for the use of the vehicles, whether for autonomous driving, mobility services or communication.

Why will AI be so important in the future? Let's look at two examples that will show areas that need to be addressed.

A human being has the ability to store things in their long-term memory that has been seen once and then quickly and easily recognize it again.

As an example, let's look at a pedestrian cross-walk which is easily recognized as such by most drivers. A driver identifying a cross-walk is done without regard for the color of the street markings (lane lines) as well as the color of the cross-walk stripes. However, a computer would possibly have a problem with this as color changes and the meanings of some colors for traffic markings are not automatically considered. In some locales, it is not uncommon for cross-walk lines to be yellow or white, although most cross-walk markings on public roads in North America are white. Cross-walk lines in privately controlled parking areas may be painted different colors and not white.

For the second example, let's consider a shrub or a hedge near the edge of a roadway. Most roadside fauna would be recognized as a stationary obstacle and pose no avoidance issues. What happens with shrubs or hedges when its leaves have been wind-blown and are moving? A driver would not have a problem with identification these objects that pose no real safety concern; the vehicle's computers could misinterpret this and detect a moving object instead of a shrub and take evasive action. This misdiagnosis sometimes happens with rear collision avoidance systems. A person backing up to a curb may have the brakes applied abruptly as they approach the curb, especially if the approach speed is somewhat fast.

In addition to networking and communication with the environment, future vehicles must also be able to interpret various situations in order to be able to respond accordingly. Ultimately, AI when fully functional will make autonomous driving a safe endeavor.

Data Transmissions

One of the biggest challenges to autonomous driving is the large volume of data that must be shared. An autonomous vehicle generates about one GB of data per second. This is why the 5G standard is required for Intelligent Vehicles that share data. At current levels, even a 5G data network would be at its maximum limits with a fully autonomous vehicle. An intelligent data management system, therefore, is essential to the successful launch and adoption of autonomous vehicles.

BMW CarData

The BMW Group already offers its customers innovative and customizable services in the area of individual mobility. BMW CarData was introduced in order to be able to integrate services of third parties.

With BMW CarData the customer has control of his data and can decide what should happen to the data. In the ConnectedDrive account, the customer can customize account settings which allow vehicle status data such as the odometer reading, usage-based data like average fuel consumption or event data such as eCall to be transferred to BMW. In 2018, BMW launched aCall, a system that identifies when a vehicle is involved in a low-speed collision. This system was first made available on the G30 and has been included on all vehicles produced since the G30 was introduced to the market.

Third-party service providers can obtain required data need for certain services once the customer consents when they endorse an Electronic Service Agreement. Needed data is transmitted in an encrypted format in order to guarantee data security for the customer.

For the customer, BMW CarData provides security and the user controls the data coming from their vehicle. The customer can request a CarData report at any time via the ConnectedDrive portal in the CarData archive. The CarData report provides information about which data has been forwarded. Apart from data security, maximum transparency for the customer of any shared data is also guaranteed.

Mobility Services

The BMW Group supports a mobility concept that builds on sustainability and links mobility services together intelligently. For example, for the market introduction of the BMW i3, intermodal route planning was presented, which called out public transportation when selecting a route using the available navigation system.

Car-sharing programs such as DriveNow or mobility services like ChargeNow and ParkNow are now available.

Illustration 3: Mobility Services

Legal Considerations

While the development of technical systems continues, a legal framework that will support Level 3 through Level 5 must be developed. Ethics committees are already compiling new rule sets that will address liability. Infrastructure laws must also be addressed in many countries. These motor vehicle laws must address topics such as pedestrian right-of-way at crosswalks which may need to change with Level 5 to be more sensitive to the needs of pedestrian safety. Vehicle control laws will also need to be modified. In certain countries now, Lane Assistant is not permitted by law. For example, this system is permitted in the US; the European Union (EU) prohibits this system on vehicles sold in EU countries. Similar changes were needed when Park Assist and Back Up Assistant systems were introduced as many countries require that the operator of a motor vehicle keep at least one hand on the steering wheel at all times.

Consequently, currently offered Driver Assistance Systems within the BMW model range need to comply with country-specific regulations. This makes national-market variants a real possibility.

Summary

- BMW still considers its vehicles to be the **Ultimate Driving Machine.** The company will give the customer the choice between the Ultimate Driving Machine and the **Ultimate Automated Driving Machine**
- Systems like the BMW Personal CoPilot and the Intelligent Personal Assistant are now being offered.
- Most currently available BMW Driver Assistance Systems are the precursor to fully autonomous driving
- There are five levels of autonomous driving. In 2019, BMW vehicles had reached Level 2 and feature some options that provide Semi-Automated driving capabilities
- Autonomous vehicles require network speeds greater than 1 GB of data transfers per second.
- Autonomous vehicles must be able to process high levels of data as well as communicate with the environment and with other vehicles in the space they occupy
- With greater navigational needs, systems must be developed that can provide greater resolution than current mapping systems
- For autonomous vehicles to operate safely and efficiently, AI systems must be developed that can assess situations and quickly make operational decisions
- The legal framework in many countries may need to change to address how automated systems operate at Level 2 and above

DRIVER ASSISTANCE SYSTEM SENSORS

BMW Driver Assistance Systems rely on inputs and date from various sensor located around the vehicle's periphery. The main sensors are located:

- Behind the front and rear bumper panels (Lane Control Systems)
- Under the bumper panel in the lower grillework (ACC with Stop and Go)
- In the bumper panels (Park Distance Control, Surround View, Parking Assistant)
- Behind the grille (Night Vision)
- Behind the windscreen (KAFAS, Rain Sensor, Auto Headlights)
- Above the Instrument Cluster (Drive Camera System)
- In the Roof Function Center near the rear view mirror (Gesture Control)
- In the side-view mirror (Surround View)

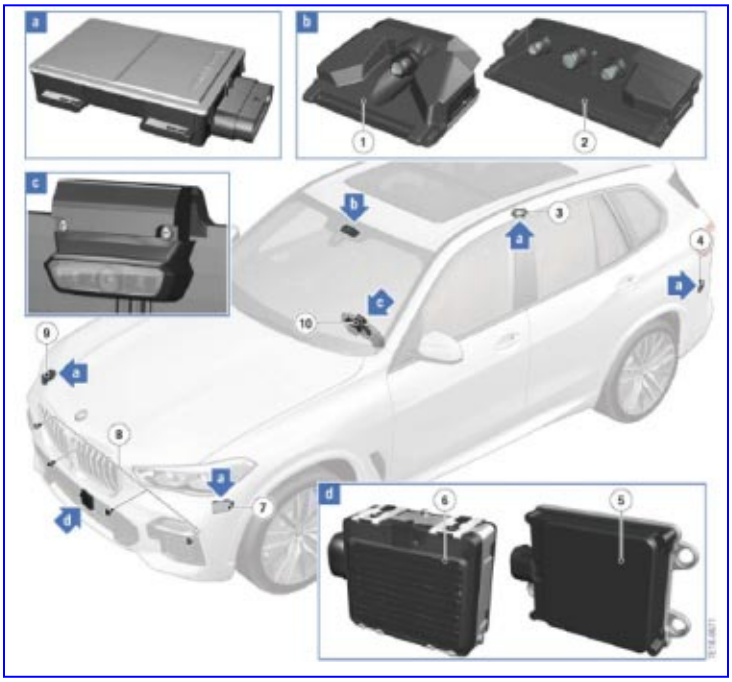

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Illustration 4: Overview of the different sensors

Sensor Types

Ultrasonic Sensors

Used primarily for parking guidance systems, ultrasonic sensors emit ultrasonic pulses (sound waves). The system's processor then measures the return signal's speed and determines the proximity of the object to the sensor.

The Park Distance Control (PDC) system includes four ultrasonic sensors positioned on both the front and rear bumper panels that can detect potential parking hazards.

If an object is detected, the driver is alerted via both audible and visual warnings. An auditory "beep" will be transmitted through the speakers in the appropriate corner of the vehicle cabin. The "beeping" becomes more rapid as the object nears, ultimately ending in a constant "flat line" tone when the object is within one foot (0.3m) of the vehicle.

Additionally, a graphic display of the vehicle appears in the iDrive monitor, and uses red, yellow and green color indicators to visualize the location and distance of the unseen object.

Park Distance Control is activated automatically by engaging the Reverse gear or manually on most BMW vehicles using the PDC button located to the left of the buttons for the electronic parking brake and Auto Hold functions on the center console.

PDC sensors may sound false warnings if they are covered completely with water running off the hood panel or the trunk/tailgate as in heavy rain or when initially driving off in a wet vehicle. If sensors are installed in a bumper cutout that is too small for the sensor, the bumper panel may impinge on the sensor face, triggering a false warning. Technicians must use the correct punch and backing die whenever PDC mounting holes need to be punched into a replacement bumper panel.

Imaging Systems

Side View Cameras

This feature provides an early look at cross traffic at blind driveways and intersections to help avoid pulling into unseen cross traffic (illustration 4, below). The Side View Cameras are positioned ahead of the front wheels and housed in the wheel arch sections of the front bumper panel on both sides of the vehicle. The images from both cameras are shown simultaneously in the iDrive display. The cameras give a wide angle view of the area directly to the side for up to 330 feet (100m) in both directions. A yellow line in each image indicates where the front of the vehicle begins.

This feature is only active when stopped or at low speeds. It will automatically disengage when the vehicle exceeds 9 mph (~14 km/h). The button to turn the system on is located in the center console and features a picture of a video camera to aid in quickly locating it. When the system is engaged, the driver can adjust the brightness and contrast the iDrive controller.

Illustration 4: Side View Camera images

Illustration 5: Merged Image: Top, Rear , and Side View Camera

Top View Cameras

The Top View Cameras provide an even more comprehensive and complete picture of the car and its surroundings (illustration 5, above right). In addition to the standard Reversing (rear view) Camera and the Park Distance Control sensors, Top View uses two cameras in the outside mirrors on the driver and passenger doors, and combines all three images (side view, reversing camera, top view cameras) through a central processor. This is why the system is known as TRSVC **(Top, R**ear, **S**ide **V**iew **C**ameras) This provides an overall picture presented in the iDrive display showing both the car and its surroundings from a bird's eye perspective 270-degrees around the vehicle. This clear overhead-type view enables the driver to maneuver more precisely, even in confined spaces.

The image quality of all camera-based monitoring systems can be impaired by rain, snow, ice, and dirt in front of the lens. For optimal performance, camera lenses and forward surfaces should be clean.

Top, Rear, Side View Camera Limitations

The system cannot be used in the following situations:

- With a door open
- With the trunk lid open
- With an exterior mirror folded in
- In poor light

KAFAS Cameras

There have been several variants of the KAFAS camera and usage is dependent on the model, the selected options and the introduction year of the particular Service Pack. The **KAFAS Mono System** uses a single camera lens and an image sensor and works based on object classification. This system can calculate distances to an object based on complex software algorithms. The **KAFAS Stereo System** can be identified by its two camera lenses and uses two image sensors. This camera system generates a 3D image and, when operations are within system limits, can calculate distance using the 3D images. Both of these systems are found on BMW vehicles with certain option packages and utilizing Service Pack 2015.

As the need for more accurate data increased, KAFAS cameras further evolved with the introduction of Service Pack 2018. As compared to the KAFAS Mono, the **KAFAS MID Camera System** (illustration 4) has extended object detection range capabilities, a larger field of view, higher computing capacity, and better low-light performance for better after dark performance.

The KAFAS Stereo System camera originally found on the G11-12 (7-Series) has been updated to the **KAFAS HIGH Camera System** (illustration 5). The latest version includes three camera lenses. There is a Fish-eye (wide angle) lens for close range data acquisition used with Surround View, one for medium range, and one for data fusion with Radar sensors at distances up to just over 800 feet (250m).

Illustration 6: KAFAS Mid Camera

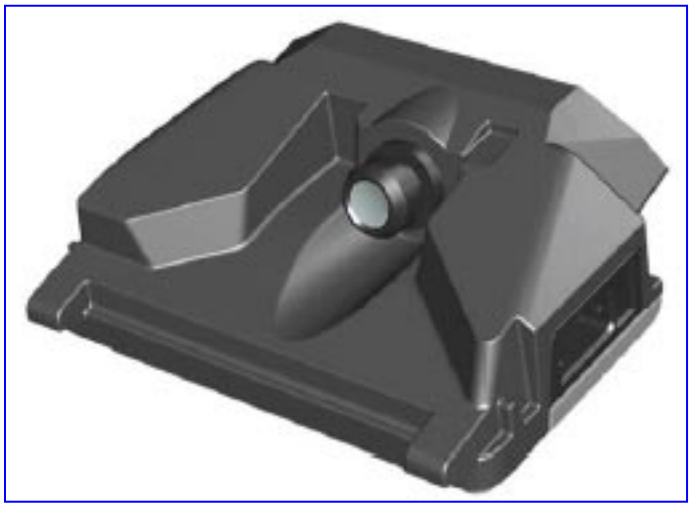


Illustration 7: KAFAS High Camera System

KAFAS Functional Limitations

The function of the KAFAS camera and the driver assistance that rely on its data may be impaired due to the physical limitations of the optical system that includes:

- Heavy fog, rain, spray, or snow
- Strong backlight in the camera lens
- If the KAFAS viewing aperture or windscreen are dirty
- On tight bends and acute angle turns
- If road boundary or limit lines are covered by an object
- If driving at close proximity to a leading vehicle
- If the windscreen in front of the rear view mirror is obscured by mist, dirt, or stickers
- If road boundary or limit lines are missing, worn, poorly visible, converging/diverging or not clearly visible (i.e. road construction/repair)
- If road markings are covered by snow, ice, dirt, or water
- Up to 10 seconds after driving readiness is activated by the Start/Stop button
- During the calibration of the KAFAS system immediately after vehicle delivery or any changes made to the camera system

Drivers are warned that due to functional limitations and system restrictions of KAFAS camera structure, system warnings may not be issued, issued at a later time, or may be unwarranted. Drivers are further warned to be attentive to their surroundings and ready to intervene at any time to avoid the risk of an accident.

Night Vision

The advanced technology found on the **Night Vision** system helps the driver perceive critical situations at night or during twilight. An **infrared camera** positioned at the front of the vehicle behind the kidney grille transmits an image to the iDrive display; the greater the object's warmth, the brighter its image on the display.

The Night Vision camera is installed behind the left ornamental grille. Rain, dirt, snow or ice can impair the functionality of the camera. The camera is automatically heated at low ambient temperatures. When the

The camera scans a range up to 1,600 ft. ahead of the vehicle. Its maximum 36-degree viewing angle is relatively large, and the view will vary according to the road's path and driver input. To capture more distant objects at higher speeds, a digital zoom function can be activated. Brightness, contrast and other image parameters can be adjusted via the iDrive system; Night Vision can be turned on or off via a switch in the lighting control group.

Night Vision includes a **Pedestrian Detection** feature, which detects the direction a pedestrian near the roadway is moving. If the pedestrian's direction of travel is parallel to the road, the system will sense and display their presence on the iDrive display (or, if so equipped, the Head-Up Display) but the system will not warn the driver. If the pedestrian is on a path to cross the road, the system issues a warning.The Pedestrian Detection function of the Night Vision system only functions when ambient temperatures are 82.4° (°F) or below.

Night Vision is particularly valuable under such conditions as :

- Poor vision on dark, rural, undivided highways
- Obstacles or sharp curves that low headlight beams reveal too late
- Less-than-ideal driver judgments regarding speed, following distance and other driving variables
- Blinding headlights from opposing traffic.

With Night Vision, the driver can possibly recognize dangerous situations significantly earlier than with the headlights alone. Conceivably, the driver might be able to begin reacting to a possible hazard sooner.

System Limitations

As with many sophisticated technologies, Night Vision is highly beneficial, but is not a substitute for careful driving or attention to traffic and the road ahead. Weather conditions can affect the function of Night Vision, since rain or fog can filter infrared light and therefore degrade the quality of images that the system captures.

Because the Night Vision camera is essentially a military device, special measures are required for safety reasons. If a component is faulty or the vehicle is damaged, the Night Vision camera must be returned to the system supplier.

Radar Sensors

Several different types of Radar sensors are now being utilized due to the need for different types of sensors required for semi-automated (Level 2 and 3) driving conditions. Radar sensors are now responsible for rear monitoring and distance calculations. With the introduction of Service Pack 2018, a total of six different control units can use data from these radar sensors.

Front Radar Sensor

A newly developed Front Radar Sensor was introduced with the launch of the G05 (BMW X5). This sensor is used with the ACC Stop&Go option and is part of option package 5DF.

The Front Radar Sensor utilizes a replaceable Radome (front enclosure).

Illustration 8: Front Radar Sensor (FRS)

Front Radar Sensor Long

As the name may seem to suggest, this system is not simply a long-range sensor but a full range sensor. It has been in service on many G-model vehicles such as the G0x, G1x, and G3x variants. This Radar sensor is part of option package 5AU, Active Driving Assistance Professional.

Illustration 9: Front Radar Sensor Long Range from a G05 (FRSF)

Front and Rear Side Radar Sensors

Depending on the system and vehicle platform, up to four (4) Front and Rear Side Radar sensors may be installed. They include:

- Side Radar Sensor Short Range Front Left (SRSNVL)
- Side Radar Sensor Short Range Front Right (SRSNVR)
- Rear Radar Sensor Short Range Left (HRSNL)
- Rear Radar Sensor Short Range Right (HRSNR)

Front and Rear Side Radar Sensors are classified as short-range. These sensors have an operating range between 15 ft. (4.5m) front and 230 ft (70m) rear. These sensors also monitor the spaces to the right and left side of a vehicle and have a lateral range of about 6m to detect vehicles and about 10m to locate stationary objects such as roadside structures.

Side Radar Sensors are located behind the front and rear bumper panels. Performance of these sensors can be affected by anything that can possibly attenuate Radar signals such as:

- Stickers placed on the bumper panel. WrapGuard paint protection films as well as Car Pool Lane or other types of adhesive stickers are examples
- Paint Film Build in Refinish Types 1 and 3.
- Application of high-build filling primers, plastic welding rods, or other cosmetic plastic panel repair material

LiDAR Sensors.

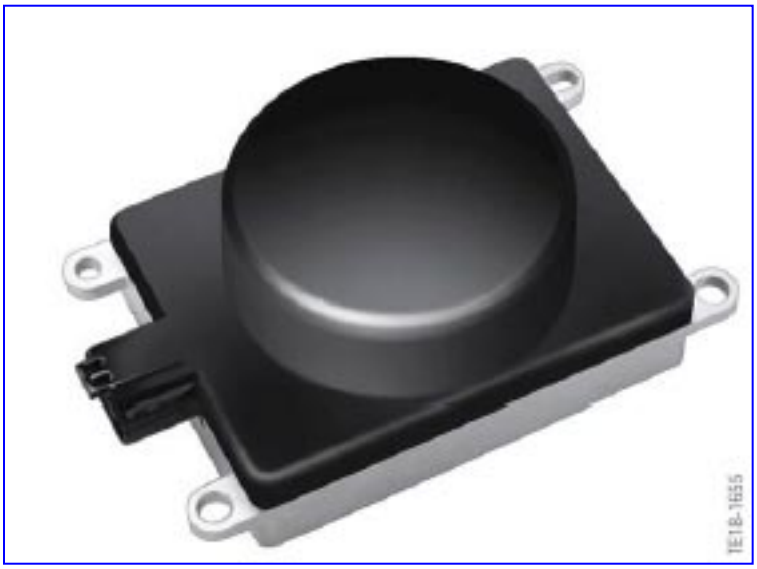
Even in difficult situations such as direct sunlight or darkness, sensors which work using a LiDAR technology are able to adequately map the vehicle's surrounding environment.

The designation "LiDAR" is derived from the operating principle and essentially means "Light Detection and Ranging". A LiDAR sensor scans the surrounding area and generates a 3D image of its surroundings. T operating principle of a Lidar system is similar to that of RADAR. The difference is that LiDAR uses a laser beam instead of high frequency radio waves or microwaves.

The signals emitted by the laser are received by the LiDAR by means of multispectral cameras. Multispectral cameras are characterized by the fact that they can absorb the reflected light of the laser (from the surface of the object) in several wavelengths. The reflected laser light can also be received by means of a special integrated chip. From a technical standpoint, this would mean that the multispectral cameras could ultimately be deleted, freeing up design possibilities.

LiDAR works in a similar way to Radar and Sonar yet uses light waves from a laser, instead of radio or sound waves. A LiDAR system calculates how long it takes for the light to hit an object or surface and reflect back to the scanner. LiDAR sensors can fire up to 1 million pulses a second, making them ideal for mapping objects.

Illustration 10: An example of a LIDAR sensor with integrated chip



Rain/Light/Solar/Condensation Sensor

This sensor has several important functions. The **Rain Sensor** uses transmit diodes and receiver diodes (infrared) to evaluate the degree of reflection from the windscreen. The arrangement of transmit and receiver diodes in pairs creates measurement paths. The rain intensity is detected by analyzing the different measurement paths.

The **Light Sensor** detects the ambient brightness and the brightness of light reaching the windscreen forward of the vehicle.

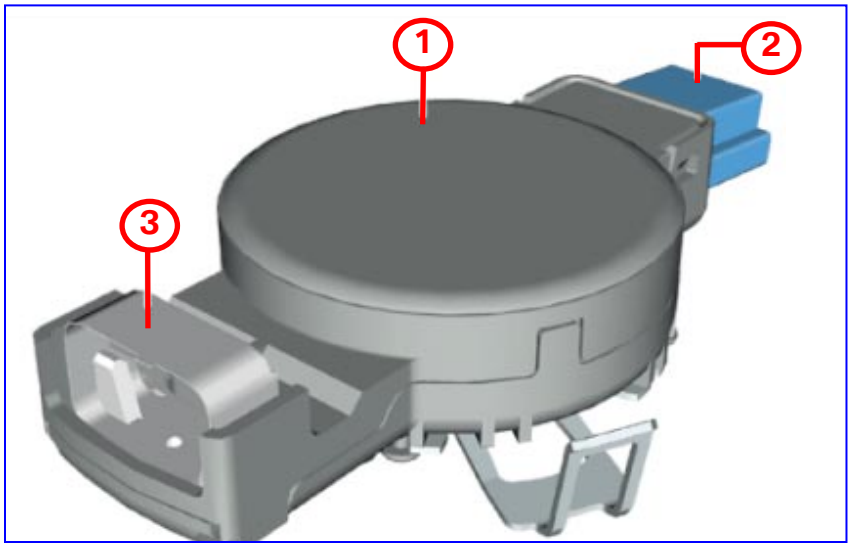
If the vehicle is fitted with a Head-Up Display, there is a separate photosensor that adjusts the brightness of the Head-Up Display.

The **Solar Sensor** is used for the range of functions of the integrated automatic heating and air conditioning system. The solar sensor measures the intensity of sunlight on the vehicle.

A **Condensation Sensor** ensures prompt recognition of incipient condensation and is interfaced to the automatic climate control system. It adjusts the system before the driver notices any fogging tendency. Countermeasures can be initiated at an early stage without the driver needing to intervene. The condensation sensor is active only in the automatic program of the integrated heating and air conditioning system.

The Rain/Light/Solar/Condensation sensor is installed in the mirror base. This sensor is locked in place on a mounting plate by means of a retaining spring. The mounting plate is firmly bonded to the inside of the windscreen. The optical connection of the Rain/Light/Solar/Condensation sensor to the windscreen is established by using a silicone gel pad that is fitted to the optical element and this pad is replaceable on newer models.

Illustration 11: Rain/Light/Solar/Condensation sensor



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2	Connector Plug
3	Condensation Sensor

Depending on the vehicle model and model year, the Rain/Light/Solar/Condensation may need to be replaced whenever the windscreen is removed or replaced. This may not be required with later model vehicles. Newer vehicles may only require replacement the silicone gel pad. Please consult AIR for the applicable service procedure.

Driver Camera System

Autonomous driving at Levels 2 and 3 require a system that detects both driver alertness and driver awareness or readiness. The Driver Camera System (DCS) integrates an infrared camera that makes it possible to detect the driver's viewing direction. Using information from the DCS, the control unit can assess the driver's alertness and whether the driver's eyes are open or closed. This alertness evaluation has a distinct impact on the Fatigue Alert system and it provides a better assesment of the driver's condition than just relying on steering inputs. It also interfaces with several safety systems such as the Cross Traffic Alert, Evasion Aid, the Extended Traffic Jam Assistant, and the Emergency Stop system. With the Evasion Aid and Cross Traffic Alert systems, the time before system intervention takes place is decreased if the DCS detects that the driver is inattentive (not paying attention or not looking straight ahead). All of these enhanced safety systems are part of the **Active Driving Assistant Professional,** option package code 5AU.

With the release of the **Extended Traffic Jam Assistant** and using the DCS, BMW has achieved a true Level 2 Semi-automated Driving System whereby the driver can take both hands off the wheel at speeds below 40 mph (65 kph). This system has an unrestricted hands-off time period if all system parameters continue to be met.

The DCS is mounted just above the instrument cluster and uses sensors to detect the driver's eyes as well as the tip of the driver's nose. Using these marks, the DCS system can calculate where the driver is looking.

Illustration 12: The Driver Camera System (DCS) Item #1 (below)

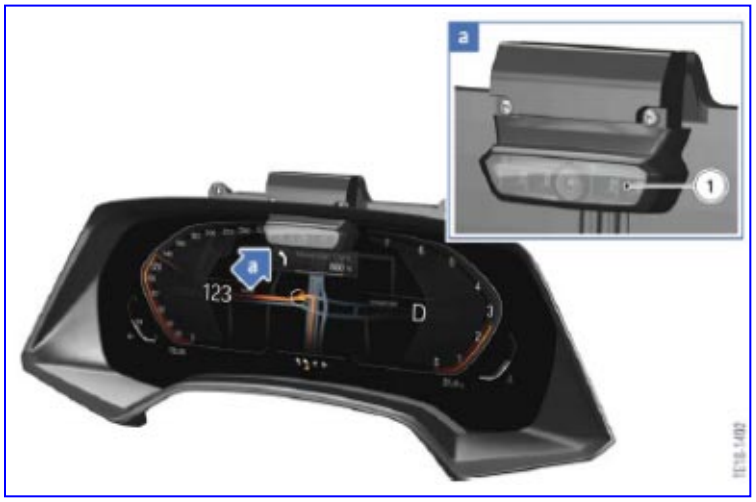
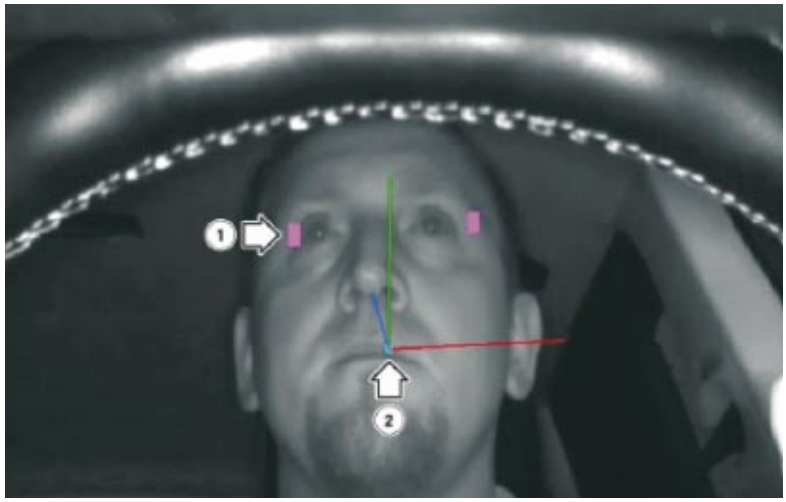


Illustration 13: What th DCS sees



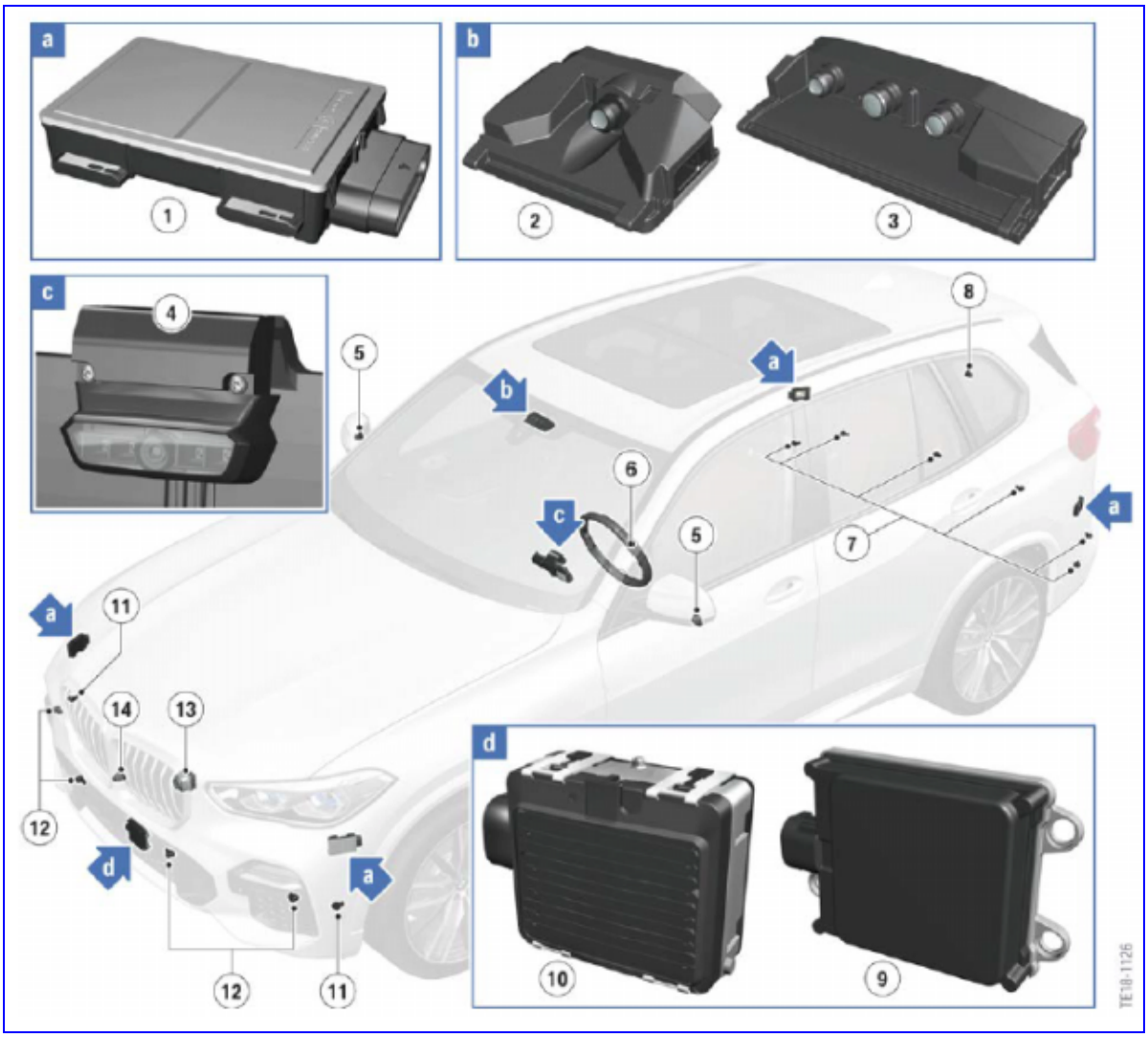
System Integration

Vehicle Options package may utilize a variety of sensors, Before and advisor creates a damage assessment, they will need to identify the optional equipment as well as the option packages so that the sensors may be located and inspected. The following table lists the option packages for a G05 (BMW X5)and the sensor types.

Vehicle Equipment	KAFAS Camera	Front Radar Sensor	Side radar Sensors
Active Driving Assistant (SA 5AS)	 KAFAS Mid Camera		 Rear Radar Sensors (HRSNL, HRSNR)
ACC Stop & Go (SA 5DF)	 KAFAS Mid Camera	 Front Radar Sensor	 Rear Radar Sensors (HRSNL, HRSNR)
Active Driving Assistant Professional (SA 5AU)[1]	 KAFAS High Camera	 Front Radar Sensor Long Range (FRSF)	 Front, Rear Sensors 

[1] SA 5AU also receives the Driver Camera System (DCS)

Sensor Locations



Index	Explanation
1	Side Radar Sensors (HRSNR, HRSNL, SRSNVR, SRSNVL)
2	KAFAS MID Camera
3	KAFAS HIGH Camera
4	Driver Camera System
5	Side View Camera
6	Capacitive/Inductive sensor in the steering wheel rim
7	Ultrasonic Sensors for Park Distance Control (PDC) Rear
8	Rear view camera (RFK)
9	Front Radar Sensor Long-range (FRSF)
10	Front Radar Sensor (FRS)
11	Ultrasonic Sensor, Park Maneuvering Assistant (PMA)
12	Ultrasonic Sensors for Park Distance Control (PDC) Front
13	Night Vision Infrared Camera
14	Front Camera

Side Radar Sensors (1)

The front side radar sensors are mounted behind the bumper panel (illustration 14, below). The rear side radar sensor is mounted on a panel just behind the rear bumper trim panel (illustration 15).

Illustration 14: Front Side radar Sensor

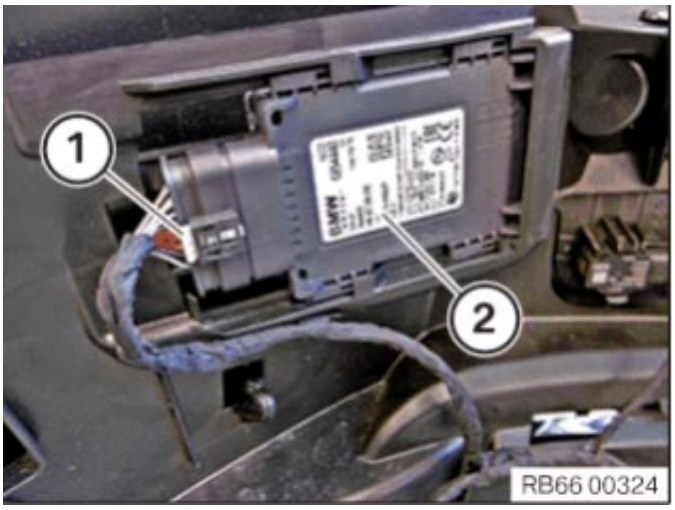
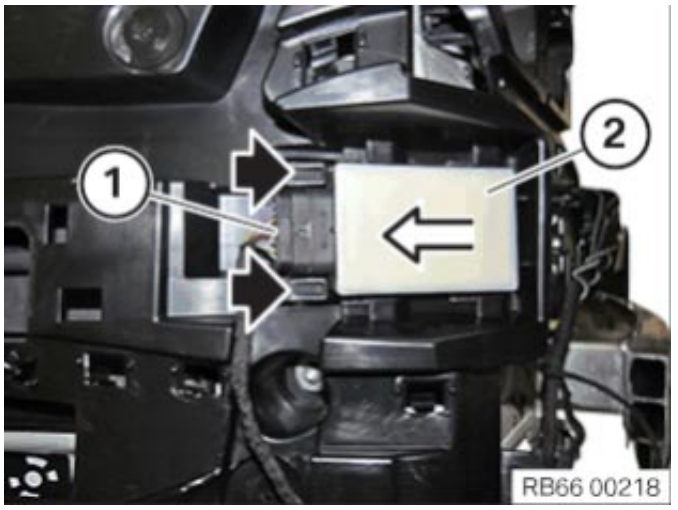


Illustration 15: Rear Side radar Sensor



KAFAS Camera (2, 3)

Both the KAFAS Mid and KAFAS High cameras (based on option packages) are located behind the upper section of the windscreen, just forward of the Roof Function System and above the rear view mirror mounting.

Driver Camera System (4)

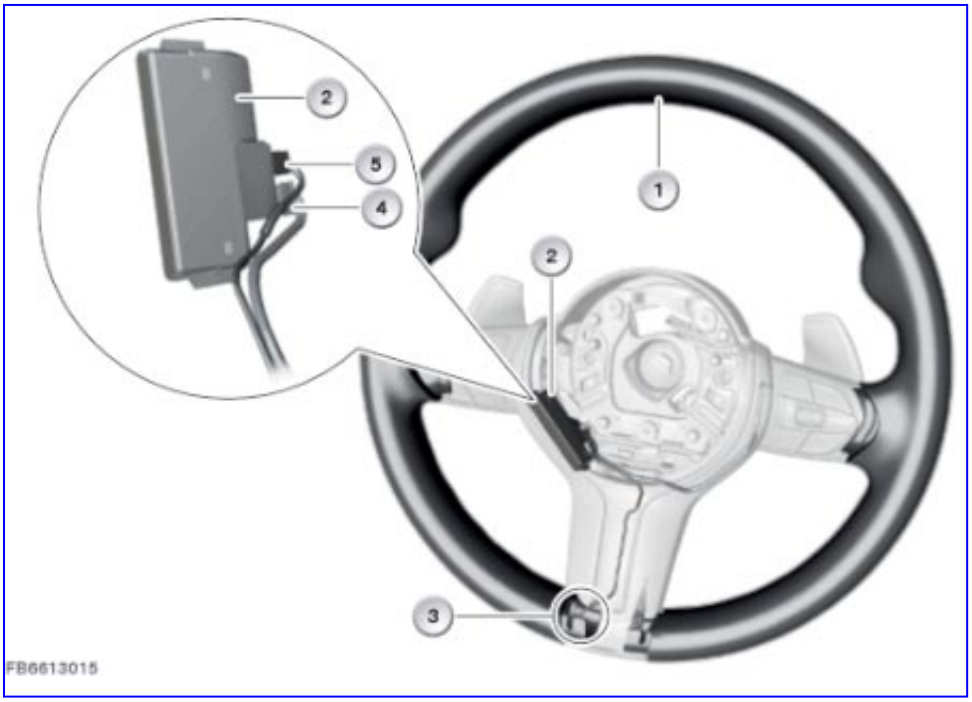
The camera is mounted just above the instrument cluster.

Side View Camera (5)

Also called the Top View camera, these cameras are mounted on the lower section of both exterior side view mirrors. The camera can be serviced without removing the mirror assembly from the door.

Steering Wheel Capacitive Sensor (6)

Also called a “Touch Detection Sensor”, the system can detect whether or not the driver’s hands are located on the steering wheel rim. The system will not detect the driver’s hands if they are on the steering wheel spokes or the airbag cover. The touch sensor (1, below) consists of a mat with a capacitive sensor. The electronics (2) are located in the center section of the steering wheel. Used on several systems that provide steering assistance such as the Traffic Jam Assistant. Depending on the system, audible and visual warnings can be issued if the driver’s hands are not positioned on the rim of the steering wheel.



Park Distance Control (7, 12)

Park Distance Control sensors are mounted in the front and rear bumper panels. They are forward or rearward facing sensors. Older models may only have rear PDC sensors. These sensors are plainly visible.

Rear View Camera (8)

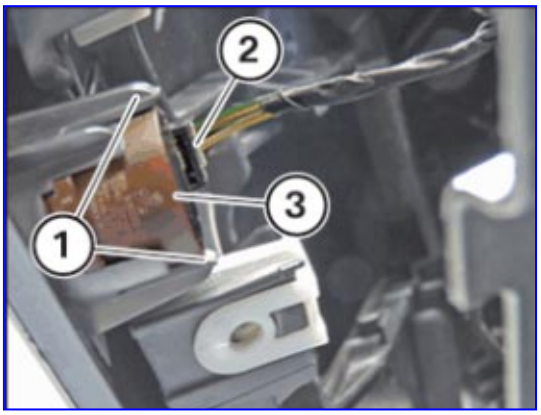
This camera is mounted on the tailgate or rear lid compartment. The rear view camera provides support when parking, driving in reverse, and while maneuvring. To aid the driver, the area behind the vehicle is shown on the central information display. The detection range of the camera has a maximum range of 100 meters. The horizontal angle for the capture is approximately 190°. The vertical angle for the capture is approximately 130°.

Front Radar Sensors (9, 10)

Both the Front Radar Sensor (FRS) an the Front Radar Sensor Long Range (FRSF) are located in the lower grille area of the front bumper.

Parking Assistant (11)

Park Maneuver Assistant and Parking Assistant systems use data from both ultrasonic sensors as well as the TRSVC Camera. Early systems used sensors mounted in the front side wall trim (left). Later versions utilize the TRSVC camera as well as ultrasonic sensors located on the sides of the front and rear bumper panels (right).



Night Vision Infrared Camera (13)

The Night Vision Infrared sensor is located just behind the kidney grilles on most vehicles.

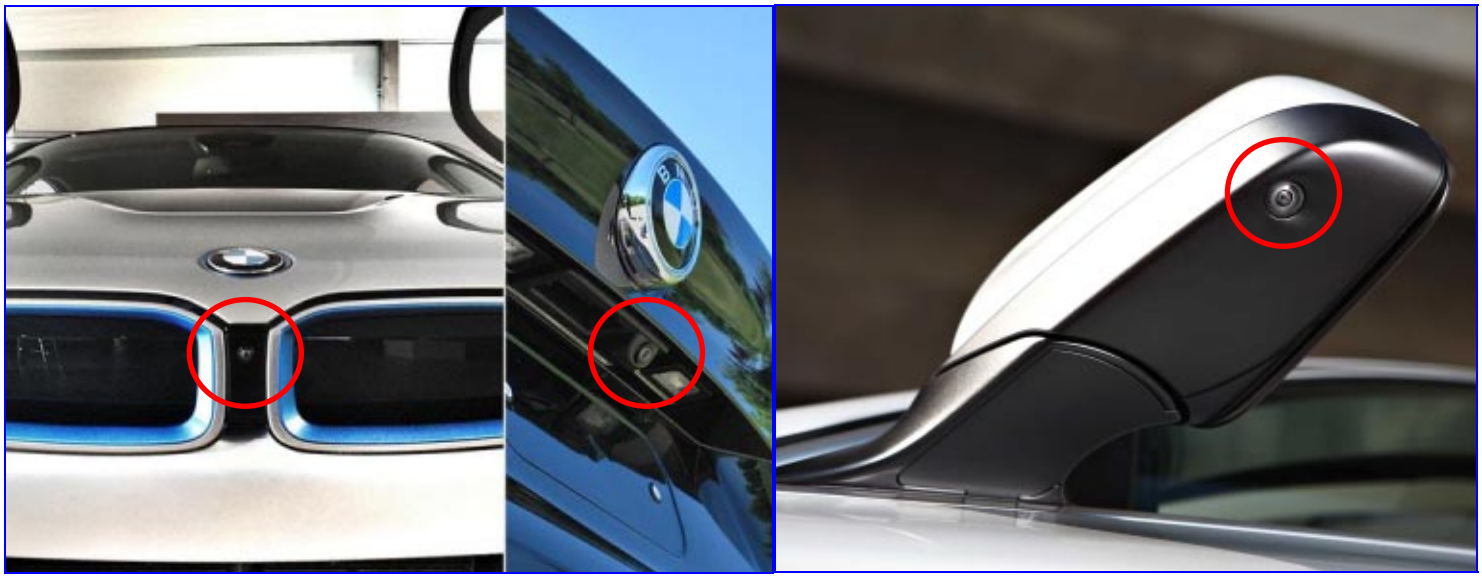
Front Camera (14 (Surround View)

On the original version of Surround View, the cameras were mounted to the front bumper panel just ahead of the front wheels on both sides of the vehicle. A yellow line in each iDrive image indicated the vehicle front, showing the positioning of the vehicle relative to traffic. This helped the driver avoid pulling into otherwise unseen cross-traffic when emerging from a blind intersection or a garage.

The Top View cameras provide a comprehensive and complete picture of the BMW and its surroundings. Top View uses a camera in each exterior side view mirror (#5) and the Rear View Camera (#8), and combines these images via a central processor into a picture in the iDrive display showing the vehicle and its surroundings from a 270-degree “bird’s-eye” perspective. This overview helps the driver maneuver precisely, even in blind or confined spaces.

As a system enhancement found on the X3, X4, X5 and X6 SAVs, the side-mounted front side cameras (in the bumper panel) were replaced with a single wide-angle camera located at the center of the BMW kidney grilles (Front Camera, #14). This enhanced version also added a rear camera positioned on the trunk lid above the license plate, giving the same type of wide-angle view to the rear sides as the front.

Further enhancements included a 3D version (2016 7-Series and later). Images from the four cameras (front mounted, two exterior side-view mirror cameras, and rear-mounted camera) are combined with 3D computer graphics to form an enhanced all- around version of the Surround View. Top View and 3D views are shown next to each other on the iDrive display for an even better overview when parking. The driver can select from prescribed Side, Rear and Top Views, or freely range among them. An additional view for car-wash entries is also available.



Gesture Control

The Gesture Control camera is located in the Roof Function center, near the rear view mirror. If the vehicle is equipped with Gesture Control, the camera is located in this panel.

Gesture Control is part of the new multimodal iDrive 5.0 operating concept and BMW is the first automotive manufacturer to introduce Gesture Control technology on a production vehicle. All gestures used for this control scheme are easy-to-learn, natural gestures, made in a detection field above the front center console:

- Point (with index finger of right hand) to accept an incoming call
- Swipe right to reject an incoming call
- Rotate clockwise or counter-clockwise (with index finger of either hand) for volume adjustment
- Two (with right index and middle finger) is a user-configurable gesture
- Clamp + hand movement (as if pinching and then pushing away or pulling toward) to activate 360 degree view around the vehicle using Surround View 3D camera.

Gesture Control can be activated or de-activated at any time using the iDrive menu. Gestures are accompanied by logical acoustic and visual effects (can be turned off if desired). For assistance in using the Gesture Control system, all of the currently available gesture options can be displayed on the iDrive screen.

Gesture control allows the driver to adjust settings, retrieve or reject telephone calls without looking away from the road ahead. A planned future use for Gesture Control will integrate this feature with the BMW Intelligent Personal Assistant and an enhanced mapping system. The driver will be able to point at a roadside building such as a restaurant or store and get information from the Assistant.

Sensor Limitations

While these systems per-
form exceptionally well in most driving conditions, there are physical limitations that may affect system operation. As such, BMW cautions drivers to remain attentive and in control of their vehicle at all times.

In general, Driver Assistance Systems may be affected by several variables including:

- Weather conditions
- Bright Light
- Surface cleanliness
- Road conditions
- System limitations
- **Collision Repair and Refinish methods that do not conform to BMW guidelines**

We will examine several systems and discuss some of their limitations. For moe detailed information about each system, please consult AIR.

KAFAS Camera

The KAFAS optical system can be affected by:

- Heavy fog, rain, spray, ice, frost, or snow
- Strong light in the camera lens
- If the camera's viewing aperture or the windscreen is dirty
- If the boundary lines on the road surface are missing, worn, poorly visible, converging or diverging, or not clearly visible
- If the boundary lines are covered by snow, ice, dirt, or water
- If the boundary lines are covered by any objects
- If the vehicle is being driven at close proximity to the vehicle ahead
- Up to ten seconds after driving readiness is activated with the start/stop button
- During the calibration process for the KAFAS camera after the camera has been replaced or when the vehicle is first placed in service when new

Driver Camera System

The Driver Camera System operation can be restricted in the following situations:

- The driver's face must remain visible. It may work with ski masks with a cutout for the eyes and nose. It will not function properly if the nose is completely covered or the driver's face is obscured.
- Any time that the DCS camera lens is covered
- If the driver's face is blocked by the steering wheel
- When high levels of backlight are shining into the DCS lens
- Whenever the driver's face is covered (i.e. costume or ski masks (nose is covered)
- If the driver is using infrared-blocking sunglasses. The DCS system will work if the driver is wearing sunglasses using conventional or Polarized lenses.

Radar Sensors

Radar signals can be attenuated or reduced by placing certain objects in front of them and may not work properly in the following situations:

- When a number plate is mounted in front of the Front Radar Sensor
- Placement of stickers on the bumper trim within a 10 cm radius of a side radar sensor
- Mud or any other heavy accumulation on the radar sensor or on the bumper panel in front of a radar sensor.

Ultrasonic Sensors

Sensors used in the Park Distance Control and Park Assist systems can be affected by:

- Interference with the mounting area. Sensor holes in the bumper panel must be accurately sized. If the sensor or sensor mounting ring is pinched due to a hole that is undersized, the system may issue false or intermittent warnings
- A buildup of snow, ice, or mud on th sensor
- Water rolling off the hood or tail gate in large quantities will trigger a false warning.
- Steep approach or departure angles.

Collision Repair

If the vehicle has been involved in a collision, the Driver Assistance sensors and their mounting surfaces must be carefully evaluated. Depending on the system and sensor type, sensor performance can be affected if the sensor position has been affected.

Most sensors can be removed and reinstalled without affecting their operation. However, if the mounting panel has been adjusted, re-aligned, damaged, or repaired, the sensor may need to be recalibrated. As an example, the Reversing Camera in the tail gate can be removed and reinstalled without the need to recalibrate the camera. It will need to recalibrated if the tail gate is repositioned. Consult AIR for more details.

Bumper panel service presents another challenge. Because of the potential to reduce radar signals resulting from excess film build, especially from paint solids like metallic flakes, BMW has specific repair and refinish procedures that applies to bumper panels on vehicles with certain options.

For vehicles with option packages 05AS (Driving Assistant), 05AT (Driving Assistant Plus) and 05AU (Driving Assistant Professional), bumpers cannot be refinished in Paint Stage 1 or Paint Stage 3 on certain vehicles.

TECHNICAL INFORMATION

To guarantee the system function in vehicles with lane change warning sensor (optional equipment S5ASA, 05AS, S5ATA, 05AT, S5AUA and 05AU), repainting the bumper panel may not be repainted either in paint stage 1 or paint stage 3.

Do not attach labels in the sampling range of the sensor.

Paint Stages

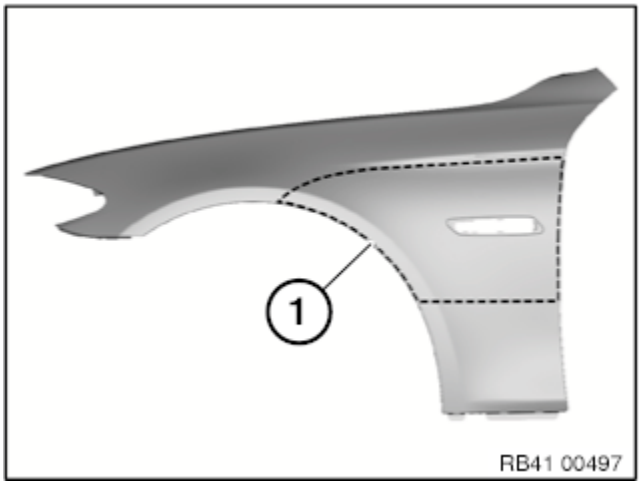
BMW classifies all paint repair into three distinct paint stages:

- Paint Stage 1: A blending process only, within the same part or adjacent panel (topcoat only)
- Paint Stage 2: Application of the complete paint coating system on a new replacement part. This may include metal etch, 2k Filler / Sealer application and refinish process.
- Paint Stage 3: paintwork performed on a repaired body part where the part substrate is effected. Body filler of less than 50% followed by an application of the complete paint coating system including etching primer, 2K filler and top coat refinish

Please see the ColorSystem Manual for TIS found in TMSi for the complete document and for any updates.

Panel Repair

Certain F-variant vehicles have the Park Assist (PMA) sensor mounted to the front side panel, located between the wheel opening and the front door edge. AIR provides a warning about collision repairs to the area surrounding the PMA sensor since it can have a profound effect on sensor alignment and aim. Repairs cannot be performed in the areas surrounded by a dotted line (below). The Park Assist sensor has been relocated on later models.



F01, F10 with PMA:
Metal straightening (repair) in the dotted area (1) is not permitted. The side wall panel must be replaced.

Windscreen Removal or Replacement

There are several Driver Assistance systems that rely on data from the KAFAS camera, located just behind the windscreen and immediately forward of the rear view mirror. The glass must be optically clear and cannot distort the image that the camera sees. Therefore, fit only Original BMW replacement windscreens.

If the vehicle being repaired has the Head-Up Display option, it is essential that the glass be an Original BMW Replacement part. A special windscreen must be fitted to ensure that the Head-Up Display image can be projected correctly. This windscreen is made in three sections. The outer and an inner glass panes are connected by a wedge-shaped plastic safety film. The wedge shape prevents double projection of the Head-Up Display.

When the windscreen is replaced, the vehicle identification number and Electronic Parts Catalogue must be checked to ascertain whether the windscreen in question is suitable for use with vehicles equipped with the optional HUD system. With a conventional windscreen, the projected image is reflected on the inner and outer glass pane, producing a double image (illustration #14). The Original BMW windscreen is shaped to provide a clear, distortion-free image from the HUD projection system. To avoid a double-image, Original BMW windscreens use a tapered-style safety layer between the glass laminates. In this way, the image stays in focus and is reflected to the driver's eye without distortion.

Illustration 14: HUD Image projected on a conventional windscreen

After the windscreen has be replaced or reinstalled, calibrate the KAFAS camera using the BMW Diagnostic System. The calibration is not complete until the vehicle has been driven.

Summary:

- Current Driver Assistance Systems will eventually be integrated into a fully autonomous vehicle
- Presently, the Extended Traffic Jam Assistant offers Level 2 Automation and the driver can operate the vehicle hands-free for extended time periods provided that certain parameters are met
- Virtually all Driver Assistance systems rely on accurate data from sensors located around the periphery of the vehicle. As such, these sensors are subject to damage from collisions
- Become familiar with the different sensor types, their location, and how collision service can affect their performance
- Collision Advisors do not need to know how sensors operate or the technical aspects of system service. Advisors should become familiar with the current range of Driver Assistance Systems, how they operate, and the functional limitations of each system

LOCATING OPTION CODES

Since many Driver Assistance systems have sensors that are not in plain sight, Advisors will need to identify the systems installed on a vehicle when collision damage is first being assessed. Correctly identifying the installed systems helps advisors create a repair plan that addresses any special repair requirements.

Key Reader

If your collision center is equipped with a Key Reader, several steps can be shortened when starting the damage discovery process. Since the E65 was launched, data stored in the Key Fob can be quickly retrieved to start a Repair Order. With the Key Reader, Advisors can identify:

- The vehicle owner's name and address
- Vehicle mileage
- The 17-digit VIN
- The next due service date
- Any maintenance that may be due or overdue
- Any Check Control messages
- Certain key Diagnostic Trouble Codes

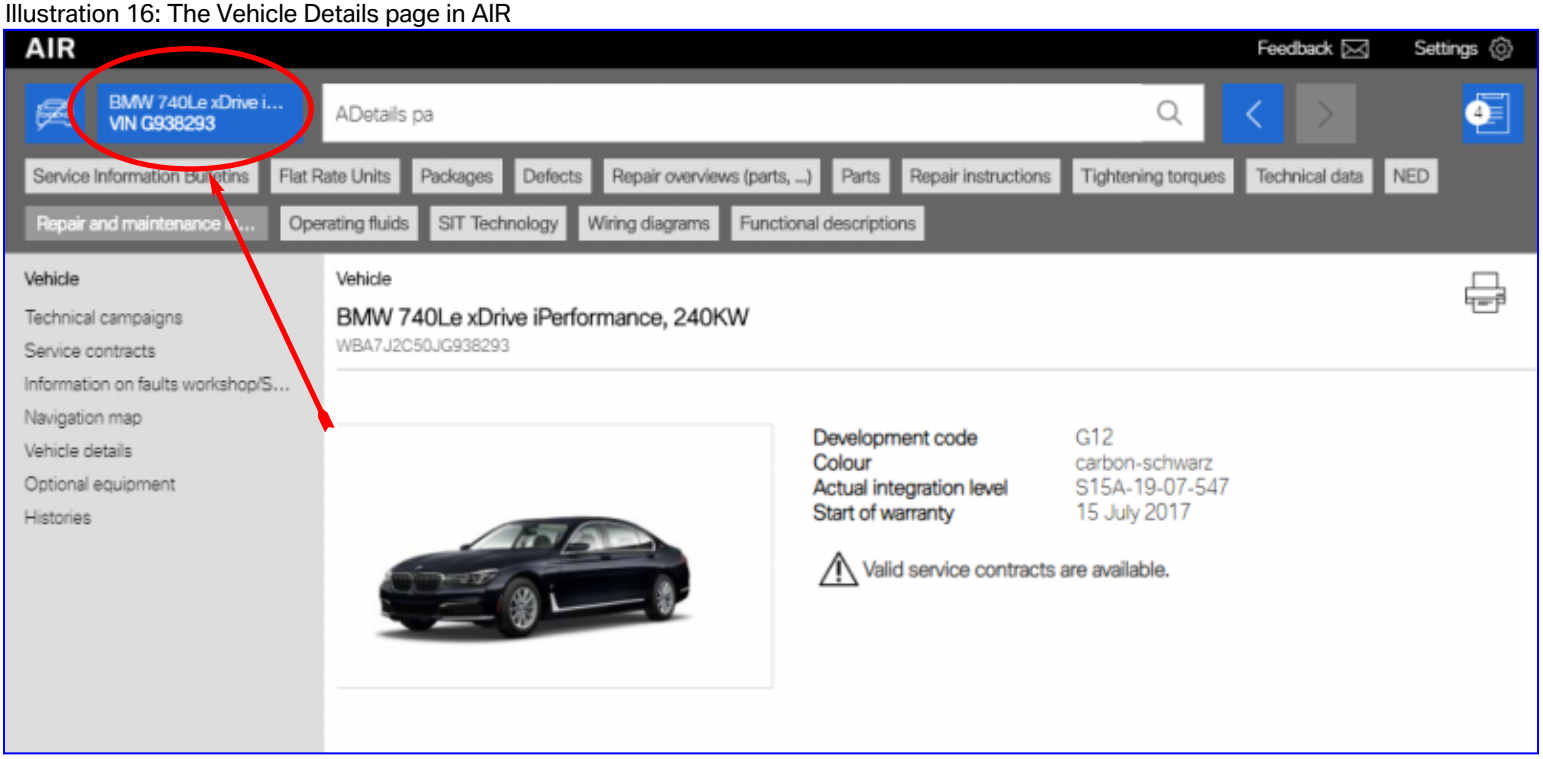
Illustration 15: The Remote Key Reader terminal

Since the Key Reader requires a data connection to the BMW Center's network and access to the Dealer Management System, this option may not be available to many CCRCs and not availabile at all to CCRCs that are considered Independent Repair Facilities outside of the dealer network.

AIR: Vehicle Details Page

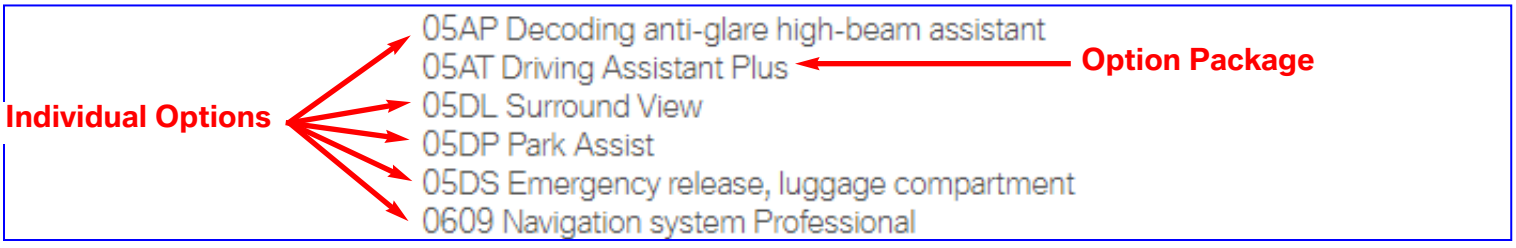
AIR will provide Advisors with Option Codes for a particular vehicle once the serial number (the last seven characters of the VIN) have been entered. For more information about AIR, please refer to BMW instructor-led training course **SB025**, *Online Resources for Collision Repair.* The Vehicle Details page is the first page displayed after entering the vehicle's Serial Number. This page can be reviewed at any time by clicking on the blue box to the left of the Search Bar (illustration 16, below).

Illustration 16: The Vehicle Details page in AIR



Below the upper section that lists Vehicle Details such as the Model Name, Body Style, Production Date, Interior and Exterior Color Codes, and the full 17-digit VIN, Advisors will see a list of the **Vehicle Option Codes** with basic descriptions. The option codes may be for **Individual Options** or for **Option Packages.** Illustration 17 (below) shows some of the options that are installed on a 2017 740Le xDrive iPerformance. Option **05AT**, **Driving Assistant Plus**, is an Option Package that is comprised of several other systems.

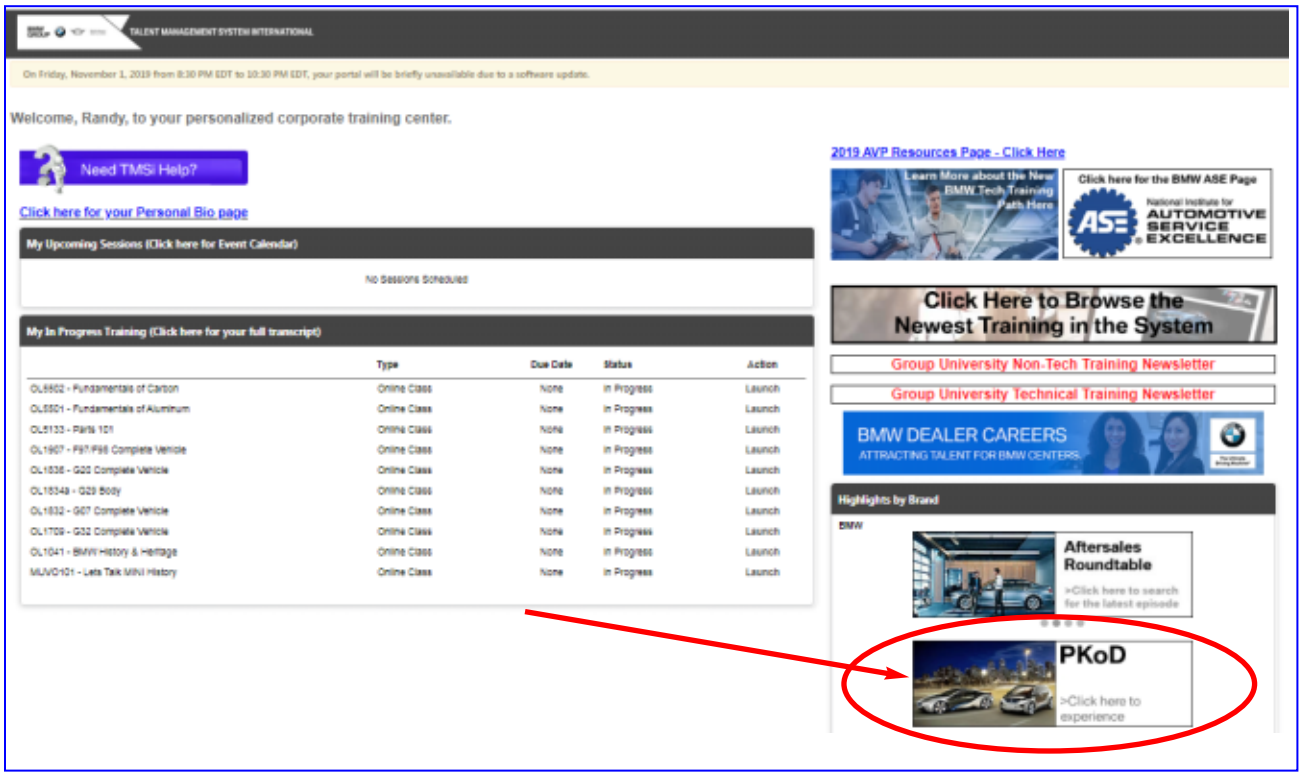
Illustration 17: Option details found in AIR



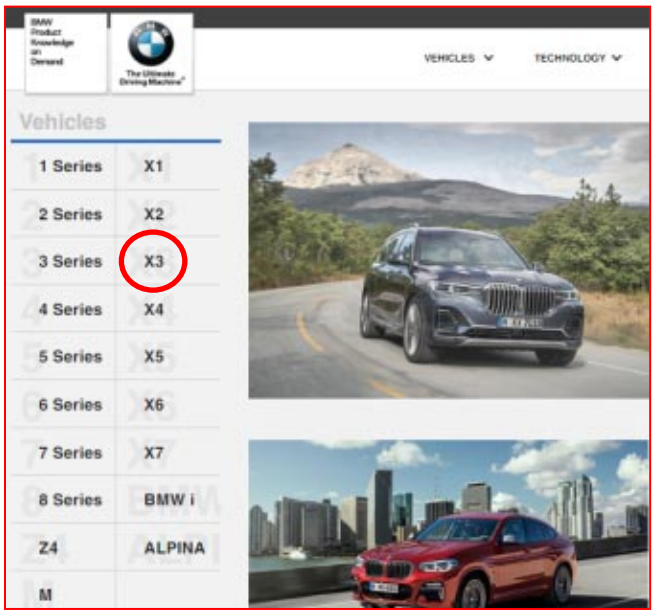
TMSi: PKoD Vehicle Ordering Guide

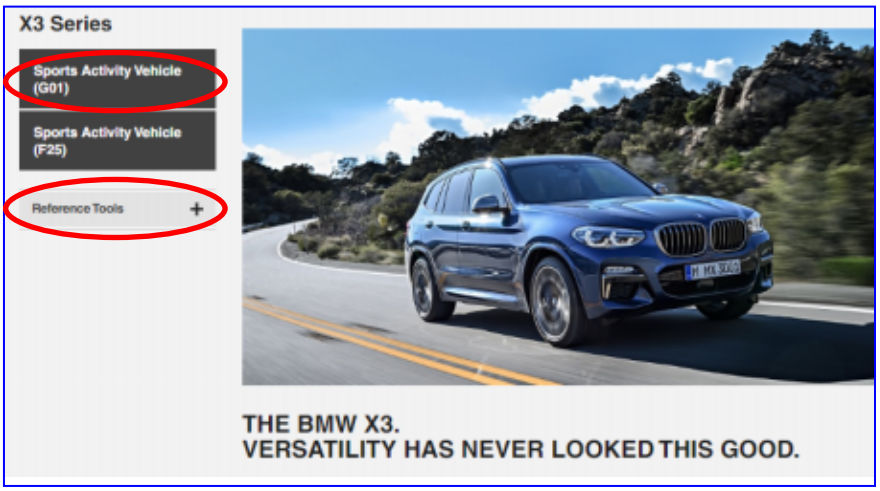
The **Ordering Guide** found in **PKoD** (Product Knowledge on Demand), located in TMSi, provides advisors with detailed information about the options that are available for different model vehicles, including the contents of different Option Packages. The **Features Glossary** contains information about the features found on BMW vehicles.

To access PKoD, first navigate to TMSi. To launch PKoD, find and then click on the banner found on the TMSi Landing Page.



When PKoD Launches, select the vehicle type, choose the vehicle based on its Development Code (Engineering Code). In the left-hand column, expand the **Reference Tools** section.

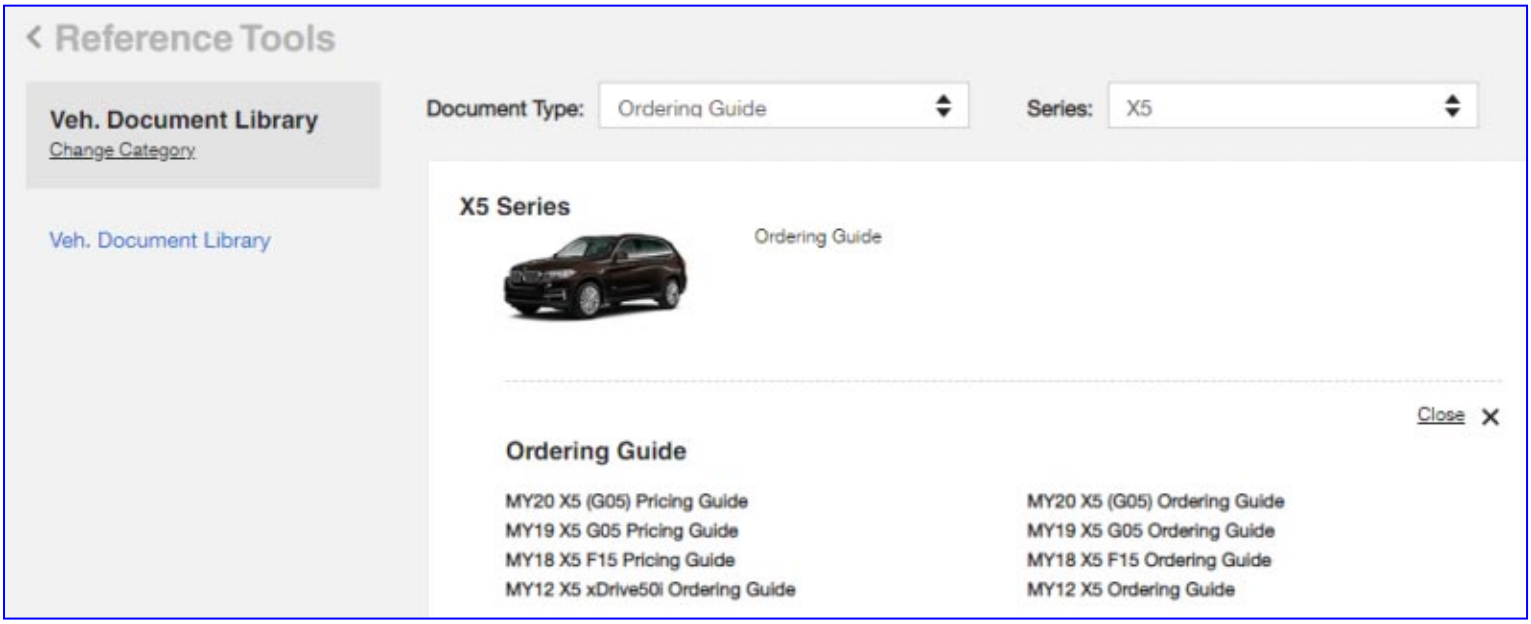




PKoD Ordering Guide

The Ordering Guide provides information about the different options that are available for a specific vehicle. It also provides information about the different systems that are part of Option Packages such as Option Packages 05AS Driving Assistant, 05AT Driving Assistant Plus, and 05AU Driving Assistant Professional.

The Ordering Guides are downloadable pdf files. After selecting the vehicle and the applicable Development Code, select the year from the list of vehicles. In the illustration below, both the 2019 and 2020. Click on the link for the vehicle being repaired. We will use the 2020 G05 as an example.



The Ordering Guide lists the Standard Equipment for the selected vehicle, Exterior Color choices, Interior Upholsteries, and Option Packages. Note that as part of the **Option Harmonization** program, **BMW Individual** paint schemes and trim items are available on some models as stand-alone options classified as **Priority 1.** Vehicles with Priority 1 options may have a sill plate in the front door opening that says **BMW Individual.** Vehicles with BMW Individual or Priority 1 options take an additional five to eight weeks to manufacture. Customer vehicles with BMW Individual or Priority 1 options may need to be informed that replacement parts may be delayed about the same amount of time.

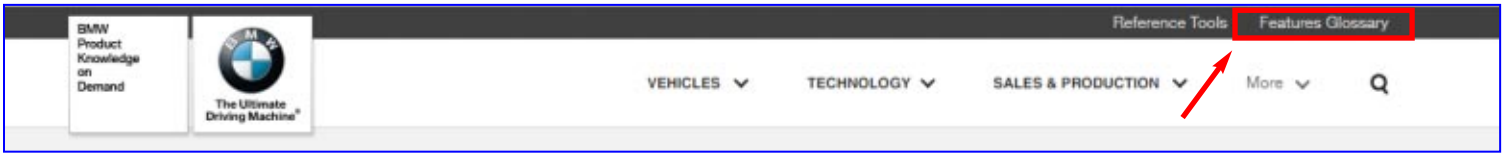
When using the Ordering Guide, make sure to review the entire document and select the correct model since many Ordering Guides have several different models listed. The 2020 X5 (G05) Ordering Guide lists four vehicle variations:

- X5 sDrive40i
- X5 xDrive40i
- X5 xDrive50i
- X5 M50

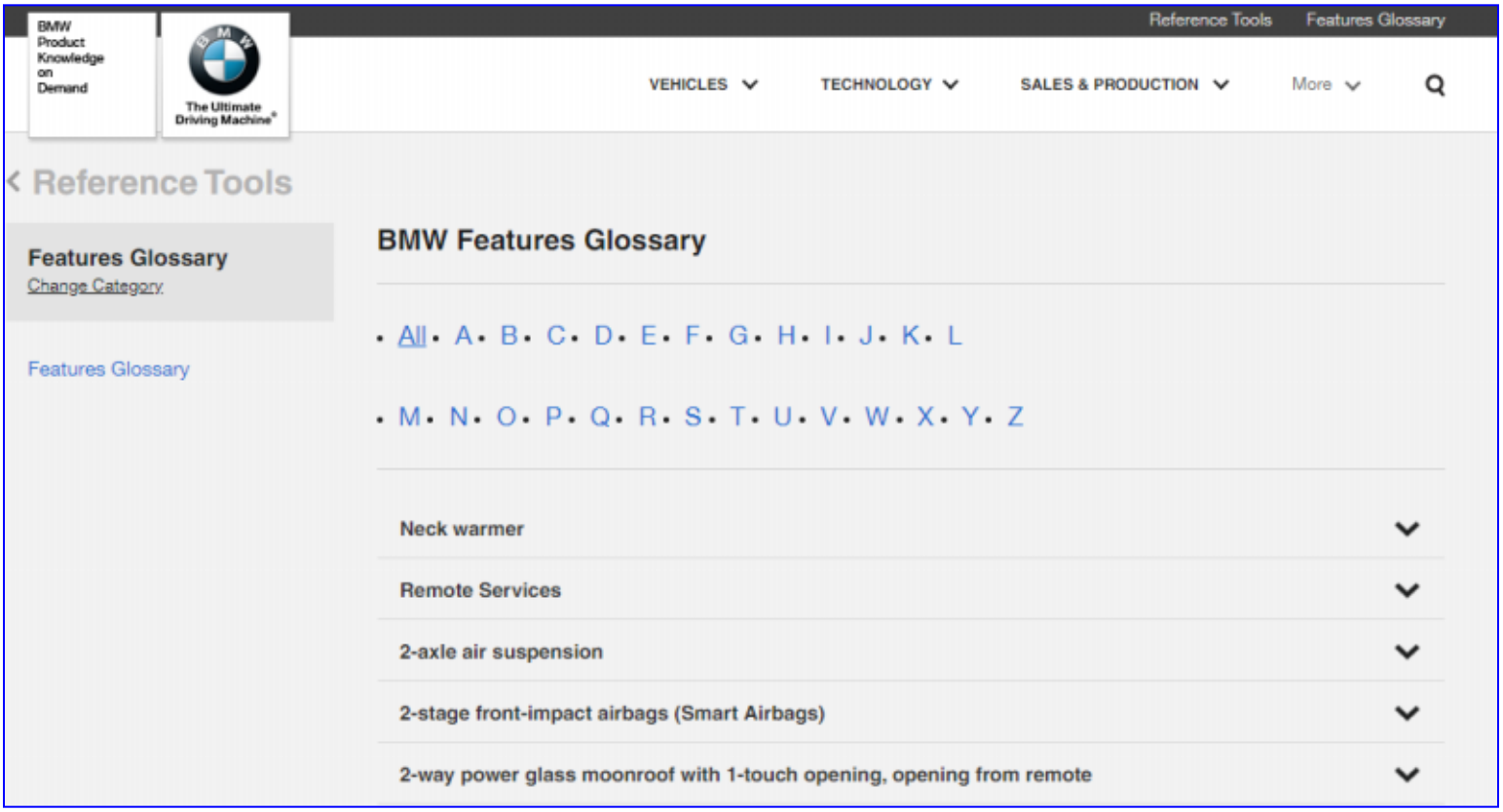
Frozen finishes are still shown in AIR as having a 490 paint code (Special Paint). There may be Priority 1 paint options for unique colors or paint technology.

To identify BMW Individual options, it may still be necessary to access ETK and look at the Options Tab.

PKoD has a **Features Glossary** section. This can be found on the top of the page in the gray band just above the magnifying glass icon. To launch this application, click on the link.



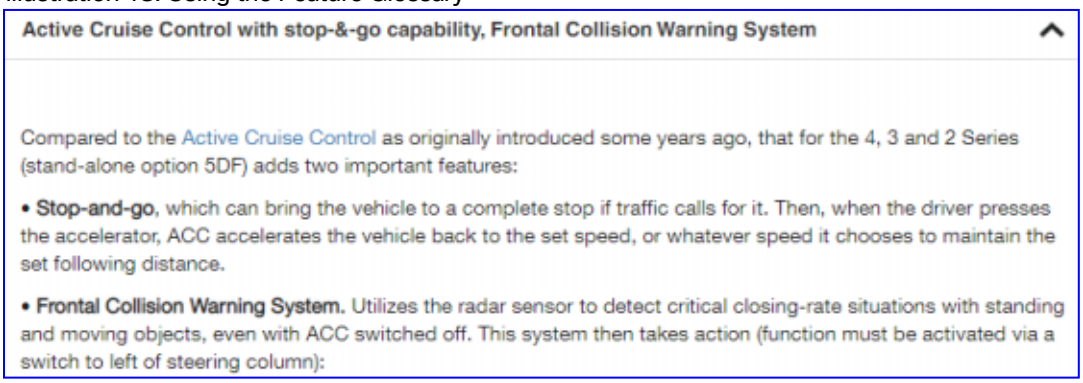
The Glossary contents can be arranged alphabetically by first letter, or users can opt to show all of the Glossary's topics. In Illustration 13, **All** has been selected by the user. The selection choice is underlined.



Clicking on any topic will expand the selection.

The Feature Glossary helps Advisors develop a better understanding of the system found on BMW vehicles. It provides a basic overview of the systems.

Illustration 18: Using the Feature Glossary



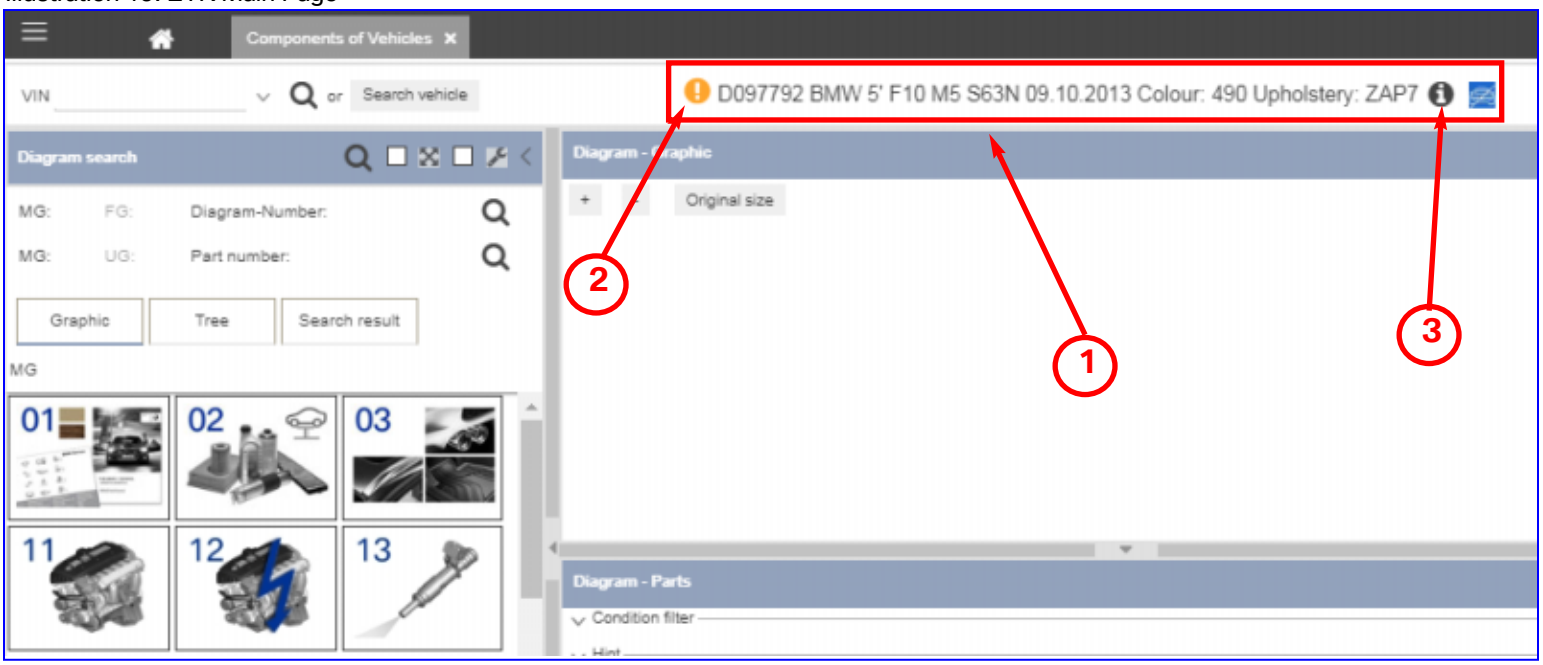
ETK Options Tab

Another resource for identifying vehicle options is the Electronic Parts Catalog (ETK). ETK is now accessed from DCSnet and requires additional user authorizations since it is not part of the basic DealerSpeed access rights for technicians, estimators, or collision center managers. Rights can be assigned by the DEMS administrator at the Center (US) or the RSDM administrator (Canada).

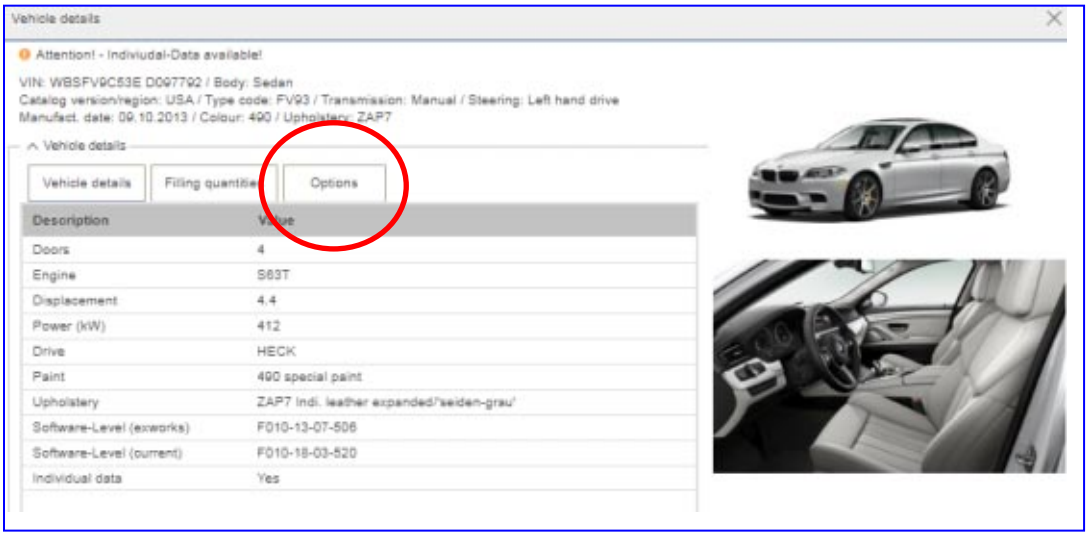
To access ETK, navigate to DCSnet and click on the link in the lefthand margin labeled ETK. Like many BMW online resources, this application decodes the VIN, so the last seven characters of the VIN is all that is needed to identify a specific vehicle.

When ETK launches, select **Components of Vehicle** and enter the last seven characters of the target vehicle's VIN. In the example below, the vehicle being researched is an M5. Once ETK finds the vehicle associated with the entered serial number, it will show basic model information in the ETK page header (illustration 19, #1, below).

Illustration 19: ETK Main Page

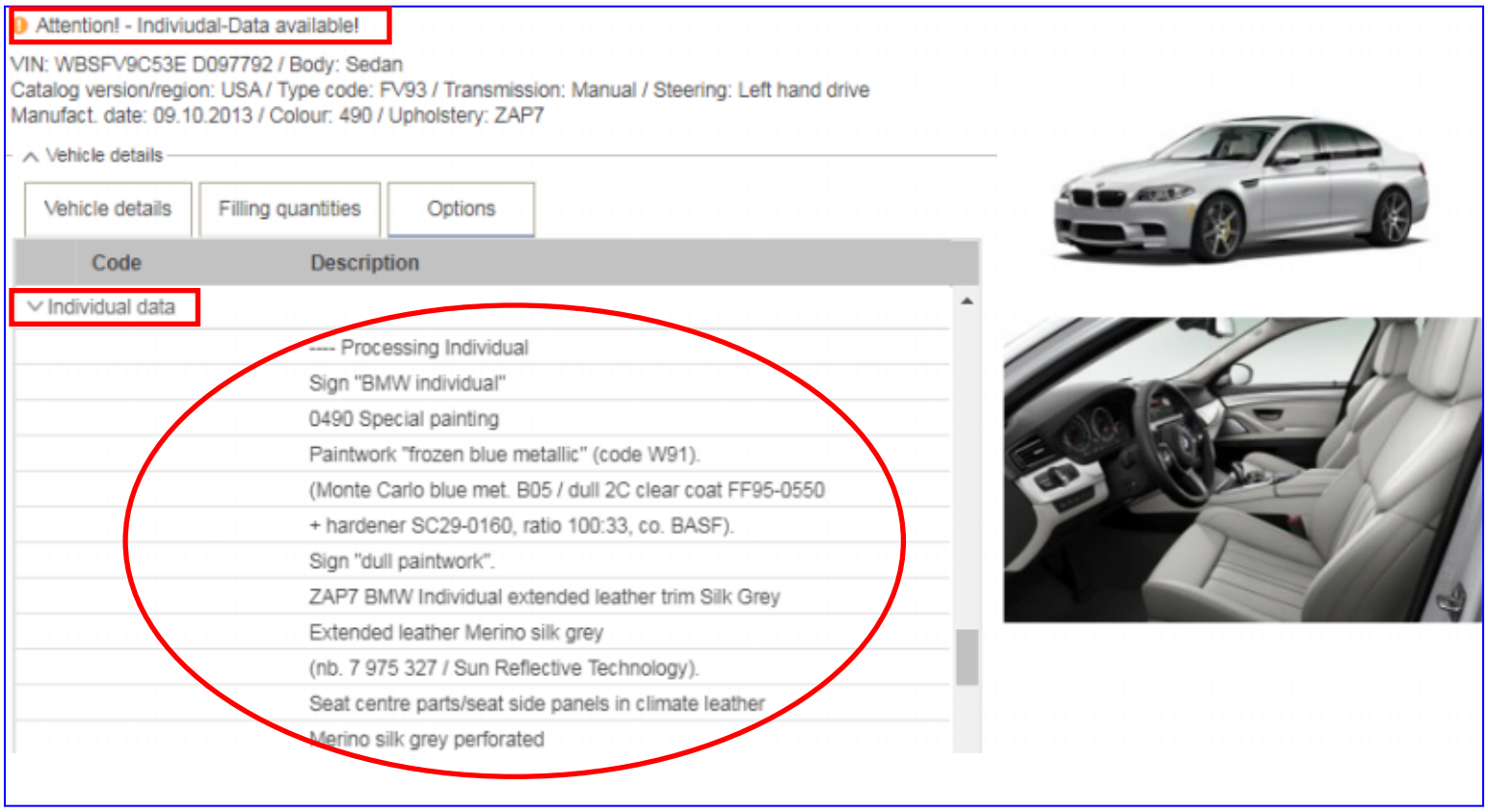


The yellow asterisk icon (illustration 19, #2 above) indicates that there is **Individual Data** for this vehicle. To view the details, click on the black information icon to the right of the header (illustration 19, #3).



This opens the **Vehicle Details** window. When the window opens, it will display basic information about the vehicle. The **Options Tab** can be clicked to display a complete list of factory-installed options including any BMW Individual items. Interior as well as exterior Individual items will be listed.

Once the Options Tab has been selected, Advisors can view a complete list of options that includes any BMW Individual features, if so equipped. If ETK shows a notation that Individual Data is present, scroll down to the bottom of the options list to view these items.



Summary

- Advisors must identify all of the optional systems on a vehicle in order to create a thorough damage assessment and identify all the required service procedures
- The Vehicle page in AIR provides a list of options. At this time, additional resources will need to be consulted to identify BMW Individual options, including any Special Paint options
- Option codes shown in AIR can be for individual options or option packages. Use PKoD to determine the contents of option packages
- The Electronic parts catalog (ETK) provides the most complete list of options including details about BMW Individual options. Accessing ETK requires special DealerSpeed access rights.
- The Features Glossary in PKoD provides Advisors with a ready reference for many of the Driver Assistance systems found on BMW vehicles

DRIVER ASSISTANCE SYSTEMS

Each year, BMW provides drivers with systems that enhance the driving experience. Safety is a primary concern. BMW vehicles provide drivers with either visual or acoustical warnings to potentially hazardous situations. In some situations, the vehicle may intervene to help the driver avoid collisions. BMW also offers convenience systems that help the driver navigate, communicate more effectively, enjoy the driving experience, and more accurately maneuver their vehicle.

This module addresses four topics:

- Active Safety
- Warning Systems
- Parking and Maneuvering
- Vehicle Guidance

Active Safety

The primary function of these systems is to detect hazardous situations and help the driver actively avoid collisions. Unlike warning systems, Active Safety Systems will intervene in cases where the driver does not react quickly enough to avoid a collision.

City Collision Mitigation

City Collision Mitigation is part of Frontal Collision Warning system and detects a stopped vehicle ahead and warns the driver if their vehicle is approaching another object too quickly. Designed to automatically help avoid a rear-end collision, the system will start braking the vehicle when a collision is approximately one second away. City Collision Mitigation can help prevent collisions up to a differing pace of 10 mph, and at higher differences can help reduce the severity of a collision. City Collision Mitigation is designed to work at speeds between 2 and 37 mph.

Collision Warning with Braking Function

The collision warning first warns visually (pre-warning), then also acoustically (acute warning) before critical situations that would lead to a rear-end collision. If the driver does not react, the system initiates panic braking in an emergency. The function is able to brake for moving and stationary vehicles. The warning is designed in such a way that the driver can prevent the imminent collision by a fast response.

Depending on the system installed, this feature uses data from the KAFAS camera or the KAFAS Camera fused with data from the ACC Radar sensor. Automatic brake intervention takes place between 3-50 mph (5-85 km/h) for KAFAS systems and from 3-120 mph (5-210 km/h) for KAFAS/ACC systems.

Evasion Aid

This system supports the driver when making evasive maneuvers in certain situations. Radar sensors as well as the KAFAS camera monitor the area around the vehicle. If an acute warning is issued, the vehicle pre-conditions the brakes and adjusts the steering and controls stability with the Vehicle Stability Control system.

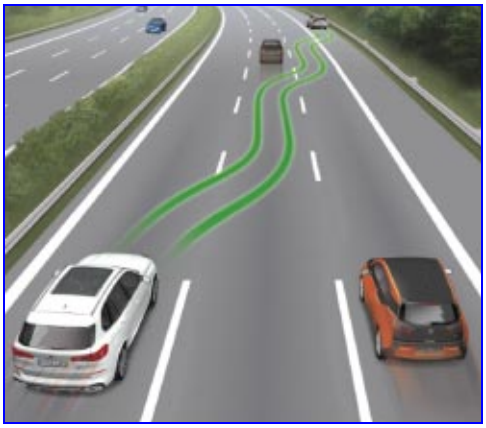
Warning Systems

Intersection Collision Warning

The system detects impending collision from crossing traffic at speeds from approximately 6-50 mph (10-80 km/h). The brakes are applied and force is adjusted depending on the situation. This system requires the KAFAS High camera, the Front Radar Sensor Long Range, and the Short-range front right and front left Side Radar sensors.

Emergency Stop Assistant

This system was made available on some G-variant vehicles with the SA 5AU Active Driving Assistant Professional package. It is designed to function when the driver suffers a blackout or loses consciousness during operation. In a worst-case scenario the driver, if able, can activate the Emergency Stop Assistant in order to safely stop the vehicle within the framework of the system limits. Passengers can also activate the Emergency Stop Assistant if the driver is unable by engaging the Electronic Parking Brake switch.



The characteristics of the lateral guidance will vary based on country specific regulations. In one version, the Emergency Stop Assistant keeps the vehicle in its lane and slows the vehicle to a stop. Other versions perform an Automatic Lane Change in order to safely stop the vehicle on the hard shoulder or emergency lane. An E-Call is automatically initiated.

A possible Automatic Lane Change may occur in a speed range from 43 mph (70 km/h) to 63 mph (100 km/h). The system can be activated from a speed of 5 mph (10 km/h) by the driver or a passenger.

Daytime Pedestrian Warning With City Braking Function

Pedestrian Warning is designed to help prevent and reduce the severity of an accident involving pedestrians. The system alerts drivers approximately 1 second before a possible accident with both visual and acoustic warnings while the brakes pre-fill for quicker response. If the driver does not brake the vehicle, the system will automatically begin braking shortly thereafter. Depending on installed options this system uses data from the camera systems (KAFAS or KAFAS Mid, or KAFAS High) and if equipped, the Front Radar Sensor or Front Radar Sensor Long Range.

The latest systems now recognize bicyclists as well as pedestrians.

- Operating speed between 2-50 mph (3-80 km/h, depending on installed options)
- Can track multiple pedestrians
- System will cancel when significant steering intervention or acceleration intervention occurs
- Since it relies on camera data, this system works in daylight conditions (dawn till dusk) while Night Vision (if equipped) is intended to cover nighttime conditions
- The system can detect walking and standing pedestrians.

Lane Departure Warning

Employing a camera near the interior rearview mirror as well as cameras in the exterior side-view mirrors, this system monitors road lane markings. When Lane Departure Warning (LDW) is switched on, anytime the vehicle begins to move across a lane marking without the turn signals activated, this system vibrates the steering wheel. If the driver does activate the turn signals, LDW does not react.

Steering Intervention provides obstacle evasion and ensures the vehicle is returned to its own lane if necessary. This system requires recalibration whenever any components are replaced. Calibration is also required when the windscreen is replaced. A camera heating system is integrated into the windscreen. If windscreen heating system is inoperable, the windscreen must be replaced.

Correct operation is predicated on clear lane markings that are not obscured by rain, snow, mud, or other masking factors.

Lane Change Warning with Active Steering Intervention

Sometimes referred to as “Active Blind Spot Detection”, this system provides a visual warning when a vehicle is in the rear blind spot on the right or left side of a BMW. This system alerts drivers to possible collisions at speeds over 31 mph (50 km/h) resulting from a lane change. This system collects data from the two rear short range side radar sensors that are located behind corners of the rear bumper trim panel. Lane Change Warning with Active Steering Intervention is available with **05AU Driving Assistant Professional**.

Active Blind Spot Detection uses two radar sensors under the rear bumper to monitor the area directly behind and to the sides of the vehicle. At speeds above 30 mph, if a vehicle approaches within approximately 200 feet from either side or directly from the rear, the system illuminates a small triangle in the appropriate exterior mirror (illustration 20, below). If the driver indicates a lane change using the turn signal, the system will produce a steering wheel vibration and flash the warning triangle in the exterior mirror to alert the driver. Using the Electronic Power Steering (EPS) , the vehicle will then be steered back into its original lane. The system can be turned on or off as desired via a dash-mounted button located to the left of the steering wheel below the headlight control switch.

Illustration 20 Lane Change Warning triangle

Radar signals can be attenuated or reduced by objects in front of the sensor such as stickers, wrap-guard appliques, ice coating, heavy rain, mud. No stickers can be placed on the bumper trim panel within a 10cm radius in front of sensor. There must be no mechanical damage (e.g. dents) to the sensor mounting areas.

A Check Control message will appear in the iDrive display when the system is not fully functional. Refinish painting (repaired panels) is not allowed in Refinish Stage 1or Refinish Stage 3 to bumper panels with optional equipment S5A SA, 05AS, S5ATA, 05AT, S5AUA and 05AU. This warning includes the Lane Change Warning System. The warning can be found in AIR, MG51.

Active Lane Keeping Assistant with Active Side Collision Protection

Available at speeds between 0 and 130 mph (0-210 km/h), this function actively keeps the vehicle in the center of the lane by providing active steering input when the vehicle starts to drift off-course. It also includes a **Side Collision prevention** function - if a vehicle in the adjacent lane starts to veer too close, steering input will tug the driver away from a potential side collision.

Supported by the KAFAS camera and both front and rear side Radar sensors that monitor the vehicle's surroundings, it relies on detecting lane markings on both sides or, at speeds less than 37 mph (60 km/h), just the vehicle ahead. The driver's hands must be on the steering wheel, the camera's view not obstructed, and the lane cannot be too narrow. If the driver activates the turn signal, this function de-activates.

Vehicle Guidance

While these systems enhance vehicle safety, they were designed to assist the driver with vehicle control, such as maintaining vehicle speed as well as lane-keeping and lane control.

Active Cruise Control with Stop&Go Function

This system, also referred to as ACC with Stop&Go, functions like its predecessor, the **Active Cruise Control** (ACC) system and adds two important features: **Stop-and-Go** as well as **Frontal Collision Warning**.

With ACC, in addition to the speed-maintaining, acceleration and deceleration functions of the standard cruise control, ACC adjusts the vehicle speed according to traffic conditions.

Using a centrally-mounted radar sensor at the front of the vehicle, ACC senses the speed of vehicles traveling ahead, and adjusts the BMW driver's speed to maintain a safe following distance. Among its features:

- There are four radar sensors in sensor unit, providing a field of vision of +/- 8°.
- Can interact with GPS Navigation to enhance ACC operation.
- The radar sensors' lenses are heated, so that the system functions dependably even in bad weather conditions.

When the system senses traffic ahead, ACC's special capabilities come into play:

- Driver can choose from four following distances. Via four bars below "vehicle ahead" icon, chosen following distance is displayed briefly after election (more bars = greater distance).
- When radar sensor detects a vehicle ahead, "vehicle ahead" icon illuminates. ACC adjusts the BMW driver's speed to maintain the selected following distance.
- When adjusting vehicle speed, ACC may apply brakes. It may also apply brakes when the driver changes set speed abruptly. If brake application causes DSC or ABS to activate, a specific warning indicator appears in the instrument-panel display.
- If a vehicle pulls into the BMW driver's lane ahead, ACC recognizes that vehicle only when it has fully moved into the lane. If the vehicle cuts suddenly into the lane, ACC may not adjust speed quickly enough, in which case the vehicle icon is surrounded by a blinking triangular warning signal indicating that the driver should take evasive action. ACC does not react to stationary vehicles or other objects ahead.
- When traffic ahead clears, ACC automatically resumes the previously set cruising speed.

ACC can also reduce vehicle speed when a curve is entered at too high a speed. However, the system does not “look ahead” to curves, so any such adjustment occurs only after the curve is entered. In sharp curves, ACC may react briefly to oncoming vehicles; the driver can cancel this action by stepping on the accelerator.

ACC is an advanced, stress-reducing driving enhancement, particularly in fast-moving yet congested traffic. **The capabilities of ACC in no way relieve the driver of responsibility to devote full attention to driving, to traffic and to all aspects of the driving environment!**

Dynamic Cruise Control

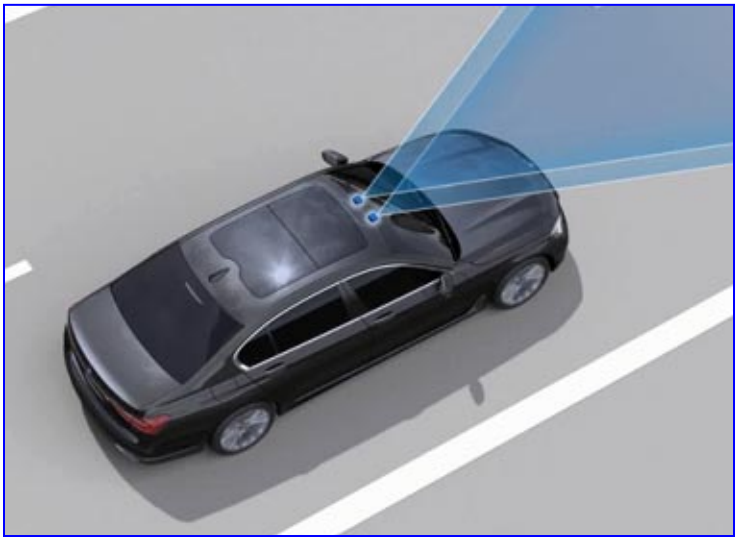
Sometimes confused with ACC Stop&Go by Advisors during a review of vehicle options in AIR due to the fact that this system is sometimes referred to as **Cruise Control with Brake**, Dynamic Cruise Control (DCC) will maintain vehicle speed in varying terrain conditions. In addition to controlling the engine to maintain the set speed, this system can also lightly apply the brakes if necessary to maintain speed while traveling downhill. This gives it greater capability in controlling speed, for example, in rolling or hilly terrain. The set speed can be maintained even when the vehicle is traveling downhill. Conventional cruise control systems may allow the vehicle’s speed to increase while traveling down a grade. DCC maintains the set speed regardless of the angle of descent.

Also specific to Dynamic Cruise Control is a 2-step choice of increasing or decreasing speed: A light tipping of the steering-wheel-mounted rotary tab upward/downward increases/decreases speed by one mph; more vigorous tipping alters speed by 5 mph.

Steering and Lane Control Assistant

Also referred to as the Lane Keeping Assistant, the system helps keep the vehicle centered in its lane. It is found in the Driving Assistant Plus option package (05AT). The system functions at speeds from 43.5 mph (70 km/h) to130 mph (210 km/h). Two lane limit markings must be detected by the cameras for the system to operate. Below 43.5 mph (70 km/h), the Traffic Jam Assistant or Extended Traffic Jam Assistant take over lateral guidance of the vehicle. Corrective steering actions can be overridden by the driver at any time.

To ensure the driver's attention and ability to react, the driver must have both hands on the steering wheel when the steering and lane guidance assistant is active. If the driver takes both hands off the steering wheel, the function is aborted after a few seconds and the driver is prompted to take over steering.



This system relies on data from either a KAFAS Mid or KAFAS High Stereo camera system as well as five Radar sensors; either the Front Radar Sensor or Front Long Range Sensor, and four short-range side radar sensors.

The steering and lane guidance assistant function can be combined with active cruise control.

The system is automatically deactivated in these situations:

- KAFAS camera cannot detect any lane markings and no preceding vehicle has been detected.
- Manual steering intervention by the driver.
- Activation of the Dynamic Traction Control (DTC).
- Deactivation of the Dynamic Stability Control (DSC)
- Active DSC control operation.
- Steering wheel touch detection must sense at least one hand on the steering wheel.

System Limitations

- During heavy fog, rain or snowfall
- If ambient light is insufficient
- If backlighting is strong
- Contamination of the KAFAS camera's field of view
- Significant contamination of the front or rear bumper panel in the area of the radar sensors
- Labels attached in the area of the radar sensors
- Excessive paint film or improper repairs
- On sharp corners and on narrow roadways
- Driving with gloves
- Protective covers on the steering wheel
- During the calibration process of the KAFAS camera

Speed Limit Info

Speed Limit Information utilizes the KAFAS camera to capture current speed limit signs, and displays a graphic representation of the sign in the space between the speedometer and tachometer, as well as in the optional Head-up Display (if present).

This feature is capable of reading signs on the edge of the road, as well as signs posted above the lane on bridges, tunnels, or highway overpasses.

When detecting a speed limit sign, the system uses a symbol in the shape of a white square to display the currently detected speed limit. The sign turns to red if the limit is being exceeded.

Speed Limit Assistant

The Speed Limit Assistant function works with the **Road Sign Recognition** (now called **Speed Limit Info**) and **Active Cruise Control with Stop&Go** functions. The driver is supported during proactive driving by adopting future speed limits recognized by the Speed Limit Info system or the speed limit information retrieved from the navigation system.

When the Speed Limit Assistant is switched on and ACC is activated, a green symbol is displayed in the instrument cluster showing the message ASSIST.

The system requires options 05AT Driving Assistant Plus, 05DF ACC, and either 606 or 609 Navigation Systems.

This system needs to be configured in the iDrive system where the driver can set a "Tolerance Range" and can choose to adjust speeds automatically or manually. If the LIM button is pressed on the multifunction steering wheel and the ACC system is active, the vehicle's speeds can be automatically adjusted to the posted speed limits identified from either the navigation software or from the Speed Limit Info system.

Index	Explanation
A	Speed Limit Assistant suggested speed is adopted
B	Speed Limit Assistant suggested speed is available
1	Speed Limit is confirmed by pressing on the Multi-function lever
2	Speed Limit
3	Speed Limit that can be adopted by pressing the SET button on the Multi-function lever

Automatic Lane Change

Introduced on the G05, this system supports the driver in lane-changing maneuvers and can help avoid side collisions. When the Steering and Traffic Jam Assistant is active, this system is activated by depressing the turn indicator to the detent (one-touch signaling). Front and Rear Side radar sensors and the KAFAS camera analyze whether a danger-free lane change is possible and if there is sufficient room to implement a lane change. The Front Radar Sensor also identifies the speed of nearby vehicles

Radar sensors have a rear range of about 250 ft. (70 m) and a side range of about 15-50 ft. (5-15 m) depending on vehicle speed.

If the system sensors do not detect obstacles, the system will perform an automatic lane change. The driver monitors the lane change and can cancel the automatic lane change if needed. The driver's hands must remain on the steering wheel during automatic lane change maneuvers. Once the lane change is completed, it reverts back to Steering Assistant mode

If aborted by the driver (the driver releases the lever too quickly) or by the system if an object is detected, a Blind Spot Collision Warning is issued and the vehicle is guided back to its original lane.

The system's maximum steering torque can always be overcome by the driver if the driver wishes to take control.

Parking and Maneuvering

These systems can assist with intricate maneuvers when parking or exiting a parking space.

Park Distance Control

Park Distance Control (PDC) helps drivers avoid colliding with unseen obstructions when maneuvering at parking speeds. It now comes in the front-and-rear version only, and is either standard or optional on all models.

PDC employs four ultrasonic sensors in the front and four in the rear bumper to warn the driver when the vehicle is approaching objects or obstructions that may not be visible to the driver. All forward and the rear corner sensors trigger a warning beep at approximately 2 ft. (0.6 m) distance to the object. The beeping becomes faster as the bumper approaches the object, turning into a constant tone when the distance closes to less than 1 ft. (0.3m).

The rear bumper's center sensors first trigger beeping at about 5 ft. (1.5 m) ; when the distance is less than 1 ft. (0.3 m) the beep becomes a constant tone.

PDC activates anytime the ignition is on and reverse gear is engaged, and automatically de-activates when the vehicle is driven forward approximately 164 ft. (50 m) or reaches about 18 mph (258 km/h). It can be activated or de-activated by pressing its console switch, and this is necessary for use of PDC in forward maneuvers.

Active Park Distance Control

This relatively new function augments the familiar PDC's beep warning by automatically applying emergency braking when the reversing vehicle gets so close to an object behind or at the side of the vehicle that a collision is imminent. Functioning at speeds below about 3 mph (5 km/h), and taking into considering the vehicle's path, this helps prevent or minimize vehicle damage in parking maneuvers. The driver can override this function by pressing the accelerator pedal, and thus get closer to an object if so desired. The system can sometimes sense an object and apply brakes if a curb is approached too quickly or if the approach angle when backing is steep.

Parking Assistant

Previous generation systems were known as Park Maneuvering Assistant, this advanced option either assists in parking, or in some models fully automates it. Using ultrasonic sensors in the front side flashers, its system recognizes spaces longer than 20 ft. (6.0 m), about 4 ft. (1.2 m) longer than the vehicle, depending upon model and measures their width and length as the vehicle drives by at speeds less than 22 mph (35 km/h) and indicates their suitability in the iDrive display. This occurs whether or not the driver has activated the system.

Once the driver has pulled up next to the vehicle ahead of the space, Parking Assistant can be activated by pressing the console "P" button, then engaging reverse gear, or by engaging reverse gear, then pressing the iDrive controller. With earlier versions, all the driver has to do at this point is operate the accelerator, apply the brakes and "supervise" the maneuver. Parking Assistant turns the Electric power steering to back up precisely into the space, simultaneously monitoring and correcting the vehicle's path as it goes. Even if the driver breaks off the maneuver, it can pick up and complete the process once the driver resumes it. Throughout the maneuver, Parking Assistant gives the driver appropriate audible instructions or indications.Later system versions also operate the accelerator and brakes; thus it completely assuming the process of parallel parking. The "P" button must be held down for the entire parking maneuver; if released the maneuver will be interrupted.

A more enhanced version (2016 3 Series), added the capability for parking spots that are perpendicular as well as parallel to the road. The system retained the need for the driver to operate the accelerator and brakes.

The "Ultimate" version was introduced with the 2016 7 Series. This system completely assumes parallel parking duties and also operates for parking into perpendicular spaces. Active Park Distance Control, which automatically brakes the vehicle to avoid parking collisions, is not part of the Parking Assistant option but contributes further to the parking experience.

Front Cross-traffic Warning

The front crossing traffic warning provides information when entering crossing traffic, certain exits and when approaching traffic junctions that cannot be easily viewed from the driver' seat. This system is currently part of Option Package 05AT, Driving Assistant Plus. It utilizes the Short range Front and Rear Side Radar Sensors. For vehicles with certain options, it uses the Front Camera as well as the Top View cameras.

The system provides both acoustic and visual warnings. The system issues these warnings whenever a moving object is detected in the sensor's range for approximately 2.0 seconds.

The front cross-traffic warning can be activated or de-activated by the driver using the Vehicle Settings option in the iDrive system. The front crossing traffic warning is activated when the Park Distance Control is also switched on. With Option **05DL Surround View** or 0**5DN Parking Assistant Plus** the front crossing traffic warning is activated when the Panorama View has been previously activated by the driver.

If the vehicle is equipped with 05DL Surround View or 05DN Parking Assistant Plus, the warning is displayed in the form of a red bar in the front camera image on the central information display (CID, right illustration). Otherwise, the warning is displayed in the PDC views in the CID.

System Limitations

The system may not function properly in the following conditions:

- During heavy fog, rain or snowfall
- On narrow bends
- In the case of a very dirty front bumper panel in the area of the front sensors
- Labels attached in the area of the front sensors

Rear Cross-traffic Warning

Similar in operation to the Front Cross Traffic Warning system, the Rear Cross-traffic Warning provides the driver with information about vehicle surroundings when maneuvring out of a parking space backwards and warns against possible collisions with crossing traffic for traffic situations with poor visibility.

The system provides both acoustic and visual warnings. The system issues these warnings whenever a moving object is detected in the sensor's range for approximately 2.0 seconds.

The rear cross-traffic warning can be activated or de-activated by the driver using the Vehicle Settings option in the iDrive system. The system is found in packages **05AS Driving Assistant** and **05AT Driving Assistant Plus.**

The system becomes active when the driver engages reverse gear and the PDC system is active. If the vehicle has **05ADK Surround View** or **05DN Parking Assistant Plus**, the rear cross-traffic warning becomes active when **Panorama View** is active.

If the vehicle is equipped with **05DL Surround View** or **05DN Parking Assistant Plus**, the warning is displayed in the form of a red bar in the rear camera image on the CID. Otherwise, the warning is displayed in the PDC views in the CID.

Like Front Cross Traffic Warning, this systems also uses the Short range Front and Rear Side Radar Sensors. For vehicles with certain options, it uses the Rear View Camera as well as the Top View cameras.

In the following situations the rear crossing traffic warning is automatically deactivated:

- The vehicle's driving speed is above 4 mph (7 km/h)
- Either the **Lane Guidance Assistant** or **TrafficJam Assistant** are active
- An active parking process has been initiated using **Parking Maneuvring Assistant (PMA)** and PMA is active.
- During trailer towing operation

System Limitations

The system may not function properly in the following conditions:

- During heavy fog, rain or snowfall
- On narrow bends
- In the case of a very dirty rear apron in the area of the rear sensors
- Labels attached in the area of the rear sensors
- Excessive paint film build. Refinishing in Paint Stage 1 and Paint Stage 3 are prohibited.

Back Up Assistant

The **Back-up Assistant** allows for increased comfort when maneuvering in a confined area. The system takes over steering to maneuver the vehicle mirroring the path most recently used in the forward direction. This system makes reversing for a distance of up to 55 yards (50 m) a particularly effortless task. All the driver has to do is operate the accelerator and brakes and monitor the surrounding area.

The system is initiated by pressing the menu button on the CID when the vehicle is stationary and shifted into reverse. The steering movements made during the vehicle's last forward maneuver are stored by the system and retained, even from drives from the previous day.

The driver must observe the vehicle's surroundings and be sensitive to new warnings. If the vehicle's surrounding area has changed since the vehicle was parked (an object or vehicle is now in the back up path), the system cannot compensate for these changes. If an object is detected, the rear PDC will issue a warning and the driver will need to abort the operation and make path corrections manually.

Warning Systems - Update

This assortment of driving aids will warn the driver of potentially dangerous situations, such as improperly entering a one-way street, side and rear collisions, dangerous changes in lane position, and speed limits.

Wrong Way Assistant

The wrong-way assistant function assists the driver in traffic situations and on stretches of road which could be confusing, for example when merging onto a highway or at traffic circles/roundabouts.

In suburban areas, this system can detect one-way streets and will warn the driver before driving into the street in the wrong direction.

The wrong-way assistant evaluates both detected road signs and navigation system data.

The system will display a warning in the instrument cluster or the Head-Up Display (when equipped).

The system is found in **05AT Driving Assistant Plus** with either the **SA609 Professional Navigation System** or **SA606 Business Navigation System.** The system is always active and cannot be turned off by the driver.

The wrong-way assistant is available in the speed range from 25-100 mph (40-160 km/h) provided that all sensors do not display any faults. The warning is not issued until the vehicle has passed the corresponding road sign.

The system uses data from the KAFAS camera system and navigation information to assess the situation.

System Limitations

- During heavy fog, rain or snowfall
- Missing or covered road signs
- Road signs that are not of the standard shape or type
- Strong backlight
- Contamination of the KAFAS camera's field of view
- Map data is not up-to-date
- Areas that are not covered by the navigation system
- During calibration of the KAFAS camera

Rear Collision Warning

The radar sensors for the Lane Change Warning system (SWW) function that are located in the rear bumper panel monitor the area behind the vehicle. If another vehicle is approaching at a significantly higher speed than this vehicle, the hazard warning lights system is activated as a warning to the traffic behind. If a collision is unavoidable, all passive safety system are activated in order to minimize the consequences of the impact.

This system is part of **05AS Driving Assistant** and **05AT Driving Assistant Plus.** The system defaults to active every time the vehicles is started. The system is deactivated when the vehicle is in reverse gear or whenever towing a trailer.

System Limitations

- During heavy fog, rain or snowfall
- On sharp corners and on narrow roadways
- If the area of the radar sensors in the rear bumper panel is very dirty or sensors are covered
- Labels attached in the area of the radar sensors.
- Improper repairs to the rear bumper panel

Intersection Warning

This system may be called Crossroads Warning or Junction Warning. It is included in **05AT Driver Assistance Plus** with either **609 Professional Navigation System** or **606 Business Navigation System**.

The Intersection Warning function detects whether there is a threat of collision with crossing traffic by issuing an early warning to the driver. The driver may then be able to prevent the collision from occurring.

The KAFAS camera and the ACC sensor monitor the traffic conditions. These sensors record the distance from other vehicles as well as the speed and direction of movement of these vehicles. The vehicle's own speed is also evaluated. A visual warning is issued if a risk of an accident with crossing traffic is detected approximately one second before a potential collision. A warning is only given if the crossing vehicle is travelling at a slower speed than this vehicle.

The brake system is also primed or pre-conditioned to optimize stopping distance. An automatic brake intervention is not carried out. Research has shown that many drivers do not apply the brakes forcefully enough in emergency situations. The braking force is increased even with lower levels of pedal input.

The Intersection Warning is active in the speed range from approximately 9 mph (15 km/h) to about 40 mph (65 km/h). It is not possible for the driver to configure the system to individual requirements. This system can only be deactivated by switching off certain assistance systems by using the Intelligent Safety button located in the center of the dashboard below the CID.

<u>System Limitations</u>

- During heavy fog, rain or snowfall
- If crossing traffic is concealed by other objects
- Sharp bends or building complexes
- If the crossing traffic is travelling at very high or very slow speeds
- If the crossing traffic is travelling at
- If the area of the sensors in the front bumper panel is very dirty
- Map data is not up-to-date
- During calibration of the KAFAS camera

Lane Change Warning

Similar in function to Lane Change Warning with Active Steering Intervention, this system will only provide a visual warning when a vehicle is in the rear blind spot on the right or left side of a BMW and not actively steer the vehicle away from danger. This system alerts drivers to possible collisions at speeds over 31 mph (50 km/h) resulting from a lane change. This system collects data from the two rear short range side radar sensors that are located behind corners of the rear bumper trim panel. The Lane Change Warning system is available with **05AS Driving Assistant**.

The system will produce a steering wheel vibration and flash the warning triangle in the exterior mirror to alert the driver. If the turn signal is operated while a warning is active, the display in the exterior rearview mirrors starts to flash at high intensity , issuing an acute warning.

If lane markings are present on the road, the lines will be detected by the KAFAS camera. This information is then used by the Lane Change Warning function to improve the accuracy of the function. However, lane markings are not a prerequisite for operation of the function. The Lane Change Warning function is also available without lane markings.

The rear short-range radar sensors behind the rear bumper panel monitor the area behind the vehicle for a distance of approximately 260 feet (80 m). Trailer operation is not supported. This system will be automatically deactivated during towing operations.

The Lane Change Warning function is available in the speed range from 12-155 mph (20-250 km/h.

The system can be turned on or off using the iDrive system. The warning time of the Lane Change Warning function as well as the intensity of the steering wheel vibration can also be increased or decreased using iDrive.

System Limitations

- During heavy fog, rain or snowfall
- On sharp bends
- Warning when turning off with multiple lanes
- In the case of heavy contamination or damage to the rear bumper panel in the area of the rear short-range radar sensors on left and right
- Vehicle wrapping has been applied, or stickers attached in the area of the rear short-range radar sensors
- Rear-mounted rack or similar without connection to the trailer module (AHM)

Predictive Road Sign Recognition

This enhances system is based on the **Road Sign Recognition** (Speed Limit Info) function described previously (see page 49).

In addition to the functions of road sign detection system, the next change in speed limit ahead of the vehicle and the remaining distance are displayed in the instrument cluster (KOMBI). This is based on data from the navigation system.

If there are dynamic speed limits ahead, for example due to a traffic control system or in the area of a construction site, the display of the next speed limit ahead is generated based on data from the back end. BMW Group vehicles with active ConnectedDrive services and with the "Speed Limit Info" function send detected dynamic speed limits to BMW;'s back end. Following vehicles with the corresponding equipment use information from this back end. This is similar to the ay that online map guidance systems provide traffic information to other vehicles. An update of the data in the back end for construction sites is carried out up to once a day. An update of the data in the back end for traffic control systems is carried out approximately every 30 seconds after a dynamic speed limit has been detected by a BMW vehicle. BMW owners will see more application of this predictive type of warning based on information gathered from other vehicles as cars move more towards higher levels of autonomy.

To function, this system requires **05AU Driving Assistant Professional** or **05AS Driving Assistant** with **05DF ACC with Stop&Go. Additionally, a**nticipatory road sign detection is only provided in combination with a navigation system and requires active ConnectedDrive services in the vehicle.

For this system to function, the driver must configure the system properly using the iDrive. In General Settings, the driver must agree to data protection (agree to all protection) and then activate this selection. The **Learning map and map updating** must also be activated in the data protection menu.

System Limitations

- During calibration of the KAFAS camera
- In case of invalid, outdated or unavailable navigation data

The availability of dynamic speed limits depends on the region or country being driven through.

Right of Way Warnings

Also known as **Junction Traffic Sign Warning**, this system supports the driver by recognizing and observing right of way signs.

The Right of Way Warning system will issue warnings in situations in which the driver must yield, stop, or give way because of the signage. This applies to:

- Any road junction.
- A T-junction.
- At an exit.
- Traffic circles or roundabouts
- Red traffic lights

At series launch in July 2018, warnings were only issued for the following detected road signs:

- Yield
- Stop

Beginning in March 2019, the system would also issue warnings at red traffic lights.

The data for this system is collected by the KAFAS camera's road sign detection.

The system evaluates the road sign and a Yield or Stop sign must be clearly detected based on the signage shape. A plausibility check is run using navigational data.

If validated, the system can then warn the driver in potentially critical situations. Depending on the signage, either purely visual (advance warning) or acoustic (acute warning):

- There is an advance warning if a Yield sign is detected.
- There is an advance warning and an acute warning if a Stop sign or a red traffic light is detected.

During the advance warning the corresponding road sign is shown in the instrument cluster (KOMBI) and in the Head-Up Display. A warning signal is also issued during the acute warning. In addition, the brake system is pre-conditioned. This shortens the stopping distance after the brake pedal is pressed.

The driver only receives a system warning; there is no automatic brake intervention.

The junction traffic sign warning is available up to a driving speed of approximately 40 mph (65 km/h). The minimum driving speed is variable.

The system is part of the **05AU Driving Assistant Professional** option package. It must be configured by the driver using the iDrive system and can be switched on or off.

System Limitations

- During heavy fog, rain or snowfall
- Low light levels
- If backlight is strong
- On sharp bends
- On steep uphill or downhill gradients
- If the signage is not clear or the light signal of the traffic lights is not clear
- Concealed or dirty road signs
- Concealed or dirty traffic lights
- Road signs too small or too large
- Traffic lights too small or too large
- If road signs are distorted
- If traffic lights are distorted
- Contamination of the KAFAS camera's field of view
- During calibration of the KAFAS camera
- Up to 10 seconds after engine start
- In case of invalid, outdated or unavailable navigation data.

This function is available only in approved countries and the system may vary depending on the national-market version. The Right of Way Warning for red traffic lights will be available from March 2019.

Intelligent Safety

This function provides convenient access to several Driver Assistance Functions. It allows the driver to quickly disable and re-enable certain systems such as:

- Collision Warning with Brake
- Pedestrian Warning with City Braking
- Lane Departure Warning
- Lane Change Warning

Control of certain Driver Assistance Systems using Intelligent Safety system is vehicle- and option-dependent.

The Intelligent Safety switch is located in the center of the dashboard. While some systems are automatically active after driving of, some remain in the state that was configured by the driver using the iDrive Individual menu setting. The system defaults to being active when the vehicle is first started.

System Operation

The button defaults to a system ready state and will show a green circler around the vehicle icon (#1, below) on the Intelligent Safety switch. Pressing the switch will bring up the Configuration screen in the iDrive display where the owner can set individual preferences if they prefer. Once the systems have been configured, pressing the button repeatedly will change the settings.

Button	Status
 1	Button lights up green: all Intelligent Safety systems are switched on.
 2	Button lights up orange: some Intelligent Safety systems are switched off.
 3	Button does not light up: all Intelligent Safety systems are switched off.

When the circle is illuminated in orange, the system has been switched to the Individual mode (#2, above). The individual settings are activated and stored for the driver profile currently used. As soon as a setting is changed using the configuration menu, all settings of the menu are activated.

Pressing and holding the button will switch off all Intelligent Safety systems (#3, above).

Summary

- Driver Assistance Systems are grouped into four broad categories: **Active Safety, Vehicle Guidance, Parking and Maneuvering,** and **Warning Systems**
- Advisors need to become familiar with the different types of Driver Assistance systems, how they are designed to operate, how systems are turned on and off, the types of sensors they utilize, and where sensors are located.
- Advisors should also become familiar with any possible system limitations
- BMW will continue to expand its offerings of Driver Assistance systems to make the driving experience safer, less stressful, and more enjoyable.

INSPECTION FOLLOWING A COLLISION

Identifying collision-related damage to Driver Assistance Systems is not difficult. A systematic inspection approach must be used by Advisors and technicians that includes:

- Visual inspection of sensors
- Obtaining any repair information found in AIR
- Checking for any illuminated Malfunction Indicator Lamps and Check Control messages
- Using diagnostic test equipment to locate any stored fault codes

Advisors will need to know how collision repair and refinishing procedures can affect the operation of different Driver Assistance Systems. Some sensors can be removed and re-installed easily with no added steps; others may need to be aimed, reprogrammed or recalibrated. Certain systems may require special test equipment to perform system restoration.

Visual Inspection

Like all collision damage assessments, the first step after obtaining basic information from the driver is a visual inspection. This means that advisors will need to know where different sensors are located on the vehicle. To help locating certain sensors, AIR will provide components location information. Additionally, advisors should also check the status of the malfunction indicator lamps as well as recording any Check Control messages. Still, some systems may not illuminate any warning lamps or display any faults. The center may need to interrogate control modules to identify system status.

Sensors may be located behind outer panels or behind the windscreen. Front and rear side Radar sensors are located behind the bumper panels. The Night Vision infrared sensor is behind the grille. Ultrasonic sensors are mounted to the bumper panel or to bumper trim. These sensors are all mounted on the periphery of the vehicle.

While performing the first visual inspection, advisors will need to identify any physical damage to these sensors or to optical systems. Sensors that have sustained physical damage will need to be replaced. Damage to any sensor mounting surface also needs to be noted.

Disassembly will be required to identify damage to certain sensors or to their mounting. Disassembly for inspection before repairs are dispatched to a technicians is a best practice and helps minimize time spent completing repairs.

As with any damage assessment, have a plan. Work from one end of the vehicle to the next: front-to back, or rear to front.

Check Control

The Check Control system monitors functions in the vehicle and notifies the driver of malfunctions in the monitored systems. A Check Control message is displayed as a combination of indicator or warning lights and SMS text messages in the instrument cluster and, if applicable, in the Head-up Display. In addition, an acoustic signal may sound and an SMS text message may appear on the Control Display.

Red warning lamps mean a system is not operational or is impaired and operating the vehicle may be dangerous or cause damage.

Yellow lamps may flash intermittently during operation. Using the Dynamic Stability Control (DSC) system as an example, when the indicator light flashes during operation, DSC is controlling driving and braking forces. Once the vehicle has been stabilized, the DSC lamp will extinguish. If the DSC indicator light lights up and stays illuminated, then the DSC system has malfunctioned and will need service.

If the DSC lamp is on and displays the word “Off”, the system has been deactivated by the driver.

Some Check Control messages are displayed continuously and are not cleared until the malfunction is eliminated. If several malfunctions occur at once, the messages are displayed consecutively.

The messages can be hidden for approximately 8 seconds. After this time, they are displayed again automatically.

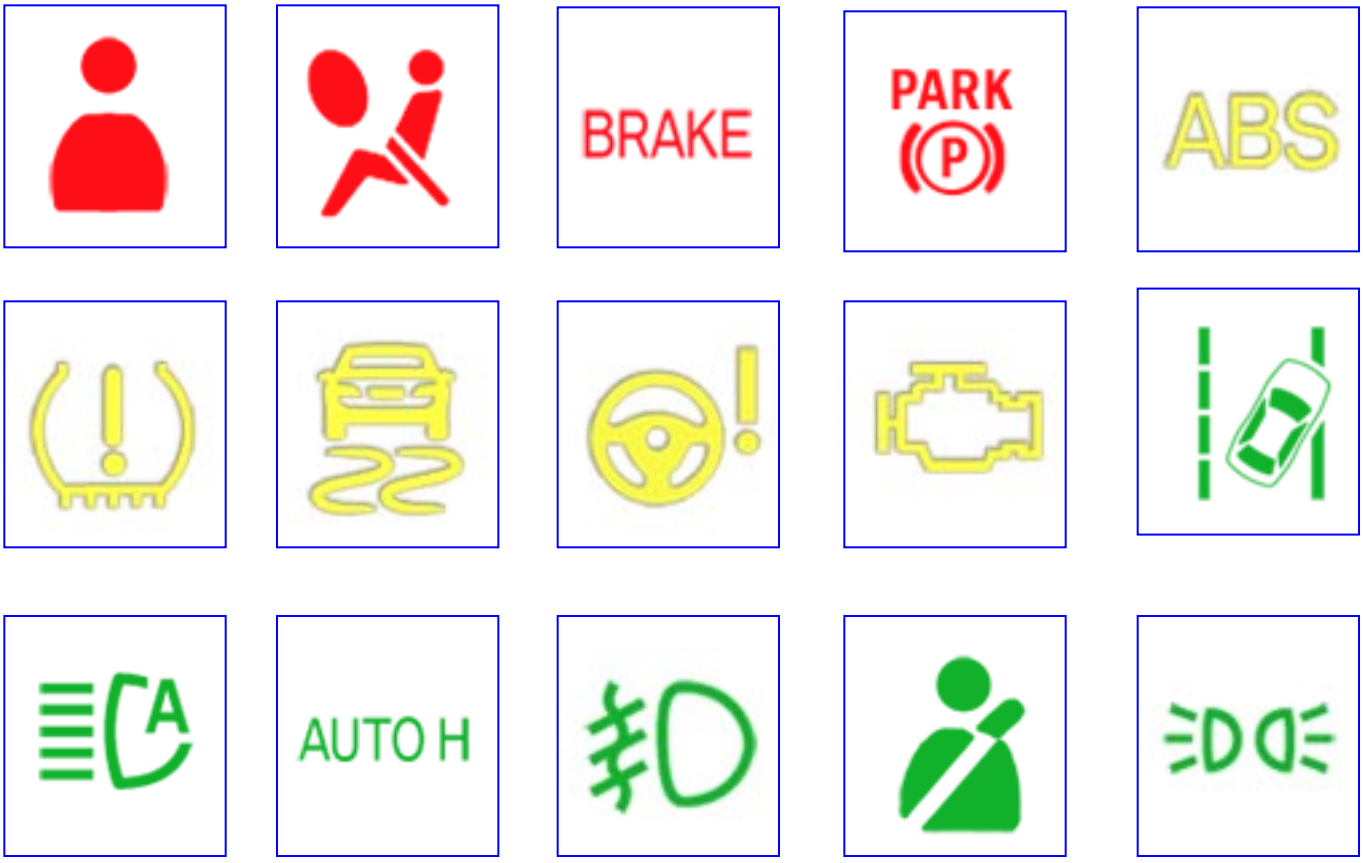
Certain Check Control messages are hidden automatically after approximately 20 seconds. The Check Control messages are stored and can be displayed again later.

To display stored Check Control messages using the iDrive system, take the following steps:

1. Go to "My Vehicle"
2. "Vehicle status"
3. Move the Controller to the left.
4. "Check Control"
5. Select the SMS text message.

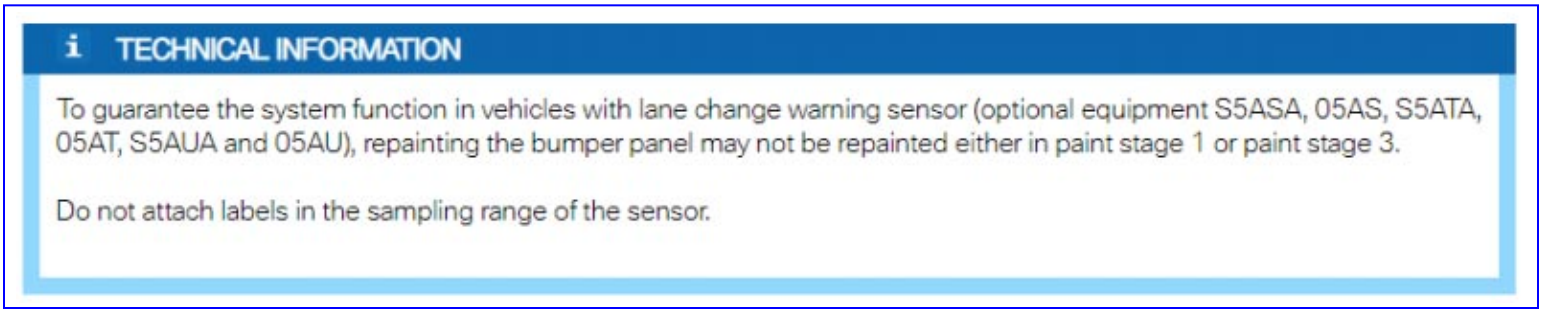
If a Triangle with asterisk is displayed, there is at least one Check Control message that is being displayed or has been stored. SMS text messages in combination with a symbol in the instrument cluster explain a Check Control message and the meaning of the indicator/warning lights. Additional information, such as the reason for an error or malfunction or the required action, can be called up via Check Control.

With urgent messages the added text will be automatically displayed on the Control Display.



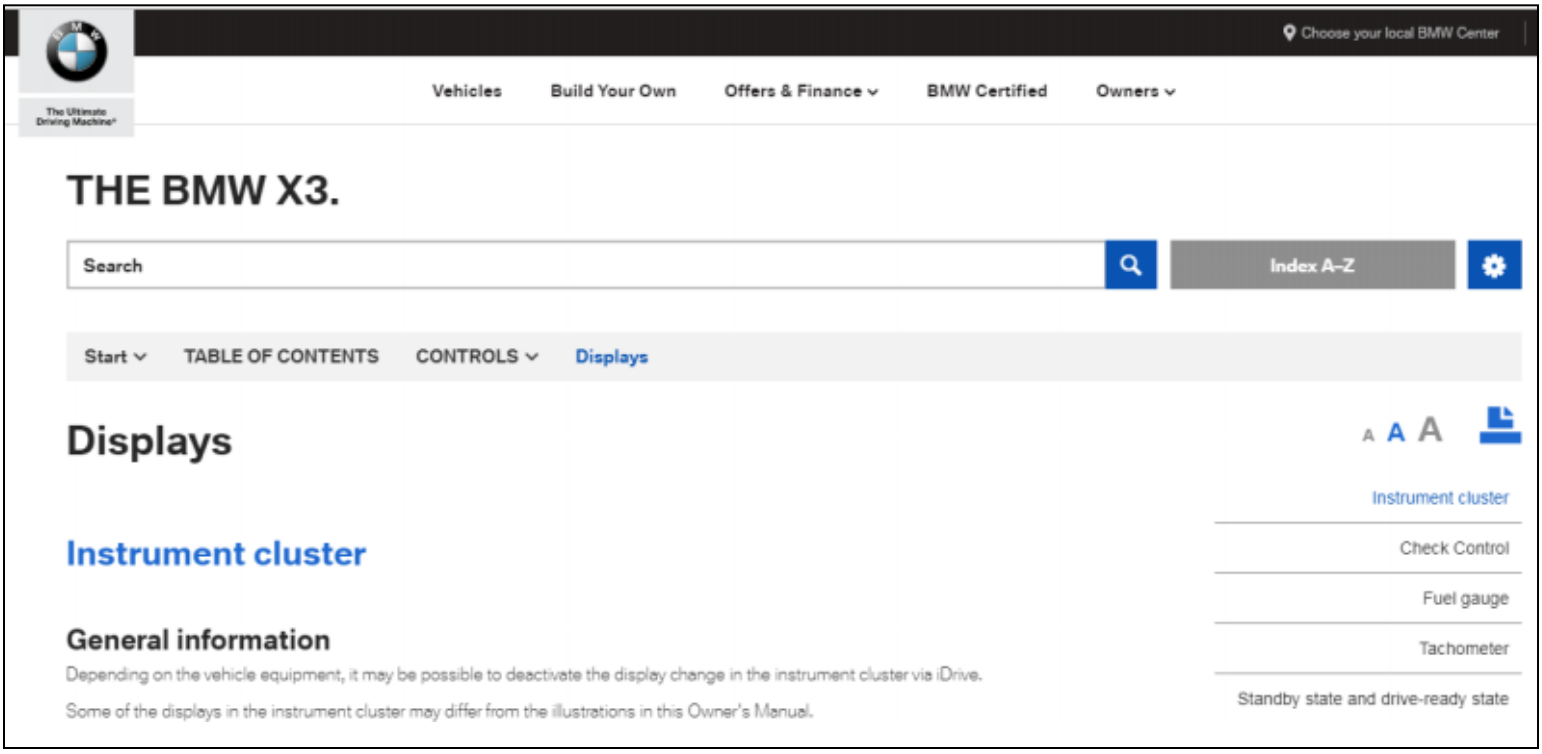
Obtain Repair Information

In general, advisors should start researching Driver Assistance system repairs in Main Group 66: Distance Systems, Cruise control, Remote Operation. Most repair information for Driver Assistance Systems can be found in this section. Always consult the Main Group that contains information about the damaged part. This section may contain special information about the sensors attached to the part.



System Information

PKoD as well as the Online Owner's Manual contains information about the various systems, system limitations, and normal system operation. Advisors can utilize these resources to become more familiar with BMW Driver Assistance Systems. PKoD contains links to many videos that illustrate these systems in operation.



System Service

Due to the critical nature of the system components and especially the sensors that provide essential data, it is imperative that BMW service requirements be followed when these sensors are either replaced or removed and reinstalled during repairs. Depending on the mounting location, other repair guidelines must also be noted. These sensors may be surface-mounted, or located behind another component such as the KAFAS camera, the infrared sensor for the Night Vision system, and several of the front and rear radar sensors. This chart summarizes some of the service requirements for the removal and installation or replacement of electronic components in the body area and the windscreen. As with all repairs involving Driver Assistance systems, please consult AIR for the most current service procedures and requirements.

Advisors ane technicians can identify whether a component may need recalibration or initialization using charts loctaed in AIR, Section 61-35. Please refer to the following documents:

- **Overview of Additional Work for the Removal and Installation or Replacement of Electronic Components in the body area/windscreen**
- **Overview, Rain Sensor (additional work when replacing the windscreen / sensor replacement)**

These table provide information about removal or replacement of sensors and whether special tools may be required. Links are provided to documents related to each component. Illustration 21 (below) contains information that can be found in these tables.

Illustration 21: AIR guidelines for removal or replacement of Driver Assistance sensors

Component	**R&I** Calibration Initialization required	**R&I** Special Tools Required?	**Replacement** Programming & Encoding Calibration & Initialization Required	**Replacement** Special Tools Required?	**Comments**
Rear Section					
Reversing Camera	No	No	Yes	No	Recalibration required when the tailgate is aligned
PDC Sensor	No	No	No	No	
PMA Sensor	No	No	No	No	
Sensor, Lane Change Warning	No*	No	Yes	No	*Required after body repairs to areas around sensor **Comply with Refinishing Regulations!**
Windscreen					
Camera-based driver support systems	No*	No	Yes	No	Necessary after windscreen replacement

Rain Sensor Service

Service to the Rain/Light/Condensation sensors will vary based on the vehicle platform, sensor type and sensor shape, and the production year. In some situations, the Rain/Light/Solar/Condensation sensor must be replaced. The document provides guidelines that help determine the scope of repairs that will be required. while some service proedures require that the sensor be renewed, newer models may not require sensor replacement when the windscreen is removed or replaced. Please refer to the following tables.

Diagnostic Test Equipment

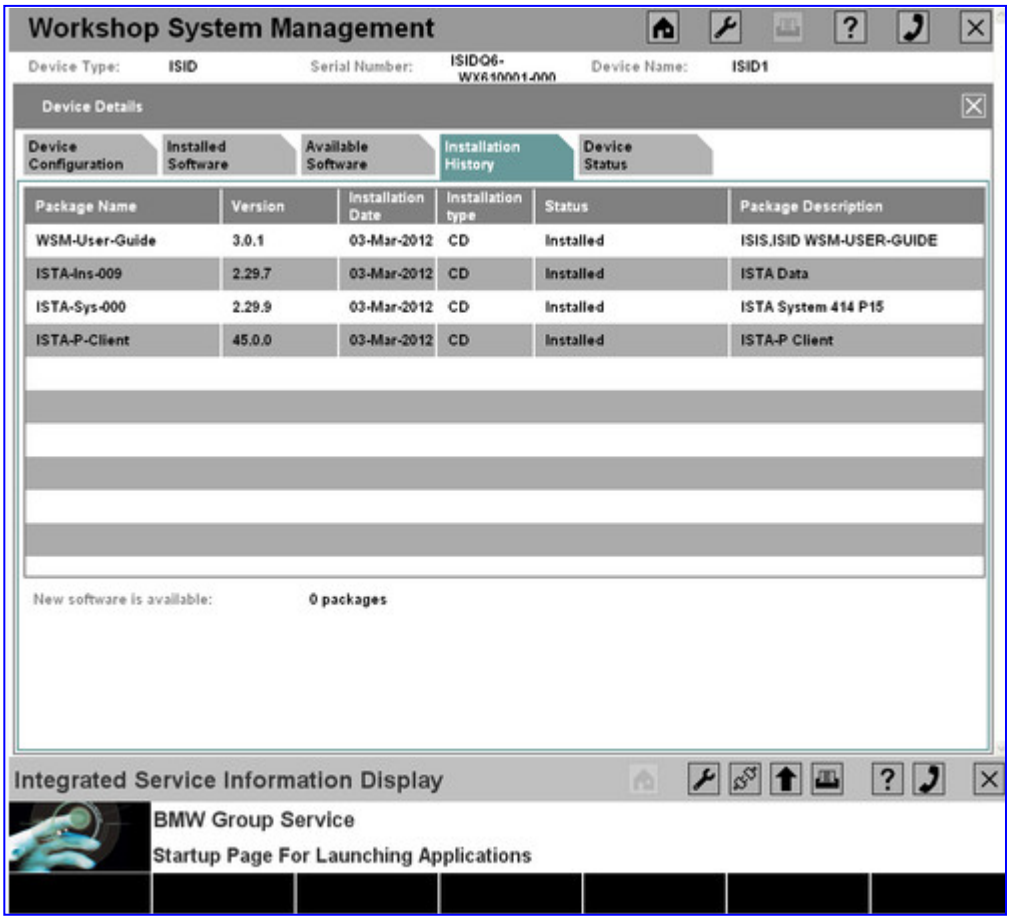
Before Repairs Begin

As noted previously, BMW requires that any control module be interrogated before the battery is disconnected. Test equipment should also be utilized to identify any stored fault codes if the system displays any Check Control messages.

After repairs have been completed, the control modules need to be checked once again to confirm that all problems have been resolved. Any stored fault codes will need to be erased.

The service department may need to perform diagnostic operations if the collision center does not have the required equipment or training.

Depending on the system, the vehicle may need to be driven to complete any system re-learning or recalibration. A test drive should be performed to confirm system readiness and to validate proper operation after repairs have been completed.



Summary

- Advisors should be familiar with how different Driver Assistance systems operate. PKoD and the Owner's Manual can help familiarize advisors with the different systems found on BMW vehicles
- A damage assessment process will start with a visual inspection that should include identifying any Check Control messages and the status of malfunction indicator lamps
- In certain situations, diagnostic equipment may be needed to interrogate system control modules. Always check for stored codes before the battery is disconnected
- If a sensor or camera needs to be removed or replaced, AIR will provide guidelines about the need for reprogramming and whether special test equipment may be needed.